

# **Getting Started with Your Plug and Play AT Serial Board for Windows**

**March 1995 Edition**

**Part Number 320909A-01**

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# **FCC/DOC Radio Frequency Interference Compliance**

This equipment generates and uses radio frequency energy and, if not installed and used in strict accordance with the instructions in this manual, may cause interference to radio and television reception. This equipment has been tested and found to comply with the following two regulatory agencies:

## **Federal Communications Commission**

This device complies with Part 15 of the Federal Communications Commission (FCC) Rules for a Class B digital device. A Class B device is distinguishable from a Class A device by the appearance of an FCC ID number located on the Class B device.

## **Canadian Department of Communications**

This device complies with the limits for radio noise emissions from digital apparatus set out in the Radio Interference Regulations of the Canadian Department of Communications (DOC).

Le présent appareil numérique n'émet pas de bruits radioélectriques dépassant les limites applicables aux appareils numériques de classe B prescrites dans le règlement sur le brouillage radioélectrique édicté par le ministère des communications du Canada.

## **Instructions to Users**

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

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

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

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

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

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

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# About This Manual

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This manual contains instructions to help you install and configure the National Instruments Plug and Play AT serial interface board and the NI serial driver software for Windows. The board is intended for use in personal computers equipped with 16-bit ISA slots. The NI serial driver software is intended for use with Windows version 3.1 or higher. This manual assumes that you are already familiar with Windows.

This manual uses the term *AT serial board* to refer to a National Instruments AT-232 or AT-485 board for the ISA (PC AT) bus.

## 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 briefly describes the Plug and Play AT serial board, the NI serial driver software, and the Plug and Play standard.
- Chapter 2, *Software Installation*, contains instructions to help you install the NI serial driver software.
- Chapter 3, *Hardware Installation, Verification, and Configuration*, contains instructions to help you install your Plug and Play AT serial board, verify the hardware installation, connect the cables, and configure the hardware using SerialConf.
- Chapter 4, *Using Your Plug and Play AT Serial Board*, describes how to set the hardware transceiver control mode for your Plug and Play AT-485 board, discusses how to use your AT serial board with DOS applications, and lists some general programming requirements.
- Appendix A, *Specifications*, describes the physical characteristics of the Plug and Play AT serial board and the recommended operating conditions.
- Appendix B, *Serial Port Information*, discusses the RS-232, RS-422, and RS-485 standards and explains some of the different issues involved with these types of serial communication.
- Appendix C, *Troubleshooting and Common Questions*, describes how to troubleshoot problems and contains a list of common questions.
- Appendix D, *Customer Communication*, contains forms you can use to request help from National Instruments or to comment on our products and manuals.

## About This Manual

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

## Conventions Used in This Manual

The following conventions are used in this manual.

<b>bold</b>	Bold text denotes menus, menu items, dialog buttons, or options.
<i>italic</i>	Italic text denotes emphasis, a cross reference, or an introduction to a key concept.
<b><i>bold italic</i></b>	Bold italic text denotes a note, caution, or warning.
monospace	Text in this font denotes text or characters that are to be literally input from the keyboard, sections of code, programming examples, and syntax examples. This font is also used for the proper names of disk drives, directories, programs, subprograms, subroutines, device names, functions, variables, field names and filenames.
<b>bold monospace</b>	Bold lowercase text in this font denotes the messages and responses that the computer automatically prints to the screen.
<i>italic monospace</i>	Italic lowercase text in this font denotes that you must supply the appropriate words or values in the place of these items.
AT serial board	AT serial board refers generically to either the AT-232 or AT-485 board in cases where the material can apply to either board.
AT-232	AT-232 refers to a two or four-port National Instruments board with RS-232 ports for the ISA (PC AT) bus.
AT-485	AT-485 refers to a two or four-port National Instruments board with RS-485/RS-422 ports for the ISA (PC AT) bus.

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

## **Related Documentation**

The following documents contain information that you may 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*
- *ISA Configuration Utility (ICU) User's Guide*, Intel Corporation
- *Microsoft Windows Software Developer Kit, Vol.1: Overview*, Microsoft Corporation
- *Microsoft Windows Software Developer Kit, Vol.2: Functions*, Microsoft Corporation
- *Microsoft Windows User's Guide*, Microsoft Corporation
- *NS16550AF Universal Asynchronous Receiver/Transmitter with FIFOs*, National Semiconductor
- *Plug and Play ISA Specification*, Intel Corporation and Microsoft 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 D, *Customer Communication*, at the end of this manual.

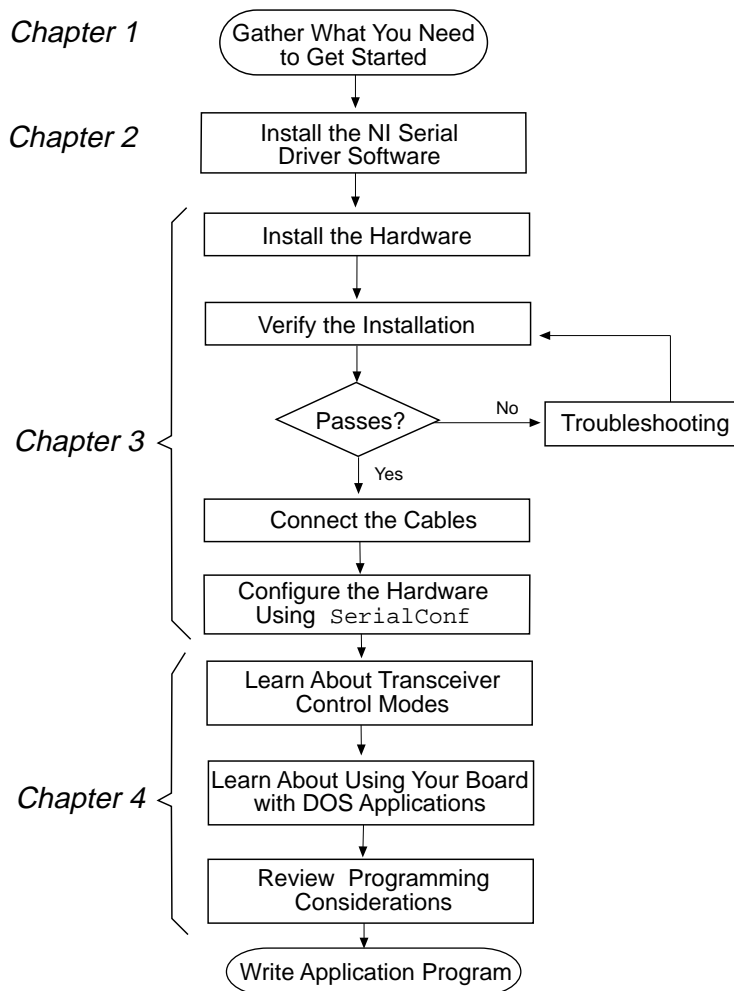
# Chapter 1

## Introduction

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This chapter explains how to use this manual, lists what you need to get started, and briefly describes the Plug and Play AT serial board, the NI serial driver software, and the Plug and Play standard.

### How to Use This Manual



## What You Need to Get Started

Make sure you have all of the items listed before you attempt to install the Plug and Play AT serial board.

- AT-232 board (two or four port)  
or  
AT-485 board (two or four port)
- 3.5 in. high density (1.44 MB) *NI Serial Driver Software for Windows. Distribution Disk for the AT-232 and the AT-485*
- Microsoft Windows version 3.1 or higher installed on your computer
- At least 2 MB available on your hard drive

## Optional Equipment

Call National Instruments for more information about the following optional equipment.

- DB-9 RS-485 termination connector (AT-485 boards 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)
- RS-232 9-pin to 9-pin null modem cable
- RS-232 9-pin to 25-pin null modem cable

## AT Serial Board Overview

The Plug and Play AT serial boards give you a variety of solutions for serial communications. The AT-232 board works with the RS-232 protocol, and the AT-485 board works with the RS-422 and RS-485 protocols. You can use an AT-232 board for serial communication up to distances of 50 ft. Using serial cable lengths up to 4,000 ft., you can connect the AT-485 with up to 31 devices.

Both boards are available with two or four ports. 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 AT-485 board supports four hardware transceiver control modes for reliable communication with two-wire and four-wire devices. Refer to Chapter 4, *Using Your Plug and Play AT Serial Board*, for more information about transceiver control modes.

Both the AT-232 and AT-485 boards use standard 16550-compatible UARTs (Universal Asynchronous Receiver/Transmitters) for 100 percent compatibility with standard PC COM ports. The boards contain FIFOs (First-In-First-Outs) 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 A, *Specifications*, for more information about the AT serial board specifications and operating conditions.

## NI Serial Driver Software Overview

The NI serial driver software for Windows includes a Windows device driver that can provide full interrupt-driven, buffered I/O for multiple COM ports. Using this driver, you can obtain a maximum baud rate of 115.2 kbytes/s, and you can use up to nine serial ports under Windows 3.1. Refer to Appendix A, *Specifications*, for more information about software specifications and recommended operating conditions.

The NI serial driver software includes the following components:

- Device driver
- Hardware diagnostic test
- Configuration utility

## Plug and Play Overview

The term Plug and Play refers to a new industry standard designed to help you add peripheral cards in a personal computer system. With Plug and Play, you can configure a new add-on card entirely from software, without having to move jumpers or change DIP switches.

A Plug and Play ready system is one in which cooperation takes place between the hardware, the operating system, device drivers, and applications. Most add-on boards need system resources (DMA channels, interrupts, I/O space) in order to interact with software such as device drivers. Centralized resource management is needed to arbitrate the assignment of system resources such as interrupt levels (IRQs) and DMA channels. For example, if a given Plug and Play ISA board is configured to use DMA channel 5, the centralized resource manager should prevent the assignment of DMA channel 5 to any other card. This support is not provided by Windows 3.1. However, a Plug and Play ready system can be achieved under Windows with Intel's Plug and Play Kit for MS-DOS and Windows, which may come pre-installed on some machines.

For those systems that are not Plug and Play ready, National Instruments provides jumperless configuration. Specific resources must be chosen for the board using a configuration utility, but you are not required to power down the system and change physical jumper settings on the board.

For maximum flexibility, National Instruments provides the `ni-pnp` utility, which checks the configuration of your National Instruments Plug and Play boards, regardless of which type of system you have (jumperless or Plug and Play ready).

## **ni-pnp Utility Overview**

The `ni-pnp` utility is a program that runs each time your computer is rebooted. It collects information about all of the National Instruments Plug and Play boards in your system. It then creates a list of these interfaces, which the NI serial driver uses. In systems that are Plug and Play ready, `ni-pnp` simply retrieves the current configuration of each interface. In systems where there is no Plug and Play software, `ni-pnp` performs the actual configuration of each interface. It relies on the resource settings made with the NI serial driver configuration utility to assign resources to the boards. After the configuration of each board is determined, `ni-pnp` provides this information to the NI serial driver. `ni-pnp` relieves the driver from the job of finding and configuring Plug and Play boards.

## **Optional Programming Tools**

Your kit includes the NI serial driver software for Windows. In addition, you can order the LabWindows<sup>®</sup>/CVI or LabVIEW software from National Instruments. LabWindows/CVI and LabVIEW include instrument driver libraries that make it easier to communicate with your serial instruments.

LabWindows/CVI is an interactive ANSI C development environment for building test and measurement and instrument control systems. It includes interactive code-generation tools and a graphical editor for building custom user interfaces. It also includes built-in libraries for IEEE 488.2, VXI, RS-232 control, and plug-in data acquisition. When you order LabWindows/CVI, you also get more than 300 complete instrument drivers, which are modular, source-code programs that handle the communication with your instrument so that you do not have to learn the programming details.

LabVIEW is a complete programming environment that departs from the sequential nature of traditional programming languages and features a graphical programming environment. It includes all the tools needed for instrument control, data acquisition, analysis, and presentation. LabVIEW also includes an extensive instrument driver library.

For more information about LabWindows/CVI and LabVIEW, contact National Instruments.



## **Using the AT Serial Board with Other National Instruments Products**

The AT serial boards are fully compatible with standard PC serial ports. You can use standard serial I/O functions in LabVIEW and LabWindows/CVI with all AT serial boards. Refer to the LabVIEW or LabWindows/CVI documentation for more information.

# Chapter 2

## Software Installation

---

This chapter contains instructions to help you install the NI serial driver software.

### Install the NI Serial Driver Software

Complete the following steps to install the NI serial driver software.

1. Insert the *NI Serial Driver Software for Windows* distribution disk into an unused drive.
2. Choose **Run...** from the **File** menu in the **Program Manager** window and type the following command into the dialog box:

```
x:\setup
```

where *x* is the letter of the drive containing the distribution disk (usually a or b).

The software installation begins with the following screen:



Figure 2-1. NI Serial Driver Installation Screen

The interactive Windows setup program takes you through the necessary steps to install the NI serial driver software. For help during the installation, press the **Help** button. You can exit the setup at any time by pressing the **Exit** button.

The installation program installs the bootup programs `ni-pnp.exe` and `nisboot.exe`, and it adds entries to execute these programs in your `autoexec.bat` file. For applications to work with your AT serial board, you must not remove either of these entries. In addition, `ni-pnp.exe` must execute before `nisboot.exe`, so do not change the order of these lines in your `autoexec.bat` file. For more information about `nisboot.exe`, refer to the section entitled *Using Your Board with DOS Applications* in Chapter 4, *Using Your Plug and Play AT Serial Board*.

The installation program also modifies your `system.ini` file by updating the standard Windows COM driver to the enhanced serial driver from National Instruments.

3. After the installation is complete, restart Windows.

After you have installed your software, you are ready to install the AT serial board. Refer to Chapter 3, *Hardware Installation, Verification, and Configuration*.

# Chapter 3

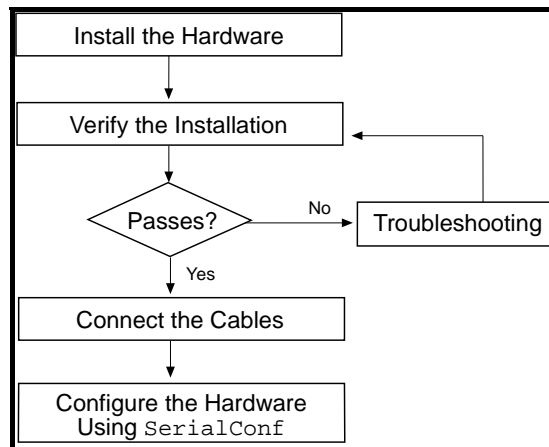
## Hardware Installation, Verification, and Configuration

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This chapter contains instructions to help you install your Plug and Play AT serial board, verify the hardware installation, connect the cables, and configure the hardware using SerialConf.

**Warning:** *Several components on your Plug and Play AT serial board can be damaged by electrostatic discharge. 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.*

### How to Use This Chapter



#### Install the Hardware

Keep in mind the following naming conventions as you read through the rest of this manual.

- *AT-232* refers to a two or four-port National Instruments board with RS-232 ports for the ISA (PC AT) bus.
- *AT-485* refers to a two or four-port National Instruments board with RS-485/RS-422 ports for the ISA (PC AT) bus.
- *AT serial board* refers generically to either the AT-232 or AT-485 board in cases where the material can apply to either board.

Follow these steps to install the Plug and Play AT serial board:

**Note:** *If you are installing an AT-485, you may need to adjust the value of the bias resistors, depending on your application. For more information, refer to Appendix B, Serial Port Information.*

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. Sometimes the board seems to click firmly into place, even though it is only part of the way in.
5. Screw the mounting bracket of the AT serial board to the back panel rail of the computer.
6. Replace the cover.
7. Turn on your computer.

## Verify the Hardware Installation Using serdiag

To verify and test the hardware installation, run the hardware diagnostic program `serdiag` that came with your NI serial driver software. `serdiag` verifies that your hardware is functioning properly and that the configuration of your board does not conflict with anything else in your system.

Be sure to disconnect all serial cables before running `serdiag`. To run `serdiag`, double-click on the **serdiag** icon in the **NI Serial Software** group.

If `serdiag` completes with no errors, your hardware is functioning properly. If it returns an error message, refer to Appendix C, *Troubleshooting and Common Questions*, for troubleshooting instructions.

## Connect the Cables

You can use the two-port AT serial boards with the standard DB-9 connector found on most serial cables. To use the DB-9 connector with the four-port AT serial boards, you need the 10-position modular jack to DB-9 cable available from National Instruments. You can also use a DB-25 connector with the four-port AT serial boards by ordering the 10-position modular jack to DB-25 cable from National Instruments.

Figure 3-1 and Table 3-1 give the pin locations and descriptions of the DB-9 connector, which is found on the two-port AT serial board and the 10-position modular jack to DB-9 cable.

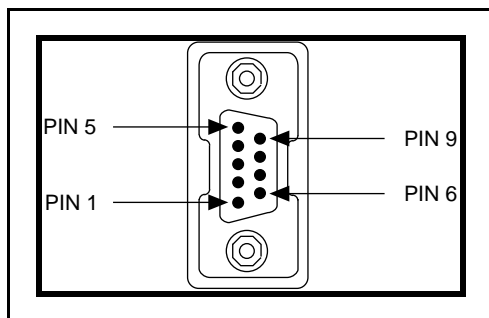


Figure 3-1. DB-9 Connector Pin Locations

Table 3-1. DB-9 Pin Descriptions

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

Figure 3-2 and Table 3-2 give the pin locations and descriptions of the 10-position modular jack, which is found on the four-port AT serial board.

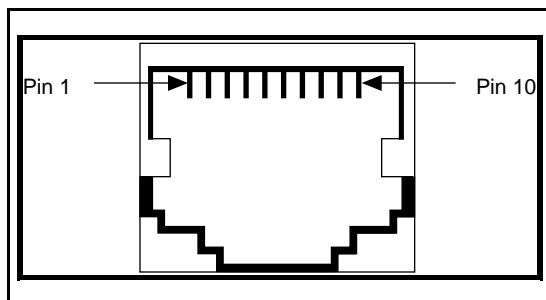


Figure 3-2. 10-Position Modular Jack Pin Locations

Table 3-2. 10-Position Modular Jack Pin Descriptions

DB-25 Pin	AT-232 Signal	AT-485 Signal
Pin 10	DCD	GND
Pin 9	RXD	CTS+ (HSI+)
Pin 8	TXD	RTS+ (HSO+)
Pin 7	DTR	RXD+
Pin 6	GND	RXD-
Pin 5	DSR	CTS- (HSI-)
Pin 4	RTS	RTS- (HSO-)
Pin 3	CTS	TXD+
Pin 2	RI	TXD-

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

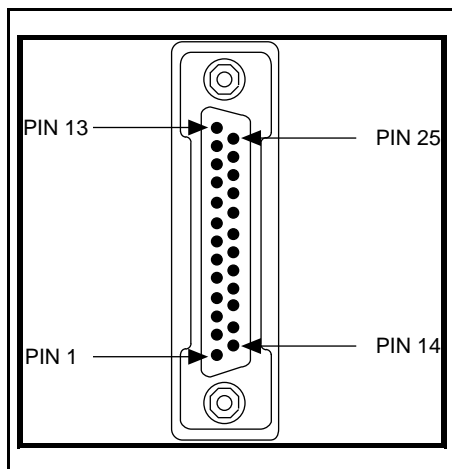


Figure 3-3. DB-25 Connector Pin Locations

Table 3-3. DB-25 Pin Descriptions

DB-25 Pin	AT-232 Signal	AT-485 Signal
Pin 2	TXD	RTS+ (HSO+)
Pin 3	RXD	CTS+ (HSI+)
Pin 4	RTS	RTS- (HSO-)
Pin 5	CTS	TXD+
Pin 6	DSR	CTS- (HSI-)
Pin 7	GND	RXD-
Pin 8	DCD	GND
Pin 20	DTR	RXD+
Pin 22	RI	TXD-



Figure 3-4 shows how to connect the cables when you install a four-port version of the AT serial board.

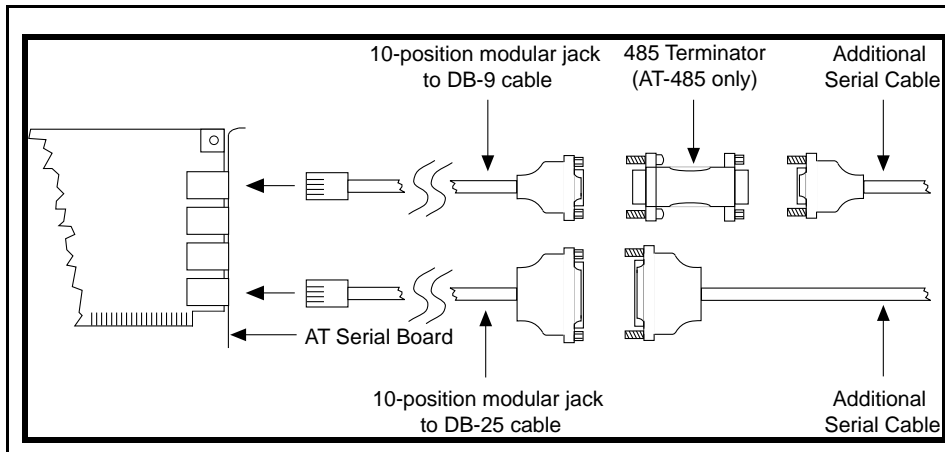


Figure 3-4. Connecting the Cables to Your Four-Port AT Serial Board

## Connecting Two-Wire Devices

The AT-485 boards are designed to work with either two- or four-wire devices. If you are using a two-wire device, refer to the device's 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 module to a port on your AT-485 using half-duplex communication, you need a single twisted pair of wires. At the AT-485, you should 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. You should connect the other end of this wire to both the TXD+ and RXD+ signals on the data acquisition module. You 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. Refer to Chapter 4, *Using Your Plug and Play AT Serial Board*, for information on setting the transceiver mode for two-wire communication. Refer to Appendix B, *Serial Port Information*, for more information on duplex architectures.

## Configure the AT Serial Board Using SerialConf

SerialConf is an interactive utility for examining or modifying the configuration of your AT serial board and the NI serial driver software. In addition, you can use it to configure any serial ports already present on your computer.

**Note:** *You must install the AT serial board before you run SerialConf.*

**Note:** *You must use SerialConf to configure your board. The Ports program in the Windows Control Panel does not function properly when changing the hardware settings of your AT serial board. Also, you must not directly modify the configuration file that ni-pnp creates in the root directory of the boot drive.*

Before starting SerialConf, you should note the base I/O addresses and interrupt levels of all boards currently installed in your system. This information will help you to choose unused base I/O addresses and interrupt levels for your serial ports.

To run SerialConf, double-click on the National Instruments eagle icon labeled **SerialConf** in the **Control Panel**, which is located in the **Main** group of the **Program Manager**.

SerialConf begins with the following screen:

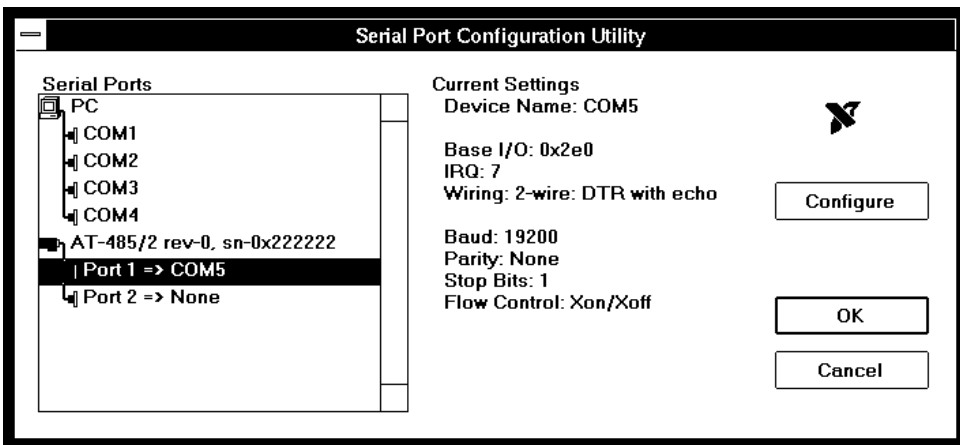


Figure 3-5. Serial Port Configuration Utility Screen

SerialConf displays a list of all the serial board and port names present in your computer. The first four entries show the default COM ports supported under Windows. The AT serial boards detected in your computer appear in the list below the default ports. The *sn* number, which appears next to each serial board in the list, represents the serial

number found on the back panel of that board. The ports are ordered top-to-bottom on the back panel. Click on any name in the list to examine the board or port. The next two sections describe how to use the **Configure** button to change the settings for a selected port.

## Communications Device Names

Windows applications that use serial ports access the ports by name. These names, referred to as *communications device names* or *device names*, are of the form COM $x$ , where  $x$  is a decimal digit ranging from 1 to 9. Using the SerialConf utility, you can assign these communications device names to any of the serial ports present in your system. The following section discusses how to assign a device name to a serial port as well as how to assign values to other serial port settings.

## Changing Communications Port Settings

To change the settings for any serial port in your system, first click on the entry for that port in the Serial Ports box. A description of the port appears to the right of the box, along with its current settings. Click on the **Configure** button to change the settings. The following configuration dialog box appears:

**Note:** *The first time you run SerialConf, the ports on your AT serial boards are unassigned and disabled.*

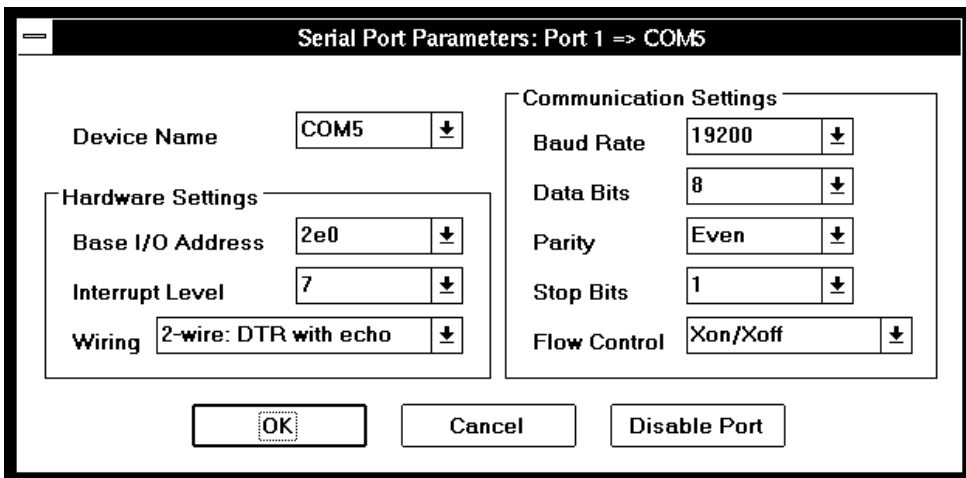


Figure 3-6. Serial Port Configuration Parameters Screen

The following options are available in the configuration dialog box:

**Device Name** The communications device name that Windows applications will use to refer to this serial port. The name must be in the range of COM1–COM9 for Windows 3.x.

#### **Hardware Settings:**

**Base I/O Address** The hardware base address at which the serial port resides.

**Interrupt Level** The IRQ level a port will use when interrupting.

**Note:** *If you are using the Intel ISA Configuration Utility to configure your Plug and Play system, you cannot change the base I/O address or interrupt level settings in this dialog box. To change these parameters, consult the Intel Plug and Play Software User's Guide.*

**Transceiver Mode** The transceiver mode you want to use. (This option applies only to AT-485 boards.) See Chapter 4, *Using Your Plug and Play AT Serial Board*, for more information about transceiver modes.

#### **Communication Settings:**

**Baud Rate** The speed for a serial port.

**Data Bits** The number of data bits in a single serial byte.

**Parity** The specification for even, odd, or no parity bits in each transmitted byte.

**Stop Bits** The number of terminating bits on the end of each transmitted serial byte.

**Flow Control** The method for temporarily halting the stream of serial bytes to prevent overflow. See Chapter 4, *Using Your Plug and Play AT Serial Board*, for more information about flow control.

**Note:** *All Communication Settings are simply default values stored in the Windows configuration file win.ini for use by applications. Your applications must read win.ini for your communication settings to take effect.*

In the configuration dialog box, you can change any of the settings by clicking on the arrow button to the right of the setting. When you click on the arrow button, a list of valid values for that setting appears. Select the desired setting from the list. Notice that you cannot assign the same device name, base I/O address, or interrupt level settings to

two different ports. If you try to assign a value for one of these settings that is already used by another port, the following message appears:

**The selected setting is already assigned to another port.**

**Note:** *If you are reassigning the device name, base I/O address, or interrupt level assigned to a port built into your computer, you must reconfigure or disable the built-in port using the setup program or procedure supplied with your computer.*

After you have selected the serial port parameters for the current port, click on the **OK** button to save the changes or click on **Cancel** to exit the dialog box without saving changes. Use the **Disable Port** button to keep the serial port from requesting any resources from the system at startup. The port remains disabled until you reassign a base address and interrupt level to the port.

Repeat the configuration procedure for each serial port in your system. After you have completed all changes, click on the **OK** button in the Serial Port Configuration Utility dialog box to save your changes. A dialog box will appear that explains the next steps necessary to implement your changes.

**Note:** *Some Windows programs perform direct configuration of serial ports, bypassing the configuration performed by National Instruments software. In particular, such programs may alter transceiver mode. You can reboot your computer to reconfigure an AT serial board to its default settings. You can also directly set the transceiver mode as described in Chapter 4, Using Your Plug and Play AT Serial Board.*

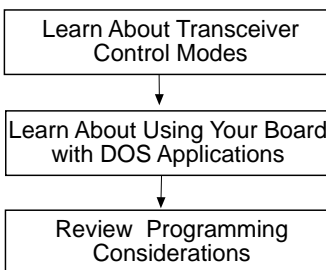
# Chapter 4

## Using Your Plug and Play AT Serial Board

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This chapter describes how to set the hardware transceiver control mode for your Plug and Play AT-485 board, discusses how to use your AT serial board with DOS applications, and lists some general programming requirements.

### How to Use This Chapter



### Advanced Transceiver Control

The Plug and Play AT-485 board supports four modes of hardware transceiver control. (Transceiver modes apply only to the AT-485 boards.) You use hardware flow control to enable and disable your transmitters and receivers to work 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

## Four-Wire Mode

You should 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

You use this mode in half-duplex systems where the  $\overline{\text{DTR}}$  (Data Terminal Ready) line must control the transmitter. In this 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 a two-wire system, 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. You 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, this mode solves the problem of receiving packets that you have transmitted.

## Two-Wire Mode: $\overline{\text{TXRDY}}$ Auto Control

In this mode, the hardware transparently enables the transmitter and receiver in a two-wire system. This mode removes the burden of flow control from the user software. 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 packets that you have transmitted.

**Note:** *It is recommended that you use the two-wire  $\overline{\text{TXRDY}}$  auto control mode when you are communicating with a two-wire device. 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.*

## Setting the Transceiver Control Mode

The recommended method for setting the transceiver control mode is with `SerialConf`. The mode you select in `SerialConf` is automatically configured when you open a port on an AT serial board. You can also set the hardware transceiver control mode from within your software. 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. Control Bytes

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

## Setting the Transceiver Mode with EscapeComm

The NI serial driver software extends the Windows function `EscapeComm` for programming the transceiver control mode. Table 4-3 lists the `EscapeComm` function codes for setting different transceiver modes.

Table 4-3. EscapeComm Function Codes

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



## Using Your Board with DOS Applications

The NI serial driver installation program installs the bootup utilities `ni-pnp.exe` and `nisboot.exe` on your hard disk, and it adds entries to your `autoexec.bat` file that execute these utilities. The `nisboot.exe` program assists DOS programs in accessing your AT serial board. One of its tasks is to copy information about the base I/O addresses of your serial ports into the BIOS RAM data area, where many DOS applications look for information about serial ports. Notice that a maximum of four serial ports can be stored in this manner, due to limitations inherent in the BIOS.

`nisboot` configures the transceiver control mode for your AT-485 boards when it is executed from the `autoexec.bat` file. Thus, if you change the transceiver control mode (wire mode) from the Windows **Control Panel**, you must execute `nisboot` before the new mode will take effect in your DOS applications.

If you cannot get some DOS applications to access your AT serial board, use `SerialConf` to set the base addresses of your AT serial ports to the standard base addresses. Some DOS applications may only require their serial ports to be at certain standard addresses. In addition, some applications that use serial port interrupts may require standard IRQ settings for their COM ports. Table 4-4 lists the standard base addresses and IRQ settings for your COM ports.

Table 4-4. Standard DOS Base Addresses and IRQ Settings

COM Port	Base Address	IRQ Setting
COM1	3f8	4
COM2	2f8	3
COM3	3e8	4
COM4	2e8	3

## General Programming Requirements

The NI serial driver software has several enhancements over the standard Windows serial driver. In addition to working with up to nine serial ports, the driver supports communication speeds up to 115,200 baud.

### Setting the Maximum Baud Rate

To select 115,200 baud from a Windows 3.1 application written in C, you should define the following constant in your program:

```
#define CBR_115200 0xff20
```

You can then use this constant as you would any other baud rate value in your Windows communication calls. For example, you can place it into a DCB structure and pass it to `SetCommState`.

### Other Programming Points

As you begin developing your application, remember the following points:

- You must assign a Windows COM name to each AT serial port so that your application can access the port. Use the `SerialConf` utility to assign Windows COM names.
- You must use the standard Microsoft Windows serial communication calls.

For more information about naming serial ports, refer to Chapter 3, *Hardware Installation, Verification, and Configuration*. For information about Microsoft Windows serial communication calls, refer to the *Windows Software Development Kit, Vol. 1: Overview*, and *Vol. 2: Functions*.

# Appendix A

## Specifications

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This appendix describes the physical characteristics of the Plug and Play AT serial board and the recommended operating conditions.

### Hardware Specifications

Table A-1. Physical Characteristics of the Two-Port AT Serial Board

Characteristic	Specification
Dimensions	10.67 cm. by 16.51 cm. (4.2 in. by 6.5 in.)
I/O Connector	DB-9
Power Requirement (from PC AT I/O channel)	
AT-485	+5 VDC 390 mA Typical 510 mA Maximum
AT-232	+5 VDC 260 mA Typical 340 mA Maximum

Table A-2. Physical Characteristics of the Four-Port AT Serial Board

Characteristic	Specification
Dimensions	10.67 cm. by 16.51 cm. (4.2 in. by 6.5 in.)
I/O Connector*	10-position modular jack
Power Requirement (from PC AT I/O channel)	
AT-485	+5 VDC 600 mA Typical 780 mA Maximum
AT-232	+5 VDC 340 mA Typical 450 mA Maximum
* The four-port AT serial board requires a cable to convert the 10-position modular jack to either DB-9 or DB-25 connectors.	

Table A-3. Environmental Characteristics

<b>Characteristic</b>	<b>Specification</b>
Operating Environment Component Temperature Relative Humidity	0° to 40° C 10% to 90%, noncondensing
Storage Environment Temperature Relative Humidity	-20° to 70° C 5% to 90%, noncondensing
EMI	FCC Class B Certified

## Software Specifications

Table A-4. Software Characteristics

<b>Characteristic</b>	<b>Specification</b>
Maximum Serial Transfer Rate	115,200 baud*
Space Required for Software NI Serial Driver Software	10 KB (.01 MB)
* Actual speed may vary considerably from speed shown due to system and instrumentation capabilities.	

# Appendix B

## Serial Port Information

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

### RS-232

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*, standardizes serial communication between computers and between computer terminals and modems. Most applications use the RS-232 standard for interfacing 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 often increase the actual performance of the bus past the limitations on speed and distance recommended in the specification.

### RS-422

RS-422, as specified in the EIA RS-422-A Standard, *Electrical Characteristics of Balanced Voltage Digital Interface Circuits*, 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 much more immune to noise as well as voltage loss due to transmission line effects. Thus, you can use RS-422 for much longer distances (up to 4,000 ft.) and much greater transmission speeds (up to 10 Mbytes/s) than RS-232.

### RS-485

RS-485, as specified in the EIA-485 Standard, *Standard for Electrical Characteristics of Generators and Receivers for Use in Balanced Digital Multipoint Systems*, 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, and the ability to withstand multiple drivers driving conflicting signals at the same time.

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	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 kbytes/s	10 Mbytes/s	10 Mbytes/s
Maximum CMV	$\pm 25V$	+6V to -.25V	+12V to -7V
Driver output	5–25V	2–6V	1.5–6V
Driver load	>3 k $\Omega$	100 $\Omega$	60 $\Omega$

## Serial Communication Issues

This section explains some serial communication issues, such as 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 is used for both sending and receiving 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, there is no need to switch between transmitting and receiving.

In a differential serial bus (for example, RS-422 or RS-485), a half-duplex system can transmit and receive 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 communications 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's transmitter to all of the slave receivers. A second transmission line connects all of the slave transmitters to the bus master's receiver. Because in a differential system each transmission line is composed of 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.

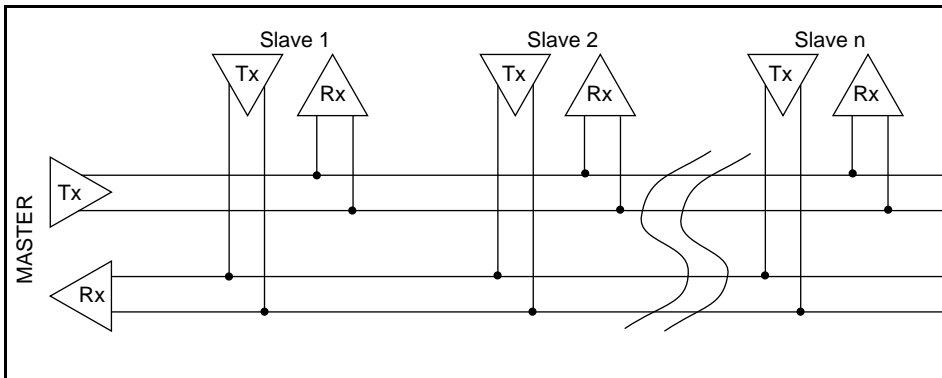


Figure B-1. Typical Full-Duplex System

### Half Duplex

A typical half-duplex multidrop bus architecture also involves a master-slave protocol. 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.

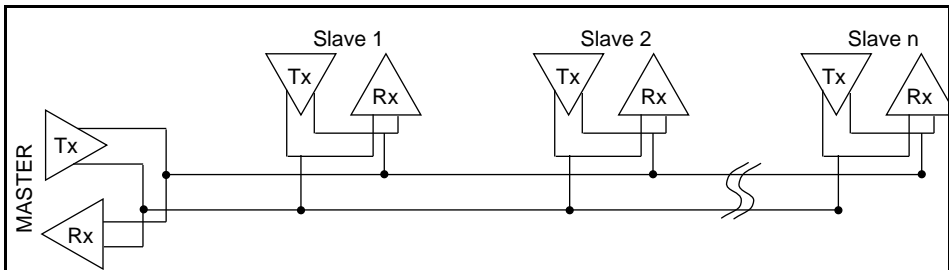


Figure B-2. Typical Half-Duplex System

## 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 chain multiple instruments together, you would need a terminating resistor at only the first and last instruments. The terminating resistor should match the characteristic impedance of the transmission line (typically 100-120  $\Omega$ ). National Instruments offers an optional DB-9 RS-485 termination connector that contains embedded terminating resistors for easy termination. Figure B-3 shows a multidrop network using terminating resistors.

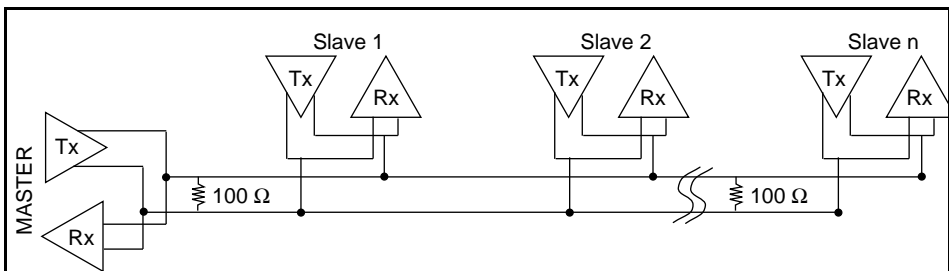


Figure B-3. Multidrop Network Using Terminating Resistors



## 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 these data bits, you should force the transmission line into a known state. By installing two  $620\ \Omega$  bias resistors at one node on the transmission line, you can create 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 only install these resistors on one node. Figure B-4 shows a transmission line using bias resistors.

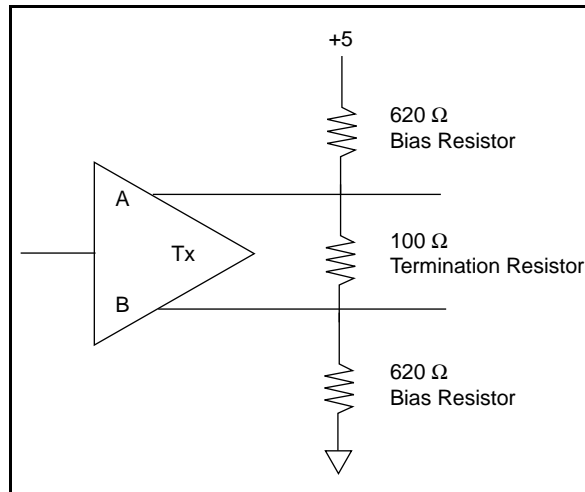


Figure B-4. Transmission Line Using Bias Resistors

Rather than using two  $620\ \Omega$  resistors at one node, you can also 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  $4.7\ \text{k}\Omega$  resistors at each node to effectively achieve the same result.

## DTE vs. DCE

Data Terminal Equipment (DTE) and Data Communications Equipment (DCE) were the terms used in the RS-232 specification for the types of equipment on either end of a serial connection. (A DCE is now called Data Circuit-Terminating Equipment in Revision D of the RS-232 specification.) In general, DTE and DCE refer to computer equipment and modems respectively. Because the RS-232 specification mainly involved connecting a DTE directly to a DCE and vice versa, the pinouts were defined so that cabling was 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 commonly known as *straight-through* cabling.

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

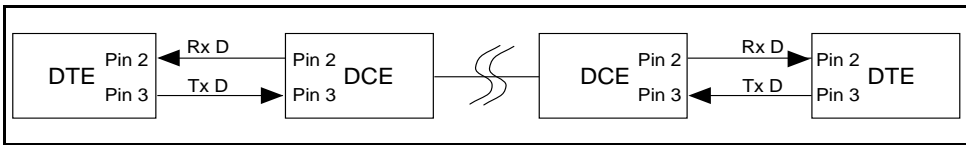


Figure B-5. Straight-Through Cabling in a DTE-to-DCE Interface

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 were wired together using a straight-through cable, one transmitter would be connected to the other transmitter, and one receiver would be connected to the other receiver. In this setup, no transmissions could 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. You should use a null-modem cable to communicate from one AT serial port to another. Figure B-6 shows null-modem cabling in a DTE-to-DCE interface.

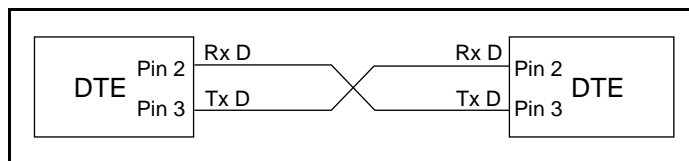


Figure B-6. Null-Modem Cabling in a DTE-to-DCE Interface

# Appendix C

## Troubleshooting and Common Questions

---

This appendix describes how to troubleshoot problems and contains a list of common questions.

### Troubleshooting ni-pnp Error Messages

The `ni-pnp.exe` program should be located in the root directory of your boot drive, usually `C:\`. It should be run from your `autoexec.bat` file, so that `ni-pnp` executes every time your system is started. `ni-pnp` normally produces very little output when it is run, displaying only the name of each National Instruments interface board it detects. Most errors that `ni-pnp` might detect are handled transparently. If `ni-pnp` finds an error from which it cannot recover, it displays a message and describes the best method for fixing the problem.

Some possible problems that `ni-pnp` might report include boards with unassigned resources and boards for which resource conflicts exist. If `ni-pnp` encounters a board with no assigned resources, it displays the following message:

**This interface has no assigned resources.**

If you get this message, you must run the serial software configuration utility and assign resources to the board. If `ni-pnp` detects an I/O address conflict, it displays the following message:

**I/O Address Conflict.**

If you get this message, you must run the serial software configuration utility and change the base I/O address for the board.

You can run `ni-pnp` in a verbose output mode. In this mode, `ni-pnp` displays more information about each interface, including its assigned resources. To run `ni-pnp` in verbose mode, change to the directory which contains `ni-pnp.exe`. This is the root of the boot drive (usually `C:\`). Run `ni-pnp` with the verbose output flag by typing `ni-pnp /v`.

Another, more serious error can also occur on systems that are not Plug and Play ready. Since `ni-pnp` must assign resources to the boards, it must first perform the Plug and Play ISA isolation sequence. The isolation sequence is a method by which all Plug and Play boards can be detected. It is possible, although rare, that this isolation sequence could lock up your computer. If this occurs, restart your computer. `ni-pnp` will then detect that your computer was locked up and display an error message describing the problem. `ni-pnp` can enter a fail-safe detection mode where it records each I/O port before testing that port. If your computer locks up while testing a port in this mode,

`ni -pnp` will exclude that I/O port from future testing. If you know that you do not have any National Instruments Plug and Play boards in your system, you can configure `ni -pnp` so that it does not attempt to detect any Plug and Play boards. `ni -pnp` will prompt you to choose between entering the fail-safe mode or disabling the detection of Plug and Play boards.

## Troubleshooting `serdiag` Error Messages

### Resource Conflicts

In this section the term *resource* refers to an ISA interrupt level or a base I/O address range. A resource conflict occurs if an AT serial port is assigned a resource that is being used by some other device in the system. Most `serdiag` errors are caused by resource conflicts. Your system will not work properly if a resource conflict exists, so you should resolve all conflicts before using your AT serial board.

### Interrupt Conflicts

You must configure each AT serial port to use one unique ISA interrupt level. An interrupt conflict occurs if another plug-in board (or a device on the computer motherboard) is configured to use the same ISA interrupt level. To resolve an interrupt conflict, you must do one of the following:

- Change the interrupt level used by the AT serial port.
- Change the interrupt level used by the other plug-in board.
- Configure the AT serial port not to use interrupts. (This solution is not recommended and will not work if you are using Windows.)

Refer to the section later in this appendix entitled *Steps to Troubleshoot `serdiag` Error Messages*.

### I/O Address Range Conflicts

Each AT serial port uses 8 contiguous I/O addresses. The lowest address used by the AT serial port is the *base address*. For example, if the base address of an AT serial port is 3E8 (hex), the AT serial port uses all 8 addresses in the range 3E8 through 3EF (hex). An I/O address range conflict exists if another plug-in board (or a device on the computer motherboard) is configured to use any address in the I/O address range used by any of the ports on the AT serial board. To resolve an I/O range conflict do one of the following:

- Change the base address used by the conflicting AT serial port.
- Change the I/O range used by the other plug-in board.

Refer to the following section, *Steps to Troubleshoot `serdiag` Error Messages*.

## Steps to Troubleshoot serdiag Error Messages

Use the following steps to troubleshoot serdiag error messages.

1. Verify that all serial cables are disconnected. If any serial cables are connected to your AT serial board, disconnect the cables and run serdiag again.
2. Note which error message serdiag displays. The most common error messages are as follows:

```
<<< Base I/O Address Conflict >>>
```

```
<<< Interrupt Level Conflict >>>
```

```
<<< Error Reading NI-PNP.INI >>>
```

If the error is in reading `ni-pnp.ini`, try reinstalling the software and then run serdiag again. If a resource conflict exists, write down the exact resource tested. For example, if an IRQ resource conflict exists, note which IRQ setting was tested.

3. Run the `ni-pnp` utility in verbose mode to determine what software configures the Plug and Play circuitry of your AT serial board.
4. If `ni-pnp` reports **Intel Configuration Manager version x.xx Found**, refer to the next section entitled *Resolving Conflicts with the Intel Configuration Utility*. Otherwise, continue with step 5.
5. Run `SerialConf` to change the resources used by your AT serial board. If serdiag indicated that your AT serial board failed because of a base I/O address conflict, change the base I/O address location of the conflicting port in `SerialConf`. Similarly, if serdiag indicated an interrupt level conflict, change the IRQ setting in `SerialConf`. For more information about `SerialConf`, refer to Chapter 3, *Hardware Installation, Verification, and Configuration*.
6. Save the new `SerialConf` settings.
7. Reboot the computer.
8. Run serdiag again and go back to step 1.

## Resolving Conflicts with the Intel Configuration Utility

If a resource conflict exists, the Intel software does not have the resource information for some legacy ISA board in your system. It is therefore free to assign to the AT serial board some resource that is already used. To resolve the resource conflict, complete the following steps:

1. Run the Intel ISA Configuration Utility (ICU).
2. Modify the configuration of the AT serial board. For example, if `serdiag` error message noted in step 2 above indicates an interrupt conflict on interrupt level 11, configure that AT serial board to use another available interrupt level.
3. Try to determine which other plug-in board is using the conflicting resource. Consult the documentation that came with the other plug-in boards.
4. Depending on whether you can determine which other plug-in board is using the conflicting resource, complete the following steps:
  - a. If you can determine which plug-in board is using the conflicting resource, add the board information to the ICU system configuration. After you add the board information, skip to step 5.
  - b. If you cannot determine which plug-in board is using the conflicting resource, you need to add an *Unknown* board to the system configuration.
  - c. When the dialog box asks if you have a configuration file for this unknown board, respond “No”.
  - d. For Card Name, enter “Unknown”.
  - e. Assign the conflicting resources to the board. For example, if `serdiag` error message noted in step 2 above indicates an interrupt conflict on interrupt level 11, assign interrupt level 11 to the “Unknown” board.
5. Save the changes and exit the ICU.
6. Reboot the computer and run `serdiag` again.

If you still have problems after completing these steps, you may have other conflicts to resolve. Repeat these steps until you have resolved all of the conflicts.

## Common Questions

### How can I determine which type of AT Serial board I have installed?

Run the `SerialConf` utility, which displays information about the serial boards currently configured for use in your system. For more information about the `SerialConf` utility, refer to Chapter 3, *Hardware Installation, Verification, and Configuration*.

### How can I determine which version of the NI serial driver software I have installed?

Using the **File Manager**, locate the file `nicomm.drv` in the `WINDOWS\SYSTEM` directory. Select **Properties** from the **File** menu to display the version number and copyright information. You can also obtain the version number from the label on your distribution diskette.

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

Refer to the troubleshooting sections of this chapter for specific information about what might cause these tests to fail.

### Will `ni-pnp` work on a system that comes with the Intel Plug and Play software pre-installed?

Yes. `ni-pnp` is designed to either configure National Instruments Plug and Play boards if the Intel software is not installed or check the configuration of boards if the Intel software is installed.

### How can I determine if the Intel Plug and Play software is installed on my computer?

Run the `ni-pnp` utility in verbose mode. `ni-pnp` will display the message **Intel Configuration Manager version x.xx Found** if the Intel Configuration Manager is installed.

### What information should I have before I call National Instruments?

When you call National Instruments, you should have the results of `serdiag` and the output from `SerialConf` and `ni-pnp`. Also, make sure you have filled out the configuration form in Appendix D, *Customer Communication*.

# Appendix D

## Customer Communication

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

National Instruments provides comprehensive technical assistance around the world. In the U.S. and Canada, applications engineers are available Monday through Friday from 8:00 a.m. to 6:00 p.m. (central time). In other countries, contact the nearest branch office. You may fax questions to us at any time.

### Corporate Headquarters

(512) 795-8248

Technical support fax: (800) 328-2203  
(512) 794-5678

<b>Branch Offices</b>	<b>Phone Number</b>	<b>Fax Number</b>
Australia	(03) 879 9422	(03) 879 9179
Austria	(0662) 435986	(0662) 437010-19
Belgium	02/757.00.20	02/757.03.11
Denmark	45 76 26 00	45 76 71 11
Finland	(90) 527 2321	(90) 502 2930
France	(1) 48 14 24 00	(1) 48 14 24 14
Germany	089/741 31 30	089/714 60 35
Italy	02/48301892	02/48301915
Japan	(03) 3788-1921	(03) 3788-1923
Mexico	95 800 010 0793	95 800 010 0793
Netherlands	03480-33466	03480-30673
Norway	32-848400	32-848600
Singapore	22658862265887	
Spain	(91) 640 0085	(91) 640 0533
Sweden	08-730 49 70	08-730 43 70
Switzerland	056/20 51 51	056/20 51 55
Taiwan	02 377 1200	02 737 4644
U.K.	0635 523545	0635 523154



# Technical Support Form

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Technical support is available at any time by fax. Include the information from your configuration form. Use additional pages if necessary.

Name \_\_\_\_\_

Company \_\_\_\_\_

Address \_\_\_\_\_

Fax (\_\_\_\_) \_\_\_\_\_ Phone (\_\_\_\_) \_\_\_\_\_

Computer brand \_\_\_\_\_

Model \_\_\_\_\_ Processor \_\_\_\_\_

Operating system \_\_\_\_\_

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 \_\_\_\_\_

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The problem is \_\_\_\_\_

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List any error messages \_\_\_\_\_

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The following steps will reproduce the problem \_\_\_\_\_

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# Plug and Play AT Serial Board Hardware and Software Configuration Form

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Record the settings and revisions of your hardware and software on the line to the right of each item. Update this form each time you revise your software or hardware configuration, and use this form as a reference for your current configuration.

## National Instruments Products

- Plug and Play AT Serial Board and Revision Number
  - AT-232 Board Revision \_\_\_\_\_  
Two Port \_\_\_\_\_ Four Port \_\_\_\_\_
  - or
  - AT-485 Board Revision \_\_\_\_\_  
Two Port \_\_\_\_\_ Four Port \_\_\_\_\_
- NI Serial Driver Software Revision Number on Distribution Disk \_\_\_\_\_

- Board Settings

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

## Other Products

- Computer Make and Model \_\_\_\_\_
- Microprocessor \_\_\_\_\_

(continues)

- Clock Frequency \_\_\_\_\_
- 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 \_\_\_\_\_



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

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Thank you for your help.

Name \_\_\_\_\_

Title \_\_\_\_\_

Company \_\_\_\_\_

Address \_\_\_\_\_

\_\_\_\_\_

Phone ( \_\_\_\_\_ ) \_\_\_\_\_

Mail to:     Technical Publications  
              National Instruments Corporation  
              6504 Bridge Point Parkway, MS 53-02  
              Austin, TX 78730-5039

Fax to:      Technical Publications  
              National Instruments Corporation  
              MS 53-02  
              (512) 794-5678

# Glossary

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Prefix	Meaning	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
BIOS	Basic Input/Output System
C	Celsius
COM	Computer Output Microform
CMV	common mode voltage
DB- <i>xx</i>	subminiature D connector (where <i>xx</i> is the number of pins)
DCE	Data Communications Equipment or Data Circuit-Terminating Equipment
DIP	dual inline package
DTE	Data Terminal Equipment
$\overline{\text{DTR}}$	Data Terminal Ready (where the overscore denotes that the signal is active low)
EIA	Electronic Industries Association
EMI	electromagnetic interference
FCC	Federal Communications Commission
ft.	feet

## *Glossary*

Hz	hertz
I/O	input/output
IEEE	Institute of Electrical and Electronic Engineers
in.	inches
IRQ	interrupt request
ISA	Industry Standard Architecture
jumperless	describes configuration of a Plug and Play ISA board in a non-Plug and Play system—such configuration is accomplished entirely from software, but the user must still choose specific system resources for the board
m	meters
MB	megabytes of memory
PC	personal computer
RAM	random-access memory
resource	hardware settings used by devices in a computer system, including ISA interrupt level, DMA channel, and base I/O address
RX	Receive
s	seconds
TX	Transmit
$\overline{\text{TXRDY}}$	Transmit Ready (where the overscore denotes that the signal is active low)
UART	universal asynchronous receiver/transmitter
V	volts
VDC	volts direct current