Serial

Getting Started with Your PXI Serial Hardware and Software for Windows 98/95

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Internet Support
E-mail: support@natinst.com
FTP Site: ftp.natinst.com
Web Address: http://www.natinst.com

Bulletin Board Support
BBS United States: 512 794 5422
BBS United Kingdom: 01635 551422
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Fax-on-Demand Support
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Telephone Support (USA)
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National Instruments Corporate Headquarters
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This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

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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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About This Manual

This manual contains instructions to help you install and configure the National Instruments serial hardware and the NI Serial software for Windows 98/95. This manual includes information about the RS-232 boards (PXI-8420 two-, four-, and eight-port, and PXI-8422 two- and four-port) and the RS-485 boards (PXI-8421 two-, four-, and eight-port, and PXI-8423 two- and four-port).

This manual assumes that you are already familiar with Windows 98/95.

Organization of This Manual

This manual is organized as follows:

- Chapter 1, *Introduction*, explains how to use this manual, lists what you need to get started and optional equipment you can order, and briefly describes the serial hardware and the NI Serial software.
- Chapter 2, *Installation and Verification*, describes how to install the NI Serial software, serial hardware, and cables, and how to verify the installation.
- Chapter 3, *Configuration*, describes how to view or change the communication port settings.
- Chapter 4, *Using Your Serial Hardware*, describes how to set the hardware transceiver control mode for your RS-485 interfaces and lists some general programming requirements.
- Appendix A, *Serial Port Information*, describes the RS-232, RS-422, and RS-485 standards and explains some of the issues involved with these types of serial communication.
- Appendix B, *Uninstalling the Hardware and Software*, describes how to uninstall your serial hardware and the NI Serial software.
- Appendix C, *Troubleshooting and Common Questions*, describes how to troubleshoot problems and answers some common questions.
- Appendix D, *Specifications*, describes the characteristics of the serial hardware, the NI Serial software, along with the recommended operating conditions.
- Appendix E, *Customer Communication*, contains forms you can use to request help from National Instruments or to comment on our products and manuals.

- The *Glossary* contains an alphabetical list and description of terms used in this manual, including abbreviations, acronyms, metric prefixes, mnemonics, and symbols.

Conventions Used in This Manual

This manual uses the following conventions:

»	The **»** symbol leads you through nested menu items and dialog box options to a final action. The sequence **File»Page Setup»Options»Substitute Fonts** directs you to open the **File** menu, select the **Page Setup** item, select **Options**, and finally select the **Substitute Fonts** option from the last dialog box.
$\overline{\text{DTR}}$	Signal names with an overscore, such as $\overline{\text{DTR}}$, indicate that the signal is active low.
☞	This icon to the left of bold italicized text denotes a note, which alerts you to important information.
⚠	This icon to the left of bold italicized text denotes a caution, which advises you of precautions to take to avoid injury, data loss, or a system crash.
bold	Bold text denotes the names of menus, menu items, dialog boxes, dialog box buttons or options, icons, windows, or Windows tabs.
bold italic	Bold italic text denotes a note or caution.
italic	Italic text denotes variables, emphasis, a cross reference, or an introduction to a key concept. This font also denotes text from which you supply the appropriate word or value, as in Windows 3.*x*.
`monospace`	Text in this font denotes text or characters that you should literally 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 for statements and comments taken from programs.
`monospace bold`	Bold text in this font denotes the messages and responses that the computer automatically prints to the screen.
PXI serial boards	*PXI serial boards* refers to all port versions of the PXI serial boards.

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*, and *Programmer's Guide to Windows 98/95*, Microsoft Corporation
- *NS16550AF Universal Asynchronous Receiver/Transmitter with FIFOs*, National Semiconductor
- *ST16C654 Asynchronous Receiver/Transmitter with FIFOs*, EXAR Corporation

Customer Communication

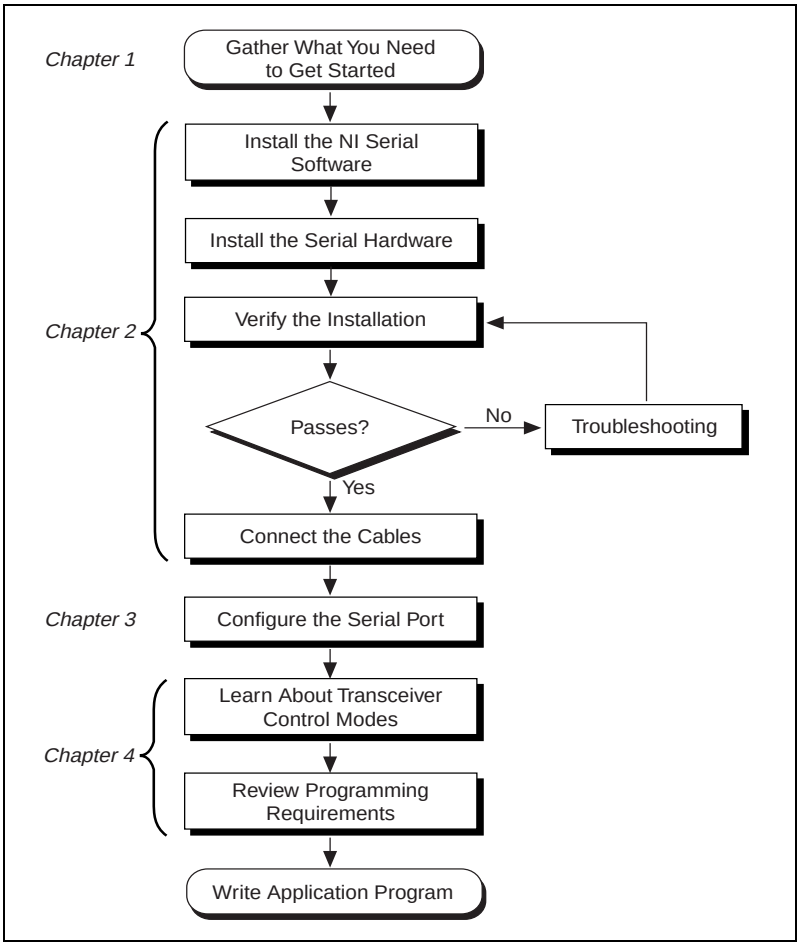
National Instruments wants to receive your comments on our products and manuals. We are interested in the applications you develop with our products, and we want to help if you have problems with them. To make it easy for you to contact us, this manual contains comment and configuration forms for you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

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 serial hardware and the NI Serial 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 98/95 or higher installed on your computer
- ❑ One of the following serial boards, which is included in your kit:

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

- ❑ 3.5 in., high-density disk (1.44 MB), *NI Serial Software for Windows 98/95 and Windows NT (Setup Disk)*, 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 [RS-485 (PXI-8421 and PXI-8423 only)]
- 10-position modular jack to DB-9 cable (four-port boards only)
- 10-position modular jack to DB-25 cable (four-port boards only)
- 68-pin to DB-9 adapter cable (eight-port boards only)
- RS-232 9-pin to 9-pin null modem cable
- RS-232 9-pin to 25-pin null modem cable

PXI Serial Hardware Overview

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, and an eight-port version (PXI-8420 and PXI-8421 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. Throughout this manual, *PXI serial boards* refers to all port 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. Non-isolated 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 4, *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 D, *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 2-port RS-232 4-port RS-232 8-port
PXI-8421	RS-485 2-port RS-485 4-port RS-485 8-port
PXI-8422	RS-232 2-port isolated RS-232 4-port isolated
PXI-8423	RS-485 2-port isolated RS-485 4-port isolated

NI Serial Software Overview

The NI Serial software for Windows 98/95 includes a native Windows device driver that provides full interrupt-driven, buffered I/O for multiple COM ports. Using this driver, you can obtain a maximum baud rate of 460.8 KBaud on the PCI-485 and 115.2 KBaud on the PCI-232. You can also use any number of serial ports under Windows 98/95. The NI Serial software also includes a configuration utility, which is fully integrated into the Windows 98/95 Device Manager. For more information about software specifications, refer to Appendix D, *Specifications*.

The NI Serial software includes the following components:

- Device driver
- Diagnostic utility
- Configuration utility

The NI Serial software supports all National Instruments serial hardware, including the AT, PCI, PXI, CompactPCI, and PCMCIA versions.

Time-Saving Development Tools

Your kit includes the NI Serial software for Windows 98/95. In addition, you can order the LabWindows/CVI 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.

LabWindows/CVI is similar to LabVIEW, except that it combines an interactive, easy-to-use development approach with the programming power and flexibility of compiled ANSI C code.

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

Using Your Serial Hardware with LabVIEW and LabWindows/CVI

After you install your serial hardware and the NI Serial software, you can use standard serial I/O functions in LabVIEW and LabWindows/CVI with your serial interface. If you already have LabVIEW or LabWindows/CVI and want to use it with your serial hardware, refer to your LabVIEW or LabWindows/CVI documentation for information about serial I/O functions.

2

Installation and Verification

This chapter describes how to install the NI Serial software, serial hardware, and cables, and how to verify the installation.

Install the NI Serial Software

Before you install your serial hardware, complete the following steps to install the NI Serial software for Windows 98/95:

1. Select **Start»Settings»Control Panel**.
2. Double-click on the **Add/Remove Programs** icon. A dialog box similar to the one shown in Figure 2-1 appears.

Figure 2-1. Add/Remove Programs Properties Dialog Box

3. Click on the **Install** button.
4. When prompted, insert the *NI Serial Software for Windows 98/95 and Windows NT (Setup Disk)*, and click on the **Next** button. The setup wizard begins with the screen shown in Figure 2-2.

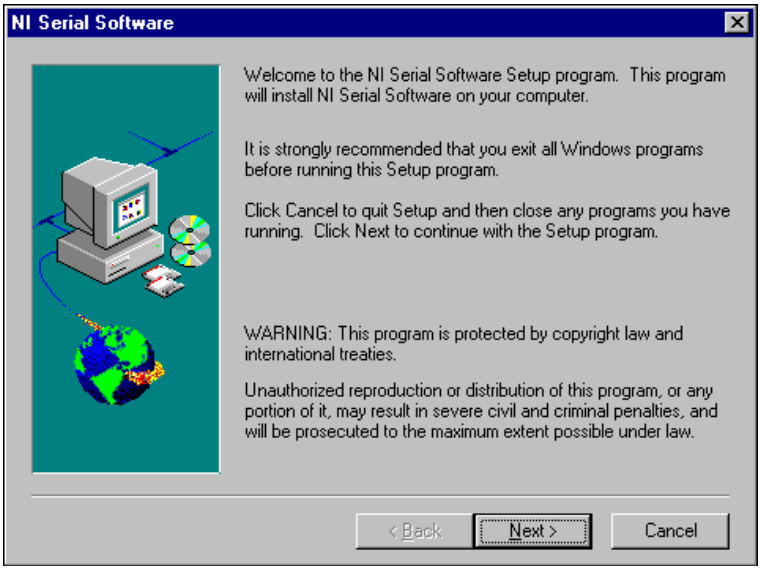


Figure 2-2. NI Serial Setup Screen

The setup wizard guides you through the necessary steps to install the NI Serial software. To go back and change values where appropriate, click on the **Back** button. To exit the setup wizard at any time, click on 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 98/95, skip to the next section, *Install the Hardware*. Otherwise, continue to step 6.
6. If your hardware is already installed, restart Windows 98/95.

   Windows 98/95 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 on the **OK** button.

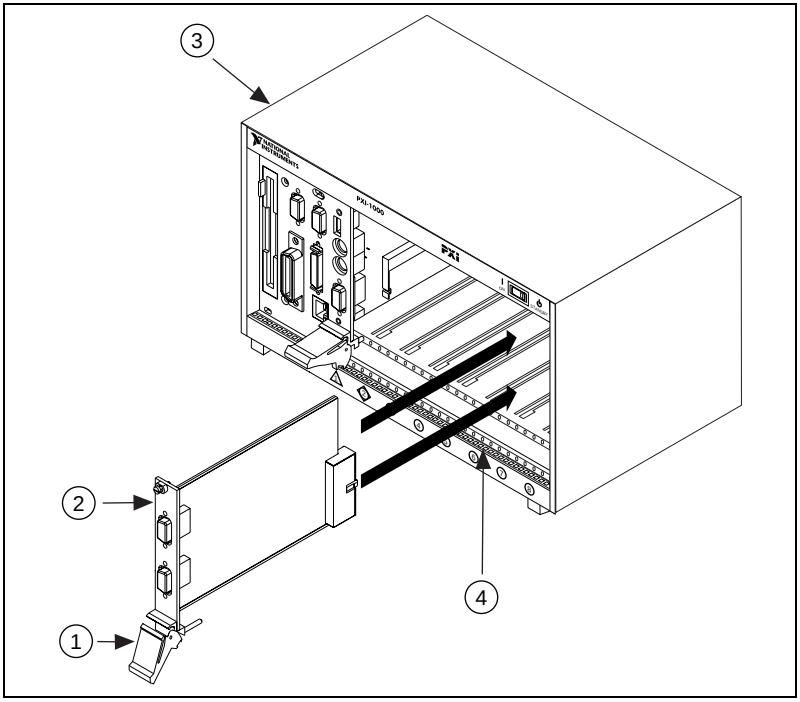
   If no **New Hardware Found** dialog box appears, refer to the *Forcing Windows to Detect Your Hardware* section in Appendix C, *Troubleshooting and Common Questions*.

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 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 2-3 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 2-3. 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 98/95.
8. Windows 98/95 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 on the **OK** button.

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

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

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 98/95 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 on the **System** icon.
2. Click on the **Device Manager** tab and click on the **View devices by type** button.
3. Double-click on the **Ports (COM & LPT)** icon to display all of the ports.
4. Double-click on 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 2-4 shows the Device Manager tab for serial hardware that is installed properly.

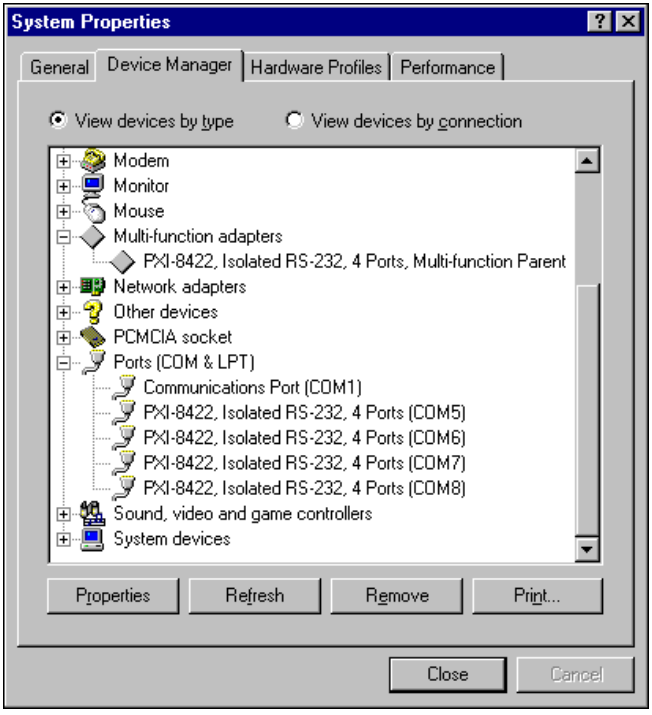


Figure 2-4. Device Manager Tab for PXI Serial Board Ports

5. Verify the hardware resources, as follows:
   a. In the **Device Manager** tab, under **Multi-function adapters,** double-click on a serial board.
   b. Click on the **Resources** tab. If the resources were assigned properly, the **Resources** tab shows which resources are assigned to your serial ports.
   c. Repeat steps 6a and 6b 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 on the serial port (COM*x*).
   b. Click on 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. Run the diagnostic utility, as follows: 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 C, *Troubleshooting and Common Questions*, to troubleshoot the problem.

After you verify the hardware and software installation, continue to the next section, *Connect the Cables*.

Connect the Cables

For the two-port PXI serial boards, you can use the standard DB-9 connector found on most serial cables. To use the DB-9 connector with the four-port PXI serial boards, 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 PXI serial boards by ordering the 10-position modular jack to DB-25 converter cable from National Instruments. The eight-port PXI serial boards include a pig tail cable adapter, providing eight standard DB-9 connectors.

DB-9 Connector

Figure 2-5 and Table 2-1 give the pin locations and descriptions of the DB-9 connector, which is on the two-port PXI serial board, the 10-position modular jack to DB-9 cable, and the cable adapter for the eight-port board.

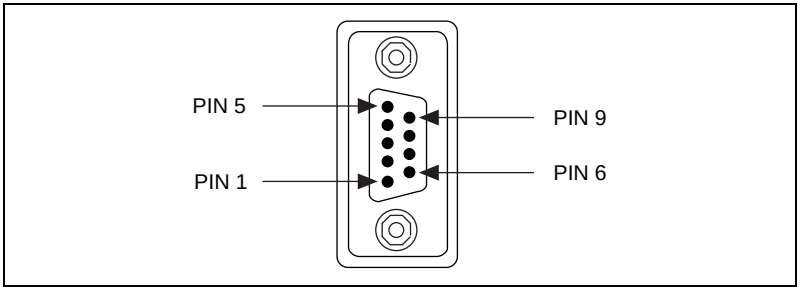


Figure 2-5. DB-9 Connector Pin Locations

Table 2-1. DB-9 Pin Descriptions

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

Modular Jack Connector

Figure 2-6 and Table 2-2 give the pin locations and descriptions of the 10-position modular jack, which is on the four-port PXI serial board.

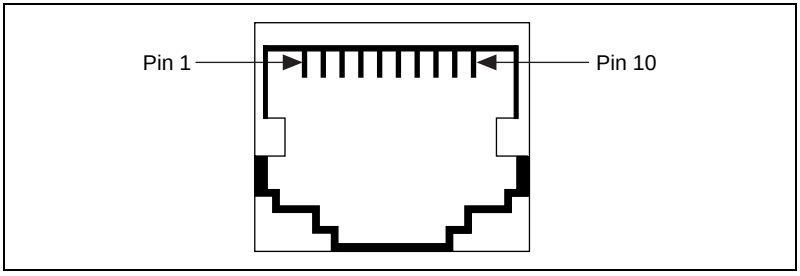


Figure 2-6. 10-Position Modular Jack Pin Locations

Table 2-2. 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–)
4	RTS	RTS– (HSO–)
3	CTS	TXD+
2	RI	TXD–
1	No Connect	No Connect

DB-25 Connector

Figure 2-7 and Table 2-3 give the pin locations and descriptions of the DB-25 connector, which is on the optional 10-position modular jack to DB-25 cable.

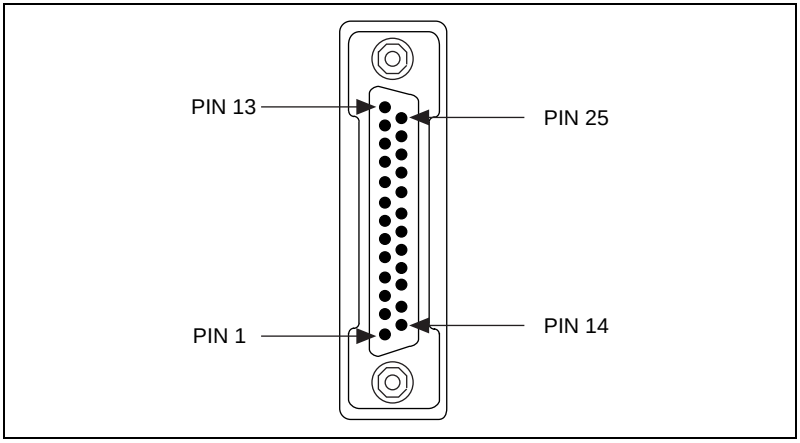


Figure 2-7. DB-25 Connector Pin Locations

Table 2-3. DB-25 Pin Descriptions

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

Figure 2-8 shows how to connect the cables when you install a four-port PXI serial board.

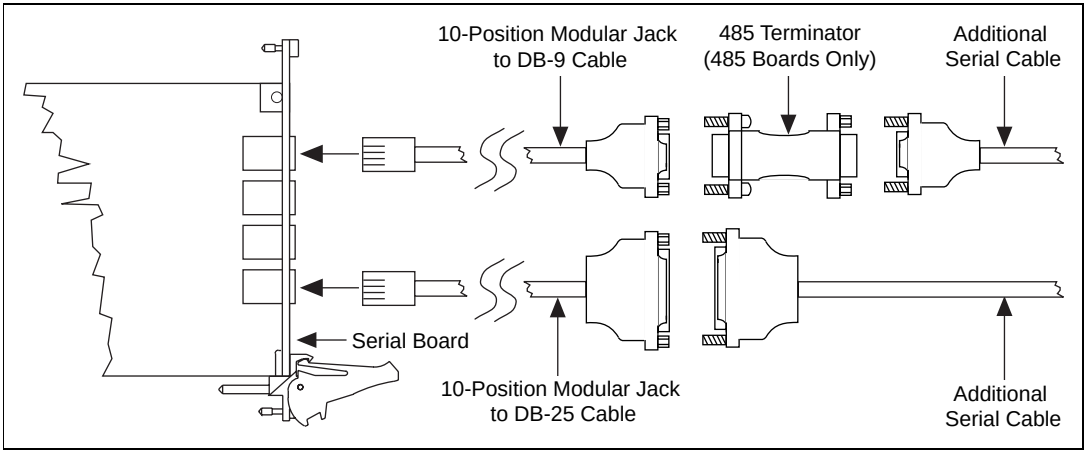


Figure 2-8. Connecting the Cables to Your Four-Port PXI Serial Board

68-Pin Connector

Figure 2-9 and Table 2-4 give the pin locations and descriptions of the 68-pin connector, which is on the eight-port PXI serial board.

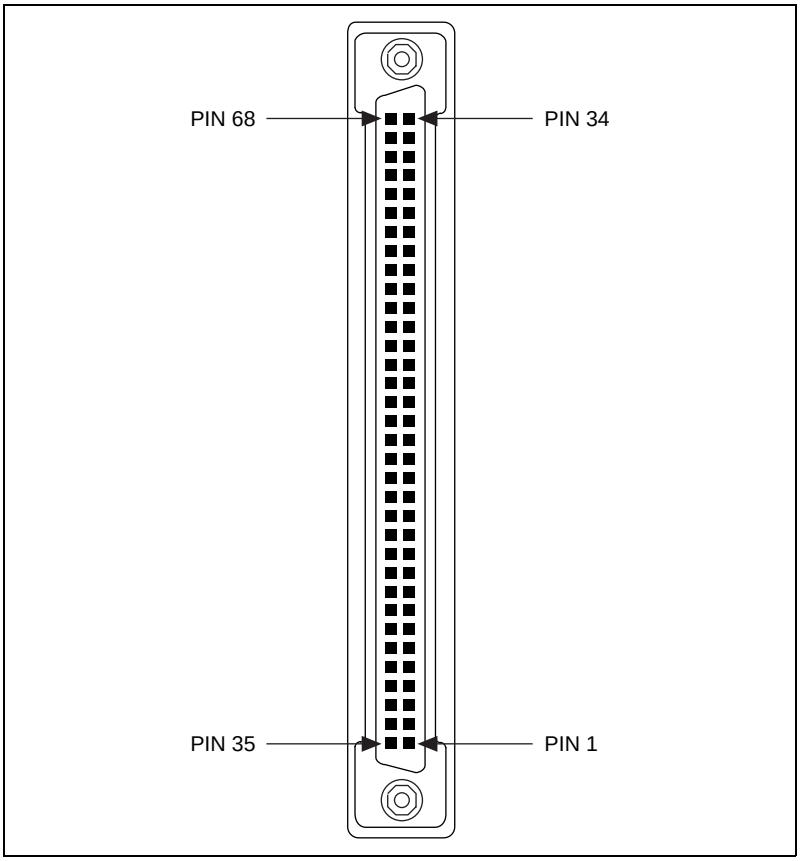


Figure 2-9. 68-Pin Connector Pin Locations

Table 2-4. 68-Pin Connector Pin Descriptions

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

Connecting Two-Wire Devices

The RS-485 boards (PXI-8421 and PXI-8423) are 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 RS-485 using half-duplex communication, you need a single twisted pair of wires. At the RS-485, 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 4, *Using Your Serial Hardware*. For more information about duplex architectures, refer to Appendix A, *Serial Port Information*.

3

Configuration

This chapter describes how to view or change the communication port settings.

View or Change Communication Port Settings

The serial configuration utility is fully integrated into the Windows 98/95 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 on the **System** icon.
2. Click on the **Device Manager** tab and click on the **View devices by type** button.
3. Double-click on 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 C, 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 on the **Resources** tab.
   - To view or change the port settings, click on 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 on 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 4, Using Your Serial Hardware.***

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

Port Settings Tab

In the **Port Settings** tab, you can change any of the settings by clicking on the arrow button to the right of a field. When you click on the arrow button, a list of valid values for that field appears and you can select the desired setting from the list. Figure 3-1 shows the **Port Settings** tab.

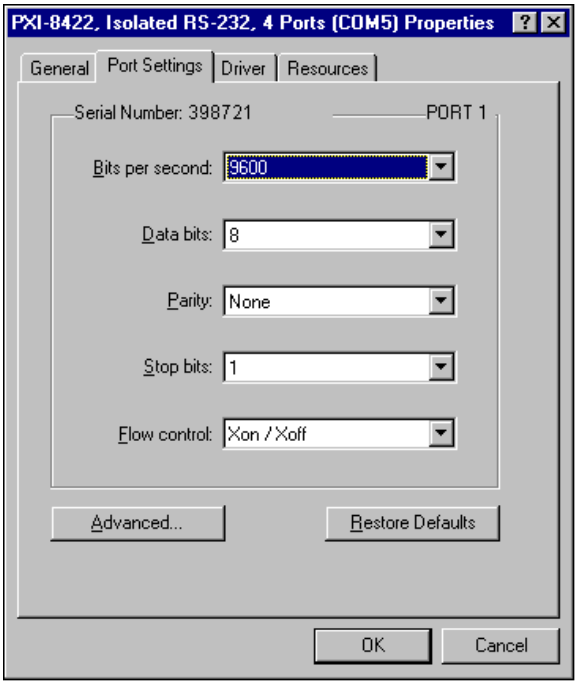


Figure 3-1. Port Settings Tab

The following sections describe the options you can set in the Device Manager **Port Settings** tab.

Bits per Second

Bits per second, or baud rate, is the speed for a serial port.

Data Bits

Data bits is the number of data bits in a single serial byte.

Parity

Parity is the specification for even, odd, or no parity bits in each transmitted byte.

Stop Bits

Stop bits is the number of terminating bits on the end of each transmitted serial byte.

Flow Control

Flow control is a method for temporarily halting the stream of serial bytes to prevent overflow.

Advanced Port Settings

To view or change the advanced port settings, click on the **Advanced** button. Figure 3-2 shows the **Advanced Port Settings** dialog box.

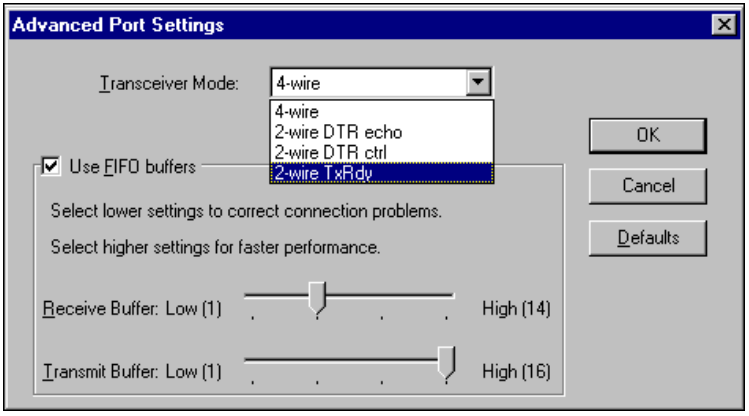


Figure 3-2. Advanced Port Settings Dialog Box

The following sections describe the advanced port setting options.

Transceiver Mode

This field shows the transceiver mode in use, and applies only to RS-485 boards. For more information about transceiver modes, refer to Chapter 4, *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 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 on the **Restore Defaults** button.

4

Using Your Serial Hardware

This chapter describes how to set the hardware transceiver control mode for your RS-485 interfaces and lists some general programming requirements.

General Programming Requirements

The NI Serial software is fully integrated into the standard Windows 98/95 communications software. NI serial ports are used like any other Windows 98/95 communications (COM) port. Windows 98/95 has standard communication functions for use within either Win16 or Win32 applications.

When you develop your application, remember that you must use the standard Microsoft Windows serial communication functions. For information about Microsoft Windows serial communication functions, refer to the *Win32 Software Development Kit* and to the *Win32 Overviews* and *Win32 Reference* online help.

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

Advanced Transceiver Control for the RS-485

☞ **Note** ***Transceiver modes apply only to the RS-485 boards (PXI-8421 and PXI-8423).***

The RS-485 boards support four modes of hardware transceiver control. You can use hardware flow control to enable and disable your transmitters and receivers so that they function on different bus topologies. Table 4-1 lists the status of the transmitters and receivers under each of the transceiver control modes.

Table 4-1. Transceiver Control Modes

Mode	Transmitter	Receiver
Four-wire mode	Always enabled	Always enabled
Two-wire mode: $\overline{\text{DTR}}$ with echo	Enabled with $\overline{\text{DTR}}$ unasserted	Always enabled
Two-wire mode: $\overline{\text{DTR}}$ controlled	Enabled with $\overline{\text{DTR}}$ unasserted	Enabled with $\overline{\text{DTR}}$ asserted
Two-wire mode: $\overline{\text{TXRDY}}$ auto control	Enabled with $\overline{\text{TXRDY}}$ asserted	Enabled with $\overline{\text{TXRDY}}$ unasserted

☞ **Note** ***Signal names with an overscore, such as*** $\overline{\text{DTR}}$***, indicate that the signal is active low.***

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: $\overline{\text{DTR}}$ with Echo

Use this mode in half-duplex systems where the $\overline{\text{DTR}}$ (Data Terminal Ready) line must control the transmitter. In the $\overline{\text{DTR}}$-with-echo mode, the transmitter is tri-stated when the $\overline{\text{DTR}}$ signal of the UART (Universal Asynchronous Receiver/Transmitter) is asserted. To transmit, your application must first clear the $\overline{\text{DTR}}$ bit to enable the transmitter. After the data is fully transmitted, your application once again sets the $\overline{\text{DTR}}$ bit to disable the transmitter. Because the receiver is always enabled in this mode, you not only receive packets from other devices, you also receive the packets sent from your transmitter.

Two-Wire Mode: $\overline{\text{DTR}}$ Controlled

This mode is similar to the two-wire, $\overline{\text{DTR}}$-with-echo mode. Use this mode in half-duplex systems where the $\overline{\text{DTR}}$ line must control the transmitter. Although this mode uses the same method as the $\overline{\text{DTR}}$-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: $\overline{\text{TXRDY}}$ 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 flow control from your application. By connecting the transmitter to the $\overline{\text{TXRDY}}$ (Transmit Ready) line, the hardware 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 $\overline{\text{TXRDY}}$ 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 in Appendix A, Serial Port Information.

Setting the Transceiver Control Mode

To set the transceiver control mode, use the Windows 98/95 Device Manager. For instructions on how to use the Device Manager, refer to Chapter 3, *Configuration*. The mode you select in the Device Manager is automatically configured when you open a port on a serial interface.

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 4-2 shows the control bytes for each mode.

Table 4-2. Transceiver Mode Control Bytes

Transceiver Mode	Control Byte
Four-wire mode	0x00
Two-wire mode: $\overline{\text{DTR}}$ with echo	0x01
Two-wire mode: $\overline{\text{DTR}}$ controlled	0x02
Two-wire mode: $\overline{\text{TXRDY}}$ 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 RS-485 board to two-wire mode with $\overline{\text{DTR}}$ control, you would write a 0x02 to I/O address 0x3FF. The RS-485 board would immediately switch to the two-wire mode with $\overline{\text{DTR}}$ control.

Setting the Transceiver Mode with DeviceIoControl

The NI Serial software extends the `DeviceIoControl` Windows function for programming the transceiver control mode. To program the transceiver control mode using `DeviceIoControl`, complete the following steps:

1. Add the following lines to your source code:

```
#include <winioctl.h>

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

2. Use the Win32 function `DeviceIoControl`, as follows:
   a. Use the defined control code value listed in step 1 to set the transceiver mode.
   b. Use the input buffer values (unsigned long) listed in Table 4-3 for programming different transceiver modes.

Table 4-3. DeviceIoControl Function Input Values

Transceiver Mode	DeviceIoControl Function Input Value
Four-wire mode	128
Two-wire mode: $\overline{\text{DTR}}$ with echo	129
Two-wire mode: $\overline{\text{DTR}}$ controlled	130
Two-wire mode: $\overline{\text{TXRDY}}$ auto control	131

For example, to set $\overline{\text{TXRDY}}$ two-wire auto control mode, use the following code:

```
ULONG TranceiverMode = 131;
DeviceIoControl(hDevice,
IOCTL_SERIAL_SET_TRANSCEIVER_MODE,(PVOID)
&TransceiverMode,sizeof(ULONG),lpOutBuffer,
nOutBufferSize,lpBytesReturned,lpOverlapped);
```

A

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

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

Feature	RS-232	RS-422	RS-485
Type of transmission lines	Unbalanced	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 kb/s	10 Mb/s	10 Mb/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. Most 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 kb/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 Mb/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 A-1 shows a typical full-duplex system.

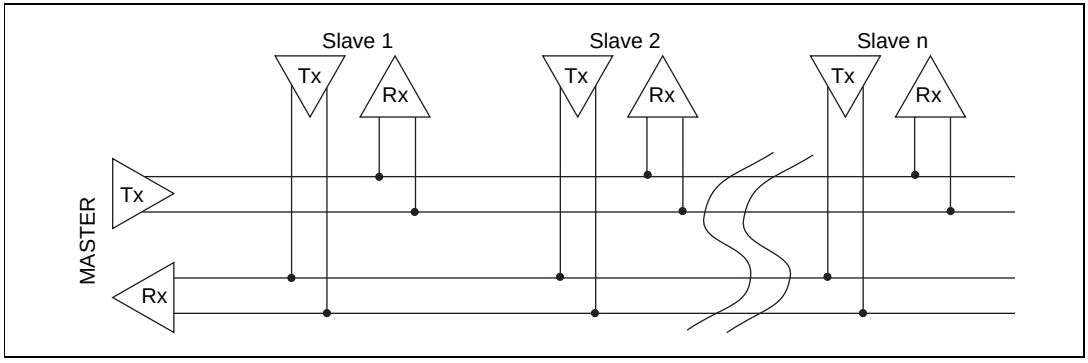


Figure A-1. Typical Full-Duplex System

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 A-2 shows a typical half-duplex system.

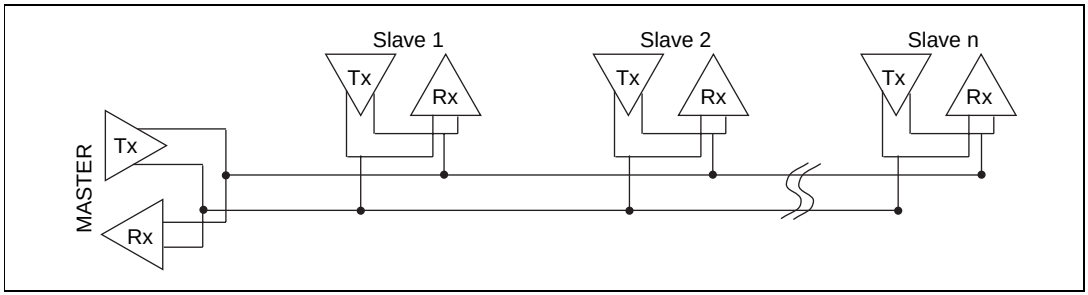


Figure A-2. Typical Half-Duplex System

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 A-3 shows a multidrop network using terminating resistors.

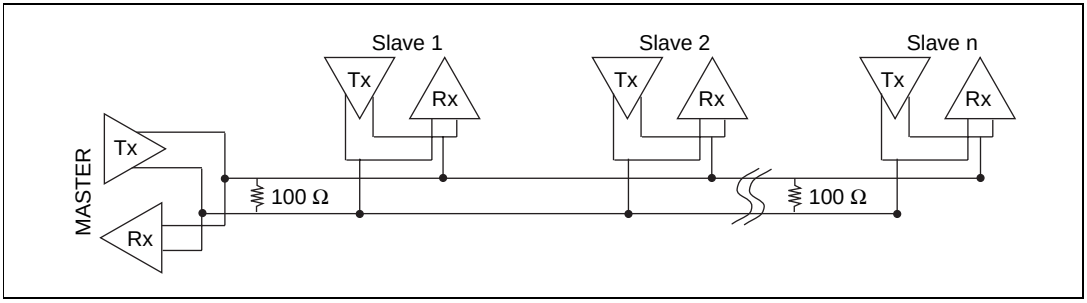


Figure A-3. Multidrop Network Using Terminating Resistors

Bias Resistors

A 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, force the transmission line into a known state. To do so, install two 620 Ω 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 less than 200 mV, the threshold voltage for the receiver. You should install these resistors on only one node.

☞ **Note** ***Bias resistors are not available on the eight-port PXI-8421.***

Figure A-4 shows a transmission line using bias resistors.

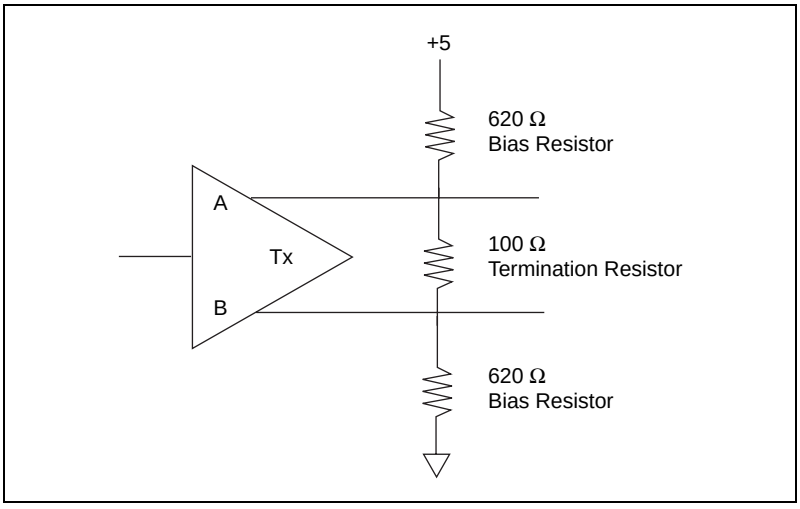


Figure A-4. Transmission Line Using Bias Resistors

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.

DTE vs. 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.

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

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

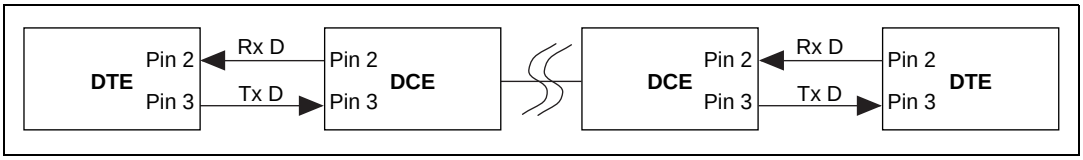


Figure A-5. Straight-Through Cabling in a DTE-to-DCE Interface

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 serial port to another, use a null-modem cable.

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

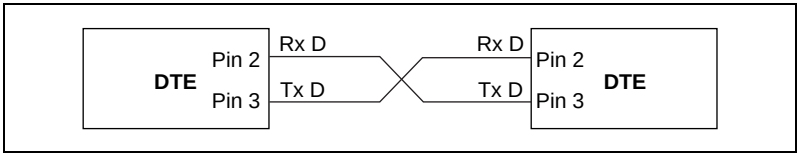


Figure A-6. Null-Modem Cabling in a DTE-to-DTE Interface

B

Uninstalling the Hardware and Software

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

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 on the **System** icon.
2. Select the **Device Manager** tab and click on the **View devices by type** button.
3. Double-click on 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 B-1.

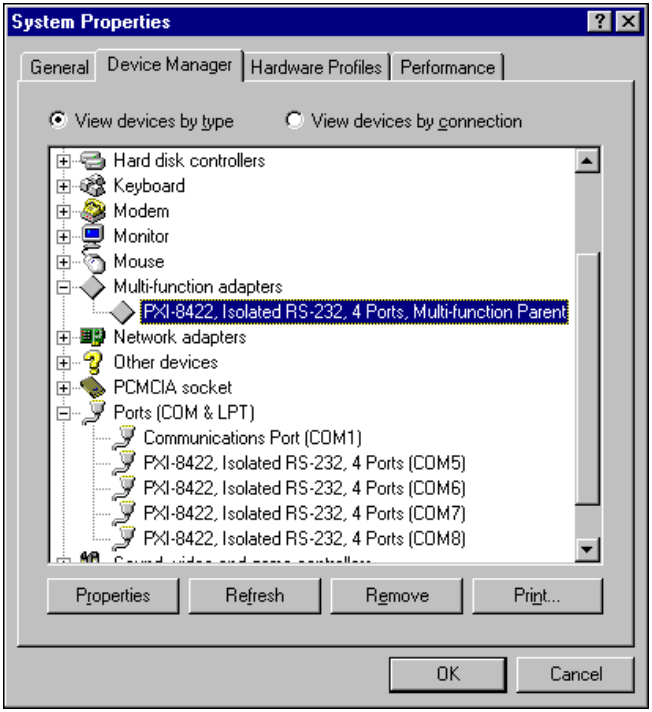


Figure B-1. Selecting an Interface to Uninstall

5. Click on the **Remove** button.
6. In the **Confirm Device Removal** dialog box, click on the **OK** button to remove the hardware information, or click on 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 on the **Add/Remove Programs** icon. A dialog box similar to the one shown in Figure B-2 appears. This dialog box lists the software that you can uninstall.

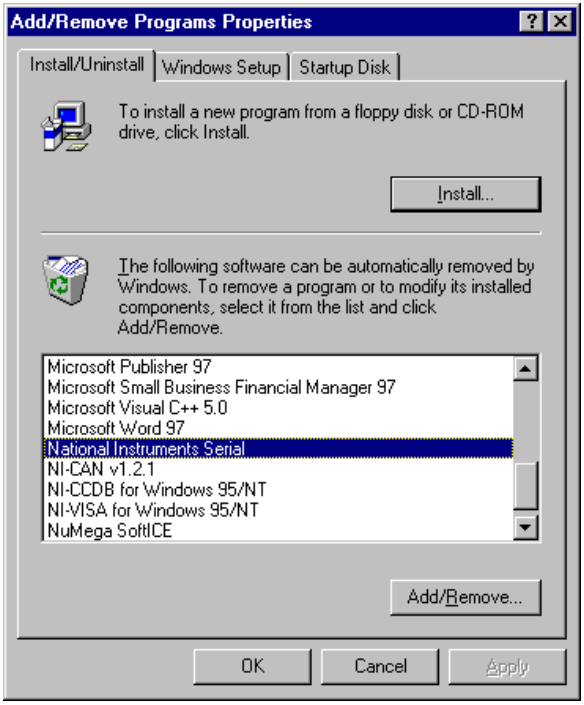


Figure B-2. Add/Remove Programs Properties Dialog Box

3. Select the NI Serial software you want to uninstall, and click on the **Add/Remove** button. The uninstallation program removes all folders, utilities, and registry entries associated with the NI Serial software. Figure B-3 shows the results of a successful uninstallation.

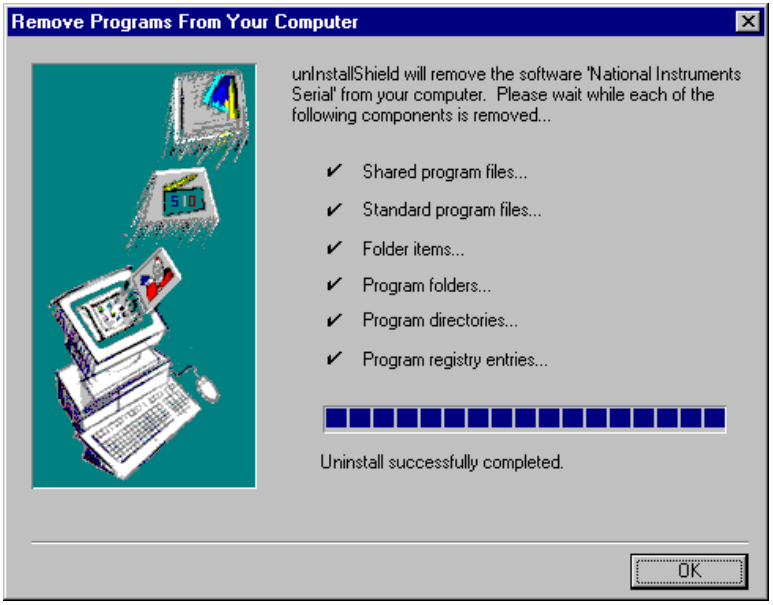


Figure B-3. Successful Uninstallation

4. Shut down Windows 98/95, turn off your computer, and physically remove the serial interfaces from your system.

The uninstallation program only removes 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.

If you want to reinstall the hardware and software, refer to Chapter 2, *Installation and Verification*.

C

Troubleshooting and Common Questions

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

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 on the **System** icon.
2. Click on the **Device Manager** tab.
3. Double-click on the **Computer** icon and click on the **View Resources** tab.
4. Click on 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 on the **Cancel** button.
6. In the **Device Manager** tab, double-click on 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 on the checkbox to remove the checkmark.
8. Click on the **Resources** tab and make sure that **Use automatic settings** is unchecked.
9. Repeat steps 7 through 9 for each unused device.
10. Click on the **OK** button to save your changes.
11. Restart Windows 98/95 to assign resources to your serial port. Then, complete step 6 in the *Verify the Installation* section of Chapter 2, *Installation and Verification*.

Selecting Conflict-Free Resources

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 on the **System** icon.
2. Click on the **Device Manager** tab and click on the **View devices by type** button.
3. Double-click on the **Multi-function adapters** icon.
4. From the **Multi-function adapters** list, double-click on the serial interface that you want to change.
5. Click on the **Resources** tab.
6. Uncheck the **Use automatic settings** checkbox and click on 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 I/O address and interrupt level from the **Setting based on** list box.
7. Click on 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 on 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 Chapter 2, *Installation and Verification*.
   c. Click on the **Resources** tab. If the resources were assigned properly, the **Resources** tab shows which resources are assigned to your serial ports.
   d. Check the hardware resources. If they are in conflict, refer to the previous section, *Selecting Conflict-Free Resources*.

2. In some versions of Windows 98/95, 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 Chapter 2, *Installation and Verification*.

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 Chapter 2, *Installation and Verification*.

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 on 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 Chapter 2, *Installation and Verification*.

   c. Click on the **Resources** tab. If the resources were assigned properly, the **Resources** tab shows which resources are assigned to your serial ports.

   d. Check the hardware resources. If they are in conflict, refer to the previous section, *Selecting Conflict-Free Resources*.

2. In some versions of Windows 98/95, 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 Chapter 2, *Installation and Verification*.

3. Physically make sure the correct number of boards/ports are installed.

I/O Address Test Failed

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

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 98/95 user's 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

If Windows 98/95 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 on the **System** icon.
2. Click on the **Device Manager** tab and click on the **View devices by type** button.
3. Double-click on the **Other Devices** icon. Windows 98/95 lists the boards it does not recognize under **Other Devices**.
4. Double-click on the **Multi-function adapters** icon, where Windows 98/95 lists the parent devices of the PXI ports.
5. Select the interface that Windows 98/95 did not detect, as shown in Figure C-1.

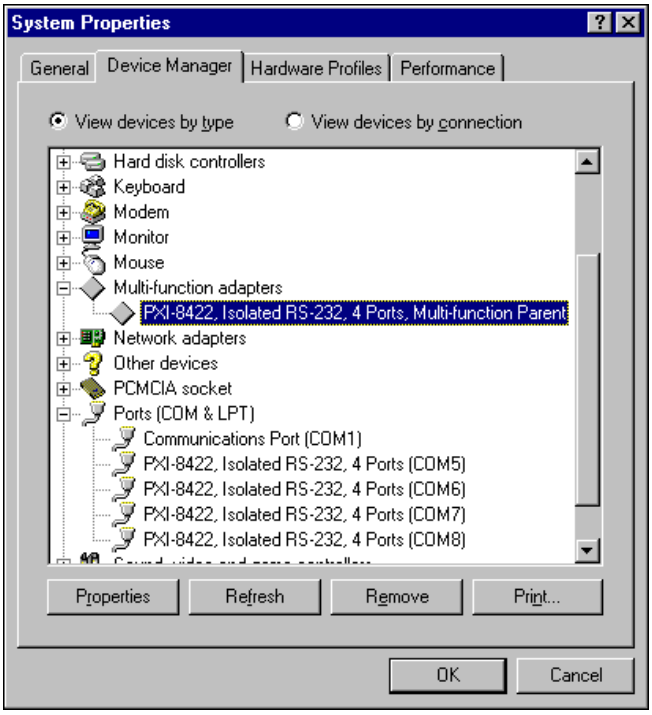


Figure C-1. Port Selected in Device Manager

6. Click on the **Remove** button.
7. Click on the **OK** button to remove the serial hardware information.
8. Repeat steps 5 through 7 until you have removed all serial interfaces.
9. Click on the **Refresh** button.
10. Windows 98/95 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 on the **OK** button.

Common Questions

How can I determine which type of serial hardware I have installed?

1. Select **Start»Settings»Control Panel** and double-click on the **System** icon.
2. Click on the **Device Manager** tab and click on the **View devices by type** button.

3. Double-click on the **Ports (COM & LPT)** icon to display a list of installed ports.

How can I determine which version of the NI Serial software I have installed?

The **Read Me** file gives the version of the software. To open the file, select **Start»Programs»National Instruments Serial»Read Me**.

What do I do if the diagnostic test fails with an error?

Refer to the *Troubleshooting Diagnostic Messages* section earlier in this appendix.

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:

1. In the **Device Manager** tab, under **Ports (COM & LPT)**, double-click on a serial port.
2. Click on 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.

How can I name National Instruments serial ports COM1, COM2, COM3, or COM4?

To name serial ports COM1, COM2, COM3, or COM4, change the base I/O address of the port. To do so, refer to the *Selecting Conflict-Free Resources* section earlier in this appendix.

When you change the base I/O address, Windows 98/95 automatically converts it to the corresponding COM name listed in Table C-1. You do not need to change the IRQ setting for Windows 98/95 to change the name.

Table C-1. Standard DOS-Based Addresses

COM Port	Base Address
COM1	3f8
COM2	2f8
COM3	3e8
COM4	2e8

How do I change the resources assigned to the serial interface?

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.

To change the resources of serial ports, complete the following steps:

1. In the **Device Manager** tab, under **Multi-function adapters**, double-click on a serial interface.
2. Click on the **Resources** tab to change the resources. Your changes are automatically reflected to the child devices under **Ports (COM & LPT)**.

How do I remove information about serial boards from the Device Manager?

Refer to the *Uninstall the Hardware* section in Appendix B, *Uninstalling the Hardware and Software*.

What is the maximum baud rate supported and how can I set it?

The maximum baud rate supported is 460.8 Kbaud for RS-485 and 115.2 Kbaud for RS-232. 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.

What information should I have before I call National Instruments?

Before you call National Instruments, fill out the forms in Appendix E, *Customer Communication*.

D

Specifications

This appendix describes the characteristics of the serial hardware, the NI Serial software, along with the recommended operating conditions.

Two-Port Boards

Dimensions..... 100 by 160 mm
(3.94 by 6.30 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

PXI-8423/2

+5 VDC..... 800 mA typical
1300 mA maximum

Four-Port Boards

Dimensions .....100 by 160 mm
(3.94 by 6.30 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 .....1000 mA typical
1500 mA maximum

[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.

Eight-Port Boards

Dimensions..... 100 by 160 mm
(3.94 by 6.30 in.)

I/O connector[1] ..... 68-position, SCSI type connector

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..... 1100 mA typical
2000 mA maximum

Environmental Characteristics

Operating environment

Component temperature..... 0° to 70° C

Relative humidity..... 10% to 90%, noncondensing

Storage environment

Temperature ..... –40° to 120° C

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

EMI ..... FCC Class A Certified

Software Characteristics

Maximum serial transfer rate[2]

RS-485 ..... 460,800 bps

RS-232 ..... 115,200 bps

Space required for NI Serial software.... 1 MB

[1] 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.

[2] Actual speed may vary considerably from speed shown due to system and instrumentation capabilities.

E

Customer Communication

For your convenience, this appendix contains forms to help you gather the information necessary to help us solve your technical problems and a form you can use to comment on the product documentation. When you contact us, we need the information on the Technical Support Form and the configuration form, if your manual contains one, about your system configuration to answer your questions as quickly as possible.

National Instruments has technical assistance through electronic, fax, and telephone systems to quickly provide the information you need. Our electronic services include a bulletin board service, an FTP site, a fax-on-demand system, and e-mail support. If you have a hardware or software problem, first try the electronic support systems. If the information available on these systems does not answer your questions, we offer fax and telephone support through our technical support centers, which are staffed by applications engineers.

Electronic Services

Bulletin Board Support

National Instruments has BBS and FTP sites dedicated for 24-hour support with a collection of files and documents to answer most common customer questions. From these sites, you can also download the latest instrument drivers, updates, and example programs. For recorded instructions on how to use the bulletin board and FTP services and for BBS automated information, call 512 795 6990. You can access these services at:

United States: 512 794 5422
Up to 14,400 baud, 8 data bits, 1 stop bit, no parity

United Kingdom: 01635 551422
Up to 9,600 baud, 8 data bits, 1 stop bit, no parity

France: 01 48 65 15 59
Up to 9,600 baud, 8 data bits, 1 stop bit, no parity

FTP Support

To access our FTP site, log on to our Internet host, `ftp.natinst.com`, as `anonymous` and use your Internet address, such as `joesmith@anywhere.com`, as your password. The support files and documents are located in the `/support` directories.

Fax-on-Demand Support

Fax-on-Demand is a 24-hour information retrieval system containing a library of documents on a wide range of technical information. You can access Fax-on-Demand from a touch-tone telephone at 512 418 1111.

E-Mail Support (Currently USA Only)

You can submit technical support questions to the applications engineering team through e-mail at the Internet address listed below. Remember to include your name, address, and phone number so we can contact you with solutions and suggestions.

`support@natinst.com`

Telephone and Fax Support

National Instruments has branch offices all over the world. Use the list below to find the technical support number for your country. If there is no National Instruments office in your country, contact the source from which you purchased your software to obtain support.

Country	Telephone	Fax
Australia	03 9879 5166	03 9879 6277
Austria	0662 45 79 90 0	0662 45 79 90 19
Belgium	02 757 00 20	02 757 03 11
Brazil	011 288 3336	011 288 8528
Canada (Ontario)	905 785 0085	905 785 0086
Canada (Québec)	514 694 8521	514 694 4399
Denmark	45 76 26 00	45 76 26 02
Finland	09 725 725 11	09 725 725 55
France	01 48 14 24 24	01 48 14 24 14
Germany	089 741 31 30	089 714 60 35
Hong Kong	2645 3186	2686 8505
Israel	03 6120092	03 6120095
Italy	02 413091	02 41309215
Japan	03 5472 2970	03 5472 2977
Korea	02 596 7456	02 596 7455
Mexico	5 520 2635	5 520 3282
Netherlands	0348 433466	0348 430673
Norway	32 84 84 00	32 84 86 00
Singapore	2265886	2265887
Spain	91 640 0085	91 640 0533
Sweden	08 730 49 70	08 730 43 70
Switzerland	056 200 51 51	056 200 51 55
Taiwan	02 377 1200	02 737 4644
United Kingdom	01635 523545	01635 523154
United States	512 795 8248	512 794 5678

Technical Support Form

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

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

Name _____

Company _____

Address _____

_____

Fax (___) _____Phone (___) _____

Chassis brand_____ Model _____Processor_____

Operating system (include version number) _____

Clock speed _____MHz RAM _____MB Display adapter _____

Mouse ___yes ___no Other adapters installed_____

Hard disk capacity _____MB Brand_____

Instruments used _____

_____

National Instruments hardware product model _____ Revision _____

Configuration _____

National Instruments software product _____ Version _____

Configuration _____

The problem is: _____

_____

_____

_____

_____

List any error messages: _____

_____

_____

The following steps reproduce the problem: _____

_____

_____

_____

_____

Hardware and Software Configuration Form

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

National Instruments Products

Serial interface type and revision _____

PXI board revision _____

Two port _____ Four port _____ Eight port _____

Isolated two port _____ Isolated four port _____

NI Serial software for Windows 98/95 version number on disk _____

Diagnostic test results _____

Hardware Settings

COM*x*	Base I/O Address	Interrupt Level
COM1		
COM2		
COM3		
COM4		
COM5		
COM6		
COM7		
COM8		
COM9		

Other Products

Computer make and model _____

Microprocessor _____ Clock frequency or speed _____

Type of monitor card installed _____ Windows version _____

Application programming language (Microsoft C, Visual Basic for Windows) _____

Number of serial ports in system:

Built in _____ Adapter cards _____

Other boards in system _____

Base I/O address of other boards _____

Interrupt level of other boards _____

Documentation Comment Form

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

Title: *Getting Started with Your PXI Serial Hardware and Software for Windows 98/95*

Edition Date: December 1998

Part Number: 322012B-01

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

_____

_____

_____

_____

_____

_____

_____

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

_____

_____

_____

_____

_____

_____

_____

Thank you for your help.

Name _____

Title _____

Company _____

Address _____

_____

E-Mail Address _____

Phone (___) _____ Fax (___) _____

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National Instruments Corporation
6504 Bridge Point Parkway
Austin, Texas 78730-5039

Fax to: Technical Publications
National Instruments Corporation
512 794 5678

Glossary

Prefix	Meanings	Value
m-	milli-	10^{-3}
c-	centi-	10^{-2}
k-	kilo-	10^{3}
M-	mega-	10^{6}

°	degrees
%	percent
Ω	ohms
A	amperes
ANSI	American National Standards Institute
b	bits
B	bytes
baud	bits per second
bps	bits per second
C	Celsius
COM	Computer Output Microform; used in reference to a communication port
CTS	clear to send
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

$\overline{\text{DTR}}$	data terminal ready—the overscore denotes that the signal is active low
duplex	the means of bandwidth usage in a serial system
EIA	Electronic Industries Association
EMI	electromagnetic interference
FCC	Federal Communications Commission
FIFO	First-In-First-Out
ft	feet
GND	ground
HSI	handshake input
HSO	handshake output
Hz	Hertz
IEEE	Institute of Electrical and Electronic Engineers
in.	inches
I/O	input/output
IRQ	interrupt request
ISA	Industry Standard Architecture
KBaud	kilobits per second
m	meters
MB	megabytes of memory
PC	personal computer
PCI	Peripheral Components Interconnect
PCMCIA	Personal Computer Memory Card International Association
PXI	PCI eXtensions for Instrumentation
RAM	random-access memory
RI	ring indicate
RTS	request to send
RX	receive

RXD	receive data
s	seconds
SCSI	Small Computer Systems Interface
TX	transmit
TXD	transmit data
$\overline{\text{TXRDY}}$	transmit ready—the overscore denotes that the signal is active low
UART	Universal Asynchronous Receiver/Transmitter
V	volts
VDC	volts direct current
VXI	VME eXtensions for Instrumentation
Win16	describes a 16-bit Windows application
Win32	describes a 32-bit Windows application