DeviceNet

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

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FCC/DOC Radio Frequency Interference Class A 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. Classification requirements are the same for the Federal Communications Commission (FCC) and the Canadian Department of Communications (DOC). This equipment has been tested and found to comply with the following two regulatory agencies:

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

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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: *Interference to Home Electronic Entertainment Equipment Handbook*. This booklet is available from the U.S. Government Printing Office, Washington, DC 20402.

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

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

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About This Manual

This manual contains instructions to help you install and configure the National Instruments CAN hardware for DeviceNet and the NI-DNET software for Windows NT. The National Instruments CAN hardware for DeviceNet supported under Windows NT includes the PCI-CAN and the PCMCIA-CAN.

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

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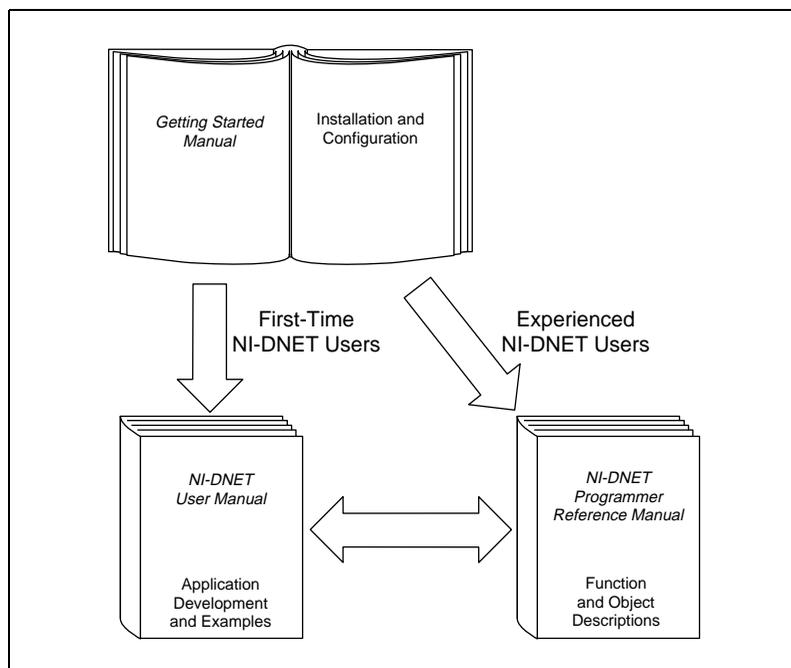
Use this getting started manual to install and configure your CAN hardware for DeviceNet and the NI-DNET software for Windows NT.

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

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

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, provides an overview of the CAN hardware for DeviceNet and the NI-DNET software for Windows NT, and describes optional equipment you can order.

- Chapter 2, *Installation*, describes how to install the NI-DNET software for Windows NT and the CAN hardware for DeviceNet.

- Chapter 3, *Verify the Installation*, describes how to verify the hardware and software installation and make changes to the configuration.

- Chapter 4, *Begin to Use the NI-DNET Software*, helps you get started with the NI-DNET software for Windows NT.

- Appendix A, *Uninstalling the Hardware and Software*, describes how to uninstall the CAN hardware for DeviceNet and the NI-DNET software for Windows NT.

- Appendix B, *Cabling Requirements*, describes the cabling requirements for the hardware.

- Appendix C, *Troubleshooting and Common Questions*, describes how to troubleshoot problems and answers some common questions.

- Appendix D, *Specifications*, describes the physical characteristics of the CAN hardware for DeviceNet and the recommended operating conditions.

- Appendix E, *Customer Communication*, contains forms you can use to request help from National Instruments or to comment on our products and manuals.

- The *Glossary* contains an alphabetical list and 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:

»	The » symbol leads you through nested menu items and dialog box options to a final action. The sequence **File»Page Setup»Options»Substitute Fonts** directs you to open the **File** menu, select the **Page Setup** item, select **Options**, and finally select the **Substitute Fonts** option from the last dialog box.
⚠	This icon to the left of bold italicized text denotes a caution, which advises you of precautions to take to avoid injury, data loss, or a system crash.
bold	Bold text denotes the names of menus, menu items, dialog boxes, dialog box buttons or options, icons, windows, Windows NT tabs, or LEDs.
bold italic	Bold italic text denotes a caution.
CAN hardware for DeviceNet	CAN hardware for DeviceNet refers to the PCI-CAN and PCMCIA-CAN in cases where the material applies to both cards.
italic	Italic text denotes emphasis, a cross reference, or an introduction to a key concept. This font also denotes text for which you supply the appropriate word or value, such as in Windows 3.*x*.
`monospace`	Text in this font denotes text or characters that you should literally enter from the keyboard, sections of code, programming examples, and syntax examples. This font is also used for the proper names of disk drives, paths, directories, programs, subprograms, subroutines, device names, functions, parameters, operations, variables, filenames, and extensions, and for statements and comments taken from program code.
`monospace italic`	Italic text in this font denotes that you must supply the appropriate words or values in the place of these items.
paths	Paths in this manual are denoted using backslashes (\) to separate drive names, directories, folders, and files.

Related Documentation

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

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

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

- *Microsoft Windows NT User's Guide*, Microsoft Corporation

- *PC Card Standard, Release 2.1*, Personal Computer Memory Card International Association (PCMCIA)

- *PCI Local Bus Specification*, Revision 2.0, PCI Special Interest Group

Customer Communication

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

1

Introduction

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

How to Use This Manual

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User Manual and                ▼
Programmer Reference  ┌─────────────────────────┐
Manual                │ Write Application Program│
                      └─────────────────────────┘
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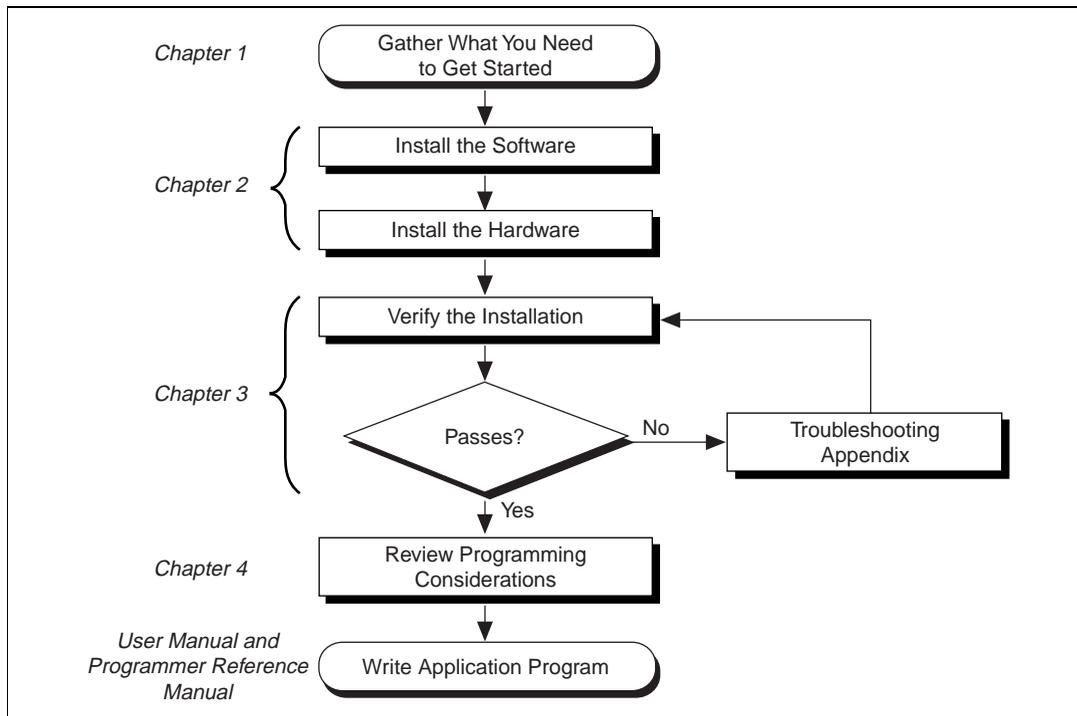
What You Need to Get Started

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

❑ Windows NT 3.51 or later installed on your computer

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

> PCI-CAN
> PCMCIA-CAN

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

NI-DNET Software for Windows 95/98 and Windows NT (Disk 1 of 3)
NI-DNET Software for Windows 95/98 and Windows NT (Disk 2 of 3)
NI-DNET Software for Windows 95/98 and Windows NT (Disk 3 of 3)

❑ PCMCIA-CAN bus-powered cable, which is included in your kit if you have a PCMCIA-CAN

❑ DeviceNet interface cables that meet the requirements in Appendix B, *Cabling Requirements*

DeviceNet Hardware Overview

The National Instruments CAN hardware for DeviceNet supported under Windows NT includes the PCI-CAN and PCMCIA-CAN.

The PCI-CAN is software configurable and compliant with the *PCI Local Bus Specification*. With a PCI-CAN, you can make your PC-compatible computer with PCI Local Bus slots communicate with and control DeviceNet devices.

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

The PCI-CAN or PCMCIA-CAN in your kit is fully compliant with the *DeviceNet Specification*.

The DeviceNet physical communication link protocol is based on the Controller Area Network (CAN) protocol. The physical layers of the

PCI-CAN and PCMCIA-CAN fully conform to the DeviceNet physical layer requirements. The physical layer is optically isolated to 500 volts and is powered from the DeviceNet bus power supply. DeviceNet interfacing is accomplished using the Intel 82527 CAN controller chip. For more information on the DeviceNet physical layer and cables used to connect to your DeviceNet devices, see Appendix B, *Cabling Requirements*.

The PCI-CAN is available with two physical connector types:

- Combicon-style pluggable screw terminals (as required by the *DeviceNet Specification*)

- DB-9 D-Sub (for non-DeviceNet applications)

The PCMCIA-CAN is shipped with a cable that is fully DeviceNet compliant. PCMCIA-CAN cards are also available with a cable that powers the CAN physical layer from the card.

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

NI-DNET Software Overview

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

The NI-DNET software for Windows NT supports the concurrent use of multiple National Instruments DeviceNet cards. For example, you can use both a PCI-CAN and PCMCIA-CAN in the same system at the same time. The NI-DNET software is fully integrated into the Windows NT operating system.

The NI-DNET software, along with the CAN hardware for DeviceNet, transforms your computer into a DeviceNet interface with complete communications and bus management capability. The NI-DNET software can act as a DeviceNet master in order to communicate with up to 63 slave devices. Communication capabilities include explicit messaging, polled I/O, strobed I/O, and change-of-state/cyclic I/O. The NI-DNET software can also act as a DeviceNet slave.

The NI-DNET software includes the following components:

- Firmware (runs on embedded Intel 386EX)

- Device driver

- Hardware Configuration utility

- Language interface libraries for Microsoft Visual C/C++ 2.0 or later, Borland C/C++ 5.0 or later, LabWindows/CVI 4.0 or later, and LabVIEW 4.0 or later

- Example programs that use NI-DNET functions

- WinDnet support files

The NI-DNET software components are described in more detail in Chapter 1, *Introduction*, of the *NI-DNET User Manual*.

Optional Programming Tools

Your kit includes the NI-DNET software for Windows NT. In addition, you can order the LabWindows/CVI, LabVIEW, BridgeVIEW, or Lookout software from National 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 hundreds of 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.

BridgeVIEW is a radical departure from traditional automation software that provides a flexible program development system for a variety of DeviceNet applications including general manufacturing, test, and control. Leveraging National Instruments' patented graphical programming language G (otherwise known as LabVIEW), BridgeVIEW gives you the ability to integrate functionality in a way that is not possible with traditional automation software. In addition to the programming advantages of G,

BridgeVIEW also provides a number of powerful features for the development of your industrial automation application: graphical HMI (Human Machine Interface); ease of use; fill-in-the-blank configuration utilities; HMI G Wizard for simplified HMI development; historical data collection and trending; alarm and event reporting and logging; security; and connectivity to PLCs and industrial device networks like DeviceNet.

Lookout is a software package that gives users an object-oriented, event-driven environment for building a variety of applications including HMI, large supervisory control and data acquisition (SCADA) applications, discrete manufacturing, batch applications, and telemetry systems. Lookout utilizes a graphical interface and requires no programming or scripting. Lookout's unique object-oriented approach increases productivity while reducing engineering design and maintenance costs. Unlike products that offer graphical user interfaces objects, Lookout is actually object-oriented in all aspects of system development. With Lookout, tasks such as driver setup, database configuration, historical logging, security management, and more are combined into a single, integrated system.

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

2

Installation

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

Install the NI-DNET Software

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

Installation for Windows NT 3.51

1. Log onto your Windows NT system using the Administrator
    account. The NI-DNET setup program must have Administrator
    privileges because the program modifies the configuration registry of
    your system.

2. Insert the *NI-DNET Software for Windows 95/98 and Windows NT
    (Disk 1 of 3)* into an unused drive.

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

    x:\setup

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

4. The software installation wizard begins with the screen shown in Figure 2-1.
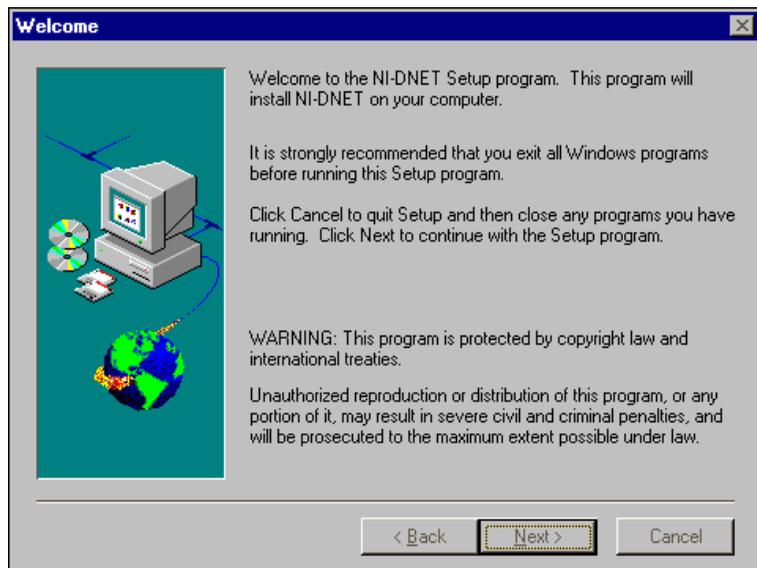
Figure 2-1. NI-DNET Software Setup Screen

The setup wizard guides you through the necessary steps to install the NI-DNET 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.

5. Shut down Windows NT and turn off your computer when you complete the setup.

6. Proceed to the next section, *Install the Hardware*.

Installation for Windows NT 4.0

1. Log onto your Windows NT system using the Administrator account. The NI-DNET 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 2-2 appears.

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

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

5. When prompted, insert the *NI-DNET Software for Windows 95/98 and Windows NT (Disk 1 of 3)*, and click on the **Next** button to proceed.

The software installation wizard begins with the screen shown in Figure 2-3.
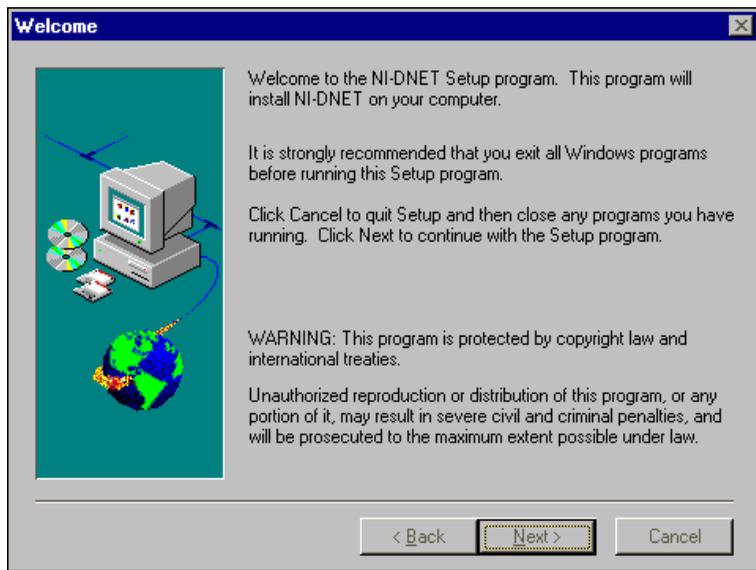
Figure 2-3. NI-DNET Software Setup Screen

The setup wizard guides you through the necessary steps to install the NI-DNET software. You may go back and change values where appropriate by clicking on the **Back** button. If at any time you want to exit the setup, click on the **Cancel** button.

6. Shut down Windows NT and turn off your computer when you complete the setup.

7. Proceed to the next section, *Install the Hardware*.

Install the Hardware

This section describes how to install your CAN hardware for DeviceNet.

Install Your PCI-CAN

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

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

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

3. Find an unused PCI expansion slot in your computer.

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

5. If you plan to use your PCI-CAN in a non DeviceNet-compliant system where bus power is not available, you need to configure the power supply jumpers. See Appendix B, *Cabling Requirements*, for more information.

6. Insert the PCI-CAN into the slot with the DeviceNet connector sticking out of the opening on the back panel. It might be a tight fit, but do not force the card into place. Figure 2-4 shows how to install the PCI-CAN into a PCI expansion slot.
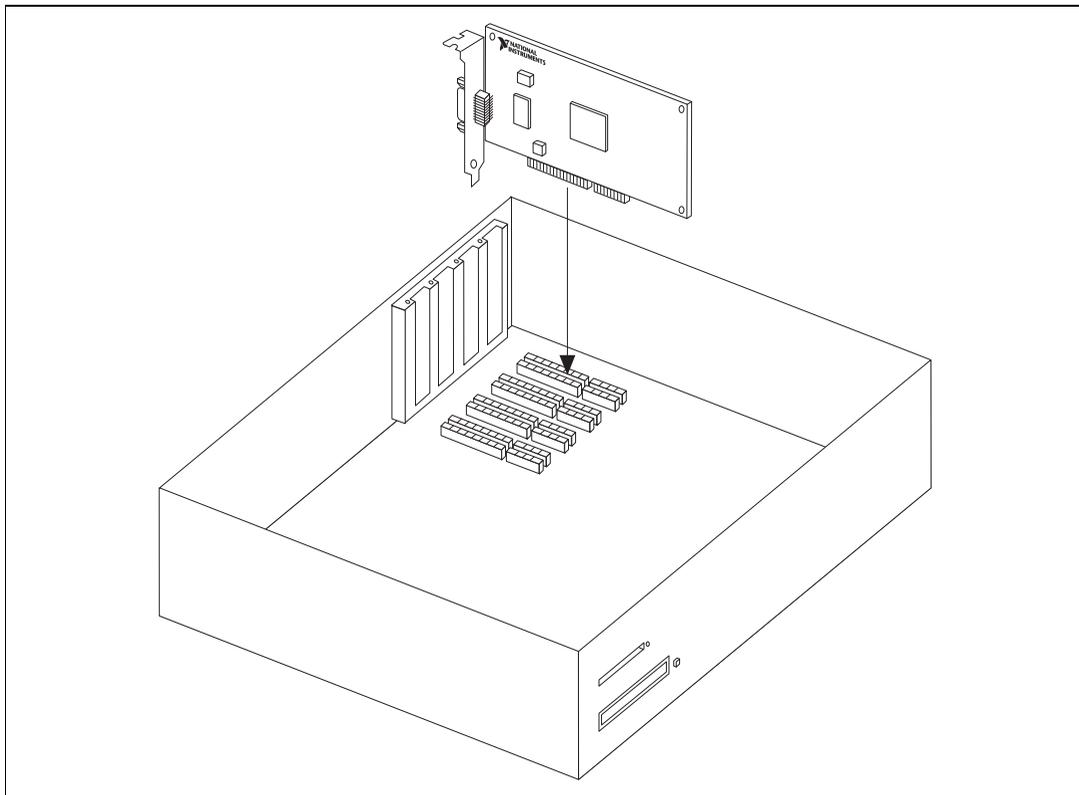
Figure 2-4. Installing the PCI-CAN

7. Screw the mounting bracket of the PCI-CAN to the back panel rail of the computer.

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

9. Turn on your computer and start Windows NT.

Connect the Cables

After you have installed your card, connect the DeviceNet cables to your PCI-CAN DeviceNet connector. Because exact cabling requirements vary for each application, National Instruments does not provide DeviceNet cables. Refer to Appendix B, *Cabling Requirements*, for information about the cabling requirements of the hardware.

The PCI-CAN installation is now complete. Proceed to Chapter 3, *Verify the Installation*, to verify that your hardware and software installed correctly.

Install Your PCMCIA-CAN

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

1. Shut down Windows NT and power off your computer.

2. Insert the PCMCIA-CAN into a free PC Card (PCMCIA) socket. The card has no jumpers or switches to set.

3. Connect the PCMCIA-CAN bus-powered cable to the card. Figure 2-5 shows how to insert the card and how to connect the PCMCIA-CAN bus-powered cable to the card.
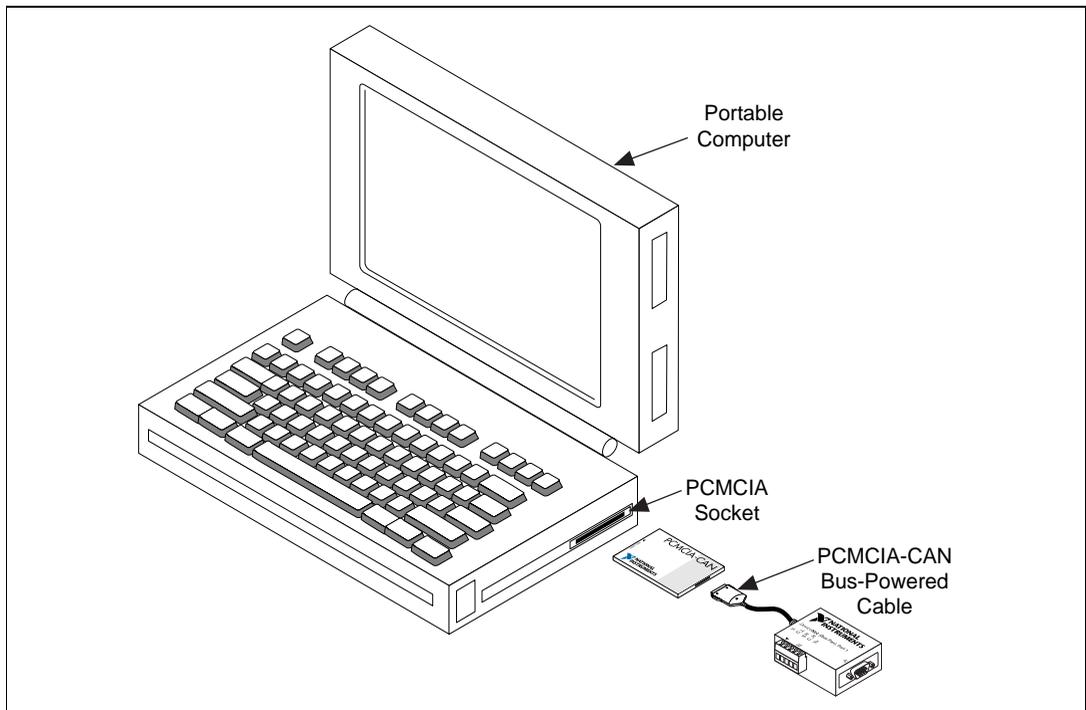
Figure 2-5. Inserting the PCMCIA-CAN

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 card, connect your DeviceNet cables to the PCMCIA-CAN bus-powered cable. Because exact cabling requirements vary for each application, National Instruments does not provide DeviceNet cables. Refer to Appendix B, *Cabling Requirements*, for information about the cabling requirements of the hardware.

The PCMCIA-CAN installation is now complete. Proceed to Chapter 3, *Verify the Installation*, to verify that your hardware and software installed correctly.

3

Verify the Installation

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

Run the NI-DNET Hardware Configuration Utility

You can use the NI-DNET Hardware Configuration utility, installed with your NI-DNET 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 hardware does not conflict with anything else in your system.

To use the NI-DNET Hardware Configuration utility, you must first log in as `Administrator` or as a user with Administrator privileges.

To run the Hardware Configuration utility under Windows NT 4.0, select the **Hardware Configuration** item under **Start»Programs»NI-DNET Software**.

To run the Hardware Configuration utility under Windows NT 3.51, select the **Hardware Configuration** item in the **NI-DNET Software** program group.

Verify Resources

When you install a PCI-CAN, your computer automatically assigns valid resources to it. Because this resource assignment is automatic, you can verify the installation immediately.

When you install a PCMCIA-CAN, your computer assigns default resources to it. Because the default resources may conflict with other hardware in your system, you must double-click on PCMCIA-CAN card's name, then use the **Resources** tab to select valid resources for

the PCMCIA-CAN. Figure 3-1 shows the **Resources** tab for the
PCMCIA-CAN.
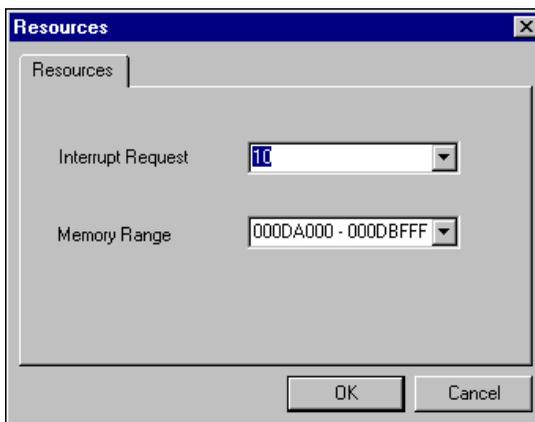
Figure 3-1. PCMCIA-CAN Resources Tab

If the PCMCIA-CAN resources do not conflict with other hardware in your
system, select **OK** and exit the NI-DNET Hardware Configuration utility.
If the PCMCIA-CAN resources are not valid, select valid resources and exit
the NI-DNET Hardware Configuration utility. After you verify
PCMCIA-CAN resources, you must restart Windows NT. You can then
restart the NI-DNET Hardware Configuration utility to proceed with
verifying the installation.

Test Installed DeviceNet Ports

The main listing of the NI-DNET Hardware Configuration utility displays
each installed PCI-CAN or PCMCIA-CAN card. If you have physically
installed your card but it is not listed in the NI-DNET Hardware
Configuration utility, refer to the *Missing Card in the NI-DNET Hardware
Configuration Utility* section in Appendix C, *Troubleshooting and
Common Questions*.

To view information about a card's physical DeviceNet ports, click on the
plus sign next to the card's name in the list. Since the NI-DNET software
supports only single port hardware, the utility displays **Port 1** for each card.

To run a hardware and software diagnostic test for all installed DeviceNet ports, select **Test All** from the **Test** menu. A progress bar displays the progression of the diagnostic test. When the diagnostic tests are complete, a checkmark next to a DeviceNet port indicates successful diagnostic testing, and an X indicates failure.

Figure 3-2 shows the NI-DNET Hardware Configuration utility after it has tested two cards.
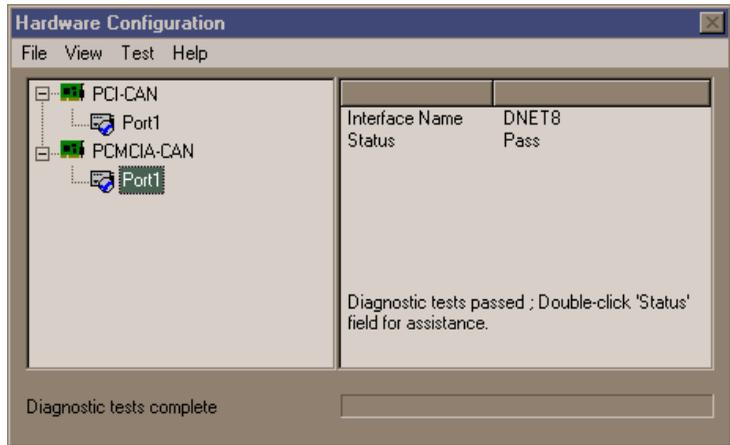
Figure 3-2. NI-DNET Hardware Configuration Utility after Testing

If each installed DeviceNet port is shown with a checkmark, you are ready to use the NI-DNET software. Select **Exit** from the **File** menu and proceed to Chapter 4, *Begin to Use the NI-DNET Software*.

If the diagnostic test fails for any port, you can see information on the failure by selecting the failed port name in the list then double-clicking on the **Status** field to the right. Use that help text and the information in Appendix C, *Troubleshooting and Common Questions*, to troubleshoot the problem.

After you have resolved a diagnostic failure for a particular DeviceNet port, you can test that port again by selecting it from the list then selecting **Test One** from the **Test** menu.

If you want to refresh the diagnostic status of all DeviceNet ports in order to run the diagnostic tests again, select **Refresh** from the **View** menu.

Changing an Interface Name

When you select a DeviceNet port in the list, the **Interface Name** for that port is shown to the right. This NI-DNET interface name is used within your application as a reference to the selected DeviceNet port. For a single card, the default NI-DNET interface name is **DNET0**.

If you want to change the NI-DNET interface name associated with a port, double-click on the port name. The resulting dialog box provides an **Interface Name** drop-down box you can use to select **DNET0**, **DNET1**, and so on. Changing the NI-DNET interface name is normally done only when you have multiple cards in your system. For example, if you have two PCI-CAN cards installed, you would normally assign one card as **DNET0** and the other as **DNET1**.

Figure 3-3 shows the dialog box used to change a port's NI-DNET interface name.
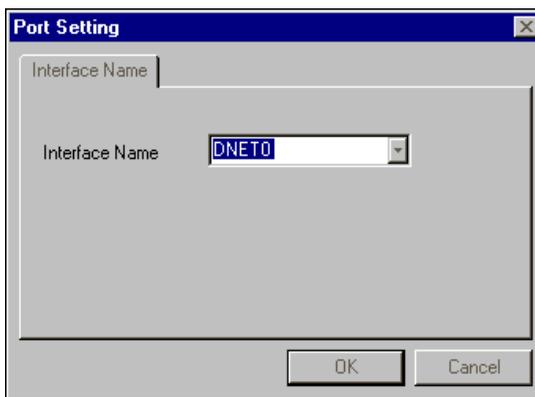
Figure 3-3. Interface Name Change Dialog Box

4

Begin to Use the NI-DNET Software

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

NI-DNET Application Example

The section introduces you to the NI-DNET software using SingleDevice, an example that accomplishes I/O communication as a DeviceNet master with a single slave device.

SingleDevice

This example accomplishes I/O communication as a DeviceNet master with a single slave device. You can use this example with any type of DeviceNet slave device. This example should be a starting point for you to learn to use the NI-DNET software.

The LabVIEW front panel for this example is shown in Figure 4-1. The LabWindows/CVI front panel is similar.
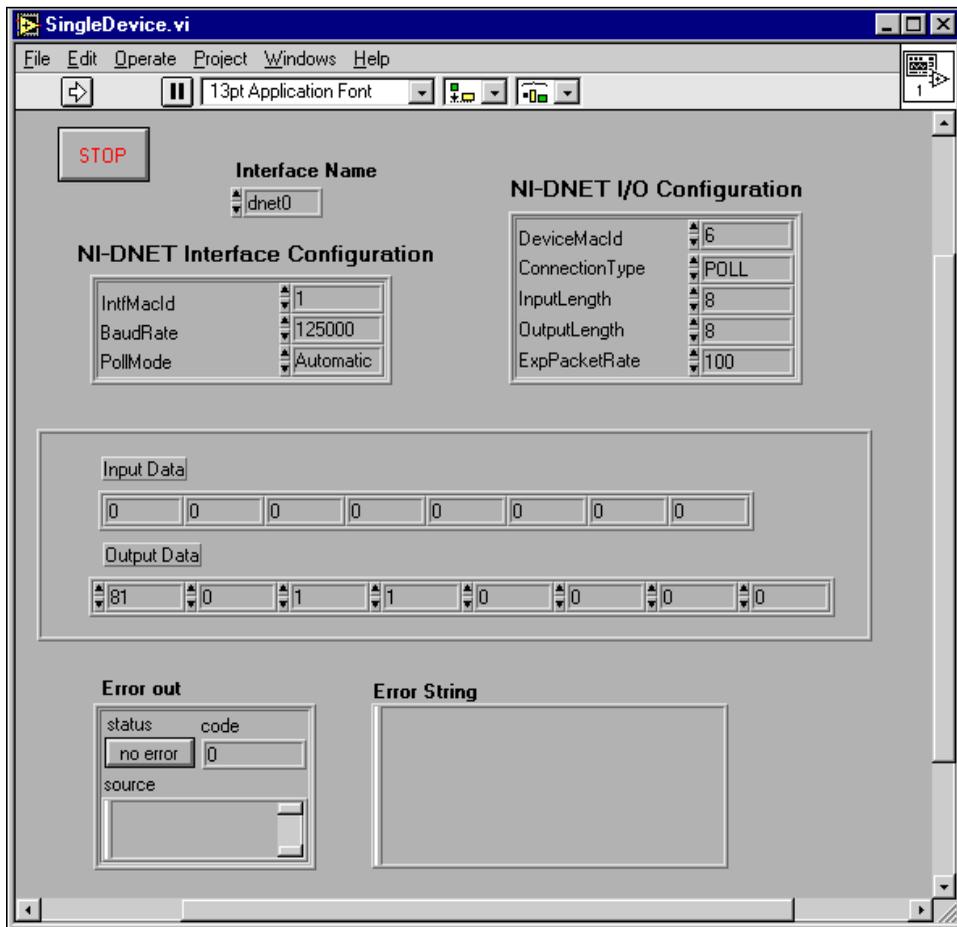
Figure 4-1. SingleDevice Front Panel

Run the Example

Follow these steps to run the example:

1. Connect a single DeviceNet slave device to your DeviceNet interface. For information on DeviceNet cabling, refer to Appendix B, *Cabling Requirements*.

2. Determine the baud rate and MAC ID used by your slave device.

   Many devices provide external switches for the MAC ID and baud rate. If this is the case, consult the documentation provided by your device's vendor.

If your device does not have baud rate and MAC ID external switches, the baud rate is often fixed at 125,000 (or determined by the device automatically), and the MAC ID is configured using a network management utility. For information on network management utilities, refer to Chapter 3, *NI-DNET Programming Techniques*, in the *NI-DNET User Manual*.

If you know the baud rate of your device but not the MAC ID, NI-DNET provides a utility used to tell you the MAC ID of each connected device (`SimpleWho`). For information on `SimpleWho`, refer to Chapter 3, *NI-DNET Programming Techniques*, in the *NI-DNET User Manual*.

3. Determine the type of I/O communication supported by your DeviceNet device. For example, most photoelectric sensors support strobed I/O with an input length of 1 byte. You need to know the I/O connection type (poll, strobe, and so on), number of input bytes, and number of output bytes.

   This information should be included in the documentation provided by your device's vendor. If not, you can use the `SimpleWho` utility mentioned in Step 2 to find the information.

4. Load `SingleDevice` into your programming environment.

   - LabVIEW or BridgeVIEW: Select **File»Open,** then find `SingleDevice.vi` in the LabVIEW or BridgeVIEW `Examples` directory.

   - LabWindows/CVI: Select **File»Open»Project,** then find `SingleDevice.prj` in the LabWindows/CVI `Samples` directory.

   - For other programming environments, such as Microsoft C/C++, you can open `SingleDevice.c` in the NI-DNET `Examples` directory. Since the steps needed to edit, compile, and run `SingleDevice.c` are specific to your programming environment, the following steps provide information only for LabVIEW, BridgeVIEW, or LabWindows/CVI.

5. Change the front panel controls to match the capabilities of your slave device.

   For LabVIEW or BridgeVIEW, you must change the front panel controls prior to running the example.

   For LabWindows/CVI, you must first run the example in order to access the front panel controls.

- **Interface Name**: This name selects the DeviceNet interface to use. If you only have one National Instruments DeviceNet card installed, the default `DNET0` is appropriate.

- **Interface MAC ID**: This selects the DeviceNet MAC ID to use for your National Instruments DeviceNet card (it does not refer to a device). If you do not know of an unused MAC ID in your network, a MAC ID of `0` is often acceptable.

- **Baud Rate**: This selects the baud rate used by your DeviceNet device. Enter the value you determined in Step 2.

- **Poll Mode**: Leave this control set to `Automatic`.

- **Device MAC ID**: This selects the MAC ID of your DeviceNet device. Enter the value you determined in Step 2.

- **Connection Type**: This selects the type of I/O connection to use with your DeviceNet device. Enter the value you determined in Step 3.

- **Input Length**: This selects the number of bytes to read from the device's I/O connection. Enter the value you determined in Step 3.

- **Output Length**: This selects the number of bytes to write to the device's I/O connection. Enter the value you determined in Step 3.

- **Exp Packet Rate**: This determines the rate of I/O communication. Since you set **Poll Mode** to `Automatic`, if you specified a **Connection Type** of `Strobe` or `Poll`, then this rate is determined automatically by NI-DNET, and the value in this control is ignored (you can leave it zero). If you specified a **Connection Type** of `COS`, set this control to `10000`. If you specified a **Connection Type** of `Cyclic`, set this control to `100`.

6. Start I/O communication.

    For LabVIEW or BridgeVIEW, click on the **Run** button (right arrow) on the LabVIEW/BridgeVIEW menu bar to run the example.

    For LabWindows/CVI, click on the **Start** button on the example's front panel.

    After you start I/O communication, you can view the slave's input bytes on the front panel **Input Data** indicators, and you can enter new output bytes using the front panel **Output Data** controls. You can use these input and output bytes to test and manipulate the physical capabilities of your slave device.

7. Stop the example.

   For LabVIEW or BridgeVIEW, click on the **Stop** button on the example's front panel. If needed, you can still view any errors or other information on the front panel.

   For LabWindows/CVI, click on the **Stop** button on the example's front panel. Although I/O communication has stopped, you can still view any errors or other information on the front panel. Click on the **Exit** button to close the front panel and exit back to the LabWindows/CVI environment.

Congratulations on completing your first DeviceNet application! For more information about the SingleDevice example, including a program flow chart for the example's source code, refer to Chapter 4, *Application Examples*, in the *NI-DNET User Manual*.

General Programming Considerations

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

- For your LabVIEW or BridgeVIEW application, you must use the NI-DNET LabVIEW functions. The NI-DNET functions can be added to your LabVIEW palettes by selecting **Edit»Select Palette Set»nidnet_view** from within LabVIEW.

- For LabWindows/CVI applications, you must use the NI-DNET function panels for LabWindows/CVI. These function panels can be used by selecting **Libraries»NI-DNET** from within LabWindows/CVI.

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

- Use the DeviceNet examples included with the NI-DNET software as a guide for your own application development.

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

A

Uninstalling the Hardware and Software

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

Uninstalling the Hardware from Windows NT

Because the current version of Windows NT does not maintain hardware information for the card, you just need to physically remove the card from your computer. To do so, shut down Windows NT, power off your computer, remove any cables attached to your card, and physically remove the card from your computer.

Uninstalling the NI-DNET Software from Windows NT

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

To uninstall the NI-DNET software for Windows NT, you must first log in as Administrator or as a user who has Administrator privileges.

Uninstalling for Windows NT 3.51

Complete the following steps to remove the NI-DNET software from Windows NT 3.51:

1. Open the program group **NI-DNET Software**.
2. Double-click on the **Uninstall** icon.

3. The uninstall program runs and removes all folders, utilities, device drivers, DLLs, and registry entries associated with the NI-DNET software. Figure A-1 shows the results of a successful uninstallation.
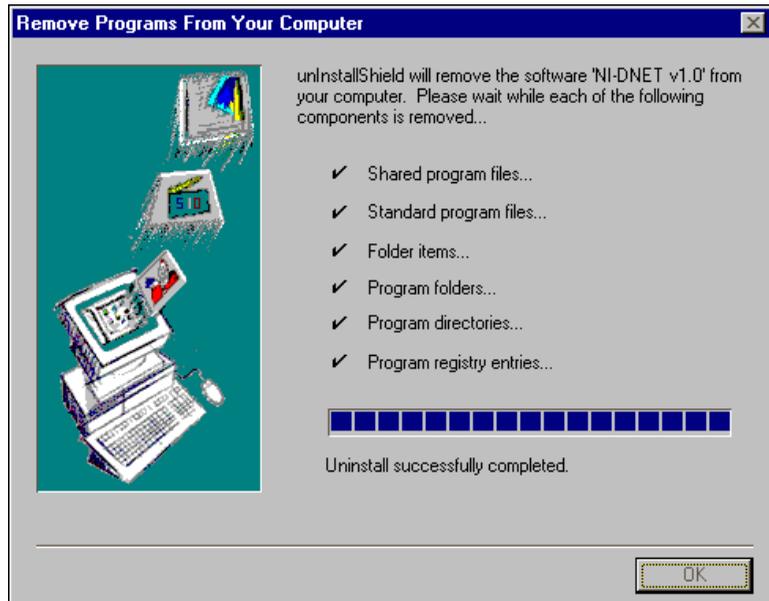
Figure A-1. NI-DNET Uninstallation Results

Uninstalling for Windows NT 4.0

Complete the following steps to remove the NI-DNET 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-2 appears. This dialog box lists the software available for removal.
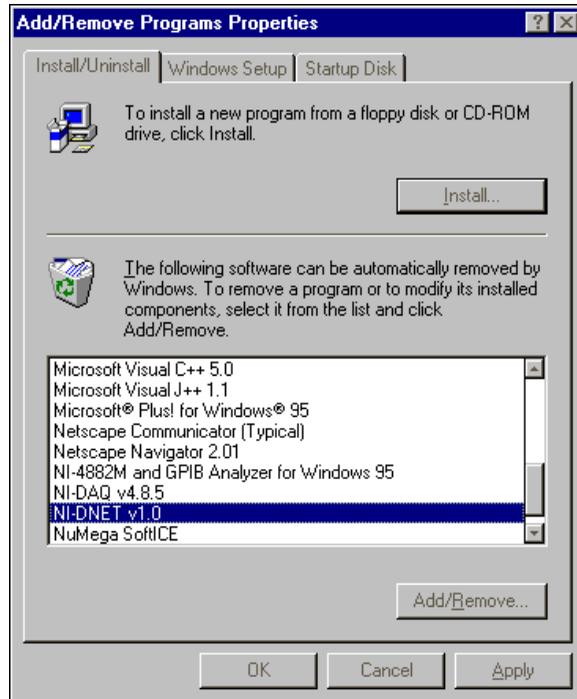
Figure A-2. Add/Remove Programs Properties Dialog Box

2. Select the NI-DNET 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-DNET software. Figure A-3 shows the results of a successful uninstallation.
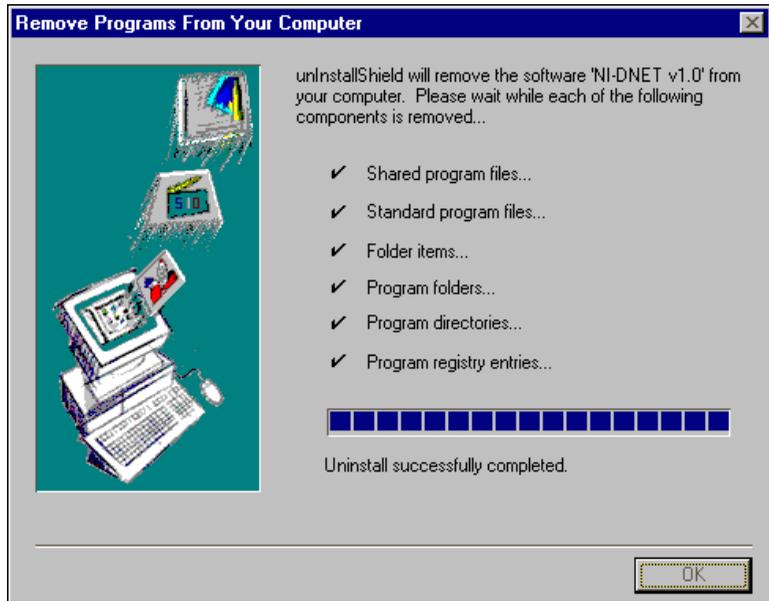
Figure A-3. NI-DNET Uninstallation Results

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*.

B

Cabling Requirements

This appendix describes the cabling requirements for the hardware.

Cables should be constructed to meet these requirements as well as the requirements of DeviceNet. DeviceNet cabling requirements can be found in the *DeviceNet Specification*.

Connector Pinouts

The PCI-CAN (Combicon) and the PCMCIA-CAN bus-powered cable each have a Combicon-style pluggable screw terminal connector. The PCMCIA-CAN bus-powered cable also has a DB-9 D-Sub connector.

The 5-pin Combicon-style pluggable screw terminal follows the pinout required by the *DeviceNet Specification*. Figure B-1 shows the pinout for this connector.
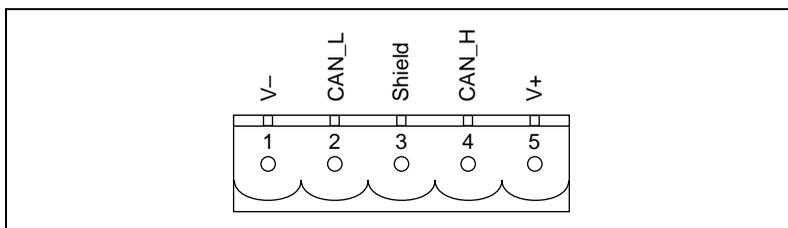
Figure B-1. Pinout for 5-Pin Combicon-Style Pluggable Screw Terminal

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

For the PCI-CAN and the PCMCIA-CAN bus-powered cable, V+ and V– supply power to the DeviceNet physical layer. See the next section, *Power Supply Information for the DeviceNet Ports*, for more information.

Figure B-2 shows the end of a PCMCIA-CAN bus-powered 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 following the pinout in Figure B-3.
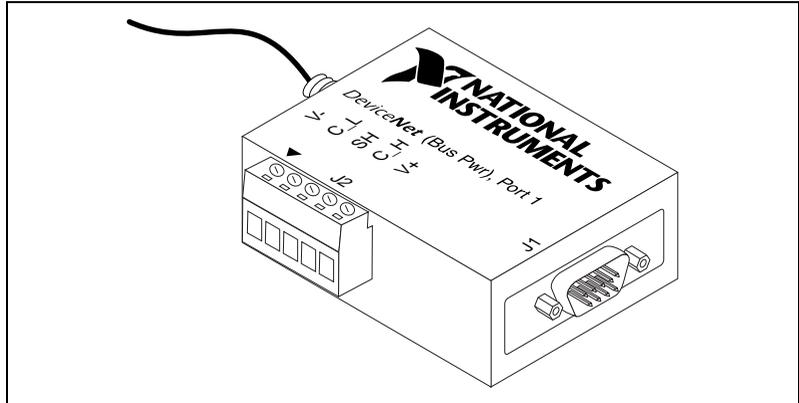
Figure B-2. PCMCIA-CAN Bus-Powered Cable

The 9-pin D-Sub follows the pinout recommended by CiA Draft Standard 102. Figure B-3 shows the pinout for this connector.
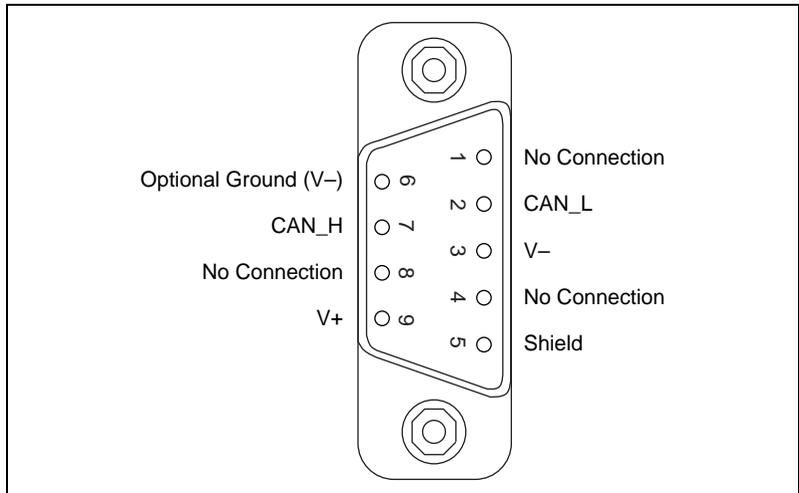
Figure B-3. Pinout for 9-Pin D-Sub Connector

Power Supply Information for the DeviceNet Ports

For the PCI-CAN and the PCMCIA-CAN bus-powered cable, the bus must supply power to each DeviceNet port. The bus power supply should be a DC power supply with an output of 10 V to 30 V. The DeviceNet physical layer is powered from the bus using the V+ and V− lines.

The power requirements for the DeviceNet port are shown in Table B-1. You should take these requirements into account when determining the requirements of the bus power supply for the system.

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

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

For the PCI-CAN, a jumper controls the source of power for the DeviceNet physical layer. The location of this jumper is shown in Figure B-4.

1	Power Supply Jumper J6	3	Serial Number
2	Product Name	4	Assembly Number
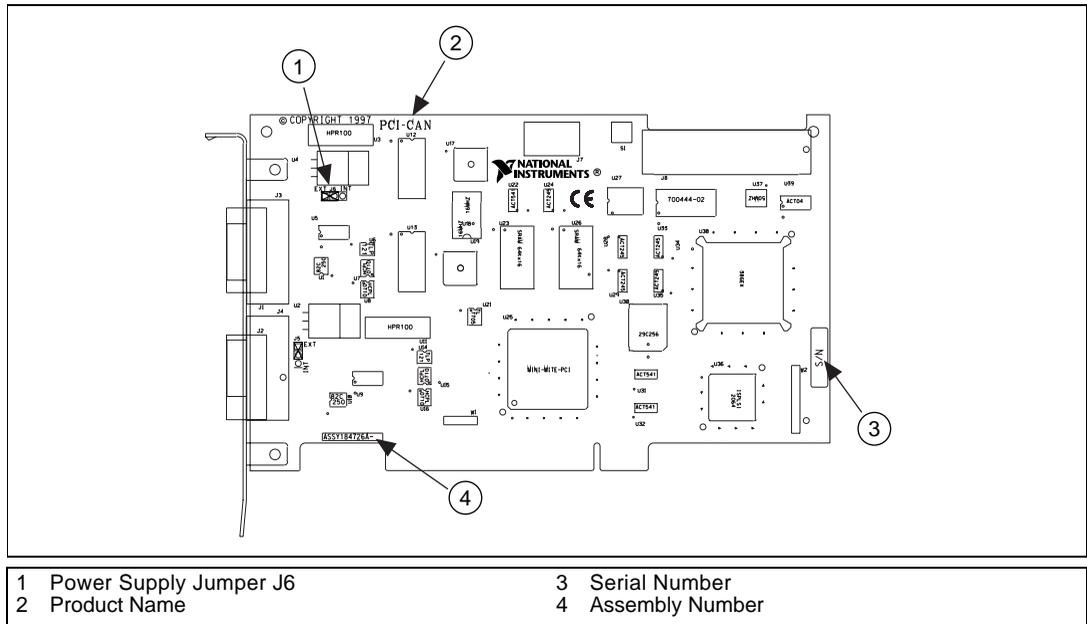
Figure B-4. PCI-CAN Power Source Jumper

The PCI-CAN is shipped with this jumper set in the EXT position. In this position, the physical layer is powered from the bus (the V+ and V– pins on the Combicon connector). The jumper must be in this position for the DeviceNet interface to be compliant with the *DeviceNet Specification*.

If the DeviceNet interface is being used in a system where bus power is not available, the jumper may be set in the INT position. In this position, the physical layer is powered by the host computer or internally. The physical layer is still optically isolated. Figure B-5 shows how to configure your jumpers for internal or external power supplies.
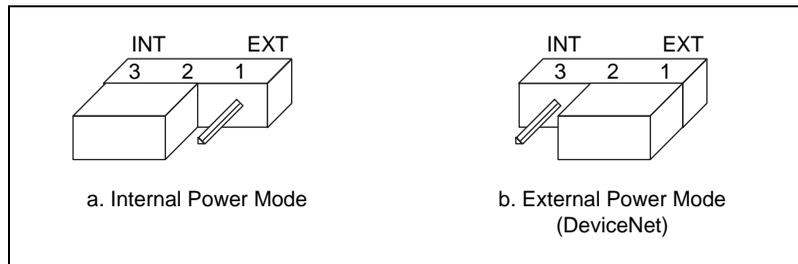
Figure B-5. Power Source Jumpers

The PCMCIA-CAN is shipped with the bus power version of the PCMCIA-CAN cable. An internally-powered version of the PCMCIA-CAN cable can be ordered from National Instruments.

Cable Specifications

Cables should meet the requirements of the DeviceNet cable specification. DeviceNet cabling requirements can be found in the *DeviceNet Specification*.

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

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 *DeviceNet Specification*.

Table B-2 lists the DeviceNet cable length specifications.

Table B-2. DeviceNet Cable Length Specifications

Baud Rate	Trunk Length	Drop Length Maximum	Drop Length Cumulative
500 kb/s	100 m (328 ft.)	6 m (20 ft.)	39 m (128 ft.)
250 kb/s	250 m (820 ft.)	6 m (20 ft.)	78 m (256 ft.)
125 kb/s	500 m (1640 ft.)	6 m (20 ft.)	156 m (512 ft.)

Maximum Number of Devices

The maximum number of devices that you can connect to a DeviceNet port depends on the electrical characteristics of the devices on the network. 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 DeviceNet bus, DeviceNet 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.
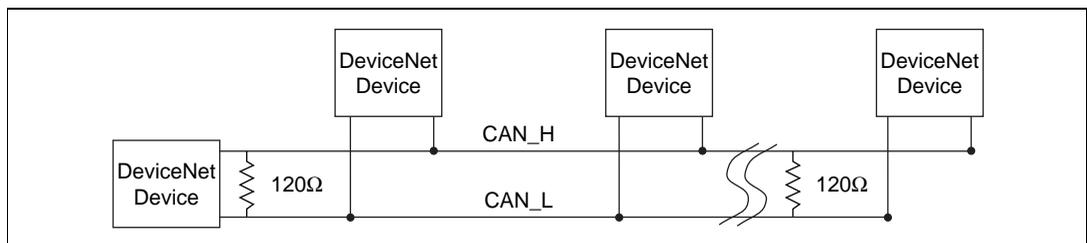
Figure B-6. Termination Resistor Placement

The termination resistors on a cable should match the nominal impedance of the cable. DeviceNet 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 each be capable of dissipating at least 0.25 W of power.

Cabling Example

Figure B-7 shows an example of a cable to connect two DeviceNet devices.
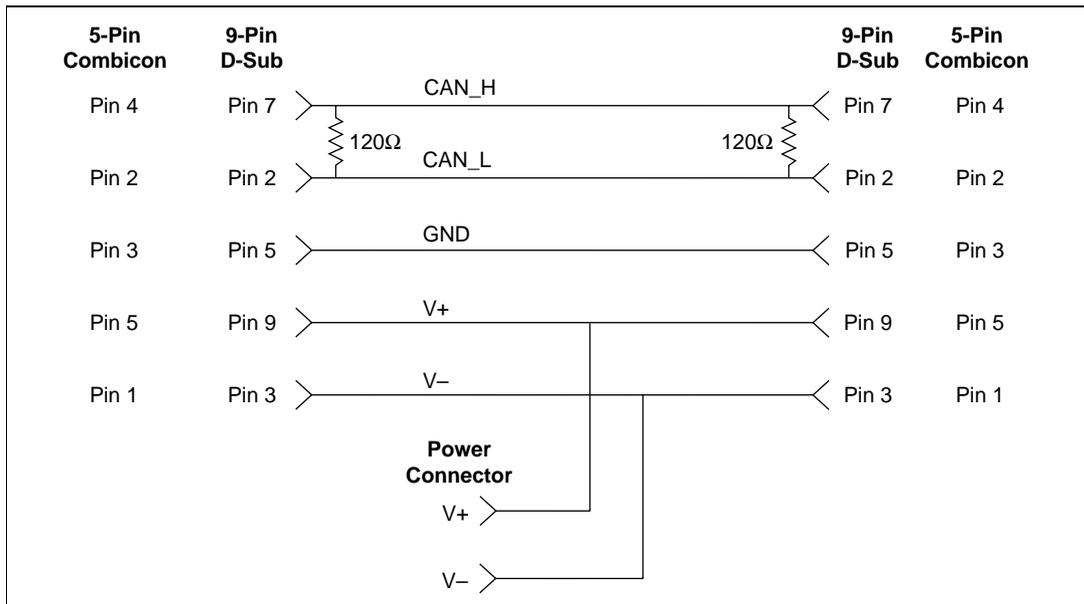
Figure B-7. Cabling Example

C

Troubleshooting and Common Questions

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

Hardware Configuration Utility Failures

The following sections explain common error messages generated by the NI-DNET Hardware Configuration utility.

Resource Error

This error occurs if the memory resource or interrupt resource assigned to a card conflicts with the resources being used by other hardware in the system. If a resource error occurs, double-click on the card name in the NI-DNET Hardware Configuration utility to view the resources. For the PCMCIA-CAN, change the conflicting resource shown in **Resources** until the card passes the diagnostic test. For the PCI-CAN, if legacy hardware in your system is using the resources, change the resource configuration of the legacy hardware (if you need help, refer to the documentation that came with your hardware). After you select valid resources, you must exit the Hardware Configuration utility and restart Windows NT for the changes to take effect. If the problem persists, contact National Instruments.

NI-DNET Software Problem Encountered

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

Missing Card in the NI-DNET Hardware Configuration Utility

If your card is not listed in the NI-DNET Hardware Configuration utility, the card is not properly installed. For CAN hardware for DeviceNet, this means that your card is not physically present in the system. If your card is

firmly plugged into its slot and the problem persists, contact National
Instruments.

Hardware Problem Encountered

This error occurs if the NI-DNET Hardware Configuration utility detects a
defect in the 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 card.

Common Questions

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

Run the NI-DNET Hardware Configuration utility. To run the utility, select
the **Hardware Configuration** item under **Start»Programs»NI-DNET
Software**, and select the **About** item under the **Help** menu. The NI-DNET
utility displays information about the version of the NI-DNET software
currently installed.

**Which CAN hardware for DeviceNet does the NI-DNET software for
Windows NT support?**

The NI-DNET software for Windows NT supports the PCI-CAN and
PCMCIA-CAN. Although the PCI-CAN/2 works with NI-DNET, only
port 1 can be used. Port 2 cannot be used with NI-DNET.

Does NI-DNET support two-port CAN cards?

No. Refer to the previous question.

**How many cards can I configure for use with my NI-DNET software
for Windows NT?**

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

How do I connect a DeviceNet device to my DeviceNet port?

You need a DeviceNet-compliant cable. For information about cabling
requirements for National Instruments DeviceNet ports, refer to
Appendix B, *Cabling Requirements*.

What do I do if the NI-DNET Hardware Configuration utility test fails with an error?

Refer to the *Hardware Configuration Utility Failures* section in this appendix for specific information about what might cause the NI-DNET Hardware Configuration utility to fail. If you have already completed the troubleshooting steps, fill out the forms in Appendix E, *Customer Communication*, and contact National Instruments.

Are interrupts required for the CAN hardware for DeviceNet?

Yes, one interrupt per card is required. You can set interrupts using the **Resources** tab of the Hardware Configuration utility.

How do I use NI-DNET within my programming environment?

For information about using NI-DNET from within LabVIEW, BridgeVIEW, LabWindows/CVI, Microsoft C, and other programming environments, refer to the *NI-DNET 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.

How can I monitor low-level CAN messages on a DeviceNet network?

You can use your CAN hardware for DeviceNet with National Instruments NI-CAN software. The NI-CAN software is suited to general purpose CAN applications, such as automotive tests, and can receive all CAN messages on a DeviceNet network. Using NI-CAN for this purpose generally requires a detailed knowledge of the *DeviceNet Specification*. For more information on NI-CAN, refer to the README.TXT file in your NI-DNET installation directory.

What is NI-CAN?

NI-CAN is National Instruments software for general-purpose access to Controller Area Network (CAN). CAN is the underlying communications protocol used by DeviceNet. Unless you have a detailed knowledge of the *DeviceNet Specification* and you need to implement portions of that specification within your application, NI-DNET is the preferable method

for accessing a DeviceNet network. For more information on NI-CAN, refer to the `README.TXT` file in your NI-DNET installation directory.

What information should I have before I call National Instruments?

When you call National Instruments, you should have all of the information filled out on the *Hardware and Software Configuration Form* in Appendix E, *Customer Communication*.

D

Specifications

This appendix describes the physical characteristics of the CAN hardware for DeviceNet and the recommended operating conditions.

Table D-1. PCI-CAN Characteristics

Characteristic	Specification
Dimensions	10.67 by 17.46 cm (4.2 by 6.88 in.)
Power Requirement	+5 VDC 775 mA typical
I/O Connector	5-pin Combicon-style pluggable DeviceNet screw terminal

Operating Environment
    Ambient Temperature
    Relative Humidity
	0° to 55° C
	10% to 90%, noncondensing

Storage Environment
    Temperature
    Relative Humidity
	–20° to 70° C
	5% to 90%, noncondensing

EMI	FCC Class A Verified

Table D-2. PCMCIA-CAN Characteristics

Characteristic	Specification
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 5-pin Combicon-style pluggable screw terminal for each port

Operating Environment
    Component Temperature
    Relative Humidity
	
	0° to 55° C
	10% to 90%, noncondensing

Storage Environment
    Temperature
    Relative Humidity
	
	–20° to 70° C
	5% to 90%, noncondensing

EMI	FCC Class A Verified

Table D-3. DeviceNet Port Characteristics for Bus-Powered Ports

Characteristic	Specification
Power Requirement	10 to 30 V 40 mA typical 100 mA maximum
Isolation	500 VDC optical

E

Customer Communication

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

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

Electronic Services

Bulletin Board Support

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

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

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

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

FTP Support

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

Fax-on-Demand Support

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

E-Mail Support (Currently USA Only)

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

`support@natinst.com`

Telephone and Fax Support

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

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

Technical Support Form

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

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

Name _____

Company _____

Address _____

_____

Fax (___) _____Phone (___) _____

Computer brand _____ Model _____Processor_____

Operating system (include version number) _____

Clock speed _____MHz RAM _____MB   Display adapter _____

Mouse ___yes   ___no   Other adapters installed _____

Hard disk capacity _____MB Brand _____

Instruments used _____

_____

National Instruments hardware product model _____ Revision _____

Configuration _____

National Instruments software product _____ Version _____

Configuration _____

The problem is: _____

_____

_____

_____

_____

List any error messages: _____

_____

_____

The following steps reproduce the problem: _____

_____

_____

_____

_____

Hardware and Software Configuration Form

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

National Instruments Products

Information from NI-DNET Hardware Configuration Utility

Hardware type (such as PCI-CAN) _____

Diagnostic Status _____

Resources: Interrupt Request _____ Memory Range _____

Serial Number _____

Hardware Revision _____

NI-DNET Software Version (**Help»About**) _____

Other Products

Programming Environment Information

Programming Language _____

Compiler Vendor _____

Compiler Version _____

Application Information

LabVIEW, BridgeVIEW, LabWindows/CVI Application _____

Win32 Application _____

If Win 32, method of accessing DLL (link with language interface or direct entry?) _____

_____

Documentation Comment Form

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

Title: *Getting Started with Your CAN Hardware for DeviceNet and the NI-DNET™ Software for Windows NT*

Edition Date: April 1998

Part Number: 321865A-01

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

_____

_____

_____

_____

_____

_____

_____

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

_____

_____

_____

_____

_____

_____

_____

Thank you for your help.

Name _____

Title _____

Company _____

Address _____

_____

E-Mail Address _____

Phone (___) _____ Fax (___) _____

Mail to: Technical Publications
National Instruments Corporation
6504 Bridge Point Parkway
Austin, Texas 78730-5039

Fax to: Technical Publications
National Instruments Corporation
512 794 5678

Glossary

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

°	degrees
Ω	ohms
%	percent
A	amperes
ANSI	American National Standards Institute
applet	program that can only be used within another application
b	bits
B	bytes
C	Celsius
CAN	Controller Area Network
change-of-state I/O	Master/slave I/O connection which is similar to cyclic I/O, but data can be sent when a change in the data is detected
CiA	CAN in Automation
cyclic I/O	Master/slave I/O connection in which the slave (or master) sends data at a fixed interval
DC	direct current
DLL	dynamic link library
EMI	electromagnetic interference
explicit messaging connection	General-purpose connection used for executing services on a particular object in a DeviceNet device

FCC	Federal Communications Commission
ft.	feet
HMI	human-machine interface
Hz	hertz
IEEE	Institute of Electrical and Electronic Engineers
in.	inches
I/O	input/output
m	meters
MAC ID	Media Access Control Layer Identifier
master/slave	DeviceNet communication scheme in which a master device allocates connections to one or more slave devices, and those slave devices can only communicate with the master and not one another
PC	personal computer
PCI	peripheral component interconnect
PCMCIA	Personal Computer Memory Card International Association
PLC	Programmable Logic Control
polled I/O	Master/slave I/O connection in which the master sends a poll command to a slave, then receives a poll response from that slave
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)
s	seconds
SCADA	supervisory control and data acquisition
strobed I/O	Master/slave I/O connection in which the master broadcasts a single strobe command to all strobed slaves then receives a strobe response from each strobed slave
V	volts
VDC	volts direct current

| VXI | VME eXtensions for Instrumentation (bus) |
| W | watts |