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NI-Serial

Serial Hardware and Software for Windows User Manual

PCI, PXI, USB, PCMCIA, and AT Serial Hardware

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FCC/Canada Radio Frequency Interference Compliance

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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). All NI products are FCC Class A products.

Depending on where it is operated, this Class A 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.

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

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

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 Marking Declaration of Conformity*, may cause interference to radio and television reception. Classification requirements are the same for the Federal Communications Commission (FCC) and the Canadian Department of Communications (DOC).

Changes or modifications not expressly approved by 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 is 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.

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Readers in the European Union (EU) must refer to the Manufacturer's Declaration of Conformity (DoC) for information* pertaining to the CE Marking 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.

To obtain the DoC for this product, click **Declaration of Conformity** at `ni.com/hardref.nsf/`. This Web site lists the DoCs by product family. Select the appropriate product family, followed by your product, and a link to the DoC appears in Adobe Acrobat format. Click the Acrobat icon to download or read the DoC.

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

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About This Manual

This manual contains instructions to help you install and configure the NI-Serial hardware and software for Windows 2000/NT/XP/Me/9*x*. This manual includes information about the following serial hardware:

- PCI-232/2, PCI-232/4, PCI-232/8, PCI-232/16, PCI-485/2, PCI-485/4, and PCI-485/8 boards in both isolated and nonisolated versions
- PXI-8420 (two, four, eight, and 16 port), PXI-8421 (two, four, and eight port), PXI-8422 (two and four port), and PXI-8423 (two and four port)
- USB-232, USB-232/2, USB-232/4, USB-485, USB-485/2, and USB-485/4
- PCMCIA-232, PCMCIA-232/2, PCMCIA-232/4, PCMCIA-485, and PCMCIA-485/2
- AT-232/2, AT-232/4, AT-485/2, and AT-485/4 boards in both isolated and nonisolated versions

This manual assumes that you are already familiar with Windows 2000/NT/XP/Me/9*x*.

Conventions

The following conventions appear in this manual:

»	The » symbol leads you through nested menu items and dialog box options to a final action. The sequence **File»Page Setup»Options** directs you to pull down the **File** menu, select the **Page Setup** item, and select **Options** from the last dialog box.
♦	The ♦ symbol indicates that the following text applies only to a specific product, a specific operating system, or a specific software version.
	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.
AT serial boards	AT serial boards refers to all port versions of the AT serial boards.
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.

italic	Italic text denotes variables, emphasis, a cross reference, or an introduction to a key concept. This font also denotes text that is a placeholder for a word or value that you must supply.
`monospace`	Text in this font denotes text or characters that you should enter from the keyboard, sections of code, programming examples, and syntax examples. This font is also used for the proper names of disk drives, paths, directories, programs, subprograms, subroutines, device names, functions, operations, variables, filenames and extensions, and code excerpts.
`monospace bold`	Bold text in this font denotes the messages and responses that the computer automatically prints to the screen. This font also emphasizes lines of code that are different from the other examples.
PCI serial boards	PCI serial boards refers to all versions of the PCI serial boards.
PCMCIA serial boards	PCMCIA serial boards refers to all versions of the PCMCIA serial boards.
Platform	Text in this font denotes a specific platform and indicates that the text following it applies only to that platform.
PXI serial boards	PXI serial boards refers to all versions of the PXI serial boards.
USB serial hardware	USB serial hardware refers to all versions of the USB serial hardware.

Related Documentation

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

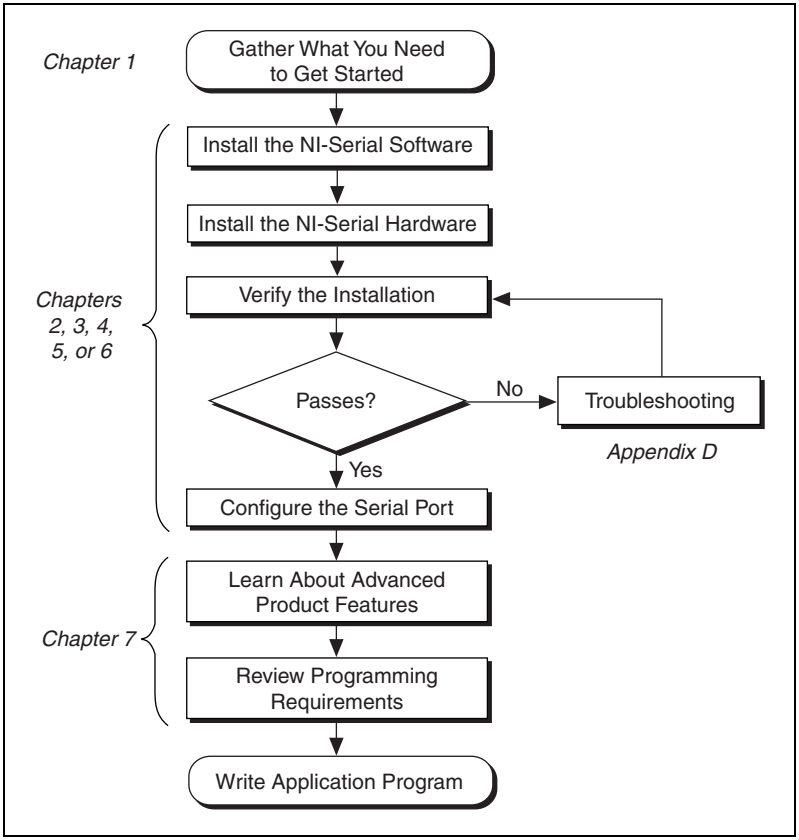
- ANSI/EIA-232-D Standard, *Interface Between Data Terminal Equipment and Data Circuit-Terminating Equipment Employing Serial Binary Data Interchange*
- EIA/RS-422-A Standard, *Electrical Characteristics of Balanced Voltage Digital Interface Circuits*
- EIA-485 Standard, *Standard for Electrical Characteristics of Generators and Receivers for Use in Balanced Digital Multipoint Systems*
- *Microsoft Win32 Software Developer Kit*, Online Documentation for *Win32 Overviews*, *Win32 Reference*, *Microsoft Programmer's Guide to Windows 98/95*, and *Microsoft Windows NT System Guide*, Microsoft Corporation

1

Introduction

This chapter explains how to use this manual, lists what you need to get started and optional equipment you can order, and briefly describes the NI-Serial hardware and software.

How to Use this Manual



What You Need to Get Started

Before you install your serial hardware and the NI-Serial software, make sure you have all of the following items:

- ❑ Windows 2000/NT/XP/Me/9*x* installed on your computer for PCI/PXI/PCMCIA/AT kits or Windows 2000/XP installed on your computer for USB kits
- ❑ One of the following hardware kits:

  PCI Kits
  - PCI-232 (two, four, eight, or 16 port)
  - PCI-485 (two, four, or eight port)
  - PCI-232 isolated (two or four port)
  - PCI-485 isolated (two or four port)

  PXI Kits
  - PXI-8420 (two, four, eight, or 16 port)
  - PXI-8421 (two, four, or eight port)
  - PXI-8422 (two or four port)
  - PXI-8423 (two or four port)

  USB Kits
  - USB-232 (one, two, or four port)
  - USB-485 (one, two, or four port)

  PCMCIA Kits
  - PCMCIA-232 (one, two, or four port)
  - PCMCIA-485 (one or two port)

  AT Kits
  - AT-232 (two or four port)
  - AT-485 (two or four port)
  - AT-232 (two or four port) isolated
  - AT-485 (two or four port) isolated
- ❑ One of the following CDs:
  - *NI-Serial Software for Windows 2000/NT/XP/Me/9x*, which is included in your kit
  - *NI-Serial Software (USB) for Windows 2000/XP*, which is included in your kit

Optional Equipment

For more information about ordering the following optional equipment, contact National Instruments:

- DB-9 RS-485 termination connector (PCI-485, USB-485, PCMCIA-485, PXI-8421, PXI-8423, and AT-485 only)
- 10-position modular jack to DB-9 cable (PCI, PXI, and AT four-port boards only)
- 10-position modular jack to DB-25 cable (PCI, PXI, and AT four-port boards only)
- 68-pin to DB-9 adapter cable (PCI and PXI eight-port boards only)
- RS-232 9-pin to 9-pin null modem cable
- RS-232 9-pin to 9-pin straight-through cable
- RS-232 9-pin to 25-pin null modem cable
- RS-485 9-pin to 9-pin null modem cable
- Breakout box (PCI/PXI-232 16-port board only)
- External power supply (USB-485/4 only)
- USB cable (USB only)

Serial Hardware Overview

PCI Kits

The serial hardware gives you a variety of solutions for serial communication. The PCI-232 boards work with the RS-232 protocols, and the PCI-485 boards work with the RS-422 and RS-485 protocols. You can use the PCI-232 boards for serial communication up to distances of 50 ft. You can connect the PCI-485 boards to up to 31 devices using serial cable lengths up to 4,000 ft.

Additionally, the PCI serial boards are available in a two-port version (PCI-232/2 and PCI-485/2), a four-port version (PCI-232/4 and PCI-485/4), an eight-port version (PCI-232/8 and PCI-485/8), and a 16-port version (PCI-232/16). The two-port versions use DB-9 connectors. The four-port versions use 10-position modular jacks to provide all four connections on a single back panel. Optional cable accessories convert the 10-position modular jacks to either DB-9 or DB-25 connectors with standard pinouts. The eight-port versions use adapter cables to convert the 68-pin connector on the board to eight DB-9 connectors. The 16-port

version uses a breakout box to convert the 100-pin connector on the board to 16 DB-9 connectors. Throughout this manual, *PCI serial boards* refers to all versions of the PCI serial boards.

The isolated PCI-232 and PCI-485 boards are designed for applications in harsh environments. Isolated ports provide reliable communication in situations involving ground loops from different ground levels or high common mode voltage induced on the lines in noisy environments. Nonisolated ports may not provide reliable communication in those situations. The isolation between each communication port and the host PC ensures the safe operation of the PC and the devices connected to other ports on the same board, in case of accidental high voltages on communication lines.

The PCI-485 boards support four hardware transceiver control modes for reliable communication with two- and four-wire devices. For more information about transceiver control modes, refer to Chapter 7, *Using Your Serial Hardware*.

All serial hardware uses standard 16550-compatible UARTs (Universal Asynchronous Receiver/Transmitters) for complete compatibility with standard PC COM ports. The serial hardware contains FIFOs (First-In-First-Out) buffers to reduce susceptibility to interrupt latency for faster transmission rates. Full Plug and Play compatibility allows switchless configuration and installation. For more information about the serial hardware specifications and operating conditions, refer to Appendix E, *Specifications*.

PXI Kits

The serial hardware gives you a variety of solutions for serial communication. The RS-232 boards (PXI-8420 and PXI-8422) work with the RS-232 protocols. The RS-485 boards (PXI-8421 and PXI-8423) work with the RS-422 and RS-485 protocols. You can use the RS-232 boards for serial communication up to distances of 50 ft. You can connect the RS-485 boards to up to 31 devices using serial cable lengths up to 4,000 ft.

Additionally, the PXI serial boards are available in a two-port version, a four-port version, an eight-port version (PXI-8420 and PXI-8421 only), and a 16-port version (PXI-8420 only). The two-port versions use DB-9 connectors. The four-port versions use 10-position modular jacks to provide all four connections on a single front panel. Optional cable accessories convert the 10-position modular jacks to either DB-9 or DB-25 connectors with standard pinouts. The eight-port versions use two different adapter cables to convert the 68-pin connector on the board to eight DB-9 connectors. The 16-port version uses a breakout box to convert the 100-pin connector on the board to sixteen DB-9 connectors. Throughout this manual, *PXI serial boards* refers to all versions of the PXI serial boards.

The isolated PXI boards are designed for applications in harsh environments. Isolated ports provide reliable communication in situations involving ground loops from different ground levels or high common mode voltage induced on the lines in noisy environments. Nonisolated ports may not provide reliable communication in those situations. The isolation between each communication port and the host PC ensures the safe operation of the PC and the devices connected to other ports on the same board, in case of accidental high voltages on communication lines.

The RS-485 boards (PXI-8421 and PXI-8423) support four hardware transceiver control modes for reliable communication with two- and four-wire devices. For more information about transceiver control modes, refer to Chapter 7, *Using Your Serial Hardware*.

All serial hardware uses standard 16550-compatible UARTs (Universal Asynchronous Receiver/Transmitters) for complete compatibility with standard PC COM ports. The serial hardware contains FIFOs (First-In-First-Out) buffers to reduce susceptibility to interrupt latency for faster transmission rates. Full Plug and Play compatibility allows switchless configuration and installation. For more information about the serial hardware specifications and operating conditions, refer to Appendix E, *Specifications*.

Table 1-1 lists the PXI serial board numbers and corresponding board descriptions.

Table 1-1. PXI Board Names and Descriptions

PXI Board Name	Description
PXI-8420	RS-232 two port RS-232 four port RS-232 eight port RS-232 16 port
PXI-8421	RS-485 two port RS-485 four port RS-485 eight port
PXI-8422	RS-232 two port isolated RS-232 four port isolated
PXI-8423	RS-485 two port isolated RS-485 four port isolated

USB Kits

The serial hardware gives you a variety of solutions for serial communication. The USB-232 hardware works with the RS-232 interface standard, and the USB-485 hardware works with the RS-422 and RS-485 interface standards. You can use the USB-232 hardware for serial communication up to distances of 50 ft. You can connect the USB-485 hardware to up to 31 devices using serial cable lengths up to 4,000 ft.

Additionally, the USB serial hardware is available in one-port versions (USB-232 and USB-485), two-port versions (USB-232/2 and USB-485/2) and four-port versions (USB-232/4 and USB-485/4). All versions use DB-9 connectors. Throughout this manual, *USB serial hardware* refers to all versions of the USB serial hardware.

The USB-232 two and four-port hardware supports three hardware transceiver modes supporting both DTE and DCE configurations. For more information about transceiver control modes, refer to Chapter 7, *Using Your Serial Hardware*.

The USB-485 hardware supports four hardware transceiver control modes for reliable communication with two- and four-wire devices. For more information about transceiver control modes, refer to Chapter 7, *Using Your Serial Hardware*. In addition, the USB-485 hardware supports

programmatic control of the bias resistors. For more information, refer to Chapter 7, *Using Your Serial Hardware*.

All serial hardware uses standard 16550-compatible UARTs (Universal Asynchronous Receiver/Transmitters) for complete compatibility with standard PC COM ports. The serial hardware contains FIFO (First-In-First-Out) and USB buffers to reduce susceptibility to system latency for faster transmission rates. Full Plug and Play compatibility allows switchless configuration and installation. For more information about the serial hardware specifications and operating conditions, refer to Appendix E, *Specifications*.

PCMCIA Kits

The serial hardware gives you a variety of solutions for serial communications. The PCMCIA-232 interfaces work with the RS-232 protocols, and the PCMCIA-485 interfaces work with the RS-422 and RS-485 protocols. You can use the PCMCIA-232 hardware for serial communication up to distances of 50 ft. You can connect the PCMCIA-485 hardware with up to 31 devices using serial cable lengths up to 4,000 ft.

The PCMCIA-232 is available with one, two, or four ports. The PCMCIA-485 is available in a one-port version or two-port version. All PCMCIA cards come with cables for each port that terminates in a standard DB-9 D-Sub connector. Throughout this manual, references to PCMCIA serial interfaces generally refer to all versions of the interfaces.

The PCMCIA-485 interfaces support four hardware transceiver control modes for reliable communication with two-wire and four-wire devices. Refer to Chapter 7, *Using Your Serial Hardware*, for more information about transceiver control modes.

All of the serial hardware uses standard 16550-compatible UARTs (Universal Asynchronous Receiver/Transmitters) for 100 percent compatibility with standard PC COM ports. The serial hardware contains FIFOs (First-In-First-Out buffers) for reduced susceptibility to interrupt latency and faster transmission rates. Full Plug and Play compatibility gives you the convenience of switchless configuration and installation. Refer to Appendix E, *Specifications*, for more information about the serial hardware specifications and operating conditions.

AT Kits

The serial hardware gives you a variety of solutions for serial communications. The AT-232 boards work with the RS-232 protocols, and the AT-485 boards work with the RS-422 and RS-485 protocols. You can use the AT-232 hardware for serial communication up to distances of 50 ft. You can connect the AT-485 hardware with up to 31 devices using serial cable lengths up to 4,000 ft.

The AT boards are available in two different versions:

- Shared IRQ: All ports on the board share the same IRQ.
- Isolated: All ports on the board are isolated and share the same IRQ.

Additionally, the AT serial boards are available in a two-port version (AT-232/2 and AT-485/2) or a four-port version (AT-232/4 and AT-485/4). The two-port versions use DB-9 connectors. The four-port versions use 10-position modular jacks to provide all four connections on a single back panel. Optional cable accessories convert the 10-position modular jacks to either DB-9 or DB-25 connectors with standard pinouts. Throughout this manual, references to AT serial boards generally refer to all versions of the boards.

The isolated AT-232 and AT-485 boards are designed for applications in harsh environments. Isolated ports provide reliable communication in situations involving ground loops from different ground levels or high common mode voltage induced on the lines in noisy environments. The nonisolated ports may not provide reliable communication in those situations. The isolation between each communication port and the host PC ensures safe operation of the PC and the devices connected to other ports on the same board in case of accidental high voltages on communication lines.

The AT-485 boards support four hardware transceiver control modes for reliable communication with two- and four-wire devices. For more information about transceiver control modes, refer to Chapter 7, *Using Your Serial Hardware*.

All serial hardware uses standard 16550-compatible UARTs (Universal Asynchronous Receiver/Transmitters) for complete compatibility with standard PC COM ports. The serial hardware contains FIFOs (First-In-First-Out) buffers to reduce susceptibility to interrupt latency for faster transmission rates. Full Plug and Play compatibility allows switchless configuration and installation. For more information about the serial hardware specifications and operating conditions, refer to Appendix E, *Specifications*.

NI-Serial Software Overview

The NI-Serial software for Windows 2000/NT/XP/Me/9*x* includes either a native Windows 2000/XP/Me/9*x* device driver and Windows NT kernel driver that provide full interrupt-driven, buffered I/O for multiple plug-in COM ports, or a native Windows 2000/XP device driver that provides buffered I/O for multiple USB COM ports. The maximum baud rates and maximum number of COM ports vary between hardware and operating systems, as shown in Table 1-2 and Table 1-3.

Table 1-2. Maximum Number of COM Ports

Operating System	Maximum Number of COM Ports (Plug In)	Maximum Number of COM Ports (USB)
Windows 95	99	—
Windows 98	99	—
Windows Me	99	—
Windows NT	99	—
Windows 2000/XP	256	256

If you require additional ports, contact National Instruments.

Table 1-3. Maximum Baud Rate

Hardware Platform	Maximum Baud Rate
PCI/PXI/AT-232, PCMCIA-232/4	115.2 kbits/s
All other PCMCIA	921.6 kbits/s
AT-485	115.2 kbits/s
USB-232	230.4 kbits/s
PCI/PXI/USB-485	460.8 kbits/s

Older versions of the serial hardware may support lower maximum baud rates. The NI-Serial software also includes a configuration utility, which is fully integrated into the Windows 2000/XP/Me/9*x* Device Manager and Windows NT Control Panel. Its port Settings view indicates the maximum baud rate your hardware supports. For more information about software specifications, refer to Appendix E, *Specifications*.

The NI-Serial software includes the following components:

- Device driver
- Diagnostic utility
- Configuration utility
- Product manual

Time-Saving Development Tools

Your kit includes either the NI-Serial software for Windows 2000/NT/XP/Me/9*x* or NI-Serial (USB) software for Windows 2000/XP. In addition, you can order the Measurement Studio or 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.

Measurement Studio bundles LabWindows™/CVI™ for C programmers, ComponentWorks for Microsoft Visual C++ programmers, and ComponentWorks++ for Microsoft Visual C++ programmers. Measurement Studio is designed for building measurement and automation applications with the programming environment of your choice:

- LabWindows/CVI is an interactive ANSI C programming environment designed for building virtual instrument applications. LabWindows/CVI delivers a drag-and-drop editor for building user interfaces, a complete ANSI C environment for building your test program logic, and a collection of automated code generation tools, as well as utilities for building automated test systems, monitoring applications, or laboratory experiments.
- ComponentWorks for Visual Basic is a collection of ActiveX controls designed for building virtual instrumentation systems. Based on ActiveX technology, ComponentWorks controls are configured through simple property pages. You can use the ComponentWorks

GPIB, Serial, and VISA I/O controls and property pages to set up communication with your instruments.

- ComponentWorks++ for Visual C++ takes advantage of integrated C++ libraries and ActiveX to help you build measurement and automation applications. With the ComponentWorks++ instrument classes, you can use the IEEE 488.2 library and VISA, an industry-standard I/O library, to communicate with GPIB, VXI, or Serial devices using the same set of components.

After you install your serial hardware and the NI-Serial software, you can use NI-VISA in LabVIEW and Measurement Studio with your serial interface. If you already have one or more of these applications and want to use them with your serial interface, refer to your product documentation for information about serial I/O functions. For ordering information, contact National Instruments.

NI-VISA is a standard I/O application programming interface (API) for instrumentation programming.

In its full implementation, NI-VISA can control VXI/VME, PXI, GPIB, TCP/IP, or Serial instruments, making the appropriate driver calls depending on the type of instrument being used. NI-VISA uses the same operations to communicate with instruments regardless of the interface type. For example, the NI-VISA command to write an ASCII string to a message-based instrument is the same whether the instrument is Serial, GPIB, or VXI. As a result, NI-VISA gives you interface independence. This makes it easier to switch bus interfaces and means that users who must program instruments for multiple interfaces need learn only one API.

Another advantage of NI-VISA is that it is an object-oriented API that will easily adapt to new instrumentation interfaces as they evolve, making application migration to the new interfaces easy.

VISA is the industry standard for developing instrument drivers. Most current drivers written by National Instruments use NI-VISA and support Windows, Solaris 2, VxWorks, Linux, and Macintosh, as long as the appropriate *system*-level drivers are available for that platform. NI-VISA for VxWorks currently supports only the VXI and Serial interfaces.

2

PCI Serial Hardware Installation, Verification, and Configuration

This chapter describes how to install the NI-Serial software and PCI serial hardware and how to verify the installation. It also describes how to configure the communication port settings.

To begin your installation, see the section of this chapter containing instructions for your operating system (*Windows 2000/XP*, *Windows Me/9x*, or *Windows NT*.)

Windows 2000/XP

Install the Software

Before you install your serial hardware, complete the following steps to install the NI-Serial software for Windows 2000/XP:

1. Select **Start»Settings»Control Panel**.
2. Double-click the **Add/Remove Programs** icon. The **Add/Remove Programs** dialog box appears.
3. Click the **Add New Programs** button and then the **CD or Floppy** button.
4. When prompted, insert the *NI-Serial Software for Windows 2000/NT/XP/Me/9x* CD and click the **Next** button.
5. When prompted, click the **Finish** button to install the program files from the CD.
6. The setup wizard begins. The setup wizard guides you through the necessary steps to install the NI-Serial software. To exit the setup wizard at any time, click the **Cancel** button.
7. If you need to install your hardware, or if this is your first time to install the NI-Serial software for Windows 2000/XP, skip to the next section, *Install the Hardware*. Otherwise, continue to step 8.

8. If your hardware is already installed, restart Windows 2000/XP.
9. Windows 2000/XP should automatically detect your hardware and display the Found New Hardware Wizard. Complete the wizard by clicking **Next** in each window and then **Finish**. When you complete the wizard, continue to the *Verify the Installation* section.

   If the Found New Hardware Wizard does not appear, refer to the *Forcing Windows to Detect Your Hardware* section of Appendix D, *Troubleshooting and Common Questions*.

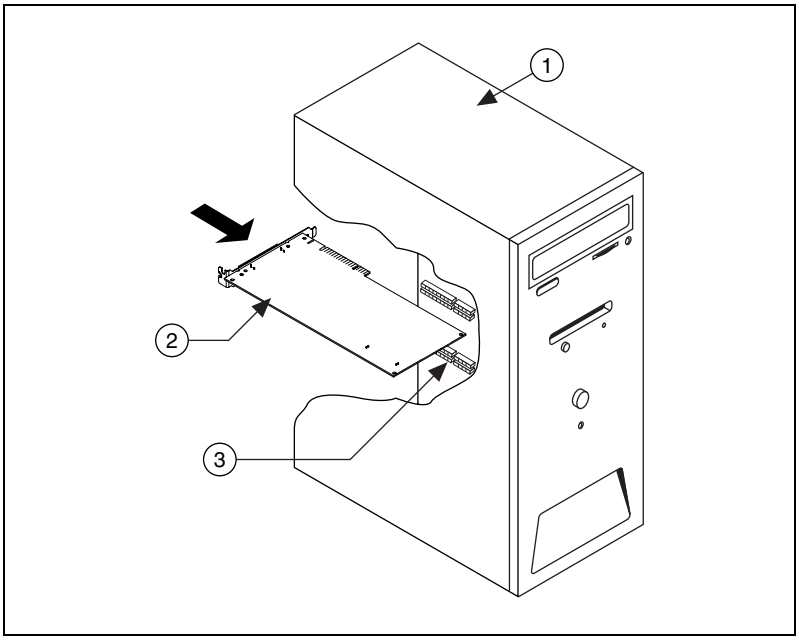
Install the Hardware

Note If you are installing a PCI-485, you might need to adjust the value of the bias resistors, depending on your application. Bias resistors are not available on the eight-port PCI-485. For more information, refer to Chapter 7, *Using Your Serial Hardware*.

Caution Before you remove your board from the package, touch the antistatic plastic package to a metal part of your system chassis to discharge electrostatic energy, which can damage several components on your serial board.

To install your PCI serial board, complete the following steps:

1. Turn off your computer. Keep the computer plugged in so that it remains grounded while you install the PCI serial board.
2. Remove the top or side cover of the computer.
3. Find an unused PCI expansion slot in your computer.
4. Remove the corresponding expansion slot cover on the back panel of the computer.
5. Touch a metal part on your chassis to discharge any static electricity.
6. Insert the PCI serial board into the slot with the serial connectors toward the opening on the back panel. Make sure that you insert the board all the way into the slot. The board might seem to click firmly into place, even though it is only part of the way in. Figure 2-1 shows how to install the PCI serial board into an expansion slot.



1 PC 2 PCI Serial Board 3 PCI Slot

Figure 2-1. PCI Serial Board Installation

7. Screw the PCI serial board mounting bracket to the back panel mounting rail of the computer.
8. Replace the cover.
9. Turn on your computer and start Windows 2000/XP.
10. Windows 2000/XP should automatically detect your hardware and display the Found New Hardware Wizard. Complete the wizard by clicking **Next** in each window and then **Finish**.

    If the Found New Hardware Wizard does not appear, refer to the *Forcing Windows to Detect Your Hardware* section of Appendix D, *Troubleshooting and Common Questions*.

The serial hardware installation is complete.

Verify the Installation

To verify the hardware and software installation, complete the following steps:

1. Select **Start»Settings»Control Panel** and double-click the **System** icon.

2. Click the **Hardware** tab and then click the **Device Manager** button.
3. Double-click the **Ports (COM & LPT)** icon to display all of the ports.
4. Double-click the **Multi-function adapters** icon.

   The PCI serial boards are configured as devices belonging to the *multi-function adapters* class. The multi-function parent device is listed under the **Multi-function adapters** icon, and each child device is listed as a port under the **Ports (COM & LPT)** icon.

   Figure 2-2 shows the Device Manager tab for serial hardware that is installed properly.

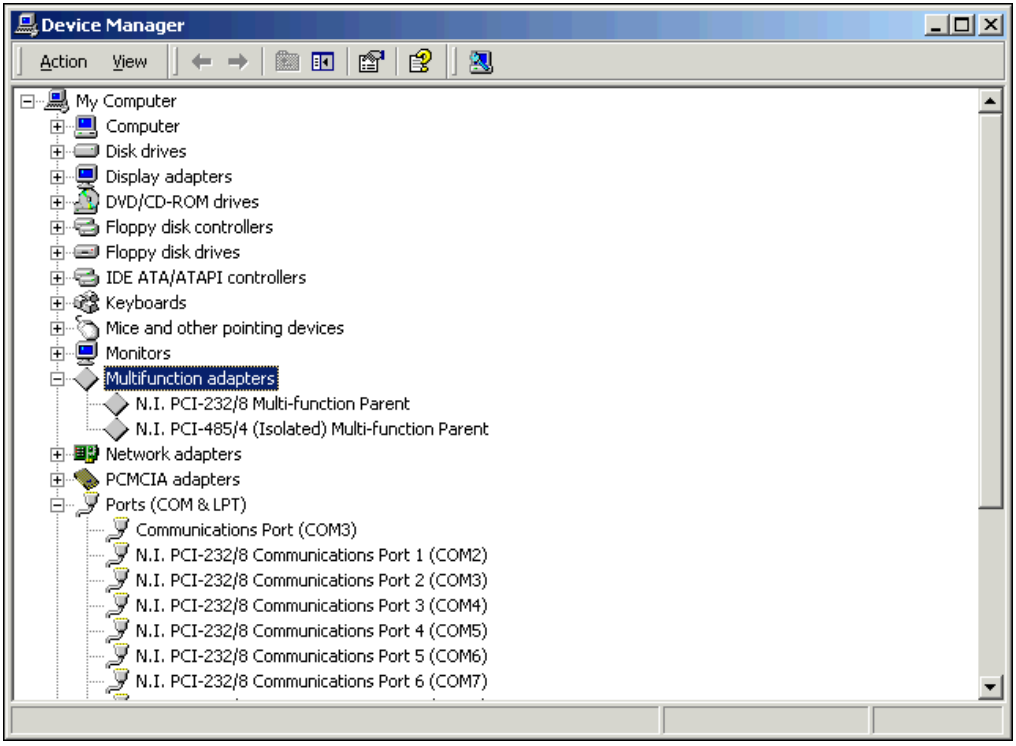


Figure 2-2. Device Manager for PCI Serial Board Ports

5. Verify the hardware resources, as follows:
   a. In the Device Manager under **Multi-function adapters**, double-click a serial board.
   b. Click the **Resources** tab. If the resources were assigned properly, the **Resources** tab shows which resources are assigned to your serial ports.
   c. Repeat steps 5a and 5b until you have verified the resources for each board.
6. (Optional) To determine which physical port is associated with COM*x*, note the Port 1, Port 2, etc. entries next to the COM numbers. For all serial hardware, PORT1 refers to the top port, PORT2 refers to the next port down, and so on.
7. To run the diagnostic utility, select **Start»Programs»National Instruments»NI-Serial»Diagnostics**.

   The diagnostic utility verifies that your serial driver is installed properly, that the configuration of your hardware does not conflict with anything else in your system, and that the serial driver can communicate with your hardware correctly.

   If the test is successful, your serial hardware and software are installed properly. If the test fails, refer to Appendix D, *Troubleshooting and Common Questions*, to troubleshoot the problem.
8. After you verify the hardware and software installation, connect the cables. Refer to Appendix A, *Connector Descriptions*, for information about cable connections.

Configure Communication Port Settings

The serial configuration utility is fully integrated into the Windows 2000/XP Device Manager. You can use it to view or change the configuration of your serial ports.

To configure a serial port, complete the following steps:

1. Select **Start»Settings»Control Panel** and double-click the **System** icon.
2. Click the **Hardware** tab and then click the **Device Manager** button.
3. Double-click the **Ports (COM & LPT)** icon.

4. Double-click the port you want to configure and refer to the following instructions:
   - To view the hardware resources assigned to the serial port, click the **Resources** tab.
   - To view or change the port settings, click the **Port Settings** tab. For more information about the settings, refer to the next section, *Port Settings Tab*.
   - To change the RS-485 transceiver mode, or to enable or disable the FIFOs on the serial hardware, in the **Port Settings** tab, click the **Advanced** button. For more information about the settings, refer to the next section, *Port Settings Tab*.

Note Transceiver modes apply to RS-485 interfaces only. For more information about transceiver modes, refer to Chapter 7, *Using Your Serial Hardware*.

5. To save your changes, click the **OK** button. To exit without saving the changes, click the **Cancel** button.

Port Settings Tab

In the **Port Settings** tab, you can change any of the settings by clicking the arrow button to the right of a field. When you click the arrow button, a list of valid values for that field appears and you can select the desired setting from the list. Figure 2-3 shows the **Port Settings** tab.

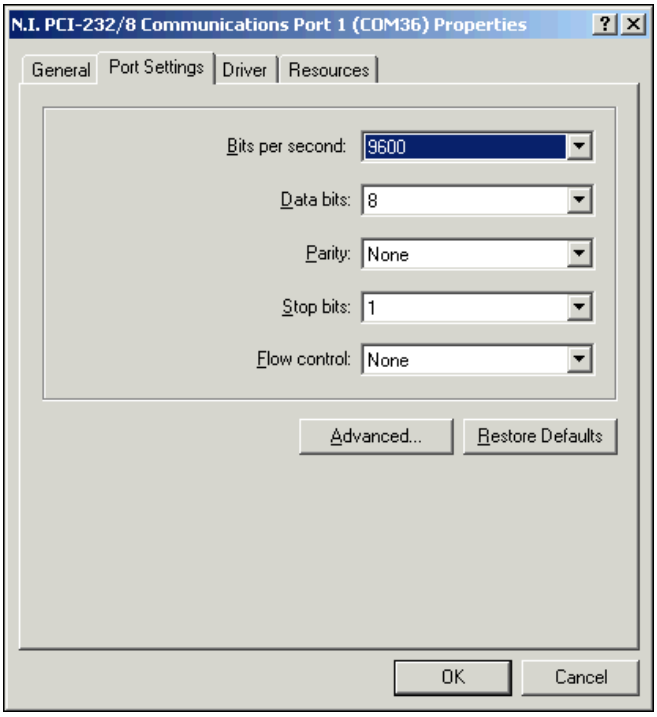


Figure 2-3. Port Settings Tab

Advanced Settings

To view or change the advanced settings, click the **Advanced** button. Figure 2-4 shows the **Advanced Settings** dialog box.

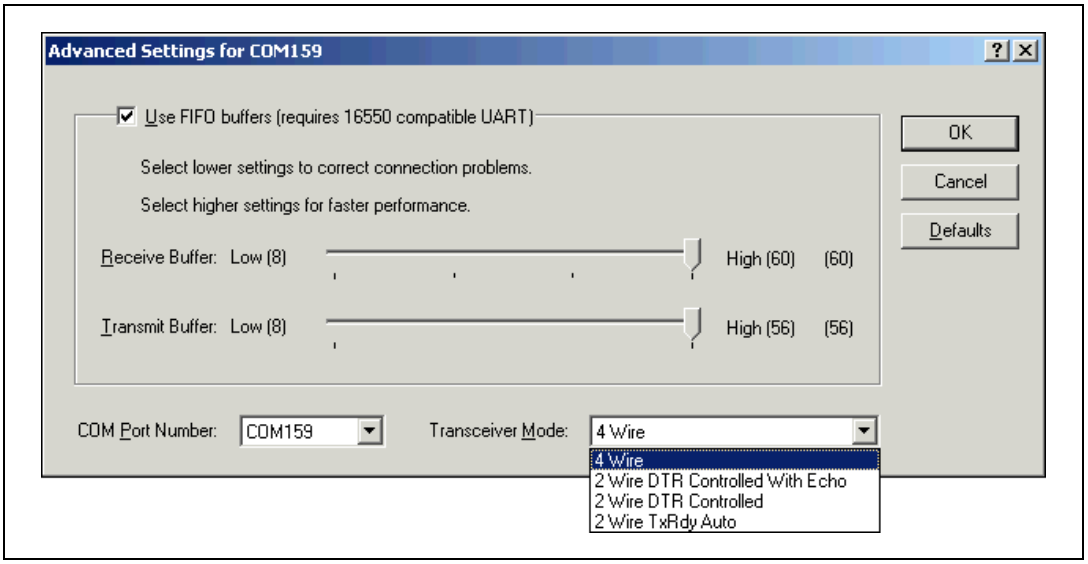


Figure 2-4. Advanced Settings Dialog Box

The following sections describe the advanced settings options.

Transceiver Mode

This field shows the RS-485 transceiver mode in use, and applies only to PCI-485 boards. For more information about transceiver modes, refer to Chapter 7, *Using Your Serial Hardware*.

Use FIFO Buffers

FIFO buffers are present on the 16550-compatible UARTs—one for the transmitter and one for the receiver. The **Receive Buffer** control sets the number of characters received in the FIFO before the PC is interrupted to read the data. The **Transmit Buffer** control sets the maximum number of bytes written to the FIFO in a block when the PC is interrupted to write the data. When you configure FIFO settings, consider the following points:

- You can select larger FIFO buffer sizes to reduce the number of interrupts your PC receives and therefore minimize system overhead.
- If transfer rates are high, you can lower the **Receive Buffer** value to prevent overrun errors due to interrupt latency.
- If your data transfer sizes are small and your **Receive Buffer** value is above your data sizes, your system is less efficient. Therefore, set the **Receive Buffer** value below your data sizes.

Restore Defaults

To reset the fields to their default values at any time, click the **Restore Defaults** button.

Windows Me/9*x*

Install the Software

Before you install your serial hardware, complete the following steps to install the NI-Serial software for Windows Me/9*x*:

1. Select **Start»Settings»Control Panel**.
2. Double-click the **Add/Remove Programs** icon. The **Add/Remove Programs** dialog box appears.
3. Click the **Install** button.
4. When prompted, insert the *NI-Serial Software for Windows 2000/NT/XP/Me/9x* CD, and click the **Next** button.
5. When prompted, click the **Finish** button to install the program files from floppy disks or CD-ROM.
6. The setup wizard begins. The setup wizard guides you through the necessary steps to install the NI-Serial software. To exit the setup wizard at any time, click the **Cancel** button.
7. If you need to install your hardware, or if this is your first time to install the NI-Serial software for Windows Me/9*x*, skip to the next section, *Install the Hardware*. Otherwise, continue to step 8.
8. If your hardware is already installed, restart Windows Me/9*x*.
9. Windows Me/9*x* should automatically detect your hardware and display one or more **New Hardware Found** dialog boxes. Your operating system (Windows Me/9*x*) may show the **Windows Default Driver** option. If so, make sure the **Windows Default Driver** is selected and click the **OK** button. If the **Windows Default Driver** option is not shown, the installation continues automatically. When you finish, continue to the *Verify the Installation* section.

   If no **New Hardware Found** dialog box appears, refer to the *Forcing Windows to Detect Your Hardware* section of Appendix D, *Troubleshooting and Common Questions*.

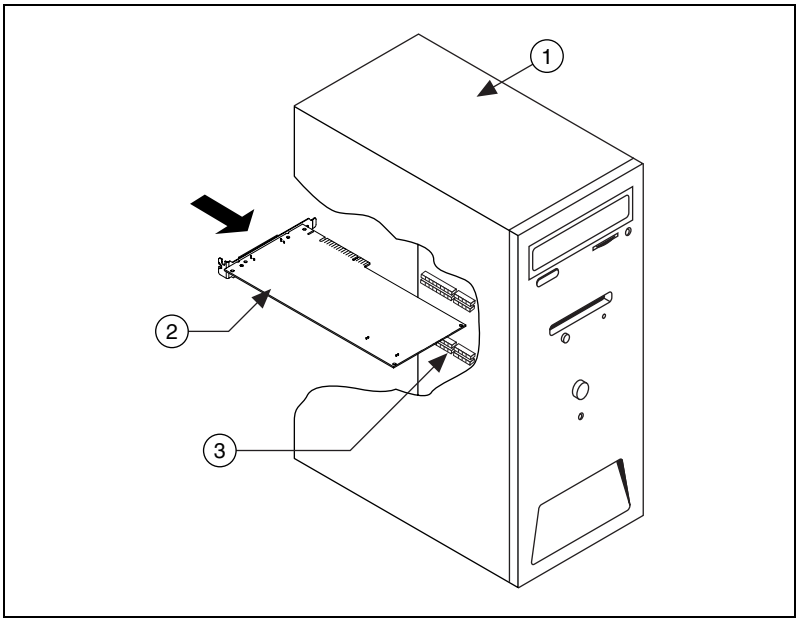
Install the Hardware

Note If you are installing a PCI-485, you might need to adjust the value of the bias resistors, depending on your application. Bias resistors are not available on the eight-port PCI-485. For more information, refer to Chapter 7, *Using Your Serial Hardware*.

Caution Before you remove your board from the package, touch the antistatic plastic package to a metal part of your system chassis to discharge electrostatic energy, which can damage several components on your serial board.

To install your PCI serial board, complete the following steps:

1. Turn off your computer. Keep the computer plugged in so that it remains grounded while you install the PCI serial board.
2. Remove the top or side cover of the computer.
3. Find an unused PCI expansion slot in your computer.
4. Remove the corresponding expansion slot cover on the back panel of the computer.
5. Touch a metal part on your chassis to discharge any static electricity.
6. Insert the PCI serial board into the slot with the serial connectors toward the opening on the back panel. Make sure that you insert the board all the way into the slot. The board might seem to click firmly into place, even though it is only part of the way in. Figure 2-5 shows how to install the PCI serial board into an expansion slot.



1 PC 2 PCI Serial Board 3 PCI Slot

Figure 2-5. PCI Serial Board Installation

7. Screw the PCI serial board mounting bracket to the back panel mounting rail of the computer.
8. Replace the cover.
9. Turn on your computer and start Windows Me/9*x*.
10. Windows Me/9*x* should automatically detect your hardware and display one or more **New Hardware Found** dialog boxes. Your operating system (Windows Me/9*x*) may show the **Windows Default Driver** option. If so, make sure the **Windows Default Driver** is selected and click the **OK** button. If the **Windows Default Driver** option is not shown, the installation continues automatically.

    If no **New Hardware Found** dialog box appears, refer to the *Forcing Windows to Detect Your Hardware* section of Appendix D, *Troubleshooting and Common Questions*.

The serial hardware installation is complete.

Verify the Installation

Before you verify the installation, keep in mind that the serial ports built into your computer are typically named from COM1 to COM4. Windows Me/9*x* typically issues port names to the ports on NI-Serial hardware starting with COM5, COM6, and so on. If not enough resources are available to assign to all the NI serial ports, the port with the higher COM*x* name is not configured.

To verify the hardware and software installation, complete the following steps:

1. Select **Start»Settings»Control Panel** and double-click the **System** icon.
2. Click the **Device Manager** tab and then click the **View devices by type** button.
3. Double-click the **Ports (COM & LPT)** icon to display all of the ports.
4. Double-click the **Multi-function adapters** icon.

   The PCI serial boards are configured as devices belonging to the *multi-function adapters* class. The multi-function parent device is listed under the **Multi-function adapters** icon, and each child device is listed as a port under the **Ports (COM & LPT)** icon.

   Figure 2-6 shows the Device Manager tab for serial hardware that is installed properly.

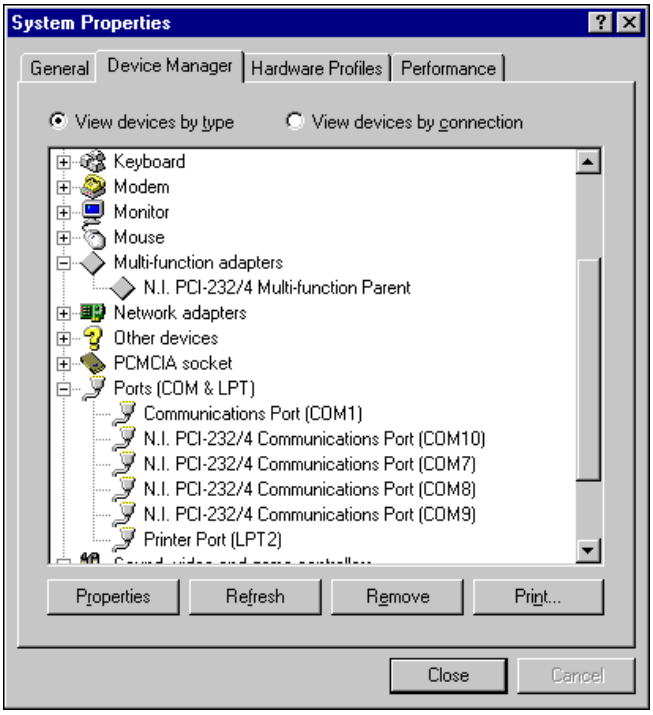


Figure 2-6. Device Manager Tab for PCI Serial Board Ports

5. Verify the hardware resources, as follows:
   a. In the **Device Manager** tab, under **Multi-function adapters**, double-click a serial board.
   b. Click the **Resources** tab. If the resources were assigned properly, the **Resources** tab shows which resources are assigned to your serial ports.
   c. Repeat steps 5a and 5b until you have verified the resources for each board.
6. (Optional) To determine which physical port is associated with COM*x*, complete the following steps:
   a. In the **Device Manager** tab, under **Ports (COM & LPT)**, double-click the serial port (COM*x*).
   b. Click the **Port Settings** tab to display the serial number of the serial hardware and the physical port number starting at 1. For all serial hardware, PORT1 refers to the top port, PORT2 refers to the next port down, and so on.

7. To run the diagnostic utility, select **Start»Programs»National Instruments Serial»Diagnostics**.

   The diagnostic utility verifies that your serial driver is installed properly, that the configuration of your hardware does not conflict with anything else in your system, and that the serial driver can communicate with your hardware correctly.

   If the test is successful, your serial hardware and software are installed properly. If the test fails, refer to Appendix D, *Troubleshooting and Common Questions*, to troubleshoot the problem.

8. After you verify the hardware and software installation, connect the cables. Refer to Appendix A, *Connector Descriptions*, for information about cable connections.

Configure Communication Port Settings

The serial configuration utility is fully integrated into the Windows Me/9*x* Device Manager. You can use it to view or change the configuration of your serial ports.

To configure a serial port, complete the following steps:

1. Select **Start»Settings»Control Panel** and double-click the **System** icon.
2. Click the **Device Manager** tab and then click the **View devices by type** button.
3. Double-click the **Ports (COM & LPT)** icon.

Note If you want your serial ports to use the names COM1, COM2, COM3, or COM4, refer to the *Common Questions* section of Appendix D, *Troubleshooting and Common Questions*.

4. Double-click on the port you want to configure and refer to the following instructions:
   - To view the hardware resources assigned to the serial port, click the **Resources** tab.
   - To view or change the port settings, click the **Port Settings** tab. For more information about the settings, refer to the next section, *Port Settings Tab*.
   - To change the RS-485 transceiver mode, or to enable or disable the FIFOs on the serial hardware, in the **Port Settings** tab, click the **Advanced** button. For more information about the settings, refer to the next section, *Port Settings Tab*.

Note Transceiver modes apply to RS-485 interfaces only. For more information about transceiver modes, refer to Chapter 7, *Using Your Serial Hardware*.

5. To save your changes, click the **OK** button. To exit without saving the changes, click the **Cancel** button.

Port Settings Tab

In the **Port Settings** tab, you can change any of the settings by clicking the arrow button to the right of a field. When you click the arrow button, a list of valid values for that field appears and you can select the desired setting from the list. Figure 2-7 shows the **Port Settings** tab.

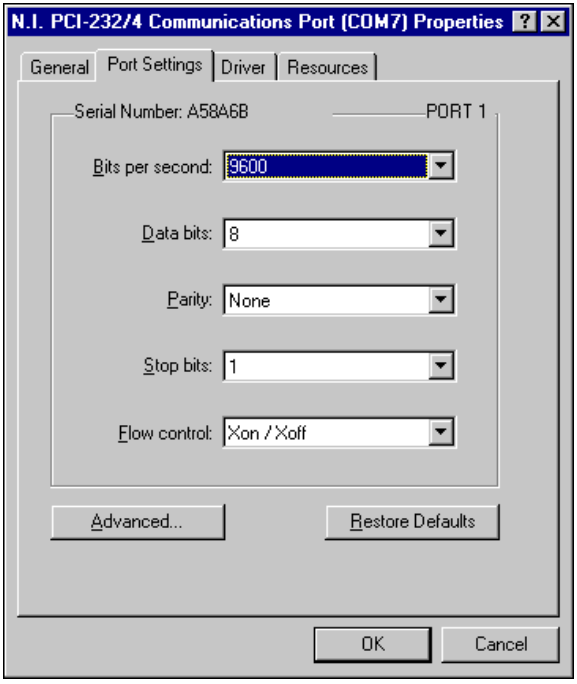


Figure 2-7. Port Settings Tab

Advanced Port Settings

To view or change the advanced port settings, click the **Advanced** button. Figure 2-8 shows the **Advanced Port Settings** dialog box.

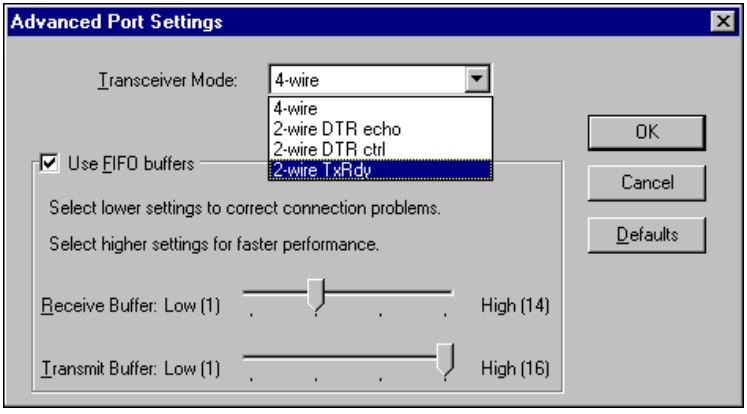


Figure 2-8. Advanced Port Settings Dialog Box

The following sections describe the advanced port setting options.

Transceiver Mode

This field shows the transceiver mode in use, and applies only to PCI-485 boards. For more information about transceiver modes, refer to Chapter 7, *Using Your Serial Hardware*.

Use FIFO Buffers

FIFO buffers are present on the 16550-compatible UARTs—one for the transmitter and one for the receiver. The **Receive Buffer** control sets the number of characters received in the FIFO before the PC is interrupted to read the data. The **Transmit Buffer** control sets the maximum number of bytes written to the FIFO in a block when the PC is interrupted to write the data. When you configure FIFO settings, consider the following points:

- You can select larger FIFO buffer sizes to reduce the number of interrupts your PC receives and therefore minimize system overhead.
- If transfer rates are high, you can lower the **Receive Buffer** value to prevent overrun errors due to interrupt latency.
- If your data transfer sizes are small and your **Receive Buffer** value is above your data sizes, your system is less efficient. Therefore, set the **Receive Buffer** value below your data sizes.

Restore Defaults

To reset the fields to their default values at any time, click the **Restore Defaults** button.

Windows NT

Install the Software

Before you install your serial hardware, complete the following steps to install the NI-Serial software for Windows NT:

1. Log in as `Administrator` or as a user who has `Administrator` privileges.
2. Select **Start»Settings»Control Panel**.
3. Double-click the **Add/Remove Programs** icon. The **Add/Remove Programs** dialog box appears.
4. Click the **Install** button.
5. When prompted, insert the *NI-Serial Software for Windows 2000/NT/XP/Me/9x* CD, and click the **Next** button.
6. When prompted, click the **Finish** button to install the program files.
7. The setup wizard begins. The setup wizard guides you through the necessary steps to install the NI-Serial software. To exit the setup wizard at any time, click the **Cancel** button.

Note The setup wizard backs up the Windows NT serial driver `serial.sys` to `serial.bak` and then overwrites `serial.sys`. You can find `serial.sys` in the `WinNT\system32\drivers` directory.

8. If your hardware is already installed, restart Windows NT and continue to the *Verify the Installation* section.

The software installation is complete.

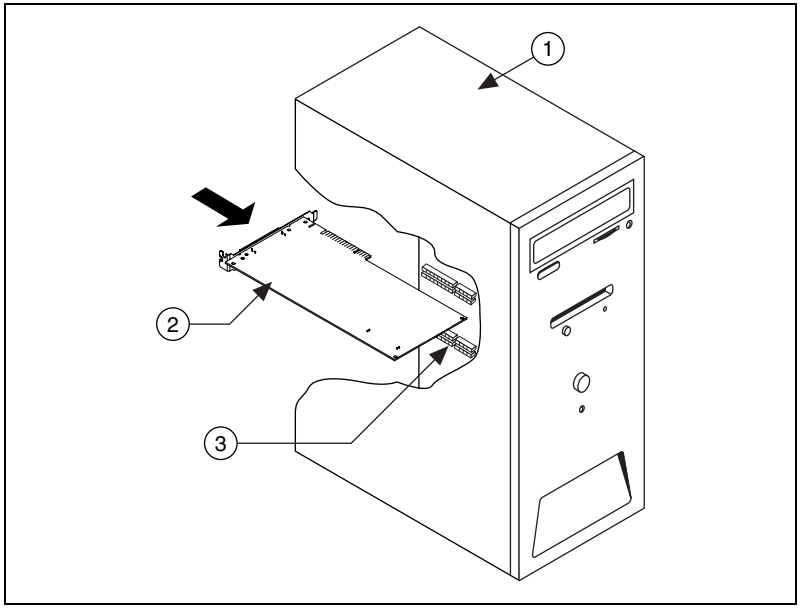
Install the Hardware

Note If you are installing a PCI-485, you might need to adjust the value of the bias resistors, depending on your application. Bias resistors are not available on the eight-port PCI-485. For more information, refer to Chapter 7, *Using Your Serial Hardware*.

Caution Before you remove your board from the package, touch the antistatic plastic package to a metal part of your system chassis to discharge electrostatic energy, which can damage several components on your serial board.

To install your PCI serial board, complete the following steps:

1. Turn off your computer. Keep the computer plugged in so that it remains grounded while you install the PCI serial board.
2. Remove the top or side cover of the computer.
3. Find an unused PCI expansion slot in your computer.
4. Remove the corresponding expansion slot cover on the back panel of the computer.
5. Touch a metal part on your chassis to discharge any static electricity.
6. Insert the PCI serial board into the slot with the serial connectors toward the opening on the back panel. Make sure that you insert the board all the way into the slot. The board might seem to click firmly into place, even though it is only part of the way in. Figure 2-9 shows how to install the PCI serial board into an expansion slot.



1 PC	2 PCI Serial Board	3 PCI Slot

Figure 2-9. Installing the PCI Serial Board

7. Screw the PCI serial board mounting bracket to the back panel mounting rail of the computer.
8. Replace the cover.
9. Turn on your computer and start Windows NT.

The hardware installation is complete.

Verify the Installation

To verify the hardware and software installation, complete the following steps:

1. Determine which physical port is associated with COM*x*, as follows:
   a. Select **Start»Settings»Control Panel** and double-click the **niports** icon.

      A list of installed National Instruments ports with their logical COM*x* names appears. If your interface is not on this list, refer to Appendix D, *Troubleshooting and Common Questions*.

   b. Select the COM port that you want to verify and click the **Settings** button.

      The **General Port Settings** dialog box displays the serial number of the serial hardware and the physical port number starting at 1. For all serial hardware, PORT1 refers to the top port, PORT2 refers to the next port down, and so on.
2. To run the diagnostic utility, select **Start»Programs»National Instruments Serial»diagnostics**.

   The diagnostic utility verifies that your serial driver is installed properly, that the configuration of your hardware does not conflict with anything else in your system, and that the serial driver can communicate with your hardware correctly.

   If the test is successful, your serial hardware and software are installed properly. If the test fails, refer to Appendix D, *Troubleshooting and Common Questions*, to troubleshoot the problem.
3. After you verify the hardware and software installation, connect the cables. Refer to Appendix A, *Connector Descriptions*, for information about cable connections.

Configure Communication Port Settings

The serial configuration utility is fully integrated into the Windows NT Control Panel. You can use it to view or change the configuration of your serial ports.

To configure a serial port, complete the following steps:

1. Select **Start»Settings»Control Panel** and double-click the **niports** icon. A list of installed National Instruments ports appears, as shown in Figure 2-10.

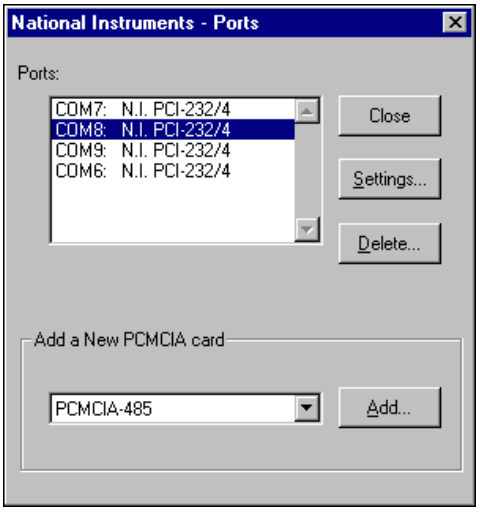


Figure 2-10. niports Configuration Utility

2. Select the port that you want to configure and refer to the following instructions:
   - To remove hardware information about the port from Windows NT, click the **Delete** button. You should do this before you remove your hardware.
   - To view or change the port settings, click the **Settings** button. For more information about the settings, refer to the next section, *General Port Settings*.
   - In the **General Port Settings** dialog box, click the **Resources** button to view the resources for the port.

General Port Settings

The following sections describe the options you can set in the **General Port Settings** dialog box, shown in Figure 2-11.

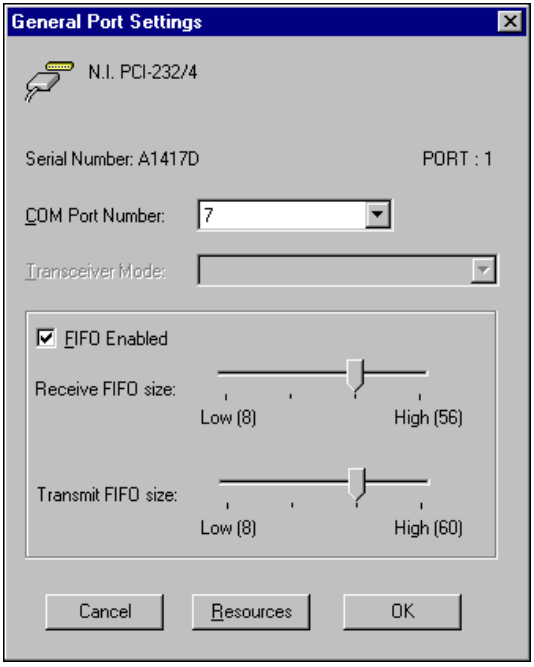


Figure 2-11. General Port Settings Dialog Box

COM Port Number

You can use the **COM Port Number** control to change the logical COM*x* name of the selected port.

Transceiver Mode

The **Transceiver Mode** list box shows the transceiver mode in use, and applies only to PCI-485 boards. For more information about transceiver modes, refer to Chapter 7, *Using Your Serial Hardware*.

FIFO Enabled

You can use the **FIFO Enabled** checkbox to enable or disable the FIFO buffers on the selected port. FIFO buffers are present on the 16550-compatible UARTs—one for the transmitter and one for the receiver.

FIFO Buffer Size

The **Receive FIFO size** control sets the number of characters received in the FIFO before the PC is interrupted to read the data. The **Transmit FIFO size** control sets the maximum number of bytes written to the FIFO in a block when the PC is interrupted to write the data. When you configure FIFO settings, consider the following points:

- You can select larger FIFO buffer sizes to reduce the number of interrupts your PC receives and therefore minimize system overhead.
- If transfer rates are high, you can lower the **Receive FIFO size** value to prevent overrun errors due to interrupt latency.
- If your data transfer sizes are small and your **Receive FIFO size** value is above your data sizes, your system is less efficient. Therefore, set the **Receive FIFO size** value below your data sizes.

Resources

To view the resource configuration dialog box for the selected port, click the **Resources** button. You cannot change these resources; they are automatically assigned.

3

PXI Serial Hardware Installation, Verification, and Configuration

This chapter describes how to install the NI-Serial software and PXI serial hardware and how to verify the installation. It also describes how to view or change the communication port settings.

To begin your installation, see the section of this chapter containing instructions for your operating system (*Windows 2000/XP*, *Windows Me/9x*, or *Windows NT*).

Windows 2000/XP

Install the Software

Before you install your serial hardware, complete the following steps to install the NI-Serial software for Windows 2000/XP:

1. Select **Start»Settings»Control Panel**.
2. Double-click the **Add/Remove Programs** icon. The **Add/Remove Programs** dialog box appears.
3. Click the **Add New Programs** button and then the **CD or Floppy** button.
4. When prompted, insert the *NI-Serial Software for Windows 2000/NT/XP/Me/9x* CD and click the **Next** button.
5. When prompted, click the **Finish** button to install the program files from the CD.
6. The setup wizard begins. The setup wizard guides you through the necessary steps to install the NI-Serial software. To exit the setup wizard at any time, click the **Cancel** button.
7. If you need to install your hardware, or if this is your first time to install the NI-Serial software for Windows 2000/XP, skip to the next section, *Install the Hardware*. Otherwise, continue to step 8.

8. If your hardware is already installed, restart Windows 2000/XP.
9. Windows 2000/XP should automatically detect your hardware and display the Found New Hardware Wizard. Complete the wizard by clicking **Next** in each window and then **Finish**. When you complete the wizard, continue to the *Verify the Installation* section.

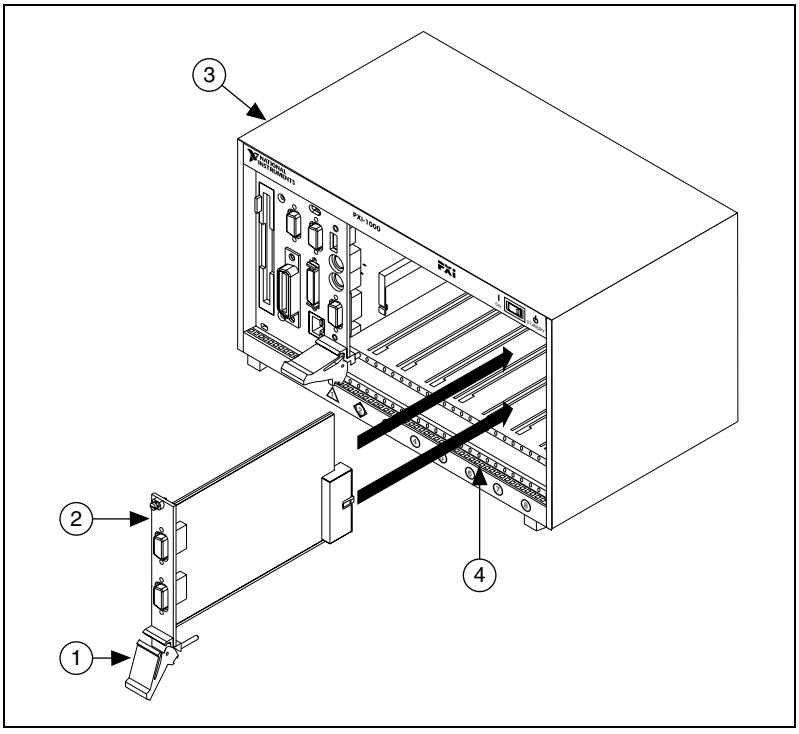
   If the Found New Hardware Wizard does not appear, refer to the *Forcing Windows to Detect Your Hardware* section of Appendix D, *Troubleshooting and Common Questions*.

Install the Hardware

Caution Before you remove your board from the package, touch the antistatic plastic package to a metal part of your system chassis to discharge electrostatic energy, which can damage several components on your serial board.

To install your PXI serial board, complete the following steps:

1. Turn off your PXI or CompactPCI chassis. Keep the chassis plugged in so that it remains grounded while you install the PXI serial board.
2. Find an unused PXI or CompactPCI 5 V peripheral slot.
3. Remove the corresponding filler panel.
4. Touch a metal part on your chassis to discharge any static electricity.
5. Insert the PXI serial board into the 5 V slot. Use the injector/ejector handle to fully inject the device into place. Figure 3-1 shows how to install the PXI serial board into a PXI or CompactPCI chassis.



1	Injector/Ejector Handle (In Down Position)	3	PXI Chassis
2	PXI Serial Board	4	Injector/Ejector Rail

Figure 3-1. Installing the PXI Serial Board

6. Screw the PXI serial board front panel to the front panel mounting rail of the PXI or CompactPCI chassis.
7. Turn on your PXI or CompactPCI chassis and start Windows 2000/XP.
8. Windows 2000/XP should automatically detect your hardware and display the Found New Hardware Wizard. Complete the wizard by clicking **Next** in each window and then **Finish**.

   If the Found New Hardware Wizard does not appear, refer to the *Forcing Windows to Detect Your Hardware* section of Appendix D, *Troubleshooting and Common Questions*.

The serial hardware installation is complete.

Verify the Installation

To verify the hardware and software installation, complete the following steps:

1. Select **Start»Settings»Control Panel** and double-click the **System** icon.
2. Click the **Hardware** tab and then click the **Device Manager** button.
3. Double-click the **Ports (COM & LPT)** icon to display all of the ports.
4. Double-click the **Multi-function adapters** icon.

   The PXI serial boards are configured as devices belonging to the *multi-function adapters* class. The multi-function parent device is listed under the **Multi-function adapters** icon, and each child device is listed as a port under the **Ports (COM & LPT)** icon.

   Figure 3-2 shows the Device Manager tab for serial hardware that is installed properly.

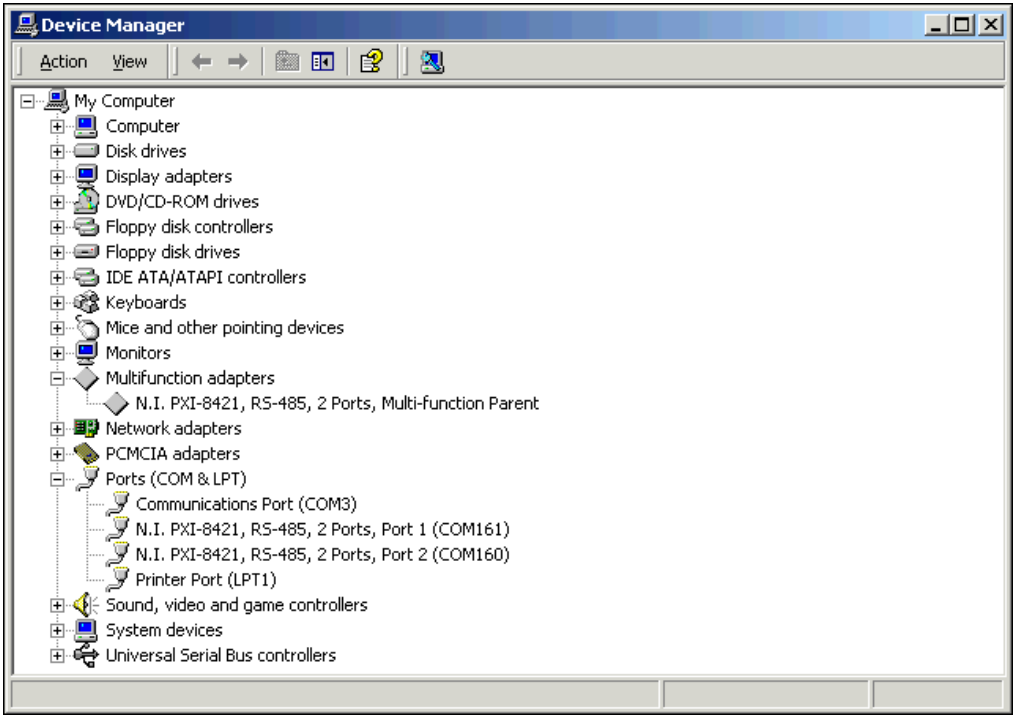


Figure 3-2. Device Manager for PXI Serial Board Ports

5. Verify the hardware resources, as follows:
   a. In the Device Manager under **Multi-function adapters**, double-click a serial board.
   b. Click the **Resources** tab. If the resources were assigned properly, the **Resources** tab shows which resources are assigned to your serial ports.
   c. Repeat steps 5a and 5b until you have verified the resources for each board.
6. (Optional) To determine which physical port is associated with COM*x*, note the Port 1, Port 2, etc. entries next to the COM numbers. For all serial hardware, PORT1 refers to the top port, PORT2 refers to the next port down, and so on.
7. To run the diagnostic utility, select **Start»Programs»National Instruments»NI-Serial»Diagnostics**.

   The diagnostic utility verifies that your serial driver is installed properly, that the configuration of your hardware does not conflict with anything else in your system, and that the serial driver can communicate with your hardware correctly.

   If the test is successful, your serial hardware and software are installed properly. If the test fails, refer to Appendix D, *Troubleshooting and Common Questions*, to troubleshoot the problem.
8. After you verify the hardware and software installation, connect the cables. Refer to Appendix A, *Connector Descriptions*, for information about cable connections.

Configure Communication Port Settings

The serial configuration utility is fully integrated into the Windows 2000/XP Device Manager. You can use it to view or change the configuration of your serial ports.

To configure a serial port, complete the following steps:

1. Select **Start»Settings»Control Panel** and double-click the **System** icon.
2. Click the **Hardware** tab and then click the **Device Manager** button.
3. Double-click the **Ports (COM & LPT)** icon.

4. Double-click the port you want to configure and refer to the following instructions:
   - To view the hardware resources assigned to the serial port, click the **Resources** tab.
   - To view or change the port settings, click the **Port Settings** tab. For more information about the settings, refer to the next section, *Port Settings Tab*.
   - To change the RS-485 transceiver mode, or to enable or disable the FIFOs on the serial hardware, in the **Port Settings** tab, click the **Advanced** button. For more information about the settings, refer to the next section, *Port Settings Tab*.

Note Transceiver modes apply to RS-485 interfaces only. For more information about transceiver modes, refer to Chapter 7, *Using Your Serial Hardware*.

5. To save your changes, click the **OK** button. To exit without saving the changes, click the **Cancel** button.

Port Settings Tab

In the **Port Settings** tab, you can change any of the settings by clicking the arrow button to the right of a field. When you click the arrow button, a list of valid values for that field appears and you can select the desired setting from the list. Figure 3-3 shows the **Port Settings** tab.

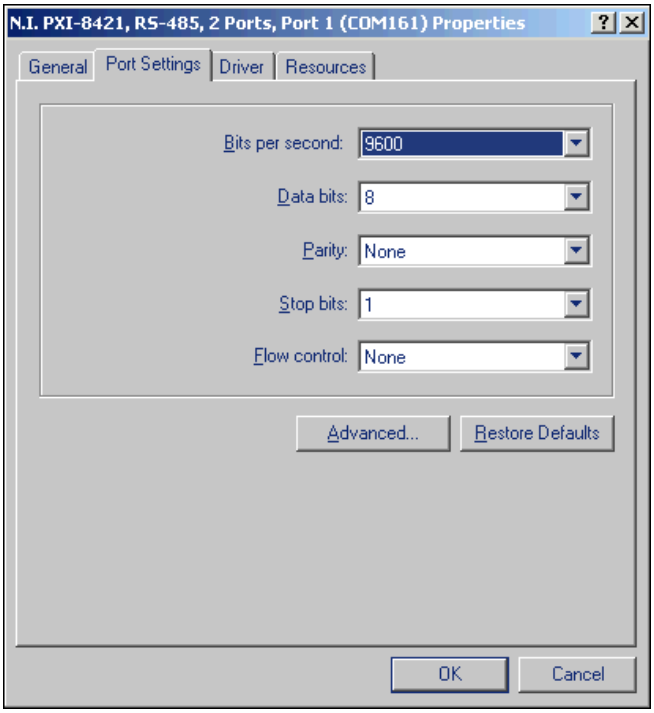


Figure 3-3. Port Settings Tab

Advanced Settings

To view or change the advanced settings, click the **Advanced** button. Figure 3-4 shows the **Advanced Settings** dialog box.

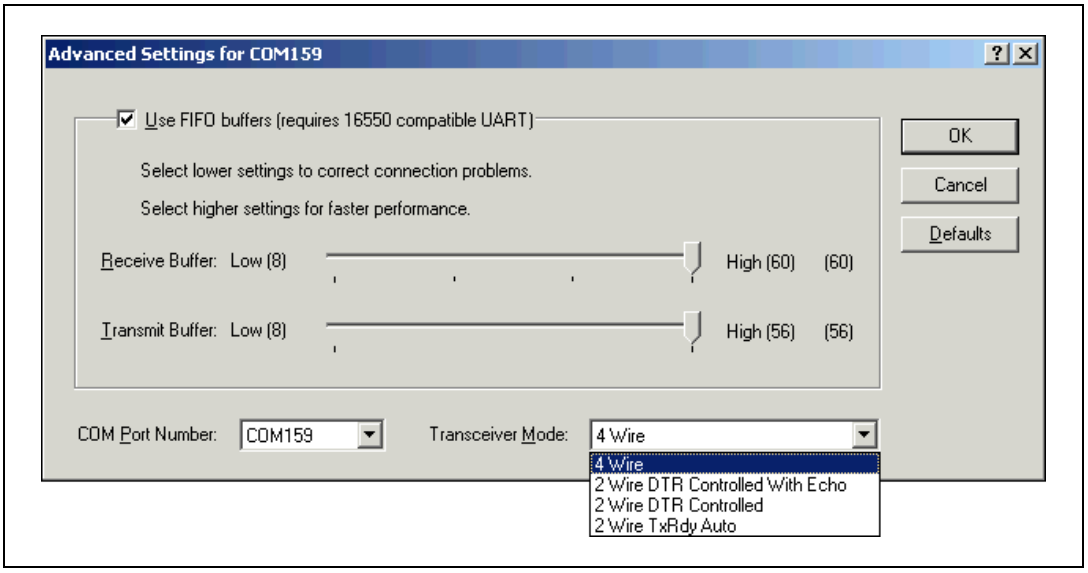


Figure 3-4. Advanced Settings Dialog Box

The following sections describe the advanced settings options.

Transceiver Mode

This field shows the transceiver mode in use, and applies only to RS-485 boards. For more information about transceiver modes, refer to Chapter 7, *Using Your Serial Hardware*.

Use FIFO Buffers

FIFO buffers are present on the 16550-compatible UARTs—one for the transmitter and one for the receiver. The **Receive Buffer** control sets the number of characters received in the FIFO before the PC is interrupted to read the data. The **Transmit Buffer** control sets the maximum number of bytes written to the FIFO in a block when the PC is interrupted to write the data. When you configure FIFO settings, consider the following points:

- You can select larger FIFO buffer sizes to reduce the number of interrupts your PC receives and therefore minimize system overhead.
- If transfer rates are high, you can lower the **Receive Buffer** value to prevent overrun errors due to interrupt latency.
- If your data transfer sizes are small and your **Receive Buffer** value is above your data sizes, your system is less efficient. Therefore, set the **Receive Buffer** value below your data sizes.

Restore Defaults

To reset the fields to their default values at any time, click the **Restore Defaults** button.

Windows Me/9*x*

Install the Software

Before you install your serial hardware, complete the following steps to install the NI-Serial software for Windows Me/9*x*:

1. Select **Start»Settings»Control Panel**.
2. Double-click the **Add/Remove Programs** icon. The **Add/Remove Programs** dialog box appears.
3. Click the **Install** button.
4. When prompted, insert the *NI-Serial Software for Windows 2000/NT/XP/Me/9x* CD and click the **Next** button. The setup wizard begins. The setup wizard guides you through the necessary steps to install the NI-Serial software. To go back and change values where appropriate, click the **Back** button. To exit the setup wizard at any time, click the **Cancel** button.
5. If you need to install your hardware, or if this is your first time to install the NI-Serial software for Windows Me/9*x*, skip to the next section, *Install the Hardware*. Otherwise, continue to step 6.
6. If your hardware is already installed, restart Windows Me/9*x*.

   Windows Me/9*x* should automatically detect your hardware and display one or more **New Hardware Found** dialog boxes. Make sure that **Windows Default Driver** is selected and click the **OK** button. When you finish, continue to the *Verify the Installation* section.

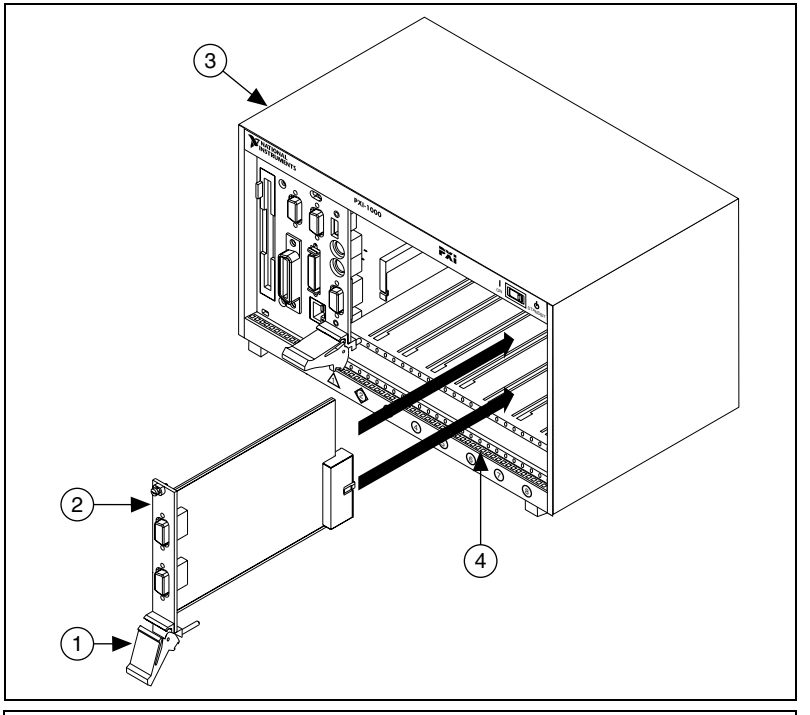
   If no **New Hardware Found** dialog box appears, refer to the *Forcing Windows to Detect Your Hardware* section of Appendix D, *Troubleshooting and Common Questions*.

Install the Hardware

Caution Before you remove your board from the package, touch the antistatic plastic package to a metal part of your system chassis to discharge electrostatic energy, which can damage several components on your serial board.

To install your PXI serial board, complete the following steps:

1. Turn off your PXI or CompactPCI chassis. Keep the chassis plugged in so that it remains grounded while you install the PXI serial board.
2. Find an unused PXI or CompactPCI 5 V peripheral slot.
3. Remove the corresponding filler panel.
4. Touch a metal part on your chassis to discharge any static electricity.
5. Insert the PXI serial board into the 5 V slot. Use the injector/ejector handle to fully inject the device into place. Figure 3-5 shows how to install the PXI serial board into a PXI or CompactPCI chassis.



1	Injector/Ejector Handle (In Down Position)	3	PXI Chassis
2	PXI Serial Board	4	Injector/Ejector Rail

Figure 3-5. Installing the PXI Serial Board

6. Screw the PXI serial board front panel to the front panel mounting rail of the PXI or CompactPCI chassis.
7. Turn on your PXI or CompactPCI chassis and start Windows Me/9*x*.

8. Windows Me/9*x* should automatically detect your hardware and display one or more **New Hardware Found** dialog boxes. Make sure that **Windows Default Driver** is selected and click the **OK** button.

   If no **New Hardware Found** dialog box appears, refer to the *Forcing Windows to Detect Your Hardware* section of Appendix D, *Troubleshooting and Common Questions*.

The serial hardware installation is complete.

Verify the Installation

Before you verify the installation, keep in mind that the serial ports built into your computer are typically named from COM1 to COM4. Windows Me/9*x* typically issues port names to the ports on NI-Serial hardware starting with COM5, COM6, and so on. If not enough resources are available to assign to all the NI serial ports, the port with the higher COM*x* name is not configured.

To verify the hardware and software installation, complete the following steps:

1. Select **Start»Settings»Control Panel** and double-click the **System** icon.
2. Click the **Device Manager** tab and then click the **View devices by type** button.
3. Double-click the **Ports (COM & LPT)** icon to display all of the ports.
4. Double-click the **Multi-function adapters** icon.

   The PXI serial boards are configured as devices belonging to the *multi-function adapters* class. The multi-function parent device is listed under the **Multi-function adapters** icon, and each child device is listed as a port under the **Ports (COM & LPT)** icon.

   Figure 3-6 shows the Device Manager tab for serial hardware that is installed properly.

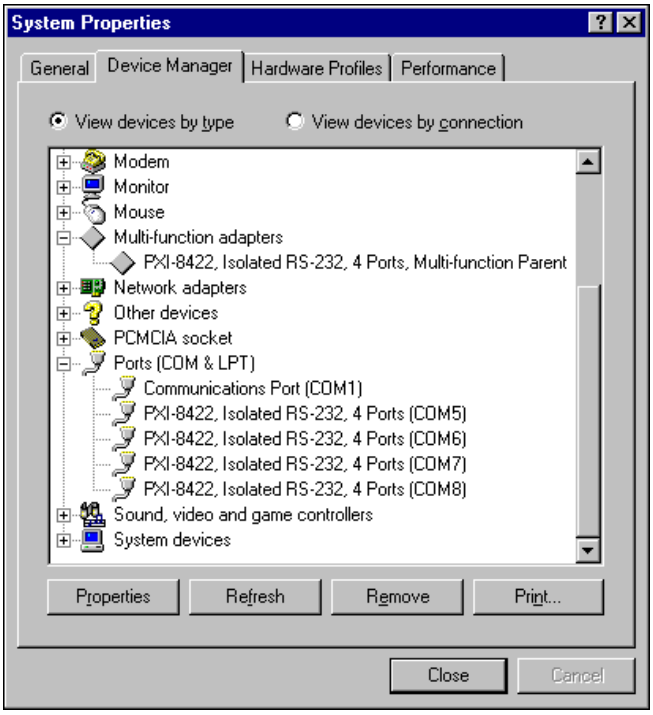


Figure 3-6. Device Manager for PXI Serial Board Ports

5. Verify the hardware resources, as follows:
   a. In the **Device Manager** tab, under **Multi-function adapters**, double-click a serial board.
   b. Click the **Resources** tab. If the resources were assigned properly, the **Resources** tab shows which resources are assigned to your serial ports.
   c. Repeat steps 5a and 5b until you have verified the resources for each board.
6. (Optional) To determine which physical port is associated with COM*x*, complete the following steps:
   a. In the **Device Manager** tab, under **Ports (COM & LPT)**, double-click the serial port (COM*x*).
   b. Click the **Port Settings** tab to display the serial number of the serial hardware and the physical port number starting at 1. For all serial hardware, PORT1 refers to the top port, PORT2 refers to the next port down, and so on.

7. To run the diagnostic utility, select **Start»Programs»National Instruments Serial»diagnostics**.

   The diagnostic utility verifies that your serial driver is installed properly, that the configuration of your hardware does not conflict with anything else in your system, and that the serial driver can communicate with your hardware correctly.

   If the test is successful, your serial hardware and software are installed properly. If the test fails, refer to Appendix D, *Troubleshooting and Common Questions*, to troubleshoot the problem.

8. After you verify the hardware and software installation, connect the cables. Refer to Appendix A, *Connector Descriptions*, for information about cable connections.

Configure Communication Port Settings

The serial configuration utility is fully integrated into the Windows Me/9*x* Device Manager. You can use it to view or change the configuration of your serial ports.

To configure a serial port, complete the following steps:

1. Select **Start»Settings»Control Panel** and double-click the **System** icon.
2. Click the **Device Manager** tab and then click the **View devices by type** button.
3. Double-click the **Ports (COM & LPT)** icon.

Note If you want your serial ports to use the names COM1, COM2, COM3, or COM4, refer to the *Common Questions* section of Appendix D, *Troubleshooting and Common Questions*.

4. Double-click the port you want to configure and refer to the following instructions:
   - To view the hardware resources assigned to the serial port, click the **Resources** tab.
   - To view or change the port settings, click the **Port Settings** tab. For more information about the settings, refer to the next section, *Port Settings Tab*.
   - To change the RS-485 transceiver mode, or to enable or disable the FIFOs on the serial hardware, in the **Port Settings** tab, click the **Advanced** button. For more information about the settings, refer to the next section, *Port Settings Tab*.

Note Transceiver modes apply to RS-485 interfaces only. For more information about transceiver modes, refer to Chapter 7, *Using Your Serial Hardware*.

5. To save your changes, click the **OK** button. To exit without saving the changes, click the **Cancel** button.

Port Settings Tab

In the **Port Settings** tab, you can change any of the settings by clicking the arrow button to the right of a field. When you click the arrow button, a list of valid values for that field appears and you can select the desired setting from the list. Figure 3-7 shows the **Port Settings** tab.

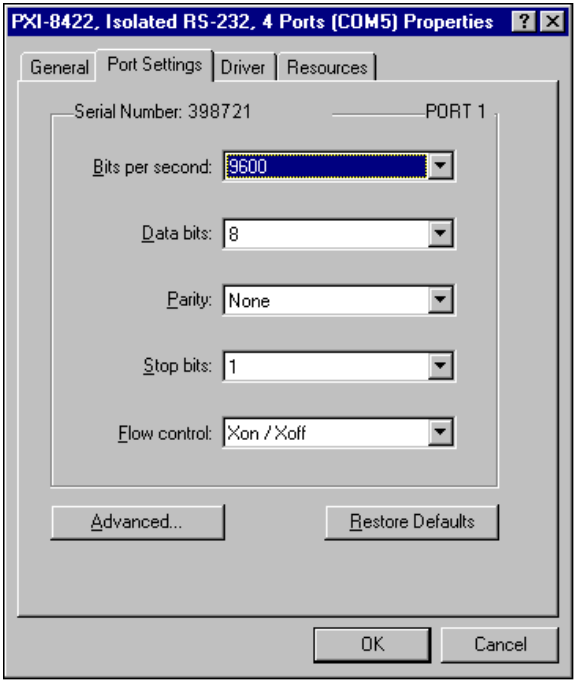


Figure 3-7. Port Settings Tab

Advanced Port Settings

To view or change the advanced port settings, click the **Advanced** button. Figure 3-8 shows the **Advanced Port Settings** dialog box.

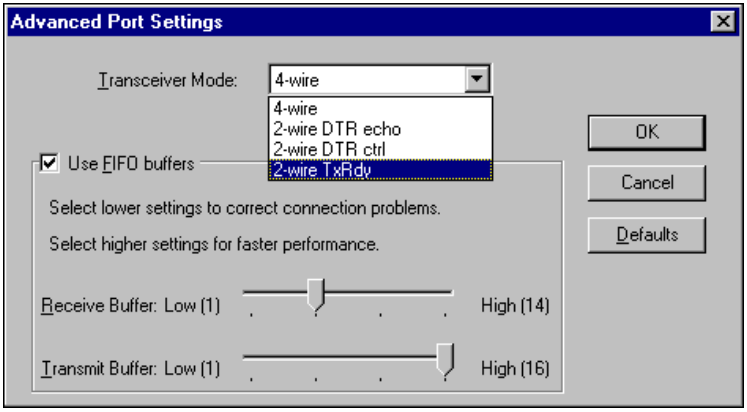


Figure 3-8. Advanced Settings Dialog Box

The following sections describe the advanced settings options.

Transceiver Mode

This field shows the transceiver mode in use, and applies only to RS-485 boards. For more information about transceiver modes, refer to Chapter 7, *Using Your Serial Hardware*.

Use FIFO Buffers

FIFO buffers are present on the 16550-compatible UARTs—one for the transmitter and one for the receiver. The **Receive Buffer** control sets the number of characters received in the FIFO before the PC is interrupted to read the data. The **Transmit Buffer** control sets the maximum number of bytes written to the FIFO in a block when the PC is interrupted to write the data. When you configure FIFO settings, consider the following points:

- You can select larger FIFO buffer sizes to reduce the number of interrupts your PC receives and therefore minimize system overhead.
- If transfer rates are high, you can lower the **Receive Buffer** value to prevent overrun errors due to interrupt latency.
- If your data transfer sizes are small and your **Receive Buffer** value is above your data sizes, your system is less efficient. Therefore, set the **Receive Buffer** value below your data sizes.

Restore Defaults

To reset the fields to their default values at any time, click the **Restore Defaults** button.

Windows NT

Install the Software

Before you install your serial hardware, complete the following steps to install the NI-Serial software for Windows NT:

1. Log in as `Administrator` or as a user who has `Administrator` privileges.
2. Select **Start»Settings»Control Panel**.
3. Double-click the **Add/Remove Programs** icon. The **Add/Remove Programs** dialog box appears.
4. Click the **Install** button.
5. When prompted, insert the *NI-Serial Software for Windows 2000/NT/XP/Me/9x*, and click the **Next** button. The setup wizard begins. The setup wizard guides you through the necessary steps to install the NI-Serial software. To go back and change values where appropriate, click the **Back** button. To exit the setup wizard at any time, click the **Cancel** button.

Note The setup wizard backs up the Windows NT serial driver `serial.sys` to `serial.bak` and then overwrites `serial.sys`. You can find `serial.sys` in the `WinNT\system32\drivers` directory.

6. If your hardware is already installed, restart Windows NT and continue to the *Verify the Installation* section.

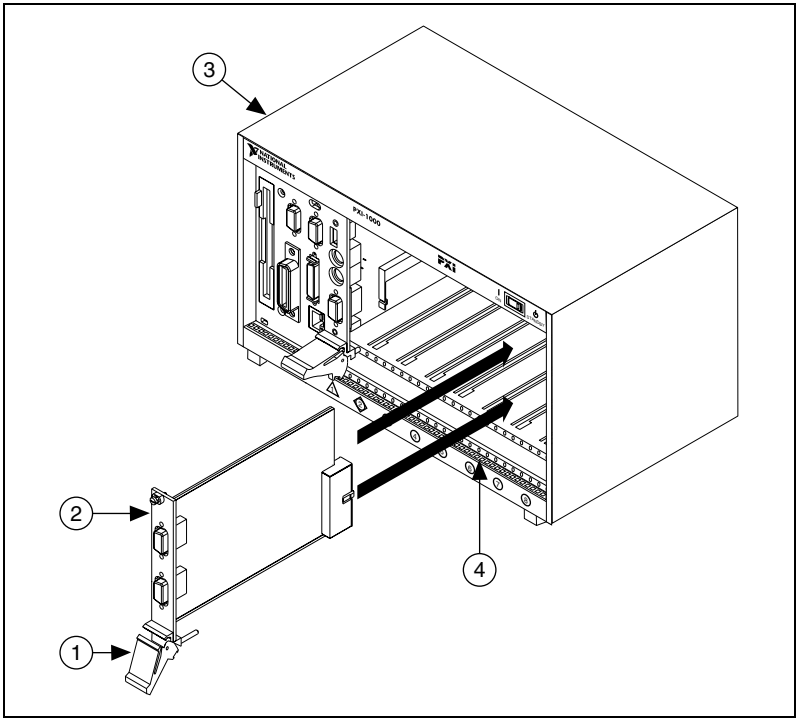
The software installation is complete.

Install the Hardware

Caution Before you remove your board from the package, touch the antistatic plastic package to a metal part of your system chassis to discharge electrostatic energy, which can damage several components on your serial board.

To install your PXI serial board, complete the following steps:

1. Turn off your PXI or CompactPCI chassis. Keep the PXI or CompactPCI chassis plugged in so that it remains grounded while you install the PXI serial board.
2. Find an unused PXI or CompactPCI 5 V peripheral slot.
3. Remove the corresponding filler panel.
4. Touch a metal part on your chassis to discharge any static electricity.
5. Insert the PXI serial board into the 5 V slot. Use the injector/ejector handle to fully inject the device into place. Figure 3-9 shows how to install the PXI serial board into a PXI or CompactPCI chassis.



1	Injector/Ejector Handle (In Down Position)	3	PXI Chassis
2	PXI Serial Board	4	Injector/Ejector Rail

Figure 3-9. Installing the PXI Serial Board

6. Screw the PXI serial board front panel to the front panel mounting rail of the PXI or CompactPCI chassis.
7. Turn on your PXI or CompactPCI chassis and start Windows NT.

The serial hardware installation is complete.

Verify the Installation

To verify the hardware and software installation, complete the following steps:

1. Determine which physical port is associated with COM*x*, as follows:
   a. Select **Start»Settings»Control Panel** and double-click the **niports** icon.

      A list of installed National Instruments ports with their logical COM*x* names appears. If your interface is not on this list, refer to Appendix D, *Troubleshooting and Common Questions*.

   b. Select the COM port that you want to verify and click the **Settings** button.

      The **General Port Settings** dialog box displays the serial number of the serial hardware and the physical port number starting at 1. For all serial hardware, PORT1 refers to the top port, PORT2 refers to the next port down, and so on.
2. To run the diagnostic utility, select **Start»Programs»National Instruments Serial»diagnostics**.

   The diagnostic utility verifies that your serial driver is installed properly, that the configuration of your hardware does not conflict with anything else in your system, and that the serial driver can communicate with your hardware correctly.

   If the test is successful, your serial hardware and software are installed properly. If the test fails, refer to Appendix D, *Troubleshooting and Common Questions*, to troubleshoot the problem.
3. After you verify the hardware and software installation, connect the cables. Refer to Appendix A, *Connector Descriptions*, for information about cable connections.

Configure Communication Port Settings

The serial configuration utility is fully integrated into the Windows NT Control Panel. You can use it to view or change the configuration of your serial ports.

To configure a serial port, complete the following steps:

1. Select **Start»Settings»Control Panel** and double-click the **niports** icon. A list of installed National Instruments ports appears, as shown in Figure 3-10.

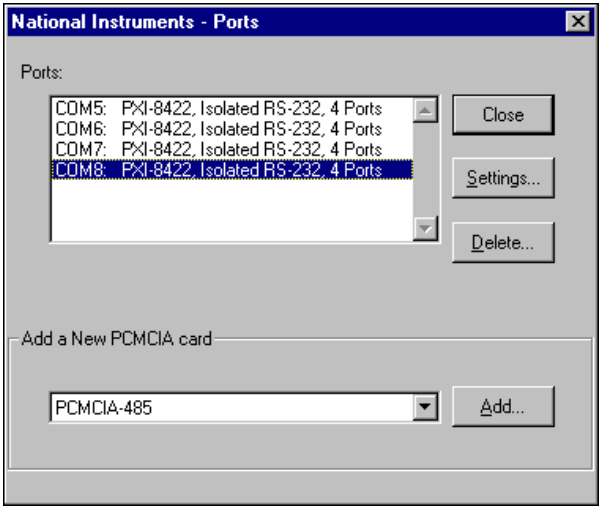


Figure 3-10. niports Configuration Utility

2. Select the port that you want to configure and refer to the following instructions:
   - To remove hardware information about the port from Windows NT, click the **Delete** button. You should do this before you remove your hardware.
   - To view or change the port settings, click the **Settings** button. For more information about the settings, refer to the next section, *General Port Settings*.
   - In the **General Port Settings** dialog box, click the **Resources** button to view the resources for the port.

General Port Settings

The following sections describe the options you can set in the **General Port Settings** dialog box, shown in Figure 3-11.

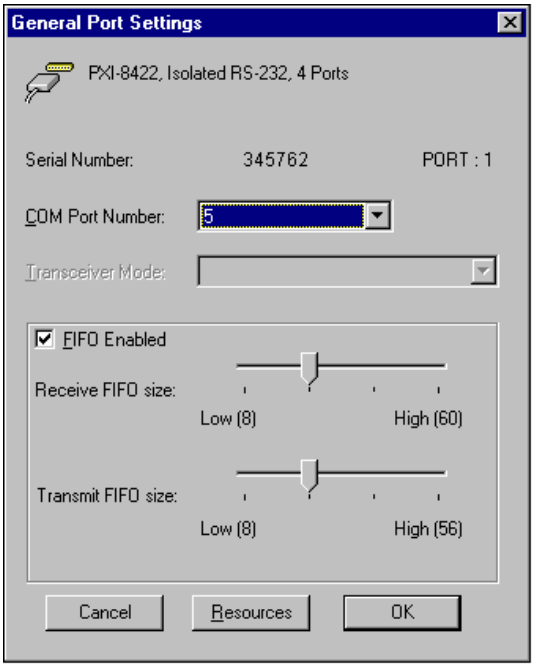


Figure 3-11. General Port Settings Dialog Box

COM Port Number

You can use the **COM Port Number** control to change the logical COM*x* name of the selected port.

Transceiver Mode

The **Transceiver Mode** list box shows the transceiver mode in use, and applies only to RS-485 boards. For more information about transceiver modes, refer to Chapter 7, *Using Your Serial Hardware*.

FIFO Enabled

You can use the **FIFO Enabled** checkbox to enable or disable the FIFO buffers on the selected port. FIFO buffers are present on the 16550-compatible UARTs—one for the transmitter and one for the receiver.

FIFO Buffer Size

The **Receive FIFO size** control sets the number of characters received in the FIFO before the PC is interrupted to read the data. The **Transmit FIFO size** control sets the maximum number of bytes written to the FIFO in a block when the PC is interrupted to write the data. When you configure FIFO settings, consider the following points:

- You can select larger FIFO buffer sizes to reduce the number of interrupts your PC receives and therefore minimize system overhead.
- If transfer rates are high, you can lower the **Receive FIFO size** value to prevent overrun errors due to interrupt latency.
- If your data transfer sizes are small and your **Receive FIFO size** value is above your data sizes, your system is less efficient. Therefore, set the **Receive FIFO size** value below your data sizes.

Resources

To view the resource configuration dialog box for the selected port, click the **Resources** button. You cannot change these resources; they are automatically assigned.

4

USB Serial Hardware Installation, Verification, and Configuration

This chapter describes how to install the NI-Serial software and USB serial hardware and how to verify the installation. It also describes how to configure the communication port settings.

Install the Software

Before you install your serial hardware, complete the following steps to install the NI-Serial (USB) software for Windows 2000/XP:

1. Log in as `Administrator` or a user with `Administrator` privileges.
2. Select **Start»Settings»Control Panel**.
3. Double-click the **Add/Remove Programs** icon. The **Add/Remove Programs** dialog box appears.
4. Click the **Add New Programs** button and then the **CD or Floppy** button.
5. When prompted, insert the *NI-Serial (USB) Software for Windows 2000/XP* CD and click the **Next** button.
6. When prompted, click the **Finish** button to install the program files from the CD.
7. The setup wizard begins. The setup wizard guides you through the necessary steps to install the NI-Serial software. To exit the setup wizard at any time, click the **Cancel** button.

Install the Hardware

Note If you are installing a USB-485/2 or USB-485/4, you might need to adjust the value of the bias resistors, depending on your application. For more information, refer to Chapter 7, *Using Your Serial Hardware*.

To install your USB serial hardware, complete the following steps:

1. Install the software.
2. If you are installing a USB-485/4, connect the external power supply.
3. Connect the USB connector from the USB hardware to an available USB port on your computer or USB hub.
4. If your computer is not already on, turn it on and start Windows 2000/XP.
5. Windows 2000/XP should automatically detect your hardware and display the Found New Hardware Wizard. If necessary, complete the wizard by clicking **Next** in each window and then **Finish**.

   If the Found New Hardware Wizard does not appear, refer to the *Forcing Windows to Detect Your Hardware* section of Appendix D, *Troubleshooting and Common Questions*.

The serial hardware installation is complete. Continue to the next section, *Verify the Installation*.

Verify the Installation

To verify the hardware and software installation, complete the following steps:

1. Select **Start»Settings»Control Panel** and double-click the **System** icon. Click the **Hardware** tab and then click the **Device Manager** button or select the **Device Manager** tab.
2. Double-click the **Ports (COM & LPT)** icon to display all ports. Verify that all installed ports are visible.

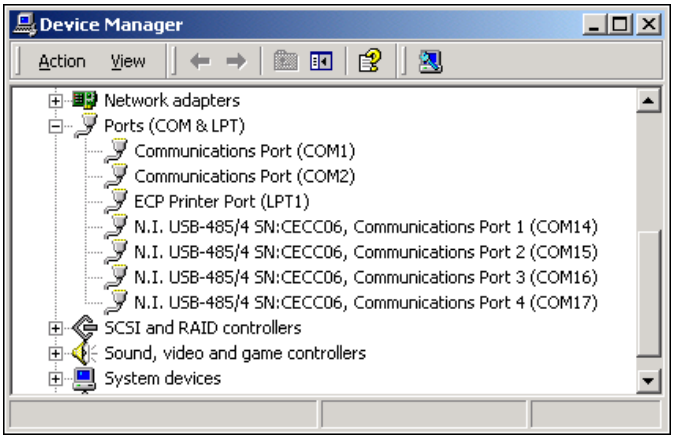


Figure 4-1. Device Manager for USB Serial Board Ports

3. (Optional) To determine which physical port is associated with COM*x*, note the Port 1, Port 2, etc. entries next to the COM numbers.
4. To run the diagnostic utility, select **Start»Programs»National Instruments»NI-Serial»USB»Diagnostics**.

   The diagnostic utility verifies that your software is installed properly and that the serial driver can communicate with your hardware correctly.

   If the test is successful, your serial hardware and software are installed properly. If the test fails, refer to Appendix D, *Troubleshooting and Common Questions*, to troubleshoot the problem.
5. After you verify the hardware and software installation, connect the serial cables to your devices. Refer to Appendix A, *Connector Descriptions*, for information about cable connections.

Configure Communication Port Settings

The serial configuration utility is fully integrated into the Windows 2000/XP Device Manager. You can use it to view or change the configuration of your serial ports.

To configure a serial port, complete the following steps:

1. Select **Start»Settings»Control Panel** and double-click the **System** icon.
2. Click the **Hardware** tab and then click the **Device Manager** button.
3. Double-click the **Ports (COM & LPT)** icon.

4. Double-click the port you want to configure and refer to the following instructions:
   - To view or change the port settings, click the **Port Settings** tab. For more information about the settings, refer to the next section, *Port Settings Tab*.
   - To change the COM port number, the RS-485 transceiver mode, or RS-232 transceiver mode, or enable/disable the RS-485 bias resistors, in the **Port Settings** tab, click the **Advanced** button. For more information about the settings, refer to the next section, *Port Settings Tab*.
5. To save your changes, click the **OK** button. To exit without saving the changes, click the **Cancel** button.

Note RS-232 transceiver modes apply to USB-232 two- or four-port hardware only, and RS-485 transceiver modes and RS-485 bias resistor control applies to USB-485 hardware only.

Port Settings Tab

In the **Port Settings** tab, you can change any of the settings by clicking the arrow button to the right of a field. When you click the arrow button, a list of valid values for that field appears and you can select the desired setting from the list. Figure 4-2 shows the **Port Settings** tab.

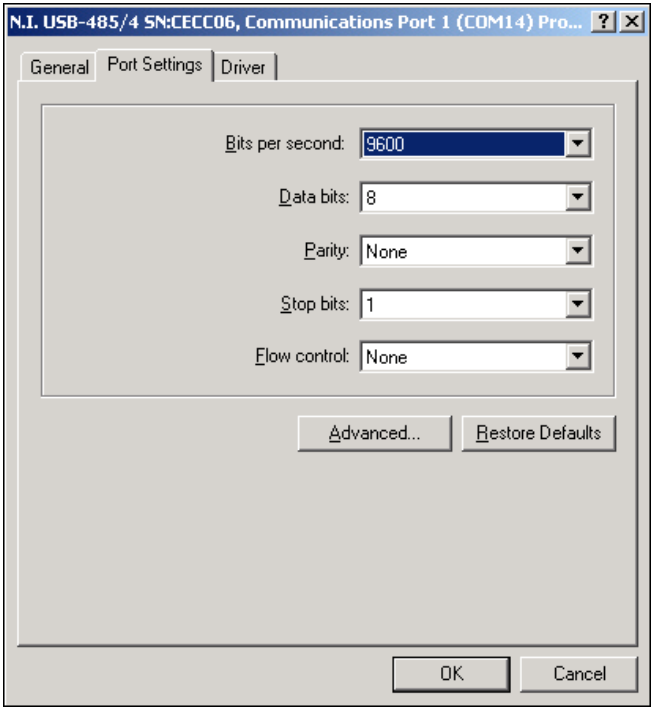


Figure 4-2. Port Settings Tab

Advanced Settings

To view or change the advanced settings, click the **Advanced** button. Figure 4-3 shows the **Advanced Settings** dialog box.

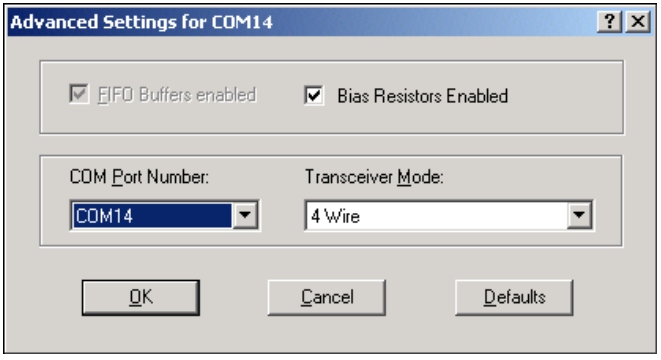


Figure 4-3. Advanced Settings Dialog Box

The following sections describe the advanced settings options.

Transceiver Mode

This field shows the transceiver mode in use. For more information about transceiver modes, refer to Chapter 7, *Using Your Serial Hardware*.

Bias Resistors Enabled

To enable the programmatically controlled bias resistors, check this box. This checkbox applies only to USB-485 hardware. For more information about bias resistors, refer to Chapter 7, *Using Your Serial Hardware*.

FIFO Buffers Enabled

The FIFO buffers for USB serial hardware are always enabled and cannot be adjusted.

COM Port Number

Use this field to select the COM port number for your device.

Restore Defaults

To reset the fields to their default values at any time, click the **Defaults** button.

5

PCMCIA Serial Hardware Installation, Verification, and Configuration

This chapter describes how to install the NI-Serial software and PCMCIA serial hardware and how to verify the installation. It also describes how to view or change the communication port settings.

To begin your installation, see the section of this chapter containing instructions for your operating system (*Windows 2000/XP*, *Windows Me/9x*, or *Windows NT*).

Windows 2000/XP

Install the Software

Before you install your serial hardware, complete the following steps to install the NI-Serial software for Windows 2000/XP:

1. Select **Start»Settings»Control Panel**.
2. Double-click the **Add/Remove Programs** icon. The **Add/Remove Programs** dialog box appears.
3. Click the **Add New Programs** button and then the **CD or Floppy** button.
4. When prompted, insert the *NI-Serial Software for Windows 2000/NT/XP/Me/9x* CD and click the **Next** button.
5. When prompted, click the **Finish** button to install the program files from the CD.
6. The setup wizard begins. The setup wizard guides you through the necessary steps to install the NI-Serial software. To exit the setup wizard at any time, click the **Cancel** button.
7. If you need to install your hardware, or if this is your first time to install the NI-Serial software for Windows 2000/XP, skip to the next section, *Install the Hardware*. Otherwise, continue to step 8.

8. Windows 2000/XP should automatically detect your hardware and display the Found New Hardware Wizard. Complete the wizard by clicking **Next** in each window and then **Finish**. When you complete the wizard, continue to the *Verify the Installation* section.

   If the Found New Hardware Wizard does not appear, refer to the *Forcing Windows to Detect Your Hardware* section of Appendix D, *Troubleshooting and Common Questions*.

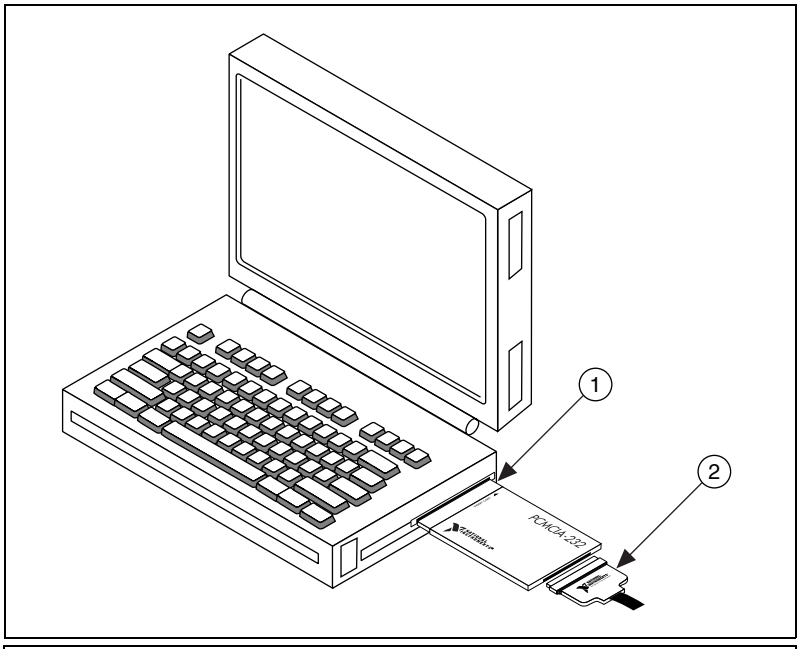
Install the Hardware

To install the PCMCIA-232 or PCMCIA-485 in your computer, first start Windows 2000/XP. If the card is not already inserted, insert it into a free PC Card (PCMCIA) socket the same way you insert a disk into a floppy drive. The card has no jumpers or switches to set, and you do not need to shut down the system before you insert it.

Windows 2000/XP should automatically detect your hardware and display the Found New Hardware Wizard. Complete the wizard by clicking **Next** in each window and then **Finish**.

If the Found New Hardware Wizard does not appear, refer to the *Forcing Windows to Detect Your Hardware* section of Appendix D, *Troubleshooting and Common Questions*.

Figure 5-1 shows how to insert a PCMCIA serial card and how to connect the cable.



1	PCMCIA Socket	2	PCMCIA Serial Cable

Figure 5-1. Inserting a PCMCIA Serial Card

The serial hardware installation is complete. Continue to the next section, *Verify the Installation*.

Verify the Installation

To verify the hardware and software installation, complete the following steps:

1. Select **Start»Settings»Control Panel** and double-click the **System** icon.
2. Click the **Hardware** tab and then click the **Device Manager** button.
3. Double-click the **Ports (COM & LPT)** icon to display all of the ports.
4. Double-click the **Multi-function adapters** icon.

   The PCMCIA serial cards are configured as devices belonging to the *multi-function adapters* class. The multi-function parent device is listed under the **Multi-function adapters** icon, and each child device is listed as a port under the **Ports (COM & LPT)** icon.

Figure 5-2 shows the Device Manager tab for serial hardware that is installed properly.

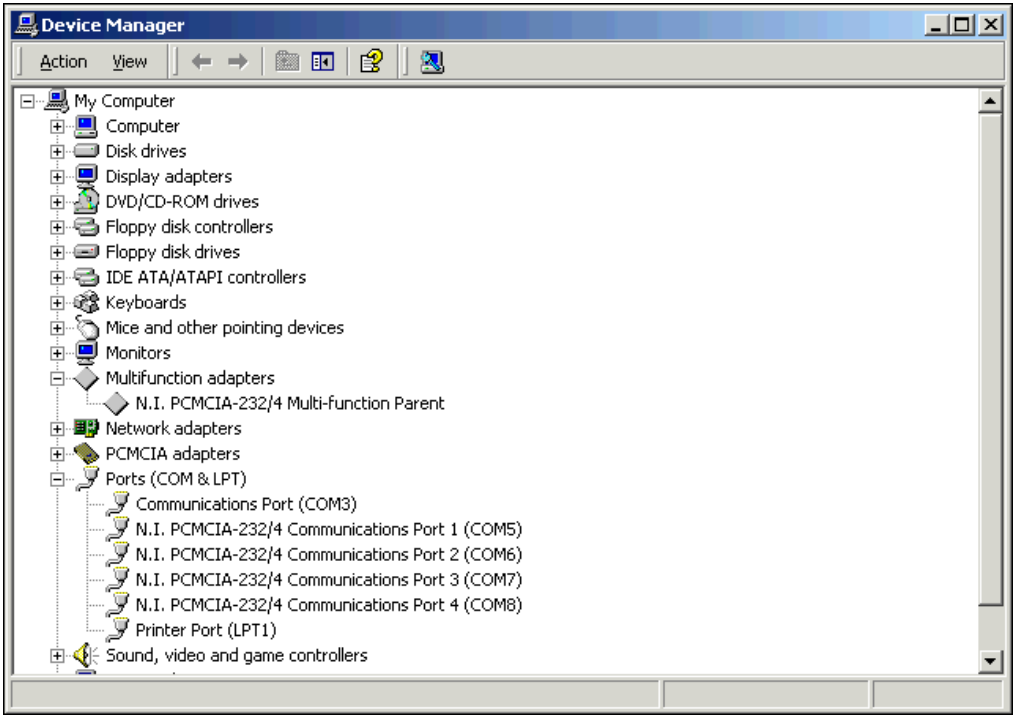


Figure 5-2. Device Manager for PCMCIA Serial Card Ports

5. Verify the hardware resources, as follows:
   a. In the Device Manager under **Multi-function adapters**, double-click a serial card.
   b. Click the **Resources** tab. If the resources were assigned properly, the **Resources** tab shows which resources are assigned to your serial ports.
   c. Repeat steps 5a and 5b until you have verified the resources for each board.
6. (Optional) To determine which physical port is associated with COM*x*, note the Port 1, Port 2, etc. entries next to the COM numbers. For all serial hardware, PORT1 refers to the top port, PORT2 refers to the next port down, and so on.
7. To run the diagnostic utility, select **Start»Programs»National Instruments»NI-Serial»Diagnostics**.

The diagnostic utility verifies that your serial driver is installed properly, that the configuration of your hardware does not conflict with anything else in your system, and that the serial driver can communicate with your hardware correctly.

If the test is successful, your serial hardware and software are installed properly. If the test fails, refer to Appendix D, *Troubleshooting and Common Questions*, to troubleshoot the problem.

8. After you verify the hardware and software installation, connect the cables. Refer to Appendix A, *Connector Descriptions*, for information about cable connections.

Configure Communication Port Settings

The serial configuration utility is fully integrated into the Windows 2000/XP Device Manager. You can use it to view or change the configuration of your serial ports.

To configure a serial port, complete the following steps:

1. Select **Start»Settings»Control Panel** and double-click the **System** icon.
2. Click the **Hardware** tab and then click the **Device Manager** button.
3. Double-click the **Ports (COM & LPT)** icon.
4. Double-click the port you want to configure and refer to the following instructions:
   - To view the hardware resources assigned to the serial port, click the **Resources** tab.
   - To view or change the port settings, click the **Port Settings** tab. For more information about the settings, refer to the next section, *Port Settings Tab*.
   - To change the RS-485 transceiver mode, or to enable or disable the FIFOs on the serial hardware, in the **Port Settings** tab, click the **Advanced** button. For more information about the settings, refer to the next section, *Port Settings Tab*.



Note Transceiver modes apply to RS-485 interfaces only. For more information about transceiver modes, refer to Chapter 7, *Using Your Serial Hardware*.

5. To save your changes, click the **OK** button. To exit without saving the changes, click the **Cancel** button.

Port Settings Tab

In the **Port Settings** tab, you can change any of the settings by clicking the arrow button to the right of a field. When you click the arrow button, a list of valid values for that field appears and you can select the desired setting from the list. Figure 5-3 shows the **Port Settings** tab.

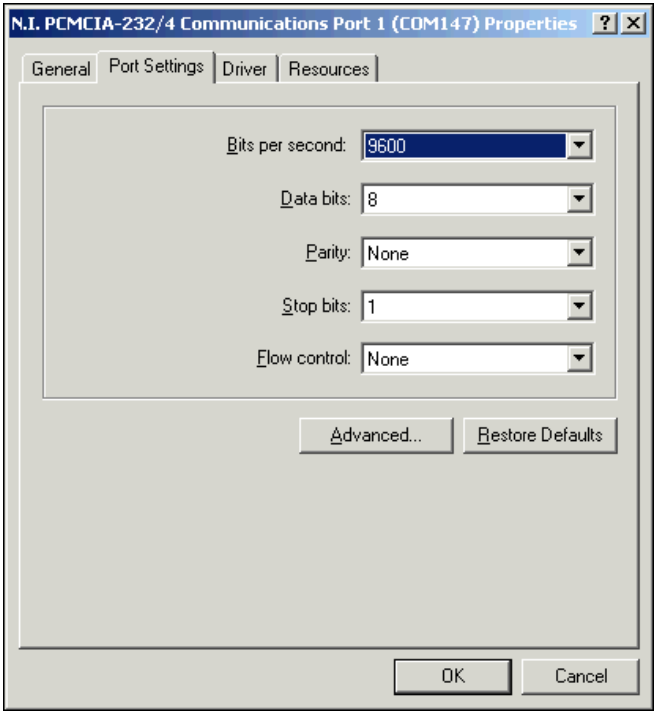


Figure 5-3. Port Settings Tab

Advanced Settings

To view or change the advanced settings, click the **Advanced** button. Figure 5-4 shows the **Advanced Settings** dialog box.

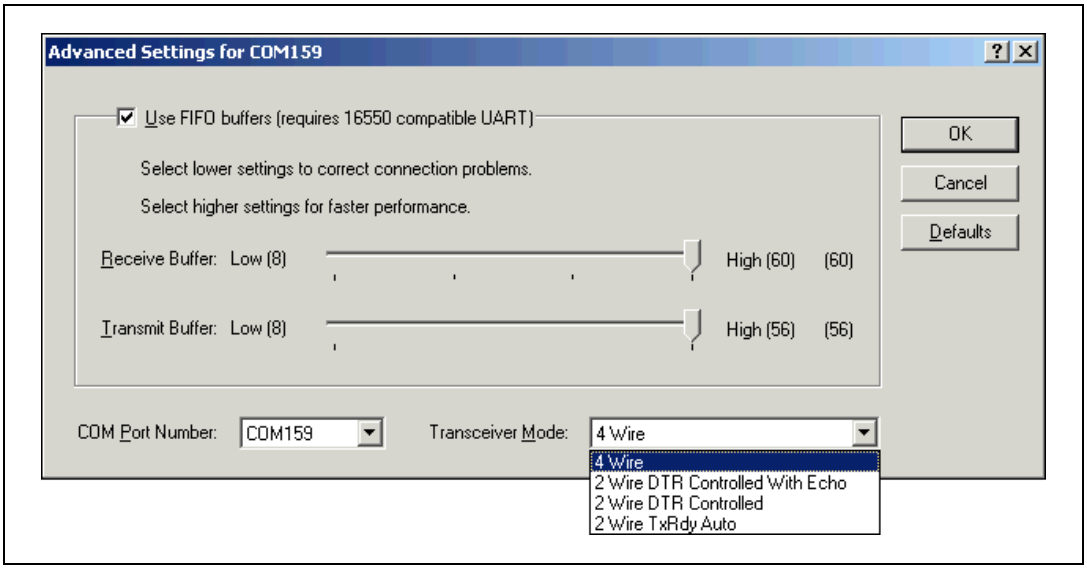


Figure 5-4. Advanced Settings Dialog Box

The following sections describe the advanced settings options.

Transceiver Mode

This field shows the transceiver mode in use, and applies only to PCMCIA-485 boards. For more information about transceiver modes, refer to Chapter 7, *Using Your Serial Hardware*.

Use FIFO Buffers

FIFO buffers are present on the 16550-compatible UARTs—one for the transmitter and one for the receiver. The **Receive Buffer** control sets the number of characters received in the FIFO before the PC is interrupted to read the data. The **Transmit Buffer** control sets the maximum number of bytes written to the FIFO in a block when the PC is interrupted to write the data. When you configure FIFO settings, consider the following points:

- You can select larger FIFO buffer sizes to reduce the number of interrupts your PC receives and therefore minimize system overhead.
- If transfer rates are high, you can lower the **Receive Buffer** value to prevent overrun errors due to interrupt latency.
- If your data transfer sizes are small and your **Receive Buffer** value is above your data sizes, your system is less efficient. Therefore, set the **Receive Buffer** value below your data sizes.

Restore Defaults

To reset the fields to their default values at any time, click the **Restore Defaults** button.

Windows Me/9*x*

Install the Software

Install the NI-Serial software for Windows Me/9*x* before you install the hardware:

1. Select **Start»Settings»Control Panel**.
2. Double-click the **Add/Remove Programs** icon in the Control Panel to launch the Add/Remove Programs applet. The **Add/Remove Programs** dialog box appears.
3. Click the **Install** button.
4. When prompted, insert the *NI-Serial Software for Windows 2000/NT/XP/Me/9x* CD and click the **Next** button to proceed. The software installation wizard begins.

   The setup wizard guides you through the necessary steps to install the NI-Serial software. You can go back and change values where appropriate by clicking the **Back** button. You can exit the setup where appropriate by clicking the **Cancel** button.
5. If you need to install your hardware, or if this is your first time to install the NI-Serial software for Windows Me/9*x*, skip to the next section, *Install the Hardware*. Otherwise, continue to Step 6.
6. If your hardware is already installed, restart Windows Me/9*x*.

   Windows Me/9*x* should automatically detect your hardware and display one or more **New Hardware Found** dialog boxes. When you finish, continue to the *Verify the Installation* section.

   If no **New Hardware Found** dialog box appears, refer to the section *Forcing Windows to Detect Your Hardware* of Appendix D, *Troubleshooting and Common Questions*.

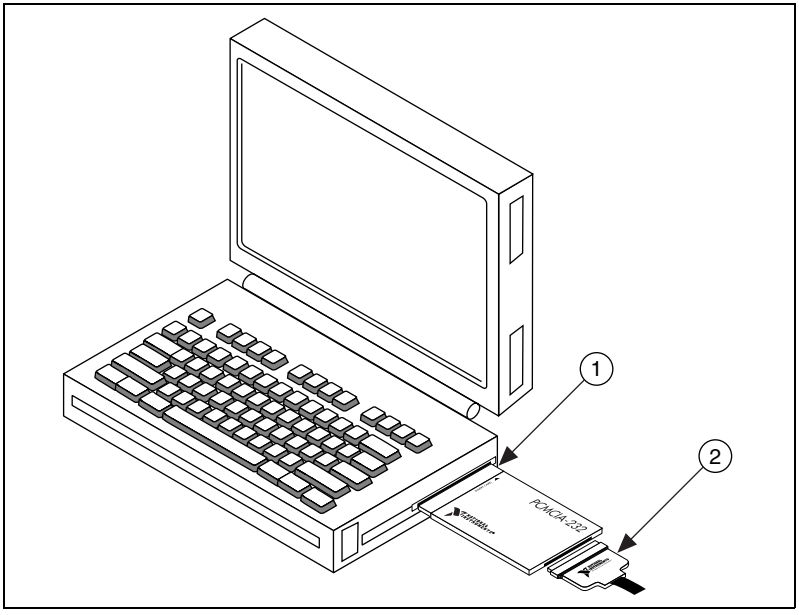
Install the Hardware

To install the PCMCIA-232 or PCMCIA-485 in your computer, first start Windows Me/9*x*. If the card is not already inserted, insert it into a free PC Card (PCMCIA) socket the same way you insert a disk into a floppy drive. The card has no jumpers or switches to set, and you do not need to shut down the system before you insert it.

Windows Me/9*x* automatically displays one or more **New Hardware Found** dialog boxes when it detects and configures a PC Card.

If the **New Hardware Found** dialog box does not appear, refer to the *Forcing Windows to Detect Your Hardware* section of Appendix D, *Troubleshooting and Common Questions*.

Figure 5-5 shows how to insert a PCMCIA serial card and how to connect the cable.



1 PCMCIA Socket 2 PCMCIA Serial Cable

Figure 5-5. Inserting a PCMCIA Serial Card

The serial hardware installation is complete.

Verify the Installation

When you begin to verify the installation, keep in mind that the serial ports built into the computer are typically named from COM1 to COM4. Windows Me/9*x* typically issues port names to the ports on NI-Serial hardware starting with COM5, COM6, and so on. If not enough resources are available to assign to all the NI serial ports, the port with the higher COM*x* name is left unconfigured.

Double-click the **System** icon in the Control Panel. In the **System Properties** window that appears, select the **Device Manager** tab, and click the **View devices by type** button at the top of the page. If necessary, double-click the **Ports (COM & LPT)** icon to view all of the ports.

The two-port and four-port PCMCIA cards are configured as devices belonging to the *multi-function adapters* class. The multi-function parent device is listed under the **Multi-function adapters** icon, and each child device is listed as a port under the **Ports (COM & LPT)** icon. If you have installed one of these interfaces, double-click the **Multi-function adapters** icon as well as the **Ports (COM & LPT)** icon.

If a circled exclamation point appears through the port icon, the serial port is not installed properly. A problem with the port could have occurred because Windows Me/9*x* could not acquire resources for the port or because an interrupt request resource conflict exists. If no circled exclamation point appears, the serial hardware is installed correctly. Figure 5-6 shows an example of NI-Serial hardware that is installed properly.

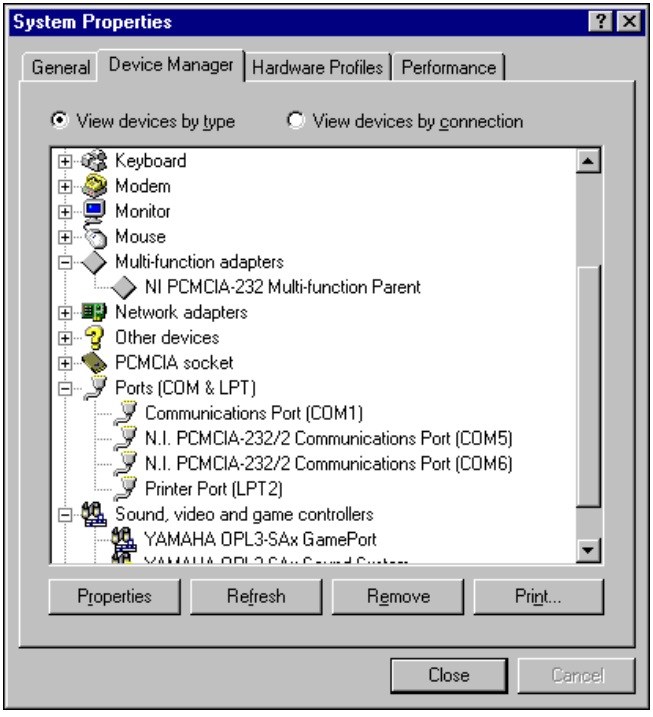


Figure 5-6. Device Manager Ports List for PCMCIA Serial Card Correctly Installed

Verify the Hardware Resources

For every port of the newly installed serial interface, double-click the name of the serial port in the Device Manager. Then, click the **Resources** tab. If the resources were assigned correctly, the **Resources** page shows which resources are assigned to your serial ports.

If Windows Me/9*x* did not assign any resources to the port, the **Resources** page shows only a **Set Configuration Manually** button. Click the **Set Configuration Manually** button and try to assign conflict-free resources to your serial hardware. For instructions, refer to the *Selecting Conflict-Free Resources* section of Appendix D, *Troubleshooting and Common Questions*. You might have to free an interrupt request level so that one can be assigned to your serial hardware. For instructions, refer to the *Freeing an Interrupt Request Level* section of Appendix D, *Troubleshooting and Common Questions*.

When you have finished verifying the hardware resources, proceed to the next section, *Determine Which Physical Port Is Associated with COMx*.

Determine Which Physical Port Is Associated with COM*x*

For every port of the newly installed serial interface, double-click the name of the serial port in the Device Manager. Then, click the **Port Settings** tab. The top of this page displays the serial number of the serial hardware, and the physical port number starting at 1.

When you have finished verifying the driver installation and physical port, proceed to the next section, *Run the Diagnostic Test*.

Run the Diagnostic Test

To verify and test the installation, run the diagnostic program that came with your NI-Serial software. The diagnostic program verifies that your serial driver is installed properly, that the configuration of your hardware does not conflict with anything else in your system, and that the serial driver can communicate with your hardware correctly.

To run the test, select the **diagnostics** item under **Start»Programs» National Instruments Serial**.

If the diagnostic test completes with no failures, your serial hardware and software are installed properly. If it fails, refer to Appendix D, *Troubleshooting and Common Questions*, for troubleshooting instructions.

After you verify the hardware and software installation, connect the cables. Refer to Appendix A, *Connector Descriptions*, for information about cable connections.

Configure Communication Port Settings

The serial configuration utility is fully integrated with the Windows Me/9*x* Device Manager. You can use it to examine or modify the configuration of the serial port.

Complete the following steps to configure the serial port. Repeat the configuration procedure for each serial port in your system.

1. Select **Start»Settings»Control Panel** and double-click the **System** icon. The **System Properties** window appears.
2. Select the **Device Manager** tab, and click the **View devices by type** button at the top of the page.
3. Double-click the **Ports (COM & LPT)** icon.
4. Double-click the name of the port you want to configure.

You can now view or change information about your serial port in the following ways:

- Click the **Resources** tab to view information about the hardware resources assigned to the serial port.
- Click the **Port Settings** tab to view information about the software configuration for the serial port. Refer to the next section, *Port Settings Tab*, for more information.
- On the **Port Settings** tab, click the **Advanced** button to change the RS-485 transceiver mode and to enable or disable the FIFOs on the serial hardware. Refer to the next section, *Port Settings Tab*, for more information.

Note If you use two-wire Auto mode, FIFOs must be enabled. Transceiver modes apply to RS-485 interfaces only. For more information about transceiver modes, refer to Chapter 7, *Using Your Serial Hardware*.

After you have selected the serial port parameters for the current port, click the **OK** button to save the changes or click the **Cancel** button to exit the dialog box without saving changes.

Port Settings Tab

On the **Port Settings** tab, you can change any of the settings by clicking the arrow button to the right of the setting. When you click the arrow button, a list of valid values for that setting appears. Select the desired setting from the list. Figure 5-7 shows the **Port Settings** tab.

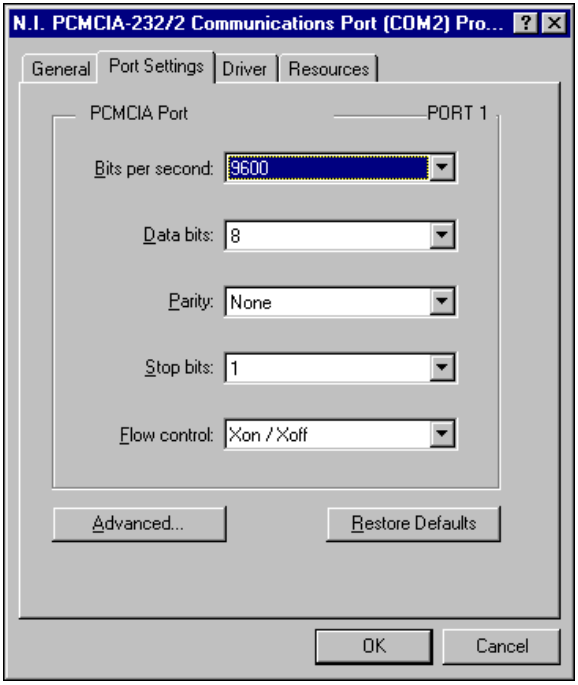


Figure 5-7. Port Settings Tab

Advanced Port Settings

You can view or change the advanced port settings by clicking the **Advanced** button on the **Port Settings** tab. Figure 5-8 shows the **Advanced Port Settings** dialog box.

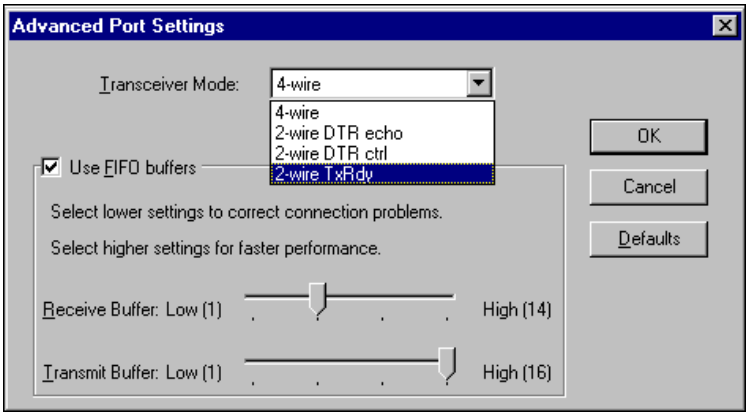


Figure 5-8. Advanced Port Settings Dialog Box

The following sections describe the advanced settings options.

Transceiver Mode

This field shows the transceiver mode in use, and applies only to PCMCIA-485 boards. For more information about transceiver modes, refer to Chapter 7, *Using Your Serial Hardware*.

Use FIFO Buffers

FIFO buffers are present on the 16550-compatible UARTs—one for the transmitter and one for the receiver. The **Receive Buffer** control sets the number of characters received in the FIFO before the PC is interrupted to read the data. The **Transmit Buffer** control sets the maximum number of bytes written to the FIFO in a block when the PC is interrupted to write the data. When you configure FIFO settings, consider the following points:

- You can select larger FIFO buffer sizes to reduce the number of interrupts your PC receives and therefore minimize system overhead.
- If transfer rates are high, you can lower the **Receive Buffer** value to prevent overrun errors due to interrupt latency.
- If your data transfer sizes are small and your **Receive Buffer** value is above your data sizes, your system is less efficient. Therefore, set the **Receive Buffer** value below your data sizes.

Note If you want your serial hardware ports to use the names COM1, COM2, COM3, or COM4, refer to the *Common Questions* section of Appendix D, *Troubleshooting and Common Questions*.

Restore Defaults

To reset the fields to their default values at any time, click the **Restore Defaults** button.

Windows NT

Install the NI-Serial Software

Install the NI-Serial software for Windows NT before you install the hardware.

1. Log on as `Administrator` or as a user who has `Administrator` privileges.
2. Select **Start»Settings»Control Panel**.
3. Double-click the **Add/Remove Programs** icon in the Control Panel to launch the Add/Remove Programs applet. The **Add/Remove Programs** dialog box appears.
4. Click the **Install** button.
5. When prompted, insert the *NI-Serial Software for Windows 2000/NT/XP/Me/9x* CD and click the **Next** button to proceed. The software installation wizard begins.

   The wizard guides you through the necessary steps to install the NI-Serial software. You can go back and change values where appropriate by clicking the **Back** button. You can exit the setup where appropriate by clicking the **Cancel** button.

Note This installation backs up the Microsoft Windows NT serial driver `serial.sys` to `serial.bak` and then overwrites `serial.sys`. You can find `serial.sys` in the Windows NT `\system32\drivers` directory.

The software installation is complete.

Select Resources for the PCMCIA Card

Complete the following steps to select resources for your PCMCIA card.

1. Select **Start»Settings»Control Panel**.
2. Double-click the **niports** icon.
3. Select the PCMCIA card you just installed from the **Add a New PCMCIA Card** list, and click the **Add** button. Follow any onscreen instructions.
4. In the **Resource Configuration** dialog box, select nonconflicting base I/O address and IRQ settings for your port/card, and click **OK**.

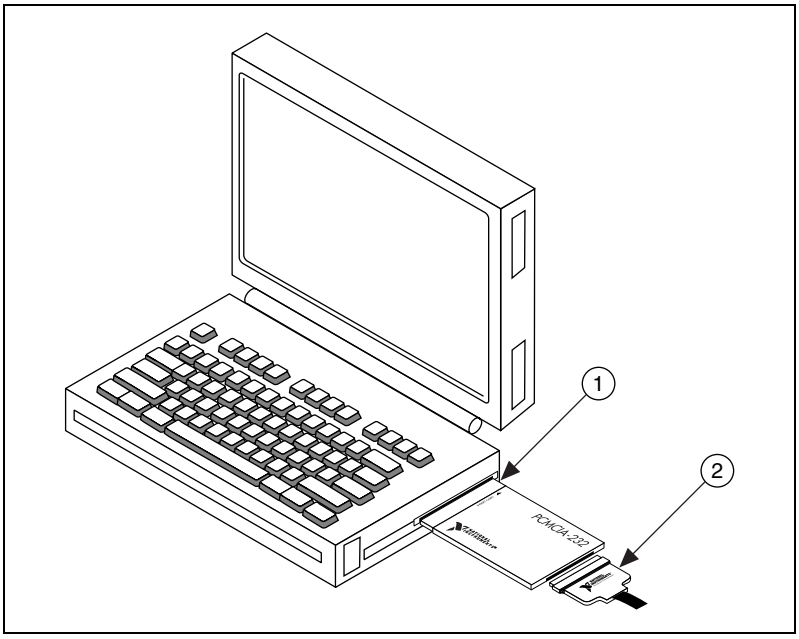
   For more information on selecting resources for your port/card, refer to the *Resource Settings* section.
5. Exit **niports**.

Install the PCMCIA Serial Hardware

Complete the following steps to install the PCMCIA-232 or PCMCIA-485 in your computer:

1. Shut down the computer.
2. Insert the card into a free PC Card (PCMCIA) socket the same way you insert a disk into a floppy drive. The card has no jumpers or switches to set.
3. Power on the computer and start Windows NT.

Figure 5-9 shows how to insert a PCMCIA serial card and how to connect the cable.



1	PCMCIA Socket	2	PCMCIA Serial Cable

Figure 5-9. Inserting a PCMCIA Serial Card

Verify the Installation

Determine Which Physical Port Is Associated with COM*x*

Select **Start»Settings»Control Panel**, and double-click **niports**. A list showing installed National Instruments ports with their logical COM*x* names appears. If your interface is not on the list, refer to Appendix D, *Troubleshooting and Common Questions*.

Select the COM port you want and click the **Settings** button to display the **General Port Settings** dialog box for that port. This dialog box displays the physical port number starting at 1.

When you have finished verifying the driver installation and physical port, proceed to the next section, *Run the Diagnostic Test*.

Run the Diagnostic Test

To verify and test the installation, run the diagnostic program that came with your NI-Serial software. The diagnostic program verifies that your serial driver is installed properly, that the configuration of your hardware does not conflict with anything else in your system, and that the serial driver can communicate with your hardware correctly.

To run the test, select the **diagnostics** item under **Start»Programs» National Instruments Serial**.

If the diagnostic test completes with no failures, your serial hardware and software are installed properly. If it fails, refer to Appendix D, *Troubleshooting and Common Questions*, for troubleshooting instructions.

After you verify the hardware and software installation, connect the cables. Refer to Appendix A, *Connector Descriptions*, for information about cable connections.

Configure Communication Port Settings

The serial configuration utility is fully integrated with the Windows NT Control Panel. You can use it to examine or modify the configuration of the serial port.

Complete the following steps to configure the serial port.

1. Select **Start»Settings»Control Panel** and double-click the **niports** icon. A list of National Instruments ports appears, as shown in Figure 5-10.

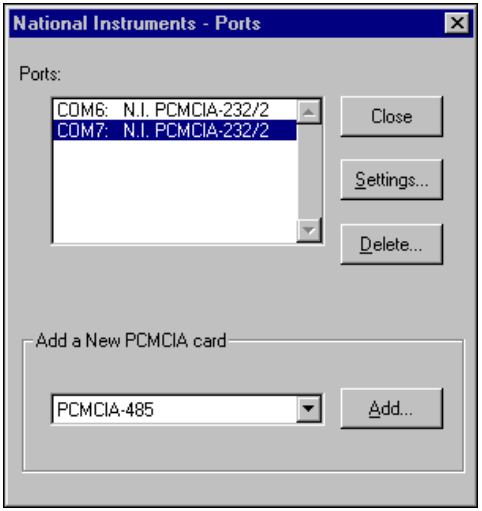


Figure 5-10. niports Configuration Utility

2. Select the port you are interested in.
3. Click the **Settings** button to view or configure the port settings. Refer to the next section, *General Port Settings*, for more information.
4. Click the **Resources** button in the **General Port Settings** dialog box to view or configure the resources for the port. Refer to the *Resource Settings* section for more information.
5. Click **Delete** to remove hardware information about the port from Windows NT. You should do this before you physically remove your PCMCIA card.
6. Click **Add** to configure resources for a new PCMCIA card.

General Port Settings

This section describes the options you can set in the **General Port Settings** dialog box, shown in Figure 5-11.

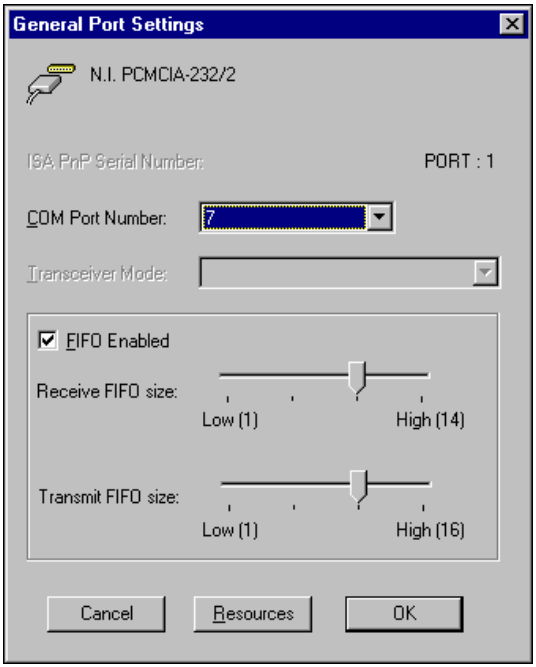


Figure 5-11. General Port Settings Dialog Box

COM Port Number

You can use the **COM Port Number** control to change the COM*x* name of the port selected.

Transceiver Mode

The transceiver mode selection shows the transceiver mode in use, and applies only to PCMCIA-485 cards. Refer to Chapter 7, *Using Your Serial Hardware*, for more information about transceiver modes. If you use two-wire Auto mode, FIFOs must be enabled.

FIFO Enabled

You can use the **FIFO Enabled** control to enable or disable the FIFO buffers on the serial port. FIFO buffers are present on the 16550-compatible UARTs—one for the transmitter and one for the receiver.

FIFO Buffers

The FIFO buffer control is available by clicking the **Advanced** button on the **Port Settings** tab. FIFO buffers are present on the 16550-compatible UARTs—one for the transmitter and one for the receiver. The receive FIFO trigger denotes the number of characters received in the FIFO before the PC is interrupted to read the data. The transmit FIFO trigger denotes the maximum number of bytes written to the FIFO in a block when the PC is interrupted to write the data. Consider the following points when selecting FIFO settings:

- You can select larger FIFO settings to reduce the number of interrupts and therefore minimize system overhead.
- If transfer rates are high, you can lower receive FIFO settings to reduce the number of interrupts and therefore prevent overrun errors due to interrupt latency.
- If data transfer sizes are small, selecting receive FIFO settings just above data sizes can reduce efficiency, so select lower settings.

Resources

Click the **Resources** button to display the resource configuration dialog box for the port. For more information on resource configuration, refer to the next section, *Resource Settings*.

Resource Settings

The following sections explain the resource configuration options for each serial interface.

PCMCIA-232, PCMCIA-485, PCMCIA-232/4

Figure 5-12 shows the resource configuration dialog box for a PCMCIA-485. The PCMCIA-232 and PCMCIA-232/4 dialog boxes are similar.

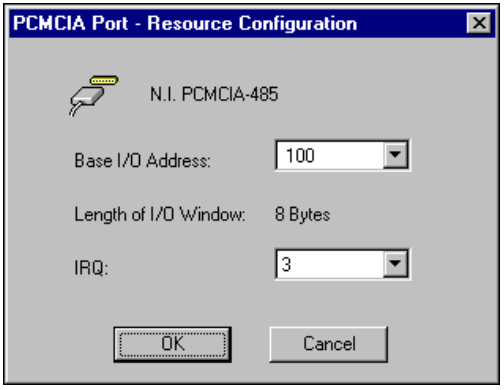


Figure 5-12. Resource Configuration Dialog Box for the PCMCIA-485

Base I/O Address: The base I/O address assigned to the port.

IRQ: The IRQ assigned to the port.

Length: The size (in bytes) of the I/O window.

For the PCMCIA-232 and PCMCIA-485, the length is 8 (the size of the I/O window for one port).

For the PCMCIA-232/4, the length is 32 bytes (the size of the I/O window for four ports).

PCMCIA-232/2, PCMCIA-485/2

These cards require two base I/O settings, one for each port, and they share an IRQ.

Figure 5-13 shows the resource configuration dialog box for a PCMCIA-485/2. The PCMCIA-232/2 dialog box is similar.

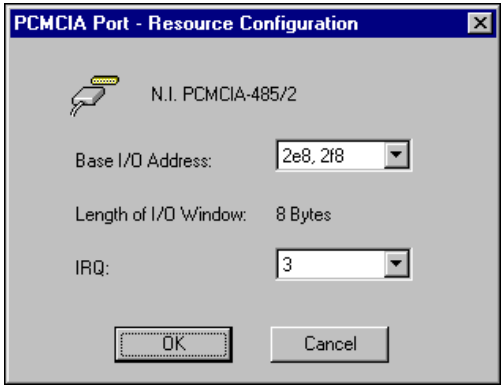


Figure 5-13. Resource Configuration Dialog Box for the PCMCIA-485/2

Base I/O Address: The base I/O addresses assigned to the two ports.

IRQ: The IRQ shared by the two ports.

Length: The size of each I/O window (in bytes).

Note When you select resources for the PCMCIA cards, use the Microsoft Windows NT diagnostics utility to make sure that the resources have not been assigned to any other device. This utility displays a list of I/O port addresses and IRQ levels that are currently being used in your system.

6

AT Serial Hardware Installation, Verification, and Configuration

This chapter describes how to install the NI-Serial software and AT serial hardware and how to verify the installation. It also describes how to view or change the communication port settings.

To begin your installation, see the section of this chapter containing instructions for your operating system (*Windows 2000/XP*, *Windows Me/9x*, or *Windows NT*).

Windows 2000/XP

Install the Software

Before you install your serial hardware, complete the following steps to install the NI-Serial software for Windows 2000/XP:

1. Select **Start»Settings»Control Panel**.
2. Double-click the **Add/Remove Programs** icon. The **Add/Remove Programs** appears.
3. Click the **Add New Programs** button and then the **CD or Floppy** button.
4. When prompted, insert the *NI-Serial Software for Windows 2000/NT/XP/Me/9x* CD and click the **Next** button.
5. When prompted, click the **Finish** button to install the program files from the CD.
6. The setup wizard begins. The setup wizard guides you through the necessary steps to install the NI-Serial software. To exit the setup wizard at any time, click the **Cancel** button.
7. If you need to install your hardware, or if this is your first time to install the NI-Serial software for Windows 2000/XP, skip to the next section, *Install the Hardware*. Otherwise, continue to step 8.
8. If your hardware is already installed, restart Windows 2000/XP.

9. Windows 2000/XP should automatically detect your hardware and display the Found New Hardware Wizard. Complete the wizard by clicking **Next** in each window and then **Finish**. When you complete the wizard, continue to the *Verify the Installation* section.

   If the Found New Hardware Wizard does not appear, refer to the *Forcing Windows to Detect Your Hardware* section of Appendix D, *Troubleshooting and Common Questions*.

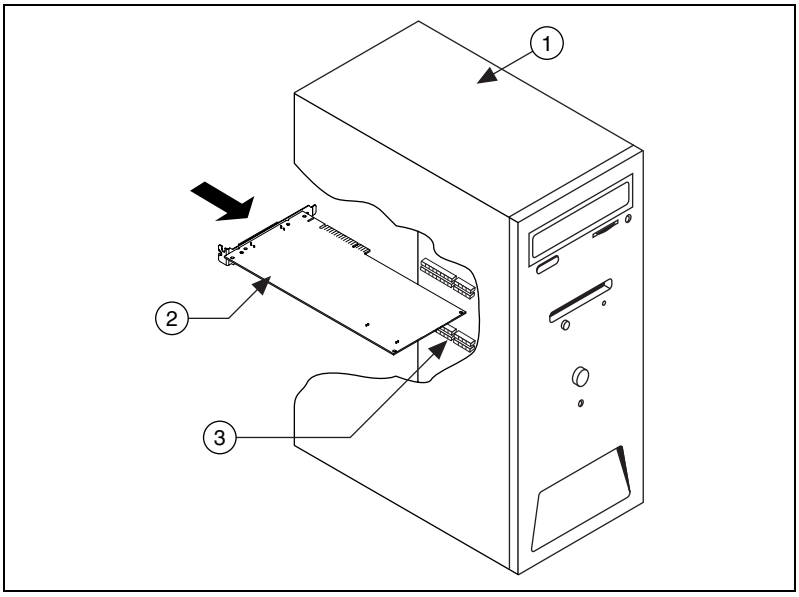
Install the Hardware

Note If you are installing a AT-485, you might need to adjust the value of the bias resistors, depending on your application. For more information, refer to Chapter 7, *Using Your Serial Hardware*.

Caution Before you remove your board from the package, touch the antistatic plastic package to a metal part of your system chassis to discharge electrostatic energy, which can damage several components on your serial board.

To install your AT serial board, complete the following steps:

1. Turn off your computer. Keep the computer plugged in so that it remains grounded while you install the AT serial board.
2. Remove the top or side cover of the computer.
3. Find an unused AT expansion slot in your computer.
4. Remove the corresponding expansion slot cover on the back panel of the computer.
5. Touch a metal part on your chassis to discharge any static electricity.
6. Insert the AT serial board into the slot with the serial connectors toward the opening on the back panel. Make sure that you insert the board all the way into the slot. The board might seem to click firmly into place, even though it is only part of the way in. Figure 6-1 shows how to install the AT serial board into an expansion slot.



1 PC 2 AT Socket 3 AT Serial Card

Figure 6-1. AT Serial Board Installation

7. Screw the AT serial board mounting bracket to the back panel mounting rail of the computer.
8. Replace the cover.
9. Turn on your computer and start Windows 2000/XP.
10. Windows 2000/XP should automatically detect your hardware and display the Found New Hardware Wizard. Complete the wizard by clicking **Next** in each window and then **Finish**.

    If the Found New Hardware Wizard does not appear, refer to the *Forcing Windows to Detect Your Hardware* section of Appendix D, *Troubleshooting and Common Questions*.

The serial hardware installation is complete.

Verify the Installation

To verify the hardware and software installation, complete the following steps:

1. Select **Start»Settings»Control Panel** and double-click the **System** icon.
2. Click the **Hardware** tab and then click the **Device Manager** button.

3. Double-click the **Ports (COM & LPT)** icon to display all of the ports.
4. Double-click the **Multi-function adapters** icon.

   The AT serial boards are configured as devices belonging to the *multi-function adapters* class. The multi-function parent device is listed under the **Multi-function adapters** icon, and each child device is listed as a port under the **Ports (COM & LPT)** icon.

   Figure 6-2 shows the Device Manager tab for serial hardware that is installed properly.

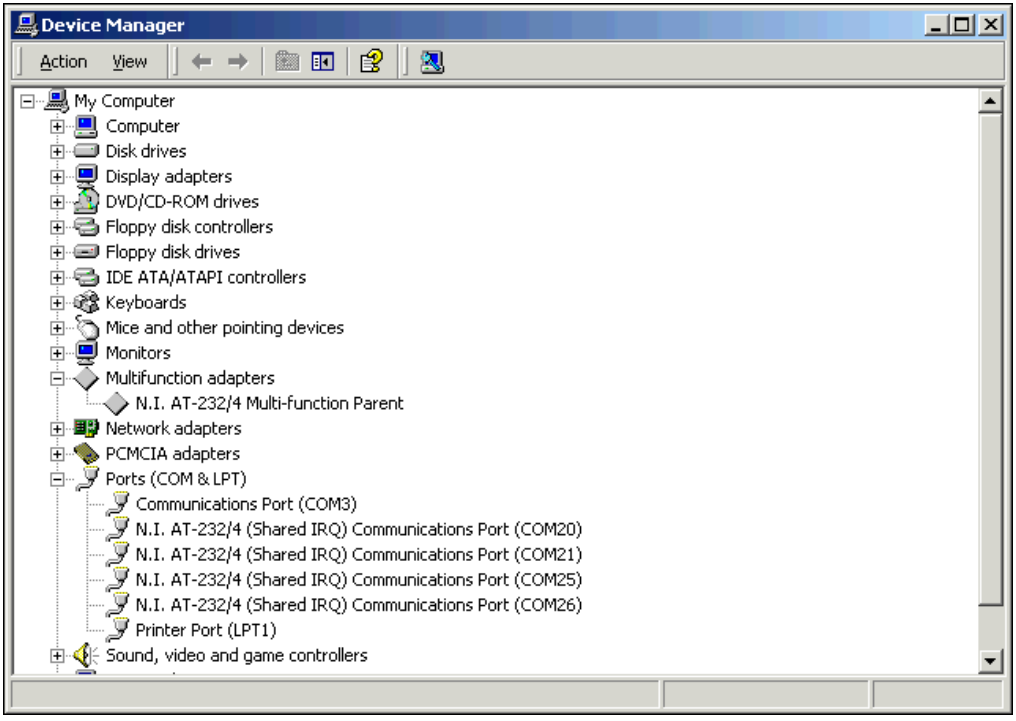


Figure 6-2. Device Manager for AT Serial Board Ports

5. Verify the hardware resources, as follows:
   a. In the Device Manager under **Multi-function adapters**, double-click a serial board.
   b. Click the **Resources** tab. If the resources were assigned properly, the **Resources** tab shows which resources are assigned to your serial ports.
   c. Repeat steps 5a and 5b until you have verified the resources for each board.
6. (Optional) To determine which physical port is associated with COM*x*, note the Port 1, Port 2, etc. entries next to the COM numbers. For all serial hardware, PORT1 refers to the top port, PORT2 refers to the next port down, and so on.
7. To run the diagnostic utility, select **Start»Programs»National Instruments»NI-Serial»Diagnostics**.

   The diagnostic utility verifies that your serial driver is installed properly, that the configuration of your hardware does not conflict with anything else in your system, and that the serial driver can communicate with your hardware correctly.

   If the test is successful, your serial hardware and software are installed properly. If the test fails, refer to Appendix D, *Troubleshooting and Common Questions*, to troubleshoot the problem.
8. After you verify the hardware and software installation, connect the cables. Refer to Appendix A, *Connector Descriptions*, for information about cable connections.

Configure Communication Port Settings

The serial configuration utility is fully integrated into the Windows 2000/XP Device Manager. You can use it to view or change the configuration of your serial ports.

To configure a serial port, complete the following steps:

1. Select **Start»Settings»Control Panel** and double-click the **System** icon.
2. Click the **Hardware** tab and then click the **Device Manager** button.
3. Double-click the **Ports (COM & LPT)** icon.

4. Double-click the port you want to configure and refer to the following instructions:
   - To view the hardware resources assigned to the serial port, click the **Resources** tab.
   - To view or change the port settings, click the **Port Settings** tab. For more information about the settings, refer to the next section, *Port Settings Tab*.
   - To change the RS-485 transceiver mode, or to enable or disable the FIFOs on the serial hardware, in the **Port Settings** tab, click the **Advanced** button. For more information about the settings, refer to the next section, *Port Settings Tab*.

Note Transceiver modes apply to RS-485 interfaces only. For more information about transceiver modes, refer to Chapter 7, *Using Your Serial Hardware*.

5. To save your changes, click the **OK** button. To exit without saving the changes, click the **Cancel** button.

Port Settings Tab

In the **Port Settings** tab, you can change any of the settings by clicking the arrow button to the right of a field. When you click the arrow button, a list of valid values for that field appears and you can select the desired setting from the list. Figure 6-3 shows the **Port Settings** tab.

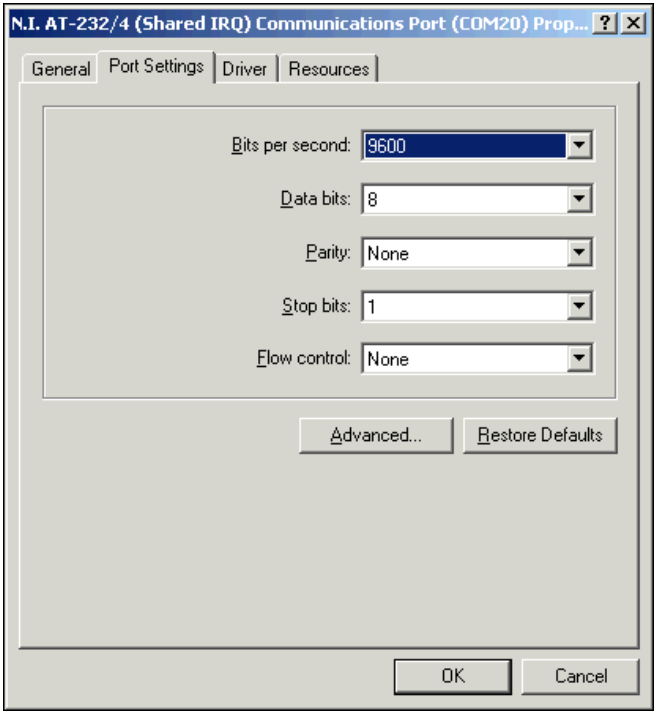


Figure 6-3. Port Settings Tab

Advanced Settings

To view or change the advanced settings, click the **Advanced** button. Figure 6-4 shows the **Advanced Settings** dialog box.

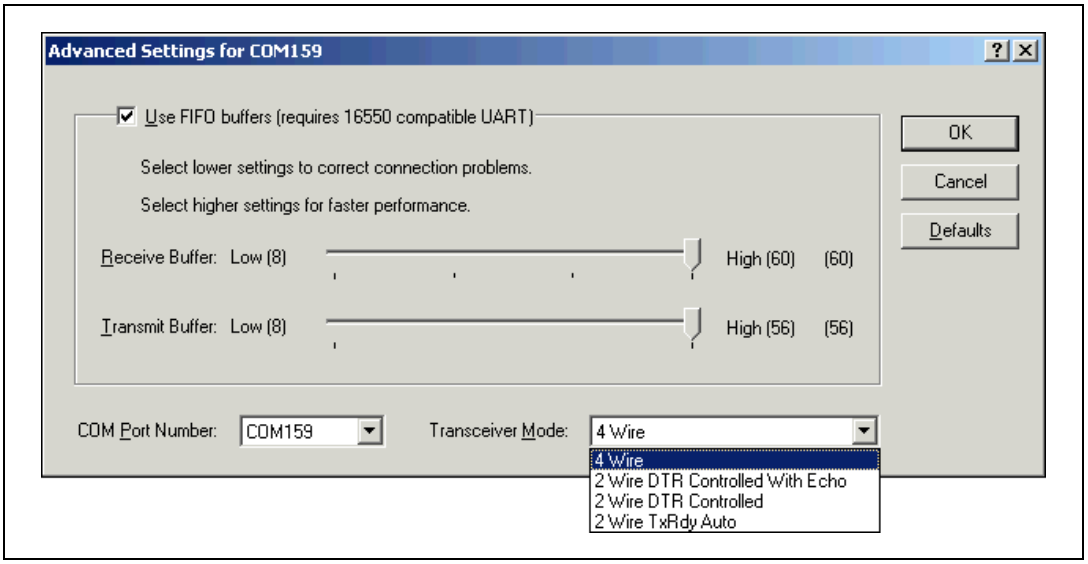


Figure 6-4. Advanced Settings Dialog Box

The following sections describe the advanced settings options.

Transceiver Mode

This field shows the transceiver mode in use, and applies only to AT-485 boards. For more information about transceiver modes, refer to Chapter 7, *Using Your Serial Hardware*.

Use FIFO Buffers

FIFO buffers are present on the 16550-compatible UARTs—one for the transmitter and one for the receiver. The **Receive Buffer** control sets the number of characters received in the FIFO before the PC is interrupted to read the data. The **Transmit Buffer** control sets the maximum number of bytes written to the FIFO in a block when the PC is interrupted to write the data. When you configure FIFO settings, consider the following points:

- You can select larger FIFO buffer sizes to reduce the number of interrupts your PC receives and therefore minimize system overhead.
- If transfer rates are high, you can lower the **Receive Buffer** value to prevent overrun errors due to interrupt latency.
- If your data transfer sizes are small and your **Receive Buffer** value is above your data sizes, your system is less efficient. Therefore, set the **Receive Buffer** value below your data sizes.

Restore Defaults

To reset the fields to their default values at any time, click the **Restore Defaults** button.

Windows Me/9*x*

Install the Software

Install the NI-Serial software for Windows Me/9*x* before you install the hardware.

1. Select **Start»Settings»Control Panel**.
2. Double-click the **Add/Remove Programs** icon in the Control Panel to launch the Add/Remove Programs applet. The **Add/Remove Programs** dialog box appears.
3. Click the **Install** button.
4. When prompted, insert the *NI-Serial Software for Windows 2000/NT/XP/Me/9x* CD, and click the **Next** button to proceed. The software installation wizard begins.

   The wizard guides you through the necessary steps to install the NI-Serial software. You can go back and change values where appropriate by clicking the **Back** button. You can exit the setup where appropriate by clicking the **Cancel** button.
5. If you need to install your hardware, or if this is your first time to install the NI-Serial software for Windows Me/9*x*, skip to the next section, *Install the Hardware*. Otherwise, continue to Step 6.
6. If your hardware is already installed, restart Windows Me/9*x*.

   Windows Me/9*x* should automatically detect your hardware and display one or more **New Hardware Found** dialog boxes, but you must make sure **Windows Default Driver** is selected and click **OK**. When you finish, continue to the *Verify the Installation* section.

   If no **New Hardware Found** dialog box appears, refer to the *Forcing Windows to Detect Your Hardware* section of Appendix D, *Troubleshooting and Common Questions*.

Install the Hardware

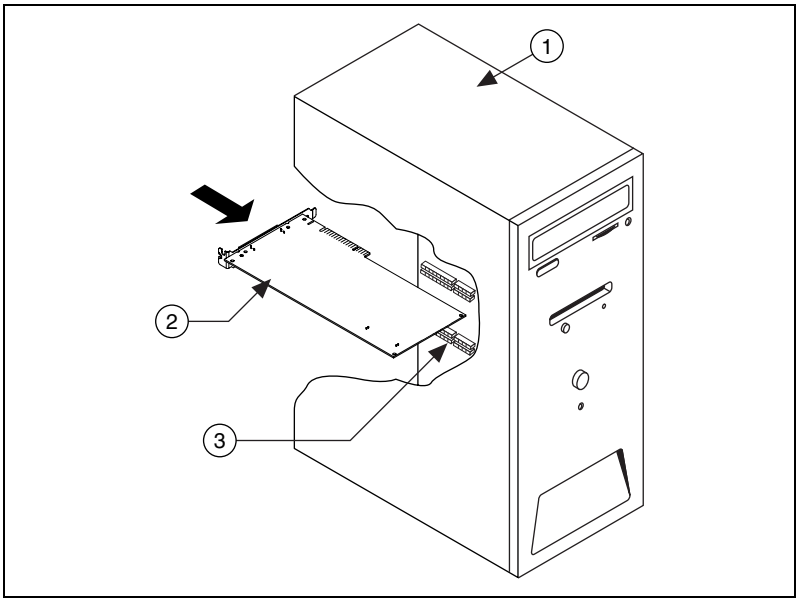
This section describes how to install your AT serial hardware.

Note If you are installing an AT-485, you might need to adjust the value of the bias resistors, depending on your application. For more information, refer to Chapter 7, *Using Your Serial Hardware*.

Caution Before you remove your board from the package, touch the antistatic plastic package to a metal part of your system chassis to discharge electrostatic energy, which can damage several components on your serial board.

To install your AT serial board, complete the following steps:

1. Turn off your computer. Keep the computer plugged in so that it remains grounded while you install the AT serial board.
2. Remove the top or side cover of the computer.
3. Find an unused AT expansion slot in your computer.
4. Remove the corresponding expansion slot cover on the back panel of the computer.
5. Touch a metal part on your chassis to discharge any static electricity.
6. Insert the AT serial board into the slot with the serial connectors toward the opening on the back panel. Make sure that you insert the board all the way into the slot. The board might seem to click firmly into place, even though it is only part of the way in. Figure 6-5 shows how to install the AT serial board into an expansion slot.



1 PC 2 AT Socket 3 AT Serial Card

Figure 6-5. AT Serial Board Installation

7. Screw the AT serial board mounting bracket to the back panel mounting rail of the computer.
8. Replace the cover.
9. Turn on your computer and start Windows Me/9*x*.
10. Watch for Windows Me/9*x* to display one or more **New Hardware Found** dialog boxes. In the dialog box, select **Windows Default Driver** and click **OK**.

    If no **New Hardware Found** dialog box appears, refer to the *Forcing Windows to Detect Your Hardware* section of Appendix D, *Troubleshooting and Common Questions*.

The serial hardware installation is complete.

Verify the Installation

When you begin to verify the installation, keep in mind that the serial ports built into the computer are typically named from COM1 to COM4. Windows Me/9*x* typically issues port names to the ports on NI-Serial hardware starting with COM5, COM6, and so on. If not enough resources are available to assign to all the NI serial ports, the port with the higher COM*x* name is left unconfigured.

Double-click the **System** icon in the Control Panel. In the **System Properties** window that appears, select the **Device Manager** tab, and click the **View devices by type** button at the top of the page. If necessary, double-click the **Ports (COM & LPT)** icon to view all of the ports.

The shared IRQ AT serial boards are configured as devices belonging to the *multi-function adapters* class. The multi-function parent device is listed under the **Multi-function adapters** icon, and each child device is listed as a port under the **Ports (COM & LPT)** icon. If you have installed one of these interfaces, double-click the **Multi-function adapters** icon as well as the **Ports (COM & LPT)** icon to look at the ports resources. To modify the hardware resources, double-click the **Multi-Function adapters** icon.

If a circled exclamation point appears through the port icon, the serial port is not installed properly. A problem with the port may have occurred because Windows Me/9*x* could not acquire resources for the port, or because an interrupt request resource conflict exists. If no circled exclamation point appears, the serial hardware is installed correctly. Figure 6-6 shows an example of NI-Serial hardware that is installed properly.

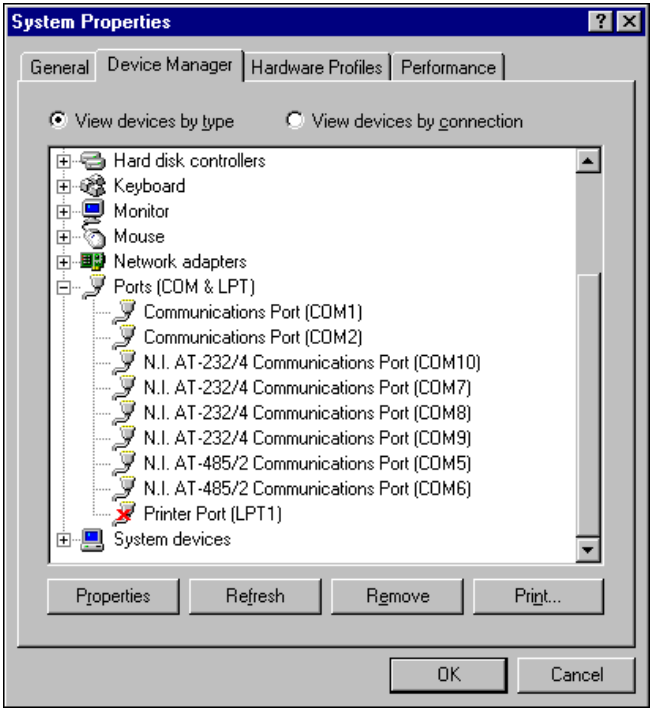


Figure 6-6. Device Manager Ports List for AT Serial Board Correctly Installed

Verify the Hardware Resources

For every port of the newly installed serial interface, double-click the name of the serial port in the Device Manager. Then, click the **Resources** tab. If the resources were assigned correctly, the **Resources** page shows which resources are assigned to your serial ports.

If Windows Me/9*x* did not assign any resources to the port, the **Resources** page shows only a **Set Configuration Manually** button. Click the **Set Configuration Manually** button and try to assign conflict-free resources to your serial hardware. For instructions, refer to the *Selecting Conflict-Free Resources* section of Appendix D, *Troubleshooting and Common Questions*. You may have to free an interrupt request level so that one can be assigned to your serial hardware. For instructions, refer to the *Freeing an Interrupt Request Level* section of Appendix D, *Troubleshooting and Common Questions*.

When you have finished verifying the hardware resources, proceed to the next section, *Determine Which Physical Port Is Associated with COMx*.

Determine Which Physical Port Is Associated with COM*x*

For every port of the newly installed serial interface, double-click the name of the serial port in the Device Manager. Then, click the **Port Settings** tab. The top of this page displays the serial number of the serial hardware, and the physical port number starting at 1. On all serial hardware, PORT1 refers to the top port, PORT2 refers to the next port down, and so on.

When you have finished verifying the driver installation and physical port, proceed to the next section, *Run the Diagnostic Test*.

Run the Diagnostic Test

To verify and test the installation, run the diagnostic program that came with your NI-Serial software. The diagnostic program verifies that your serial driver is installed properly, that the configuration of your hardware does not conflict with anything else in your system, and that the serial driver can communicate with your hardware correctly.

To run the test, select the **diagnostics** item under **Start»Programs» National Instruments Serial**.

If the diagnostic test completes with no failures, your serial hardware and software are installed properly. If it fails, refer to Appendix D, *Troubleshooting and Common Questions*, for troubleshooting instructions.

After you verify the hardware and software installation, connect the cables. Refer to Appendix A, *Connector Descriptions*, for information about cable connections.

Configure Communication Port Settings

The serial configuration utility is fully integrated into the Windows Me/9*x* Device Manager. You can use it to view or change the configuration of your serial ports.

Complete the following steps to configure the serial port. Repeat the configuration procedure for each serial port in your system.

1. Select **Start»Settings»Control Panel** and double-click the **System** icon. The **System Properties** window appears.
2. Select the **Device Manager** tab, and click the **View devices by type** button at the top of the page.

3. Double-click the **Ports (COM & LPT)** icon.
4. Double-click the name of the port you want to configure.

   You can now view or change information about your serial port in the following ways:

   - To view the hardware resources assigned to the serial port, click the **Resources** tab.
   - To view or change the port settings, click the **Port Settings** tab. For more information about the settings, refer to the next section, *Port Settings Tab*.
   - To change the RS-485 transceiver mode, or to enable or disable the FIFOs on the serial hardware, in the **Port Settings** tab, click the **Advanced** button. For more information about the settings, refer to the next section, *Port Settings Tab*.

Note If you use two-wire Auto mode, FIFOs must be enabled. Transceiver modes apply to RS-485 interfaces only. For more information about transceiver modes, refer to Chapter 7, *Using Your Serial Hardware*.

5. To save your changes, click the **OK** button. To exit without saving the changes, click the **Cancel** button.

Port Settings Tab

On the **Port Settings** tab, you can change any of the settings by clicking the arrow button to the right of the setting. When you click the arrow button, a list of valid values for that setting appears. Select the desired setting from the list. Figure 6-7 shows the **Port Settings** tab.

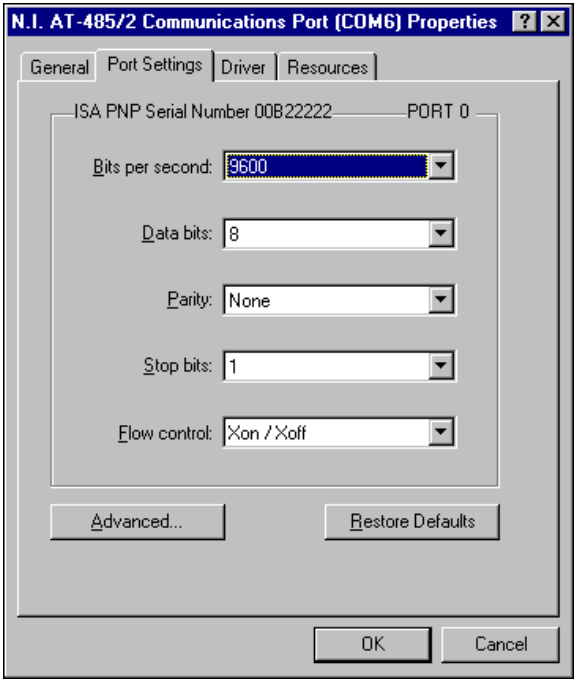


Figure 6-7. Port Settings Tab

Advanced Port Settings

You can view or change the advanced port settings by clicking the **Advanced** button on the **Port Settings** tab. Figure 6-8 shows the **Advanced Port Settings** dialog box.

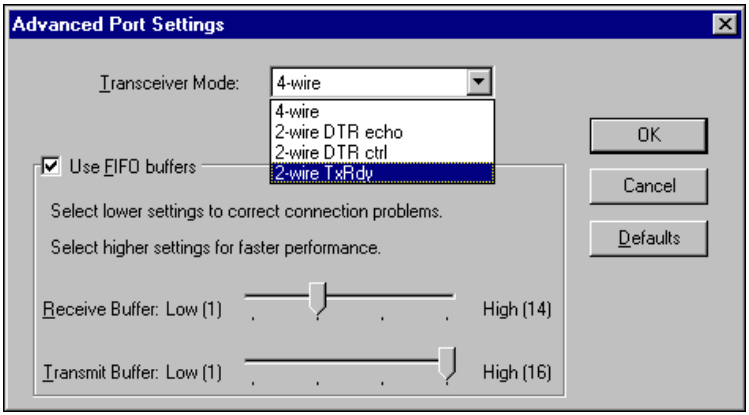


Figure 6-8. Advanced Port Settings Dialog Box

The following sections describe the advanced settings options.

Transceiver Mode

The transceiver mode selection is available by clicking the **Advanced** button on the **Port Settings** tab. It shows the transceiver mode in use and applies only to AT-485 boards. For more information about transceiver modes, refer to Chapter 7, *Using Your Serial Hardware*.

Use FIFO Buffers

The FIFO buffer control is available by clicking the **Advanced** button on the **Port Settings** tab. FIFO buffers are present on the 16550-compatible UARTs—one for the transmitter and one for the receiver. The receiver FIFO trigger denotes the number of characters received in the FIFO before the PC is interrupted to read the data. The transmit FIFO trigger denotes the maximum number of bytes written to the FIFO in a block when the PC is interrupted to write the data. Consider the following points when selecting FIFO settings:

- You can select larger FIFO settings to reduce the number of interrupts and therefore minimize system overhead.
- If transfer rates are high, you can lower receive FIFO settings to prevent overrun errors due to interrupt latency.
- If data transfer sizes are small, selecting receive FIFO settings just above data sizes can reduce efficiency, so select lower settings.

Note If you want your serial hardware ports to use the names *COM1*, *COM2*, *COM3*, or *COM4*, refer to the *Common Questions* section of Appendix D, *Troubleshooting and Common Questions*.

Windows NT

Installing the Microsoft PnP ISA Enabler Driver

When you install an AT board, you must install the PnP ISA Enabler Driver.

The AT serial hardware is Plug and Play. Windows NT 4.0 does not support Plug and Play. In order for Windows NT to detect and install the Plug and Play hardware, you must install the PnP ISA Enabler driver included on your Windows NT 4.0 CD. Complete the following steps to install the driver:

1. Locate the `Pnpisa.inf` file in the `Drvlib\Pnpisa\X86` folder on the Windows NT 4.0 CD.
2. Right-click the `Pnpisa.inf` file, then select **Install** on the menu that appears.
3. Restart the computer.

Install the NI-Serial Software

Install the NI-Serial software for Windows NT before you install the hardware. Make sure that you have already installed the PnP ISA Enabler driver as described in the previous section.

1. Log on as `Administrator` or as a user who has `Administrator` privileges.
2. Select **Start»Settings»Control Panel**.
3. Double-click the **Add/Remove Programs** icon in the Control Panel to launch the Add/Remove Programs applet. The **Add/Remove Programs** dialog box appears.
4. Click the **Install** button.
5. When prompted, insert the *NI-Serial Software for Windows 2000/NT/XP/Me/9x* CD and click the **Next** button to proceed. The software installation wizard begins.

   The wizard guides you through the necessary steps to install the NI-Serial software. You can go back and change values where

appropriate by clicking the **Back** button. You can exit the setup where appropriate by clicking the **Cancel** button.

Note This installation backs up the Microsoft Windows NT serial driver `serial.sys` to `serial.bak` and then overwrites `serial.sys`. You can find `serial.sys` in the Windows NT `\system32\drivers` directory.

The software installation is complete.

Install the Serial Hardware

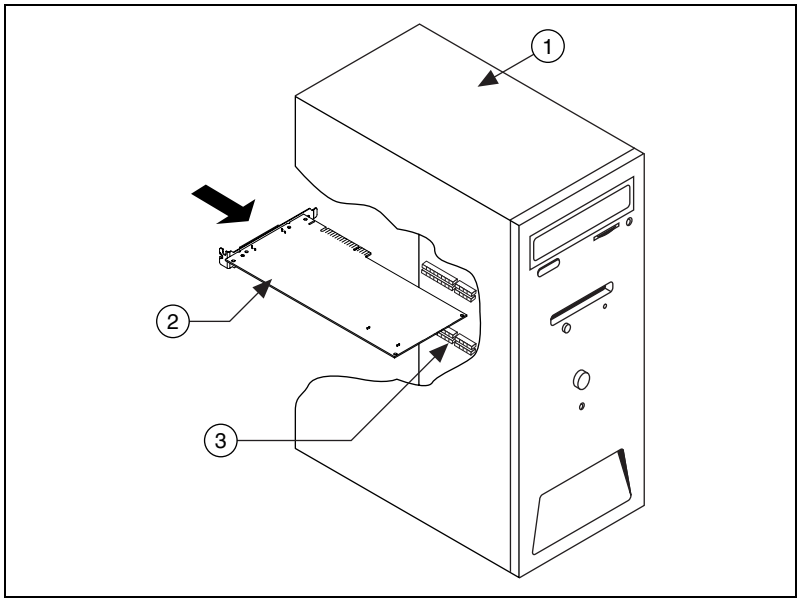
This section describes how to install your AT serial board.

Note If you are installing an AT-485, you might need to adjust the value of the bias resistors, depending on your application. For more information, refer to Chapter 7, *Using Your Serial Hardware*.

Caution Electrostatic discharge can damage several components on your board. To avoid such damage in handling the board, touch the antistatic plastic package to a metal part of your computer chassis before removing the board from the package.

Complete the following steps to install your AT serial board:

1. Turn off your computer. Keep the computer plugged in so that it remains grounded while you install the AT serial board.
2. Remove the top or side cover of the computer.
3. Remove the expansion slot cover on the back of the computer.
4. Insert the AT serial board into an unused slot with the serial connectors sticking out of the opening on the back panel. Make sure that you insert the board all the way into the slot. The board may seem to click firmly into place, even though it is only part of the way in. Figure 6-9 shows the installation of an AT serial board.



1 PC 2 AT Socket 3 AT Serial Card

Figure 6-9. AT Serial Board Installation

5. Screw the mounting bracket of the AT serial board to the back panel rail of the computer.
6. Replace the cover, and turn on your computer.
7. Windows NT displays one or more **New Hardware Found** dialog boxes, depending on your serial hardware. In each dialog box, make sure that **Windows Default Driver** is selected, and click **OK**.
8. The serial configuration software displays a **PnP Port Configuration** dialog box. Correct any resource settings that may have conflicts and then click **OK**. For more information on selecting resources for your port/card, refer to the *Resource Settings* section.
9. After you have selected the resources for all ports, choose to restart the computer when the system prompts you.

The serial hardware installation is now complete.

Verify the Installation

Determine Which Physical Port Is Associated with COM*x*

Select **Start»Settings»Control Panel**, and double-click **niports**. A list showing installed National Instruments ports with their logical COM*x* names appears. If your interface is not on the list, refer to Appendix D, *Troubleshooting and Common Questions*.

Select the COM port you want and click the **Settings** button to display the **General Port Settings** dialog box for that port. This dialog box displays the serial number of the serial hardware and the physical port number starting at 1. On all serial hardware, PORT1 refers to the top port, PORT2 refers to the next port down, and so on.

When you have finished verifying the driver installation and physical port, proceed to the next section, *Run the Diagnostic Test*.

Run the Diagnostic Test

To verify and test the installation, run the diagnostic program that came with your NI-Serial software. The diagnostic program verifies that your serial driver is installed properly, that the configuration of your hardware does not conflict with anything else in your system, and that the serial driver can communicate with your hardware correctly.

To run the test, select the **diagnostics** item under **Start»Programs» National Instruments Serial**.

If the diagnostic test completes with no failures, your serial hardware and software are installed properly. If it fails, refer to Appendix D, *Troubleshooting and Common Questions*, for troubleshooting instructions.

After you verify the hardware and software installation, connect the cables. Refer to Appendix A, *Connector Descriptions*, for information about cable connections.

Configure Communication Port Settings

The serial configuration utility is fully integrated with the Windows NT Control Panel. You can use it to examine or modify the configuration of the serial port.

Complete the following steps to configure the serial port.

1. Select **Start»Settings»Control Panel** and double-click the **niports** icon. A list of National Instruments ports appears, as shown in Figure 6-10.

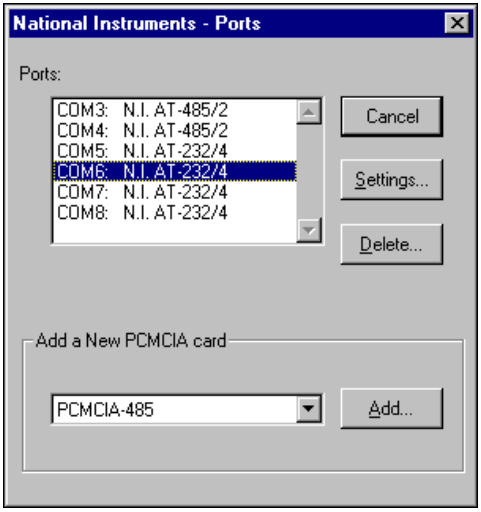


Figure 6-10. niports Configuration Utility

2. Select the port you want to configure.
3. Click the **Settings** button to view or configure the port settings. Refer to the next section, *General Port Settings*, for more information.
4. Click the **Resources** button in the **General Port Settings** dialog box to view or configure the resources for the port. Refer to the *Resource Settings* section for more information.
5. Click **Delete** to remove hardware information about the port from Windows NT. You should do this before you remove the serial interface from the system.

General Port Settings

This section describes the options you can set in the **General Port Settings** dialog box, shown in Figure 6-11.

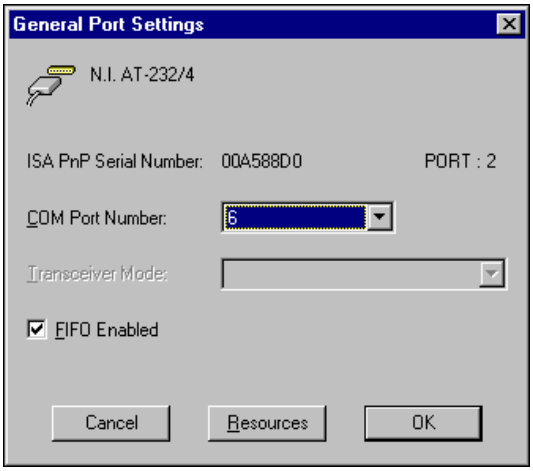


Figure 6-11. General Port Settings Dialog Box

COM Port Number

You can use the **COM Port Number** control to change the COM*x* name of the port selected.

Transceiver Mode

The transceiver mode selection shows the transceiver mode in use, and applies only to AT-485 boards. Refer to Chapter 7, *Using Your Serial Hardware*, for more information about transceiver modes. If you use two-wire Auto mode, FIFOs must be enabled.

FIFO Enabled

You can use the **FIFO Enabled** control to enable or disable the FIFO buffers on the serial port. FIFO buffers are present on the 16550-compatible UARTs—one for the transmitter and one for the receiver.

FIFO Buffer Size

FIFO buffers are present on the 16550-compatible UARTs—one for the transmitter and one for the receiver. The receiver FIFO trigger denotes the number of characters received in the FIFO before the PC is interrupted to read the data. The transmit FIFO trigger denotes the maximum number of bytes written to the FIFO in a block when the PC is interrupted to write the data. Consider the following points when selecting FIFO settings:

- You can select larger FIFO settings to reduce the number of interrupts and therefore minimize system overhead.
- If transfer rates are high, you can lower receive FIFO settings to reduce the number of interrupts and therefore prevent overrun errors due to interrupt latency.
- If data transfer sizes are small, selecting receive FIFO settings just above data sizes can reduce efficiency, so select lower settings.

Resources

Click the **Resources** button to display the resource configuration dialog box for the port. For more information on resource configuration, refer to the next section, *Resource Settings*.

Resource Settings

The following sections explain the resource configuration options for each serial interface.

AT Boards (Shared IRQ)

Figure 6-12 shows the **PnP Port Configuration** dialog box for an AT-232/4 with shared IRQ. The dialog boxes for other shared IRQ AT boards are similar.

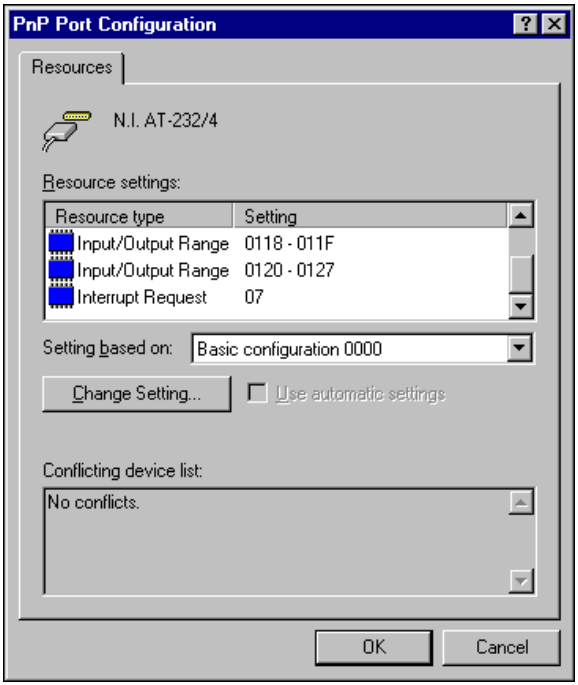


Figure 6-12. PnP Port Configuration Dialog Box for the AT-232/4

Each shared IRQ AT board requires multiple base I/O settings (one for each port) and one IRQ that is shared between the ports.

Input/Output Range: Each **Input/Output Range** listing displays the I/O address ranges assigned to the corresponding port on the board.

Interrupt Request: The IRQ shared between the ports on the board.

Note The niports utility informs you if your resources conflict with the resources of any other interface in the system. It does not check for conflicts with ports on the same board. Make sure to assign base I/O addresses that do not conflict with those assigned to another port on the same board.

Note If you are unable to change the base I/O address by double-clicking on the **Input/Output Rang**e control, select a different **Basic Configuration** in the **Setting based on:** control.

AT Boards (Non-Shared IRQ)

Each port on the board requires one I/O window and one IRQ.

Input/Output Range: The base I/O address range assigned to the port.

IRQ: The IRQ assigned to the port.

7

Using Your Serial Hardware

This chapter describes how to use the advanced features of your NI-Serial hardware and lists some general programming requirements.

General Programming Requirements

The NI-Serial software is fully integrated into the standard Windows communications software. NI serial ports are used like any other Windows communications (COM) port. Windows has standard communication functions for use within either Win16 or Win32 applications.

When you develop your application, remember that you must use the standard Windows serial communication functions or any API that uses the standard Windows serial communication functions such as NI-VISA. For more information about NI-VISA, see `ni.com/VISA`. For information about Microsoft Windows serial communication functions, refer to the *Win32 Software Development Kit* and to the *Win32 Overview and Win32 Reference* online help.

If you have LabVIEW or Measurement Studio and want to use it with your serial hardware, refer to your LabVIEW or Measurement Studio documentation for information about serial I/O functions.

Advanced Features

In addition to supporting standard 16550-compatible UART functionality, some NI serial hardware supports additional advanced features:

- RS-485 transceiver control
- RS-485 socketed bias resistors
- RS-485 programmatically controlled bias resistors
- RS-232 DTE/DCE transceiver control
- Status LEDs

To determine which features your product supports, refer to Table 7-1.

Table 7-1. Serial Hardware Features

Hardware	RS-485 Transceiver Control	RS-485 Socketed Bias Resistors	RS-485 Programmatically Controlled Bias Resistors	RS-232 DTE/DCE Transceiver Control	Status LEDs	Max Baud Rate (kbits/s)
USB-232 two port and four port				X	X	230.4
USB-232 one port						230.4
USB-485 two port and four port	X	X	X		X	460.8
USB-485 one port	X		X			460.8
PCI/PXI-485 eight port	X					460.8
All other PCI/PXI-485	X	X				460.8
PCMCIA-485	X					921.6
PCI/PXI/AT-232, PCMCIA-232/4						115.2
All other PCMCIA						921.6
AT-485	X	X				115.2

You can access some of these features through DeviceIOControl function calls, the port settings dialog box, or both. To determine which function calls your product supports, refer to Table 7-2. For more information about using DeviceIOControl, refer to the appropriate section in this chapter.

Table 7-2. Function Call Product Support

Feature	Programmatic Control Code	USB-232 (two/four port)	USB-232 (one port)	USB-485	All Other 485 Products
RS-232 Transceiver Control					
Set Transceiver Mode	SET_RS232_MODE	X			
Get Transceiver Mode	GET_RS232_MODE	X	X		
Get Transceiver State	GET_RS232_STATE	X	X		
Set DCD	SET_DCD	X			
Clear DCD	CLR_DCD	X			
Get DCD State (DCE)	GET_DCD	X	X		
Set RI	SET_RI	X			
Clear RI	CLR_RI	X			
Get RI State (DCE)	GET_RI	X	X		
RS-485 Bias Resistors					
Set Bias Mode	SET_RS485_BIAS			X	
Get Bias Mode	GET_RS485_BIAS			X	
RS-485 Transceiver Control					
Set Transceiver Mode	SET_RS485_MODE			X	X
Get Transceiver Mode	GET_RS485_MODE			X	

RS-485 Transceiver Control

The RS-485 hardware supports four modes of hardware transceiver control. You can use hardware transceiver control to enable and disable your transmitters and receivers so that they function on different bus topologies. Table 7-3 lists the status of the transmitters and receivers under each transceiver control mode.

Table 7-3. RS-485 Transceiver Control Modes

Mode	Transmitter	Receiver
Four-wire mode	Always enabled	Always enabled
Two-wire mode: DTR controlled with echo	Enabled when DTR asserted	Always enabled
Two-wire mode: DTR controlled	Enabled when DTR asserted	Enabled when DTR unasserted
Two-wire mode: Auto Control	Enabled when transmitting data	Enabled when not transmitting data

Four-Wire Mode

Use the four-wire mode for most full-duplex systems. In this mode, the transmitter and receiver are always enabled. This mode is the default.

Two-Wire Mode: DTR Controlled with Echo

You can use this mode in half-duplex systems where you need to control the transmitter programatically. In the DTR-with-echo mode, the transmitter is tri-stated when the DTR signal of the UART (Universal Asynchronous Receiver/Transmitter) is unasserted. To transmit, your application first must enable the transmitter by asserting DTR. After the data is fully transmitted, your application unasserts DTR to disable the transmitter. Because the receiver is always enabled in this mode, you receive packets not only from other devices, but also your transmitter. Thus, your receiver *echoes* all data you transmit.

Two-Wire Mode: DTR Controlled

This mode is similar to the two-wire, DTR-with-echo mode. Although this mode uses the same method as the DTR-with-echo mode to control the transmitter, the hardware automatically disables the receiver whenever

the transmitter is enabled. Thus, you do not receive the packets sent from your transmitter.

Two-Wire Mode: Auto Control

In this mode, the serial hardware transparently enables the transmitter and receiver in a two-wire system. Use this mode to remove the burden of transceiver control from your application. The hardware automatically enables the transmitter for each byte to be transmitted. Also, the hardware disables the receiver whenever the transmitter is enabled, so you do not receive the packets sent from your transmitter.



Note When you are communicating with a two-wire device, National Instruments recommends that you use the two-wire Auto Control mode. Because this mode handles the transmitter/receiver enabling for a two-wire connection in your hardware, it reduces the software overhead required to perform this operation in your application program.

For more information about serial communication in two- or four-wire modes, refer to the *Serial Communication Issues* section of Appendix B, *Serial Port Information*.

Setting the RS-485 Transceiver Control Mode

Windows 2000/XP

To set the transceiver control mode, use the Windows 2000/XP Device Manager. For instructions on how to use the Device Manager, refer to the chapter with installation instructions for your hardware platform. The mode you select in the Device Manager is automatically configured when you open a port on a serial interface.

Windows Me/9*x*

To set the transceiver control mode, use the Windows Me/9*x* Device Manager. For instructions on how to use the Device Manager, refer to chapter with installation instructions for your hardware platform. The mode you select in the Device Manager is automatically configured when you open a port on a serial interface.

For PCI/PXI/PCMCIA/AT, you can also set the hardware transceiver control mode from within a DOS application. For each port you want to control, write the control byte for the mode you want to select to the scratch register of the UART. Table 7-4 shows the control bytes for each mode.

Table 7-4. Transceiver Mode Control Bytes

Transceiver Mode	Control Byte
Four-wire mode	0x00
Two-wire mode: DTR controlled with echo	0x01
Two-wire mode: DTR controlled with echo	0x02
Two-wire mode: Auto Control	0x03

The scratch register is located at offset 7 from the base address of the port. For example, if COM2 were located at base address 0x3F8, and you want to set the board to two-wire mode with DTR control, you would write a 0x02 to address 0x3FF. The board would immediately switch to the two-wire mode with DTR control.

Windows NT

To set the transceiver control mode, use the serial configuration utility. For instructions on how to use the utility, refer to chapter with installation instructions for your hardware platform. The mode you select in the configuration utility is automatically configured when you open a port on a serial interface.

Setting the RS-485 Transceiver Mode with DeviceIoControl

The NI-Serial software uses programmatic control codes and the DeviceIoControl Windows function for programming the RS-485 transceiver control mode. To set and retrieve the RS-485 transceiver control mode, complete the following steps:



Note You can use the header file `NISerial.h`, included on your CD, to integrate this code into your program easily.

1. Add the following lines to your source code:

```
#include <winioctl.h>
#define RS485_MODE_4WIRE     0x0
#define RS485_MODE_2W_ECHO   0x1
#define RS485_MODE_2W_DTR    0x2
#define RS485_MODE_2W_AUTO   0x3
```

```
#define NISERIAL_SET_RS485_MODE
  CTL_CODE(FILE_DEVICE_SERIAL_PORT,
  4091,METHOD_BUFFERED,FILE_ANY_ACCESS)
#define NISERIAL_GET_RS485_MODE
  CTL_CODE(FILE_DEVICE_SERIAL_PORT,
  4090,METHOD_BUFFERED,FILE_ANY_ACCESS)
```

2. To set the RS-485 transceiver control mode, use `NISERIAL_SET_RS485_MODE` and DeviceIoControl. For example, to set to two-wire Auto Control mode, use the following code:

```
ULONG bytecount;
TRANSCEIVER_MODE transceiver_mode =
  RS485_MODE_4WIRE;
DeviceIoControl(
    comhandle,
    NISERIAL_SET_RS485_MODE,
    (PVOID) &transceiver_mode,
    sizeof(transceiver_mode),
    (PVOID) NULL, 0,
    &bytecount,
    NULL
);
```

Note A deprecated alternative to `NISERIAL_SET_RS485_MODE` is,

```
#define SERIAL_IOCTL_SET_TRANSCEIVER_MODE CTL_CODE(
FILE_DEVICE_SERIAL_PORT,37,METHOD_BUFFERED,FILE_ANY_ACCESS)
```

3. To retrieve the current RS-485 transceiver control mode, you can use `NISERIAL_GET_RS485_MODE` and DeviceIoControl with the following code:

```
ULONG bytecount;
TRANSCEIVER_MODE transceiver_mode;
DeviceIoControl(
    comhandle,
    NISERIAL_GET_RS485_MODE,
    (PVOID) NULL, 0,
    (PVOID) &transceiver_mode,
    sizeof(transceiver_mode),
    &bytecount,
    NULL
);
```

Bias Resistors

An RS-485 transmission line enters an indeterminate state if no nodes are transmitting on it. This indeterminate state can cause the receivers to receive invalid data bits from noise picked up on the cable. To prevent a line from receiving these data bits, the transmission line can be forced into a known state by installing two bias resistors at one node on the transmission line. Doing so creates a voltage divider that forces the voltage between the differential pair to be greater than 200 mV, the threshold voltage for the receiver. You should install these resistors on only one node.

Figure 7-1 shows a transmission line using bias resistors.

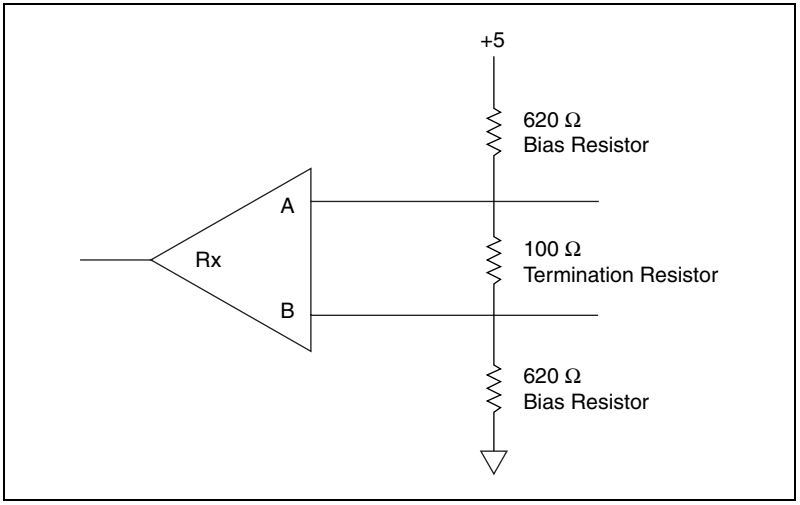


Figure 7-1. Transmission Line Using Bias Resistors

On the PCI RS-485 two- and four-port serial cards, PXI RS-485 two- and four-port serial cards, and AT RS-485 two- and four-port serial cards, there are four user-configurable bias resistors in front of each connector. These resistors are socketed and pre-loaded with 620 Ω resistors. They are connected to the receive signals of each port to maintain a known state when the bus is idle. The connections are made as follows:

- RXD+ and CTS– are pulled up to +5 V
- RXD– and CTS+ are pulled down to GND

Rather than using two 620 Ω resistors at one node, you can increase the value of the resistors and put them at every node. For instance, if there are

eight nodes in a system, you can use 4.7 kΩ resistors at each node to effectively achieve the same result.

On the USB-485 hardware, there are programatically controlled onboard bias resistors. In addition, the USB-485 two and four-port hardware has user-configurable socketed bias resistors. By default, the USB-485 hardware uses the programatically controlled bias resistors, which are connected to the receive signals of each port to maintain a known state when the bus is idle. The connections are made as follows:

- RXD+ and CTS– are pulled up to +3.3 V
- RXD– and CTS+ are pulled down to GND

Figure 7-2 shows a USB transmission line using bias resistors.

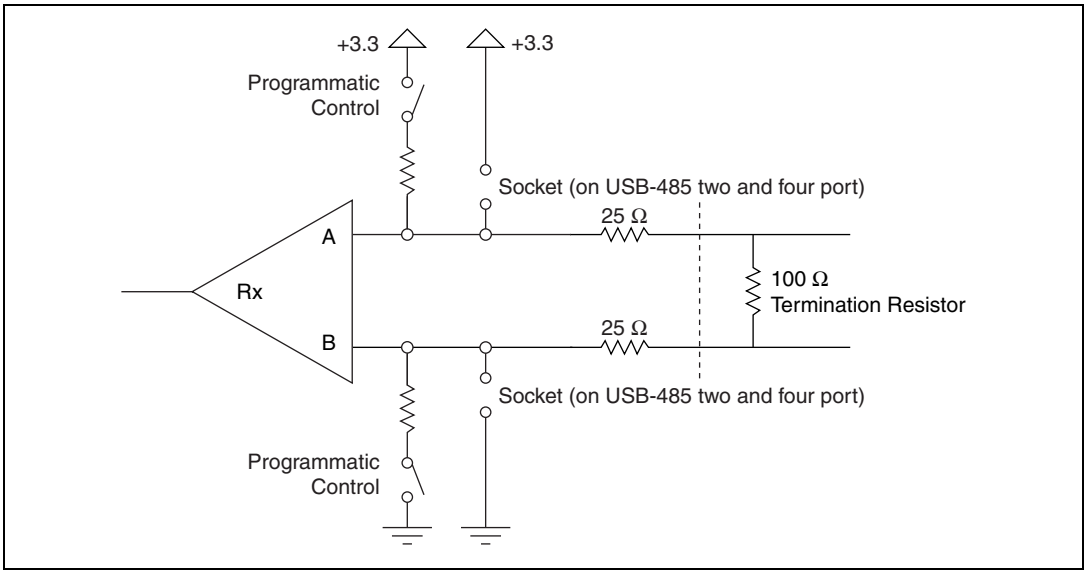


Figure 7-2. USB-485 Transmission Line Using Bias Resistors

The values of the programmatically controlled bias resistors have been calculated such that there is a voltage of at least 200 mV between the differential pair. Rather than using the programmatically controlled bias resistors, you can load custom values of resistors into the sockets in front of each connector or use external bias resistors. If these resistors are installed, make sure the programmatically controlled bias resistors are disabled.

Note The series 25 Ω resistors in Figure 7-2 are for short-circuit protection and do not impact serial communication.

Setting the RS-485 Programmatically Controlled Bias Resistor Mode

The USB-485 hardware can programmatically control the onboard (nonsocketed) bias resistors. By default, these resistors are enabled during normal device operation and disabled during USB suspend. There are two ways to control these resistors:

- Use the **Advanced Settings** tab in the control panel. If the **Enable Dynamic Bias Resistors** box is checked, the resistors are enabled automatically whenever a serial port is open during normal operation. If the box is not checked, the resistors are disabled.
- Your software can enable or disable the bias resistors programatically by making DeviceIoControl calls to the serial driver.

Setting the RS-485 Programmically Controlled Bias Resistors with DeviceIoControl

The NI-Serial software uses programmatic control codes and the DeviceIoControl Windows function for programming the RS-485 bias resistor mode. To set and retrieve the RS-485 bias resistor mode, complete the following steps:

Note You can use the header file `NISerial.h`, included on your CD, to integrate this code into your program easily.

1. Add the following lines to your source code:

```
#include <winioctl.h>
typedef ULONG SERIAL_RS485_BIAS;
#define RS485_BIAS_OFF      0
#define RS485_BIAS_ON       1

#define NISERIAL_SET_RS485_BIAS
    CTL_CODE(FILE_DEVICE_SERIAL_PORT,
    4031,METHOD_BUFFERED,FILE_ANY_ACCESS)
#define NISERIAL_GET_RS485_BIAS
    CTL_CODE(FILE_DEVICE_SERIAL_PORT,
    4030,METHOD_BUFFERED,FILE_ANY_ACCESS)
```

2. To set the RS-485 bias resistor mode, use NISERIAL_SET_RS485_BIAS and DeviceIoControl. For example, to enable programmatically controlled RS-485 bias resistors, use the following code:

```
SERIAL_RS485_BIAS serial_rs485_bias = RS485_BIAS_ON;
ULONG bytecount;
DeviceIoControl(
    comhandle,
    NISERIAL_SET_RS485_BIAS,
    (PVOID) &serial_rs485_bias,
    sizeof(serial_rs485_bias),
    (PVOID) NULL, 0,
    &bytecount,
    NULL
);
```

3. To retrieve the current RS-485 bias resistor mode, you can use NISERIAL_GET_RS485_BIAS and DeviceIoControl with the following code:

```
SERIAL_RS485_BIAS serial_rs485_bias;
ULONG bytecount;
DeviceIoControl(
    comhandle,
    NISERIAL_GET_RS485_BIAS,
    (PVOID) NULL, 0,
    (PVOID) &serial_rs485_bias,
    sizeof(serial_rs485_bias),
    &bytecount,
    NULL
);
```

RS-232 DTE/DCE Transceiver Control

The USB-232 two- and four-port hardware supports both DTE and DCE transceiver modes. By default, the RS-232 transceiver mode is forced to DTE, but you can adjust this in two ways:

- Use the **Advanced Settings** tab in the control panel. To set the transceiver mode to be used whenever a port is opened, select the desired mode from the transceiver mode pull-down menu.
- Change the transceiver mode programmatically by making a DeviceIoControl function call to the serial driver.

Table 7-5 describes the RS-232 modes.

Table 7-5. RS-232 Modes

RS-232 Mode	Description
Force DTE (Default)	The transceiver is forced into DTE mode
Force DCE	The transceiver is forced into DCE mode
Auto 232	The transceiver automatically switches between DTE and DCE modes about four times a second until a valid RS-232 signal is detected

Note When using Auto232, if you connect two serial ports set to Auto232, or if valid RS-232 signals are present in both modes, the final mode may be either DTE or DCE.

Note A valid RS-232 signal is defined as at least one valid RS-232 voltage detected on any receiver pin (RXD, CTS, DSR, RI, or DCD).

Setting the RS-232 Transceiver Mode with DeviceIoControl

The NI-Serial software uses programmatic control codes and the DeviceIoControl Windows function for programming the RS-232 transceiver mode. To set and retrieve the RS-232 transceiver mode, complete the following steps:

Note You can use the header file `NISerial.h`, included on your CD, to integrate this code into your program easily.

1. Add the following lines to your source code:

```
#include <winioctl.h>
#define RS232_MODE_DTE     0x00
#define RS232_MODE_DCE     0x01
#define RS232_MODE_AUTO    0x02

#define NISERIAL_SET_RS232_MODE
    CTL_CODE(FILE_DEVICE_SERIAL_PORT, 4081,
    METHOD_BUFFERED,FILE_ANY_ACCESS)
#define NISERIAL_GET_RS232_MODE
    CTL_CODE(FILE_DEVICE_SERIAL_PORT,
    4080,METHOD_BUFFERED,FILE_ANY_ACCESS)
```

2. To set the RS-232 transceiver, use `NISERIAL_SET_RS232_MODE` and DeviceIoControl. For example, to set to Force DCE mode, use the following code:

```
ULONG bytecount;
TRANSCEIVER_MODE transceiver_mode = RS232_MODE_DCE;
DeviceIoControl(
    comhandle,
    NISERIAL_SET_RS232_MODE,
    (PVOID) &transceiver_mode,
    sizeof(transceiver_mode),
    (PVOID) NULL, 0,
    &bytecount,
    NULL
);
```

3. To retrieve the current RS-232 transceiver mode, you can use `NISERIAL_GET_RS232_MODE` and DeviceIoControl with the following code:

```
ULONG bytecount;
TRANSCEIVER_MODE transceiver_mode;
DeviceIoControl(
    comhandle,
    NISERIAL_GET_RS232_MODE,
    (PVOID) NULL, 0,
    (PVOID) &transceiver_mode,
    sizeof(transceiver_mode),
    &bytecount,
    NULL
);
```

Retrieving the RS-232 Transceiver State with DeviceIoControl

The NI-Serial software uses programmatic control codes and the DeviceIoControl Windows function for retrieving the current RS-232 transceiver state. The function returns which mode the RS-232 transceivers are currently operating in (for example, if in Auto232 mode, and DTE mode was automatically selected, the transceiver state will be reported as DTE), and whether the serial connection is valid. To retrieve the current RS-232 transceiver state, complete the following steps:



Note You can use the header file `NISerial.h`, included on your CD, to integrate this code into your program easily.

Note *Tranceiver mode* refers to the programmed mode. *Transceiver state* refers to the physical state of the transceivers (actual operating mode and whether valid or invalid).

1. Add the following lines to your source code:

```
#include <winioctl.h>
#define RS232_MODE_DTE            0x00
#define RS232_MODE_DCE            0x01
typedef ULONG SERIAL_CONNECTION;
#define SERIAL_CONNECTION_INVALID 0x00
#define SERIAL_CONNECTION_VALID   0x01

typedef struct _SERIAL_RS232_STATE {
     TRANSCEIVER_MODE    PortMode;
     SERIAL_CONNECTION   Connection;
} SERIAL_RS232_STATE,*PSERIAL_RS232_STATE;

#define NISERIAL_GET_RS232_STATE
    CTL_CODE(FILE_DEVICE_SERIAL_PORT,
    4082,METHOD_BUFFERED,FILE_ANY_ACCESS)
```

2. To retrieve the current RS-232 transceiver state, use `NISERIAL_GET_RS232_STATE` and DeviceIoControl with the following code:

```
ULONG bytecount;
SERIAL_RS232_STATE serial_rs232_state;
DeviceIoControl(
    comhandle,
    NISERIAL_GET_RS232_STATE,
    (PVOID) NULL, 0,
    (PVOID) &serial_rs232_state,
    sizeof(serial_rs232_state),
    &bytecount,
    NULL
);
```

Setting Ring Indicate and DCD with DeviceIoControl

The NI-Serial software uses programmatic control codes and the DeviceIoControl Windows function for programming the RS-232 signals Ring Indicate (RI) and Data Carrier Detect (DCD). To set and retrieve these RS-232 signals, complete the following steps:

Note You can use the header file `NISerial.h`, included on your CD, to integrate this code into your program easily.

1. Add the following lines to your source code:

```
#include <winioctl.h>
typedef bool SERIAL_RI_OUT;
#define SERIAL_RI_ON      true
#define SERIAL_RI_OFF     false
typedef bool SERIAL_DCD_OUT;
#define SERIAL_DCD_ON     true
#define SERIAL_DCD_OFF    false

#define NISERIAL_SET_RI
   CTL_CODE(FILE_DEVICE_SERIAL_PORT,
   4062,METHOD_BUFFERED,FILE_ANY_ACCESS)
#define NISERIAL_CLR_RI
   CTL_CODE(FILE_DEVICE_SERIAL_PORT,
   4061,METHOD_BUFFERED,FILE_ANY_ACCESS)
#define NISERIAL_GET_RI
   CTL_CODE(FILE_DEVICE_SERIAL_PORT,
   4060,METHOD_BUFFERED,FILE_ANY_ACCESS)
#define NISERIAL_SET_DCD
   CTL_CODE(FILE_DEVICE_SERIAL_PORT,
   4072,METHOD_BUFFERED,FILE_ANY_ACCESS)
#define NISERIAL_CLR_DCD
   CTL_CODE(FILE_DEVICE_SERIAL_PORT,
   4071,METHOD_BUFFERED,FILE_ANY_ACCESS)
#define NISERIAL_GET_DCD
   CTL_CODE(FILE_DEVICE_SERIAL_PORT,
   4070,METHOD_BUFFERED,FILE_ANY_ACCESS)
```

2. To set the RS-232 signal RI when the transceiver is in DCE mode, use the following code:

```
ULONG bytecount;
DeviceIoControl(
    comhandle,
    NISERIAL_SET_RI,
    (PVOID) NULL, 0,
    (PVOID) NULL, 0,
    &bytecount,
    NULL
);
```

3. To clear the RS-232 signal RI when the transceiver is in DCE mode, use the following code:

```
ULONG bytecount;
DeviceIoControl(
```

```
    comhandle,
    NISERIAL_CLR_RI,
    (PVOID) NULL, 0,
    (PVOID) NULL, 0,
    &bytecount,
    NULL
);
```

4. To retrieve the current state of the RS-232 signal RI when the transceiver is in DCE mode, use the following code:

```
SERIAL_RI_OUT serial_ri_out;
ULONG bytecount;
DeviceIoControl(
    comhandle,
    NISERIAL_GET_RI,
    (PVOID) NULL, 0,
    (PVOID) &serial_ri_out, sizeof(serial_ri_out),
    &bytecount,
    NULL
);
```

5. To set the RS-232 signal DCD when the transceiver is in DCE mode, use the following code:

```
ULONG bytecount;
DeviceIoControl(
    comhandle,
    NISERIAL_SET_DCD,
    (PVOID) NULL, 0,
    (PVOID) NULL, 0,
    &bytecount,
    NULL
);
```

6. To clear the RS-232 signal DCD when the transceiver is in DCE mode, use the following code:

```
ULONG bytecount;
DeviceIoControl(
    comhandle,
    NISERIAL_CLR_DCD,
    (PVOID) NULL, 0,
    (PVOID) NULL, 0,
    &bytecount,
    NULL
);
```

7. To retrieve the current state of the RS-232 signal DCD when the transceiver is in DCE mode, use the following code:

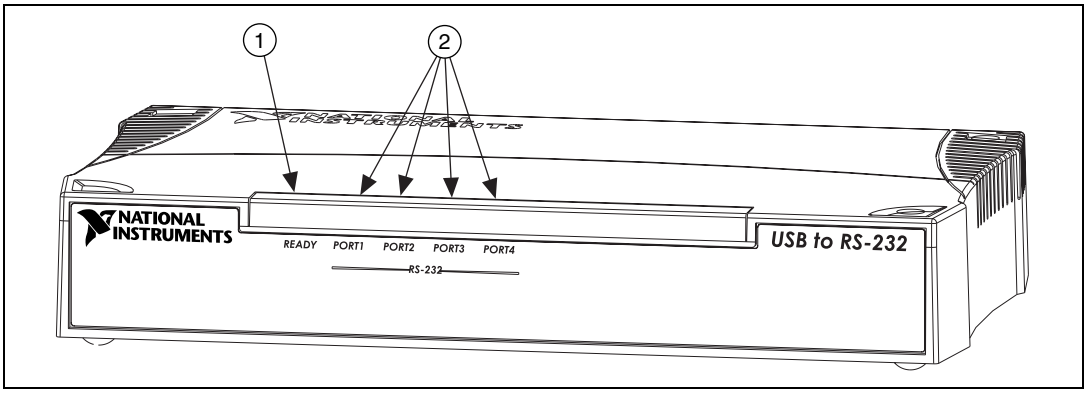
```
SERIAL_DCD_OUT serial_dcd_out;
ULONG bytecount;
DeviceIoControl(
    comhandle,
    NISERIAL_GET_DCD,
    (PVOID) NULL, 0,
    (PVOID) &serial_dcd_out,
    sizeof(serial_dcd_out),
    &bytecount,
    NULL
);
```

Status LEDs

The USB Serial two- and four-port hardware uses bicolor LEDs to indicate device and port status. Table 7-6 describes these LEDs; Figure 7-3 shows their location.

Table 7-6. USB-Serial LEDs

LED	Description
Ready	**Dim Red**—Powered, but not connected to USB (USB-485/4 only) **Red**—Powered and connected to USB, but not fully configured **Yellow**—Device is ready (normal operation) **Blinking Red or Red-Yellow**—Device error. Contact NI.
Port *x*	**Solid Red**—Port is open, but no valid signals detected (USB-232 only) **Solid Green**—Port is open **Blinking Yellow**—Port is transmitting **Blinking Green**—Port is receiving **Alternated Blinking Green/Yellow**—Port is transmitting and receiving **Blinking Red**—Port error (framing error, FIFO overrun, or parity error)



1 READY LED	2 PORT LEDs

Figure 7-3. USB-Serial Hardware LEDs

Retrieving the Serial Interface Type

The NI-Serial software uses programmatic control codes and the DeviceIoControl Windows function for retrieving the serial interface type of a paticular serial communication port. To retrieve the serial interface type, complete the following steps:

Note You can use the header file `NISerial.h`, included on your CD, to integrate this code into your program easily.

1. Add the following lines to your source code:

```
#include <winioctl.h>
typedef ULONG SERIAL_INTERFACE;
#define RS485_INTERFACE      0x00
#define RS232_INTERFACE      0x01

#define NISERIAL_GET_INTERFACE_TYPE
  CTL_CODE(FILE_DEVICE_SERIAL_PORT,
  4050,METHOD_BUFFERED,FILE_ANY_ACCESS)
```

2. To retrieve the serial interface type, use `NISERIAL_GET_INTERFACE_TYPE` and DeviceIoControl with the following code:

```
SERIAL_INTERFACE serial_interface
ULONG bytecount;
DeviceIoControl(
    comhandle,
    NISERIAL_GET_INTERFACE_TYPE,
```

```
    (PVOID) NULL, 0,
    (PVOID) &serial_interface,
    sizeof(serial_interface),
    &bytecount,
    NULL
);
```

A

Connector Descriptions

Connecting Cables

For the PCMCIA and USB hardware and two-port PCI, PXI, and AT serial hardware, you can use the standard DB-9 connector found on most serial cables. To use the DB-9 connector with the four-port PCI, PXI, and AT serial hardware, you need the 10-position modular jack to DB-9 cable, which is available from National Instruments. You can also use a DB-25 connector with the four-port serial boards by ordering the 10-position modular jack to DB-25 converter cable from National Instruments.
The eight-port serial boards include a pig tail cable adapter, providing eight standard DB-9 connectors. The 16-port boards include a breakout box, providing 16 standard DB-9 connectors.

Note To achieve the specified isolation voltage for four-port isolated PCI, PXI, or AT serial boards, use *only* the 10-position modular jack to DB-9 cable included in your four-port isolated PCI or AT serial board kit.

For more information about cable connectors, see the connector descriptions in this appendix.

Connecting Two-Wire Devices

The PCI-485, USB-485, PCMCIA-485, RS-485 PXI (PXI-8421 and PXI-8423), and AT-485 hardware is designed to work with either two- or four-wire devices. If you are using a two-wire device, refer to the device documentation for specific wiring instructions.

In general, half-duplex networks use a single twisted pair of wires for communication in both directions, so you must connect both the transmitter and the receiver at each end of the same pair of wires. For example, to connect an RS-485 data acquisition device to a port on your board using half-duplex communication, you need a single twisted pair of wires.
At the board, connect the TXD+ and RXD+ signals (pins 8 and 4 on a DB-9 connector, pins 5 and 20 on a DB-25 connector) together and to one wire. Connect the other end of this wire to both the TXD+ and RXD+ signals on the data acquisition device. Use the same method to connect the

TXD– and RXD– signals (pins 9 and 5 on a DB-9 connector, pins 22 and 7 on a DB-25 connector) to the second wire.

For information about setting the transceiver mode for two-wire communication, refer to Chapter 7, *Using Your Serial Hardware*. For more information about duplex architectures, refer to Appendix B, *Serial Port Information*.

DB-9 Connector

Figure A-1 and Table A-1 give the pin locations and descriptions of the DB-9 connector, the 10-position modular jack to DB-9 cable, the cable adapter for the eight-port board, and the DB-9 connectors to the 16-port breakout box.

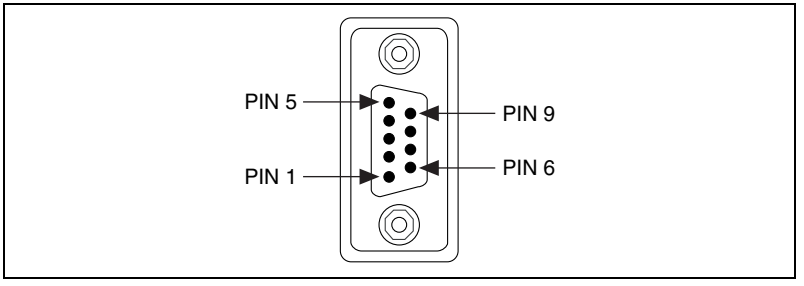


Figure A-1. DB-9 Connector Pin Locations

Table A-1. DB-9 Pin Descriptions

DB-9 Pin	232 Signal		485 Signal
	DTE	DCE	
1	DCD*	DCD	GND
2	RXD	TXD	CTS+ (HSI+)
3	TXD	RXD	RTS+ (HSO+)
4	DTR*	DSR	RXD+
5	GND	GND	RXD–
6	DSR*	DTR	CTS– (HSI–)
7	RTS	CTS	RTS– (HSO–)

Table A-1. DB-9 Pin Descriptions (Continued)

DB-9 Pin	232 Signal		485 Signal
	DTE	DCE	
8	CTS	RTS	TXD+
9	RI*	RI	TXD–

* These signals are not supported by the isolated 232 boards or ports 9–16 of the RS-232 16-port board.

Note DCE signals are available only on the USB-232 two and four-port serial hardware.

Modular Jack Connector

Figure A-2 and Table A-2 give the pin locations and descriptions of the 10-position modular jack.

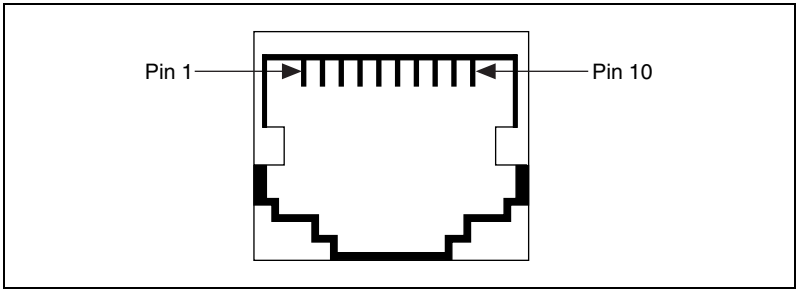


Figure A-2. 10-Position Modular Jack Pin Locations

Table A-2. 10-Position Modular Jack Pin Descriptions

10-Position Modular Jack Pin	232 Signal	485 Signal
10	DCD*	GND
9	RXD	CTS+ (HSI+)
8	TXD	RTS+ (HSO+)
7	DTR*	RXD+
6	GND	RXD–
5	DSR*	CTS– (HSI–)

Table A-2. 10-Position Modular Jack Pin Descriptions (Continued)

10-Position Modular Jack Pin	232 Signal	485 Signal
4	RTS	RTS– (HSO–)
3	CTS	TXD+
2	RI*	TXD–
1	No Connect	No Connect
* These signals are not supported by the isolated 232 ports.		

DB-25 Connector

Figure A-3 and Table A-3 give the pin locations and descriptions of the DB-25 connector, which is on the optional 10-position modular jack to DB-25 cable.

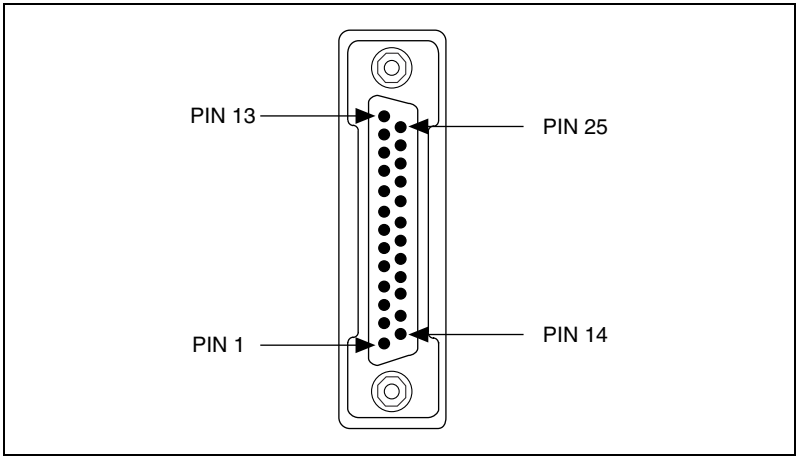


Figure A-3. DB-25 Connector Pin Locations

Table A-3. DB-25 Pin Descriptions

DB-25 Pin	232 Signal	485 Signal
2	TXD	RTS+ (HSO+)
3	RXD	CTS+ (HSI+)
4	RTS	RTS– (HSO–)

Table A-3. DB-25 Pin Descriptions (Continued)

DB-25 Pin	232 Signal	485 Signal
5	CTS	TXD+
6	DSR*	CTS– (HSI–)
7	GND	RXD–
8	DCD*	GND
20	DTR*	RXD+
22	RI*	TXD–

Pins not listed in this table are No Connect.
* These signals are not supported by the isolated 232 ports.

Figure A-4 shows how to connect the cables when you install a four-port PCI serial board.

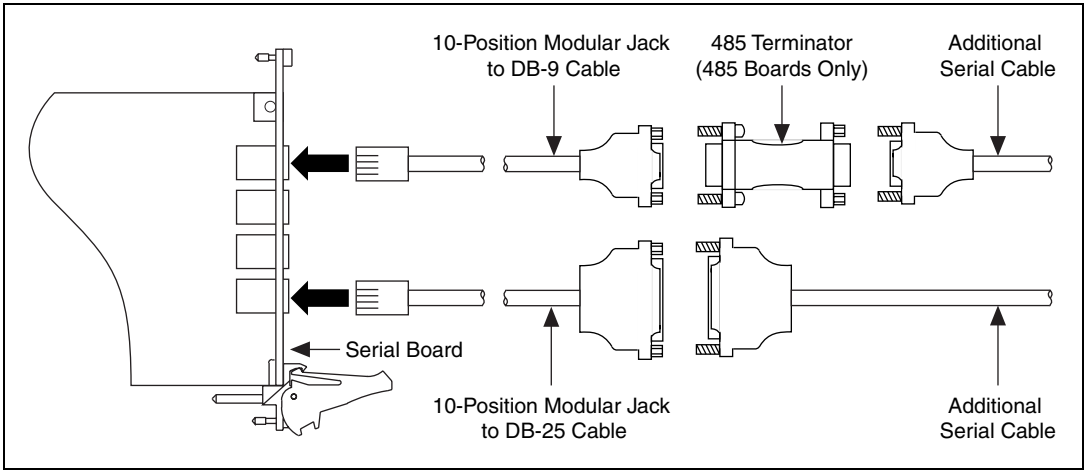


Figure A-4. Connecting the Cables to Your Four-Port PCI Serial Board

68-Pin Connector

Figure A-5 and Table A-4 give the pin locations and descriptions of the 68-pin connector.

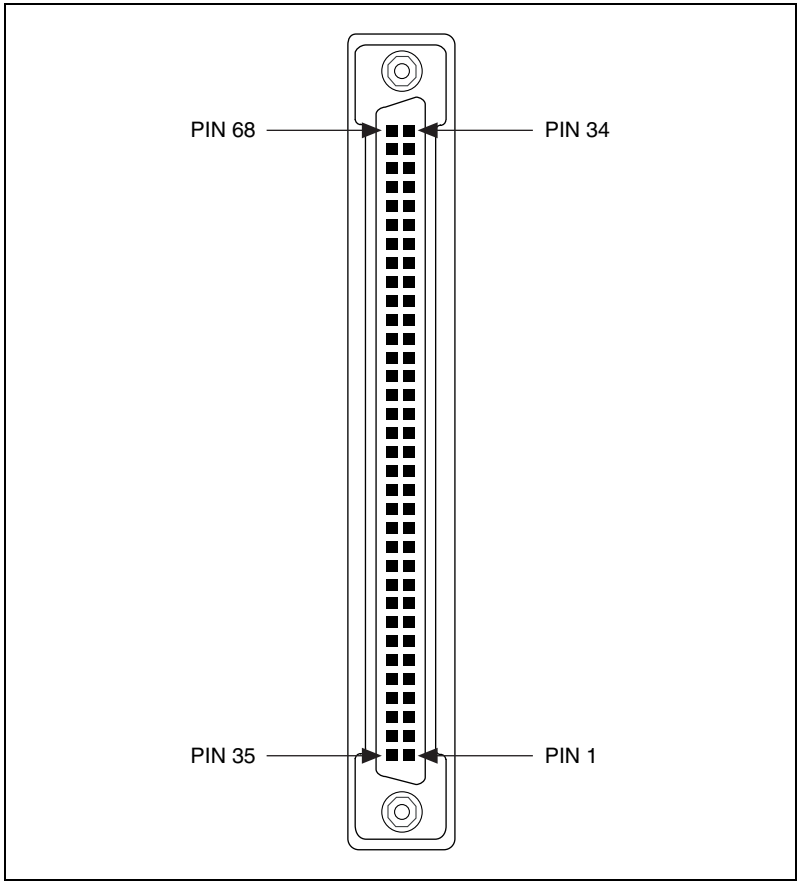


Figure A-5. 68-Pin Connector Pin Locations

Table A-4. 68-Pin Connector Pin Descriptions

68-Pin Connector Port								485 Signal	485 D-Sub 9 Connector	232 Signal	232 D-Sub 9 Connector
1	2	3	4	5	6	7	8				
66	57	49	40	32	23	15	6	RXD–	5	DCD	1
68	59	51	42	34	25	17	8	CTS+	2	RXD	2
65	56	48	39	31	22	14	5	RTS+	3	TXD	3
64	55	47	38	30	21	13	4	RXD+	4	DTR	4
60	60	43	43	26	26	9	9	GND	1	GND	5
63	54	46	37	29	20	12	3	CTS–	6	DSR	6
62	53	45	36	28	19	11	2	RTS–	7	RTS	7
61	52	44	35	27	18	10	1	TXD+	8	CTS	8
67	58	50	41	33	24	16	7	TXD–	9	RI	9

100-Pin Connector

Figure A-6 and Table A-5 give the pin locations and descriptions of the 100-pin connector.

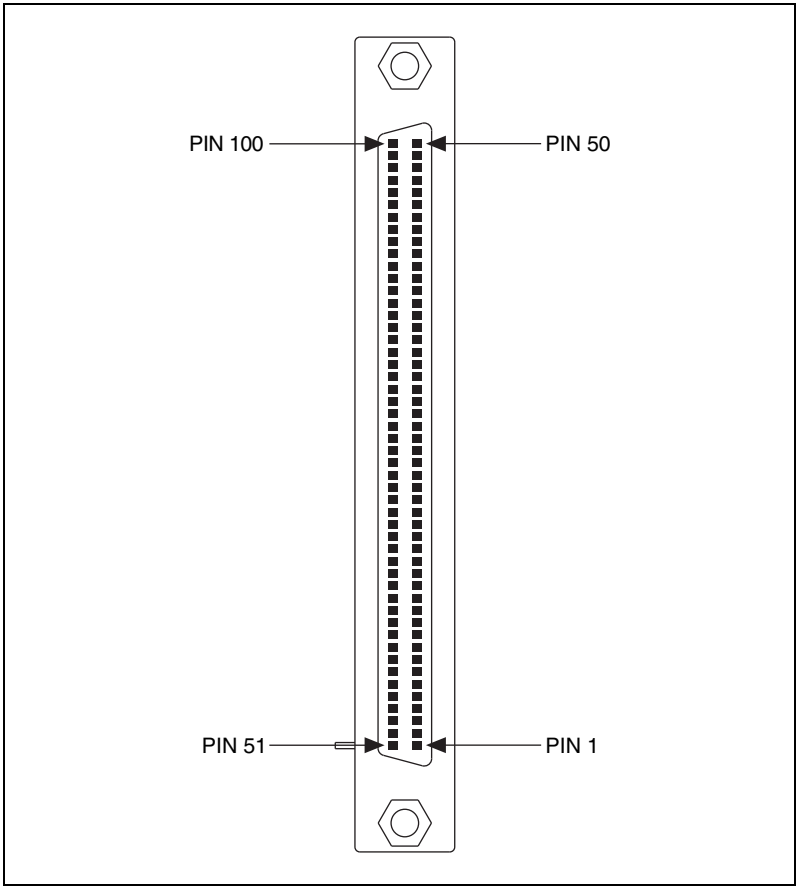


Figure A-6. 100-Pin Connector Pin Locations

Table A-5. 100-Pin Connector Pin Descriptions

100-Pin Connector Port																232 Signal	232 D-Sub 9 Connector
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**		
2	46	6	42	10	38	14	34	—	—	—	—	—	—	—	—	DCD*	1
3	47	7	43	11	39	15	35	18	32	20	30	22	28	24	26	RXD	2
4	48	8	44	12	40	16	36	19	33	21	31	23	29	25	27	TXD	3
5	49	9	45	13	41	17	37	—	—	—	—	—	—	—	—	DTR*	4
1	1	1	1	50	50	50	50	51	51	51	51	100	100	100	100	GND	5
52	96	56	92	60	88	64	84	—	—	—	—	—	—	—	—	DSR*	6
53	97	57	93	61	89	65	85	68	82	70	80	72	78	74	76	RTS	7
54	98	58	94	62	90	66	86	69	83	71	81	73	79	75	77	CTS	8
55	99	59	95	63	91	67	87	—	—	—	—	—	—	—	—	RI*	9

* These signals are not supported on ports 9–16 of the 16-port PCI and PXI serial boards.

B

Serial Port Information

This appendix describes the RS-232, RS-422, and RS-485 standards and explains some of the issues involved with these types of serial communication.

Table B-1 lists the features of the RS-232, RS-422, and RS-485 standards.

Table B-1. RS-232, RS-422, and RS-485 Features

Feature	RS-232	RS-422	RS-485
Type of transmission lines	Single ended	Differential	Differential
Maximum number of drivers	1	1	32
Maximum number of receivers	1	10	32
Maximum cable length	50 ft	4,000 ft	4,000 ft
Maximum data rate	20 kbytes/s	10 Mbytes/s	10 Mbytes/s
Maximum CMV	± 25 V	±7 V	+12 to –7 V
Driver output	5 to 25 V	2 to 6 V	1.5 to 6 V
Driver load	>3 kΩ	100 Ω	60 Ω

RS-232

As specified in the ANSI/EIA-232-D Standard, *Interface Between Data Terminal Equipment and Data Circuit-Terminating Equipment Employing Serial Binary Data Interchange*, RS-232 standardizes serial communication between computers, and between computer terminals and modems. Many applications use the RS-232 standard to interface peripherals to personal computers. RS-232 uses transmission lines in which the state of each signal is represented by referencing the voltage level of a single line to ground. RS-232 was designed for serial communication up to

distances of 50 ft and with data rates up to 20 kbytes/s. However, because of improvements in line drivers and cabling, you can usually increase the actual performance of the bus past the limitations on speed and distance recommended in the specification.

RS-422

As specified in the EIA/RS-422-A Standard, *Electrical Characteristics of Balanced Voltage Digital Interface Circuits*, RS-422 defines a serial interface much like RS-232. However, RS-422 uses balanced (or differential) transmission lines. Balanced transmission lines use two transmission lines for each signal. The state of each signal is represented, not by a voltage level on one line referenced to ground as in RS-232, but rather by the relative voltage of the two lines to each other. For example, the TX signal is carried on two wires, wire A and wire B. A logical 1 is represented by the voltage on line A being greater than the voltage on line B. A logical 0 is represented by the voltage on line A being less than the voltage on line B. Differential voltage transmission creates a signal that is more immune to noise as well as voltage loss due to transmission line effects. Thus, you can use RS-422 for longer distances (up to 4,000 ft) and greater transmission speeds (up to 10 Mbytes/s) than RS-232.

RS-485

As specified in the EIA-485 Standard, *Standard for Electrical Characteristics of Generators and Receivers for Use in Balanced Digital Multipoint Systems*, RS-485 expands on the RS-422 standard by increasing the number of devices you can use from 10 to 32 and by working with half-duplex bus architectures. Unlike the RS-422 standard, RS-485 addresses the issue of using multiple transmitters on the same line. RS-485 defines the electrical characteristics necessary to ensure adequate signal voltages under maximum load, short-circuit protection. RS-485 can also withstand multiple drivers driving conflicting signals at the same time.

Serial Communication Issues

This section explains some serial communication issues, including duplex architectures, termination methods, bias resistors, and types of connecting equipment.

Duplex Architectures

Duplex refers to the means of bandwidth usage in a serial system. The two common means of bi-directional serial communication are full duplex and half duplex. Half-duplex communication involves a transmitter and a receiver connected to each end of the same wire or pair of wires. Because the same transmission line both sends and receives data, devices cannot send data in both directions at the same time. First, one device transmits over the wire(s) to the receiver of the second device. When the first device finishes transmitting, both devices switch the connections from their transmitter to their receiver, or vice versa. The device that was receiving data can then transmit over the line.

In full-duplex communication, the devices use a separate wire (or pair of wires) for simultaneous transmission in each direction. Thus, the devices do not switch between transmitting and receiving.

In a differential serial bus (such as RS-422 or RS-485), a half-duplex system transmits and receives over the same twisted pair of wires. Thus, half-duplex communication is often referred to as *two-wire* communications. Likewise, full-duplex communication is often referred to as *four-wire* communications, because the full-duplex system uses a separate pair of wires for communication in each direction.

Full Duplex

A typical full-duplex multidrop bus architecture involves a master-slave protocol. Only one device, the master, can control access to the bus. All other devices are slaves. Slave devices must wait for the master to give them access to the bus. In a typical full-duplex system, one transmission line connects the bus master transmitter to all of the slave receivers. A second transmission line connects all of the slave transmitters to the bus master receiver. Because each transmission line has two separate wires, a full-duplex system is often referred to as a four-wire system. Figure B-1 shows a typical full-duplex system.

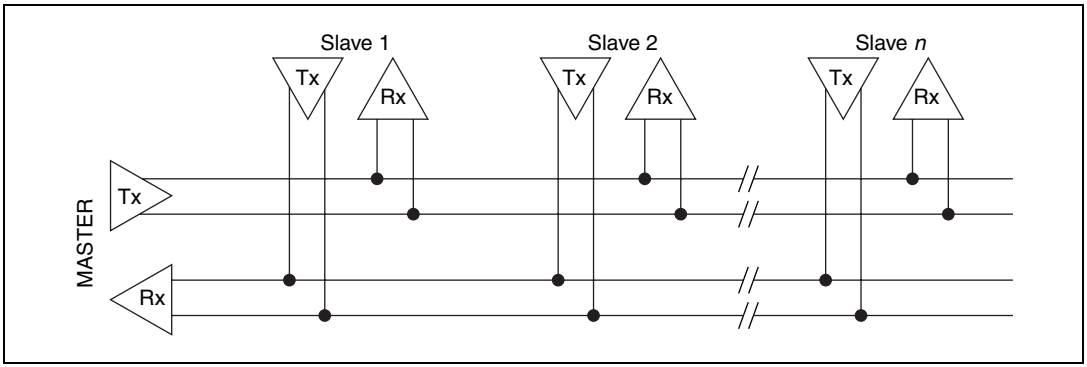


Figure B-1. Typical Full-Duplex System

Half Duplex

A typical half-duplex multidrop bus architecture also involves a master-slave protocol. However, in a half-duplex system, all transmitters and receivers are connected to the same transmission line. A half-duplex system is often referred to as a two-wire system. Figure B-2 shows a typical half-duplex system.

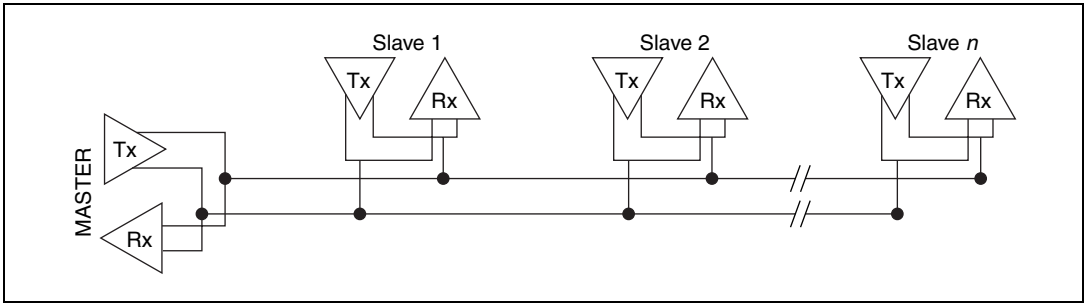


Figure B-2. Typical Half-Duplex System

RS-485 Termination

Because each differential pair of wires is a transmission line, you must properly terminate the line to prevent reflections. A common method of terminating a two-wire multidrop RS-485 network is to install terminating resistors at each end of the multidrop network. If you daisy-chained multiple instruments together, you need a terminating resistor at only the first and last instruments. The terminating resistor should match the characteristic impedance of the transmission line (typically 100 to 120 Ω). You can order an optional DB-9 RS-485 termination connector that

contains embedded terminating resistors for easy termination from National Instruments. For ordering information, contact National Instruments.

Figure B-3 shows a multidrop network using terminating resistors.

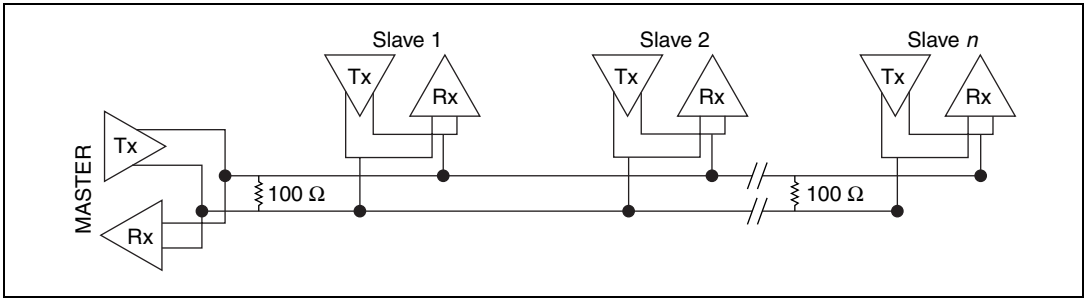


Figure B-3. Multidrop Network Using Terminating Resistors

Figure B-4 shows a full-duplex network using terminating resistors.

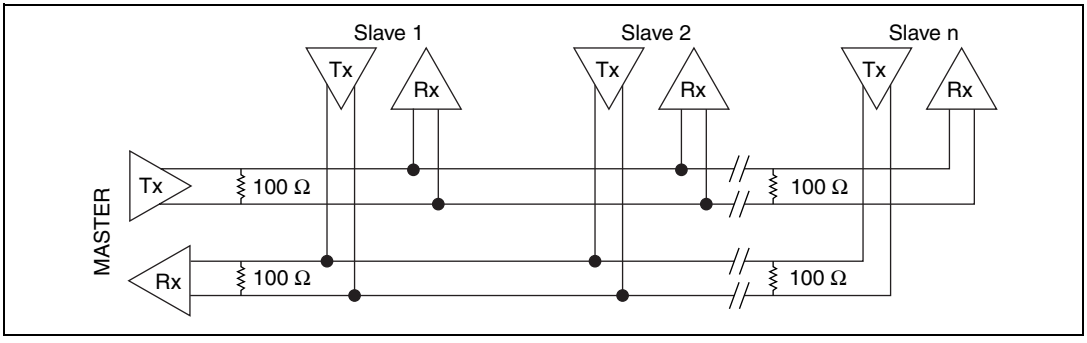


Figure B-4. Full-Duplex Network Using Terminating Resistors

Bias Resistors

An RS-485 transmission line enters an indeterminate state if no nodes are transmitting on it. This indeterminate state can cause the receivers to receive invalid data bits from noise picked up on the cable. To prevent a line from receiving these data bits, the transmission line can be forced into a known state by installing two bias resistors at one node on the transmission line. Doing so creates a voltage divider that forces the voltage between the differential pair to be greater than 200 mV, the threshold voltage for the receiver. You should install these resistors on only one node. For more information about RS-485 bias resistors, refer to Chapter 7, *Using Your Serial Hardware*.

RS-232 DTE versus DCE

In the RS-232 specification, DTE (Data Terminal Equipment) and DCE (Data Communications Equipment)[1] refer to the types of equipment on either end of a serial connection. In general, DTE and DCE refer to computer equipment and modems, respectively. Because the RS-232 specification mainly involves connecting a DTE directly to a DCE and vice versa, the pinouts are defined so that cabling is simple. That is, a cable connected a computer to a modem by wiring pin 1 to pin 1, pin 2 to pin 2, and so on. This method is known as *straight-through* cabling.

Figure B-5 shows straight-through cabling in a DTE-to-DCE interface.

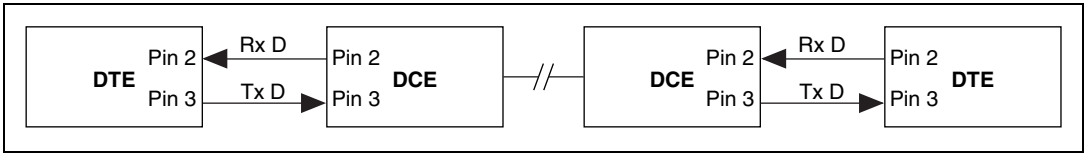


Figure B-5. Straight-Through Cabling in a DTE-to-DCE Interface

Straight-through cabling is still the standard method to connect a modem to your PC. However, because many applications use serial communication to connect two or more DTEs without modems, the cabling becomes more complicated. If two DTEs are wired together using a straight-through cable, one transmitter is connected to the other transmitter, and one receiver is connected to the other receiver. In this setup, no transmissions can occur. Thus, these applications must use a cabling scheme that connects the transmitter on one device to the receiver on the other device and vice versa. This method is known as *null-modem* cabling, because it replaces the two modems that traditional RS-232 applications would require between the two DTEs. To communicate from one DTE serial port to another, use a null-modem cable.

[1] In Revision D of the RS-232 specification, a DCE is a Data Circuit-Terminating Equipment.

Figure B-6 shows null-modem cabling in a DTE-to-DTE interface.

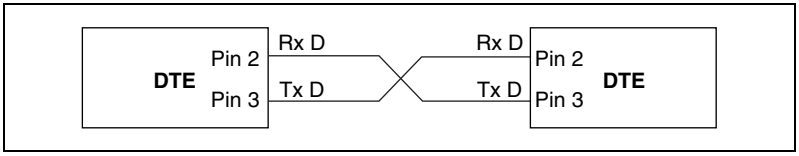


Figure B-6. Null-Modem Cabling in a DTE-to-DTE Interface

PCI/PXI/PCMCIA/AT RS-232 ports are DTE serial ports.

DCE Mode and Auto232

In addition to supporting the standard DTE transceiver mode, the USB-232 two and four-port hardware also supports a DCE transceiver mode.

In this mode, the USB-232 two- and four-port hardware acts as a DCE interface and can generate the communication signals RI and DCD. Because the Win32 API does not support the generation of these signals, special IOCTL calls must be used. For more information, refer to Chapter 7, *Using Your Serial Hardware*. In addition, TXD is swapped with RXD, CTS is swapped with RTS, and DTR is swapped with DSR. The USB-232 hardware can be forced into either DTE or DCE modes or an automatic detection mode (Auto232). When in Auto232 mode, a DTE or DCE device can be connected with either a straight-through or null-modem cable, and the hardware automatically selects the proper transceiver mode. For more information about setting these modes, refer to Chapter 7, *Using Your Serial Hardware*.

Table B-2 lists the signals in DTE and DCE modes.

Table B-2. USB-232 DTE and DCE Modes

Pin	DTE Mode	DCE Mode
1	DCD	DCD
2	RXD	TXD
3	TXD	RXD
4	DTR	DSR
5	GND	GND
6	DSR	DTR
7	RTS	CTS
8	CTS	RTS
9	RI	RI

C

Uninstalling the Hardware and Software

This appendix describes how to uninstall your serial hardware and the NI-Serial software.

To begin your uninstallation, see the section of this appendix containing instructions for your hardware platform and operating system:

PCI Hardware....C-2
Windows 2000....C-2
Windows Me/9*x*....C-3
Windows NT....C-5
PXI Hardware....C-7
Windows 2000....C-7
Windows Me/9*x*....C-9
Windows NT....C-11
USB Hardware....C-12
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Windows 2000....C-13
Windows Me/9*x*....C-15
Windows NT....C-17
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PCI Hardware

Windows 2000

Uninstall the Hardware

Before you physically remove the serial hardware from your system, you must remove the hardware information. To do so, complete the following steps:

1. Select **Start»Settings»Control Panel** and double-click the **System** icon.
2. Select the **Hardware** tab and click the **Device Manager** button.
3. Double-click the **Multi-function adapters** icon.
4. From the **Multi-function adapters** list, right-click the National Instruments interface that you want to uninstall, as shown in Figure C-1.

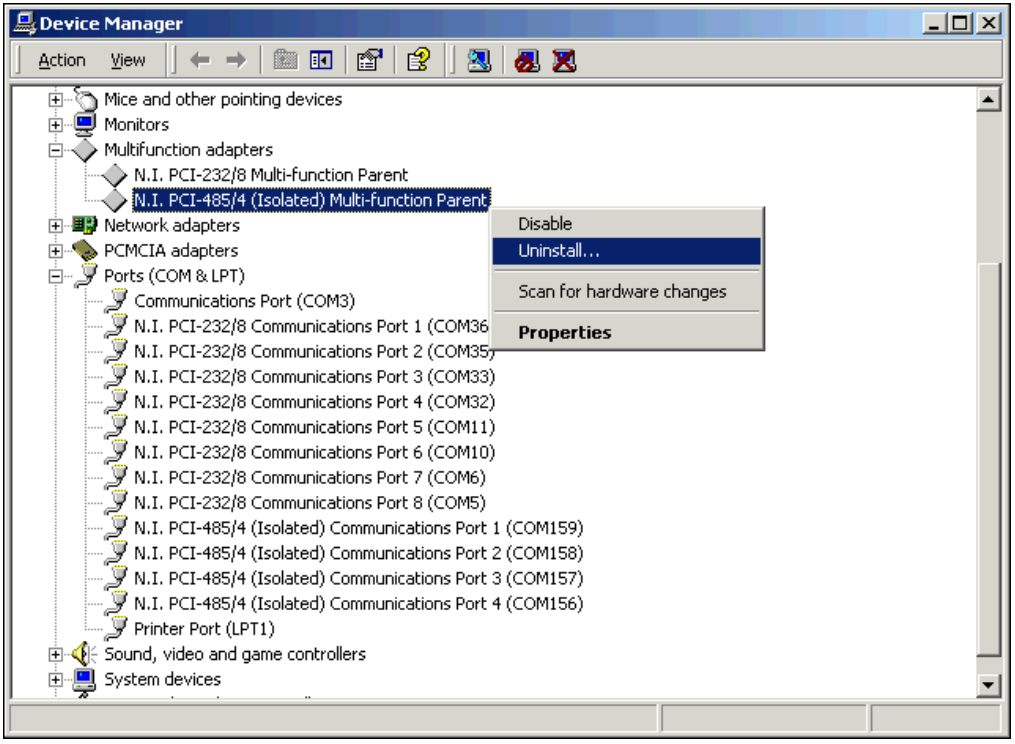


Figure C-1. Selecting an Interface to Uninstall

5. Choose the **Uninstall** option.
6. In the **Confirm Device Removal** dialog box, click the **OK** button to remove the hardware information, or click the **Cancel** button to cancel your request.

Uninstall the Software

Before you uninstall the NI-Serial software, you must remove the hardware information from your system, as described in the previous section.

To uninstall the NI-Serial software, complete the following steps:

1. Select **Start»Settings»Control Panel**.
2. Double-click the **Add/Remove Programs** icon. The **Add/Remove Programs** dialog box appears. This dialog box lists the software that you can uninstall.
3. Select **NI-Serial** and click the **Change/Remove** button. The uninstallation program removes all folders, utilities, and registry entries associated with the NI-Serial software.
4. Shut down Windows 2000, power off your computer, and physically remove the serial interfaces from your system.

The uninstallation program removes only items that the setup wizard installed. If you added anything to a directory that the setup wizard created, the uninstallation program does not delete that directory. You must remove any remaining components yourself.

To reinstall the hardware and software, refer to Chapter 2, *PCI Serial Hardware Installation, Verification, and Configuration*.

Windows Me/9*x*

Uninstall the Hardware

Before you physically remove the serial hardware from your system, you must remove the hardware information. To do so, complete the following steps:

1. Select **Start»Settings»Control Panel** and double-click the **System** icon.
2. Select the **Device Manager** tab and click the **View devices by type** button.
3. Double-click the **Multi-function adapters** icon.

4. From the **Multi-function adapters** list, select the National Instruments interface that you want to uninstall, as shown in Figure C-2.

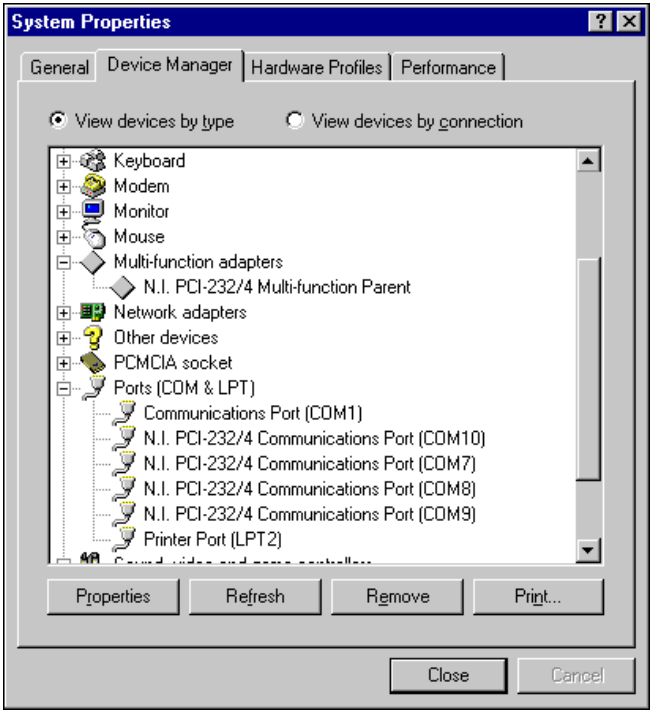


Figure C-2. Selecting an Interface to Uninstall

5. Click the **Remove** button.
6. In the **Confirm Device Removal** dialog box, click the **OK** button to remove the hardware information, or click the **Cancel** button to cancel your request.

Uninstall the Software

Before you uninstall the NI-Serial software, you must remove the hardware information from your system, as described in the previous section.

To uninstall the NI-Serial software, complete the following steps:

1. Select **Start»Settings»Control Panel**.
2. Double-click the **Add/Remove Programs** icon. The Add/Remove Programs dialog box appears. This dialog box lists the software that you can uninstall.
3. Select the NI-Serial software you want to uninstall, and click the **Add/Remove** button. The uninstallation program removes all folders, utilities, and registry entries associated with the NI-Serial software.
4. Shut down Windows Me/9*x*, power off your computer, and physically remove the serial interfaces from your system.

The uninstallation program removes only items that the setup wizard installed. If you added anything to a directory that the setup wizard created, the uninstallation program does not delete that directory. You must remove any remaining components yourself.

To reinstall the hardware and software, refer to Chapter 2, *PCI Serial Hardware Installation, Verification, and Configuration*.

Windows NT

Uninstall the Hardware

Before you physically remove the serial hardware from your system, you must remove the hardware information. To do so, complete the following steps:

1. Log in as `Administrator` or as a user who has `Administrator` privileges.
2. Select **Start»Settings»Control Panel** and double-click the **niports** icon.
3. From the **Ports** list, select the port of the board you want to uninstall, as shown in Figure C-3.

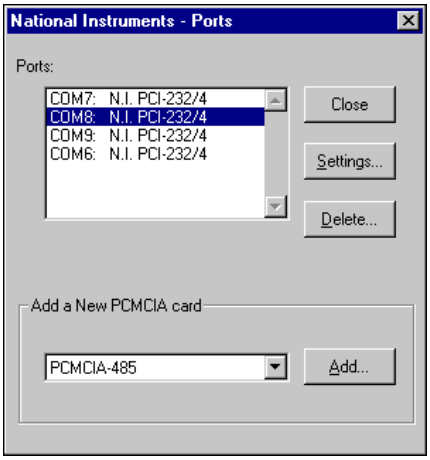


Figure C-3. Selecting an Interface to Uninstall

4. Click the **Delete** button.
5. Repeat steps 3 and 4 until you have removed every PCI serial port that you want to uninstall.

Uninstall the Software

Before you uninstall the NI-Serial software, you must remove the hardware information from your system, as described in the previous section.

To uninstall the NI-Serial software, complete the following steps:

1. Select **Start»Settings»Control Panel**.
2. Double-click the **Add/Remove Programs** icon. The **Add/Remove Programs** dialog box appears. This dialog box lists the software that you can uninstall.
3. Select the NI-Serial software you want to uninstall, and click the **Add/Remove** button. The uninstallation program removes all folders, utilities, and registry entries associated with the NI-Serial software.
4. Shut down Windows NT, power off your computer, and physically remove the serial interfaces from your system.

The uninstallation program removes only items that the setup wizard installed. If you added anything to a directory that the setup wizard created, the uninstallation program does not delete that directory. You must remove any remaining components yourself.

To reinstall the hardware and software, refer to Chapter 2, *PCI Serial Hardware Installation, Verification, and Configuration*.

PXI Hardware

Windows 2000

Uninstall the Hardware

Before you physically remove the serial hardware from your system, you must remove the hardware information. To do so, complete the following steps:

1. Select **Start»Settings»Control Panel** and double-click the **System** icon.
2. Select the **Hardware** tab and click the **Device Manager** button.
3. Double-click the **Multi-function adapters** icon.
4. From the **Multi-function adapters** list, right-click the National Instruments interface that you want to uninstall, as shown in Figure C-4.

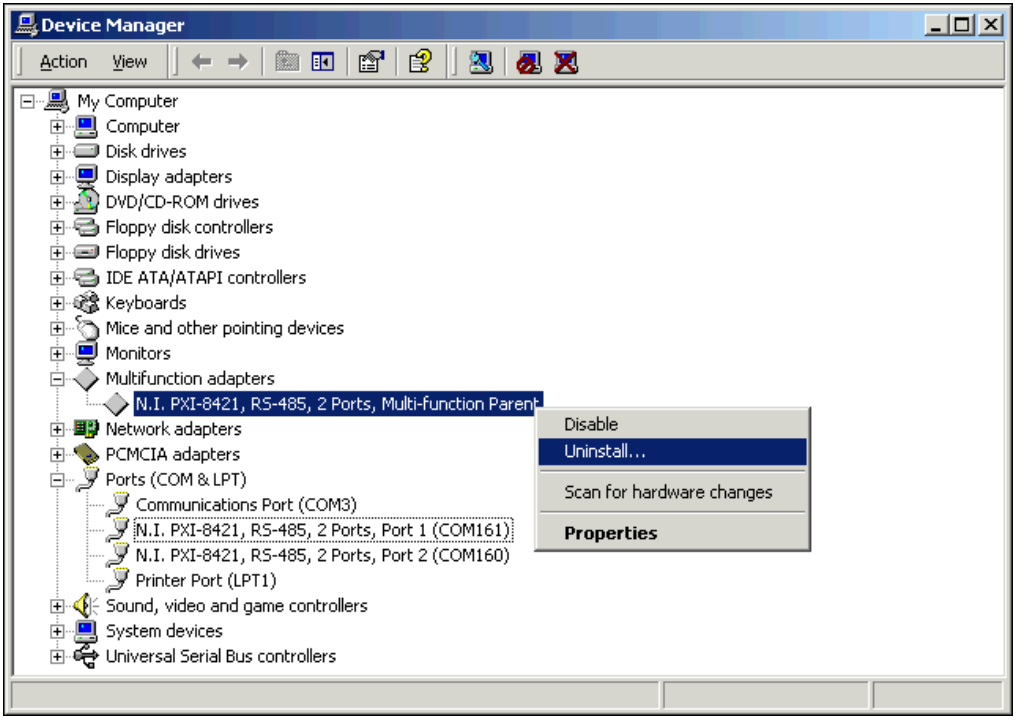


Figure C-4. Selecting an Interface to Uninstall

5. Choose the **Uninstall** option.
6. In the **Confirm Device Removal** dialog box, click the **OK** button to remove the hardware information, or click the **Cancel** button to cancel your request.

Uninstall the Software

Before you uninstall the NI-Serial software, you must remove the hardware information from your system, as described in the previous section.

To uninstall the NI-Serial software, complete the following steps:

1. Select **Start»Settings»Control Panel**.
2. Double-click the **Add/Remove Programs** icon. The **Add/Remove Programs** dialog box appears. This dialog box lists the software that you can uninstall.

3. Select **NI-Serial** and click the **Change/Remove** button. The uninstallation program removes all folders, utilities, and registry entries associated with the NI-Serial software.
4. Shut down Windows 2000, power off your computer, and physically remove the serial interfaces from your system.

The uninstallation program removes only items that the setup wizard installed. If you added anything to a directory that the setup wizard created, the uninstallation program does not delete that directory. You must remove any remaining components yourself.

To reinstall the hardware and software, refer to Chapter 3, *PXI Serial Hardware Installation, Verification, and Configuration*.

Windows Me/9*x*

Uninstall the Hardware

Before you physically remove the serial hardware from your system, you must remove the hardware information. To do so, complete the following steps:

1. Select **Start»Settings»Control Panel** and double-click the **System** icon.
2. Select the **Device Manager** tab and click the **View devices by type** button.
3. Double-click the **Multi-function adapters** icon.
4. From the **Multi-function adapters** list, select the National Instruments interface that you want to uninstall, as shown in Figure C-5.

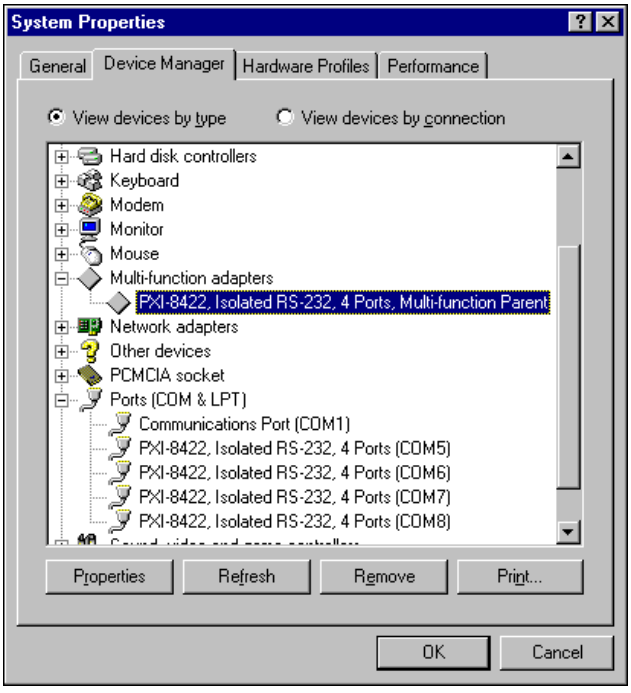


Figure C-5. Selecting an Interface to Uninstall

5. Click the **Remove** button.
6. In the **Confirm Device Removal** dialog box, click the **OK** button to remove the hardware information, or click the **Cancel** button to cancel your request.

Uninstall the Software

Before you uninstall the NI-Serial software, you must remove the hardware information from your system, as described in the previous section.

To uninstall the NI-Serial software, complete the following steps:

1. Select **Start»Settings»Control Panel**.
2. Double-click the **Add/Remove Programs** icon. The **Add/Remove Programs** dialog box appears. This dialog box lists the software that you can uninstall.
3. Select the NI-Serial software you want to uninstall, and click the **Add/Remove** button. The uninstallation program removes all folders, utilities, and registry entries associated with the NI-Serial software.

4. Shut down Windows Me/9*x*, power off your computer, and physically remove the serial interfaces from your system.

The uninstallation program removes only items that the setup wizard installed. If you added anything to a directory that the setup wizard created, the uninstallation program does not delete that directory. You must remove any remaining components yourself.

To reinstall the hardware and software, refer to Chapter 3, *PXI Serial Hardware Installation, Verification, and Configuration*.

Windows NT

Uninstall the Hardware

Before you physically remove the serial hardware from your system, you must remove the hardware information. To do so, complete the following steps:

1. Log in as `Administrator` or as a user who has `Administrator` privileges.
2. Select **Start»Settings»Control Panel** and double-click the **niports** icon. From the **Ports** list, select the port of the board you want to uninstall, as shown in Figure C-6.

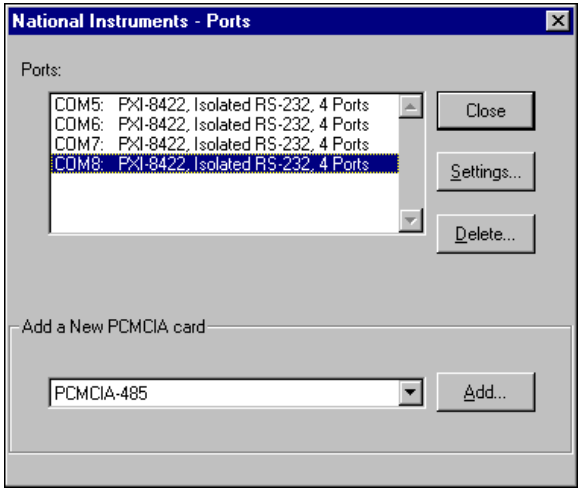


Figure C-6. Selecting an Interface to Uninstall

3. Click the **Delete** button.

4. Repeat steps 2 and 3 until you have removed every PXI serial port that you want to uninstall.

Uninstall the Software

Before you uninstall the NI-Serial software, you must remove the hardware information from your system, as described in the previous section.

To uninstall the NI-Serial software, complete the following steps:

1. Select **Start»Settings»Control Panel**.
2. Double-click the **Add/Remove Programs** icon. The **Add/Remove Programs** dialog box appears. This dialog box lists the software that you can uninstall.
3. Select the NI-Serial software you want to uninstall, and click the **Add/Remove** button. The uninstallation program removes all folders, utilities, and registry entries associated with the NI-Serial software.
4. Shut down Windows NT, power off your computer, and physically remove the serial interfaces from your system.

The uninstallation program removes only items that the setup wizard installed. If you added anything to a directory that the setup wizard created, the uninstallation program does not delete that directory. You must remove any remaining components yourself.

To reinstall the hardware and software, refer to Chapter 3, *PXI Serial Hardware Installation, Verification, and Configuration*.

USB Hardware

To uninstall the USB serial hardware and NI-Serial (USB) software, complete the following steps:

1. Select **Start»Settings»Control Panel**.
2. Double-click the **Add/Remove Programs** icon. The **Add/Remove Programs** dialog box appears. This dialog box lists the software that you can uninstall.
3. Select **NI-Serial (USB)** and click the **Change/Remove** or **Add/Remove** button. The uninstallation program removes all folders, utilities, and registry entries associated with the NI-Serial software.
4. Physically disconnect the USB serial hardware from your system.

The uninstall program removes all hardware configuration information and items that the setup wizard installed. If you added anything to a directory that the setup wizard created, the uninstallation program does not delete that directory. You must remove any remaining components yourself.

To reinstall the hardware and software, refer to Chapter 4, *USB Serial Hardware Installation, Verification, and Configuration*.

PCMCIA Hardware

Windows 2000

Uninstall the Hardware

Before you physically remove the serial hardware from your system, you must remove the hardware information. To do so, complete the following steps:

1. Select **Start»Settings»Control Panel** and double-click the **System** icon.
2. Select the **Hardware** tab and click the **Device Manager** button.
3. Double-click the **Multi-function adapters** icon.
4. From the **Multi-function adapters** list, right-click the National Instruments interface that you want to uninstall, as shown in Figure C-7.

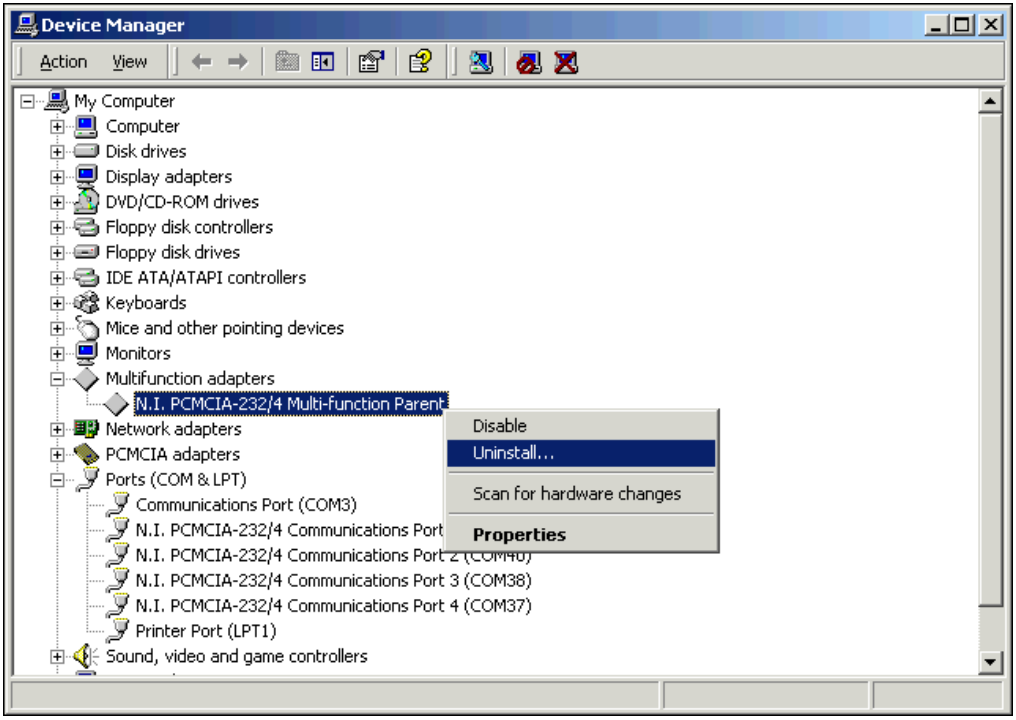


Figure C-7. Selecting an Interface to Uninstall

5. Choose the **Uninstall** option.
6. In the **Confirm Device Removal** dialog box, click the **OK** button to remove the hardware information, or click the **Cancel** button to cancel your request.

Uninstall the Software

Before you uninstall the NI-Serial software, you must remove the hardware information from your system, as described in the previous section.

To uninstall the NI-Serial software, complete the following steps:

1. Select **Start»Settings»Control Panel**.
2. Double-click the **Add/Remove Programs** icon. The **Add/Remove Programs** dialog box appears. This dialog box lists the software that you can uninstall.

3. Select **NI-Serial** and click the **Change/Remove** button. The uninstallation program removes all folders, utilities, and registry entries associated with the NI-Serial software.
4. Remove the PCMCIA serial interface from your system.

The uninstallation program removes only items that the setup wizard installed. If you added anything to a directory that the setup wizard created, the uninstallation program does not delete that directory. You must remove any remaining components yourself.

To reinstall the hardware and software, refer to Chapter 4, *USB Serial Hardware Installation, Verification, and Configuration*.

Windows Me/9*x*

Uninstall the Hardware

Before physically removing the serial hardware, you must remove the hardware information from the Windows Me/9*x* Device Manager.

Complete the following steps to uninstall the hardware:

1. Double-click the **System** icon under **Start»Settings»Control Panel**. The **System Properties** dialog box appears.
2. Select the **Device Manager** tab.
3. Click the **View devices by type** button.
4. Double-click the **Ports (COM & LPT)** icon.
5. Select the National Instruments port to remove from the list of ports, as shown in Figure C-8.

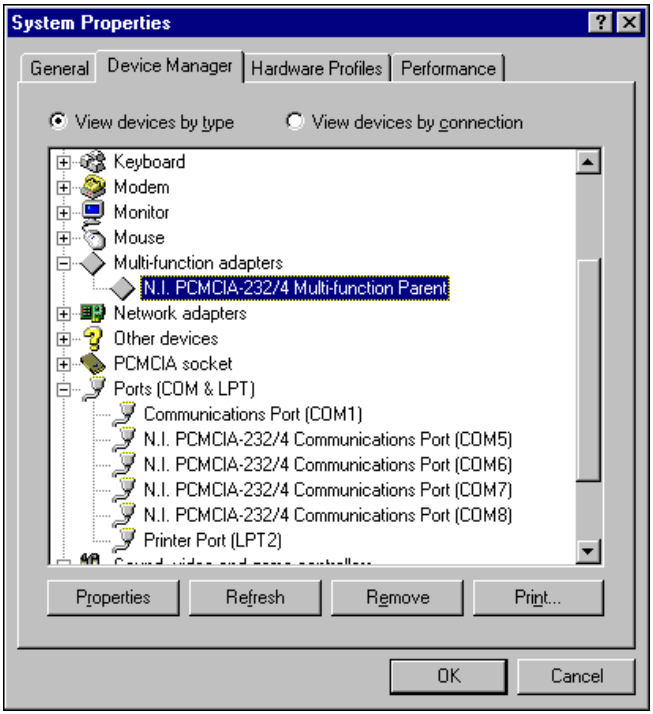


Figure C-8. Selecting an Interface to Uninstall

6. Click the **Remove** button.

Note To remove ports on two- and four-port PCMCIA cards from within the Device Manager, you must open the **Multi-function adapters** class, select the name of your interface, and click the **Remove** button.

7. In the **Confirm Device Removal** dialog box, click the **OK** button to remove this interface or click **Cancel** to cancel your request.

Uninstall the Software

Before uninstalling the software, remove all serial port information from the Windows Me/9*x* Device Manager, as described in the previous section. You do not need to shut down Windows Me/9*x* before uninstalling the software.

Complete the following steps to remove the NI-Serial software:

1. Select **Start»Settings»Control Panel**.
2. Double-click the **Add/Remove Programs** icon in the Control Panel to launch the Add/Remove Programs applet. The **Add/Remove Programs Properties** dialog box appears. This dialog box lists the software available for removal.
3. Select the serial software you want to remove, and click the **Add/Remove** button. The uninstall program runs and removes all folders, programs, VxDs, DLLs, and registry entries associated with the NI-Serial software.
4. Remove your PCMCIA card from your computer.

To reinstall the hardware and software, refer to Chapter 4, *USB Serial Hardware Installation, Verification, and Configuration*.

Windows NT

Uninstall the Hardware

Before physically removing the serial hardware, you must remove the hardware information from the Windows NT Control Panel.

Complete the following steps to uninstall the hardware:

1. Double-click the **niports** icon under **Start»Settings»Control Panel**.
2. Select the port to remove from the list of ports as shown in Figure C-9.

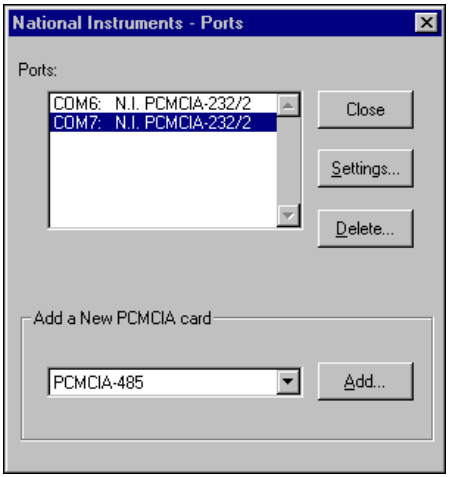


Figure C-9. Selecting an Interface to Uninstall

3. Click the **Delete** button.

Note For two- and four-port PCMCIA cards, all ports on the interface are removed.

Uninstall the Software

Before uninstalling the software, remove all serial port information from the Windows NT Control Panel, as described in the previous section. You do not need to shut down Windows NT before uninstalling the software.

Complete the following steps to remove the NI-Serial software:

1. Select **Start»Settings»Control Panel**.
2. Double-click the **Add/Remove Programs** icon in the Control Panel to launch the Add/Remove Programs applet. The **Add/Remove Programs Properties** dialog box appears. This dialog box lists the software available for removal.
3. Select the serial software you want to remove, and click the **Add/Remove** button. The uninstall program runs and removes all folders, utilities, and registry entries associated with the NI-Serial software.
4. Shut down Windows NT, power off your computer, and remove your serial interfaces.

To reinstall the hardware and software, refer to Chapter 4, *USB Serial Hardware Installation, Verification, and Configuration*.

AT Hardware

Windows 2000

Uninstall the Hardware

Before you physically remove the serial hardware from your system, you must remove the hardware information. To do so, complete the following steps:

1. Select **Start»Settings»Control Panel** and double-click the **System** icon.
2. Select the **Hardware** tab and click the **Device Manager** button.
3. Double-click the **Multi-function adapters** icon.
4. From the **Multi-function adapters** list, right-click the National Instruments interface that you want to uninstall, as shown in Figure C-10.

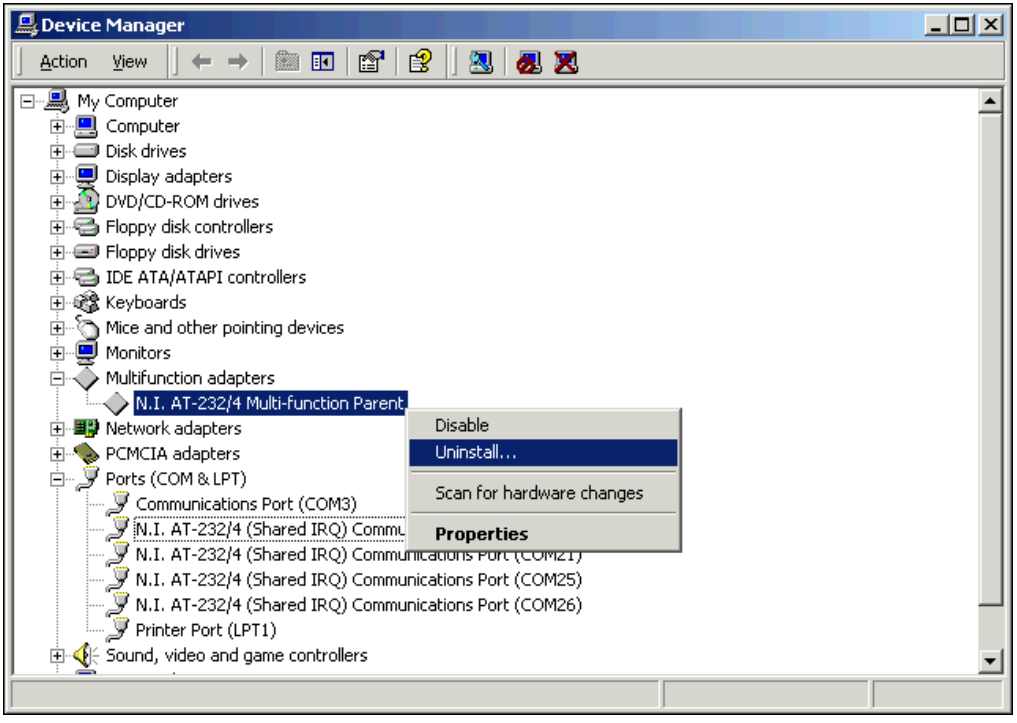


Figure C-10. Selecting an Interface to Uninstall

5. Choose the **Uninstall** option.
6. In the **Confirm Device Removal** dialog box, click the **OK** button to remove the hardware information, or click the **Cancel** button to cancel your request.

Uninstall the Software

Before you uninstall the NI-Serial software, you must remove the hardware information from your system, as described in the previous section.

To uninstall the NI-Serial software, complete the following steps:

1. Select **Start»Settings»Control Panel**.
2. Double-click the **Add/Remove Programs** icon. The **Add/Remove Programs** dialog box appears. This dialog box lists the software that you can uninstall.
3. Select **NI-Serial** and click the **Change/Remove** button. The uninstallation program removes all folders, utilities, and registry entries associated with the NI-Serial software.
4. Shut down Windows 2000, power off your computer, and physically remove the serial interfaces from your system.

The uninstallation program removes only items that the setup wizard installed. If you added anything to a directory that the setup wizard created, the uninstallation program does not delete that directory. You must remove any remaining components yourself.

To reinstall the hardware and software, refer to Chapter 5, *PCMCIA Serial Hardware Installation, Verification, and Configuration*.

Windows Me/9*x*

Uninstall the Hardware

Before physically removing the serial hardware, you must remove the hardware information from the Windows Me/9*x* Device Manager.

Complete the following steps to uninstall the hardware:

1. Double-click the **System** icon under **Start»Settings»Control Panel**. The **System Properties** dialog box appears.
2. Select the **Device Manager** tab.
3. Click the **View devices by type** button.
4. Double-click the **Ports (COM & LPT)** icon.

5. Select the National Instruments port to remove from the list of ports, as shown in Figure C-11.

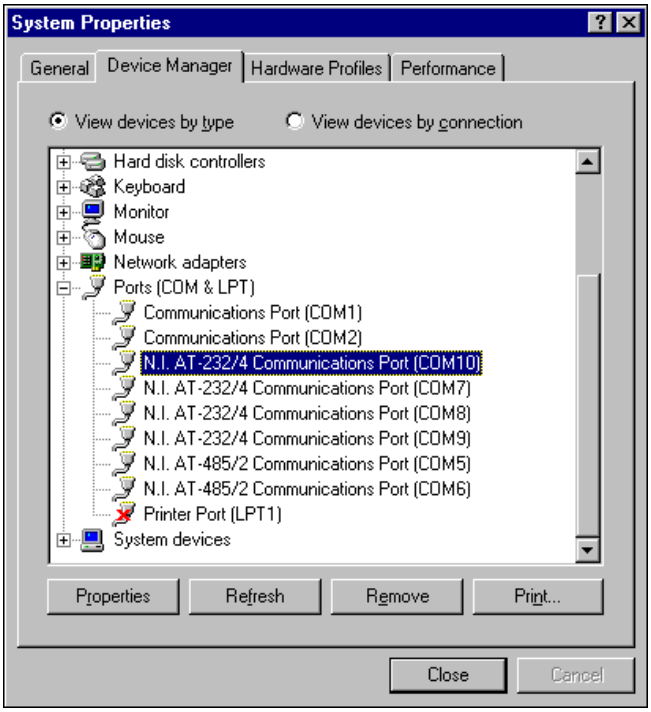


Figure C-11. Selecting an Interface to Uninstall

6. Click the **Remove** button.

Note To remove ports on shared IRQ AT boards from within the Device Manager, you must open the **Multi-function adapters** class, select the name of your interface, and click the **Remove** button.

7. In the **Confirm Device Removal** dialog box, click the **OK** button to remove this interface or click **Cancel** to cancel your request.

Uninstall the Software

Before uninstalling the software, remove all serial port information from the Windows Me/9*x* Device Manager, as described in the previous section. You do not need to shut down Windows Me/9*x* before uninstalling the software.

Complete the following steps to remove the NI-Serial software:

1. Select **Start»Settings»Control Panel**.
2. Double-click the **Add/Remove Programs** icon in the Control Panel to launch the Add/Remove Programs applet. The **Add/Remove Programs Properties** dialog box appears. This dialog box lists the software available for removal.
3. Select the serial software you want to remove, and click the **Add/Remove** button. The uninstall program runs and removes all folders, programs, VxDs, DLLs, and registry entries associated with the NI-Serial software.
4. Shut down Windows Me/9*x*, power off your computer, and physically remove the serial interfaces from your system.

To reinstall the hardware and software, refer to Chapter 5, *PCMCIA Serial Hardware Installation, Verification, and Configuration*.

Windows NT

Uninstall the Hardware

Before physically removing the serial hardware, you must remove the hardware information from the Windows NT Control Panel.

Complete the following steps to uninstall the hardware:

1. Double-click the **niports** icon under **Start»Settings»Control Panel**.
2. Select the port to remove from the list of ports as shown in Figure C-12.

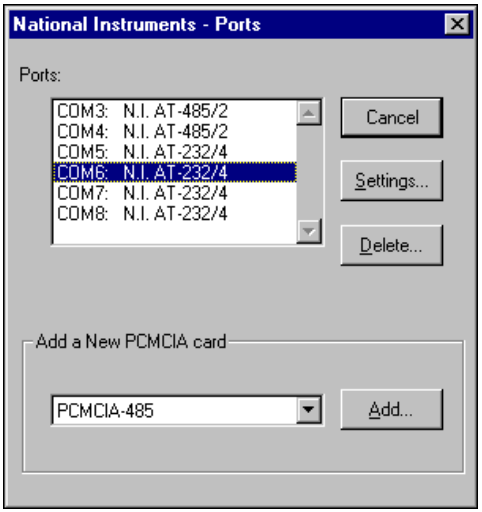


Figure C-12. Selecting an Interface to Uninstall

3. Click the **Delete** button.

Note For shared IRQ AT boards, all ports on the interface are removed.

Uninstall the Software

Before uninstalling the software, remove all serial port information from the Windows NT Control Panel, as described in the previous section. You do not need to shut down Windows NT before uninstalling the software.

Complete the following steps to remove the NI-Serial software.

1. Select **Start»Settings»Control Panel**.
2. Double-click the **Add/Remove Programs** icon in the Control Panel to launch the Add/Remove Programs applet. The **Add/Remove Programs Properties** dialog box appears. This dialog box lists the software available for removal.
3. Select the serial software you want to remove, and click the **Add/Remove** button. The uninstall program runs and removes all folders, utilities, and registry entries associated with the NI-Serial software.
4. Shut down Windows NT, power off your computer, and remove your serial interfaces.

To reinstall the hardware and software, refer to Chapter 5, *PCMCIA Serial Hardware Installation, Verification, and Configuration*.

D

Troubleshooting and Common Questions

This appendix describes how to troubleshoot problems and answers some common questions.

To find the information you are looking for, see the section of this appendix for your operating system:

PCI/PXI/PCMCIA/AT D-2
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Troubleshooting Diagnostic Messages D-3
Resolving Resource Conflicts with Legacy Boards D-4
Windows Me/9*x* D-4
Freeing an Interrupt Request Level D-4
Selecting Conflict-Free Resources D-5
Troubleshooting Diagnostic Messages D-7
Resolving Resource Conflicts with Legacy Boards D-9
Forcing Windows to Detect Your Hardware D-9
Windows NT D-12
Missing Serial Port in the niports List D-12
Resolving Resource Conflicts D-14
Troubleshooting Diagnostic Messages D-14
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PCI/PXI/PCMCIA/AT

Windows 2000

Forcing Windows to Detect Your Hardware

If Windows 2000 did not display the Found New Hardware Wizard, it did not detect your hardware. To solve this problem, complete the following steps:

1. Select **Start»Settings»Control Panel** and double-click the **System** icon.
2. Select the **Hardware** tab and click the **Device Manager** button.
3. Double-click the **Multi-function adapters** icon.
4. From the **Multi-function adapters** list, right-click the National Instruments interface that was not detected, as shown in Figure D-1. (This example shows a PCI interface.)

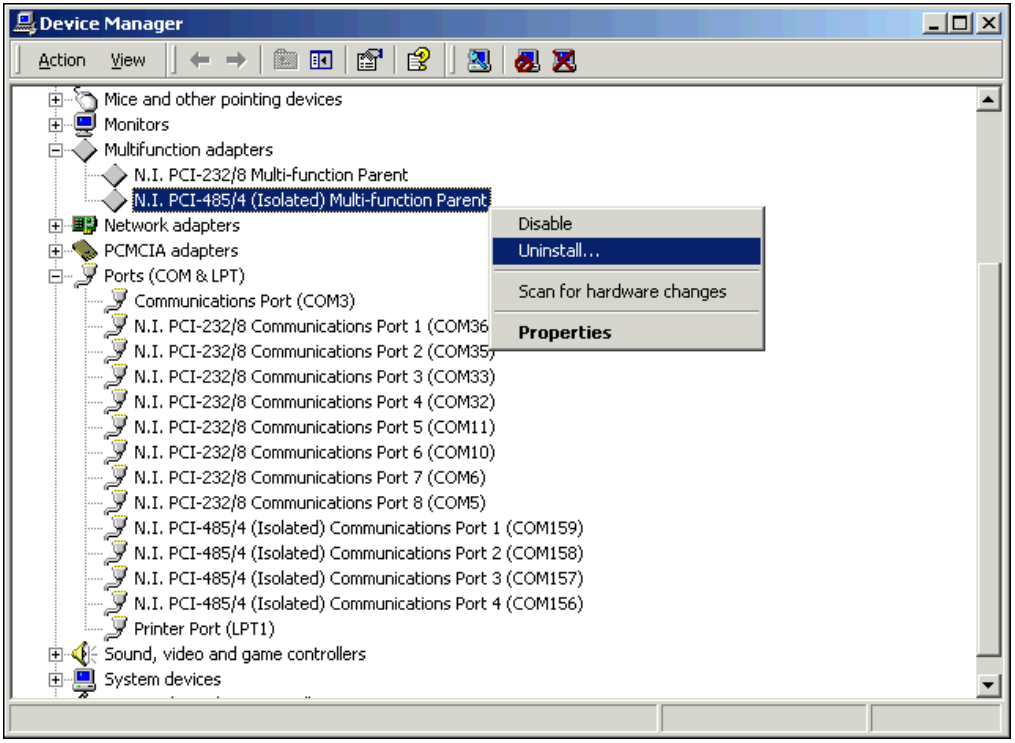


Figure D-1. Selecting an Interface to Uninstall

5. Choose the **Uninstall** option.
6. In the **Confirm Device Removal** dialog box, click the **OK** button to remove the hardware information, or click the **Cancel** button to cancel your request.
7. Click the **Scan for Hardware Changes** icon at the top of the Device Manager window.
8. Windows 2000 should automatically detect your hardware and display the Found New Hardware Wizard. Complete the wizard by clicking **Next** in each window and then **Finish**.

Troubleshooting Diagnostic Messages

This section lists possible error messages returned by the diagnostic utility, along with solutions.

No National Instruments Serial Port Found or Diagnostic Utility Does Not Show All Installed Ports

If the **`No National Instruments serial port found`** error message appears or the diagnostic utility does not show all the ports you installed, complete all the steps in the *Forcing Windows to Detect Your Hardware* section.

Address Test Failed

If the **`address test failed, Interrupt test cannot be performed`** error message appears, you might have an address conflict with legacy boards in your system. To solve this problem, change the base addresses assigned to your legacy boards and refer to the *Resolving Resource Conflicts with Legacy Boards* section.

Interrupt Test Failed

If the **`Interrupt test failed`** error message appears, you might have an IRQ conflict with legacy boards in your system. To solve this problem, change the IRQ level assigned to your legacy boards and refer to the next section, *Resolving Resource Conflicts with Legacy Boards*.

Resolving Resource Conflicts with Legacy Boards

Resource conflicts typically occur if your system contains legacy boards that use resources that are not reserved properly. If a resource conflict exists, write down the resource that caused the conflict and refer to the Microsoft Windows 2000 user guide for instructions on how to use the Device Manager to reserve I/O and IRQ resources for legacy boards.

Windows Me/9*x*

Freeing an Interrupt Request Level

To free an interrupt request level for your serial port, you must disable the device that is using the interrupt request level. To view the system-wide allocation of interrupt request resources and remove a device, complete the following steps:

1. Select **Start»Settings»Control Panel** and double-click the **System** icon.
2. Click the **Device Manager** tab.
3. Double-click the **Computer** icon and click the **View Resources** tab.
4. Click the **Interrupt Request (IRQ)** button. Scan through the list of IRQ settings to determine which devices are using which interrupt request levels.
5. When you locate a device that you are not currently using, click the **Cancel** button.
6. In the **Device Manager** tab, double-click the icon for that device.
7. In the **Device usage** field, a checkmark appears to the left of the current configuration, usually **Original Configuration (Current)**. Click the checkbox to remove the checkmark.
8. Click the **Resources** tab and make sure that **Use automatic settings** is unchecked.
9. Repeat steps 6 through 8 for each unused device.
10. Click the **OK** button to save your changes.
11. Restart Windows Me/9*x* to assign resources to your serial port. Then complete step 6 in the installation verification section of the chapter for your hardware platform.

Selecting Conflict-Free Resources

PCI and PXI Boards

When the Device Manager indicates a conflict with another device, you can usually correct the problem by manually selecting conflict-free resources. To do so, complete the following steps:

1. Select **Start»Settings»Control Panel** and double-click the **System** icon.
2. Click the **Device Manager** tab and then click the **View devices by type** button.
3. Double-click the **Multi-function adapters** icon.
4. From the **Multi-function adapters** list, double-click the serial interface that you want to change.
5. Click the **Resources** tab.
6. Uncheck the **Use automatic settings** checkbox and click the **Change Setting** button. If the system does not allow you to change the settings, select the configuration that gives you a conflict-free base address and interrupt level from the **Setting based on** list box.
7. Click the **OK** button to save your changes.

AT Boards

When the Device Manager indicates a conflict with another device, you can usually correct the problem by manually selecting conflict-free resources. To do so, complete the following steps:

1. Select **Start»Settings»Control Panel**.
2. Double-click the **System** icon.
3. Select the **Device Manager** tab, and click the **View devices by type** button at the top of the page.
4. Double-click the **Ports (COM & LPT)** icon. A list of installed ports appears.
5. Double-click the name of the serial port you want to change, then click the **Resources** tab.

Note To change the resources of ports on shared IRQ AT boards from within the Device Manager, you must open the **Multi-function adapters** class and double-click the name of your interface. Use the **Resources** page to change the resources. Any resource changes are automatically reflected to the child devices.

6. Uncheck the **Use automatic settings** checkbox and click the **Change Setting** button. If the system does not allow you to change the settings, select the configuration that gives you a conflict-free base address and interrupt level from the **Setting based on** list box.
7. Click the **OK** button to save your changes.

PCMCIA Boards

When the Device Manager indicates a conflict with another device, you can usually correct the problem by manually selecting conflict-free resources. To do so, complete the following steps:

1. Select **Start»Settings»Control Panel** and double-click the **System** icon.
2. Click the **Device Manager** tab and then click the **View devices by type** button.
3. If you have a multiport card, double-click the **Multi-function adapters** icon. Otherwise, double-click the **Ports (COM & LPT)** icon.
4. From the expanded list, double-click the serial interface that you want to change.
5. Click the **Resources** tab.



Note To change the resources of ports on two-port or four-port PCMCIA cards from within the Device Manager, you must open the **Multi-function adapters** class and double-click the name of your interface. Use the **Resources** page to change the resources. Any resource changes are automatically reflected to the child devices.

6. Uncheck the **Use automatic settings** checkbox and click the **Change Setting** button. If the system does not allow you to change the settings, select the configuration that gives you a conflict-free base address and interrupt level from the **Setting based on** list box.
7. Click the **OK** button to save your changes.

Troubleshooting Diagnostic Messages

This section lists possible error messages returned by the diagnostic utility, along with solutions.

No National Instruments Serial Port Found

If the **`No National Instruments serial port found`** error message appears, complete the following steps:

1. Verify the hardware resources, as follows:
   a. In the **Device Manager** tab, under **Multi-function adapters**, double-click a serial board.
   b. If a serial board is missing from the **Multi-function adapters** list, reinstall the hardware and software. For instructions on how to do so, refer to the installation and verification chapter for your hardware platform.
   c. Click the **Resources** tab. If the resources were assigned properly, the **Resources** tab shows which resources are assigned to your serial ports. If they are in conflict, refer to the *Resolving Resource Conflicts with Legacy Boards* section.
2. In some versions of Windows Me/9*x*, in the Device Manager, the **Driver** tab shows information about the installed driver. Make sure that the National Instruments serial driver is installed for the port.

   If the serial driver is a Microsoft driver, reinstall the NI-Serial software. For instructions on how to do so, refer to the installation and verification chapter for your hardware platform.
3. Make sure that the National Instruments serial driver is installed, as follows:
   a. Locate the `niserial.vxd` file in the `\Windows\system` directory.
   b. If the `niserial.vxd` file is missing, reinstall the hardware and software. For instructions on how to do so, refer to the installation and verification chapter for your hardware platform.

Diagnostic Utility Does Not Show All Installed Ports

If the diagnostic utility does not show all the ports you installed, complete the following steps:

1. Verify the hardware resources, as follows:
   a. In the **Device Manager** tab, under **Multi-function adapters**, double-click a serial board.
   b. If a serial board is missing from the **Multi-function adapters** list, reinstall the hardware and software. For instructions on how to do so, refer to the installation and verification chapter for your hardware platform.
   c. Click the **Resources** tab. If the resources were assigned properly, the **Resources** tab shows which resources are assigned to your serial ports. If they are in conflict, refer to the *Resolving Resource Conflicts with Legacy Boards* section.
2. In some versions of Windows Me/9*x*, in the Device Manager, the **Driver** tab shows information about the installed driver. Make sure that the National Instruments serial driver is installed for the port.

   If the serial driver is a Microsoft driver, reinstall the NI-Serial software. For instructions on how to do so, refer to the installation and verification chapter for your hardware platform.
3. Physically make sure the correct number of boards/ports are installed.

Address Test Failed

If the **`address test failed, Interrupt test cannot be performed`** error message appears, you might have an address conflict with legacy boards in your system. To solve this problem, change the base addresses assigned to your legacy boards and refer to the *Resolving Resource Conflicts with Legacy Boards* section.

Interrupt Test Failed

If the **`Interrupt test failed`** error message appears, you might have an IRQ conflict with legacy boards in your system. To solve this problem, change the IRQ level assigned to your legacy boards and refer to the next section, *Resolving Resource Conflicts with Legacy Boards*.

Resolving Resource Conflicts with Legacy Boards

Resource conflicts typically occur if your system contains legacy boards that use resources that are not reserved properly. If a resource conflict exists, write down the resource that caused the conflict and refer to the Microsoft Windows Me/9*x* user guide for instructions on how to use the Device Manager to reserve I/O and IRQ resources for legacy boards.

Forcing Windows to Detect Your Hardware

PCI and PXI Hardware

If Windows Me/9*x* did not display the **New Hardware Found** dialog box, it did not detect your hardware. To solve this problem, complete the following steps:

1. Select **Start»Settings»Control Panel** and double-click the **System** icon.
2. Click the **Device Manager** tab and then click the **View devices by type** button.
3. Double-click the **Other Devices** icon. Windows Me/9*x* lists the boards it does not recognize under **Other Devices**.
4. Double-click the **Multi-function adapters** icon, where Windows Me/9*x* lists the parent devices of the PCI or PXI ports.

5. Select the interface that Windows Me/9*x* did not detect, as shown in Figure D-2. (This example shows a PCI interface.)

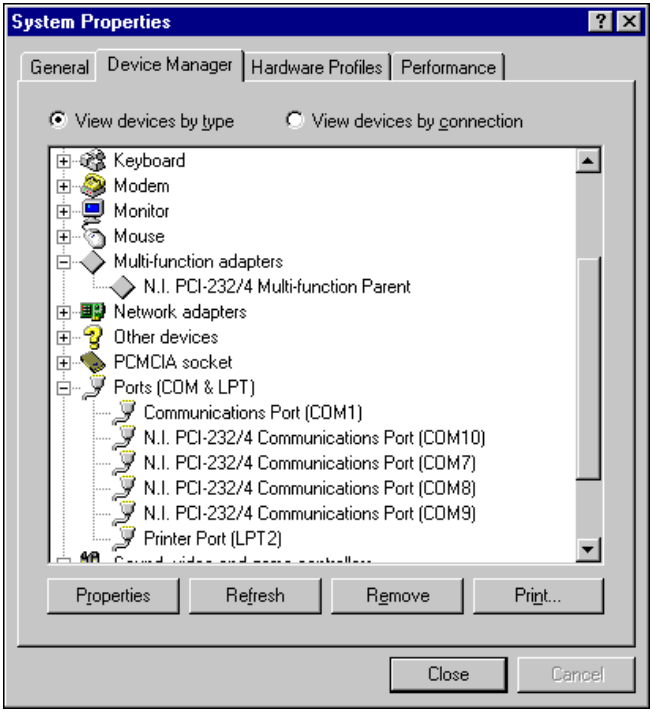


Figure D-2. Ports List in Device Manager

6. Click the **Remove** button.
7. Click the **OK** button to remove the serial hardware information.
8. Repeat steps 5 through 7 until you have removed all serial interfaces.
9. Click the **Refresh** button.
10. Windows Me/9*x* should automatically detect your hardware and display one or more **New Hardware Found** dialog boxes. Your operating system (Windows Me/9*x*) may show the **Windows Default Driver** option. If so, make sure the **Windows Default Driver** is selected and click the **OK** button. If the **Windows Default Driver** option is not shown, the installation continues automatically.

AT and PCMCIA Hardware

If Windows does not detect your serial hardware correctly, or you have been using your serial hardware with the default Windows Me/9*x* serial driver or an older version of the NI-Serial software, Windows Me/9*x* does not display the **New Hardware Found** dialog box. To fix this problem, complete the following steps:

1. Select **Start»Settings»Control Panel**.
2. Double-click the **System** icon.
3. Select the **Device Manager** tab.
4. Click the **View devices by type** button.
5. Double-click the **Ports (COM & LPT)** icon to display a list of all ports that Windows Me/9*x* recognizes.

   If you have already installed the hardware, double-click **Other Devices** to display where Windows Me/9*x* lists the ports it does not recognize.
6. Select a National Instruments port name from the list of ports that corresponds to a serial port (for example, COM 5, COM 6, COM 7, or COM 8). Figure D-3 shows the **Ports** list in the **Device Manager** with a port selected. (This example shows an AT interface.)

Note To remove ports on shared IRQ cards, you must open the **Multifunction adapter** class, select the name of the interface, and click the **Remove** button.

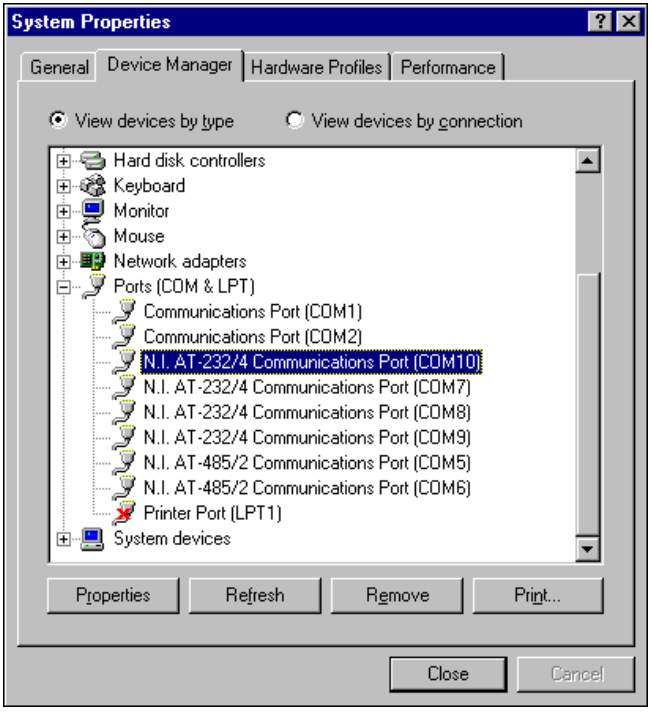


Figure D-3. Ports List in Device Manager

7. Click the **Remove** button, and click **OK** to confirm the removal of the serial hardware information.

Repeat steps 6 and 7 until all serial board entries are removed. Then click **Refresh** to force Windows Me/9*x* to detect the serial hardware and display the **New Hardware Found** dialog box.

Windows NT

Missing Serial Port in the niports List

PCI and PXI Boards

The serial configuration utility contains configuration information for serial hardware that is installed in your system.

To start the configuration utility, select **Start»Settings»Control Panel** and double-click the **niports** icon.

If your PCI or PXI serial hardware is missing from this list, complete the following steps:

1. Physically make sure that your board is installed properly.
2. Make sure that the National Instruments serial driver is installed, as follows:
   a. Locate `serial.sys` in the `WinNT\system32\drivers` directory.
   b. Right-click `serial.sys` and select **Properties**.
   c. Click the **Version** tab. If the **Company Name** is **Microsoft**, the National Instruments serial driver is not installed properly. To solve this problem, reinstall the NI-Serial software. For instructions on how to do so, refer to the installation and verification chapter for your hardware platform.

AT Boards

The serial configuration utility **niports** contains configuration information for serial hardware it is aware of that is installed in your system.

To start the configuration utility, select **Start»Settings»Control Panel**, and double-click the **niports** icon.

If your AT serial board is missing from the list, complete the following steps:

1. Make sure the hardware is installed.
2. Make sure you have installed the Microsoft PnP ISA Enabler driver. **niports** cannot recognize the AT boards without the Microsoft PnP ISA Enabler driver. For more information, refer to the *Installing the Microsoft PnP ISA Enabler Driver* section of Chapter 6, *AT Serial Hardware Installation, Verification, and Configuration*.

PCMCIA Boards

The serial configuration utility **niports** contains configuration information for serial hardware it is aware of that is installed in your system.

To start the configuration utility, select **Start»Settings»Control Panel**, and double-click the **niports** icon.

If serial ports are missing from this list, make sure you selected resources for your PCMCIA card as described in the *Select Resources for the PCMCIA Card* section of Chapter 5, *PCMCIA Serial Hardware Installation, Verification, and Configuration*.

Resolving Resource Conflicts

Resource conflicts occur when your system contains hardware that is configured to use the same resources as your serial interface. The serial driver detects some resource conflicts when it loads. When the driver detects conflicts as it loads, it records an error message describing the conflict.

To resolve a resource conflict, complete the following steps:

1. Select **Start»Programs»Administrative Tools»Event Viewer** to run the Event Viewer and determine which resource is in conflict.
2. Change the resources of the device that caused the conflict.

   To help you select conflict-free resources, you can use the Windows NT Diagnostics utility. This utility displays a list of the I/O port addresses, interrupt levels, and DMA channels that your system is currently using. You can assign resources that are not listed by this utility to your device.

   To run the Windows NT Diagnostics utility, select **Start»Programs»Administrative Tools»Windows NT Diagnostics**.

Troubleshooting Diagnostic Messages

This section lists possible error messages returned by the diagnostic utility, along with solutions.

No National Instruments Serial Port Found

If the `No National Instruments serial port found` error message appears, complete the following steps:

1. Verify the hardware resources, as follows:
   a. Select **Start»Settings»Control Panel** and double-click the **niports** icon.
   b. In the **Ports** list, select a port and click the **Settings** button.

      If the serial port is missing from the **Ports** list, reinstall the hardware and software. For instructions on how to do so, refer to the installation and verification chapter for your hardware platform.
   c. In the **General Port Settings** dialog box, click the **Resources** button to view the resources for the port.
   d. Check the hardware resources. If they are in conflict, refer to the *Resolving Resource Conflicts* section.

2. Make sure that the National Instruments serial driver is installed, as follows:
   a. Locate the `serial.sys` file in the `WinNT\system32\drivers` directory.
   b. If the `serial.sys` file is missing, reinstall the hardware and software. For instructions on how to do so, refer to the installation and verification chapter for your hardware platform.
   c. Right-click the `serial.sys` file and select **Properties**.
   d. Click the **Version** tab. If the **Company Name** is **Microsoft**, the National Instruments serial driver is not installed properly. To solve this problem, reinstall the NI-Serial software. For instructions on how to do so, refer to the installation and verification chapter for your hardware platform.

Diagnostic Utility Does Not Show All Installed Ports

If the diagnostic utility does not show all the ports you installed, complete the following steps:

1. Verify the hardware resources, as follows:
   a. Select **Start»Settings»Control Panel** and double-click the **niports** icon.
   b. In the **Ports** list, select a port and click the **Settings** button.

      If the serial port is missing from the **Ports** list, reinstall the hardware and software. For instructions on how to do so, refer to the installation and verification chapter for your hardware platform.
   c. In the **General Port Settings** dialog box, click the **Resources** button to view the resources for the port.
   d. Check the hardware resources. If they are in conflict, refer to the *Resolving Resource Conflicts* section.
2. Make sure that the National Instruments serial driver is installed, as follows:
   a. Locate the `serial.sys` file in the `WinNT\system32\drivers` directory.
   b. If the `serial.sys` file is missing, reinstall the hardware and software. For instructions on how to do so, refer to the installation and verification chapter for your hardware platform.
   c. Right-click the `serial.sys` file and select **Properties**.

d. Click the **Version** tab. If the **Company Name** is **Microsoft**, the National Instruments serial driver is not installed properly. To solve this problem, reinstall the NI-Serial software. For instructions on how to do so, refer to the installation and verification chapter for your hardware platform.

3. Physically make sure the correct number of boards and ports are installed.

Address Test Failed

If the **`address test failed, Interrupt test cannot be performed`** error message appears, you might have an address conflict with legacy boards in your system. To solve this problem, change the base addresses assigned to your legacy boards. For instructions on how to do so, refer to your legacy board documentation.

Interrupt Test Failed

If the **`Interrupt test failed`** error message appears, you might have an IRQ conflict with legacy boards in your system. To solve this problem, change the IRQ level assigned to your legacy boards. For instructions on how to do so, refer to your legacy board documentation.

USB

Windows 2000/XP

Resolving Power Conflicts

The USB-232, USB-232/2, USB-232/4, USB-485, and USB-485/2 are *high power* bus-powered devices that require more than 100 mA during normal operation. Thus, they must be plugged into an externally powered hub that can deliver up to 500 mA per USB port. If the USB network does not have enough power to support the USB serial hardware, and a system dialog box informs you that there is not enough power for the device, reconnect the hardware to an externally powered hub.

The USB-485/4 is a self-powered device that requires external power. If the device is plugged into a USB port, and the device does not have power, it will not enumerate and the ports will not show in the Device Manager. To ensure proper port enumeration, always make sure the USB-485/4 has external power before connecting it to the USB network.

Forcing Windows to Detect Your Hardware

If the diagnostic utility does not properly show your serial ports, there may have been a problem loading the NI-Serial (USB) drivers. To solve this problem, complete the following steps:

1. Disconnect and reconnect the USB serial hardware from the USB port.
2. Verify the installed USB serial hardware.
    a. Select **Start»Settings»Control Panel** and double-click the System icon.
    b. Click the **Hardware** tab and the **Device Manager** button.
    c. Double-click the **Ports (COM & LPT)** icon to display a list of installed ports.
    d. Verify that all USB serial communication ports are displayed without exclamation marks (!). If some ports are missing or have exclamation marks, proceed to step 3.
    e. Double-click the **Universal Serial Bus Controllers** icon to display a list of installed USB controllers.
    f. Verify that no USB Composite Devices have exclamation marks (!). If some devices have exclamation marks, proceed to step 3.
    g. Run the diagnostics utility to test the serial port communication. If no problems are found, you do not need to complete step 3.
3. Force the driver reinstallation.
    a. In the list of installed ports, right-click on each USB serial port, select **Uninstall**, and click **OK**.
    b. In the list of installed USB controllers, right-click each USB composite device, select **Uninstall**, and click **OK**.



Note There may be USB devices other than NI USB serial hardware that use the USB composite device driver. These devices may stop operation until then system scans for hardware changes. There will be at least one USB composite driver for every two USB serial ports.

    c. Click the **Scan for Hardware Changes** icon at the top of the Device Manager window.
    d. After Windows automatically detects your hardware, run the diagnostics utility to confirm proper serial port installation.
    e. If all your serial ports still are not visible, disconnect and reconnect the USB serial hardware to a different USB port and try step 2 again.

Troubleshooting Diagnostic Messages

This section lists the possible error messages and test results that the diagnostic utility returns, along with the solutions.

No Serial Ports Found or Diagnostic Utility Does Not Show All Installed Ports

If the **`No Serial (USB) ports detected`** error message appears or the diagnostic utility does not show all the ports you installed, complete all steps in the *Forcing Windows to Detect Your Hardware* section.

System Files Can Not Be Found

If the **`One or more *.dat files are missing`** or **`The file x is missing`** error messages appear, reinstall the NI-Serial (USB) software to replace the missing file.

Serial Port Could Not Be Opened

If the **`port could not be opened`** error message appears, verify that no other applications have the port open and rerun the diagnostic utilities. If this message continues to appear, reboot your system and try the diagnostic program again. If this does not resolve the problem, and no other applications are using this port, contact National Instruments.

Device Configuration is Corrupted or Internal Loopback Failed

If the **`device configuration may be corrupted`** or **`port failed the internal Loop Back Test`** error message appears, an internal device error has occurred. Uninstall and reinstall the NI-Serial (USB) hardware and software, disconnect all serial cables, and try the diagnostic program again. If this does not resolve the problem, contact National Instruments.

Common Questions

How can I determine which type of NI-Serial hardware I have installed?

Windows 2000/XP/Me/9*x*

1. Select **Start»Settings»Control Panel** and double-click the **System** icon.
2. Click the **Hardware** tab and then click the **Device Manager** button or select the **Device Manager** tab.
3. Double-click the **Ports (COM & LPT)** icon to display a list of installed ports.

Windows NT

1. Select **Start»Settings»Control Panel** and double-click the **System** icon.
2. Double-click the **niports** icon.

How can I determine which version of the NI-Serial software I have installed?

The `Readme.txt` file gives the version of the software. To open the file, select either **Start»Programs»National Instruments»NI-Serial» Read Me** or **Start»Programs»National Instruments»NI-Serial»USB» Read Me**.

What do I do if the diagnostic test fails with an error?

Refer to the *Troubleshooting Diagnostic Messages* section for your hardware and operating system.

How can I determine which port is associated with COM*x*?

To determine which physical port is associated with COM*x*, complete the following steps:

Windows 2000/XP/Me/9*x*

1. In the **Device Manager**, under **Ports (COM & LPT)**, double-click a serial port.
2. Click the **Port Settings** tab to display the serial number of the serial hardware and the physical port number starting at 1. Note the Port 1, Port 2, etc. entries next to the COM numbers. For all serial hardware, PORT1 refers to the top port, PORT2 refers to the next port down, and so on.

Windows NT

1. Select **Start»Settings»Control Panel** and double-click the **niports** icon.

   A list of installed National Instruments ports with their logical COM*x* names appears. If your interface is not on this list, refer to the *Missing Serial Port in the niports List* section.

2. Select a COM port and click the **Settings** button.

   The **General Port Settings** dialog box displays the serial number of the serial hardware and the physical port number starting at 1. For all serial hardware, PORT1 refers to the top port, PORT2 refers to the next port down, and so on.

How can I change the COM numbers of my National Instruments plug-in serial ports to COM1, COM2, COM3, or COM4?

Windows Me/9*x*

To name plug-in serial ports COM1, COM2, COM3, or COM4, change the base address of the port. To do so, refer to the *Troubleshooting Diagnostic Messages* section.

When you change the base address, Windows Me/9*x* automatically converts it to the corresponding COM name listed in Table D-1. You do not need to change the IRQ setting for Windows Me/9*x* to change the name. USB ports do not have base addresses and thus cannot be renamed to COM1, COM2, COM3, or COM4.

Table D-1. Standard DOS-Based Addresses

COM Port	Base Address
COM1	3f8
COM2	2f8
COM3	3e8
COM4	2e8

All Other Operating Systems

Refer to the general port settings section in the installation and verification chapter for your hardware platform.

What is the maximum baud rate supported and how can I set it?

The maximum baud rates supported are listed in Table D-2. To set the baud rate, use the **SetCommState** Win32 function and pass the actual value of the baud rate in the **BaudRate** field of the **DCB** structure.

Table D-2. Maximum Baud Rate

Hardware Platform	Maximum Baud Rate
PCI/PXI/AT-232, PCMCIA-232/4	115.2 kbits/s
All other PCMCIA	921.6 kbits/s
AT-485	115.2 kbits/s
USB-232	230.4 kbits/s
PCI/PXI/USB-485	460.8 kbits/s

Older versions of the serial hardware may support lower maximum baud rates. The NI-Serial software also includes a configuration utility, which is fully integrated into the Windows 2000/XP/Me/9*x* Device Manager and Windows NT Control Panel. Its Port Settings view indicates the maximum baud rate your hardware supports.

How do I remove information about serial boards from the Device Manager or NI Ports Utility?

Refer to the uninstallation section for your hardware platform in Appendix C, *Uninstalling the Hardware and Software*.

How many interrupts are required for my serial interface?

If you have a shared IRQ board or an isolated board, you need one interrupt per board.

If you have an older non-shared IRQ board, you need as many interrupts as there are ports on the board.

The USB serial hardware does not require interrupts.

How do I change the resources assigned to the serial interface?

- **(Windows Me/9*x* Only) PCI and PXI Boards**

  The PCI and PXI serial boards are configured as devices belonging to the *multi-function adapters* class. The multi-function parent device is listed

under the **Multi-function adapters** icon, and each child device is listed as a port under the **Ports (COM & LPT)** icon.

To change the resources of serial ports, complete the following steps:

1. In the **Device Manager** tab, under **Multi-function adapters**, double-click a serial interface.
2. Click the **Resources** tab to change the resources. Your changes are automatically reflected to the child devices under **Ports (COM & LPT)**.

- **(Windows Me/9*x* Only) AT and PCMCIA Boards**

  Because the shared IRQ boards are single physical devices that support multiple ports, they are registered as *multi-function adapters* in the Device Manager. Each port is a child device listed under **Ports (COM & LPT)**. Windows Me/9*x* does not allow the resources of the multi-function child devices to be changed directly.

  To change the resources of ports on shared IRQ boards from within the Device Manager, you must open the **Multi-function adapters** class and double-click the **Multi-function Parent** item that corresponds to your National Instruments serial interface. Use the **Resources** page to change the resources. Any resource changes are automatically reflected to the child devices. Figure D-4 shows the **Multi-function adapters** class in the Device Manager. (This example shows an AT interface.)

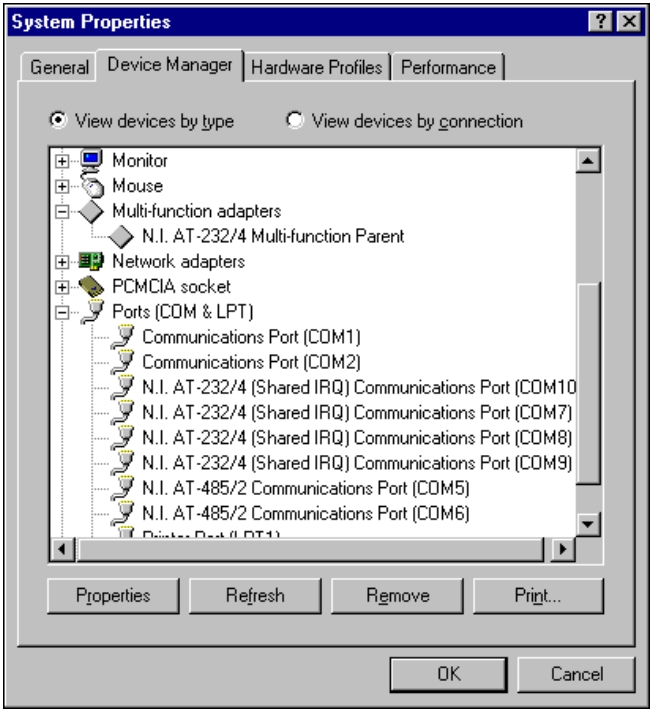


Figure D-4. Multi-Function Adapter Class in the Device Manager

What is the relationship between bits per second, throughput, and bus utilization?

The term *bits per second* (bps) refers to the bit rate of data transfer, with 1/bps being the length of time required to transmit one bit.

Throughput is the actual data transfer measured by

$$\frac{\textit{amount of data transmitted}}{\textit{time required to transmit}}$$

*Bus utilizatio*n is the percentage of time that the serial bus is actively transmitting data. Because a wide range of factors such as flow control, processor latency, and device architecture can affect serial performance, bus utilization often is not 100%. In addition, there is overhead associated with serial communication in the form of start bits, stop bits, and parity bits. This overhead reduces the throughput by 20–30%. Thus, the actual data throughput can be considerably less than the bits per second setting.

What is the difference between USB 2.0 and USB 1.1?

The USB 2.0 specification replaces the USB 1.1 specification and adds a high-speed mode of operation (480 Mbit/s) to the previously existing full-speed (12 Mbit/s) and low-speed (1.5 Mbit/s) modes of operation. Because USB 2.0 expands on the features of USB 1.1 while preserving backward device compatibility, you can use most full-speed and low-speed devices with either USB 2.0 high-speed networks or USB 1.1 full-speed networks.

Can I use the USB serial hardware in high-speed (2.0) USB networks?

Yes. Because the USB-232/485 devices are USB 2.0 full-speed compliant, you can use them in either high-speed (USB 2.0 hubs) or full-speed (USB 1.1 hubs) networks.

What happens to data sent to a closed serial port?

Because serial communication ports are active only when the port is open (for example, by using CreateFile), data may be received and made available only when the port is open. Assume that any data received by a closed com port may be lost or corrupted.

Why do loopback tests of large data transfers sometimes have problems?

In a typical loopback test, an external wrap plug is used to *loop back* transmit signals to receive signals. In this configuration, data transmitted is read back on the same serial port to test port communication. Loopback programs often perform this data transfer using a single write followed by a single read, and thus rely on driver software and serial hardware buffering to hold the data between the two function calls. However, these buffers are of finite size, and thus any data transfer that exceeds the buffer size either times out, blocks (due to flow control), or drops data. This behavior is a result of the test design and does not represent a hardware or driver error. Buffer sizes vary between operating systems and hardware, but typically range from 4–8 KB in size.

Does the serial hardware have built-in support for protocols such as SDLC and ModBus?

Because the serial hardware uses UARTs for communication, protocols such as SDLC and ModBus are not supported in hardware. However, these protocols (or their derivatives) can be supported by software applications that handle the protocol translation.

How do I use 9 data bit framing?

While NI-Serial software and hardware directly supports only 5, 6, 7, and 8 data bits, it may be possible to use the parity function to create a ninth data bit, depending on your application. To create and control a ninth data bit, enable parity and set parity mark or parity space for a ninth bit of either a 1 or 0, respectively. However, you must do this every time the ninth bit changes state, and thus it may not work for high-throughput applications.

Note USB Serial hardware does not support 9 data bit framing.

Can I use NI-Serial hardware with a non-Windows platform?

Refer to Table D-3 for operating system support for NI-Serial hardware.

Table D-3. NI-Serial Hardware Operating System Support

Bus	Operating System								
	Windows 2000	**Windows NT 4.0**	**Windows XP**	**Windows Me**	**Windows 98**	**Windows 95**	**Linux x86**	**Solaris 2.*x***	**LabVIEW Real-Time**
USB	• ♦		• ♦						
Ethernet	• ♦	•	• ♦	•	•	•	•	•	
PXI	• ♦	• ♦	• ♦	• ♦	• ♦	• ♦			•
PCI	• ♦	• ♦	• ♦	• ♦	• ♦	• ♦	• ♦		
PCMCIA	• ♦	• ♦	• ♦	• ♦	• ♦	• ♦	• ♦		
AT	• ♦	• ♦	• ♦	• ♦	• ♦	• ♦	• ♦		

• NI-VISA Support

♦ Native OS Support (Win32 or Linux)

How many serial ports can I have on my machine?

Refer to Table D-4 to determine how many serial ports are supported under each operating system.

Table D-4. Maximum Number of COM Ports

Operating System	Maximum Number of COM Ports (Plug In)	Maximum Number of COM Ports (USB)
Windows 2000/XP	256	256
Windows NT	99	—
Windows Me	99	—
Windows 98	99	—
Windows 95	99	—

Can I use USB serial hardware, Ethernet serial hardware, and plug-in serial hardware in the same computer at the same time?

As long as your operating system supports all your NI-Serial hardware, you can mix types different serial interfaces in your computer. All NI-Serial hardware and software is designed and tested for interoperability.

E

Specifications

This appendix describes the characteristics of the serial hardware, the NI-Serial software, along with the recommended operating conditions.

PCI Serial Hardware

Nonisolated Two-Port Boards

Dimensions..... 10.67 by 14.22 cm (4.2 by 5.6 in.)

I/O connector..... DB-9

Power requirement (from PCI channel)

PCI-485/2

+5 VDC..... 350 mA typical
750 mA maximum

PCI-232/2

+5 VDC..... 50 mA typical
100 mA maximum

±12 VDC..... 20 mA typical
200 mA maximum

Isolated Two-Port Boards

Dimensions..... 10.67 by 14.22 cm (4.2 by 5.6 in.)

I/O connector..... DB-9

Isolation voltage

From port to port..... 2,000 V_{rms}/60 s

From any port to host computer..... 2,000 V_{rms}/60 s

Power requirement (from PCI channel)

PCI-485/2

+5 VDC .....800 mA typical
1,300 mA maximum

PCI-232/2

+5 VDC .....400 mA typical
650 mA maximum

Nonisolated Four-Port Boards

Dimensions .....10.67 by 17.27 cm
(4.2 by 6.8 in.)

I/O connector[1] .....10-position modular jack

Power requirement (from PCI channel)

PCI-485/4

+5 VDC .....700 mA typical
1,300 mA maximum

PCI-232/4

+5 VDC .....70 mA typical
150 mA maximum

±12 VDC .....40 mA typical
400 mA maximum

Isolated Four-Port Boards

Dimensions .....10.67 by 17.27 cm
(4.2 by 6.8 in.)

I/O connector[1] .....10-position modular jack

Isolation voltage

From port to port .....2,000 V_{rms}/60 s

From any port to host computer .....2,000 V_{rms}/60 s

[1] The four-port PCI serial boards require a cable to convert the 10-position modular jack to either DB-9 or DB-25 connectors.

Power requirement (from PCI channel)

PCI-485/4

+5 VDC..... 1,000 mA typical
1,500 mA maximum

PCI-232/4

+5 VDC..... 500 mA typical
750 mA maximum

Eight-Port Boards

Dimensions..... 10.67 by14.48 cm
(4.2 by 5.7 in.)

I/O connector[1] ..... 68-position, SCSI type connector

Power requirement (from PCI channel)

PCI-485/8

+5 VDC..... 1,100 mA typical
2,000 mA maximum

PCI-232/8

+5 VDC..... 100 mA typical
180 mA maximum

±12 VDC..... 80 mA typical
800 mA maximum

16-Port Boards

Dimensions..... 10.67 by17.52 cm
(4.2 by 6.9 in.)

I/O connector[2] ..... 100-position, SCSI type
connector

Power requirement (from PCI channel)

PCI-232/16

+5 VDC..... 250 mA typical
500 mA maximum

---

[1] The eight-port PCI serial boards require a cable, which is included in your kit, to convert the 68-position connector to eight DB-9 connectors.

[2] The 16-port PCI serial boards require a breakout box, which is included in your kit, to separate the 100-position connector to 16 DB-9 connectors.

Environmental Characteristics

Operating environment

- Ambient temperature ..... 0 to 55 °C
- Relative humidity ..... 10 to 90%, noncondensing

Storage environment

- Ambient temperature ..... –40 to 85 °C
- Relative humidity ..... 5 to 95%, noncondensing

EMI ..... FCC Class A Verified

Software Characteristics

Maximum serial transfer rate[1]

- RS-485 ..... 460,800 bps
- RS-232 ..... 115,200 bps

PXI Serial Hardware

Two-Port Boards

Dimensions ..... 100 by 160 mm (3.94 by 6.37 in.)

I/O connector DB-9

Power requirement (from PXI channel)

- PXI-8420/2
  - +5 VDC ..... 100 mA typical, 150 mA maximum
  - ±12 VDC ..... 20 mA typical, 200 mA maximum
- PXI-8421/2
  - +5 VDC ..... 350 mA typical, 750 mA maximum
- PXI-8422/2
  - +5 VDC ..... 400 mA typical, 650 mA maximum

[1] Actual speed may vary considerably from speed shown due to system and instrumentation capabilities.

PXI-8423/2

+5 VDC..... 800 mA typical
1,300 mA maximum

Four-Port Boards

Dimensions..... 100 by 160 mm
(3.94 by 6.37 in.)

I/O connector[1] ..... 10-position modular jack

Power requirement (from PXI channel)

PXI-8420/4

+5 VDC..... 125 mA typical
200 mA maximum

±12 VDC..... 40 mA typical
400 mA maximum

PXI-8421/4

+5 VDC..... 350 mA typical
750 mA maximum

PXI-8422/4

+5 VDC..... 500 mA typical
750 mA maximum

PXI-8423/4

+5 VDC..... 1,000 mA typical
1,500 mA maximum

Eight-Port Boards

Dimensions..... 100 by 160 mm
(3.94 by 6.37 in.)

I/O connector[2] ..... 68-position, SCSI type connector

[1] The four-port PXI serial boards require a cable to convert the 10-position modular jack to either DB-9 or DB-25 connectors.

[2] The eight-port PXI serial boards require cables, which are included in your kit, to convert the 68-position connector to eight DB-9 connectors.

Power requirement (from PXI channel)

PXI-8420/8

+5 VDC .....150 mA typical
250 mA maximum

±12 VDC .....80 mA typical
800 mA maximum

PXI-8421/8

+5 VDC .....1,100 mA typical
2,000 mA maximum

16-Port Boards

Dimensions .....100 by 160 mm
(3.94 by 6.37 in.)

I/O connector[1] .....100-position, SCSI type connector

Power requirement (from PXI channel)

PXI-8420/16

+5 VDC .....500 mA typical
750 mA maximum

Environmental Characteristics

Operating environment

Ambient temperature .....0 to 55 °C

Relative humidity .....10 to 90%, noncondensing

Storage environment

Ambient temperature .....–40 to 85 °C

Relative humidity .....5 to 95%, noncondensing

EMI .....FCC Class A Verified

[1] The 16-port PCI serial boards require a breakout box, which is included in your kit, to separate the 100-position connector to 16 DB-9 connectors.

Software Characteristics

Maximum serial transfer rate[1]

RS-485 ..... 460,800 bps

RS-232 ..... 115,200 bps

USB Serial Hardware

One-Port Hardware

Dimensions..... 3.8 by 3.7 by 1.6 cm (1.49 by 1.44 by 0.61 in.)

Case material..... PVC

Weight

USB-232 ..... 121 g (0.27 lb)

USB-485 ..... 118 g (0.26 lb)

I/O connector..... DB-9

USB connector ..... Captive cable with USB series A plug

Power requirement (from USB channel)

USB-485

+5 VDC..... 175 mA typical
500 mA maximum

USB-232

+5 VDC..... 100 mA typical
200 mA maximum

Two and Four-Port Hardware

Dimensions..... 21.0 by 12.4 by 3.7 cm (8.25 by 4.89 by 1.44 in.)

Case material..... Hard plastic with metal baseplate

Weight..... 375 g (0.83 lb)

[1] Actual speed may vary considerably from speed shown due to system and instrumentation capabilities.

I/O connector DB-9

USB connector.....USB series B

Power requirement (from USB channel)

USB-485/2

+5 VDC .....300 mA typical
500 mA maximum

USB-232/2

+5 VDC .....200 mA typical
500 mA maximum

USB-232/4

+5 VDC .....300 mA typical
500 mA maximum

Power requirement (from external supply)

USB-485/4 (9 V–30V)

+12 VDC .....225 mA typical
500 mA maximum

Environmental Characteristics

Operating environment

Ambient temperature .....0 to 70 °C

Relative humidity .....10 to 90%, noncondensing

Storage environment

Ambient temperature

One port.....–40 to 80 °C

Two and four port.....–40 to 85 °C

Relative humidity .....5 to 95%, noncondensing

EMI .....FCC Class A Verified

Software Characteristics

Maximum serial transfer rate[1]

RS-485.....460,800 bps

RS-232.....230,400 bps

[1] Actual speed may vary considerably from speed shown due to system and instrumentation capabilities.

PCMCIA Serial Hardware

Hardware Specifications

Dimensions..... 85.6 by 54.0 by 0.5 cm
(3.370 by 2.126 by 0.197 in.)

I/O connector..... Adapter cable with DB-9 Dsub connector and converter for PC card

Power requirement
(from PCMCIA expansion slot)

PCMCIA-232

+5 VDC..... 40 mA typical,
150 mA maximum

PCMCIA-485

+5 VDC..... 110 mA typical,
225 mA maximum

PCMCIA-232/2

+5 VDC ..... 60 mA typical,
250 mA maximum

PCMCIA-485/2

+5 VDC..... 150 mA typical,
400 mA maximum

PCMCIA-232/4

+5 VDC..... 60 mA typical,
200 mA maximum

Operating environment

Ambient temperature ..... 0 to 55° C

Relative humidity..... 10 to 90%, noncondensing

Storage environment

Ambient temperature ..... –40 to 120° C

Relative humidity..... 5 to 95%, noncondensing

EMI ..... FCC Class A verified

Software Specifications

Maximum serial transfer rate[1] .....Your software port Settings view indicates the maximum rate (typically 921.6 k) for your hardware

AT Serial Hardware

Nonisolated Two-Port Boards

Dimensions .....10.67 by 16.51 cm (4.2 by 6.5 in.)

I/O connector DB-9

Power requirement
(from PC AT I/O channel)

AT-485/2

+5 VDC .....390 mA typical
510 mA maximum

AT-232/2

+5 VDC .....260 mA typical
340 mA maximum

AT-485/2 (Shared IRQ)

+5 VDC .....140 mA typical
180 mA maximum

AT-232/2 (Shared IRQ)

+5 VDC ..... 70 mA typical
100 mA maximum

Isolated Two-Port Boards

Dimensions .....10.67 by 18.70 cm (4.2 by 7.4 in.)

I/O connector DB-9

[1] Actual speed may vary considerably from speed shown due to system and instrumentation capabilities.

Isolation voltage

From Port to Port ..... 3,000 V_{rms}/60 s

From Any Port to Host Computer ..... 2,000 V_{rms}/60 s

Power requirement (from PC AT I/O channel)

AT-485/2 Isolated

+5 VDC ..... 220 mA typical
260 mA maximum

AT-232/2 Isolated

+5 VDC..... 160 mA typical
200 mA maximum

Nonisolated Four-Port Boards

Dimensions..... 10.67 by 16.51 cm (4.2 by 6.5 in.)

I/O connector[1] ..... 10-position modular jack

Power requirement (from PC AT I/O channel)

AT-485/4

+5 VDC ..... 160 mA typical
200 mA maximum

AT-232/4

+5 VDC..... 110 mA typical
150 mA maximum

AT-485/4 (Shared IRQ)

+5 VDC..... 160 mA typical
200 mA maximum

AT-232/4 (Shared IRQ)

+5 VDC..... 110 mA typical
150 mA maximum

[1] The four-port AT serial board requires a cable to convert the 10-position modular jack to either DB-9 or DB-25 connectors.

Isolated Four-Port Boards

Dimensions .....10.67 by 25.40 cm (4.2 by 10.0 in.)

I/O connector[1] .....10-position modular jack

Isolation voltage

From Port to Port .....3,000 V_{rms}/60 s

From Any Port to Host Computer .....2000 V_{rms}/60 s

Power requirement (from PC AT I/O channel)

AT-485/4 Isolated

+5 VDC .....300 mA typical, 360 mA maximum

AT-232/4 Isolated

+5 VDC .....280 mA typical, 320 mA maximum

Environmental Characteristics

Operating environment

Ambient temperature .....0 to 70° C

Relative humidity .....10 to 90%, noncondensing

Storage environment

Ambient temperature .....–40 to 85° C

Relative humidity .....5 to 95%, noncondensing

EMI

AT serial.....FCC Class B verified

AT serial isolated .....FCC Class A verified

Software Characteristics

Maximum serial transfer rate.....115,200 bps[2]

[1] The four-port isolated AT serial board requires cables, which are included in your kit, to convert the 10-position modular jack to a DB-9 connector. Use only the type of cables provided in your kit.

[2] Actual speed may vary considerably from speed shown due to system and instrumentation capabilities.

F

Technical Support and Professional Services

Visit the following sections of the National Instruments Web site at ni.com for technical support and professional services:

- **Support**—Online technical support resources include the following:
  - **Self-Help Resources**—For immediate answers and solutions, visit our extensive library of technical support resources available in English, Japanese, and Spanish at ni.com/support. These resources are available for most products at no cost to registered users and include software drivers and updates, a KnowledgeBase, product manuals, step-by-step troubleshooting wizards, hardware schematics and conformity documentation, example code, tutorials and application notes, instrument drivers, discussion forums, a measurement glossary, and so on.
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- **System Integration**—If you have time constraints, limited in-house technical resources, or other project challenges, NI Alliance Program members can help. To learn more, call your local NI office or visit ni.com/alliance.
- **Declaration of Conformity (DoC)**—A DoC is our claim of compliance with various European Council Directives using the manufacturer's self-declaration of conformance. This system affords the user protection for electronic compatibility (EMC) and product safety. You can obtain the DoC for your product by visiting ni.com/hardref.nsf.

- **Calibration Certificate**—If your product supports calibration, you can obtain the calibration certificate for your product at `ni.com/calibration`.

If you searched `ni.com` and could not find the answers you need, contact your local office or NI corporate headquarters. Phone numbers for our worldwide offices are listed at the front of this manual. You also can visit the Worldwide Offices section of `ni.com/niglobal` to access the branch office Web sites, which provide up-to-date contact information, support phone numbers, email addresses, and current events.

Glossary

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

Symbols

°	degrees
Ω	ohms
%	percent

A

A	amperes
ANSI	American National Standards Institute

B

b	bits
B	bytes

baud	bits per second
bps	bits per second

C

C	Celsius
COM	Computer Output Microform; used in reference to a communication port
CTS	clear to send

D

DB-*xx*	subminiature D connector, where *xx* is the number of pins
DCD	data carrier detect
DCE	data communications equipment or data circuit-terminating equipment
DLL	dynamic link library
DMA	direct memory access
DSR	data set ready
DTE	data terminal equipment
DTR	data terminal ready—the overscore denotes that the signal is active low
duplex	the means of bandwidth usage in a serial system

E

EIA	Electronic Industries Association
EMI	electromagnetic interference

F

FCC	Federal Communications Commission
FIFO	First-In-First-Out
ft	feet

G

GND	ground

H

HSI	handshake input
HSO	handshake output
Hz	Hertz

I

I/O	input/output
IEEE	Institute of Electrical and Electronic Engineers
in.	inches
IRQ	interrupt request
ISA	Industry Standard Architecture

K

Kbaud	kilobits per second

M

m	meters
MB	megabytes of memory

P

PC	personal computer
PCI	Peripheral Components Interconnect

R

RAM	random-access memory
RI	ring indicator
RTS	request to send
RX	receive
RXD	receive data—the overscore denotes that the signal is active low

S

s	seconds
SCSI	Small Computer Systems Interface

T

TX	transmit
TXD	transmit data—the overscore denotes that the signal is active low
TXRDY	transmit ready—the overscore denotes that the signal is active low

U

UART	Universal Asynchronous Receiver/Transmitter

V

V	volts
VDC	volts direct current
VXI	VME eXtensions for Instrumentation

W

Win16	describes a 16-bit Windows application
Win32	describes a 32-bit Windows application

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