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PCI-CAN

DeviceNet

Getting Started with Your CAN Hardware for DeviceNet and the NI-DNET™ Software for Windows 95/98

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Federal Communications Commission

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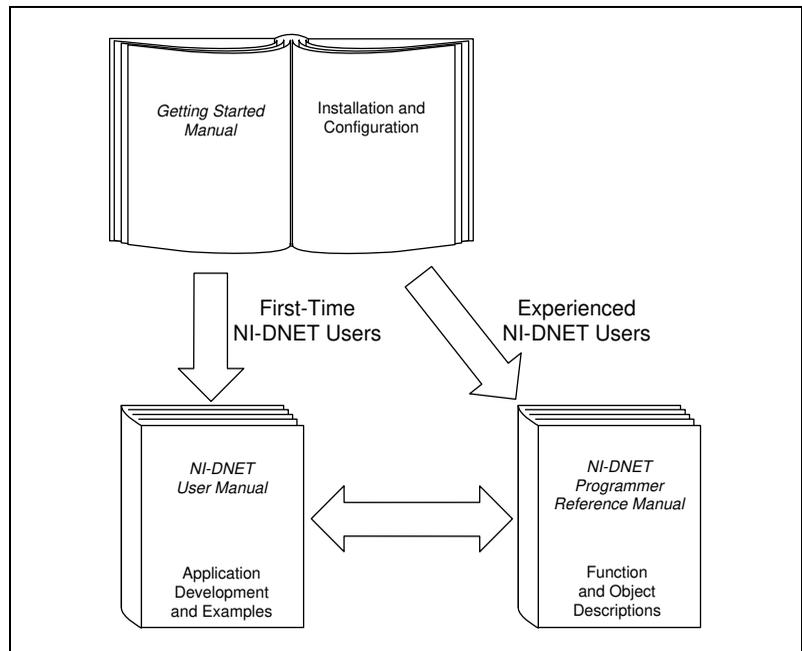
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About This Manual

This manual contains instructions to help you install and configure the National Instruments CAN hardware for DeviceNet and the NI-DNET software for Windows 95/98. The National Instruments CAN hardware for DeviceNet supported under Windows 95/98 includes the AT-CAN, PCI-CAN, and PCMCIA-CAN.

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

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 95/98.

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 95/98, and describes optional equipment you can order.
- Chapter 2, *Installation*, describes how to install the NI-DNET software for Windows 95/98 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 95/98.
- Appendix A, *Uninstalling the Hardware and Software*, describes how to uninstall the CAN hardware for DeviceNet and the NI-DNET software for Windows 95/98.
- Appendix B, *Cabling Requirements*, describes the cabling requirements for the CAN hardware for DeviceNet.
- 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 95/98 tabs, or LEDs.
<i>bold italic</i>	Bold italic text denotes a caution.
CAN hardware for DeviceNet	CAN hardware for DeviceNet refers to the AT-CAN, PCI-CAN, and PCMCIA-CAN in cases where the material applies to all the cards.
<i>italic</i>	Italic text denotes emphasis, a cross reference, or an introduction to a key concept.
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.
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 95/98 User's Guide*, Microsoft Corporation

- *PC Card Standard, Release 2.1*, Personal Computer Memory Card International
- *PCI Local Bus Specification, Revision 2.0*, PCI Special Interest Group
- *Plug and Play ISA Specification*, Intel Corporation and Microsoft Corporation

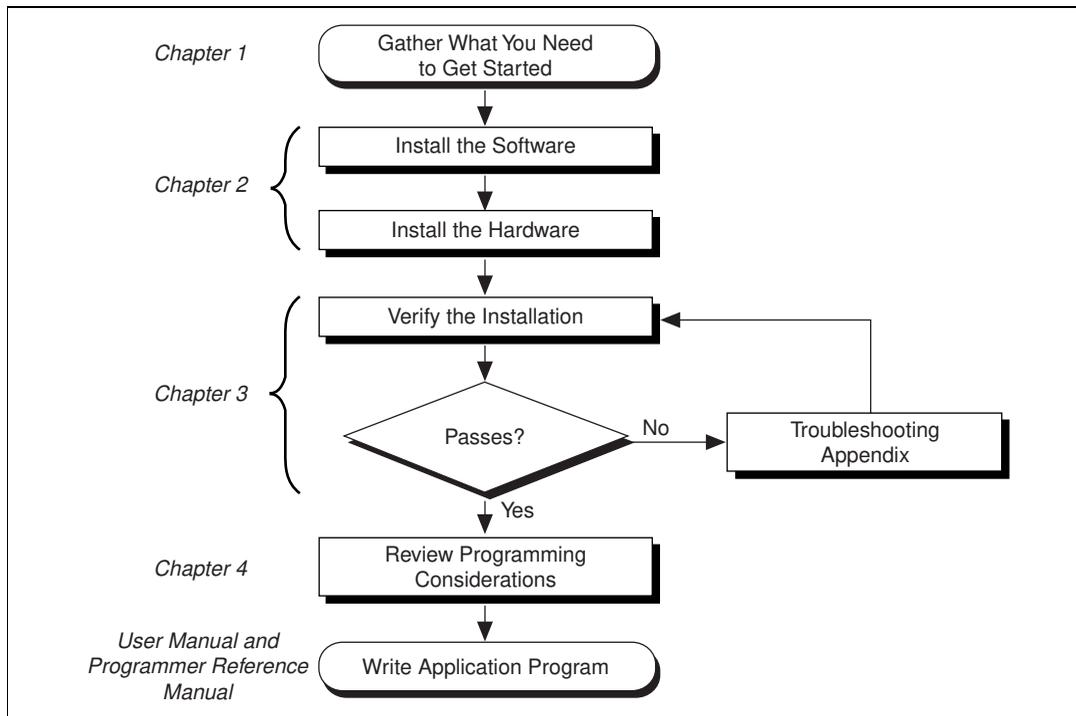
Customer Communication

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

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 95/98, and describes optional equipment you can order.

How to Use This Manual



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 95 or Windows 98 installed on your computer
- One of the following cards, which is included in your kit:
 - AT-CAN
 - 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 interface
- 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 95/98 includes the AT-CAN, PCI-CAN, and PCMCIA-CAN.

The AT-CAN is software configurable and compliant with the Plug and Play ISA standard. With an AT-CAN, you can make your PC AT-compatible computer communicate with and control DeviceNet devices.

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 AT-CAN, 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 AT-CAN, PCI-CAN, and PCMCIA-CAN fully conform to the DeviceNet physical layer requirements. The physical layer is optically isolated to 500 V 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 AT-CAN and PCI-CAN are 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 driver that is fully Plug and Play aware. The driver components are dynamically loaded when Windows detects new hardware and dynamically unloaded when Windows detects the removal of hardware.

The NI-DNET software for Windows 95/98 supports the concurrent use of multiple National Instruments DeviceNet cards. For example, you can use both a PCI-CAN and an AT-CAN in the same system at the same time.

The NI-DNET software, along with the CAN hardware for DeviceNet, transforms your computer into a DeviceNet interface with complete communications 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 95/98. 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.

Installation

This chapter describes how to install the NI-DNET software for Windows 95/98 and the CAN hardware for DeviceNet.

Install the NI-DNET Software

Install the NI-DNET software before you install the hardware.

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

3. Click on the **Install** button.
4. 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 2-2.



Figure 2-2. 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 choosing **Back**. If at any time you want to exit the setup, click on the **Cancel** button.

5. Shut down Windows and turn off your computer when you complete the setup.
6. Proceed to the next section, *Install the Hardware*.

Install the Hardware

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

Install Your AT-CAN or 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 expansion slot of the appropriate type 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 your card 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 2-3 shows how to install the AT-CAN into a 16-bit ISA expansion slot.

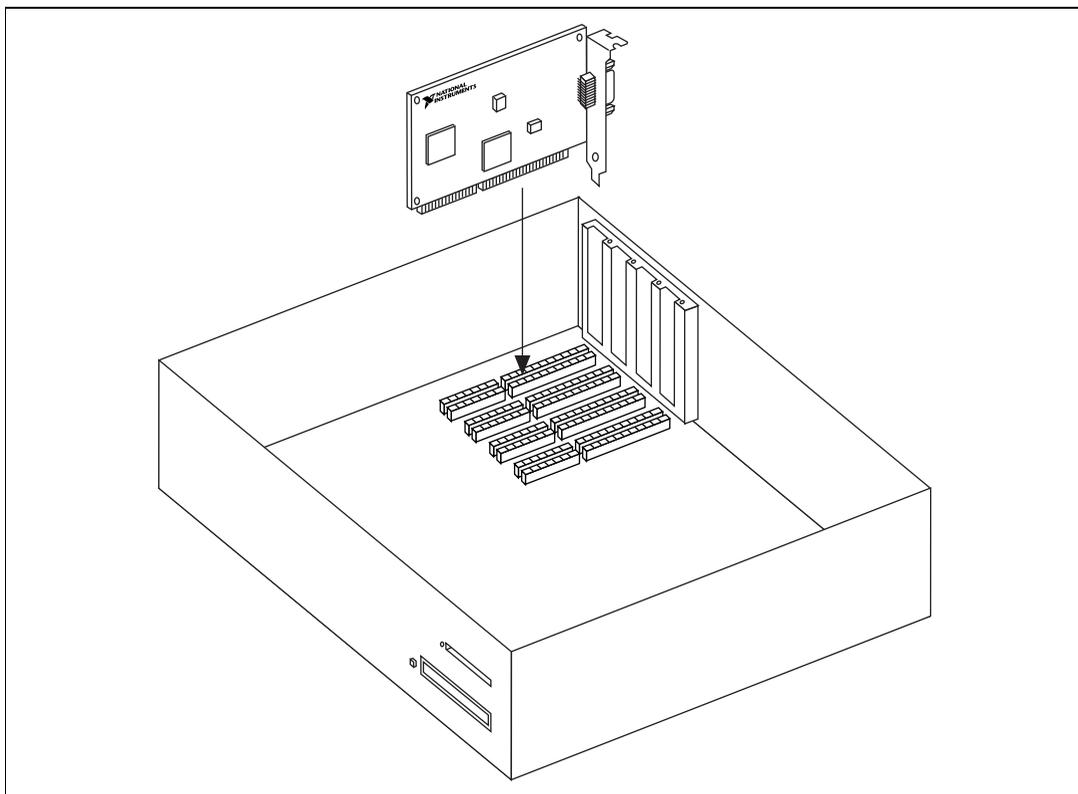


Figure 2-3. Installing the AT-CAN

7. Screw the mounting bracket of the card 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 95/98. Windows 95/98 should automatically detect the card and associate it with the NI-DNET software. A **New Hardware Found** dialog box appears, then goes away on its own. If the dialog box does not go away, select **Windows default driver** and click on the **OK** button.

If the **New Hardware Found** dialog box does not appear when you restart Windows 95/98, refer to the section *Device Manager Problems* in Appendix C, *Troubleshooting and Common Questions*.

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

Connect the Cables

After you have installed your card, connect the DeviceNet cables to your card's 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 AT-CAN or PCI-CAN hardware 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 95/98 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 2-4 shows how to insert the card and how to connect the PCMCIA-CAN bus-powered cable to the card.

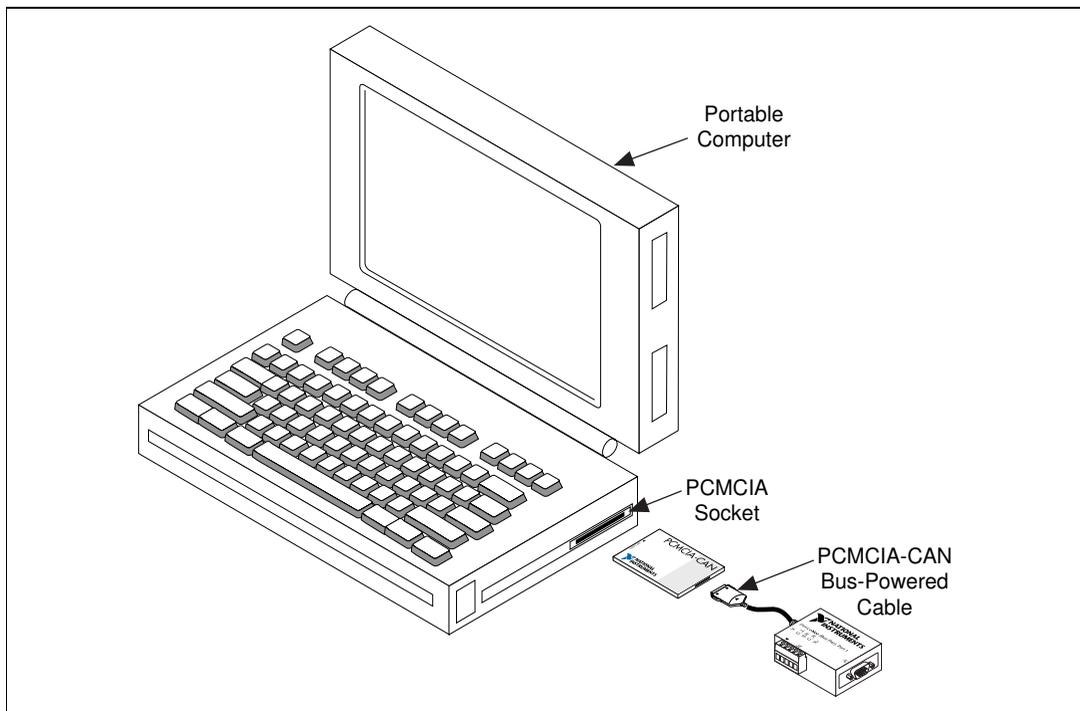


Figure 2-4. Inserting the PCMCIA-CAN

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

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

Test Installed DeviceNet Ports

The main listing of the NI-DNET Hardware Configuration utility displays each installed AT-CAN, 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, check the Windows Device Manager to see if Windows has detected the card. For more information, refer to the [Device Manager Problems](#) 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 3-1 shows the NI-DNET Hardware Configuration utility after it has tested two DeviceNet cards.

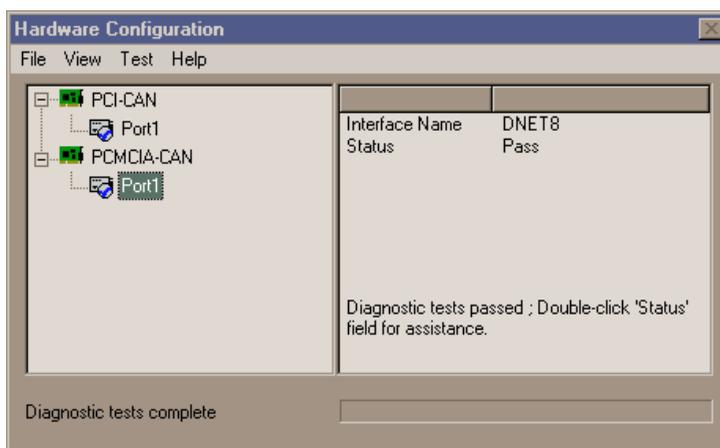


Figure 3-1. NI-DNET Hardware Configuration Utility after Testing

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 find 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. The **Refresh** selection can also be used to detect newly inserted PCMCIA-CAN cards.

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 3-2 shows the dialog box used to change a port's NI-DNET interface name.

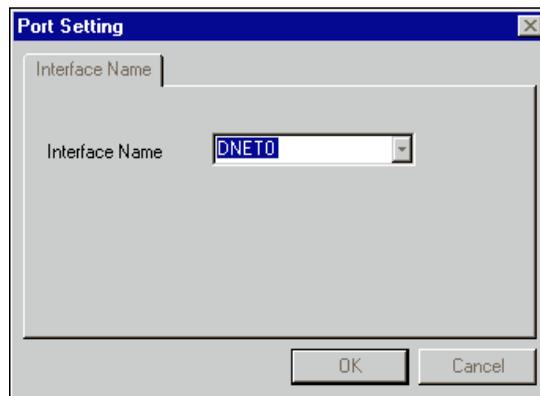


Figure 3-2. Interface Name Change Dialog Box

Begin to Use the NI-DNET Software

This chapter helps you get started with the NI-DNET software for Windows 95/98.

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.

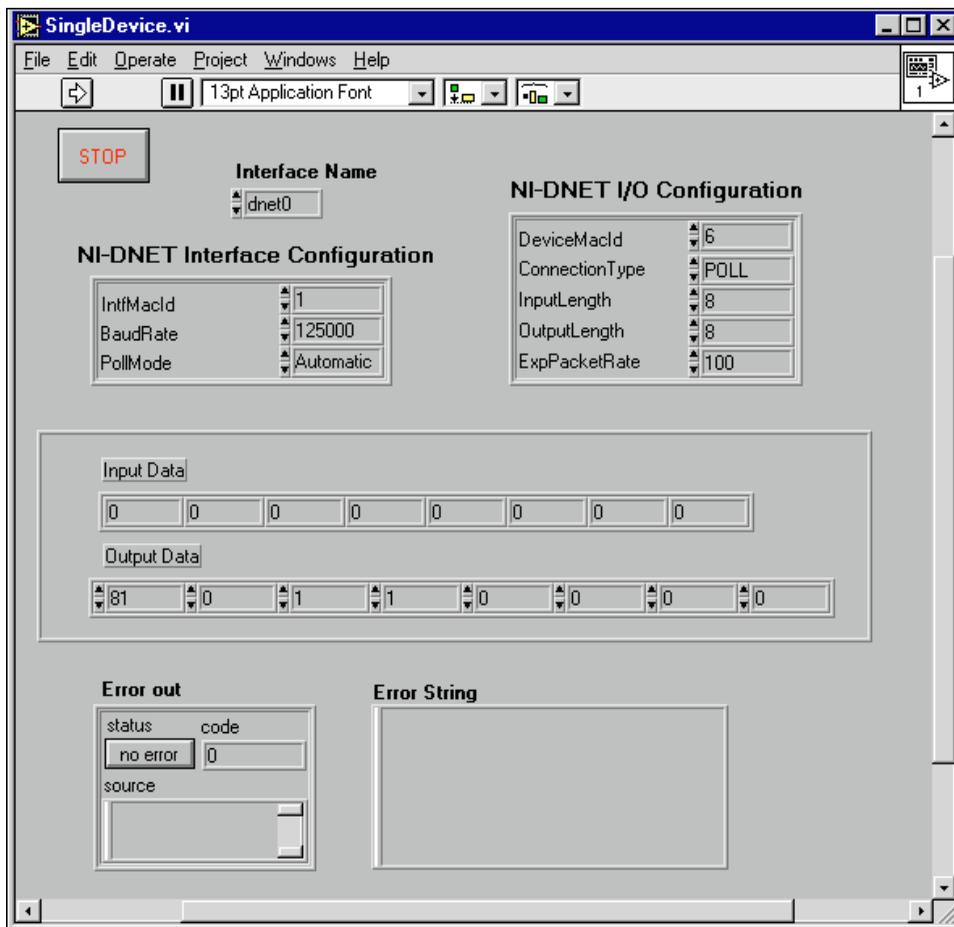


Figure 4-1. SingleDevice Front Panel

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 simple 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 Programmer Reference Manual*.

Uninstalling the Hardware and Software

This appendix describes how to uninstall the CAN hardware for DeviceNet and the NI-DNET software for Windows 95/98.

Uninstalling the Hardware from Windows 95/98

Before physically removing the card from the computer, you must remove the hardware information from the Windows 95/98 Device Manager.

To remove the hardware information from Windows 95/98, complete the following steps:

1. Select **Start»Settings»Control Panel**.
2. Double-click on the **System** icon.
3. In the **System Properties** dialog box that appears, select the **Device Manager** tab.
4. Click on the **View devices by type** button at the top of the **Device Manager** tab
5. Double-click on the **National Instruments CAN Interfaces** icon.

6. To remove a card, select it from the list of cards under **National Instruments CAN Interfaces** as shown in Figure A-1 and click on the **Remove** button.

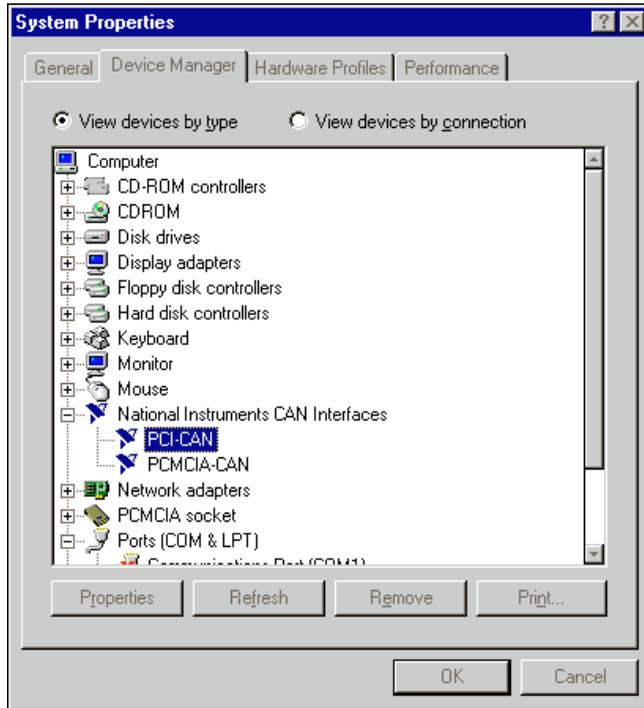


Figure A-1. Selecting an Interface to Remove from Windows 95/98

After you remove the appropriate hardware information from the Device Manager, you should shut down Windows, 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 95/98

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

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

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.

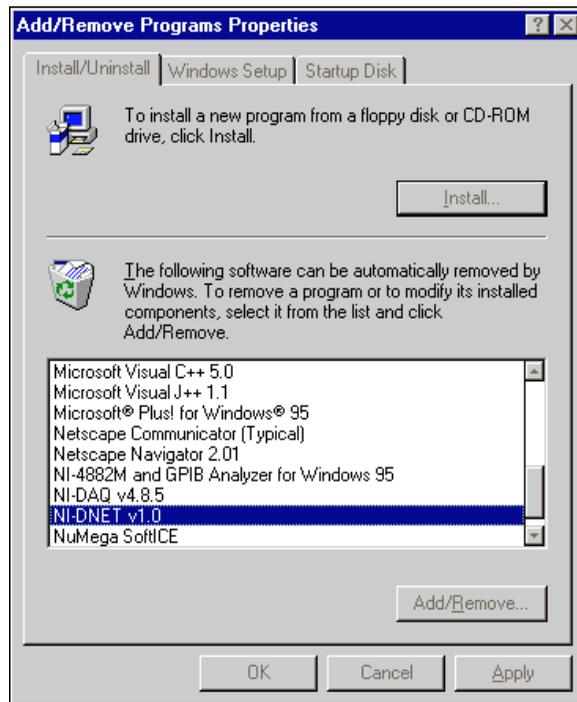


Figure A-2. Add/Remove Programs Properties Dialog Box

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.

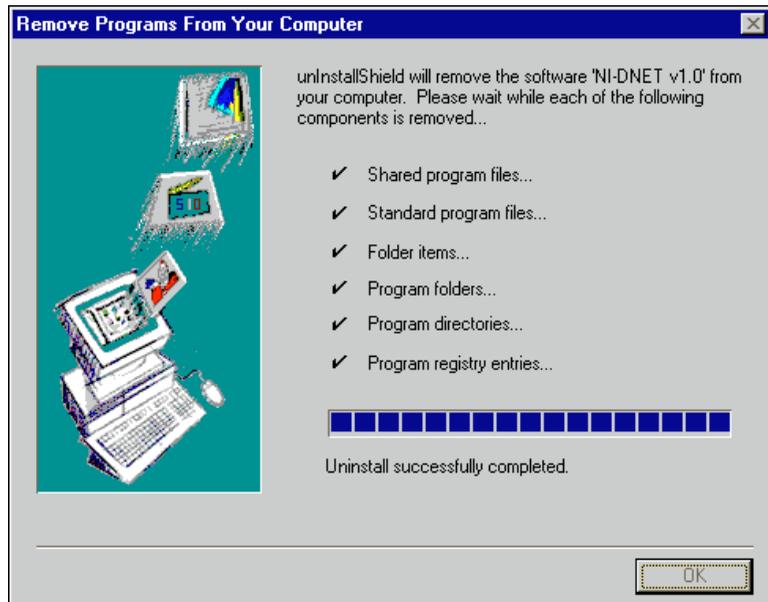


Figure A-3. NI-DNET Uninstallation Results

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 must remove any remaining components yourself.

If you want to reinstall the hardware and software, refer to Chapter 2, [Installation](#).

Cabling Requirements

This appendix describes the cabling requirements for the CAN hardware for DeviceNet.

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 AT-CAN (Combicon), PCI-CAN (Combicon), and 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.

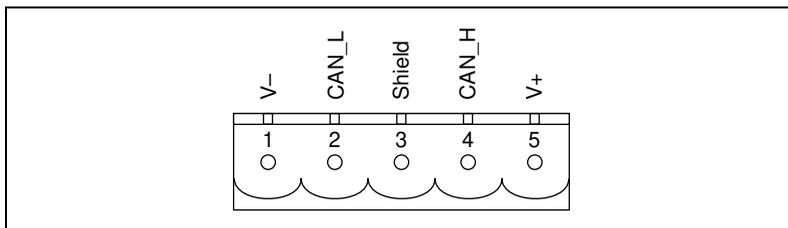


Figure B-1. Pinout for 5-Pin Combicon-Style Pluggable Screw Terminal

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 AT-CAN, 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.

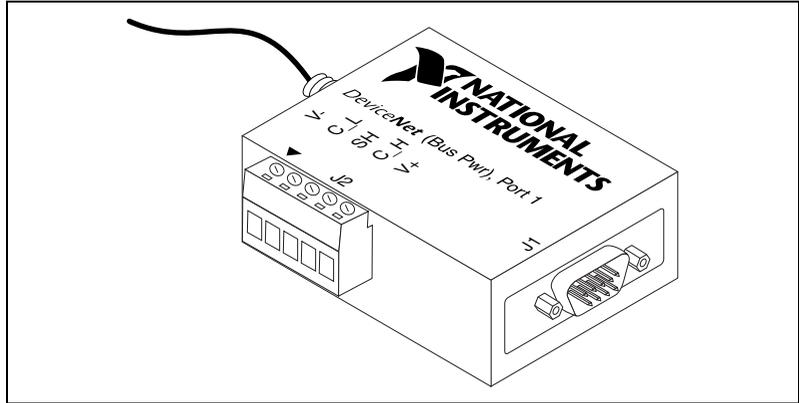


Figure B-2. PCMCIA-CAN Bus-Powered Cable

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

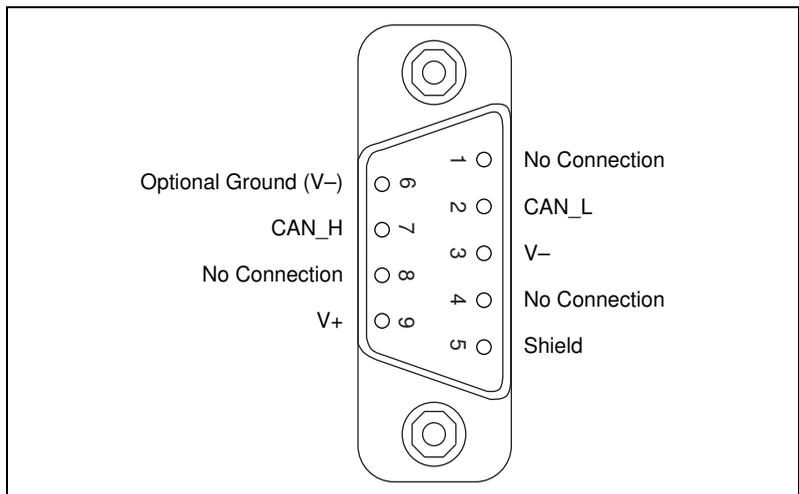


Figure B-3. Pinout for 9-Pin D-Sub Connector

Power Supply Information for the DeviceNet Ports

For the AT-CAN, 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 AT-CAN and PCI-CAN, a jumper controls the source of power for the DeviceNet physical layer. The location of this jumper for the PCI-CAN is shown in Figure B-4. The location of this jumper for the AT-CAN is shown in Figure B-5.

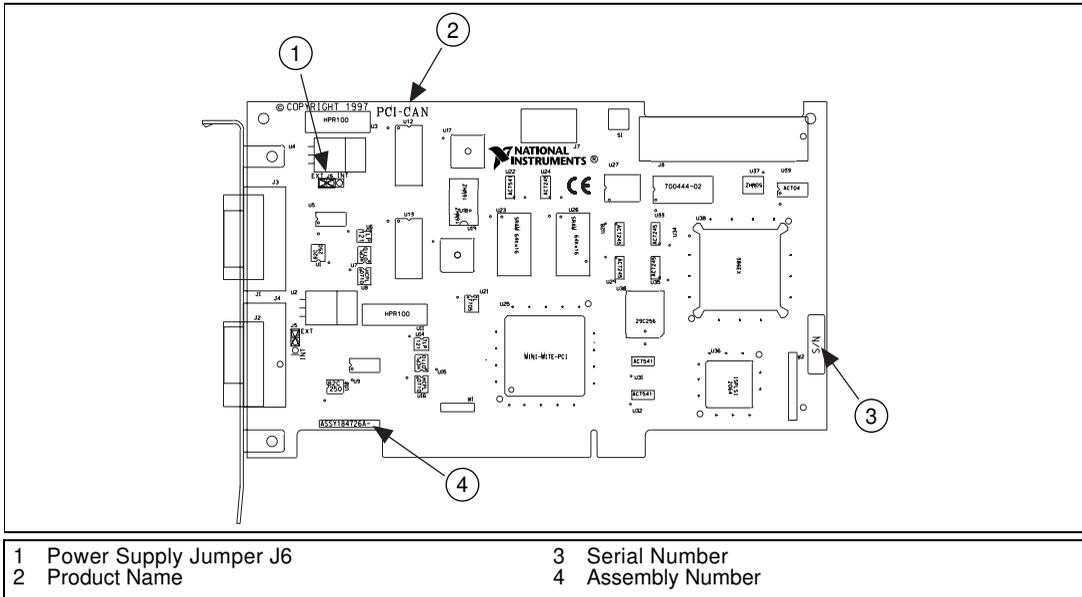


Figure B-4. PCI-CAN Power Source Jumper

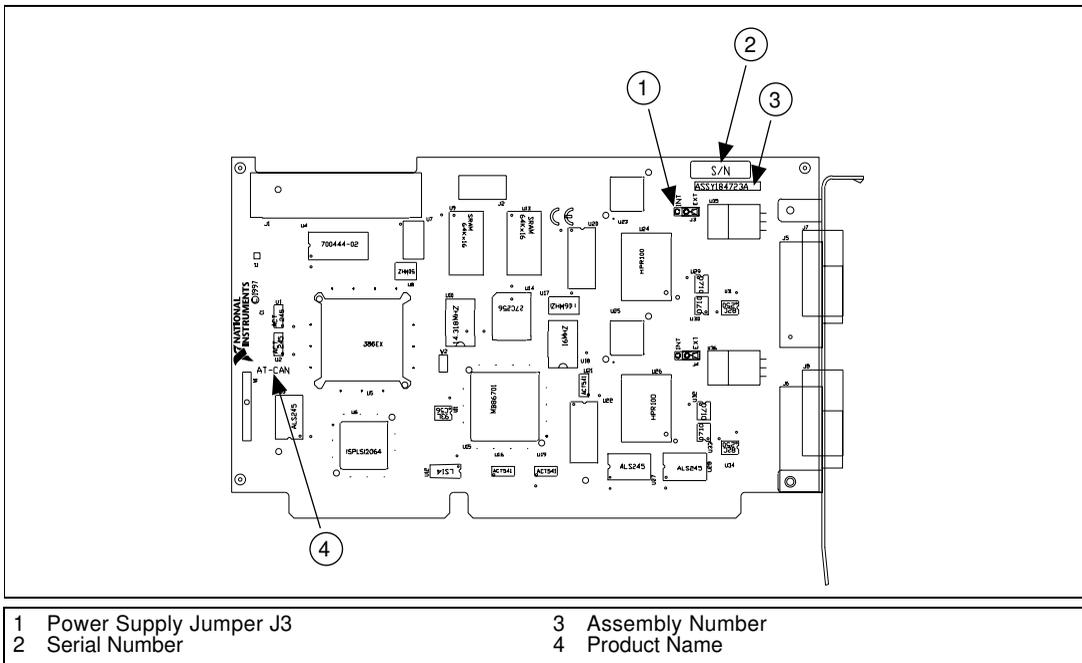


Figure B-5. AT-CAN Power Source Jumper

The AT-CAN and PCI-CAN are 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-6 shows how to configure your jumpers for internal or external power supplies.

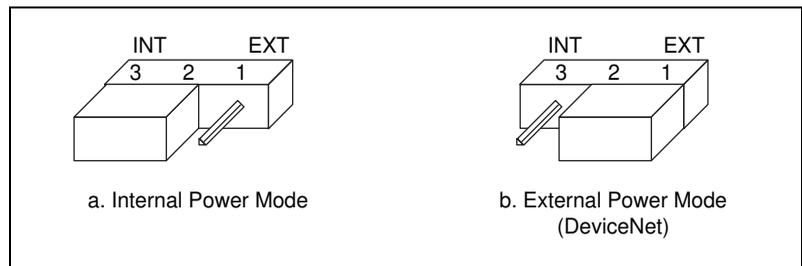


Figure B-6. Power Source Jumpers

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 recommendations 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 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-7 for an example of where termination resistors should be placed in a system with more than two devices.

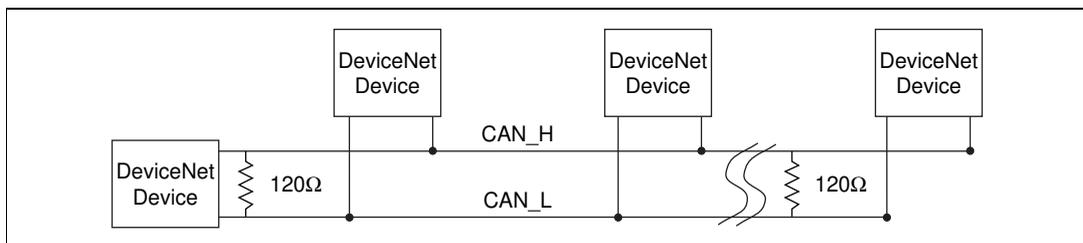


Figure B-7. Termination Resistor Placement

The termination resistors on a cable should match the nominal impedance of the cable. DeviceNet requires a cable with a nominal impedance of $120\ \Omega$; therefore, a $120\ \Omega$ resistor should be used at each end of the cable. Each termination resistor should each be capable of dissipating at least $0.25\ \text{W}$ of power.

Cabling Example

Figure B-8 shows an example of a cable to connect two DeviceNet devices.

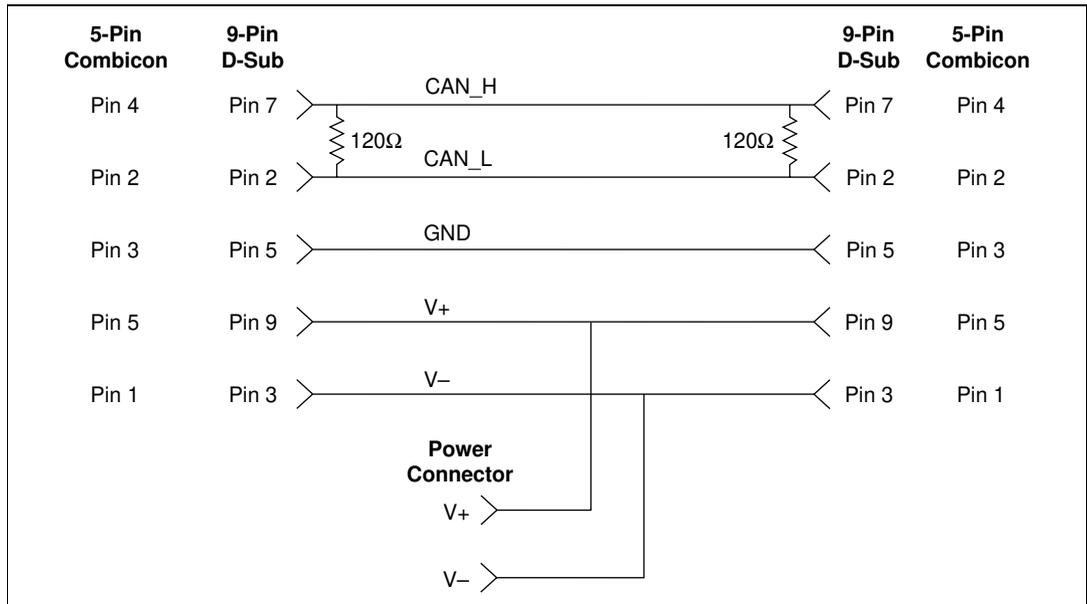


Figure B-8. Cabling Example



Troubleshooting and Common Questions

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

Hardware Configuration Utility Test Failures

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

Memory Resource Conflict

This error occurs if the memory resources assigned to a card conflict with the memory resources being used by other hardware in the system. Resource conflicts typically occur when your system contains legacy hardware that uses resources that have not been reserved properly with the Device Manager. If a resource conflict exists, write down the memory resource that caused the conflict and refer to the Microsoft Windows 95/98 User's Guide for instructions on how to use the Device Manager to reserve memory resources for legacy hardware. After the conflict has been resolved, run the NI-DNET Hardware Configuration utility again.

Interrupt Resource Conflict

This error occurs if the interrupt resources assigned to a card conflict with the interrupt resources being used by other hardware in the system. Resource conflicts typically occur when your system contains legacy hardware that uses resources that have not been reserved properly with the Device Manager. If a resource conflict exists, write down the interrupt resource that caused the conflict and refer to the Microsoft Windows 95/98 User's Guide for instructions on how to use the Device Manager to reserve interrupt resources for legacy hardware. After the conflict has been resolved, run the NI-DNET Hardware Configuration utility again.

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 hardware 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 95/98.

Missing Card in Hardware Configuration Utility

If a card is physically installed in your system but is not listed in the NI-DNET Hardware Configuration utility, check the Windows 95/98 Device Manager to see if Windows 95/98 has detected the card. For more information, refer to the next section, *Device Manager Problems*.

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.

Device Manager Problems

The Windows Device Manager contains configuration information for all of the hardware it is aware of in your system. To start the Windows Device Manager, double-click on the **System** icon under **Start»Settings»Control Panel**. In the **System Properties** box that appears, select the **Device Manager** tab and click the **View devices by type** radio button at the top of the tab.

If there is no **National Instruments CAN Interfaces** item and you are certain your card is installed, refer to the *No National Instruments CAN Interfaces* section of this appendix. This problem occurs when Windows does not display the **New Hardware Found** dialog box when expected.

If the **National Instruments CAN Interfaces** item exists, but the card you are looking for is not listed there, refer to the *Missing Card in Device Manager* section of this appendix.

If the card you are looking for is listed but has a circled X or exclamation mark (!) over its icon, refer to the *Problem Shown in Device Manager* section of this appendix.

No National Instruments CAN Interfaces

If you are certain your card is installed but no **National Instruments CAN Interfaces** item appears in the **Device Manager**, the card is probably incorrectly listed under **Other Devices**. This problem occurs when Windows does not display the **New Hardware Found** dialog box when expected. To fix the problem, complete the following steps:

1. Select **Start»Settings»Control Panel**.
2. Double-click on the **System** icon to display the **System Properties** dialog box for the computer.
3. Click on the **Device Manager** tab at the top of the **System Properties** sheet to bring up the **Device Manager** property page. Make sure the **View devices by type** button at the top of the **Device Manager** page is selected.
4. Click on the plus sign next to **Other Devices** to display a list of all the hardware devices that Windows has detected and configured as **Other Devices**.
5. For each card listed, select the card by clicking on it, and then click on the **Remove** button to remove each card from the list of **Other Devices**.
6. After you have removed all of the cards from the list of **Other Devices**, click on the **Refresh** button to force Windows to detect each card and to display a **New Hardware Found** dialog box for each one. Your card should now appear under **National Instruments CAN Interfaces**.
7. Verify the installation as described in Chapter 3, [Verify the Installation](#).

Missing Card in Device Manager

If the **National Instruments CAN Interfaces** item exists, but the card you are looking for is not listed there, the card is not properly installed. This problem indicates that the card is not physically present in the system. Make certain that the board is fully inserted.

Problem Shown in Device Manager

If a DeviceNet interface is not working properly, its icon has a circled X or exclamation mark (!) overlaid on it, as shown in Figure C-1.



Figure C-1. Device Manager with Interface Not Working Properly

This problem can occur for several reasons. If you encounter this problem, the Device Manager should list an error code that indicates why the problem occurred. To see the error code for a particular interface, select the name of the interface and click on the **Properties** button to go to the **General** tab for that DeviceNet interface. The **Device Status** section of the **General** tab shows the error code. Locate the error code in the following list to find out why your DeviceNet interface is not working properly.

- Code 8: The NI-DNET software was incompletely installed. To solve this problem, reinstall the NI-DNET software for Windows.
- Code 9: Windows had a problem reading information from your interface. Contact National Instruments for assistance.
- Code 12: Your interface was not assigned a physical memory range. If your computer does not have 8 KB of available memory, Windows might configure your interface without a physical memory assignment. The NI-DNET software cannot function without 8 KB of physical memory. Another way to verify this problem is to look at the **Resource settings** list on the **Resources** tab to verify that the interface was not assigned a Memory Range. To solve this problem, free up an 8 KB Memory Range (such as D0000 to D1FFF hex) that is being used by another device in the system.
- Code 15: Your interface was not assigned an Interrupt Request level. If your computer does not have any available Interrupt Request levels, Windows might configure your interface without an Interrupt Request level. The NI-DNET software cannot function without an Interrupt Request level. Another way to verify this problem is to look at the **Resource settings** list on the **Resources** tab to verify that your interface was not assigned

an Interrupt Request level. To solve this problem, free up an Interrupt Request level that is being used by another device in the system.

- Code 22: Your interface is disabled. To enable your interface, check the appropriate configuration checkbox in the **Device Usage** section of the **General** tab.
- Code 24: Your interface is not present, or the Device Manager is unaware that your interface is present. To solve this problem, select your interface in the Device Manager, and click on the **Remove** button. Next, click on the **Refresh** button. At this point, the system rescans the installed hardware, and your interface should show up without any problems. If the problem persists, contact National Instruments.
- Code 27: Windows was unable to assign the DeviceNet interface any resources. To solve this problem, free up system resources by disabling other unnecessary hardware so that enough resources are available for the DeviceNet interface. The resources required for a single DeviceNet interface are an Interrupt Request level and an 8 KB physical memory range (such as D0000 to D1FFF hex).

Common Questions

What do I do if my card is listed in the Windows Device Manager with a circled X or exclamation point (!) overlaid on it?

Refer to the *Problem Shown in Device Manager* section of this appendix for specific information about what might cause this problem. If you have already completed the troubleshooting steps, fill out the forms in Appendix E, *Customer Communication*, and contact National Instruments.

How can I determine which type of card 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**. The NI-DNET utility displays information about the version of the CAN hardware for DeviceNet currently installed.

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**, then 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 95/98 support?

The NI-DNET software for Windows 95/98 supports the AT-CAN, PCI-CAN, and PCMCIA-CAN. Although the AT-CAN/2 and PCI-CAN/2 work 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 for more information.

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

Refer to the [Hardware Configuration Utility Test Failures](#) section of this appendix for specific information about what might cause the test to fail. If you have already completed the troubleshooting steps, fill out the forms in Appendix E, [Customer Communication](#), and contact National Instruments.

How many cards can I configure for use with my NI-DNET software for Windows 95/98?

The NI-DNET software for Windows 95/98 can be configured to communicate with up to 10 cards.

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*.

Specifications

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

Table D-1. AT-CAN Characteristics

Characteristic	Specification
Dimensions	10.67 by 16.51 cm (4.2 by 6.5 in.)
Power Requirement	+5 VDC 500 mA typical
I/O Connector	5-pin Combicon-style pluggable DeviceNet screw terminal
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-2. 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-3. 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-4. 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



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

Resource Summary Report from the Device Manager

To create this report, first display the **System Properties** dialog box for the computer by double-clicking on the **System** icon under **Start»Settings»Control Panel**. Then click on the **Device Manager** tab and highlight the **Computer** icon. Click on the **Print** button, and check the **Print to File** checkbox in the **Print** dialog box before clicking on **OK**.

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 95/98*

Edition Date: April 1998

Part Number: 321864A-01

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

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

Thank you for your help.

Name _____

Title _____

Company _____

Address _____

E-Mail Address _____

Phone (____) _____ Fax (____) _____

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

Fax to: Technical Publications
National Instruments Corporation
512 794 5678

Glossary

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

°	degrees
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
ISA	Industry Standard Architecture
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