Keysight M8000 Series of BER Test Solutions

M8040A High-Performance BERT

Getting Started Guide

KEYSIGHT TECHNOLOGIES

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CAUTION

A CAUTION notice denotes a hazard. It calls attention to an operating procedure, practice, or the like that, if not correctly performed or adhered to, could result in damage to the product or loss of important data. Do not proceed beyond a CAUTION notice until the indicated conditions are fully understood and met.

WARNING

A WARNING notice denotes a hazard. It calls attention to an operating procedure, practice, or the like that, if not correctly performed or adhered to, could result in personal injury or death. Do not proceed beyond a WARNING notice until the indicated conditions are fully understood and met.

Safety Summary

The following general safety precautions must be observed during all phases of operation of this instrument. Failure to comply with these precautions or with specific warnings or operating instructions in the product manuals violates safety standards of design, manufacture, and intended use of the instrument. Keysight Technologies assumes no liability for the customer's failure to comply with these requirements. Product manuals are provided with your instrument on CD-ROM and/or in printed form. Printed manuals are an option for many products. Manuals may also be available on the Web. Go to www.keysight.com and type in your product number in the Search field at the top of the page.

General

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

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

Environment Conditions

This instrument is intended for indoor use in an installation category II, pollution degree 2 environment. It is designed to operate at a maximum relative humidity of 95% and at altitudes of up to 2000 meters.

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

Before Applying Power

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

Ground the Instrument

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

Do Not Operate in an Explosive Atmosphere

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

Do Not Remove the Instrument Cover

Operating personnel must not remove instrument covers. Component replacement and internal adjustments must be made only by qualified personnel.

Instruments that appear damaged or defective should be made inoperative and secured against unintended operation until they can be repaired by qualified service personnel.

Safety Symbols

Table 1 Safety Symbol

Symbol	Description
	Indicates warning or caution. If you see this symbol on a product, you must refer to the manuals for specific Warning or Caution information to avoid personal injury or damage to the product.
	Frame or chassis ground terminal. Typically connects to the equipment's metal frame.
	KC is the Korean certification mark to demonstrate that the equipment is Class A suitable for professional use and is for use in electromagnetic environments outside of the home.
	Indicates that antistatic precautions should be taken.
	Indicates the time period during which no hazardous or toxic substance elements are expected to leak or deteriorate during normal use. Forty years is the expected useful life of the product.
	The RCM Mark is a compliance mark to the ACMA (Australian Spectrum Management Agency). This indicates compliance with all Australian EMC regulatory information.

Symbol	Description
	CSA is the Canadian certification mark to demonstrate compliance with the Safety requirements.
	CE compliance marking to the EU Safety and EMC Directives. ISM GRP-1A classification according to the international EMC standard. ICES/NMB-001 compliance marking to the Canadian EMC standard.
	This symbol on all primary and secondary packaging indicates compliance to China standard GB 18455-2001.

Table 2 Compliance and Environmental Information

Safety Symbol	Description
	This product complies with WEEE Directive (2002/96/EC) marking requirements. The affixed label indicates that you must not discard this electrical/electronic product in domestic household waste. Product Category: With reference to the equipment types in WEEE Directive Annex I, this product is classed as a “Monitoring and Control instrumentation” product. Do not dispose in domestic household waste. To return unwanted products, contact your local Keysight office, or see http://about.keysight.com/en/companyinfo/environment/takeback.shtml for more information.

About This Guide

This guide provides high-level information for an initial setup of the Keysight J-BERT M8040A High-Performance BERT. This guide focuses on setting up “bundled” systems such as the M8040A-BU1, M8040A-BU2 and M8040A-BU3.

The M8040A-BU1 system has the M8000 module(s), M9537A AXIe Embedded Host Computer, M8070B software plus license, and module licenses pre-installed.

The M8040A-BU2 bundled systems has the M8000 module(s) and their licenses pre-installed but will require host computer connection and M8070B software plus license installation. These procedures are located in this guide.

The M8040A-BU3 system has the M8000 module(s), M9537A AXIe Embedded Host Computer, M8070B software and module licenses pre-installed in Windows 10.

NOTE **Network licenses are not pre-installed on any system. If you plan to use the M8040A system over a network, you must perform the network license installation procedures in this guide.**

If you ordered a system that requires on-site installation of individual M8000 modules or the M9537A AXIe Embedded Host Computer into the M9505A AXIe Chassis, refer to the *Keysight M8000 Series of BER Test Solutions Installation Guide* for detailed module-level installation instructions.

NOTE **If you have not ordered one of the M8040A-BU1/BU2/BU3 bundles but the M9506A AXIe Chassis and the individual modules separately, refer to the *Keysight M9506A AXIe Chassis Startup Guide* at:**

https://literature.cdn.keysight.com/litweb/pdf/M9506-90001.pdf?id=3086684

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This chapter introduces you to Keysight's M8040A High-performance BERT. It also introduces you to the concept of using a host computer to communicate with the M8040A.

KEYSIGHT TECHNOLOGIES

Introduction

The Keysight Technologies M8040A is a highly integrated BERT for physical layer characterization and compliance testing.

With support for pulse amplitude modulation 4-level (PAM4) and non-return-to-zero (NRZ) signals, and symbol rates up to 64 Gbaud (corresponds to 112 Gbit/s) it covers all flavors of the emerging 400 GbE and CEI-56G standards.

The M8040A BERT´s true error analysis provides repeatable and accurate results, optimizing the performance margins of your devices.

Key Features

The M8040A provides the following features:

- Data rates from 2 to 32 and 64 GBaud
- PAM4 and NRZ selectable from M8070B user interface
- Built-in 4 tap de-emphasis to compensate loss
- Integrated and calibrated jitter injection: RJ, PJ1, PJ2, SJ, BUJ, and even-odd jitter
- Two pattern generator channels per module to emulate aggressor
- Linearity tests with adjustable PAM4 levels
- Short connections to the DUT with remote heads for the pattern generator
- True PAM4 error detection in real-time for low BER levels
- Graphical user interface and remote control via M8000 system software
- Scalable and upgradeable with options and modules

Applications

The M8040A is designed for R&D and test engineers who characterize chips, devices, transceiver modules and sub-components, boards and systems with serial I/O ports operating with data rates up to 32 Gbaud and 64 Gbaud in the data center and communications industries.

The M8040A can be used for receiver (input) testing for many popular interconnect standards, such as:

- 400 Gigabit Ethernet (IEEE 802.3bs)
- 200/100/50 Gigabit Ethernet
- OIF CEI - 56G (NRZ and PAM4 versions)

- 64G/112G Fibre Channel
- Infiniband-HDR
- Proprietary interfaces for chip-to-chip, chip-to-module, backplanes, repeaters, and active optical cables, operating up to 64 GBaud.

M8040A Modules

The M8040A modules are recognized by the model number and name located on their front panel.

Each of the supported modules has some standard hardware and software features that are available with a standard license for that module. Some upgraded features/components of a module are licensed and are only available when you purchase and install a license for that option.

The M8040A supports the following modules.

- M8045A High-Performance BERT Pattern Generator-Clock
- M8046A High-Performance BERT Analyzer
- M8057A/B Pattern Generator Remote Head

The M8045A module occupies three slots of the 5-slot M9505A AXIe chassis. It must be installed in slots 1 through 3 in the AXIe chassis unless the M9537A AXIe Embedded Controller is installed. The M9537A AXIe Embedded Controller must be installed in slot 1.

The M8046A module occupies a single slot of the 5-slot M9505A AXIe chassis.

The M8057A/B remote head is an external box which must be connected to each channel of M8045A module. Three cables are fixed on the back side of M8057A/B which need to be connected to M8045A remote head, P and N connectors.

Figure 1 on page -16 shows a typical configuration of M8045A, M8046A and M8057A/B.

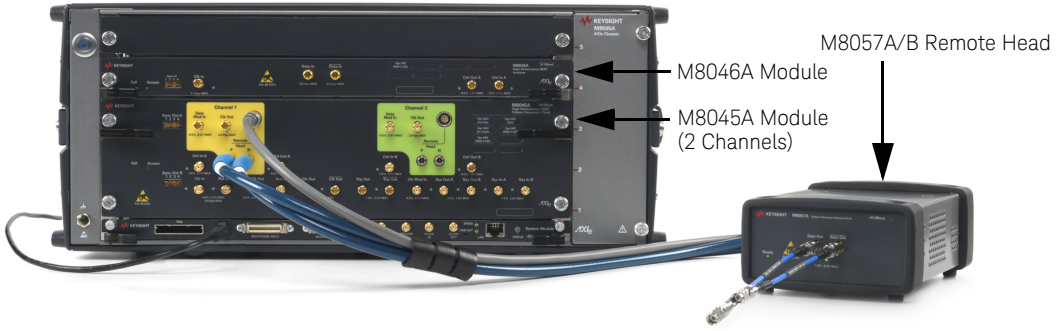

Figure 1 M8045A, M8046A and M8057A/B configuration

Details on the features and hardware components of each of the above mentioned modules are further described in this chapter.

M9505A AXIe Chassis

The M9505A AXIe chassis is a modular instrument chassis that supports complex and high density testing. The chassis provides five slots for installing multiple AXIe based instrument modules such as the M8045A, M8046A, etc. Besides providing a frame for the installation of these instrument modules, the M9505A AXIe chassis also provides power, a cooling system, a PCIe Gen2 local data bus, a Gigabit LAN interconnect, and a USB and PCIe connection for external host computer connectivity.

.

NOTE The USB connection is recommended when using a laptop or desktop PC as an external controller. The PCIe connection is recommended for use with a desktop PC as an external controller only.

NOTE PCIe connectivity between the M9505A AXIe Chassis and an external desktop PC controller is recommended when full channel plus large patterns need to be downloaded.

Refer to the *Keysight M9505A AXIe Chassis Startup Guide* to get detailed information about the AXIe chassis.

Figure 2 M9505A 5-slot chassis

M9505A AXIe Chassis Embedded System Module (USB ESM)

The bottom slot of the AXIe chassis is reserved for the Embedded System Module (ESM) which is factory installed. The ESM has a USB 2.0 interface as well as a PCIe x8, Gen1 and Gen2 compliant interface to connect an external host computer to the chassis.

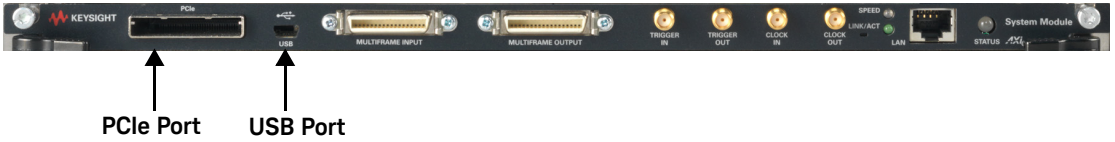

Figure 3 M9505A AXIe Chassis Embedded System Module

The ESM:

- runs the chassis embedded operating system (Windows 7) which manages all internal tasks and communications.
- tracks inserted modules and manages power requirements.
- monitors chassis temperature and controls variable- speed chassis fans.
- monitors module sensors and reports component failures to a system log.
- acts as a Gigabit Ethernet switch; forwards frames along the backplane.
- connects an external host computer to the chassis.
- synchronizes timing across all modules through the Keysight Trigger Bus, using an internal or external clock source.

LAN connector on AXIe ESM is not used. Only use LAN connection on the host computer.
Either the PCIe (desktop only) or USB (desktop or laptop) port can be used in this ESM but not both simultaneously. When you use the PCIe port, the USB port is automatically disabled until the PCIe port is no longer in use.

Keysight M9537A AXIe Embedded Controller Module

The M9537A AXIe Embedded Controller is a one slot module that you can install in the M9505A AXIe chassis like any other instrument module. This module acts as a host computer when installed in the M9505A AXIe chassis. It is always installed in slot 1 of the M9505A AXIe chassis.

The following figure displays this module.

Figure 4 M9537A AXIe Embedded Controller Module

Host Computer

A host computer is used to:

- host all the software components of the instrument modules needed to control, configure, and use the modules.
- communicate with the ESM of the M9505A AXIe chassis to allow you to monitor and control the chassis.

A host computer can be:

- the M9537A AXIe Embedded Controller module.
- a laptop with a USB port.
- a desktop PC with a USB port or x8 or wider PCIe slot for the cabled PCIe adapter card.

Refer to the Computer Hardware and Software Requirements on page 34 for external host computer minimum requirements.

M8045A High-Performance BERT Pattern Generator-Clock Module

The M8045A is an instrument module that can be installed into the M9505A 5-slot AXIe Chassis. This module occupies three slots.

M8045A Features

- Up to two Pattern Generator channels per 2-slot-module
- Symbol rate 2 to 64.8 Gbaud
- NRZ and PAM4 format is software-selectable
- Minimum data rate = 2 Gb/s
- PAM4 up to 64 Gbaud
- Built in de-emphasis
- Built in and calibrated jitter generation
- External jitter modulation per channel
- Remote head to get close to the DUT
- Pattern memory, PRBS, pattern sequencing
- Sequencing control by external control signals

Refer to the *Online Help* installed and integrated into the M8070B software to learn about how to use this module.

M8045A Module Components

The following figure displays the front panel of the M8045A module:

Figure 5 M8045A module front panel

As displayed in Figure 5 on page -20, the M8045A module has the following components.

Table 3 Insertion/Extraction and Retaining

Component	Description
Retaining screws	The screws on both ends of the module are used to retain the module tightly inside the M9505A AXIe Chassis slot once you have fully placed it inside the chassis. To remove the module, you first need to loosen these screws ensuring that these screws disengage completely.
Module Insertion/Extraction Handles	The handles on both sides of the module to insert or eject the module from the slot of the M9505A AXIe Chassis.

Table 4 Front Panel LEDs

Connector Name	Active when...	Color
Fail	power-up fault condition	red
Access	power-up ready state	green
Data Mod In 1/2	output is active	green
Clk Out 1/2	output is active	green
Ctrl Out 1/2	output is active	green
Ctrl In 1/2	logic level is detected	green
P & N 1/2	output is active	green
Clk In	signal is detected	green
Ref Clk In	signal is detected	green
Ref Clk Out	not used	green
Aux In	not used	n/a
Clk Out	output is active	green
Trig Out	output is active	green

Connector Name	Active when...	Color
Clk Mod In	input is active	green
Sys Out A/Sys Out B	output is active	green
Sys In A/Sys In B	logic state is detected	green

M8045A Front Panel Input/Output Ports

CAUTION The inputs of the M8045A module are sensitive to static electricity. Therefore, take necessary anti-static precautions, such as wearing a grounded wrist strap, to minimize the possibility of electrostatic damage.

Table 5 M8045A Front Panel Input/Output Ports

Component	Description
CLK Out1	▪ Low Jitter (~150fs) Clk out. Baud-rate / 1,2,4,8,16 ▪ Same Jitter as Data out or clean clk ▪ Typ 1.5 V pp
CLK Out2	▪ Low Jitter (~150fs) Clk out. Baud-rate / 1,2,4,8,16 ▪ Same Jitter as Data out or clean clk ▪ Typ 1.5 V pp
LINK 1234 A, B	This communication link enables interactive link training with low latency between a M8045A pattern generator channel and a M8046A analyzer module. Requires to use cable M8051A-801 and M8045A with a serial number of MY/DExxx1000 or higher.
P and N	P and N must be connected to M8057A/B remote head.
REMOTE HEAD 1, 2	Remote Head Control. This output provides power and control signals for the remote head amplifier
DATA MOD IN 1, 2	This input is used for data out delay modulation by an external source.

Component	Description
CTRL IN A, B	The data module has 2 control inputs at the front panel. The functionality of each individual input can be selected. ▪ Error Add Input Every rising edge at the input generates a single error in the output stream by flipping a single bit. The maximum repetition rate is data rate divided by 4 times the vector size. ▪ Output Blanking If the input level is above the threshold level pattern generation stops and only 0's are sent on data out. Normal operation resumes when the input level is below the threshold. ▪ Electrical Idle If the input level is above the threshold level the output amplifier enters electrical idle. Normal operation resumes when the input level is below the threshold.
CTRL OUT A, B	The data module has 2 control output at the front panel. ▪ Ctrl Out A is the control output of channel 1. ▪ Ctrl Out B is the control output of channel 2. ▪ A pattern sequence that is using CTRL OUT A or CTRL OUT B will always drive all the control outputs of the channels that execute the pattern sequence. For independent control of Ctrl Out A and B, use independent sequences for channel 1 and 2.
SYNC OUT A,B	This output is used to synchronize two or more modules to a common system clock. It is connected to the SYNC IN of the other module or to the M8192A if more than two modules are used.
CLK IN	Clock not used for M8045A.
REF CLK IN	Reference clock input for applications that provide a host reference clock in the range of 10 MHz ... 16 GHz. It may be SSC modulated and is used as the reference for the system clock of all TX and RX channels. A SSC tolerant PLL is used to multiply the reference clock to the system clock.
REF CLK OUT	The reference clock output is used to provide a 10 MHz or 100 MHz reference clock to the DUT or other test equipment.
AUX IN	Port not in use.
CLK OUT	Differential clock output.
TRIG OUT	This output is used to send a trigger signal to another connected device, such as an oscilloscope.

Component	Description
CLK MOD IN	Input for delay modulation of TRIG OUT and CLK OUT channel, always affects both outputs.
SYS IN A, SYS IN B	These are control inputs at system level and can be used to generate events for the sequencer. The granularity is the vector size.
SYS OUT A, SYS OUT B	These are control outputs at system level and can be used to signal events to the DUT or external instruments. The granularity is the vector size.

M8046A High-Performance BERT Analyzer Module

The M8046A is an instrument module that can be installed into the M9505A 5- slot AXIe chassis. This module occupies two slots and requires the M8045A module for proper operation.

NOTE **The three or four channel configuration requires a cable (provided with the M8046A) that connects the M8045A SYNC OUT to the M8046A SYNC IN to synchronize the two modules to a common system clock.**

The M8046A supports symbol rates up to 32 GBaud, the default is NRZ format.

The analyzer module can be used for error analysis in conjunction with the M8045A pattern generator, the M8195A/M8196A Arbitrary Waveform generators or as stand-alone.

M8046A Features

- Symbol rates 2.50 Gbaud to 58 Gbaud
- One channel per 1-slot module
- Supports NRZ and PAM4
- 70 mV input sensitivity for NRZ and 40mV + 12% of input range per eye for PAM4
- Built-in equalization
- Real-time bit error and symbol error analysis
- PCIe link training for Gen3, Gen4, and Gen5
- Built-in Clock Recovery
- SKP OS filtering for PCIe, USB 3.x and SATA/SAS

M8046A Module Components

The following figure displays the front panel of the M8046A module with its various components:

Figure 6 M8046A module front panel

As displayed in Figure 6 on page -26, the M8046A module has the following components.

Table 6 Insertion/Extraction and Retaining

Component	Description
Retaining screws	The screws on both ends of the module are used to retain the module tightly inside the M9505A AXIe Chassis slot once you have fully placed it inside the chassis. To remove the module, you first need to loosen these screws ensuring that these screws disengage completely.
Module Insertion/Extraction Handles	The handles on both sides of the module to insert or eject the module from the slot of the M9505 AXIe Chassis.

Table 7 Front Panel LEDs

Connector Name	Active when...	Color
Fail	power-up fault condition	red
Access	power-up ready state	green
Clk In x	on when output active and CLK detected	green
Ctrl Out x	on when output active	green
Ctrl In x	logic state is detected	green
Data In	data received	green

M8046A Front Panel Inputs/Outputs Ports

CAUTION The inputs of the M8046A module are sensitive to static electricity. Therefore, take necessary anti-static precautions, such as wearing a grounded wrist strap, to minimize the possibility of electrostatic damage.

Table 8 M8046A Front Panel Inputs/Outputs Ports

Component	Description
Data In and /Data In	Differential data inputs (3.5 mm, female)
Rec Clk Out	This output provides a recovered clock when using the integrated clock recovery function of M8046A. It can be used to trigger a DCA sampling oscilloscope. It is only provided for M8046A modules with S/N above DExxx1000.
Clk In	Clock input to sample the incoming data.
LINK 1234 A, B	This communication link enables interactive link training with low latency between a M8045A pattern generator channel and a M8046A analyzer module. Requires to use cable M8051A-801 and M8045A with a serial number of MY/DExxx1000 or higher.
Sync In	This input is used to synchronize two or more modules to a common system clock. It is connected to the Sync Out of the other module or to the clock distribution module if more than two modules are installed. The sync cable is required if M8046A is connected with M8045A Pattern Generator module. Not needed if external clock is used.
Ctrl Out A	Outputs a pulse in case of an error. Generates a pulse or static high/low if used from sequencer.
Ctrl In A	This can be used to control the pattern sequence on the error detector.

M8057A/B Pattern Generator Remote Head

The M8057A/B remote head is an external box which must be connected to each channel of M8045A module. The three cables are fixed on the back side of M8057A/B which need to be connected to M8045A remote head, P and N connectors. It helps in minimizing signal degradations caused by lossy channels.

NOTE **Please note that it is mandatory to connect M8057A/B remote head with each channel of M8045A module. Operation without M8057A/B remote head will not allow you to receive data.**

M8057A/B Remote Head Components

The following figure displays the front panel of the M8057A remote head with its various components. The similar front panel components are also available on the M8057B remote head.

Figure 7 M8057A/B remote head front panel

As displayed in Figure 7 on page -28, the M8057A/B remote head has the following components.

Table 9 Front Panel LEDs

Connector Name	Active when...	Color
Ready	remote head is operation	green

Table 10 M8057A/B Front Panel Inputs/Outputs Ports

Component	Description
Data Out and /Data Out	Connected to DUT

The following figure displays the back panel of the M8057A/B remote head with its various components:

Figure 8 M8057A/B remote head back panel

As displayed in Figure 8 on page -29, the back panel of M8057A/B remote head has cables which connects with each channel of M8045A remote head controls (P and N). The length of these cables are 85 cm.

Ensure that the chassis is NOT powered up or connected to a power source while making connections to M8057A/B.

Also, make sure NOT to remove the M8057A/B connections when it is powered on. However, if you wish to remove the M8057A/B connections, ensure that the instrument is powered off.

2 Basic Setup for M8040A

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Step 1 - Unpack the Shipment

The M8040A-BU1, M8040A-BU2 or M8040A-BU3 is shipped with the modules pre-installed in the M9505A AXIe Chassis.

Unpack and verify the shipment contents to check if you have received all the items that you ordered. The shipment contents can vary depending on the options that you ordered. Therefore, the shipping list delivered with the shipment should supersede these lists.

Table 11 Typical contents of an M8040A instrument shipment

Item	Description
M8040A-BU1 or M8040A-BU2 or M8040A-BU3	The M8040A that you ordered. All modules are pre-installed in the M9505A AXIe Chassis.
Accessories	The accessories will vary depending on the M8040A and the options that you ordered while purchasing the module. Accessories include standard items that are shipped with the M8040A as well as optional items that you ordered separately. (Please check the M8040A product data sheet for the latest list of default and optional accessories. Latest version can be downloaded from www.keysight.com/find/M8040A)
M8070B	CD-ROM with M8070B system software.
Start Here	Document which provides instructions to be followed before operating the M8040A High-Performance BERT.
Tips for Preventing Damage Guide	Document which provides tips for preventing damage to M8040A High- Performance BERT.
Getting Started Guide	This document, *M8040A Getting Started Guide.* (Please check the Keysight website: www.keysight.com/find/M8040A for the latest guide.)

Carefully inspect all items in the shipment for any damage.

Return the Damaged/Defective Item to Keysight for Repair/Replacement

If anything is missing, defective, or damaged,

1 Review the warranty information shipped with your product or check the warranty information on Keysight website.
   - To check the warranty information on your module, go to www.keysight.com/find/warranty and specify the module's model number (for example, M8045A) in the Product Number field, and specify the serial number from the top of the module in the Serial Number field.
2 Contact the nearest Keysight Sales Office. If you need assistance finding Keysight contact information, go to www.keysight.com/find/assist (worldwide contact information for repair and service).

Step 2 - Set up the M8040A

This step does not have to be performed while verifying the basic setup for power up and connectivity. However, you will need to decide on a benchtop or rack mounted usage of the M8040A after this basic verification. For the procedures on how to set up the M8040A, refer to the *Installation Guide*.

Step 3 - Set up the External Host Computer (not required for M8040A-BU1)

NOTE **Perform this step if you are using a laptop or desktop computer as the host computer.**

The host computer communicates with the ESM and instrument modules in the chassis and hosts all the software components needed to use the instrument modules.

Computer Hardware and Software Requirements

The following are the hardware and software requirements that should be met on the host computer before the installation of software components on this computer:

Hardware requirements

- Pentium® processor 1 GHz or equivalent
- 16 GB available RAM
- USB 2.0 (Mini-B) recommended
- PCIe 2.0/8x (only for highest data throughput and desktop PC)
- VGA resolution 1024 x 768
- 1.5 GB or more free hard disc space

Software requirements

- The following operating systems are supported:
  - Windows 10 (64 bit)
  - Windows 8.1 (64 bit)
  - Windows 8 (64 bit)
  - Windows 7 (64 bit)
- Keysight I/O libraries version 17.1

NOTE The M8070B software is required to control the M8040A.

NOTE PCIe connectivity between the M9505A AXIe Chassis and an external desktop PC controller is recommended when full channel plus large patterns need to be downloaded.

To connect via USB

If you are planning to use USB connectivity between the M9505A AXIe Chassis and host computer, then you can use a laptop or desktop computer with USB 3.0 support as the host computer.

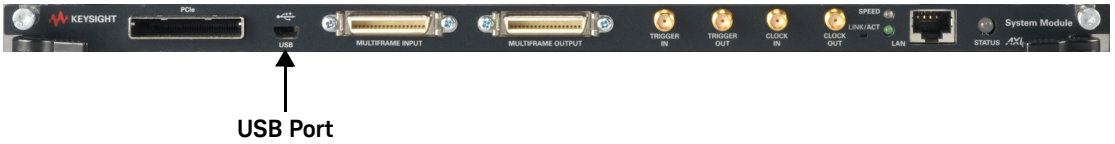

Figure 9 USB port on the font panel of the AXIe ESM

To connect via PCIe

In case of PCIe connectivity, the host computer can be a desktop PC with an available x8 or wider PCIe slot.

Review the Keysight recommended list of host computers at http://literature.cdn.keysight.com/litweb/pdf/5990-7632EN.pdf that are compatible with the Keysight M9505A AXIe Chassis.

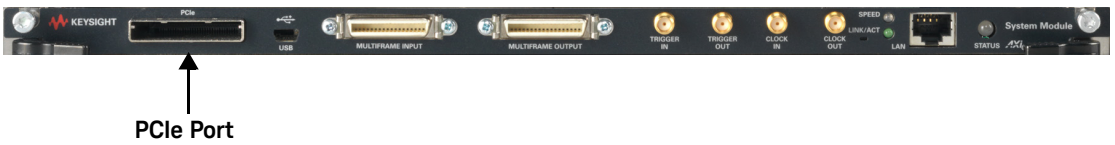

Figure 10 PCIe port on the front panel of the AXIe ESM

Step 4 - Connect the M9505A AXIe Chassis to a Power Supply

You can use an external power supply, typically AC power mains.

1 The instrument module uses the power supplied by the M9505A AXIe Chassis in which it is installed. The M9505A AXIe Chassis power cord comes with the chassis shipment. Insert the power cord into the inlet at the rear of the chassis.

2 Connect the cord to an appropriate AC power main.

3 Push the circuit breaker to the right, which is the ON position.

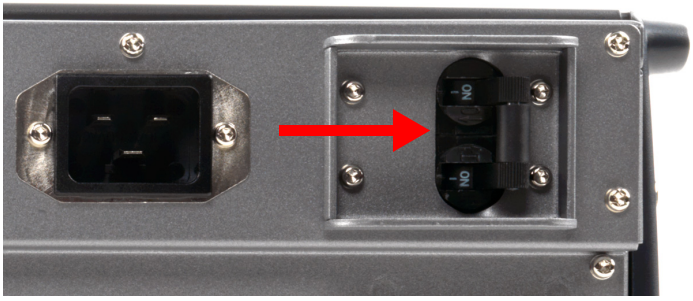

Figure 11 Chassis circuit breaker

Step 5 - Power Up (if connecting via PCIe)

Power up all the connected hardware components in the M9505A AXIe Chassis.

1 Press the ON/Standby button on the front panel of the chassis to power on the chassis.

Figure 12 Chassis ON/standby button

2 After powering up the chassis, wait until the Status LED of the ESM is solid green. This ensures that the PCIe channel in the chassis is ready for the successful connectivity of the chassis to the host computer.

3 Wait until the Access LED(s) of the module(s) in the chassis is/are solid green.

4 Power up the host computer. By this time, the Status LED of the ESM in the chassis and the Access LED(s) of the module(s) should have been steady green indicating a power ready status of the setup.

   The step to power up the host computer is not required if you are using the M9537A AXIe Embedded Controller module as the host computer because it gets powered on simultaneously with the chassis through the chassis backplane.

NOTE

If you plan to connect the M8040A to a corporate LAN and the M9537A AXIe Embedded Controller is installed, you must use the Ethernet port available on the M9537A AXIe Embedded Controller or the LAN port on the external PC.

NOTE

To power down a chassis, first turn off the host computer and then power down the chassis using the On/Standby button on its front panel.

If you are using the M9537A AXIe Embedded Controller module as the host computer, ensure that you first shut down the controller by executing the Windows shutdown process.

Do not use the circuit breaker for routine chassis turn off.

The module(s) are turned off automatically with the chassis.

Step 6 - Verify Basic M8040A Operation

After powering ON the connected hardware components, you can verify if you have correctly set up the hardware if:

- a steady green status light is displayed on the ESM of the M9505A AXIe Chassis indicating that the chassis has powered up successfully.
- the Access LED on the front panel of the instrument module turns on indicating that the module is in a power- ready state.
- the Out of Service (OOS) LED on the front panel of the M9537A AXIe Embedded Controller turns off. (Applicable only when you are using M9537A AXIe Embedded Controller as the host computer).

If the chassis does not power up to a steady green Status light, or powers up to a steady red light, the chassis has detected a failure and requires service.

If the Fail LED on the front panel of the instrument module is steady red and does not turn off, it indicates a power fault condition. In such a situation, the instrument module may require repair/service.

Contact your Keysight representative to replace or service the chassis/module.

Step 7 - Install Keysight IO Libraries Suite (not required for M8040A-BU1)

IO Libraries Suite version 16.3 or later is required. Always use the latest version of the Keysight IO Libraries.

NOTE **Perform this step if you are setting up an M8040A-BU2 system or the host computer you are using as part of the M8040A system requires I/O library installation.**

1. Disconnect any devices connected to the host computer.
2. If open, close all applications on the host computer.
3. Insert the *Automation-Ready* CD in your CD-ROM drive or download and install the IO Libraries from www.keysight.com/find/iosuite.
4. Follow the instructions as prompted during the installation.
5. After installation, you will see the Keysight IO icon in the taskbar notification area of the host computer screen.

Step 8 - Install M8070B Software (not required for M8040A-BU1)

NOTE **Perform this step if you are setting up an M8040A-BU2 system or the host computer you are using as part of the M8040A system requires I/O library installation.**

The M8070B software does not require any license for its installation. However, it can only be used to perform some basic operations. For advance operations, you need to install the plugins in the M8070B software. For details, go to Step 9 - Install the Plugins on page 40. These plugins need a valid license for their activation. For details, go to Step 10 - Install the Licenses on page 41.

NOTE **A CD-ROM is shipped when ordering the M8070B (part of the M8040A configuration).**

To install the software

1 Insert the CD ROM into the host computer or download the latest M8070B software from www.keysight.com/find/M8040A.
2 Double-click the setup (.exe) file.
The InstallShield Wizard is displayed.
3 If displayed, click **Install** to continue or click **Next** if the system controller meets the minimum system configuration requirements displayed by the wizard.
4 When displayed, accept the license agreement and click **Next**.
5 Click **Install** to start the installation then follow any on-screen prompts/instructions.
6 In Windows click **Start** > **All Programs** > **Keysight M8070B** > **Keysight M8070B** to verify software installation. The Startup screen of the M8070B software should display.

Step 9 - Install the Plugins

The basic functionality of the M8070B can be used without installing any license. However, for advanced features, you need to install the M8070B plugins. The plugins file (*.M8KP) can be downloaded from Keysight web page. The M8070B software supports the following plugins:

- Advanced Measurement Package

  https://www.keysight.com/main/software.jspx?ckey=3019474&lc=eng&cc=IN&nid=-32914.1176817&id=3019474

- Error Distribution Analysis Package

  https://www.keysight.com/main/software.jspx?ckey=3020058&lc=eng&cc=IN&nid=-32914.1176817&id=3020058

Please make sure that you have M8070B software version 6.0 or later installed on your system. The M8070B software comes with a **Plugin Manager** to simplify all the tasks related to plugin management. The **Plugin Manager** also allows you to install, uninstall and upgrade the plugins.

NOTE Please note that the M8070B plugins requires a license for its activation.

For further details on how to install, update or uninstall plugins, please refer to the *M8000 Series User Guide* or *M8000 Series Plugins Getting Started Guide*.

Step 10 - Install the Licenses

NOTE All M8040A-BU1 licenses have been pre-installed (except for a floating/networked license). All other system configurations require license installation as described in this step.

The usage of M8070B plugins is govern by Keysight Licensing. Keysight Licensing provides tools and processes for floating, USB portable, node-locked, and transportable licenses. These licenses can be installed using the **Keysight License Manager**. It helps you install licenses on your local machine (instrument or computer), or configure your local machine to use licenses from a remote license server.

Depending upon the license types, the following version of **Keysight License Manager** can be used to install the licenses:

- The node-locked and transportable licenses are installed by **Keysight License Manager 5**.
- The floating and USB probable licenses are installed by **Keysight License Manager 6**.

NOTE Please note that the Keysight License Manager 5 and Keysight License Manager 6 get installed on your system when you install M8070B system software.

For details on how to install these licenses, you can refer the following documents:

- M8000 Series User Guide (https://literature.cdn.keysight.com/litweb/pdf/M8000-91B08.pdf)
- Keysight Licensing Administrator's Guide (https://literature.cdn.keysight.com/litweb/pdf/5951-5739.pdf)

Installing Module Licenses (for upgrades only)

Installing module licenses is only necessary if you add module options onsite. Module licenses enable specific options in the modules of the M8040A system. Once a module license has been installed using the Keysight License Manager, the next time the M8070B software and M8040A hardware are started, the license is recognized by the M8070B software and compared to the module's serial number. If the PC Host ID and serial number match, the EEPROM in the module is programmed and the option is enabled. Even if the M8070B software license is transported to another host computer, the module option will remain enabled.

The following procedure shows how to redeem and install a module license.

1. Locate the Software License Entitlement Certificate (email or paper copy).
2. Follow the instructions on the Software License Entitlement Certificate to redeem your license.
3. You will receive a license file (in an email). The file has the suffix .lic.
4. Follow the instructions in the email to complete the installation of the license file.
5. In the M8070B software interface, verify that the license has been installed by selecting **Utilities** > **Licenses** then viewing the license status in the **Installed** column.

Affix Option Label (optional)

Whenever the M8040A is upgraded with additional options, it is recommended that you affix the corresponding label(s) to the front panel of the module. The option labels provide a quick view of which options are installed in each module. Figure 13 on page -43 shows the option label sheet provided with your M8040A system.

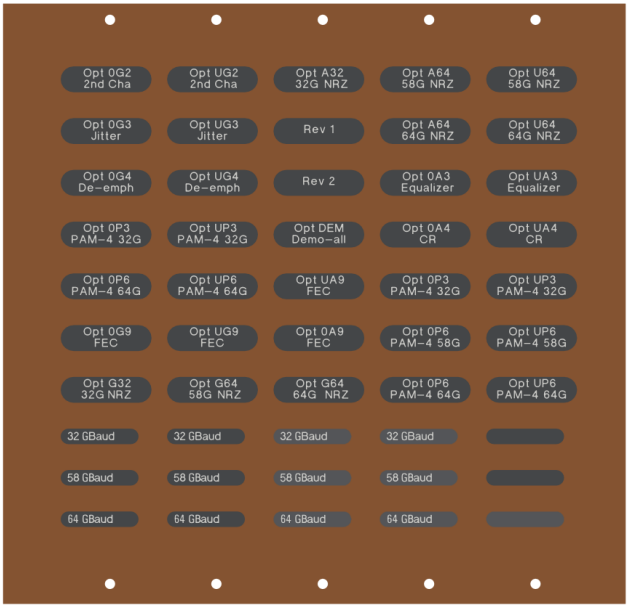

Figure 13 Option label sheet

1 Locate the option label sheet shown in Figure 13 on page -43.
2 Affix the option labels as shown in Figure 14 on page -43.

Figure 14 Affix option labels

Step 11 - Turning off the Chassis and Modules

Turn off the chassis and module in the following sequence:

1 Turn off the host computer. If you are using the Keysight AXIe Embedded Controller module as the host computer, ensure that you shut down the controller by executing the Windows shutdown process.

2 Turn off the chassis by pressing the chassis ON/STANDBY switch on the front panel of chassis. Do not use the circuit breaker for routine turn off. The module(s) are turned off automatically with the chassis.

Step 12 - Connect the M8040A to the Device Under Test (DUT)

This section describes how you can connect the M8040A to a DUT.

NOTE **If you are connecting M8040A over USB, make sure to disable the "Sleep Mode" of the external PC or laptop. Failing to do so may cause you to re-initialize the M8070B software.**

Typical Test Setup Example

Figure 15 on page -44 is an example of a common test setup for testing a DUT.

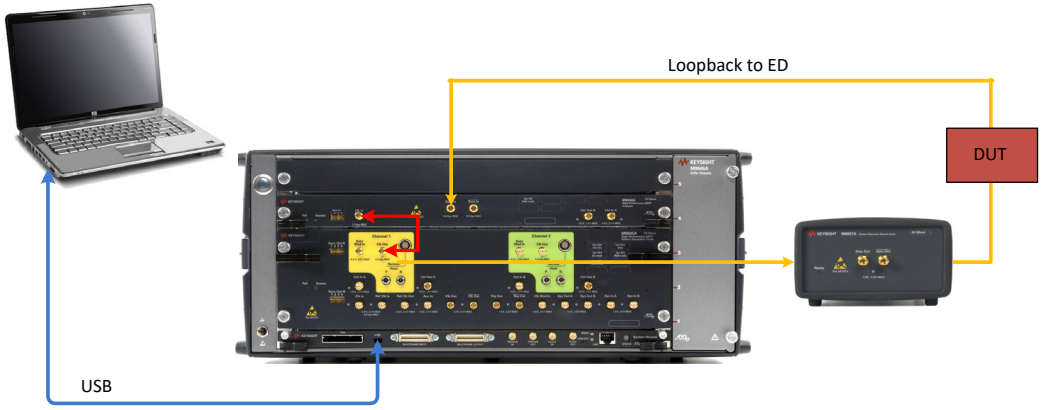

Figure 15 Typical test setup example

M9537A Embedded Controller Setup Example

Figure 16 on page -45 shows a basic setup using the M9537A Embedded Controller. The embedded controller module must be installed in slot 1 of the M9505A AXIe Chassis. The embedded controller module communicates with the ESM through the chassis backplane. Therefore, there is no need to establish any external PCIe/USB or LAN connection between the embedded controller module and chassis.

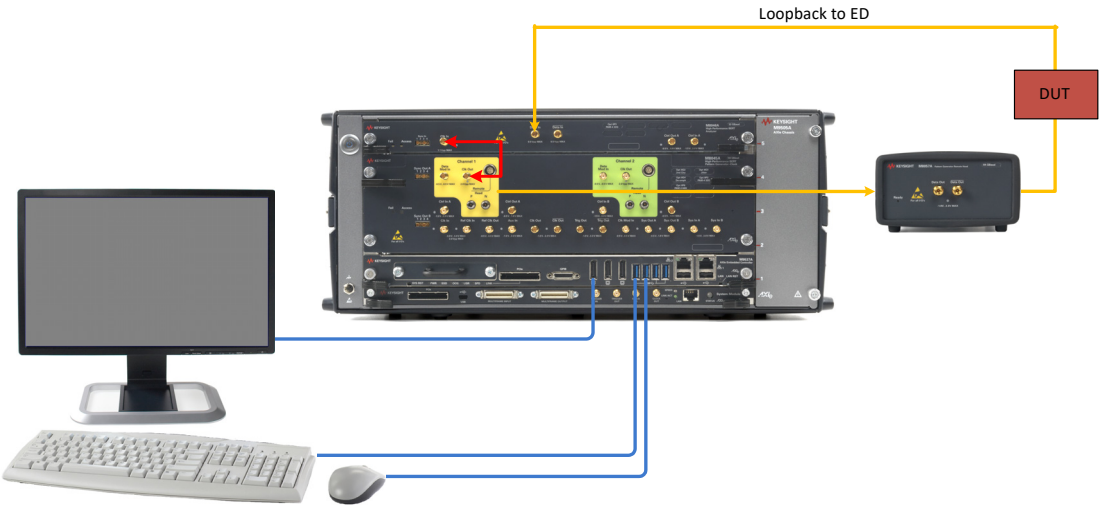

Figure 16 M9537A embedded controller setup example

Hardware Connections

Make the hardware connections as described below:

- Connect the M8057A/B to M8045A channel 1 remote head control.
- Connect the M8057A/B to M8045A channel 1 remote head controls (P and N).
- Ensure that the chassis is NOT powered up or connected to a power source while making connections to M8057A/B.
- Terminate unused ports (TRG Out, Data Out and Clk Out) with 50 Ohm to GND.

3 Using the M8040A High-Performance BERT

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KEYSIGHT TECHNOLOGIES

Locating Electronic Manuals and Online Help

Various electronic manuals and the *M8000 Series Online Help* provide information on how to configure and use the supported instrument modules.

On installing the M8070B software, you will find documentation by clicking **Start** > **All Programs** > **Keysight M8070B** > **Keysight M8070B Documentation**.

You can also visit www.keysight.com/find/m8040a to find the latest versions of various manuals and the data sheet for each M8040A module.

Routine Care

NOTE Except for performing initial chassis verification or troubleshooting, do not operate the chassis with empty slots. Always insert a filler panel in empty slots. This is especially important for the slots on either side of an installed instrument module. This allows proper air flow and cooling, and provides EMI shielding for the chassis and installed components. Leaving slots empty can increase fan speed, raise ambient noise, overheat components, and can cause the module to shut down.

CAUTION Do not block the vent holes on the chassis. This overheats and damages their components. Leave a gap of at least 2” (50 mm) around all vent holes.

CAUTION Some instruments, such as M8057A/B, have an internal fan to keep the components cooled to normal operating temperatures. Make sure that there is enough clearance for adequate air-flow.

CAUTION The enclosure surface of the module may become hot during use. If you need to remove the module, first power down the AXIe chassis, allow the module to cool, and then pull the module out of the chassis.

NOTE For preventing damage, for usage tips, and for ESD information, read and follow the instructions in the "*Tips for Preventing Damage Guide*" (Document Part No. #M8000-91010).

Starting the M8070B Software

1 Ensure that the system is powered up and ready to start as described in the sections Basic Setup for M8040A on page 31.

2 On the host computer, click on **Start** > **All Programs** > **Keysight M8070B** > **Keysight M8070B**.

3 When the **Load Settings** screen appears as shown in Figure 17 on page -49, load the last used, factor preset, or new settings.

Figure 17 Load Settings screen

4 The screen shown in Figure 18 on page -50 should now be displayed.

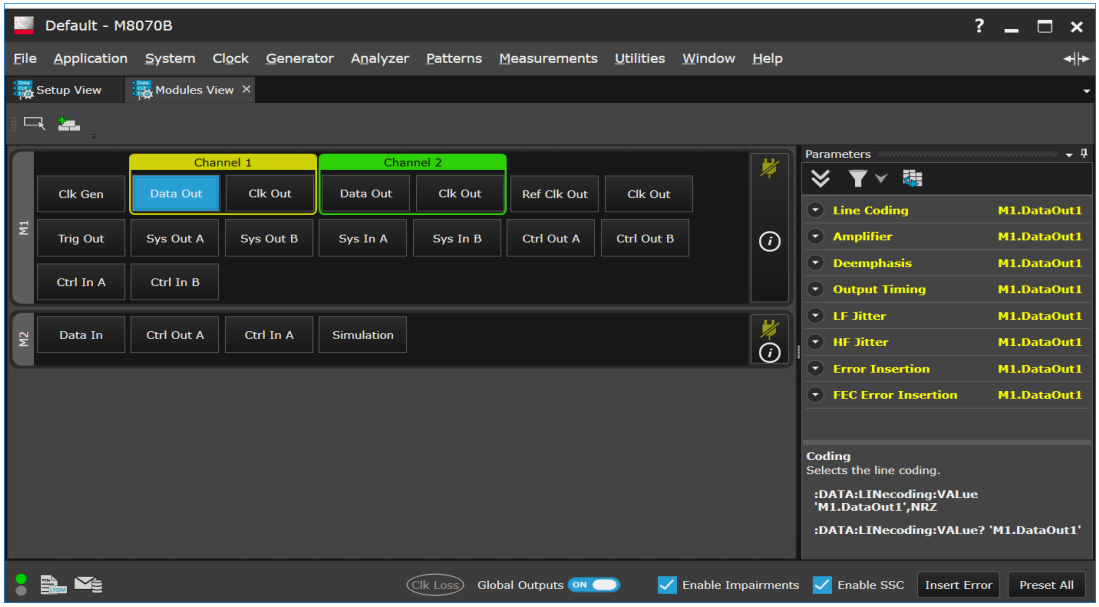

Figure 18 M8070B user interface

Perform a Measurement

The following measurement example verifies a BER of 0 in channel 1 of the M8045A, M8046A and M8057A/B.

1 Connect M8045A CLK OUT of Channel 1 to M8046A CLK IN.

2 Connect DATA OUT of Remote-Head M8057A/B, which is connected to Channel 1 of M8045A, to the DATA IN of M8046A.

3 In the M8070B software interface, set the data rate to 10 Gb/s as follows:

a Click on **System** > **System View**.

b Click on the **PLL Synthesizer Internal** block as shown in Figure 19 on page -51 to display the **Synthesizer** properties.

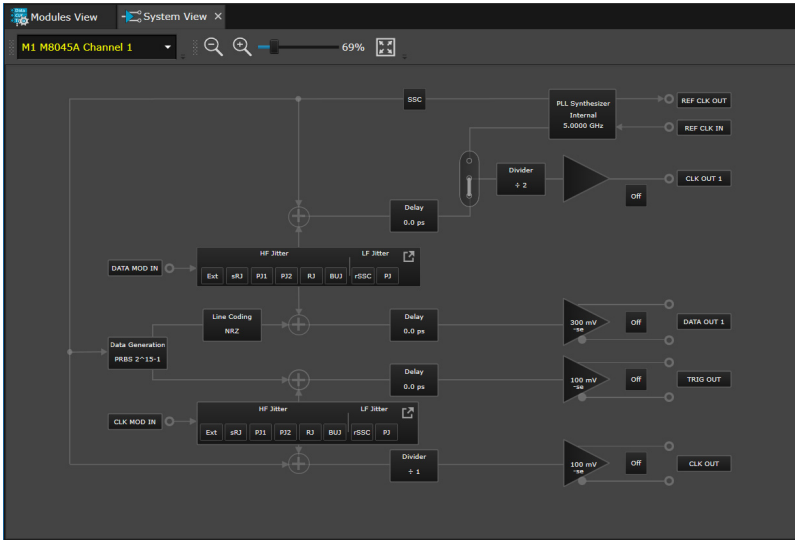

Figure 19 Synthesizer parameters

c In the **Synthesizer** parameters, click in the numeric field corresponding to the **Frequency** setting.

d Using the numeric keypad, enter **10** then click on the **GHz** button as shown in Figure 20 on page -51. If your system has a maximum data rate of 8 Gb/s, leave the frequency setting at 5 GHz.

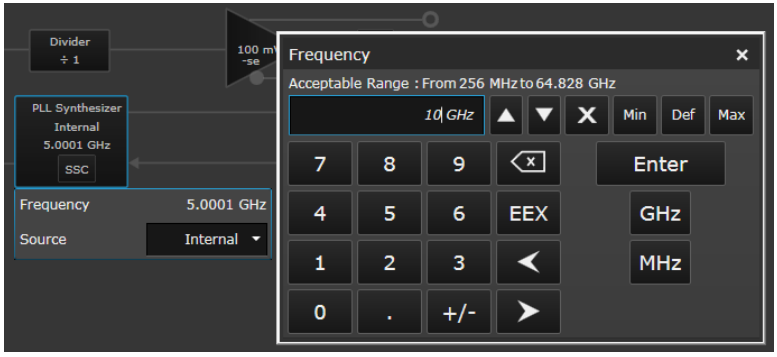

Figure 20 Set frequency to 10 GHz

4 On the menu bar, click on **Patterns** > **Select Pattern...**. A **Select Sequence Pattern** dialog will appear as shown in Figure 21 on page -52.

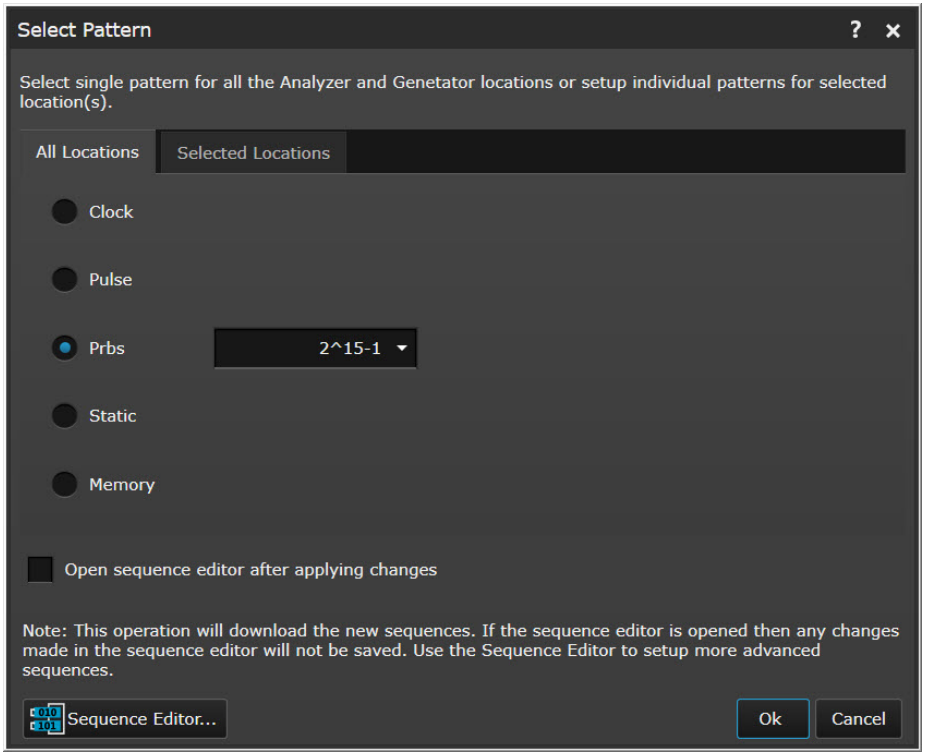

Figure 21 Select Sequence Pattern Dialog

5 In the **Select Sequence Pattern** dialog, select **Prbs** as the **Pattern Type** and then select **2^9- 1** as the **Polynomial** as shown in Figure 22 on page -53.

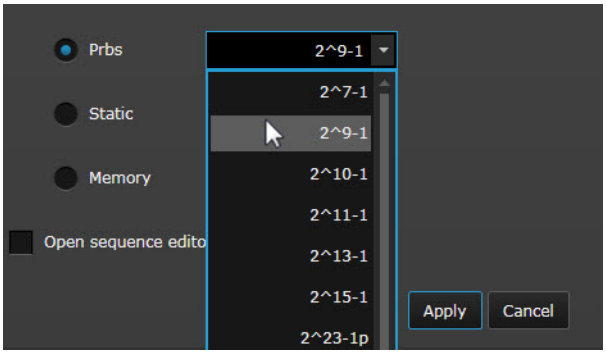

Figure 22 Select PRBS and Polynomial

6 Once done, click on **Apply** button.

7 Now, click on the **Modules View** tab.

8 Click on **Channel 1** > **Data Out** corresponding to the M8045A (M1) as shown in Figure 23 on page -53.

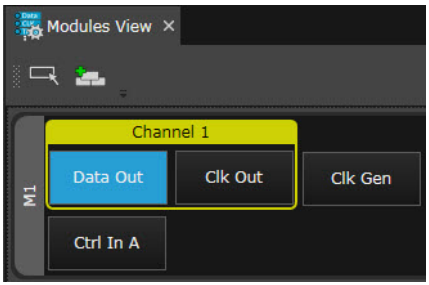

Figure 23 Select Channel 1 DataOut

9 On the **Properties Window**, expand **Amplifier**.

10 Select the coupling type as **AC Coupling**.

NOTE You must select 'AC Coupling' when doing a loopback to the M8046A error detector.

11 Enable the output of the pattern generator by clicking on the **Output State** button as shown in Figure 24 on page -54.

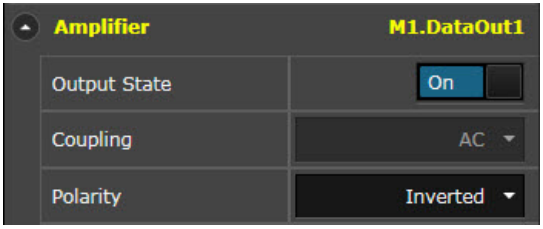

Figure 24 Enable pattern generator output

12 Enable the global outputs by clicking on the **Output** button present on the **Status Bar** as shown in Figure 25 on page -54.

Figure 25 Enable global outputs

13 Click on **Data In** corresponding to the M8046A(M2) as shown in Figure 26 on page -54.

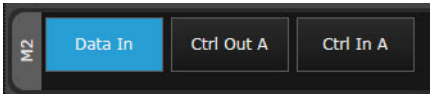

Figure 26 Select M8046A DataIn

14 On the **Properties Window**, expand **Analyzer**.

15 Click on the **Alignment BER Threshold** button to synchronize and align the error analyzer as shown in Figure 27 on page -55.

Alternatively, you can also click on the  **Start BER Threshold Auto Alignment** button present on the **Status Indicator** to synchronize and align the error analyzer.

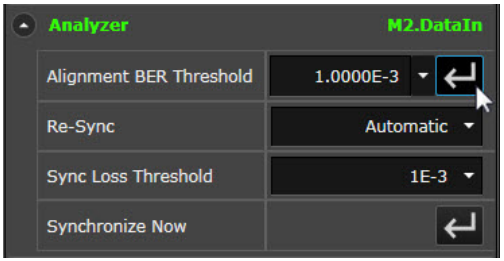

Figure 27 Alignment BER Threshold

16 At any time you can click on the **Hide Status Indicators Window** icon (bottom-left of display) to view/hide the module status including BER.

17 From the menu bar, click on **Measurements** > **Error Ratio**.

18 The default acquisition parameter settings are used as shown in Figure 28 on page -55.

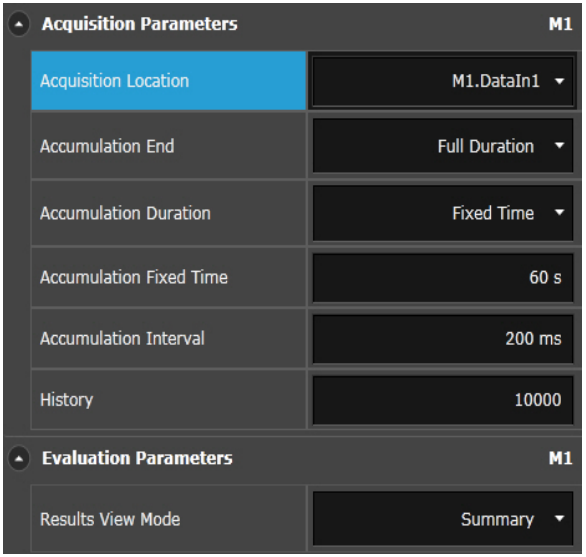

Figure 28 Acquisition parameter settings

19 Click on the **Start Measurement** button to start the measurement as shown in Figure 29 on page -56.

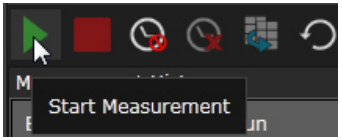

Figure 29 Start measurement

20 After the measurement has completed (60 sec), review the results shown below the graph in the **Calculated Results** table as shown in Figure 30 on page -56.

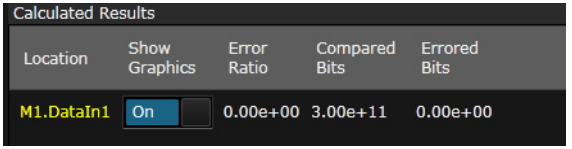

Figure 30 Calculated results

Updating Software Components

Updated versions of the M8070B and module specific software components are available on the Keysight website.

These software components are available as .EXE files. To download a software upgrade:

1 Go to http://www.keysight.com/find/M8070B
2 Click the **Technical Support** tab.
3 Click **Drivers and Software**.
4 Type the model number of the instrument module for which software update is needed and click **Find**. Model number is located on the front panel of the module.
5 Click the **Driver and Software** link on the module page.
6 Download the required software update from the list of available updates.

Contacting Keysight Service and Support

To locate a sales or a service office near you, go to www.keysight.com/find/contactus

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