# VXI-MXI™-Express

## VXI-MXI-Express Series User Manual

*NI VXI-8360T*
*NI VXI-8360LT*

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**Caution** To ensure the specified EMC performance, operate this product only with shielded cables and accessories.

# Contents

# About This Manual

This manual contains instructions for installing and configuring the NI VXI-8360T/LT controller interface kit. It also discusses how to start developing your VXI/VME application.

## Products Covered

**Note** The model numbers listed below are followed by their specific NI assembly numbers in parentheses. *x* denotes all letter revisions of the assembly. Ensure the specifications of interest match the NI assembly number that is printed on either the front or back side of the board.

- NI VXI-8360T (198399x-02)
- NI VXI-8360LT (152725x-01)

## 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. When this symbol is marked on a product, refer to the *Safety* section in Appendix A, *Specifications*, for information about precautions to take.

**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. Italic text 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. |
| VXI-MXI-Express Series controller | This term refers to the NI VXI-8360T or NI VXI-8360LT. |
| MXI-Express x1 host adapter | This term refers to the NI PCIe-8361, NI PCIe-8362, NI ExpressCard-8360, and MXI-Express x1 host adapters. |

# Related Documentation

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

- Your computer and/or chassis documentation
- ANSI/IEEE Standard 1014-1987, *IEEE Standard for a Versatile Backplane Bus: VMEbus*
- ANSI/IEEE Standard 1155-1998, *IEEE VMEbus Extensions for Instrumentation: VXIbus*
- ANSI/VITA 1-1994, *VME64*
- VXI-6, *VXIbus Mainframe Extender Specification*, Rev. 2.0, VXIbus Consortium
- *NI-VISA Help*
- *NI-VXI Help*
- *Measurement & Automation Explorer Help for NI-VISA/NI-VXI*
- *Set Up Your MXI-Express x1 System*
- *MXI-Express x1 Series User Manual*
- *PCI Specification*, Revision 3.0
- *PCI-PCI Bridge Architecture Specification*, Revision 1.2
- *PCI Express Specification*, Revision 1.0a
- *PICMG CompactPCI 2.0 R3.0* specification
- *PICMG EXP.0 CompactPCI Express Specification R1.0*
- *PCMCIA ExpressCard Standard*, Revision 1.0
- *PCI Express Base Specification*, Revision 1.1

# 1

# Introduction

## Description and Features

The NI VXI-8360T/LT controller is a C-size, VXIbus, Slot 0-capable device that can reside in any C-size or D-size VXI mainframe.

**Note** D-size VXI mainframes have connections for a P3 connector. The NI VXI-8360T/LT controller, however, does not have this connector and cannot provide the necessary control for VXI devices that need P3 support.

The NI VXI-8360T/LT controller links a PCI Express-based host computer to the VXIbus using the National Instruments MXI-Express x1 interface. The MXI-Express x1 link enables your computer to perform as though it were plugged directly into the VXI backplane, giving it the capabilities of an embedded computer.

With MXI-Express x1, you can do the following:

- Control a VXI backplane with a PCI Express or ExpressCard-based PC or laptop/mobile host adapter.
- Physically separate the measurement or automation system from a host PC or laptop.
- Combine VXI, PCI Express, CompactPCI, CompactPCI Express, PXI, PXI Express, and CompactRIO devices into the same system.

Several different MXI-Express x1 interfaces are compatible with the NI VXI-8360T/LT controller. Refer to the *Set Up Your MXI-Express x1 System Guide* included in this kit for information about connectivity support.

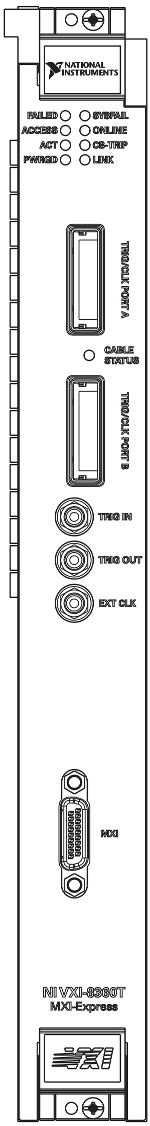
The NI VXI-8360T incorporates functionality allowing the extension of the 8 TTL backplane triggers and CLK10 between multiple chassis through convenient front panel connectors. Refer to Appendix C, *Using the Trigger Ports on the NI VXI-8360T*, for more information about using the TRIG/CLK ports on the NI VXI-8360T.

The NI VXI-8360LT allows the extension of the 8 TTL backplane triggers to two M-LVDS front panel trigger bus connectors that are mechanically and electrically compatible with the LXI-wired trigger bus specification when configured in a specific way. Refer to Appendix D, *Using the Trigger Ports on the NI VXI-8360LT*, for more information about using the trigger bus ports on the NI VXI-8360T.

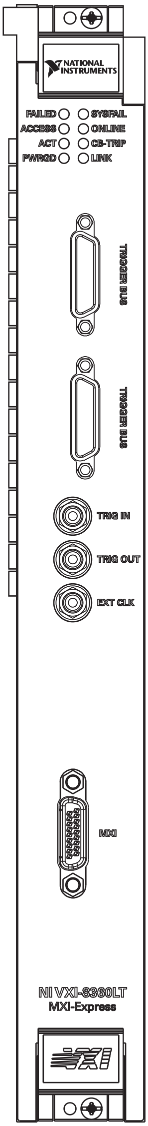
Kits that include a MXI-Express interface board also include a 3 m MXI-Express x1 cable. 1 m and 7 m cables are also available and can be purchased separately.

The kits also include the NI-VXI/NI-VISA CD, which installs the VXI device drivers, NI-VISA, MAX, Resman, and other useful utilities. This software also enables additional features of the NI VXI-8360T/LT, such as Variable Power On (VPO) support, that are not covered in this manual. Refer to the respective software release notes for more information.

## NI VXI-8360T Front Panel Features

| Front Panel | Features |
|---|---|
|  | • Eight front panel status LEDs<br>– **FAILED**—Indicates the NI VXI-8360T failed power on diagnostics.<br>– **SYSFAIL**—Indicates the VMEbus SYSFAIL line has been asserted by a device on the backplane.<br>– **ONLINE**—Indicates the board is detected by the NI-VXI/VISA driver.<br>– **ACCESS**—Indicates a VXI bus master is accessing the NI VXI-8360T.<br>– **CB**—Indicates the circuit breaker has tripped from an over current condition on the +5.0 $V_{DC}$ rail of the NI VXI-8360T.<br>– **ACT**—Indicates bus activity on the MXI-Express link.<br>– **PWRGD**—Indicates the on board power supplies are in regulation.<br>– **LINK**—Indicates the MXI-Express link connecting the host computer to the NI VXI-8360T has been established.<br>• **TRIG/CLK PORT A(B)**—These ports allow the user to daisy-chain the 8 TTL triggers and/or CLK10 between multiple chassis.<br>• **CABLE STATUS LED**—Indicates if the cable connections to the TRG/CLK ports are correct.<br>– **Off**—Indicates no cables are connected to the TRIG/CLK PORT A(B) ports.<br>– **Blinking Red**—Indicates incorrect trigger cable connection.<br>– **Solid Green**—Indicates correct trigger cable connection.<br>• Three front panel SMB connectors for:<br>– Trigger input<br>– Trigger output<br>– CLK10 I/O<br>• One MXI-Express x1 connector |

# NI VXI-8360LT Front Panel Features

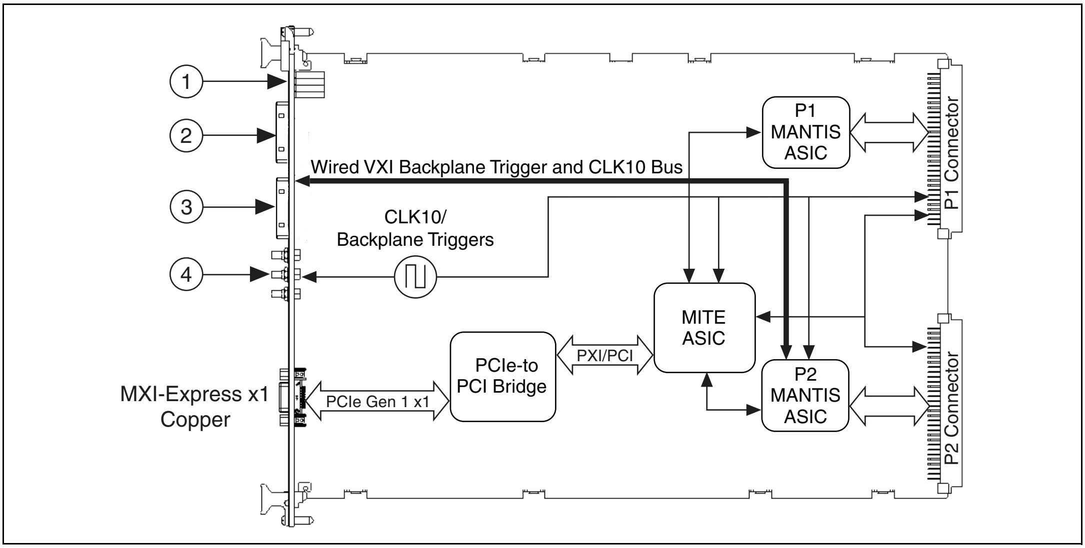
<table>
<tr><th>Front Panel</th><th>Features</th></tr>
<tr><td>


</td><td>

- Eight front panel status LEDs
  - **FAILED**—Indicates the NI VXI-8360LT failed power on diagnostics.
  - **SYSFAIL**—Indicates the VMEbus SYSFAIL line has been asserted by a device on the backplane.
  - **ONLINE**—Indicates the board is detected by the NI-VXI/VISA driver.
  - **ACCESS**—Indicates a VXI bus master is accessing the NI VXI-8360LT.
  - **CB**—Indicates the circuit breaker has tripped from an over current condition on the +5.0 $V_{DC}$ rail of the NI VXI-8360LT.
  - **ACT**—Indicates bus activity on the MXI-Express link.
  - **PWRGD**—Indicates the on board power supplies are in regulation.
  - **LINK**—Indicates the MXI-Express link connecting the host computer to the NI VXI-8360LT has been established.
- **Two Trigger Bus Ports**—These ports allow the user to daisy chain the 8 M-LVDS backplane triggers and/or CLK10 between multiple chassis.
- Three front panel SMB connectors for:
  - Trigger input
  - Trigger output
  - CLK10 I/O
- One MXI-Express x1 connector

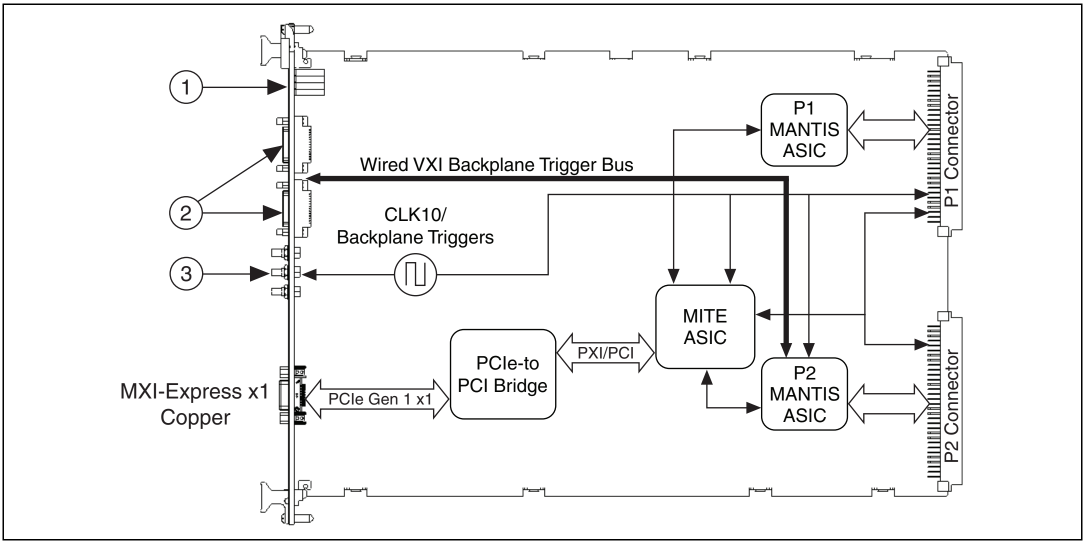
</td></tr>
</table>

# Functional Block Diagrams




| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1 | Status LEDs | 2 | TRG/CLK Port A | 3 | TRG/CLK Port B | 4 | SMB I/O |

**Figure 1-1.** NI VXI-8360T (198399x-02) Functional Block Diagram




| | | | | | |
|---|---|---|---|---|---|
| 1 | Status LEDs | 2 | Trigger Bus Ports | 3 | SMB I/O |

**Figure 1-2.** NI VXI-8360LT (152725x-01) Functional Block Diagram

The NI VXI-8360T/LT is, by factory default, hardware configured to automatically detect if it is in Slot 0, and will supply a CLK10 sourced from an onboard oscillator. Refer to Appendix B, *Advanced Hardware Configuration Settings*, for additional hardware configuration options.

# MXI-Express x1 Functional Overview

The NI VXI-8360T/LT controllers enable control of a VXI mainframe with a host computer using MXI-Express x1 technology.

MXI-Express x1 is based on PCI Express technology. A MXI-Express x1 kit may use a combination of PCI Express switches or PCI Express-to-PCI bridges to enable control of a VXI chassis from a PC with an available PCI Express or ExpressCard slot.

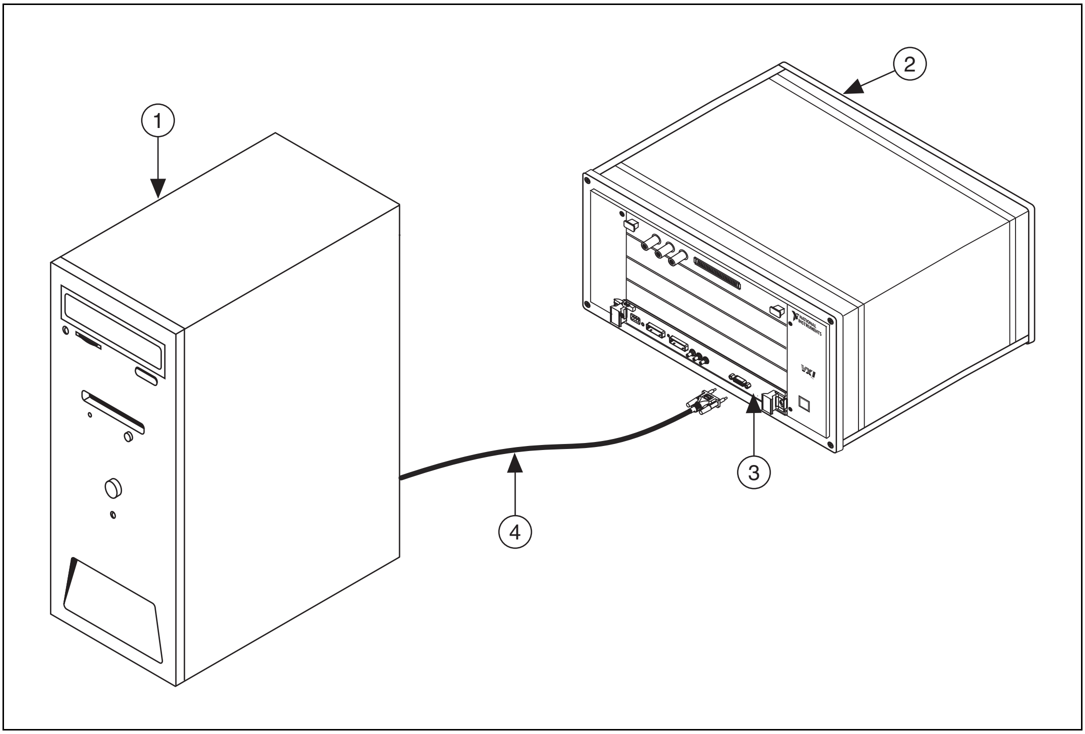
The link between the PC and the chassis is a x1 cabled MXI-Express link. This link is a dual-simplex communication channel comprised of a low-voltage, differentially driven signal pair. The link can transmit at a rate of 2.5 Gbps in each direction simultaneously. This port is not compatible with the cabled PCI Express specification developed by the PCI-SIG.

The BIOS of some host machines may not support the extension of the PCI-Express fabric or PCI bus. Since this is the primary function of MXI-Express x1 products, those systems may not boot or function correctly. To address this issue, certain MXI-Express x1 products have additional functionality intended to hide all PCI or PCI-Express resources that are connected to the host machine allowing *NI MXI-Express BIOS Compatibility Software* to handle the enumeration process of these resources.

In the cases where this software is required, there may be a dip switch on the MXI-Express x1 host adapter that needs to be toggled as instructed by the documentation for the software.

## Basic MXI-Express x1 Systems

Figure 1-3 is an example of a basic VXI system being controlled by a PCI-Express based host computer via a MXI-Express x1 link.




| | |
|---|---|
| 1 Host Computer | 3 NI VXI-8360T/LT Controller in Slot 0 |
| 2 VXI Mainframe | 4 MXI-Express x1 Cable |

**Figure 1-3.** Host System with NI VXI-8360T/LT Controller

Refer to the *MXI-Express x1 Series User Manual* or the *Set Up Your MXI-Express x1 System* guide included in your kit for more information about MXI-Express x1 connectivity support for the NI VXI-8360T/LT controller.

## Larger MXI-Express x1 Systems

By leveraging the PCI Express technology used in MXI-Express x1 products, you can connect more than a single chassis to a host controller.

The NI PCIe-8362, for example, has two MXI-Express x1 ports. This allows for connecting two targets simultaneously, also known as a star configuration or star topology. Also, if multiple PCI or PCI Express slots are available in the host PC, additional chassis can be connected by installing additional NI MXI-Express x1 host boards to achieve the same star topology.

You can also daisy-chain from a PXI or PXI Express chassis that is already controlled by an embedded controller, host PC, or laptop to a VXI mainframe using MXI-Express x1 products.

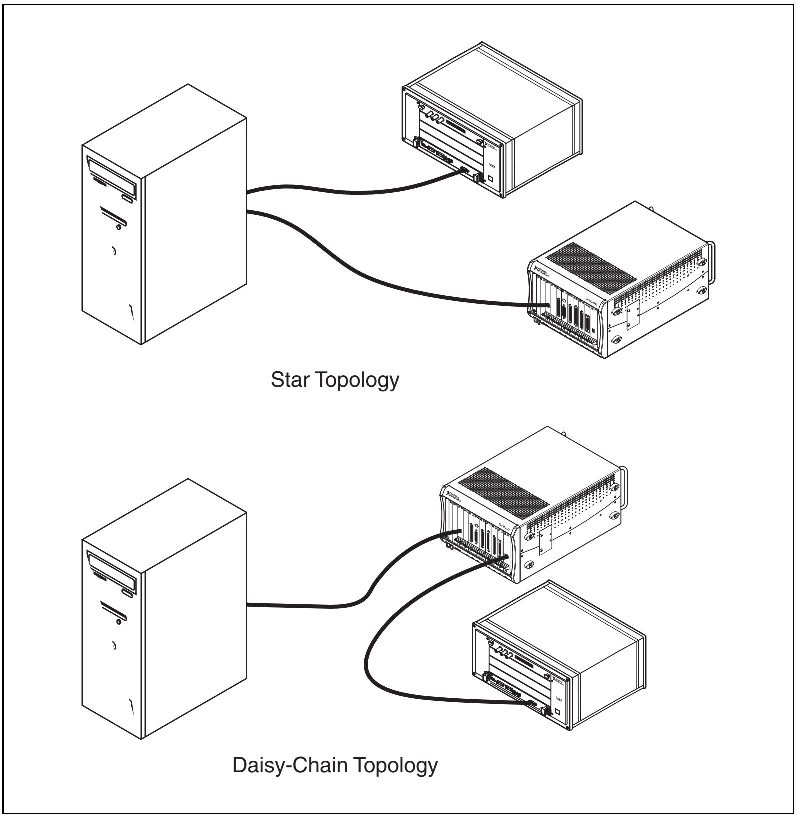



**Figure 1-4.** Example MXI-Express x1 System Expansion Topologies

**Note** The NI VXI-8360T/LT controller cannot be used to daisy-chain the MXI-Express x1 link from one VXI mainframe to another VXI mainframe.

# 2

# Installation and Configuration

## Equipment Needed

- ❑ A host computer with an available PCI Express slot[1].
- ❑ A MXI-Express x1 host board that is appropriate for the host system slot.

  Refer to the connectivity tables in the *Set Up Your MXI-Express x1 System* guide to determine which MXI-Express x1 products are compatible with the NI VXI-8360T and NI VXI-8360LT.
- ❑ A VXIbus mainframe
- ❑ A NI VXI-8360T/LT controller
- ❑ MXI-Express x1 copper cable
- ❑ National Instruments NI-VXI driver software CD

[1] Some x16 slots may not work correctly with MXI-Express adapters.

# Unpacking

Your MXI-Express x1 boards 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 a computer, laptop, PXI/CompactPCI, PXI Express/CompactPCI Express, CompactRIO, or VXI chassis.

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

# Software Installation

Run `setup.exe` on the NI-VXI/VISA software CD included with your kit to install the software and for installation instructions. The CD will install the driver for the product as well as NI-VISA by default.

With NI-VISA installed on your computer, you can run any VXI*plug&play* software that is compatible with the WINNT/GWINNT framework. This includes instrument drivers and executable soft front panel software included with VXI*plug&play*-compatible instruments from a variety of vendors.

**Caution** To keep the manufacturer/model name tables or the VME device configuration from a previous installation, be sure to back them up before starting Setup. They are in the `TBL` subdirectory of your NI-VXI directory, usually `Program Files\National Instruments\VXI`.

When the installation process completes, reboot the system for the changes to take effect. If you backed up the manufacturer and model name files, restore them to the `TBL` subdirectory of your NI-VXI directory before running MAX.

**Note** If you save and restore the TBL files from an older version of NI-VXI, the software will use TBL files that do not have the latest updates from National Instruments and may not include recent hardware releases. If you added additional manufacturer or model names to your TBL files, we recommend merging those changes with the latest updates included with this version of NI-VXI, so that all your devices are properly identified.

For more information about the NI-VXI API, refer to Chapter 3, *Developing Your Application*.

# Hardware Installation and Configuration

Prior to installation of the NI VXI-8360T/LT controller, determine if any onboard jumper settings need to be changed. The NI VXI-8360T/LT controllers' default configuration of onboard jumpers should be acceptable for most systems. Refer to Appendix B, *Default Jumper Settings*, only if your system uses the front-panel CLK10 and trigger SMB connectors.

**Caution** To guard against electrostatic discharge, touch the antistatic plastic packages to a metal part of your computer or chassis before removing the boards from their packages. Your computer or chassis should be plugged in but powered off.

**Caution** The protection provided by the NI VXI-8360T/LT device can be impaired if it is used in a manner not described in this document.

## Installing Your NI VXI-8360T/LT Controller

1. Power off the chassis.
2. Verify that the backplane connector is intact and that there are no bent or missing pins on the controller.
3. Insert the NI VXI-8360T/LT controller into the chassis in Slot 0, as shown in Figure 1-3.
4. Firmly press the NI VXI-8360T/LT controller into the mating connectors to ensure the module is fully inserted and seated in the connector.
5. Tighten the two ejector handle screws.

6. Verify that any other VXI devices with system controller capability that are in the same chassis are not configured as system controller.
7. Ensure that no other VXI devices in your system are manually configured for the same logical address as your controller.

**Note** Although the NI VXI-8360T/LT controllers are typically installed in Slot 0 of the VXI chassis, they may operate in other slots of the chassis. If you choose to install the controller in a slot other than Slot 0, the automatic detection circuitry on the controller will detect the slot and configure the controller appropriately, as long as the J2 jumper is set to Auto-detect.

**Caution** Having more than one device configured as system controller can damage the VXI system. For VXI systems that include VME devices, ensure that the VME devices are not configured in the upper 16 KB (starting from 0xC000) of the A16 address space. This region is reserved for VXI device configuration registers, which are used for initializing, configuring, and interacting with VXI devices. The NI VXI-8360T/LT controller also uses this region for this purpose.

## Installing Your MXI-Express x1 Host Adapter or Peripheral

Refer to the *Setup Your MXI-Express x1 System* guide included in the kit for hardware installation instructions.

## Connecting Cables

Connect the NI VXI-8360T/LT controller to the MXI-Express x1 host adapter in the host computer, using the MXI-Express x1 cable as shown in Figure 1-3, *Host System with NI VXI-8360T/LT Controller*.

For information about connecting trigger cables for the NI VXI-8360T, refer to Appendix C, *Using the Trigger Ports on the NI VXI-8360T*.

For information about connecting trigger cables for the NI VXI-8360LT, refer to Appendix D, *Using the Trigger Ports on the NI VXI-8360LT*.

For more information about MAX, refer to its online help by selecting the **Help»Help Topics** menu.

## Powering On/Off the MXI-Express System

For instructions, refer to the *Powering On the MXI-Express x1 System* section and *Powering Off the MXI-Express x1 System* section of the *Setup Your MXI-Express x1 System* guide.

If using Variable Power On (VPO) refer to the *NI-VXI Release Notes* for more information about powering up/down the system.

# Software Configuration

The configuration utilities in your software kit are Resource Manager (Resman) and Measurement & Automation Explorer (MAX).

Resman configures all devices on the VXI backplane for operation and allocates memory for devices that request it. Resman must be executed every time the chassis or computer power is cycled, so that your application can access devices in the VXI chassis.

**Note** You can also configure MAX to run Resman automatically at every computer startup by selecting the **Run Auto VXI Resource Manager at Startup** checkbox from the **Tools»NI-VXI»VXI Options** menu.

MAX presents a graphical display of your entire test and measurement system to help you configure and check the status of various components, including the NI VXI-8360T/LT controller.

Complete the following steps to configure the VXI System.

1. Open MAX.
2. Select the VXI system that is controlled by the NI VXI-8360T/LT controller listed under **Devices and Interfaces**.

3. Verify the configuration of your VXI system by right-clicking the device in the configuration tree, and selecting **Properties** or **Hardware Configuration**, as shown in Figure 2-1.

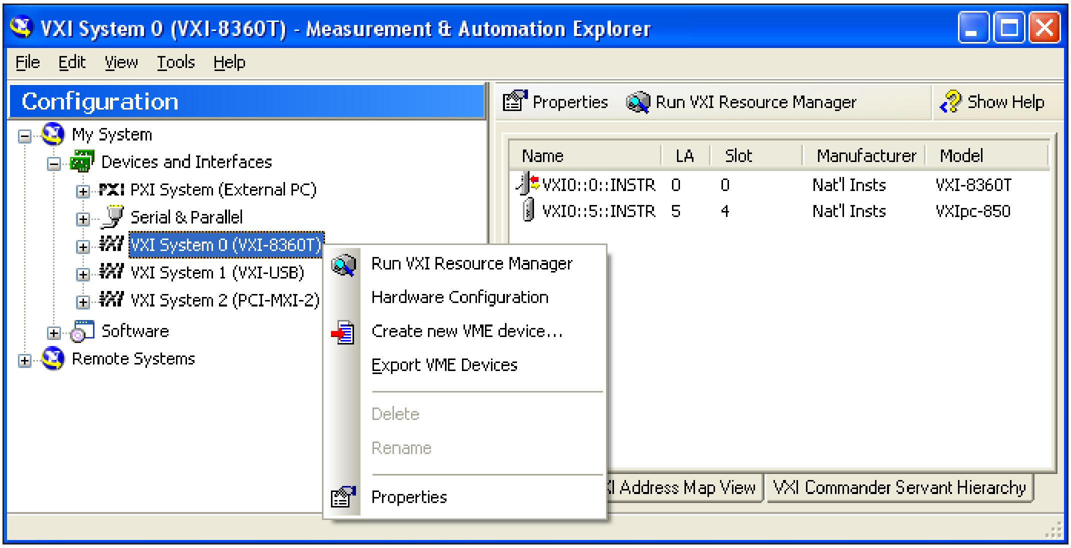



**Figure 2-1.** Right-Clicking on a VXI System in MAX

4. Run Resman by either clicking the Run VXI Resource Manager button in the toolbar or right-clicking on the VXI system, as shown in Figure 2-1.

   If Resman encounters any issues during configuration, it will report errors in Max under the system listing.

**Note** If you change any configuration settings, you will need to run Resman to apply the changes.

**Note** You can also run Resman for all VXI systems at once in MAX by selecting **Tools» NI-VXI»VXI Resource Manager**.

**Note** If you are using extenders such as MXI-2 to create a multichassis system, you may need to run Resman before configuring some of your devices.

5. Verify the configuration, as needed, through the interactive control utility, VISAIC (**Start»Programs» National Instruments»VISA» VISA Interactive Control**), as described in Chapter 3, *Developing Your Application*.

## Default Software Settings

The following tables list the default software settings in Measurement & Automation Explorer (MAX) for the NI VXI-8360T/LT controller.

**Table 2-1.** MAX Device Tab Default Settings

| Editor Field | Default Setting |
|---|---|
| Device class | Message-based |
| Number of handlers | 1 |

**Table 2-2.** MAX Shared Memory Tab Default Settings

| Editor Field | Default Setting |
|---|---|
| Don’t share memory | — |
| A24/A32 write posting | Enabled |

**Table 2-3.** MAX VXI Bus Tab Default Settings

| Editor Field | Default Setting |
|---|---|
| Bus timeout value | 500 µs |
| VXI retry generation | Enabled |
| Automatic retries | Enabled |
| VXI transfer limit | 256 |
| A24/A32 write posting | Enabled |
| Requester mode | Release on Request |
| Request level | 3 |
| Operate as fair requester | Enabled |
| Bus arbitration mode | Prioritized |
| Arbiter timeout | Disabled |

**Table 2-4.** MAX PCI Tab Default Settings

| Editor Field | Default Setting |
|---|---|
| Low-level register access API support | Enabled |
| User window size | 512 KB |
| DMA setting | Enable DMA on this controller |

**Table 2-5.** MAX SMB Tab Default Settings

| Editor Field | Default Setting |
|---|---|
| CLK10 50 Ω termination | Disabled |
| Invert CLK10 polarity | Enabled |
| TRIG IN 50 Ω termination | Disabled |

# 3 Developing Your Application

This chapter discusses the software utilities you can use to start developing applications that use NI-VXI. Be sure to check the release notes for the latest application development notes and changes.

Your software features several system development utilities including MAX, Resman, NI I/O Trace, VISA Interactive Control (VISAIC), and optionally VXI Interactive Control (VIC). You can also access online help and a variety of examples to learn how to use NI-VXI for certain tasks. Each component assists you with one of four development steps: configuration, device interaction, programming, and debugging.

You can access the utilities, help files, and release notes through the Windows **Start** menu by opening the **National Instruments»VXI** or **National Instruments»VISA** program groups.

## National Instruments Application Software

In addition to the NI-VISA/NI-VXI software, you can use the National Instruments LabVIEW, Measurement Studio, and LabWindows™/CVI™ application programs and instrument drivers to ease your programming task. These standardized programs match the modular virtual instrument capability of VXI and can reduce your VXI/VME software development time. These programs are fully VXI*plug&play* compliant and feature extensive libraries of VXI instrument drivers written to take full advantage of direct VXI control. LabVIEW, Measurement Studio, and LabWindows/CVI include all the tools needed for instrument control, data acquisition, analysis, and presentation.

LabVIEW is an easy-to-use, graphical programming environment you can use to acquire data from thousands of different instruments, including IEEE 488.2 devices, VXI devices, serial devices, PLCs, and plug-in data acquisition boards. After you have acquired raw data, you can convert it into meaningful results using the powerful data analysis routines in LabVIEW. LabVIEW also comes with hundreds of instrument drivers, which dramatically reduce software development time, because you do not need to spend time programming the low-level control of each instrument.

Measurement Studio allows you to choose from standard environments such as Microsoft Visual Basic, Visual C++, and Visual Studio .NET to create your application, using tools specific for each language. With Measurement Studio, you can write programs quickly and easily and modify them as your needs change.

LabWindows/CVI is an interactive ANSI C programming environment designed for building virtual instrument applications. LabWindows/CVI delivers a drag-and-drop editor for building user interfaces, a complete ANSI C environment for building your test program logic, and a collection of automated code generation tools, as well as utilities for building automated test systems, monitoring applications, or laboratory experiments.

To use any of these application programs, install them before installing the NI-VISA/NI-VXI software. LabVIEW, Measurement Studio, and LabWindows/CVI integrate the VXI and VISA libraries required to support your NI VXI-8360T/LT controller. You also get hundreds of complete instrument drivers, which are modular, source-code programs that handle the communication with your instrument to speed your application development.

## NI-VXI, NI-VISA, and Related Terms

Before you develop your application, it is important to understand the difference between NI-VXI, NI-VISA, and similar terms.

- *NI-VXI/NI-VISA CD* is the software package that ships with National Instruments VXI and VME controllers. This software CD includes Measurement & Automation Explorer (MAX), NI-VISA, NI I/O Trace, Resource Manager (Resman), VXI device drivers, and other utilities for configuring and controlling your VXI or VME system.
- *NI-VISA* is the native API for communicating with VXI/VME devices. NI-VISA is the National Instruments implementation of the VISA I/O standard, which is a common interface to many types of instruments (such as VXI, GPIB, PXI, Serial, TCP/IP, and so on). NI-VXI is optimized for use through NI-VISA, and NI recommends using NI-VISA to develop all new VXI/VME applications.
- The *NI-VXI API* is an optional development environment that was developed before NI-VISA. Although NI-VXI still supports the NI-VXI API, NI recommends using NI-VISA for all new VXI/VME applications. Refer to the *NI-VXI API Notes* section for more information regarding the NI-VXI API.

- The *NI-VXI compatibility layer* allows older programs that use the NI-VXI API to communicate with VXI devices through VISA. Using this compatibility layer, older programs can run in NI-VXI 3.0 or later without being rewritten to use the VISA interface. This layer installs with NI-VXI by default. It should be completely transparent and provide a high level of performance; however, there may be some slight changes in behavior for certain applications.

# Programming for VXI

NI-VISA and the NI-VXI API are the two National Instruments programming interfaces for accessing your VXI/VME instruments. With NI-VXI 3.0 or later, NI-VISA is the native API for communicating with a VXI or VME system, and NI recommends using it for all new applications. Older programs that use the NI-VXI API now use the NI-VXI-to-NI-VISA compatibility layer to communicate with the VXI devices.

Both NI-VISA and the NI-VXI API include functions for register-level access to VXI instruments and messaging capability to message-based devices. You can also use either interface to service asynchronous events such as triggers, signals, and interrupts, and also assert them. Compatibility with the NI-VXI API is included for legacy applications only—NI recommends that you write all new VXI/VME applications in VISA.

The best way to learn NI-VISA programming is by reviewing the example programs your software includes. The examples directory contains working VISA programs that illustrate many different types of applications. You can find these examples in the Windows Start menu under **Programs» National Instruments»VISA»Examples**.

If you are just getting started, you should learn how to access registers with high-level calls and send messages with word-serial functions. The NI-VISA examples for these tasks are `HighReg.c` and `RdWrt.c`. Refer to the other examples as you try more advanced techniques. Consult the NI-VISA online help for additional information about these topics.

Table 3-1 summarizes the topics the example programs address. All NI-VISA files are found through the Windows Start menu under **Programs»National Instruments»VISA»Examples**, in the subdirectories listed below.

**Table 3-1.** NI-VISA/NI-VXI Examples

| Coverage | NI-VISA Example | NI-VXI Example (Optional) |
|---|---|---|
| Message-Based Access | `C\General\RdWrt.c` | `VXIws.c` |
| High-Level Register Access | `C\VXI-VME\HighReg.c` | `VXIhigh.c` |
| Low-Level Register Access | `C\VXI-VME\LowReg.c` | `VXIlow.c` |
| Interrupt Handling | `C\VXI-VME\AsyncIntr.c` and `WaitIntr.c` | `VXIint.c` |
| Trigger Handling | `C\VXI-VME\WaitTrig.c` | `VXItrig.c` |

**Note** MAX includes configuration options that affect low-level functions and shared memory, as well as trigger mappings and other attributes of your VXI system. Refer to the MAX online help for information regarding these options.

## Optimizing Large VXIbus Transfers

For best performance, keep the following in mind when using `viMove()` or `VXImove()`:

- Make sure your buffers are 32-bit aligned.
- Transfer 32-bit data whenever possible.
- Use VXI block access privileges to significantly improve performance to devices that can accept block transfers, and likewise use D64 access privileges for devices that can accept the VME64 64-bit data transfer protocol.
- To optimize move performance on virtual memory systems such as the Windows operating system, lock the user buffer in memory yourself so the move operation does not need to lock the buffer.
- To optimize move performance on paged memory systems such as the Windows operating system, use a contiguous buffer so the move operation does not need to build a scatter-gather list for the user buffer.

**Note** `viMemAlloc()` or `VXImemAlloc()` returns 32-bit aligned, page-locked, continuous buffers that work efficiently with the move operations.

## NI-VXI API Notes

The following notes apply only if you are using the NI-VXI API. National Instruments recommends that all new VXI/VME applications use the NI-VISA API, but you can still develop with the older NI-VXI API for compatibility with legacy code.

### Compiler Symbols

You may need to define certain compiler symbols so that the NI-VXI library can work properly with your program. The required symbol indicates your operating system platform; for example, VXINT designates the application as a Windows 2000/NT/XP/Me/98 application.

**Note** LabWindows/CVI automatically defines the correct symbol. You do not need to define `VXINT` when using LabWindows/CVI.

The additional symbol `BINARY_COMPATIBLE` is optional. It ensures that the resulting application is binary compatible with other National Instruments VXI controllers using the same operating system. This symbol may cause a slight performance degradation when you use low-level VXIbus access functions on some controllers.

You can define these symbols using `#define` statements in your source code or using the appropriate option in your compiler (typically either `-D` or `/D`). If you use `#define` statements, they must appear in your code before the line that includes the NI-VXI API header `nivxi.h`.

### Compatibility Layer Options

Although NI-VXI supports multiple VXI controllers through NI-VISA, the NI-VXI API supports only a single controller. To specify which controller the emulation layer should use, run MAX. Select **Tools»NI-VXI» VXI Options**. Select the VXI system that will support the emulation layer.

In NI-VXI 3.0 or later, when you enable for triggers or interrupts, only the local controller is enabled. In the NI-VXI API functions for enabling triggers and interrupts, the controller parameter is ignored. If you need to enable a remote controller for triggers, use the MAX frame resource to map the trigger back to the local controller. Refer to the *NI-VISA Help* for additional information.

The interrupt and trigger routing in the NI-VXI 3.0 or later low-level drivers is somewhat different from the default routing in previous versions of NI-VXI. Therefore, the compatibility layer may behave differently than the original NI-VXI API with regard to these settings. In particular, if you are receiving triggers on an external controller, you may need to modify the trigger configuration on your extender module using MAX. Consult the manual for your extender module for details. In general, interrupts are routed automatically based on the interrupt configuration the resource manager detects. Whether the changed routing behavior affects your program is application dependent.

Because VISA is an instrument-centric API, certain functions from the more controller-centric NI-VXI API do not match perfectly with a VISA counterpart. When an application enables an event with the NI-VXI API compatibility layer, each logical address is enabled for that event separately. For example, if the application enables an interrupt level, VISA will enable the interrupt on each logical address, one at a time, until all the devices are enabled. This means that some interrupts could be lost from devices with higher numbered logical addresses. MAX provides an option for users to pick which logical address is enabled first. Select **Tools»NI-VXI»VXI Options**. Set **Prioritized Signal LA** to the logical address of the device that generates the events. This prevents possible loss of events from that device.

# Device Interaction and Debugging Tools

NI I/O Trace and VISAIC are useful utilities for identifying the causes of problems in your application, and are installed by default with your NI-VXI installation.

## NI I/O Trace

NI I/O Trace tracks the calls your application makes to National Instruments drivers, including NI-VISA, NI-VXI, and NI-488. NI I/O Trace highlights functions that return errors, so during development you can quickly spot which functions failed during a program's execution. NI I/O Trace can log the calls your program makes to these drivers so you can check them for errors at your convenience, or use the NI I/O Trace log as a reference when discussing the problem with National Instruments technical support. Figure 3-1 shows an example of an error returned from a call to `viMemAllocEx`.

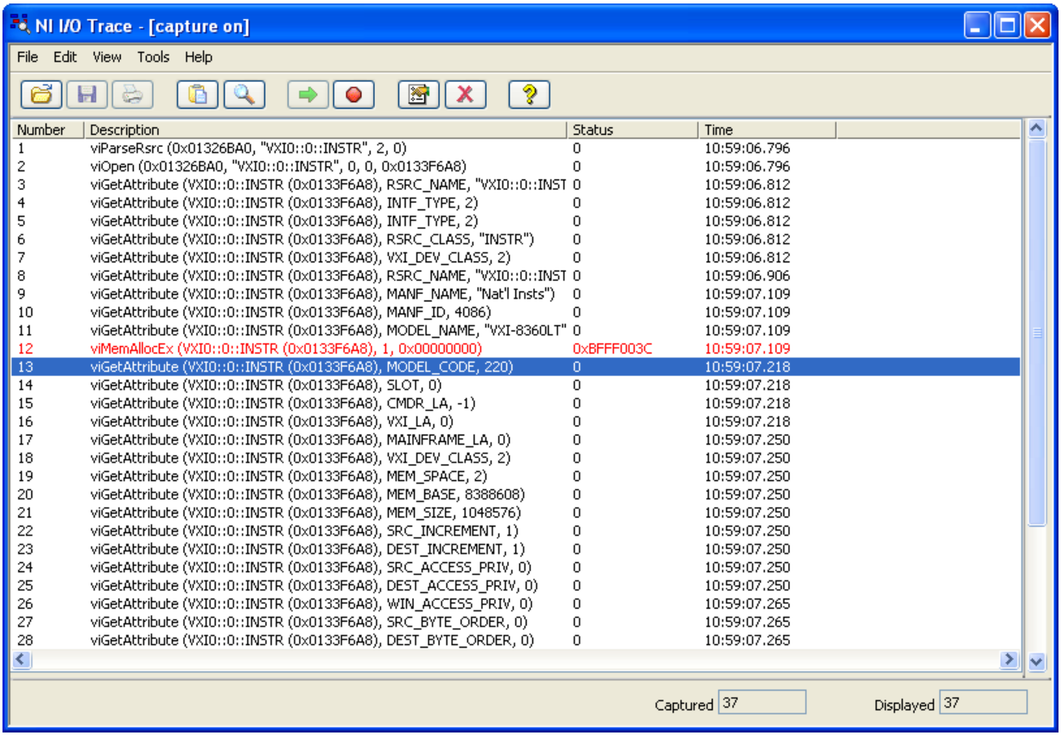



**Figure 3-1.** NI I/O Trace

## VISA Interactive Control (VISAIC)

You can interact with your VXI/VME devices using the VISA Interactive Control (VISAIC) utility. VISAIC allows you to control your VXI/VME devices without using LabVIEW, Measurement Studio, LabWindows/CVI, or another programming language. You can also control your devices in MAX by right-clicking a device name and selecting **Open VISA Session**.

Try the following in VISAIC: In the tree view, navigate using your mouse to the VISA resource for your controller—probably VXI0::0::INSTR, representing the VXI system 0, logical address 0 instrument resource, as shown in Figure 3-2.

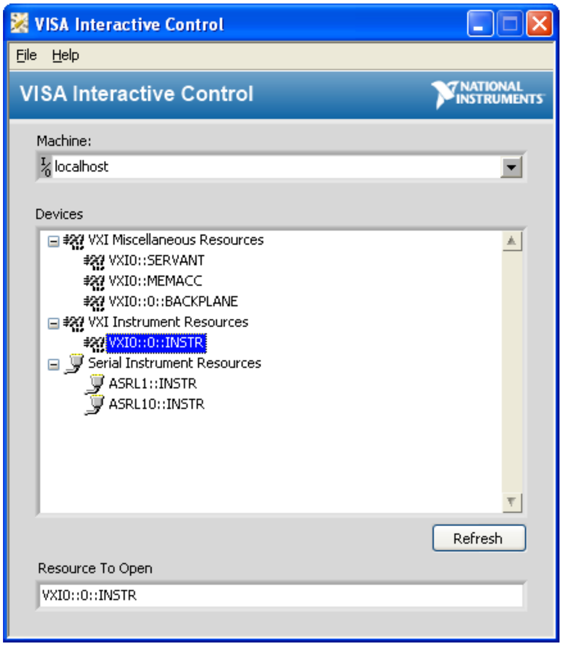



**Figure 3-2.** Select Your Controller in VISAIC

Open the selected resource and navigate to **Input/Output** and select the **In** tab. In this tab, you can read registers on your device, such as the VXI device configuration registers. Execute the **In** operation with Width set to 16-bits and other parameters set to default values. The In Value field shows the I/O operation result, such as `0x8ff6`. The Return Data field shows the function status, such as `No Error` for `VI_SUCCESS`, as shown in Figure 3-3.

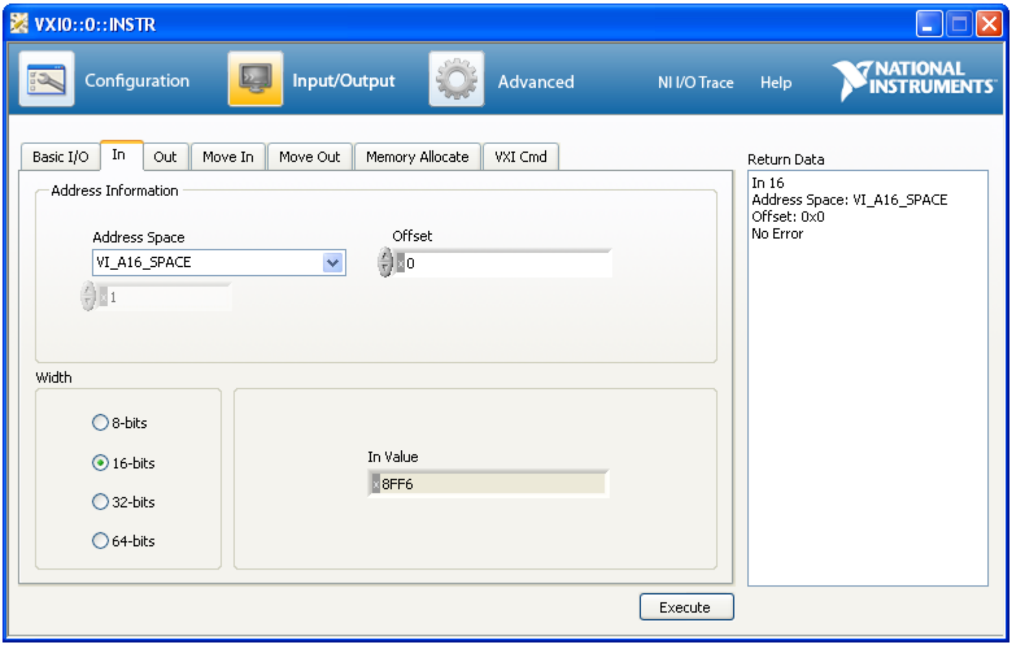



**Figure 3-3.** Successful In Access in the VISAIC Input/Output Tab (This Window May Look Slightly Different for LabVIEW Users)

If the data value ends in `FF6`, you have successfully read the National Instruments manufacturer ID from your VXI/VME controller's ID register. You may now want to read the configuration registers from other VXI devices in your system by opening the devices in VISAIC. Try reading a register from each device listed in the MAX view of your VXI system. This way, you can verify that your VXI controller can access each device in your VXI system successfully. You can also access VXI and VME devices configured in A16, A24, or A32 space by opening the VXI MEMACC resource, which is VISA's representation of VXI memory. For more information about VISAIC operations and commands, refer to the online help in the **Help** menu and the context-sensitive help (such as What's This?), available by clicking **Help** and mousing over any panel.

# VXI Interactive Control (VIC)

You can also use VXI Interactive Control Program (VIC) to control your VXI/VME devices and develop and debug VXI application programs. You can launch VISAIC (or VIC) from the **Tools** menu in MAX or from the **VISA** or **VXI** subgroups in **Start»Programs»National Instruments**.

# A Specifications

This appendix lists the system specifications for the following products only:

- NI VXI-8360T (198399x-02)
- NI VXI-8360LT (152725x-01)

**Note** The model numbers listed above are followed by their specific NI assembly numbers in parentheses. *x* denotes all letter revisions of the assembly. Ensure the specifications of interest match the NI assembly number that is printed on either the front or back side of the board.

For specifications on other MXI-Express x1 products that can connect to the NI VXI-8360T and NI VXI-8360LT, refer to the *MXI-Express x1 Series User Manual*.

# NI VXI-8360T (198399*x*-02)

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

## Power Requirements

| Voltage | Current | |
|---|---|---|
| | Typical (DC) | Dynamic |
| +5 V | 1.600 A | 1.600 A |
| +12 V | 0.020 A | 0.020 A |
| –5.2 V | 0.177 A | 0.125 A |
| –2 V | 0.060 A | 0.125 A |

## Physical

Size ........................................................C size, C-1

Dimensions ............................................. 23.3 × 34.0 cm (9.2 × 13.4 in.)

Weight ....................................................1.3 kg (46.8 oz)

Slot requirements....................................Single VXI C-size slot

Compatibility ..........................................Fully compatible with VXI specification

VXI keying class ....................................Class 1 TTL

MTBF .....................................................Contact factory

# Front Panel I/O Connectors

## EXT CLK SMB Connector

Output drive ........................................... 50 Ω source terminated output driver

Voltage level ........................................... 0.1 to 4.9 V into open circuit (typical)
0.1 to 2.5 V into 50 Ω (typical)

Absolute maximum DC current ............. ±50 mA

Output coupling...................................... DC

## TRIG IN SMB Connector

Input buffer ............................................ TTL compatible

Input coupling ........................................ DC

## TRIG OUT SMB Connector

Output drive ........................................... 50 Ω line driver

Voltage level............................................. 2.0 V minimum into 50 Ω (typical)

Output coupling...................................... DC

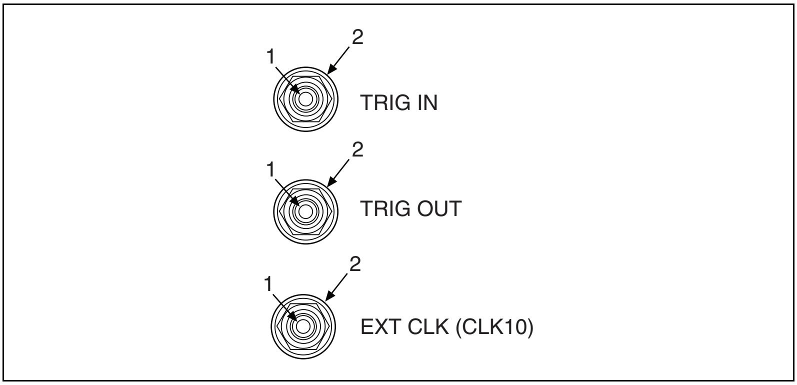
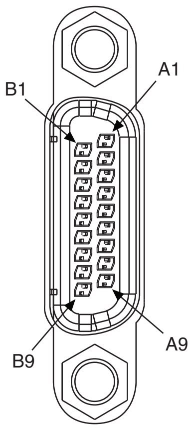



**Figure A-1.** Front Panel SMB Connectors

**Table A-1.** SMB Connector Pinout

| Pin | Signal Name | Signal Description |
|---|---|---|
| 1 | SIGNALCONDUCTOR | Trigger/CLK |
| 2 (Shield) | GND | Ground |

## MXI-Express x1 Connector

<table>
<tr><th>MXI-Express x1 Connector</th><th>Pin Number</th><th>Signal Description</th></tr>
<tr><td rowspan="18">
</td><td>A1</td><td>PERn0</td></tr>
<tr><td>A2</td><td>PERp0</td></tr>
<tr><td>A3</td><td>RSVD</td></tr>
<tr><td>A4</td><td>SB_RTN</td></tr>
<tr><td>A5</td><td>CREFCLK–</td></tr>
<tr><td>A6</td><td>CREFCLK+</td></tr>
<tr><td>A7</td><td>PWR_RTN</td></tr>
<tr><td>A8</td><td>CPERST#</td></tr>
<tr><td>A9</td><td>GND</td></tr>
<tr><td>B1</td><td>GND</td></tr>
<tr><td>B2</td><td>RSVD</td></tr>
<tr><td>B3</td><td>CWAKE#</td></tr>
<tr><td>B4</td><td>CPRSNT#</td></tr>
<tr><td>B5</td><td>GND</td></tr>
<tr><td>B6</td><td>PWR</td></tr>
<tr><td>B7</td><td>CPWRON</td></tr>
<tr><td>B8</td><td>PETn0</td></tr>
<tr><td>B9</td><td>PETp0</td></tr>
</table>

### Two TRIG/CLK PORTs

Connector type ........................................ Cabled MXI-Express x4[1]

Maximum trigger bus length.................. 19 m of cables

Maximum number of devices on bus..... 6[2]

## Environmental

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: meets MIL-PRF-28800F Class 3 low temperature limit and MIL-PRF-28800F Class 2 high temperature limit.)

Relative humidity range ......................... 10% to 90%
(Tested in accordance with IEC-60068-2-56.)

### Storage Environment

Ambient temperature range.................... –40 to 85 °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%
(Tested in accordance with IEC-60068-2-56.)

EMI ......................................................... FCC Class A verified, EC verified

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[1] Not to be used for MXI-Express communication.

[2] Additional devices sharing the bus may function, but is not supported by National Instruments.

## Shock and Vibration

Operational 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 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.)

## Safety

This product meets 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, CSA 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 generates 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:

- 2006/95/EC; Low-Voltage Directive (safety)
- 2004/108/EC; Electromagnetic Compatibility Directive (EMC)

## Online Product Certification

To obtain product certifications and the Declaration of Conformity (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

NI is committed to designing and manufacturing products in an environmentally responsible manner. NI recognizes that eliminating certain hazardous substances from our products is beneficial to the environment and to NI customers.

For additional environmental information, refer to the *NI and the Environment* Web page at `ni.com/environment`. This page contains the environmental regulations and directives with which NI complies, as well as other environmental information not included in this document.

## Waste Electrical and Electronic Equipment (WEEE)

**EU Customers** At the end of the product life cycle, all products must be sent to a WEEE recycling center. For more information about WEEE recycling centers, National Instruments WEEE initiatives, and compliance with WEEE Directive 2002/96/EC on Waste Electrical and Electronic Equipment, visit `ni.com/environment/weee`.

## 电子信息产品污染控制管理办法 （中国 RoHS）

**中国客户** National Instruments 符合中国电子信息产品中限制使用某些有害物质指令 (RoHS)。关于 National Instruments 中国 RoHS 合规性信息，请登录 `ni.com/environment/rohs_china`。(For information about China RoHS compliance, go to `ni.com/environment/rohs_china`.)

# 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.

# NI VXI-8360LT (152725*x*-01)

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

## Power Requirements

| Voltage | Current Typical (DC) |
|---|---|
| +5 V | 1.750 A[1] |
| +12 V | 0.020 A |
| –5.2 V | 0.177 A |
| –2 V | 0.060 A |

[1] An additional 0.079 A may be drawn when a combined 100 mA is sourced from the 3.3 V pins of the trigger bus port connectors.

## Physical

Size ........................................................ C size, C-1

Dimensions............................................ 23.3 × 34.0 cm (9.2 × 13.4 in.)

Weight.................................................... 1.3 kg (47.2 oz)

Slot requirements .................................. Single VXI C-size slot

Compatibility ......................................... Fully compatible with VXI specification

VXI keying class.................................... Class 1 TTL

MTBF.................................................... 322,638 hours

# Front Panel I/O Connectors

## EXT CLK SMB Connector

Output drive ............................................50 Ω source terminated output driver

Voltage level..................................................0.1 to 4.9 V into open circuit (typical)
0.1 to 2.5 V into 50 Ω (typical)

Absolute maximum DC current.............±50 mA

Output coupling ......................................DC

## TRIG IN SMB Connector

Input buffer .............................................TTL compatible

Input coupling.........................................DC

## TRIG OUT SMB Connector

Output drive ............................................50 Ω line driver

Voltage level...............................................2.0 V minimum into 50 Ω (typical)

Output coupling ......................................DC

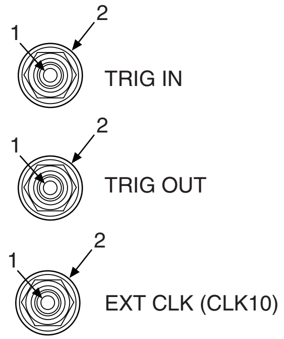
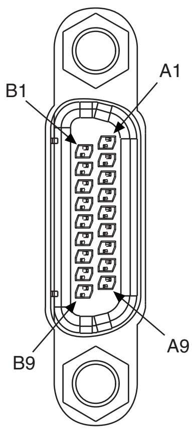



**Figure A-2.** Front Panel SMB Connectors

**Table A-2.** SMB Connector Pinout

| Pin | Signal Name | Signal Description |
|---|---|---|
| 1 | SIGNALCONDUCTOR | Trigger/CLK |
| 2 (Shield) | GND | Ground |

# MXI-Express x1 Connector

| MXI-Express x1 Connector | Pin Number | Signal Description |
|---|---|---|
|   | A1 | PERn0 |
| | A2 | PERp0 |
| | A3 | RSVD |
| | A4 | SB_RTN |
| | A5 | CREFCLK– |
| | A6 | CREFCLK+ |
| | A7 | PWR_RTN |
| | A8 | CPERST# |
| | A9 | GND |
| | B1 | GND |
| | B2 | RSVD |
| | B3 | CWAKE# |
| | B4 | CPRSNT# |
| | B5 | GND |
| | B6 | PWR |
| | B7 | CPWRON |
| | B8 | PETn0 |
| | B9 | PETp0 |

## Two Trigger Bus Ports

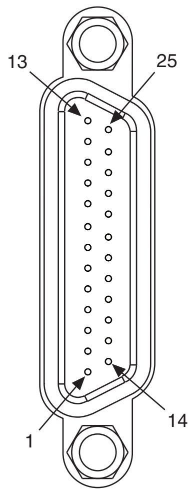
Physical interface......................................TIA/EIA899 M-LVDS compatible

Bus transceiver..............................................Texas Instruments SN65MLVD080

Maximum trigger bus length ..................20 m of cables

Maximum number of devices on bus .....6[1]

[1] Additional devices sharing the bus may function, but is not supported by National Instruments.

<table>
<tr><th>Trigger Bus Port</th><th>Pin Number</th><th>Signal Description</th></tr>
<tr><td rowspan="25">
</td><td>1</td><td>+3.3 V</td></tr>
<tr><td>2</td><td>+3.3 V Return</td></tr>
<tr><td>3</td><td>LXI1p</td></tr>
<tr><td>4</td><td>LXI1n</td></tr>
<tr><td>5</td><td>GND</td></tr>
<tr><td>6</td><td>LXI3p</td></tr>
<tr><td>7</td><td>LXI3n</td></tr>
<tr><td>8</td><td>GND</td></tr>
<tr><td>9</td><td>LXI5p</td></tr>
<tr><td>10</td><td>LXI5n</td></tr>
<tr><td>11</td><td>RSVD</td></tr>
<tr><td>12</td><td>LXI7p</td></tr>
<tr><td>13</td><td>LXI7n</td></tr>
<tr><td>14</td><td>LXI0p</td></tr>
<tr><td>15</td><td>LXI0n</td></tr>
<tr><td>16</td><td>RSVD</td></tr>
<tr><td>17</td><td>LXI2p</td></tr>
<tr><td>18</td><td>LXI2n</td></tr>
<tr><td>19</td><td>GND</td></tr>
<tr><td>20</td><td>LXI4p</td></tr>
<tr><td>21</td><td>LXI4n</td></tr>
<tr><td>22</td><td>GND</td></tr>
<tr><td>23</td><td>LXI6p</td></tr>
<tr><td>24</td><td>LXI6n</td></tr>
<tr><td>25</td><td>RSVD</td></tr>
</table>

## Environmental

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: meets MIL-PRF-28800F Class 3 low temperature limit and MIL-PRF-28800F Class 2 high temperature limit.)

Relative humidity range..........................10% to 90%
(Tested in accordance with IEC-60068-2-56.)

## Storage Environment

Ambient temperature range ....................–40 to 85 °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%
(Tested in accordance with IEC-60068-2-56.)

EMI .......................................................FCC Class A verified, EC verified

# Shock and Vibration

Operational 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 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.)

## Safety

This product meets 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, CSA 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 generates 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

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

- 2006/95/EC; Low-Voltage Directive (safety)
- 2004/108/EC; Electromagnetic Compatibility Directive (EMC)

## Online Product Certification

To obtain product certifications and the Declaration of Conformity (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

NI is committed to designing and manufacturing products in an environmentally responsible manner. NI recognizes that eliminating certain hazardous substances from our products is beneficial to the environment and to NI customers.

For additional environmental information, refer to the *NI and the Environment* Web page at `ni.com/environment`. This page contains the environmental regulations and directives with which NI complies, as well as other environmental information not included in this document.

### Waste Electrical and Electronic Equipment (WEEE)

**EU Customers** At the end of the product life cycle, all products must be sent to a WEEE recycling center. For more information about WEEE recycling centers, National Instruments WEEE initiatives, and compliance with WEEE Directive 2002/96/EC on Waste Electrical and Electronic Equipment, visit `ni.com/environment/weee`.

### 电子信息产品污染控制管理办法 （中国 RoHS）

**中国客户** National Instruments 符合中国电子信息产品中限制使用某些有害物质指令 (RoHS)。关于 National Instruments 中国 RoHS 合规性信息，请登录 `ni.com/environment/rohs_china`。(For information about China RoHS compliance, go to `ni.com/environment/rohs_china`.)

## 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

# Advanced Hardware Configuration Settings

This appendix describes the alternate hardware configuration settings for the NI VXI-8360T/LT controller. The board is set at the factory for the most commonly used configuration. This information is intended for more advanced users. Do *not* attempt to reconfigure any jumpers unless you are familiar with its purpose.

The following hardware configuration settings are user configurable.

- Slot 0 detection
- VXIbus CLK10 routing
- SMB Trigger I/O
- Backplane trigger I/O

For the jumper locations and default settings, see Figure B-1, *Default Jumper Settings*.

**Note** To gain access to the jumpers, remove the side panel cover that is fastened with screws.

# Default Jumper Settings

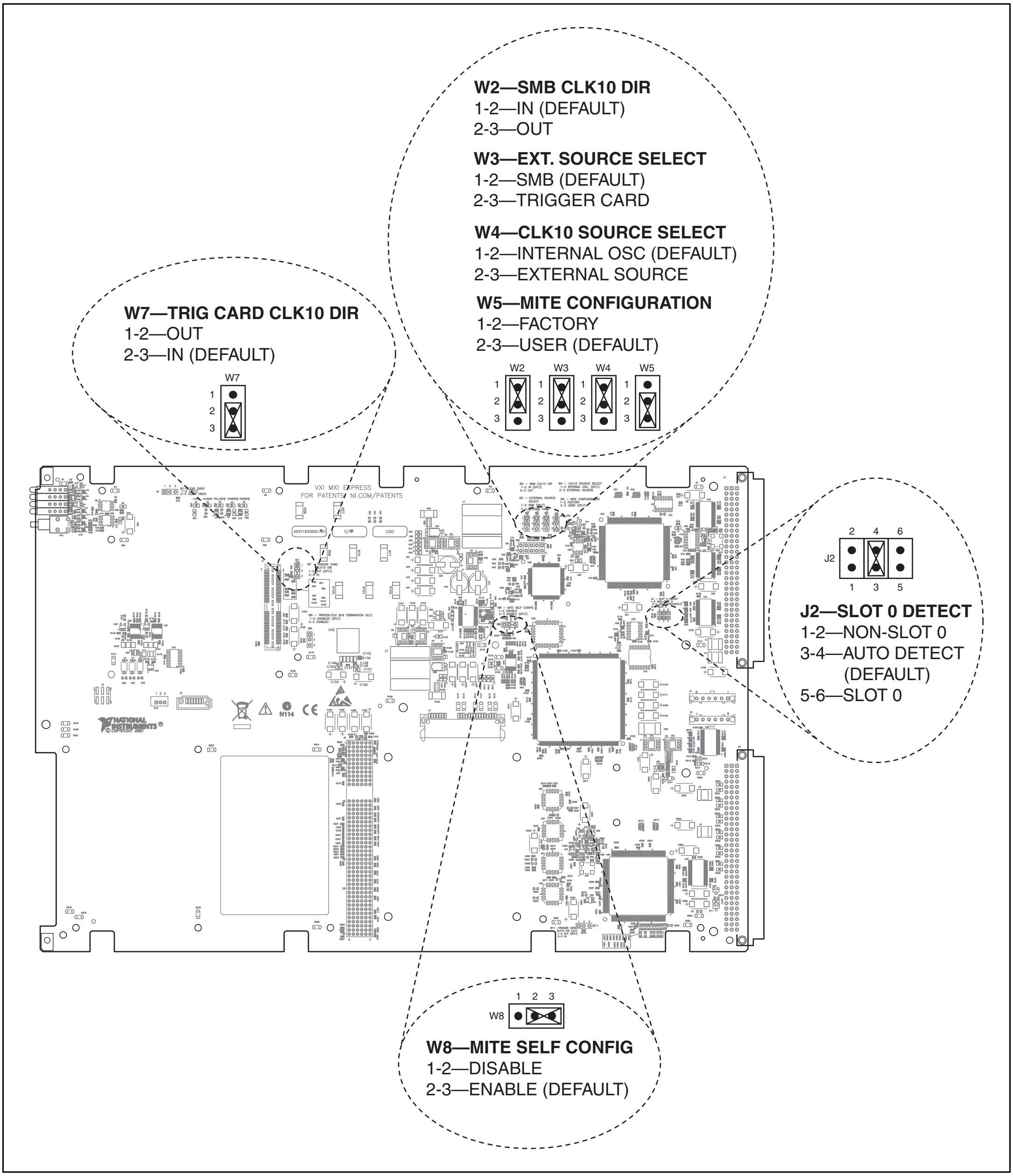



**Figure B-1.** VXI-MXI-Express Factory Default Jumper Settings

# Slot 0 Detection

The NI VXI-8360T/LT controller is configured at the factory to automatically detect if it is installed in Slot 0 of a VXI mainframe. With automatic System Controller slot detection the NI VXI-8360T/LT controller can be installed in any VXIbus slot.

The NI VXI-8360T/LT controller can be manually configured for either System Controller or Non-System Controller operation. Use the three position jumper J2 as shown in Figure B-2 to select between automatic detection, System Controller, or Non-System Controller.

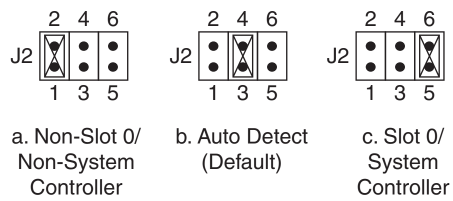



**Figure B-2.** Slot 0 Detection through the J2 Jumper

**Caution** Do *not* install a device configured as the System Controller in any slot other than Slot 0. When installing into a slot other than Slot 0, first reconfigure it as either a Non-System Controller or for automatic detection. Failing to do so may result in damage to the NI VXI-8360T/LT controller and/or the backplane.

When the NI VXI-8360T/LT controller is installed in Slot 0 of a VXI system it becomes the VXIbus System Controller. As the System Controller the NI VXI-8360T/LT controller has VXIbus Data Transfer Arbiter circuitry that accepts bus requests on all four VXIbus request levels, prioritizes the requests, and grants the bus to the highest priority requester. As the VXIbus System Controller the NI VXI-8360T/LT controller also drives the 16 MHz VXIbus system clock via an onboard 16 MHz oscillator. As required by the specification, when installed in Slot 0, the NI VXI-8360T/LT controller drives CLK10, a differential ECL output, to the VXIbus backplane. When the system is not installed in Slot 0 it will only receive the CLK10 signal.

# VXIbus CLK10 Routing

When the NI VXI-8360T/LT controller is installed in Slot 0 of your mainframe, it supplies the VXIbus CLK10 signal. Three different sources for CLK10 are available with the NI VXI-8360T/LT controller:

- The internal 10 MHz ±100 ppm CLK10 oscillator. This is the default CLK10 source.
- The front panel EXT CLK SMB connector. When configured as an input the front panel SMB allows an external source to be used as the source for the VXIbus CLK10 signal.
- **(NI VXI-8360T Only)** The front panel TRIG/CLK PORT A(B). CLK10 can be routed into the NI VXI-8360T from another NI VXI-8360T through the TRIG/CLK PORT A(B) on the front panel. Onboard jumpers are used to set this configuration.

## CLK10 Routing Options

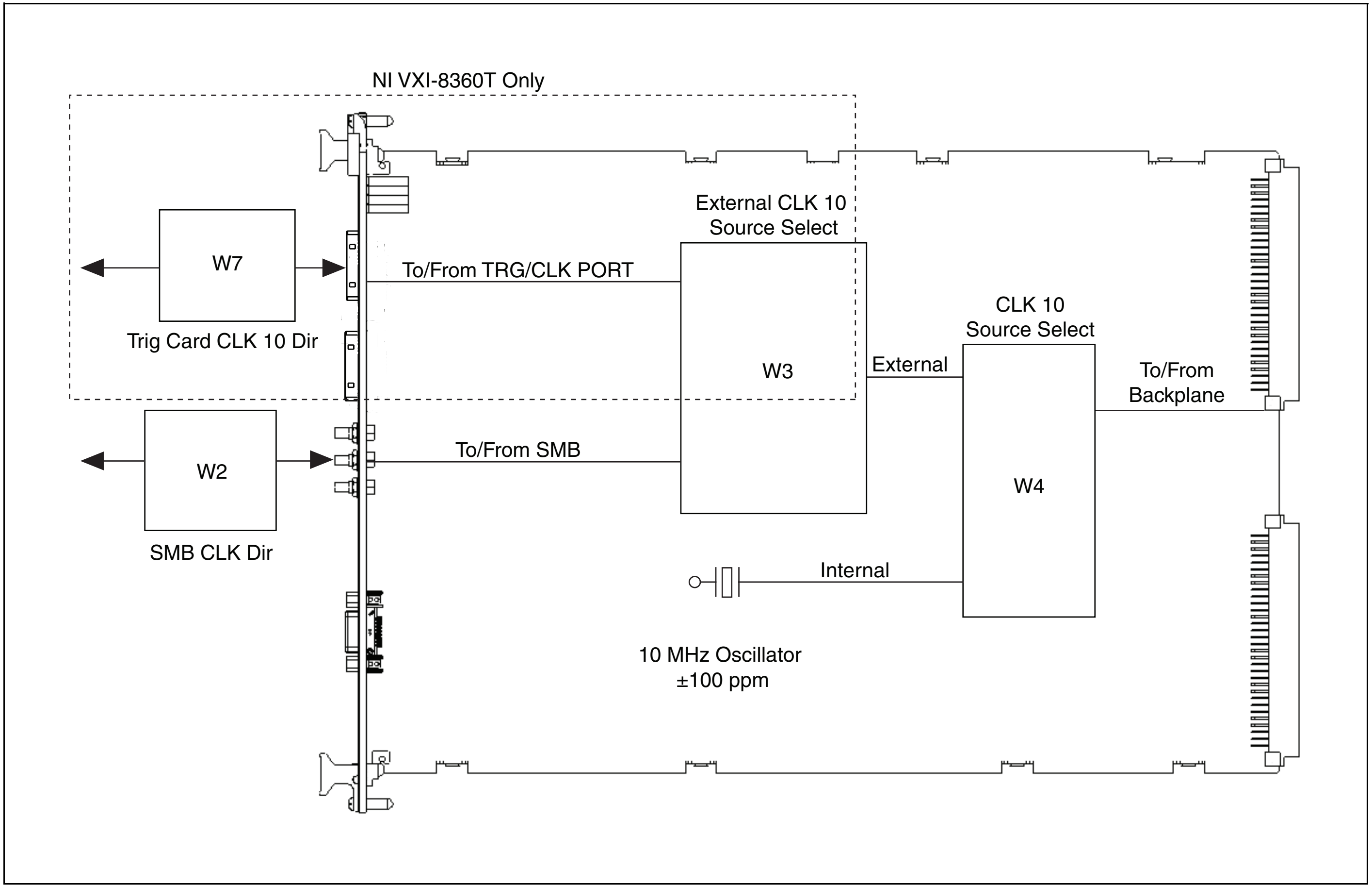



**Figure B-3.** CLK10 Routing Options

**Table B-1.** NI VXI-8360T/LT Slot 0 CLK10 Routing Options and Jumper Configurations

| Product | CLK10 Source | EXT CLK Front Panel SMB | TRG/CLK Ports | W7 | W2 | W3 | W4 |
|---|---|---|---|---|---|---|---|
| NI VXI-8360T | Internal Oscillator | Off | CLK10 Out | Out | In | X | Internal |
| NI VXI-8360T/LT | | | Off | In | In | X | Internal |
| NI VXI-8360T | | CLK10 Out | CLK10 Out | Out | Out | X | Internal |
| NI VXI-8360T/LT | | | Off | In | Out | X | Internal |
| NI VXI-8360T | EXT CLK SMB | Input for CLK10 | CLK10 Out | Out | X | SMB | External |
| NI VXI-8360T/LT | | | Off | In | X | SMB | External |
| NI VXI-8360T | Trigger Port | Off | Input for CLK10 | Out | In | Trigger Card | External |
| NI VXI-8360T | | CLK10 Out | | Out | Out | Trigger Card | External |
| NI VXI-8360T | Not recommended. Undefined operation. | | | In | X | Trigger Card | External |

**Table B-2.** NI VXI-8360T/LT Non Slot 0 CLK10 Routing Options and Jumper Configurations

| Product | CLK10 Source | EXT CLK Front Panel SMB | TRG/CLK Ports | W7 | W2 | W3 | W4 |
|---|---|---|---|---|---|---|---|
| NI VXI-8360T/LT | Backplane (from Slot 0 controller) | CLK10 Out | Off | In | Out | X | X |
| NI VXI-8360T/LT | | Off | Off | In | In | X | X |
| NI VXI-8360T | | CLK10 Out | CLK10 Out | Out | Out | X | X |
| NI VXI-8360T | | Off | CLK10 Out | Out | In | X | X |

## Inverting CLK10

If the front panel SMB connector EXT CLK is configured as an output this software setting provides the capability to invert the clock output. This setting can be found in the hardware configuration panels in MAX as shown in Figure B-4.

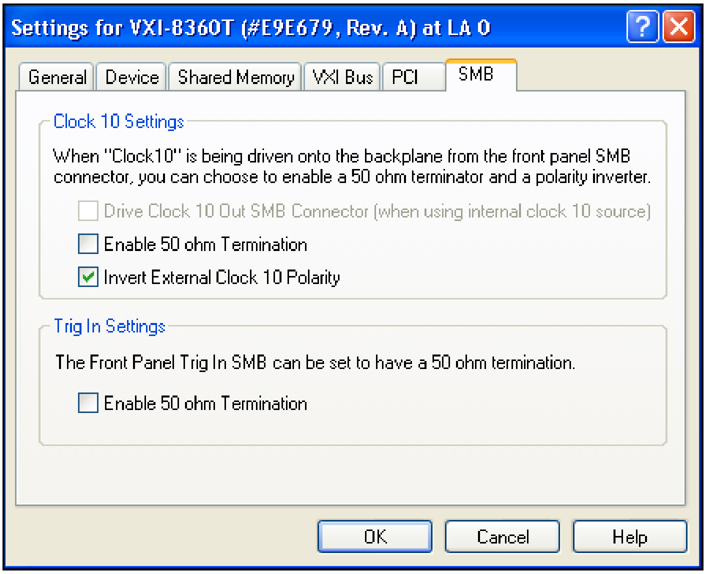



**Figure B-4.** Inverting the CLK10 Signal through MAX

## CLK10 Termination

If the front panel SMB connector EXT CLK is configured as an input this software setting can enable 50 Ω parallel termination. This setting can be found in the hardware configuration panels in MAX, as shown in Figure B-4.

## Front Panel/SMB Trigger Input Termination

Optional software enabled 50 Ω parallel termination is available for the front panel trigger input. This setting can be found in the hardware configuration panels in MAX, as shown in Figure B-4.

**Note** Parallel termination is not necessary when the signal is driven by a 50 Ω source, such as a NI VXI-8360T/LT controller.

# Power-On Self Configuration

The NI VXI-8360T/LT controller has an onboard EEPROM, which stores default register values for the VXI circuitry. These values are loaded when you power up the computer. The values read from the EEPROM program the PCI interface and the VXIbus registers so that the VXI interface is ready to respond to Resource Manager accesses within the required 5 seconds of SYSRST# deasserting.

You can disable this power-on self-configuration (POSC) circuit by changing switch W8. Although this makes the VXI circuitry unusable, it is sometimes helpful in debugging address and interrupt conflicts with add-in boards. In general, however, you should leave W8 in its factory-default setting. Figure B-5 shows the possible configurations for W8.

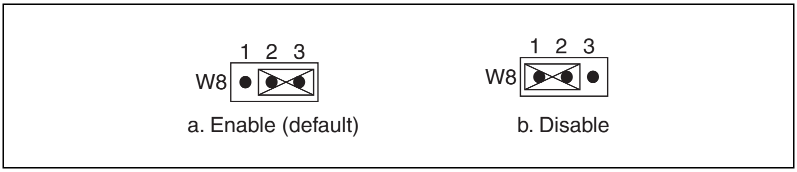



**Figure B-5.** Power-on Self Configuration Status

# C

# Using the Trigger Ports on the NI VXI-8360T

The NI VXI-8360T allows you to extend the 8 VXI backplane triggers and CLK10 through convenient front panel connectors. Each trigger and the CLK are independently configurable as either inputs to the frame or outputs from the frame. The wired VXI backplane trigger and CLK10 bus is connected in a daisy chain topology and can support up to 6 devices with a total of 19 m of cables.

**Cautions** The wired VXI backplane trigger and CLK10 bus uses MXI-Express x4 cables and connectors, however these are not MXI-Express x4 ports. Do *not* connect the trigger ports to a MXI-Express x4 or PCI Express x4 device.

The trigger bus may be able to support more devices and/or greater cable lengths, but these configurations have not been validated by National Instruments and are not currently supported.

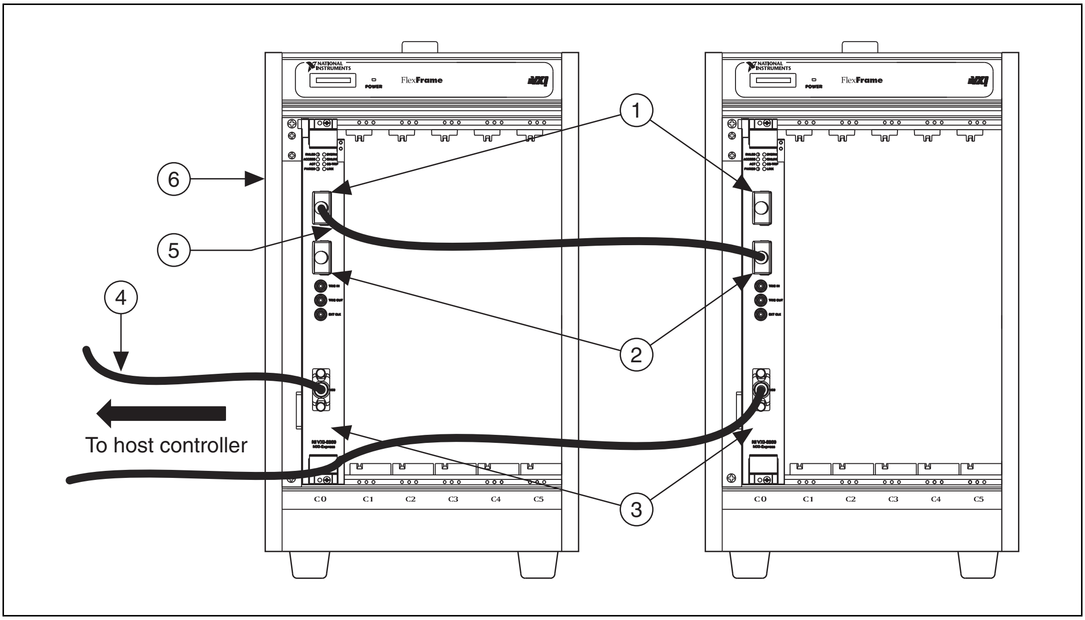
## Connecting the Trigger Port Cables

When connecting the cables between two devices on the wired VXI backplane trigger and CLK10 bus, always ensure you connect TRIG/CLK PORT A of one device to TRIG/CLK PORT B of the second device, or TRIG/CLK PORT B of one device to TRIG/CLK PORT A of the second device, as shown in Figure C-1.

If the cables are not connected correctly, the Cable Status LED will blink red, and the trigger drivers in that system will be disabled.

**Note** Trigger bus cables may be removed and inserted while power is on.

End of bus termination is also required for proper operation. The VXI-8360T automatically detects its position on the wired VXI backplane trigger and CLK10 bus and it will enable its termination if it detects it is at the end of the bus




| | |
|---|---|
| 1 TRIG/CLK PORT A | 4 MXI-Express x1 cable |
| 2 TRIG/CLK PORT B | 5 Trigger Cable |
| 3 NI VXI-8360T Controller in Slot 0 | 6 VXI Mainframe |

**Figure C-1.** NI VXI-8360T Trigger Cabling

# Software Configuration

Triggers are mapped into and out of your NI VXI-8360T through software using the following steps.

1. Open MAX.
2. Find your device under **Devices and Interfaces**.
3. Right click on your device and select **Properties**.
4. Click on the **Signal Mappings Tab**.
5. From each TTL Trigger select **Into the Frame**, **Out of the Frame**, or **None**.
6. Click **OK** and re-run the Resman for the changes to take effect.

**Note** Do not map the same trigger out of the frame on more than one device on the trigger bus. This will cause the bus to be driven by more than one device. Protection circuitry prevents this from causing physical damage, however your setup will not function properly.

# Configuring the Wired Trigger and Clock Bus

Each of the 8 physical trigger channels is independently configurable and designed to be used in a point-to-multipoint topology where one device acts as the trigger driver and the remaining devices are listeners.

To map a trigger from the VXI backplane to multiple chassis, configure the trigger to be mapped as **Out of the Frame** in MAX. This configures the trigger as a driver. The remaining devices on the wired VXI backplane trigger and CLK10 bus need to be configured as listeners by configuring their respective triggers as **In to the Frame**.

To map CLK10 **Out of the Frame** set jumper W7 to connect pins 1-2. To map CLK10 **In to the Frame** set jumper W7 to connect pins 2-3. Refer to Appendix B, *Advanced Hardware Configuration Settings*, for more information about setting the hardware jumper.

D

# Using the Trigger Ports on the NI VXI-8360LT

The NI VXI-8360LT allows you to extend the 8 TTL backplane triggers over a wired VXI backplane trigger bus through convenient front panel connectors. The wired VXI backplane trigger bus allows a simple way to have an event in one system trigger events in other VXI systems.

The wired trigger bus physical interface is based off of the TIA/EIA-899 Multi-Point Low Voltage Differential Signaling (M-LVDS) standard. The physical interface allows the construction of large multi-drop systems and reliable triggering over long distance. Topologies up to 6 devices over 20 m of cable are supported. The wired VXI backplane trigger bus may be capable of supporting more devices over greater cable lengths but, these configurations have not been validated by National Instruments.

The 8 triggers on the wired VXI backplane trigger bus correspond to the 8 TTL triggers on the VXI backplane (e.g., TTLTRG0* on the VXI backplane corresponds to Trigger Number 0 on the wired VXI backplane trigger bus). Each of the 8 physical trigger channels are independently configurable and can be used in one of two topologies: point-to-multipoint or multipoint-to-multipoint.

## Driven Mode Operation

This is a point-to-multipoint configuration where one device on the trigger channel is configured as a driver and the remaining devices are configured as listeners. The device configured as the driver sets the state of the trigger channel and the other devices receive that state. If two or more devices are configured to drive the trigger channel the behavior of the bus is undefined.

## Wired-OR Mode Operation

This is a multipoint-to-multipoint topology where multiple devices can assert a trigger channel to multiple listeners. For this topology, the trigger channel behaves in a wired-OR manner with all drivers tri-stated. A bias device is used to pull the trigger to a known, unasserted state and then the triggering device(s) drive(s) the bus to its asserted state.

## LXI Compatibility

The physical and electrical interface of the wired VXI backplane trigger bus is compatible with the LXI wired trigger bus. The physical interface uses the standardized 25-pin micro-D type connector. The electrical interface uses the *LXI-wired Trigger Bus cable and Terminator 2.0* specified Texas Instruments (SN65MLVD080) bus transceiver.

The LXI wired trigger bus has a much broader triggering definition and can be considered as a superset of the VXI-8360LT's wired VXI backplane trigger bus. The two trigger domains are compatible with a few constraints:

1. All LXI devices that share the wired VXI backplane trigger bus must be configured for active high assertion of triggers whether in Driven mode or Wired-OR mode.
2. The LXI specification states that each trigger channel shall be individually configurable as an input or output (or both). The NI VXI driver software allows a trigger be mapped **In to the Frame** (input) or **Out of the Frame** (output) but not both. This constrains a single trigger to be either a driver or a receiver.

# Connecting the Trigger Port Cables

The physical pinout for the two trigger ports is identical so there are no special cable connection requirements between the ports.

**Note** Trigger bus cables may be removed and inserted while power is on.

End of bus termination is required for proper operation. Use two 50 Ω resistors in series across each trigger differential pair with the center tap decoupled to ground with a capacitor. Commercially available terminators are recommended.

# Configuring the Wired Trigger Bus

The 8 triggers in the wired VXI backplane trigger bus are configured via hardware and software. Hardware switches located on the top edge of the NI VXI-8360LT control the operating mode of the trigger. The factory default switch settings for all 8 triggers are displayed in Figure D-1, *Trigger Configuration Sticker (Located on the Side of the NI VXI-8360LT)*.

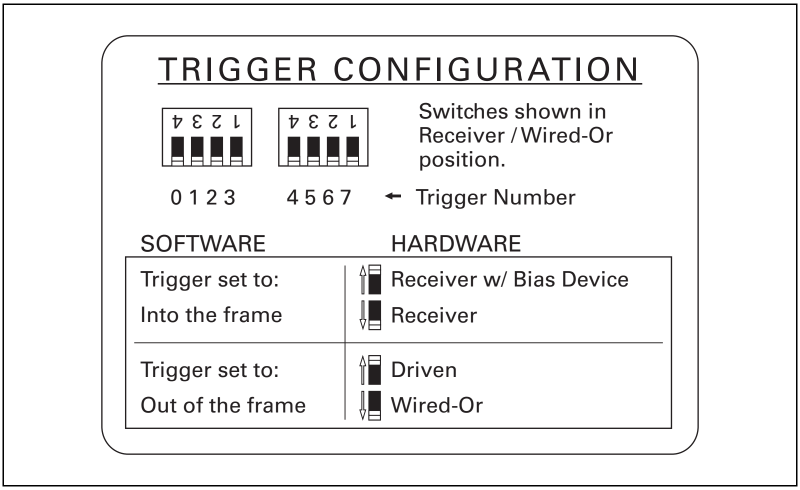



**Figure D-1.** Trigger Configuration Sticker
(Located on the Side of the NI VXI-8360LT)

Software controls whether the trigger is routed **In to the Frame** or **Out of the Frame**.

Triggers are mapped into and out of your NI VXI-8360LT though software using the following steps.

1. Open MAX.
2. Find your device under **Devices and Interfaces**.
3. Right click on your device and select **Properties**.
4. Click on the **Signal Mappings Tab**.
5. For each TTL Trigger select **Into the Frame**, **Out of the Frame**, or **None**.
6. Click **OK** and re-run the Resman for the changes to take effect.

## For Driven Mode Triggers

Complete the following steps to map a trigger from the VXI backplane to the wired VXI backplane trigger bus:

### Driving Device

1. In MAX configure the trigger to be mapped as **Out of the Frame**.
2. Set the trigger's hardware switch to **Driven**.

### Listening Device

1. In MAX configure the respective trigger lines as **Into the Frame**.
2. Set the trigger's hardware switch to **Receiver**.

**Note** Do not select **Receiver w/Bias Device** in Driven mode. Doing so will produce undefined results.

## For Wired-Or Mode Triggers

Complete the following steps to map a trigger from the VXI backplane to the wired VXI backplane trigger bus:

### Driving Device

1. In MAX configure the trigger to be mapped as **Out of the Frame**.
2. Set the trigger's hardware switch to configure it as a **Wired-OR**.

### Listening Device

1. In MAX configure the trigger to be mapped as **In to Frame**.
2. Set the trigger's hardware switch to select the type of receiver needed. If the device is going to bias the wired VXI backplane trigger bus, set the trigger's hardware switch for **Receiver w/BIAS Device**.
3. If the device is going to be a receiver, set the trigger hardware switch to **Receiver**.

**Note** Ensure only one receiving device is configured as the **Receiver w/BIAS Device**. Having more than one bias device on a trigger channel will produce undefined results.

E

# How to Fix an Invalid EEPROM Configuration

The NI VXI-8360T/LT controller uses an EEPROM to store configuration settings required at power on. Certain EEPROM configurations could cause your computer to lock up while booting. Generally, the size and location of memory windows will cause this issue.

Many PCI-based computers will not boot if a board in the system is requesting more memory space than the computer can allocate. If you encounter this situation you should reduce the size of the NI VXI-8360T/LT controller user memory window.

The EEPROM can also become corrupt if the NI VXI-8360T/LT controller loses power while software is updating the EEPROM.

To aid in EEPROM recovery the EEPROM is divided into two halves—one half is factory configured and the other half is user configurable. By default the VXI-MXI-Express boots from the user half of the EEPROM. Should the EEPROM become corrupt complete the following steps to restore the EEPROM to its factory settings:

1. Power off your computer.

**Caution** To protect both yourself and the mainframe from electrical hazards, the mainframe should remain off until you finish changing the settings on the NI VXI-8360T/LT controller.

2. Change jumper W5 to the position shown in Figure E-1 to restore the factory configuration. Refer to Figure B-1, *VXI-MXI-Express Factory Default Jumper Settings*, of Appendix B, *Advanced Hardware Configuration Settings*, for jumper locations.

Figure E-1 shows the configuration settings for EEPROM operation. Use jumper W5 to control whether the NI VXI-8360T/LT controller boots off the factory-configured EEPROM settings or the user-modified settings.

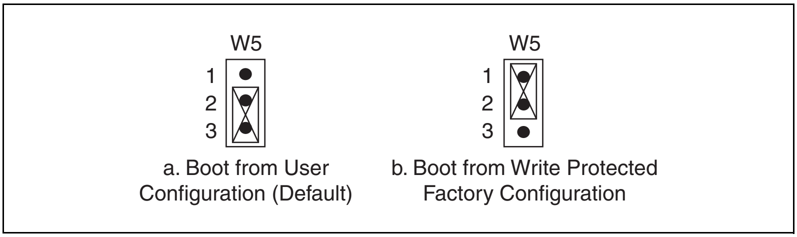



**Figure E-1.** EEPROM Configuration

3. Power on the computer. The computer should boot this time because the factory-default configuration is being used to initialize the NI VXI-8360T/LT controller.
4. Right-click on the VXI system in MAX and select the **Hardware Configuration** utility.
5. A dialog box will appear explaining that the Factory Override switch has been set, and the NI VXI-8360T/LT controller is running using factory default settings. Click **OK** to continue.
6. In the **General** tab under Quick Configuration select **Default Configuration**.
7. Click **Yes** in the pop up box if you are sure you want to restore the factory defaults.
8. Click **OK** in the hardware configuration panel to save the settings.
9. After saving the configuration, exit Windows and power off the computer.
10. Change jumper W5 back to the default position, as shown in Figure E-1.
11. Power on the computer. If the computer does not boot with this configuration, you will need to repeat these steps, modifying your configuration until a final configuration is reached.

F

# VMEbus Capability Codes

**Table F-1.** VMEbus Capability Codes

| Capability Code | Description |
|---|---|
| A32, A24, A16 (master) | VMEbus master A32, A24, and A16 addressing |
| A32, A24, A16 (slave) | VMEbus slave A32, A24, and A16 addressing |
| D32, D16, D08(EO) (master) | VMEbus master D32, D16, and D08 data sizes |
| D32, D16, D08(EO) (slave) | VMEbus slave D32, D16, and D08 data sizes |
| BLT, MBLT (master) | VMEbus master block and D64 transfers |
| BLT, MBLT (slave) | VMEbus slave block and D64 transfers |
| RMW (master) | VMEbus master read/modify/write transfers |
| RMW (slave) | VMEbus slave read/modify/write transfers |
| RETRY (master) | VMEbus master retry support |
| RETRY (slave) | VMEbus slave retry support |
| FSD | First slot detector |
| SCON | VMEbus System Controller |
| PRI, RRS | Prioritized or Round Robin Select arbiter |
| ROR, FAIR | Release on Request and FAIR bus requester |
| IH(7–1) | Interrupt handler for levels 7–1 |
| I(7–1) | Interrupt requester for levels 7–1 |
| D32, D16, D08(O) (Interrupt Handler) | VMEbus D32, D16, D08(O) interrupt handler |
| D32, D16, D08(O) (Interrupter) | VMEbus D32, D16, D08(O) interrupter |
| ROAK, RORA | Release on Acknowledge or Register Access interrupter |
| BTO(x) | VMEbus bus timer (programmable limit) |

# G

# Common Questions

**What is the maximum length of the NI VXI-8360T/LT controller MXI-Express x1 copper cable?**

The maximum length for the NI VXI-8360T/LT controller MXI-Express x1 copper cable is 7 m. National Instruments offers 1 m, 3 m, and 7 m copper cables.

**I need more devices than can fit in one chassis. How can I expand my NI VXI-8360T/LT controller system?**

Many applications can be easily extended to multiple chassis by adding additional NI VXI-8360T/LT controllers to the host computer and using the trigger and clock sharing features of the NI VXI-8360T to synchronize events between chassis. In the event that VXI or VME bus mastering devices must communicate to devices in other chassis directly, National Instruments recommends that you use a VXI-MXI-2 interface, which implements the VXI-6 specification for mainframe extension. This extends full VXI functionality across multiple mainframes, including a common device address space, interframe triggering, interrupts, and bus mastering. Place a VXI-MXI-2 in the same mainframe with the Slot 0 NI VXI-8360T/LT controller, and another VXI-MXI-2 in Slot 0 of the next mainframe. You can then fill up this mainframe with additional devices. Refer to the *MXI-2 Configuration Reference Manual* available at `ni.com` for additional configuration instructions.

**How can I determine the serial number of the NI VXI-8360T/LT controller?**

This information is displayed in the title bar of the Hardware Configuration window in MAX. The serial number can also be found on the sticker applied to the side of the controller.

**What is Resman?**

Resman is the utility that performs the duties of a VXI Resource Manager as discussed in the VXIbus specification.

**When do I need to run Resman?**

Run Resman whenever you need to configure your VXI instruments (for example, when you power cycle either the host computer or the chassis).

When you set a National Instruments controller to Logical Address 0, you will at some point need to run Resman to configure your VXI instruments. If your controller uses a different (nonzero) logical address and is a message-based device, you need to start Resman before running it on the Logical Address 0 computer.

**Which NI-VXI utility program must I use to configure the NI VXI-8360T/LT controller?**

Use Measurement & Automation Explorer (MAX) to configure the NI VXI-8360T/LT controller. MAX is in the `National Instruments` program group folder, and a shortcut is on your desktop.

**How do I handle VME devices?**

Although there is no way to automatically detect VME devices in a system, you can add them easily through the Add Device Wizard in MAX. Through this procedure, you can reserve resources for each of your VME devices and configure MAX to show VME devices on the screen with all your other devices.

**Which NI-VXI utility program must I use to perform startup Resource Manager operations?**

Use the Resman program to perform startup Resource Manager operations in **Start»Programs»National Instruments»VXI**. Resman uses the settings configured in MAX. It initializes your VXI/VMEbus system and makes the information it collects accessible through MAX. You can also run Resource Manager operations from MAX. Through MAX, you can also configure Resman to run automatically at Windows startup.

### What can I do to make sure that my system is up and running?

The fastest method for testing the system is to run Resman. This program attempts to access memory in the upper A16 address space of each device in the system. If Resman does not report any problems, the NI VXI-8360T/LT controller communication system is operational. To test individual devices, you can use the VIC or VISAIC program to interactively issue NI-VXI functions or NI-VISA operations, respectively. You can use `viIn()` and `viOut()` with the NI-VISA API (or `VXIin()` or `VXIinReg()` and `VXIout()` or `VXIoutReg()` with the NI-VXI API) to test register-based devices by programming their registers. If you have any message-based devices, you can send and receive messages with the `viRead()` and `viWrite()` operations in the NI-VISA API (or `WSrd()` and `WSwrt()` functions in the NI-VXI API). Notice that `VXIinReg()` and `VXIoutReg()` are for VXI devices only, but you can use `VXIin()` and `VXIout()` for both VXI and VME. Finally, if you are using LabVIEW or LabWindows/CVI and you have instrument drivers for the devices in your chassis, you can use the interactive features of these programs to quickly test the functionality of the devices.

### What is the accuracy of the CLK10 signal?

The CLK10 generated by the NI VXI-8360T/LT controller is ±100 ppm per the VXI specification. To use a more accurate reference for CLK10, connect the signal to the controller through the EXT CLK SMB input on the front panel.

# H

# Technical Support and Professional Services

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# Glossary

| Symbol | Prefix | Value |
|---|---|---|
| p | pico | $10^{-12}$ |
| n | nano | $10^{-9}$ |
| µ | micro | $10^{-6}$ |
| m | milli | $10^{-3}$ |
| k | kilo | $10^{3}$ |
| M | mega | $10^{6}$ |
| G | giga | $10^{9}$ |
| T | tera | $10^{12}$ |

## Symbols

° degrees

Ω ohms

## A

A amperes

address Character code that identifies a specific location (or series of locations) in memory. In VISA, it identifies a resource.

address modifier One of six signals in the VMEbus specification used by VMEbus masters to indicate the address space in which a data transfer is to take place.

address space A set of $2^n$ memory locations differentiated from other such sets in VXI/VMEbus systems by six addressing lines known as address modifiers. $n$ is the number of address lines required to uniquely specify a byte location in a given space. Valid numbers for $n$ are 16, 24, 32, and 64. In VME/VXI, because there are six address modifiers, there are 64 possible address spaces.

ANSI American National Standards Institute

| | |
|---|---|
| API | Application Programming Interface—the direct interface that an end user sees when creating an application. |
| arbitration | A process in which a potential bus master gains control over a particular bus. |

## B

| | |
|---|---|
| B | Byte—eight related bits of data, an 8-bit binary number. Also used to denote the amount of memory required to store one byte of data. |
| backplane | An assembly, typically a printed circuit board, with 96-pin connectors and signal paths that bus the connector pins. A C-size VXIbus system will have two sets of bused connectors called J1 and J2. A D-size VXIbus system will have three sets of bused connectors called J1, J2, and J3. |
| BERR* | bus error signal |
| BIOS | Basic Input/Output System. BIOS functions are the fundamental level of any PC or compatible computer. BIOS functions embody the basic operations needed for successful use of the computer's hardware resources. |
| block-mode transfer | An uninterrupted transfer of data elements in which the master sources only the first address at the beginning of the cycle. The slave is then responsible for incrementing the address on subsequent transfers so that the next element is transferred to or from the proper storage location. A VME data transfer may have no more than 256 elements. |
| 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 buses include the ISA bus, PCI bus, VXI bus, and VME bus. |
| bus error | An error that signals failed access to an address. Bus errors occur with low-level accesses to memory and usually involve hardware with bus mapping capabilities. For example, nonexistent memory, a nonexistent register, or an incorrect device access can cause a bus error. |

| | |
|---|---|
| bus master | A device that is capable of requesting the Data Transfer Bus (DTB) for the purpose of accessing a slave device. |
| byte order | How bytes are arranged within a word or how words are arranged within a longword. Motorola ordering stores the most significant byte (MSB) or word first, followed by the least significant byte (LSB) or word. Intel ordering stores the LSB or word first, followed by the MSB or word. |

## C

| | |
|---|---|
| C | Celsius |
| CLK10 | A 10 MHz, ±100 ppm, individually buffered (to each module slot), differential ECL system clock that is sourced from Slot 0 of a VXIbus mainframe and distributed to Slots 1 through 12 on P2. It is distributed to each slot as a single-source, single-destination signal with a matched delay of under 8 ns. |
| Commander | A message-based device that is also a bus master and can control one or more Servants. |
| configuration registers | A set of registers through which the system can identify a module device type, model, manufacturer, address space, and memory requirements. To support automatic system and memory configuration, the VXI specification requires that all VXIbus devices have a set of such registers. |

## D

| | |
|---|---|
| Data Transfer Bus | DTB; one of four buses on the VMEbus backplane. The DTB is used by a bus master to transfer binary data between itself and a slave device. |
| DMA | Direct Memory Access—a method by which data is transferred between devices and internal memory without intervention of the central processing unit. DMA is the fastest method of transferring data to/from computer memory. |
| DRAM | Dynamic RAM (Random Access Memory)—storage that the computer must refresh at frequent intervals. |

| | |
|---|---|
| dynamic configuration | A method of automatically assigning logical addresses to VXIbus devices at system startup or other configuration times. |
| dynamically configured device | A device that has its logical address assigned by the Resource Manager. A VXI device initially responds at Logical Address 255 when its MODID line is asserted. The Resource Manager subsequently assigns it a new logical address, to which the device responds until powered down. |

## E

| | |
|---|---|
| ECL | Emitter-Coupled Logic |
| EEPROM | Electronically Erasable Programmable Read Only Memory—ROM that can be erased with an electrical signal and reprogrammed. |
| embedded controller | An intelligent CPU (controller) interface plugged directly into the VXI backplane, giving it direct access to the VXIbus. It must have all of its required VXI interface capabilities built in. |
| EMC | electromagnetic compliance |
| EMI | electromagnetic interference |
| external trigger | A voltage pulse from an external source that triggers an event. |

## F

| | |
|---|---|
| fair requester | A VXIbus device that will not arbitrate for the VXIbus after releasing it until it detects the bus request signal inactive. This ensures that all requesting devices will be granted use of the bus. |
| firmware | Software embedded in the NI VXI-8360T/LT controller, contained on EEPROM and flash memory that can be updated with a special utility (part of MAX). In combination with the hardware, the firmware enables the NI VXI-8360T/LT controller to act as a translator between USB and VXI protocols. |

## G

| | |
|---|---|
| g | (1) grams<br>(2) a measure of acceleration equal to 9.8 $m/s^2$ |
| GPIB | General Purpose Interface Bus (IEEE 488) |
| $g_{RMS}$ | A measure of random vibration. The root mean square of acceleration levels in a random vibration test profile. |

## H

| | |
|---|---|
| hex | Hexadecimal—the numbering system with base 16, using the digits 0 to 9 and letters A to F. |
| Hz | hertz; cycles per second |

## I

| | |
|---|---|
| I/O | Input/output—the techniques, media, and devices used to achieve communication between machines and users. |
| IEC | International Electrotechnical Commission. The IEC publishes internationally recognized standards. IEC 60068 contains information on environmental testing procedures and severities. |
| IEEE | Institute of Electrical and Electronics Engineers |
| in. | inches |
| instrument driver | A set of routines designed to control a specific instrument or family of instruments, and any necessary related files for LabWindows/CVI or LabVIEW. |
| interrupt | A means for a device to request service from another device; a computer signal indicating that the CPU should suspend its current task to service a designated activity. |
| interrupt handler | A VMEbus functional module that detects interrupt requests generated by interrupters and responds to those requests by requesting status and identify information. |

| | |
|---|---|
| interrupt level | The relative priority at which a device can interrupt. |
| IRQ* | interrupt signal |

## K

| | |
|---|---|
| K | kilo—the prefix for 1,024, or $2^{10}$, used with B (byte) in quantifying data or computer memory. |
| k | kilo—the standard metric prefix for 1,000, or $10^3$, used with units of measure such as volts, hertz, and meters. |

## L

| | |
|---|---|
| logical address | An 8-bit number that uniquely identifies each VXIbus device in a system. It defines the A16 register address of a device, and indicates Commander and Servant relationships. |

## M

| | |
|---|---|
| m | meters |
| M | mega—(1) the standard metric prefix for 1 million or $10^6$, when used with units of measure such as volts and hertz; (2) the prefix for 1,048,576, or $2^{20}$, when used with B (byte) to quantify data or computer memory. |
| master | A functional part of a VME/VXIbus device that initiates data transfers on the backplane. A transfer can be either a read or a write. |
| message-based device | An intelligent device that implements the defined VXIbus registers and communication protocols. These devices are able to use Word Serial Protocol to communicate with one another through communication registers. |
| MODID | Module ID lines—used in VXI to geographically locate boards and to dynamically configure boards. |
| MTBF | Mean Time Between Failure |

| | |
|---|---|
| MXI-3 | A PCI Master/Slave system implementing the PCI-to-PCI Bridge register set. It couples two physically separate PCI buses with either a copper or fiber optic data link capable of 1.5 Gbits/s serial data rates. |
| MXI-Express | An extension of MXI based upon PCI Express. MXI-Express provides bandwidth of up to 110 MB/s. |

## N

| | |
|---|---|
| NI-488.2 or NI-488.2M | The National Instruments industry-standard software for controlling GPIB instruments. |
| NI-DAQ | The National Instruments industry-standard software for data acquisition instruments. |
| NI-VISA | The National Instruments implementation of the VISA standard; an interface-independent software that provides a unified programming interface for VXI, GPIB, and serial instruments. |
| NI-VXI | The National Instruments bus interface software for VME/VXIbus systems. |
| Non-Slot 0 device | A device configured for installation in any slot in a VXIbus mainframe other than Slot 0. Installing such a device into Slot 0 can damage the device, the VXIbus backplane, or both. |

## P

| | |
|---|---|
| PCI | Peripheral Component Interconnect. The PCI bus is a high-performance 32-bit or 64-bit bus with multiplexed address and data lines. |
| PCI Express | A serialized, highly scalable I/O interconnect standard that leverages existing PCI technology such as the software model and the load-store architecture. |

# R

| | |
|---|---|
| register-based device | A Servant-only device that supports VXIbus configuration registers. Register-based devices are typically controlled by message-based devices via device-dependent register reads and writes. |
| Resman | The name of the National Instruments Resource Manager in NI-VXI bus interface software. *See also* Resource Manager. |
| Resource Manager | A message-based Commander located at Logical Address 0, which provides configuration management services such as address map configuration, Commander and Servant mappings, and self-test and diagnostic management. |
| retry | An acknowledge by a destination that signifies that the cycle did not complete and should be repeated. |
| RMS | Root mean squared. *See also* $g_{RMS}$. |

# S

| | |
|---|---|
| s | seconds |
| slave | A functional part of a VME/VXIbus device that detects data transfer cycles initiated by a VMEbus master and responds to the transfers when the address specifies one of the device's registers. |
| Slot 0 device | A device configured for installation in Slot 0 of a VXIbus mainframe. This device is unique in the VXIbus system in that it performs the VXI/VMEbus System Controller functions, including clock sourcing and arbitration for data transfers across the backplane. Installing such a device into any other slot can damage the device, the VXIbus backplane, or both. |
| SMB | Sub Miniature Type B connector that features a snap coupling for fast connection. |
| statically configured device | A device whose logical address cannot be set through software; that is, it is not dynamically configurable. |
| SYSFAIL | A VMEbus signal that is used by a device to indicate an internal failure. A failed device asserts this line. In VXI, a device that fails also clears its PASSed bit in its Status register. |

## T

| | |
|---|---|
| trigger | Either TTL or ECL lines used for intermodule communication. |
| TTL | Transistor-Transistor Logic |

## U

| | |
|---|---|
| USB | Universal Serial Bus—a serial bus for connecting computers to keyboards, printers, and other peripheral devices. |

## V

| | |
|---|---|
| V | volts |
| VIC | VXI Interactive Control program, a part of the NI-VXI bus interface software. Used to program VXI devices and develop and debug VXI application programs. |
| VISA | Virtual Instrument Software Architecture. This is the general name given to VISA and its associated architecture. |
| VISAIC | VISA Interactive Control program, a part of the NI-VISA software. Used to program devices and develop and debug application programs. |
| VITA | VMEbus International Trade Association |
| VME | Versa Module Eurocard or IEEE 1014 |
| VMEbus System Controller | A device configured for installation in Slot 0 or a VXIbus mainframe or the first slot in a VMEbus chassis. This device is unique in the VMEbus system in that it performs the VMEbus System Controller functions, including clock sourcing and arbitration for data transfers across the backplane. Installing such a device into any other slot can damage the device, the VMEbus/VXIbus backplane, or both. |
| VXIbus | VMEbus Extensions for Instrumentation |

## W

| | |
|---|---|
| W | watts |
| Word Serial Protocol | The simplest required communication protocol supported by message-based devices in a VXIbus system. It utilizes the A16 communication registers to transfer data using a simple polling handshake method. |
| write posting | A mechanism that signifies that a device will immediately give a successful acknowledge to a write transfer and place the transfer in a local buffer. The device can then independently complete the write cycle to the destination. |

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