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VXI

VXI-USB User Manual

December 2004
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All Class A products display a simple warning statement of one paragraph in length regarding interference and undesired operation. The FCC rules have restrictions regarding the locations where FCC Class A products can be operated.

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

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

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

Class A

Federal Communications Commission

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

Canadian Department of Communications

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

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

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

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About This Manual

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

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

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Related Documentation

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

- 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*
- *Universal Serial Bus Specification*, Revision 2.0
- 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*

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1 Introduction

This chapter describes your VXI-USB interface kit, lists what you need to get started, and includes a brief description of the hardware and software. The VXI-USB interface kit links a PC-based computer to the VXIbus using the Universal Serial Bus (USB). This kit makes your computer perform as if it were plugged directly into the VXI backplane, giving your external computer the capability of an embedded computer. USB 2.0 features hot plug-in capability under Windows, which means you can add and configure USB devices without powering down your system. Your kit contains a National Instruments VXI-USB interface module, which plugs into your VXI mainframe and links your computer to the VXIbus. Your kit includes the NI-VXI/NI-VISA bus interface software, which is fully VXI*plug&play* compliant. NI-VXI/NI-VISA is the National Instruments implementation of the VISA I/O software standard on which all VXI*plug&play* software components are based.

What You Need to Get Started

To set up and use the VXI-USB interface kit, you need the following items:

- ❑ Computer running the Windows 2000 or Windows XP operating system, with a USB 2.0 port or plug-in card (USB 2.0 plug-in cards may not have the same level of performance as an integrated USB 2.0 port)
- ❑ VXIbus mainframe
- ❑ VXI-USB interface module that plugs directly into a VXI mainframe
- ❑ USB 2.0-compliant cable
- ❑ National Instruments software CD
- ❑ This manual

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VXI-USB Interface Kit Overview

The interface kit described in this manual links a USB-equipped computer directly to the VXIbus using USB 2.0. The VXI-USB kit uses this high-speed (480 Mbps) serial bus to link your computer running Windows to a VXI chassis.

Note You can use the VXI-USB kit with USB 1.0, but performance will be significantly slower than with USB 2.0 for many types of operations.

Note You can connect multiple USB devices to the host. However, increasing the number of USB devices in a system can lower the VXI-USB performance.

The VXI-USB kit includes the NI-VXI/NI-VISA software for Windows, a C-size VXI-USB module, and a USB cable. A USB-equipped computer connected to a VXI-USB interface can function as a VXI Commander and Resource Manager. With the VXI-USB interface kit, your computer performs as if it is plugged directly into the VXI backplane as an embedded CPU module. The VXI-USB transparently translates between USB and VXI protocols.

VXI 3.0 Specification Support

The VXI-USB has been designed for VXIbus Specification 3.0, and also is compatible with VXIbus Specification 2.0. The VXI-USB supports new VXIbus 3.0 features such as 2eVME transfers (with a theoretical bandwidth up to 160 Mbytes/s), A64 memory space allocation, and a Resource Manager that supports A64 allocation. NI-VXI includes an NI-VISA driver for the VXI-USB that has additional functionality for using these VXIbus 3.0 features. If you have a VXI device that supports these features, consult the VXI-USB release notes for information about how to access them from NI-VISA.

Hardware Description

The VXI-USB module is a VXIbus Slot 0-capable device, so it can reside in slot 0 of any C-size or D-size chassis.

Note D-size VXI mainframes have connections for a P3 connector. The VXI-USB, however, does not have this connector and cannot provide the necessary control for VXI devices that need P3 support.

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The VXI-USB links the computer to the VXIbus and converts USB data transfers into VXIbus data transfers and vice versa. The VXI-USB includes additional USB Series A ports you can use to connect other USB devices.

VXI-USB Front Panel Features

The VXI-USB has the following front panel features:

- Front panel LEDs
  - **FAILED**—Indicates the VXI-USB is asserting SYSFAIL on the bus due to a controller failure.
  - **SYSFAIL**—Indicates the VMEbus SYSFAIL line is asserted by the VXI-USB or another device on the bus.
  - **VXI**—Indicates the VXI-USB is being accessed as a VXI slave.
  - **ONLINE**
    - **Green**—Indicates the VXI-USB is configured by Resman.
    - **Amber**—Indicates the VXI-USB is not configured by Resman.
  - **USB**—Indicates there is USB traffic to/from the VXI-USB (this excludes any traffic to all other downstream USB devices).
  - **LINK**
    - **Green**—Indicates the VXI-USB is connected to a USB host and has a full-speed (USB 1.*x*, 12 Mbps) connection.
    - **Amber**—Indicates the VXI-USB is connected to a USB host and has a high-speed (USB 2.0, 480 Mbps) connection.
- One host (Series B) USB connector
- Two device (Series A) USB connectors
- Three SMB connectors
  - Trigger input
  - Trigger output
  - External clock
- System reset pushbutton

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Advanced Configuration Options

The VXI-USB default hardware configuration should be acceptable for most systems. Refer to Appendix B, *Default Settings*, only if your system uses the front-panel CLK10 and trigger SMB connectors.

The NI-VISA/NI-VXI bus interface software includes a Resource Manager, an interactive configuration and troubleshooting program, a comprehensive library of software routines for VXI/VME programming, a logging utility you can use for debugging, and graphical interactive control programs for interacting with VISA. You can use this software to seamlessly program multiple-mainframe configurations and have software compatibility across a variety of controller platforms.

NI-VISA has a comprehensive library of software routines not only for VXI/VME programming, but also for GPIB, GPIB-VXI, PXI, TCP/IP, and Serial. You can use this software to program instruments connected through different types of interfaces.

Measurement & Automation Explorer (MAX) helps you view your entire test and measurement system and configure various components, whether they are VXI, GPIB, PXI, or Serial devices. You can also add VME devices to your system easily with MAX and view them on a screen display along with the rest of your system. MAX also features various options for running the Resource Manager, Resman. You can still execute Resman independently to configure your instruments after a power cycle. But you can also perform resource manager operations directly from MAX or configure it to run Resman automatically at startup.

The NI Spy utility tracks the calls your application makes to National Instruments drivers, including NI-VXI, NI-VISA, and NI-488.2. NI Spy helps you debug your application by clearly highlighting the functions that return errors. You can let NI Spy keep a log of your program's calls to these drivers so that you can check them for errors at your convenience.

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

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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 VXI-USB. 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.

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2

Installation and Configuration

This chapter explains how to set up your test system.

Installing the Software

Use the Setup program that came with your NI-VXI/NI-VISA software to install the entire software package or a software update, or to reinstall software in the event that your files were accidentally erased. Some of the utilities rely on the LabWindows/CVI Run-Time Engine. This software is installed, if necessary, during the NI-VXI/NI-VISA installation.

Depending on the type of installation you choose, you may need up to 50 MB of free space on your hard drive to accommodate the NI-VXI and NI-VISA software.

To be compliant with VXI*plug&play* specifications, a VXI controller must provide the VISA I/O driver library standardized by VXI*plug&play*. VISA ensures that your controller can run all VXI*plug&play*-compatible software now and in the future.

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

Installing the NI-VXI and NI-VISA Software

This section describes how to install the NI-VXI and NI-VISA software.

Carefully read these directions along with any messages on the screen before making your selections. You can quit the Setup program at any time by clicking the **Cancel** button.

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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`.

Setup is an interactive, self-guiding program that installs the NI-VXI and NI-VISA software and configures your system to use the software with the VXI-USB. Complete the following steps to perform the installation:

1. For the CD, select **Start»Run** and enter the following text, where *X* is your CD drive (usually D):

   X`:\setup.exe`

   Press <Enter>. Typically, this setup program runs automatically when you insert the CD.
2. Click the **Next** button at the Welcome screen to start the installation and accept the license agreement.

Note If you have a previous version of the NI-VXI software installed, Setup installs the new version over the previous version.

3. Select the type of installation from the Installation Options screen.
   - *Typical* setup installs runtime support and NI-VISA development support.
   - *Complete* setup installs everything including NI-VXI API development support. For more information about the NI-VXI API, refer to Chapter 3, *Developing Your Application*.
   - *Custom* setup gives you more control over which driver components you want installed on your system. This option is recommended for advanced users.
4. Click the **Next** button. Confirm that you are ready to install and click **Next** again to begin the installation.
5. Setup now copies the necessary files to your hard drive and creates program icons.

Completing the Software Installation

Review the information in any `README` files that Setup prompts you to read.

When the installation process completes, reboot the system for the changes to take effect. If you backed up the manufacturer and model name files,

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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.

Configuring the Hardware (Optional)

This section contains basic information about configuring your VXI-USB hardware. Because the default settings for your VXI-USB hardware are acceptable for most typical applications, this section is optional.

Refer to Appendix B, *Default Settings*, for a complete listing of the hardware and software default settings.

Use Measurement & Automation Explorer (MAX) to change any VXI-USB configuration settings. You can also use MAX to check for software updates, including updates that may be available for the VXI-USB firmware. Figure 2-1 shows the firmware update panel.

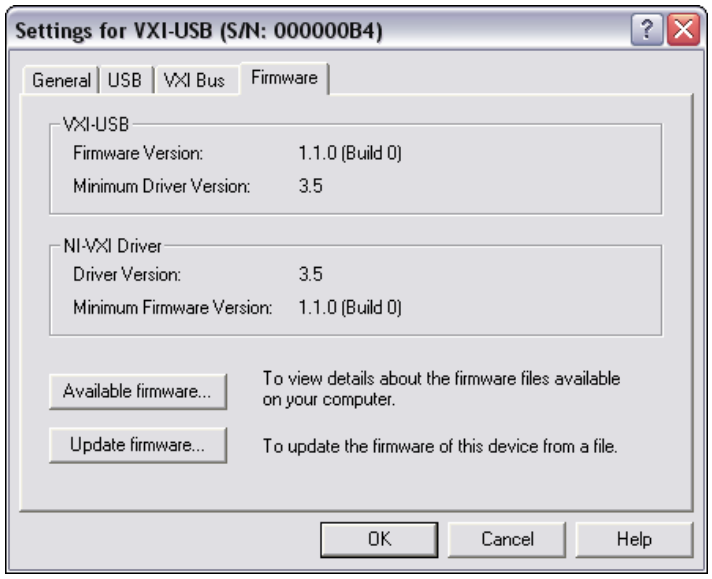


Figure 2-1. VXI-USB Firmware Update Panel

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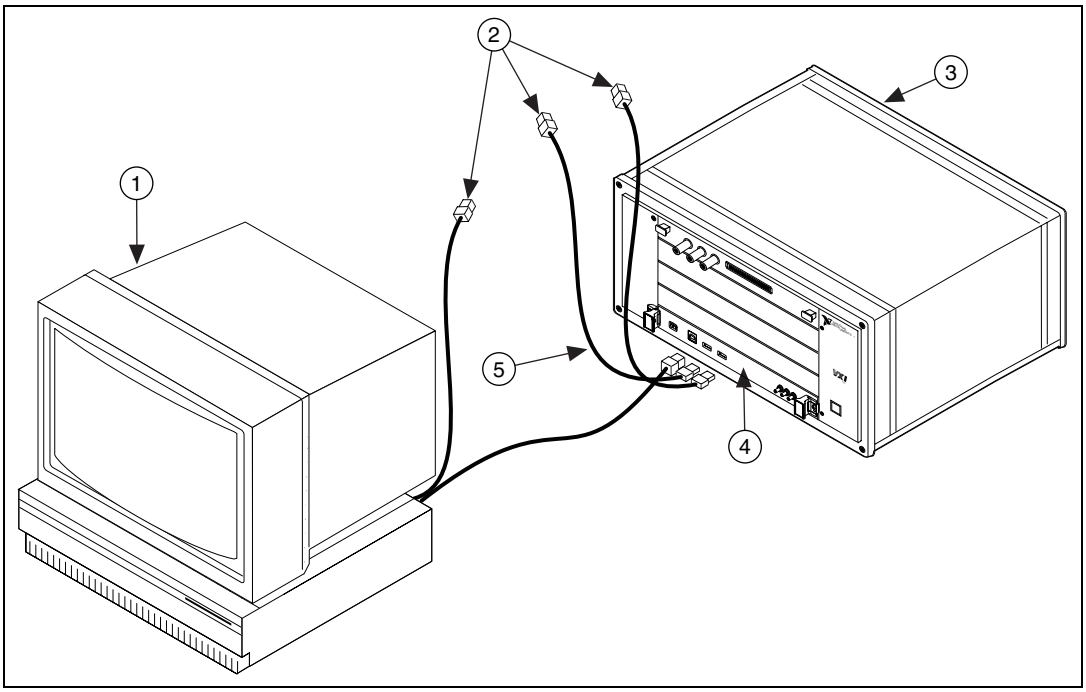
For information about the software, including optional settings, use MAX and its online help. Use the Windows **Start** menu to open the program group for National Instruments, launch MAX, and select **Help»Help Topics**.

Installing the Hardware

This section summarizes how to install your VXI-USB hardware. Your kit contains a VXI-USB interface module.

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.

Figure 2-2 shows a system that includes a USB 2.0-equipped computer, a VXI-USB, and USB devices.



1 External Computer	4 VXI-USB in Slot 0
2 Connections to Other USB Devices	5 USB Cables
3 VXI Mainframe	

Figure 2-2. USB System

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Installing Your VXI-USB Interface Module

All kits contain a VXI-USB interface module.

To install the VXI-USB in Slot 0 of your VXI chassis, complete the following steps:

1. Power off the chassis.
2. Verify that the backplane connector is intact and that there are no bent or missing pins on the module.
3. Insert the VXI-USB into the chassis in Slot 0, as shown in Figure 2-2.
4. Power on the chassis.

The VXI system controllers operate certain VXI lines as required for VXI systems. Verify that any other VXI devices with system controller capability that are in the same chassis are not configured as system controller.

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 VXI-USB also uses this region for this purpose.

Note Also ensure that no VXI devices in your system are configured for logical address 0. This is the VXI-USB logical address, which you cannot change.

Connecting Cables

Connect the USB cable to a USB connection in your host PC and to the VXI-USB, as shown in Figure 2-2. You can use any available USB port on the PC for each device. The VXI-USB has two external ports for devices. You can connect any other USB devices to any available port on a VXI-USB, but for best performance, minimize the number of USB devices/hubs in the system. Adding to the number of devices in the tree degrades system performance.

Note Your VXI-USB controller is a Hi-Speed USB device, which means it performs much faster when connected to a Hi-Speed USB port as described in the USB 2.0 specification. USB 2.0 ports are often integrated on the motherboard of current computers. National Instruments recommends using an integrated USB 2.0 port, if available, for optimal

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performance. Plug-in boards with USB 2.0 ports are also supported but may not provide the highest performance. Full-speed (USB 1.*x*) ports are supported as well, but provide much lower performance. The LINK light (refer to Chapter 1, *Introduction*) on the front panel of your VXI-USB controller indicates your connection speed.

Software Configuration and Verification

To configure the software and verify the configuration, follow these steps:

1. Run MAX. You must run the Resource Manager (Resman) every time the chassis or computer power is cycled, so that your application can access devices in the VXI chassis. You can also configure MAX to run Resman automatically at every computer startup by selecting **Tools»NI-VXI»VXI Options** and selecting the appropriate checkbox.
2. You can also use MAX to interactively configure the National Instruments hardware in your system. Use the right-click help for information about the various configuration options. After you finish configuring the system through MAX, verify the configuration through the interactive control utility, VISAIC (**Start»Programs»National Instruments»VISA»VISA Interactive Control**), as described in Chapter 3, *Developing Your Application*.

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. Also, if you are using multiple VXI-USB controllers to create a multisystem configuration, you configure each system separately.

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3

Developing Your Application

This chapter discusses the software utilities you can use to start developing applications that use NI-VXI.

After installing the NI-VXI software, you can begin developing your VXI/VME application. Be sure to check the release notes for the latest application development notes and changes.

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* is the software package that ships with National Instruments VXI and VME controllers. NI-VXI includes Measurement & Automation Explorer (MAX), NI-VISA, NI Spy, 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 is not part of the default NI-VXI installation. The NI-VXI API 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. If you must develop an application using the older NI-VXI API, run the NI-VXI installer and perform a Complete install, or select the appropriate option in the custom installation screen. Be sure to review the *NI-VXI API Notes* section.
- 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

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provide a high level of performance; however, there may be some slight changes in behavior for certain applications.

Your software features several system development utilities including MAX, Resman, NI Spy, 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.

Configuration

The configuration utilities in your software kit are Resman and MAX. Resman performs VXI Resource Manager functions as described in the VXIbus specification. Resman configures all devices on the VXI backplane for operation and allocates memory for devices that request it. Resman does not require you to specify any settings; it automatically performs the VXI resource management whenever you run it.

Note Power cycling resets all devices, so you must run Resman to reconfigure your system every time you cycle the power on the chassis.

MAX presents a graphical display of your entire test and measurement system to help you configure various components. When you launch MAX, you see all your devices (including VXI) on the screen. You can view the properties (such as logical address, address space, and so on) of each device by clicking the device in the configuration tree. To see additional configuration options for a given device, right-click the device in the configuration tree. When you access the properties of most National Instruments devices by right-clicking, you can configure the hardware settings by selecting **Hardware Configuration**.

MAX and Resman are designed to work together. You can run Resman through MAX by either clicking the Run VXI Resource Manager button in the toolbar or right-clicking a specific VXI system on which to run Resman, as shown in Figure 3-1. You can also select **Tools»NI-VXI»VXI Resource Manager** to run Resman on all VXI systems. From the VXI Options dialog box in the **Tools»NI-VXI** menu, you can also use MAX to configure Resman to run on all VXI systems automatically when the computer boots.

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Resman reports to MAX all errors it finds in your system. When you view your VXI system in MAX, you can easily spot any errors that Resman found while configuring the system.

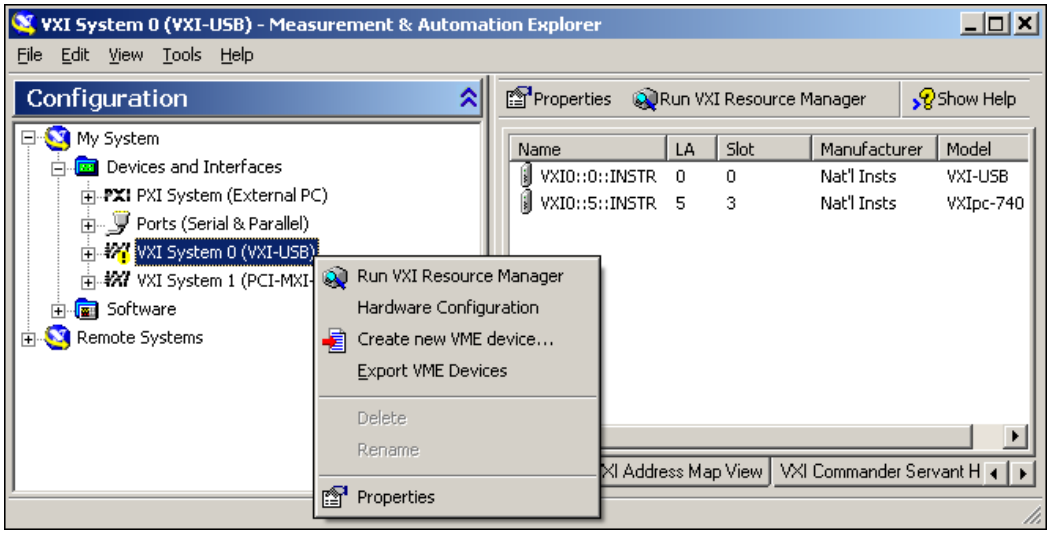


Figure 3-1. Right-Click a VXI System in MAX to Run Resman on that System

After Resman detects and configures all your VXI/VME devices, you can use MAX to view specific information about each device in your system. The default MAX view of a VXI system shows the General tab window, which contains a summary of key information about each device, including its device name, logical address, model name, and other data. For more information about MAX, refer to its online help by selecting the **Help»Help Topics** menu.

Device Interaction

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.

Note You can also use VXI Interactive Control Program (VIC) to control your VXI/VME devices and develop and debug VXI application programs. VIC is not included in the default NI-VXI installation. To install VIC, choose either a **Complete** install or select **NI-VXI API Development** from the custom installation screen in the installer. You can

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launch VISAIC (or VIC) from the **Tools** menu in MAX or from the **VISA** or **VXI** subgroups in **Start»Programs»National Instruments**.

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.

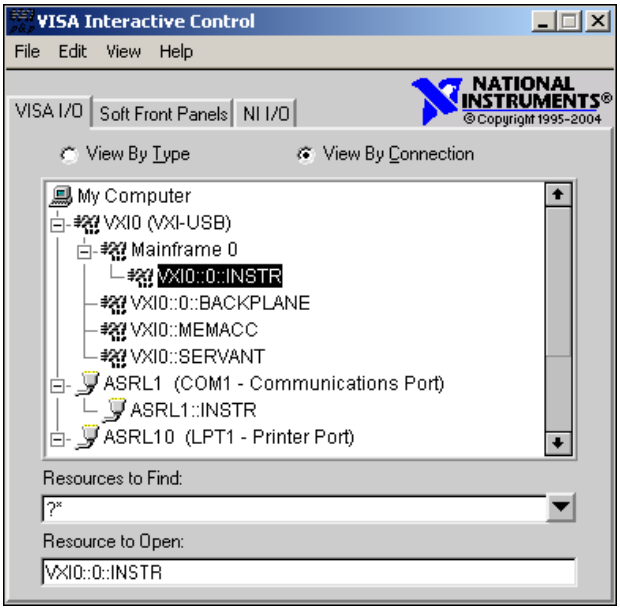


Figure 3-2. Select Your Controller in VISAIC

Open the selected resource and navigate to the Register I/O tab. In this tab, you can read registers on your device, such as the VXI device configuration registers. Execute the viIn operation (called In in LabVIEW compatibility mode) with the default parameters. The Data Value field shows the I/O operation result, such as `0x9ff6`. The Return Value field shows the function status, such as 0 for `VI_SUCCESS`, as shown in Figure 3-3.

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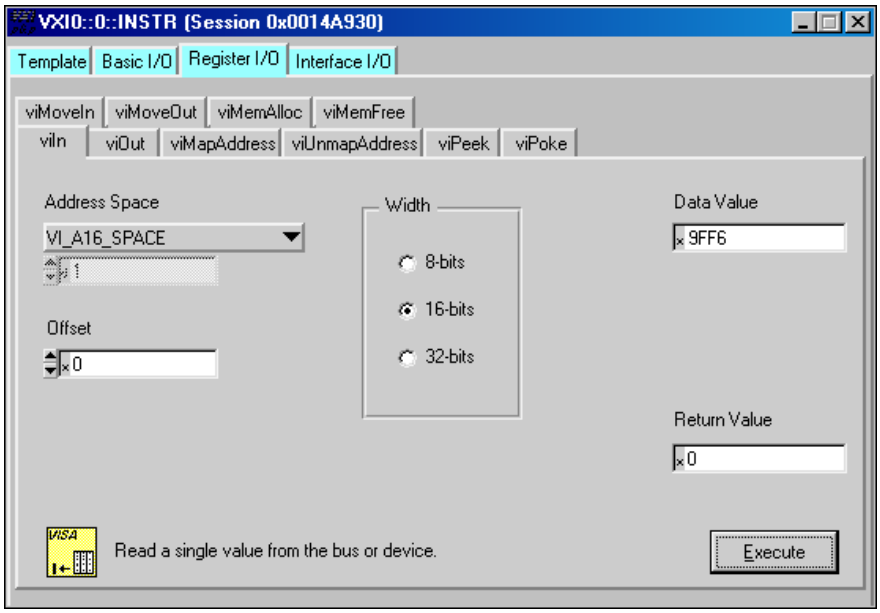


Figure 3-3. Successful viIn Access in the VISAIC Register I/O Tab (This Window May Look Slightly Different for LabVIEW Users)

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 right-clicking in any panel.

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.

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Older programs that use the NI-VXI API now use the NI-VXI-to-NI-VISA compatibility layer to communicate with the VXI devices. Using this layer, older programs can run in NI-VXI 3.0 or later without being rewritten to use the VISA interface.



Note The NI-VXI API development environment is not installed by default as part of the NI-VXI installation. If you must develop an application using the older NI-VXI API, run the NI-VXI installer and perform a Complete install or select the appropriate option in the custom installation screen. Be sure to review the *NI-VXI API Notes* section.

NI-VISA is the National Instruments implementation of the VXI*plug&play* standard defines. It provides a common interface to many types of instruments (such as VXI, GPIB, PXI, Serial, TCP/IP, and so on) and therefore is especially useful in situations where you are using multiple types of instruments.

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 `VXIpnp\WinNT\NIvisa\Examples` directory.

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 files are in the `VXIpnp\WinNT\NIvisa\Examples` directory, in the subdirectories listed below.

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

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

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NI-VXI API Notes

The following notes apply only if you are using the NI-VXI API. We recommend 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.

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

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are receiving triggers on an external controller, you may need to modify the trigger configuration on your extender module using MAX. 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.

Debugging

NI Spy and VISAIC are useful utilities for identifying the causes of problems in your application.

NI Spy tracks the calls your application makes to National Instruments programming interfaces, including NI-VISA, NI-VXI, and NI-488. NI Spy highlights functions that return errors, so during development you can quickly spot which functions failed during a program's execution. NI Spy can log the calls your program makes to these drivers so you can check them for errors at your convenience, or use the NI Spy log as a reference when discussing the problem with National Instruments technical support. Figure 3-4 shows an example of an error returned from a call to `viMemAlloc`.

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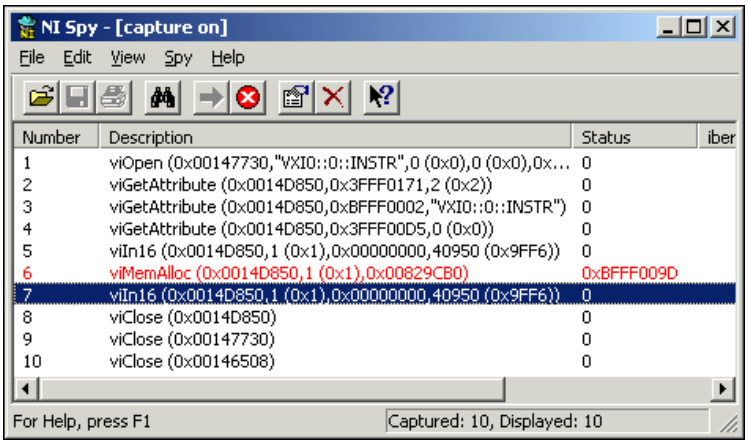


Figure 3-4. NI Spy

VISAIC, discussed in the *Device Interaction* section, is an excellent platform for quickly testing instruments and learning how to communicate with them.

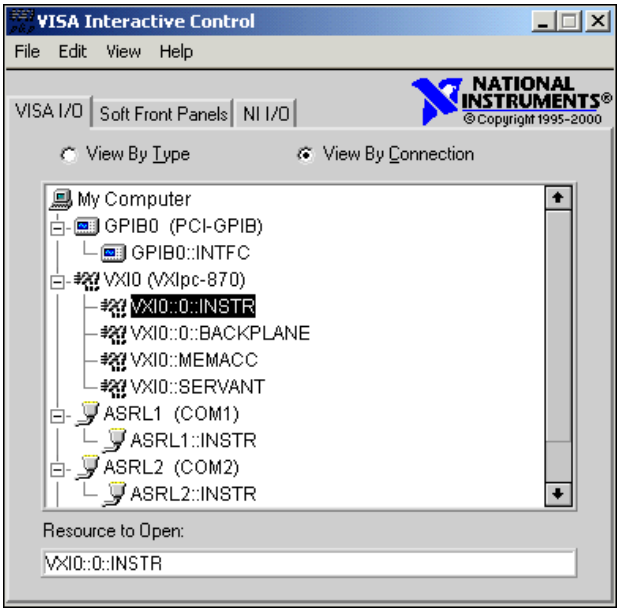


Figure 3-5. VISAIC

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A

Specifications

This appendix lists the specifications for the VXI-USB module.

Requirements

VXIbus configuration space..... 64 B

Default..... None

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.)

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

Storage Environment

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

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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Shock and Vibration

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

Random vibration

- Operating .....5 to 500 Hz, 0.3 g_{rms}
- Nonoperating .....5 to 500 Hz, 2.4 g_{rms} (Tested in accordance with IEC-60068-2-64. Nonoperating test profile exceeds the requirements of MIL-PRF-28800F, Class 3.)

Power Requirement

+5 V (excluding downstream USB devices)

- Typical.....2 A
- Maximum .....4 A

–5.2 V

- Typical.....200 mA
- Maximum .....500 mA

–2 V

- Typical.....100 mA
- Maximum .....250 mA

Physical

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

Dimensions ..... 23.3 × 43.0 cm (9.2 × 13.4 in.)

Weight .....1.14 kg (2.5 lb)

I/O connectors

- USB device (Series A).....2
- USB host (Series B).....1
- SMB.....3

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

Compatibility ..... Fully compatible with VXI specification

VXI keying class ..... Class 1 TTL

MTBF ..... Contact factory

USB Capability Description

USB 2.0, backward compatible with USB 1.1 host and devices.

Safety

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

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

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

Electromagnetic Compatibility

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

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

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

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

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CE Compliance

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

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

Electromagnetic Compatibility
Directive (EMC).....89/336/EEC

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

Cleaning

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

VMEbus Capability Codes

A64, A32, A24, A16 (master)
VMEbus master A64, A32, A24, and A16 addressing

A16 (slave)
VMEbus slave A16 addressing

D64, D32, D16, D08(EO) (master)
VMEbus master D64, D32, D16, and D08 data sizes

D16, D08(EO) (slave)
VMEbus slave D16 and D08 data sizes

BLT, MBLT (master)
VMEbus master block and D64 transfers

RMW (master)
VMEbus master read/modify/write transfers

RMW (slave)
VMEbus slave read/modify/write transfers

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RETRY (master)
VMEbus master retry support

RETRY (slave)
VMEbus slave retry support

FSD
First slot detector

SCON
VMEbus System Controller (Automatic Detection)

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)

LOCK
Can lock the VMEbus for indivisible transfers

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B

Default Settings

This appendix summarizes the default settings for the hardware and software in the VXI-USB kit. If you need more information about a particular setting or want to try a different configuration, refer to Appendix C, *Advanced Hardware Configuration Settings*, for your hardware reference and to the MAX online help for your software reference.

Default Hardware Settings

Figure B-1 and Table B-1 show the factory-default settings of the user-configurable switches on the VXI-USB.

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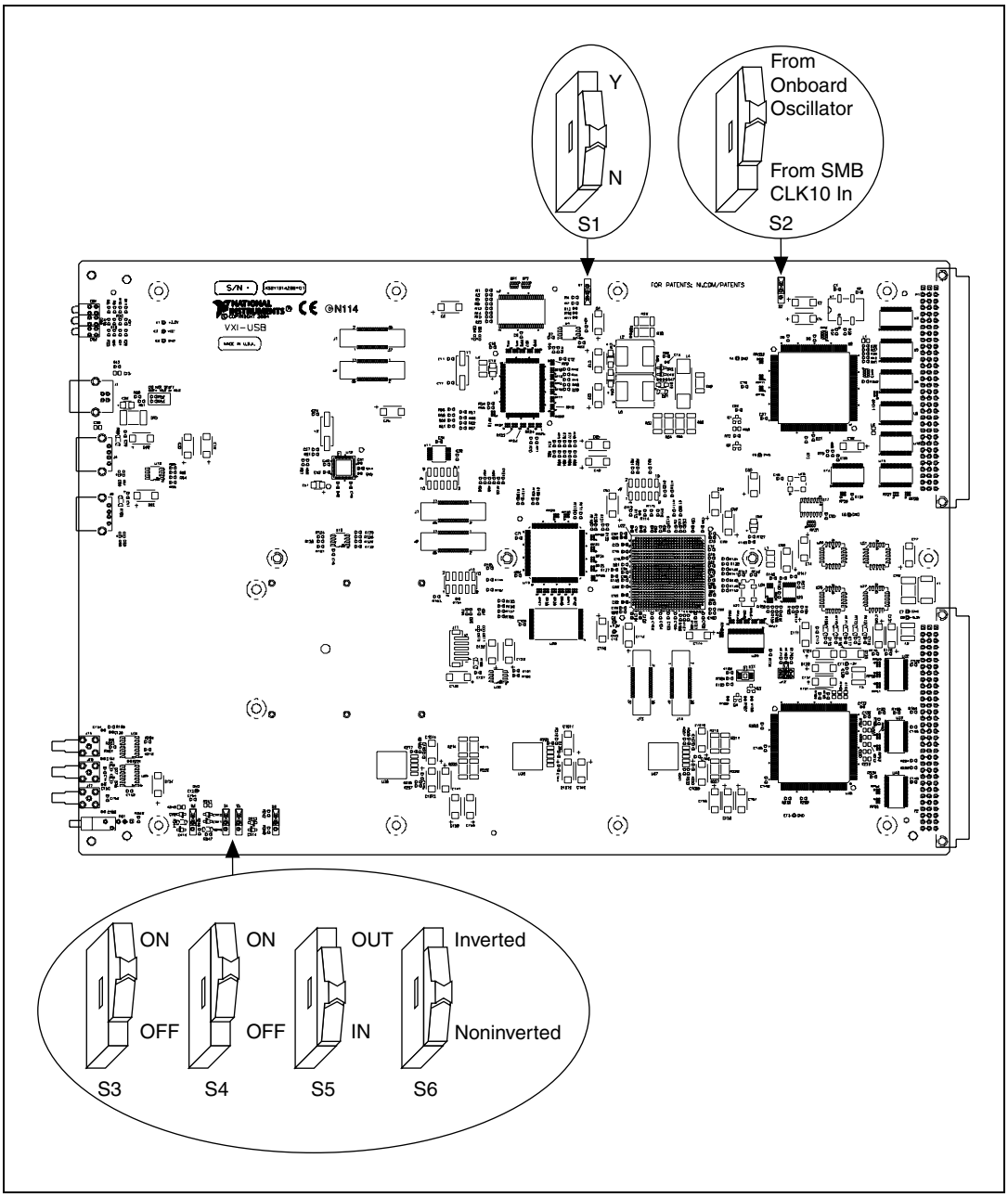


Figure B-1. VXI-USB Default Configuration Settings

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Table B-1. VXI-USB Hardware Default Settings

Hardware Component	Default Setting
S1—Firmware recovery	N: do *not* recover firmware
S2—VXIbus CLK10 source	From onboard oscillator
S3—SMB trigger in termination	ON: terminated
S4—SMB CLK10 in termination	ON: terminated
S5—SMB CLK10 direction	IN: receive CLK10 signal
S6—SMB CLK10 out polarity	Noninverted

Default Software Settings

Table B-2. MAX USB Tab Default Settings

Editor Field	Default Setting
USB block size	64 KB

Table B-3. MAX VXI Bus Tab Default Settings

Editor Field	Default Setting
Bus timeout value	500 µs
VXI retry generation	Enabled
Automatic retries	Disabled
A24/A32 write posting	Disabled
Transfer limit (bytes)	256/2048 for 2eVME protocol
Requester mode	Release on Request
Request level	3
Fair requester	Enabled
Bus arbitration mode	Prioritized
Arbiter timeout	Enabled

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C

Advanced Hardware Configuration Settings

This appendix describes the alternate hardware configuration settings of the VXI-USB. The board is set at the factory for the most commonly used configuration. Use this appendix if you want to try a different hardware configuration or if you would like more information on a particular setting. This information is intended for more advanced users.

The following hardware configuration settings are user configurable.

- Firmware recovery
- VXIbus CLK10 routing
- Trigger input termination

For the configuration switch locations and default settings, see Figure B-1, *VXI-USB Hardware Default Settings*.

Note Do *not* attempt an alternate setting unless you are familiar with its purpose. In addition, do not reconfigure any switches or jumpers not described in this appendix unless directed by National Instruments support.

Firmware Recovery

The VXI-USB has an onboard EEPROM and flash memory that stores default hardware behaviors loaded at power-on.

The Firmware Recovery Setting switch (S1) causes the VXI-USB to boot from the firmware image stored on the host. This is useful in the event that the onboard firmware memory becomes corrupted in such a way that the VXI-USB boots to an unusable state.

Figure C-1 shows the configuration settings for firmware recovery operation.

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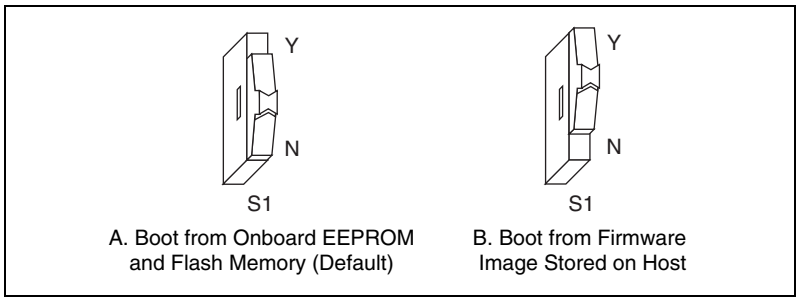


Figure C-1. Firmware Recovery Operation

VXIbus CLK10 Routing

The VXI-USB has four hardware switches that work together to control various aspects of CLK10 routing. Read this section carefully and notice that if you change one switch, you may need to change another. This section includes several diagrams that show how to configure the four switches to accomplish various CLK10 configurations.

Notice that the configuration of one switch may make the setting of another switch irrelevant. The drawings use the ▨ pattern to depict switches that are either irrelevant or disabled for a particular CLK10 configuration.

Switch S3 uses this pattern in all of the CLK10 drawings. It deals with the external trigger input SMB and is discussed later in this appendix.

The VXI-USB can use two different sources to generate the VXIbus CLK10 signal—an onboard oscillator or the external CLK SMB connector. Use switch S2 to select between these options. The VXI-USB uses the onboard oscillator by default.

The VXI-USB can also be configured to drive the external CLK SMB from the VXIbus CLK10 signal. Switch S5 controls whether the VXI-USB drives or receives the external CLK SMB. If you change the S5 setting to drive CLK10 out the external CLK10 SMB connector, do not set switch S2 to receive the SMB CLK10 signal. Instead, use its default setting so that the onboard oscillator generates the signal.

You can use an additional switch, S6, to control the polarity of the external CLK SMB signal when S5 is configured to drive it. S6 is unused when S5 is configured to receive the external CLK SMB signal.

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When switch S5 is set so that the VXI-USB receives the SMB CLK10 signal, you have the option to add a 50 Ω termination to the signal by setting switch S4. S4 is unused when S5 is configured to drive the external CLK SMB signal.

Table C-1 summarizes the most common configuration types.

Table C-1. Common CLK10 Routing Configurations

Description	Switches			
	S2 CLK10 Source	**S4 Terminate**	**S5 Direction**	**S6 Polarity**
Generate internal CLK10 with onboard oscillator	ONBRD	N/A	IN	N/A
Generate internal CLK10 and drive to external CLK SMB	ONBRD	N/A	OUT	NON
Generate internal CLK10 and drive inverted to external CLK SMB	ONBRD	N/A	OUT	INV
Receive external CLK SMB and drive to the backplane unterminated	SMB	N	IN	N/A
Receive external CLK SMB with 50 Ω termination and drive to the backplane	SMB	Y	IN	N/A

Figure C-2 shows the default settings for the CLK10 switches. This configuration is as follows:

- CLK10 is generated from the onboard oscillator (S2).
- The CLK10 signal is terminated (S4).
- The VXI-USB receives the external CLK10 signal (S5).
- The polarity of the CLK10 signal (S6) is irrelevant when the VXI-USB receives the external CLK10 signal. However, it is configured to be noninverted when the CLK10 SMB is used as output.

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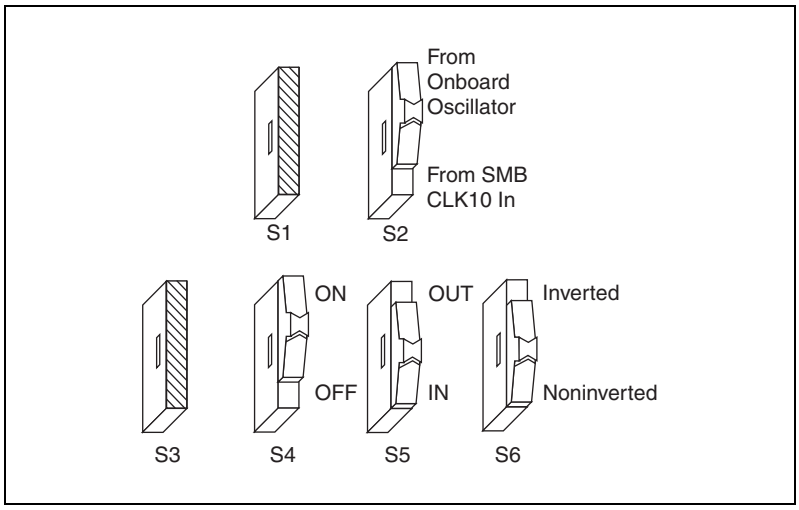


Figure C-2. Default Settings for CLK10 Switches

In Figures C-3 and C-4, switch S2 uses the alternate configuration to generate the VXIbus CLK10 signal. Instead of the onboard oscillator, the VXI-USB generates from the external CLK SMB connector and drives to the backplane. You can choose whether to terminate the signal using S4. Polarity remains irrelevant to these configurations.

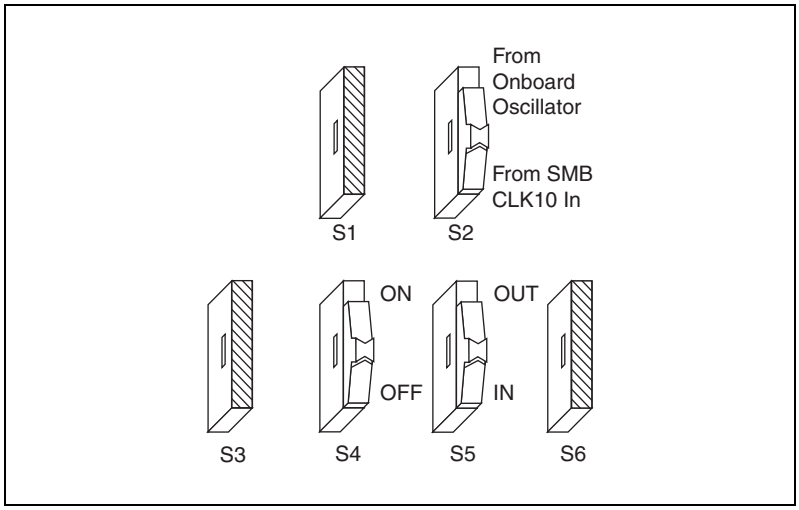


Figure C-3. Receive External CLK SMB and Drive to the Backplane Unterminated

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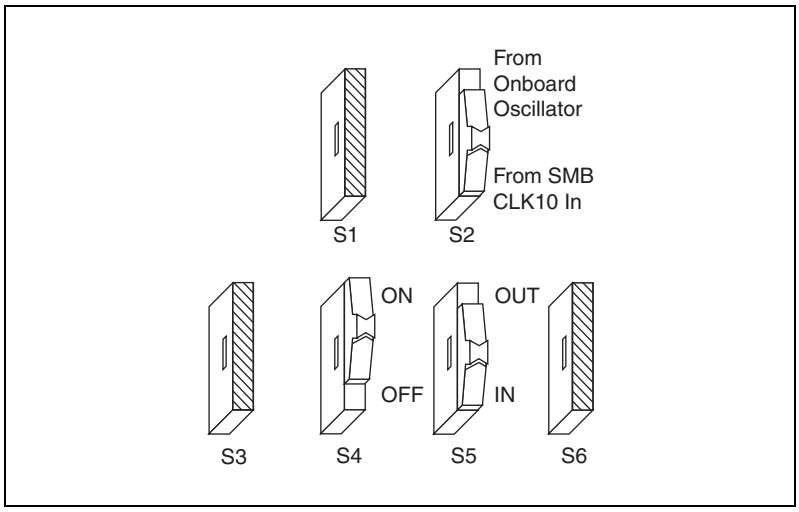


Figure C-4. Receive External CLK SMB with 50 Ω Termination and Drive to the Backplane

Figures C-5 and C-6 show two configurations for driving the external CLK SMB from the VXIbus CLK10 signal by changing switch S5 to its alternate setting. Switch S2 must be in its default position for these configurations. Signal termination is not an issue when driving the signal, so the position of S4 does not matter. The difference between these two configurations is whether to use inverted or noninverted polarity when driving the signal.

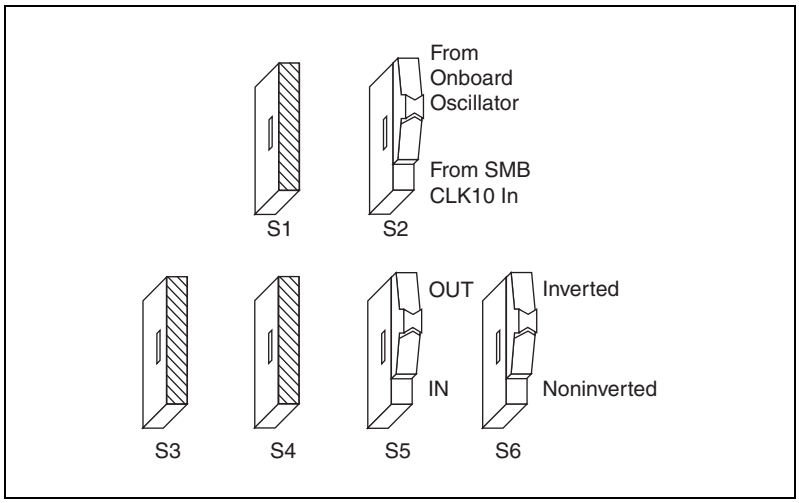


Figure C-5. Drive Inverted External CLK SMB

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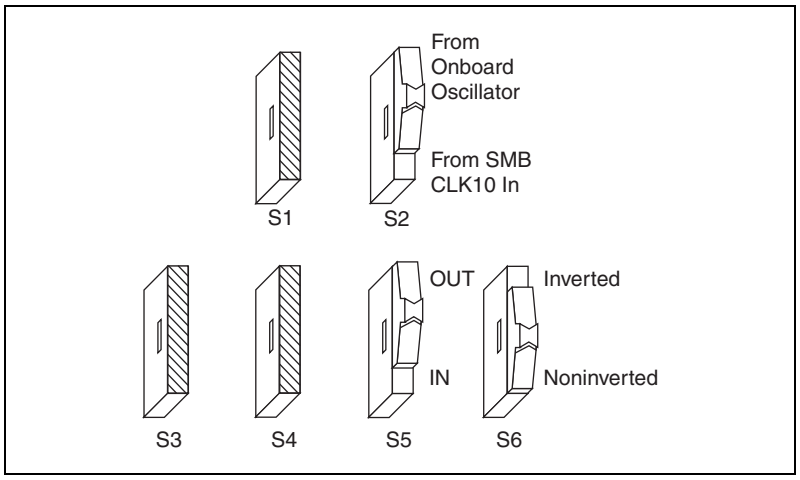


Figure C-6. Drive Noninverted External CLK SMB

Trigger Input Termination

Located within the group of CLK10 switches is switch S3, which controls whether to put a 50 Ω termination on the external trigger input SMB. Figure C-7 shows the setting for a nonterminated trigger input SMB. Use the default setting of Figure C-7B to terminate the trigger input SMB.

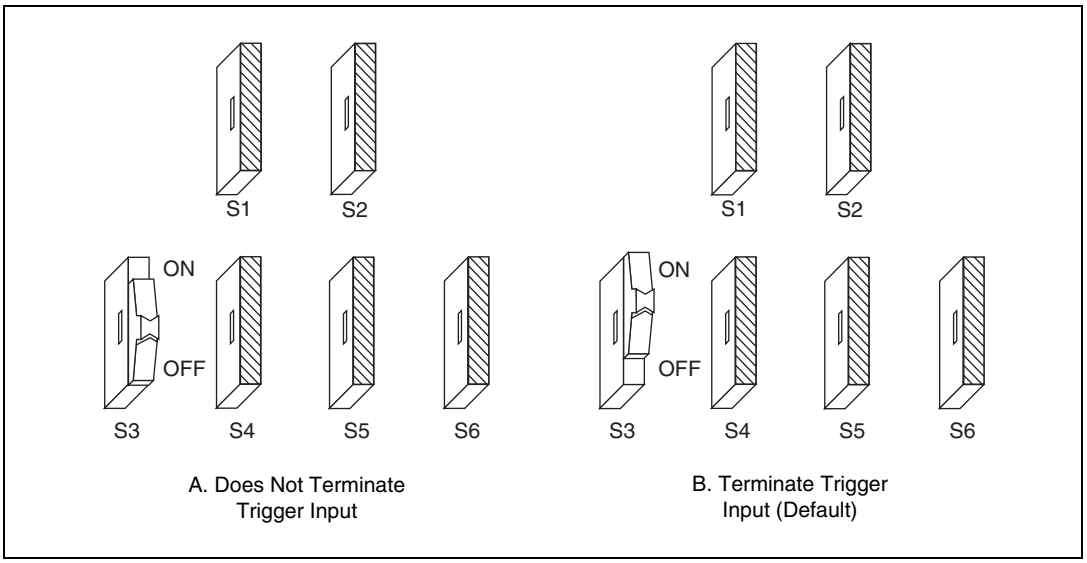


Figure C-7. SMB Trigger Input Termination

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D

Common Questions

This appendix addresses common questions you may have about using the NI-VISA/NI-VXI software on the VXI-USB platform.

What does hot plugging mean in terms of USB?

The concept of hot plugging in USB means that you can remove and insert USB cables without powering down your computer and devices. The USB Plug and Play architecture is designed so that the host computer can recognize when to load and remove the appropriate drivers.

Does it matter if I plug my VXI-USB or other USB device into any particular USB port? For example, does it matter whether I plug a USB device into the USB ports in my computer or into the VXI-USB in my mainframe?

A USB device may be plugged into any port on the VXI-USB or your computer. Doing so can change the topology of the system, which may affect system performance in some cases. The effect may vary greatly, depending on the system and types of devices installed.

Also, if your computer has integrated USB 2.0, you should use one of the integrated ports rather than a USB 2.0 plug-in card if possible. Integrated USB 2.0 ports typically offer better performance due to their tight coupling with your motherboard and chipset. Of course, if you have the choice between a USB 2.0 port and a USB 1.*x* port, always use the USB 2.0 port even if that means you are using a plug-in card instead of an integrated port.

I need more devices than can fit in one chassis. How can I expand my VXI-USB system?

You can add another VXI-USB to the system, but the additional chassis will not share the same VXI bus. The recommended strategy is to use a VXI-MXI-2, which follows the VXI-6 specification for mainframe extension. This extends full VXI functionality across multiple mainframes, including a common device address space and interframe triggering, interrupts, and bus mastering. Place a VXI-MXI-2 in the same frame as the Slot 0 VXI-USB, and another VXI-MXI-2 in Slot 0 of the next mainframe. You can then fill up this mainframe with additional devices.

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How can I determine the serial number and firmware version of the VXI-USB module?

This information is displayed in the title bar of the Hardware Configuration window in MAX.

What is Resman?

Resman is the utility that performs the duties of a VXI Resource Manager as discussed in the VXIbus specification. 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. The VXI-USB is always logical address 0.

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). You do not need to run Resman if you unplug your USB cable from the host and plug it in again without power cycling either the chassis or the host computer.

Which NI-VXI utility program must I use to configure the VXI-USB?

Use MAX to configure the VXI-USB. 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 startup.

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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 VXI-USB 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 do the LEDs on the front of the VXI-USB mean?

The VXI-USB has the following front panel LEDs:

- **FAILED**—Indicates the VXI-USB is asserting SYSFAIL on the bus due to a controller failure.
- **SYSFAIL**—Indicates the VMEbus SYSFAIL line is asserted by the VXI-USB or another device on the bus.
- **VXI**—Indicates the VXI-USB is being accessed as a VXI slave.
- **ONLINE**
  - **Green**—Indicates the VXI-USB is configured by Resman.
  - **Amber**—Indicates the VXI-USB is not configured by Resman.
- **USB**—Indicates there is USB traffic to/from the VXI-USB (this excludes any traffic to all other downstream USB devices).
- **LINK**
  - **Green**—Indicates the VXI-USB is connected to a USB host and has a full-speed (USB 1.*x*, 12 Mbps) connection.
  - **Amber**—Indicates the VXI-USB is connected to a USB host and has a high-speed (USB 2.0, 480 Mbps) connection.

When all six LEDs are solid on, the FPGA image is corrupted. Recover the firmware to repair the board.

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When all LEDs except the SYSFAIL LED are on, the hardware detected that the FPGA PLL lost lock, and the board may be in an unstable state. Power cycle the board to repair it.

In an empty chassis, when both the SYSFAIL and FAIL LEDs are solid on, the firmware image is corrupted. Recover the firmware to repair the board.

What kind of signal is CLK10 and what kind of signal do I need for an external CLK10?

CLK10 is a differential ECL signal on the VXIbus backplane. However, the oscillator for the VXI-USB and the EXT CLK input from the front panel use TTL. Therefore, supply a TTL-level signal for EXT CLK, and onboard voltage converters automatically convert the signal to differential ECL.

What is the accuracy of the CLK10 signal?

The CLK10 generated by the VXI-USB is ±100 ppm accurate. If you need a more accurate CLK10 signal, you can use the EXT CLK input at the front of the VXI-USB.

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E

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

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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.

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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.

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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 VXI-USB, 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 VXI-USB to act as a translator between USB and VXI protocols.

G

g	(1) grams (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.

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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.

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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.

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.

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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.

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* 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* 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.

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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

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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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