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PXI™

PXI-PCI 8330 Series User Manual

MXI-3 Multi-System Extension Interface for PCI, CompactPCI, and PXI Bus Computers

NATIONAL INSTRUMENTS™

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Compliance

FCC/Canada Radio Frequency Interference Compliance*

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). Depending on where it is operated, this 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. By examining the product you purchased, you can determine the FCC Class and therefore which of the two FCC/DOC Warnings apply in the following sections. (Some products may not be labeled at all for FCC; if so, the reader should then assume these are Class A devices.)

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

FCC Class B products display either a FCC ID code, starting with the letters **EXN**, or the FCC Class B compliance mark that appears as shown here on the right.



Consult the FCC web site `http://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 Mark 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 National Instruments 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 will be required to correct the interference at his 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.

Class B

Federal Communications Commission

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.

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- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

Canadian Department of Communications

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

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

European Union - Compliance to EEC Directives

Readers in the EU/EEC/EEA must refer to the Manufacturer's Declaration of Conformity (DoC) for information** pertaining to the CE Mark compliance scheme. The Manufacturer includes a DoC for most every hardware product except for those bought for OEMs, if also available from an original manufacturer that also markets in the EU, or where compliance is not required as for electrically benign apparatus or cables.

* Certain exemptions may apply in the USA, see FCC Rules §15.103 **Exempted devices**, and §15.105(c). Also available in sections of CFR 47.

** The CE Mark Declaration of Conformity will contain important supplementary information and instructions for the user or installer.

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Contents

About This Manual

Conventions ix
Related Documentation x

Chapter 1
Introduction

About the MXI-3 System 1-1
Description and Features 1-1
Large System Size 1-1
Software Transparency 1-2
High Performance 1-2
What You Need to Get Started 1-2
Unpacking 1-2

Chapter 2
Installation

Software Installation 2-1
Hardware Installation 2-2
Installing a PCI MXI-3 Card 2-2
Installing a PXI MXI-3 Card 2-3
Cabling 2-5

Chapter 3
Hardware Overview

Functional Overview 3-1
MXI-3 Chassis Expansion 3-2
Functional Unit Descriptions 3-4
National Instruments MXI-3 ASIC 3-4
Serial Transmitter 3-5
Serial Receiver 3-5
High Speed Serial Data Connector (HSSDC) Receptacle 3-5
High Speed Serial Data Connector (HSSDC) Cable 3-5
MXI-3 Cable Options 3-5

Appendix A
Specifications

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ppendix B
echnical Support Resources

lossary

ndex

igures

Figure 2-1. Installing the PCI MXI-3 2-3
Figure 2-2. PXI MXI-3 Before Installation as Secondary 2-5

Figure 3-1. MXI-3 Block Diagram 3-2
Figure 3-2. Basic MXI-3 Configurations 3-3
Figure 3-3. Additional MXI-3 Configurations 3-4

ables

Table 3-1. National Instruments MXI-3 Cables 3-5
Table 3-2. Molex and Methode MXI-3 Fiber-Optic Cables 3-6

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About This Manual

This manual describes the features, functions, and operation of the PXI-PCI 8330 Series. The four products in this series are the PCI-8330, the PXI-8330, the PCI-8335, and the PXI-8335. The PXI-PCI 8330 Series incorporates MXI-3 technology, which couples two physically separate PCI, CompactPCI, or PXI buses with a data link capable of 1.5 Gbit/s serial data rates.

Conventions

The following conventions appear in this manual:



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.



This icon denotes a warning, which advises you of precautions to take to avoid being electrically shocked.

bold — Bold text denotes items that you must select or click on 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.

`monospace italic` — Italic text in this font denotes text that is a placeholder for a word or value that you must supply.

MXI-3 card — MXI-3 card refers to both the PCI MXI-3 and PXI MXI-3 cards, unless otherwise noted.

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Related Documentation

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

- *Set Up Your MXI-3 System*
- Your computer or chassis documentation
- *PXI Specification*, revision 1.0
- *PCI Specification*, revision 2.2
- *PCI-PCI Bridge Architecture Specification*, revision 1.0
- *PICMG CompactPCI 2.0 R2.1* specification
- PXI chassis and documentation (PXI bus systems only)

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1 Introduction

This chapter describes the PXI-PCI 8330 Series, lists what you need to get started, and explains how to unpack and set up your hardware. The four products in this series are the PCI-8330, the PXI-8330, the PCI-8335, and the PXI-8335. The PXI-PCI 8330 Series incorporates MXI-3 technology. The terms *MXI-3*, *MXI-3 card* and *MXI-3 system* in this manual refer to both the PCI MXI-3 and PXI MXI-3 cards and systems, unless otherwise noted.

About the MXI-3 System

Description and Features

MXI-3 is a PCI master/slave system implementing the PCI-PCI bridge register set. It couples two physically separate buses with either a copper or fiber-optic data link capable of 1.5 Gbit/s serial data rates. With the MXI-3 system, you can do the following:

- Control a PXI/CompactPCI backplane with either a PCI or PXI/CompactPCI host system
- Increase the available number CompactPCI or PXI slots for your application
- Physically separate the measurement or automation system from the host PC
- Combine PCI, CompactPCI, and PXI devices in the same system



Note Your MXI-3 card will work in any standard CompactPCI chassis adhering to the *PICMG CompactPCI 2.0 R2.1* specification.

Large System Size

You can use MXI-3 to control PXI-PCI devices on up to 255 buses from any PCI-based system, provided the BIOS supports such a configuration. You can use either a daisy-chain or a star configuration, with maximum bus-to-bus distances of 10 meters (copper cable) or 200 meters (fiber-optic cable).

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Software Transparency

Because the MXI-3 system is a *PCI-PCI bridge*, all devices on the system appear as local devices in a single PCI system. You do not need to rewrite your device drivers for operation on a MXI-3 system.

High Performance

MXI-3 supports write posting and read prefetching to enhance performance. MXI-3 buffers and retimes the signals between the buses, maintaining the tight timing and high performance PCI requires.

What You Need to Get Started

To set up and use your MXI-3 system, you need the following:

- ❑ Two PXI MXI-3 cards *or* a PXI MXI-3 card and a PCI MXI-3 card
- ❑ Copper or fiber-optic MXI-3 cable
- ❑ Documentation—*Set Up Your MXI-3 System* and *Getting Started with Your MXI-3 System*
- ❑ Primary bus—A computer with a PCI backplane, or a PXI embedded controller in a PXI/CompactPCI chassis
- ❑ Secondary bus—A PXI/CompactPCI chassis
- ❑ Software—*MXI-3 Software Installation Diskette for Windows 2000/NT4/9x*

Unpacking

Your MXI-3 cards are shipped in antistatic packages to prevent electrostatic damage to the devices. To avoid such damage in handling the device, take the following precautions:

1. Ground yourself with a grounding strap or by holding a grounded object.
2. Before removing the device from the package, touch the antistatic package to a metal part of your computer chassis.

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

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2 Installation

This chapter explains how to install the MXI-3 software and hardware.

Software Installation

Your MXI-3 kit includes a setup program for Microsoft Windows operating systems. The setup program works in the same manner for Windows 2000/NT4/9*x*. Users of other operating systems can ignore this section.

Note The software included for Microsoft Windows is provided so that the performance of National Instruments PXI modules is optimized across a PCI-PCI bridge. The software does not affect PXI or CompactPCI modules from other vendors.

The setup program is an interactive application that installs the MXI-3 software and configures your system for use with the MXI-3 card. Follow these steps to perform the installation.

Note You can quit the setup program at any time by choosing the **Cancel** option.

1. Insert the disk labeled *MXI-3 Software for Windows 2000/NT4/9x*.
2. Select **Run** from the **Start** menu and type the following text (where *X* is the drive letter of your floppy drive):

   X:\setup.exe
3. Press <Enter>.
4. Click on the **Next** button at the **Welcome** screen to start the installation. You must accept the license agreement to enable installation.
5. The setup program now copies the necessary files to your hard drive. When the installation process is complete, you must reboot your computer for the changes to take effect.
6. Review the information in the README.TXT file for the most up-to-date information on your MXI-3 interface.

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Hardware Installation

The following are general instructions for installing the PCI MXI-3 and PXI MXI-3 cards. Consult your computer user manual or technical reference manual for specific instructions and warnings.

nstalling a PCI MXI-3 Card

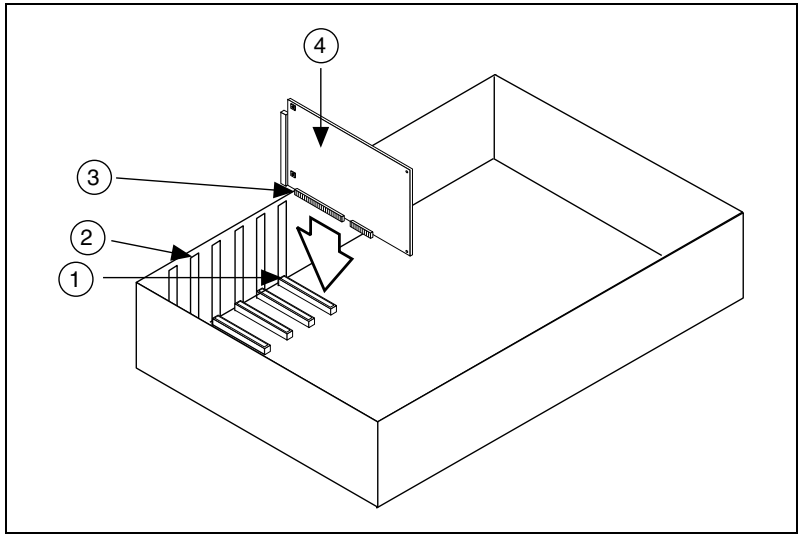
1. Turn off your computer, but leave it plugged in while installing the PCI-MXI-3 card. The power cord grounds the chassis and protects it from electrical damage while you install the module.

Warning To protect both yourself and the computer from electrical hazards, your computer should remain off until you finish installing the PCI MXI-3 device.

2. Remove the top cover or access port to the PCI bus.
3. Select any available PCI expansion slot.
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 PCI MXI-3 with the slot on the back panel. Slowly push down on the top of the PCI MXI-3 until its card-edge connector is resting on the expansion slot receptacle. Using slow, evenly distributed pressure, press the PCI MXI-3 straight down until it seats in the expansion slot.
7. Reinstall the bracket-retaining screw to secure the PCI MXI-3 to the back panel rail.

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8. Replace the computer cover.



1	PCI Bus Slot	3	PCI Bus Card-Edge Connector
2	Cut-Outs	4	PCI MXI-3 Board

Figure 2-1. Installing the PCI MXI-3

Installing a PXI MXI-3 Card

Follow these steps to install the PXI MXI-3 in your PXI or CompactPCI chassis.

1. Turn off your PXI or CompactPCI chassis, but leave it plugged in while installing the PXI MXI-3 card. The power cord grounds the chassis and protects it from electrical damage while you install the module.
2. Select a slot for the PXI MXI-3 card:
   - For use in secondary PXI bus—Choose the controller slot (Slot 1) of your chassis. This slot must support bus arbitration and bus mastering. The secondary PXI MXI-3 can operate only in such a slot.
   - For use in primary PXI bus—Choose any unused PXI or CompactPCI 5 V peripheral slot *except* Slot 1. (Slot 1 is reserved for the system controller.)

Warning To protect both yourself and the chassis from electrical hazards, leave the chassis off until you finish installing the PXI MXI-3 card.

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3. Remove or open any doors or covers blocking access to the slot in which you intend to install the PXI MXI 3.
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. Align the PXI MXI-3 card 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 MXI-3 card. It will not insert properly unless the handle is in its downward position so that it does not interfere with the injector rail on the mainframe, 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 PXI MXI-3 card 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 PXI MXI-3 card to the chassis.
9. Replace or close any doors or covers to the chassis.

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Figure 2-2 shows a PXI MXI-3 card just before installation in the system controller slot of a National Instruments PXI-1000 mainframe.

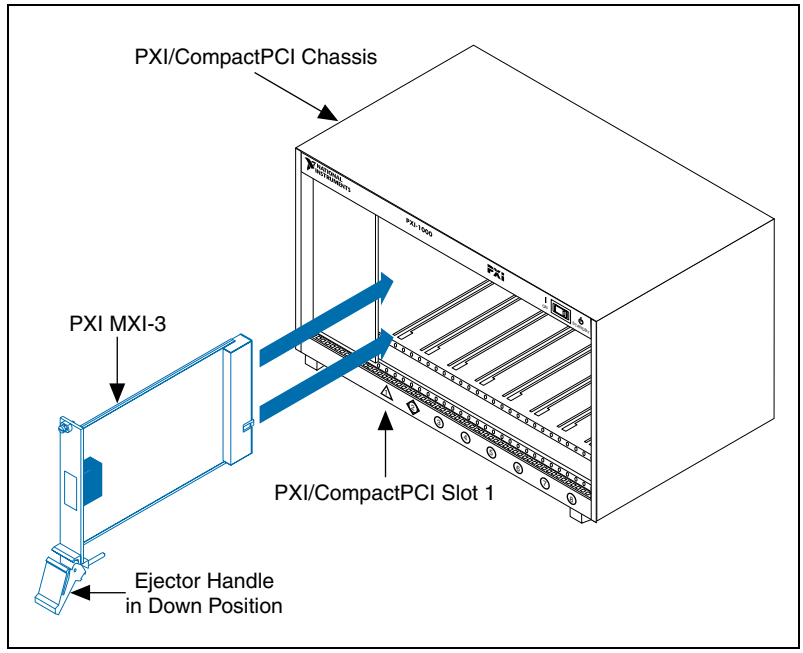


Figure 2-2. PXI MXI-3 Before Installation as Secondary

Cabling

1. Connect the appropriate serial cable to both primary and secondary MXI-3 cards. If you are using a fiber-optic cable, be sure to remove the protective caps from the connectors.

Caution Do *not* remove the cable after the system is powered on. Doing so may crash the system.

2. Turn on the system containing your secondary MXI-3 card.
3. Turn on the system containing your primary MXI-3 card.

For more information on cables, see the *MXI-3 Cable Options* section in Chapter 3, *Hardware Overview*.

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3

Hardware Overview

This chapter presents an overview of the hardware functions of your MXI-3 system, and explains the operation of each functional unit.

Functional Overview

The MXI-3 system is a PCI-PCI bridge that needs no software for normal operation. When the desktop PC or the CompactPCI/PXI controller powers on, the system BIOS scans its local PCI bus for devices. When it finds the primary interface of the MXI-3 card, it initiates configuration cycles and searches for PCI devices on the secondary side.

Figure 3-1 shows the basic architecture of the MXI-3 system. The MXI-3 card interfaces to the PCI bus with the National Instruments MXI-3 ASIC. The ASIC converts PCI transactions into a 20-bit wide parallel bus. A parallel to serial converter transmits the 20-bit data as serial data at 1.5 Gbits/s. If you are using copper cable, the system sends the serial data through the cable as a differential electrical signal. If you are using fiber-optic cable, the system converts the serial data to light using a VCSEL module.

On the other side of the system, the MXI-3 card receives the data, using high-speed photodetectors to convert light signals back to digital data in the case where a fiber-optic MXI-3 is used. A serial to parallel converter then converts the digital serial data to the original 20-bit wide packets of data for the MXI-3 ASIC. MXI-3 then recreates the PCI transaction with appropriate modifications.

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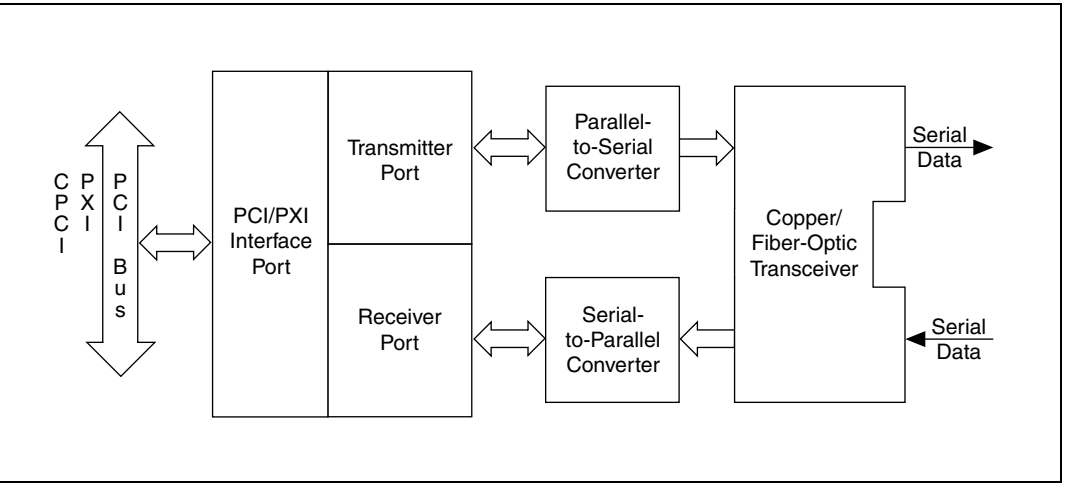


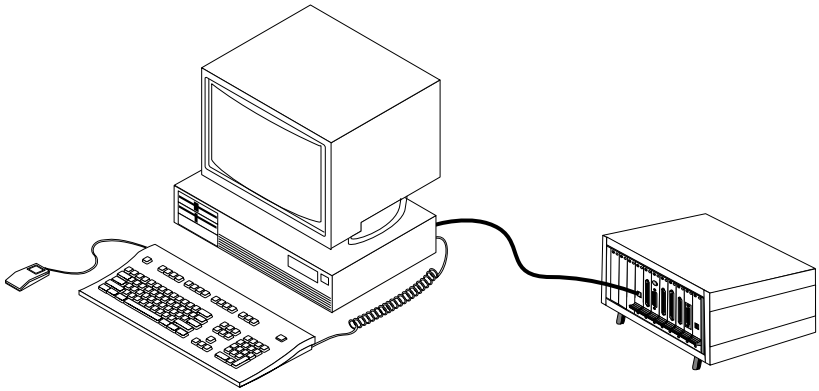
Figure 3-1. MXI-3 Block Diagram

MXI-3 Chassis Expansion

By plugging a PXI MXI-3 module into any slot other than Slot 1 of a PXI/CompactPCI chassis and a PXI MXI-3 module into Slot 1 of an additional PXI/CompactPCI chassis and connecting them with a cable, one PXI/CompactPCI chassis can be expanded to two. The PXI MXI-3 modules detect the slot in which they reside and automatically configure themselves as the primary or secondary bus interface.

Figure 3-2 shows the most basic MXI-3 configurations and Figure 3-3 shows other possible configurations.

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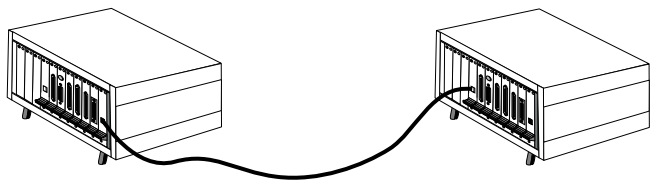


Figure 3-2. Basic MXI-3 Configurations

Because MXI-3 complies with the standard PCI-to-PCI bridging specification, it can take advantage of a variety of other extension configurations. Figure 3-3 shows how MXI-3 can be used to daisy-chain multiple systems in row, all under the control of the primary system, in this case a PC.

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Star configurations are also possible using MXI-3 interfaces in the primary system to fine tune performance.

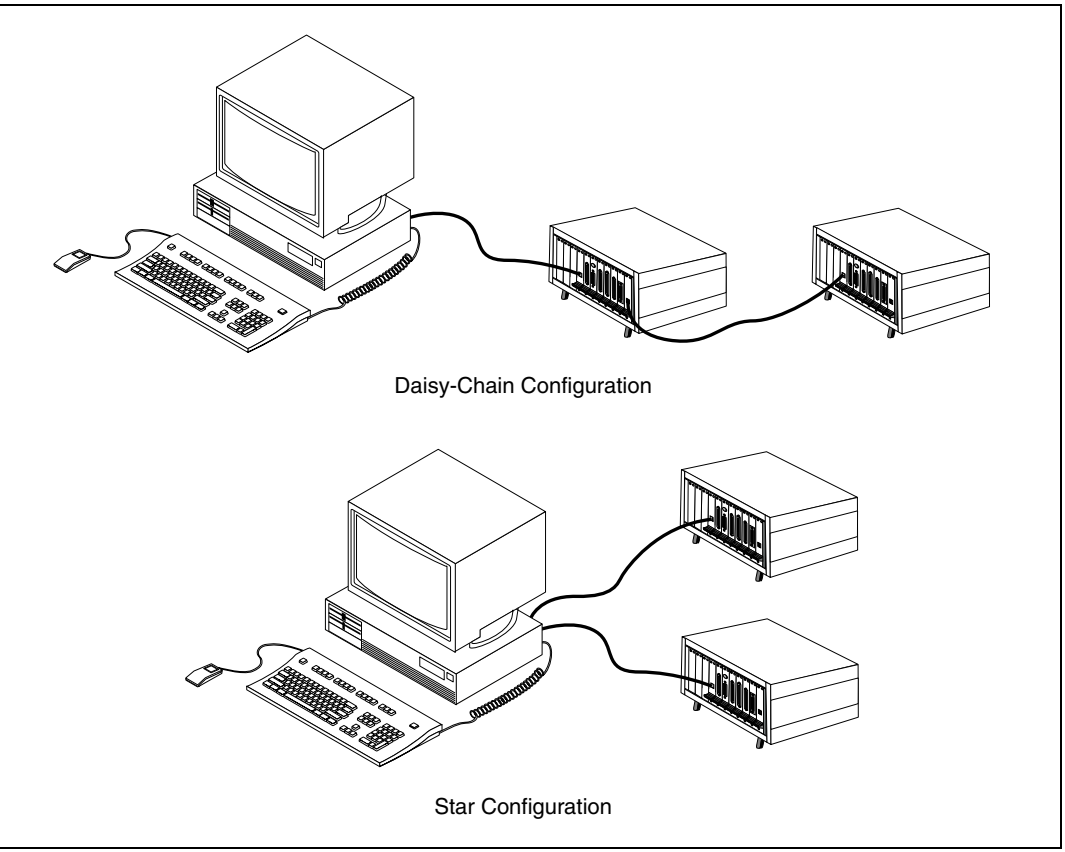


Figure 3-3. Additional MXI-3 Configurations

unctional Unit Descriptions

National Instruments MXI-3 ASIC

The MXI-3 ASIC, which contains most of the logic in the two-board system, is a PCI master/slave device using the PCI-PCI bridge register set. MXI-3 uses data queues to store data for transmission, and also uses data queues to store received data waiting for access to the target PCI bus. MXI-3 ASIC transmits data to the parallel-to-serial converters, and receives data from the serial-to-parallel converters.

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Serial Transmitter

The serial transmitter is a parallel-to-serial data converter. The parallel-to-serial converter serializes the 20-bit wide parallel data from the MXI-3 ASIC and sends it to the transceiver.

Serial Receiver

The serial receiver is a serial-to-parallel data converter. The serial-to-parallel converter deserializes the data from the receiver and supplies the 20-bit wide parallel data to the MXI-3 ASIC.

High Speed Serial Data Connector (HSSDC) Receptacle

The HSSDC 8-position right-angle receptacle assembly interfaces the electrical data to the copper serial cable.

High Speed Serial Data Connector (HSSDC) Cable

The HSSDC 8-position cable assembly is the copper medium through which the serial data is transferred.

MXI-3 Cable Options

Cables are available for both the copper and fiber-optic versions of MXI-3. Copper links are the least expensive interconnect and can span up to 10 meters between systems. Fiber optic links offer connections between systems separated by up to 200 meters without repeaters. National Instruments offers 2 meter, 5 meter, and 10 meter copper cables and a 30 meter fiber optic cable as described in Table 3-1.

Table 3-1. National Instruments MXI-3 Cables

Cable Length (meters)	Description
2 m	MXI-3 copper cable
5 m	MXI-3 fiber optic cable
10 m	MXI-3 copper cable
30 m	MXI-3 fiber optic cable

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If you require lengths greater than 30 meters in fiber optic cable, contact Molex Inc. or Methode Electronics, Inc., cable vendors for National Instruments. The fiber-optic cables offered by Molex are multimode, 62.5/125 µm cables with a duplex, zipcord, 3.0 × 6.5 mm, OFNR cable construction. The connector style is SC Duplex with a multimode, ceramic ferrule. A standard PC finish is used on both ends.

Table 3-2. Molex and Methode MXI-3 Fiber-Optic Cables

Cable Length (meters)	Molex Part Number	Methode Part Number
60 m	MXBBA-FGA-FGA-M060-A000-A000	C4-D45-060m-auni
xxx m	MXBBA-FGA-FGA-M*xxx*-A000-A000	C4-D45-*xxx*m-auni

Contact Molex through its Web site at `http://www.molex.com`, or at Molex Incorporated, 2222 Wellington Court, Lisle IL 60532-1682, USA, 1-800-786-6539.

Contact Methode Electronics, Inc. through its Web site at `http://www.methode.com`, or at Methode Electronics Inc., 7444 West Wilson Avenue, Chicago IL 60706, USA, 1-800-323-6858, 708-867-9600, FAX 708-867-9130.

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A

Specifications

This appendix lists the system specifications for PCI MXI-3 and PXI MXI-3 cards. These specifications are typical at 25 °C, unless otherwise stated.

Physical

Dimensions

- PCI ..... 10.7 by 17.5 cm (4.2 by 6.9 in.)
- PXI ..... 10.0 by 16.0 cm (3.9 by 6.3 in.)

Maximum cable lengths

- Copper..... 10 m
- Fiber-optic..... 200 m

Environment

Operating temperature..... 0 to 50 °C

Storage temperature ..... –20 to 70 °C

Operating relative humidity ..... 10 to 90%, noncondensing

Storage relative humidity ..... 5 to 95%, noncondensing

Emissions ..... EN 55011:1991 Group 1
Class A at 10 m
FCC Class A at 10 m

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B

Technical Support Resources

Web Support

National Instruments Web support is your first stop for help in solving installation, configuration, and application problems and questions. Online problem-solving and diagnostic resources include frequently asked questions, knowledge bases, product-specific troubleshooting wizards, manuals, drivers, software updates, and more. Web support is available through the Technical Support section of `www.ni.com`

NI Developer Zone

The NI Developer Zone at `zone.ni.com` is the essential resource for building measurement and automation systems. At the NI Developer Zone, you can easily access the latest example programs, system configurators, tutorials, technical news, as well as a community of developers ready to share their own techniques.

Customer Education

National Instruments provides a number of alternatives to satisfy your training needs, from self-paced tutorials, videos, and interactive CDs to instructor-led hands-on courses at locations around the world. Visit the Customer Education section of `www.ni.com` for online course schedules, syllabi, training centers, and class registration.

System Integration

If you have time constraints, limited in-house technical resources, or other dilemmas, you may prefer to employ consulting or system integration services. You can rely on the expertise available through our worldwide network of Alliance Program members. To find out more about our Alliance system integration solutions, visit the System Integration section of `www.ni.com`

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Worldwide Support

National Instruments has offices located around the world to help address your support needs. You can access our branch office Web sites from the Worldwide Offices section of `www.ni.com`. Branch office web sites provide up-to-date contact information, support phone numbers, e-mail addresses, and current events.

If you have searched the technical support resources on our Web site and still cannot find the answers you need, contact your local office or National Instruments corporate. Phone numbers for our worldwide offices are listed at the front of this manual.

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Glossary

Prefix	Meaning	Value
n-	nano-	10^{-9}
µ-	micro-	10^{-6}
m-	milli-	10^{-3}
c-	centi-	10^{-2}
k-	kilo-	10^{3}
M-	mega-	10^{6}

Symbols

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

A

ASIC	Application-Specific Integrated Circuit—a proprietary semiconductor component designed and manufactured to perform a set of specific functions for a specific customer

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

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	Celsius
ock	hardware component that controls timing for reading from or writing to groups
ounter/timer	a circuit that counts external pulses or clock pulses (timing)
evice	A plug-in instrument card or pad that can contain multiple channels and conversion devices. Plug-in boards and PCMCIA cards, which connects to your computer parallel port, are examples of devices.
gital trigger	a TTL level signal having two discrete levels—a high and a low level
MA	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.
EEE	Institute of Electrical and Electronics Engineers
IITE	MXI Interfaces To Everything—a custom ASIC designed by National Instruments that implements the PCI bus interface. The MITE supports bus mastering for high speed data transfers over the PCI bus.
CI	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.

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PCI-MITE	A custom ASIC designed by National Instruments that implements the PCI bus interface. The PCI-MITE supports bus mastering for high speed data transfers over the PCI bus. It is also used in PXI cards.
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	Stands for PCI eXtensions for Instrumentation. PXI is an open specification that builds off the CompactPCI specification by adding instrumentation-specific features.

V

VCSEL	Vertical Cavity Surface Emitting Laser

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Index

A

additional MXI-3 configurations (figure), 3-4
ASIC, 3-4

B

basic MXI-3 configurations (figure), 3-3
block diagram, 3-2

C

cable options, 3-5
chassis expansion, 3-2
configuration, basic (figure), 3-3
configurations, additional
    daisy chain (figure), 3-4
    star (figure), 3-4
conventions used in this manual, *ix*
Customer Education, B-1

D

documentation
    conventions used in this manual, *ix*
    related, *x*

F

functional unit descriptions, 3-4

H

HSSDC (High Speed Serial Data Connector Cable), 3-5
HSSDC (High Speed Serial Data Connector Receptacle), 3-5

I

installation
    cable options, 3-5
    cabling, 2-5
    hardware, 2-2
    of a PCI MXI-3 card, 2-2
    of a PXI MXI-3 card, 2-3
    software, 2-1

M

MXI-3
    block diagram, 3-2
    cable options, 3-5
    chassis expansion, 3-2
    definition, 1-1
    overview, 3-1
MXI-3 ASIC, 3-4
MXI-3 system
    definition, 1-1
    description, 1-1
    getting started, 1-2

N

National Instruments MXI-3 ASIC, 3-4
National Instruments Web support, B-1
NI Developer Zone, B-1

O

overview
    functional unit descriptions, 3-4
    hardware, 3-1
    MXI-3 block diagram, 3-2

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CI MXI-3 card
  installation, 2-2
  installation (figure), 2-3
CI-PCI bridge, 1-2
XI MXI-3 card
  installation, 2-3
  installation (figure), 2-5

lated documentation, *x*

rial receiver, 3-5
rial transmitter, 3-5
ftware, 2-1

software transparency, 1-2
specifications, A-1
system integration, B-1

T

technical support resources, B-1

W

Web support, B-1
worldwide technical support, B-2

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