CAN

Getting Started
with Your CAN Hardware
and the NI-CAN™ Software
for Windows NT

Worldwide Technical Support and Product Information

ni.com

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FCC/Canada Radio Frequency Interference Compliance*

Determining FCC Class

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

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

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

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

Consult the FCC web site http://www.fcc.gov for more information.
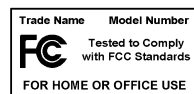
FCC/DOC Warnings

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

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

Class A
Federal Communications Commission

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

Canadian Department of Communications

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

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

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Federal Communications Commission

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.

- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

Canadian Department of Communications

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

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

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

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

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

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About This Manual

This manual contains instructions to help you install and configure the National Instruments CAN hardware and the NI-CAN software for Windows NT. The National Instruments CAN hardware supported under Windows NT includes the PCI-CAN, PCI-CAN/LS (low-speed CAN), PCI-CAN/2, PCI-CAN/LS2 (low-speed CAN), PCI-CAN/DS (dual-speed CAN), PCMCIA-CAN, and PCMCIA-CAN/2.

This manual assumes that you are already familiar with Windows NT.

How To Use the Manual Set
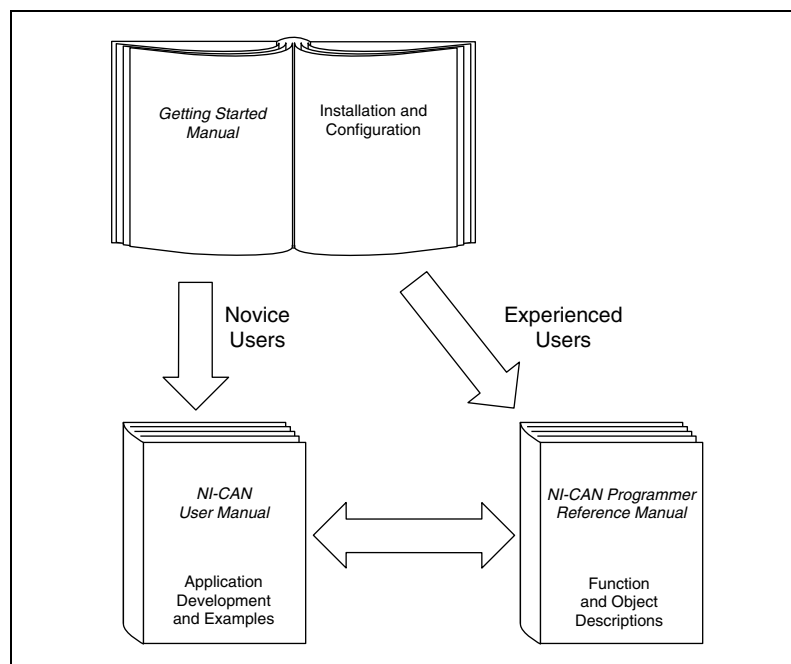
Use this getting started manual to install and configure your CAN hardware and the NI-CAN software for Windows NT.

Use the *NI-CAN User Manual* to learn the basics of CAN and how to develop an application program. The user manual also contains debugging information and detailed examples.

Use the *NI-CAN Programmer Reference Manual* for specific information about each NI-CAN function and object, such as format, parameters, and possible errors.

Conventions

The following conventions appear in this manual:

»	The **»** symbol leads you through nested menu items and dialog box options to a final action. The sequence **File»Page Setup»Options** directs you to pull down the **File** menu, select the **Page Setup** item, and select **Options** from the last dialog box.
	This icon denotes a note, which alerts you to important information.
	This icon denotes a caution, which advises you of precautions to take to avoid injury, data loss, or a system crash.
bold	Bold text denotes items that you must select or click on in the software, such as menu items and dialog box options. Bold text also denotes parameter names.
CAN hardware	*CAN hardware* refers to the PCI-CAN, PCI-CAN/LS, PCI-CAN/2, PCI-CAN/LS2, PCI-CAN/DS, PCMCIA-CAN, and PCMCIA-CAN/2 in cases where the material applies to all the interfaces.
italic	Italic text denotes variables, emphasis, a cross reference, or an introduction to a key concept. This font also denotes text that is a placeholder for a word or value that you must supply.
monospace	Text in this font denotes text or characters that you should enter from the keyboard, sections of code, programming examples, and syntax examples. This font is also used for the proper names of disk drives, paths, directories, programs, subprograms, subroutines, device names, functions, operations, variables, filenames and extensions, and code excerpts.

Related Documentation

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

- ANSI/ISO Standard 11898-1993, *Road Vehicles—Interchange of Digital Information—Controller Area Network (CAN) for High-Speed Communication*

- ANSI/ISO Standard 11519-2-1994, *Road Vehicles—Low-Speed Serial Data Communication—Part 2: Low-Speed Controller Area Network (CAN)*

- *CAN Specification Version 2.0*, 1991, Robert Bosch Gmbh., Postfach 500, D-7000 Stuttgart 1

- CiA Draft Standard 102, Version 2.0, *CAN Physical Layer for Industrial Applications*

- *DeviceNet Specification, Volume 1, Version 2.0*, Open DeviceNet Vendor Association

- *Microsoft Windows NT* user's guide, Microsoft Corporation

1

Introduction

This chapter lists what you need to get started, provides an overview of the CAN hardware and the NI-CAN software for Windows NT, and describes optional equipment you can order.

What You Need to Get Started

Make sure you have all of the following items before you attempt to install the hardware and software:

❑ Windows NT 4.0 or later installed on your computer

❑ One of the following CAN interfaces, which is included in your kit:

– PCI-CAN

– PCI-CAN/LS

– PCI-CAN/2

– PCI-CAN/LS2

– PCI-CAN/DS

– PCMCIA-CAN

– PCMCIA-CAN/2

❑ 3.5 in., high-density (1.44 MB) disks, which are included in your kit:

– *NI-CAN Software for Windows 95/98/NT*
  Version 1.4
  (Disk x of 3)

❑ PCMCIA-CAN, PCMCIA-CAN/LS, or PCMCIA-CAN/DS cable, which is included in your kit if you have a PCMCIA-CAN series card.

❑ CAN interface cables that meet the requirements in Appendix B, *Cabling Requirements for High-Speed CAN*, Appendix C, *Cabling Requirements for Low-Speed CAN*, or Appendix D, *Cabling Requirements for Dual-Speed CAN*.

CAN Hardware Overview

The National Instruments CAN hardware covered in this manual includes the AT-CAN, AT-CAN/2, PCI-CAN, PCI-CAN/LS, PCI-CAN/2, PCI-CAN/LS2, PCI-CAN/DS, PCMCIA-CAN, and PCMCIA-CAN/2.

The AT-CAN series boards are fully software configurable and compliant with the Plug and Play ISA standard. With an AT-CAN or AT-CAN/2 board, you can make your PC AT-compatible computer communicate with and control CAN devices.

The PCI-CAN, PCI-CAN/LS and PCI-CAN/DS series boards are completely software configurable and compliant with the PCI Local Bus Specification. With a PCI-CAN, PCI-CAN/LS or PCI-CAN/DS series board, you can make your PC-compatible computer with PCI Local Bus slots communicate with and control CAN devices.

The PCMCIA-CAN series cards are Type II PC Cards that are completely software configurable and compliant with the PCMCIA standards for 16-bit PC Cards. With a PCMCIA-CAN series card, you can make your PC-compatible notebook with PCMCIA sockets communicate with and control CAN devices.

CAN interfacing is accomplished using the Intel 82527 CAN controller chip. The high-speed CAN physical layer fully conforms to the ISO 11898 physical layer specification for CAN and is optically isolated to 500 V. The low-speed CAN physical layer conforms to the ISO 11519-2 physical layer specification for CAN and is also optically isolated to 500 V.

AT-CAN and PCI-CAN series boards are available with two physical connector types: DB-9 D-Sub and Combicon-style pluggable screw terminals. Low-speed PCI-CAN/LS and PCI-CAN/DS boards are available with DB-9 D-Sub connectors. PCMCIA-CAN, PCMCIA-CAN/LS and PCMCIA-CAN/DS cables include both a DB-9 D-Sub and a pluggable screw terminal.

The CAN physical layer on AT-CAN and PCI-CAN series cards can be powered either internally (from the card) or externally (from the bus cable power). The power source for the CAN physical layer for each port is configured with a jumper. There are four cables available for the PCMCIA-CAN cards. In one cable the CAN physical layer is powered internally (from the card). In the second cable the CAN physical layer is powered externally (from the bus cable power). The CAN physical layer on the PCMCIA-CAN/LS cable requires that only V–, CAN_L, and CAN_H

be connected to the bus. Power for the low-speed physical layer and the V-BAT pin of the low-speed transceiver is supplied internally through the card. This also applies to the low-speed CAN port (port 2) on the PCMCIA-CAN/DS cable. The high-speed CAN port (port 1) on the PCMCIA-CAN/DS cable provides internal physical-layer power from the card. The CAN hardware supports a wide variety of transfer rates up to 1 Mb/s.

The PCI-CAN and AT-CAN series boards use the Real-Time System Integration (RTSI) bus to solve the problem of synchronizing several functions across multiple boards to a common trigger or timing event. The RTSI bus consists of the National Instruments RTSI bus interface and ribbon cable to route timing and trigger signals between the CAN hardware and National Instruments DAQ, IMAQ, or additional CAN hardware.

All of the CAN hardware uses the Intel 386EX embedded processor to implement time-critical features provided by the NI-CAN software. The CAN hardware communicates with the NI-CAN driver through on-board shared memory and an interrupt.

NI-CAN Software Overview

The NI-CAN software includes a native, 32-bit multitasking Windows NT kernel driver.

The NI-CAN software for Windows NT supports the concurrent use of multiple types of CAN hardware. For example, you can communicate with CAN devices through both a PCI-CAN and PCI-CAN/2 in the same system at the same time. The NI-CAN software is fully integrated into the Windows NT operating system. It is configurable through the Windows NT Control Panel and uninstallable through the Add/Remove Programs applet of the Control Panel.

The NI-CAN software, along with the CAN hardware, transforms your computer into a CAN interface with complete communications and bus management capability. The NI-CAN software includes the following components:

- Firmware (runs on embedded Intel 386EX)
- Device driver
- Diagnostic test utility
- Configuration utility

- Language interface libraries for Microsoft Visual C/C++ 2.0 or later, LabWindows/CVI 4.0 or later, and LabVIEW 4.0 or later

- Example programs that use NI-CAN functions

Optional Programming Tools

Your kit includes the NI-CAN software for Windows 98/95. In addition, you can order the following software from National Instruments.

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.

Measurement Studio bundles LabWindows/CVI among other tools for C programmers designed for building measurement and automation applications. LabWindows/CVI is an interactive ANSI C programming environment designed for building virtual instrument applications. LabWindows/CVI delivers a drag-and-drop editor for building user interfaces, a complete ANSI C environment for building your test program logic, and a collection of automated code generation tools, as well as utilities for building automated test systems, monitoring applications, or laboratory experiments.

For more information about Measurement Studio and LabVIEW, contact National Instruments.

2

Installation and Configuration

This chapter describes how to install and configure the CAN hardware and the NI-CAN software for Windows NT.

Install the NI-CAN Software

Before installing the CAN hardware, complete the following steps to install the NI-CAN software for Windows NT.

Installing for Windows NT 3.51

1. Log in as `Administrator` or as a user that has Administrator privileges. The NI-CAN setup program must have `Administrator` privileges because the program modifies the configuration registry of your system.

2. Insert the CD, *NI-CAN for Windows NT/9x*.

3. In the **Run** dialog box, type the following:

   `x:\setup`

   where *x* is the letter of your CD drive.

4. After the software installs, shut down Windows NT and turn off your computer when the setup is complete.

5. Proceed to the section *Install the CAN Hardware*.

Installing for Windows NT 4.0

1. Log in as `Administrator` or as a user that has Administrator privileges. The NI-CAN setup program must have `Administrator` privileges because the program modifies the configuration registry of your system.

2. Select **Start»Settings»Control Panel**.

3. Double-click on the **Add/Remove Programs** icon in the Control Panel to launch the Add/Remove Programs applet. A dialog box similar to the one in Figure 2-1 appears.
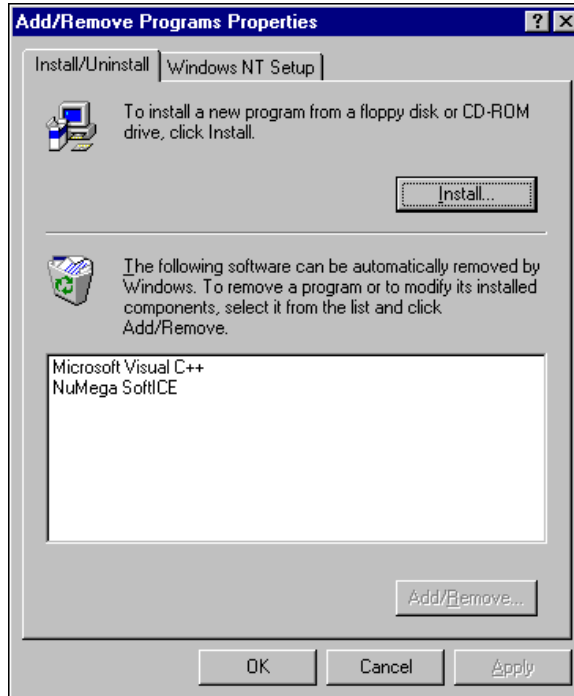
Figure 2-1. Add/Remove Programs Properties Dialog Box

You can use this same applet to uninstall the NI-CAN software at a later time. Refer to Appendix A, *Uninstalling the Hardware and Software*, for more information.

4. Click on the **Install** button.

5. Insert the program CD, *NI-CAN for Windows NT/9x*, and click on the **Next** button to proceed.

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

7. Shut down Windows NT and turn off your computer when the setup is complete.

Install the CAN Hardware

This section describes how to install your CAN hardware.

Check the Configuration of Your CAN Hardware

If you plan to use your CAN board in a system where bus power is available, you may want to configure the power supply jumpers on your board. See Appendix B, *Cabling Requirements for High-Speed CAN*, for more information.

If you are installing a low-speed CAN board or a PCMCIA-CAN/LS cable, you may need to change the power supply jumpers or termination resistors. See Appendix C, *Cabling Requirements for Low-Speed CAN*, for more information.

If you are installing a dual-speed CAN board or a PCMCIA-CAN/DS cable, you may have to change the power supply jumpers or termination resistors. See Appendix D, *Cabling Requirements for Dual-Speed CAN*, for more information.

Install Your PCI-CAN Series Board

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

1. Make sure that your computer is turned off. Keep the computer plugged in so that it remains grounded while you install the CAN interface.

2. Remove the top cover (or other access panels) to give yourself access to the computer expansion slots.

3. Find an unused expansion slot of the appropriate type in your computer.

4. Remove the corresponding slot cover on the back panel of the computer.

5. Insert the CAN interface into the slot with the CAN connector(s) sticking out of the opening on the back panel. It might be a tight fit, but do not force the interface into place. Figure 2-2 shows how to install the PCI-CAN into a PCI expansion slot.
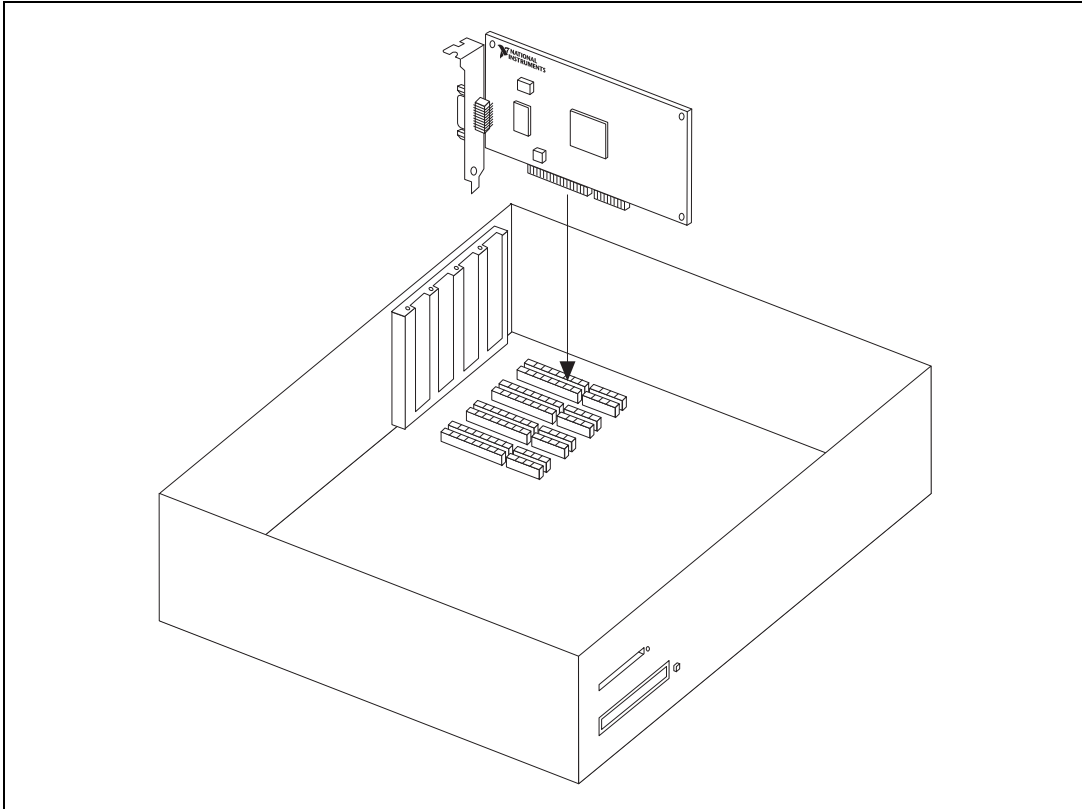
Figure 2-2. Installing the PCI-CAN

6.   Screw the mounting bracket of the CAN interface to the back panel rail of the computer.

7.   If desired, you can use a RTSI cable to connect your CAN board RTSI interface to other National Instruments RTSI-equipped hardware to share timing and triggering signals. Please refer to Appendix E, *RTSI Bus*, for information about the RTSI interface on your CAN board.

8.   Replace the top cover (or the access panel to the expansion slot).

9.   Turn on your computer and start Windows NT.

When you have finished installing the hardware, proceed to the *Connect the Cables* section, later in this chapter.

Install Your PCMCIA-CAN Series Card

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

📝 **Note**   Because of restrictions imposed by Windows NT, only one PCMCIA-CAN or PCMCIA-CAN/2 can be used in a Windows NT system. For example, if you have a PCMCIA-CAN card in your system, you cannot use another PCMCIA-CAN card at the same time.

1. Shut down your operating system and power off your system.

2. Insert the card into a free PC Card (PCMCIA) socket. The card has no jumpers or switches to set. Figure 2-3 shows how to insert the card and how to connect a PCMCIA-CAN cable to the card.
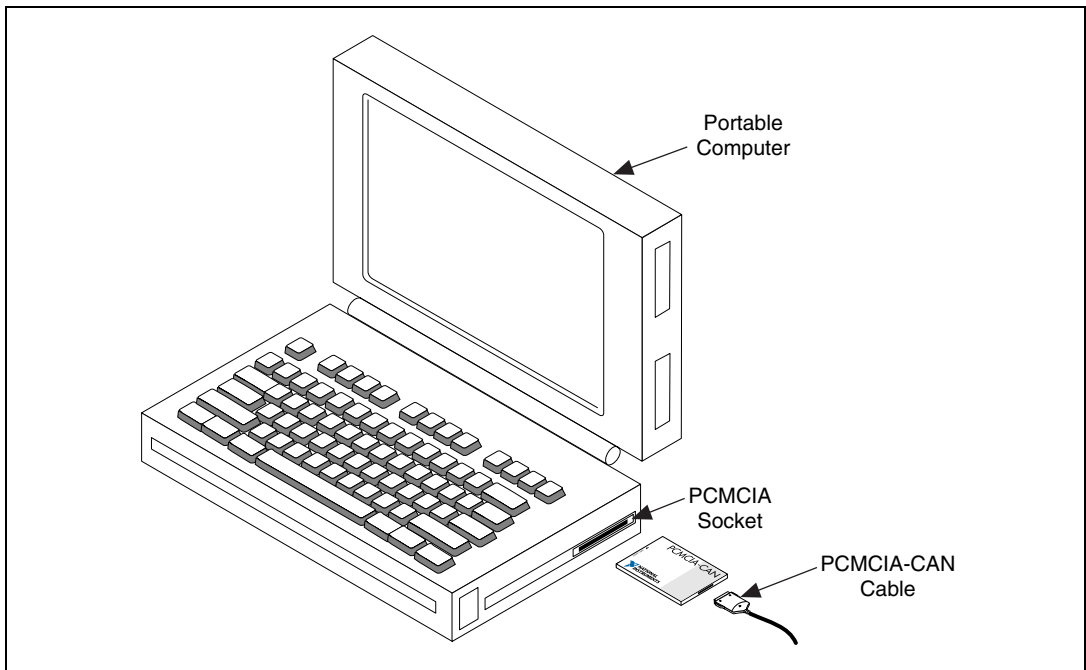

Figure 2-3. Inserting the PCMCIA-CAN

3. Connect the PCMCIA-CAN, PCMCIA-CAN/LS, or
   PCMCIA-CAN/DS cable to the card. Starting with NI-CAN
   Version 1.4, and the PCMCIA-CAN cards with low and high-speed
   CAN support, the NI-CAN software auto-detects which cable has been
   attached to the card.

4. Power on your computer.

When you have finished installing the hardware, proceed to the next
section, *Connect the Cables*.

Connect the Cables

After you have installed the CAN interface, connect your CAN cables
to the interface. Because exact cabling requirements vary for each
application, National Instruments does not provide cables, other than
the PCMCIA-CAN, PCMCIA-CAN/LS, or PCMCIA-CAN/DS cable.
Refer to either Appendix B, *Cabling Requirements for High-Speed CAN*,
Appendix C, *Cabling Requirements for Low-Speed CAN*, or Appendix D,
Cabling Requirements for Dual-Speed CAN, for information about the
cabling requirements of the CAN hardware.

Configure the NI-CAN Software

The NI-CAN Configuration utility is located in the Windows NT Control
Panel. You can use it to examine or modify the configuration of the
NI-CAN software. The context-sensitive online help, available by
right-clicking on any of the controls on the configuration utility buttons,
includes all the information that you need to configure the NI-CAN
software.

To use the NI-CAN Configuration utility, you must first log in as
Administrator or as a user that has Administrator privileges. To
configure the NI-CAN software, double-click on the **NI-CAN
Configuration** icon in the **Control Panel**:

• Windows NT 3.51—Open the **Control Panel** in the **Main** group of the
  Program Manager.

• Windows NT 4.0 or later—Select **Start»Settings»Control Panel**.

Figure 2-4 shows a CAN interface that is working properly. If no interfaces are listed under **NI-CAN Configuration**, refer to the *Missing CAN Interface in the NI-CAN Configuration Utility* section in Appendix F, *Troubleshooting and Common QuestionsCabling Requirements for Dual-Speed CAN,* to resolve the problem.
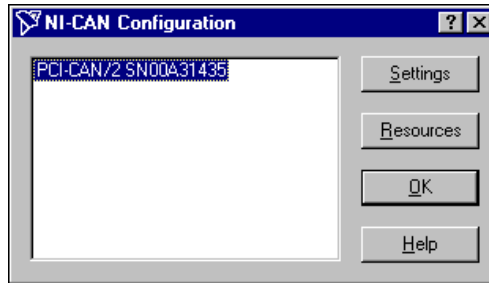

Figure 2-4. CAN Interface That Is Working Properly

To select a particular interface, click on that interface in the list.

When you install a PCI-CAN interface, your computer automatically assigns valid resources to it. Because this resource assignment is automatic, you do not need to use the **Resources** dialog box for the PCI-CAN, and you do not need to restart Windows NT.

When you install a PCMCIA-CAN interface, your computer assigns default resources to it. Because the default resources may conflict with other devices in your system, you must use the **Resources** dialog box to select valid resources for the PCMCIA-CAN. Figure 2-5 shows the **Resources** dialog box for the PCMCIA-CAN.
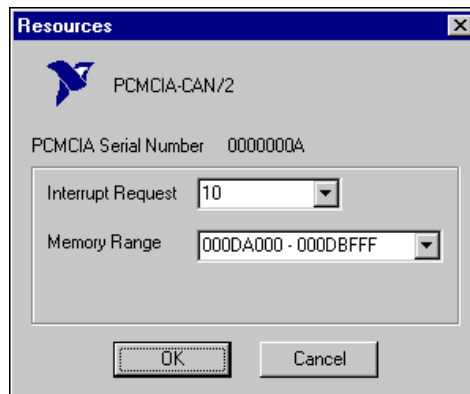

Figure 2-5. Resources Dialog Box for the PCMCIA-CAN

Click on the **Settings** button to view information about the NI-CAN software configuration for the CAN interface. Figure 2-6 shows the **Settings** dialog box.
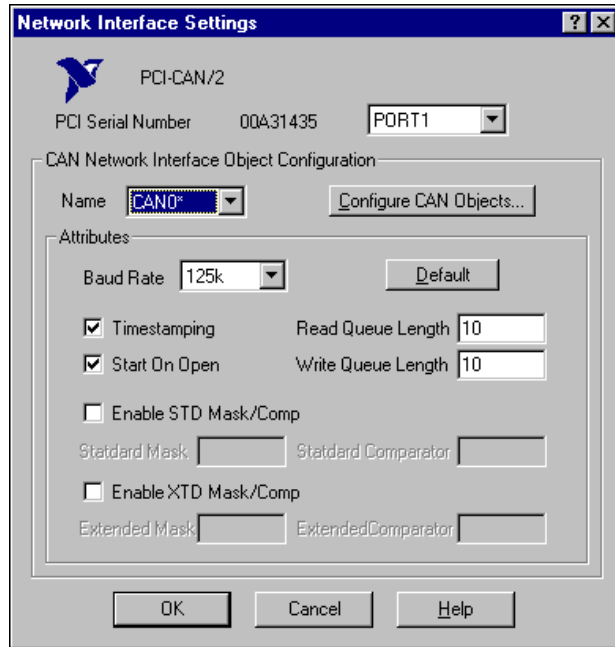

Figure 2-6. NI-CAN Hardware Settings Dialog Box

Each port of the CAN hardware interface is configured from this tab. Use the drop-down box nearest the top of the tab to select the physical port number to configure. For each port, use the **Name** drop-down box to select the name for the CAN Network Interface Object (CAN0, CAN1, and so on). You use this name to refer to the physical port from within your NI-CAN application.

To access online help for the NI-CAN Configuration utility, click on the **Help** button. Alternately, you can right-click on a specific control and select **What's This?** from the pop-up menu to see context-sensitive help for the item you have clicked on.

When you have finished configuring the NI-CAN software, proceed to Chapter 3, *Verify the Installation*.

Note If you changed the resources for any PCMCIA-CAN or PCMCIA-CAN/2 interface, you must restart Windows NT for the changes to take effect.

3

Verify the Installation

This chapter describes how to verify the hardware and software installation.

You can use the NI-CAN Diagnostic utility, installed with your NI-CAN software, to test the hardware and software installation. The utility verifies that your hardware and software are functioning properly and that the configuration of your CAN interfaces does not conflict with anything else in your system.

To run the utility, select the **NI-CAN Diagnostic** item:

• Windows NT 3.51—Double-click on the **NI-CAN Diagnostic** icon in the **NI-CAN Software for Windows NT** group of the **Program Manager**.

• Windows NT 4.0 or later—Select **Start»Programs»National Instruments CAN»NI-CAN»NI-CAN Diagnostic**.

When you have started the NI-CAN Diagnostic utility, test your CAN interfaces by clicking on the **Test All** button. You can also test one CAN interface by highlighting it and clicking on the **Test One** button. If the NI-CAN Diagnostic is successful, it puts a checkmark next to the interface and changes its status from **Untested** to **Passed**. If the NI-CAN Diagnostic fails, it puts an X next to the interface, and changes its status from **Untested** to **Failed**. Figure 3-1 shows the NI-CAN Diagnostic utility after it has tested some CAN interfaces.
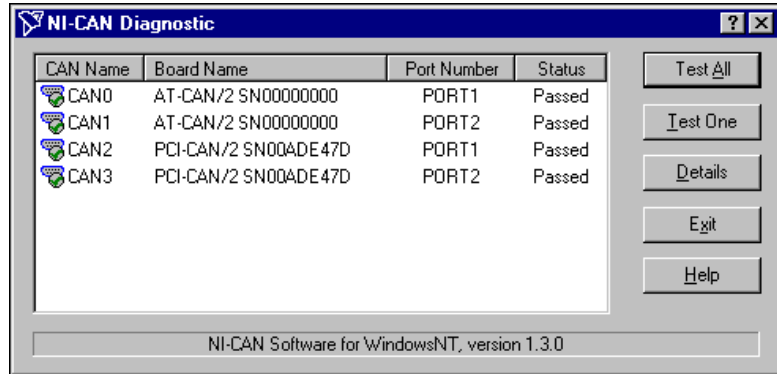
Figure 3-1. NI-CAN Diagnostic Utility after Testing

You can get details about any tested CAN interface by selecting the interface and clicking on the **Details** button. For each failed CAN interface, select it and click on the **Details** button to get a description of the failure. Use that information and the information in Appendix D, *Cabling Requirements for Dual-Speed CAN*, to troubleshoot the problem. Troubleshooting information is also available in the online help for the NI-CAN Diagnostic utility, which you can access by clicking on the **Help** button.

4

Begin to Use the NI-CAN Software

This chapter helps you get started with the NI-CAN software for Windows NT.

Using the NI-CAN Software

The functions provided by the NI-CAN software are similar to those provided by many other device drivers. For example, NI-CAN has open, close, read, and write functions. NI-CAN provides two different levels of access to a CAN network: the CAN Network Interface Object and CAN Objects. Both forms of access support timestamping of incoming data, as well as various forms of queuing.

The CAN Network Interface Object provides low-level access to a CAN network. Each CAN Network Interface Object maps to a specific CAN port, with no limitation on the maximum number of ports or cards you can use (for example, two PCI-CAN/2 interfaces would provide CAN0 through CAN3). You can use this object to transmit and receive entire CAN frames. For example, to transmit a CAN frame, you would specify the outgoing arbitration ID, frame type (data or remote), data length, and data.

The CAN Objects provide higher level access to a CAN network. Each CAN Object maps to a specific data item (arbitration ID), and you can use multiple CAN Objects for a given port. When configuring a CAN Object for use, you specify the arbitration ID, direction of data transfer, data length, and how you want the data to be accessed (such as periodically). For example, you could configure a CAN Object to transmit an outgoing data frame for a specific arbitration ID every 100 ms. After opening this CAN Object, you use the write function to provide data to transmit, and the NI-CAN embedded firmware handles all periodic timing.

For detailed information about the NI-CAN software and functions, refer to the *NI-CAN User Manual* and the *NI-CAN Programmer Reference Manual*.

General Programming Considerations

As you begin developing your Win32 NI-CAN application, remember the following points:

- For your LabVIEW application, you must use the NI-CAN LabVIEW functions in `nican.llb`.

- For your C/C++ application, you must include the NI-CAN header file, `nican.h`, in your source code.

- The NI-CAN software is accessed through the 32-bit DLL, `nican.dll`, either by linking with one of the language interfaces provided with the NI-CAN software, or by using direct DLL entry from other programming environments.

- Several sample CAN applications are included with the NI-CAN software. Use these as a guide for your own application development.

For information about developing your application, refer to the *NI-CAN User Manual*. For detailed information about NI-CAN functions and objects, refer to the *NI-CAN Programmer Reference Manual*.

Uninstalling the Hardware and Software

This appendix describes how to uninstall the CAN hardware and the NI-CAN software from Windows NT.

Uninstalling the CAN Hardware from Windows NT

Because Windows NT 3.51 and 4.0 do not maintain hardware information for the CAN interfaces, you just need to physically remove the CAN interfaces from your computer. To do so, shut down Windows NT, power off your computer, and physically remove the CAN interfaces.

Uninstalling the NI-CAN Software from Windows NT

Note The following instructions apply to Windows NT 4.0 only. If you are using Windows NT 3.51, refer to the `readme.txt` file in your NI-CAN directory for information on how to uninstall the NI-CAN software.

Before uninstalling the NI-CAN software, you should remove all CAN interface hardware from your computer, as explained in the previous section.

Complete the following steps to remove the NI-CAN software from Windows NT 4.0:

1. Select the **Add/Remove Programs** icon under **Start»Settings» Control Panel.** A dialog box similar to the one in Figure A-1 appears. This dialog box lists the software available for removal.
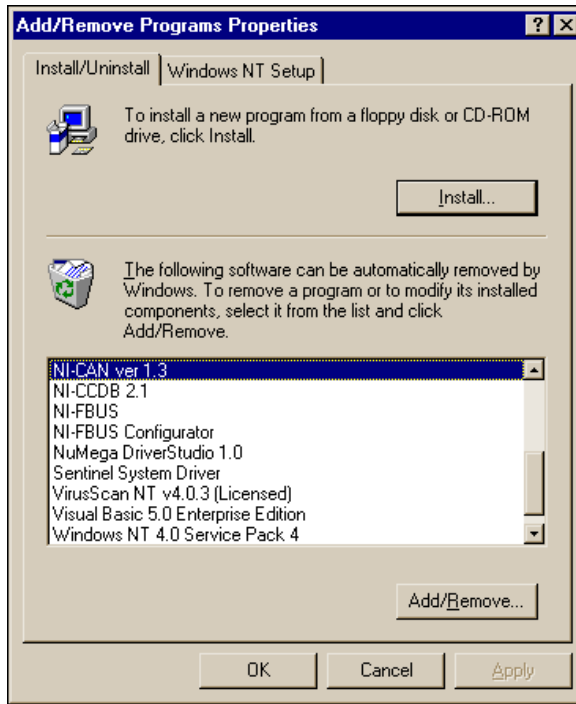
Figure A-1. Add/Remove Programs Properties Dialog Box

2. Select the NI-CAN software you want to remove, and click on the
    Add/Remove button. The uninstall program runs and removes all
    folders, utilities, device drivers, DLLs, and registry entries associated
    with the NI-CAN software.

The uninstall program removes only items that the installation program
installed. If you add anything to a directory that was created by the
installation program, the uninstall program does not delete that directory,
because the directory is not empty after the uninstallation. You need to
remove any remaining components yourself.

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

B

Cabling Requirements for High-Speed CAN

This appendix describes the cabling requirements for high-speed CAN interfaces.

Cables should be constructed to meet these requirements, as well as the requirements of the other CAN or DeviceNet devices in the network.

Connector Pinouts

Depending on the type of CAN interface you are installing, the CAN hardware either has DB-9 D-Sub connectors(s), or Combicon-style pluggable screw terminal connector(s).

The 9-pin D-Sub follows the pinout recommended by CiA DS 102. Figure B-1 shows the pinout for this connector.
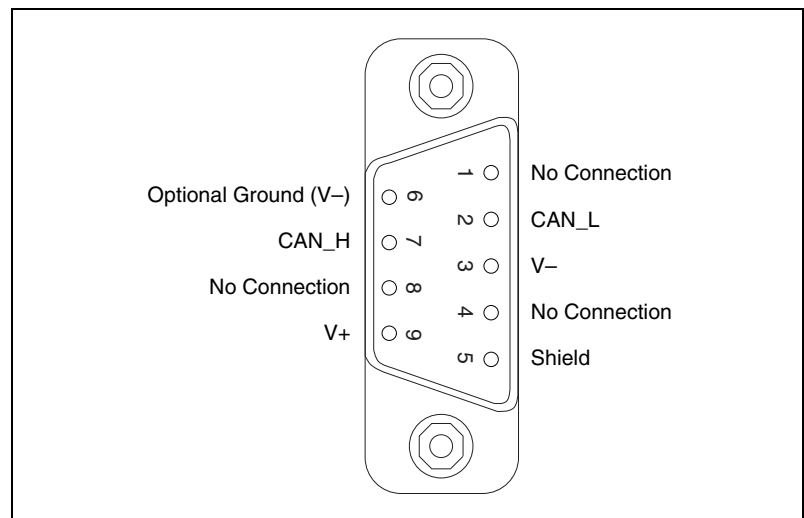
Figure B-1. Pinout for 9-Pin D-Sub Connector

The 5-pin Combicon-style pluggable screw terminal follows the pinout required by the DeviceNet specification. Figure B-2 shows the pinout for this connector.
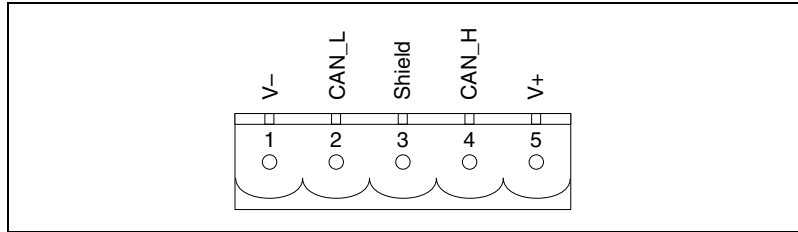
Figure B-2. Pinout for 5-Pin Combicon-Style Pluggable Screw Terminal

CAN_H and CAN_L are signal lines that carry the data on the CAN network. These signals should be connected using twisted-pair cable.

The V+ and V– pins are used to supply bus power to the CAN physical layer if external power is required for the CAN physical layer. If internal power for the CAN physical layer is used, the V– pin serves as the reference ground for CAN_H and CAN_L. See the next section, *Power Supply Information for the High-Speed CAN Ports*, for more information.

Figure B-3 shows the end of a PCMCIA-CAN cable. The arrow points to pin 1 of the 5-pin screw terminal block. All of the signals on the 5-pin Combicon-style pluggable screw terminal are connected directly to the corresponding pins on the 9-pin D-Sub.
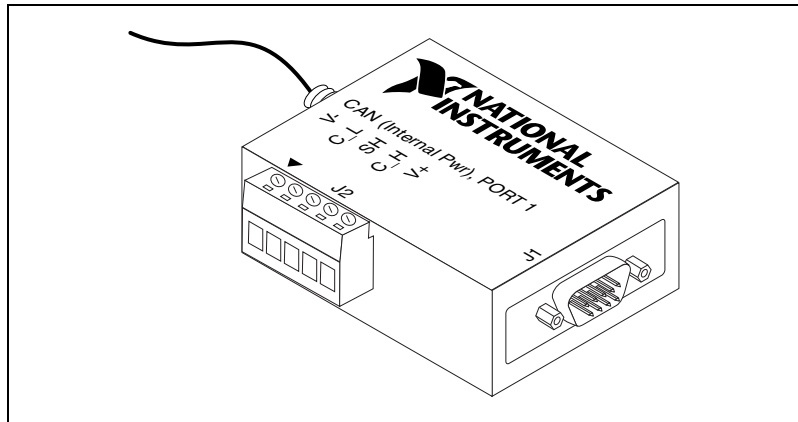
Figure B-3. PCMCIA-CAN Cable

Power Supply Information for the High-Speed CAN Ports

For the PCI-CAN series boards, the power source for the CAN physical layer is configured with a jumper. For the PCI-CAN and port one of the PCI-CAN/2, power is configured with jumper J6. For port two of the PCI-CAN/2, power is configured with jumper J5. The location of these jumpers is shown in Figure B-4.
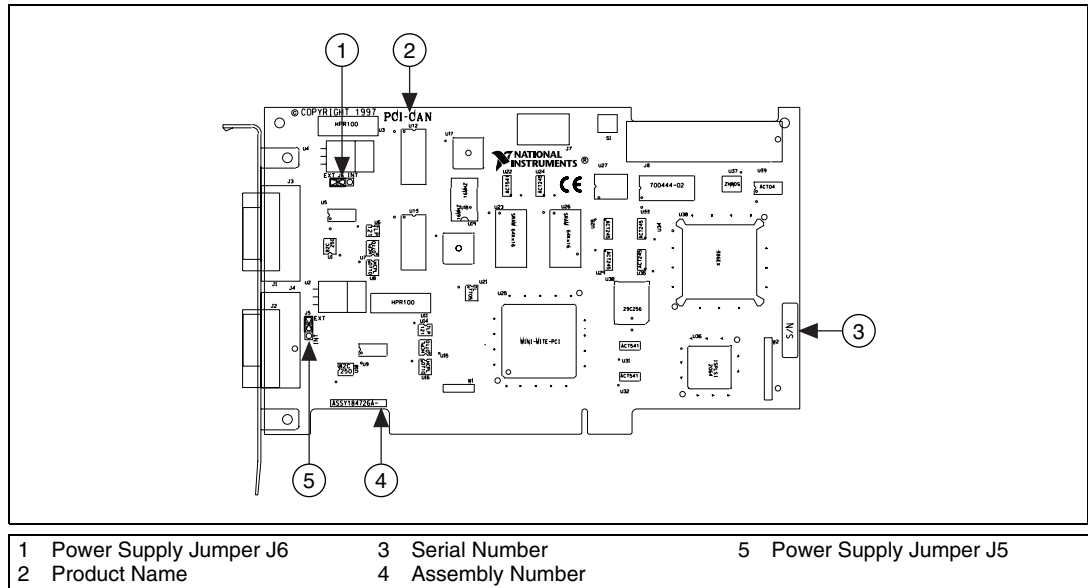

1	Power Supply Jumper J6	3	Serial Number	5	Power Supply Jumper J5
2	Product Name	4	Assembly Number		

Figure B-4. PCI-CAN/2 Parts Locator Diagram

Connecting pins 1 and 2 of a jumper configures the CAN physical layer to be powered externally (from the bus cable power). In this configuration, the power must be supplied on the V+ and V– pins on the port connector.

Connecting pins 2 and 3 of a jumper configures the CAN physical layer to be powered internally (from the card). In this configuration, the V– signal serves as the reference ground for the isolated signals.

Figure B-5 shows how to configure your jumpers for internal or external power supplies.
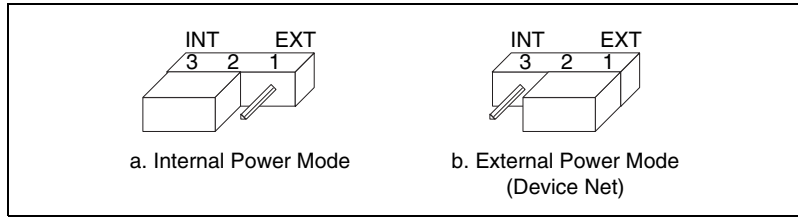
Figure B-5. Power Source Jumpers

The CAN physical layer is still isolated regardless of the power source chosen.

The PCMCIA-CAN series cards are available with two types of cable. The DeviceNet (bus powered) cable requires that the CAN physical layer be powered from the bus cable power.

The internal-powered cable supplies power to the CAN physical layer from the host computer. The V+ pin is not connected to any internal signals, but the corresponding pins on the 9-pin D-Sub and the 5 pin Combicon-style connectors are still connected. The V– pins serves as the reference ground for the isolated signals.

The CAN physical layer is isolated from the computer in both types of cable.

Bus Power Supply Requirements

If the CAN physical layer is powered from a bus power supply, the power supply should be a DC power supply with an output of 10 V to 30 V. The power requirements for the CAN ports for Bus-Powered configurations are shown in Table B-1. You should take these requirements into account when determining requirements of the bus power supply for the system.

Table B-1. Power Requirements for the CAN Physical Layer for Bus-Powered Versions

Characteristic	Specification
Voltage Requirement	V+ 10–30 VDC
Current Requirement	40 mA typical 100 mA maximum

Cable Specifications

Cables should meet the physical medium requirements specified in ISO 11898, shown in Table B-2.

Belden cable (3084A) meets all of those requirements, and should be suitable for most applications.

Table B-2. ISO 11898 Specifications for Characteristics of a CAN_H and CAN_L Pair of Wires

Characteristic	Value
Impedance	108 Ω minimum, 120 Ω nominal, 132 Ω maximum
Length-related resistance	70 mΩ/m nominal
Specific line delay	5 ns/m nominal

Cable Lengths

The allowable cable length is affected by the characteristics of the cabling and the desired bit transmission rates. Detailed cable length requirements can be found in the ISO 11898, CiA DS 102, and DeviceNet specifications.

ISO 11898 specifies 40 m total cable length with a maximum stub length of 0.3 m for a bit rate of 1 Mb/s. The ISO 11898 specification says that significantly longer cable lengths may be allowed at lower bit rates, but each node should be analyzed for signal integrity problems.

Table B-3 lists the DeviceNet cable length specifications.

Table B-3. DeviceNet Cable Length Specifications

Bit Rate	Thick Cable	Thin Cable
500 kb/s	100 m	100 m
250 kb/s	200 m	100 m
100 kb/s	500 m	100 m

Number of Devices

The maximum number of devices depends on the electrical characteristics of the devices on the network. If all of the devices meet the requirements of ISO 11898, at least 30 devices may be connected to the bus. Higher numbers of devices may be connected if the electrical characteristics of the devices do not degrade signal quality below ISO 11898 signal level specifications. If all of the devices on the network meet the DeviceNet specifications, 64 devices may be connected to the network.

Cable Termination

The pair of signal wires (CAN_H and CAN_L) constitutes a transmission line. If the transmission line is not terminated, each signal change on the line causes reflections that may cause communication failures.

Because communication flows both ways on the CAN bus, CAN requires that both ends of the cable be terminated. However, this requirement does not mean that every device should have a termination resistor. If multiple devices are placed along the cable, only the devices on the ends of the cable should have termination resistors. See Figure B-6 for an example of where termination resistors should be placed in a system with more than two devices.
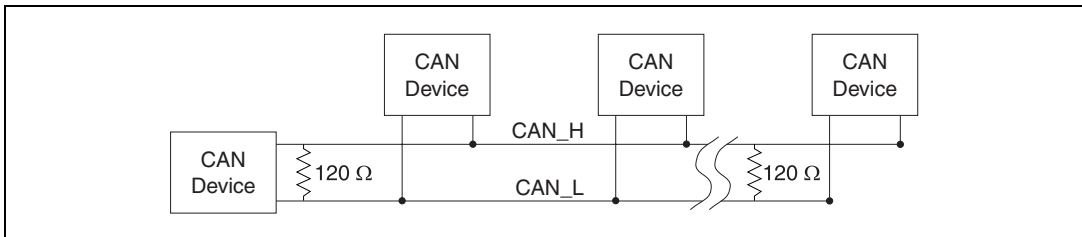
Figure B-6. Termination Resistor Placement

The termination resistors on a cable should match the nominal impedance of the cable. ISO 11898 requires a cable with a nominal impedance of 120 Ω; therefore, a 120 Ω resistor should be used at each end of the cable. Each termination resistor should be capable of dissipating 0.25 W of power.

Cabling Example

Figure B-7 shows an example of a cable to connect two CAN devices. For the internal power configuration, no V+ connection is required.
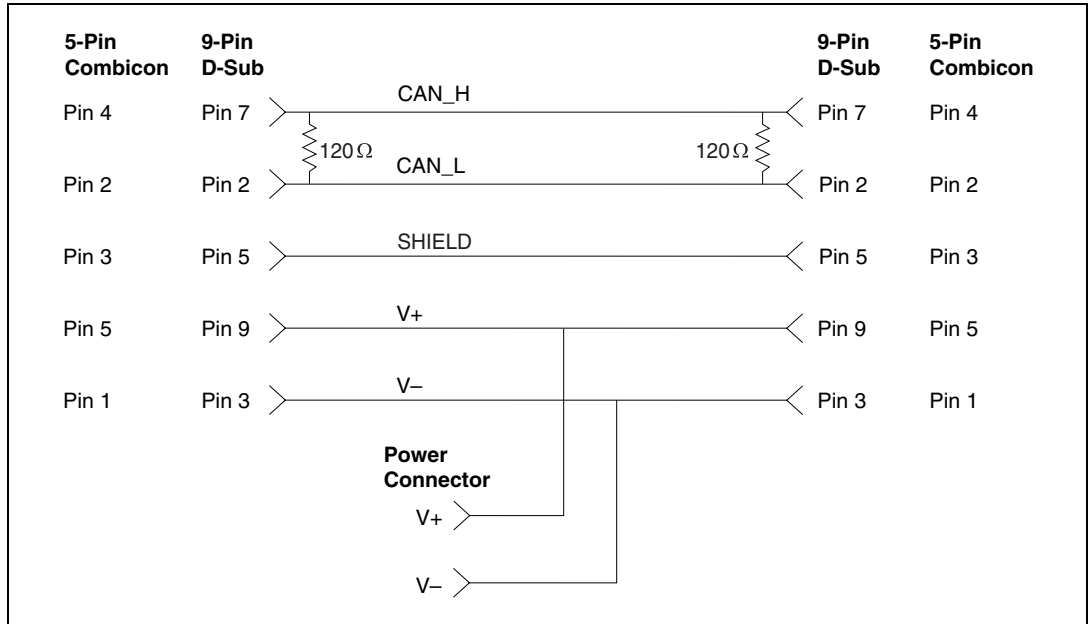
Figure B-7. Cabling Example

C

Cabling Requirements for Low-Speed CAN

This appendix describes the cabling requirements for the low-speed CAN hardware.

Cables should be constructed to meet these requirements, as well as the requirements of the other CAN devices in the network.

Connector Pinouts

The low-speed CAN hardware has DB-9 D-Sub connector(s). The 9-pin D-Sub follows the pinout recommended by CiA DS 102. Figure C-1 shows the pinout for this connector.
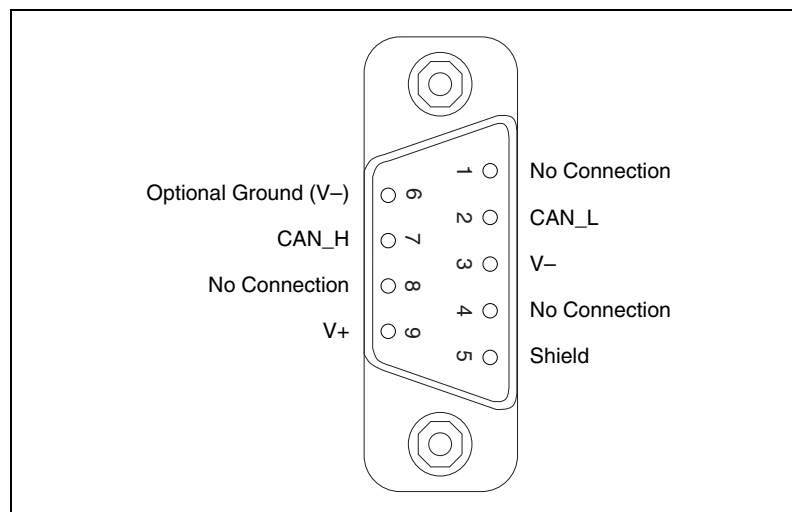
Figure C-1. Pinout for 9-Pin D-Sub Connector

CAN_H and CAN_L are signal lines that carry the data on the CAN network. These signals should be connected using twisted-pair cable.

The V+ and V– pins are used to supply bus power to the CAN physical layer if external power is required for the CAN physical layer. If internal power for the CAN physical layer is used, the V- pin serves as the reference ground for CAN_H and CAN_L. See the next section, *Power Supply Information for the Low-Speed CAN Ports*, for more information.

Figure C-2 shows the end of a PCMCIA-CAN/LS cable. The arrow points to pin 1 of the 7-pin screw terminal block. All of the signals on the 7-pin pluggable screw terminal, except RTL and RTH, are connected directly to the corresponding pins on the 9-pin D-Sub.
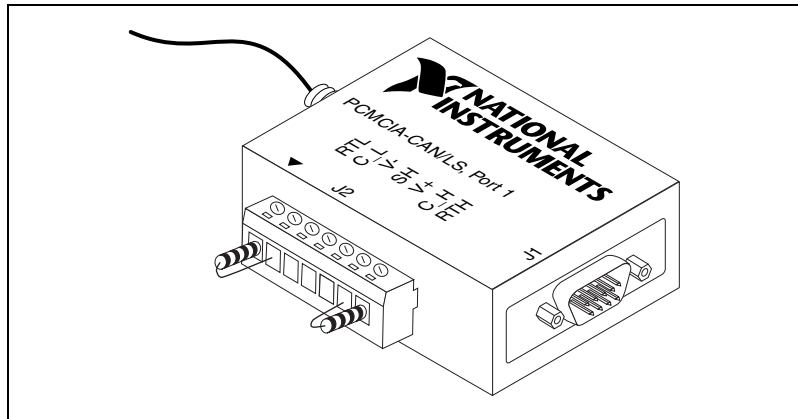
Figure C-2. PCMCIA-CAN/LS Cable

Power Supply Information for the Low-Speed CAN Ports

For the PCI-CAN/LS and port one of the PCI-CAN/LS2, power is configured with jumper J6. For port two of the PCI-CAN/LS2, power is configured with jumper J5. These jumpers are shown in Figure C-3.

| 1 | Power Supply Jumper J6 | 3 | Serial Number | 5 | Power Supply Jumper J5 |
| 2 | Product Name | 4 | Assembly Number | 6 | Termination Resistor Sockets |
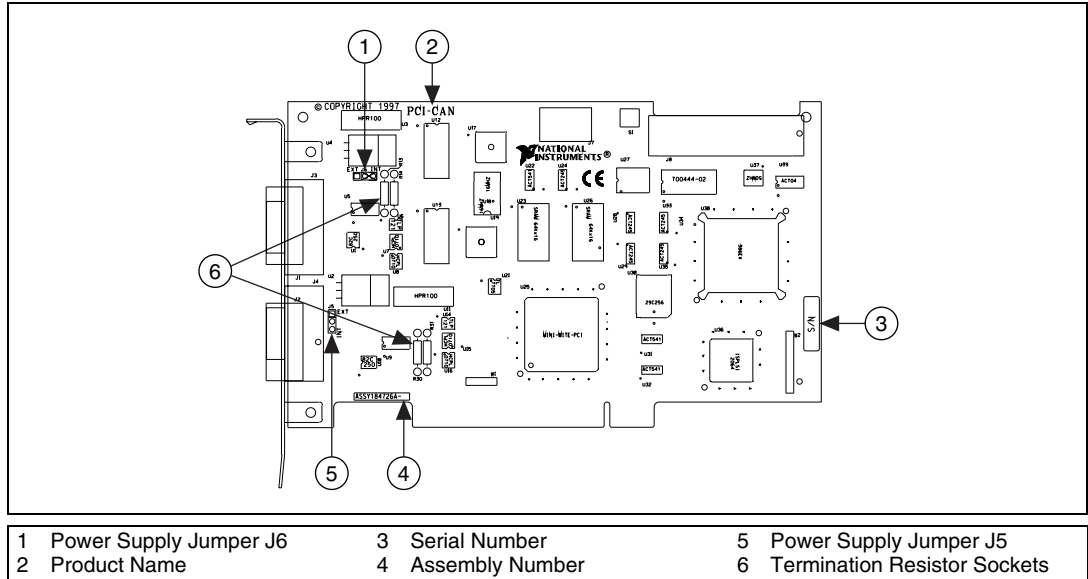
Figure C-3. PCI-CAN/LS2 Parts Locator Diagram

Connecting pins 1 and 2 of a jumper configures the CAN physical layer to be powered externally (from the bus cable power). In this configuration, the power must be supplied on the V+ and V– pins on the port connector.

Connecting pins 2 and 3 of a jumper configures the CAN physical layer to be powered internally (from the card). In this configuration, the V– signal serves as the reference ground for the isolated signals. Even if the CAN physical layer is powered internally, the fault-tolerant CAN transceiver still requires bus power to be supplied in order for it to monitor the power supply (battery) voltage.

Figure C-4 shows how to configure your jumpers for internal or external power supplies.
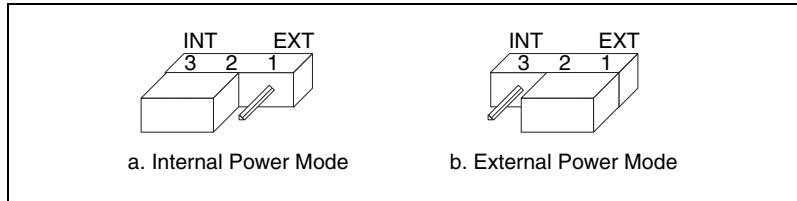
Figure C-4. Power Source Jumpers

The CAN physical layer is still isolated regardless of the power source chosen.

Bus Power Supply Requirements

If the CAN physical layer is powered from a bus power supply, the power supply should be a DC power supply with an output of 8 V to 27 V. The power requirements for the CAN ports for Bus-Powered configurations are shown in Table C-1. You should take these requirements into account when determining requirements of the bus power supply for the system.

Table C-1. Power Requirements for the Low-Speed CAN Physical Layer for Bus-Powered Versions

Characteristic	Specification
Voltage requirement	V+ 8–27 VDC
Current requirement	40 mA typical 100 mA maximum

Cable Specifications

Cables should meet the physical medium requirements specified in ISO 11519-2, shown in Table C-2.

Belden cable (3084A) meets all of those requirements, and should be suitable for most applications.

Table C-2. ISO 11519-2 Specifications for Characteristics of a CAN_H and CAN_L Pair of Wires

Characteristic	Value
Length-related resistance	90 mΩ/m nominal
Length-related capacitance: CAN_L and ground, CAN_H and ground, CAN_L and CAN_H	30 pF/m nominal

Number of Devices

The maximum number of devices depends on the electrical characteristics of the devices on the network. If all of the devices meet the requirements of ISO 11519-2, at least 20 devices may be connected to the bus. Higher numbers of devices may be connected if the electrical characteristics of the devices do not degrade signal quality below ISO 11519-2 signal level specifications.

Low-Speed Termination

Every device on the low-speed CAN network requires a termination resistor for each CAN data line: R_{RTH} for CAN_H and R_{RTL} for CAN_L. Figure C-5 shows termination resistor placement in a low-speed CAN network.
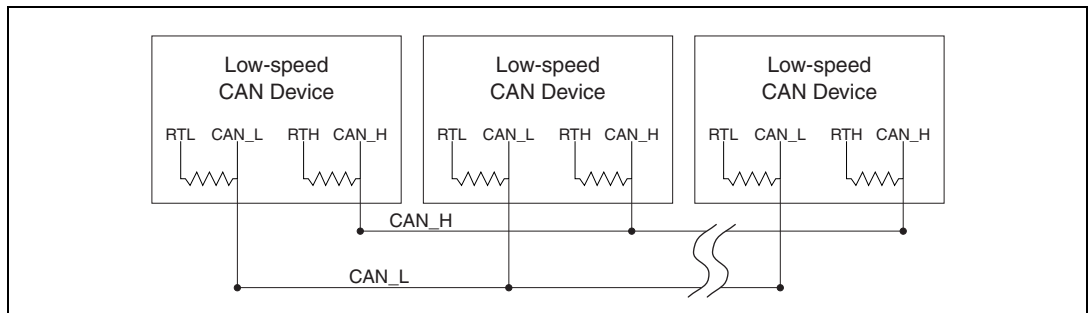
Figure C-5. Termination Resistor Placement for Low-Speed CAN

The following sections explain how to determine the correct resistor values for your low-speed CAN board, and how to replace those resistors, if necessary.

Determining the Necessary Termination Resistance for Your Board

Unlike high-speed CAN, low-speed CAN requires termination at the low-speed CAN transceiver instead of on the cable. The termination requires one resistor for each CAN line. This configuration allows the Philips fault-tolerant CAN transceiver to detect any of seven network faults. You can use your PCI-CAN/LS to connect to a low-speed CAN network having from two to 32 nodes as specified by Philips (including the port on the PCI-CAN/LS as a node). You can also use the PCI-CAN/LS to communicate with individual low-speed CAN devices. It is important to determine the overall termination of your existing network, or the termination of your individual device, before connecting it to a PCI-CAN/LS port. Philips recommends an overall RTH and RTL termination of 100 to 500 Ω (each) for a properly terminated low-speed network. The overall network termination may be determined as follows:

$$\frac{1}{R_{\text{RTH overall}^\dagger}} = \frac{1}{R_{\text{RTH node 1}}} + \frac{1}{R_{\text{RTH node 2}}} + \frac{1}{R_{\text{RTH node 3}}} + \frac{1}{R_{\text{RTH node n}}}$$

Philips also recommends an individual device RTH and RTL termination of 500 Ω to 16 kΩ. The PCI-CAN/LS board ships with mounted RTH and RTL values of 510 Ω ±5% per port. The PCI-CAN/LS kit also includes a pair of 15 kΩ ±5% resistors for each port. After determining the termination of your existing network or device, you can use the following formula to indicate which value should be placed on your PCI-CAN/LS board in order to produce the proper overall RTH and RTL termination of 100 to 500 Ω upon connection of the board:

$$R_{\text{RTH overall}^{*\dagger}} = \frac{1}{\left(\dfrac{1}{R_{\text{RTH of low-speed CAN interface}^{**}}} + \dfrac{1}{R_{\text{RTH of existing network or device}}}\right)}$$

*$R_{\text{RTH overall}}$ should be between 100 and 500 Ω

**$R_{\text{RTH of low-speed CAN interface}}$= 510 Ω ±5% (mounted) or 15 kΩ ±5% (in kit)

†$R_{\text{RTH}} = R_{\text{RTL}}$

As the formula indicates, the 510 Ω ±5% shipped on your board will work with properly terminated networks having a total RTH and RTL termination of 125 to 500 Ω, or individual devices having an RTH and RTL termination of 500 Ω to 16 kΩ. For communication with a network having an overall

RTH and RTL termination of 100 to 125 Ω, you will need to replace the 510 Ω resistors with the 15 kΩ resistors in the kit. Please refer to the next section, *Replacing the Termination Resistors on Your PCI-CAN/LS Board*.

The PCMCIA-CAN/LS cable ships with screw-terminal mounted RTH and RTL values of 510 Ω ±5% per port. The PCMCIA-CAN/LS cable also internally mounts a pair of 15.8 KΩ ±1% resistors in parallel with the external 510 Ω resistors for each port. This produces an effective RTH and RTL of 494 Ω per port for the PCMCIA-CAN/LS cable. After determining the termination of your existing network or device, you can use the formula below to indicate which configuration should be used on your PCMCIA-CAN/LS cable to produce the proper overall RTH and RTL termination of 100 to 500 Ω upon connection of the cable:

$$R_{\text{RTH overall}*\dagger} \; = \; \cfrac{1}{\left(\cfrac{1}{R_{\text{RTH of PCMCIA-CAN/LS}**}} + \cfrac{1}{R_{\text{RTH of existing network or device}}} \right)}$$

*$R_{\text{RTH overall}}$ should be between 100 and 500 Ω

**$R_{\text{RTH of PCMCIA-CAN/LS}}$ = 494 Ω (510 Ω ±5% (external) in parallel with 15.8 KΩ ±1% (internal)), or 15.8 KΩ ±1% (internal) only

†$R_{\text{RTH}} = R_{\text{RTL}}$

As the formula indicates, the 510 Ω ±5% in parallel with 15.8 KΩ ±1% shipped on your cable will work with properly terminated networks having a total RTH and RTL termination of 125 to 500 Ω, or individual devices having an RTH and RTL termination of 500 to 16 KΩ. For communication with a network having an overall RTH and RTL termination of 100 to 125 Ω, you will need to disconnect the 510 Ω resistors from the 7-pin pluggable screw terminal. This will make the RTH and RTL values of the PCMCIA-CAN/LS cable equal to the internal resistance of 15.8 KΩ ±1%. To produce RTH and RTL values between 494 Ω and 15.8 KΩ on the PCMCIA-CAN/LS cable, use the following formula:

$$R_{\text{External RTH of PCMCIA-CAN/LS}\dagger} \; = \; \cfrac{1}{\left(\cfrac{1}{R_{\text{Desired RTH of PCMCIA-CAN/LS}}} - \cfrac{1}{R_{\text{Internal RTH of PCMCIA-CAN/LS}***}} \right)}$$

***$R_{\text{Internal RTH of PCMCIA-CAN/LS}}$ = 15.8 KΩ ±1%

†$R_{\text{RTH}} = R_{\text{RTL}}$

For information on replacing the external RTH and RTL resistors on your PCMCIA-CAN/LS cable, refer to *Replacing the Termination Resistors on Your PCMCIA-CAN/LS Cable*.

Replacing the Termination Resistors on Your PCI-CAN/LS Board

Follow these steps to replace the termination resistors on your PCI-CAN/LS board, after you have determined the correct value in the section *Determining the Necessary Termination Resistance for Your Board*.

1. Remove the termination resistors on your low-speed CAN board. Figure C-6 shows the location of the termination resistor sockets on a PCI-CAN/LS2 board.

1 Port 1 Termination Resistors	2 Port 2 Termination Resistors
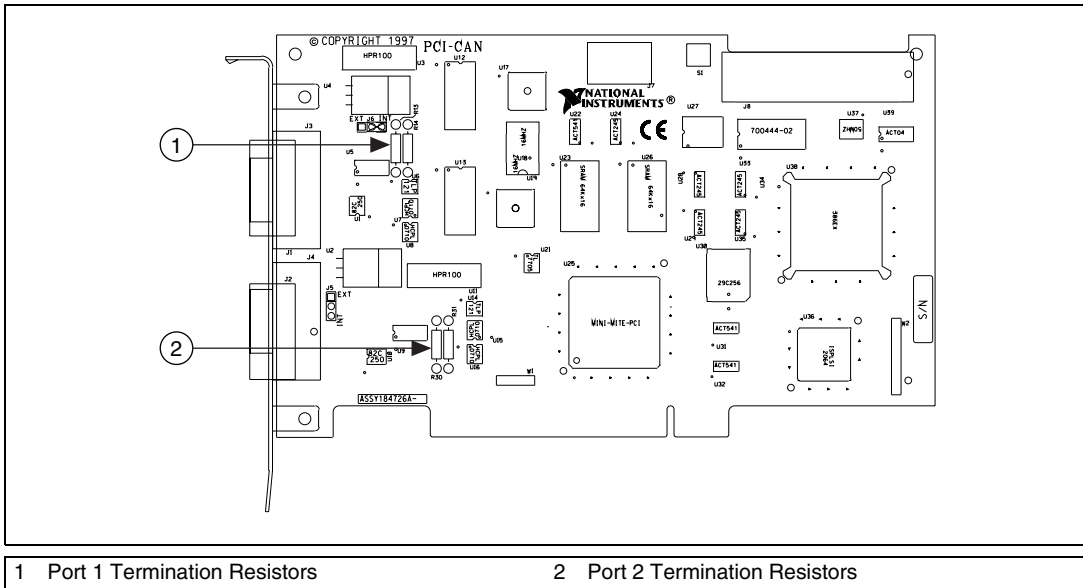
Figure C-6. Location of Termination Resistors on PCI-CAN/LS2 Board

2. Cut and bend the lead wires of the resistors you want to install. Refer to Figure C-7.
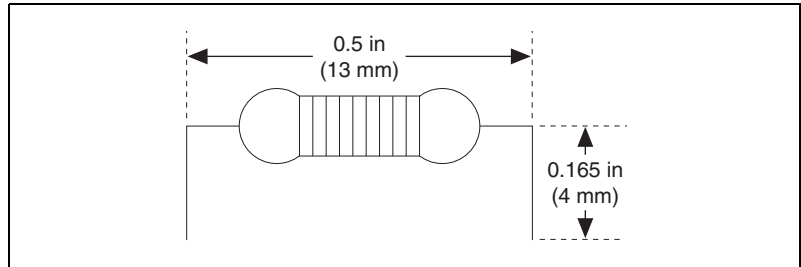
Figure C-7. Preparing Lead Wires of Replacement Resistors

3. Insert the replacement resistors into the empty sockets.

4. Refer to *Install the CAN Hardware*, in Chapter 2, *Installation and Configuration*, to complete the hardware installation.

Replacing the Termination Resistors on Your PCMCIA-CAN/LS Cable

Follow these steps to replace the termination resistors on your PCMCIA-CAN/LS cable after you have determined the correct value in the section *Determining the Necessary Termination Resistance for Your Board*.

1. Remove the two termination resistors on your PCMCIA-CAN/LS cable by loosening the pluggable terminal block mounting screws for pins 1 and 2 (RTL) and pins 6 and 7 (RTH).

2. Bend and cut the lead wires of the two resistors you want to install, as shown in the following figure.
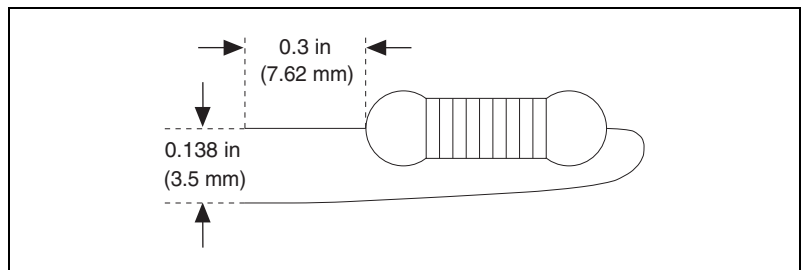
Figure C-8. Preparing Lead Wires of PCMCIA-CAN/LS Cable Replacement Resistors

3. Mount RTL by inserting the leads of one resistor into pins 1 and 2 of the pluggable terminal block and tightening the mounting screws. Mount RTH by inserting the leads of the second resistor into pins 6 and 7 of the pluggable terminal block and tightening the mounting screws.

4. Refer to *Install the CAN Hardware*, in Chapter 2, *Installation and Configuration*, to complete the hardware installation.

Cabling Example

Figure C-9 shows an example of a cable to connect two low-speed CAN devices. For the PCMCIA-CAN/LS cables, only V–, CAN_L, and CAN _H are required to be connected to the bus.
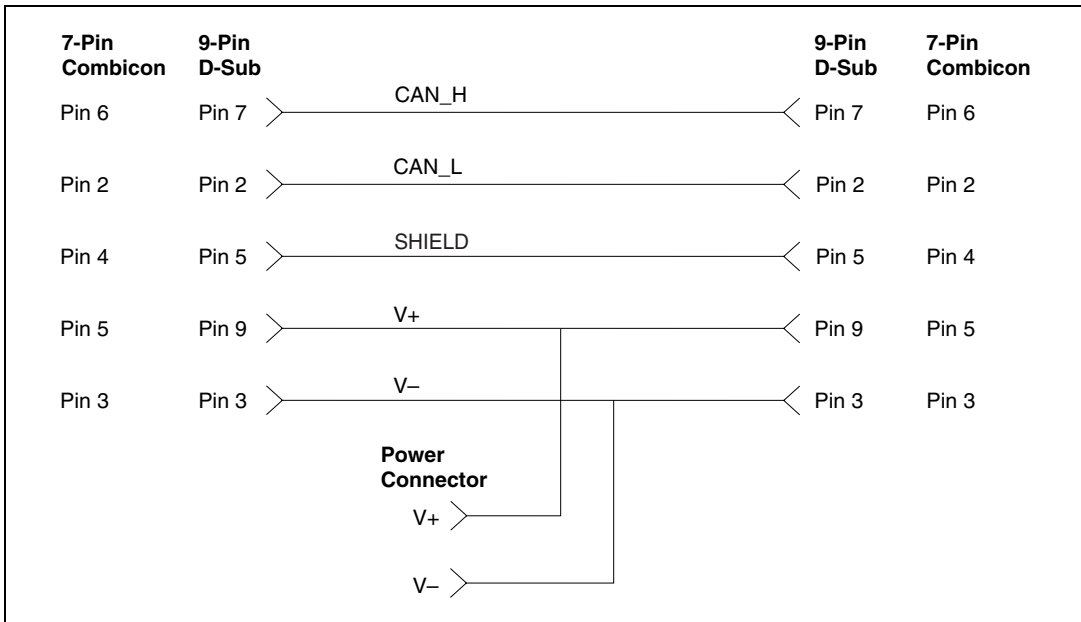
Figure C-9. Cabling Example

D

Cabling Requirements for Dual-Speed CAN

This section describes the cabling requirements for the dual-speed CAN hardware.

Port Identification

The PCI-CAN/DS board and PCMCIA-CAN/DS cable each provide a high-speed CAN port (port one), and a low-speed CAN port (port two). Port one of the PCI-CAN/DS is identical to port one of the PCI-CAN and PCI-CAN/2, and port two is identical to port two of the PCI-CAN/LS2. Port one of the PCMCIA-CAN/DS cable is identical to port one of the PCMCIA-CAN and PCMCIA-CAN/2 cables, and port two is identical to port two of the PCMCIA-CAN/LS2 cable. The PCI-CAN/DS board and PCMCIA-CAN/DS cable allow simultaneous communication with both a high-speed and low-speed bus, each with its own specific cabling and termination requirements. For cabling requirements and port information for the high-speed CAN port, please refer to Appendix B, *Cabling Requirements for High-Speed CAN*. For cabling requirements and port information for the low-speed CAN port, please refer to Appendix C, *Cabling Requirements for Low-Speed CAN*.

E

RTSI Bus

This appendix describes the RTSI interface on your CAN board.

Connector Pinouts

Figure F-1 shows the RTSI connector pinout for the AT-CAN series boards. Figure F-2 shows the RTSI connector pinout for the PCI-CAN series boards.

AT-CAN Series Trigger	AT-CAN Series Pin Number
RTSI Trigger <0>	15
RTSI Trigger <1>	13
RTSI Trigger <2>	11
RTSI Trigger <3>	9
RTSI Trigger <4>	7
RTSI Trigger <5>	5
RTSI Trigger <6>	3
RTSI Oscillator	1
GND	2, 4, 6, 8, 10, 12, 14
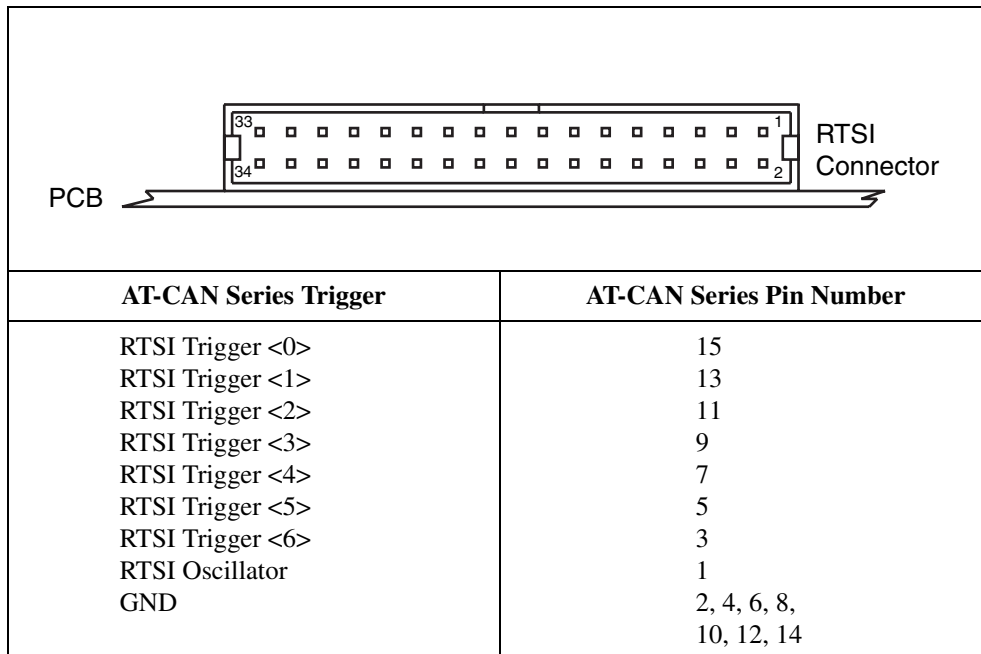
Figure E-1. AT-CAN Series RTSI Connector Pinout

PCI-CAN Series Trigger	PCI-CAN Series Pin Number
RTSI Trigger <0>	20
RTSI Trigger <1>	22
RTSI Trigger <2>	24
RTSI Trigger <3>	26
RTSI Trigger <4>	28
RTSI Trigger <5>	30
RTSI Trigger <6>	32
RTSI Oscillator	34
GND	19, 21, 23, 25, 27, 29, 31, 33
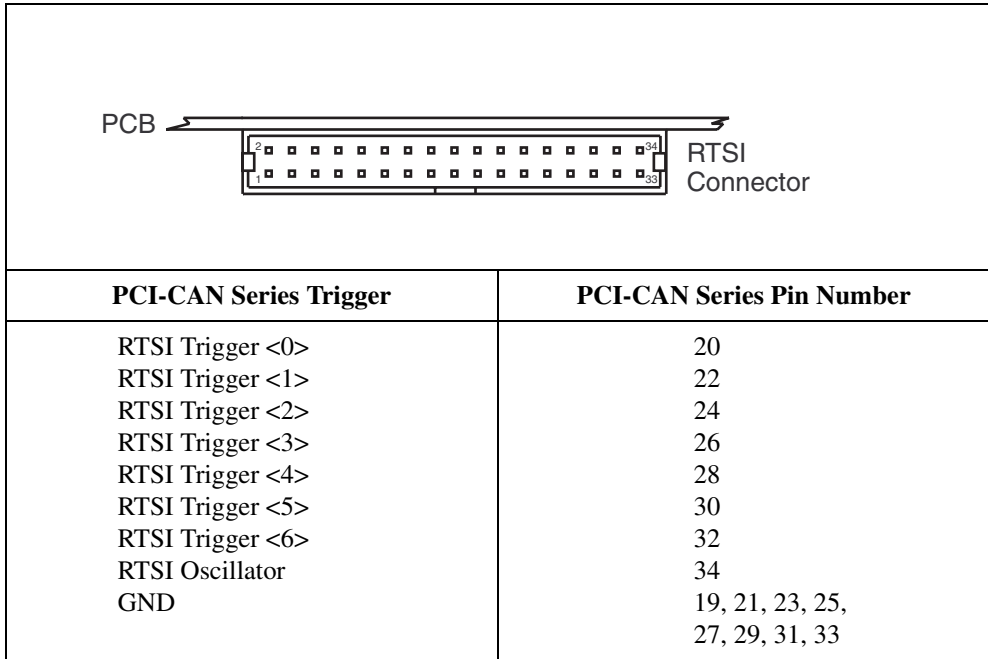
Figure E-2. PCI-CAN Series RTSI Connector Pinout

Using the National Instruments RTSI bus with your CAN board consists of connecting it to other RTSI-equipped boards with RTSI ribbon cable, to route timing and trigger signals between the boards.   Using the RTSI bus, your CAN board can be synchronized with multiple National Instruments DAQ boards in your computer. The RTSI bus can also be used to synchronize multiple CAN boards.

The AT-CAN, AT-CAN/2, PCI-CAN and PCI-CAN/2 boards allow for the connection of four RTSI input signals and four RTSI out put signals. In order to fully support the fault reporting capabilities of the low-speed transceivers used on the PCI-CAN/LS, PCI-CAN/LS2, and PCI-CAN/DS, three RTSI lines on those boards are reserved for low-speed CAN fault reporting. This allows for the connection of three RTSI input signals and two RTSI output signals to the boards, providing them the real time synchronization benefits of RTSI without sacrificing low-speed CAN fault reporting.

RTSI Cables

National Instruments offers a variety of RTSI bus cables for connecting your CAN board to other CAN or DAQ hardware. For more specific information about these cables, you can refer to the National Instruments catalog, or our Web site at ni.com, or call the office nearest you listed in the *Worldwide Offices* section at the beginning of this manual.

RTSI Programming

For more information on RTSI and RTSI programming, refer to the *NI-CAN User Manual* and the *NI-CAN Programmer Reference Manual*.

F

Troubleshooting and Common Questions

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

Missing CAN Interface in the NI-CAN Configuration Utility

The NI-CAN Configuration utility contains configuration information for all of the CAN hardware it is aware of that is installed in your system. To start the NI-CAN Configuration utility, double-click on the **NI-CAN Configuration** icon in the **Control Panel**:

*   Windows NT 3.51—Open the **Control Panel** in the **Main** group of the **Program Manager**.

*   Windows NT 4.0 or later—Select **Start»Settings»Control Panel**.

If the CAN interface you are looking for is not listed under **NI-CAN Configuration**, the CAN interface is not properly installed. For National Instruments CAN hardware, this means that the interface is not physically present in the system. If the interface is firmly plugged into its slot and the problem persists, contact National Instruments.

Diagnostic Utility Failures

The following sections explain common error messages generated by the NI-CAN Diagnostic utility.

Resource Errors

This error occurs if the memory resource or interrupt resource assigned to a CAN interface conflicts with the resources being used by other devices in the system. If a resource error occurs, click on the **Resources** button in the NI-CAN Configuration utility to view the board resources. For the

PCMCIA-CAN, change the conflicting resource shown in **Resources** until the interface passes the diagnostic test. For the PCI-CAN, if legacy boards in your system are using the resources, change the resource configuration of the legacy board. If the problem persists, contact National Instruments.

NI-CAN Software Problem Encountered

This error occurs if the NI-CAN Diagnostic utility detects that it is unable to communicate correctly with the CAN hardware using the installed NI-CAN software. If you get this error, shut down your computer, restart it, and run the NI-CAN Diagnostic utility again. If the problem persists, try reinstalling the NI-CAN software for Windows NT.

Missing CAN Interface in Diagnostic Utility

If a National Instruments CAN interface is physically installed in your system, but is not listed in the NI-CAN Diagnostic utility, check to see if the NI-CAN Configuration utility has detected the hardware. For more information, refer to the *Missing CAN Interface in the NI-CAN Configuration Utility* section earlier in this appendix.

CAN Hardware Problem Encountered

This error occurs if the NI-CAN Diagnostic utility detects a defect in the CAN hardware. If you get this error, write down the numeric code shown with the error, and contact National Instruments. Depending on the cause of the hardware failure, you may need to repair or replace your CAN interface.

Common Questions

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

Run the NI-CAN Configuration utility. To run the utility, select **Start»Settings»Control Panel»NI-CAN Configuration**. If any CAN hardware is correctly installed, it is listed under **National Instruments CAN Interfaces**.

How do I connect a CAN cable to my CAN interface?

For information about cabling requirements for National Instruments CAN hardware, refer to Appendix B, *Cabling Requirements for High-Speed CAN*. or Appendix C, *Cabling Requirements for Low-Speed CAN*.

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

Run the NI-CAN Diagnostic utility. To run the utility, select the **NI-CAN Diagnostic** item under **Start»Programs»National Instruments CAN**. The NI-CAN Diagnostic utility displays information about the version of the NI-CAN software currently installed.

What do I do if the NI-CAN Diagnostic utility fails with an error?

Refer to the *Diagnostic Utility Failures* section in this appendix for specific information about what might cause the NI-CAN Diagnostic utility to fail. If you have already completed the troubleshooting steps, contact National Instruments.

How many CAN boards can I configure for use with my NI-CAN software for Windows NT?

The NI-CAN software for Windows NT can be configured to communicate with up to 10 CAN boards.

Are interrupts required for the NI-CAN software for Windows NT?

Yes, one interrupt per board is required.

How do I use an NI-CAN language interface?

For information about using NI-CAN language interfaces, refer to Chapter 3, *Developing Your Application,* in the *NI-CAN User Manual*.

How do I use NI-CAN from within LabVIEW?

For information about using NI-CAN from within LabVIEW, refer to Chapter 3, *Developing Your Application,* in the *NI-CAN User Manual*.

Why does the uninstall program leave some components installed?

The uninstall program removes only items that the installation program installed. If you add anything to a directory that was created by the installation program, the uninstall program does not delete that directory, because the directory is not empty after the uninstallation. You must remove any remaining components yourself.

G

Specifications

This appendix describes the physical characteristics of the CAN hardware, along with the recommended operating conditions.

PCI-CAN Series

Dimensions.. 10.67 by 17.46 cm
(4.2 by 6.88 in.)

Power requirement .... +5 VDC, 775 mA typical

I/O connector.. 9-pin D-Sub for each port
(standard)
or
5-pin Combicon-style pluggable
DeviceNet screw terminal
(high-speed CAN only)

Operating environment

    Ambient temperature .... 0 to 55 °C

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

Storage environment

    Temperature .... −20 to 70 °C

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

PCMCIA-CAN Series

Dimensions ....8.56 by 5.40 by 0.5 cm
(3.4 by 2.1 by 0.4 in.)

Power requirement..................................500 mA typical

I/O connector ....Cable with 9-pin D-Sub and
pluggable screw terminal for
each port

Operating environment

Component temperature ....0 to 55 °C

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

Storage Environment

Temperature....................................–20 to 70 °C

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

High-Speed CAN Port Characteristics

Bus Power...0–30 V, 40 mA typical
100mA maximum

CAN-H, CAN-L ....–8 to +18V, DC or peak, CATI

Low-Speed CAN Port Characteristics

Bus Power...8–27 V, 40 mA typical
100 mA maximum

CAN-H, CAN-L ....–10 to +27V, DC or peak, CATI

H

Technical Support Resources

Web Support

National Instruments Web support is your first stop for help in solving installation, configuration, and application problems and questions. Online problem-solving and diagnostic resources include frequently asked questions, knowledge bases, product-specific troubleshooting wizards, manuals, drivers, software updates, and more. Web support is available through the Technical Support section of ni.com

NI Developer Zone

The NI Developer Zone at ni.com/zone is the essential resource for building measurement and automation systems. At the NI Developer Zone, you can easily access the latest example programs, system configurators, tutorials, technical news, as well as a community of developers ready to share their own techniques.

Customer Education

National Instruments provides a number of alternatives to satisfy your training needs, from self-paced tutorials, videos, and interactive CDs to instructor-led hands-on courses at locations around the world. Visit the Customer Education section of ni.com for online course schedules, syllabi, training centers, and class registration.

System Integration

If you have time constraints, limited in-house technical resources, or other dilemmas, you may prefer to employ consulting or system integration services. You can rely on the expertise available through our worldwide network of Alliance Program members. To find out more about our Alliance system integration solutions, visit the System Integration section of ni.com

Worldwide Support

National Instruments has offices located around the world to help address your support needs. You can access our branch office Web sites from the Worldwide Offices section of ni.com. Branch office Web sites provide up-to-date contact information, support phone numbers, e-mail addresses, and current events.

If you have searched the technical support resources on our Web site and still cannot find the answers you need, contact your local office or National Instruments corporate. Phone numbers for our worldwide offices are listed at the front of this manual.

Glossary

Prefix	Meaning	Value
n-	nano-	10^{-9}
m-	milli-	10^{-3}
c-	centi-	10^{-2}
k-	kilo-	10^3
M-	mega-	10^6

Symbols

°	degrees
Ω	ohms
%	percent

A

A	amperes
AC	alternating current
ANSI	American National Standards Institute
AT-compatible	compatible with the 16-bit Industry Standard Architecture

B

b	bits
B	bytes

C

C	Celsius
CAN	Controller Area Network

CAN/DS	Dual-speed CAN
CAN/LS	Low-speed CAN
CiA	CAN in Automation

D

DLL	dynamic link library
DMA	direct memory access

E

EMI	electromagnetic interference

F

FCC	Federal Communications Commission

H

Hz	hertz

I

IEEE	Institute of Electrical and Electronic Engineers
in.	inches
IRQ	interrupt request
ISA	Industry Standard Architecture
ISO	International Standards Organization

M

m	meters

P

PC	personal computer
PCI	peripheral component interconnect
PCMCIA	Personal Computer Memory Card International Association

R

RAM	random-access memory
resource	hardware settings used by National Instruments CAN hardware, including an interrupt request level (IRQ) and an 8 KB physical memory range (such as D0000 to D1FFF hex)
RTSI bus	Real-Time System Integration Bus. The National Instruments timing bus that connects CAN and DAQ boards directly, by means of connectors on top of the PCI-CAN and AT-CAN series boards, for precise synchronization of functions.

T

trigger	Any event that causes or starts some form of data capture.

S

s	seconds

V

V	volts
VDC	volts direct current

W

W	watts

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