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VME-MXI

**Getting Started with Your
VXI-AT2023 and the NI-VXI™
Software for ISC 386/ix**



December 1992 Edition

Part Number 320267-01

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- The limits for a Class A computing device, in accordance with the specifications in Part 15 of U.S. Federal Communications Commission (FCC) Rules. Operation is subject to the following two conditions:
 - This device may not cause harmful interference.
 - This device must accept any interference received, including interference that may cause undesired operation.
- The limits for radio noise emissions from digital apparatus set out in the Radio Interference Regulations of the Canadian Department of Communications (DOC).

These regulations are designed to provide reasonable protection against interference from the equipment to radio and television reception in commercial areas.

There is no guarantee that interference will not occur in a particular installation. However, the chances of interference are much less if the equipment is used according to this instruction manual.

If the equipment does cause interference to radio or television reception, which can be determined by turning the equipment on and off, one or more of the following suggestions may reduce or eliminate the problem.

- Operate the equipment and the receiver on different branches of your AC electrical system.
- Move the equipment away from the receiver with which it is interfering.
- Relocate the equipment with respect to the receiver.
- Reorient the receiver's antenna.
- Be sure that the equipment is plugged into a grounded outlet and that the grounding has not been defeated with a cheater plug.

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

If necessary, consult National Instruments or an experienced radio/television technician for additional suggestions. The following booklet prepared by the FCC may also be helpful: *How to Identify and Resolve Radio-TV Interference Problems*. This booklet is available from the U.S. Government Printing Office, Washington, DC 20402, Stock Number 004-000-00345-4.

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About This Manual

This manual contains instructions for installing and configuring the National Instruments VXI-AT2023 interface kit and the NI-VXI software for the ISC 386/ix Operating System. This manual is meant to be used with the *NI-VXI Software Reference Manual for C* (part number 320307-01) and the *NI-VXI Text Utilities Reference Manual* (part number 320321-01).

Organization of This Manual

Getting Started with Your VXI-AT2023 and the NI-VXI Software for ISC 386/ix is organized as follows:

- Chapter 1, *Introduction*, describes the VXI-AT2023 interface kit and lists the contents of your kit and optional equipment.
- Chapter 2, *Hardware Configuration and Installation*, contains the instructions to configure and install the VXI-AT2023 interface kit.
- Chapter 3, *NI-VXI Software Installation and Configuration*, lists the programs and files located on the NI-VXI distribution diskette, contains instructions for installing and configuring the NI-VXI software for ISC 386/ix, and contains a description of the `vxitedit` configuration editor.
- Appendix A, *Specifications*, lists various module specifications of the AT-MXI and VXI-MXI, such as physical dimensions and power requirements.
- Appendix B, *Customer Communication*, contains forms you can use to request help from National Instruments or to comment on our products and manuals.
- The *Glossary* contains an alphabetical list and description of terms used in this manual, including abbreviations, acronyms, metric prefixes, and symbols.

Conventions Used in This Manual

The following conventions are used to distinguish elements of text throughout this manual:

| | |
|---------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <i>italic</i> | Italic text denotes emphasis, a cross reference, or an introduction to a key concept. |
| monospace | Text in this font denotes text or characters that are to be literally input from the keyboard, the proper names of disk drives, paths, directories, programs, subprograms, device names, filenames and extensions, and for statements and comments taken from program code. |

Abbreviations, acronyms, metric prefixes, mnemonics, symbols, and terms are listed in the *Glossary*.

How to Use This Documentation Set

We suggest that you begin by reading this manual to guide you through the installation and configuration of the hardware and software. The software configuration requires that you first complete the installation and configuration of the hardware.

When you are familiar with the material in this manual, you can begin to use the *NI-VXI Software Reference Manual for C*. Chapter 1, *Introduction to VXI*, and Chapter 2, *Introduction to the NI-VXI Functions*, present the concepts of VXI and prepare you for detailed explanations of the NI-VXI functions. Study the descriptions of each function given in Chapters 3 through 13 to fully understand the purpose and syntax of each function. Refer to the *NI-VXI Text Utilities Reference Manual* to learn more about the `victext` and `vxitedit` programs.

Related Documentation

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

- *IEEE Standard for a Versatile Backplane Bus: VMEbus*, ANSI/IEEE Standard 1014-1987
- *VXI-1, VXIbus System Specification*, Rev. 1.4, VXIbus Consortium (available from National Instruments Corporation, part number 350083-01)
- *VXI-6, VXIbus Mainframe Extender Specification*, Rev. 1.0, VXIbus Consortium (available from National Instruments Corporation, part number 340258-01)
- *VXI-MXI User Manual* (part number 320222-01)

Customer Communication

National Instruments wants to receive your comments on our products and manuals. We are interested in the applications you develop with our products, and we want to help if you have problems with them. To make it easy for you to contact us, this manual contains comment and configuration forms for you to complete. These forms are in Appendix B, *Customer Communication*, at the end of this manual.

Chapter 1

Introduction

This chapter describes the VXI-AT2023 interface kit and lists the contents of your kit and optional equipment.

The VXI-AT2023 is an interface kit that links any IBM Personal Computer AT or compatible computer (hereafter referred to as the PC AT) directly to the VXIbus. A PC AT equipped with a VXI-AT2023 can function as a VXI Commander and Resource Manager. The VXI-AT2023 makes the PC AT appear as though it were plugged directly into the VXI backplane as an embedded CPU VXI module.

What Your Kit Should Contain

Your kit should contain the following components:

| Component | Part Number |
|--------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------|
| AT-MXI Interface Board | 180775-01 |
| Standard VXI-MXI Interface Module or Enhanced VXI-MXI Interface Module with INTX option | 181045-01 181045-02 |
| 3.5 in. NI-VXI Distribution Diskette for the AT-MXI and ISC 386/ix and 5.25 in. NI-VXI Distribution Diskette for the AT-MXI and ISC 386/ix | 422184-48 420184-48 |
| 2 m Type M1 MXIbus Cable * | 180758-02 |
| <i>Getting Started with Your VXI-AT2023 and the NI-VXI Software for ISC 386/ix</i> | 320267-01 |
| <i>NI-VXI Software Reference Manual for C</i> | 320307-01 |
| <i>NI-VXI Text Utilities Reference Manual</i> | 320321-01 |

* The 2 m Type M1 MXIbus cable is included in your kit unless you specified otherwise in your order. You may have ordered your kit without this cable so that you could order a different type or length of MXIbus cable. Refer to the *Optional Equipment* section on the following page.

Make sure each of these items is in your kit. If any item is missing, contact National Instruments.

Optional Equipment

| Equipment | Part Number |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------|
| Type M1 MXIbus Cables Straight Point-to-Point Connectors: <ul style="list-style-type: none"> – 1 m – 2 m – 4 m – 8 m – 20 m | 180758-01 180758-02 180758-04 180758-08 180758-20 |
| Type M2 MXIbus Cables Straight Point-to-Right Angle Daisy-Chain Connectors: <ul style="list-style-type: none"> – 1 m – 2 m – 4 m – 8 m – 20 m | 180760-01 180760-02 180760-04 180760-08 180760-20 |
| Type M3 MXIbus Cables Right Angle Point-to-Right Angle Daisy-Chain Connectors: <ul style="list-style-type: none"> – 1 m – 2 m – 4 m – 8 m – 20 m | 180761-01 180761-02 180761-04 180761-08 180761-20 |
| MXIbus Terminating Pac (External) | 180780-01 |
| VXI-MXI Standard VXIbus Mainframe Extender Kit | 776310-01 |
| VXI-MXI Enhanced VXIbus Mainframe Extender Kit | 776310-02 |
| VME-MXI Standard VMEbus Chassis Extender Kit | 776434-01 |
| VME-MXI Enhanced VMEbus Chassis Extender Kit | 776434-02 |

Chapter 2

Hardware Configuration and Installation

This chapter contains the instructions to configure and install the VXI-AT2023 interface kit. The instructions are given in the order that you should perform them. A summary of the steps is as follows:

1. Unpack the AT-MXI and VXI-MXI hardware.
2. Configure the AT-MXI hardware.
3. Install the AT-MXI hardware.
4. Configure the VXI-MXI hardware.
5. Install the VXI-MXI hardware.
6. Connect the MXIbus cable.

Step 1. Unpack the AT-MXI and VXI-MXI

Follow these steps when unpacking your AT-MXI board and VXI-MXI module:

1. Before attempting to configure or install the AT-MXI and VXI-MXI, inspect the shipping container and its contents for damage. If damage appears to have been caused in shipment, file a claim with the carrier. Retain the packing material for possible inspection and/or for reshipment.
2. Verify that the pieces contained in the package you received match the kit parts list. *Do not* remove the boards from their plastic bags at this point.
3. Your AT-MXI board and VXI-MXI module are shipped packaged in antistatic plastic bags to prevent electrostatic damage. Some of the circuitry on the AT-MXI and VXI-MXI use CMOS technology and can be damaged by electrostatic discharge. Before removing the boards from their antistatic bags, touch the bags to a metal part of your computer chassis.
4. As you remove the AT-MXI and VXI-MXI from their bags, be sure to handle them only by their edges. Avoid touching any of the IC components or connectors. Inspect them for loose components or any other sign of damage. Notify National Instruments if either board appears damaged in any way. *Do not* install equipment that appears to be damaged.

Step 2. Configure the AT-MXI Hardware

Figure 2-1 shows the location of the AT-MXI configuration jumpers and switches.

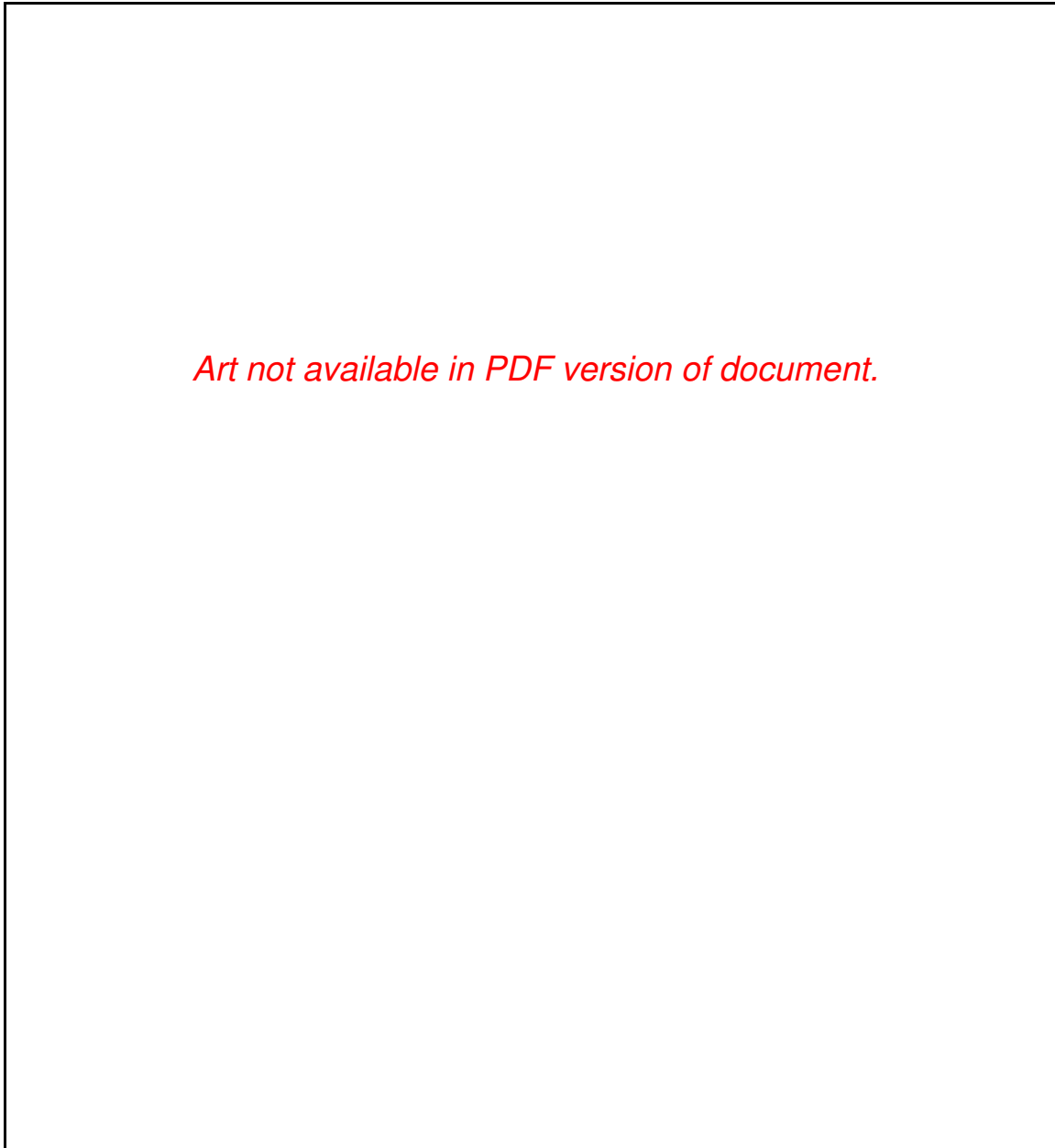


Figure 2-1. AT-MXI Parts Locator Diagram

Switch and Jumper Settings

You can configure three options on the AT-MXI board:

- Base I/O address
- Interrupt levels
- DMA channels

Table 2-1 shows the factory settings and optional configurations for the switches and jumpers on the AT-MXI.

Table 2-1. AT-MXI Factory Default Settings and Optional Configurations

| AT-MXI | Default | Optional |
|------------------------|---------|----------------------------------------------------|
| Base I/O Address (hex) | 340 | 100 to 3E0, increments of 20 hex |
| Master DMA Channel | 6 | 0, 1, 2, 3, 5, 6, 7, and Not Used |
| Slave DMA Channel | 3 | 0, 1, 2, 3, 5, 6, 7, and Not Used |
| Board Interrupt Level | 12 | 3, 4, 5, 6, 7, 9, 10, 11, 12, 14, and 15 |
| MXIbus Interrupt Level | 10 | 3, 4, 5, 6, 7, 9, 10, 11, 12, 14, 15, and Not Used |

The factory-configured settings of the base I/O address, the interrupt levels, and the Direct Memory Access (DMA) channels are suitable for most computer systems. The following sections describe under what conditions you would be required to change the configuration switches and/or jumpers on the AT-MXI and how to make these changes.

Base I/O Address Selection

The base I/O address of the AT-MXI is the starting address of the AT-MXI configuration registers in PC AT I/O space. The base I/O address is determined by the position of the five switches at location U31, as shown in Figure 2-1. The switches are set at the factory for a base I/O address of 340 hex. Because the AT-MXI requires 32 bytes of consecutive I/O space for its internal registers, the factory configuration uses the I/O address space in the range of 340 to 35F hex.

Note: Check to determine that this space is not already used by other I/O interfaces installed in your PC AT computer. If any equipment in your computer uses this I/O address space, you must change either the base I/O address of the AT-MXI or the I/O address space requirements of the other device. All PC AT devices must have a unique partition of the system's I/O address space. If you change the base I/O address of the AT-MXI, you must make a corresponding change to the AT-MXI configuration software as described in the *Configuring the NI-VXI Software* section of Chapter 3 of this manual.

Each switch in U31 (1 through 5) corresponds to one of the PC AT address lines (A5 through A9). The first switch (1) corresponds to address line A5, the next switch (2) corresponds to address line A6, and so on. The five least significant bits of the address (A4 through A0) are used by the AT-MXI to select the appropriate AT-MXI register and cannot be changed; therefore, bits A4 through A0 are always zeros when determining the base I/O address.

To change the base I/O address of the AT-MXI, press the side marked *OFF* to select a binary value of 1 for the corresponding address bit. Press the *ON* side of the switch to select a binary value of 0 for the corresponding address bit. Refer to Table 2-2.

Figure 2-2 shows two possible switch settings.

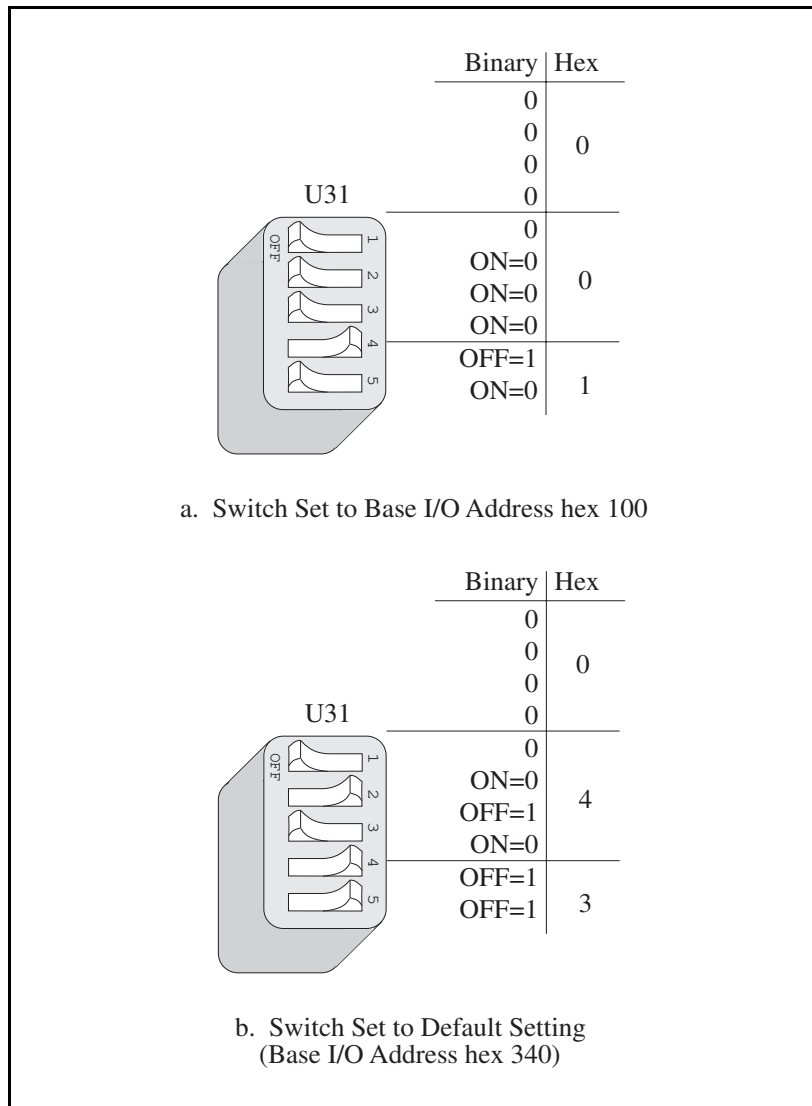


Figure 2-2. Base I/O Address Switch Settings

Table 2-2 lists the 24 possible switch settings, the corresponding base I/O address, and the I/O address space used for that setting. Notice that the base address settings that correspond to an I/O address in the range from 0 to FF hex are not listed. These addresses are used by logic on the PC AT motherboard and cannot be used by I/O adapter modules.

Table 2-2. Possible Base I/O Address Settings for the AT-MXI

| Switch Setting A9 A8 A7 A6 A5 | Base I/O Address (hex) | I/O Ports Used (hex) |
|------------------------------------------|-----------------------------------|---------------------------------|
| 0 1 0 0 0 | 100 | 100 - 11F |
| 0 1 0 0 1 | 120 | 120 - 13F |
| 0 1 0 1 0 | 140 | 140 - 15F |
| 0 1 0 1 1 | 160 | 160 - 17F |
| 0 1 1 0 0 | 180 | 180 - 19F |
| 0 1 1 0 1 | 1A0 | 1A0 - 1BF |
| 0 1 1 1 0 | 1C0 | 1C0 - 1DF |
| 0 1 1 1 1 | 1E0 | 1E0 - 1FF |
| 1 0 0 0 0 | 200 | 200 - 21F |
| 1 0 0 0 1 | 220 | 220 - 23F |
| 1 0 0 1 0 | 240 | 240 - 25F |
| 1 0 0 1 1 | 260 | 260 - 27F |
| 1 0 1 0 0 | 280 | 280 - 29F |
| 1 0 1 0 1 | 2A0 | 2A0 - 2BF |
| 1 0 1 1 0 | 2C0 | 2C0 - 2DF |
| 1 0 1 1 1 | 2E0 | 2E0 - 2FF |
| 1 1 0 0 0 | 300 | 300 - 31F |
| 1 1 0 0 1 | 320 | 320 - 33F |
| 1 1 0 1 0 | 340 (default) | 340 - 35F |

(continues)

Table 2-2. Possible Base I/O Address Settings for the AT-MXI (continued)

| Switch Setting A9 A8 A7 A6 A5 | Base I/O Address (hex) | I/O Ports Used (hex) |
|----------------------------------|---------------------------|-------------------------|
| 1 1 0 1 1 | 360 | 360 - 37F |
| 1 1 1 0 0 | 380 | 380 - 39F |
| 1 1 1 0 1 | 3A0 | 3A0 - 3BF |
| 1 1 1 1 0 | 3C0 | 3C0 - 3DF |
| 1 1 1 1 1 | 3E0 | 3E0 - 3FF |

Interrupt Level Selection

The AT-MXI interface board can use either one or two of the eleven interrupt levels of the PC AT I/O channel. Setting up an interrupt level for operation involves two steps. First you select the interrupt level by arranging the jumpers on an array of pins. Next you enable the interrupt level in the system software.

Note: You must enable the interrupt levels in the system software before they can function. If you do not enable the interrupt level, that level will not be driven and can be used by other devices, regardless of the positions of the jumpers.

Interrupt levels are selected by the position of two jumpers on the 3 by 11 array of pins labeled W3, located above the I/O card-edge connector on the AT-MXI (refer to Figure 2-1). Use the jumper *farther* from the card-edge connector to select the PC AT interrupt level that will convey board status and error information. Remember to enable this level, or board interrupt, in the system software for the AT-MXI to function properly. The factory default setting is level 12 and is enabled on this level by the default configuration software.

Use the jumper on the W3 pin array *closer* to the I/O card-edge connector to select which PC AT interrupt level corresponds to the MXIbus interrupt signal *IRQ**. Because the MXIbus interrupt is also one of the conditions covered by the other jumper, you normally do not need to use a separate interrupt level for the MXIbus *IRQ** signal; it is useful only if you want a different interrupt vector or priority for MXIbus interrupts. This jumper is set at the factory to a default level of 10.

Note: The AT-MXI does not have the ability to share interrupt levels with other devices. If you select an interrupt level by placing a jumper on a particular level and enable that level in software, no other device in the system can use that level. Make sure that no other devices in your system use the interrupt level(s) selected and enabled for use by the AT-MXI. If they do, change the interrupt level(s) of either the AT-MXI or the other devices. If you change an AT-MXI interrupt level, make a corresponding change to the AT-MXI configuration software as described in the *Configuring the NI-VXI Software* section of Chapter 3.

The AT-MXI can use interrupt levels IRQ3, 4, 5, 6, 7, 9, 10, 11, 12, 14, and 15. Be careful when reassigning interrupt levels on the AT-MXI. Notice that most PC ATs use interrupt level 6 for the diskette drive controller and interrupt level 14 for the hard disk drive controller. It is possible that various standard logic devices on the motherboard may use other interrupt levels, so check your computer documentation before changing interrupt levels.

Once you have chosen an interrupt level, place the jumper on the appropriate pins to select that interrupt level. Use the two rows of pins farther from the card-edge connector to select the board interrupt level, and the two rows of pins closer to the card-edge connector to select the MXIbus interrupt level. Figure 2-3a shows the factory default interrupt jumper setting of the AT-MXI, with board interrupt level 12 and MXIbus interrupt level 10.

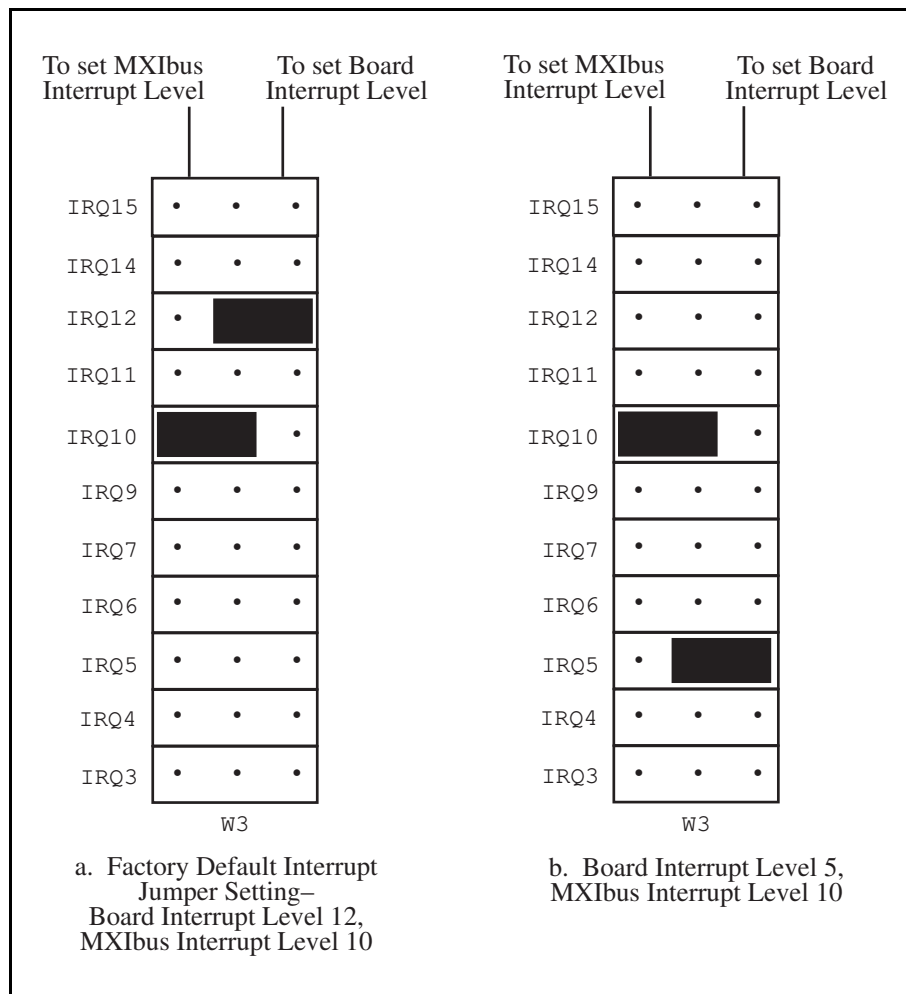


Figure 2-3. Board and MXIbus Interrupt Jumper Settings

To change to another interrupt level, remove the appropriate jumper from its current position and place it on the new posts. Figure 2-3b shows the board interrupt level changed to IRQ5.

DMA Channel Selection

The AT-MXI interface board can use one, two, or none of the seven DMA channels of the PC AT I/O channel. Setting up a DMA channel for operation involves two steps. First you select the DMA channel by arranging the jumpers on an array of pins. Next you enable the DMA channel in the system software.

Note: You must enable the DMA channels in the system software before they can function. If you do not enable the DMA channel, that channel will not be driven and can be used by other devices, regardless of the positions of the jumpers.

Select the DMA channels on the two 3 by 7 arrays of pins labeled *W1* and *W2*, located above the I/O card-edge connector on the AT-MXI (refer to Figure 2-1). Use the *W1* array to select the DMA request line(s), and use the *W2* array to select the DMA acknowledge line(s). You must position two jumpers to select a single DMA channel. The DMA ACKnowledge (*DACK_n*) and DMA ReQuest (*DRQ_n*) lines selected must have the same numeric suffix for proper operation. Therefore, make sure that the jumper positions on the *W1* array are identical to the jumper positions on the *W2* array.

Master Mode Versus Slave Mode

The AT-MXI can function as both a MXIbus master and a MXIbus slave. As a MXIbus master, the AT-MXI circuitry determines whether a PC AT cycle is to be mapped into a MXIbus cycle intended for some external MXIbus device such as a VXIbus mainframe. As a MXIbus slave, the AT-MXI circuitry determines whether an external device is attempting to access PC AT memory or I/O resources.

Note: When allocating DMA channels for use by the AT-MXI, keep in mind that master-mode and slave-mode operation are two distinct asynchronous functions and require different DMA channels.

You must enable the slave-mode DMA channel to set up shared access to PC AT resources from external MXIbus devices such as a VXI bus master in an external mainframe. If you intend to use a VXI shared memory protocol that uses the PC AT memory, you must select and enable a slave-mode DMA channel.

You can use the master-mode DMA channel to perform high-speed block-mode transfers to or from external MXIbus devices. If you selected a master-mode DMA channel and enabled it in software, any block-mode transfer that maps to or from the MXIbus will use the DMA Controller to perform the block-mode move via that channel.

If you do not enable the master-mode DMA channel in software, the jumper-selected DMA channel is not used by the AT-MXI and can be used by other devices. You can still perform block-mode transfers by using the processor's *movs* (move string) command or by writing a move string function. This does not necessarily mean that it will take any longer for the data to be transferred. In fact, most PC ATs can transfer data faster using the *movs* instruction than they can using the DMA controller. However, you may prefer to use the DMA controller if you have other useful work to do during a block-mode operation (such as when using a multitasking operation system).

The DMA jumpers are set at the factory with the master-mode interface set to DMA channel 6 and enabled by the default configuration software. The slave-mode interface is set to DMA channel 3. The default configuration software disables the slave-mode interface circuitry so that, even though the slave-mode DMA is jumpered to channel 3, the board does not use this level unless you make a change to the software configuration.

Note: Seldom, if ever, can the AT-MXI share DMA channels with other devices. If you have selected a DMA channel by placing jumpers on that channel's request and acknowledge lines and enabled the channel in software, no other devices in your system should use that channel. If DMA channels conflict, change the DMA channel(s) used by either the AT-MXI or the other device(s). If you change an AT-MXI DMA channel, make a corresponding change to the AT-MXI configuration software as described in the *Configuring the NI-VXI Software* section of Chapter 3.

The AT-MXI can use DMA Channels 0, 1, 2, 3, 5, 6, and 7. Be careful when reassigning DMA channels on the AT-MXI. Notice that most PC ATs use DMA Channel 2 for the disk controller interface. It is possible that various standard logic devices on the motherboard may use other DMA channels, so check your computer documentation before changing DMA channels.

Notice that the PC AT makes a distinction between 8-bit and 16-bit DMA channels. The 8-bit channels are 0, 1, 2, and 3. The 16-bit channels are 5, 6, and 7. The master-mode DMA channel setting must match the data width of the intended block transfers. It is preferable to use one of the 16-bit channels for the master-mode interface because a 16-bit DMA channel can transfer twice the amount of data in the same number of cycles. The slave-mode DMA channel is used only to request the PC AT bus for an alternate PC AT bus master cycle. It can use any available 8-bit or 16-bit channel regardless of the intended data width of the transfers.

Use the two rows of pins farther from the card-edge connector to select the master-mode DMA channel and the two rows closer to the card-edge connector to select the slave-mode DMA channel. Remember that the jumper positions should be identical on both the W1 and W2 arrays. Figure 2-4a shows the factory default DMA channel setting of the AT-MXI, with master-mode DMA Channel 6 and slave-mode DMA Channel 3.

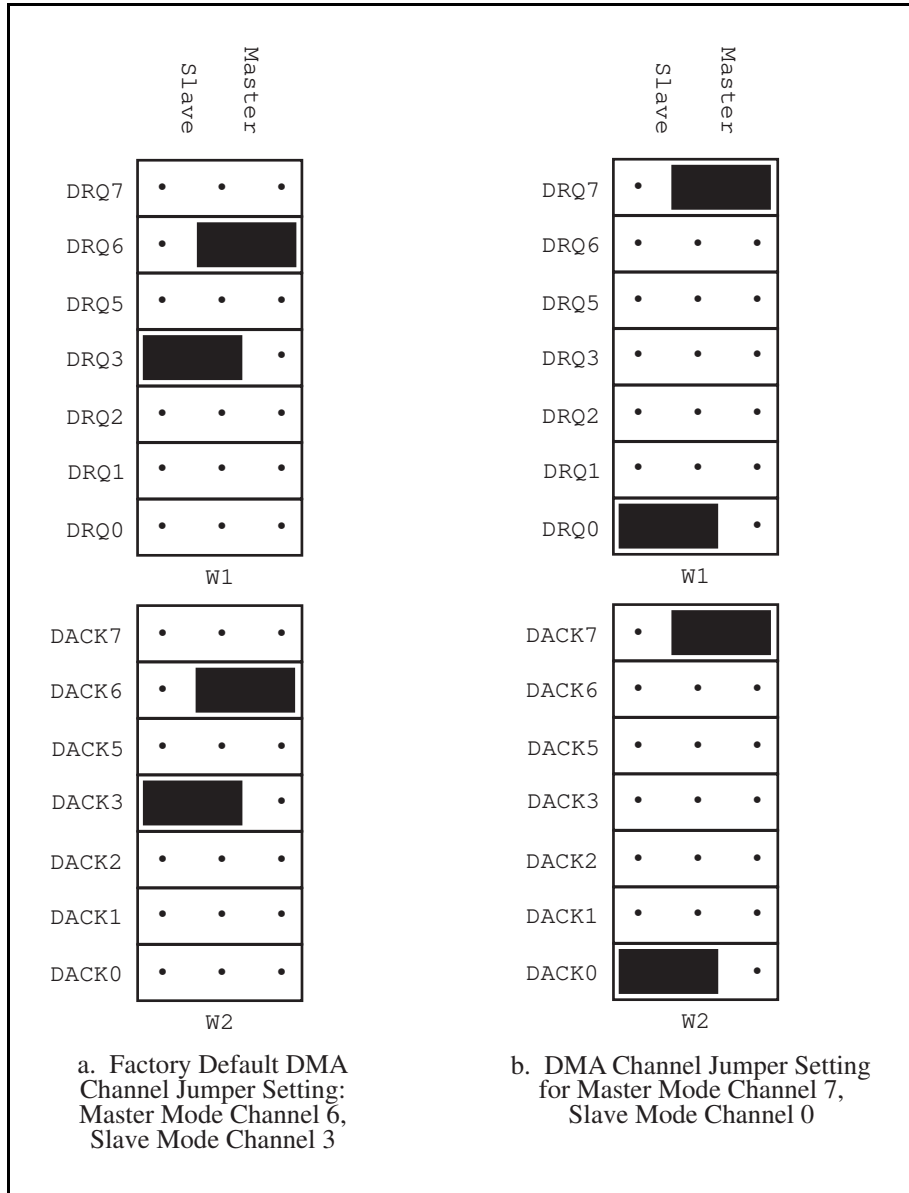


Figure 2-4. DMA Channel Settings

To select a new DMA channel, move both the DRQ and DACK jumpers onto the appropriate pins. Remember to make a corresponding change in the system software to enable the new DMA channels. Figure 2-4b displays the jumper position for selecting master-mode DMA Channel 7 and slave-mode DMA Channel 0.

Step 3. Install the AT-MXI Hardware

In the space provided here, record the settings of the base I/O address, the DMA channel(s), and the interrupt level(s) for future reference. You will need this information when you install the software.

| AT-MXI | Setting |
|------------------------|---------|
| Base I/O Address | |
| Board Interrupt Level | |
| MXIbus Interrupt Level | |
| Master DMA Channel | |
| Slave DMA Channel | |

Before attempting to install the AT-MXI, notice that some MXIbus cable connector hoods are slightly wider than most standard connector hoods and might interfere with other cables installed in adjacent PC AT slots. Normally, this will be a problem only if the cable connector hoods for the adjacent slots are also oversized. When choosing a PC AT slot in which to install the AT-MXI, verify that the MXIbus cable connector will not interfere with cables and connectors in other PC AT slots. If necessary, reposition the boards in the system to prevent cabling conflicts. It may also help to install the AT-MXI in one of the end slots so that you will have to contend with the cable connectors of only one other board.

If you cannot configure the AT-MXI to co-exist in an existing PC AT system by repositioning the boards, you can use one of the MXIbus cable options with a standard connector hood on the cable end that attaches to the AT-MXI. The standard connector hood is narrower than the MXIbus dual-connector arrangement and provides an easier fit for many system configurations. However, this approach requires that the AT-MXI be the first device in the MXIbus daisy-chain because a cable with a single connector end cannot accept another MXIbus cable to propagate the bus. Remember that the first device in the MXIbus daisy-chain must also be configured as the MXIbus System Controller.

The following instructions are general installation instructions. Consult the user or technical reference manual of your computer for specific instructions and warnings.

1. Plug in your PC AT computer before installing the AT-MXI. The plug grounds the computer and protects it from electrical damage while you are setting up.

Warning: To protect both yourself and the computer from electrical hazards, the computer should remain off until you are finished installing the board.

2. Remove the top cover or access port to the PC AT I/O bus.
3. Select any available 16-bit full-length PC AT expansion slot. The 16-bit expansion slots have two card-edge receptacle connectors.

4. Locate the metal bracket that covers the cut-out in the back panel of the PC AT chassis for the slot you have selected. Remove and save the bracket-retaining screw and the bracket cover.
5. Touch the metal part of the power supply case inside the computer to discharge any static electricity that might be on your clothes or body.
6. Line up the AT-MXI with the MXIbus connector near the cut-out on the back panel and the other card edge lined up with the respective slot guide. Slowly push down on the front of the AT-MXI until its card edge connector is resting on the expansion slot receptacle. Using slow, evenly distributed pressure, press the AT-MXI straight down until it seats in the expansion slot.
7. Reinstall the bracket retaining screw to secure the AT-MXI to the back panel rail.
8. Check the installation.
9. Replace the computer cover.

Figure 2-5 shows an AT-MXI installed in a PC AT with a MXIbus cable attached.

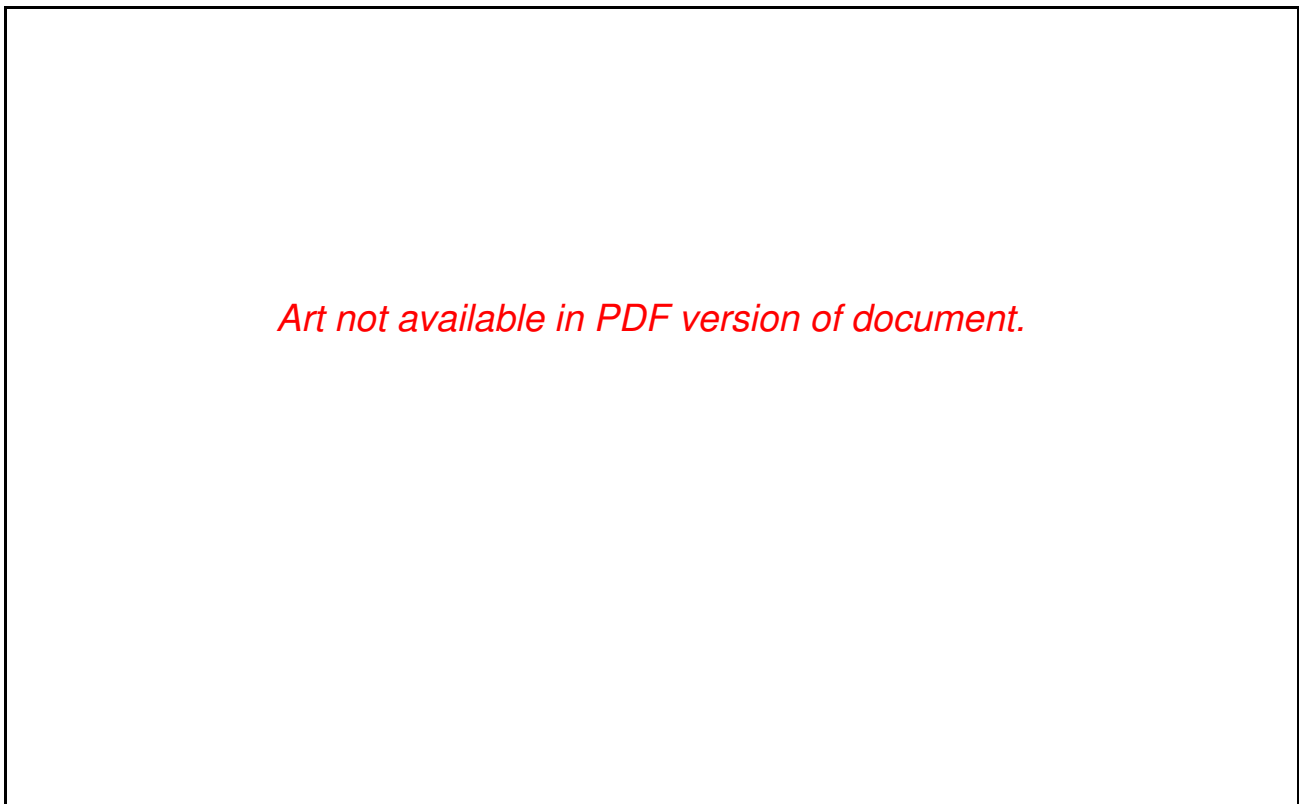


Figure 2-5. AT-MXI Installed in a Computer

Step 4. Configure the VXI-MXI Hardware

Figure 2-6 shows the location and factory default settings of the configuration switches and jumpers for a VXI-MXI without the INTX daughter card option. The remainder of this chapter describes only those options that are user-configurable. Do not change the default settings of other jumpers and switches on the VXI-MXI board unless you will be installing multiple VXI-MXIs in the same mainframe. If this is the case, refer to the *VXI-MXI User Manual* that came with your additional VXI-MXI interface for more information.

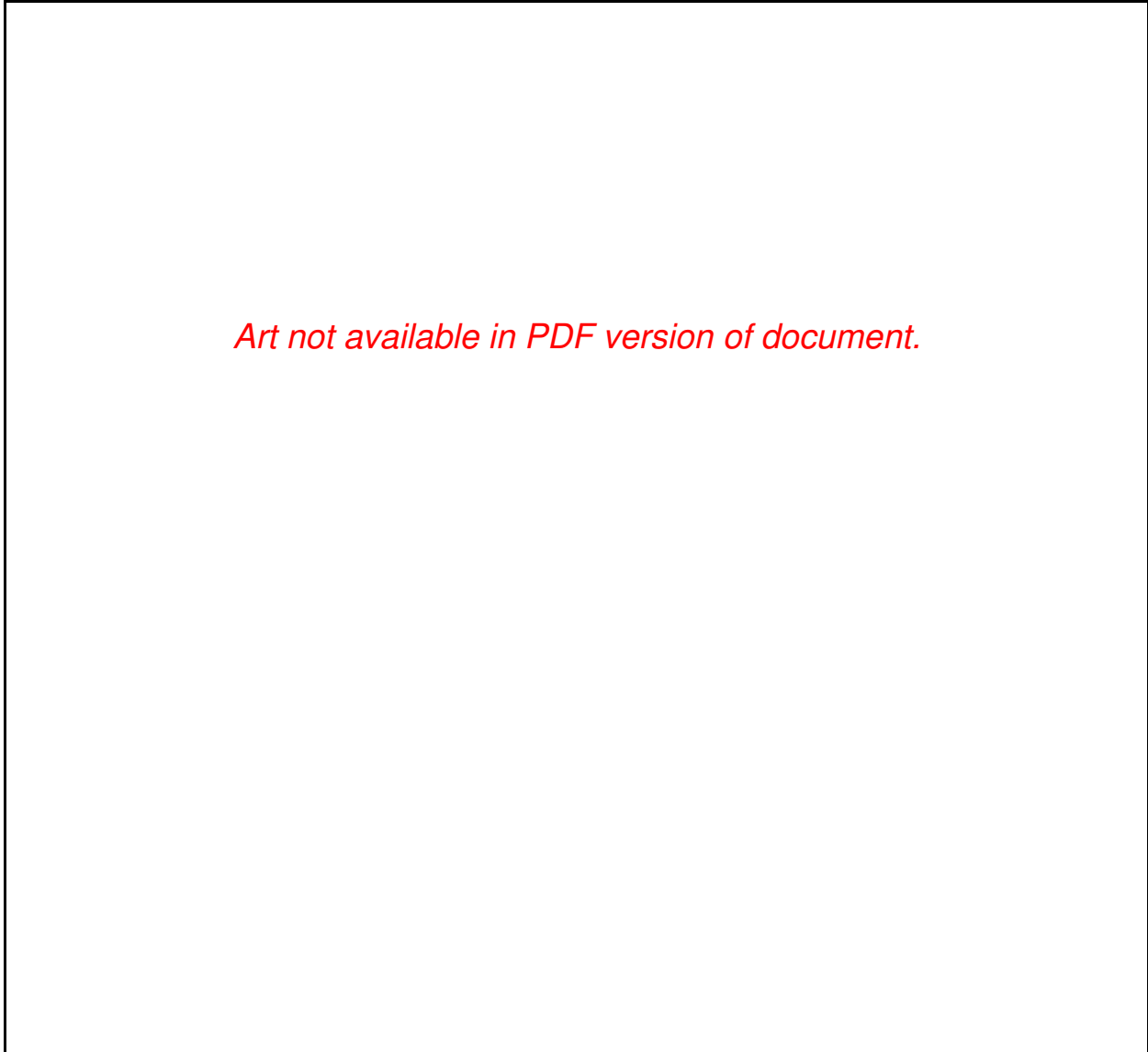


Figure 2-6. VXI-MXI Parts Locator Diagram

Figure 2-7 shows the location and factory default settings of the configuration switches and jumpers for a VXI-MXI with the INTX daughter card option. The options described in the rest of this chapter apply to VXI-MXI modules with or without the INTX option. For more information about configuring modules with the INTX option, refer to the *VXI-MXI User Manual*.

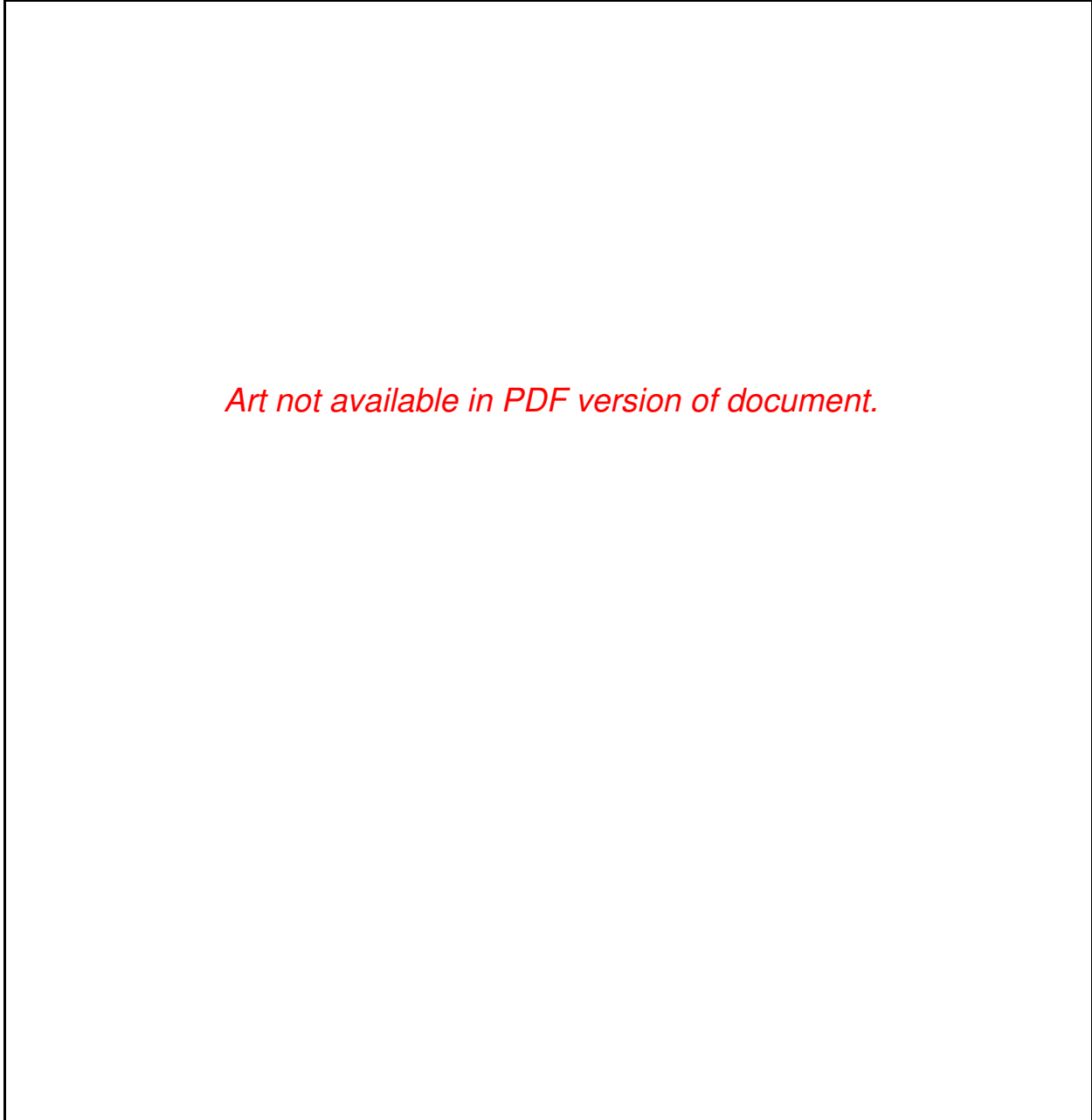


Figure 2-7. VXI-MXI with INTX Parts Locator Diagram

Front Panel Features

The VXI-MXI has the following front panel features:

- Three front panel LEDs
 - *FAILED* LED indicates that the VMEbus SYSFAIL line is asserted.
 - *VXI ACCESS* LED indicates when the VXI-MXI is accessed from the VXIbus.
 - *MXI ACCESS* LED indicates when the VXI-MXI is accessed from the MXIbus.
- MXIbus connector
- Three SMB connectors
 - Trigger input
 - Trigger output
 - External clock
- System reset pushbutton
- INTX connector (if you have a VXI-MXI with the INTX daughter card connection)

Removing the Metal Enclosure

The VXI-MXI is housed in a metal enclosure to improve EMC performance and to provide easy handling. Because the enclosure includes cutouts to facilitate changes to the switch and jumper settings, it should not be necessary to remove it under normal circumstances.

Should you find it necessary to open the enclosure, remove the three screws on the top, the three screws on the bottom, and the three screws on the right side panel of the enclosure.

VXIbus Slot 0

The VXI-MXI is shipped from the factory configured to be installed in Slot 0 of the VXIbus mainframe. If another device is already in Slot 0, you must decide which device will be the Slot 0 device and reconfigure the other device for Non-Slot 0 use.

Warning: Do not install a device configured for Slot 0 into another slot without first reconfiguring it for Non-Slot 0 use. Doing so could result in damage to the Non-Slot 0 device, the VXIbus backplane, or both.

Figure 2-8 shows the default configuration settings for the VXI-MXI installed as the Slot 0 device.

To configure the VXI-MXI as a Non-Slot 0 device, change slide switches S1 and S8 and jumper blocks W7 (labeled *VME BTO Chain Position* on the front panel), and W9 and W10 (labeled *CLK10 Source Select* on the front panel) as shown in Figure 2-9.

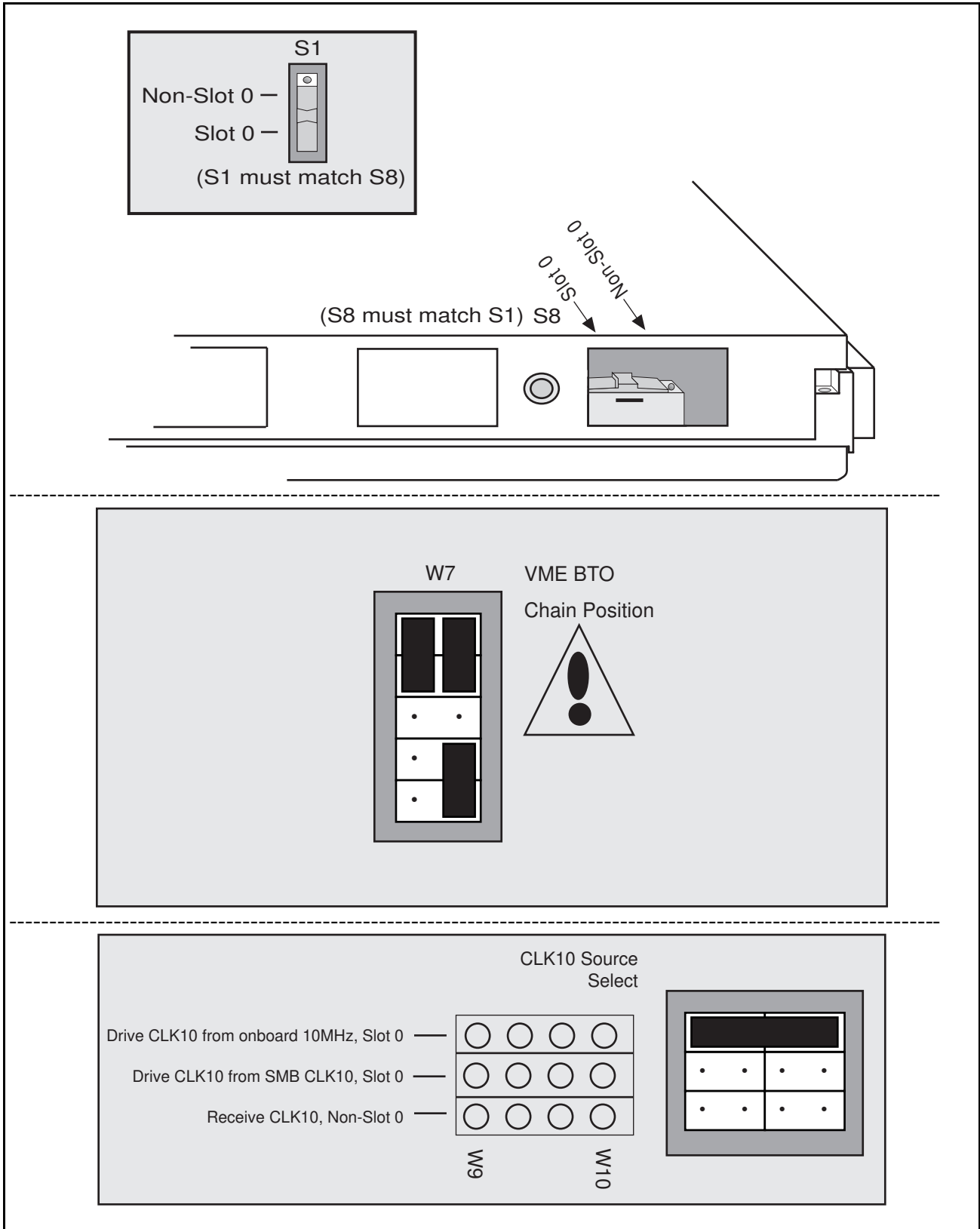


Figure 2-8. VXIbus Slot 0 Configuration

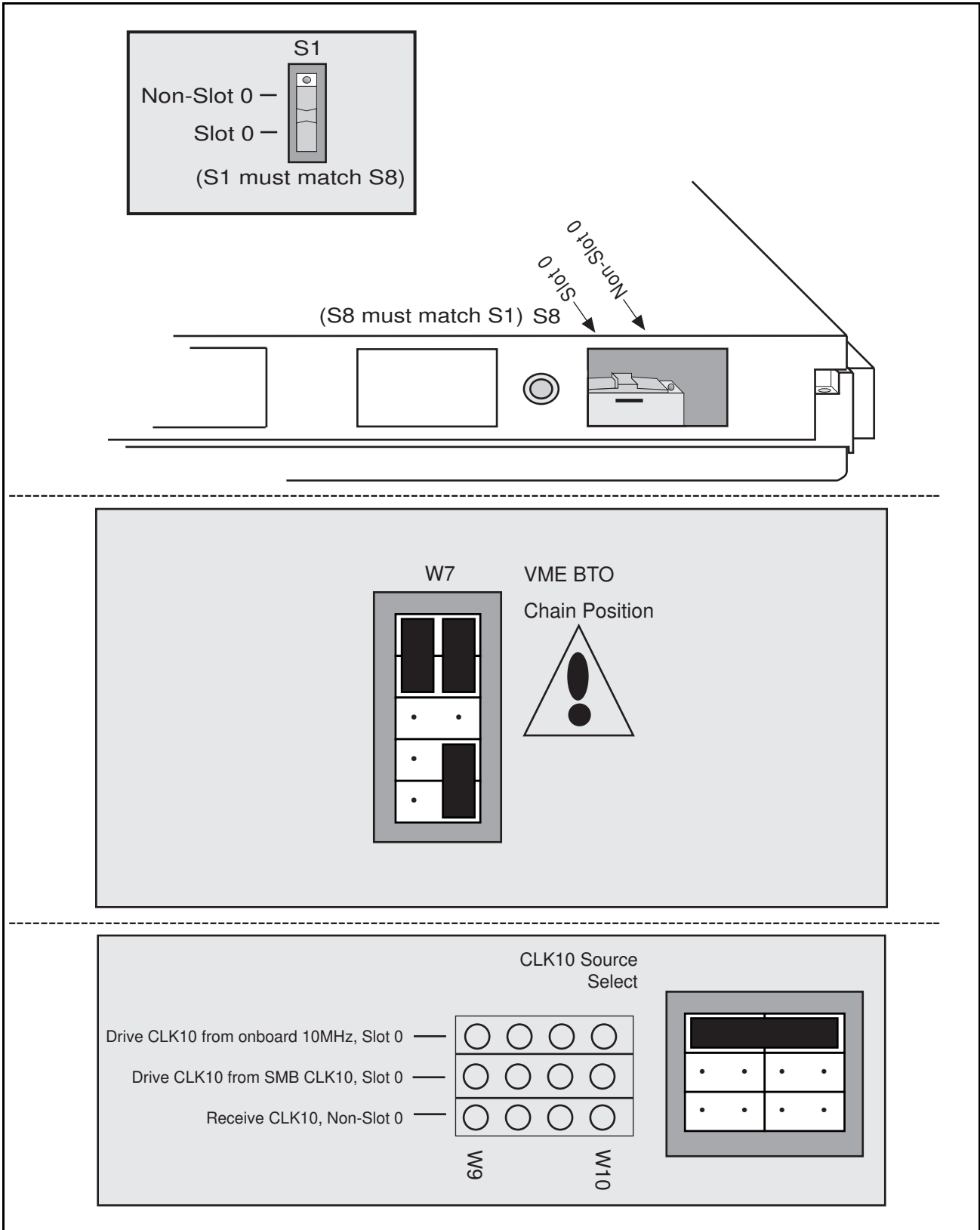


Figure 2-9. VXIbus Non-Slot 0 Configuration

When installed in Slot 0, the VXI-MXI becomes the VMEbus System Controller (set by slide switches S1 and S8). As a VMEbus System Controller, it has VMEbus Data Transfer Bus Arbiter (PRI ARBITER) circuitry that accepts bus requests on all four VMEbus request levels, prioritizes the requests, and grants the bus to the highest priority requester. As VMEbus System Controller, the VXI-MXI also drives the 16-MHz VMEbus system clock by an onboard 16-MHz oscillator with a 50% \pm 5% duty cycle.

The VXI-MXI also performs VMEbus BTO functions as described in the following section. The setting of the VME BTO Chain Position jumper block determines how to control these functions. As required by the VXIbus specification for a Slot 0 device, the VXI-MXI drives the 10-MHz signal, CLK10, on a differential ECL output. This is controlled by the CLK10 Source Select jumpers at locations W9 and W10. The Slot 0 setting of the CLK10 Source Select jumpers cause the VXI-MXI to drive CLK10 on the backplane. When configured for Non-Slot 0, the VXI-MXI instead receives the CLK10 signal.

Warning: Configuring more than one VXIbus device to drive the CLK10 lines can damage the VXIbus backplane or the CLK10 drivers on the VXIbus devices.

VMEbus BTO

The VMEbus Bus Timeout (BTO) is a watchdog timer for transfers on the VMEbus Data Transfer Bus. After a specified amount of time (usually user-configurable), the BTO circuitry terminates a VMEbus cycle if no slave has responded. The VXI-MXI must provide the VMEbus BTO to function properly because, when a MXIbus cycle is involved, the VMEbus timeout must be disabled and the MXIbus BTO enabled. You should disable the BTO of any other BTO module residing in the mainframe. If this is not possible, set it to its maximum setting to give the MXIbus cycles as much time as possible to complete.

VXI Logical Address

Each device in a VXIbus/MXIbus system is assigned a unique number between 0 and 254. This 8-bit number, called the *logical address*, defines the base address for the VXI configuration registers located on the device. With unique logical addresses, each VXIbus device in the system is assigned 64 bytes of configuration space in the upper 16 kilobytes of A16 space.

Some VXIbus devices have *dynamically configurable* logical addresses. These devices have an initial logical address of hex FF, which indicates that they can be dynamically configured. While the VXI-MXI does support dynamic configuration of VXI devices within its mainframe, it is itself a *statically configured* device and is preset at the factory with a VXI logical address of 1.

The AT-MXI is designated as the VXIbus Resource Manager (RM). As defined by the VXIbus specification, the RM in a VXI system has a logical address of 0.

Ensure that no other statically configurable VXIbus devices have logical addresses of either 0 or 1. If they do, change the logical address settings of the other devices so that every device in the system has a unique associated logical address.

Do not change the logical address of the VXI-MXI unless you are connecting multiple VXI-MXIs to the MXIbus. In this case, refer to the *VXI-MXI User Manual* that came with your additional VXI-MXIs for more information. You can change the logical address of the VXI-MXI by changing the setting of the 8-bit DIP switch labeled *LOGICAL ADDRESS SWITCH* on the front panel. The ON position on the DIP switch corresponds to a logic value of 0, and the OFF position corresponds to a logic value of 1. Verify that the VXI-MXI does not have the same logical address as any other statically configured VXIbus device in your system. Remember that logical addresses hex 0 and FF are not allowed for the VXI-MXI.

Figure 2-10 shows switch settings for logical address hex 1 and C0.

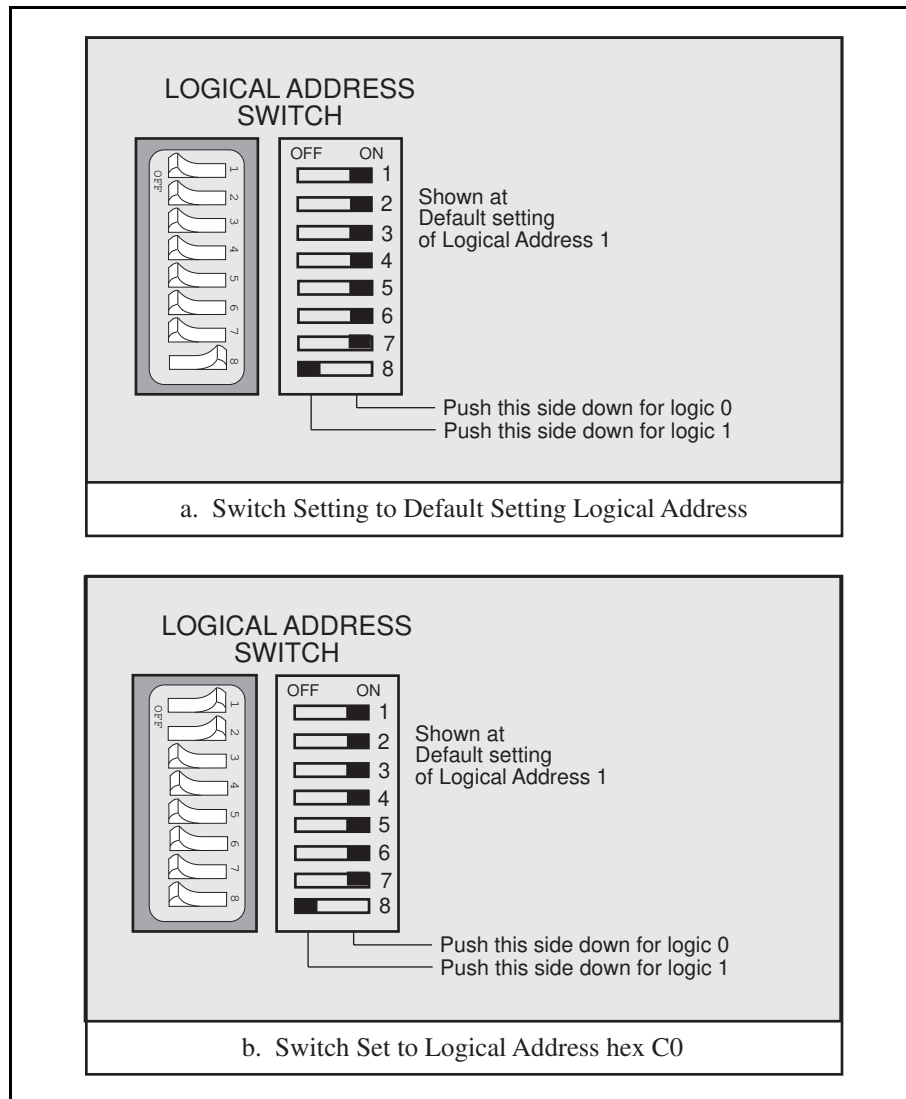


Figure 2-10. Logical Address Selection

VMEbus Request Level Selection

The VXI-MXI uses one of the four VMEbus request levels to request use of the VME Data Transfer Bus (DTB). The VXI-MXI requests use of the DTB whenever an external MXIbus device, such as

a PC AT computer with an AT-MXI interface, attempts a transfer that maps into the VXIbus mainframe.

The VXI-MXI uses VMEbus request level 3 in its factory default setting, as required by the VXIbus specification. This is suitable for most VXIbus systems. However, you can change the VXI-MXI to use any of the other three request levels (0, 1, or 2) by changing the jumper configuration on the jumper blocks labeled *VMEbus Request Level* on the front panel. You may want to change request levels to change the priority of the VXI-MXI request signal. For more information, refer to the VMEbus specification.

To change the VMEbus request level of the VXI-MXI, rearrange the jumpers on the pin arrays as shown in Figure 2-11.

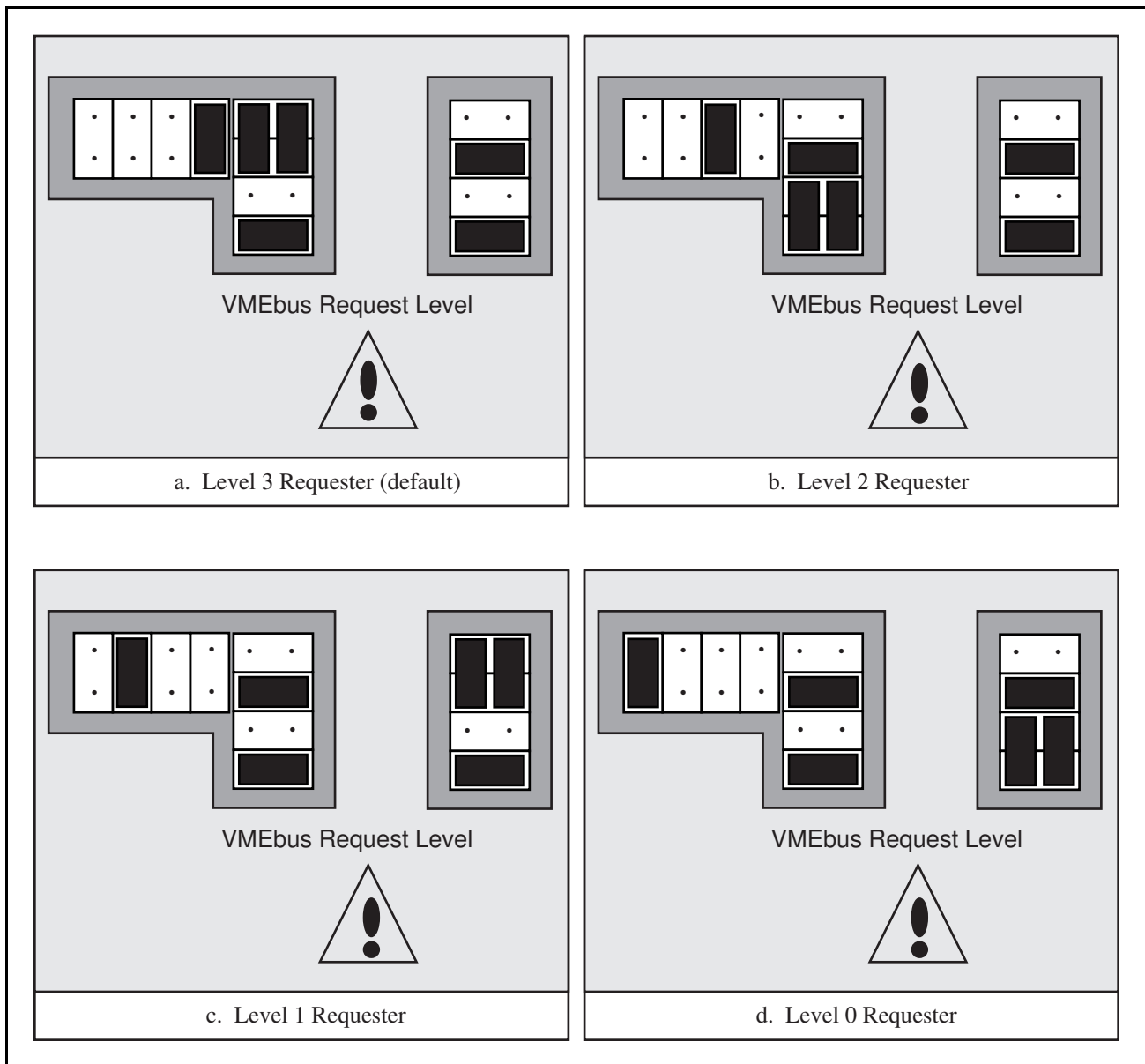


Figure 2-11. VXI-MXI VMEbus Requester Jumper Settings

Step 5. Install the VXI-MXI Hardware

This section lists general installation instructions for the VXI-MXI. Consult the user manual or technical reference manual of your VXIbus mainframe for specific instructions and warnings.

1. Remove power from the mainframe.
2. Remove or open any doors or covers blocking access to the mainframe slots.
3. If the VXI-MXI will be installed in a D-size mainframe, install a support designed for installing C-size cards in D-size mainframes.

Warning: Be certain that the slot you select in your VXIbus mainframe matches the VXI-MXI configuration as either a Slot 0 device or a Non-Slot 0 device. If you install your VXI-MXI into a slot that does not correspond with the jumper settings, you risk damage to the VXI-MXI, the VXIbus backplane, or both.

4. Insert the VXI-MXI in the slot you have selected by aligning the top and bottom of the card with the card-edge guides inside the mainframe. Slowly push the VXI-MXI straight into the slot until its plug connectors are resting on the backplane's receptacle connectors. Using slow, evenly distributed pressure, press the VXI-MXI straight in until it seats in the expansion slot. The front panel of the VXI-MXI should be even with the front panel of the mainframe.
5. Tighten the retaining screws on the top and bottom edges of the front panel.
6. Check the installation.
7. Replace or close any doors or covers to the mainframe.
8. Connect the cables as described in the following section before restoring power.

Step 6. Connect the MXIbus Cable

There are two basic types of MXIbus cables. MXIbus cables can have either a single connector on each end, or a single connector on one cable end and a double connector on the other end. Your VXI-AT2023 kit comes standard with a cable with single connectors on each end.

Nonpolarized Cables

The cable with a single connector on each cable end is nonpolarized, meaning that you can connect either end to either device. Be sure to tighten the screw locks to ensure proper pin connection. See Figure 2-12.

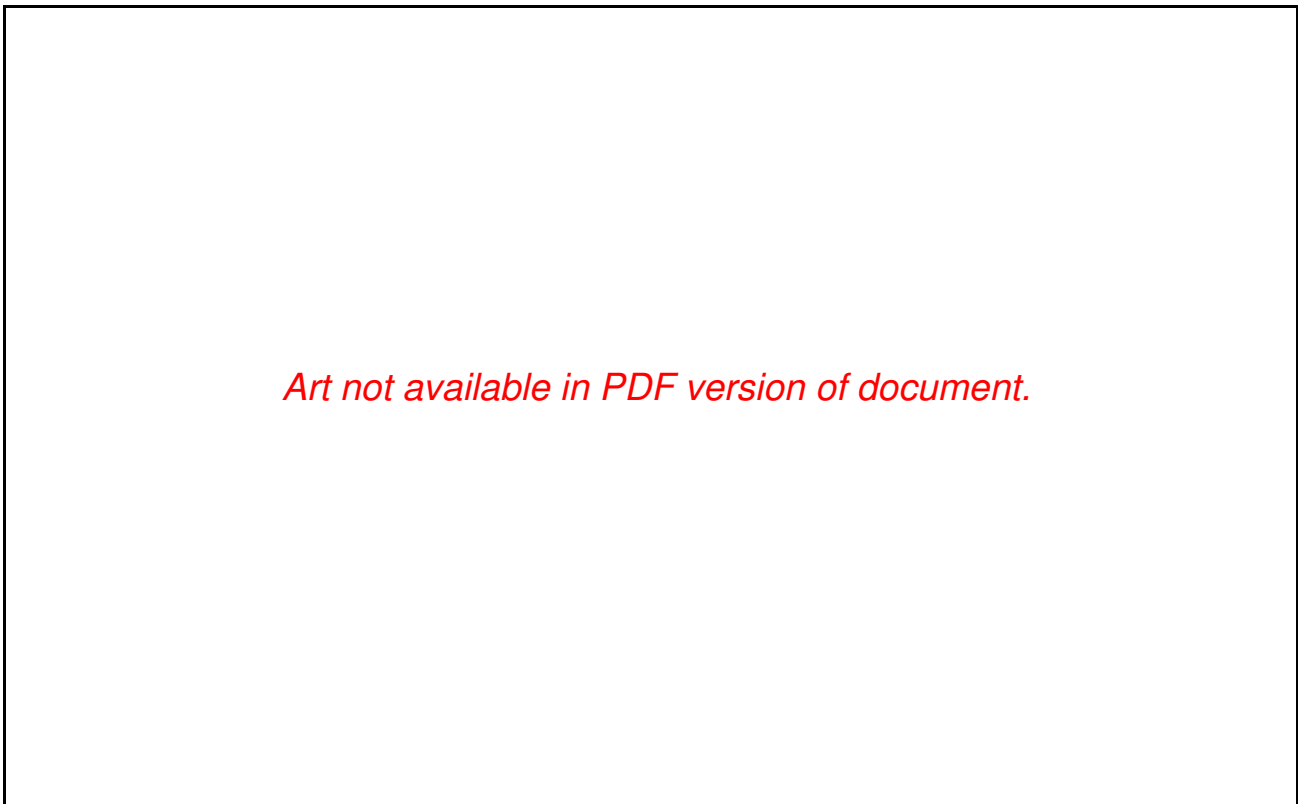


Figure 2-12. MXIbus Single-Ended Cable Configuration

Polarized Cables

If you are using a MXIbus cable with a single connector on one cable end and a double connector on the other end, it is a polarized cable that you must install correctly for the system to function properly. Connect the end with the *single* connector to the AT-MXI and the end of the cable with the *double* connector to the VXI-MXI. Be sure to tighten the screw locks to ensure proper pin connection. See Figure 2-13.

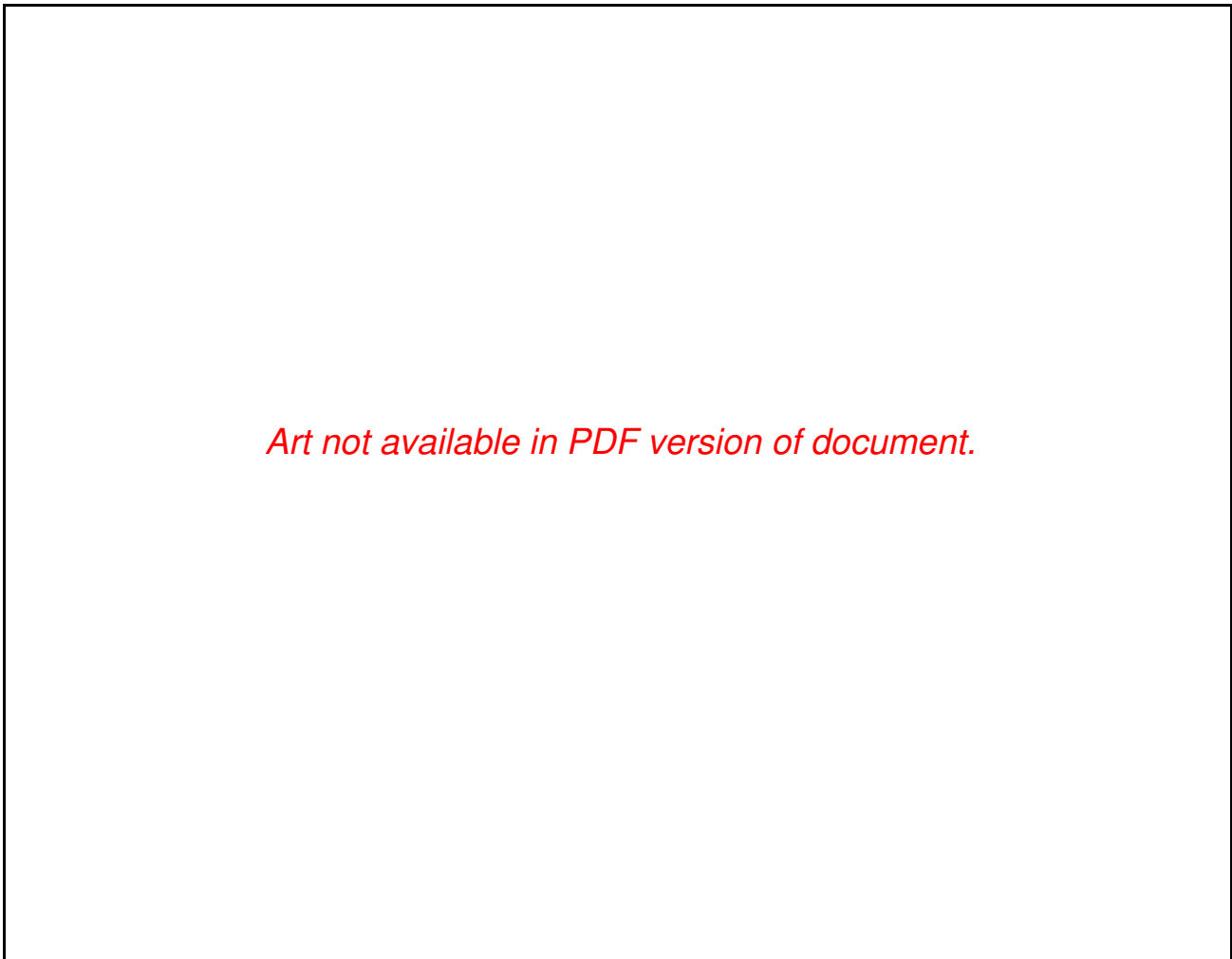


Figure 2-13. MXIbus Dual-Ended Cable Configuration

When you have properly connected the MXIbus cable, power on the VXI mainframe and then the PC AT computer.

Note: Always turn on the mainframe first. Doing so makes it possible for the PC AT to access the VXI cards in the mainframe as soon as the PC AT starts up.

Chapter 3

NI-VXI Software Installation and Configuration

This chapter lists the programs and files located on the NI-VXI distribution diskette, contains instructions for installing and configuring the NI-VXI software, and contains a description of the `vxitedit` configuration editor.

The NI-VXI Software Package

Before installing the software, review the files on the *NI-VXI Distribution Diskette for the AT-MXI and ISC 386/ix* (hereafter referred to as the NI-VXI distribution diskette).

Main Programs and Files

The following are the main programs and files of the NI-VXI software package:

- `vxiiinit` is the MXIbus initialization program. This program initializes the AT-MXI board for operation. Run this program before using the NI-VXI software.
- `resman` is the National Instruments multimainframe Resource Manager. Run this program after `vxiiinit`.
- `victext` is the text-based interactive control program that executes functions you enter from the keyboard. It helps you learn the functions, program your VXI device, and develop and debug your application program. This program is described in detail in the *NI-VXI Text Utilities Reference Manual*.
- `vxitedit` is the text-based VXI Resource Editor program you use to edit system and device information. You can use this program to configure the system, edit the manufacturer name and ID association, and edit the information about the model names of VXI and non-VXI devices in the system, as well as the interrupt configuration information for the system. This program also displays the system configuration information devised by the Resource Manager. This program is described in detail in the *NI-VXI Text Utilities Reference Manual*.
- `nivxi.o` is the NI-VXI device driver for ISC 386/ix.
- `cvxi.c` is the NI-VXI C language interface for the NI-VXI device driver.
- `Installvxi` and `Removevxi` are the shell scripts for installing and removing the NI-VXI device driver, respectively.
- `README.DOC` describes the various files on the NI-VXI distribution diskette and contains the latest updates and corrections to the manual when appropriate.

Additional Programs and Files

The `/tbl` directory contains the following table files.

- `creg.tbl` contains device information for use by the Resource Manager.
- `mfnameid.tbl` contains the global data base of the manufacturer names and their ID associations.
- `model.tbl` contains the global data base of the model names, manufacturer names, and the model codes associations.
- `device.tbl` contains the global data base of the device names, manufacturer names, model names, and frame and slot associations for the system.
- `nonvxi.tbl` contains the global data base for all non-VXI devices in the system.
- `intcfg.tbl` contains the system interrupt configuration information.
- `trigcfg.tbl` contains TTL trigger configuration editor information.
- `utilbus.tbl` contains the utility bus configuration editor information.
- `vxibus.cfg` contains the bus configuration information.
- `vxila.cfg` contains the logical address configuration information.
- `vxidev.cfg` contains the device configuration information.

The `/include` directory contains include files for the C language interface.

- `nivxi.h` is the main header file containing the C prototypes for the NI-VXI functions.
- `cvxi.h` contains definitions for constants used by the C language interface `cvxi.c` file.
- `datasize.h` contains data size specifications.
- `busacc.h` contains parameter and return values for the bus access functions.
- `devinfo.h` contains parameter and return values for the device information and system configuration functions.
- `vxint.h` contains parameter and return values for the interrupt and signal functions.
- `sysint.h` contains parameter and return values for the system interrupt functions.
- `trig.h` contains parameter and return values for the trigger functions.
- `ws.h` contains parameter and return values for the Commander and Servant Word Serial functions.

The `/help` directory contains the various help (`.help`) files used by `victext` and `vxitedit`.

The `/example` directory contains example programs showing you how to use the NI-VXI software.

Installing the Software

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

Step 1. Set Up a Working Directory

1. Log on as root.
2. To create a working directory (for example, `/usr/nivxi`), change to the parent directory, `/usr`.

```
cd /usr
```

3. Copy the files from the NI-VXI distribution diskette to this directory using the `tar` command.

For a 3.5 in. floppy diskette (in drive 0):

```
tar xvfo /dev/rdisk/f0q18dt
```

For a 5.25 in. floppy diskette (in drive 0):

```
tar xvfo /dev/rdisk/f0q15dt
```

This will create the `nivxi` directory in the current working directory (`/usr`).

Step 2. Install the Driver into the System

Follow these steps to install the NI-VXI driver into the system.

1. Run the VXI installation shell script `Installvxi` in your working directory (`nivxi`). Follow the instructions in the shell script. If you need to change any of the default installation settings, enter the new values when prompted to do so; otherwise, press the `<RETURN>` key to select the default settings.

```
./Installvxi
```

2. If the installation completes successfully, reboot the system to use the new kernel with the NI-VXI driver.

Step 3. Change the Path for the Utility Files (Optional)

If you want to run the NI-VXI utilities from any directory other than `/usr/nivxi`, set the environment variable `NIVXIPATH` to the main directory containing the `/hlp` and `/tbl` subdirectories.

Note: The manner for setting up the environment variable depends on the shell you are using. Consult the online manual pages for information on setting up an environment variable.

For example, for the Bourne shell (the default shell on ISC 386/ix), if your main directory for the NI-VXI software is `/usr/nivxi`, add the following statements in the `.profile` file in your home directory:

```
NIVXIPATH=/usr/nivxi
export NIVXIPATH
```

If you are using the C-Shell (`csh`), and your main directory for the NI-VXI software is `/usr/nivxi`, add the following statement in your `.cshrc` file in your home directory:

```
set NIVXIPATH /usr/nivxi
```

If you set the `NIVXIPATH` environment variable in this manner, the NI-VXI utilities can access table, configuration and help files from the `/usr/nivxi/tbl` and `/usr/nivxi/hlp` directories. You can also add this directory to your default search path by modifying the `PATH` environment variable.

Configuring the NI-VXI Software

Run the `vxitedit` device configuration utility if you need to make any changes to the default software configuration. You can also run `vxitedit` if you just want to examine the software configurations.

The following sections describe how to modify and/or view the configuration information for the AT-MXI board. To modify or view manufacturer names, model names, or device ID associations, or to obtain more information on non-VXI devices, refer to the *NI-VXI Text Utilities Reference Manual*.

Default Configurations

The NI-VXI software has factory default configurations. These default configurations match the factory default configurations of the hardware interface.

If you do not use `vxitedit` to make changes, the default characteristics of the software will remain in effect.

Using `vxitedit`

To run the `vxitedit` program, type `vxitedit`. Select the Configuration Editor from the main menu. The three configuration options available under the Configuration Editor are Logical Address Configuration, Bus Configuration, and Device Configuration. The Device Configuration option is not used. Do not modify the `vxidev.cfg` file, as it contains some system-dependent information used by the `vxiiinit` initialization program.

Type `help` to obtain online assistance within any editor, including determining which commands are applicable to the editor you are using. Type `save` to apply any changes you have made, and then type `exit`. If you want to exit without saving your changes, type `abort`. When you return to the main menu, you can enter another editor by selecting the number for that editor.

For further instructions on the use of the `vxitedit` program, refer to the *NI-VXI Text Utilities Reference Manual*.

The following sections describe the various configuration options available under the Logical Address and Bus Configuration Editors.

Logical Address Configuration

Table 3-1 describes the characteristics of the options available under the Logical Address Configuration menu.

Table 3-1. Logical Address Configuration Characteristics

| Characteristic | Description | Default Value |
|------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|
| AT-MXI Base I/O Address | Indicates the I/O Address of the AT-MXI configuration registers. This value must correspond to the selected jumper settings on the board. Range = 100h to 3E0h in increments of 20h (hex) | 0x340 |
| Master Window Base | A 64 kilobyte memory-mapped I/O window, which the AT-MXI board uses to access the VXIbus. Range = A000h to E000h in increments of 1000h (hex) | 0xD000 |
| Address Space | Indicates the address spaces used by the AT-MXI. 0 = A16/A24 3 = A16 only | 3 |
| Master DMA Channel | Indicates the DMA channel that the AT-MXI uses to perform master-mode block transfers onto the VXIbus. This value must correspond to the jumper settings on the AT-MXI board. You can select the NONE option with any setting. Range = 0, 1, 2, 3, 5, 6, 7, 0xff (NONE) | 6 |
| AT-MXI Board Interrupt Level | Indicates the interrupt level used by the board to interrupt the processor. This value must correspond to the jumper settings on the AT-MXI board. Range = 3, 4, 5, 6, 7, 9, 10, 11, 12, 14, 15 | 12 |

(continues)

Table 3-1. Logical Address Configuration Characteristics (continued)

| Characteristic | Description | Default Value |
|-----------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|
| Slave I/O Window Base | <p>The I/O space in the PC with the AT-MXI can be accessed in A16 space over the VXI bus. This field sets up the base address for these accesses.</p> <p>Range = 0000h to FE00h in increments of 100h (hex)</p> <p>Notice that selecting a base address above C000h can conflict with the existing VXI devices in the system. <i>resman</i> does not handle any device requesting memory in A16 space, including the AT-MXI. <i>resman</i> does not give a warning in the event of an address conflict in A16 space. Also, opening A16 windows on frame extenders in the system for A16 accesses depends <i>only</i> on the logical addresses of the devices in the system.</p> | 0x0000 |
| Slave I/O Window Size | <p>Indicates the size of the window in A16 space for accesses to the PC I/O space over the VXIbus.</p> <p>Range = 64K, 32K, 16K, 8K, 4K, 2K, 1K, 512 bytes, 0xff (DISABLE)</p> | 0xff |
| Slave Mem Window Size | <p>Indicates the size of VXI Shared RAM in the A24 space. If the Address Space selection for the AT-MXI is A16 only, this field is ignored.</p> <p>Range = 8M, 4M, 2M, 1M</p> | 1 megabyte |
| Slave AT Mem Offset | <p>Indicates the offset in the local RAM above which the RAM is shared over the VXIbus in A24 space.</p> <p>Range = 0 to 15, in increments of 1M</p> | 0 megabytes |

(continues)

Table 3-1. Logical Address Configuration Characteristics (continued)

| Characteristic | Description | Default Value |
|------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|
| Slave DMA Channel | <p>This indicates the slave DMA channel to be used in all slave accesses to the VXI Shared RAM in A24 space or the PC I/O in A16 space. This value must correspond to jumper settings on the AT-MXI board. You can select the NONE option with any jumper settings.</p> <p>Range = 0, 1, 2, 3, 5, 6, 7, 0xff (NONE)</p> <p>Note: If you select the NONE option, slave accesses to VXI Shared RAM and to PC I/O space will not succeed. Accesses to VXI-defined registers on the AT-MXI board, however, remain unaffected.</p> | 3 |
| Resource Manager Delay | <p>Time in seconds that the Resource Manager waits before accessing the configuration registers of any other device in the system.</p> <p>Range = 0 sec to 65535 sec</p> | 5 sec |

Bus Configuration

Table 3-2 describes the characteristics of the options available under the Bus Configuration menu.

Table 3-2. Bus Configuration Characteristics

| Characteristic | Description | Default Value |
|--------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|
| MXIbus System Controller | <p>A MXIbus link must have a single device that is responsible for MXIbus interrupt and bus arbitration as well as bus timeouts. This device is referred to as the MXIbus System Controller and is always the first device in the MXIbus daisy-chain. The AT-MXI is always designated as the MXIbus System Controller when used in this kit and should <i>not</i> be changed.</p> <p>0 = Not MXIbus System Controller 1 = MXIbus System Controller</p> | 1 |
| MXIbus Fair Request | <p>MXIbus requesters give all MXIbus devices equal opportunity to become bus masters and transfer data, regardless of their position within the MXIbus daisy-chain. MXIbus devices that are not fair requesters have a fixed priority scheme characterized by their relative position within the MXIbus daisy-chain. Devices closest to the MXIbus System Controller have the highest priority. The default configuration programs the AT-MXI to be an unfair requester and should be changed only if you add more MXIbus devices to the system. Refer to the user manual included with your additional MXIbus devices for more information.</p> <p>0 = Not a MXIbus Fair Requester 1 = MXIbus Fair Requester</p> | 0 |
| MXIbus Interrupt Level | <p>Indicates the interrupt level used by the MXI IRQ to interrupt the processor. This value must correspond to jumper settings on the AT-MXI board; however, you can select the NONE option with any jumper settings. If you select the NONE option, the same interrupt level used for AT-MXI board interrupts is used for this interrupt.</p> <p>Range = 3, 4, 5, 6, 7, 9, 10, 11, 12, 14, 15, or 0xff (NONE)</p> | 0xff |

Exiting vxitedit and Reinitializing the Hardware

To exit `vxitedit`, type the number `11` when the main menu is displayed or type `exit`. If you changed any information, the program prompts you to save your changes before exiting the menu. Saving the configuration information updates the configuration files `vxila.cfg` and `vxibus.cfg`. Do not modify the `vxidev.cfg` file, which contains some system-dependent timer information used by the `vxiiinit` program. Run `vxiiinit.exe` to reinitialize the hardware according to the new settings.

If you changed any of the software configuration settings from the default settings, record the new settings on the *VXI-AT2023 Hardware and Software Configuration Form* in Appendix B.

Developing Your Application Program

After you have verified that the driver software has been installed successfully, you can begin to develop your VXI application software.

Use the VXI Text Interactive Control (`victext`) program to communicate with VXI devices through commands you enter at the keyboard. This feature helps you learn how to communicate with devices, troubleshoot problems, and develop your application.

The `victext` command set includes the same capability of NI-VXI function calls in addition to auxiliary commands that are unique to `victext`. You can use this utility to send data and Word Serial commands to devices from the keyboard and to display data received from devices on the screen. After each function executes, `victext` displays the device's response and the status.

The `victext` utility is designed to help you learn how to use the NI-VXI functions to program devices. Once you develop a sequence of steps that works successfully for your system, you can easily incorporate the sequence into an application program using the appropriate language and syntax.

The file `cvxi.c` interfaces between your C language application program and the operating system entry points to the VXI driver. The functions available in `cvxi.c` are described in detail in the *NI-VXI Software Reference Manual for C*. To use these functions, you must compile `cvxi.c` and include the resulting object file during the link phase of each application compile operation.

The `/example` subdirectory contains various example programs along with a makefile that show how to use various functions in the NI-VXI software and how to develop application programs using these functions.

Appendix A

Specifications

This appendix lists various module specifications of the AT-MXI and VXI-MXI, such as physical dimensions and power requirements.

AT-MXI

The following pages list the specifications for the AT-MXI module.

Capability Codes

MXIbus

| Capability Code | Description |
|-----------------|-----------------------------------------------|
| MA32 | Master Mode A32, A24 and A16 addressing |
| MBLT | Master Mode block transfers |
| SA24 | Slave Mode A24 and A16 addressing |
| SBLT | Slave Mode block transfers |
| MD16 | Master Mode D16 and D08 data sizes |
| SD16 | Slave Mode D16 and D08 data sizes |
| SC | Optional MXIbus System Controller |
| FAIR | Can be a fair MXIbus requester |
| LOCK | Can lock the MXIbus for indivisible transfers |
| TERM | Can terminate the MXIbus |

AT Bus

| Capability Code | Description |
|-----------------|-----------------------------------------------|
| AM | Can function as an AT Alternate Master |
| LOCK | Can lock the AT bus for indivisible transfers |
| DMA16 | Supports D08 or D16 DMA transfers |
| INT | Can interrupt on the PC AT bus |

Electrical

| Source | Typical | Direct Current (max) |
|--------|---------|----------------------|
| +5 VDC | 3.3 A | 4.4 A |

Environmental

| | |
|-----------------------|----------------------------------------------------------------------------------|
| Component Temperature | 0° to 70° C (32° to 158° F) operating -55° to 150° C (-67° to 302° F) storage |
| Emissions | FCC Class A |
| Relative Humidity | 0% to 95% noncondensing; operating 0% to 100% noncondensing; storage |
| Safety | Not applicable |
| Shock and Vibration | Not applicable |

Physical

| | |
|-------------------|-------------------------------------------------------------|
| Board Size | Standard full-length AT-height board (13.36 in. by 4.8 in.) |
| Connectors | Single fully implemented MXIbus connector |
| Slot Requirements | Single AT (ISA) slot |

Reliability

| | |
|------|-----------------|
| MTBF | Contact Factory |
|------|-----------------|

Requirements

| | |
|-----------------------|--------------|
| Memory space required | 64 kilobytes |
| I/O space required | 32 bytes |

Timing

Master Mode

| Transfer Type | Transfer Rate |
|---------------|---------------|
| Write | 530 nsec |
| Read | 430 nsec |
| Block Write | 290 nsec |
| Block Read | 190 nsec |

Slave Mode

| Transfer Type | Transfer Rate |
|---------------|---------------|
| Write | 840 nsec |
| Read | 840 nsec |
| Block Write | 590 nsec |
| Block Read | 590 nsec |

Other

Daisy-Chain Delay 120 nsec
 (Passing GIN to GOUT or GOUT generation from System Controller)

VXI-MXI

The following pages list the specifications for the VXI-MXI module.

Capability Codes

VMEbus

| Capability Code | Description |
|----------------------|------------------------------------------|
| MA32, MA24, MA16 | Master Mode A32, A24, and A16 addressing |
| SA32, SA24, SA16 | Slave Mode A32, A24, and A16 addressing |
| MD32, MD16, MD08(EO) | Master Mode D32, D16, and D08 data sizes |
| SD32, SD16, SD08(EO) | Slave Mode D32, D16, and D08 data sizes |
| MBLOCK | Master Mode block transfers |
| SBLOCK | Slave Mode block transfers |
| MRMW | Master Mode Read/Modify/Write |
| SRMW | Slave Mode Read/Modify/Write |
| PRI | Prioritized arbitration |
| ROR | Release on Request bus requester |
| IH | Interrupt Handler |
| IR | Interrupt Requester |
| ROAK | Release on Acknowledge interrupter |
| BTO | Bus Timeout |
| SC | Optional VMEbus System Controller |
| IACK | IACK daisy-chain driver |

VXIbus

| Capability Code | Description |
|-----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------|
| TRIG+1 | Supports TTLTRIG0:7 and ECLTRIG0:1 trigger lines and full protocol operations for each. The VXI-MXI may participate in only one protocol operation at a time. |

MXIbus

| Capability Code | Description |
|------------------------|------------------------------------------|
| MA32, MA24, MA16 | Master Mode A32, A24, and A16 addressing |
| SA32, SA24, SA16 | Slave Mode A32, A24, and A16 addressing |
| MD32, MD16, MD08(EO) | Master Mode D32, D16, and D08 data sizes |
| SD32, SD16, SD08(EO) | Slave Mode D32, D16, and D08 data sizes |
| MBLOCK | Master Mode block transfers |
| SBLOCK | Slave Mode block transfers |
| SC | Optional MXIbus System Controller |
| FAIR | Optional MXIbus fair requester |
| TERM | Can accept MXIbus termination resistors |
| IH | Interrupt Handler |
| IR | Interrupt Requester |

Electrical

| Source | DC Current Ratings | | Dynamic Current |
|---------------|---------------------------|----------------|------------------------|
| | Typical | Maximum | |
| +5 VDC | 5.25 A | 6.7 A | 0.67 A |
| -5.2 VDC | 300 mA | 400 mA | 50 mA |
| -2 VDC | 100 mA | 125 mA | 20 mA |

Environmental

Component temperature

0° to 70° C operating;
-40° to 85° C storage

Airflow

3.5 liters/sec for 10° rise

Relative humidity

10% to 90% noncondensing operating;
0% to 95% noncondensing storage

Emissions FCC Class A
 Safety Not applicable
 Shock and Vibration Not applicable

Physical

Board size Fully shielded VXI C-size board
 (233.35 mm by 340 mm; 9.187 in. by 13.386 in.)
 Connectors Single fully implemented MXIbus connector
 Single INTX connector (on boards equipped
 with optional INTX daughter card)
 Slot Requirements Single VXI C-size slot
 VXI Keying Class Class 1 TTL
 Fully compatible with VXI specification
 Fully enclosed and shielded

Reliability

MTBF Contact Factory

Requirements

A16 Space 64 bytes

Timing

Master Mode

| Transfer Type | Transfer Rate |
|---------------|---------------|
| Write | 675.5 nsec |
| Read | 625.5 nsec |
| Block Write | 320 nsec |
| Block Read | 270 nsec |

Slave Mode

| Transfer Type | Transfer Rate |
|---------------|---------------|
| Write | 381 nsec |
| Read | 381 nsec |
| Block Write | 238 nsec |
| Block Read | 238 nsec |

Other

Daisy-Chain Delay 120 nsec
 (Passing GIN to GOUT or GOUT generation from System Controller)

Appendix B

Customer Communication

For your convenience, this appendix contains a form to help you gather the information necessary to help us solve technical problems you might have as well as a form you can use to comment on the product documentation. Filling out a copy of the *Technical Support Form* before contacting National Instruments helps us help you better and faster.

Technical Support

Because it helps us solve your problems more easily, we encourage you to fax us a completed copy of the *Technical Support Form* and the configuration forms from the user manuals of the National Instruments hardware or software you are using, even if you wish to contact us later by telephone. You can contact us by fax at any time at the following number:

(512) 794-5678

You can use the following numbers between the hours of 8:00 a.m. and 5:30 p.m. (central time) to call the National Instruments applications engineering department:

(512) 794-0100

(800) 433-3488 (toll-free in the U.S. and Canada)

For best service, please complete the *Technical Support Form* and any applicable configuration forms, record any error messages, and be available at your computer when calling for technical support.

Documentation Comments

You can use the *Documentation Comment Form* to express your opinion of our documents. Please mail or fax it according to the instructions printed at the bottom of the form.

Technical Support Form

Photocopy this form and update it each time you make changes to your software or hardware, and use the completed copy of this form as a reference for your current configuration. Completing this form accurately before contacting National Instruments for technical support helps our applications engineers answer your questions more efficiently.

If you are using any National Instruments hardware or software products related to this problem, include the configuration forms from their user manuals. Use additional pages if necessary.

Name _____

Company _____

Address _____

Fax (____) _____ Phone (____) _____

Computer brand _____ Model _____ Processor _____

Operating system _____

Speed _____MHz RAM _____M Display adapter _____

Mouse _____yes _____no Other adapters installed _____

Hard disk capacity _____M Brand _____

Instruments used _____

National Instruments hardware product model _____ Revision _____

Configuration _____

National Instruments software product _____ Version _____

Configuration _____

The problem is _____

List any error messages _____

The following steps will reproduce the problem _____

VXI-AT2023 Hardware and Software Configuration Form

Record the settings and revisions of your hardware and software on the line to the right of each item. Complete a new copy of this form each time you revise your software or hardware configuration, and use this form as a reference for your current configuration. Completing this form accurately before contacting National Instruments for technical support helps our applications engineers answer your questions more efficiently.

National Instruments Products

- NI-VXI Software Revision Number _____
(Disk Label: *NI-VXI Distribution Diskette for the AT-MXI and ISC 386/ix*)
- Application Programming Language _____
- AT-MXI Base I/O Address _____
- AT-MXI Master Window Base _____
- AT-MXI Address Space _____
- AT-MXI Master DMA Channel _____
- AT-MXI Board Interrupt Level _____
- AT-MXI Slave I/O Window Base _____
- AT-MXI Slave I/O Window Size _____
- AT-MXI Slave Memory Window Size _____
- AT-MXI Slave AT Memory Offset _____
- AT-MXI Slave DMA Channel _____
- AT-MXI is MXIbus System Controller? _____
- AT-MXI is Fair Requester? _____
- MXIbus Interrupt Level _____
- VXI-MXI Installed in Slot 0? _____
- VXI-MXI Logical Address _____
- VXI-MXI VMEbus Request Level _____
- VXI-MXI Hardware Revision _____
- AT-MXI Hardware Revision _____

Other Products

- Computer Make and Model _____
- Microprocessor _____
- Clock Frequency (Bus and Microprocessor) _____
- Total Memory in System _____
- Type of Video Board Installed _____
- UNIX Version _____
- Programming Language Version _____
- Other Boards in System _____
- Base I/O Address of Other Boards _____
- DMA Channels of Other Boards _____
- Interrupt Level of Other Boards _____
- VXibus Mainframe Make and Model _____
- Other VXibus Devices in System _____
- Static Logical Addresses of Other
VXibus Devices _____

Documentation Comment Form

National Instruments encourages you to comment on the documentation supplied with our products. This information helps us provide quality products to meet your needs.

Title: **Getting Started with Your VXI-AT2023 and the NI-VXI™ Software for ISC 386/ix**

Edition Date: **December 1992**

Part Number: **320267-01**

Please comment on the completeness, clarity, and organization of the manual.

If you find errors in the manual, please record the page numbers and describe the errors.

Thank you for your help.

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Glossary

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

Symbols

| | |
|---|---------------|
| ° | degrees |
| % | percent |
| ± | plus or minus |

A

A amperes

A16 space VXIbus address space equivalent to the VME 64 kilobyte *short* address space. In VXI, the upper 16 kilobytes of A16 space is allocated for use by VXI devices configuration registers. This 16 kilobyte region is referred to as VXI configuration space.

A24 space VXIbus address space equivalent to the VME 16 megabyte *standard* address space.

A32 space VXIbus address space equivalent to the VME 4 gigabyte *extended* address space.

address Character code that identifies a specific location (or series of locations) in memory.

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, and 32. In VME/VXI, because there are six address modifiers, there are 64 possible address spaces.

address window A portion of address space that can be accessed from the application program.

ANSI American National Standards Institute

arbitration A process in which a potential bus master gains control over a particular bus.

asynchronous Not synchronized; not controlled by time signals.

B

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.

binary A numbering system with a base of 2.

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. In VME, the data transfer may have no more than 256 elements; MXI does not have this restriction.

BTO Bus Timeout Unit; a functional module that times the duration of each data transfer and terminates the cycle if the duration is excessive. Without the termination capability of this module, a bus master attempt to access a nonexistent slave could result in an indefinitely long wait for a slave response.

bus master A device that is capable of requesting the Data Transfer Bus (DTB) for the purpose of accessing a slave device.

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 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 nsec.

CMOS Complementary Metal Oxide Semiconductor; a process used in making chips.

Commander A Message-Based device which is also a bus master and can control one or more Servants.

D

| | |
|-------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| DACK | DMA Acknowledge |
| daisy-chain | A method of propagating signals along a bus, in which the devices are prioritized on the basis of their position on the bus. |
| 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. |
| DIP | Dual Inline Package |
| DMA | Direct Memory Access; a method by which data is transferred between devices and internal memory without intervention of the central processing unit. |
| DRQ | DMA Request |
| DTB | See <i>Data Transfer Bus</i> . |
| 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. A MXIbus device responds at Logical Address 255 during a priority select cycle. The Resource Manager subsequently assigns it a new logical address, which the device responds to until powered down. |

E

| | |
|---------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ECL | Emitter-Coupled Logic |
| 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. |
| EMI | Electromagnetic Interference |
| external controller | In this configuration, a plug-in interface board in a computer is connected to the VXI mainframe via one or more VXIbus extended controllers. The computer then exerts overall control over VXIbus system operations. |

F

| | |
|---|------------|
| F | Fahrenheit |
|---|------------|

fair requester A MXIbus master that will not arbitrate for the MXIbus after releasing it until it detects the bus request signal inactive. This ensures that all requesting devices will be granted use of the bus.

FCC Federal Communications Commission

G

GPIB General Purpose Interface Bus; the industry-standard IEEE 488 bus.

GIN Daisy-chain Grant In signal

GOUT Daisy-chain Grant Out signal

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

IC Integrated Circuit

IEEE Institute of Electrical and Electronics Engineers

in. inches

I/O input/output; the techniques, media, and devices used to achieve communication between machines and users.

interrupt A means for a device to request service from another device.

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.

INTX Interrupt Timing and Extension

IRQ* Interrupt signal

ISA Industry Standard Architecture

K

K 1,024; kilobytes of memory

L

LED Light Emitting Diode

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 1,048,576; megabytes of memory

m meters

master A functional part of a MXI/VME/VXIbus device that initiates data transfers on the backplane. A transfer can be either a read or a write.

master-mode operation A device is in master mode if it is performing a bus cycle which it initiated.

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 Identification lines

movs Move string command

MTBF Mean Time Between Failure

MXIbus Multisystem eXtension Interface Bus; a high-performance communication link that interconnects devices using round, flexible cables.

MXIbus System Controller A functional module that has arbiter, daisy-chain driver, and MXIbus cycle timeout responsibility. Always the first device in the MXIbus daisy-chain.

N

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

PC AT Personal Computer Advanced Technology

propagation The transmission of signal through a computer system.

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.

RM See *Resource Manager*.

S

seconds

Servant A device controlled by a Commander; there are Message-Based and Register-Based Servants.

Shared Memory Protocol A communication protocol that uses a block of memory that is accessible to both a client and a server. The memory block operates as a message buffer for communications.

shell An interactive program for commands.

shell script The commands used to perform batch processing.

slave A functional part of a MXI/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.

slave-mode operation A device is in slave mode if it is responding to a bus cycle.

| | |
|------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 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 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. |
| 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. |
| T | |
| trigger | Either TTL or ECL lines used for intermodule communication. |
| TTL | Transistor-Transistor Logic |
| V | |
| VDC | volts direct current |
| victext | Text-based VXI Interactive Control Program, a part of the NI-VXI bus interface software package. Used to program VXI devices, and develop and debug VXI application programs. |
| VME | Versa Module Eurocard or IEEE 1014 |
| VMEbus System Controller | See <i>Slot 0 Device</i> . |
| VXIbus | VMEbus Extensions for Instrumentation |
| vxiiinit | A program in the NI-VXI bus interface software package that initializes the board interrupts, shared RAM, VXI register configurations, and bus configurations. This program must be run at least once after rebooting your machine to initialize the system. |
| vxitedit | Text-based VXI Resource Editor program, a part of the NI-VXI bus interface software package. Used to configure the system, edit the manufacturer name and ID numbers, edit the model names of VXI and non-VXI devices in the system, as well as the system interrupt configuration information, and display the system configuration information generated by the Resource Manager. |

W

Word Serial
Protocol

The simplest required communication protocol supported by Message-Based devices in the VXIbus system. It utilizes the A16 communication registers to transfer data using a simple polling handshake method.