

**Getting Started with Your PCI-GPIB
and the NI-488.2M™ Software
for Digital UNIX**

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

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About This Manual

This manual contains instructions for installing and configuring the National Instruments PCI-GPIB interface board and the NI-488.2M multitasking software for use with a DEC Alpha Station running the Digital UNIX operating system. This manual is meant to be used with the *NI-488.2M Software Reference Manual*.

Organization of This Manual

This manual is organized as follows:

- Chapter 1, *Introduction*, explains how to use this manual, lists what you need to get started, and includes a brief description of the NI-488.2M software and the PCI-GPIB.
- Chapter 2, *Hardware Installation*, contains instructions for installing your PCI-GPIB.
- Chapter 3, *Software Installation and Configuration*, contains instructions for installing and configuring your NI-488.2M software.
- Chapter 4, *Installation Verification and Troubleshooting*, describes how to verify the installation and troubleshoot problems.
- Chapter 5, *Using Your NI-488.2M Software*, describes the `ibic` utility and lists some programming considerations.
- Appendix A, *Hardware Specifications*, describes the electrical, physical, and environmental characteristics of the PCI-GPIB and the recommended operating conditions.
- Appendix B, *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 that this manual uses, including abbreviations, acronyms, metric prefixes, mnemonics, and symbols.

Conventions Used in This Manual

The following conventions are used in this manual.

<i>bold italic</i>	Bold italic text denotes a note, caution, or warning.
bold monospace	Bold text in this font denotes the messages and responses that the computer automatically prints to the screen.
<i>italic</i>	Italic text denotes a cross reference.
<i>italic monospace</i>	Italic text in this font denotes that you must supply the appropriate words or values in place of these items.
monospace	Text in this font denotes text or characters that are to be literally input from the keyboard. It is also used for the proper names of disk drives, directories, programs, device names, variables, and filenames.

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

Related Documentation

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

- ANSI/IEEE Standard 488.1-1987, *IEEE Standard Digital Interface for Programmable Instrumentation*.
- ANSI/IEEE Standard 488.2-1992, *IEEE Standard Codes, Formats, Protocols, and Common Commands*.

Customer Communication

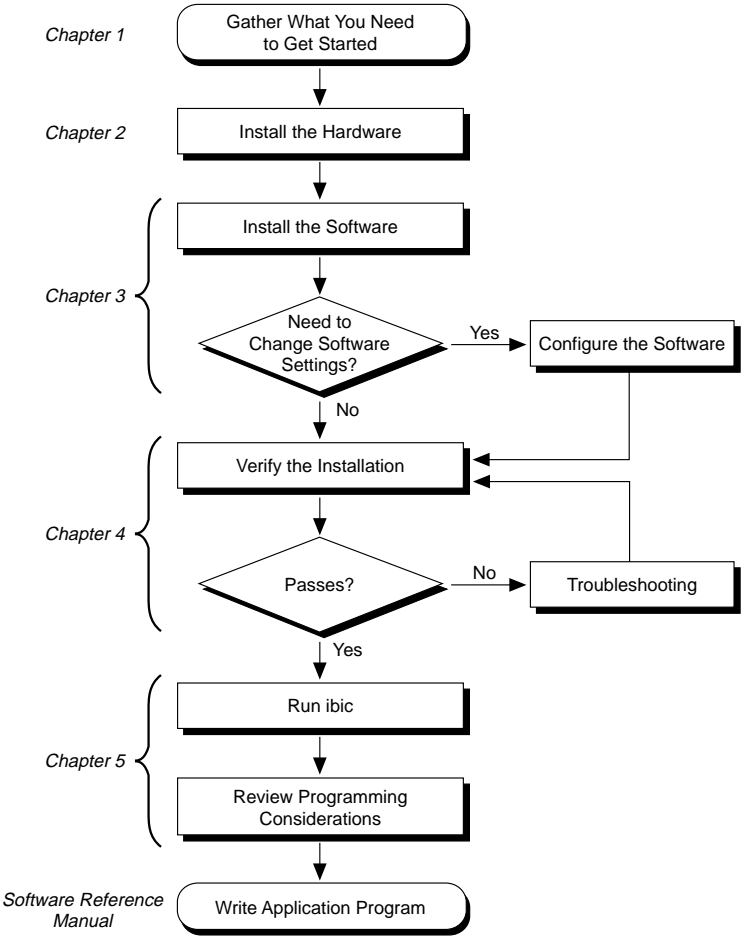
National Instruments wants to receive your comments on our products and manuals. We are interested in the applications you develop with our products, and we want to help if you have problems with them. To make it easy for you to contact us, this manual contains comment and configuration forms for you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

Chapter 1

Introduction

This chapter explains how to use this manual, lists what you need to get started, and describes the NI-488.2M software and the PCI-GPIB.

How to Use This Manual



What You Need to Get Started

- PCI-GPIB board
- 3.5 in. *NI-488.2M Distribution Disk for PCI-GPIB and Digital UNIX*
or
NI-488.2M Distribution Tape for PCI-GPIB and Digital UNIX
- Digital UNIX 3.x or higher installed on your computer
- Super-user privilege

Software Description

The NI-488.2M software for Digital UNIX includes a multitasking driver and utilities that transform a DEC Alpha Station running Digital UNIX into a GPIB Controller with complete communications and bus management capabilities. The NI-488.2M software also includes a C language interface, a program to test the installation of the software, an interactive control program, and an interactive configuration program.

The NI-488.2M driver supports up to four PCI-GPIB boards and is completely compatible with both IEEE 488 and IEEE 488.2 instruments.

Hardware Description

The PCI-GPIB is an IEEE 488 interface for computers with PCI expansion slots. The TNT4882C ASIC performs the basic IEEE 488 Talker, Listener, and Controller functions, including those required by the most recent GPIB standard, IEEE 488.2. The PCI-GPIB can sustain data transfer rates of up to 1.2 Mbytes/s, and can also implement a high-speed GPIB protocol (HS488), so that you can have data transfers of up to 1.5 Mbytes/s, depending on the speed of your system.

You can use standard GPIB cables to connect the PCI-GPIB with up to 14 instruments. If you need to use more than the maximum number of instruments, you can use the National Instruments GPIB extenders or the

GPIB expander/isolator to add additional instruments to the system. Double-shielded GPIB cables are also available.

Refer to Appendix A, *Hardware Specifications*, for more information about the PCI-GPIB specifications and recommended operating conditions.

Chapter 2

Hardware Installation

This chapter contains instructions for installing your PCI-GPIB.

Warning: *Electrostatic discharge can damage several components on your PCI-GPIB. To avoid such damage in handling the board, touch the antistatic plastic package to a metal part of your computer chassis before removing the board from the package.*

Before you install the PCI-GPIB, consult the manual that came with your workstation for specific instructions and warnings. You must have super-user privileges to install the hardware and software. This requires you to log on as `root`.

Perform the following steps to install the PCI-GPIB:

1. Shut down your system by entering the following commands at the command line prompt:

```
sync ; sync ; halt
```

2. Turn off your computer after it has been shut down. Keep the computer plugged in so that it remains grounded while you install the GPIB hardware.
3. Remove the top cover (or other access panels) to give yourself access to the computer expansion slots.
4. Find an unused PCI expansion slot in your computer.
5. Remove the corresponding slot cover on the back panel of the computer.
6. Insert the PCI-GPIB into the slot with the GPIB connector sticking out of the opening on the back panel, as shown in Figure 2-1. It might be a tight fit, but do not force the board into place.

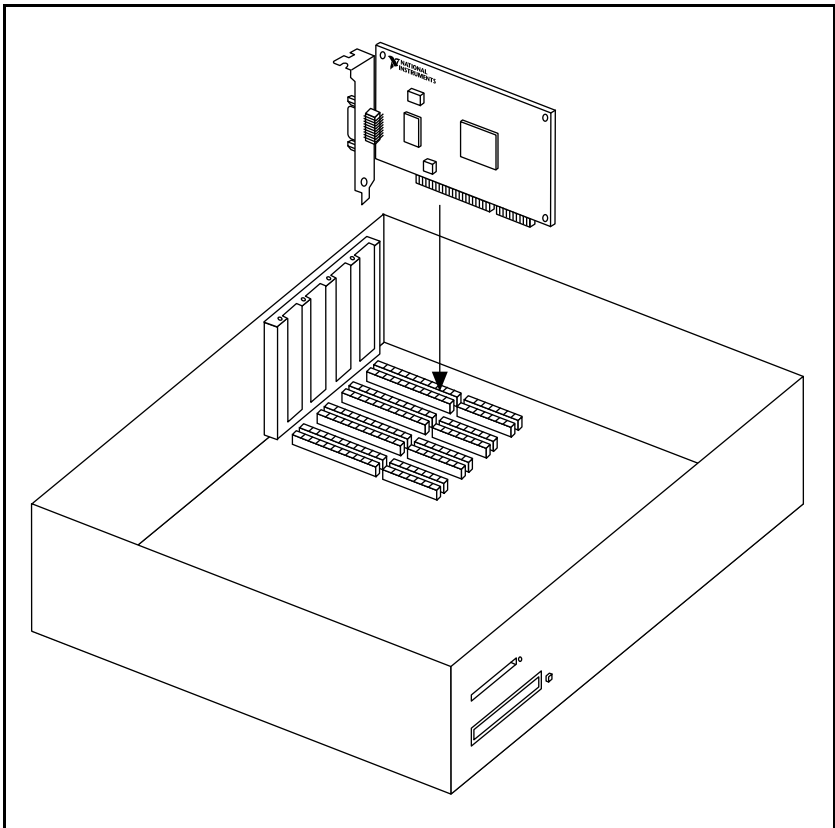


Figure 2-1. Installing the PCI-GPIB

7. Screw the mounting bracket of the PCI-GPIB 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. The PCI-GPIB interface board is now installed.

Chapter 3

Software Installation and Configuration

This chapter contains instructions for installing and configuring your NI-488.2M software.

NI-488.2M Software Components

The NI-488.2M software includes the following components:

- NI-488.2M driver (`gpib.o`)
- An include file for user programs (`ugpib.h`)
- C language interface libraries (`libgpib.a` and `libgpib.so`)
- Source code of C language interface library (`cib.c` and `cib.h`)
- An interactive configuration utility (`ibconf`)
- A software diagnostic utility (`ibtsta`)
- An interactive GPIB control program (`ibic`)

Remove an Existing Driver

If you have a previous version of the NI-488.2M software for the PCI-GPIB installed in your system, you must remove it before you install the new version.

To check for an existing driver, enter the following command:

```
/usr/sbin/setld -i | grep PCIGPIB
```

If the following message appears, you have an existing driver installed in your system:

```
PCIGPIB XXX installed National Instruments GPIB Driver  
ver x.xx
```

where *XXX* is a three-digit number corresponding to the version number. If you have installed and removed the driver, the same message appears without the word **installed**.

You must be a super user to remove the driver from the kernel configuration. To remove the driver, enter the following command:

```
/usr/sbin/setld -d PCIGPIBXXX
```

where *XXX* is a three-digit number corresponding to the version number.

Install the Software

After you have removed any existing driver for the PCI-GPIB, follow these steps to install your NI-488.2M software. Remember you must be a super user to install the software.

1. Run the system utility `setld` to install the software. The commands you enter depend on whether you are installing the software from tape or diskette.

If you are installing from tape, insert the distribution tape into the tape drive and enter the following command:

```
/usr/sbin/setld -l /dev/rmt0h
```

If you are installing from diskette, insert the distribution diskette into the disk drive and enter the following commands:

```
mkdir /tmp/pcigpib
cd /tmp/pcigpib
tar xvf /dev/rfd0a
/usr/sbin/setld -l .
cd ..
rm -r pcigpib
```

where `/dev/rfd0a` is the special file for your floppy disk drive. If you do not know the name of your floppy disk special file, ask your system administrator.

2. Rebuild a new kernel using the `doconfig` system utility. Enter the following command:

```
/usr/sbin/doconfig
```

3. Save the old kernel and move the new kernel to `/vmunix`, so it becomes the system default boot kernel. Then reboot your computer. Enter the following commands:

```
mv /vmunix /vmunix.save
mv /sys/XXX/vmunix /vmunix
reboot
```

where `XXX` is the name of the configuration that you entered while running `doconfig`. The default is the host name of the computer.

After you have installed your software, you might want to view or modify the driver configuration. Refer to the next section for instructions on running the configuration utility `ibconf`. If you do not need to run `ibconf`, refer to Chapter 4, *Installation Verification and Troubleshooting*, for further instructions.

Configure the Software with `ibconf` (Optional)

The `ibconf` utility is the National Instruments GPIB driver configuration utility. After installing the software, you can run `ibconf` to examine or modify the software configuration. You also might want to run `ibconf` to change configuration options such as device names or timeout values. Follow these steps to run `ibconf`.

1. Log on as super-user (`root`).
2. Start `ibconf` by entering the following command:

```
/usr/bin/ibconf filename
```

where *filename* is optional and refers to the UNIX kernel built with the NI-488.2M driver. The default UNIX kernel file is `/vmunix`. To run `ibconf` on the kernel `/vmunix`, enter the following command:

```
/usr/bin/ibconf
```

3. Use the help instructions on your screen to move around the screen, make changes, and exit the program.
4. If you made any changes, reboot your computer from the changed kernel so that the new settings become active.

For more information about `ibconf`, refer to the *NI-488.2M Software Reference Manual*.

After you have installed and configured the software, you should verify the installation. Refer to Chapter 4, *Installation Verification and Troubleshooting*, for instructions on verifying the software and hardware installation.

Chapter 4

Installation Verification and Troubleshooting

This chapter describes how to verify the installation and troubleshoot problems.

Verify the System Boot Messages

If the following messages are printed out on the console during the system boot, after the installation of the driver, the NI-488.2M software has established communication with the hardware device and recognized it.

```
National Instruments PCI-GPIB (gpibx S/N nnn) XXXXXXXX

*****
* NI-488.2M GPIB Device Driver, Version 1.x *
* Copyright (c) 1996 National Instruments Corp. *
* All Rights Reserved. *
*****
```

where *nnn* is the serial number of the board, and *XXXXXXX* could either be blank, indicating the driver is capable of DMA I/O transfers, or ***** NON-DMA *****, indicating the driver is not capable of DMA I/O transfers.

Run the Software Diagnostic Program

To further verify and test the hardware and software installation, run the *ibtsta* software diagnostic program that came with your NI-488.2M software. The *ibtsta* program is an NI-488.2M application that makes calls to the driver just as an application does. *ibtsta* checks for correct access to the device driver and to the GPIB boards.

Follow these steps to run *ibtsta*:

1. Disconnect all GPIB cables.

2. Enter the following command:

```
/usr/bin/ibtsta
```

If `ibtsta` completes with no errors, you have installed the NI-488.2M software correctly. If an error occurs, refer to the next section for troubleshooting instructions.

Troubleshooting `ibtsta` Messages

If `ibtsta` fails, the program generates error messages that appear on your screen. These error messages explain what went wrong when you ran `ibtsta`, and describe how you can correct the errors.

For example, the following message might appear on your screen if you did not disconnect all your GPIB cables:

```
The fact that the ENOL error was not received when
expected indicates the possible presence of other
devices on the bus.
```

```
Please disconnect ALL GPIB cables from the GPIB board,
then run this test again.
```

The following message might appear if the `/dev/gpib0` special file is not present:

```
The special file /dev/gpib0 cannot be found.
```

In this case, or in a similar case in which device special files are not created, verify the following:

- Make sure that the GPIB driver is installed.
- Verify that you built a kernel with the driver and that you booted the system from the new kernel.
- If the two previous items are correct, run the system utility `kmknod` by entering the following command:

```
/sbin/kmknod
```

If `ibtsta` fails again, fill out the forms in Appendix B, *Customer Communication*, and contact National Instruments.

Common Questions

How do I know that my GPIB board is installed correctly?

The `ibtsta` test verifies that both the hardware and software are installed correctly. If the test fails, and you cannot correct the problem, fill out the forms in Appendix B, *Customer Communication*, and contact National Instruments.

What do I do if `ibtsta` fails with an error?

If you cannot correct the problem by following the troubleshooting instructions in this chapter, fill out the forms in Appendix B, *Customer Communication*, and contact National Instruments.

What could be causing a problem with accessing the NI-488.2M distribution diskette?

Check the name of the special file for your tape drive or floppy disk drive. It should be `/dev/rmt xh` or `/dev/rfd xa`, where `x` is an integer number. Contact your system administrator for more information.

Another possibility is that the data on the distribution diskette is corrupted. Contact National Instruments in this case.

Why can't I run `ibconf`?

If you do not have the necessary reading and writing permission, you cannot run `ibconf`, because `ibconf` changes the binary code of the kernel (`/vmunix`). For your own protection, only the super user has permission to write to the kernel on most systems. If you are not a super user, ask your system administrator (super user) to change the configuration for you. Use `chmod` to change permission codes on files.

If you are a super user and you cannot run `ibconf`, then either the driver is not built into the kernel or the kernel file is corrupted. Try reinstalling the

NI-488.2M driver and rebuilding the kernel. Refer to Chapter 3, *Software Installation and Configuration*, for information on installing the driver.

Why does `ibfind` return -1 with an `iberr` value of EDVR?

The driver might not be properly installed. Check your installation. You can check the installation by verifying the boot messages log (usually `/var/adm/messages`) to see if any errors occurred during installation. If the driver is properly installed, some of the GPIB special files might be missing. Try running `kmknod` again by entering `/sbin/kmknod` at the command prompt.

Why do the device special files not get created even after I run the `kmknod` utility?

There could be duplicate entries for one or more kernel layered products in the `NAME.list` file in the `/usr/sys/conf` directory (where `NAME` is the name of your system configuration file which, by default, is the system host name). If so, edit the file by commenting out all such entries except one by putting a `#` sign at the beginning of the line containing the entry. Then rebuild the kernel by entering the command `doconfig -c NAME` and reboot the system with the new kernel.

Where is my GPIB base directory?

Your GPIB base directory is `/usr/opt/PCIGPIB100`. It includes all of your GPIB-related files.

How do I use the NI-488.2M language interface?

For information about using the NI-488.2M language interface refer to the *Programming Considerations* section of Chapter 5, *Using Your NI-488.2M Software*.

When would I use `ibic`?

You can use `ibic` to test and verify instrument communication, troubleshoot problems, and develop your application program. For more

information about `ibic`, refer to the *NI-488.2M Software Reference Manual*.

What information should I have before I call National Instruments?

When you call National Instruments, you should have the results of the diagnostic test `ibtsta`. You should also have run `ibic` to try to find the source of your problem. Also, make sure you have filled out the configuration form in Appendix B, *Customer Communication*.

Chapter 5

Using Your NI-488.2M Software

This chapter describes the `ibic` utility and lists some programming considerations.

Introduction to `ibic`

The Interface Bus Interactive Control utility, `ibic`, comes with your NI-488.2M software. You can use `ibic` to enter NI-488 functions and NI-488.2 routines interactively and display the results of the function calls automatically. Without writing an application, you can use `ibic` to do any of the following:

- Verify GPIB communication with your device quickly and easily.
- Learn the syntax of the NI-488 functions and NI-488.2 routines before writing your application.
- Become familiar with the commands of your device.
- Receive data from your GPIB device.

For more information about `ibic`, refer to the *NI-488.2M Software Reference Manual*.

Programming Considerations

To create an executable application program using the C language interface, complete the following steps:

1. Include the header file `ugpib.h` in your application.

```
#include <sys/ugpib.h>
```

2. Compile the application program (assume that the example program you just created is in a file called `test.c`) by entering one of the following commands:

- a. If you want to use the shared library `/usr/shlib/libgpib.so`, enter the following command:

```
cc test.c -o test -no_archive -lgpib
```

The `-no_archive` option is positional and can be used more than once. It affects only those options that follow it.

- b. If you want to use the non-shared library `/usr/lib/libgpib.a`, enter the following command:

```
cc test.c -o test -non_shared -lgpib
```

- c. Optionally, you can enter the command without specifying the `no_archive` or `non_shared` flag as follows:

```
cc test.c -o test -lgpib
```

In this case, the compiler, by default, first tries to use the shared library. If that library is not available, it tries to link to the non-shared library.

For more detailed information about compiling, refer to the man pages on `cc` and `ld`.

3. Run the program by entering the following command:

```
test
```

For detailed information about each NI-488 function and NI-488.2 routine, refer to the *NI-488.2M Software Reference Manual*.

Appendix A

Hardware Specifications

This appendix specifies the electrical, environmental, and physical characteristics of the PCI-GPIB and the recommended operating conditions.

Table A-1. Electrical Characteristics

Characteristic	Specification
Number of GPIB Loads	1
Maximum Transfer Rate (programmed I/O)	1.2 Mbytes/s using three-wire handshake* 1.5 Mbytes/s using HS488*
Power Requirement	+5 VDC, 600 mA maximum
* Actual rates are dependent on instrument capabilities and system configuration.	

Table A-2. Environmental Characteristics

Characteristic	Specification
Operating Temperature	0° to 40° C
Storage Temperature	-20° to 70° C
Relative Humidity	5% to 90%, noncondensing
EMI	FCC Class A Verified

Table A-3. Physical Characteristics

Characteristic	Specification
Dimensions	13.34 by 10.67 cm (5.25 by 4.20 in.)
I/O Connector	IEEE 488 Standard 24-pin

Appendix B

Customer Communication

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

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

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Canada (Quebec)	514 694 8521	514 694 4399
Denmark	45 76 26 00	45 76 26 02
Finland	90 527 2321	90 502 2930
France	1 48 14 24 24	1 48 14 24 14
Germany	089 741 31 30	089 714 60 35
Hong Kong	2645 3186	2686 8505
Italy	02 413091	02 41309225
Japan	03 5472 2970	03 5472 2977
Korea	02 596 7456	02 596 7455
Mexico	95 800 010 0793	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
U.K.	01635 523545	01635 523154

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 _____

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 _____

(continues)

National Instruments software product _____

Version _____

Configuration _____

The problem is _____

List any error messages _____

The following steps will reproduce the problem _____

PCI-GPIB 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.

National Instruments Products

- PCI-GPIB Hardware Revision _____
- NI-488.2M Software Version
Number on Distribution Medium _____
- Number of PCI-GPIB Boards in System _____

Other Products

- Computer Make and Model _____
- Clock Frequency _____
- Operating System Version _____
- Other Boards in System _____

Glossary

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

- ° degrees
- % percent
- A amperes
- ANSI American National Standards Institute
- ASIC application-specific integrated circuit
- C Celsius
- DMA direct memory access
- EMI electromagnetic interference
- FCC Federal Communications Commission
- GPIB General Purpose Interface Bus
- Hz hertz
- ibic Interface Bus Interactive Control
- IEEE Institute of Electrical and Electronic Engineers
- in. inches
- I/O input/output
- ISA Industry Standard Architecture
- m meters
- MB megabytes of memory
- PCI Peripheral Component Interconnect
- RAM random-access memory
- s seconds
- VDC volts direct current