Keysight M8050A High-Performance BERT

M8042A Pattern Generator Module

M8043A Error Analyzer Module

M8046A High-Performance BERT Analyzer Module

M8009A Clock Module

M8058A/M8059A/M8068A/M8069A Remote Head for M8042A Pattern Generator

M8052A Remote Head for M8043A Error Analyzer

M8053A Interference Source Module

KEYSIGHT

GETTING STARTED GUIDE

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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.

External Connections

Any other instruments connected to this instrument shall be approved to a suitable safety standard and must include reinforced insulation from hazardous voltages, in particular mains.

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.
	Contains parts or assemblies susceptible to damage by electrostatic discharge (ESD). Use electrostatic discharge protective handling procedures to avoid malfunctions or potential damage to the instruments.
	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.
	Indicates that the product was tested and has met the certification requirements for electrical, plumbing and/or mechanical products.

Symbol	Description
	The CE mark is a registered trademark of the European Community. This CE mark shows that the product complies with all the relevant European Legal Directives. CAN ICES/NMB-001(A) - This ISM device complies with the Canadian ICES-001(A). Cet appareil ISM est conforme a la norme NMB-001(A) du Canada. ISM GRP 1-A - This is an Industrial Scientific and Medical (ISM) Group 1 Class A product.
	This symbol on all primary and secondary packaging indicates compliance to China standard GB 18455-2001.

Compliance and Environmental Information

Table 2 Compliance and Environmental Information

Safety Symbol	Description
	The crossed out wheeled bin symbol indicates that separate collection for waste electric and electronic equipment (WEEE) is required, as obligated by DIRECTIVE 2012/19/EU and other National legislation. See http://about.keysight.com/en/companyinfo/environment/takeback.shtml to understand your Trade in options with Keysight in addition to product takeback instructions.

About This Guide

This guide provides high-level information for an initial setup of the Keysight M8050A High-Performance BERT. This guide focuses on setting up “bundled” systems such as the M8050A-BU2, M8050A-BU3, M8050A-BU4 and M8050A-BU5.

The M8050A-BU2 and M8050A-BU4 bundled systems has the M8050A module(s) and pre-configured system consisting of one M9505A 5-slot AXIe Chassis with USB option.

The M8050A-BU3 and M8050A-BU5 bundled systems has the M8050A module(s) and pre-configured system (pre-installed M9537A with M8070B and M8050A module driver) consisting of one M9505A 5-slot AXIe chassis with USB option and one M9537A AXIe Embedded PC Controller.

If you ordered a system that requires on-site installation of individual M8050A 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.

Contents

1 Introduction

This chapter introduces you to Keysight's M8050A High-Performance BERT. It also introduces you to the concept of using a host computer to communicate with the M8050A. The M8050A assembly supports the following modules.

- Generator Module
  - M8042A Pattern Generator Module
- Analyzer Modules
  - M8043A Error Analyzer Module
  - M8046A High-Performance BERT Analyzer Module
  - UXR-Series Real-Time Oscilloscope
- Clock Module
  - M8009A Clock Module
- Remote Heads
  - M8058A/M8059A/M8068A/M8069A Remote Head for M8042A Pattern Generator
  - M8052A Remote Head for M8043A Error Analyzer
- Interference Source Module
  - M8053A Interference Source Module

Introduction

The Keysight M8050A high-performance BERT enables accurate characterization of receivers used in next generation data center networks and server interfaces with symbol rates up to 120 GBd.

The M8050A high-performance BERT is one part of the Keysight M8000 Series of BER test solutions. It can be combined with other hardware and software of the M8000 Series.

M8050A Modules

Overview

The M8050A 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 M8050A supports the following modules.

- M8042A Pattern Generator Module
- M8043A Error Analyzer Module
- M8046A High-Performance BERT Analyzer Module
- UXR-Series Real-Time Oscilloscope
- M8009A Clock Module
- M8058A/M8059A/M8068A/M8069A Remote Heads for M8042A Pattern Generator
- M8052A Remote Head for M8043A Error Analyzer
- M8053A Interference Source Module

All the M8050A modules are controlled by the M8070B system software.

Figure 1 on page -15 shows a typical configuration of M8050A and its modules operating from 2.0 to 64.4 GBd.

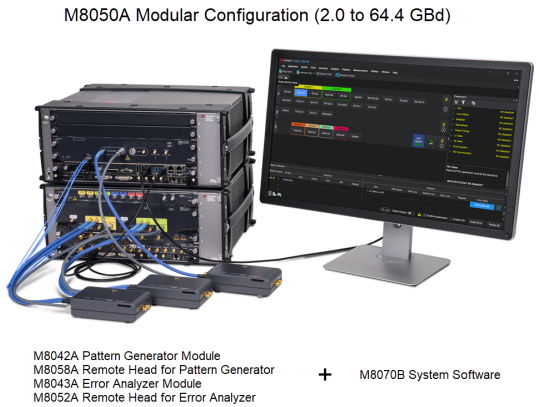


Figure 1 M8050A modular configuration (2.0 to 64.4 GBd)

Figure 2 on page -16 shows a typical configuration of M8050A and its modules operating from 64 to 120 GBd.

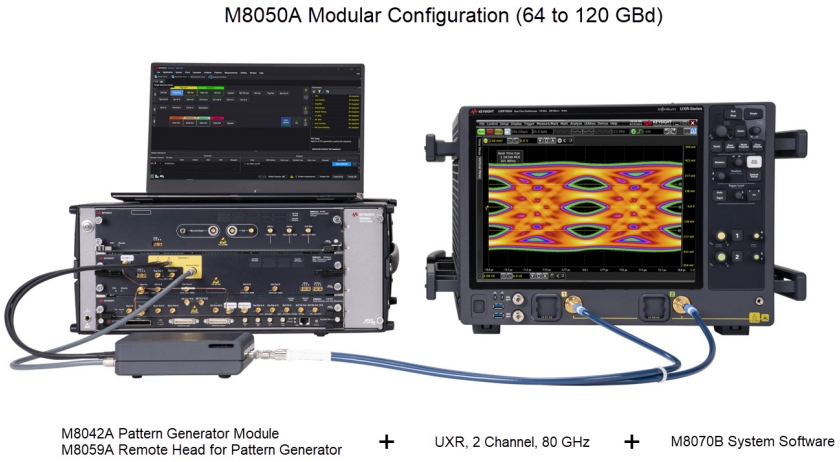


Figure 2 M8050A modular configuration (64 to 120 GBd)

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 M8050A, 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 waveforms need to be downloaded.

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

Figure 3 M9505A 5-slot chassis

AXIe 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.

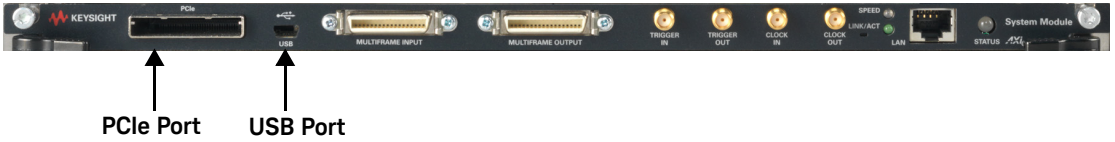


Figure 4 AXIe Embedded System Module

The ESM:

- runs the chassis embedded operating system 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 5 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 42 for external host computer minimum requirements.

M8042A Pattern Generator

The M8042A pattern generator module operates from 2 to 120 GBd. It is available as one channel or two channel version. You can select three symbol rate ranges.The M8042A is an instrument module that can be installed into the M9505A 5- slot AXIe chassis. The one channel version occupies two slots while the two channel version occupies three slots in the M9505A 5- slot AXIe chassis. The M8042A requires the clock module with jitter modulation M8009A, and one remote head for each data output channel. For operation above 64 GBd the 120 GBd pattern generator remote head M8059A/M8069A is required.

For the following generator functions a module option is required:

- Pattern generation up to 32 GBd for NRZ and PAM4 (M8042A-G32)
- Pattern generation up to 64 GBd for NRZ and PAM4 (M8042A-G642)
- Pattern generation up to 120 GBd for NRZ and PAM4 (M8042A-G12)
- De-emphasis, module-wide license (M8042A-0G4)

M8042A Module Components

The following figure displays the front panel of the M8042A module:

Figure 6 M8042A module front panel

As displayed in Figure 6 on page -20, the M8042A module has the following components.

Table 3 Front Panel LEDs

Front Panel LED	Active when...	Color
Fail	power-up fault condition	red
Access	power-up ready state	green

Table 4 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.

M8042A Front Panel Input/Output Ports

CAUTION The inputs of the M8042A 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.

The M8042A pattern generator module provides many supplementary inputs and outputs. Shown here is the overview of all inputs and outputs for a two-channel version of M8042A.

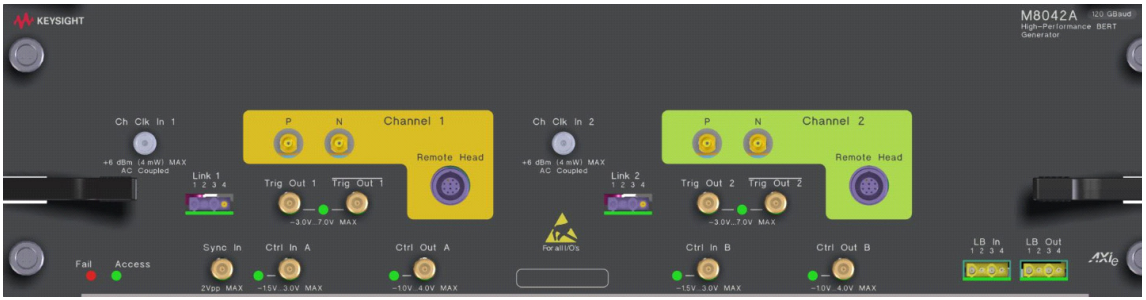


Figure 7 M8042A two channel version

Table 5 M8042A Front Panel Input/Output Ports

Connector	Description
P, N, Remote head channel 1/2	For connection to remote head
Ch Clk In 1/2	Clock from M8009A
Link 1/2	For link training and synchronization with other modules
Sync In	Sync from M8009A
Trig Out 1/2	Trigger output 3.5 mm (f)
Crtl In A/B	Trigger sequencer and error insertion 3.5 mm (f)
Crtl Out A/B	Generates a pulse or static high/low if used from sequencer 3.5 mm (f)
LB In/Out	Local bus connection to next chasis

M8043A Error Analyzer

The M8043A error analyzer module operates from 2.0 to 64.4 GBd. It requires the remote head M8052A. The M8043A is an instrument module that can be installed into the M9505A 5-slot AXIe chassis. This module occupies two slots in the M9505A 5-slot AXIe chassis and is always recommended to install on the slots above the M8042A and M8009A modules. The M8043A comes always with a built-in clock recovery. Integrated equalization with FIR, FFE and CTLE is optional. For error analysis above 64.4 GBd we recommend using the UXR0802A/04A with control from M8070B. See below for more details.

Using the remote input of the M8043A module directly is prohibited.

The following analyzer options are provided:

- Error analysis up to 32.4 GBd for NRZ and PAM4 (M8043A-A32)
- Error analysis up to 64.4 GBd for NRZ and PAM4 (M8043A-A64)
- Equalization and de-embedding capability (M8043A-0A3)

M8043A Module Components

The following figure displays the front panel of the M8043A module:

Figure 8 M8043A module front panel

As displayed in Figure 6 on page -20, the M8043A module has the following components.

Table 6 Front Panel LEDs

Front Panel LED	Active when...	Color
Fail	power-up fault condition	red
Access	power-up ready state	green
Ctrl Out	ON when output active	green
Ctrl In	logic state is detected	green

Table 7 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.

M8043A Front Panel Input/Output Ports

CAUTION The inputs of the M8043A 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.

The M8043A error analyzer module provides many supplementary inputs and outputs. Shown here is the overview of all inputs and outputs provided by M8043A.

Figure 9 M8043A front panel input/output ports

Table 8 M8043A Front Panel Input/Output Ports

Connector	Description
Remote Head	This port provides data input and control signals for M8052A remote head.
Cal	This calibration output is used for factory calibration at Keysight facilities.
Link	This communication link is for future use.
Clk In	This port enables source-synchronous operation, allowing effective analysis of data with Spread Spectrum Clocking (SSC). Clock Input operation requires M8043A serial number above MY64A01000.
Ctrl In	This port provide functionality that can be selected as: sequence trigger, pattern capture event.
Crtl Out	This port outputs a pulse in case of an error. It generates a pulse or static high/low if used from sequencer.

M8046A Analyzer Module

The M8046A is an instrument module that can be installed into the M9505A 5- slot AXIe chassis. This module occupies single slot and supports symbol rates up to 64 GBaud.

M8046A Features

For details on the M8046A features, refer to the M8040A data sheet: www.keysight.com/in/en/assets/7018-05226/data-sheets/5992-1525.pdf

M8046A Module Components

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

Figure 10 M8046A module front panel

As displayed in Figure 10 on page -26, the M8046A module has the following components.

Table 9 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 10 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 Input/Output 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 11 M8046A Front Panel Input/Output Ports

Component	Description
Data In and /Data In	Differential data inputs (3.5 mm, female)
Clk In	Clock input to sample the incoming data. Full/half and quarter-rate clock. Single ended. CTRL IN can be used as sequence trigger or pattern capture event.
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	Functionality can be selected as: sequence trigger, pattern capture event.
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.

M8009A Clock Generator

Keysight's M8009A clock generator is designed as sample clock source for the M8042A pattern generator. The M8009A clock module with integrated jitter modulation operates from 4 to 60 GHz. It can be locked to external reference clocks.

For the following functions a module option is required:

- Advanced jitter modulation for up to two channels, license (M8009A-0G3)
- Reference clock multiplier, license (M8009A-0G6)
- Clock Generator two channel 60 GHz, 1 slot AXIe (M8009A-062). This option is only available only for the new hardware i.e. M8009A-062.

The M8009A is an instrument module that can be installed into the M9505A 5-slot AXIe chassis. It comes as a 1-slot AXIe module, which allows the M8009A plus up to two M8042A pattern generator modules to be plugged into a single 5-slot AXIe chassis.

M8009A Module Components

The following figure provides an overview of all inputs and outputs of the M8009A clock module with jitter modulation:

The following figure shows the front panel of the M8009A clock module:

Figure 11 M8009A-061 module front panel

The following figure shows the front panel of the M8009A-062 clock module with the new "Clk Out 32G" port:

Figure 12 M8009A-062 module front panel

As displayed in Figure 12 on page -28, the M8009A module has the following components.

Table 12 Front Panel LEDs

Front Panel LED	Active when...	Color
Fail	power-up fault condition	red
Access	power-up ready state	green

Table 13 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.

M8009A Front Panel Input/Output Ports

CAUTION The inputs of the M8009A 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 14 M8009A Front Panel Input/Output Ports

Connector	Description
Clk Out 32G	This signal is intended to be used to drive a DUT that requires a sub-rate clock. It can contain identical jitter as channel clock output 1. The clock signal is aligned to the data pattern. M8009A-062 is a license that is available for the new hardware of M8009A i.e. M8009A-062. This port is only available on M8009A modules with M8009A-062 option. However, Clk Out 32G is also accessible to user even without this license installed in the system. It provides the signal with the frequency range from 1 to 32.4 GHz.
Clk Out 16G	This signal provides a reference clock for a DUT. It can be operated with jitter and without jitter. It provides a differential clock with adjustable amplitude, offset and termination. No phase alignment to data output. It provides the signal with the frequency range from 31.25 MHz to 16.2499 GHz.
Ch Clk Out 1	This signal provides the clock signal for the pattern generator M8042A and AWG modules. Ch Clk Out 1 has to be connected to Ch Clk In 1 of the M8042A module.
Ch Clk Out 2	This output can be switched between two modes: ▪ Channel clock mode This signal provides the clock signal for the second channel of the pattern generator M8042A. Ch Clk Out 2 has to be connected to Ch Clk In 2 of the M8042A module. Independent jitter profile for Ch Clk Out 2 compared to Ch Clk Out 1 ▪ Forwarded clock mode This signal is intended to be used to drive a DUT that requires a data rate divide by a second clock. It can contain identical jitter as the Ch Clk 1 Output 1. This clock signal is synchronous to the data pattern, phase relation will change when divider settings are modified.
Sync In	This input is reserved for future use.
Sync Out A/B/C	This output is used to sync with M8042A module only.
Sys Trig In A/B	This signal is reserved for future use.

Connector	Description
Ref Clk In	This input allows locking the system clock to an external reference clock of 10 or 100 MHz instead of the internal oscillator.
Ref Clk Out	This signal provides a reference clock to lock with other instruments in the test setup. It provides clock frequency 10 MHz or 100 MHz.
Ref Clk Out 16G	This signal provides a clock between 8 and 16 GHz, relative to symbol rate. It can be used as clock input or as trigger input for a precision time base of a DCA. Clean clock only.

M8058A/M8059A/M8068A/M8069A Remote Head for M8042A Pattern Generator

The M8058A/M8059A/M8068A/M8069A remote head includes an external amplifier that is used in combination with the M8042A Pattern Generator. It helps in minimizing signal degradations caused by lossy channels. Four remote heads are available for the pattern generator module M8042A.

The M8068A and M8069A offer significantly higher output amplitude than the M8058A and M8059A.

The following figure shows the M8058A and M8059A remote heads:

M8058A - Pattern Generator Remote Head up to 64.8 GBd

M8059A - Pattern Generator Remote Head up to 120 GBd

Figure 13 M8058A and M8059A remote heads

The following figure shows the M8068A and M8069A remote heads:

M8068A - Pattern Generator Remote Head up to 64.8 GBd

M8069A - Pattern Generator Remote Head up to 120 GBd

Figure 14 M8068A and M8069A remote heads

The 64 GBd M8058A/M8068A remote head is shown at the left side and this provides 1.85 mm connectors. It is used to accommodate close connection to the device under test for symbol rates up to 64.8 GBd.

The 120 GBd M8059A/M8069A remote head is shown on the right side and provides 1.0 mm connectors and is used to accommodate close connection to the device under test for symbol rates up to 120 GBd.

The three cables on the back side of the remote heads are used to connect with the M8042A pattern generator module and are not removable.

Please refer "*Tips for Preventing Damage*" document for mounting remote head cables.

M8058A/M8059A/M8068A/M8069A Remote Head Components

The following figure displays the front panel of the M8058A/M8059A/M8068A/M8069A remote head with its various components.

Figure 15 M8058A/M8059A/M8068A/M8069A remote head

As displayed in Figure 15 on page -33, the M8058A/M8059A/M8068A/M8069A remote head has the following components.

Table 15 Front Panel LED

Front Panel LED	Active when...	Color
Ready	remote head is operational	green
Data Out, $\overline{\text{Data Out}}$	On when data output is active	green

Table 16 M8058A/M8059A/M8068A/M8069A Front Panel Connector

Connector	Description
Data Out and $\overline{\text{Data Out}}$	Connected to DUT

The back panel of M8058A/M8059A/M8068A/M8069A remote head has cables which connects with each channel of M8042A remote head ports. The length of the remote head including cables is ~830 mm.

Ensure that the chassis is NOT powered up or connected to a power source while making connections to M8058A/M8059A/M8068A/M8069A.

Also, make sure NOT to remove the M8058A/M8059A/M8068A/M8069A connections when it is powered on. However, if you wish to remove the M8058A/M8059A/M8068A/M8069A connections, ensure that the instrument is powered off.

M8052A Remote Head for M8043A Error Analyzer

The M8052A remote head includes an external amplifier and a CTLE that is used in combination with the M8043A Error Analyzer.

The following figure shows the M8052A remote head:

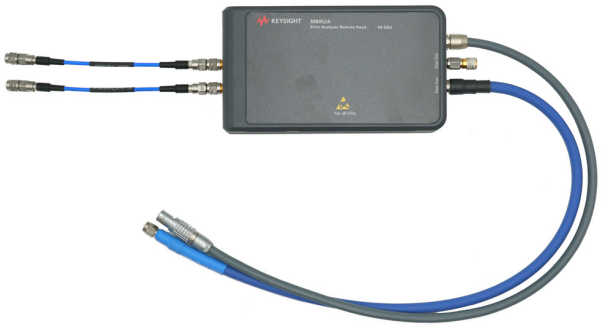


Figure 16 M8052A remote head

Two cables on the back side of the remote head are used to connect with the M8043A error analyzer and are not removable.

Please refer "*Tips for Preventing Damage*" document for mounting remote head cables.

M8052A Remote Head Components

The following figure displays the front panel of the M8052A remote head with its various components.

Figure 17 M8052A remote head components

As displayed in Figure 17 on page -35, the M8052A remote head has the following components.

Table 17 Front Panel LED

Front Panel LED	Active when...	Color
Ready	remote head is operational	green

Table 18 M8052A Front Panel Connector

Connector	Description
Data In and $\overline{\text{Data In}}$	Connected to DUT

The back panel of M8052A remote head has two cables which connects with the remote head ports of the M8043A. The length of these cables is about 500 mm.

Ensure that the chassis is NOT powered up or connected to a power source while making connections to M8052A.

Also, make sure NOT to remove the M8052A connections when it is powered on. However, if you wish to remove the M8052A connections from the M8043A module, ensure that the instrument is powered off.

M8053A Interference Source Module

The Keysight M8053A interference source module allows you to generate repeatable and accurate level impairments for testing of high-speed digital receivers that support symbol rates up to 120 GBd. The M8053A interference source module is controlled through the M8070B system software. The M8053A interference source module occupies 2 slots in an AXIe chassis and should be used in combination with the M8050A modules.

Key Features & Specifications

- Random level interference with crest factor > 5
- Sinusoidal level interference
- Common mode and differential mode
- Bandwidth adjustable up to 64 GHz
- 2 output channels with differential signals avoiding baluns
- Adjustable amplitude up to 1 Vpp (se), 2 Vpp (diff.)
- 2-slot AXIe module for combined configurations with M8050A high-performance BERT
- Matched coupler pair for interference injection before and after the ISI channel (NEXT, FEXT)
- Graphical user interface and remote control via M8070B system software for M8000 series of BER test solution

Details of M8053A module can be found at:
www.keysight.com/find/M8053A

For more information on how to install M8053A module in AXIe Chassis refer to Installing M8053A Module in AXIe Chassis on page 47.

M8053A Front Panel Input/Output Ports

CAUTION The inputs of the M8053A 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.

The M8053A interference source module provides many supplementary inputs and outputs. Shown here is the overview of all inputs and outputs provided by M8053A.

Figure 18 M8053A front panel input/output ports

Table 19 M8053A Front Panel Input/Output Ports

Connector	Description
Data Out and /Data Out	Differential data outputs (1.85 mm connectors).
Trig Out	Differential output that generates sub-rate clocks.
Ref Clk In	This input allows locking the system clock to an external reference clock of 10 or 100 MHz instead of the internal oscillator.
Ref CLK Out 16 G	This signal provides a clock of 15 to 16 GHz, sample rate divided by 16. It can be used for as clock input for the precision time base of a DCA.

2 Basic Setup for M8050A

Step 1 - Unpack the Shipment

The M8050A-BU2/BU3/BU4/BU5 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 20 Typical contents of an M8050A instrument shipment

Item	Description
M8050A-BU2/BU3/BU4/ BU5 Bundled Systems	The M8050A that you ordered. M8050A-BU2/BU3/BU4/BU5 is a pre-installed bundle of AXIe chassis and modules. The M8050A-BU2 and M8050A-BU4 bundled systems has the M8050A module(s) and pre-configured system consisting of one M9505A 5-slot AXIe Chassis with USB option. The M8050A-BU3 and M8050A-BU5 bundled systems has the M8050A module(s) and pre-configured system (pre-installed M9537A with M8070B and M8050A module driver) consisting of one M9505A 5-slot AXIe chassis with USB option and one M9537A AXIe Embedded PC Controller.
Accessories	The accessories will vary depending on the M8050A and the options that you ordered while purchasing the module. Accessories include standard items that are shipped with the M8050A as well as optional items that you ordered separately. (Please check the M8050A product data sheet for the latest list of default and optional accessories. Latest version can be downloaded from www.keysight.com/find/M8050A)
Start Here	Document which provides instructions to be followed before operating the M8050A High-Performance BERT.
Tips for Preventing Damage Guide	Document which provides tips for preventing damage to M8050A High-Performance BERT.
Getting Started Guide	This document, *M8050A High-Performance BERT Getting Started Guide.* (Please check the Keysight website: www.keysight.com/find/M8050A 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, M8050A) 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 M8050A

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 M8050A after this basic verification. For the procedures on how to set up the M8050A, refer to the *M8000 Series Installation Guide*.

Ensure that the sum of power consumed by all modules should not exceed the max DC power delivered from the AXIe Chassis. In this case, the module connected at the last may not be turned on.

Step 3 - Set up the External Host Computer (not required for M8050A-BU3/BU5)

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

- Windows 10 or Windows 11
- Keysight IO Libraries Suite 2024 Update 2 Build 21.1.17 or higher

NOTE The M8070B software is required to control the M8050A modules.

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 2.0 or 3.0 support as the host computer.

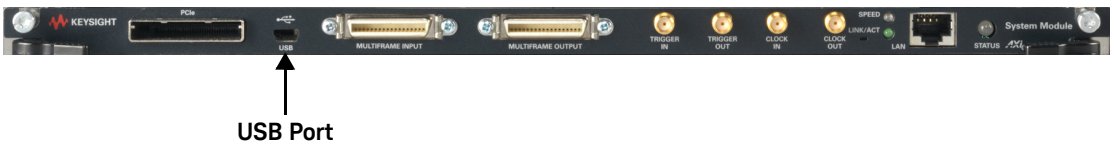


Figure 19 USB port on the front panel of the AXIe ESM

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.

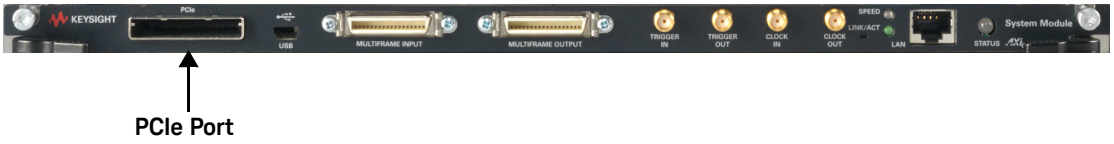


Figure 20 PCIe port on the front panel of the AXIe ESM

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

Ensure that the sum of power consumed by all modules should not exceed the max DC power delivered from the AXIe Chassis. In this case, the module connected at the last may not be turned on.

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.

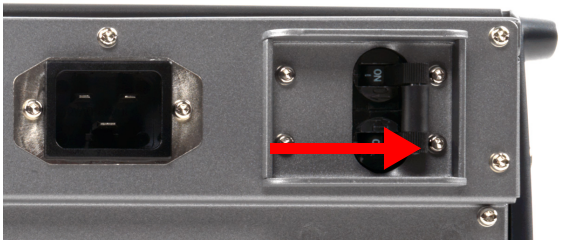


Figure 21 Chassis circuit breaker

Step 5 - Connect M8050A Modules with M8009A Clock Module

This section describe how to connect M8042A pattern generator and M8009A clock modules in order to prepare single-channel, two-channel and four-channel systems.

The following table shows the required cables:

Clk Module Connections	Part No.	Option	Description
DAT Clk Cable channel 1	M8199-61624		Clock Cable for Pattern Generator M8042A, Channel 1
DAT Clk Cable channel 2	M8199-61624		Clock Cable for Pattern Generator M8042A, Channel 2
Sync Cable 3.5mm	M8042-61623	M8042A-803	Synchronization Cable, Semi-rigid for Pattern Generator M8042A and M8009A
Local Bus Cable	M8041-61601		Local bus cable

Preparing Single-Channel System

For a single channel system, you will require a M8042A pattern generator (one channel) and M8009A clock modules.

Follow the given steps to make the single-channel system:

1 Connect M8009A Channel Clock Out 1 port with the M8042A Channel Clock In 1 port using M8199-61624 cable or a semi-rigid (M8042A-801) cable.

2 Connect M8009A Sync Out A port with the M8042A Sync In port using a 3.5 mm sync cable.

Figure 22 Single-channel system

Preparing Two-Channel System

For a two-channel system, you will require a M8042A pattern generator (two channels) and M8009A clock modules.

Follow the given steps to make the two-channel system:

1 Connect M8009A Channel Clock Out 1 port with the M8042A Channel Clock In 1 port using M8199-61624 cable or a semi-rigid (M8042A-801) cable.

2 Connect M8009A Channel Clock Out 2 port with the M8042A Channel Clock In 2 port using M8199-61624 cable or a semi-rigid (M8042A-802) cable.

3 Connect M8009A Sync Out A port with the M8042A Sync In port using a 3.5 mm sync cable.

Figure 23 Two-channel system

Preparing Four-Channel System

For a four-channel system, you will require two M8042A two-channel pattern generators, two M8009A clock modules, two 5-slot chassis, and the necessary connecting cables. Install one M8009A and M8042A in each of the chassis. Make sure the M8009A is in a lower slot number than M8042A.

Select one of the two chassis as primary and the other as secondary. This is important as the following cabling instructions rely on this setup.

Follow the steps outlined below to set up the four-channel system:

1 Connect M8009A Sync Out A port with the M8042A Sync In port using a 3.5 mm sync cable.

2 Connect M8009A Channel Clock Out 1 port with the M8042A Channel Clock In 1 port using either an M8199-61624 cable or a semi-rigid (M8042A-801) cable.

3 Connect M8009A Channel Clock Out 2 port with the M8042A Channel Clock In 2 port using either an M8199-61624 cable or a semi-rigid (M8042A-802) cable.

4 Connect the M8009A Ref Clk Out 16 G port to the M8009A Ref Clk In port using either an M8199-61624 cable or a semi-rigid M8042A-802 cable. Additionally, connect the M8009A Sync Out B port to the M8009A Sync In port. Finally, connect the Clock Out port of the chassis defined as primary to the Clock In port of the System Module defined as secondary chassis.

5 Use a local bus (LB) cable (M8041-61601) to connect the M8042A LB Out port to the M8042A LB In port on the second chassis.

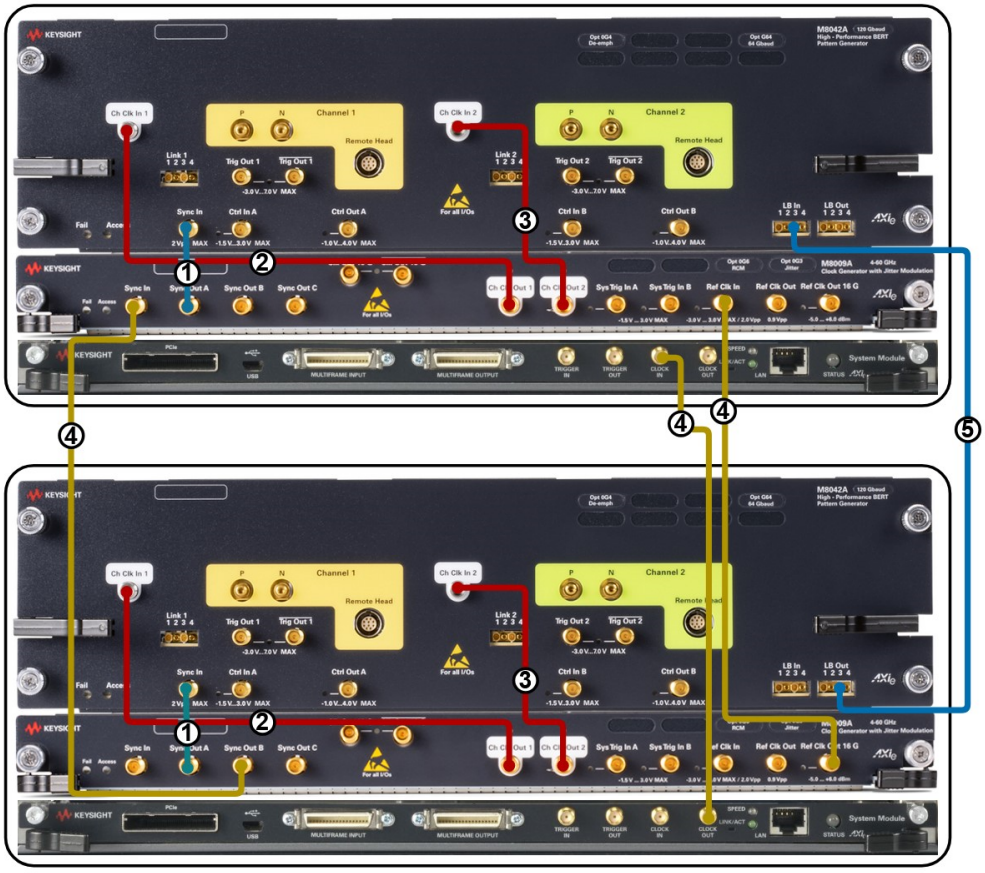


Figure 24 Four-channel system

Installing M8053A Module in AXIe Chassis

The M8053A interference source can be configured with a M8050A high-performance BERT in a single 5-slot M9505A/M9506A AXIe chassis. The M8053A Interference Source module occupies two slots of the AXIe chassis. The M8053A module should be installed in the upper slot. The following figure illustrates an M8053A module with M8042A module (one channel) and M8009A clock module installed in a 5-slot AXIe chassis.

M8042A (1-channel), M8009A, M8053A in single chassis

It is also possible to configure the M8053A in a second AXIe chassis (M9502A/M9505A/M9506A). In case of installing an M8042A module (two channels) and an M8009A clock module in a 5-slot AXIe chassis, the M8053A module must be installed in separate 5-slot AXIe chassis.

M8042A (2-Channels), M8009A in chassis - 1

M8043A, M8053A in chassis - 2

The whole BERT system including the M8053A is controlled by the M8070B system software.

NOTE

It is recommended to connect two or multiple chassis via USB to two (multiple) USB ports of the controller. Thereafter, no further MultiFrame cable connections are required.

Step 6 - 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 25 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 M8050A 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 7 - Verify Basic M8050A 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. See Contacting Keysight Service and Support on page 64.

Step 8 - Install Keysight IO Libraries Suite (not required for M8050A-BU3/BU5)

IO Libraries Suite version 17.1 or later is required. Always use the latest version of the Keysight IO Libraries.

NOTE **Perform this step if you are setting up an M8050A-BU2/BU4 system or the host computer you are using as part of the M8050A 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. 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 9 - Install M8070B Software (not required for M8050A-BU3/BU5)

NOTE **Perform this step if you are setting up an M8050A-BU2/BU4 system or an M8050A system in which the host computer 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 module drivers in the M8070B software. For details, go to Step 11 - Install Module Drivers in the M8070B Software on page 52.
These module drivers need a valid license for their activation. For details, go to Step 12 - Install the Licenses on page 53.

To install the software

1 Download the latest M8070B software from www.keysight.com/find/M8070B.

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.

NOTE

Verify your account permissions. Ensure that you have full administrative privileges (run as Administrator) before you install or upgrade the M8070B software on a PC running Windows 10. Not doing so may result in the installation failure. Please contact your system administrator to provide you the administrative rights.

Step 10 - Starting the M8070B Software

1 Ensure that the system is powered up and ready to start as described in the sections Basic Setup for M8050A on page 39.

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

3 Select the module options from **M8070B Startup Options** dialog box. For details on the **M8070B Startup Options** dialog box, refer to *M8000 Series User Guide* or *Online Help*.

4 Click **OK**. The Startup screen of the M8070B software should display.

Step 11 - Install Module Drivers in the M8070B Software

The M8070B system software supports module drivers. To use these drivers, it is necessary to install the module drivers in the M8070B software.

Please make sure that you have M8070B software version 9.0 or later installed on your system.

The module driver file can be downloaded from Keysight web page www.keysight.com/find/M8050A.

Currently, the M8070B software supports the following M8050A module drivers:

- M8042A Pattern Generator Module
- M8043A Error Analyzer Module
- M8009A Clock Module

The M8070B software comes with a **Manage Module Drivers** utility to simplify all the tasks related to module driver management. The **Manage Module Drivers** allows you to install, uninstall, and upgrade the module drivers.

For complete details on how to install, update or uninstall module drivers, please refer to the *M8000 Series User Guide* or Online *Help*.

NOTE

Verify your account permissions. Ensure that you have full administrative privileges (run as Administrator) before you install or upgrade the M8050A module drivers on a PC running Windows 10. Not doing so may result in the installation failure. Please contact your system administrator to provide you the administrative rights.

Step 12 - Install the Licenses

The usage of M8070B module drivers and 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 Utilities**. 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 license utilities can be used to install the licenses:

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

NOTE Please note that the Keysight License Manager 5 and Keysight PathWave Manager 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://www.keysight.com/in/en/assets/9018-04784/user-manuals/9018-04784.pdf)
- Keysight Licensing Administrator's Guide (https://www.keysight.com/in/en/assets/9018-04713/programming-guides/9018-04713.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 M8050A system. Once a module license has been installed using the Keysight License Manager, the next time the M8070B software and M8050A 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.

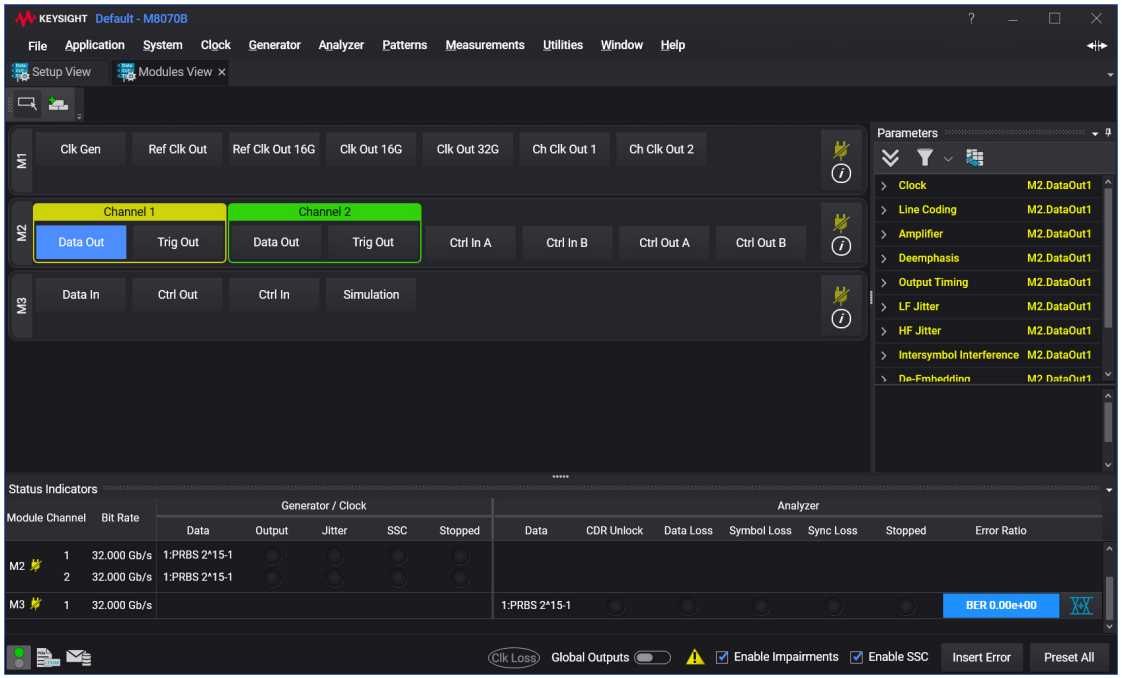
5 In the M8070B software interface, verify that the license has been installed by selecting **Utilities** > **Licenses** then viewing the license status in the **Installed** column.

Step 13 - Starting the Module Driver Interface from M8070B Software

1 In Windows click on **Start** > **All Programs** > **Keysight M8070B** > **Keysight M8070B**.

2 Select the module driver (for example; *M8042A*) from the **M8070B Startup Options** dialog box. For details on the **M8070B Startup Options** dialog box, refer to *M8000 Series User Guide* or *Online Help*.

3 Click **OK**. The M8070B software screen should now be displayed as shown in the following figure:



For details on the how to control the module driver using M8070B software interface, refer to *M8000 Series User Guide* or *Online Help*.

Step 14 - Using UXR Series Real-Time Oscilloscope as Analyzer

The M8070B system software supports certain real-time oscilloscopes to measure BER of NRZ signals and BER as well as SER of PAM4 signals. The real-time oscilloscope is completely controlled from M8070B to capture a signal and convert into a pattern stream that is then uploaded into the M8070B for comparison with an expected pattern and provide BER/SER measurements.

For more details on how to control UXR-Series Real-Time Oscilloscope from M8070B, refer to *Keysight M8070ADVB Advanced Measurement Package User Guide*.

NOTE **In order to support the UXR-Series Real-Time Oscilloscope, ensure that you have installed Advanced Measurement Package (M8070ADVB) in the M8070B system software.**

Step 15 - Performing a Functional Test

This section describes how to perform a basic functional test using a M8042A pattern generator module with any supported real-time scope or M8046A module as an error detector. The M8046A error detector requires options A64 (Data Rate up to 64 Gbaud) and 0A5 (Clock Recovery).

NOTE **In order to support the Real-Time Oscilloscope, ensure that you have installed Advanced Measurement Package (M8070ADVB) in the M8070B system software.**

Follow the steps given below:

1 Connect Remote Heads (M8058A or M8059A) to Data Input of Scope or M8046A. For M8058A Remote head, use 150 mm, 1.85 mm cable and for M8059A, use the 150 mm, 1.00 mm cable. For M8046A, use the recommended cable pair M8046A-802 (2.4 mm matched cable pair).

2 Take care to use appropriate adapters for connecting remote heads to UXR or to M8046A matched cable pair. You might also require an adapter 1.0 mm to 2.4 mm, depending on the analyzer connectors.

3 Start the M8070B system software.

Figure 26 Basic functional setup

4 During boot-up of M8070B software, select "**Factory Preset**" or go to **File** > **Factory Preset** option.

5 Switch the output coupling to AC.

6 If you are using M8046A as an analyzer, then enable CDR. However, if you are using UXR series real-time scope an analyzer, then enable Follow Sys Clk (Data In > Clock).

7 Also, if you are using M8046A as an analyzer, then enable the Equalization and PAM4 options.

8 Turn on data out signals (Data Out and Output State).

9 Turn on Global Outputs.

10 Press the BER Threshold auto align button.

11 After a few seconds Error Ratio should go to BER=0.00 as shown in the following figure:

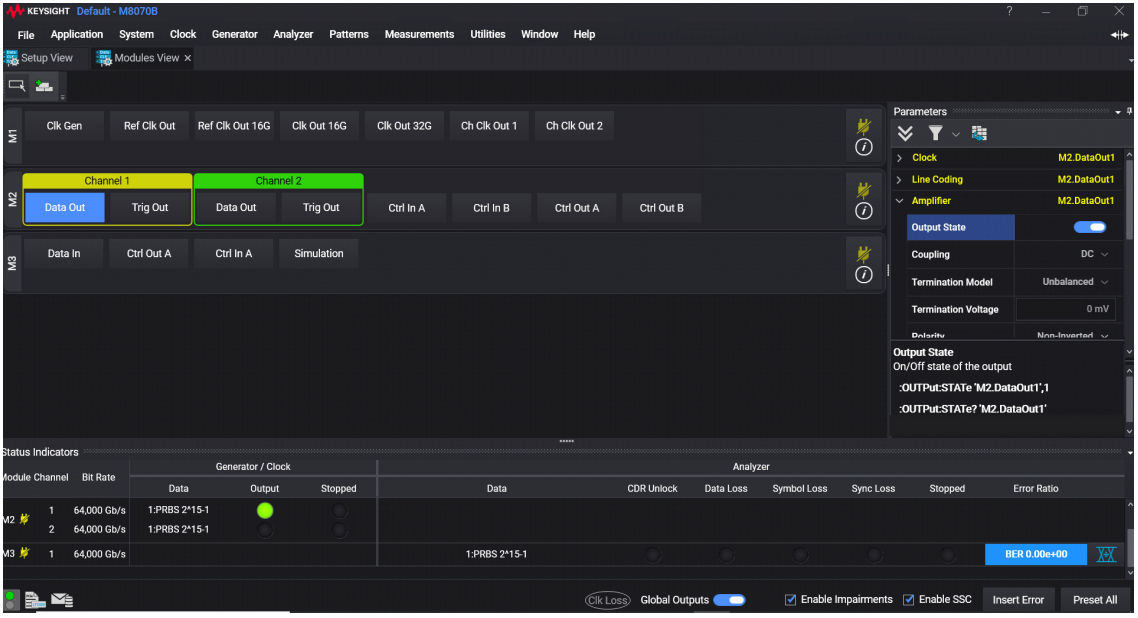


Figure 27 Setup showing BER=0.00

Step 16 - Turning off the Chassis and Modules (If Required)

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.

3 Maintenance

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**.

For module driver related documents, navigate to:

C:\Program Files\Keysight\M8070B\Modules\%ModuleDriverPackageName%\doc

where <ModuleDriverPackageName> is the name of the folder corresponding to the package of interest.

You can also visit www.keysight.com/find/M8050A to find the latest versions of related manuals and the data sheet for each M8050A 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 M8058A/M8059A/M8068A/M8069A, 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 "*M8100A Tips for Preventing Damage Guide*" (Document Part No. #M8000-91B30).

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** option.
3. Click the **Drivers, Firmware and Software** tab.
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 **Drivers, Firmware 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

Index

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