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Getting Started with Your EXM-GPIB and the NI-488.2™ Software for DOS

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

Federal Communications Commission

This device complies with Part 15 of the Federal Communications Commission (FCC) Rules for a Class A digital device. Operation is subject to the following two conditions:

1. This device may not cause harmful interference in commercial environments.

2. This device must accept any interference received, including interference that may cause undesired operation.

Canadian Department of Communications

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

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

Instructions to Users

These regulations are designed to provide reasonable protection against harmful interference from the equipment to radio reception in commercial areas. 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.

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

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- Operate the equipment and the receiver on different branches of your AC electrical system.

- Move the equipment away from the receiver with which it is interfering.
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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: *How to Identify and Resolve Radio-TV Interference Problems.* This booklet is available from the U.S. Government Printing Office, Washington, DC 20402, Stock Number 004-000-00345-4.

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About This Manual

This manual contains instructions for installing and configuring the National Instruments EXM-GPIB interface board and the NI-488.2 software for MS-DOS. The hardware is intended for use on RadiSys embedded PC systems, including VME, VXI, or EMC systems equipped with 16-bit EXM slots. The software is intended for use with MS-DOS version 3.0 or higher. This manual is meant to be used with the *NI-488.2 Software Reference Manual for MS-DOS* (part number 320282-01). References to EXM-GPIB apply equally to EXM-27.

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-488.2 software and the EXM-GPIB board.
- Chapter 2, *Hardware Installation and Configuration*, contains instructions for installing and configuring your EXM-GPIB board.
- Chapter 3, *Software Installation and Configuration*, contains instructions for installing and configuring your NI-488.2 software.
- Chapter 4, *Installation Verification and Troubleshooting*, describes how to verify the installation, troubleshoot error messages, and correct DMA transfer errors.
- Chapter 5, *Using Your NI-488.2 Software,* describes the ibic utility and lists some programming considerations.
- Appendix A, *Hardware Specifications*, describes the physical characteristics of the EXM-GPIB board 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 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.

italic	Italic text denotes emphasis, a cross reference, or an introduction to a key concept.
bold italic	Bold italic text denotes a note, caution or warning.
`monospace`	Lowercase text in this font denotes text or characters that are to be literally input from the keyboard, sections of code, programming examples, and syntax examples. This font is also used for the proper names of disk drives, directories, programs, subprograms, subroutines, device names, functions, variables, and filenames.
`bold monospace`	Bold lowercase text in this font denotes the messages and responses that the computer automatically prints to the screen.
<>	Angle brackets enclose the name of a key on the keyboard–for example, <PageDown>.
-	A hyphen between two or more key names enclosed in angle brackets denotes that you should simultaneously press the named keys–for example, <Control-Alt-Delete>.
<Enter>	Key names are capitalized.
IEEE 488 and IEEE 488.2	*IEEE 488* and *IEEE 488.2* are used throughout this manual to refer to the ANSI/IEEE Standard 488.1-1987 and the ANSI/IEEE Standard 488.2-1987, respectively, which define the GPIB.

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 488.2-1987, *IEEE Standard Codes, Formats, Protocols, and Common Commands.*
- *EPC-7 Hardware Reference*, RadiSys Corp.

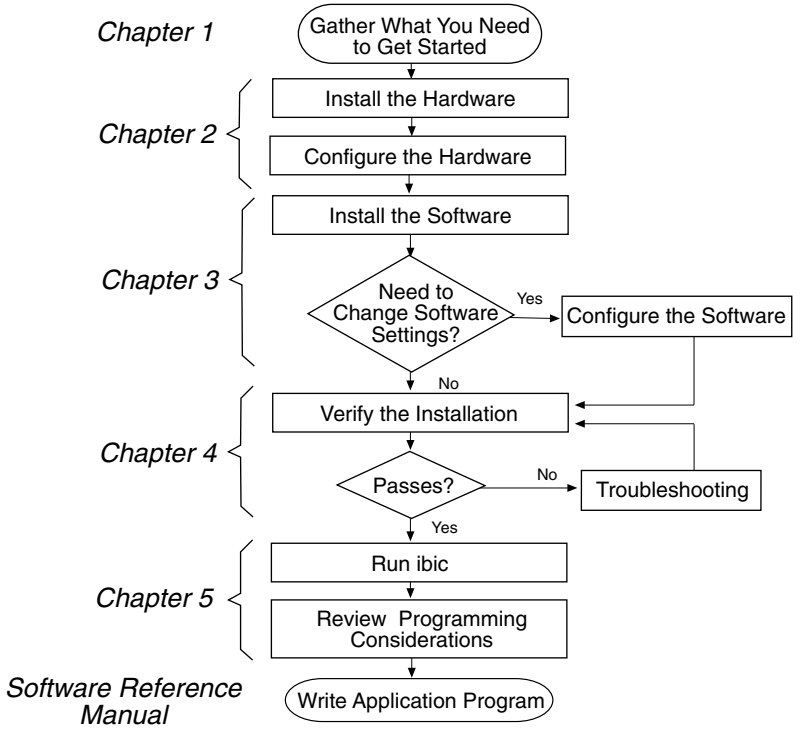
Customer Communication

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 includes a brief description of the NI-488.2 software and the EXM-GPIB board.

How to Use This Manual



What You Need to Get Started

- ❑ EXM-GPIB board (part number 182355-01)
- ❑ 3.5 in. *NI-488.2 Distribution Disk for EXM-GPIB for DOS Driver and Language Interfaces* (part number 422927-97)
- ❑ MS-DOS version 3.0 or higher (or equivalent) installed on your computer

Software Description

The NI-488.2 software package for DOS consists of a driver and utilities that transform a 16-bit EXM computer running DOS into a GPIB Controller with complete communications and bus management capabilities.

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

The NI-488.2 driver is a memory-resident program that is loaded as a device by the system configuration file. The driver file is approximately 50 KB in size.

Hardware Description

You can use standard GPIB cables to connect the EXM-GPIB with up to 13 instruments. If you want to use more than 13 instruments, you can order a bus extender or expander from National Instruments. Refer to Appendix A, *Hardware Specifications*, for more information about the EXM-GPIB hardware specifications and operating conditions.

Chapter 2
Hardware Installation and Configuration

This chapter contains instructions for installing and configuring your EXM-GPIB board.

Setting the Shield Ground Configuration (Optional)

The EXM-GPIB board is set at the factory with the jumper in place to connect the logic ground of the board to its shield ground. This configuration minimizes EMI emissions.

Caution: ***The EXM-GPIB board was tested for compliance with FCC standards with the shield ground connected to logic ground. Removing the jumper might cause EMI emissions to exceed any or all of the applicable standards.***

If your application requires the logic ground to be disconnected from shield ground, follow these steps:

1. Locate the jumper W1 on your EXM-GPIB board.

2. Remove the jumper and place it across only one of the jumper pins as shown in Figure 2-1.

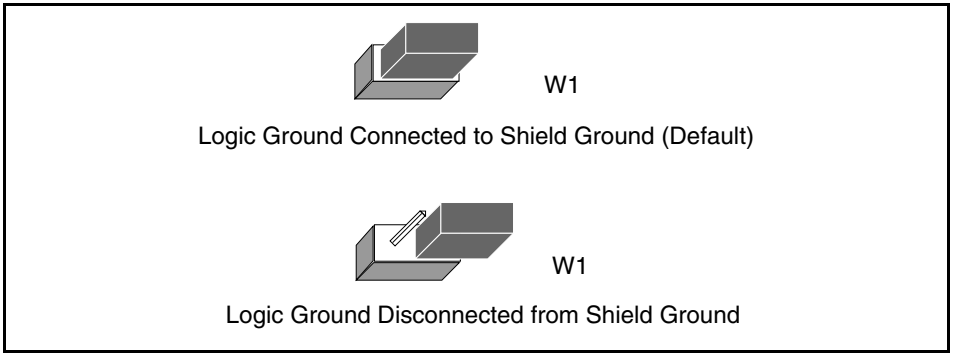


Figure 2-1. Ground Configuration Jumper Settings

3. Record the jumper setting on the *EXM-GPIB Hardware and Software Configuration Form* in Appendix B, *Customer Communication*.

Install the Hardware

You can install the EXM-GPIB board in any unused 16-bit EXM expansion slot (AT-style) in your computer. The EXM-GPIB board does *not* work if installed in an 8-bit expansion slot (PC-style). Consult the user manual or technical reference manual of your computer for specific instructions and warnings.

To install the EXM-GPIB board, perform the following steps:

1. Turn off your computer.

2. Remove the expansion slot cover on the front panel of the computer.

3. Insert the EXM-GPIB board in an unused 16-bit EXM slot with the GPIB receptacle sticking out of the opening on the front panel. It may be a tight fit, but do not force the board into place.

4. Screw the mounting bracket of the EXM-GPIB board into place.

5. Check the installation.

6. Turn on your computer.

7. The boot software asks you if you want to run the RadiSys EPC hardware setup program. Run the hardware setup program and refer to the following section for configuration instructions.

Configure the Hardware

After installing the EXM-GPIB board into an EXM slot of your RadiSys computer, follow these steps to configure the software settings for the base I/O address, interrupt level, and DMA channel:

1. If you did not automatically enter the EPC hardware setup program after you installed the driver, press <Cntl-Alt-Esc> at the DOS prompt to enter it.

2. Select the EXM menu. The following table appears with entries that correspond to configuration registers of the EPC:

Slot	ID	OB1	OB2
0	FF	00	00
1	FF	00	00
2	FF	00	00
3	FF	00	00
4	FF	00	00
5	FF	00	00

3. For every slot in which you have installed an EXM-GPIB board, you must enter the proper configuration values for the three columns ID, OB1, and OB2 as follows:

   ID: Enter 6D, the ID for the EXM-GPIB board. FF means no board is present.

   OB1: Enter a 1-byte hexadecimal number to configure the interrupt level and DMA channel of each board as follows:

7	6	5	4	3	2	1	0
D6	D5	0	0	I2	I1	I0	1

   D6 D5 : 00 = No DMA
   10 = DMA Channel 6
   01 = DMA Channel 5

   I2 I1 I0 : 000 = No Interrupts
   001 = Interrupt level 3
   011 = Interrupt level 5
   101 = Interrupt level 12

   Bit 0 must be set to 1. Bits 4 and 5 are *don't care* bits.

   OB2: enter a 1-byte hexadecimal number to configure the base I/O address of each board as follows:

7	6	5	4	3	2	1	0
0	0	0	0	B8	B7	B6	B5

   Bits 7 through 4 are *don't care* bits. B8 through B5 make up bits 8 through 5 of the base I/O address for the board; they can be any value between 0 (binary 0000) and 15 (binary 1111).

   The base I/O address is the following 10-bit number:

   1 B8 B7 B6 B5 0 0 0 0 0

   You must select a base I/O address that does not conflict with the address of any other device in your system.

Example

Consider a table with the following entries:

Slot	ID	OB1	OB2
0	FF	00	00
1	FF	00	00
2	6D	8B	06
3	6D	47	04
4	FF	00	00
5	FF	00	00

In this table, the entries indicate that two EXM-GPIB boards are installed in slots 2 and 3 of the EPC. The board in slot 2 is `GPIB0`. For `GPIB0`, OB1 is 8B (10001011 in binary), which means it uses DMA channel 6 and interrupt level 12. OB2 is 06 (00000110 in binary), which means B8B7B6B5 is 0110. Therefore, the I/O address of `GPIB0` is 2C0 in hex (1011000000 in binary). The board in slot 3, `GPIB1`, will use DMA channel 5, interrupt level 5, and reside at base address 0x280.

Note: ***The GPIB board in the lowest-numbered slot is designated as*** `GPIB0` ***in the NI-488.2 software. The GPIB board in the next slot is*** `GPIB1`***, and so on***.

4. Save the configuration.

5. Exit the EPC hardware setup program.

6. Reboot your computer.

Chapter 3
Software Installation and Configuration

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

NI-488.2 Software Components

Before you install the software, you should already have the EXM-GPIB board installed in your computer. The NI-488.2 package includes the following components:

- NI-488.2 driver
- An installation program
- Diagnostics
- An interactive GPIB control program
- An interactive configuration utility
- Language interfaces for C, QuickBASIC, BASIC, BASICA, and the universal language interface
- Sample programs that use NI-488 functions and NI-488.2 routines

Install the Software

Complete the following steps to install the NI-488.2 software.

1. Insert the NI-488.2 distribution diskette into an unused drive.
2. Install the software by entering one of the following commands.

   x`: install`

   or for the quick install option:

   x`: install/q`

   where *x* is the letter of the drive containing the distribution diskette.

   The quick version of the `install` program creates a directory, `c:\exmgpib`, and copies the NI-488.2 software files to that directory.

If you want to change the default file names and installation settings of the `install` program, refer to the *NI-488.2 Software Reference Manual for MS-DOS* for information on running the interactive version of `install`.

The `install` program copies the NI-488.2 software files to the `c:\exmgpib` directory. It also modifies the `c:\config.sys` file to include the following line.

```
device = c:\exmgpib\gpib.com
```

`install` then runs the EXM-GPIB hardware diagnostic program, `ibdiag`. `ibdiag` confirms that the hardware is functioning properly and verifies that the software configuration settings are correct. Refer to Chapter 4, *Installation Verification and Troubleshooting*, for more information on `ibdiag`.

An early version of the BIOS chip on the EPC has a faulty boot program that does not initialize the DMA Controller properly. The NI-488.2 software installation program corrects this problem by installing `exm27.sys` at the top of the `config.sys` file. This corrective patch is activated at boot time only for EPC computers with a faulty BIOS chip.

3. Reboot your computer.

Configure the Software with ibconf (Optional)

`ibconf` is an interactive utility you can use to examine or modify the configuration of the driver. You might want to run `ibconf` to change the settings for device names or timeout values. You can also use `ibconf` to disable DMA transfers and interrupts.

To run `ibconf`, go to the `c:\exmgpib` directory where the NI-488.2 software is installed, and enter the following command:

```
ibconf
```

After you enter `ibconf`, use the cursor keys and help information to examine the settings and make any necessary changes. To exit `ibconf`, press <Esc> or the function key <F9> and save your changes.

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

After the software is installed and configured, you should verify the installation. Refer to Chapter 4, *Installation Verification and Troubleshooting*.

Chapter 4
Installation Verification and Troubleshooting

This chapter describes how to verify the installation, troubleshoot error messages, and correct DMA transfer errors.

Run the Hardware Diagnostic Program

To verify and test the hardware installation, run the hardware diagnostic program `ibdiag` that came with your NI-488.2 software. `ibdiag` verifies that your hardware is functioning properly and that the hardware configuration settings are correct and are not used by any other device in your system.

Follow these steps to run `ibdiag`:

1. Disconnect any GPIB cables from the EXM-GPIB.
2. Go to the directory where the software is installed (default is `c:\exmgpib`).
3. Enter the following command:

   ```
   ibdiag
   ```

If `ibdiag` completes with no errors, your hardware is functioning properly. If an error does occur, an error message asks if you want to continue testing. Do not continue testing. Type <n> to stop testing and then <q> to quit. Use the EPC setup program to select different hardware settings and run `ibdiag` again. If you still get an error message, record the error message and refer to Appendix B, *Customer Communication*, before contacting National Instruments for technical support.

Run the Software Diagnostic Program

To verify and test the hardware and software installation, run the software diagnostic program `ibtest` that came with your NI-488.2 software. The `ibtest` program is an NI-488.2 application that makes calls to the driver just as your application would. Follow these steps to run `ibtest`:

1. Disconnect all GPIB cables from the EXM-GPIB.
2. Go to the directory where the software is installed (default is `c:\exmgpib`)
3. Enter the following command:

   ```
   ibtest
   ```

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

Troubleshooting ibtest Error Messages

The following sections explain common error messages generated by `ibtest`.

Note: ***In the following paragraphs,*** `GPIBx` ***refers to board*** `GPIB0,GPIB1,GPIB2,` ***or*** `GPIB3` ***as appropriate.***

Presence Test of Driver

The `ibtest` program tests for the presence of the NI-488.2 driver. It displays the following message if it detects a problem:

`<<< No driver present for GPIBx. >>>`

If this message appears, take one of following actions:

- You can ignore this message when it applies to a nonexistent board. The `ibtest` program always tries to test for four EXM-GPIB boards. In most cases you will have fewer than four boards installed in your computer. This message appears when `ibtest` tries to test a board that does not exist.
- Make sure that you installed the GPIB driver. Verify that the line `device=c:\exmgpib\gpib.com` appears in your `config.sys` file and reboot.

Presence Test of GPIB Board

The following error message appears if `GPIBx` is not installed or if the software is not configured properly:

`<<< No board present for GPIBx. >>>`

If this message appears, you could have either of these situations:

- The `Use this GPIB Interface` field in `ibconf` is set to `no` for board `GPIBx`. If you want to use this board you need to set this field to `yes`.
- The board is not installed or configured correctly. Check that the board is properly installed. You can run the EPC hardware setup program to verify the board configuration. Refer to *Configure the Hardware* in Chapter 2, *Hardware Installation and Configuration*, for detailed instructions.

Incorrect Interrupt Level

The `ibtest` program hangs if the EXM-GPIB board under test is configured to use an invalid interrupt level or an interrupt level used by another device in your system. If this occurs, you can either run the EPC hardware setup program and select a different interrupt level or use `ibconf` to disable interrupts. For detailed instructions, refer to the sections *Configure the Hardware* in Chapter 2 and *Configure the Software with ibconf* in Chapter 3.

GPIB Cables Connected

The following error message appears if a GPIB cable is connected to the board when you run `ibtest`.

```
Call(25) 'ibcmd " "' failed, ibsta (0x134) not what was expected (0x8130)

Call(25) 'ibcmd " "' failed, expected ibsta (0x100) to have the ERR bit set.
```

Disconnect all GPIB cables before trying the test again.

DMA Transfer Errors

An early version of the BIOS chip on the EPC has a faulty boot program that does not initialize the DMA Controller properly. The NI-488.2 software installation program corrects this problem by installing `exm27.sys` at the top of the `config.sys` file. This corrective patch is activated at boot time only for EPC computers with a faulty BIOS chip. Make sure that the following line appears in the `config.sys` file:

```
device=c:\exmgpib\exm27.sys
```

This line must appear before the line that loads `gpib.com` and before any other memory manager line that begins with `device=`.

After modifying the `config.sys` file, reboot your computer.

Chapter 5
Using Your NI-488.2 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-488.2 software. You can use `ibic` to enter NI-488.2 functions interactively and display the results of the function calls automatically. Without writing an application, you can use `ibic` to:

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

For more information about `ibic`, use the `ibic` help function or refer to the *NI-488.2 Software Reference Manual for MS-DOS*.

Programming Considerations

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

- You must include the header file in your source code.
- You must link the language interface object file with your compiled source code.

For more information about using the NI-488.2 software and each NI-488 function and NI-488.2 routine, refer to the *NI-488.2 Software Reference Manual for MS-DOS*.

Appendix A
Hardware Specifications

This appendix describes the physical characteristics of the EXM-GPIB board and the recommended operating conditions.

Table A-1. Electrical Characteristics

Characteristic	Specification
Transfer Rates	
GPIB Reads	over 1 Mbytes/s*
GPIB Writes	over 1 Mbytes/s*
GPIB Commands	500 kbytes/s*
Power Requirement (from EXM expansion slot)	+5 VDC 0.6 A Typical 0.8 A Maximum
* Actual speed may vary considerably from those shown due to instrumentation capabilities.	

Table A-2. Physical Characteristics

Characteristic	Specification
Dimensions	3.0 in. by 5.9 in.
I/O Connector	IEEE 488 Standard 24-pin

Table A-3. Environmental Characteristics

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

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.

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Technical Support Form

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

Name _____

Company _____

Address _____

_____

Fax (___)_____ Phone (___)_____

Computer brand _____

Model _____ Processor _____

Operating system _____

Speed _____MHz RAM _____MB

Display adapter _____

Mouse _____yes _____no

Other adapters installed _____

Hard disk capacity _____MB Brand _____

Instruments used _____

National Instruments hardware product model _____

Revision _____

Configuration _____

(continues)

National Instruments software product _____

Version _____

Configuration _____

The problem is _____

_____

_____

_____

_____

_____

_____

_____

List any error messages _____

_____

_____

_____

_____

_____

_____

_____

The following steps will reproduce the problem _____

_____

_____

_____

_____

_____

_____

EXM-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. Update this form each time you revise your software or hardware configuration, and use this form as a reference for your current configuration.

National Instruments Products

- EXM-GPIB Hardware Revision _____
- NI-488.2 Software Revision Number on Distribution medium

  _____
- Board Settings:

	Base I/O Address	Interrupt Level	DMA Channel
GPIB0	_____	_____	_____
GPIB1	_____	_____	_____
GPIB2	_____	_____	_____
GPIB3	_____	_____	_____

- Shield Ground Connected to Logic (Yes or No) _____

Other Products

- Computer Make and Model _____
- Microprocessor _____
- Clock Frequency (Bus and Microprocessor)_____
- Type of Video Board Installed _____
- DOS Version _____
- Application Programming Language (BASIC, C, Pascal, and so on) _____

  _____

(continues)

- Other Boards in System _____
- Base I/O Address of Other Boards _____
- Arbitration Levels of Other Boards_____
- Interrupt Level of Other Boards _____
- VXIbus Mainframe Make and Model_____
- Other VXIbus Devices in System _____
- Static Logical Addresses of Other VXIbus Devices_____

  _____

Documentation Comment Form

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Edition Date: **April 1994**

Part Number: **370892A-01**

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

(continues)

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

_____

_____

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Thank you for your help.

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Glossary

Prefix	Meaning	Value
k-	kilo-	10^3
M-	mega-	10^6

o	degrees
%	percent
A	amperes
AC	alternating current
ANSI	American National Standards Institute
BIOS	Basic Input/Output System
C	Celsius
DMA	direct memory access
EMI	electromagnetic interference
EPC	Embedded Personal Computer
GPIB	General Purpose Interface Bus
hex	hexadecimal
Hz	hertz
I/O	input/output
in.	inches
IEEE	Institute of Electrical and Electronic Engineers
KB	kilobytes of memory
MB	megabytes of memory
PC	personal computer
RAM	random-access memory
s	seconds
VDC	volts direct current

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