MXI™

MXI-Express Series User Manual

MXI-Express Multisystem eXtension Interface for PCI Express, Compact PCI, and PXI Bus Computers

NI PCIe-8360
NI PXI-8360

NATIONAL INSTRUMENTS™

Worldwide Technical Support and Product Information

`ni.com`

National Instruments Corporate Headquarters

11500 North Mopac Expressway   Austin, Texas 78759-3504   USA   Tel: 512 683 0100

Worldwide Offices

Australia 1800 300 800, Austria 43 0 662 45 79 90 0, Belgium 32 0 2 757 00 20, Brazil 55 11 3262 3599,
Canada 800 433 3488, China 86 21 6555 7838, Czech Republic 420 224 235 774, Denmark 45 45 76 26 00,
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Compliance with FCC/Canada Radio Frequency Interference Regulations

Determining FCC Class

The Federal Communications Commission (FCC) has rules to protect wireless communications from interference. The FCC places digital electronics into two classes. These classes are known as Class A (for use in industrial-commercial locations only) or Class B (for use in residential or commercial locations). All National Instruments (NI) products are FCC Class A products.

Depending on where it is operated, this Class A product could be subject to restrictions in the FCC rules. (In Canada, the Department of Communications (DOC), of Industry Canada, regulates wireless interference in much the same way.) Digital electronics emit weak signals during normal operation that can affect radio, television, or other wireless products.

All Class A products display a simple warning statement of one paragraph in length regarding interference and undesired operation. The FCC rules have restrictions regarding the locations where FCC Class A products can be operated.

Consult the FCC Web site at www.fcc.gov for more information.

FCC/DOC Warnings

This equipment generates and uses radio frequency energy and, if not installed and used in strict accordance with the instructions in this manual and the CE marking Declaration of Conformity*, may cause interference to radio and television reception. Classification requirements are the same for the Federal Communications Commission (FCC) and the Canadian Department of Communications (DOC).

Changes or modifications not expressly approved by NI could void the user's authority to operate the equipment under the FCC Rules.

Class A

Federal Communications Commission

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user is required to correct the interference at their own expense.

Canadian Department of Communications

This Class A digital apparatus meets all requirements of the Canadian Interference-Causing Equipment Regulations.

Cet appareil numérique de la classe A respecte toutes les exigences du Règlement sur le matériel brouilleur du Canada.

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*   The CE marking Declaration of Conformity contains important supplementary information and instructions for the user or installer.

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About This Manual

This manual describes the features, functions, and operation of the MXI-Express series of products. The products in this series are the NI PCIe-8360 and the NI PXI-8360.

Conventions

The following conventions appear in this manual:

»　　　　　　The **»** symbol leads you through nested menu items and dialog box options to a final action. The sequence **File»Page Setup»Options** directs you to pull down the **File** menu, select the **Page Setup** item, and select **Options** from the last dialog box.

　　　　　　This icon denotes a note, which alerts you to important information.

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

bold　　　　　　Bold text denotes items that you must select or click in the software, such as menu items and dialog box options. Bold text also denotes parameter names.

italic　　　　　　Italic text denotes variables, emphasis, a cross reference, or an introduction to a key concept. This font also denotes text that is a placeholder for a word or value that you must supply.

`monospace`　　　　　　Text in this font denotes text or characters that you should enter from the keyboard, sections of code, programming examples, and syntax examples. This font is also used for the proper names of disk drives, paths, directories, programs, subprograms, subroutines, device names, functions, operations, variables, filenames and extensions, and code excerpts.

MXI-Express card　　　　　　MXI-Express card refers to any of the following cards, unless otherwise noted: NI PCIe-8360 and NI PXI-8360.

Note　In this manual, whenever a PXI chassis is referenced, a CompactPCI chassis could be used instead.

Related Documentation

The following documents contain information that you might find helpful as you read this manual:

*   *Set Up Your MXI-Express System*

*   Your computer or chassis documentation

*   *PXI Hardware Specification*, Revision 2.1

*   *PXI Software Specification*, Revision 2.1

*   *PCI Specification*, Revision 2.3

*   *PCI-PCI Bridge Architecture Specification*, Revision 1.1

*   *PICMG CompactPCI 2.0 R3.0* specification

*   *PCI Express Specification*, Revision 1.0a

1

Introduction

This chapter describes the MXI-Express series of products, lists what you need to get started, and explains how to unpack and set up your hardware.

The two products in this series are the NI PCIe-8360 and NI PXI-8360. For the remainder of this manual the term *MXI-Express card* refers to any product in the MXI-Express series.

MXI-Express cards must always be installed as a PCI Express card and a PXI card.

About the MXI-Express Series

Description and Features

MXI-Express functions as a cabled PCI Express link of up to 7 m and a PCI Express-to-PCI bridge. With MXI-Express, you can do the following:

- Control a PXI/CompactPCI backplane with a PCI Express-based PC
- Physically separate the measurement or automation system from a host PC
- Combine PCI Express, CompactPCI, and PXI devices in the same system

Basic MXI-Express System

The simplest MXI-Express system consists of an NI PCIe-8360 in a PC connected to an NI PXI-8360 in the controller slot of a PXI/CompactPCI chassis, as shown in Figure 1-1.
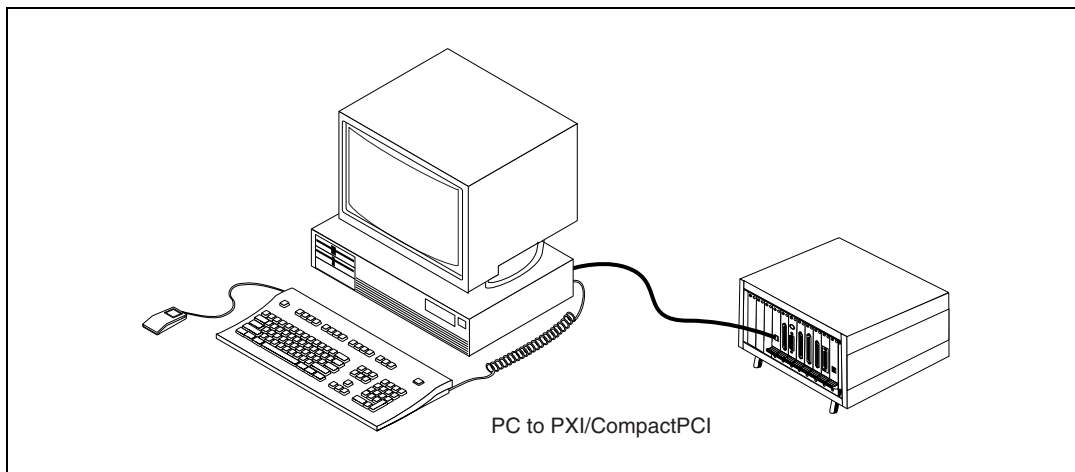
Figure 1-1. Basic MXI-Express Configuration

Larger MXI-Express Systems

Each NI PCIe-8360 has two MXI-Express connectors. One NI PCIe-8360 may be connected to two different NI PXI-8360 cards in separate PXI/CompactPCI chassis. If multiple PCI Express slots are available in the host PC, additional PXI chassis can be connected by installing an NI PCIe-8360 in any available PCI Express slot.

Figure 1-2 shows how you can use MXI-Express cards to connect multiple expansion chassis to a PC in a star topology. The star topology is the only supported topology due to the point-to-point nature of PCI Express.
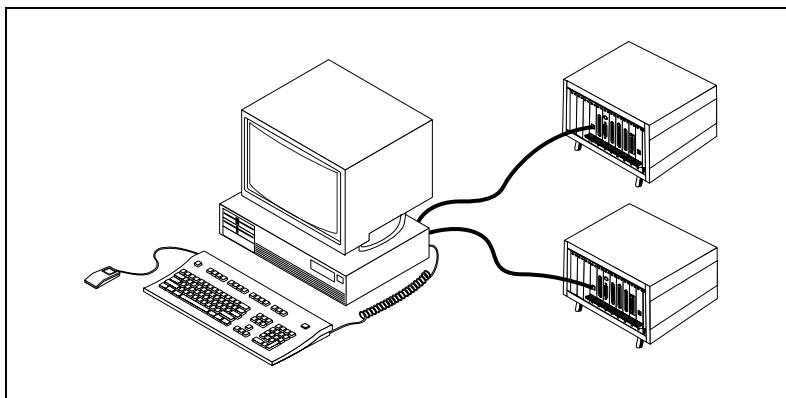

Figure 1-2. Star Topology MXI-Express Configuration

What You Need to Get Started

To set up and use your MXI-Express cards, you need the following:

❑   One NI PCIe-8360 and one NI PXI-8360

❑   A MXI-Express cable

❑   A host PC with an available x1 (or wider) PCI Express slot

❑   An expansion chassis—the PXI/CompactPCI chassis that you control with MXI-Express

Note   Your PXI MXI-Express card will work in any standard CompactPCI chassis adhering to the *PICMG CompactPCI 2.0 R3.0* specification, or in PXI chassis that are compatible with the *PXI Hardware Specification*, Revision 1.0 or later. Your PCI Express MXI-Express card will work in systems compliant with the *PCI Express Specification*, Revision 1.0a or later.

Unpacking

Your MXI-Express cards are shipped in antistatic packages to prevent electrostatic damage (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 PXI/CompactPCI chassis.

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

2

Hardware Installation

This chapter explains how to install the MXI-Express hardware.

Hardware Installation

The following are general instructions for installing the MXI-Express cards. Consult your computer user manual or technical reference manual for specific instructions and warnings.

Note The software for your MXI-Express kit is included with the current NI driver CD, and is installed with the PXI platform software included as part of NI-VISA and other NI driver software products.

Installing an NI PCIe-8360

1. Power off your computer, but leave it plugged in while installing the NI PCIe-8360. The power cord grounds the chassis and protects it from electrical damage while you install the card.

⚠ **Caution** To protect both yourself and the computer from electrical hazards, your computer should remain off until you finish installing the NI PCIe-8360.

2. Remove the top cover or access port to the PCI Express bus.

3. Select any available PCI Express expansion slot (x1 or wider).

Note The BIOS or motherboard may not support the NI PCIe-8360 in a slot intended for a graphics card.

4. 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.

5. 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.

6. Line up the NI PCIe-8360 with the slot on the back panel. Slowly push down on the top of the NI PCIe-8360 until its card-edge connector is resting on the expansion slot receptacle. Using slow, evenly distributed pressure, press the NI PCIe-8360 straight down until it seats in the expansion slot.

7. Reinstall the bracket-retaining screw to secure the NI PCIe-8360 to the back panel rail.
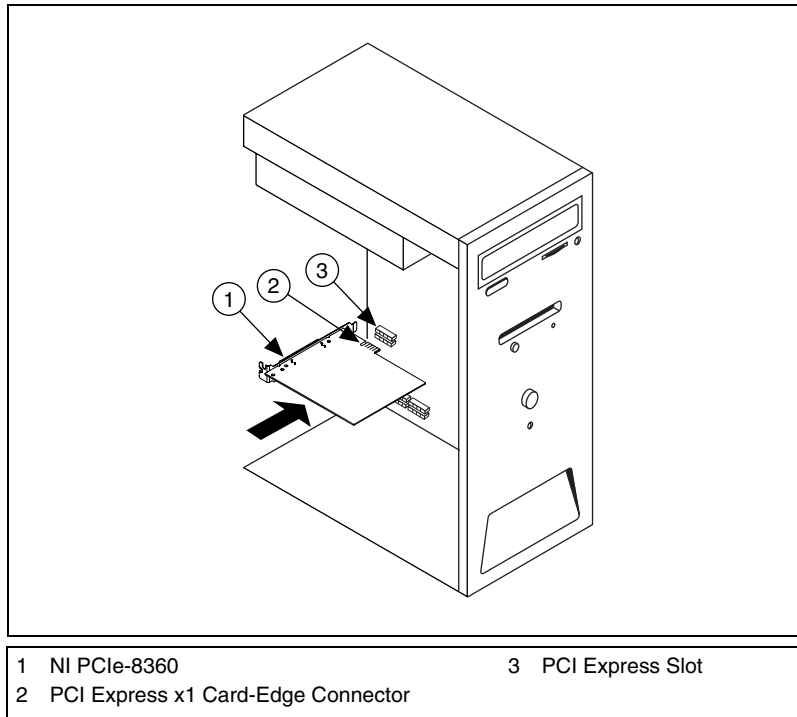
8. Replace the computer cover.

1	NI PCIe-8360	3	PCI Express Slot
2	PCI Express x1 Card-Edge Connector		

Figure 2-1. Installing the NI PCIe-8360

Installing an NI PXI-8360

Complete the following steps to install the NI PXI-8360 in your PXI or CompactPCI chassis.

1. Power off your PXI or CompactPCI chassis, but leave it plugged in while installing the NI PXI-8360. The power cord grounds the chassis and protects it from electrical damage while you install the module.

2. Select a slot for the NI PXI-8360. The NI PXI-8360 must be installed in the controller slot (slot 1 in PXI).

⚠ **Caution**   To protect both yourself and the chassis from electrical hazards, leave the chassis off until you finish installing the NI PXI-8360.

3. Remove or open any doors or covers blocking access to the slot in which you intend to install the NI PXI-8360.

4. Touch the metal part of the case to discharge any static electricity that might be on your clothes or body.

5. 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 NI PXI-8360 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 NI PXI-8360. 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 Figure 2-2.

6. Hold the handle as you slowly slide the module into the chassis until the handle catches on the injector/ejector rail.

7. Raise the injector/ejector handle until the module firmly seats into the backplane receptacle connectors. The front panel of the NI PXI-8360 should be even with the front panel of the chassis.

8. Tighten the bracket-retaining screws on the top and bottom of the front panel to secure the NI PXI-8360 to the chassis.

9. Replace or close any doors or covers to the chassis.

Figure 2-2 shows an NI PXI-8360 just before installation in the system controller slot of a National Instruments chassis.
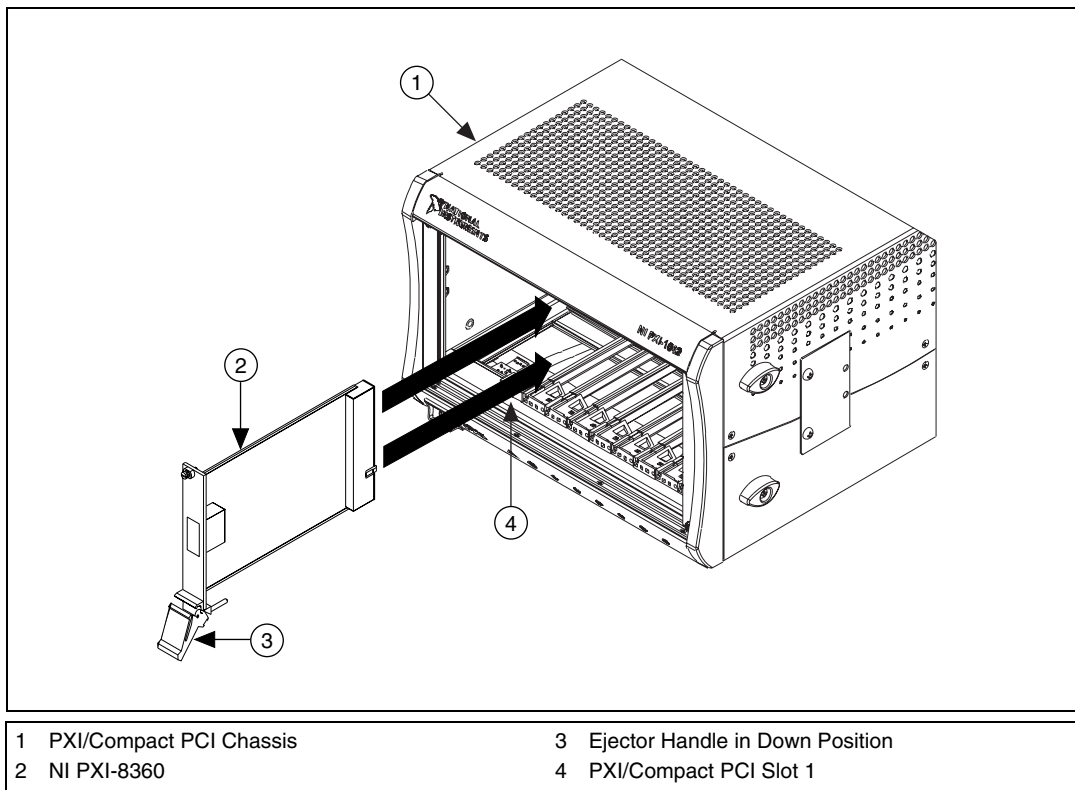

1	PXI/Compact PCI Chassis	3	Ejector Handle in Down Position
2	NI PXI-8360	4	PXI/Compact PCI Slot 1

Figure 2-2. NI PXI-8360 Card Before Installation

Cabling

1. Connect the appropriate MXI-Express cable to both MXI-Express cards. The cables have no polarity, so either end may be connected to either card.

⚠ **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. If a cable becomes unplugged, plug it back into the system.

📝 **Note**   For more information about cables, refer to the *MXI-Express Cable Options* section of Chapter 3, *Hardware Overview*.

Powering Up the MXI-Express System

1. Power on all of the expansion chassis in any order you choose.

2. Power on the host.

Typical PCI-PCI bridges 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 turned on before the host PC for the BIOS and OS to correctly configure a MXI-Express system.

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

Powering Down the MXI-Express System

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 not to 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. The order in which expansion chassis are powered off, relative to each other, is not important.

3

Hardware Overview

This chapter presents an overview of MXI-Express hardware functionality and explains the operation of each functional unit.

Functional Overview

MXI-Express is based on PCI Express technology. A MXI-Express kit uses a PCI Express switch and PCI Express-to-PCI bridge to enable control of a PXI or CompactPCI chassis from a PC with an available PCI Express slot. The PCI Express-to-PCI bridge architecture is transparent to device drivers, so no additional software is needed to support using PXI and CompactPCI devices in a chassis connected using MXI-Express.

The link between the PC and the chassis is a x1 cabled PCI Express link. This link is a dual-simplex communication channel comprised of a low-voltage, differentially driven signal pair. The link can transmit at a rate of 2.5 Gbps in each direction simultaneously.

Figure 3-1 shows the basic architecture of MXI-Express. The NI PCIe-8360 consists of a PCI Express x1 card edge connector, a PCI Express switch, and two cabled PCI Express connectors. The NI PXI-8360 consists of one cabled PCI Express connector, a PCI Express-to-PCI bridge, and a PXI connector.
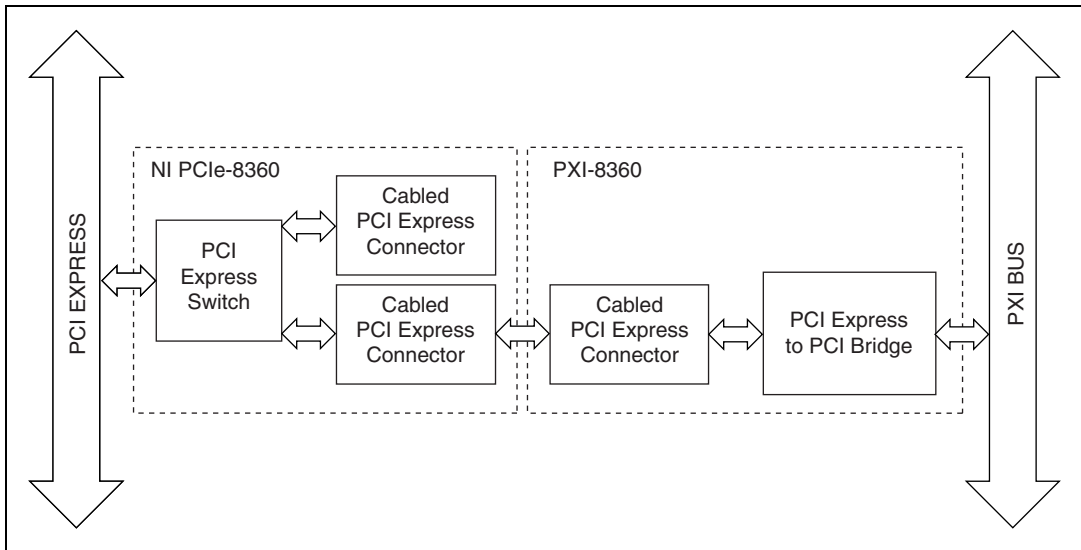
Figure 3-1. MXI-Express Block Diagram

Functional Unit Descriptions

PCI Express x1 Card Edge Connector

The card edge connector allows you to use the NI PCIe-8360 in a x1 or wider PCI Express slot in a PC. The PCI Express Card Electromechanical Specification defines this connector.

PCI Express x1 Switch

The PCI Express Base Specification defines a PCI Express switch as a logical collection of PCI Express-to-PCI Express bridge devices. On the NI PCIe-8360, the upstream port of the switch is connected to the PCI Express x1 card edge connector, and the two downstream ports are connected to the two cabled PCI Express connectors.

Cabled PCI Express Connector

The cabled PCI Express connector provides all necessary signals to connect an NI PCIe-8360 and an NI PXI-8360. These signals include the PCI Express transmit and receive pair, the system clock, and a presence detect signal.

PCI Express-to-PCI Bridge

The PCI Express Base Specification defines a PCI Express-to-PCI bridge as a device that connects a PCI Express fabric and a PCI hierarchy. On the NI PXI-8360, the PCI Express-to-PCI bridge connects the x1 PCI Express link and the PCI bus in a PXI or CompactPCI chassis.

LED Indicators

The LEDs on MXI-Express give status information about power supplies and link state. The NI PCIe-8360 has two tri-color LEDs, one for each port on the panel. The NI PXI-8360 has two LEDs, one for power supply status and one for link state.

The LEDs on the NI PCIe-8360 indicate the following:

Color	Meaning
Off	Power is off
Red	Power is out of spec
Amber	Power is within spec; no link to chassis
Green	Power is within spec; link established

The LEDs on the NI PXI-8360 indicate the following:

LED	Color	Meaning
PWR	Off	No power
	Red	Power is out of spec
	Green	Power is within spec
LINK	Off	Link not established
	Green	Link established

MXI-Express Cable Options

MXI-Express is available with cables of various lengths. Table 3-1 shows the cables available from National Instruments.

Table 3-1. National Instruments MXI-Express Cables

Cable Length (Meters)	Description
3 m	MXI-Express copper cable
7 m	MXI-Express copper cable

A

Specifications

This appendix lists the system specifications for NI PCIe-8360 and NI PXI-8360 cards. These specifications are typical at 25 °C, unless otherwise stated.

Physical

Dimensions

NI PXI-8360 .... 10.0×16.0 cm (3.9×6.3 in.)

NI PCIe-8360................................... 10.7×17.5 cm (4.4×6.9 in.)

Maximum cable length........................... 7 m

Slot requirements

NI PXI-8360 .... One system slot

NI PCIe-8360................................... One slot (PCI Express)

Compatibility .... Fully compatible with the *PXI Hardware Specification*, Revision 2.1 and the *PCI Express Specification*, Revision 1.0a

Weight

NI PXI-8360 .... 0.25 Kg (0.55 lb) typical

NI PCIe-8360................................... 0.19 Kg (0.42 lb) typical

Power requirements

NI PXI-8360

Power Rail	Typical Current	Maximum Current
+3.3 V	1.500 A	1.750 A
+5 V	5 mA	20 mA
+12 V	5 mA	20 mA
–12 V	0 mA	0 mA

NI PCIe-8360

Power Rail	Typical Current	Maximum Current
+3.3 V	1.800 A	2.000 A
+3.3 V Aux	0 A	0 A
+12 V	0 A	0 A

Environment

NI PXI-8360

Maximum altitude....................................2,000 m

Pollution Degree 2

Indoor use only

Operating Environment

Ambient temperature range ....0 to 55 °C (tested in accordance
with IEC-60068-2-1 and
IEC-60068-2-2)

Operating relative humidity....................10 to 90%, noncondensing
(tested in accordance with
IEC-60068-2-56)

Storage Environment

Ambient temperature range ....–20 to 70 °C (tested in accordance
with IEC-60068-2-1 and
IEC-60068-2-2)

Storage relative humidity........................5 to 95%, noncondensing
(tested in accordance with
IEC-60068-2-56)

Shock and Vibration

Operational shock .... 30 g peak, half-sine, 11 ms pulse
(Tested in accordance with
IEC-60068-2-27. Test profile
developed in accordance with
MIL-PRF-28800F.)

Random Vibration

Operating.. 5 to 500 Hz, 0.3 g_{rms}

Nonoperating... 5 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.)

NI PCIe-8360

Maximum altitude .... 2,000 m

Pollution Degree 2

Indoor use only

Operating Environment

Ambient temperature range.................... 0 to 40 °C (tested in accordance
with IEC-60068-2-1 and
IEC-60068-2-2)

Operating relative humidity .... 10 to 90%, noncondensing
(tested in accordance with
IEC-60068-2-56)

Storage Environment

Ambient temperature range.................... –20 to 70 °C (tested in accordance
with IEC-60068-2-1 and
IEC-60068-2-2)

Storage relative humidity .... 5 to 95%, noncondensing
(tested in accordance with
IEC-60068-2-56)

⚠ **Caution** Clean the NI PXI-8360 and NI PCIe-8360 with a soft nonmetallic brush. Make sure that the device is completely dry and free from contaminants before returning it to service.

📝 **Note** For full EMC compliance, operate this device with shielded cabling. In addition, all covers and filler panels must be installed. Refer to the Declaration of Conformity (DoC) for this product for any additional regulatory compliance information. To obtain 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.

Safety

This product is designed to meet the requirements of the following standards of safety for electrical equipment for measurement, control, and laboratory use:

• IEC 61010-1, EN 61010-1

• UL 61010-1

• CAN/CSA-C22.2 No. 61010-1

📝 **Note** For UL and other safety certifications, refer to the product label or visit `ni.com/certification`, search by model number or product line, and click the appropriate link in the Certification column.

Electromagnetic Compatibility

Emissions..EN 55011 Class A at 10 m.
FCC Part 15A above 1 GHz

Immunity ....EN 61326:1997 + A2:2001,
Table 1

CE, C-Tick, and FCC Part 15 (Class A) Compliant

📝 **Note** For EMC compliance, operate this device with shielded cabling.

CE Compliance

This product meets the essential requirements of applicable European Directives, as amended for CE marking, as follows:

Low-Voltage Directive (safety)..............73/23/EEC

Electromagnetic Compatibility
Directive (EMC) 89/336/EEC

Note Refer to the Declaration of Conformity (DoC) for this product for any additional regulatory compliance information. To obtain 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.

Cleaning

If you need to clean the module, use a soft, nonmetallic brush. Make sure that the module is completely dry and free from contaminants before returning it to service.

B

Common Questions

This appendix lists common questions related to the use of the MXI-Express controllers.

General Hardware

What are the board names of the MXI-Express remote controllers?

- NI PCIe-8360: PCI Express MXI-Express interface
- NI PXI-8360: PXI MXI-Express interface

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

The PCI specification allows up to 255 bus segments. MXI-Express does not limit this number, but the maximum number of bus segments allowed can be BIOS or operating system dependent. Also, a computer may already have several PCI bus segments internally, and the MXI-Express link also has multiple PCI buses internally.

Note Due to the point-to-point nature of PCI Express, MXI-Express supports only the star configuration. You must use traditional MXI for the daisy chain configuration.

General Cabling

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

The maximum length for a MXI-Express copper cable is 7 m. National Instruments offers 3 m and 7 m copper cables.

General Software

Under which operating systems will MXI-Express work?

MXI-Express is a PCI-to-PCI bridge that is recognized by the majority of operating systems. It should automatically work with most systems like Windows, Macintosh OS X, Linux, and Solaris, but only Windows XP has been verified in the initial release of MXI-Express.

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

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

If the MXI-Express software does not support your operating system, you can still use MXI-Express and the operating system will provide a mechanism for you to ignore the MXI-Express configuration device that is built into the MXI-Express hardware.

MXI-3 required optimization software. Does MXI-Express require the same?

No. The necessary optimization is now done automatically by the MXI-Express hardware.

How does my MXI-Express board show up in the Windows Device Manager?

MXI-Express boards contain two types of PCI devices onboard and will have several listings in the Windows Device Manager (WDM). The first devices show up in the WDM listed under System devices as **PCI standard PCI-to-PCI bridges**. The second device type shows up in the WDM as an **NI PXI-8360** when the correct MXI-Express driver is installed. This second device provides configuration information for the software. The NI PCIe-8360 includes three PCI standard PCI-to-PCI bridges. The NI PXI-8360 includes two additional bridges and one NI PXI-8360 device.

If the MXI-Express software is not installed, the PCI-to-PCI function will still be detected and work correctly, but the **MXI-Express configuration device** will be detected as an unknown device.

MXI-3 and MXI-4 to MXI-Express Upgrade Questions

What are some of the improvements from MXI-3 and MXI-4 to MXI-Express?

MXI-Express incorporates the latest technology to include:

• Support for PCI Express slots.

• Improved error correction and handling for noisy or harsh environments.

• Improved mechanical connectivity.

• Improved performance.

• Support for two chassis from a single card in the host PC.

Can a MXI-3, MXI-4, and MXI-Express board be used together directly?

No. MXI-3, MXI-4, and MXI-Express boards use different cable connectors and cannot be connected together. Additionally, the board-to-board communication protocols differ.

Can I use a MXI-3, MXI-4, and MXI-Express kit in the same multichassis PXI system?

Yes. Different MXI kits can be intermixed to connect multiple PXI chassis together. As mentioned previously, an individual MXI-3 or MXI-4 board will not cable directly to a MXI-Express board.

MXI-3 and MXI-4 systems required the use of a specific boot ordering. Is this a requirement with MXI-Express?

Yes. The requirements of the PCI bus still mandate that you must power on secondary PXI chassis before powering on the host PC when using MXI-Express.

With MXI-3 and several chassis connected in series (daisy chain configuration), you were required to power on the chassis in order starting with the chassis at the end of the chain and move towards the host controller. Now with MXI-Express, multiple chassis are connected in parallel and can be powered on in any order, except that you need to ensure that the last component powered on is the host PC.

For more details, refer to the *Powering Up the MXI-Express System* section of Chapter 2, *Hardware Installation*.

C

Technical Support and Professional Services

Visit the following sections of the National Instruments Web site at `ni.com` for technical support and professional services:

- **Support**—Online technical support resources at `ni.com/support` include the following:

  - **Self-Help Resources**—For answers and solutions, visit the award-winning National Instruments Web site for software drivers and updates, a searchable KnowledgeBase, product manuals, step-by-step troubleshooting wizards, thousands of example programs, tutorials, application notes, instrument drivers, and so on.

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    For information about other technical support options in your area, visit `ni.com/services` or contact your local office at `ni.com/contact`.

- **Training and Certification**—Visit `ni.com/training` for self-paced training, eLearning virtual classrooms, interactive CDs, and Certification program information. You also can register for instructor-led, hands-on courses at locations around the world.

- **System Integration**—If you have time constraints, limited in-house technical resources, or other project challenges, National Instruments Alliance Partner members can help. To learn more, call your local NI office or visit `ni.com/alliance`.

- **Declaration of Conformity (DoC)**—A DoC is our claim of compliance with the Council of the European Communities using the manufacturer's declaration of conformity. This system affords the user protection for electronic compatibility (EMC) and product safety. You can obtain the DoC for your product by visiting `ni.com/certification`.

- **Calibration Certificate**—If your product supports calibration, you can obtain the calibration certificate for your product at `ni.com/calibration`.

If you searched `ni.com` and could not find the answers you need, contact your local office or NI corporate headquarters. Phone numbers for our worldwide offices are listed at the front of this manual. You also can visit the Worldwide Offices section of `ni.com/niglobal` to access the branch office Web sites, which provide up-to-date contact information, support phone numbers, email addresses, and current events.

Glossary

Symbol	Prefix	Value
n	nano	10^{-9}
μ	micro	10^{-6}
m	milli	10^{-3}
k	kilo	10^{3}
M	mega	10^{6}

Symbols

°	Degrees
≥	Equal or greater than
≤	Equal or less than
%	Percent

B

bus   the group of conductors that interconnect individual circuitry in a computer. Typically, a bus is the expansion vehicle to which I/O or other devices are connected. Examples of PC buses are the AT bus, NuBus, Micro Channel, and EISA bus.

bus master   a type of a plug-in board or controller with the ability to read and write devices on the computer bus

C

C   Celsius

clock   hardware component that controls timing for reading from or writing to groups

counter/timer   a circuit that counts external pulses or clock pulses (timing)

D

device   a plug-in instrument card or pad that can contain multiple channels and conversion devices. Plug-in boards and PCMCIA cards, which connect to your computer parallel port, are examples of devices.

digital trigger   a TTL level signal having two discrete levels—a high and a low level

DMA   direct memory access—a method by which data can be transferred to/from computer memory from/to a device or memory on the bus while the processor does something else. DMA is the fastest method of transferring data to/from computer memory.

F

FPGA   Field Programmable Gate Array—a logic device that has its functionality defined after it is manufactured.

I

IEEE   Institute of Electrical and Electronics Engineers

P

PCI   Peripheral Component Interconnect—a high-performance expansion bus architecture originally developed by Intel to replace ISA and EISA. It is achieving widespread acceptance as a standard for PCs and workstations; it offers a theoretical maximum transfer rate of 132 Mbytes/s.

PCI Express   a scalable full-simplex serial bus standard that operates at 2.5 Gbps and offers both asynchronous and isochronous data transfers

PCI-PCI bridge   a device that transparently expands the PCI bus on a computer motherboard to another bus segment in the same machine. The bridge expands the number of PCI expansion slots, but remains transparent to the end user.

PXI   PCI eXtensions for Instrumentation. PXI is an open specification that builds off the CompactPCI specification by adding instrumentation-specific features.

X

x1   a link or port with one physical lane

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