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

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Federal Communications Commission

This device complies with Part 15 of the Federal Communications Commission (FCC) Rules for a Class B digital device. A Class B device is distinguishable from a Class A device by the appearance of an FCC ID number located on the Class B device.

Canadian Department of Communications

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

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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 installed and 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.

- Reorient or relocate 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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Preface

This manual contains instructions for installing and configuring the
National Instruments AT-GPIB interface board and NI-488M multitasking
software driver for use with the AT&T UNIX System V Release 4.0 (or
higher). This hardware and software are intended for use on a PC AT
compatible computer with 386 or higher processor. This manual is meant to
be used with the *NI-488M Software Reference Manual*.

Organization of This Manual

This manual is organized as follows:

Chapter 1, *Introduction*, lists the contents of your NI-488M kit and optional
equipment, and briefly describes the NI-488M software.

Chapter 2, *Hardware Installation*, contains step-by-step instructions for
installing the AT-GPIB interface board in a PC AT.

Chapter 3, *Software Installation and Configuration*, lists all the programs
and files located on the distribution disk and contains steps for installing
and configuring the NI-488M software and verifying the installation. This
chapter also contains other useful information including information for
getting started with a GPIB application program, the steps for removing the
NI-488M software, and the steps for changing the software configuration
after a successful installation.

Appendix A, *New NI-488M Functions*, describes three new 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
physical and electrical characteristics of the AT-GPIB interface board and
the conditions under which it should be used.

Appendix C, *Changing Hardware Configuration Settings*, contains
instructions for changing the configuration settings of your AT-GPIB
interface board.

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

Conventions Used in This Manual

The following conventions are used throughout this manual.

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.
<>	Angle brackets enclose the name of a key on the keyboard–for example, <PgDn>.
<Return>	Key names are capitalized.

Abbreviations

The following metric system prefixes are used with abbreviations for units of measure in this manual:

Prefix	Meaning	Value
m-	milli-	10^{-3}
k-	kilo-	10^{3}
M-	mega-	10^{6}

The following abbreviations for units of measure are used in this manual:

A	amperes
C	Celsius
°	degrees
hex	hexadecimal
Hz	hertz
in.	inches
M	megabytes of memory
m	meters
%	percent
sec	seconds

Acronyms

The following acronyms are used in this manual:

ANSI	American National Standards Institute
DMA	direct memory access
EMI	electromagnetic interference
GPIB	General Purpose Interface (IEEE-488) bus
IEEE	Institute of Electrical and Electronic Engineers
I/O	input/output
EOI	end or identify
VDC	volts direct current

Note: References in this manual to IEEE-488 are referring to the ANSI/IEEE Standard 488.1-1987, which defines the GPIB.

Related Document

The following document contains information that you may find helpful as you read this manual.

- ANSI/IEEE Standard 488.1-1987, *IEEE Standard Digital Interface for Programmable Instrumentation*

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

Contents

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Chapter 1
Introduction

This chapter lists the contents of your NI-488M kit and optional equipment, and briefly describes the NI-488M software.

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

What Your Kit Should Contain

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

Component	Part Number
NI-488M Software Distribution Disks for the AT-GPIB and the AT&T UNIX System V	
• 3.5 in. Disk	422865-55
• 5.25 in. Disk	420865-55
Getting Started with Your AT-GPIB and the NI-488M Software for AT&T UNIX System V	320463-01
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 interface board (part number 181060-01).

Optional Equipment

Equipment	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
* To meet FCC emission limits for this Class B device, you must use a shielded (Type X1 or X2) GPIB cable. Operating this equipment with a non-shielded cable may cause interference to radio and television reception in residential areas.	

Software Description

The NI-488M software is a comprehensive package of programs and drivers that transforms any computer running AT&T UNIX System V Release 4.0 (or higher) into a GPIB Controller with complete communications and bus management capabilities. The NI-488M kit also includes a C language interface and an interactive control program.

Unpacking Your AT-GPIB

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

1. Do not remove the board from its plastic bag at this point.

2. Notice that your AT-GPIB board is shipped packaged in an antistatic plastic bag to prevent electrostatic damage to the board. Several components on the board can be damaged by electrostatic discharge. To avoid such damage in handling the board, touch the plastic bag to a metal part of your computer chassis before removing the board from the bag.

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

Chapter 2
Hardware Installation

This chapter contains step-by-step instructions for installing the AT-GPIB interface board in a PC AT.

Table 2-1 shows the default settings for the AT-GPIB.

Table 2-1. AT-GPIB Default Settings

Parameters	Default Settings
Base I/O Address (hex)	2C0
DMA Channel	5
Interrupt Line (IRQ)	11

If these settings are known to conflict with your existing hardware or if you are installing a second board, refer to Appendix C to change these settings. Otherwise, proceed to the next paragraph.

The AT-GPIB can be installed in any unused expansion slot in your computer. After you change the settings (if needed), verify the switches and jumper settings, and record the settings on the *AT-GPIB Hardware and Software Configuration Form* located in Appendix D, you are ready to install the AT-GPIB.

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 in an unused 16-bit slot (you may have to remove a blank expansion slot cover bracket) with the IEEE-488 receptacle sticking out of the opening on the back panel. It may 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.

The AT-GPIB interface board is now installed and ready for verification testing. Proceed to Chapter 3, *Software Installation and Configuration*.

Chapter 3
Software Installation and Configuration

This chapter lists all the programs and files located on the distribution disk and contains steps for installing and configuring the NI-488M software and verifying the installation. This chapter also contains other useful information including information for getting started with a GPIB application program, the steps for removing the NI-488M software, and the steps for changing the software configuration after a successful installation.

Step 1.   Preparation

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

*   You must have super-user privilege.

*   The AT&T UNIX *Link Kit,* which is needed for adding device drivers, must already be installed. Install the Link Kit now if you have not already done so.

*   The instructions in this chapter assume that your AT-GPIB board is already installed If you have not installed your GPIB board, install it now. Refer to Chapter 2, *Hardware Installation*, for instructions on how to install your hardware.

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

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

Review the files contained on the NI-488M distribution diskette. The files are as follows:

`Driver.o`	NI-488M driver for AT-GPIB
`Master`	Master file entry for AT-GPIB
`System`	System file entry for AT-GPIB
`Node`	GPIB device node file for AT-GPIB

`cib.c`	C language library
`ugpib.h`	Include file for user programs
`ibinstall`	Install script for the driver
`ibremove`	Remove script for the driver
`ibrmnod`	Utility to remove GPIB device nodes
`ibic`	Interactive control utility
`ibconf`	Software configuration utility
`dcsamp.c`	Example program for device calls in C
`bcsamp.c`	Example program for board calls in C
`ibtsta`	Installation test part A
`ibtstb`	Installation test part B

Step 2.   Installation

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

Note: For the remainder of this chapter, the word *enter* indicates that the user must type the indicated command line and press <Return>.

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 diskette to this directory using the `tar` command shown in Step 3a or 3b according to the size of your distribution diskette.

a.   For a 3.5 in. diskette:

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

```
tar xvf /dev/dsk/f03ht
```

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

```
tar xvf /dev/dsk/f13ht
```

b.   For a 5.25 in. diskette:

  • 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. This procedure is necessary because the *NI-488M Software Reference Manual* assumes that a library has already been created for the C language interface.

To compile the file `cib.c` and create a C language library, enter the following commands.

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

Alternatively, you can add `cib.o` to an existing library or include `cib.o` during the link phase of each compile operation.

D. Ensure the Software and Hardware Settings Match

1. Compare your AT-GPIB hardware settings with the default software settings. If you configured your hardware with a setting other than the settings shown in Table 3-1, you must also configure the software to match your new setting(s).

Table 3-1. Software Default Settings

Fields	Software Default Settings	
	gpib0	**gpib1**
Base I/O Address (hex)	2C0	240
Interrupt Vector Number	11	10
DMA Channel	5	6
Note: The NI-488M software supports two boards: gpib0 is the name of the first board, and gpib1 is the name of the second board.		

If your hardware and software settings are identical, go to Step E. If not, continue with the following step.

2. Change the software settings if not identical to hardware.

Change the base I/O address, interrupt vector number, or DMA channel according to the instructions in this step.

DMA Channel

Open the `./Master` file, which contains the following lines:

```
ib   ocrwis    ircH    ib    0    0    1    2    5
ib   ocrwis    ircH    ib    0    0    1    2    6
```

If you installed only one AT-GPIB board, change only the first line of information.

The last field contains the DMA channel used by the GPIB. The default is channel 5. To disable DMA, change the setting to -1. To select another DMA channel, enter the number of that DMA channel.

Base I/O Address and Interrupt Vector Number

Open the `./System` file, which contains the following lines:

```
ib    Y    1    6    1    11    2C0    2DF    0    0
ib    Y    1    6    1    10    240    25F    0    0
```

If you installed only one AT-GPIB board, change only the first line of information.

The sixth field is the interrupt vector number.

The seventh field is the starting I/O address (in hex) of the board.

The eighth field is the ending I/O address (in hex) of the board.

The seventh and eighth fields must be in the range between 0 and 3FF for the AT-GPIB. The value of the eighth field is obtained by adding 31 decimal or 1F hex to the value of the seventh field.

If you changed the base I/O address, interrupt vector number, or DMA channel settings, record the settings on the *AT-GPIB Hardware and Software Configuration Form* located in Appendix D.

E. Install the NI-488M Driver

The NI-488M driver must be installed and linked into the kernel.

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
```

The program will prompt you for the information it needs to install the driver.

If the installation fails, `ibinstall` displays the error encountered during the installation. If the error indicates a conflict between an AT-GPIB setting and another device setting, you may have to change the setting. Refer to Appendix C, *Changing Hardware Configuration Settings*, for information on changing the hardware settings. Refer to *Step D. Ensure the Software and Hardware Settings Match* for information on changing the software settings.

After the new kernel is successfully built, restart the system to run on the new kernel by entering the following commands:

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

Step 3.   Software Configuration

After the software is installed correctly, run the software configuration utility `ibconf` (you must have super-user privilege). You must run `ibconf` because it creates all device nodes needed by the software.

`ibconf` is a screen-oriented utility that you can use to inspect and modify the default software parameters. If you changed the software settings of the AT-GPIB interface board, such as the base I/O address, interrupt vector number, or DMA channel, you must make a corresponding change to the parameters shown in `ibconf`.

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

The synopsis of the command is as follows:

```
ibconf  [file]
```

where *file* can be any UNIX file with the NI-488M driver installed. The default UNIX kernel file is /unix.

A. Run ibconf

To create the device nodes and/or change the GPIB parameters, simply enter

```
ibconf
```

This is equivalent to ibconf /unix.

If you have given your UNIX kernel file a name other than /unix, use the file option to give the whole pathname of the UNIX kernel. For example, if the kernel name is /unix.new, enter the following command:

```
ibconf /unix.new
```

B. Exit ibconf

Save the current configuration by typing y before exiting ibconf. Even if you have not made any changes to the configuration settings, you should still type a y to have ibconf create the special device files (for example, gpib0, gpib1, dev1, dev2,...) in the /dev directory.

This completes the software installation and configuration procedures.

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 new kernel by entering the following commands:

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

Step 4. Installation Verification

There are two software installation tests: `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.

Application Development

Once the driver software has been installed and verified successfully, you are ready to proceed with development of your NI-488M application software. The file `cib.c` is 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 these functions, you must either 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 compiling time as shown in the following examples:

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

    or

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

The application program must also include the following header file

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

For more information on the GPIB library `libgpib.a`, refer to *Step 2C.
Install the C Library* presented previously in this chapter.

Steps for Removing the NI-488M Software

You may want to remove the NI-488M software at some time. Here are the
steps for removing the NI-488M software:

1. Remove the driver from the kernel.

    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:

    ```
    ./ibremove
    ```

    Answer `y` to all the questions.

    `ibremove` uses `ibrmnod` to delete the GPIB device nodes and
    expects `ibrmnod` to be present in the current directory.

2. Restart the system by entering the following commands:

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

Steps for Changing Configuration after a Successful Installation

To change the base I/O address, interrupt vector number, or DMA channel settings after the software has been successfully installed, follow these steps:

1. Change the jumper and switch settings on the board. Refer to Appendix C*, Changing Hardware Configuration Settings,* for more information.

Note: If you change any jumper or switch settings, record the settings on the *AT-GPIB Hardware and Software Configuration Form* located in Appendix D.

2. Remove the NI-488M driver with the old configuration by entering the following command:

   ```
   ./ibremove
   ```

   Refer to *Steps for Removing the NI-488M Software* in this chapter for more information.

3. Edit the `Master` and `System` files. Refer to item 2 of *Step 2D*. *Ensure the Software and Hardware Settings Match* in this chapter for more information on how to change software settings.

4. Install the NI-488M driver with the new configuration by entering the following command:

   ```
   ./ibinstall
   ```

   The program will prompt you for the information it needs to install the driver. Refer to *Step 2E. Install the NI-488M Driver* in this chapter for more information.

5. Restart your system by entering the following command:

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

6. Run `ibconf` by entering the following command:

       ibconf

   Refer to *Step 3. Software Configuration* in this chapter for more information.

Appendix A
New NI-488M Functions

This appendix describes three new 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 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, a negative number is returned in place of the device descriptor. 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, it returns the EDVR error.

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

```
if ((ud = ibdev(0,6,0x67,7,1,0)) < 0) {
    /* 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 physical and electrical characteristics of the AT-GPIB interface board and the conditions under which it should be used.

IEEE 488 Bus

Turbo488 Clock   20.0 MHz

NAT4882 Interface Controller Clock   20.0 MHz

Transfer Rate

*   Read from GPIB instrument   Over 1 Mbytes/sec

*   Write to GPIB instrument   Over 1 Mbytes/sec

*   GPIB commands   350 kbytes/sec

(Actual speed may vary considerably from those shown due to instrumentation capabilities.)

Power Requirement (from PC AT I/O Channel Bus)

+5 VDC   0.66A typical
                                        1.50A maximum

Physical

Dimensions   4.2 in. x 6.5 in.

I/O Connector   IEEE-488 Standard 24-Pin

EMI Certification

FCC Class B

Operating Environment

Component Temperature   0° to 70° C

Relative Humidity   5% to 90%, noncondensing

Storage Environment

Temperature   -55° to 150° C

Relative Humidity   5% to 90%, noncondensing

Appendix C
Changing Hardware Configuration Settings

This appendix contains instructions for changing the configuration settings of your AT-GPIB interface board. You need to change the configuration settings only if the default settings conflict with another board in your system.

Figure C-1 shows the location of the AT-GPIB configuration jumpers and switches.
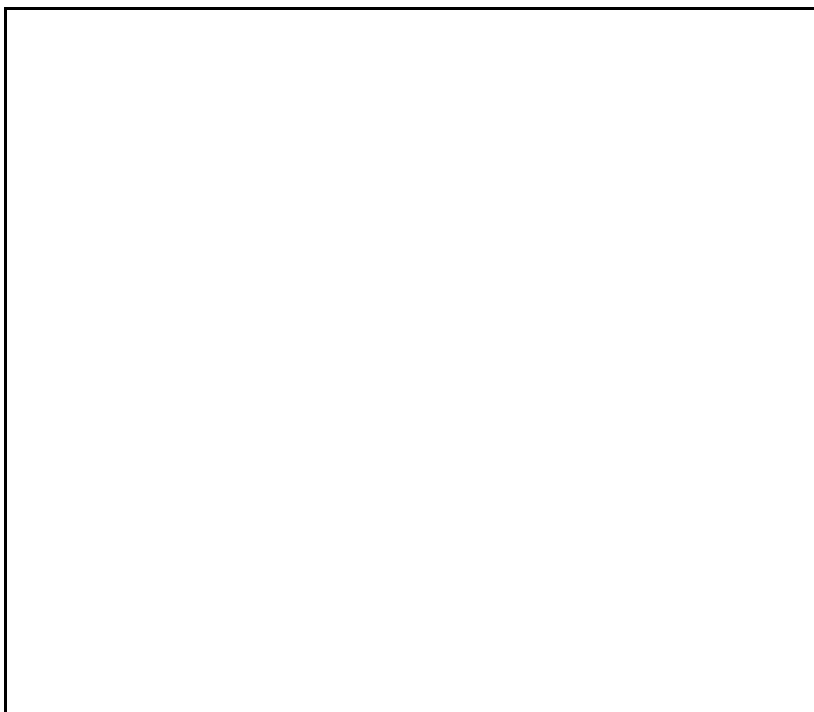
Figure C-1. AT-GPIB Parts Locator Diagram

Note : Shut down the operating system and power down the computer before you take off the board to change the configuration.

Switch and Jumper Settings

Table C-1 shows the default settings and available hardware configurations for the AT-GPIB.

Table C-1. Default Settings and Available Configurations

AT-GPIB	Default Settings	Available Configurations
Base I/O Address (hex)	2C0	100 to 3E0
DMA Channel	5	5, 6, 7, and Not Used
Interrupt Line (IRQ)	11	3, 4, 5, 6, 7, 9, 10, 11, 12, 14, 15, and Not Used

Base I/O Address Selection

The base I/O address is determined by the switches at position U25. The switches are set at the factory for the base I/O address 2C0 hex. The AT-GPIB uses the I/O address space 2C0 through 2DF hex with this setting. If you install more than one AT-GPIB interface board in your computer, each board must be configured to use a unique base I/O address. The default AT-GPIB base I/O addresses for the NI-488M software for AT&T UNIX are shown in Table C-2.

Table C-2. Software Default AT-GPIB Base I/O Addresses

Board	Default Base I/O Address
First AT-GPIB (gpib0)	2C0 hex
Second AT-GPIB (gpib1)	240 hex

Check to determine that the software default I/O address space is not already used by other equipment installed in your computer. If any equipment in your computer uses this I/O address space, change the base I/O address of the AT-GPIB.

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 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.

Press down on the side of the switch marked 1 to select a binary value of 1 for the corresponding address bit. Press down on the side marked 0 to select a binary value of 0 for the corresponding address bit (refer to Figure C-2).

Figure C-2 shows two possible switch settings. In this figure, the black side of the switch is the side you press down. Each of the address selections shows how the base I/O address was calculated from the switch positions.

Key

■ = side you must press down; Off=1; On=0

Push this side down (OFF) for logic 1

Push this side down (ON) for logic 0

ADDRESS

	Binary	Hex
9	1	2
8	0	
7	1	C
6	1	
5	0	
	0	
	0	0
	0	
	0	

a. Switch Set to Match Hardware
Default Setting and Software
Default Setting for gpib0
(Base I/O Address 2C0 hex)

ADDRESS

	Binary	Hex
9	1	2
8	0	
7	0	4
6	1	
5	0	
	0	
	0	0
	0	
	0	

b. Switch Set to Match Software
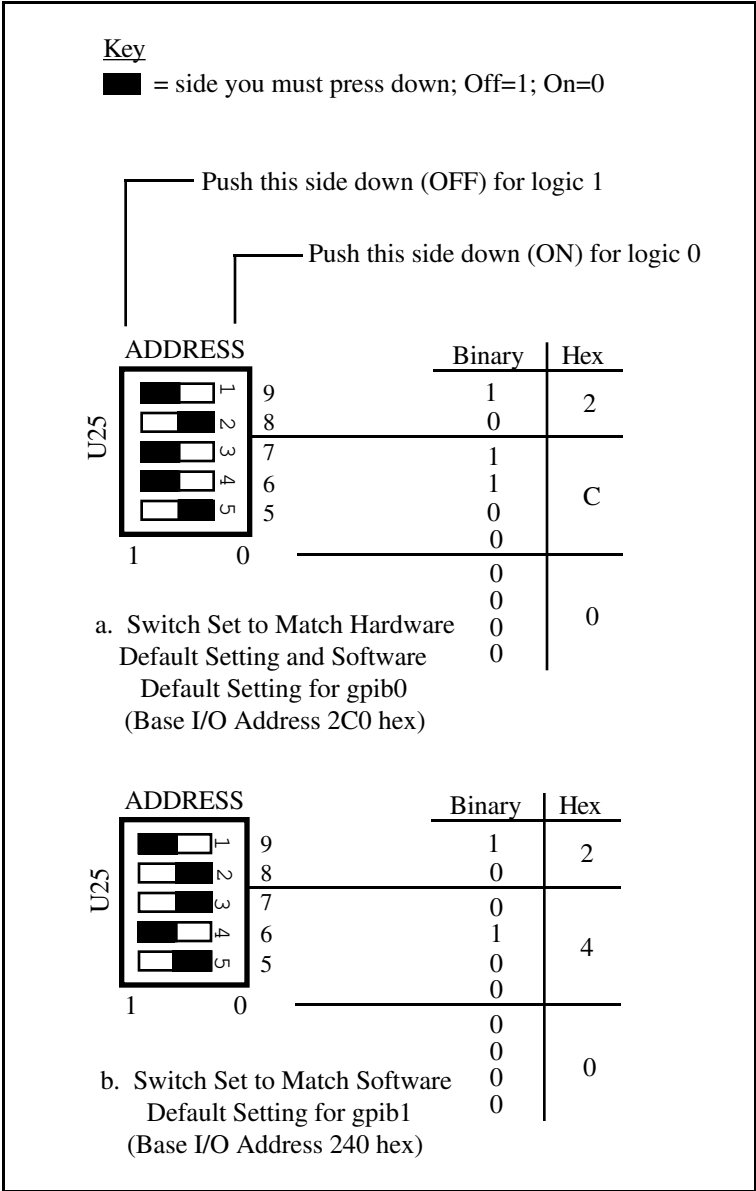Default Setting for gpib1
(Base I/O Address 240 hex)

Figure C-2. Base I/O Address Switch Settings

To change the base I/O address, remove the plastic cover on U25, press each switch to the desired position, check each switch to make sure it is pressed down all the way, and place the plastic cover back on again.

Interrupt Selection

The AT-GPIB interface board can use one of 11 interrupt lines on the PC AT I/O channel. The interrupt line is selected by placing a jumper across the double rows of pins located above the I/O slot edge connector on the AT-GPIB (refer to Figure C-1). To select an interrupt line, place the jumper in the appropriate position. The interrupt lines that the AT-GPIB hardware can use are IRQ3, 4, 5, 6, 7, 9, 10, 11, 12, 14, and 15. If you install more than one AT-GPIB interface board in your computer, each board must be configured to use a unique interrupt request line. The default AT-GPIB interrupt request levels for the NI-488M for AT&T UNIX software are shown in Table C-3.

Table C-3. Default AT-GPIB Interrupt Request Lines

Board	Default IRQ Line
First AT-GPIB (gpib0)	11
Second AT-GPIB (gpib1)	10

Note: Do *not* use interrupt line 6 or interrupt line 14. Interrupt line 6 is used by the diskette drive Controller and interrupt line 14 is used by the hard disk drive Controller on most PC ATs.

Once you have selected an interrupt line, place the jumper on the appropriate pins to enable the interrupt line. For interrupt lines 3 through 7, or 9, use jumper set W3 (refer to Figure C-1). For lines 10 through 15, use jumper set W2 (refer to Figure C-1). Figure C-3 shows the default setting IRQ11, a possible setting of IRQ10, and a jumper set to interrupt line 5.
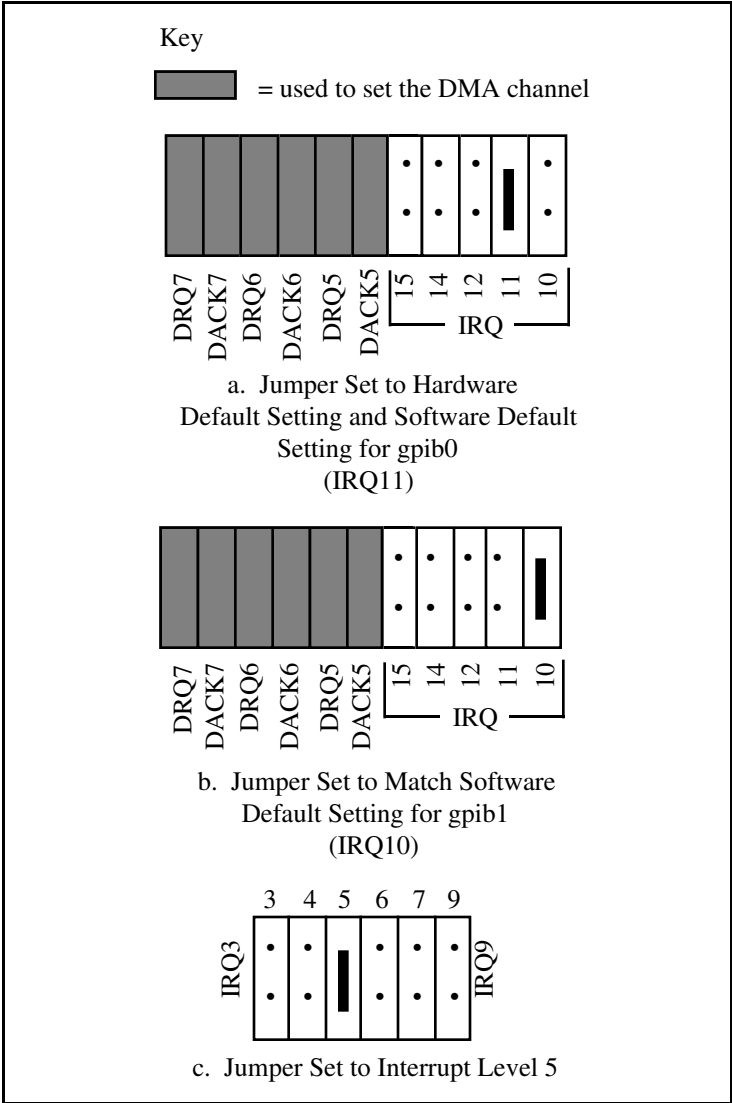
Figure C-3. Interrupt Jumper Settings

To change to another interrupt line, remove the jumper from its stored position and place it on the new posts.

DMA Channel Selection

The AT-GPIB hardware is set at the factory to use DMA channel 5 (see Figure C-1 for the DMA channel location). The DMA channels that the AT-GPIB can use are channels 5, 6, 7, and no DMA channel. If you install more than one AT-GPIB interface board in your computer, each board must be configured to use a unique DMA channel. The default AT-GPIB DMA channels for the NI-488M for AT&T UNIX software driver are shown in Table C-4. You must change the DMA channel setting on the hardware to match the software DMA channel setting.

Table C-4. Default AT-GPIB DMA Channel

Board	Default DMA Channel
First AT-GPIB (gpib0)	5
Second AT-GPIB (gpib1)	6

Check to determine that the default DMA channel setting is not already used by equipment already installed in your computer. If any equipment in your computer uses this DMA channel, change the DMA channel used by the AT-GPIB or the conflicting hardware.

Note: DMA channels 5, 6, and 7 are the three 16-bit channels on the PC AT I/O channel. The AT-GPIB does *not* use and *cannot* be configured to use the 8-bit DMA channels on the PC AT I/O channel.

Each DMA channel consists of two signal lines as shown in Table C-5.

Table C-5. 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. 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 C-4 shows jumper positions for selecting DMA channels 5 and 6.

Key

    ▨ = used to set the interrupt line

DRQ7 DACK7 DRQ6 DACK6 DRQ5 DACK5 15 14 12 11 10
                               IRQ

a. Jumper Set to Hardware
Default Setting and
Software Setting for gpib0
(DMA Channel 5)

DRQ7 DACK7 DRQ6 DACK6 DRQ5 DACK5 15 14 12 11 10
                               IRQ

b. Jumper Set to Match Software
Default Setting for gpib1
(DMA Channel 6)
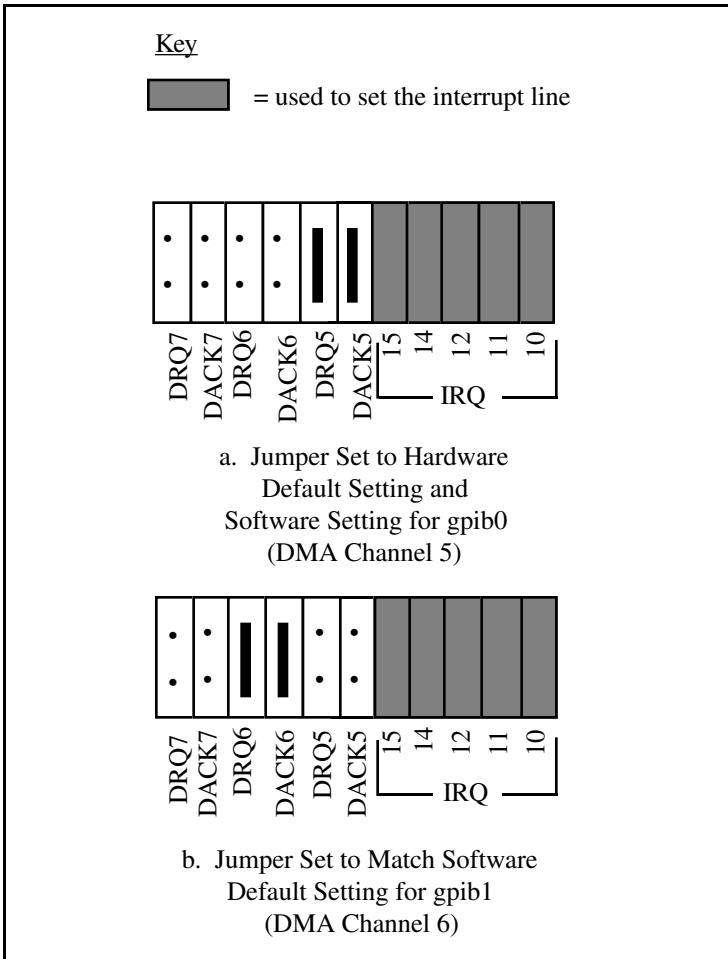
Figure C-4. DMA Channel Jumper Setting

If you do not want to use DMA for GPIB transfers (the AT-GPIB alternatively can use programmed I/O GPIB transfers), you can logically disconnect the AT-GPIB from the DMA lines by selecting NONE for the DMA channel of the AT-GPIB when you run `ibconf` (refer to Chapter 3 for information on running `ibconf`). By using this programmable method, the board can remain installed in the backplane and no jumpers have to be moved or changed.

You can also physically disconnect the AT-GPIB from the DMA channel lines of the PC AT bus by removing the two jumpers (although this is not required), if you do not want to use DMA for GPIB transfers. The jumpers can be stored on the board in the positions shown in Figure C-5. Removing the jumpers disables the ability of the AT-GPIB to assert a DRQ line on the PC AT I/O channel. Make sure that you make a corresponding change to the software DMA channel setting during the software installation discussed in Chapter 3.
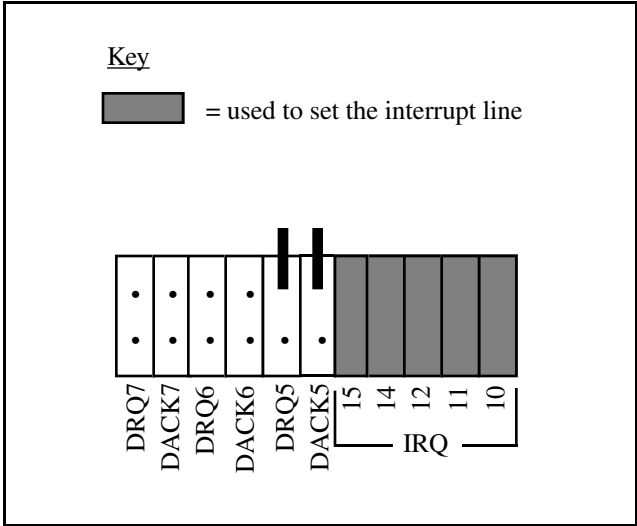
Figure C-5. DMA Jumper Setting for No DMA Channel

Shield Ground Configuration

The AT-GPIB is set at the factory with the jumper in place to connect the logic ground of the AT-GPIB to its shield ground. This configuration minimizes the EMI emitted from a PC AT equipped with an AT-GPIB. 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 C-6.
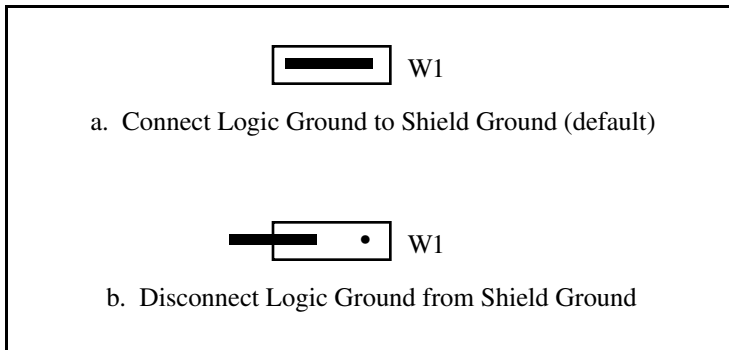
Figure C-6. Ground Configuration Jumper Settings

Note: The AT-GPIB 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.

Reset Software Settings and Rebuild Kernel

After the hardware configurations have been reset, configure your software to match the new hardware settings and then run `./ibinstall` again to rebuild the kernel with your new settings. Refer to *Step D. Ensure the Software and Hardware Settings Match* in Chapter 3 for information on configuring your software. Refer to *Step E. Install the NI-488M Driver* in Chapter 3 for instructions on running `ibinstall.`

Appendix D
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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                           (512) 794-5678

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France	(1) 48 14 24 00	(1) 48 14 24 14
Germany	089/741 31 30	089/714 60 35
Italy	02/48301892	02/48301915
Japan	(03) 3788-1921	(03) 3788-1923
Netherlands	03480-33466	03480-30673
Norway	32-848400	32-848600
Spain	(91) 640 0085	(91) 640 0533
Sweden	08-730 49 70	08-730 43 70
Switzerland	056/20 51 51	056/20 51 55
U.K.	0635 523545	0635 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 _____

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

National Instruments Products

Hardware

- AT-GPIB Revision: _____

- Hardware Settings:

	Base I/O Address	Interrupt Line	DMA Channel
1st AT-GPIB	_____	_____	_____
2nd AT-GPIB	_____	_____	_____

Software

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

- Software Settings:

	Base I/O Address	Interrupt Vector Number	DMA Channel
gpib0	_____	_____	_____
gpib1	_____	_____	_____

Other Products

- Programming Language and Version: ____

- AT&T UNIX System V Version: _____

- Computer Make and Model: _____

- Microprocessor: _____

- Clock Frequency: ____

- Type of Video Board Installed: _____

- Type of other boards installed and their respective hardware settings:

Board Type	Base I/O Address	Interrupt Level	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 AT&T UNIX System V

Edition Date: **August 1994**

Part Number: **320463-01**

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

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

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