

GPIB

Getting Started with Your GPIB-232CT-A and the NI-488.2™ Software for MacOS

Worldwide Technical Support and Product Information

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FCC/Canada Radio Frequency Interference Compliance*

Determining FCC Class

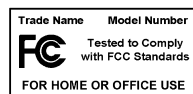
The Federal Communications Commission (FCC) has rules to protect wireless communications from interference. The FCC places digital electronics into two classes. These classes are known as Class A (for use in industrial-commercial locations only) or Class B (for use in residential or commercial locations). Depending on where it is operated, this product could be subject to restrictions in the FCC rules. (In Canada, the Department of Communications (DOC), of Industry Canada, regulates wireless interference in much the same way.)

Digital electronics emit weak signals during normal operation that can affect radio, television, or other wireless products. By examining the product you purchased, you can determine the FCC Class and therefore which of the two FCC/DOC Warnings apply in the following sections. (Some products may not be labelled at all for FCC, if so the reader should then assume these are Class A devices.)

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

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

The curious reader can consult the FCC web site <http://www.fcc.gov> for more information.



FCC/DOC Warnings

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

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

Class A

Federal Communications Commission

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

Canadian Department of Communications

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

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

Class B

Federal Communications Commission

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful

interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

Canadian Department of Communications

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

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

European Union - Compliance to EEC Directives

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

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

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

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About This Manual

This manual contains instructions to help you install and configure the National Instruments GPIB-232CT-A RS-232-to-GPIB Controller and NI-488.2 software for MacOS. You should use this manual with the *NI-488.2 User Manual for MacOS* and *NI-488.2 Function Reference Manual for MacOS*.

This manual assumes that you are already familiar with MacOS.

Conventions

The following conventions appear in this manual:



This icon denotes a note, which alerts you to important information.



This icon denotes a caution, which advises you of precautions to take to avoid injury, data loss, or a system crash.



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

bold

Bold text denotes items that you must select or click on in the software, such as menu items and dialog box options. Bold text also denotes parameter names.

IEEE 488 and
IEEE 488.2

IEEE 488 and *IEEE 488.2* refer to the ANSI/IEEE Standard 488.1-1987 and ANSI/IEEE Standard 488.2-1992, respectively, which define the GPIB.

italic

Italic text denotes variables, emphasis, a cross reference, or an introduction to a key concept. This font also denotes text that is a placeholder for a word or value that you must supply.

Macintosh

Macintosh refers any computer using MacOS.

monospace

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

RS-232

RS-232 refers to the ANSI/EIA-232-C standard.

Related Documentation

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

- ANSI/EIA-232-C, *Interface Between Data Terminal Equipment and Data Circuit-Terminating Equipment Employing Serial Binary Data Interchange*
- ANSI/IEEE Standard 488.1-1987, *IEEE Standard Digital Interface for Programmable Instrumentation*
- ANSI/IEEE Standard 488.2-1992, *IEEE Standard Codes, Formats, Protocols, and Common Commands*

Introduction

This chapter lists what you need to get started and optional equipment you can order, and briefly describes the GPIB-232CT-A and the NI-488.2 software.

What You Need to Get Started

Before you install your GPIB hardware and the NI-488.2 software for MacOS, make sure you have all of the following items:

- 3.5 in. high density (1.44 MB) *NI-488.2 Software for MacOS Distribution Disk*, which is included in your kit
- One of the following controllers, which is included in your kit:
 - GPIB-232CT-A, 100–120 VAC
 - GPIB-232CT-A, 220–240 VAC
 - GPIB-232CT-A, DC
- If you have an AC version, one of the following power cords, which is included in your kit:
 - U.S.A. standard power cord
 - Swiss power cord
 - Australian power cord
 - Universal European power cord
 - North American power cord
 - U.K. power cord
- If you have a DC version, one of the following DC power supplies, which is included in your kit:
 - Wall-mount power supply (100–120 VAC, 9 V, 1 A)
 - Desktop power supply (220–240 VAC, 9 V, 1 A)

- One of the following shielded GPIB cables, which you can purchase from National Instruments:
 - Type X1 single-shielded cables (1, 2, or 4 m)
 - Type X2 double-shielded cables (1, 2, or 4 m)



Caution To meet FCC emission limits for this device, you must use a shielded (Type X1 or X2) GPIB cable. If you operate this equipment with a non-shielded cable, it may interfere with radio and television reception.

Optional Equipment

You can call National Instruments to order RS-232 shielded cables for the GPIB-232CT-A (9-pin D-Sub) to Macintosh (8-pin Mini-DIN), 1 m.

GPIB-232CT-A Hardware Overview

The GPIB-232CT-A, shown in Figure 1-1, is a high-performance serial-to-GPIB interface. It provides a computer with an RS-232 port, a means of controlling, talking, and listening on the GPIB. The GPIB-232CT-A is also capable of interfacing RS-232 instruments and peripherals to the GPIB.

The GPIB-232CT-A has all the software and logic required to implement the physical and electrical specifications of the IEEE 488 and RS-232 standards. It can interpret and execute high-level commands that you send to it over the serial port, and perform GPIB-to-RS-232 protocol conversion. The GPIB-232CT-A also conforms to all versions of the IEEE 488 standard, including IEEE 488.2. The NAT4882 Controller chip implements all IEEE 488 Talker/Listener/Controller functionality.

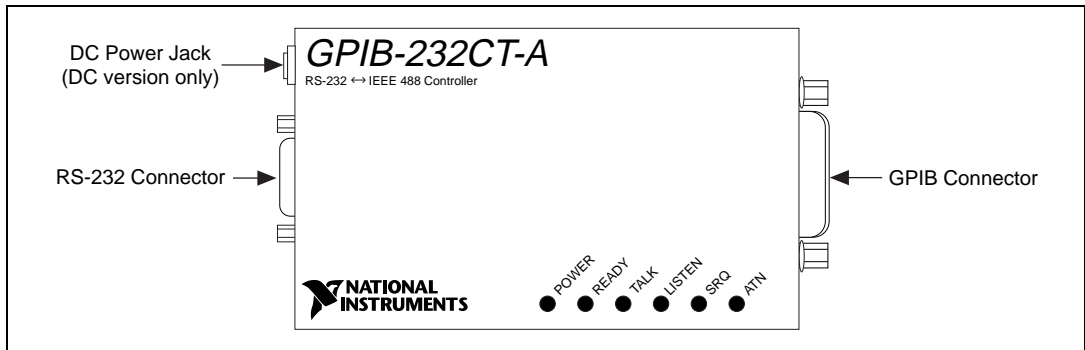


Figure 1-1. GPIB-232CT-A

NI-488.2 Software Overview

The NI-488.2 software for MacOS is a comprehensive set of programs and drivers for transforming the Macintosh into a GPIB Controller with complete communications and bus management capability. The NI-488.2 software also includes an interactive debugger; FutureBASIC, Macintosh Programmer's Workshop (MPW) C, THINK C, and Metrowerks CodeWarrior C language interfaces; and a shared library for C programmers developing applications for PowerPC.

The NI-488.2 software includes the following components:

- **NI-488.2 Installer** is the software installation program.
- **NI-488 INIT** is an INIT that loads the device drivers for installed National Instruments GPIB interfaces when you power on or restart your Macintosh.
- **NI-488 Config** is a control panel configuration utility that you can use to examine or change the software settings.
- The **C LI** and **BASIC LI** folders contain language interfaces for Macintosh Programmer's Workshop (MPW) C, THINK C, Metrowerks CodeWarrior C, FutureBASIC, and a shared library for C programmers developing applications for the PowerPC platform.
- **IBIC 488.2** is an interactive GPIB control utility.
- **NI-488.2 Test** is a software diagnostic utility.
- The **Ethernet** folder contains utilities that are applicable only if you have a National Instruments GPIB-ENET.
- The **Read Me** file contains the latest updates and corrections to the manual when appropriate.

Time-Saving Development Tools

Your kit includes the NI-488.2 software for MacOS. In addition, you can order the LabVIEW software from National Instruments to speed your application development time and make it easier to communicate with your instruments.

LabVIEW is an easy-to-use, graphical programming environment you can use to acquire data from thousands of different instruments, including IEEE 488.2 devices, VXI devices, serial devices, PLCs, and plug-in data acquisition boards. After you have acquired raw data, you can convert it into meaningful results using the powerful data analysis routines in LabVIEW. LabVIEW also comes with hundreds of instrument drivers, which dramatically reduce software development time, because you do not have to spend time programming the low-level control of each instrument. Your kit includes the NI-488.2 software for MacOS. In addition, you can order the LabVIEW software from National Instruments. LabVIEW includes instrument driver libraries that make it easier to communicate with your GPIB instruments.

For ordering information, or to request free demonstration software, contact National Instruments.

Configure and Install Your Hardware

This chapter contains instructions for configuring your GPIB-232CT-A and connecting it to your computer.

Configure Your Hardware (Optional)

The default hardware settings for the GPIB-232CT-A are compatible with the default software settings. If you change the hardware settings, make sure that you also change the software settings so that they are compatible.

The GPIB-232CT-A is shipped from the factory configured to operate in Serial (S) mode. In S mode, the computer attached to the RS-232 port of the GPIB-232CT-A is the controlling device. The RS-232 serial port is configured at 9600 baud, 1 stop bit, no parity, and 8 data bits. To change the parameters, set the configuration switches on the back panel.

The DIP switch is used to configure the serial port parameters of the GPIB-232CT-A while in S mode. In G mode, the GPIB-232CT-A is used to interface an RS-232 device as a GPIB Talker/Listener.

Figure 2-1 shows the factory default setting of the DIP switch. Notice that Figure 2-1 shows the DC version of the GPIB-232CT-A. The AC version does not have a power switch shown on the right.

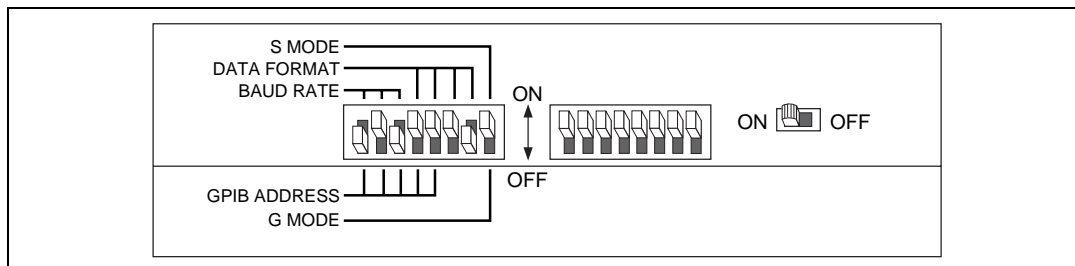


Figure 2-1. Factory Default Setting (S Mode) for DIP Switch



Note For the purpose of this explanation, the switches have been assigned numbers as a point of reference. These numbers do *not* appear on the GPIB-232CT-A itself. In this explanation, the three switches labeled BAUD RATE are switches 1 through 3, the DATA FORMAT switches are switches 4 through 7, and the S MODE switch is switch 8.

In Figure 2-1, switches 1 through 3 are ON, OFF, and ON, respectively, indicating that the serial port is operating at 9600 baud. Switches 4 and 5 are both OFF, which indicates that parity is disabled. Switch 6 is OFF, indicating 1 stop bit/character. Switch 7 is ON, indicating that the GPIB-232CT-A is using 8 bits per character for serial data transfers. Switch 8 is OFF, indicating that the GPIB-232CT-A is operating in S mode.

Tables 2-1 and 2-2 show the possible configurations of the eight switches and what each configuration indicates. The factory default settings are in *bold italics*.

Table 2-1. Configuration Parameters for Switches 1 through 3

Switches			Indication
1	2	3	
OFF	OFF	OFF	300 baud
ON	OFF	OFF	600 baud
OFF	ON	OFF	1200 baud
ON	ON	OFF	2400 baud
OFF	OFF	ON	4800 baud
<i>ON</i>	<i>OFF</i>	<i>ON</i>	<i>9600 baud</i>
OFF	ON	ON	19200 baud
ON	ON	ON	38400 baud

Table 2-2. Configuration Parameters for Switches 4 through 8

Switch	Position	Indication
4	OFF	Odd parity
	ON	Even parity
5	OFF	Parity generation/checking disabled
	ON	Parity generation/checking enabled
6	OFF	1 stop bit/character
	ON	2 stop bits/character
7	OFF	7 bits/character
	ON	8 bits/character
8	OFF	Operates in S mode
	ON	Operates in G mode

Install Your Hardware

Complete the following steps to connect your GPIB-232CT-A to your computer.

Step 1. Verify the Voltage Requirement

Verify that the voltage marked on your GPIB-232CT-A or on the power supply matches the voltage that is supplied in your area.



Caution Do *not* operate your GPIB-232CT-A at any voltage other than the one marked on your GPIB-232CT-A. Doing so could damage the unit. Replacement fuses for the AC version must be the proper type and size. For fuse specifications, refer to Appendix A, [Specifications](#).

Step 2. Shut Down Your System

Before you connect the cables, complete the following steps:

1. Shut down your system.
2. Turn off your computer and unplug the power cord.

Step 3. Connect the Cables

To connect the cables, complete the following steps:

1. Connect the serial cable to the GPIB-232CT-A 9-pin D-Sub connector and securely fasten the holding screws. Connect the other end of the cable to your Macintosh. *Be sure* to use only shielded serial cables, and follow all RS-232 cabling restrictions.
2. Connect the GPIB cable to the GPIB-232CT-A 24-pin Champ connector and tighten the thumb screws on the connector. Connect the other end to your GPIB device(s). *Be sure* to follow all IEEE 488 cabling restrictions, and use only shielded GPIB cables.
3. If you have an AC version, connect the power cord to the power receptacle on the front panel of the GPIB-232CT-A, then plug the supply into an AC outlet of the correct voltage.

If you have a DC version, connect the DC power plug of the DC power supply to the power jack on the serial end of the GPIB-232CT-A, then plug the supply into an AC outlet of the correct voltage.

Step 4. Power on Your System and Switch on Your GPIB-232CT-A

To power on your system, complete the following steps:

1. Plug the power cords for your computer system into a power outlet and power on all devices.
2. If you have an AC version, use the front panel rocker switch to power on your GPIB-232CT-A. If you have a DC version, use the power switch on the rear panel to power on your GPIB-232CT-A.

The **POWER** LED indicator should come on immediately. The **READY** LED indicator should come on after the GPIB-232CT-A has passed its power-on self test, indicating the unit is ready for operation. If the **READY** LED does not come on within seven seconds after the unit is powered on, recheck all connections and switch settings and retry the power-on sequence. If the **READY** LED still does not come on, refer to Chapter 4, [Troubleshooting](#), for information on areas to check if you have problems installing the GPIB-232CT-A.

Install and Configure the Software

This chapter contains instructions for installing and configuring the NI-488.2 software and describes how to verify the installation.

Install the Software

The NI-488.2 software is in compressed form on one disk. Installing all of the software requires about 1.5 MB of space on your hard disk and takes about five minutes.

Install the NI-488.2 software by completing the following steps.

Step 1. Install the NI-488.2 Files and Folders



Caution Virus detection software might prevent the installer from copying important files to the **System Folder**. You must disable or bypass any virus prevention software before attempting the installation procedure.

To install the NI-488.2 files and folders, complete the following steps:

1. Insert the NI-488.2 software distribution disk and double-click on the **NI-488.2 Installer** icon.

- Click on the icon on the left side of the **Installer** window, shown in Figure 3-1, and drag it to any available disk on the right side of the window.

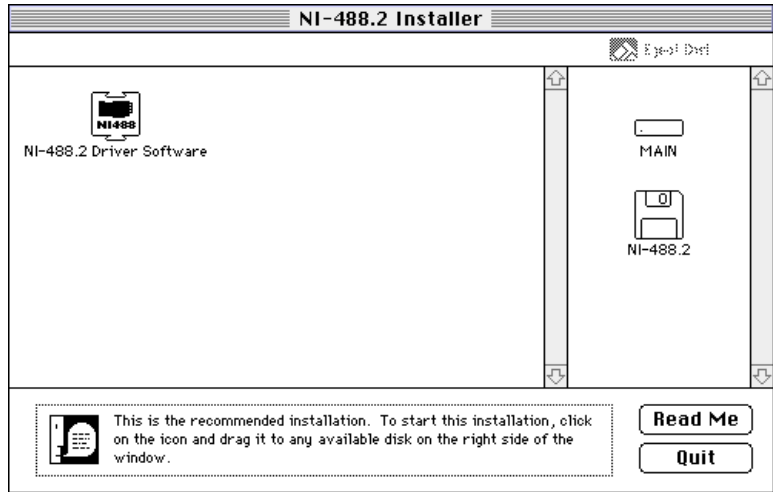


Figure 3-1. Installer Window

After installation of all of the software, the **NI-488.2** folder should contain the items shown in Figure 3-2. The **NI-488 Config** file is placed in the **Control Panels** folder and the **NI-488 INIT** and **NI-DMA/DSP** files are installed in the **Extensions** folder.

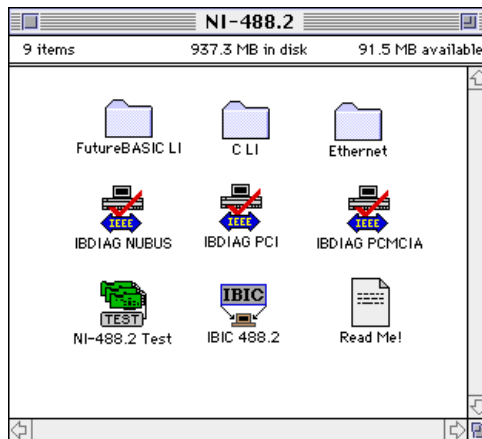


Figure 3-2. File and Folder Organization after Installation

Step 2. Examine or Change the Software Settings

You might want to configure the NI-488.2 software using the configuration utility. The default settings for the software work for most applications and devices. However, you might want to change a device name or primary address. Also, if more than one GPIB interface or external box is installed, you might want to associate a device with a particular interface.

You can activate the configuration utility by selecting **Control Panels** from the **Apple Icon** menu and selecting **NI-488 Config**.

After the configuration utility is activated, click on the **Interface Type** menu and select **Serial box products** as shown in Figure 3-3. Check either the modem box (**M**) or the printer box (**P**), depending on which Macintosh serial port you have connected to the GPIB-232CT-A. The GPIB bus number associated with the serial port appears under the checkbox.

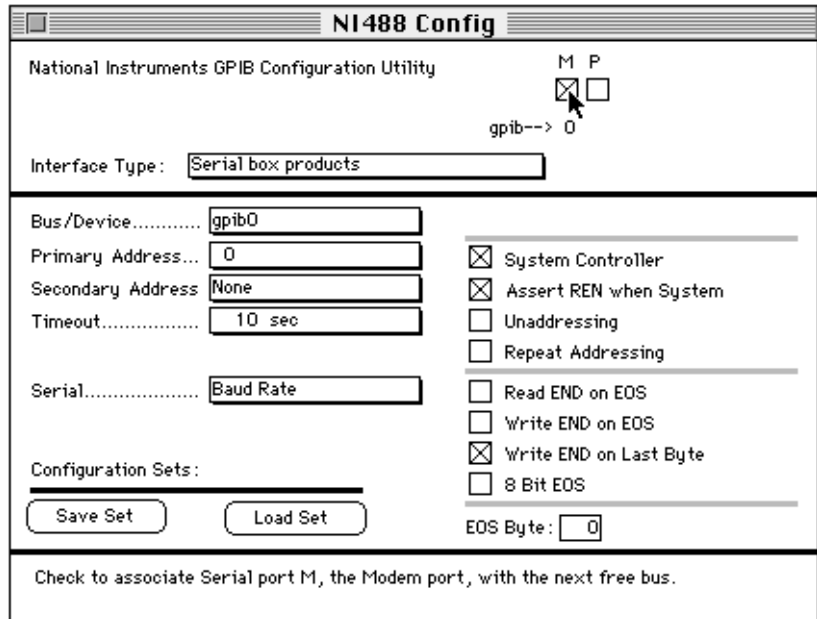


Figure 3-3. NI-488 Config Control Panel

Step 3. Restart Your Macintosh

The NI-488.2 driver is installed every time you start or restart your Macintosh. The NI-488.2 software displays the National Instruments icon momentarily in the lower left corner of the screen to indicate that the driver is being installed. If the National Instruments icon does not appear on your screen, repeat the installation procedure before continuing to the next section, *Verify the Software Installation*.

Verify the Software Installation

This step verifies that the software is installed and functioning with the GPIB-232CT-A. First, disconnect all GPIB cables from the GPIB-232CT-A, then double-click on the **NI-488.2 Test** icon in the **NI-488.2** folder.

If no error messages appear on the screen, the installation is complete. If error messages do appear on the screen, select **Restart** from the **Special** menu, and double-click on the **NI-488.2 Test** icon. If the test fails again, reinstall the NI-488.2 software from the distribution disk, restart your Macintosh, and double-click on the **NI-488.2 Test** icon.

If any one of the software installation steps fails, review the material in Chapter 4, *Troubleshooting*, which describes how to troubleshoot problems and lists some common questions. If you need to change a software setting, refer to Chapter 6, *GPIB Configuration Utility*, in the *NI-488.2 User Manual for MacOS*. If the software settings are correct and the verification still fails, carefully note all error information and contact National Instruments.

If the verification test is successful, you are ready to write your own application. Refer to the *NI-488.2 Function Reference Manual for MacOS* for sample applications.

Troubleshooting

This chapter describes how to troubleshoot hardware and software problems and lists some common questions.

If you still have problems after completing the steps in this chapter, refer to Appendix C, *Technical Support Resources*.

Troubleshooting Hardware Problems



Warning The AC version of the GPIB-232CT-A contains circuitry that operates with hazardous voltages. Do NOT open the unit unless so instructed by National Instruments. Be sure to remove the power cord before opening the unit.

Check the following if you encounter hardware problems:

- Verify that all cables are securely connected to the GPIB-232CT-A.
- Check the DIP switch settings on the GPIB-232CT-A. The DIP switch selects the serial port configuration. Most applications require the default setting, which is shown in Figure 2-1. Refer to the *Configure Your Hardware (Optional)* section of Chapter 2, *Configure and Install Your Hardware*, for information on setting the GPIB-232CT-A configuration using this switch.
- Verify that the GPIB-232CT-A is powered on.
- If you have an AC version, check the fuse.



Warning For continued protection against fire, replace the fuse only with the same type and rating of fuse. See Appendix A, *Specifications*, for fuse specifications.

Troubleshooting Software Problems

The **NI-488 Config** control panel (GPIB configuration utility) should show the following software configuration:

- **Interface Type** box should be set to **Serial box products**.
- An **x** should appear in either the box labeled **M**, if you connected the GPIB-232CT-A to the Macintosh modem port, or the box labeled **P**, if you connected it to the Macintosh printer port.

You can use the **NI-488 Config** control panel utility to examine and adjust the configuration of the software. Refer to Chapter 6, *GPIB Configuration Utility*, in the *NI-488.2 User Manual for MacOS* for more information on running the utility and for information about the configurable software parameters.

If the software verification test fails, make sure that no GPIB cables are connected to the GPIB-232CT-A.

Common Questions

When should I use IBIC 488.2?

You can use IBIC 488.2 to practice communication with your instrument, troubleshoot problems, and develop your application program. For more information about IBIC 488.2, refer to Chapter 4, *Interface Bus Interactive Control Utility*, in the *NI-488.2 User Manual for MacOS*.

How do I use an NI-488.2 language interface?

For information about using NI-488.2 language interfaces, refer to the *NI-488.2 User Manual for MacOS*.

What do I do if the software verification test fails with an error?

Refer to the *Troubleshooting Software Problems* section of this chapter for information about what might cause this test to fail.

What do I do if I have installed the NI-488.2 software and now my Macintosh crashes upon startup?

Try changing the name of the **NI-488 INIT** to **ZNI-488 INIT**. Because INITs load in alphabetical order, the **ZNI-488 INIT** will load last, preventing possible corruption from INITs that load after it. If changing the name of the **NI-488 INIT** does not solve the problem, another INIT file

might have a conflict with the **NI-488 INIT**. Try removing some of your other INIT files. You can store them in a temporary folder, in case you need to reload them later. If you are using System 7.5 or later, you can use the **Extensions Manager** control panel to disable certain extensions and control panels.

My system has been crashing since I switched to a Quadra computer. What should I do?

This problem was associated with some versions of the **NB Handler INIT**. Upgrade to the **NI-488 INIT** to resolve this situation.

What information should I have before I call National Instruments?

Before you call National Instruments, you should have the results of the software verification test.

Begin to Use the NI-488.2 Software

This chapter describes the IBIC 488.2 utility and lists some general programming considerations.

Introduction to IBIC 488.2

The NI-488.2 software includes the Interface Bus Interactive Control utility, IBIC 488.2. You can use IBIC 488.2 to enter NI-488 functions and NI-488.2 routines interactively and display the results of the function calls automatically. Without writing an application, you can use IBIC 488.2 to do the following:

- Verify GPIB communication with your device quickly and easily.
- Become familiar with the commands of your device.
- Receive data from your GPIB device.
- Learn new functions and routines before integrating them into your application.
- Troubleshoot problems with your application.

For more information about IBIC 488.2, refer to the *NI-488.2 User Manual for MacOS*.

General Programming Considerations

Depending on the programming language you use to develop your application, you must include certain files, statements, or global variables at the beginning of your application. For specific instructions, refer to the *NI-488.2 User Manual for MacOS*.

For information about choosing a programming method, developing your application, or compiling and linking, refer to the *NI-488.2 User Manual for MacOS*. For detailed information about each NI-488 function and NI-488.2 routine, refer to the *NI-488.2 Function Reference Manual for MacOS*.

Specifications

This appendix lists the electrical, environmental, and physical characteristics of the GPIB-232CT-A and the recommended operating conditions.

Electrical Characteristics

AC Version

Power supply unit

100–120 VAC $\pm 10\%$	50–60 Hz
220–240 VAC $\pm 10\%$	50–60 Hz

Current requirement

100–120 VAC	55 mA
220–240 VAC	45 mA

Fuse rating and type

100–120 VAC	300 mA, UL/CSA approved
220–240 VAC	500 mA, IEC approved

DC Version

Power supply unit (50–60 Hz input, 9 VDC at 1 A output)

Wall-mount type	100–120 VAC $\pm 10\%$
Desktop type	220–240 VAC $\pm 10\%$

DC input..... +5 to +13, regulated

Current 700 mA minimum

Environmental Characteristics

AC Version

Operating temperature	10 to 40 °C
Storage temperature	0 to 70 °C
Relative humidity	10% to 95%, noncondensing
EMI	FCC Class A Verified

DC Version

Operating temperature	10 to 40 °C
Storage temperature	0 to 70 °C
Relative humidity	10% to 95%, noncondensing
EMI	FCC Class B Certified

Physical Characteristics

AC Version

Case size	118.1 by 76.2 by 44.2 mm (4.65 by 3.0 by 1.74 in.)
Case material	All metal enclosure
Weight	340 g (12 oz)

DC Version

Case size	118.1 by 76.2 by 28.2 mm (4.65 by 3.0 by 1.11 in.)
Case material	All metal enclosure
Weight	198 g (7 oz)

Interfacing to a Serial Device

This appendix describes the RS-232 serial port on the GPIB-232CT-A and explains how to interface a DCE or DTE serial device to the RS-232 serial port.

The GPIB-232CT-A transfers serial data using the electrical signals, mechanical connections, data format, and control protocols defined in the RS-232C standard. The RS-232 port on the GPIB-232CT-A provides an asynchronous serial communication link to a serial peripheral device.

RS-232C Standard

The RS-232C standard (international standard CCITT V.24) was formulated in 1969 largely from the efforts of the Electronic Industries Association (EIA) and Bell Laboratories. The standard describes the electrical specifications and arrangement of control and data signals on both sides of a serial communications interface. Its original intent was to interface terminals to modems. Many manufacturers of computers and instruments have adopted the standard for their serial communications needs. For more information on the RS-232C standard, contact:

Global Engineering Documents
2805 McGaw Avenue
Irvine, CA 92714
(714) 261-1455

Description of the RS-232 Port

The RS-232 serial port on the GPIB-232CT-A uses a male 9-pin D-Sub connector with a DTE interface configuration. Table B-1 shows the signal lines supported on the GPIB-232CT-A.

Interfacing Serial Devices to the RS-232 Serial Port

To interface other serial devices to the RS-232 serial port on the GPIB-232CT-A, first refer to the manual that came with your serial device to determine if the device is configured as a DTE or DCE. Also, determine from the manual how the control lines are used and whether they must be driven for the serial port to operate.



Note The GPIB-232CT-A serial port is configured to be a DTE.

Figure B-1 shows the location of the RS-232 connector.

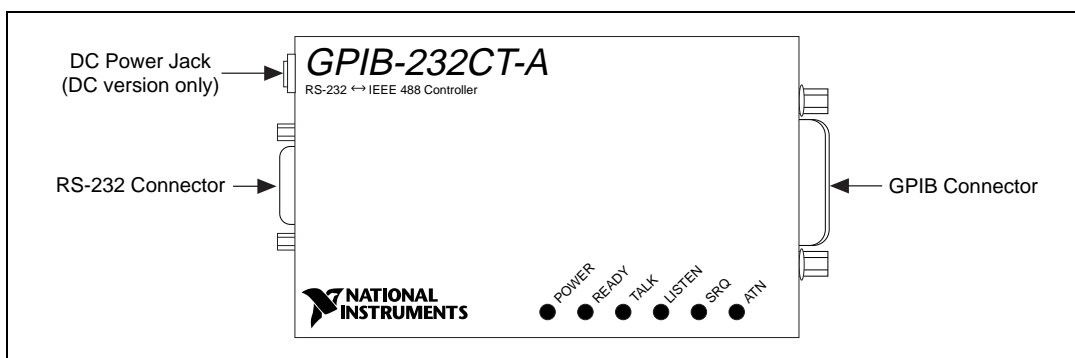


Figure B-1. Location of the RS-232 Connector

Interfacing to a DCE with Handshaking

A correctly configured DTE-to-DCE interface is wired *straight across*: GPIB-232CT-A TXD to DCE TXD, GPIB-232CT-A RXD to DCE RXD, and so on as shown in Table B-1.

Table B-1. Cable Wiring Scheme for GPIB-232CT-A DTE to Serial Device DCE

GPIB-232CT-A Signal to DCE Serial Device Signal	Standard DTE to DCE 9-pin 9-pin		Standard DTE to DCE 9-pin 25-pin	
	<i>RXD</i> to <i>RXD</i> ¹	2	to 2	2
<i>TXD</i> to <i>TXD</i> ¹	3	to 3	3	to 2
DTR to DTR	4	to 4	4	to 20

Table B-1. Cable Wiring Scheme for GPIB-232CT-A DTE to Serial Device DCE (Continued)

GPIB-232CT-A Signal to DCE Serial Device Signal	Standard DTE to DCE 9-pin 9-pin		Standard DTE to DCE 9-pin 25-pin	
	5	5	5	7
<i>GND</i> to <i>GND</i> ¹	5	5	5	7
RTS to RTS	7	7	7	4
CTS to CTS	8	8	8	5

¹ The connections must be implemented.

Figure B-2 shows a properly configured 9-pin DTE to 9-pin DCE cable including the hardware handshake lines RTS, CTS, and DTR. With this configuration, the GPIB-232CT-A can function properly (handshake) on buffer full conditions. Figure B-3 shows an equivalent 9-pin DTE to 25-pin DCE cable configuration.

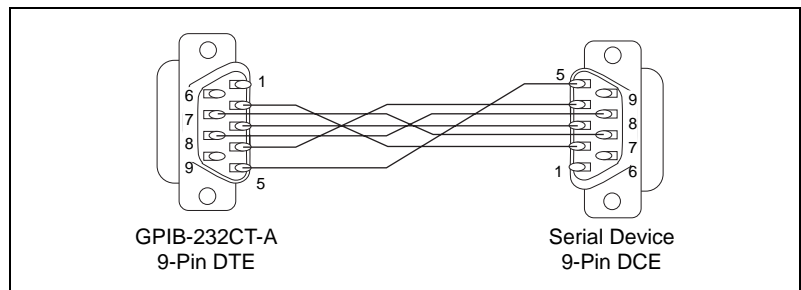


Figure B-2. Cable Configuration for 9-pin DTE to 9-pin DCE with Handshaking

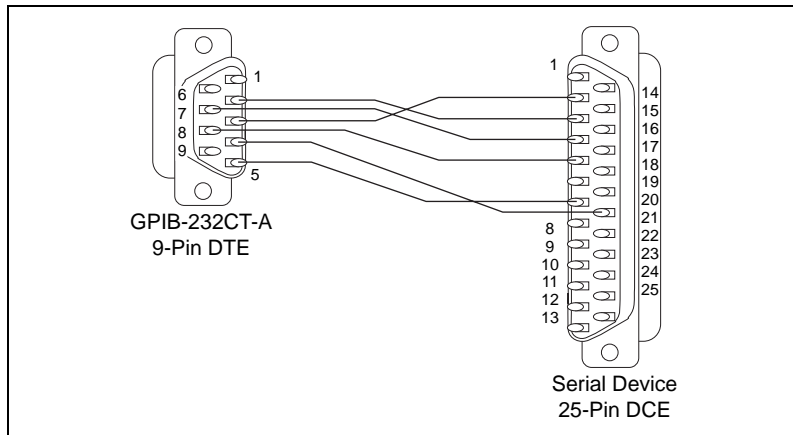


Figure B-3. Cable Configuration for 9-pin DTE to 25-pin DCE with Handshaking

Interfacing to a DCE without Handshaking

If your serial device does not require or use the hardware handshaking protocol used by the GPIB-232CT-A, you have the following two options:

- Use a minimum configuration cable which does not support hardware handshaking and use XON/XOFF software handshaking (if necessary). To create a minimum configuration cable, connect the signals shown in *bold italics* in Table B-2.
- Wire a custom cable that properly interfaces the GPIB-232CT-A hardware handshaking protocol to the handshaking protocol of your serial device.

Minimum Configuration Cable

The minimum configuration cable assumes that the DCE does not require external hardware handshaking. The minimum configuration for a DTE 9-pin to DCE 9-pin cable is shown in Figure B-4. Figure B-5 shows an equivalent 9-pin to 25-pin cable.

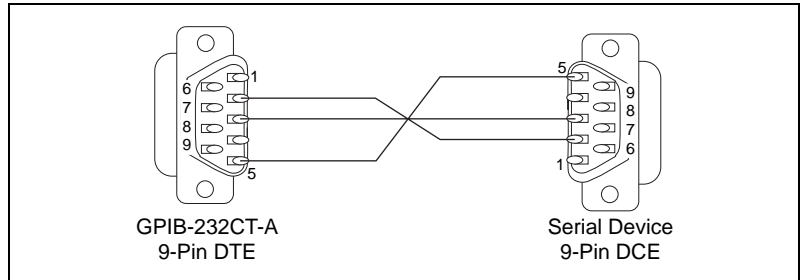


Figure B-4. Minimum Configuration for 9-pin DTE to 9-pin DCE

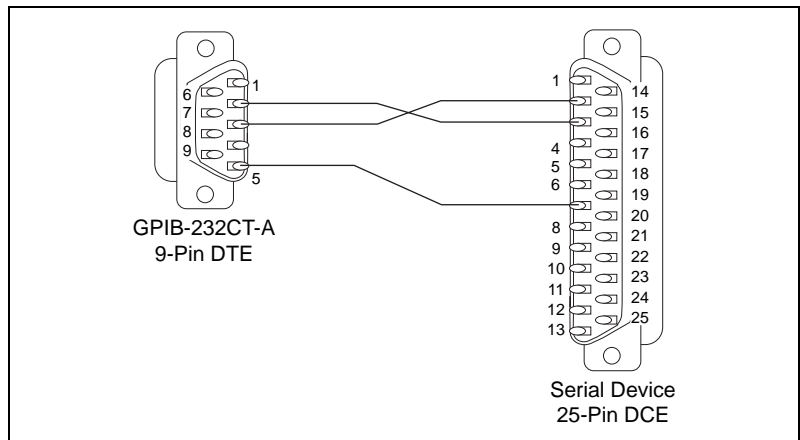


Figure B-5. Minimum Configuration for 9-pin DTE to 25-pin DCE

Custom Cables

If your application requires a custom cable, you can construct one if you have a thorough knowledge of the handshaking protocols involved. Review the RS-232 characteristics of your serial device and build the cable to properly connect the handshake lines of the two devices. Because the DTE-to-DCE connection is a straight across connection, it often involves only connecting RTS to RTS, CTS to CTS, DTR to DTR, and so on. If the documentation for your serial device does not provide a thorough explanation of its handshaking protocol, the ANSI/EIA-232-C standard is a good reference, provided your device conforms to the RS-232 protocol.



Caution Although handshaking might not be required, it is best to use some form of handshaking to prevent loss of data.

Interfacing to a DTE with Handshaking

For serial devices set up as DTEs, you must wire a DTE-to-DTE interface cable, commonly known as a null modem cable. The cable allows the GPIB-232CT-A to act as though it is communicating with a DCE, but it swaps the appropriate pins to achieve a DTE configuration. This wiring configuration is shown in Table B-2.

Table B-2. Cable Wiring Scheme for GPIB-232CT-A DTE to Serial Device DTE

GPIB-232CT-A Signal to DTE Serial Device Signal	Standard DTE to DTE 9-pin 9-pin		Standard DTE to DTE 9-pin 25-pin	
<i>RXD</i> to <i>TXD</i> ¹	2	to 3	2	to 2
<i>TXD</i> to <i>RXD</i> ¹	3	to 2	3	to 3
DTR to DSR	4	to 6	4	to 6
<i>GND</i> to <i>GND</i> ¹	5	to 5	5	to 7
RTS to CTS	7	to 8	7	to 5
CTS to RTS	8	to 7	8	to 4

¹ The connections must be implemented.

Figure B-6 shows a typical 9-pin to 9-pin null modem cable with the RTS, CTS, and DTR handshake lines implemented. Figure B-7 shows an equivalent 9-pin DTE to 25-pin DTE cable configuration.

The cable configuration in Figure B-6 allows you to connect to the 9-pin serial port of a personal computer. The cable in Figure B-7 shows how to connect to the 25-pin serial port of a personal computer.

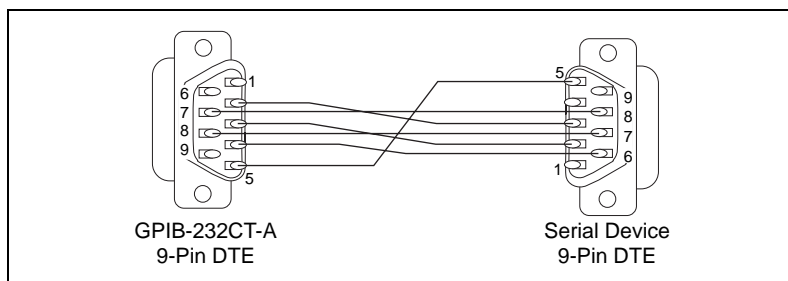


Figure B-6. Cable Configuration for 9-pin DTE to 9-pin DTE with Handshaking

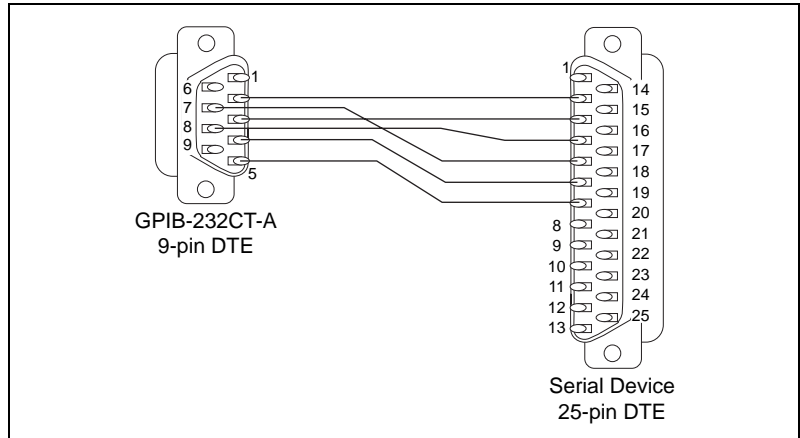


Figure B-7. Cable Configuration for 9-pin DTE to 25-pin DTE with Handshaking

Interfacing to a DTE without Handshaking

If your serial device does not require or use the same hardware handshaking protocol used by the GPIB-232CT-A, you have the following two options:

- Use a minimum configuration null modem cable which does not support the hardware handshake lines and use XON/XOFF software handshaking (if necessary). To create a minimum configuration cable, connect the signals shown in *bold italics* in Table B-3.
- Wire a custom cable that properly interfaces the GPIB-232CT-A hardware handshaking protocol to the handshaking protocol of your serial device.

Minimum Configuration Cable

The minimum cable configuration assumes that the serial device does not require external hardware handshaking. The minimum configuration for a 9-pin to 9-pin null modem cable is shown in Figure B-8. Figure B-9 shows an equivalent 9-pin to 25-pin cable.

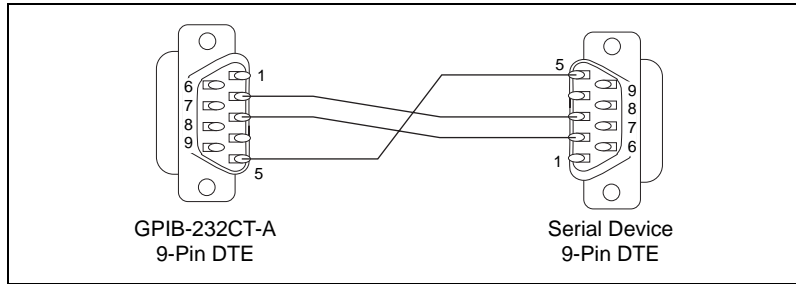


Figure B-8. Minimum Configuration for 9-pin DTE to 9-pin DTE

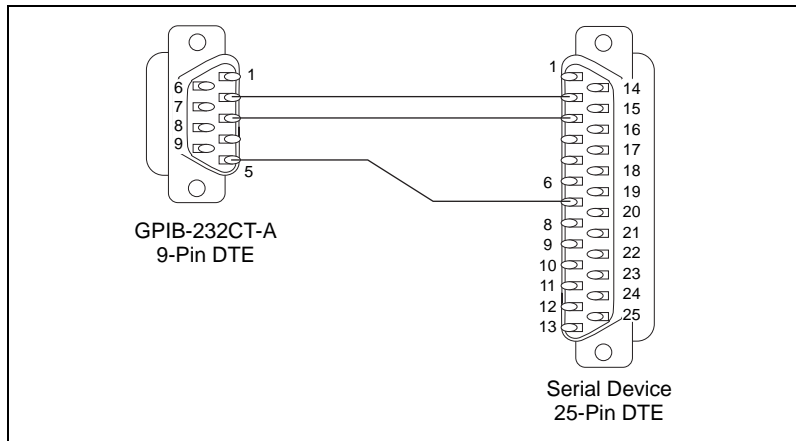


Figure B-9. Minimum Configuration for 9-pin DTE to 25-pin DTE

Custom Cables

If your application requires a custom cable, you can construct one if you have a thorough knowledge of the handshaking protocols involved. Review the RS-232 characteristics of your serial device and build the cable to properly connect the handshake lines of the two devices. If the documentation for your serial device does not provide a thorough explanation of its handshaking protocol, the ANSI/EIA-232-C standard is a good reference, provided your device conforms to the RS-232 protocol.



Caution Although handshaking might not be required, it is best to use some form of handshaking to prevent loss of data.

Interfacing the GPIB-232CT-A to the Macintosh

Table B-3 shows the wiring scheme needed to create a cable to connect the GPIB-232CT-A to a Macintosh serial port.

Table B-3. Cable Wiring Scheme for GPIB-232CT-A DTE to Macintosh Serial Port

GPIB-232CT-A Signal to Macintosh Serial Port	9-pin D-Sub	to	8-pin Mini-DIN
RXD to TXD-	2	to	3
TXD to RXD-	3	to	5
GND to GND, RXD+	5	to	4,8
RTS to HSKi	7	to	2
CTS to HSKo	8	to	1

Figure B-10 shows a properly configured GPIB-232CT-A DTE (9-pin D-Sub) to Macintosh (8-pin Mini-DIN) cable.

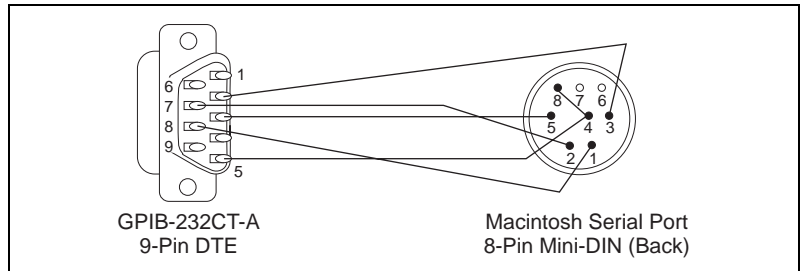


Figure B-10. Cable Configuration for 9-pin DTE to 8-pin Mini-DIN



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.ni.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

National Instruments has offices located around the globe. Many branch offices maintain a Web site to provide information on local services. You can access these Web sites from www.ni.com/worldwide

If you have trouble connecting to our Web site, please contact your local National Instruments office or the source from which you purchased your National Instruments product(s) to obtain support.

For telephone support in the United States, dial 512 795 8248. For telephone support outside the United States, contact your local branch office:

Australia 03 9879 5166, Austria 0662 45 79 90 0, Belgium 02 757 00 20,
Brazil 011 284 5011, Canada (Calgary) 403 274 9391,
Canada (Ontario) 905 785 0085, Canada (Québec) 514 694 8521,
China 0755 3904939, Denmark 45 76 26 00, Finland 09 725 725 11,
France 01 48 14 24 24, Germany 089 741 31 30, Greece 30 1 42 96 427,
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, Poland 48 22 528 94 06,
Portugal 351 1 726 9011, Singapore 2265886, Spain 91 640 0085,
Sweden 08 587 895 00, Switzerland 056 200 51 51,
Taiwan 02 2377 1200, United Kingdom 01635 523545

Glossary

Prefix	Meaning	Value
m-	milli-	10^{-3}
k-	kilo-	10^3
M-	mega-	10^6

°	degrees
%	percent
A	amperes
AC	alternating current
ANSI	American National Standards Institute
C	Celsius
CSA	Canadian Standards Association
CTS	Clear to Send
DIP	dual inline package
EIA	Electronic Industries Association
EMI	electromagnetic interference
FCC	Federal Communications Commission
g	grams
GND	ground
GPIB	General Purpose Interface Bus
Hz	hertz
IBIC	Interface Bus Interactive Control
IEC	International Electrotechnical Commission

Glossary

IEEE	Institute for Electrical and Electronic Engineers
in.	inches
LED	light-emitting diode
m	meters
MB	megabytes of memory
oz	ounces
RTS	Request to Send
RXD	Receive Data
s	seconds
TIMO	Time limit exceeded
TXD	Transmit Data
UL	Underwriters Laboratories
V	volts
VAC	volts alternating current
VDC	volts direct current