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# Diagnose and Resolve PXIe and AXIe Chassis Communication Problems

## Keysight PXIe/AXIe Chassis

M9010A PXIe Chassis

M9502A AXIe Chassis

M9019A PXIe Chassis

M9505A AXIe Chassis

M9046A PXIe Chassis

M9506A AXIe Chassis





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## Introduction

Keysight PXIe and AXIe chassis are the backbone of a PXIe or AXIe system. These chassis have high performance backplanes providing PXI and AXIe modules the ability to communicate rapidly with one another and the controller. It is important to make sure the chassis and modules enumerate correctly before any system control takes place. This paper helps you understand the hardware connections, the firmware and software components of the system, and gives guidelines on how to diagnose and resolve chassis communication problems.

## Understand the system hardware connections

PXIe and AXIe chassis systems consist of the chassis itself plus other related modules, such as host controllers, system modules, and the instrument modules which are installed in the chassis backplane. Understanding the hardware connections will help you verify if there are any hardware issues in the system.

### Host Controllers

The computer that controls the chassis is known as the host controller or system controller. The host controller can be either a remote controller or an embedded controller.

#### Remote Controller and System Interface Module

A remote controller can be a desktop personal computer (PC) or a rack mounted PC.

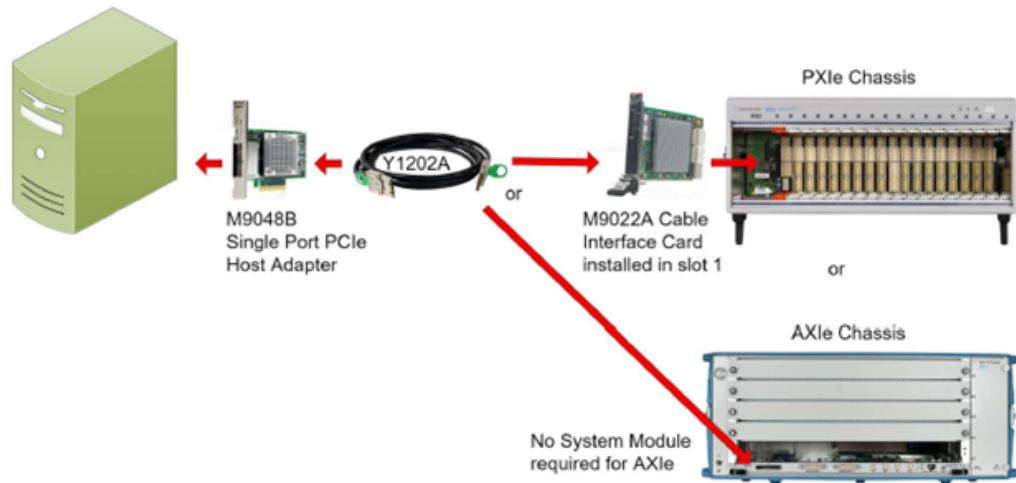
- For Keysight PXIe chassis, the remote controller connects to the chassis with a Keysight M9048B or M9049A Host Adapter PCIe Interface module (desktop adapter) installed in the PC, through a PCIe cable to an M9022A, M9023A, or M9024A PXIe System Interface Module installed in slot 1 of the chassis. If use with M9025A PXIe System Module in slot 1, only a Thunderbolt 3 cable is needed to communicate with the PC.
- The M9502A 2-Slot, M9505A 5-Slot, and M9506A 5-Slot AXIe chassis come with an embedded system module (ESM) in the chassis to communicate and control the chassis.

#### NOTE

The M9506A ESM cannot be used in M9502A and M9505A.

The ESM also has a LAN connection to use for chassis communication (i.e. chassis firmware updates, web interface to monitor/control the chassis, etc.). However, a LAN connection does not provide communication with individual AXIe modules. You will need to use PCIe to control the AXIe modules instead. With M9506A, you will need to use Thunderbolt to control the AXIe modules instead. In addition, if an AXIe instrument module supports USB, you can use a USB cable to connect the AXIe chassis to the host via the ESM with the USB option. A PCIe interface card/cable is not required for this configuration to control the AXIe modules.

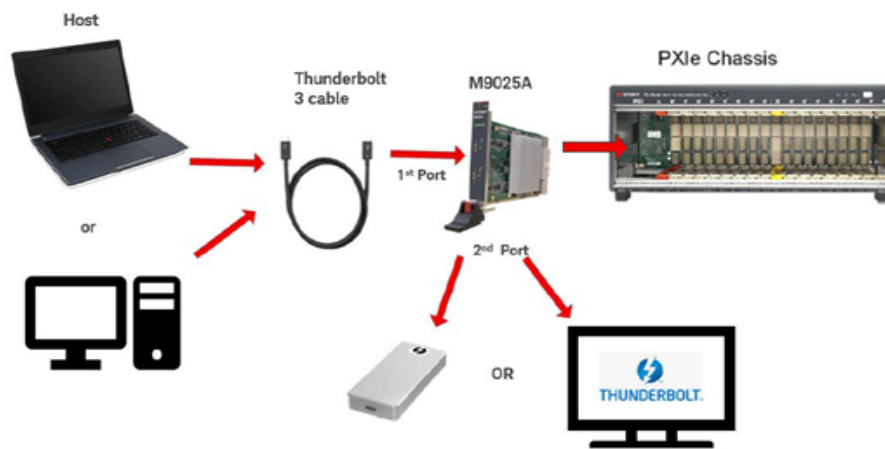
Figure 1 below shows two of the many configurations that can be setup with the PXIe and AXIe chassis system. Figures 2 and 3 show examples of how you can connect with Thunderbolt 3 cable. Figure 4 shows the recommended LAN connection if you want to use LAN to communicate with the AXIe chassis.



**Figure 1** Basic external PC system configuration



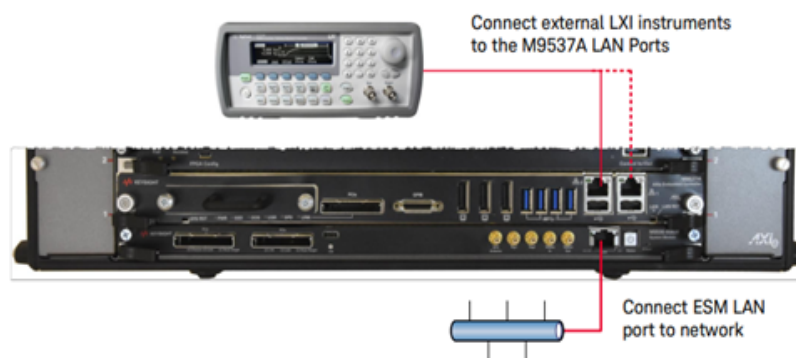
Understand the system hardware connections



**Figure 2** Basic external PC system configuration with Thunderbolt 3 connectivity



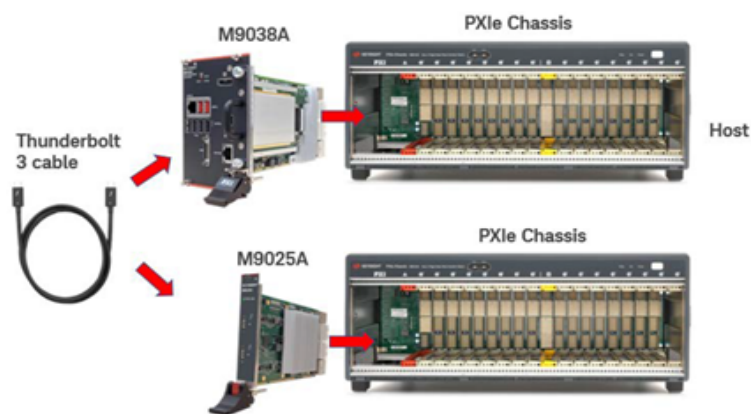
**Figure 3** Connecting an External Laptop PC to the M9506A with Thunderbolt 3



**Figure 4** Recommended LAN Connections for AXIe System

## Embedded Controller

An embedded controller, such as Keysight's M9035A, M9037A, or M9038A PXIe embedded controller, is a small form-factor, Windows-based PC designed for installation in the system controller slot 1 of the chassis. An embedded controller consumes two or three expansion slots to the left of the PXIe chassis slot 1. Figure 5 shows how you can utilize the Thunderbolt ports on M9038A to communicate to a second chassis.



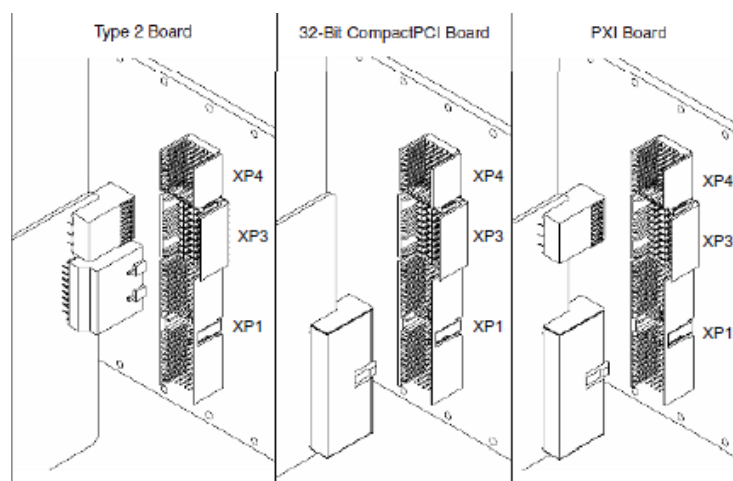
**Figure 5** M9038A Embedded Controller to a second PXIe chassis

In an AXIe chassis, the embedded controller, such as the M9537A AXIe Embedded Controller, is installed in slot 1.

## Chassis Backplane

### PXIe Chassis Backplane and Supported Module Types

Keysight PXIe chassis backplanes support different type of modules. This gives the system designer flexibility to mix and match the number and location of PXIe and hybrid-compatible modules. The hybrid slots support the three types of boards shown below in Figure 6. A Type 2 board connects to both XP4, which contains the PXIe instrumentation signals, and XP3, which contains the PCIe signals. A 32-bit CompactPCI board connects to only the CompactPCI signals. A PXI board connects to both the XP4 (PXI instrumentation signals) and the CompactPCI signals. Refer to the PXIe chassis user guide and the *Keysight PXIe Chassis Interactive Block Diagram* for detail of the pin-outs.



**Figure 6** PXIe Hybrid Slots Detail

## AXIe Chassis Backplane and Module Layouts

Keysight AXIe chassis are fully compatible with the AXIe 1.0 specification. Figures 7, 8, and 9 below show the chassis backplane, with modules removed from all slots.

The backplane provides Zone 1 connector J10 and Zone 2 connectors P20, P21, P22, P23, P24. Connector designations are shown for instrument slot 1. The M9502A backplane differs from the M9505A and M9506A in that the 2-slot backplane does not use P22. A typical module layout is shown below the backplane photos, with the mating connectors J20 through J24 and P10. Depending on module type, the module may implement all or none of J20-J24. Connector P10 is required to power the module. Refer to the AXIe chassis' user guide for pin-out details.

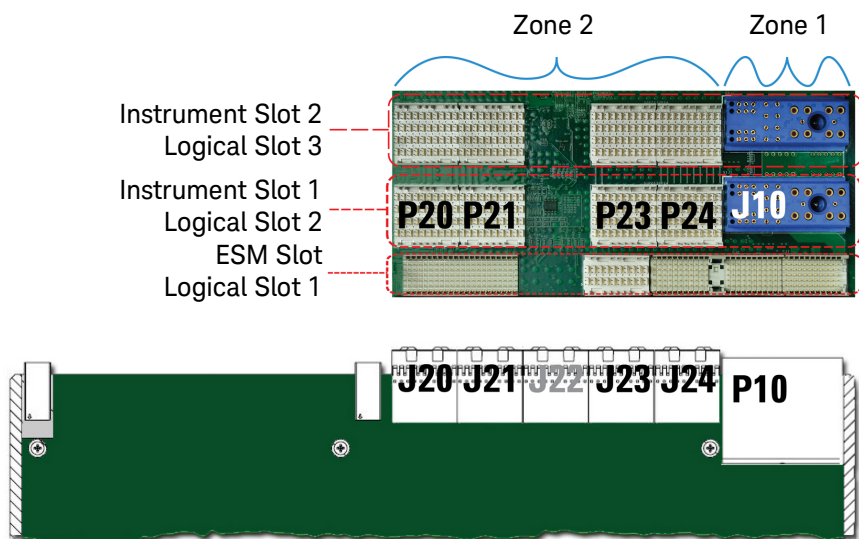


Figure 7 M9502A AXIe Backplane Connector Layout

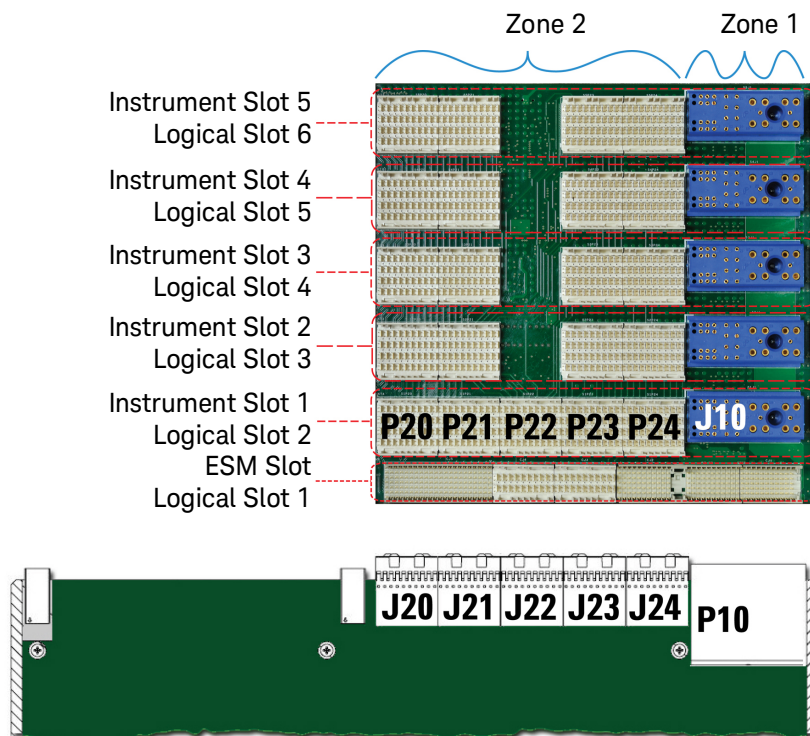
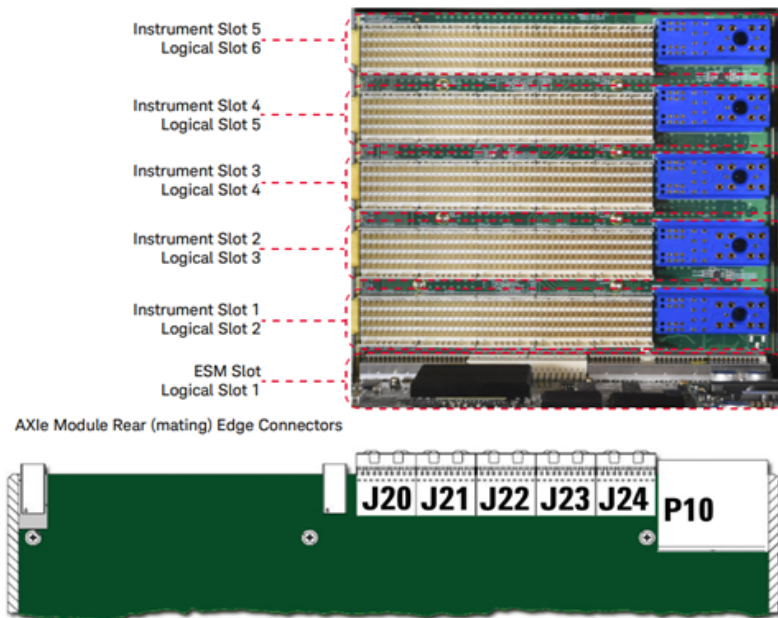


Figure 8 M9505A AXIe Backplane Connector Layout

Understand the system hardware connections



**Figure 9** M9506A AXIe Backplane Connector Layout

## Understand the Software Components

To control the hardware components of the PXIe or AXIe chassis system, system firmware must be up-to-date in the hardware. Keysight's *IO Libraries Suite* and software drivers need to be installed on the host controller. The following details describe the software components required to communicate with the PXIe or AXIe chassis system.

### Required Keysight IO Libraries Suite

Keysight's *IO Libraries Suite* is a collection of libraries and utilities that enable you to connect your chassis to the host controller and run programs on the host controller that interact with the chassis and modules. The *IO Libraries Suite* is used with all Keysight instruments and is not specific to the PXIe or AXIe chassis. Download the latest version from: [www.keysight.com/find/iosuite](http://www.keysight.com/find/iosuite). Remember to always install *IO Libraries Suite* before installing any instrument driver software. Also, always use the latest version of the *IO Libraries Suite* to avoid any compatibility issues.

### Required System Firmware and Software Drivers

It is important to understand the firmware (installed in the PXIe or AXIe chassis or module) and the software driver (installed in the host controller) components in order to troubleshoot the system. Having knowledge of these components help you determine if there are any control issues in the system. The following paragraphs describe the control components in a PXIe or AXIe system.

Both chassis and instrument module firmware and software driver version information can be viewed in the Soft Front Panel (SFP) **About** dialog menu bar by clicking **Help** → **About** or through the product's IVI drivers. Details of the firmware and software driver components are shown in the product user guides. The revision history can be viewed at the product firmware and software driver update websites.

#### Chassis Firmware

The chassis firmware is part of the chassis and controls the chassis lower-level hardware components. Every chassis comes from the factory with firmware installed in it. Firmware files contain multiple files for controlling various components in the chassis. If any of these components are missing or not updated to be compatible with the software drivers, communication issues may result. The latest firmware and installation instructions are always available on the product's Keysight web page. Keysight recommends that you always use the latest, most up-to-date firmware.

## **Chassis Software Driver**

The chassis software driver is the component that lets the host controller operating system communicate and control the chassis. The driver, specific to the chassis you are controlling, needs to be installed in the host controller to communicate with the chassis. If the chassis driver is missing or not updated to be compatible with the firmware, communication issues may result. Drivers are often supplied with each chassis on a CD. The latest drivers are always available on the product's Keysight web page. Keysight recommends that you always use the latest, most up-to-date drivers.

## **Module Firmware**

Like the chassis, the module firmware is part of the module and controls the module's lower-level hardware components. Every module comes from the factory with firmware installed on it. If a module's firmware is missing or out of date, communication issues may result. The latest firmware (if any) and installation instructions are always available on the product's Keysight web page. Keysight recommends that you always use the latest, most up-to-date firmware.

## **Module Software Drivers**

Every PXI or AXIe instrument module, including embedded controllers such as the M9035A, M9037A, M9038A or M9537A, also needs to have its driver software installed on the host controller. If any module's software drivers are missing or out of date, communication issues may result. A missing system module driver can cause inconsistent and/or incomplete chassis enumeration. The latest drivers are always available on the product's Keysight web page. Keysight recommends that you always use the latest, most up-to-date drivers.

## Guidelines to Diagnose and Resolve Communication Problems

Setting up a PXIe or AXIe system can be complicated since the system consists of so many different components. You might experience communication and control issues in the system if these components are not set up correctly. Follow the guidelines and tips below for details of how to diagnose and resolve some common communication issues. If the following guidelines do not help resolve your issue, please contact [www.keysight.com/find/contactus](http://www.keysight.com/find/contactus) for further help with setting up your system.

### Avoid Bent Pins

The chassis backplane connectors contain hundreds of pins. These pins mate with the sockets on the module when you slide the module into the chassis. When you first insert the module, you insert it between the top and bottom rails. As you slide the module in, the side of the connectors touch to further align the module's connector over the pins. The final push to insert the module seats the pins tightly in the connectors.

Be aware that misuse can result in bent pins. If a chassis backplane has a single bent pin, it is possible that the damage is limited to one slot. However, a bent pin can touch an adjacent pin, causing an electrical short that further damages all slots in the chassis. The impact of a bent pin can range from none, to subtle, to severe. A bent pin can cause unpredictable behavior in the chassis and the instruments. It can be very difficult to determine the root cause of this erratic behavior. Refer to the product's user guides for methods to avoid bent pins.

### Use Supported Host Controllers

Check the *PC Tested Configurations with PXI/AXIe Chassis* document ([www.keysight.com/find/PXIAXIeTestedPC](http://www.keysight.com/find/PXIAXIeTestedPC)) for a list of host controllers tested to be compatible with the PXIe or AXIe chassis. Keysight can support only configurations with host controllers that are listed in this document. Keysight cannot guarantee other controllers outside of this list will work for your application. Check back on the list often as Keysight updates the list when newer supported models are available. Contact [www.keysight.com/find/contactus](http://www.keysight.com/find/contactus) if you must use a computer that is not listed on the list.



## Setup Applications with Recommended and Supported Configurations

There are many configurations you can create to setup a proper PXIe or AXIe system. Refer to the Interface Modules and Adapters for PXIe and AXIe Systems Data Sheet (<https://literature.cdn.keysight.com/litweb/pdf/5992-0377EN.pdf>) for other examples of recommended and supported configurations. You can also use the Multi-Chassis Designer Tool ([www.keysight.com/find/pxie-multichassis](http://www.keysight.com/find/pxie-multichassis)) to check if your configuration is supported.

## Power-up the Chassis First

Even if you are connected through USB or Thunderbolt, always power up all chassis and wait for all status LEDs on modules and chassis to have solid green lights before booting the PC if you are using an external PC. An embedded PC will power-up correctly if using a single chassis, but secondary chassis must be powered-up first. If you are connecting multiple chassis together, consider using the multi-chassis power sequencing capability built into many of Keysight's chassis.

## Do Not Hot Plug or Unplug

Even if you are connected through LAN, USB or Thunderbolt, treat these like PCIe cabled solutions. If you change any connectivity cabling between chassis and the external PC, always power cycle the whole system with proper power sequencing to allow PC to enumerate the system properly again.

## Ensure LEDs are Lit Correctly on System Module

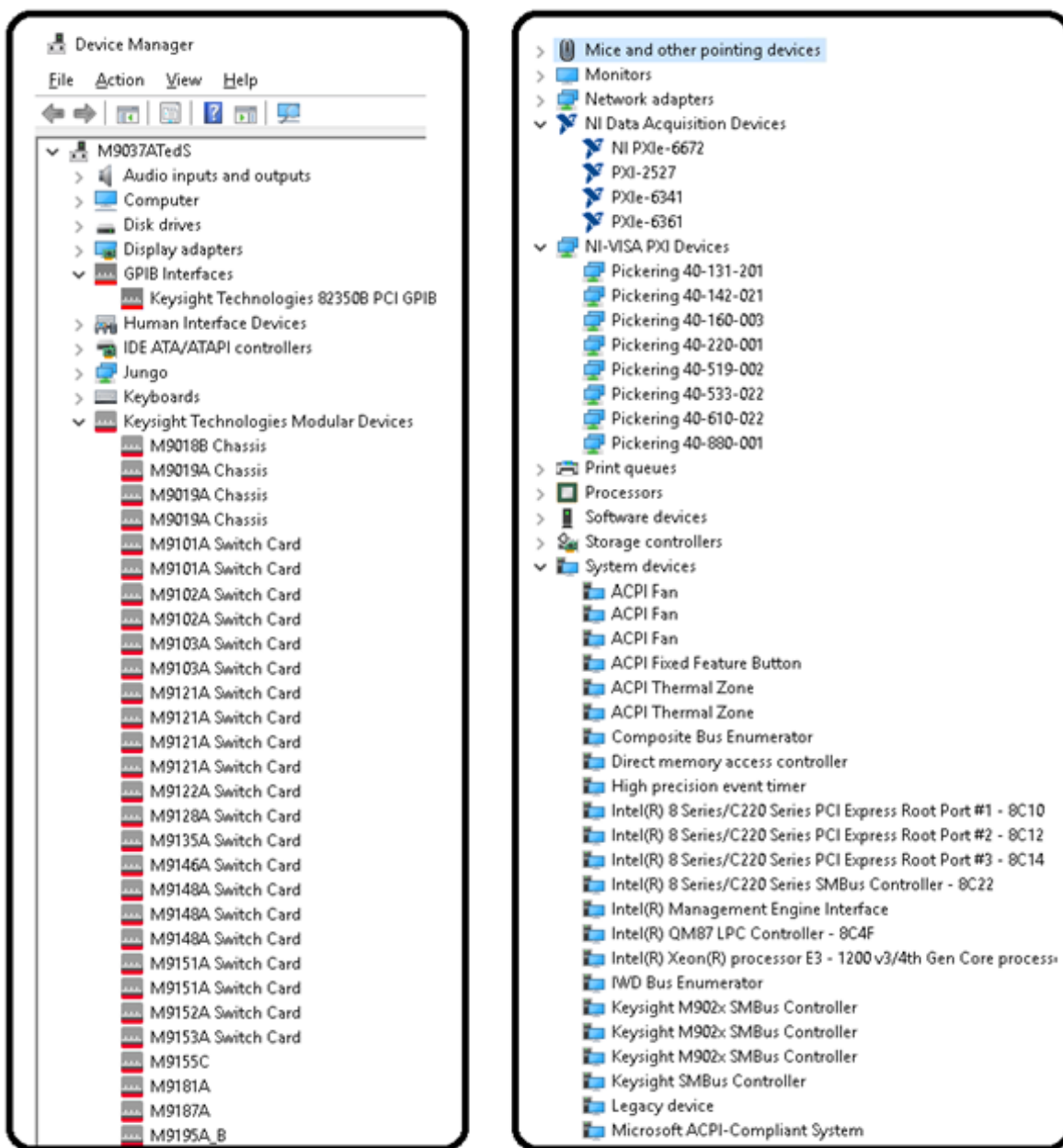
If you are using the M902xA system modules in the PXIe system with PC configuration, ensure the status LEDs are lit and are the correct color for your given configuration. The status LEDs tell you the status of the module, the link connection, and the backplane connection. There are also a series of LEDs across the top and bottom of the system modules indicating power and configuration. Refer to the PXIe System Modules Installation Guide ([www.keysight.com/find/PXIeSystemModulesInstallation](http://www.keysight.com/find/PXIeSystemModulesInstallation)) for details of how to diagnose connection issues with these LEDs.

## Lower Transfer Rate Settings to Ensure Reliability

Sometimes a device cannot correctly follow the PCIe training protocol and the link fails to connect reliably. As a workaround or diagnostics debug step, you can use the DIP switches on the system modules to lower the maximum negotiated PCIe speed to Gen1. This lower speed may allow your device to function reliably. Refer to the PXIe System Modules Installation Guide ([www.keysight.com/find/PXIeSystemModulesInstallation](http://www.keysight.com/find/PXIeSystemModulesInstallation)) for instructions on setting the DIP switches.

## Make Sure All Required Software Drivers are Installed

Every hardware component in the system must have the software drivers installed for the operating system to communicate with them. This includes the chassis, system module and any other modules installed on the chassis backplane. You can use the host controller's Windows Device Manager to verify that the chassis and modules are installed correctly. Figure 10 below shows example of a typical multi-chassis PXIe system setup.



**Figure 10** Device Manager View of a Typical Multi-Chassis PXIe System Setup

### **System Module Driver Needs to be Installed in PC Configuration**

The system module driver must be installed when setting up the PXIe or AXIe system. The Desktop Adapter module does not require a driver and it cannot be seen in the Device Manager. However, the System Module is like all other modules connected on the chassis backplane – it needs its driver to communicate with the chassis. Without this driver, you will not be able to see the chassis or its installed modules on the system in Windows Device Manager. Make sure the System Module driver is installed in the host controller. Refer to the System Module web page to install this driver.

### **Install Controller Driver in Embedded Controller Configuration**

Typically, when you purchase an embedded controller, it is delivered with the embedded controller driver installed. However, if you re-image the controller with your own version of the operating system, you need to reinstall this driver to get your system to work properly. Refer to the embedded controller websites to install this driver.

## Use Updated Keysight IO Libraries Suite

As products are updated, the IO libraries components need to be updated as well to support these products. To make sure all the chassis and modules show up correctly, the IO libraries need to be updated. You can download and install the latest version of the IO libraries at [www.keysight.com/find/iolib](http://www.keysight.com/find/iolib). Figure 11 below shows the Keysight Connection Expert (KCE) view of a typical multi-chassis PXIe system setup. Note that if your chassis and modules are not identified correctly in Device Manager, then KCE will not be able to configure the system and may have missing components or miss-numbered chassis.

The screenshot shows the Keysight Connection Expert 2018 interface. The main window is titled "Keysight Connection Expert 2018" and has a tab for "PXI/AXIe Chassis". Below the tab are three sub-tabs: "Chassis Content", "Chassis Triggers", and "Chassis Numbers".

On the left side, under "Chassis Content", there is a list of four chassis:

Chassis	Model	Slots	Module
Chassis 1	M9019A	18 Slots	PXI
Chassis 2	M9018B	18 Slots	PXI
Chassis 3	M9019A	18 Slots	PXI
Chassis 4	M9019A	18 Slots	PXI

The right side of the interface shows "Details for Chassis 1 M9019A 18 Slot PXI". This section includes:

- Manufacturer:** Keysight Technologies
- Model:** M9019A
- Serial Number:** TW56050028
- Connection Strings:**
  - Chassis Address: PXI0::116-0.0::INSTR
  - Backplane Address: PXI0::1::BACKPLANE
- Slot Information:**

Slot	Module	Manufacturer	Address	Actions
Slot1	M9037A	Agilent Technologies	PXI0::139-0.0::INSTR	Go to Instruments View Start Soft Front Panel
Slot2	M9151A	Agilent Technologies	PXI0::115-8.0::INSTR	Go to Instruments View Start Soft Front Panel
Slot3	M9146A	Agilent Technologies	PXI0::115-8.0::INSTR	Go to Instruments View Start Soft Front Panel
Slot4	<Unused>			
Slot5	<Unused>			
Slot6	PXI-2527	Nabional Instruments	PXI0::115-8.0::INSTR	Go to Instruments View

**Figure 11** Keysight Connection Expert View of a Typical Multi-Chassis PXIe System Setup

## Use Updated Firmware and Software Drivers

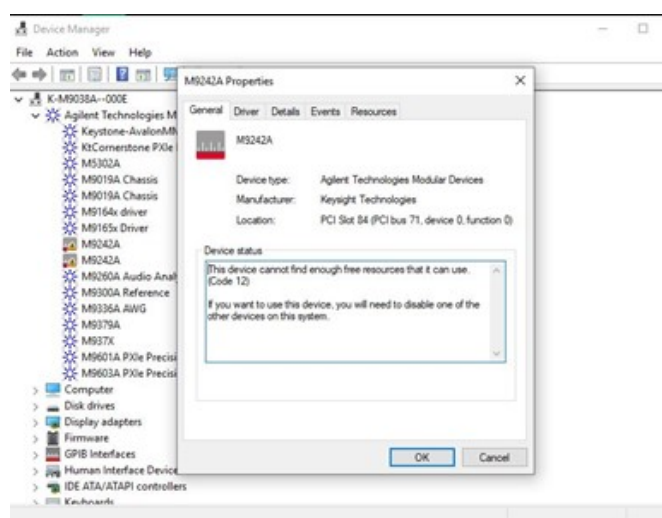
Often the firmware and software driver bits for the chassis and the modules need to be updated to support continuous improvements. Use the most up-to-date release of these two to ensure they are compatible with each other and support the latest functionality available in the hardware. Refer to the product's firmware and software drivers update websites to install the latest versions of these bits.

## Avoid Overheating the Chassis

Module temperatures in a system can impact operation. It's important to actively manage the environment inside your chassis. Refer to the Keysight PXIe Chassis Cooling Guidelines white paper ([www.keysight.com/find/PXIeChassisCoolingGuidelines](http://www.keysight.com/find/PXIeChassisCoolingGuidelines)) for details on protecting your PXIe chassis from overheating. Refer to the AXIe chassis user guide for similar guidelines for the AXIe chassis.

## Use Laptops with 11th Gen or Newer CPU for Thunderbolt Solutions

The Thunderbolt connection on some systems may have limitations in supporting large memory space requests. When using modules that requests large prefetchable memory space greater than 10MB, for example the PXIe VXT (M9410A/M9011A), Oscilloscopes (M924xA), AWG (M9336A), or SMU (M9111A), you may run into PCIe enumeration issues that most often results in Code 12 errors in Windows Device Manager.



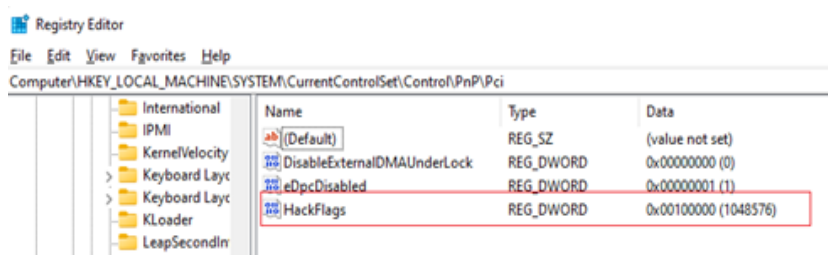
**Figure 12** Example Code 12 error in Windows Device Manager

Newer laptops with 11th Gen or newer Intel CPUs (e.g. HP ZBook Power G8, Dell Precision 3560) with built-in Thunderbolt support can handle these larger memory requests, and is recommended. Desktop workstations are not recommended with Thunderbolt applications. In general, the Thunderbolt connection system can only support one chassis and another Thunderbolt non-chassis device (e.g. monitor or external storage drive).

## Flattening Portal Bridge (FPB) Workaround

There is a known issue on some versions of Windows 10 with the Flattening Portal Bridge (FPB) feature incorrectly configuring the hardware and resulting in failure to enumerate the chassis and modules correctly. If you run into PCIe enumeration issues (e.g. Code 12 errors), disable the FPB using the following instructions to see if that resolves the issue.

- 1 Click **Start** and type **regedit** in the Start Search box.
- 2 Navigate to **regedit** in the list and left-click.
- 3 Locate the following registry subkey:  
HKEY\_LOCAL\_MACHINE\SYSTEM\CurrentControlSet\Control\PnP\Pci
- 4 If the HackFlags registry entry is not present:
  - a On the Edit menu, point to New, and then left-click **DWORD (32-bit) Value**.
  - b Type **HackFlags** and press **ENTER**.
  - c On the Edit menu, left-click **Modify**.
  - d In the Value data box, type **0100000**.
  - e Select **Hexadecimal** in the Base area, then left-click **OK**.
  - f Exit Registry Editor.
- 5 If the HackFlags registry entry is present:
  - a Right-click **HackFlags**, then left-click **Modify**.
  - b In the Value data box, type **0100000**.
  - c Select **Hexadecimal** in the Base area, then left-click **OK**.
  - d Exit Registry Editor.
- 6 Your new entry should look like the screen shot below:



- 7 Reboot the system

## Summary

As you can see, many different factors affect the communications and control of a PXIe or AXIe system. After understanding the hardware connections, knowing the firmware and software components of the system, and following the guidelines provided, you will be able to diagnose and resolve common chassis communication problems. Remember to take these into account when setting up your PXIe or AXIe system to use in your application.

- 1** Check that all modules are installed correctly in the chassis.
- 2** Always power-up the chassis first then power-up the controller.
- 3** If using an external host controller, make sure the correct LEDs are lit and are the correct color.
- 4** Confirm the host controller's Windows Device Manager properly identifies all chassis and modules.
- 5** If Device Manager has not correctly identified every component, check to make sure the drivers are installed for the missing components.
- 6** If Device Manager has not correctly identified every component, lower the transfer rate settings to Gen1.
- 7** Check Keysight Connection Expert to see if all components are identified and correctly labeled/numbered.
- 8** If there are errors in Keysight Connection Expert, ensure the system module driver is loaded.
- 9** Open the Soft Front Panel for each module and perform a self-test if the module has one.
- 10** Ensure the latest driver is being used and firmware is up-to-date.
- 11** If using AXIe, you can also use the chassis web interface to see if the modules are listed. The chassis health menu is also useful to ensure the cards are operating correctly and there are no errors.

For the most current version of this document, please refer to:  
[www.keysight.com/find/ResolvePXIAXIeComProblems](http://www.keysight.com/find/ResolvePXIAXIeComProblems)







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