Keysight PXIe System Modules

M9022A, M9023A, M9024A, M9025A

KEYSIGHT

INSTALLATION GUIDE

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Safety Information

CAUTION

A CAUTION denotes a hazard. It calls attention to an operating procedure or practice 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 denotes a hazard. It calls attention to an operating procedure or practice, 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 Information

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.

General

Do not use this product in any manner not specified by the manufacturer. The protective features of this product must not be impaired if it is used in a manner specified in the operation instructions.

Before Applying Power

Verify that all safety precautions are taken. Make all connections to the unit before applying power. Note the external markings described under "Safety Symbols".

Ground the Instrument

Keysight chassis are provided with a grounding-type power plug. The instrument chassis and cover must be connected to an electrical ground to minimize shock hazard. The ground pin must be firmly connected to an electrical ground (safety ground) terminal 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 module/chassis in the presence of flammable gases or fumes.

Do Not Operate Near Flammable Liquids

Do not operate the module/chassis in the presence of flammable liquids or near containers of such liquids.

Cleaning

Clean the outside of the Keysight module/chassis with a soft, lint-free, slightly dampened cloth. Do not use detergent or chemical solvents. To prevent electrical shock, disconnect the instrument from mains before cleaning. Use a dry cloth or one sightly dampened with water to clean the external case parts. Do not attempt to clean internally.

Do Not Remove Instrument Cover

Only qualified, service-trained personnel who are aware of the hazards involved should remove instrument covers. Always disconnect the power cable and any external circuits before removing the instrument cover.

Keep Away From Live Circuits

Operating personnel must not remove equipment covers or shields. Procedures involving the removal of covers and shields are for use by service-trained personnel only. Under certain conditions, dangerous voltages may exist even with the equipment switched off. To avoid dangerous electrical shock, DO NOT perform procedures involving cover or shield removal unless you are qualified to do so.

Do Not Operate Damaged Equipment

Whenever it is possible that the safety protection features built into this prod-uct have been impaired, either through physical damage, excessive moisture, or any other reason, REMOVE POWER and do not use the product until safe operation can be verified by service-trained personnel. If necessary, return the product to an Keysight Technolo-gies Sales and Service Office for ser-vice and repair to ensure the safety features are maintained.

Do Not Block The Primary Disconnect

The primary disconnect device is the appliance connector/power cord when a chassis used by itself, but when installed into a rack or system the disconnect may be impaired and must be considered part of the installation.

Do Not Modify the Instrument

Do not install substitute parts or perform any unauthorized modification to the product. Return the product to an Keysight Sales and Service Office to ensure that safety features are maintained.

In Case of Damage

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

CAUTION

Do NOT block vents and fan exhaust: To ensure adequate cooling and ventilation, leave a gap of at least 50mm (2") around vent holes on both sides of the chassis.

Do NOT operate with empty slots: To ensure proper cooling and avoid damaging equipment, fill each empty slot with an PXIe filler panel module.

Do NOT stack free-standing chassis: Stacked chassis should be rack-mounted.

All modules are grounded through the chassis: During installation, tighten each module's retaining screws to secure the module to the chassis and to make the ground connection.

WARNING

Operator is responsible to maintain safe operating conditions. To ensure safe operating conditions, modules should not be operated beyond the full temperature range specified in the Environmental and physical specification. Exceeding safe operating conditions can result in shorter lifespan, improper module performance and user safety issues. When the modules are in use and operation within the specified full temperature range is not maintained, module surface temperatures may exceed safe handling conditions which can cause discomfort or burns if touched. In the event of a module exceeding the full temperature range, always allow the module to cool before touching or removing modules from the chassis.

Safety Symbols

CAUTION

A CAUTION denotes a hazard. It calls attention to an operating procedure or practice, 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 denotes a hazard. It calls attention to an operating procedure or practice, 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.

Products may display the following symbols:

Warning, risk of electric shock

The instruction documentation symbol. The product is marked with this symbol when it is necessary for the user to refer to the instruction in the documentation.

Earth Ground.

Frame or chassis Terminal.

Alternating Current (AC).

Standby Power. Unit is not completely disconnected from AC mains when switch is in standby.

Antistatic precautions should be taken.

CAT I
CAT II
CAT III
CAT IV

IEC Measurement Category I, II, III, or IV

For localized Safety Warnings, Refer to Keysight Safety document (p/n 9320-6792).

ON position of the power line switch.

OFF position of the power line switch.

DC Voltage

3 Three-phase alternating current

Alternating Current (AC).

Standby Power. Unit is not completely disconnected from AC mains when switch is in standby.

Presence of a Laser device

Protective Conductor Terminal

Equipment is protected throughout by double or reinforced insulation

Protective Conductor Terminal

C US

The CSA mark is a registered trademark of the Canadian Standards Association and indicates compliance to the standards laid out by them. Refer to the product Declaration of Conformity for details.

The CE marking is registered trademark of the European Community (if accompanied by a year, it is the year when the design was proven). It indicates that the product complies with all relevant directives.

UK CA

UK conformity mark is a UK government owned mark. When affixed to the product is declaring all applicable Directives and Regulations have been met in full.

ccr.keysight@keysight.com

The Keysight email address is required by EU directives applicable to our product.

CAN ICES/NMB-001(A)

Canada EMC label.
Interference-Causing Equipment Standard for industrial, scientific and medical (ISM) equipment. Matériel industriel, scientifique et médical (ISM)

ICES/NMB-001 CE ISM GRP.1 CLASS A

CE/ICES/ISM Label.
This is a space saver label that combines three markings - CE with CAN ICES (see above) and ISM (see below).

The RCM mark is a registered trademark of the Australian Communications and Media Authority.

ICES/NMB-001
ISM GRP.1 CLASS A

This is a combined marking to indicate product compliance with the Industry-Canadian Interference-Causing Equipment Standard (ICES/NMB-001). This is also a symbol of an Industrial Scientific and Medical Group 1 Class A product (CISPR 11, Clause 5).

Safety Symbols (continued)

ISM 1-A

This is a symbol of an Industrial Scientific and Medical Group 1 Class A product. (CISPR 11, Clause 5)

South Korean Certification (KC) mark. It includes the marking's identifier code.

A 급 기기 (업무용 방송통신기자재)
이 기기는 업무용 (A 급) 전자파적합기
기로서 판 매자 또는 사용자는 이 점을 주
의하시기 바라 며 , 가정외의 지역에서
사용하는 것을 목적으 로 합니다.

China Restricted Substance Product Label. The EPUP (environmental protection use period) number in the center indicates the time period during which no hazardous or toxic substances or elements are expected to leak or deteriorate during normal use and generally reflects the expected useful life of the product.

Universal recycling symbol. This symbol indicates compliance with the China standard GB 18455-2001 as required by the China RoHS regulations for paper/fiberboard packaging.

IP x y

This mark indicates product has been designed to meet the requirements of "IP x y", where "x" is the solid particle protection and "y" is the liquid ingress protection.

Waste Electrical and Electronic Equipment (WEEE) Directive 2002/96/EC

This WEEE symbol indicates separate collection for electrical and electronic equipment, mandated under EU law as of August 13, 2005. All electric and electronic equipment are required to be separated from normal waste for disposal.

To return unwanted products, contact your local Keysight office, or for more information see http://about.keysight.com/en/companyinfo/environment/takeback.shtml.

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Introduction

Keysight's M9022A, M9023A, M9024A and M9025A PXIe system modules provide a cabled PCIe link between a PXIe or AXIe chassis and an external computer, or a computer embedded in a PXIe chassis.

With an external computer you can connect up to 6 chassis via a star or cascade configuration. The star configuration can be either x8 or x16 links.

With a computer embedded in a chassis, you can connect up to 6 chassis with a cascade configuration at x8.

NOTE

To ensure proper system operation, use an approved host computer (embedded, rack-mount, desktop) along with an approved PCIe adapter and cable. While you may use other controllers, the approved computers have verified hardware support for PCIe x8/x16 and their BIOS can properly enumerate multiple instruments on the shared PCIe bus.

Keysight provides a list of tested host PCs at: www.keysight.com/find/PXIAXIeTestedPC.

The PXIe system modules provide the following features:

- **M9022A** *Single Port* PXIe *System Module.* Up to Gen 3 at 8 GT/s with x8 lanes.
- **M9023A** *Dual Port* PXIe *System Module.* Up to Gen 3 at 8 GT/s with x8 or x16 lanes.
- **M9024A** *Dual Port* PXIe *System Module.* Up to Gen 3 at 8 GT/s with x8 or x16 lanes. The module also has IO ports: two LAN, four USB 2.0, two USB 3.0 and one GPIB.
- **M9025A** *Dual Port Thunderbolt* PXIe System Module.* Up to 22Gbps available bandwidth for PCIe use.

Each M9022A, M9023A, and M9025A comes complete with a 3-slot Controller Expansion Slot Blocker. For installation instructions, see "Step 3: Install the Controller Expansion Slot Blocker" on page 15.

NOTE

The chassis controller expansion slots must have the Slot Blocker installed for proper chassis cooling efficiency.

* Thunderbolt™ is the brand name of an interface standard developed by Intel (in conjunction with Apple) that allows connection of external peripherals to a computer. Charging devices such as laptop computers over Thunderbolt 3 is not supported.

The PCIe cable connections provide very high bandwidth serial links between modules on different chassis and a host computer. These links are transparent to computer applications and allow direct control of PXI and PXIe modules. Use the Y1202A 2-meter or Y1203A 0.5-meter cables to:

- Connect PXIe system modules to a PC with a host adapter module
- Connect PXIe system modules to the front panel of an M9037A PXIe or M9537A AXIe embedded PC
- Connect PXIe system modules to system module in adjacent chassis in a cascade or “daisy chain”

These modules can be used in a wide range of configurations with the PCIe cables connecting up to four chassis in Star or Cascade topologies. There are a few examples later in this document in section “M9025A System Module Installation” on page 33.

M9025A System Module is based on Thunderbolt 3 technology which enables control of PXIe chassis from a Thunderbolt 3 based PC or laptop. There are a few examples later in this document in section “External PC to a Single Chassis Configuration (Thunderbolt System)” on page 37 and section “External PC to Two Chassis Configuration (Thunderbolt System)” on page 39.

For additional information on using these chassis inter-connection components, see the Keysight Multi-chassis Designer; found at www.keysight.com/find/pxie-multichassis, or by searching on the document name.

NOTE Keysight provides a list of tested host PCs at: www.keysight.com/find/PXIAXIeTestedPC.

NOTE This product has been designed and tested in accordance with accepted industry standards and has been supplied in a safe condition. The documentation contains information and warnings that must be followed by the user to ensure safe operation and to maintain the product in a safe condition.

System Limitations

Enumeration Limitations

All of the modules can be used with embedded controllers or external PCs. However, PCs are not equal in their ability to enumerate PCIe devices. The set of PCs where operation has been verified is listed in the document *PC Tested Configurations with PXI/AXIe Chassis* (5990-7632EN). Find this document at www.keysight.com/find/PXIAXIeTestedPC. Also, review the *Diagnose and Resolve PXIe and AXIe Chassis Communication Problems* document at www.keysight.com/find/ResolvePXIAXIeComProblems for diagnostic procedures on chassis communication issues.

Multiple M9024A Limitations

The additional ports on the M9024A operate like IO ports on the PC. For multiple chassis systems, only one M9024A can be used. For multiple chassis systems with an Embedded Controller, a single M9024A may be installed in a target chassis.

Cable Length Limitation

If application requires cable lengths greater than the 2-meter lengths and/or fiber optic cables, refer to “Dolphin Interconnect Solutions Modules Installation” on page 35.

Step 1: Unpack and Inspect the Module

CAUTION **Keysight's PXIe Modules are shipped in materials that prevent static electricity damage. The modules should only be removed from the packaging in an anti-static area ensuring that correct anti-static precautions are taken. Store all modules in anti-static envelopes when not in use.**

ESD

Electrostatic discharge (ESD) can damage or destroy electronic components. All work on electronic assemblies should be performed at a static-safe work station. The following figure shows an example of a static-safe work station using two types of ESD protection. Purchase acceptable ESD accessories from your local supplier.

- Conductive table-mat and wrist-strap combination.
- Conductive floor-mat and heel-strap combination.

Both types, when used together, provide a significant level of ESD protection. Of the two, only the table-mat and wrist-strap combination provides adequate ESD protection when used alone. To ensure user safety, the static-safe accessories must provide at least 1 MΩ of isolation from ground.

Inspect for damage

After unpacking the module, carefully inspect it for any shipping damage. Report any damage to the shipping agent immediately, as such damage is not covered by the warranty.

CAUTION **To avoid damage when handling a module; do not touch exposed connector pins.**

1. After unpacking the module, verify that all items listed on the packing list are included.
2. Inspect the module for shipping damage.
3. Save all packing material for storage or return shipment to Keysight.

If you need to return the module

Should it become necessary to return a Keysight module for repair or service, follow the steps below:

1. Review the warranty information shipped with your product.
2. Contact Keysight to obtain a return authorization and return address. If you need assistance finding Keysight contact information go to www.keysight.com/find/assist (worldwide contact information for repair and service) or refer to the **Support** information on the product web page, for example: www.keysight.com/find/M9025A.
3. Write the following information on a tag and attach it to the malfunctioning equipment.
   - Name and address of owner. A Post Office box is not acceptable as a return address.
   - Product model number (for example, M9025A)
   - Product serial number (for example, TWXXXXXXXX). The serial number label is located on the side of the module.
   - A description of failure or service required.
4. Carefully pack the module in its original ESD bag and carton. If the original carton is not available, use bubble wrap or packing peanuts, place the instrument in a sealed container and mark the container “FRAGILE”.
5. On the shipping label, write ATTENTION REPAIR DEPARTMENT and the service order number (if known).

NOTE If any correspondence is required, refer to the product by model number and serial number.

Step 2: Verify Shipment Contents

Your shipment should have included the following:

- The Keysight M902xA module that you ordered.
- Controller Expansion Slot Blocker.
- M9025A ships with one Thunderbolt 3 USB Type-C Cable with Bracket Assembly.
- Printed *Keysight PXIe System Modules Installation Guide* (this document).

When shipping the M902xA module, use original packaging or comparable to avoid damage to the product.

NOTE

A driver is required for the M9022A, M9023A, M9024A, and M9025A modules. Refer to "Step 5. Install the Driver" on page 20 for driver installation information. A single driver install utility services the M9022A, M9023A, M9024A, and M9025A modules. It is available on the software CD as well as on each of the Keysight product web sites:

www.keysight.com/find/M9022A

www.keysight.com/find/M9023A

www.keysight.com/find/M9024A

www.keysight.com/find/M9025A

NOTE

The most current version of Keysight IO Libraries is required prior to installing and running any other software. The latest version can be downloaded from: www.keysight.com/find/iosuite.

NOTE

A GPIB cable is NOT supplied with the M9024A System Module. Note that the GPIB cable is a standard micro type 2 GPIB cable with standard pin wiring and is compatible with the M9037A Embedded Controller GP-IB cable. It is available from Keysight as an accessory cable, part number Y1260A.

Step 3: Install the Controller Expansion Slot Blocker

Each M9022A, M9023A, and M9025A comes with a 3-slot Controller Expansion Slot Blocker.

The Controller Expansion Slot Blocker provides one 3-slot blocker (baseplate and cover with captive screws) and two M3 Phillips screws. See below.

Figure 1 Controller Expansion Slot Blocker Pieces

Additional or replacement kits are available from Keysight; order the Keysight Y1214C Air Inlet Module Kit. It includes the 3-slot Controller Expansion Slot Blocker, two M3 Phillips screws, and two single-slot Air Inlet Modules.

NOTE The chassis controller expansion slots must have the slot blocker installed for proper chassis cooling efficiency.

CAUTION The 3-slot Controller Expansion Slot Blocker must be installed in the embedded controller space.

Installation and Removal

Installation of the Air Inlet Modules is similar to installing any other PXIe module.

1. Make sure the PXIe chassis power is turned off; but the AC power cable must remain plugged to provide a ground connection for ESD protection.
2. To install the Controller Expansion Slot Blocker:
   - **a** Remove slot covers over the three slots just to the left of the red slot guides.
   - **b** Note that the Controller Expansion Slot Blocker consists of a base plate, a front plate, and two M3 Phillips screws. Install the base plate in the chassis before you attach the face plate.

In the following photographs, chassis covers and all modules were removed for clarity. You do not need to remove modules or chassis covers to install the Controller Expansion Slot Blocker.

   - **c** Position the base plate as shown in the following photographs. Note that the tab goes toward the back of the chassis.

Figure 2 Base Plate Installation

WARNING **To ensure mandatory safety requirements are being met, the module must be installed in a chassis which has been certified and marked by a Nationally Recognized Testing Lab (such as CSA, UL, TUV, ETL etc.) in which all the means of protection are properly implemented. NOTE: CE marking alone is not adequate.**

d The tab on the base plate must go under the rear aluminum chassis rail as shown below.

Figure 3 Locate the Base Plate Tab under the Chassis Rail

e Install the face plate. Secure the face plate to the base plate with the two M3 Phillips screws. Secure the face plate to the chassis by the four module mounting screws. Do not over tighten the screws.

WARNING **Safety of any system incorporating the equipment is the responsibility of the assembler of the system.**

Figure 4 Secure the Front Cover

3 Plug in and power up the PXIe chassis. Verify that the chassis fans are operating and free of airflow obstructions.

NOTE Install all chassis covers and slot blockers. Install the other PXIe modules.

CAUTION Missing filler panels may disrupt necessary chassis air circulation. for additional cooling information see the PXI Chassis Cooling Capacity Guidelines at:

https://www.keysight.com/us/en/assets/7018-06302/white-papers/5992-3270.pdf

Step 4: Install the System Module in the Chassis

The Keysight PXIe System Modules have been designed for easy installation. However, the following standard precautions, installation procedures, and general information must be observed to ensure proper installation and to prevent damage to the board, other system components, or injury to personnel.

CAUTION **The following safety precautions must be observed when installing or operating the Keysight PXIe System Modules. Exercise care when handling the module as the heat sink can get very hot. Do not touch the heat sink when installing or removing the module. The board should not be placed on any surface or in any form of storage container until the board and heat sink have cooled to room temperature.**

Follow these steps to install the System Module in a PXIe chassis.

1. Ensure the PXIe chassis is turned off. The chassis should be plugged into an AC power source; the AC power cord grounds the chassis and protects it from electrical damage while System Module is installed.
2. On the PXIe chassis, set the rear panel **INHIBIT** switch to **DEF**.
3. Remove the screw protection caps from the System Module mouting screws.
4. Before inserting the System Module into the chassis, back the mounting screws out to ensure that there is no interference between the mounting screws and the mounting rails.
5. Ensure that the ejector handle is pushed down in the unlatched (downward) position.
6. Holding the System Module by the ejector handle, carefully align the System Module board with the chassis guide rails (top and bottom) for slot 1 (red guide rails) and insert the System Module into the guide rails,
7. Slide the System Module completely into the chassis. When you begin to feel resistance, lift up on the ejector handle to fully inject the System Module into the chassis.
8. Secure System Module to the chassis using the mounting screws. Use a #1 Pozidriv® or a slotted screw driver and torque to 5Lb-In (0.57N-m). Performance may suffer if the mounting screws are not tightened properly.
9. A 3-slot Controller Expansion slot blocker should be installed immediately to the left of the System Module M9022A, M9023A, and M9025A to ensure proper air flow.
10. Connect other peripherals (such as the keyboard, mouse, monitor, LAN cable for remote access, etc.) to the System Module.
11. Power up the PXIe chassis. Verify that the chassis fans are operating and free of obstructions that may restrict air flow.

Step 5. Install the Driver

The M9022A, M9023A, M9024A, and M9025A PXIe System Modules require a driver installed on the host PC. These PXIe System Modules work with Windows 7 SP1 32/64 bit, Widows Embedded System (WES) 7 32/64, Windows 8.1 Update1 32/64 bit, and Win 10 32/64 bit. One install program works for all Keysight PXIe System Modules. This single driver is available at each of the product's Keysight web page:

www.keysight.com/find/M9022A

www.keysight.com/find/M9023A

www.keysight.com/find/M9024A

www.keysight.com/find/M9025A

From the product website, select **Visit Technical Support > Drivers, Firmware & Software**. Select the **M902x** driver. Follow the on-screen instructions to install the driver on your host PC.

If the driver installation does not detect an M902x module it will display the following message. Click **Yes** to continue the installation.

Figure 5 M902x Installer cannot detect an M902x module

M9024A Driver Installation

Have the M9024A in the chassis when you install the PXIe System Module driver. If you install the software without the M9024A present, the USB 2.0, USB 3.0, and GPIB port drivers will not be installed. Later, if you add an M9024A, you may need to rerun the installer if Windows cannot locate the drivers. When you rerun the installer, choose Modify to load the additional drivers.

Using Different PXIe Chassis

To use the M9022A, M9023A, M9024A, or M9025A PXIe system modules with the M9018B chassis, use the chassis *PCIe Switch Fabric Configurator* to set the chassis switch fabric to 2x8.

The link configuration for the Gen 3-capable M9010A, M9019A, and M9046A chassis is fixed, so there is no need to configure the chassis switch fabric when using the M9022A, M9023A, M9024A, or M9025A PXIe system modules.

NOTE For a full discussion of PCIe link configuration, see the topic "Viewing the PCIe Link Configuration" in the Software Front Panel (SFP) help system for the chassis, or "PCIe Link Configuration" in the *Keysight M9018B PXIe Chassis User Guide.*

General Installation Considerations

The following table shows which PXIe chassis slots the PXIe System Modules may be installed in:

System Module	PXIe Chassis	Chassis Slot
M9022A	M9010A, M9018B, M9019A, M9046A	1 only
M9023A	M9010A, M9018B, M9019A, M9046A	1 only
M9024A	M9010A, M9018B, M9019A, M9046A	1 only
M9025A	M9010A, M9018B, M9019A, M9046A	1 only

NOTE

Some non-Keysight PXIe chassis manufacturers install small chassis stops just to the left of the slot 1 guide rails (both top and bottom). Refer to the photo below. These must be removed prior to installing the M9024A System Module. They snap in and are easily pulled out.

Follow these steps to install the module in a PXIe chassis.

1. Turn off the host PC and the PXIe chassis. The chassis should be plugged into an AC power source; the AC power cord grounds the chassis and protects it from electrical damage while modules are installed.
2. On the M9018B chassis, set the rear panel **INHIBIT** switch to **DEF**.
3. Remove the module from its protective bag. Observe electrostatic discharge precautions.
4. Ensure the switches on the System Module are set correctly.
   a. Refer to "Module Switch Settings Summary" on page 26 for information on the System Module switches.
5. Remove the screw protection caps from the module retaining screws.
6. Push down on the module's ejector/injector handle.
7. Carefully align the module board edges with the chassis guide rails (red guide rails for slot 1) and insert the module into the guide rails.
8. Push inward on the module until it is firmly seated in the chassis. (Do not force the handle if there is resistance; this may damage the connectors and/or backplane.)
9. Pull up on the ejector/injector handle to firmly seat the module.
10. Tighten the module's captive retaining screws.

11 A slot blocker should be installed immediately to the left of the slot 1 module to ensure proper airflow.

12 If you're using a PCIe cable, attach the PCIe cable by first pulling back on the retractor ring. With the keyed slot aligned with the key ridge on the PCIe adapter, insert the cable connector into the cable port connector on the adapter until the cable locks in place. Attach the other end of the cable to the PCIe adapter on your Host computer.

13 If you're using Thunderbolt 3 cable, back the captive retaining screw of Bracket Assembly out to ensure that there is no interference between the captive retaining screw and module Front Panel. Align connector housing of Thunderbolt 3 cable to fit within pocket of Bracket Assembly, insert the Thunderbolt 3 cable into the Thunderbolt Port and tighten the Bracket Assembly's captive retaining screw. Attach the other end of the Thunderbolt 3 cable to PC, laptop and/or other Thunderbolt 3 products (e.g. monitors or external storage drives).

Figure 6 Bracket Assembly and Thunderbolt connection on module

NOTE

If you are using an external PC, you must power up the chassis BEFORE you power up the PC. When you power down your system, shut down the PC BEFORE you power down the chassis. This applies to both PCIe and Thunderbolt connections.

If you are using an embedded controller in a multi-chassis configuration, you must power up the target chassis BEFORE you power up the chassis containing the embedded controller.

14 Power up the PXIe chassis. Verify that the chassis fans are operating and free of obstructions that may restrict air flow.

15 Power up the Host PC.

M9022A, M9023A, M9024A System Module Installation

Understanding Features Controlled by Switch Settings

Mode Settings

The Mode settings, Host and Target, do not apply to the M9022A because it has only one PCIe port on the front panel (always in Target Mode).

The M9023A and M9024A are Dual Port PXIe System Modules.

PCIe Port 1 is always a “target,” but the PCIe Port 2 can be configured via switch settings to be either ‘host” or “target.” The default setting for the PCIe Port 2 is “host.”

Port 1	Port 2	Application
Target	Host (default)	x8, Single PCIe cable to chassis, Multi-chassis Cascade, Multi-chassis Star
Target	Target	x16, two PCIe Cables to chassis, Star Multi-chassis

Mode Host (default) x8

The top port (PCIe Port 1) is always connected to the upstream device (that is, the device closest to the computer); for example when the upstream device is a PC, PCIe Port 1 is the target. In the default configuration the PCIe Port 2 connects to a downstream device; for example when the downstream device is a chassis, PCIe Port 2 is the host. Both of these connections will use a single 8 lane PCIe cable. See Figure 20 on page 43 for an example PCIe cable topography that uses this configuration.

Mode Target x16

The mode “target” is possible via switch settings. In this mode PCIe Port 2 connects to a upstream device. There are no downstream devices. This mode is used to achieve maximum bandwidth between a chassis and a PC.

With two x8 PCIe cables working in parallel, the total number of lanes of communication is 16. See Figure 17 on page 40 for an example of a PCIe cable topology that uses this configuration. Note that when two cables are connecting a PC to chassis, the top cable connector on PC host adapters must be connected to the top (PCIe Port 1) on the M9023A or M9024A. Likewise, the bottom two ports must connected to each other.

Transfer Rate Settings

Link settings determine the fastest transfer rate at which the module will support PCIe. The default switch setting allows the PCIe links to train to a maximum of Gen3. The module will train its link to a slower speed if the other end of the link cannot support Gen3.

Some devices are old or low performance and can not support Gen3 speeds.

Sometimes a device also cannot correctly follow the PCIe training protocol and the link fails to connect reliably. As a workaround or diagnostics debug step, you can throw the switches on the M9022A, M9023A, and M9024A modules to lower the maximum speed to Gen 1. This lower speed may allow the device to function reliably. For these devices, the Gen1 speed is usually not a throughput performance bottleneck.

Using the M9024A on an M9018B with 4x4 PCIe Switch Fabric

M9024A can be used in an M9010A, M9018B, M9019A, or M9046A PXIe Chassis. The M9018B can be configured using the *PCIe Switch Fabric Configurator* to set the PXIe Chassis switch fabric to one of 1x8, 2x8, or 4x4. The 2x8 configuration is the default configuration for the M9022A, M9023A, and M9024A modules. However, if you set the M9018B to a switch fabric of 4x4, and you are using the M9024A, you will need to make a switch setting change on the M9024A so that the IO ports will operate properly.

Module Switch Settings Summary

Figure 7 Switch Settings

Setting Switches for Host/Target Mode

Function	SW1 Switches		Notes
	1	2	
Host Mode (default)	High	Low	Cable port 1 is PCIe x8 input (target mode), Cable port 2 is PCIe x8 output (downstream port to next chassis)
Target Mode	High	High	Cable ports 1 and 2 combined as PCIe x16 input. Both ports are in target mode.

Setting Switches for PCIe Gen Speed

Function	SW1 Switches*		Notes
	3	4	
Link Speed Gen 3 (default)	High	High	
Link Speed Gen 1	High	Low	

* Leave Switches 5 and 6 in the High position.

M9022A, M9023A, M9024A Front Panel LEDs Summary

Figure 8 M9022A, M9023A, M9024A Front Panel LEDs

* The lower port "Status of module" definition depends on the mode of the lower port. If the lower port is in the default mode "Host", then this LED is shown the status of the lower port. If the lower port is in mode "target," then this LED is a copy of the top LED "Status of module."

LED	Color	Description
Status of Module	Off	No Power
	Red	Power Supply problem or FPGA (normal to go briefly Red on power-up and power-down.)
	Blue	Module okay but no link present
	Green	Link present
Status of Host connection	Off	No link present
	White	Gen 1 Connection
	Blue	Gen 2 Connection
	Green	Gen 3 Connection
Status of backplane connection (Top LED is Link 1 status Bottom LED is Link 2 status)	Off	No link present
	White	Gen 1 Connection
	Blue	Gen 2 Connection
	Green	Gen 3 Connection
Host or Target mode	Green	Host mode (default) (x8)
	Blue	Target mode (x16)

There are also a series of five LEDs across the top of the PC board and six LED across the bottom of the PC board indicating power and configuration.

Figure 9 M9022A, M9023A, M9024A PC Board LEDs

LED	Indicates
D17	PXI power is okay
D14	0.9 VDC power is okay
D15	1.8 VDC power is okay
D9	FPGA configuration is okay
D23	PCIe link status for FPGA
D10 - D13	PCIe Link Status when the backplane is 4-link routing. When the backplane is 2-link routing, D10 indicates PCIe link status for left side mezzanine board.
D31- D32	PCIe Link Status when the backplane is 2-link routing. When the backplane is 4-link routing, D31 indicates PCIe link status for left side mezzanine board.

On the backside of the M9024A module are two LEDs:

Figure 10 Back of M9024A module showing two LEDs

LED	Indicates
D3	Configuration is okay for GPB controller
D4	1.0 VDC power is okay

M9024A I/O Interfaces

To use the M9024A USB, Ethernet and GPIB ports, use the IO Libraries to verify the programming address. These ports cannot be used to control the PXIe chassis. The IO ports are an extension of the Windows PC and should be observable in Windows Device Manager.

USB

Keysight's M9024A System Module provides four USB 2.0 Type A ports and two USB 3.0 Type A ports on the faceplate. All USB ports are compatible with high-speed, full-speed and low-speed USB devices. The USB 2.0 and 3.0 ports do not support the USB Battery Charging specification. Do not connect non-standard or defective USB devices.

Differences between USB 2.0 and USB 3.0 USB 3.0 is the latest version of the Universal Serial Bus (USB). It provides better speed and more efficient power management than USB 2.0. USB 3.0 is backward compatible with USB 2.0 devices; however, data transfer speeds are limited to USB 2.0 levels when these devices inter-operate.

	USB 2.0	USB 3.0
Backwards Compatibility	USB 1.1	USB 1.1 and USB 2.0 (data transfer speeds are limited to USB 1.1 or USB 2.0 levels)
Speed	480 Mbps (known as High Speed/ HS)	10 times faster than USB 2.0. Super Speed or SS, 4.8 Gbps
Signaling Method	Half duplex	Full duplex (Asynchronous -- it can send and receive data simultaneously)
Power	Up to 500 mA	Up to 900 mA. Allows better power efficiency with less power for idle states. Can power more devices from one hub.
Number of wires within cable	4	9
Cables and Connectors	Grey color	Blue color. USB 3.0 receptacles are electrically compatible with USB 2.0 plugs if they physically match. USB 3.0 type-A plugs and receptacles are completely backward compatible, and USB 3.0 type-B receptacles accept USB 2.0 and earlier plugs. However, USB 3.0 type-B plugs will not fit into USB 2.0 and earlier receptacles. This means that USB 3.0 cables cannot be used with USB 2.0 and USB 1.1 peripherals, although USB 2.0 cables can be used with USB 3.0 devices, if at USB 2.0 speeds.

Ethernet

The M9024A has two RJ-45 connectors with link speed/activity LEDs on the faceplate.

Activity LED	No Link	Link Established	Link established and Network activity	
	Off	On (Amber)	LED flashes (Amber)	
Speed LED	No Link	10 Mbps	100 Mbps	1 Gba
	Off	Off	On (Green)	“On (Amber)

GPIB connector

The GPIB connector on M9024A is a D-sub 25-pin connector and is used to control external bench-top instruments. The on-board GPIB controller has the following features:

- Compatible with the IEEE 488 standard
- Up to 1.5MB/s data transfer rates
- On-board 2 KB FIFO for read/write operations
- Connect up to 14 instruments
- GPIB is a standard VISA Resource

NOTE A GPIB cable isn't supplied with the M9024A. The GPIB cable is a specific type available from Keysight as an accessory cable; part number Y1260A. This cable also works with the M9037A Embedded Controller's GPIB port. The M9024A GPIB port is not compatible with the M9036A GPIB cable, part number M9036-31301.

NOTE Please install the most recent version of Keysight IO Libraries Suite to use the GPIB.

The following table provides the pin-out of the front panel D-sub 25-pin GPIB connector.

Pin	Signal	Description	Pin	Signal	Description
1	DIO1#	GPIB Data 1	14	DIO6#	GPIB Data 6
2	DIO2#	GPIB Data 2	15	DIO7#	GPIB Data 7
3	DIO3#	GPIB Data 3	16	DIO8#	GPIB Data 8
4	DIO4#	GPIB Data 4	17	REN	Remote Enable
5	EOI	End or Identify	18	GND	Signal Ground
6	DAV	Data Valid	19	GND	Signal Ground
7	NRFD	Not Ready for Data	20	GND	Signal Ground
8	NDAC	Not Data Accepted	21	GND	Signal Ground
9	IFC	Interface Clear	22	GND	Signal Ground
10	SRQ	Service Request	23	GND	Signal Ground
11	ATN	Attention	24	GND	Signal Ground
12	Shield	Chassis Ground	25	GND	Signal Ground
13	DIO5#	GPIB Data 5			

M9025A System Module Installation

Refer to "Troubleshooting with M9025A" on page 51 for detail of which chassis can support M9025A.

M9025A LEDs

The M9025A front panel has three LEDs. The following table describes the LED indications:

LED	Color	Description
Status of Module	Off	No Power
	Red	Power Supply problem or FPGA (normal to go briefly Red on power-up and power-down.)
	Blue	Chassis ON without Thunderbolt connections
	Green	Chassis successful Link with Thunderbolt connections

Figure 11 M9025A Front Panel LEDs

Figure 12 shows the M9025A supports dual simplex communication between PC to chassis through thunderbolt communication. The PCIe communication can transmit simultaneously up to 22 Gbps in each direction.

Figure 12 M9025A Block Diagram

M9025A I/O Interfaces

Thunderbolt 3 Controller

The Thunderbolt Connector on M9025A is a USB Type C. Thunderbolt connection also supports USB-C power delivery. It cannot support USB non-Thunderbolt ports. The power delivery of the Thunderbolt connection is also known as USB-PD. The USB power delivery supports the following power profiles:

- 5V @ 3A
- 9V @ 3A
- 12V @ 3A
- 15V @ 2.5A

Dolphin Interconnect Solutions Modules Installation

If application requires cable lengths greater than the 2-meter lengths and/or fiber optic cables, refer to Dolphin Interconnect Solutions to meet this demand. Dolphin offers a line of standard host and system modules for use in traditional IO expansion. Dolphin adapter modules are designed to support both long and short PCIe copper cables as well as PCIe active fiber optical cables (AOC). These modules require no software and rely on standard PCIe bridging technology to connect downstream targets. Dolphin adapter modules can be used to connect expansion boxes and daisy chain multiple PXIe chassis. Below table shows the corresponding Keysight's product numbers to Dolphin's numbers if users want to order the products from Keysight. Refer to the Dolphin documentations for more detail at https://www.dolphinics.com/.

Keysight Model Number	Dolphin Part Number	Keysight Model Description
SP0630A	MXH932	Dolphin MXH932 PCIe Card - Gen4 x16 PCIe Transparent Host / Target Adapter
SP0631A	MXP924	Dolphin MXP924 PXIe System Module - Gen 4 x16 PCIe cable adapter
SP0632A	MXP909	Dolphin MXP909 PXIe Gen4 Transparent Peripheral Module
SP0633A	PCIe4L-1M	Dolphin PCIe4L-1M PCIe Gen4 x4 CMI copper cable, 1.0 meter
SP0634A	MSF4C-10M	Dolphin MSF4C-10M Integrated Optical cable, 10 meter, fiber cable

Connecting a PC to a PXIe or AXIe Chassis

The following examples show a few of the possible configurations between a PC (both PXIe embedded PC and an external PC) and a PXIe or AXIe chassis. Many other configurations are possible. Keysight provides a Multi-Chassis Designer to help you understand and design multi-chassis systems. Click here: www.keysight.com/find/pxie-multichassis.

NOTE

To ensure proper system operation, use an approved host computer (embedded, rackmount, desktop or laptop) along with an approved PCIe adapter and cable. While you may use other controllers, the approved computers have verified hardware support for PCIe x8 and their BIOS can properly enumerate multiple instruments on the shared PCIe bus.

Keysight provides a list of tested host PCs at: www.keysight.com/find/PXIAXIeTestedPC.

External PC to a Single Chassis Configuration

The simplest system consists of an external PC with a PCIe Host Adapter card (such as the Keysight M9048B) connected to a PXIe or AXIe chassis. A PXIe chassis requires a System Module. An AXIe chassis does not require a system module, because a cable port is included in the ESM half height module.

Figure 13 Basic external PC system configuration

External PC to a Single Chassis Configuration (Thunderbolt System)

For an external PC or laptop with Thunderbolt 3 technology, the M9025A system module can be used to connect the PXIe chassis to PC or laptop.The second Thunderbolt 3 port in M9025A can be daisy-chained to other Thunderbolt-3 products, for example monitors or SSD drives.

Figure 14 Basic external PC system configuration with Thunderbolt 3 connectivity

External PC to Two Chassis Configuration

Another simple system consists of an external PC with a PCIe Host Adapter card (such as the Keysight M9049A) connected to two PXIe or AXIe chassis. A PXIe chassis requires a System Module such as the Keysight M9022A. An AXIe chassis does not require a system module interface, because a cable port is included in the ESM half height module. The link speed is determined by the chassis; for example, Gen 2 speed with the M9018B PXIe chassis or the M9502A or M9505A AXIe chassis; Gen 3 speed is available with Gen 3 PXIe chassis such as the M9019A.

Figure 15 Simple two chassis configuration

External PC to Two Chassis Configuration (Thunderbolt System)

For external PC or laptop with Thunderbolt 3, two PXIe chassis can be connected in a daisy-chain manner as shown in Figure 16. However, in most cases, M9025A Thunderbolt cable ports are not supported with multi-chassis configuration. This is because most of the host controllers are unable to handle the number of resources required for multi-chassis with Thunderbolt. Below image is only a representation of what might work if the host controller can support it. Same with star configuration. Refer to Tested PC and PXI/AXIe Chassis Configurations for detail.

Figure 16 Simple two chassis configuration with Thunderbolt 3 connectivity if host controller can support it.

External PC, X16 connection to single PXIe chassis configuration

The following configuration represents the fastest speed (x16) between the PC and the chassis. Make certain that all switches on the PXIe system modules are set correctly to configure this operation. Make certain the top connector on the M9049A module connects to the top connector on the M9023A module and the bottom connectors connect together.

Figure 17 x16 Connection to the PXIe chassis

M9037A Embedded Controller to Second Chassis

Figure 18 M9037A Embedded Controller to a second PXIe chassis

M9038A Embedded Controller to Second Chassis

Figure 19 M9038A Embedded Controller to a second PXIe chassis

NOTE In most cases, M9025A Thunderbolt cable ports are not supported with multi-chassis configuration. This is because most of the host controllers are unable to handle the number of resources required for multi-chassis with Thunderbolt. Refer to Tested PC and PXI/AXIe Chassis Configurations for detail.

M9037A Embedded Controller to Cascade of PXIe Chassis

Figure 20 Cascade or “Daisy-Chain” of PXIe Chassis

Connectivity with Dolphin Modules

The following examples show a few of the possible configurations between a PC (both PXIe embedded PC and an external PC) and a PXIe chassis. Many other configurations are possible.

M9038A Embedded Controller with Dolphin to Second Chassis

Figure 21 M9038A Embedded Controller with Dolphin to a second PXIe chassis

M9038A Embedded Controller with Dolphin Cascade or Daisy-Chain of PXIe Chassis

Figure 22 M9038A with Dolphin Cascade or Daisy-Chain of PXIe chassis

Dolphin Multichassis Cascade or Daisy-Chain Configuration

Figure 23 Dolphin Multichassis Cascade or Daisy-Chain Configuration

Dolphin Multichassis Star Configuration

Figure 24 Dolphin Multichassis Star Configuration

Remote Chassis Power On and PCIe Wake

PCIe Wake refers to a signal placed on the PCIe link that turns on the PC when the chassis powers-on.

Remote Chassis Power On is a when the host PC turns on the chassis using the PCIe sideband CPWRON signal.

NOTE Some PCs BIOSs may have PCIe Wake included under the Wake on LAN (WoL) setting. If you cannot find a specific BIOS setting for PCIe Wake, try enabling/disabling the Wake on LAN feature.

PCIe Wake Generated by the Chassis

The Keysight M9010A, M9018B, M9019A and M9046A PXIe chassis assert the PCIe Wake signal when they power on. The signal propagates through the PCIe cable to the host PC. Whether or not the host PC powers on when receiving the WAKE signal is controlled by the PC's BIOS and by the PCIe Host Adapter installed in the PC. Some PCIe Host Adapters have a switch setting that determines if the adapter passes the signal on to the PC. For information on the Keysight PCIe Host Adapters M9048B and M9049A, see the *Keysight Remote PC PCIe Host Desktop Adapter Modules Installation Guide*. For information about your PC's BIOS, consult your PC's documentation.

Chassis Power On Generated by the Host PC

When the chassis receives the Chassis Power On (CPWRON) signal, its behavior is determined by the CPWRON switch setting on the System Module (M9022A, M9023A, or M9024A) installed in the chassis. If the switch is set to Enable, the chassis powers on when the signal is received. If the switch is set to Disable, the chassis does not power on. The default setting is Disabled. See Figure 25 below. There is no power-on switch in M9025A.

M9022A, M9023A, M9024A Chassis Power-On Switch

Figure 25 PCIe Wake Switch for PXIe System Modules

Module Characteristics

	M9022A	M9023A/M9024A	M9025A
Size:	1 slot 3U PXI	1 slot 3U PXI	1 slot 3U PXI
Supported Chassis	All PXIe chassis	All PXIe chassis	All PXIe chassis
PCIe link configuration:			
PCIe Backplane	Gen 3 x8 +x16	Gen 3 x8 +x16	Gen 3 x8 +x8
PCIe Target port	Gen 3 x8	Gen 3 x8	Not applicable
PCIe Host Port	Not applicable	Gen 3 x8	Not applicable
PCIe Dual Target Port	Not applicable	Gen 3 x16 (dual x8)	Not applicable
Front panel connector	One x8 PCIe IPASS cable connector	Two x8 PCIe IPASS cable connector	Two Thunderbolt connectors
Front panel indicators	Power/Present indicator: orange (power up), Green (power up and link partner present) Speed indicator: Green LED (Gen3= solid, Gen2 = 2 Hz blink, Gen1 = 1 Hz blink)		Power/Present indicator: flash red briefly (power up and down), remain red (power supply or FPGA fault), blue (ON without Thunderbolt connection), green (successful link with Thunderbolt connection)
Power consumption	15 W	16 W / 18 W	36.61 W
Cable length (max)	Up to 5 meter for Gen 2 Up to 2 meter for Gen 3	Up to 2 meter passive cable supported	Up to 2 meter Thunderbolt 3 cable supported
Operating Temperature	0 °C - 55 °C	0 °C - 55 °C	0 °C - 55 °C

Related Products

Product	Description
M9048B	PCIe Host Adapter: Single Port (x8), Gen 3
M9049A	PCIe Host Adapter: Dual Port (16), Gen 3
Y1202A	PCIe cable: x8, 2.0M
Y1203A	PCIe cable: x8, 0.5M, used for chassis-to-chassis in multiple chassis systems
Y1205A	Thunderbolt 3 USB Type-C Cable with Bracket Assembly

Troubleshooting and Service

There are no user-serviceable parts on these modules. For troubleshooting, refer to the LED descriptions earlier in this guide. If the LEDs are not lit at all, there may be no power applied. Also, ensure the switches are set correctly.

If you are unable to establish communications from the host controller PC to the chassis, check the following. Upon further investigation, you might discover that the chassis is also not displayed in Windows Device Manager.

- Ensure the appropriate chassis drivers and system module driver are installed on the host controller PC.
- A faulty PCIe adapter card plugged into the host controller PC
- A faulty PCIe cable
- A failure of the chassis power supply

NOTE A downloadable driver is required for the M9022A, M9023A, M9024A, and M9025A modules. Refer to "Step 5. Install the Driver" on page 20 for driver installation information.

NOTE The most current version of Keysight IO Libraries is required prior to installing and running any other software. The latest version can be downloaded from: www.keysight.com/find/iosuite.

NOTE The additional ports on the M9024A operate like IO ports on the PCIe bus. Refer to Keysight IO Libraries Suite to use the additional ports. For multiple chassis systems with an Embedded Controller, the M9024A may be installed in M9024A PXIe chassis.

If power is applied and the switches are set correctly, and either the LEDS are not lit or are lit incorrectly, the module may be defective.

Repair part numbers:

Part Number	Description
M9022-66101	M9022A module replacement assembly
M9023-66101	M9023A module replacement assembly
M9024-66101	M9024A module replacement assembly
M9025-66101	M9025A module replacement assembly
8121-3588	USB-C Cable

Troubleshooting with M9025A

The M9025A can be used with Keysight PXIe chassis M9010A, M9018B, M9019A, M9046A, and some 3rd party PXIe chassis. However, not all PXIe chassis with M9025A can work with PXI modules. The system will support PXIe modules, but will not be able to enumerate PXI modules when used with affected serial (SN) and manufacturing (MNID) numbers chassis in table below.

Chassis with M9025A System NOT able to Enumerate PXI Modules but will Support PXIe Modules

Chassis	SN	MNID
M9018B	TW56490161- TW60363960	1C56490161-1C60360581
M9019A	TW58240920- TW60373216	1C56230105- 1C60370319

Code 10 Errors When Used with M9025A

If you run into code 10 errors under Device Manager for PCI Express to PCI/PCI-X Bridge when used with M9025A in Keysight PXIe chassis with SN or MNID outside the affected ranges from table above, refer to service note M9010A-04, M9018B-03 or M9019A-03 for resolution detail. At https://support.keysight.com/, go to **Support > Safety and Service Notes >** type in the service note number in the search to get there.

Code 12 Errors When Used with M9025A

If you run into code 12 errors under Device Manager for PCI Express to PCI/PCI-X Bridge when used with M9025A in supported Keysight PXIe chassis, install drivers version 1.0.172.1 or later at the PXIe System Module product websites (e.g. https://www.keysight.com/find/M9025A), navigate to **Technical Support > Drivers, Firmware and Software > M902x PXIe System Module Driver**. Cycle power the system after you update the drivers.

If updating the drivers does not resolve the issue, please contact support for the particular module you are working with as the module firmware needs to be updated to work with this system.

M9025A Thunderbolt Port Does Not Support Hot Plugging

You may find that your system is unable to boot up or have the Blue Screen Of Death (BSOD) displayed after hot plug or unplug of the Thunderbolt cable when used with the M9025A. Treat Thunderbolt as PCIe cabled-solutions and follow the same boot up and power down procedures as PCIe to resolve the issue.

M9025A Does Not Support Multi-Chassis Configuration

In most cases, M9025A Thunderbolt cable ports are not supported with multi-chassis configuration. This is because most of the host controllers are unable to handle the number of resources required for multi-chassis with Thunderbolt. Refer to Tested PC and PXI/AXIe Chassis Configurations for detail.

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