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USER MANUAL

MXI-Express Gen-3 x16

MXI-Express Gen-3 x16 Multisystem eXtension Interface for PCI Express, CompactPCI Express, and PXI Express Bus Systems

This document provides installation, configuration, and reference information for MXI-Express Gen-3 x16 controllers.



Caution This icon denotes a caution, which advises you of precautions to take to avoid injury, loss of data, or a system crash.



Caution Using the MXI-Express Gen-3 x16 controllers in a manner not described in this document may impair the protection the controllers provide.

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Overview

Gen-3 MXI-Express is based on off-the-shelf PCI Express technologies. A Gen-3 MXI-Express module can control PXI Express or CompactPCI Express chassis from a PC or a PXI Express or CompactPCI Express chassis. The architecture is transparent to device drivers, so no additional software is needed for PXI Express devices installed in connected chassis.

Note For full PXI/PXI Express functionality such as chassis and controller identification, trigger routing, and slot detection, install the PXI Platform Services software included with your kit. You also can find this software at `ni.com/updates` by searching for *PXI Platform Services*.

The basic PCI Express lane consists of dual unidirectional differential links implemented as one transmit pair and one receive pair. The link between the PC and chassis can be up to 16 lanes wide and supports speeds up to PCI Express Gen-3.

The following table lists the signaling rate of each PCI Express generation.

Table 1. PXI Express Generation Signaling Rates

PCI Express Generation	Signaling Rate
First	2.5 Gb/s/lane/direction of raw bandwidth
Second	5.0 Gb/s/lane/direction of raw bandwidth
Third	8.0 Gb/s/lane/direction of raw bandwidth

Note This link is compatible with the cabled PCI Express specification developed by the PCI-SIG.

Description and Features

MXI-Express Gen-3 x16 extends PCI Express communication over a cable up to 3 m. With MXI-Express Gen-3 x16, you can do the following:

- Control a PXI Express or CompactPCI Express backplane with a PCI Express-based PC.
- Physically separate the measurement or automation system from a host PC.
- Control multiple PXI Express or CompactPCI Express chassis with a single PCI Express-based PC or PXI Express embedded controller. (The PXIe-8398 and PXIe-8399 controllers also can control multiple chassis in a daisy-chain configuration.)

The following table lists the models and their features for comparison.

Table 2. Feature Comparison of Available MXI-Express Gen-3 x16 Interfaces

Model	Slot Type	Number of Lanes	Cable Support
PCIe-8398	PCI Express Gen-3 x16	16	MXI-Express x8
PXIe-8394	PXI Express Peripheral Expansion Module	16	MXI-Express x8, MXI-Express x4
PXIe-8398	PXI Express Controller	16	MXI-Express x8, MXI-Express x4
PXIe-8399	PXI Express Controller With One Expansion Slot	32	MXI-Express x8, MXI-Express x4

Tip For optimum link widths and performance, use the PXIe-8394, PXIe-8398, and PXIe-8399 in chassis that support Gen 3 links.

Functional Block Diagram

Figure 1. PCIe-8398 (156877*x*-01L) Block Diagram

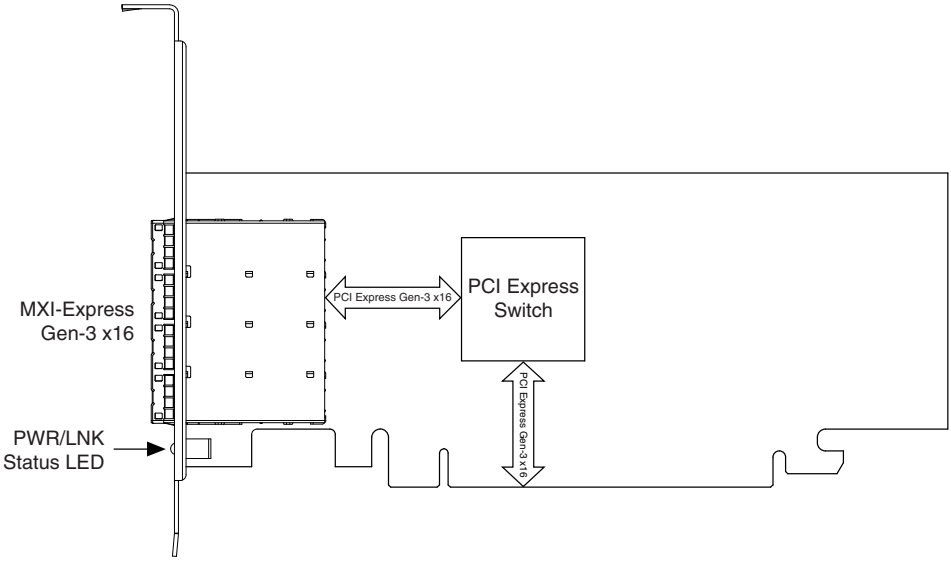
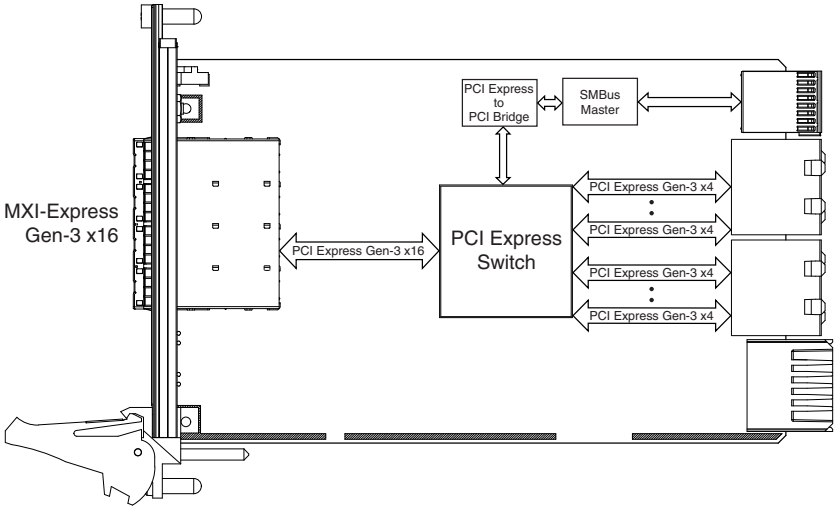


Figure 2. PXIe-8398 (156874*x*-01L) and PXIe-8399 (156874*x*-02L) Block Diagram

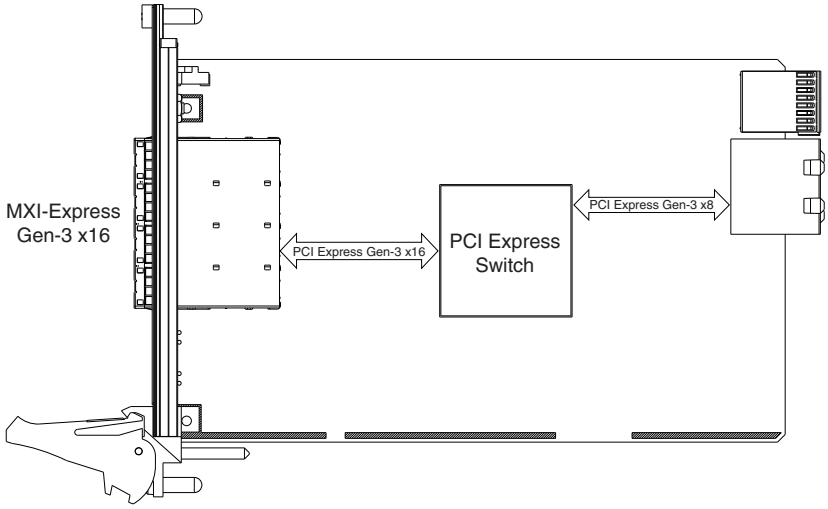


Note The width and speed of the PXI Express backplane links are chassis dependent.

The PXIe-8398 and PXIe-8399 work in both two and four-link chassis. A four-link chassis supports four links up to x4 width each, for a maximum of 16 PCI Express lanes. A two-link chassis supports one link up to x8 and a second link up to x16, for a maximum of 24 PCI Express lanes. The PXIe-8398 and PXIe-8399 maximize the use of all available backplane lanes for either configuration.

Note National Instruments offers Gen 3 PXI Express chassis that allow the PXIe-8398 and PXIe-8399 to establish Gen 3 backplane links.

Figure 3. PXIe-8394 (156874*x*-04L) Block Diagram



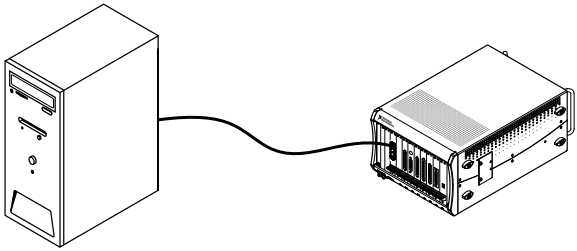
Note The width and speed of the PXIe-8394 backplane links are chassis dependent.

Note National Instruments offers Gen 3 PXI Express chassis that allow the PXIe-8394 to establish Gen 3 backplane links. A chassis can support up to a x8 link.

Basic MXI-Express Gen-3 x16 Systems

The simplest MXI-Express Gen-3 x16 system consists of a PCIe-8398 in a PC connected to a PXIe-8398 in the controller slot of a PXI Express chassis, as shown in the following figure.

Figure 4. Example of a Basic MXI-Express Gen-3 x16 Link Topology



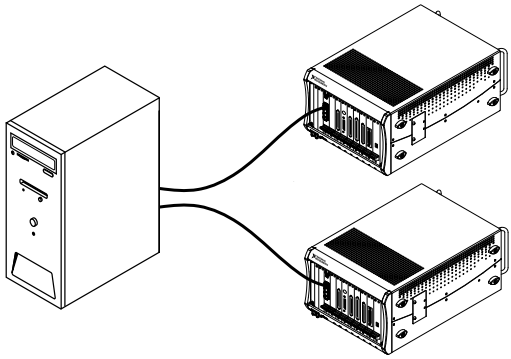
Note In this manual, whenever a PXI Express chassis is referenced, you could use a CompactPCI Express chassis instead.

Larger MXI-Express Gen-3 x16 Systems

There are several ways to connect multiple chassis to a host system. Which you choose depends on your design goals and requirements.

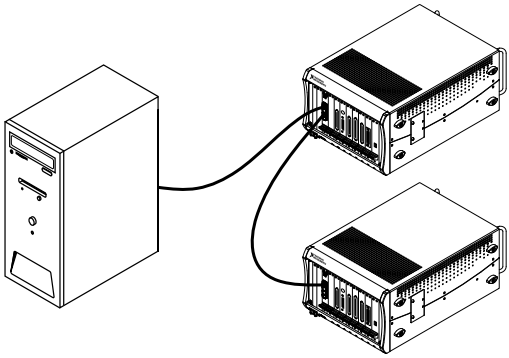
If you are using a PC to control the chassis, and if multiple x16 PCI Express slots are available in the host PC, you can use multiple PCIe-8398 modules to connect to the PXIe-8398 in each chassis ("star" topology). This method offers the most bandwidth and lowest latency to the host for all the chassis.

Figure 5. Example of a Star MXI-Express Gen-3 x16 System Expansion Topology



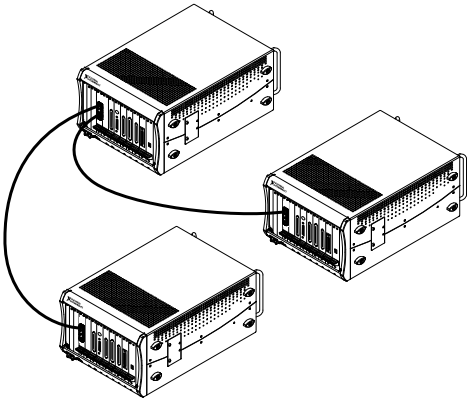
If you are using a PC to control multiple chassis but do not have additional PCI Express slots in the PC, you can use a PXIe-8399 to daisy-chain to an additional chassis ("daisy-chain" topology). The PXIe-8399 supports two x16 links on its front panel, and you can connect the second link to an additional chassis. For example, you could set up two chassis using a PCIe-8398 in the host PC cabled to a PXIe-8399 in the first chassis. The PXIe-8399 in the first chassis would also be cabled to a PXIe-8398 in the second chassis. If a third chassis is desired, the second chassis could use another PXIe-8399.

Figure 6. Example of a Daisy-Chain MXI-Express Gen-3 x16 System Expansion Topology



If you are using an embedded controller, you can use a PXIe-8394 to expand to additional chassis. As with a PC host, you can use a PXIe-8394 card per additional chassis (preferred), or you can daisy-chain additional chassis using the PXIe-8399. The PXIe-8394 backplane connection is limited to Gen 3 x8.

Figure 7. Example of a MXI-Express Gen-3 x16 System Expansion Topology Using a PXIe-8394 in Each Chassis



Systems need not be exclusively star or daisy-chain. It is generally preferable to use a star topology, but you can daisy-chain or star additional chassis as needed. There are additional choices, described in the next section, if the full x16 bandwidth is not required.

Connection Options

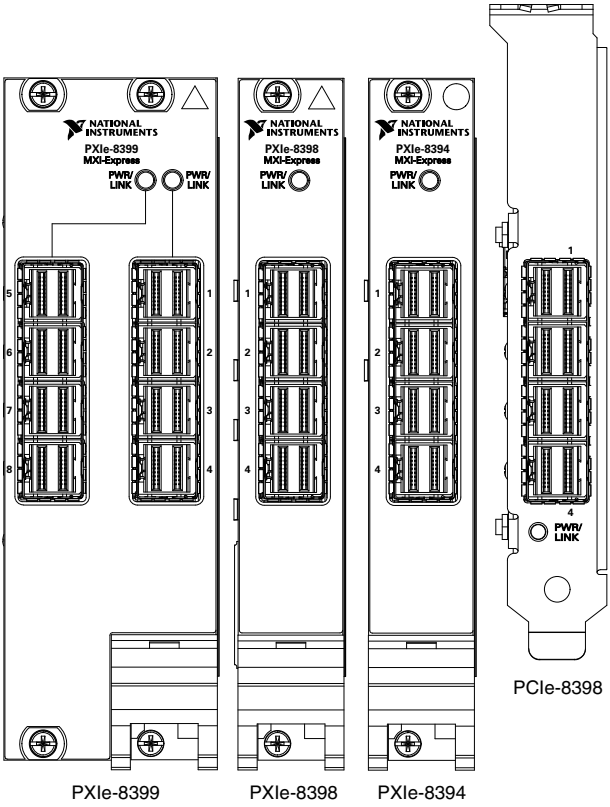
The MXI-Express Gen-3 x16 connectors are modular and can be cabled in several configurations. The hardware makes the configurations without user intervention. The

configuration mechanism requires PCI Express cables, not the connector-compatible cables that other standards use. When multiple cables are used for a single link, the cables must be the same length.

Note National Instruments offers x8 cables. x16 connections require two cables, and the cables must connect the ports in ascending order. For example, ports 1-2 of a PCIe-8398 will connect to ports 1-2 of a PXIe-8398, and ports 3-4 will connect to 3-4.

For the PXIe-8399, connect daisy-chain ports 5 and 6 to ports 1 and 2 on the PXIe-8398 or PXIe-8399.

Figure 8. Connection Options



Port 1 of the PXIe-8398 and PXIe-8399 is upstream facing, meaning it is the link going toward the host. This means it is connected to a PXIe-8394, PCIe-8398, or a downstream facing port of a PXIe-8398 or PXIe-8399.

Ports 1-4 ordinarily are cabled to the host PC or the chassis containing the embedded controller. In this configuration, ports 1-4 form a x16 link, offering the highest throughput.

Ports 5-8 of a PXIe-8399 and ports 1-4 of a PXIe-8394 and PCIe-8398 are always downstream facing, meaning they may be connected only to additional chassis that are farther from the host. They ordinarily are connected to a single PXIe-8398 or PXIe-8399.

Ports 2, 3, and 4 of the PXIe-8398 and PXIe-8399 are upstream facing by default, but they change direction based on cabling. While they are normally used (along with port 1) to form a x16 upstream link, they may alternatively be connected to additional chassis, and they become downstream facing ports. There can be only one upstream facing link per chassis, but it may comprise one, two, or four ports to form a x4, x8, or x16 link.

The following table lists possible configurations.

Module	Configuration 1	Configuration 2	Configuration 3	Configuration 4
PCIe-8398	1-4: x16	1-2: x8 3-4: x8	—	—
PXIe-8394, PXIe-8398, PXIe-8399 ports 1-4	1-4: x16	1-2: x8 3-4: x8	1-2: x8 3: x4 4: x4	1: x4 2: x4 3: x4 4: x4
PXIe-8399 ports 5-8	5-8: x16	5-6: x8 7-8: x8	5-6: x8 7: x4 8: x4	5: x4 6: x4 7: x4 8: x4

The flexible port configurations allow you to prioritize bandwidth (Configuration 1), high fanout (Configuration 4), or a blend of the two.

Compatibility with Host PCs

The BIOS of some host computers may have limited support or no support for extending the PCI Express fabric. These systems may fail to boot or fail to function correctly.

For more information about host system compatibility with MXI-Express Gen-3 x16 products, refer to the NI Developer Zone document *Tips to Help You Successfully Use NI MXI-Express Controllers* at `ni.com`.

Installation and Configuration

This section explains how to unpack, install, and configure the MXI-Express Gen-3 x16 hardware and software.

Equipment Needed

Connecting a PC to an Expansion Chassis

- Host PC with an available PCI Express Gen-3 x16 slot
- PXI Express chassis
- Two Gen 3 MXI-Express x8 cables
- One PCIe-8398
- One PXIe-8398

Connecting Additional Expansion Chassis to a System with a PXIe-8399

- Chassis to daisy-chain from with a PXIe-8399 in slot 1
- Expansion chassis to daisy-chain to
- Two Gen 3 MXI-Express x8 cables
- One PXIe-8398

Connecting Additional Expansion Chassis to a System with a PXIe-8394

- Chassis to daisy-chain from
- Expansion chassis to daisy-chain to
- One Gen 3 MXI-Express x8 cable
- One PXIe-8398 or PXIe-8399
- One PCIe-8394

Note Not all PCI Express expansion slots that have x16 physical connectors are electrically capable of x16 PCI Express operation. Check with the motherboard manufacturer to verify that the slot is capable of x16 PCI Express operation.

Unpacking

Your MXI-Express Gen-3 x16 products are shipped in antistatic packages to prevent electrostatic discharge (ESD) to the devices. ESD can damage several components on the device.

Caution *Never* touch the exposed pins of connectors. Doing so may damage the device.

To avoid such damage in handling the device, take the following precautions:

- Ground yourself using a grounding strap or by holding a grounded object.
- Touch the antistatic package to a metal part of the computer chassis before removing the device from the package.

Remove the device from the package and inspect the device for loose components or any sign of damage. Notify NI if the device appears damaged in any way. Do not install a damaged device into the computer or into a PXI Express or CompactPCI Express chassis.

Store the device in the antistatic envelope when not in use.

Hardware Installation

The following are general instructions for installing the MXI-Express Gen-3 x16 products. Consult your computer user manual or technical reference manual for further instructions and warnings.

Caution The protection provided by the MXI-Express Gen-3 x16 products can be impaired if they are used in a manner not described in this document.

Installing a PCIe-8398

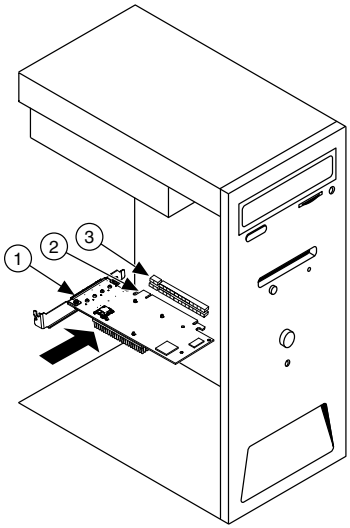
Complete the following steps to install the PCIe-8398 in your computer.

1. Power off your computer.

   Caution To protect both yourself and the computer from electrical hazards, your computer should remain off until you finish installing all hardware as instructed.
2. Remove the top cover or access port to the PCI Express expansion slots.
3. Touch the metal part of the power supply case inside the computer to discharge any static electricity that might be on your clothes or body.
4. Unplug the computer and wait 30 seconds to allow the energy stored in the computer's power supply to fully dissipate.
5. Select any available PCI Express expansion slot (Gen-3 x16).
6. Locate the metal bracket that covers the cut-out in the back panel of the computer for the slot you have selected. Remove and save the bracket-retaining screw and the bracket cover.
7. Line up the PCIe-8398 with the slot on the back panel. Slowly lower the PCIe-8398 until its card-edge connector is resting on the expansion slot receptacle. Using slow, evenly distributed pressure, press the PCIe-8398 straight down until it seats in the expansion slot, as shown in the following figure.
8. Secure the PCIe-8398 to the back panel rail using a bracket retaining screw.

9. Replace the computer cover.
10. Plug in the computer.

Figure 9. Installing the PCIe-8398



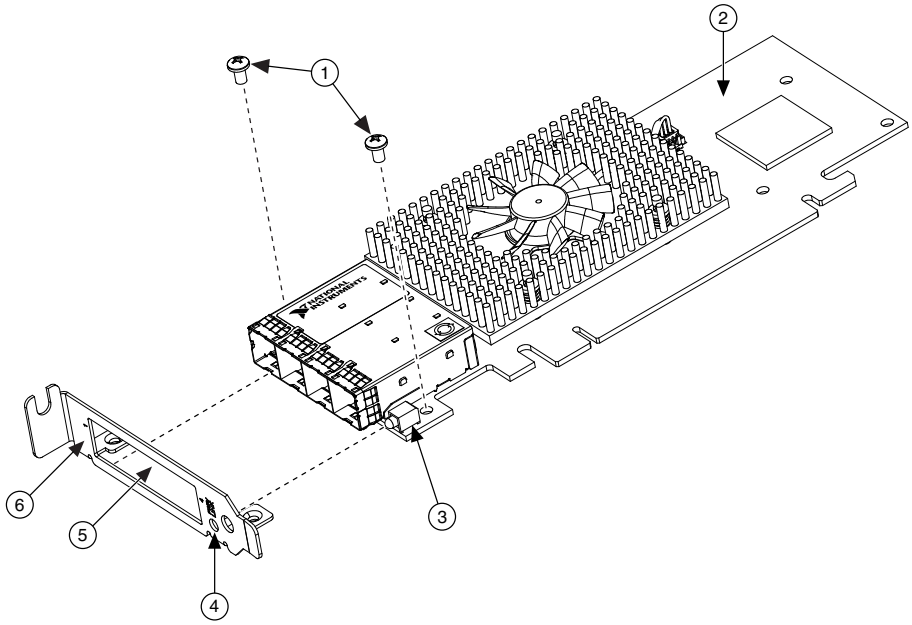
1. PCIe-8398
2. PCI Express x16 Card-Edge Connector
3. PCI Express Slot (x16)

Installing the Low-Profile Bracket on the PCIe-8398 (Optional)

To install the PCIe-8398 in a host computer that requires a low-profile height card, you must replace the front bracket with the low-profile bracket included with your kit. Complete the following steps to replace the bracket.

1. Remove the standard height front bracket already installed on your PCIe-8398 card by removing the two 4-40 × 5/32 in. Phillips head screws that attach the bracket to the card. Note that the two mounting tabs for the standard height bracket rest against the back side of the card. Set the two screws aside to re-use when installing the low-profile bracket.

Figure 10. Removing the Standard Bracket from the PCIe-8398



1. 4-40 × 5/32 in. Phillips Head Screw (x2)
2. Top Side of Card
3. LED
4. Bracket Hole for LED
5. Bracket Hole for Connector
6. Bracket

2. Fit the low-profile bracket onto the PCIe-8398. Note that the two mounting tabs that the screws thread into rest against the back side of the card for the low-profile bracket. Ensure that the LED is situated in the display hole correctly.
3. Align the mounting holes on the card with the threaded holes on the mounting tabs of the bracket, and insert the screws from the *top* side.
4. Tighten each screw to a maximum torque of 5 in. • lb (0.565 N • m).

Installing a PXIe-8398, PXIe-8399, or PXIe-8394

The following table provides information on which PXI Express MXI-Express Gen-3 x16 boards are compatible with which chassis slot types.

Table 3. MXI-Express Gen-3 x16 PXI Express Board Slot Type Compatibility

PXI Express Board	PXI Express Chassis		
	Controller	Peripheral	Hybrid
PXIe-8398	✓	—	—
PXIe-8399	✓	—	—
PXIe-8394	—	✓	✓

Note In this section, all the above models are referred to as a *PXI Express board*.

Complete the following steps to install the PXI Express board in your PXI Express or CompactPCI Express chassis.

1. Power off your PXI Express or CompactPCI Express chassis, but leave it plugged in while installing the PXI Express board. The power cord grounds the chassis and protects it from electrical damage while you install the module.

   Caution To protect both yourself and the chassis from electrical hazards, leave the chassis off until you finish installing the PXI Express board.
2. Remove or open any doors or covers blocking access to the slot in which you intend to install the PXI Express board.
3. Touch a metal part of the chassis to discharge any static electricity that might be on your clothes or body.
4. Make sure the injector/ejector handle is in its downward position. Be sure to remove all connector packaging and protective caps from retaining screws on the module. Align the PXI Express board with the card guides on the top and bottom of the system controller slot.

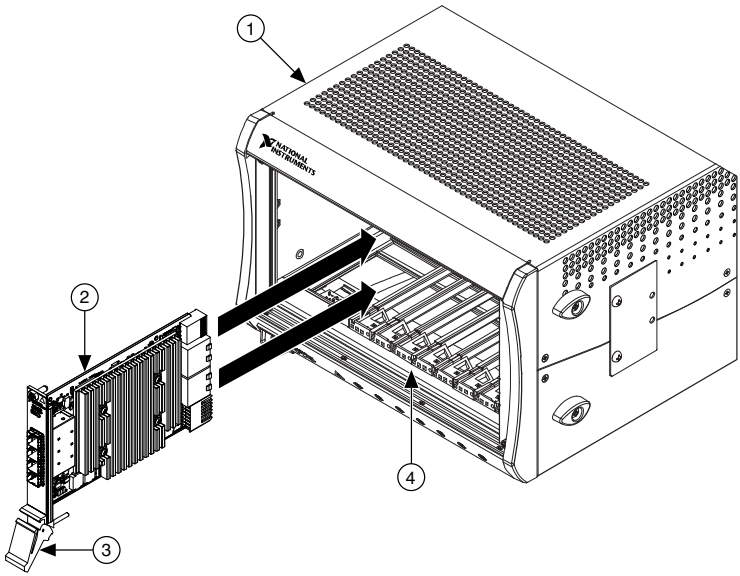
   Caution Do not raise the injector/ejector handle as you insert the PXI Express board. It will not insert properly unless the handle is in its downward position so that it does not interfere with the injector/ejector rail on the chassis, as shown in the following figure.
5. Hold the handle as you slowly slide the module into the chassis until the handle catches on the injector/ejector rail.
6. Raise the injector/ejector handle until the module firmly seats into the backplane receptacle connectors. The front panel of the PXI Express board should be even with the front panel of the chassis.

   Note LEDs on the back side of the PXIe-8398 or PXIe-8399 will light, indicating the presence of 5 V auxiliary power. Refer to the *LED Indicators* section for details.

7. Tighten the bracket-retaining screws on the top and bottom of the front panel to secure the PXI Express board to the chassis.
8. Replace or close any doors or covers to the chassis.

The following figure shows a PXI Express board just before installation in the system controller slot of a PXI Express chassis.

Figure 11. Example PXI Express Board Installation In a PXI Express Chassis



1. PXI Express/CompactPCI Express Chassis
2. PXI Express Board
3. Ejector Handle in Down Position
4. Injector/Ejector Rail

Cabling

The following table shows the various MXI-Express x8 copper cables available from National Instruments.

Table 4. National Instruments MXI-Express x8 Copper Cables

Cable Length (Meters)	Description	Part Number
1 m	MXI-Express x8 copper	785550-01
3 m	MXI-Express x8	785550-03

Connect the MXI-Express x8 cables to both MXI-Express Gen-3 x16 modules. The cables have no polarity, so either end may be connected to either card.

Note Two x8 cables plugged into the MXI-Express Gen-3 x16 modules make the x16 link.

Caution Do not remove the cable after the system is powered on. Doing so can hang or cause errors in applications communicating with devices behind MXI-Express Gen-3 x16. If a cable becomes unplugged, plug it back into the system. You will need to restart your computer.

Powering On the MXI-Express Gen-3 x16 System

1. Power on all the expansion chassis in any order you choose.
   The PXIe-8398 has a built-in feature that powers on/off the chassis it is controlling when the host system is powered on/off. You can override this feature by manually powering on the downstream chassis through chassis-specific means.
2. Power on the host.

Note There are no requirements for how expansion chassis are powered up relative to each other, as long as they are all on before the computer is powered on.

Observe the LED status on the PCIe-8398, PXIe-8399, PXIe-8398, and PXIe-8394 where applicable. A properly connected and powered up system should report a valid link and power status on all of these boards once the host PC is powered on. Refer to the *LED Indicators* section for more information.

Typical PCI Express switches are used to add PCI devices to a PCI hierarchy in which all the bridges and devices are contained within a single chassis. Because of this, BIOSes and operating systems make the assumption that all PCI devices in the entire hierarchy will be available as soon as code execution begins at power-up time. This assumption means that all of the expansion chassis must be powered on before the host PC for the BIOS and OS to correctly configure a MXI-Express Gen-3 x16 system.

Powering Off the MXI-Express Gen-3 x16 System

Once the host PC is powered off, the expansion chassis will power down automatically. Because operating systems and drivers commonly make the assumption that PCI devices will be present in the system from power-up to power-down, it is important to not power off the expansion chassis until after the host PC is powered off. Powering off the expansion chassis while the host is still on can cause crashes or hangs.

Note To power off the chassis while the host computer or host chassis is on, you may need to hold the power button for at least four seconds.

LED Indicators

The LEDs on MXI-Express Gen-3 x16 cards display status information about power supplies and link state. The PCIe-8398, PXIe-8398, and PXIe-8394 have one tri-color LED on the panel, indicating power and link status. The PXIe-8399 has two tri-color LEDs.

Board	LED	Color	Meaning
PXIe-8398 (156874*x*-01L) PXIe-8394 (156874*x*-04L) PXIe-8399 (156874*x*-02L)	PWR/LINK	Off	Power is off
		Blinking Red	Power is out of spec
		Solid Amber	Power is within spec; no cable link, or not all cables linked
		Solid Green	Power is within spec; link established on all connected cables

Board	LED	Color	Meaning
PCIe-8398 (156877*x*-01L)	PWR/LINK	Solid Red	Thermal limit has been exceeded[1]
		Off	Power is off
		Blinking Red	Power is out of spec
		Solid Amber	Power is within spec; no cable link, or not all cables linked
		Solid Green	Power is within spec; links established on all connected cables

[1] To clear this state, remove all power from the board. Ensure the heatsink is dust free and check for air blockages in the chassis.

Pay special attention to the solid red state of the PCIe-8398 front panel LED. In the event of a fan failure, a thermal limit in the PCI Express switch could be exceeded. To protect the board, the internal temperature of the PCI Express switch is monitored. If the temperature exceeds a predetermined limit, the board shuts down, and the front panel LED is solid red.

To clear the solid red state, remove all power from the board. Ensure the heatsink is dust free, check the fan to verify it is operating, and check the computer to ensure there are no airflow blockages.

PXI Express Onboard LEDs

The PXIe-8394, PXIe-8398, and PXIe-8399 have additional LEDs that provide information about the status of several PCI Express links.

Each LED is an indicator for four PCI Express lanes. Blink patterns are encoded into each LED to indicate the number of lanes linked and the link speed. The blink pattern repeats every two seconds. In general, if the LED is on, it means all four lanes are linked, and the number of blinks indicates the speed. If the LED is off but blinking on, it means fewer than four lanes are linked, and the number of blinks indicates the speed. The following table lists the patterns.

LED Blink Pattern (Two-Second Period)	Meaning
Off	No link
On	All four lanes linked at PCI Express Gen 3
Primarily on, blinks off twice	All four lanes linked at PCI Express Gen 2
Primarily on, blinks off once	All four lanes linked at PCI Express Gen 1
Primarily off, blinks on three times	One or two lanes linked at PCI Express Gen 3
Primarily off, blinks on twice	One or two lanes linked at PCI Express Gen 2
Primarily off, blinks on once	One or two lanes linked at PCI Express Gen 1

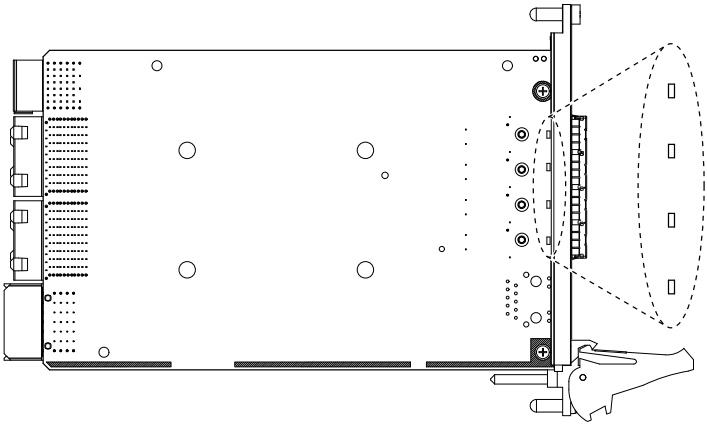
Note The following table lists the maximum theoretical throughput of PCI Express lanes. *Raw Bitrate* is the speed of bits on the wire. *Bitrate After Encoding* is the speed of bits after subtracting symbol encoding overhead, and is the max theoretical throughput. You'll typically get 70% to 80% of the after-encoding rate after protocol overhead and other detractors.

PCI Express Generation	Raw Bitrate	Bitrate After Encoding
PCI Express Gen 3	8 Gb/s/lane	7.88 Gb/s/lane
PCI Express Gen 2	5 Gb/s/lane	4 Gb/s/lane
PCI Express Gen 1	2.5 Gb/s/lane	2 Gb/s/lane

LEDs for Ports 1-4

Onboard link indicators for front panel cable links 1-4 are directly behind the connectors on the back side of the board, as shown in the following figure. The LEDs represent the lanes of the port they're adjacent to.

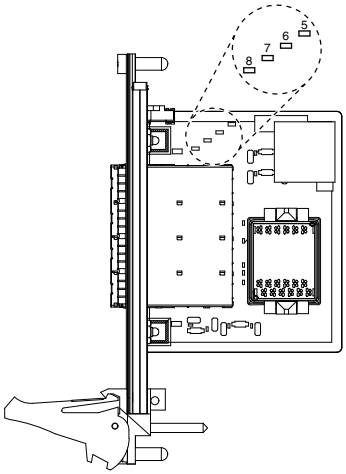
Figure 12. LEDs for Ports 1-4



LEDs for Ports 5-8 of the PXIe-8399

These LEDs, shown in the following figure, are between the two PCBs that comprise the PXIe-8399. They are on the smaller PCB and may be visible through openings on the top of the chassis. They represent, from top-right to bottom-left, ports 5, 6, 7, and 8.

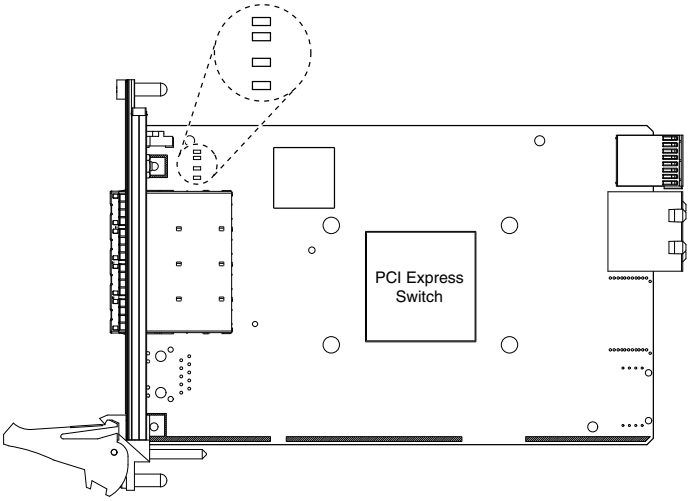
Figure 13. PXIe-8399 LEDs for Ports 5-8



LEDs for Backplane Links

Onboard link indicators for the first 16 backplane lanes are on the top side of the board, as shown in the following figure.

Figure 14. Backplane Link Status LEDs



The Backplane Link Status LEDs report the status of the PCI Express links established between any PCI Express switches that reside on the backplane of the chassis that the PXIe-8398 or PXIe-8399 is controlling. In some cases, the link is with the peripheral boards installed in the chassis passive slots.

The chassis backplane architecture determines the PXIe-8398 and PXIe-8399 link configuration. Refer to the chassis documentation for more information about its backplane PCI Express link topology to the controller slot, as well as identifying any passive PXI Express slots. A passive slot has a direct copper path to the controller slot instead of being routed through a backplane PCI Express switch. Peripheral products installed in these slots determine the actual link established to the PXIe-8398 or PXIe-8399, and the corresponding backplane link status LED is set appropriately.

For a 4-link backplane, the LEDs represent links 1, 2, 3, and 4 from top to bottom. For a 2-link backplane, the top two LEDs represent link 1 (x8 max), and the bottom two LEDs indicate the status of the first eight lanes of link 2 (x16 max).

For the PXIe-8394, the top two LEDs indicate the status of the backplane link, which can be up to x8 (eight lanes). The bottom two LEDs are unused.

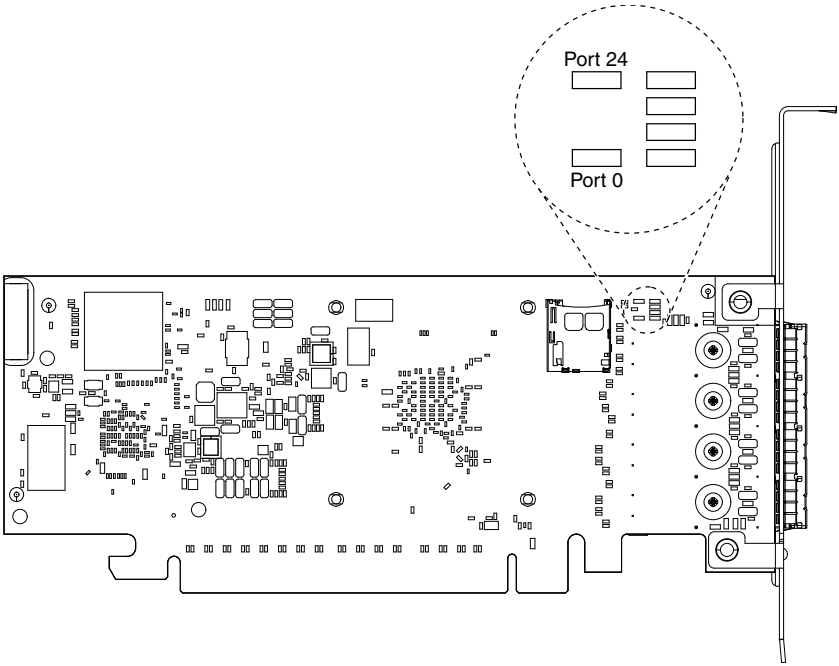
PCIe-8398 Onboard LEDs

The PCIe-8398 also has several onboard LEDs that provide additional information about the PCI Express link status.

As shown in the following figure, there are six LEDs on the upper right corner of the secondary, or back side, of the board. Two of the LEDs provide link status information. The Port 0 LED reflects the status of the card edge connector and typically is solid green. Port 24 is

an onboard link between the PCI Express switch and an onboard device, and it should be blinking. The remaining LEDs are for National Instruments internal use.

Figure 15. PCIe-8398 LEDs



Software Installation and Configuration

MXI-Express Gen-3 x16 is based on PCI Express technology, using PCI Express switches to enable control of a PXI Express chassis from a PC or another PXI Express chassis with an available PCI Express or PXI Express slot. This technology will be recognized as a collection of PCI-to-PCI bridges to the operating system, and has CompactPCI Express level support without any additional software.

Note For full PXI/PXI Express functionality such as chassis and controller identification, trigger routing, and slot detection, install the PXI Platform Services software included with your kit. You also can find this software at `ni.com/updates` by searching for *PXI Platform Services*.

For operating system support, refer to the KnowledgeBase 53399AQ7, *PXI Platform Services Operating System Support*, at `ni.com/kb`.

For information about configuring your system in MAX, open MAX and navigate to **Help»Help Topics»PXI**.

Note This requires the PXI Platform Services software and Measurement & Automation Explorer (MAX), included on your *PXI Platform Services* CD or your driver CD.

Specifications

This section lists the system specifications for the following models:

- PCIe-8398 (156877*x*-01L)
- PXIe-8398 (156874*x*-01L)
- PXIe-8399 (156874*x*-02L)
- PXIe-8394 (156874*x*-04L)

Note After each model number is its specific NI assembly number in parentheses. Ensure that the specifications of interest match the NI assembly number printed on either the front or back side of the board.

Note *x* denotes all letter revisions of the assembly.

PCIe-8398 (156877*x*-01L) Specifications

Note These specifications are typical at 25 °C, unless otherwise stated, and are subject to change without notice.

Physical

Dimensions	6.89 cm × 167.65 cm (2.71 in. × 6.60 in.)
Maximum cable length	3 m
Slot requirements	One slot (PCI Express x16)
Compatibility	Fully compatible with the *PCI Express Specification*, Revision 3.0
Weight	0.147 kg (0.325 lb) typical

Power Requirements

Power Rail	Typical Current	Maximum Current
+3.3 V	1.688 A	1.9 A
+3.3 V_{AUX}	40 mA	146 mA
+12 V	731 mA	1.6 A

Environment

Maximum altitude	2,000 m
Pollution Degree	2

Indoor use only.

Operating Environment

Ambient temperature range	0 °C to 55 °C (Tested in accordance with IEC-60068-2-1 and IEC-60068-2-2.)
Relative humidity range	10% to 90%, noncondensing (Tested in accordance with IEC-60068-2-56.)

Storage Environment

Ambient temperature range	-20 °C to 70 °C (Tested in accordance with IEC-60068-2-1 and IEC-60068-2-2.)
Relative humidity range	5% to 95%, noncondensing (Tested in accordance with IEC-60068-2-56.)

Note Clean the PCIe-8398 with a soft nonmetallic brush. Make sure that the device is completely dry and free from contaminants before returning it to service.

Safety

This product is designed to meet the requirements of the following standards of safety for information technology equipment:

- IEC 61010-1, EN 61010-1
- CAN/CSA-C22.2 No. 61010-1

Note For UL and other safety certifications, refer to the product label or the *Online Product Certification* section.

Electromagnetic Compatibility

This product meets the requirements of the following EMC standards for electrical equipment for measurement, control, and laboratory use:

- EN 61326-1 (IEC 61326-1): Class A emissions; Basic immunity
- EN 55011 (CISPR 11): Group 1, Class A emissions
- AS/NZS CISPR 11: Group 1, Class A emissions
- FCC 47 CFR Part 15B: Class A emissions
- ICES-001: Class A emissions

Note In the United States (per FCC 47 CFR), Class A equipment is intended for use in commercial, light-industrial, and heavy-industrial locations. In Europe, Canada, Australia, and New Zealand (per CISPR 11), Class A equipment is intended for use only in heavy-industrial locations.

Note Group 1 equipment (per CISPR 11) is any industrial, scientific, or medical equipment that does not intentionally generate radio frequency energy for the treatment of material or inspection/analysis purposes.

Note For EMC declarations and certifications, and additional information, refer to the *Online Product Certification* section.

CE Compliance CE

This product meets the essential requirements of applicable European Directives, as follows:

- 2014/35/EU; Low-Voltage Directive (safety)
- 2014/30/EU; Electromagnetic Compatibility Directive (EMC)

Online Product Certification

Refer to the product Declaration of Conformity (DoC) for additional regulatory compliance information. To obtain product certifications and the DoC for this product, visit *ni.com/certification*, search by model number or product line, and click the appropriate link in the Certification column.

Environmental Management

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PXIe-8398 (156874*x*-01L) Specifications

Note These specifications are typical at 25 °C, unless otherwise stated, and are subject to change without notice.

Physical

Dimensions	10.7 cm × 17.5 cm (4.4 in. × 6.9 in.)
Maximum cable length	3 m
Slot requirements	One system slot (PXI Express or CompactPCI Express)
Compatibility	Fully compatible with the *PXI Express Hardware Specification*, Revision 1.0; *PICMG CompactPCI Express EXP.0 R2.0 Specification*; and the *PCI Express External Cable Specification*, Revision 3.0
Weight	0.36 kg (0.81 lb) typical

Power Requirements

Power Rail	Typical Current	Maximum Current
+3.3 V	750 mA	1.1 A
+5 V	100 mA	200 mA
+12 V[1]	1100 mA	2300 mA
+5 V_{AUX}	200 mA	500 mA

[1]Not including the power consumed by an active cable. NI copper cables (785550-0*x*) are passive.

Environment

Maximum altitude	2,000 m
Pollution Degree	2

Indoor use only.

Operating Environment

Ambient temperature range	0 °C to 55 °C (Tested in accordance with IEC-60068-2-1 and IEC-60068-2-2. Meets MIL-PRF-28800F Class 3 low temperature limit and MIL-PRF-28800F Class 2 high temperature limit.)
Relative humidity range	10% to 90%, noncondensing (Tested in accordance with IEC-60068-2-56.)

Storage Environment

Ambient temperature range	-40 °C to 71 °C (Tested in accordance with IEC-60068-2-1 and IEC-60068-2-2. Meets MIL-PRF-28800F Class 3 limits.)
Relative humidity range	5% to 95%, noncondensing (Tested in accordance with IEC-60068-2-56.)

Caution Clean the PXIe-8398 with a soft nonmetallic brush. Make sure that the device is completely dry and free from contaminants before returning it to service.

Shock and Vibration

Operating shock	30 g peak, half-sine, 11 ms pulse (Tested in accordance with IEC-60068-2-27. Meets MIL-PRF-28800F Class 2 limits.)
Random vibration	
Operating	5 Hz to 500 Hz, 0.3 g_{rms}
Nonoperating	5 Hz to 500 Hz, 2.4 g_{rms} (Tested in accordance with IEC-60068-2-64. Nonoperating test profile exceeds the requirements of MIL-PRF-28800F, Class 3.)

Safety

This product is designed to meet the requirements of the following standards of safety for information technology equipment:

- IEC 61010-1, EN 61010-1
- CAN/CSA-C22.2 No. 61010-1

Note For UL and other safety certifications, refer to the product label or the *Online Product Certification* section.

Electromagnetic Compatibility

This product meets the requirements of the following EMC standards for electrical equipment for measurement, control, and laboratory use:

- EN 61326-1 (IEC 61326-1): Class A emissions; Basic immunity
- EN 55011 (CISPR 11): Group 1, Class A emissions
- AS/NZS CISPR 11: Group 1, Class A emissions
- FCC 47 CFR Part 15B: Class A emissions
- ICES-001: Class A emissions

Note In the United States (per FCC 47 CFR), Class A equipment is intended for use in commercial, light-industrial, and heavy-industrial locations. In Europe, Canada, Australia, and New Zealand (per CISPR 11), Class A equipment is intended for use only in heavy-industrial locations.

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Note For EMC declarations and certifications, and additional information, refer to the *Online Product Certification* section.

CE Compliance CE

This product meets the essential requirements of applicable European Directives, as follows:

- 2014/35/EU; Low-Voltage Directive (safety)
- 2014/30/EU; Electromagnetic Compatibility Directive (EMC)

Online Product Certification

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PXIe-8399 (156874*x*-02L) Specifications

Note These specifications are typical at 25 °C, unless otherwise stated, and are subject to change without notice.

Physical

Dimensions	10.7 cm × 17.5 cm (4.4 in. × 6.9 in.)
Maximum cable length	3 m
Slot requirements	One system slot plus one controller expansion slot
Compatibility	Fully compatible with the *PXI Express Hardware Specification*, Revision 1.0; *PICMG CompactPCI Express EXP.0 R2.0 Specification*; and the *PCI Express External Cable Specification*, Revision 3.0
Weight	0.45 kg (0.99 lb) typical

Power Requirements

Power Rail	Typical Current	Maximum Current
+3.3 V	750 mA	1.1 A
+5 V	100 mA	200 mA
+12 V[1]	1100 mA	2500 mA
+5 V_{AUX}	200 mA	500 mA

[1]Not including the power consumed by an active cable. NI copper cables (785550-0*x*) are passive.

Environment

Maximum altitude	2,000 m
Pollution Degree	2

Indoor use only.

Operating Environment

Ambient temperature range	0 °C to 55 °C (Tested in accordance with IEC-60068-2-1 and IEC-60068-2-2. Meets MIL-PRF-28800F Class 3 low temperature limit and MIL-PRF-28800F Class 2 high temperature limit.)
Relative humidity range	10% to 90%, noncondensing (Tested in accordance with IEC-60068-2-56.)

Storage Environment

Ambient temperature range	-40 °C to 71 °C (Tested in accordance with IEC-60068-2-1 and IEC-60068-2-2. Meets MIL-PRF-28800F Class 3 limits.)
Relative humidity range	5% to 95%, noncondensing (Tested in accordance with IEC-60068-2-56.)

Caution Clean the PXIe-8399 with a soft nonmetallic brush. Make sure that the device is completely dry and free from contaminants before returning it to service.

Shock and Vibration

Operating shock	30 g peak, half-sine, 11 ms pulse (Tested in accordance with IEC-60068-2-27. Meets MIL-PRF-28800F Class 2 limits.)
Random vibration	
Operating	5 Hz to 500 Hz, 0.3 g_{rms}
Nonoperating	5 Hz to 500 Hz, 2.4 g_{rms} (Tested in accordance with IEC-60068-2-64. Nonoperating test profile exceeds the requirements of MIL-PRF-28800F, Class 3.)

Safety

This product is designed to meet the requirements of the following standards of safety for information technology equipment:

- IEC 61010-1, EN 61010-1
- CAN/CSA-C22.2 No. 61010-1

Note For UL and other safety certifications, refer to the product label or the *Online Product Certification* section.

Electromagnetic Compatibility

This product meets the requirements of the following EMC standards for electrical equipment for measurement, control, and laboratory use:

- EN 61326-1 (IEC 61326-1): Class A emissions; Basic immunity
- EN 55011 (CISPR 11): Group 1, Class A emissions
- AS/NZS CISPR 11: Group 1, Class A emissions
- FCC 47 CFR Part 15B: Class A emissions
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Note For EMC declarations and certifications, and additional information, refer to the *Online Product Certification* section.

CE Compliance CE

This product meets the essential requirements of applicable European Directives, as follows:

- 2014/35/EU; Low-Voltage Directive (safety)
- 2014/30/EU; Electromagnetic Compatibility Directive (EMC)

Online Product Certification

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PXIe-8394 (156874*x*-04L) Specifications

Note These specifications are typical at 25 °C, unless otherwise stated, and are subject to change without notice.

Physical

Dimensions	10.7 cm × 17.5 cm (4.4 in. × 6.9 in.)
Maximum cable length	3 m

Slot requirements	One peripheral slot (PXI Express or CompactPCI Express)
Compatibility	Fully compatible with the *PXI Express Hardware Specification*, Revision 1.0; *PICMG CompactPCI Express EXP.0 R2.0 Specification*; and the *PCI Express External Cable Specification*, Revision 3.0
Weight	0.35 kg (0.76 lb) typical

Power Requirements

Power Rail	Typical Current	Maximum Current
+3.3 V	150 mA	250 mA
+12 V[1]	850 mA	2200 mA
+5 V_{AUX}	5 mA	15 mA

[1]Not including the power consumed by an active cable. NI copper cables (785550-0*x*) are passive.

Environment

Maximum altitude	2,000 m
Pollution Degree	2

Indoor use only.

Operating Environment

Ambient temperature range	0 °C to 55 °C (Tested in accordance with IEC-60068-2-1 and IEC-60068-2-2. Meets MIL-PRF-28800F Class 3 low temperature limit and MIL-PRF-28800F Class 2 high temperature limit.)
Relative humidity range	10% to 90%, noncondensing (Tested in accordance with IEC-60068-2-56.)

Storage Environment

Ambient temperature range	-40 °C to 71 °C (Tested in accordance with IEC-60068-2-1 and IEC-60068-2-2. Meets MIL-PRF-28800F Class 3 limits.)
Relative humidity range	5% to 95%, noncondensing (Tested in accordance with IEC-60068-2-56.)

Caution Clean the PXIe-8394 with a soft nonmetallic brush. Make sure that the device is completely dry and free from contaminants before returning it to service.

Shock and Vibration

Operating shock	30 g peak, half-sine, 11 ms pulse (Tested in accordance with IEC-60068-2-27. Meets MIL-PRF-28800F Class 2 limits.)
Random vibration	
Operating	5 Hz to 500 Hz, 0.3 g_{rms}
Nonoperating	5 Hz to 500 Hz, 2.4 g_{rms} (Tested in accordance with IEC-60068-2-64. Nonoperating test profile exceeds the requirements of MIL-PRF-28800F, Class 3.)

Safety

This product is designed to meet the requirements of the following standards of safety for information technology equipment:

- IEC 61010-1, EN 61010-1
- CAN/CSA-C22.2 No. 61010-1

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Electromagnetic Compatibility

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CE Compliance CE

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Online Product Certification

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Common Questions

This section includes common questions related to using the MXI-Express Gen-3 x16 controllers.

General Hardware

What connectors does MXI-Express Gen-3 x16 use?

MXI-Express Gen-3 x16 uses the connector system defined in the SFF-8644 and SFF-8614 specifications. It's often referred to as *Mini-SAS HD*.

How many PXI bus segments can I connect together with MXI-Express Gen-3 x16?

The PCI specification allows up to 255 bus segments. MXI-Express Gen-3 x16 does not limit this number, but the maximum number of bus segments allowed can be BIOS or operating system dependent. Also, a computer will use several PCI bus segments internally, and the MXI-Express Gen-3 x16 link also uses multiple PCI buses internally. Every PCI Express slot uses one bus number. A PXI Express module will use additional bus numbers only if it includes a bridge or switch.

Will my PC work with MXI-Express Gen-3 x16 products?

It depends on the robustness of the BIOS in your PC. In most cases, the BIOS should be able to enumerate the bridge resources that the MXI products require for operation, especially for smaller MXI system configurations. For more information, refer to the NI Developer Zone article, *Tips to Help You Successfully Use NI MXI-Express Controllers*, at `ni.com`.

What is the maximum length of a MXI-Express Gen-3 copper cable?

The maximum length for a MXI-Express Gen-3 copper cable is 3 m. National Instruments offers 3 m copper cables. Refer to the *Cabling* section for more information.

MXI-Express Gen-3 x16 Upgrade Questions

What are some of the improvements in MXI-Express Gen-3 x16?

MXI-Express Gen-3 x16 incorporates the latest technology to include:

- Support for Gen 3 PCI Express slots.
- Improved performance.
- Modular cabling for flexibility in bandwidth management and fanout.

Can I use an older MXI kit and MXI-Express Gen-3 x16 kit in the same multichassis PXI system?

Yes. You can mix different MXI kits to connect multiple PXI and PXI Express chassis together.

Is a specific boot ordering a requirement with MXI-Express Gen-3 x16?

Yes. The requirements of the PCI bus still mandate that you must power on secondary PXI/PXI Express chassis before powering on the host PC when using MXI-Express Gen-3 x16. MXI Express Gen-3 x16 will generally power up the entire system appropriately when you power up any component of the system.

For more details, refer to the *Powering On the MXI-Express Gen-3 x16 System* section.

General Software

Under which operating systems will MXI-Express Gen-3 x16 products work?

MXI-Express Gen-3 x16 is recognized as a collection of PCI-to-PCI bridges to the majority of operating systems. It should automatically have CompactPCI Express support with most systems such as Windows, Macintosh OS X, Linux, and Solaris. For full PXI Express functionality, PXI Platform Services software is required. Refer to the *Software Installation and Configuration* section for more information.

What software is required to use my MXI-Express Gen-3 x16 kit?

For Windows and LabVIEW RT, the required software is included as part of the latest version of NI PXI Platform Services included with your kit. The software for your MXI-Express Gen-3 x16 controller enhances the product, allowing you to view information about the organization of your PXI Express system, gain access to the trigger routing capabilities of the PXI Express chassis, and programmatically retrieve data about the chassis and modules you have installed.

Refer to KnowledgeBase KB 53399AQ7, *PXI Platform Services Operating System Support*, for the current supported operating systems for NI PXI Platform Services.

If PXI Platform Services does not support your operating system, you can still use MXI-Express Gen-3 x16 as a PCI Express expansion solution. However, access to features such as chassis and controller identification, trigger routing, and slot detection will be lost.

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