Getting Started with Your AT-GPIB and the NI-488M™ Software for INTERACTIVE UNIX System V

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FCC/DOC Radio Frequency Interference Compliance

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

• The limits for a Class B computing device, in accordance with the specifications in Part 15 of U.S. Federal Communications Commission (FCC) Rules. Operation is subject to the following two conditions:

    – This device may not cause harmful interference.

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

• The limits for radio noise emissions from digital apparatus set out in the Radio Interference Regulations of the Canadian Department of Communications (DOC).

These regulations are designed to provide reasonable protection against interference from the equipment to radio and television reception in residential areas.

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 used according to this instruction manual.

If the equipment does cause interference to radio or television reception, which can be determined by turning the equipment on and off, one or more of the following suggestions may reduce or eliminate the problem.

• 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.

• Relocate the equipment with respect to the receiver.

• Reorient the receiver's antenna.

- Be sure that the equipment is plugged into a grounded outlet and that the grounding has not been defeated with a cheater plug.

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

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.

Bescheinigung des Herstellers/Importeurs

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Der Detusche Bundespost wurde das Inverkehrbringen dieses Gerätes angezeigt und die Berechtigung zur Überprüfung der Serie auf Bestimmungen eingeräumt.

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About This Manual

This manual contains instructions for installing and configuring the National Instruments AT-GPIB interface board and NI-488M multitasking software for use with the INTERACTIVE UNIX System V Release 3.2 operating system. The hardware and software are intended for use on a PC AT compatible computer with a 386 or higher processor. This manual is meant to be used with the National Instruments IEEE 488 Multitasking UNIX software reference (*NI-488M Software Reference Manual*, Part Number 320062-01).

The material in this manual is for users who have extensive knowledge of the INTERACTIVE UNIX operating system and have super-user privilege. This manual also assumes that the user has already received an AT-GPIB board along with a user manual.

Organization of This Manual

This manual is organized as follows:

- Chapter 1, *Introduction*, contains a picture of the AT-GPIB board, lists the contents of your NI-488M kit and optional equipment, and briefly describes the AT-GPIB board and NI-488M software.

- Chapter 2, *Software Installation*, lists all the programs and files located on the distribution disk and contains the steps for installing the NI-488M software.

- Chapter 3, *Hardware Configuration and Installation*, contains step-by-step instructions for unpacking, configuring, and installing your AT-GPIB board in a PC AT after you have installed your NI-488M software.

- Chapter 4, *Software Verification and Configuration*, describes how to verify the software installation and configure the software. It also contains information about using the NI-488M software with your application program and removing the NI-488M software.

- Appendix A, *Additional NI-488M Functions*, describes three additional NI-488M functions included in the NI-488M software. These functions are not described in the *NI-488M Software Reference Manual*.

- Appendix B, *Hardware Specifications*, contains a description of the electrical, physical, and environmental characteristics of the AT-GPIB board and the conditions under which it should be used.

- Appendix C, *Customer Communication*, contains forms you can use when requesting 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.

enter	*Enter* is reserved to mean that the commands immediately succeeding the word must be typed into the computer and then executed by pressing the <Return> key on the keyboard.
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 ANSI/IEEE Standard 488.2-1987, respectively, which define the GPIB.
INTERACTIVE UNIX	The term *INTERACTIVE UNIX* is used throughout this manual to refer to the INTERACTIVE UNIX System V Release 3.2 operating system.
italic	Italic text denotes emphasis, a cross reference, or an introduction to a key concept.
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, paths, directories, programs, subprograms, subroutines, device names, functions, variables, filenames, and extensions, and for statements and comments taken from program code.

`monospace`	Italic text in this font denotes that you must supply the appropriate words or values in the place of these items.
NI-488M software	The term *NI-488M software* is used throughout this manual to refer to the NI-488M software for INTERACTIVE UNIX unless otherwise noted.
PC AT	The term *PC AT* is used throughout this manual to refer to the PC computer with an AT bus and a 386 or higher processor.
[ ]	Square brackets enclose optional keystrokes, words, or values that you might need to supply.

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*

- *INTERACTIVE UNIX System V/386 Release 3.2 Operating System Guide*

- *INTERACTIVE UNIX Software Development System Guide and Programmer's Reference Manual*

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 C, *Customer Communication*, at the end of this manual.

Chapter 1
Introduction

This chapter contains a picture of the AT-GPIB board, lists the contents of your NI-488M kit and optional equipment, and briefly describes the AT-GPIB board and NI-488M software.

Figure 1-1 shows the AT-GPIB board.
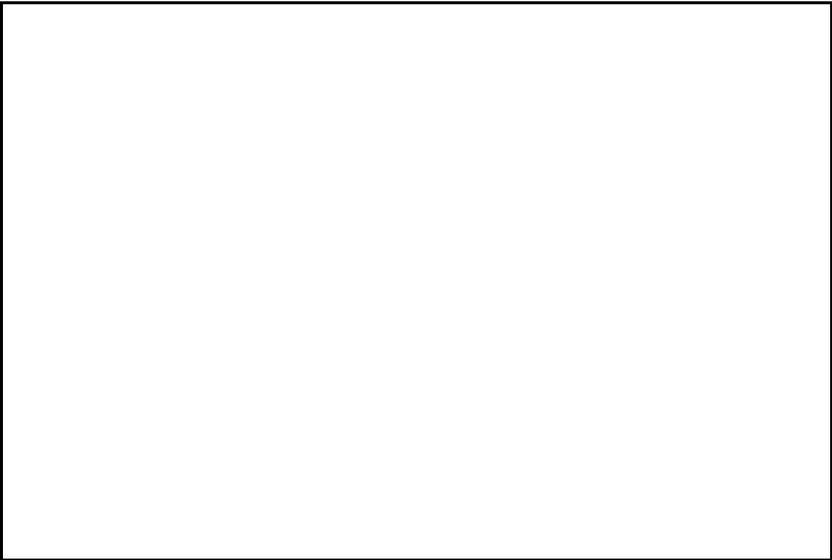
Figure 1-1. AT-GPIB Board

What Your Kit Should Contain

Your NI-488M software kit should contain the following components:

Component	Part Number
NI-488M Distribution Disk for AT-GPIB and INTERACTIVE UNIX System V/386 Driver and C Interface	
3.5 in. disk	422884-55
5.25 in. disk	420884-55
Getting Started with Your AT-GPIB and the NI-488M Software for INTERACTIVE UNIX System V	320518-01
NI-488M Software Reference Manual	320062-01

Make sure each of these items is in your kit. If any item is missing, contact National Instruments.

Note: To complete the hardware and software installation, you need the AT-GPIB board (part number 181060-01).

Optional Equipment

You can call National Instruments to order the following optional
equipment to go with your kit:

Component	Part Number
Double Shielded Cables*:	
GPIB Type X2 Cable – 1 m	763061-01
GPIB Type X2 Cable – 2 m	763061-02
GPIB Type X2 Cable – 4 m	763061-03
* In order to meet FCC emission limits for a Class B device, you must use a double shielded (Type X2) GPIB cable. Operating this equipment with a single shielded (Type X1) cable may cause interference to radio and television reception in residential areas.	

Hardware Description

The AT-GPIB board is a full-function, high-performance IEEE 488
interface for use on a PC AT compatible computer with a 386 or higher
processor (herein referred to as the PC AT) that is equipped with 16-bit
plug-in slots. The AT-GPIB board makes the PC AT a high-performance
IEEE 488 Controller.

Software Description

The NI-488M software is a comprehensive package of programs and drivers
that transforms any computer running INTERACTIVE UNIX System V
Release 3.2 into a GPIB Controller with complete communications and bus
management capabilities. The NI-488M software also includes a C
language interface and an interactive control utility, `ibic`.

Chapter 2
Software Installation

This chapter lists all the programs and files located on the distribution disk and contains the steps for installing the NI-488M software.

Step 1.   Prepare to Install the Software

Before installing the NI-488M software, consider the following:

*   You must have super-user privilege.

*   The *INTERACTIVE UNIX Kernel Configuration Subset,* which is needed for adding device drivers, must already be installed. Install the subset now if you have not already done so.

*   The *NI-488M Distribution Disk for AT-GPIB and INTERACTIVE UNIX System V/386 Driver and C Interface* is in `tar` format.

    Note: This disk will be referred to as the *NI-488M distribution disk* throughout the remainder of this manual.

The files contained on the NI-488M distribution disk are as follows:

ibinstall	Installation script for the driver
Driver_16dev.o	NI-488M driver for AT-GPIB with 16 device entries
Driver_32dev.o	NI-488M driver for AT-GPIB with 32 device entries
Space.c	NI-488M driver data structure for AT-GPIB
ibconf	Software configuration utility
ibic	Interactive control utility
ibtsta	Installation test part A
ibtstb	Installation test part B
ugpib.h	Include file for user programs
cib.c	C language library
bcsamp.c	Example C program using NI-488M board calls
dcsamp.c	Example C program using NI-488M device calls

Step 2.　Install the Software

Follow these procedures to install the NI-488M software.

The term *enter* is used throughout the remainder of this manual to mean that the commands immediately succeeding the word must be typed into the computer and then executed by pressing the <Return> key on the keyboard.

A.　Set Up a Working Directory

1.　Log on as `root`.

2.　Create a working directory (for example, `/usr/gpib`) and change to that directory by entering the following commands:

```
cd usr
mkdir gpib
cd gpib
```

3.　Copy the files from the NI-488M distribution disk to your working directory using the `tar` command shown in Step 3a or 3b, according to the size of your distribution disk.

    a.　For a 3.5 in. disk:

       • Enter the following command to copy files from drive `0`:

```
tar xvf /dev/dsk/f0q9dt
```

       • Enter the following command to copy files from drive `1`:

```
tar xvf /dev/dsk/f1q9dt
```

    b.　For a 5.25 in. disk:

       • Enter the following command to copy files from drive `0`:

```
tar xvf /dev/dsk/f0q15dt
```

       • Enter the following command to copy files from drive `1`:

```
tar xvf /dev/dsk/f1q15dt
```

B. Install the Utility Files

1. Copy the file ugpib.h to /usr/include/sys by entering the
    following command:

    ```
    cp ugpib.h /usr/include/sys
    ```

2. Copy the files ibic, ibconf, ibtsta, and ibtstb to a directory
    in the command search path (for example, /usr/bin) by entering the
    following commands:

    ```
    cp ibic /usr/bin
    cp ibconf /usr/bin
    cp ibtsta /usr/bin
    cp ibtstb /usr/bin
    ```

C. Install the C Library

Compile and convert the file cib.c to a C library file. To compile cib.c
and create a C language library, enter the following commands:

```
cc -c cib.c
ar rv /usr/lib/libgpib.a cib.o
```

You can also add cib.o to an existing library or include cib.o during the
link phase of each compile operation.

D. Install the NI-488M Driver and Build the New Kernel

The NI-488M driver must be installed into the kernel configuration, and a
new kernel must be built with the new configuration.

Using the Installation Script

The following steps explain how to use the installation script.

1. To install the NI-488M driver, go to the working directory
    (/usr/gpib) that you created earlier in this chapter under
    Step 2A. Set Up a Working Directory, and enter the following
    command:

    ```
    ./ibinstall
    ```

2. Choose your software settings when the installation script prompts you. Use the default settings if possible. The script prepares the files in the current directory for installation.

3. The `insdriver` system utility is called by `ibinstall` to insert the information for the NI-488M driver into the kernel configuration. `insdriver` is user-interactive.

4. The `kconfig` system utility is called by `insdriver` to rebuild and install a new kernel with the NI-488M driver installed. Choose the **BUILD** menu from the `kconfig` main menu. You must also choose the **INSTALL** menu if you are not explicitly prompted to install the kernel. `kconfig` is user-interactive.

The following sections contain some helpful information about running `ibinstall`, using `kconfig`, and resolving potential conflicts.

Choosing the Software Settings

You can install up to four AT-GPIB boards. For each AT-GPIB board you install, you must select a *unique* base address, DMA channel, and interrupt request line. Use the software default settings if possible. Table 2-1 lists the software default settings and other possible settings.

Record the software settings that you choose in Table 3-1 in Chapter 3 of this manual, and on the configuration form in Appendix C, *Customer Communication*. You should record the settings so that you can refer to them when you set the jumpers and switches on your AT-GPIB boards.

Table 2-1. Software Default Settings and Possible Settings

AT-GPIB	Possible Settings	Software Default Settings			
		gpib0	gpib1	gpib2	gpib3
Base I/O Address (hex) (stop address = start or base address + 1F hex)	100 to 3E0 (in 20 hex increments)	2C0	2A0	280	260
DMA Channel	5, 6, 7, and NONE	6	7	NONE	NONE
Interrupt Request Line (IRQ)	3, 4, 5, 6, 7, 9, 10, 11, 12, 14, 15	10	12	9	11

The NI-488M driver shares the system resources with other device drivers, so not all possible settings may be available.

The system checks your base I/O address and interrupt request line settings to make sure they are unique for each AT-GPIB board installed, but it checks the DMA channel setting for gpib0 only. The INTERACTIVE UNIX operating system specifies only one DMA channel for each device driver, so the DMA channel specified for the NI-488M driver is used by gpib0. You are responsible for potential conflicts if you choose a DMA channel for a board other than gpib0. You can change the AT-GPIB DMA channels for boards other than gpib0 by running the installation script ibinstall.

Table 2-2 shows the default configuration for available DMA channels in the INTERACTIVE UNIX operating system.

Table 2-2. INTERACTIVE UNIX Default Configuration for DMA
Channels

DMA Channel	Availability
5	Used by ESDI Disk Controller mcesdi. By default, this driver is configured as a required driver in the system.
6	Free
7	By default, DMA channel 7 can be used by the Compaq 525MB SCSI Tape Driver cpqs. cpqs is is in the Additional Drivers Package of the operating system. Even when the package is installed, it is not configured as an active device in the kernel, so channel 7 is available.

Using the kconfig Utility

When you are running the installation script, the kconfig system utility
main menu appears on your screen with options to **CONFIGURE**, **BUILD**,
or **INSTALL**. Choose the **BUILD** menu to build a new kernel and then
install it as the kernel that the system uses when it starts up. If the system
does not prompt you to install the kernel, you need to also choose the
INSTALL menu. If the system detects a conflict, the kconfig utility
main menu appears on your screen again. To resolve the conflict, refer to
Resolving Conflicts Found While Building the New Kernel later in this
chapter.

kconfig varies from system to system, but it is largely self-explanatory.
For more information about using kconfig, refer to the section entitled
Using kconfig to Tailor Your System Kernel in the *INTERACTIVE UNIX
System Maintenance Procedures* section of the *INTERACTIVE UNIX System
V/386 Release 3.2 Operating System Guide*.

Ending the Installation Procedure

After the kernel is successfully built and installed, you *must* wait for the following message to appear on your screen:

```
The system is down
Press any key to reboot
```

When you see this message, power off your computer, remove the distribution disk from the floppy drive, and proceed to Chapter 3, *Hardware Configuration and Installation.*

Resolving Conflicts Found While Building the New Kernel

When you use the `kconfig` system utility to build the new kernel, the system might detect conflicts between the NI-488M driver settings and the settings of other drivers installed in your system. If this occurs try the following options in the order in which they are listed. (If you are in the UNIX shell, you can enter the `kconfig` utility directly by entering the command `kconfig`.)

1. If the conflicting device is `gendev`, use the `kconfig` **CONFIGURE** menu to reconfigure the High-Performance Disk Driver (HPDD). Then choose the **BUILD** menu to build the kernel again.

    `gendev` is the name of the HPDD. By default, HPDD is configured to attempt to recognize more than 7 Controllers, which is more than you might have in the system. The HPDD also uses many system resources. By reconfiguring the HPDD, you release most of the resources and improve system performance at boot time.

2. If the conflicting device is one which you do not use and is listed in the driver list under the `kconfig` **CONFIGURE** menu, you can remove the driver from the kernel configuration. If you want to use that device in the future, you can add it the same way you removed it, and remove the NI-488M driver. After reconfiguring the kernel, choose the **BUILD** menu to build the kernel again.

3. Change the settings of the NI-488M driver. In version 3.0 of INTERACTIVE UNIX, you can use the `kconfig` utility to change the settings of device drivers. If you are using this version, you can use the `kconfig` **CONFIGURE** menu to change the NI-488M driver's software configuration settings, then choose the **BUILD** menu to build the kernel again. If you are using an earlier version of INTERACTIVE

UNIX, you must quit the kconfig utility and run ibinstall again using different settings for the NI-488M driver. Record your new settings in Table 3-1 and on the configuration form in Appendix C, *Customer Communication*.

Note: If you are using version 3.0 of INTERACTIVE UNIX, do *not* use `kconfig` to change the DMA, interrupt request level, base I/O address, or memory address of any other device drivers without first consulting the documentation for the drivers. However, you can still use kconfig to add or remove any driver in the kernel configuration (turn it on or off).

If you need more information about the kernel configuration, you can use the files `/etc/conf/cf.d/mdevice` and `/etc/conf/cf.d/sdevice`. For an explanation of these files, refer to section 4 of the *INTERACTIVE UNIX Software Development System Guide and Programmer's Reference Manual*.

Chapter 3
Hardware Configuration and Installation

This chapter contains step-by-step instructions for unpacking, configuring, and installing your AT-GPIB board in a PC AT after you have installed your NI-488M software.

Step 1. Unpack Your AT-GPIB

If you have not already unpacked your AT-GPIB board, follow these steps.

1. Do *not* remove the board from its plastic package at this point. Your AT-GPIB board is shipped in an antistatic plastic package to prevent electrostatic damage to the board. Several components on the board can be damaged by electrostatic discharge.

2. To avoid electrostatic damage in handling the board, touch the plastic package to a metal part of your computer chassis before removing the board from the package.

3. Remove your AT-GPIB board from the package and inspect the board for loose components or any other sign of damage. Notify National Instruments if your board appears damaged in any way. Do *not* install a damaged board into your computer.

Step 2. Configure the Hardware

The AT-GPIB board is shipped from the factory with default settings that do not match the NI-488M software default settings. You must change the hardware settings to match the software settings.

Warning: If your AT-GPIB board is already installed, shut down the operating system and power down the computer before you remove the board to change the settings.

Figure 3-1 shows the location of the AT-GPIB configuration jumpers and switches.

Figure 3-1. AT-GPIB Parts Locator Diagram

Choose the Switch and Jumper Settings

The NI-488M software supports four boards: `gpib0` is the default name of the first board, `gpib1` is the name of the second board, and so on. The switch and jumper settings on your AT-GPIB board must match the corresponding software settings. Table 3-1 shows the hardware default settings and the software settings you used when you installed your software.

Table 3-1. Hardware Default Settings and Your Software Settings

AT-GPIB	Hardware Default Settings	Your Software Settings			
		gpib0	gpib1	gpib2	gpib3
Base I/O Address (hex)	2C0				
DMA Channel	5				
Interrupt Request Line (IRQ)	11				

If you forgot to record your software settings in Table 3-1, you can view them anytime you reboot your computer. They appear on the screen with the National Instruments copyright message.

Set the Base I/O Address

Use the settings you recorded in Table 3-1 to set the base I/O addresses on your AT-GPIB board(s). The base I/O address is determined by the switches at position U25 (refer to Figure 3-1). The switches are set at the factory for base I/O address 2C0 hex (refer to Figure 3-2). This setting uses the I/O address space 2C0 through 2DF hex. If you install more than one AT-GPIB board in your computer, each board must be configured to use a unique base I/O address.

Each switch in U25 corresponds to one of the PC AT bus address lines A9 through A5. The top switch (1) corresponds to address line A9, the next switch from the top (2) corresponds to address line A8, and so on. The five least significant bits of the address (A4 through A0) are used by the AT-GPIB board to select the appropriate GPIB adapter register and cannot be changed; therefore, bits A4 through A0 are always 00000 (binary) when determining the base I/O address.

To select a binary value of 1 (OFF) for an address bit, press down on the side of the switch marked 1. Press down on the side marked 0 to select a binary value of 0 (ON) for the corresponding address bit.

Figure 3-2 shows the two switch settings to match software defaults for gpib0 and gpib1. In this figure, the black side of the switch is the side

you press down. Figure 3-2 also shows how each base I/O address was
calculated from the switch positions.
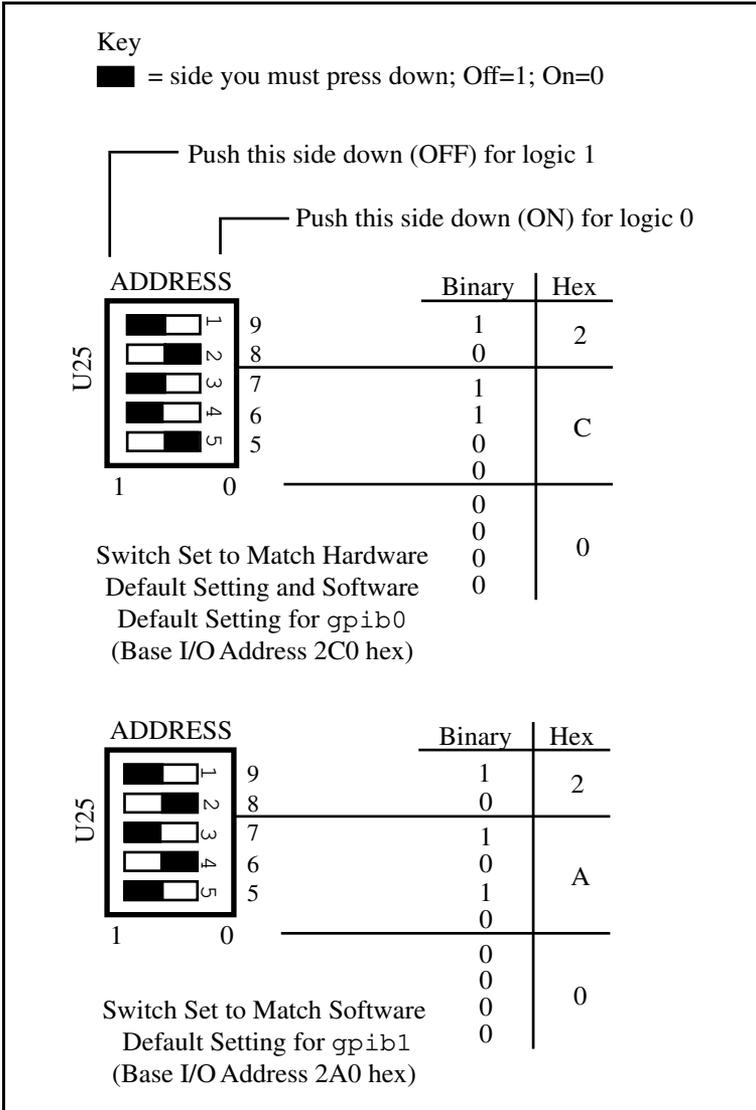
Figure 3-2. Base I/O Address Switch Settings

Set the Interrupt Request Line

Use the settings you recorded in Table 3-1 to set the interrupt request lines on your AT-GPIB board(s). If you install more than one AT-GPIB board in your computer, each board must be configured to use a unique interrupt request line. You must change the interrupt request level to match the software settings.

To enable an interrupt line, place the jumper on the appropriate pins. For interrupt lines 3 through 7, or 9, use jumper set W3 (refer to Figure 3-1). For lines 10 through 15, use jumper set W2 (refer to Figure 3-1). Figure 3-3 shows the interrupt levels set to IRQ10 to match `gpib0` and IRQ12 to match `gpib1`.
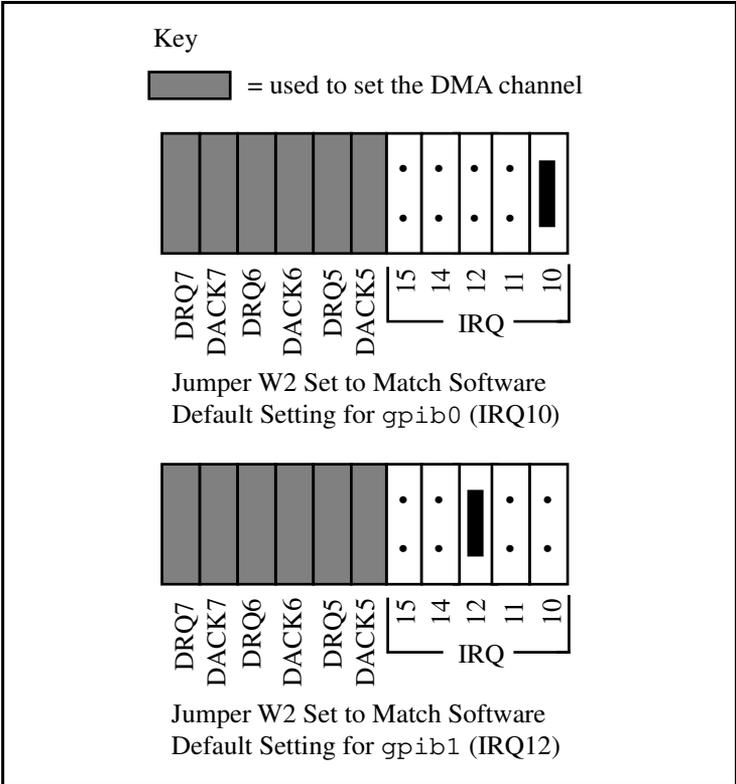
Figure 3-3. Interrupt Jumper Settings to Match Software Defaults

Set the DMA Channel

Use the settings you recorded in Table 3-1 to set the DMA channels on your AT-GPIB board(s). If you install more than one AT-GPIB board in your computer, each board must be configured to use a unique DMA channel. You must change the DMA channel setting on the hardware to match the software DMA channel setting.

Each DMA channel consists of two signal lines as shown in Table 3-2.

Table 3-2. DMA Channels for the AT-GPIB

DMA Channel	Signal Lines	
	DMA Acknowledge	**DMA Request**
5	DACK5	DRQ5
6	DACK6	DRQ6
7	DACK7	DRQ7

You must position two jumpers to select a DMA channel (refer to Figure 3-1). One jumper selects the DMA request line, and the other selects the DMA acknowledge line. You must move these two jumpers as a pair, and the DMA acknowledge and DMA request lines that you select must have the same numeric suffix for proper operation. Figure 3-4 shows jumper positions for selecting DMA channels 6 and 7.
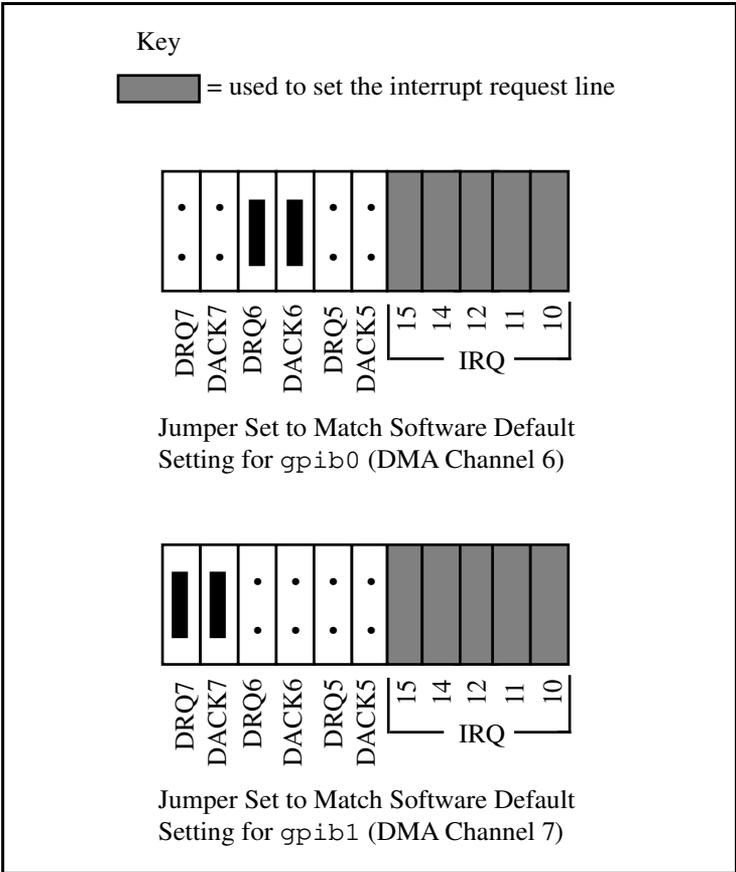
Figure 3-4. DMA Channel Jumper Setting

If you do not want to use DMA for GPIB transfers, remove the two DMA jumpers on the AT-GPIB board. Removing the jumpers disconnects the AT-GPIB board from the DMA channel lines of the PC AT bus and disables the board from asserting a DRQ line on the PC AT I/O channel. After removing the jumpers, you can store them on the board as shown in Figure 3-5.
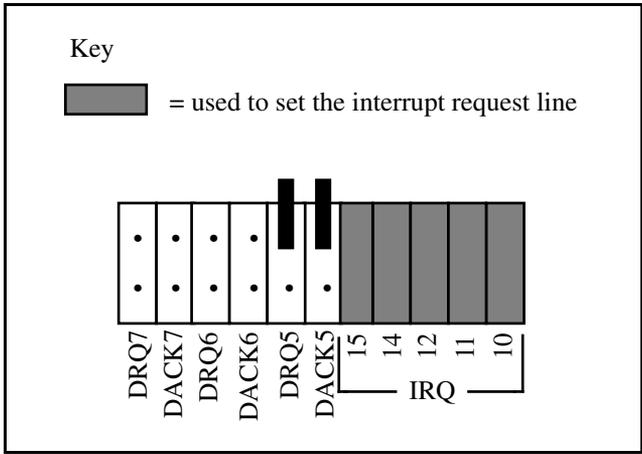
Figure 3-5. DMA Jumper Setting for No DMA Channel

Set the Shield Ground Configuration

The AT-GPIB board is set at the factory with the jumper in place to connect the logic ground of the AT-GPIB board to its shield ground. This configuration minimizes the EMI emitted from a PC AT equipped with an AT-GPIB board. However, if your application requires that logic ground be disconnected from shield ground, remove the jumper (W1) and place it across only one of the jumper pins. Jumper settings for logic ground connected and disconnected from shield ground are shown in Figure 3-6.

a. Connect Logic Ground to Shield Ground (default)

b. Disconnect Logic Ground from Shield Ground
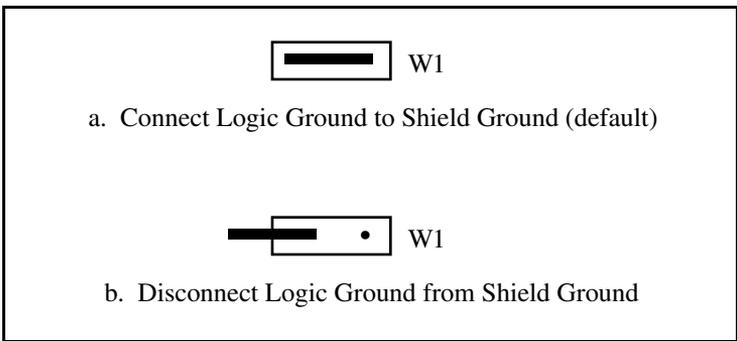
Figure 3-6. Ground Configuration Jumper Settings

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

Step 3. Install the Hardware

You can install the AT-GPIB board in any unused expansion slot in your computer. After you change the switch and jumper settings, verify the settings, and record the settings in Table 3-1 and on the *AT-GPIB Hardware and Software Configuration Form* located in Appendix C, you are ready to install your AT-GPIB board.

The following steps are general installation instructions. Consult the manual that came with your computer for specific instructions and warnings.

1. Turn off your computer.

2. Unplug the power cord.

3. Remove the top cover or access port to the I/O channel.

4. Insert the AT-GPIB board in an unused 16-bit slot (you might have to remove a blank expansion slot cover bracket) with the IEEE 488 receptacle sticking out of the opening on the back panel. It might be a tight fit, but do not force the board into place. Make sure the board is securely installed.

5. Screw the AT-GPIB mounting bracket to the back panel rail of the computer.

6. Replace the top cover.

7. Plug the power cord into the wall outlet.

8. Turn your computer back on.

Your AT-GPIB board is now installed. Proceed to Chapter 4, *Software Verification and Configuration*.

Chapter 4
Software Verification and Configuration

This chapter describes how to verify the software installation and configure the software. It also contains information about using the NI-488M software with your application program and removing the NI-488M software.

Verify the Software Installation

After you have installed the new kernel successfully, verify the installation. If the installation was successful, the National Instruments copyright statement appears on your screen when you reboot your computer, along with the software settings for each AT-GPIB board installed. If you do not see the copyright message, then the NI-488M driver is not in the kernel that the system uses to boot up with, and you need to reinstall the driver. If the boot message indicates that a board is not installed, you need to check the AT-GPIB board's base address setting. It must match the setting on the screen.

Also, two software installation tests are included on your distribution disk: `ibtsta` and `ibtstb`.

- `ibtsta` checks for a correct node `/dev/gpib0` and correct access to the device driver.

- `ibtstb` checks for correct DMA and interrupt operation. `ibtstb` requires a GPIB analyzer and can be omitted if an analyzer is not available.

Complete the following steps to verify the software installation.

1. Run `ibtsta` by entering the following command:

        ibtsta

2. If `ibtsta` completes with no errors and a bus analyzer is available,
    connect the bus analyzer to the GPIB board, and then run `ibtstb` by
    entering the following command:

    ```
    ibtstb
    ```

If no error occurs, the NI-488M driver is installed correctly. If an error does
occur, try the following solutions until the verification test is successful.

1. Run the verification test again, following the instructions carefully.

2. Check the interrupt and DMA settings on your AT-GPIB board(s).
    They should match the settings that appear on your screen with the
    National Instruments copyright when you boot your computer.

3. Return to the *Using the Installation Script* section in Chapter 2,
    Software Installation, and repeat the installation procedure, following
    the instructions carefully.

4. If the installation is still not successful, refer to Appendix C, *Customer
    Communication*, and fill out the configuration information before
    contacting National Instruments.

Configure the Software with ibconf (Optional)

You might want to view or change some of the default software parameters.
The software configuration utility `ibconf` allows you to change these
software parameters. For example, `ibconf` allows you to change the
following items:

• names of devices

• connection of devices to boards

• primary and secondary GPIB address

• timeout value

• EOS byte

• whether the board is System Controller

`ibconf` is self-explanatory with help screens to explain all commands and options.

Use the following command to access `ibconf`:

```
ibconf  [file]
```

where [*file*] refers to the full pathname of your UNIX kernel, if it is different than the default, `/unix.`

When you are finished changing the configuration, enter the command to exit `ibconf` and type `y` for yes to save the current configuration. If you did not make any changes to the configuration settings or only renamed devices, you do *not* have to restart the system. However, if you made any changes to the configuration settings, restart the system to run on the reconfigured kernel by entering the following commands:

```
cd /
shutdown -y -g0 -i6
```

Using the NI-488M Software with Your Application Program

After the NI-488M software is installed and verified successfully, you are ready to proceed with development of your application software.

• The file `cib.c` provides the interface between your C language application program and the operating system entry points to the NI-488M driver. The functions available in `cib.c` are described in detail in the *NI-488M Software Reference Manual*. To use the functions available in `cib.c`, you must compile `cib.c` and include the resulting object file during the link phase of each application compile operation or link the GPIB library `libgpib.a` at compile time as shown in the following examples:

```
cc dcsamp.c cib.o
```

   or

```
cc dcsamp.c -lgpib
```

For more information on the C library (GPIB library) `libgpib.a`, refer to *Step 2C. Install the C Library* in Chapter 2, *Software Installation*.

• The application program must also include the following header file as shown:

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

Removing the NI-488M Software

You might want to remove the NI-488M software at some time. You can remove the NI-488M driver using the `kconfig` utility. For more information about using `kconfig`, refer to the section entitled *Using kconfig to Tailor Your System Kernel* in the *INTERACTIVE UNIX System Maintenance Procedures* section of the *INTERACTIVE UNIX System V/386 Release 3.2 Operating System Guide*.

Appendix A
Additional NI-488M Functions

This appendix describes three additional NI-488M functions included in the NI-488M software. These functions are not described in the *NI-488M Software Reference Manual*.

IBDEV(3)   **board only**   IBDEV(3)

Purpose

      Open and initialize an unused device when the device name is unknown.

Synopsis

```
#include <sys/ugpib.h>
ibdev (boardindex, pad, sad, tmo, eot, eos)
int boardindex, pad, sad, tmo, eot, eos;
```

Description

      `boardindex` is an index from 0 to [(number of boards) - 1] of the access board that the device descriptor must be associated with. The arguments `pad`, `sad`, `tmo`, `eot`, and `eos` dynamically set the software configuration for the NI-488M I/O functions. These arguments configure the primary address, secondary address, I/O timeout, asserting EOI on last byte of data sourced, and the End-Of-String (EOS) mode and byte, respectively. (Refer to *IBPAD*, *IBSAD*, *IBTMO*, *IBEOT*, and *IBEOS* in the *NI-488M Software Reference Manual* for more information on each argument.)

      The `ibdev` command selects an unopened device, opens it, and initializes it. You can use this function in place of `ibfind`.

      `ibdev` returns a device descriptor of the first unopened user-configurable device that it finds. For this reason, it is very important to use `ibdev` *only after* all of your `ibfind` calls have been made. This is the only way to ensure that `ibdev` does not use a device that you plan to use via an `ibfind` call. The `ibdev` function performs the equivalent of the `ibonl` function to open the device.

     Note: Be sure to return the device descriptor to the pool of available devices by calling `ibonl` with $v = 0$ when you are finished using the device. If you do not, that device will not be available for the next `ibdev` call.

IBDEV(3)   (continued)   IBDEV(3)

If the `ibdev` call fails, the error bit in `ibsta` is set. There are two distinct errors that can occur with the `ibdev` call:

- If no device is available or the specified `boardindex` refers to a non-existent board, `iberr` contains the EDVR error.

- If one of the last five parameters is an illegal value, it returns with a good device descriptor and `iberr` contains the EARG error.

Example

`ibdev` opens an available device and assigns it to access `gpib0` (`boardindex` = 0) with a primary address of 6 (`pad` = 6), a secondary address of hex 67 (`sad` = 0x67), a timeout of 10 msec (`tmo` = 7), the END message enabled (`eot` = 1) and the EOS mode disabled (`eos` = 0).

```
ud = ibdev(0,6,0x67,7,1,0);
if (ibsta & ERR) {
    /* Handle GPIB error here. */
    if (iberr == EDVR) {
        /* Bad boardindex or no devices
         * available.
         */
    }
    else if (iberr == EARG) {
        /* The call succeeded, but at least one
         * pad, sad, tmo, eos, or eot is incorrect.
         */
    }
}
```

IBLINES(3)   **board only**   IBLINES(3)

Purpose

      Return the status of the GPIB control lines.

Synopsis

```
#include <sys/ugpib.h>
iblines (ud, clines)
int ud;
int *clines
```

Description

      ud is a board descriptor. A *valid* mask is returned along with the GPIB control line state information in clines. The low-order byte (bits 0 through 7) of clines contains a mask indicating the capability of the GPIB interface board to sense the status of each GPIB control line. The next-order byte (bits 8 through 15) contains the GPIB control line state information. Bits 16 through 31 are undefined. The pattern of the defined bytes is as follows:

7	6	5	4	3	2	1	0
EOI	ATN	SRQ	REN	IFC	NRFD	NDAC	DAV

      To determine if a GPIB control line is asserted, first check the appropriate bit in the lower byte to determine if the line can be monitored. If the bit can be monitored (indicated by a 1 in the appropriate bit position), check the corresponding bit in the upper byte. If the bit is set (1), the corresponding control line is asserted. If the bit is clear (0), the control line is unasserted.

      For iblines to return valid data, a *well-behaved* IEEE 488 bus must exist. A *well-behaved* IEEE 488 bus is a bus in which all attached devices are following the IEEE 488 specification.

IBLINES(3)   (continued)   IBLINES(3)

Example

Test for Remote Enable (REN).

```
int clines;

if ((brd0 = ibfind ("gpib0")) < 0) error();
if ((ibsta = iblines (brd0 , &clines)) & ERR)
error();
if (!(clines & 0x10)) {
    printf("GPIB board cannot monitor REN!");
    exit();
}
if (clines & 0x1000) {
    printf("REN is asserted.");
    exit();
}
printf("REN is not asserted.");
```

IBLN(3)   **device or board**   IBLN(3)

Purpose
       Check for the presence of a device on the bus.

Synopsis
```
#include <sys/ugpib.h>
ibln (ud, pad, sad, listen)
int ud, pad, sad
short *listen
```

Description
       ud is a board or device descriptor. pad (legal values are 0 through 30) specifies the primary GPIB address of the device. sad (legal values are hex 60 through 7E, NO_SAD, or ALL_SAD) specifies the secondary GPIB address of the device.

       The function ibln returns a non-zero value in the variable listen if a Listener is at the specified GPIB address.

       Notice that the sad parameter can be a value in hex 60 to 7E or one of the constants NO_SAD or ALL_SAD. You can test for a Listener using only GPIB primary addressing by making sad = NO_SAD, or you can test all secondary addresses associated with a single primary address (a total of 31 device addresses) when you set sad = ALL_SAD. In this case, ibln sends the primary address and all secondary addresses before waiting for NDAC to settle. If the listen flag is true, you must search only the 31 secondary addresses associated with a single primary address to locate the Listener.

       The two special constants that can be used in place of a secondary address are as follows:

```
NO_SAD = 0
ALL_SAD = -1
```

       If ud specifies a device, ibln tests for a Listener on the board associated with the given device.

       Refer also to *IBFIND* in the *NI-488M Software Reference Manual*.

IBLN(3)   (continued)   IBLN(3)

Example

Test for a GPIB Listener at pad 2 and sad 0x60.

```
ibln (ud, 2, 0x60, &listen);
if (!listen) {
/* No Listener found at this address */
}
```

Appendix B
Hardware Specifications

This appendix contains a description of the electrical, physical, and environmetal characteristics of the AT-GPIB board and the conditions under which it should be used.

Table B-1. Electrical Characteristics

Characteristic	Specification
NAT4882 clock Turbo clock	20 MHz 20 MHz
Transfer Rates GPIB Reads GPIB Writes GPIB Commands	 over 1 Mbytes/sec* over 1 Mbytes/sec* over 350 kbytes/sec*
Power Requirement (from PC AT I/O Channel)	+5 VDC 0.66 A typical, 1.50 A maximum
*Actual rates depend upon instrumentation capabilities.	

Table B-2. Physical Characteristics

Characteristic	Specification
Dimensions	4.2 in. x 6.5 in.
I/O Connector	IEEE 488 standard 24-pin

Table B-3. Environmental Characteristics

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

Appendix C
Customer Communication

For your convenience this appendix contains forms to help you gather the information necessary to help us solve possible technical problems, as well as a form you can use to comment on the product documentation.

By completing these forms before calling National Instruments, you will save yourself time, and our applications engineers will be able to answer your questions more accurately and efficiently. The forms contain the information that the applications engineers need from you to help solve your problem. Briefly jot down the information requested on the line after each
item.

Fax Technical Support

If you encounter any technical problems, please complete the fax and configuration forms before requesting technical support by fax. You can contact us by fax at any time at the following number:

(512) 794-5678

Telephone Technical Support

For best service by telephone, please complete the fax and configuration forms, record any error messages, and be available at your computer when you call for technical support. You can use the following numbers between the hours of 8:00 a.m. and 5:30 p.m. (central time) to call the National Instruments applications engineering department:

(512) 794-0100
(800) IEEE-488 (toll-free U.S. and Canada)

Documentation Comments

You can use the *Documentation Comment Form* for your comments about our documents. Please mail or fax it to National Instruments.

Technical Support Fax Form

Technical support is available at any time by fax at (512) 794-5678. For best results, provide as much information as possible. 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 _____M

    Display adapter _____

    Mouse _____yes   _____no

    Other adapters installed _____

    Hard disk capacity _____M   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 will reproduce the problem _____

_____

_____

_____

_____

_____

_____

AT-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

Hardware

• AT-GPIB Revision _____

• Hardware Settings

	Base I/O Address	Interrupt Request Line	DMA Channel
First AT-GPIB	_____	_____	_____
Second AT-GPIB	_____	_____	_____
Third AT-GPIB	_____	_____	_____
Fourth AT-GPIB	_____	_____	_____

Software

• NI-488M Software Revision/Version Number on Distribution Medium _____

- Software Settings

	Base I/O Address	Interrupt Request Line	DMA Channel
gpib0	_____	_____	_____
gpib1	_____	_____	_____
gpib2	_____	_____	_____
gpib3	_____	_____	_____

Other Products

- Programming Language and Version _____

- INTERACTIVE UNIX SYSTEM V Release 3.2 Version _____

- Computer Make and Model _____

- Microprocessor _____

- Clock Frequency _

- Type of other boards installed and their respective hardware settings

Board Type	Base I/O Address	Interrupt Request Line	DMA Channel
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____

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 AT-GPIB and the NI-488M™ Software for INTERACTIVE UNIX System V**

Edition Date: **July 1992**

Part Number: **320518-01**

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

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(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
m- k- M-	milli- kilo- mega-	10^{-3} 10^{3} 10^{6}

°	degrees
%	percent

A	amperes
ANSI	American National Standards Institute
ATN	Attention
C	Celsius
DAV	Data Valid
DMA	direct memory access
DRQ	DMA Request
EMI	electromagnetic interference
EOI	end or identify
EOS	End-of-String
FCC	Federal Communications Commission
GPIB	General Purpose Interface (IEEE 488) bus
hex	hexadecimal
Hz	hertz
I/O	input/output
IEEE	Institute of Electrical and Electronic Engineers
IFC	Interface Clear
in.	inches
IRQ	Interrupt Request
M	megabytes of memory
m	meters
NDAC	Not Data Accepted
NRFD	Not Ready for Data
REN	Remote Enable
SCSI	Small Computer System Interface (bus)
sec	seconds
SRQ	Service Request
VDC	volts direct current