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DAQ

VXI-AO-48XDC User Manual

DC Setpoint Module for VXIbus

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About This Manual

This manual describes the mechanical and electrical aspects of the VXI-AO-48XDC and contains information concerning its configuration, installation, and operation. The VXI-AO-48XDC is designed for precise DC setpoint applications and provides general purpose digital I/O.

How To Use the Manual Set

The *VXI-AO-48XDC User Manual* is one piece of the documentation set for your VXI data acquisition (VXI-DAQ) system. You could have any of several types of documentation, depending on the hardware and software in your system. Use the different types of documentation you have as follows:

- Your VXI-DAQ hardware documentation—These documents have detailed information about the VXI-DAQ hardware that plugs into or is connected to your computer. Use these documents for hardware installation and configuration instructions, specification information about your VXI-DAQ hardware, and application hints.
- Software documentation—You may have both application software and driver software documentation. National Instruments application software includes ComponentWorks, LabVIEW, LabWindows/CVI, Measure, and VirtualBench. National Instruments driver software includes NI-DAQ and VXI*plug&play* instrument drivers. After you set up your hardware system, use either your application or driver software documentation to help you write your application. If you have a large, complicated system, it is worthwhile to look through the software documentation before you configure your hardware.
- Accessory installation guides or manuals—If you are using accessory products, read the terminal block and cable assembly installation guides or accessory board user manuals. They explain how to physically connect the relevant pieces of the system. Consult these guides when you are making your connections.

Conventions Used in This Manual

The following conventions are used in this manual:

< >	Angle brackets containing numbers separated by an ellipsis represent a range of values associated with a bit or signal name—for example, Port0_Line<7..0>.
☞	This icon to the left of bold italicized text denotes a note, which alerts you to important information.
	This icon to the left of bold italicized text denotes a warning, which advises you of precautions to take to avoid being electrically shocked.
bold	Bold text denotes the names of menus, menu items, or dialog box buttons or options.
bold italic	Bold italic text denotes a note, caution, or warning.
italic	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, 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, variables, file names and extensions, and for statements and comments taken from program code.
NI-DAQ	NI-DAQ refers to the NI-DAQ driver software.

1

Introduction

This chapter describes the VXI-AO-48XDC, lists what you need to get started, describes software programming choices, optional equipment, and custom cables, and explains how to unpack the VXI-AO-48XDC.

About the VXI-AO-48XDC

Thank you for purchasing the National Instruments VXI-AO-48XDC. The VXI-AO-48XDC is a precise DC setpoint module for the VXIbus. The module has 48 voltage output channels and 48 current output channels. In addition, the module has 32 digital I/O lines.

You can use the VXI-AO-48XDC in a wide variety of DC setpoint and digital applications. With the VXI-AO-48XDC, your VXIbus system can serve as a digital I/O system controller for laboratory testing, production testing, and industrial process monitoring and control. Use your VXI-AO-48XDC module to:

- Generate experimental stimuli
- Generate analog functions
- Connect to a variety of signal types, including:
  - Electromechanical relays
  - LEDs
  - Optically isolated, solid-state relays and I/O module mounting racks

Detailed specifications for the VXI-AO-48XDC are in Appendix A, *Specifications*.

What You Need to Get Started

To set up and use your VXI-AO-48XDC, you will need the following:

- ❑ VXI-AO-48XDC module
- ❑ *VXI-AO-48XDC User Manual*

- ❑ One of the following software packages and documentation:
  - ComponentWorks
  - LabVIEW for Windows
  - LabWindows/CVI for Windows
  - Measure
  - NI-VISA
  - NI-DAQ for PC compatibles
  - VirtualBench
  - VXI*plug&play* instrument driver
- ❑ Your VXIbus system

Software Programming Choices

There are several options to choose from when programming your National Instruments VXI-DAQ hardware. You can use LabVIEW, LabWindows/CVI, ComponentWorks, VirtualBench, or other application development environments with either NI-DAQ or the VXI*plug&play* instrument driver. Both NI-DAQ and the VXI*plug&play* instrument driver access the VXI-DAQ hardware through the VISA driver software.

National Instruments Application Software

ComponentWorks contains tools for data acquisition and instrument control built on NI-DAQ driver software. ComponentWorks provides a higher-level programming interface for building virtual instruments through standard OLE controls and DLLs. With ComponentWorks, you can use all of the configuration tools, resource management utilities, and interactive control utilities included with NI-DAQ.

LabVIEW features interactive graphics, a state-of-the-art user interface, and a powerful graphical programming language. The LabVIEW Data Acquisition VI Library, a series of VIs for using LabVIEW with National Instruments DAQ hardware, is included with LabVIEW. The LabVIEW Data Acquisition VI Library is functionally equivalent to the NI-DAQ software.

LabWindows/CVI features interactive graphics, a state-of-the-art user interface, and uses the ANSI-standard C programming language. The LabWindows/CVI Data Acquisition Library, a series of functions for using LabWindows/CVI with National Instruments DAQ hardware, is included

with the NI-DAQ software kit. The LabWindows/CVI Data Acquisition Library is functionally equivalent to the NI-DAQ software.

VirtualBench features VIs that combine DAQ products, software, and your computer to create a standalone instrument with the added benefit of the processing, display, and storage capabilities of your computer. VirtualBench instruments load and save waveform data to disk in the same forms that can be used in popular spreadsheet programs and word processors.

Using ComponentWorks, LabVIEW, LabWindows/CVI, or VirtualBench software will greatly reduce the development time for your data acquisition and control application.

NI-DAQ Driver Software

The NI-DAQ driver software is included at no charge with all National Instruments DAQ hardware. NI-DAQ is not packaged with accessory products. NI-DAQ has an extensive library of functions that you can call from your application programming environment. These functions include routines for analog input (A/D conversion), buffered data acquisition (high-speed A/D conversion), analog output (D/A conversion), waveform generation, digital I/O, counter/timer operations, SCXI, RTSI, self-calibration, messaging, and acquiring data to extended memory.

NI-DAQ has both high-level DAQ I/O functions for maximum ease of use and low-level DAQ I/O functions for maximum flexibility and performance. Examples of high-level functions are streaming data to disk or acquiring a certain number of data points. An example of a low-level function is writing directly to registers on the DAQ device. NI-DAQ does not sacrifice the performance of National Instruments DAQ devices because it lets multiple devices operate at their peak performance.

NI-DAQ maintains a consistent software interface among its different versions so that you can change platforms with minimal modifications to your code.

VXI*plug&play* Instrument Driver

National Instruments distributes VXI*plug&play* instrument drivers free of charge. VXI*plug&play* instrument drivers are one level above the NI-DAQ device driver and contain high-level software functions whose architecture is specified by the VXI*plug&play* Systems Alliance. The VXI*plug&play* standards increase interoperability with other vendors, and ensure that drivers are designed and presented in a consistent fashion that facilitates

ease of use. Refer to Figure 1-1 to see the relationship between your software components.

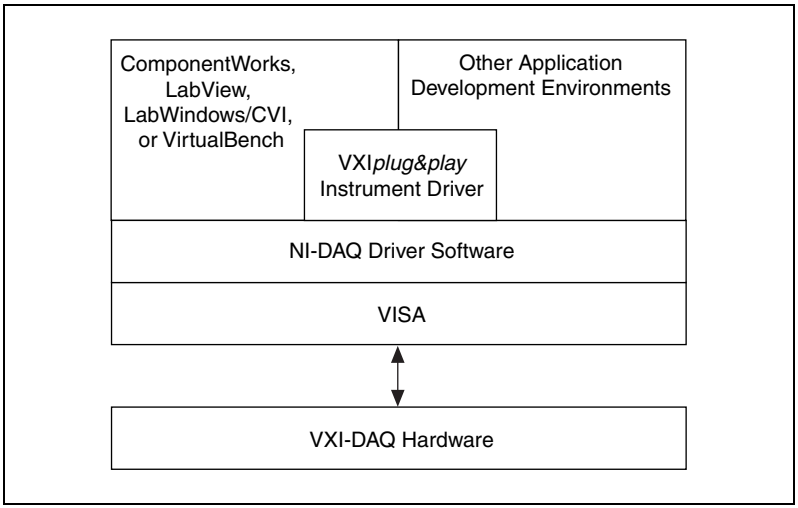


Figure 1-1. The Relationship between the Programming Environment, Your Instrument Driver, and Your VXI-DAQ Hardware

Optional Equipment

National Instruments offers a variety of products to use with your VXI-AO-48XDC module, including cables, connector blocks, and other accessories, as follows:

- Cables and cable assemblies, shielded and ribbon
- Connector blocks, shielded and unshielded screw terminals

For more specific information about these products, refer to your National Instruments catalogue or call the office nearest you.

Custom Cabling

National Instruments offers cables and accessories for you to prototype your application or to use if you frequently change module interconnections.

You can interface the VXI-AO-48XDC to a wide range of test instruments, I/O racks and modules, screw terminal panels, and almost any device with a parallel interface. The VXI-AO-48XDC digital I/O connector is a

standard, 96-pin DIN header connector. Refer to your National Instruments catalogue for specific information.

Unpacking

Your VXI-AO-48XDC module is shipped in an antistatic package to prevent electrostatic damage to the module. Electrostatic discharge can damage several components on the module. To avoid such damage in handling the module, take the following precautions:

- Ground yourself via a grounding strap or by holding a grounded object.
- Touch the antistatic package to a metal part of your VXIbus chassis before removing the module from the package.
- Remove the module from the package and inspect the module for loose components or any other sign of damage. Notify National Instruments if the module appears damaged in any way. Do *not* install a damaged module into your VXIbus backplane.
- *Never* touch the exposed pins of connectors.

2

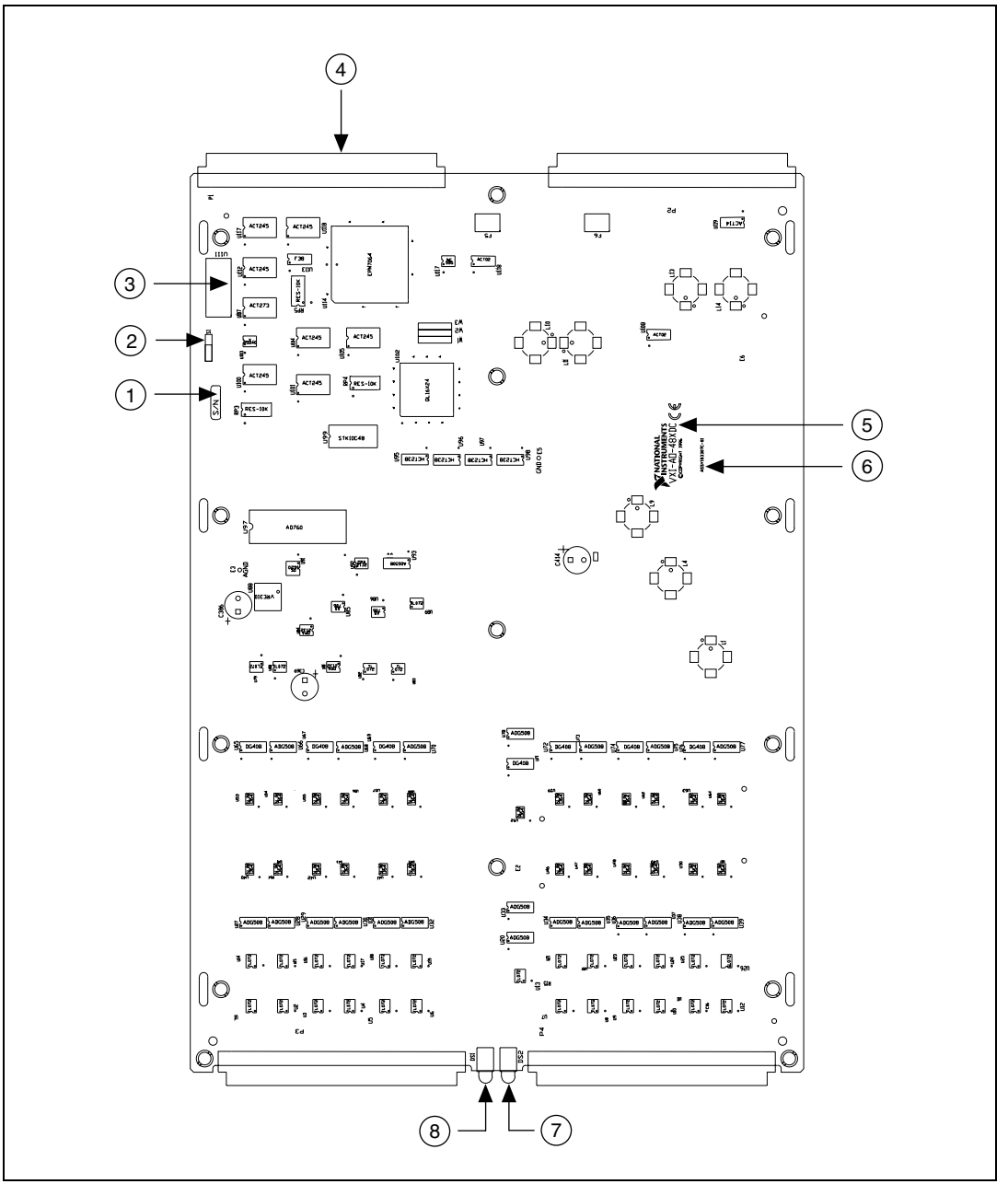
Configuration and Installation

This chapter describes how to configure and install your VXI-AO-48XDC module.

Module Configuration

This section describes how to configure the VXIbus logical address on your VXI-AO-48XDC.

Figure 2-1 shows the VXI-AO-48XDC as it appears with the component side facing you. The drawing shows the location of various module components, including the logical address switch.



1	Serial Number	3	Logical Address Switch	5	Product Name	7	Status Light
2	S1	4	P1 Connector	6	Assembly Number	8	Access Light

Figure 2-1. VXI-AO-48XDC Parts Locator Diagram

VXIbus Logical Address

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

Logical address 0 is reserved for the Resource Manager in the VXIbus system. Because the VXI-AO-48XDC cannot act as a Resource Manager, do not configure the VXI-AO-48XDC with a logical address of 0. The factory-default logical address for the VXI-AO-48XDC is *5*.

Some VXIbus modules have dynamically configurable logical addresses. These modules have an initial logical address of hex FF or decimal 255, which indicates that they can be dynamically configured.

The VXI-AO-48XDC supports dynamic configuration of its logical address. However, adding or removing modules can change the logical address of the VXI-AO-48XDC. Tracking these changes in your application software can be troublesome.

In many cases, static configuration of the logical address is easier. For example, ensure that no other statically configurable VXIbus modules have a logical address of *5*. If they do, change the logical address setting of either the VXI-AO-48XDC or the other module so that every module in the system has a different logical address.

To change the VXI-AO-48XDC logical address, modify the setting of the 8-bit DIP switch labeled *Logical Address Switch* (see Figure 2-1 for the switch location). The *down* position of the DIP switch corresponds to a logic value of *0* and the *up* position corresponds to a logic value of *1*. Verify that the VXI-AO-48XDC does not have the same logical address as any other statically configured VXIbus module in your system.

☞ **Note** ***Logical address 0 is** not **allowed for the VXI-AO-48XDC.***

Figure 2-2 shows switch settings for logical addresses hex 5 and C0.

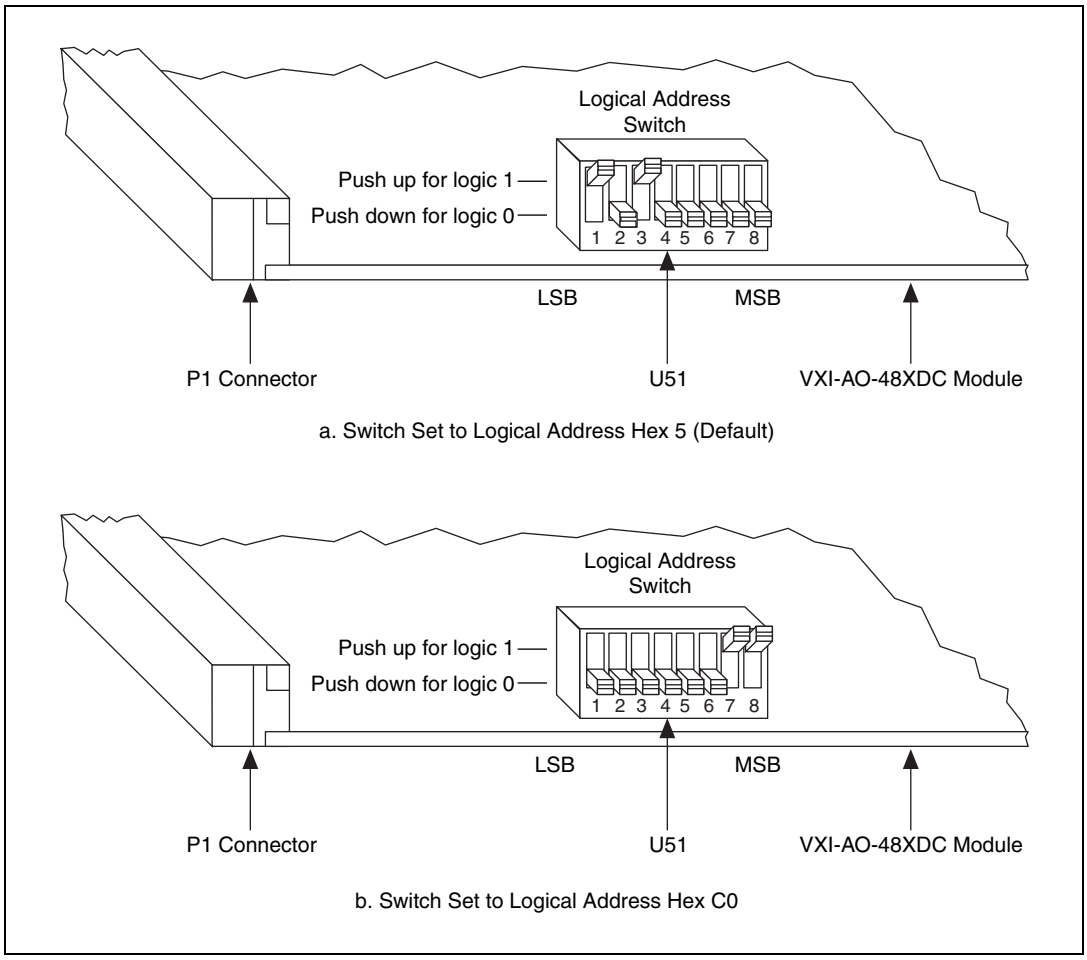


Figure 2-2. Logical Address Selection

Hardware Installation

This section contains general installation instructions for the VXI-AO-48XDC. Consult your VXIbus mainframe user manual or technical reference manual for specific instructions and warnings.

1. Plug in your mainframe before installing the VXI-AO-48XDC. The power cord grounds the mainframe and protects it from electrical damage while you are installing the module. Do *not* turn on the mainframe.

Warning ***To protect both yourself and the mainframe from electrical hazards, do not turn on the mainframe until you are finished installing the VXI-AO-48XDC module.***

2. Remove or open any doors or covers blocking access to the mainframe slots.
3. If you are installing the VXI-AO-48XDC into a D-size mainframe, first install an appropriate support for C-size modules.
4. Insert the VXI-AO-48XDC in the slot you have selected:
   a. Align the top and bottom of the module with the card-edge guides inside the mainframe.
   b. Slowly push the VXI-AO-48XDC straight into the slot until its plug connectors rest on the backplane receptacle connectors.
   c. Using evenly distributed pressure, slowly press the VXI-AO-48XDC straight in until it seats in the expansion slot.
   d. Make sure the front panel of the VXI-AO-48XDC is even with the front panel of the mainframe.
5. Tighten the retaining screws on the top and bottom edges of the front panel.
6. Replace or close any doors or covers to the mainframe.

Software Installation

If you are using a VXI*plug&play* instrument driver, follow the instructions in the Setup Utility on the diskettes that were included with your VXI-DAQ hardware. This user manual assumes that the VISA software is installed. If VISA is not installed, you must get the VISA software from the supplier of your VXIbus controller.

If you are using NI-DAQ, refer to your release notes. Find the installation section for your operating system and follow the instructions given there.

If you are using ComponentWorks, LabVIEW, LabWindows/CVI, or VirtualBench, refer to the appropriate release notes to install your application software. After you have installed your application software, refer to the NI-DAQ release notes and follow the instructions given there for your operating system and application software.

3

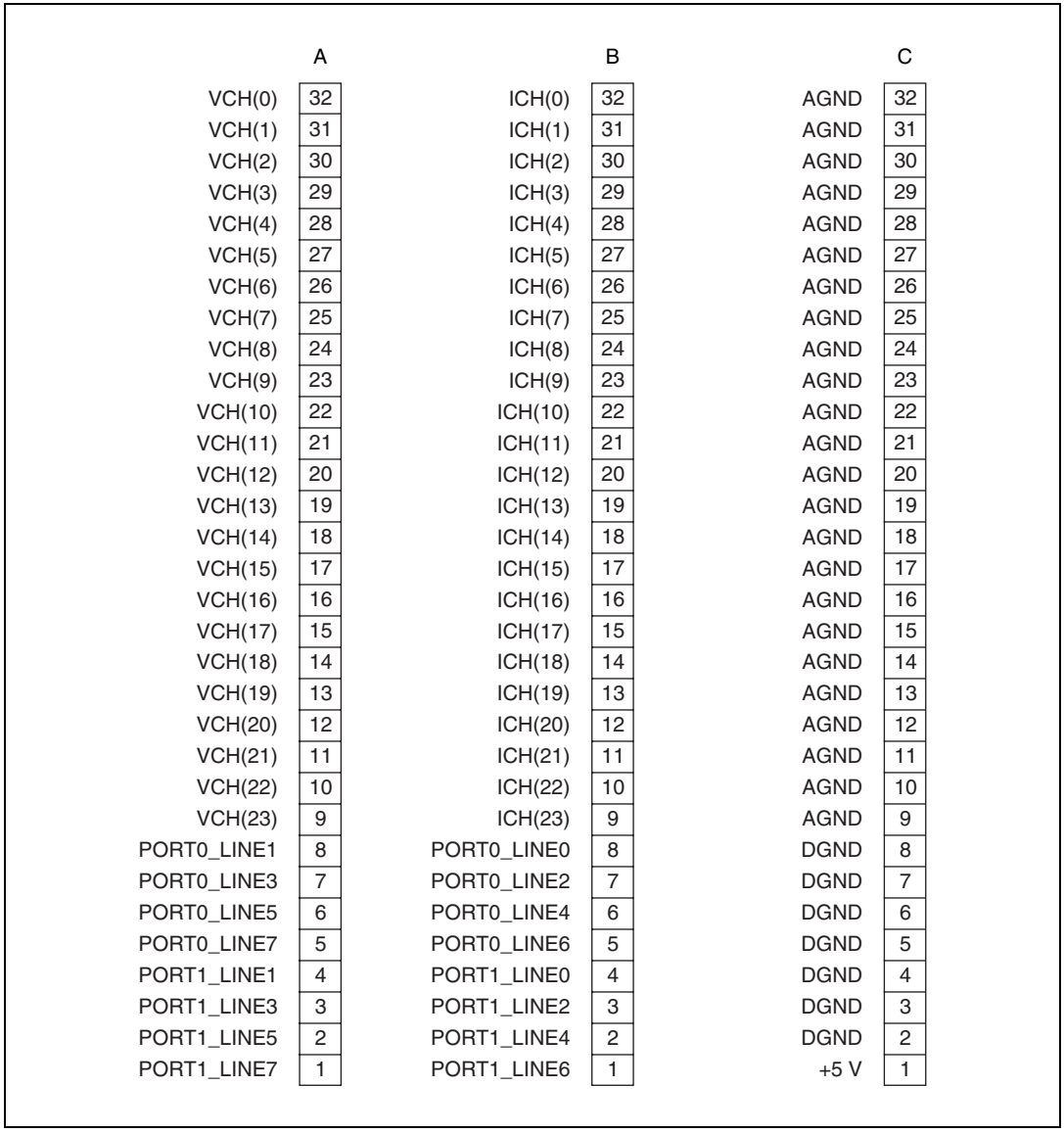
Signal Connections

This chapter provides connection instructions for the signals on the VXI-AO-48XDC I/O connector.

Warning ***Connections that exceed any of the maximum ratings of input or output signals on the VXI-AO-48XDC can damage the VXI-AO-48XDC module and the VXIbus system. Maximum input ratings for each signal are given in this chapter under the discussion of that signal. National Instruments is not liable for any damages resulting from any incorrect signal connections.***

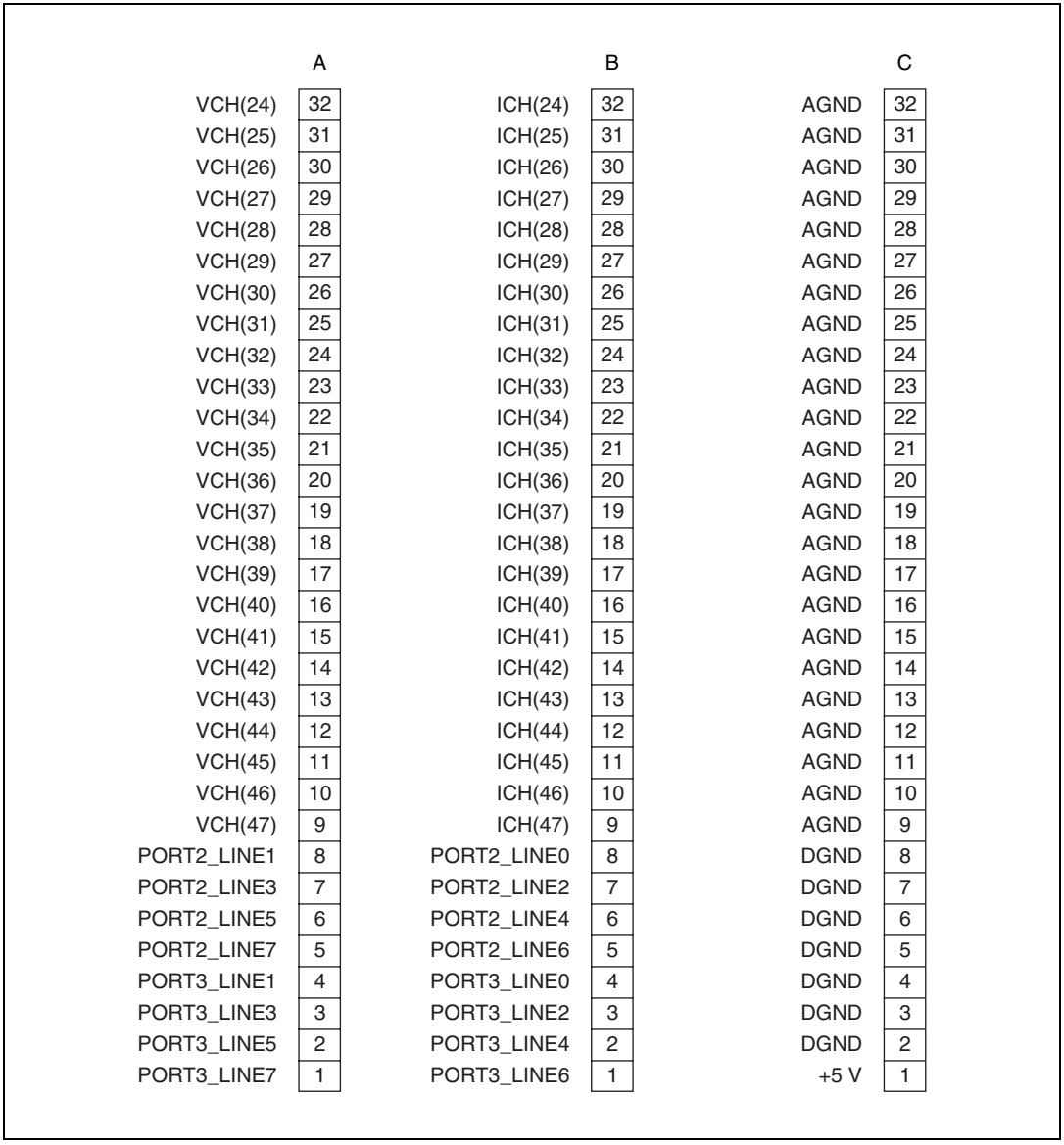
I/O Connector Pin Assignments

Figures 3-1 and 3-2 show the pin assignments for the VXI-AO-48XDC I/O connectors.



A		B		C	
VCH(0)	32	ICH(0)	32	AGND	32
VCH(1)	31	ICH(1)	31	AGND	31
VCH(2)	30	ICH(2)	30	AGND	30
VCH(3)	29	ICH(3)	29	AGND	29
VCH(4)	28	ICH(4)	28	AGND	28
VCH(5)	27	ICH(5)	27	AGND	27
VCH(6)	26	ICH(6)	26	AGND	26
VCH(7)	25	ICH(7)	25	AGND	25
VCH(8)	24	ICH(8)	24	AGND	24
VCH(9)	23	ICH(9)	23	AGND	23
VCH(10)	22	ICH(10)	22	AGND	22
VCH(11)	21	ICH(11)	21	AGND	21
VCH(12)	20	ICH(12)	20	AGND	20
VCH(13)	19	ICH(13)	19	AGND	19
VCH(14)	18	ICH(14)	18	AGND	18
VCH(15)	17	ICH(15)	17	AGND	17
VCH(16)	16	ICH(16)	16	AGND	16
VCH(17)	15	ICH(17)	15	AGND	15
VCH(18)	14	ICH(18)	14	AGND	14
VCH(19)	13	ICH(19)	13	AGND	13
VCH(20)	12	ICH(20)	12	AGND	12
VCH(21)	11	ICH(21)	11	AGND	11
VCH(22)	10	ICH(22)	10	AGND	10
VCH(23)	9	ICH(23)	9	AGND	9
PORT0_LINE1	8	PORT0_LINE0	8	DGND	8
PORT0_LINE3	7	PORT0_LINE2	7	DGND	7
PORT0_LINE5	6	PORT0_LINE4	6	DGND	6
PORT0_LINE7	5	PORT0_LINE6	5	DGND	5
PORT1_LINE1	4	PORT1_LINE0	4	DGND	4
PORT1_LINE3	3	PORT1_LINE2	3	DGND	3
PORT1_LINE5	2	PORT1_LINE4	2	DGND	2
PORT1_LINE7	1	PORT1_LINE6	1	+5 V	1

Figure 3-1. CH <0..23> Connector Pin Assignments



	A		B		C
VCH(24)	32	ICH(24)	32	AGND	32
VCH(25)	31	ICH(25)	31	AGND	31
VCH(26)	30	ICH(26)	30	AGND	30
VCH(27)	29	ICH(27)	29	AGND	29
VCH(28)	28	ICH(28)	28	AGND	28
VCH(29)	27	ICH(29)	27	AGND	27
VCH(30)	26	ICH(30)	26	AGND	26
VCH(31)	25	ICH(31)	25	AGND	25
VCH(32)	24	ICH(32)	24	AGND	24
VCH(33)	23	ICH(33)	23	AGND	23
VCH(34)	22	ICH(34)	22	AGND	22
VCH(35)	21	ICH(35)	21	AGND	21
VCH(36)	20	ICH(36)	20	AGND	20
VCH(37)	19	ICH(37)	19	AGND	19
VCH(38)	18	ICH(38)	18	AGND	18
VCH(39)	17	ICH(39)	17	AGND	17
VCH(40)	16	ICH(40)	16	AGND	16
VCH(41)	15	ICH(41)	15	AGND	15
VCH(42)	14	ICH(42)	14	AGND	14
VCH(43)	13	ICH(43)	13	AGND	13
VCH(44)	12	ICH(44)	12	AGND	12
VCH(45)	11	ICH(45)	11	AGND	11
VCH(46)	10	ICH(46)	10	AGND	10
VCH(47)	9	ICH(47)	9	AGND	9
PORT2_LINE1	8	PORT2_LINE0	8	DGND	8
PORT2_LINE3	7	PORT2_LINE2	7	DGND	7
PORT2_LINE5	6	PORT2_LINE4	6	DGND	6
PORT2_LINE7	5	PORT2_LINE6	5	DGND	5
PORT3_LINE1	4	PORT3_LINE0	4	DGND	4
PORT3_LINE3	3	PORT3_LINE2	3	DGND	3
PORT3_LINE5	2	PORT3_LINE4	2	DGND	2
PORT3_LINE7	1	PORT3_LINE6	1	+5 V	1

Figure 3-2. CH <24..47> Connector Pin Assignments

Signal Connection Descriptions

Tables 3-1 and 3-2 contain descriptions of the signal connections.

Table 3-1. CH<0..23> Connector Descriptions

Pin	Signal Name	Description
A5, B5, A6, B6, A7, B7, A8, B8	Port0_Line<7..0>	Input/Output Lines for Port 0—Line 7 is the MSB and Line 0 is the LSB.
A1, B1, A2, B2, A3, B3, A4, B4	Port1_Line<7..0>	Input/Output Lines for Port 1—Line 7 is the MSB and Line 0 is the LSB.
B<32..9>	ICH <0..23>	Current output channels.
A<32..9>	VCH <0..23>	Voltage output channels.
C1	+5 V	+5 V—This pin is connected to the VXIbus system +5 VDC supply through a self-resetting circuit breaker.
C<32..9>	AGND	Analog Ground—These pins are connected to the VXI-AO-48XDC analog ground plane. All VXI-AO-48XDC ground planes connect to the VXIbus system ground signal.
C<8..2>	DGND	Digital Ground—These pins are connected to the VXIbus system ground signal. All VXI-AO-48XDC ground planes connect to the VXIbus system ground signal.

Table 3-2. CH<24..47> Connector Descriptions

Pin	Signal Name	Description
A5, B5, A6, B6, A7, B7, A8, B8	Port2_Line<7..0>	Input/Output Lines for Port 2—Line 7 is the MSB and Line 0 is the LSB.
A1, B1, A2, B2, A3, B3, A4, B4	Port3_Line<7..0>	Input/Output Lines for Port 3—Line 7 is the MSB and Line 0 is the LSB
B<32..9>	ICH<24..47>	Current output channels.
A<32..9>	VCH <24..47>	Voltage output channels.
C1	+5 V	+5 V—This pin is connected to the VXIbus system +5 VDC supply through a self-resetting circuit breaker.

Table 3-2. CH<24..47> Connector Descriptions (Continued)

Pin	Signal Name	Description
C<32..9>	AGND	Analog Ground—These pins are connected to the VXI-AO-48XDC analog ground plane. All VXI-AO-48XDC ground planes connect to the VXIbus system ground signal.
C<8..2>	DGND	Digital Ground—These pins are connected to the VXIbus system ground signal. All VXI-AO-48XDC ground planes connect to the VXIbus system ground signal.

Refer to Appendix A, *Specifications*, for detailed information.

Analog Output Signal Connections

Both voltage and current outputs are available on the VXI-AO-48XDC. This section describes how to make connections for each type of output. Figure 3-3 shows how to connect the voltage channel (VCH) outputs.

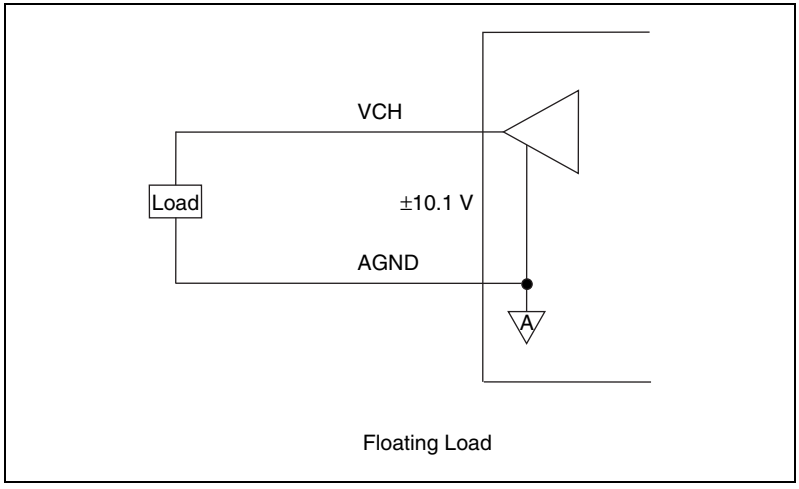


Figure 3-3. VCH Connection as a Voltage Output

Voltage Output

You can connect a floating load to your VXI-AO-48XDC module at the voltage output channel.

Warning ***Because the VXI-AO-48XDC module is not electrically isolated from high voltages, a load with high common mode voltages can damage the VXI-AO-48XDC module. National Instruments is not liable for any damages resulting from any such signal connections.***

Your VXI-AO-48XDC module has a bipolar voltage range of –10.1 to +10.1 V. Maximum load current is ±10 mA for 16-bit linearity.

Power-up Condition

- Output voltage at user-defined value to full accuracy within 1 s of power-up board reset

Current Output

You can connect a floating or grounded load to your VXI-AO-48XDC module at the current output channel. You do not need an external floating power supply to complete the controlled current loop. You can control the current loop from 0.1 to 20.2 mA. The compliance for the current loop is 0 V to 10 VDC.

Warning ***Because the VXI-AO-48XDC module is not electronically isolated from high voltages, a load with high common mode voltages may damage the VXI-AO-48XDC module. National Instruments is not liable for any damages resulting from any such signal connections.***

Power-up Condition

- Output current: within ±1.1 mA maximum of user-defined current within 0.5 s of power-up board reset
- Output current at user-defined value to full accuracy within 7 s of power-up board reset

Figure 3-4 shows how to connect a current channel (ICH) as a current output.

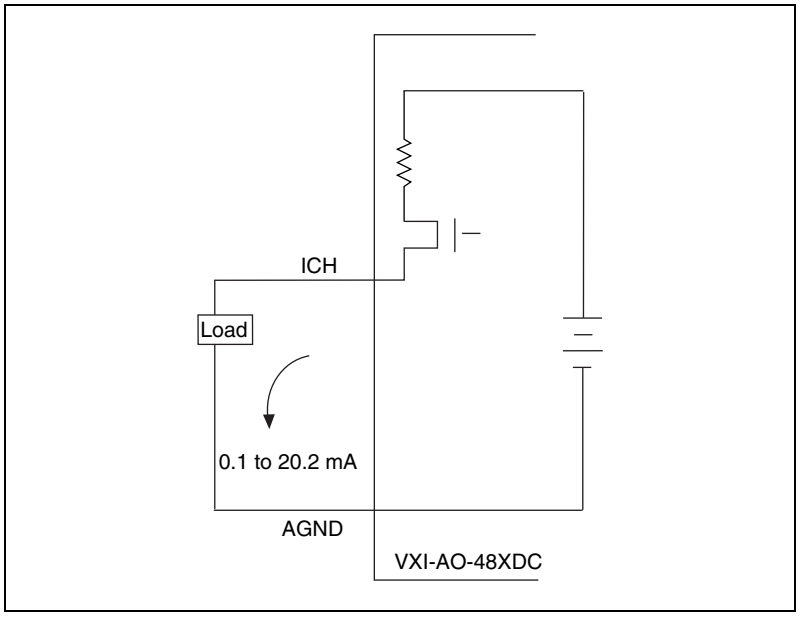


Figure 3-4. ICH Connection as a Current Output

Digital I/O Signal Connections

Figure 3-5 illustrates signal connections for three typical digital I/O applications.

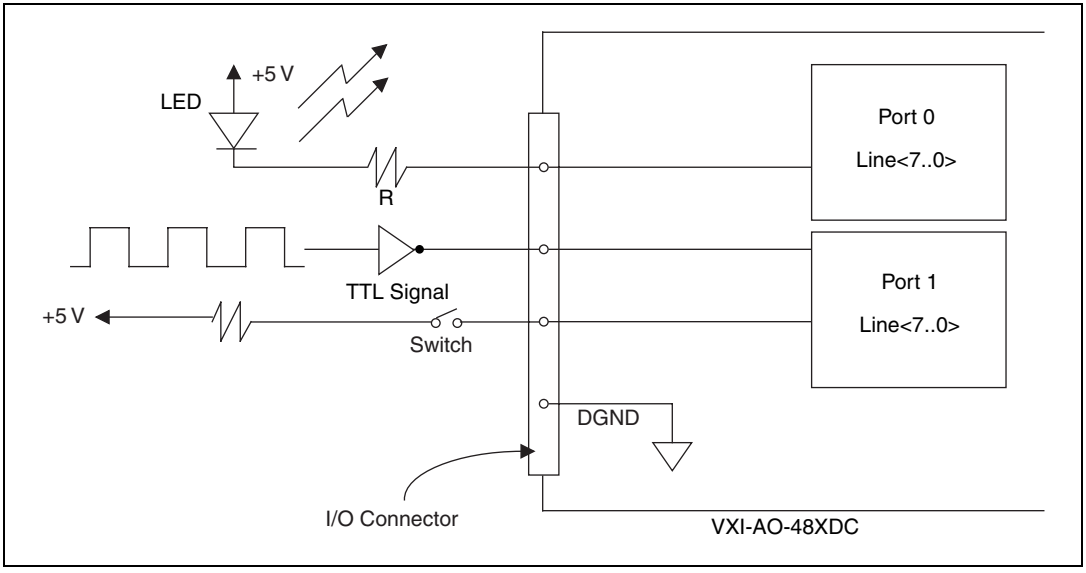


Figure 3-5. Digital I/O Connections

In Figure 3-5, port 0 is configured for digital output and port 1 is configured for digital input.

Digital input applications include receiving TTL signals and sensing external device states such as the switch in Figure 3-5. Digital output applications include sending TTL signals and driving external devices such as the LED shown in Figure 3-5.

☞ **Note** ***The VXI-AO-48XDC allows line-by-line control of digital I/O connections.***

Refer to Appendix A, *Specifications*, for a list of the digital I/O signal ratings.

Power-up Condition

At power up, ports 0 through 3 of the digital I/O circuitry on the VXI-AO-48XDC are configured as input ports.

Power Connections

Pin C1 of both I/O connectors is connected to the +5 V supply from the VXIbus power supply. These pins are referenced to GND and can supply power to external circuitry. The +5 V supply has a total of 2 A available. However, you must limit the current through each connector pin to 1.0 A.

The +5 V power supply has a self-resetting protection circuit breaker in series. If the circuit breaker protection is activated, simply remove the circuit causing the heavy current load and the circuit breaker will reset itself. For more information on these output pins, see the *Digital I/O* and *Power Requirement* sections in Appendix A, *Specifications*.

Power rating	1.0 A per pin at +5 V ±10%, +4.55 to +5.25 VDC at 1 A per pin

Warning ***Under no circumstances should you connect these +5 V power pins directly to ground or to any other voltage source on the VXI-AO-48XDC or any other device. Doing so can damage the VXI-AO-48XDC and your VXIbus system. National Instruments is not liable for damage resulting from such a connection.***

4

Hardware Overview

This chapter contains a functional overview of the VXI-AO-48XDC and explains the operation of each functional unit making up the module.

The block diagram in Figure 4-1 illustrates the key functional components of the VXI-AO-48XDC module.

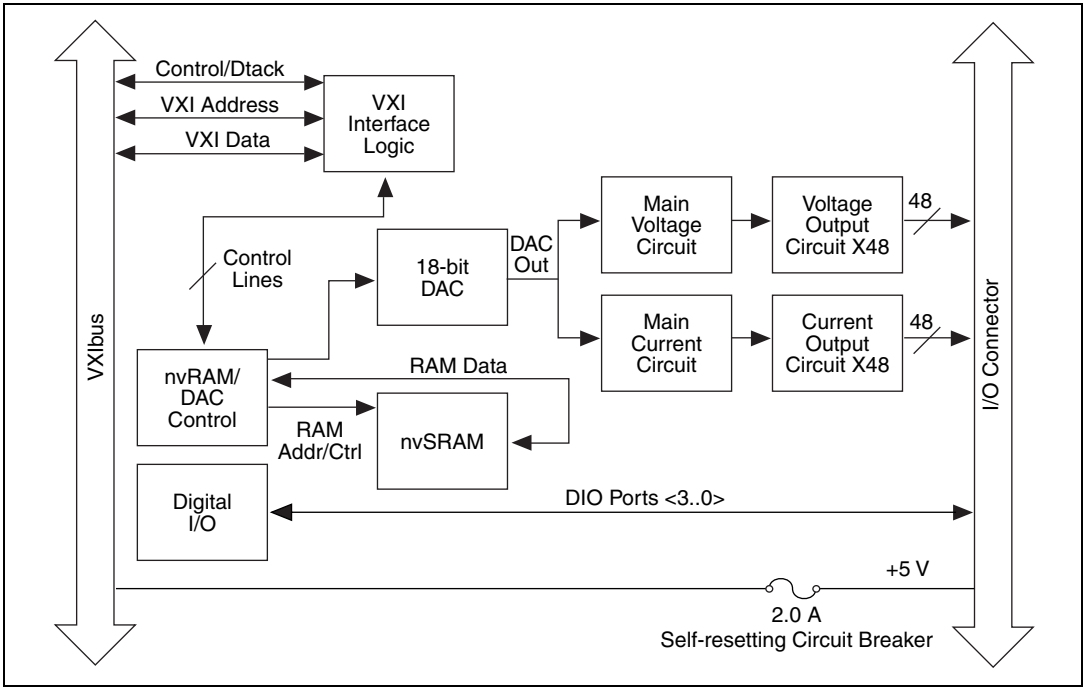


Figure 4-1. VXI-AO-48XDC Block Diagram

The VXIbus I/O channel consists of an address bus, a data bus, interrupt lines, and several control and support signals.

Data Transceivers

The data transceivers control the transmission of data to and from the VXIbus.

VXIbus Interface Circuitry

An onboard switch setting determines the VXI-AO-48XDC logical address. The address decoder, which is part of the interface circuitry, monitors the VXIbus address. If the VXIbus address matches the module's selected I/O logical address, the module is enabled and the corresponding register on the VXI-AO-48XDC is accessed.

In addition, the VXIbus interface circuitry monitors and transmits the VXIbus interface circuitry signals.

I/O Connector

All I/O is transmitted through two standard, 96-pin header connectors. See Chapter 2, *Configuration and Installation*, and Chapter 3, *Signal Connections*, for additional information.

nvRAM/DAC Control

The VXI-AO-48XDC has one 18-bit DAC that is time-division multiplexed to create the 48 voltage and 48 current output channels. Each voltage and current channel has a track and hold circuit to maintain the channel value between DAC updates.

Data is stored in an nvRAM (nonvolatile RAM). The nvRAM/DAC control reads the DAC channel data stored in the nvRAM and updates the DAC periodically. The nvRAM/DAC control also controls the analog demultiplexing circuits to route the DAC output to the correct analog output channel.

You can save nvRAM data, thus allowing power-on values on all analog channels.

Digital I/O Control

The VXI-AO-48XDC has 32 digital I/O lines configured as four 8-bit ports. You can configure each line independently as an input or output. The DIO lines have 12 mA of sink capability and 8 mA of source capability. All digital lines are TTL compatible. At power up all digital lines are configured as inputs.

Serial Number EPROM

The serial number EPROM is a nonvolatile memory used to hold the module serial number as well as some other identification information used by the driver software.

Temperature Sensor

The onboard temperature sensor measures the air temperature flowing over the module. This sensor is positioned near the onboard precision voltage reference, which can be affected by extreme temperatures. This sensor has a serial digital interface.

5

Calibration

This chapter discusses the calibration procedures for your VXI-AO-48XDC module. Calibration is the process of minimizing measurement and output voltage errors by making small circuit adjustments. On the VXI-AO-48XDC, you write values to four calibration channels to make these adjustments.

Self-Calibration

The VXI-AO-48XDC performs continuous self-calibration. In addition to the 48 accessible voltage channels and 48 accessible current channels, there are two voltage channels and two current channels that get scanned and refreshed along with the others. These four channels are the voltage offset channel, the voltage gain channel, the current offset channel, and the current gain channel. The outputs of these four channels are compared to onboard references, and the 18-bit DAC's offset and gain are adjusted to minimize the errors of the four outputs. Since the VXI-AO-48XDC has excellent channel-to-channel matching of offset and gain errors, minimizing the errors of the four calibration channels also minimizes the errors for all the voltage and current outputs.

External Calibration

Because of the nature of the VXI-AO-48XDC calibration circuitry, the only calibration adjustment you must make is to adjust the values of the four calibration channels to account for time- or temperature-related drift of the onboard references. These four values are loaded into nonvolatile RAM.

Note ***The VXI-AO-48XDC is calibrated at the factory to conform to the published specifications. No recalibration is necessary for at least one year, unless you are operating the module in extreme temperatures.***

To perform calibration, you need a voltage and current measuring device that is much more accurate than your VXI-AO-48XDC. A DMM with an accuracy of a few ppm will generally suffice, but be sure to check its specifications. Also be sure that no other devices are connected to the

VXI-AO-48XDC when you calibrate it. This will ensure that no ground loops can corrupt the calibration.

Your VXI-AO-48XDC has a switch to prevent you from accidentally writing to the calibration channels. Before you can calibrate your module, you must move the switch (S1) to enable calibration, as labeled on the top cover. Refer to Figure 2-1, *VXI-AO-48XDC Parts Locator Diagram*, for the switch location.

Table 5-1 lists the channel numbers of the calibration channels.

Table 5-1. Calibration Channel Numbers

Calibration Channel	Channel Number
Voltage offset	Voltage channel 48
Voltage gain	Voltage channel 49
Current offset	Current channel 48
Current gain	Current channel 49

Voltage Output Calibration

There are two adjustments to make for the voltage outputs: offset and gain. You should perform offset adjustment first. It is a good idea to calibrate twice, because a large change in the voltage gain channel value could impact the accuracy of the offset calibration.

Offset Adjustment

To calibrate the offset, set one of the voltage output channels to 0 V and measure it with a precise voltmeter. Then change the voltage offset channel value until the output is zero. The voltage you write to the voltage offset channel will be close to zero, and increasing it will lower the voltage you measure.

Gain Adjustment

To calibrate the gain, set the voltage output channel to a voltage near full-scale, such as +10 V. Then change the voltage gain channel value until the output that you measure is as close as possible to the voltage that you wrote to the output channel. The voltage you write to the voltage gain channel will be close to +10 V, and increasing it will lower the magnitude of the voltage you measure.

You can also calibrate using several output channels instead of just one by averaging channels together. Do this by writing the values to all the channels you wish to average and using a resistive averaging circuit to average the outputs. This will reduce the sensitivity of the calibration process to interchannel mismatch.

When you are done, save the calibration channel values to nonvolatile RAM.

Current Output Calibration

There are two adjustments to make for the current outputs: offset and gain. You should perform offset adjustment first. It is a good idea to calibrate twice, because a large change in the current gain channel value could impact the accuracy of the offset calibration.

Offset Adjustment

To calibrate the offset, set one of the current output channels to 100 µA and measure it with a precise ammeter. Then change the current offset channel value until the output is as close as possible to 100 µA. The current you write to the current offset channel will be close to 10 µA, and increasing it will lower the current you measure.

Gain Adjustment

To calibrate the gain, set the current output channel to a current near full-scale, such as 20 mA. Then change the current gain channel value until the output that you measure is as close as possible to the current that you wrote to the output channel. The current you write to the current gain channel will be close to 19.608 mA, and increasing it will lower the current you measure.

You can also calibrate using several output channels instead of just one by adding channels together. Do this by writing the values to all the channels you wish to add and summing the outputs by connecting them together. This will reduce the sensitivity of the calibration process to interchannel mismatch.

When you are done, save the calibration channel values to nonvolatile RAM.

Calibration Programming Considerations

To perform the above-mentioned calibration with the C programming language, use the NI-DAQ `AO_VWrite and AO_Change_Parameter` APIs. Use the `AO_Change_Parameter` function and the associated `ND_OUTPUT_TYPE` parameter to select either the voltage calibration channels or the current calibration channels. Use the `AO_VWrite` function to write the new calibration values to the device. Note that the `AO_Write` function does not support the calibration channels because this function's interface cannot specify the required precision. Use the `Set_DAQ_Device_Info` function and the associated `ND_AO48XDC_SET_POWERUP_STATE` parameter to save the new calibration channel values to nonvolatile RAM.

Refer to the *NI-DAQ Function Reference Manual for PC Compatibles* for more information on using these functions to calibrate your VXI-AO-48XDC module.

To perform the above-mentioned calibration with LabVIEW, use the AO Update Channel VI and the AO Hardware Config VI. Use the channel type terminal of the AO Hardware Config VI to select either the voltage calibration channels or the current calibration channels. Use the AO Update Channel VI to write the new calibration values to the device. Use the AO Parameter VI and select the **Save Power-on State** option to save the new calibration channel values to nonvolatile RAM.

A

Specifications

This appendix lists the VXI-AO-48XDC specifications. These specifications are valid for an ambient temperature of 0 to 55 °C, unless otherwise stated.

Analog Output

Number of voltage channels 48

Number of current channels 48

Resolution 18-bit

Type of DAC ..... double-buffered, self-calibrating

Transfer Characteristics

Relative accuracy (INL) ..... ±3 LSB max

DNL ..... ±2 LSB max

Monotonicity ..... 17 bits, guaranteed

Voltage Output

Range ..... ±10.1 V

Output coupling ..... DC

Output impedance ..... 0.1 Ω max

Current drive ..... ±10 mA max

Load capacitance ..... 10,000 pF max

Protection ..... Short circuit to ground

Absolute accuracy ..... ±1 mV max

Noise ..... 100 μV rms, DC to 1 MHz

Current Output

Range .....0.1 to 20.2 mA

Type .....Source, does not require external excitation source

Output impedance .....1 GΩ min

Output compliance .....0 to 10 V

Absolute accuracy .....±7 µA max

Noise .....1 µA rms, DC to 1 MHz

Protection .....Short circuit and open circuit

Dynamic Characteristics

Settling time (including channel latency)

Accuracy		
±0.1%	**±0.01%**	**±0.001%**
5 ms typ, 12 ms max	10 ms typ, 24 ms max	40 ms typ, 100 ms max

Stability

Offset temperature coefficient

voltage .....5 µV/°C

current .....10 nA/°C

Gain temperature coefficient

voltage .....1 ppm/°C

current .....2 ppm/°C

Digital I/O

Number of channels .....32 I/O

Compatibility .....TTL

Digital logic levels

Level	Min	Max
Input low voltage	—	0.8 V
Input high voltage	2.0 V	—
Output low voltage	—	0.4 V, I_{OL} = 12 mA
Output high voltage	2.4 V, I_{OH} = 8 mA	—
Input leakage current	—	10 µA

Bus Interface

Type ..... Slave

Power Requirement

+5 V..... 2 A

+12 V..... 800 mA

–12 V..... 800 mA

+24 V..... 100 mA

–24 V..... 100 mA

Note ***These power usage figures do not include the power used by external devices that are connected to the fused supply present on the I/O connector. They assume that all voltage and current outputs are fully loaded.***

Physical

Dimensions..... VXI C-size single slot

I/O connector..... 96-pin (DIN x 2)

Environment

Operating

Temperature.....0 to 55 °C ambient

Relative humidity .....5% to 90% noncondensing

Storage

Temperature.....–20 to 70 °C ambient

Relative humidity .....5% to 90% noncondensing

B

Common Questions

This appendix contains commonly asked questions and their answers relating to usage and special features of your VXI-AO-48XDC module.

General Information

What if I short-circuit the power supply on the VXI-AO-48XDC connector?

Pin C1 of the I/O connectors is connected to the +5 V supply from the VXIbus power supply. These pins are referenced to GND and can be used to power external circuitry. The +5 V supply has a total of 2 A available. However, the current through each connector pin must be limited to 1.0 A.

Each power supply has a self-resetting protection circuit breaker in series. If the circuit breaker protection is activated, simply remove the circuit causing the heavy current load and the circuit breaker will reset itself. For more information on these output pins, see the *Digital I/O* and *Power Requirement* sections in Appendix A, *Specifications*.

Installation and Configuration

What jumpers/switches should I be aware of when configuring my VXI-AO-48XDC module?

The only switch you must configure is the logical address switch. Refer to the *VXIbus Logical Address* section of Chapter 2, *Configuration and Installation*, for this information.

Which National Instruments document should I read first to get started using DAQ software?

The release notes document for your application or driver software is always the best starting place.

What version of NI-DAQ must I have to program my VXI-AO-48XDC module?

You must have NI-DAQ for PC compatibles version 5.0 or higher for your VXI-AO-48XDC module.

What is the best way to test my module without having to program it?

The NI-DAQ Test Panels provide a quick and easy way for you to test the functionality of your module. To run Test Panels from Measurement & Automation Explorer, go to the **Devices and Interfaces** view and right-click on the icon for the module to be tested. Select **Properties**. In the **System** panel, click the **Run Test Panels** button.

Timing and Digital I/O

What are the power-on states of the DIO lines on the I/O connector?

At system power-on and reset, all ports are configured as inputs. Refer to the *Digital I/O Control* section in Chapter 4, *Hardware Overview*, for more information.

Analog Output

What are the power-on states of the voltage and current outputs?

At system power-on and reset, all analog outputs are at the values you last saved.

How fast does the VXI-AO-48XDC module scan channels?

The VXI-AO-48XDC has one 18-bit DAC that is time-division multiplexed to create the 48 voltage and 48 current output channels. Thus a channel can change value a maximum of 5 ms after it has been updated by software.

How are the voltage and current outputs related?

They are completely independent of each other.

C

Technical Support Resources

This appendix describes the comprehensive resources available to you in the Technical Support section of the National Instruments Web site and provides technical support telephone numbers for you to use if you have trouble connecting to our Web site or if you do not have internet access.

NI Web Support

To provide you with immediate answers and solutions 24 hours a day, 365 days a year, National Instruments maintains extensive online technical support resources. They are available to you at no cost, are updated daily, and can be found in the Technical Support section of our Web site at `www.natinst.com/support`.

Online Problem-Solving and Diagnostic Resources

- **KnowledgeBase**—A searchable database containing thousands of frequently asked questions (FAQs) and their corresponding answers or solutions, including special sections devoted to our newest products. The database is updated daily in response to new customer experiences and feedback.
- **Troubleshooting Wizards**—Step-by-step guides lead you through common problems and answer questions about our entire product line. Wizards include screen shots that illustrate the steps being described and provide detailed information ranging from simple getting started instructions to advanced topics.
- **Product Manuals**—A comprehensive, searchable library of the latest editions of National Instruments hardware and software product manuals.
- **Hardware Reference Database**—A searchable database containing brief hardware descriptions, mechanical drawings, and helpful images of jumper settings and connector pinouts.
- **Application Notes**—A library with more than 100 short papers addressing specific topics such as creating and calling DLLs, developing your own instrument driver software, and porting applications between platforms and operating systems.

Software-Related Resources

- **Instrument Driver Network**—A library with hundreds of instrument drivers for control of standalone instruments via GPIB, VXI, or serial interfaces. You also can submit a request for a particular instrument driver if it does not already appear in the library.
- **Example Programs Database**—A database with numerous, non-shipping example programs for National Instruments programming environments. You can use them to complement the example programs that are already included with National Instruments products.
- **Software Library**—A library with updates and patches to application software, links to the latest versions of driver software for National Instruments hardware products, and utility routines.

Worldwide Support

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Denmark 45 76 26 00, Finland 09 725 725 11, France 01 48 14 24 24,
Germany 089 741 31 30, Hong Kong 2645 3186, India 91805275406,
Israel 03 6120092, Italy 02 413091, Japan 03 5472 2970,
Korea 02 596 7456, Mexico (D.F.) 5 280 7625,
Mexico (Monterrey) 8 357 7695, Netherlands 0348 433466,
Norway 32 27 73 00, Singapore 2265886, Spain (Madrid) 91 640 0085,
Spain (Barcelona) 93 582 0251, Sweden 08 587 895 00,
Switzerland 056 200 51 51, Taiwan 02 2377 1200,
United Kingdom 01635 523545

Glossary

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

Symbols

~	approximately
°	degrees
–	negative of, or minus
Ω	ohms
/	per
%	percent
±	plus or minus
+	positive of, or plus

A

A	amperes
A16 space	VXIbus address space equivalent to the VME 64 KB short address space. In VXI, the upper 16 KB of A16 space is allocated for use by VXI module's configuration registers. This 16 KB region is referred to as VXI configuration space.

A/D	analog-to-digital
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.
API	application programming interface

B

backplane	An assembly, typically a printed circuit board, with 96-pin connectors and signal paths that bus the connector pins. VXIbus systems will have two sets of bused connectors, called the J1 and J2 backplanes, or have three sets of bused connectors, called the J1, J2, and J3 backplane.
base address	A memory address that serves as the starting address for programmable registers. All other addresses are located by adding to the base address.
BCD	binary-coded decimal
bit	One binary digit, either 0 or 1.
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.
byte	Eight related bits of data, an eight-bit binary number. Also used to denote the amount of memory required to store one byte of data.

C

C	Celsius
channel	Pin or wire lead to which you apply or from which you read the analog or digital signal. Analog signals can be single-ended or differential. For digital signals, you group channels to form ports. Ports usually consist of either four or eight digital channels.
Configuration Registers	(1) A set of registers through which the system can identify a module device type, model, manufacturer, address space, and memory requirements. In order to support automatic system and memory configuration, the VXIbus specification requires that all VXIbus devices have a set of such registers. (2) The A16 registers of a device that are required for the system configuration process.

D

D/A	digital-to-analog
DAQ	data acquisition—(1) Collecting and measuring electrical signals from sensors, transducers, and test probes or fixtures and inputting them to a computer for processing; (2) Collecting and measuring the same kinds of electrical signals with A/D and/or DIO boards plugged into a computer, and possibly generating control signals with D/A and/or DIO boards in the same computer.
default setting	A default parameter value recorded in the driver. In many cases, the default input of a control is a certain value (often 0) that means use the current default setting. For example, the default input for a parameter may be *do not change current setting*, and the default setting may be *no AMUX-64T boards*. If you do change the value of such a parameter, the new value becomes the new setting. You can set default settings for some parameters in the configuration utility or by manually using switches located on the device.

device	(1) A plug-in data acquisition board, card, or pad that can contain multiple channels and conversion devices. Plug-in boards, PCMCIA cards, and devices such as the DAQPad-1200, which connects to your computer parallel port, are all examples of DAQ devices. (2) A component of a VXIbus system, normally one VXIbus board. However, multiple-slot devices and multiple-device modules can operate on a VXIbus system as a single device. Some examples of devices are computers, multimeters, multiplexers, oscillators, operator interfaces, and counters.
digital input group	A collection of digital input ports. You can associate each group with its own clock rates, handshaking modes, buffer configurations, and so on. A port cannot belong to more than one group.
digital output group	A collection of digital output ports. You can associate each group with its own clock rates, handshaking modes, buffer configurations, and so on. A port cannot belong to more than one group.
digital trigger	A TTL-level signal having two discrete levels—high and low.
DIN	Deutsche Industrie Norme
DIO	digital input/output
DIP	dual inline package
dithering	The addition of Gaussian noise to an analog input signal.
DLL	Dynamic Link Library—A software module in Microsoft Windows containing executable code and data that can be called or used by Windows applications or by other DLLs. Functions and data in a DLL are loaded and linked at run time when they are referenced by a Windows application or other DLLs.
DMA	direct memory access
DRAM	Dynamic RAM
drivers/driver software	Software that controls a specific hardware device such as a DAQ board.
dual-access memory	Memory that can be sequentially, but not simultaneously, accessed by more than one controller or processor. Also known as shared memory.
dual-ported memory	Memory that can be simultaneously accessed by more than one controller or processor.

dynamic configuration	A method of automatically assigning logical addresses to VXIbus devices at system startup or other configuration times. Each slot can contain one or more devices. Different devices within a slot can share address decoding hardware.
dynamic range	The ratio of the largest signal level a circuit can handle to the smallest signal level it can handle (usually taken to be the noise level), normally expressed in dB.
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, which the device responds to until powered down.

E

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.
EPROM	Erasable Programmable Read-Only Memory (ROM) that can be erased (usually by ultraviolet light exposure) and reprogrammed.
event	Signals or interrupts generated by a device to notify another device of an asynchronous event. The contents of events are device-dependent.
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.
external trigger	A voltage pulse from an external source that triggers an event such as A/D conversion.

F

floating signal sources	Signal sources with voltage signals that are not connected to an absolute reference or system ground. Also called nonreferenced signal sources. Some common example of floating signal sources are batteries, transformers, or thermocouples.
ft	feet

function	A set of software instructions executed by a single line of code that may have input and/or output parameters and returns a value when executed.

G

GND	ground signal or bit

H

hardware	The physical components of a computer system, such as the circuit boards, plug-in boards, chassis, enclosures, peripherals, cables, and so on.
hardware triggering	A form of triggering where you set the start time of an acquisition and gather data at a known position in time relative to a trigger signal.
hex	hexadecimal
Hz	hertz—A unit of frequency equal to one cycle per second.

I

IC	integrated circuit
in.	inches
INL	Integral Nonlinearity—A measure in LSB of the worst-case deviation from the ideal A/D or D/A transfer characteristic of the analog I/O circuitry.
input range	The difference between the maximum and minimum voltages an analog input channel can measure at a gain of 1. The input range is a scalar value, not a pair of numbers. By itself the input range does not uniquely determine the upper and lower voltage limits. An input range of 10 V could mean an upper limit of +10 V and a lower of 0 V or an upper limit of +5 V and a lower limit of –5 V. The combination of input range, polarity, and gain determines the input limits of an analog input channel. For some boards, jumpers set the input range and polarity, while you can program them for other boards. Most boards have programmable gains.
instrument driver	A set of high-level software functions that controls a specific VXI or RS-232 programmable instrument or a specific plug-in DAQ board.

interrupt	A computer signal indicating that the CPU should suspend its current task to service a designated activity.
interrupt level	The relative priority at which a device can interrupt.
interval scanning	Scanning method where there is a longer interval between scans than there is between individual channels comprising a scan.
I/O	Input/output—The transfer of data to/from a computer system involving communications channels, operator interface devices, and/or data acquisition and control interfaces.

K

KB	kilobytes—1,024 bytes when referring to memory
kS	1,000 samples

L

latched digital I/O	A type of digital acquisition/generation where a device or module accepts or transfers data after a digital pulse has been received. Also called handshaked digital I/O.
LED	light-emitting diode
logical address	An 8-bit number that uniquely identifies each VXIbus device in a system. It defines the A16 register addresses of a device, and indicates Commander and Servant relationships.
LSB	least significant bit

M

m	meters
mainframe	The chassis of a VXI system that mechanically contains VXI modules inserted into the backplane, ensuring that connectors fit properly and that adjacent modules do not contact each other. It also provides cooling airflow, and ensures that modules do not disengage from the backplane due to vibration or shock.

MANTIS	A National Instruments custom ASIC.
MB	megabytes of memory
memory device	A memory storage device that has configuration registers.
MITE	A National Instruments custom ASIC. A sophisticated dual-channel DMA controller that incorporates the Synchronous MXI and VME64 protocols to achieve high-performance block transfer rates.
module	Typically a board assembly and its associated mechanical parts, front panel, optional shields, and so on. A module contains everything required to occupy one or more slots in a mainframe.
MSB	most significant bit
multitasking	A property of an operating system in which several processes can be run simultaneously.

N

NC	Normally closed, or not connected
NI-DAQ	National Instruments driver software for DAQ hardware
node	Execution elements of a block diagram consisting of functions, structures, and subVIs
noise	An undesirable electrical signal—Noise comes from external sources such as the AC power line, motors, generators, transformers, fluorescent lights, soldering irons, CRT displays, computers, electrical storms, welders, radio transmitters, and internal sources such as semiconductors, resistors, and capacitors. Noise corrupts signals you are trying to send or receive.
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.
nvRAM	nonvolatile RAM

O

operating system	Base-level software that controls a computer, runs programs, interacts with users, and communicates with installed hardware or peripheral devices.
optical isolation	The technique of using an optoelectric transmitter and receiver to transfer data without electrical continuity, to eliminate high-potential differences and transients.
output limits	The upper and lower voltage or current outputs for an analog output channel. The output limits determine the polarity and voltage reference settings for a board.
output settling time	The amount of time required for the analog output voltage to reach its final value within specified limits.

P

PC	personal computer
port	(1) A communications connection on a computer or a remote controller. (2) A digital port, consisting of four or eight lines of digital input and/or output.
PPI	programmable peripheral interface
ppm	parts per million

R

RAM	random access memory
resolution	The smallest signal increment that can be detected by a measurement system. Resolution can be expressed in bits, in proportions, or in percent of full scale. For example, a system has 12-bit resolution, one part in 4,096 resolution, and 0.0244 percent of full scale.
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 diagnostics management

responses	Signals or interrupts generated by a device to notify another device of an asynchronous event. Responses contain the information in the Response register of a sender.
RTSI	Real-Time System Integration

S

s	seconds
S	sample
settling time	The amount of time required for a voltage to reach its final value within specified limits.
signal	Any communication between message-based devices consisting of a write to a Signal register.
slot	A position where a module can be inserted into a VXIbus backplane. Each slot provides the 96-pin J connectors to interface with the board P connectors. A slot can have one, two, or three connectors.
slot 0 device	A VXIbus device that provides basic resources to VXI Slots 1 through 12. For B and C-size systems, the resources provided are CLK10 and MODID. For a D-size system, the Slot 0 device also provides CLK100.
S/s	Samples per Second—Used to express the rate at which a DAQ board samples an analog signal.
statically configured device	A device whose logical address cannot be set through software; that is, it is not dynamically configurable.
system	A system consists of one or more mainframes that are connected, all sharing a common Resource Manager. Each device in a system has a unique logical address.
system RAM	RAM installed on a personal computer and used by the operating system, as contrasted with onboard RAM.

T

transfer rate	The rate, measured in bytes/s, at which data is moved from source to destination after software initialization and set up operations; the maximum rate at which the hardware can operate.
TTL	Transistor-transistor logic

U

update	The output equivalent of a scan. One or more analog or digital output samples. Typically, the number of output samples in an update is equal to the number of channels in the output group. For example, one pulse from the update clock produces one update which sends one new sample to every analog output channel in the group.
update rate	The number of output updates per second.

V

V	volts
VDC	volts direct current
VI	Virtual Instrument—(1) A combination of hardware and/or software elements, typically used with a PC, that has the functionality of a classic stand-alone instrument. (2) A LabVIEW software module (VI), which consists of a front panel user interface and a block diagram program.
VISA	A new driver software architecture developed by National Instruments to unify instrumentation software (GPIB, DAQ, and VXI). It has been accepted as a standard for VXI by the VXI*plug&play* Systems Alliance.
VXIbus	VMEbus eXtensions for Instrumentation
VXI*plug&play* Systems Alliance	A group of VXI developers dedicated to making VXI devices as easy to use as possible, primarily by simplifying software development.

W

waveform	Multiple voltage readings taken at a specific sampling rate
wire	Data path between nodes.
word serial	The simplest required communication protocol used by message-based devices in the VXIbus system. It uses the A16 communication registers to transfer data with a simple polling handshake method.

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