Getting Started with Your AT-GPIB and the NI-488M™ Software for SCO UNIX System V/386

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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

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

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

Instructions to Users

These regulations are designed to provide reasonable protection against 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

Hiermit wird bescheinigt, daß die AT-GPIB in Übereinstimmung mit den Bestimmungen der Vfg. 1046/1984 funk entstört ist.

Der Detuschen 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-488 multitasking software (NI-488M) driver for use with the SCO UNIX System V/386 Release 3.2.2 (or higher) or Open Desktop Release 1.0 (or higher) Operating System. This hardware and software is intended for use on a 386-based IBM personal computer. 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 what you need to get started, and briefly describes the NI-488M software.

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

*   Chapter 3, *Software Installation and Configuration*, lists all the programs and files located on the distribution diskette and contains the steps for installing and configuring the NI-488M software. This chapter also contains a description of the software configuration utility, `ibconf`, and information for getting started with a GPIB application program.

*   Appendix A, *New NI-488M Functions*, describes three new NI-488M functions included in the NI-488M software.

*   Appendix B, *Special Instructions for Changing the Software Settings*, contains special instructions for changing the base I/O address, interrupt vector number, and DMA channel software settings.

*   Appendix C, *Hardware Specifications*, lists the electrical, environmental, and physical characteristics of the AT-GPIB board and the conditions under which it should be operated.

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

- The *Glossary* contains an alphabetical list and description of terms used in this manual, including abbreviations, acronyms, metric prefixes, mnemonics, and symbols.

Conventions Used in This Manual

The following conventions are used in this manual.

italic   Italic text denotes emphasis, a cross reference, or an introduction to a key concept.

`monospace`   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.

`italic monospace`   Italic text in this font denotes that you must supply the appropriate words or values in place of these items.

<>   Angle brackets enclose the name of a key on the keyboard—for example, <Shift>.

<Return>   Key names are capitalized.

IEEE 488   IEEE 488 refers to the ANSI/IEEE Standard 488-1978, which defines the GPIB.

NI-488M   NI-488M refers to the NI-488M software for SCO UNIX System V/386.

SCO UNIX   *SCO UNIX* refers to the SCO UNIX System
                           V/386 Release 3.2.2 (or higher) or Open Desktop
                           Release 1.0 (or higher) Operating System.

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.

•   *Getting Started with Your AT-GPIB/TNT and NI-488.2 Software for
    DOS*

•   *UNIX System V/386 Release 3.2 Integrated Software Development
    Guide*

•   *IBM Personal Computer AT Technical Reference*

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.

Chapter 1
Introduction

This chapter lists what you need to get started, and briefly describes the NI-488M software.

The AT-GPIB is a full-function, high-performance IEEE 488 interface for a 386-based IBM personal computer (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 You Need to Get Started

☐ AT-GPIB board, which you can purchase from National Instruments

☐ 3.5 in. *NI-488M Distribution Disk AT-GPIB SCO UNIX System V/386 Handler and C Interface*, which comes in your kit

☐ Shielded GPIB cables*, which you can purchase from National Instruments:
   Type X1 single-shielded cables – 1 m, 2 m, or 4 m
   Type X2 double-shielded cables – 1 m, 2 m, or 4 m

* 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 set of programs and drivers that transforms any computer running SCO UNIX System V/386 Release 3.2.2 or higher or Open Desktop Release 1.0 or higher (herein referred to as SCO UNIX System V/386) into a GPIB Controller with complete communications and bus management capabilities. The NI-488M software also comes with a C language interface and an interactive control program.

Chapter 2
Hardware Configuration and Installation

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

Step 1. Configure the Hardware

Figure 2-1 shows the location of the AT-GPIB configuration jumpers and switches.

Figure 2-1. AT-GPIB Parts Locator Diagram

Because SCO UNIX defines the base I/O address, the interrupt line, and the Direct Memory Access (DMA) channel, the hardware settings to which the AT-GPIB board was configured at the factory are *not* suitable for use under SCO UNIX System V/386. You must change the hardware jumper settings to match the default software configuration settings given in Table 2-1.

Switch and Jumper Settings

Table 2-1 shows the software and hardware default settings and available hardware configurations for the AT-GPIB board.

Table 2-1. Software and Hardware Default Settings and Available
Hardware Configurations

AT-GPIB	Software Default Settings	Hardware Default Settings	Available Hardware Configurations
Base I/O Address (hex)	260	2C0	100 to 3E0
DMA Channel	7	5	5, 6, 7, and Not Used
Interrupt Line (IRQ)	5	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 board uses the I/O address space 2C0 through 2DF hex with this setting. 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. The default AT-GPIB board base I/O addresses for the NI-488M software are shown in Table 2-2. You must change the base I/O address setting in the hardware to match the software base I/O address setting.

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

Board	Default Base I/O Address
First AT-GPIB (`gpib0`)	260 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 either the AT-GPIB board or the other device. (See Table 2-3 later in this chapter for other possible AT-GPIB board base I/O address settings.)

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.

Press down on the side 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 2-2).

Figure 2-2 shows the hardware default base I/O address setting and the setting to which you must change your hardware to match the software base I/O address default setting. 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.
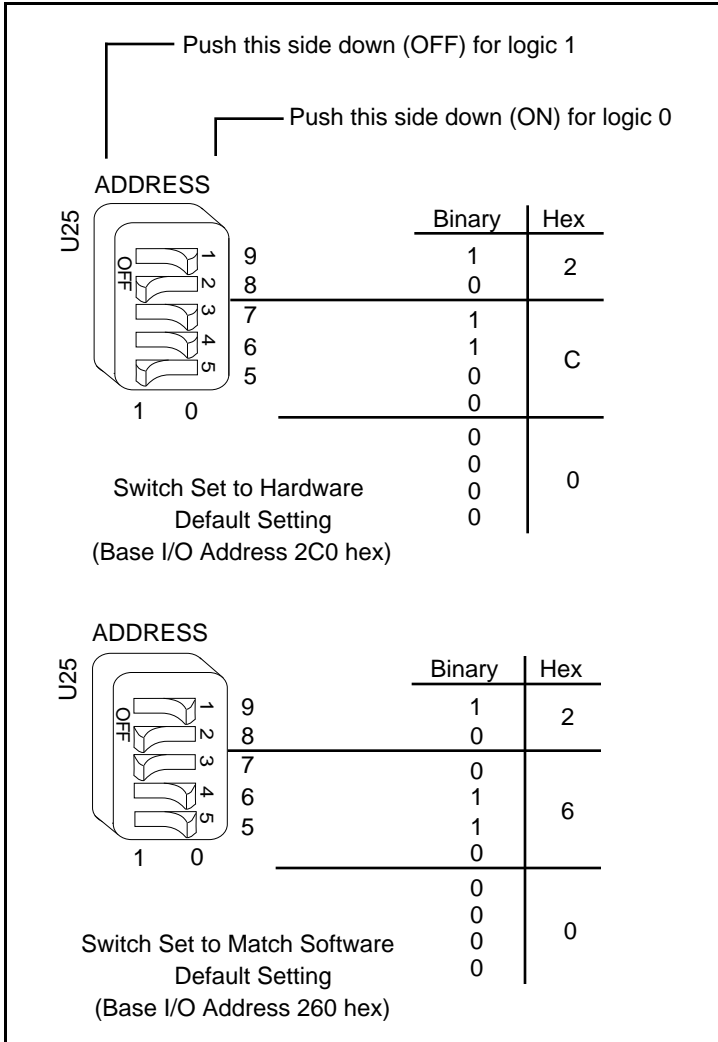
Figure 2-2. Base I/O Address Switch Settings

To change the base I/O address press each switch to the desired position, then check each switch to make sure it is pressed down all the way. Table 2-3 lists the possible switch settings, the corresponding base I/O address, and the I/O address space used for that setting.

Table 2-3. Possible Base I/O Address Switch Settings for the AT-GPIB

Switch Setting A9 A8 A7 A6 A5					Base I/O Address (hex)	I/O Address Space Used (hex)
0	1	0	0	0	100	100 to 11F
0	1	0	0	1	120	120 to 13F
0	1	0	1	0	140	140 to 15F
0	1	0	1	1	160	160 to 17F
0	1	1	0	0	180	180 to 19F
0	1	1	0	1	1A0	1A0 to 1BF
0	1	1	1	0	1C0	1C0 to 1DF
0	1	1	1	1	1E0	1E0 to 1FF
1	0	0	0	0	200	200 to 21F
1	0	0	0	1	220	220 to 23F
1	0	0	1	0	240	240 to 25F
1	0	0	1	1	260	260 to 27F
1	0	1	0	0	280	280 to 29F
1	0	1	0	1	2A0	2A0 to 2BF
1	0	1	1	0	2C0	2C0 to 2DF
1	0	1	1	1	2E0	2E0 to 2FF
1	1	0	0	0	300	300 to 31F
1	1	0	0	1	320	320 to 33F
1	1	0	1	0	340	340 to 35F
1	1	0	1	1	360	360 to 37F
1	1	1	0	0	380	380 to 39F

(continues)

Table 2-3. Possible Base I/O Address Switch Settings for the AT-GPIB
(Continued)

Switch Setting A9 A8 A7 A6 A5	Base I/O Address (hex)	I/O Address Space Used (hex)
1 1 1 0 1	3A0	3A0 to 3BF
1 1 1 1 0	3C0	3C0 to 3DF
1 1 1 1 1	3E0	3E0 to 3FF

If you change the hardware base I/O address to something *other than* 260
hex, make sure that you make a corresponding change to the software
base I/O address setting as described under *Configure the Software* in
Chapter 3, *Software Installation and Configuration*. Also, make sure that
you record the new setting on the *AT-GPIB Hardware and Software
Configuration Form* in Appendix D, *Customer Communication*.

Possible Conflicts

Table 2-4 lists some of the I/O addresses used by other PC AT plug-in
interface boards and adapters. This is not a complete list, but it may help in
determining possible address conflicts. Symptoms of I/O address conflicts
vary widely. At one extreme, conflicts can prevent the computer from
booting. At the other extreme, conflicts can cause problems that do not
surface until a considerable amount of time has elapsed. When they do
surface, the problem can exhibit itself simply as strange behavior.

National Instruments has made every effort to select a software default base
I/O address that will work. However, because of the numerous different
interface boards available for use in the PC AT, it is not possible to select a
base I/O address that is guaranteed to work in all systems.

Table 2-4. PC AT I/O Address Map

I/O Address Range (Hex)	Device
100 to 1EF 1F0 to 1F8	IBM PC AT Fixed Disk
200 to 20F 208 210 to 217 210 to 213	PC and PC AT Game Controller, reserved LIM Expanded Memory Card PC Expansion Unit
218 219 to 21E 21F 220 to 23F 240 to 25F 248 258 260 to 27F 259 to 267 268 269 to 277 278 to 27F	LIM Expanded Memory Card Reserved AT-GPIB board 1 (software default) LIM Expanded Memory Card LIM Expanded Memory Card AT-GPIB board 0 (software default) LIM Expanded Memory Card AT Parallel Printer Port 2
280 to 29F 2A0 to 2A7 2A8 2A9 to 2AF 2B0 to 2DF 2B8 2B9 to 2BF 2C0 to 2C7 2C8 to 2E0 2E1 2E2 to 2E3 2E4 to 2E7 2E8 2E9 to 2F7 2F8 to 2FF	WD EtherCard+ (default) LIM Expanded Memory Card PC, AT EGA (alternate) LIM Expanded Memory Card AMI Serial Port Card IBM GPIB Adapter 0, GPIB-PCIIA 0 (base) IBM Data Acquisition Adapter 0 LIM Expanded Memory Card PC, AT Serial Port 2 (COM2)

(continues)

Table 2-4. PC AT I/O Address Map (continued)

I/O Address Range (Hex)	Device
300 to 31F	PC, AT Prototype card
300 to 30F	3Com EtherLink (default)
320 to 32F	IBM PC/XT Fixed Disk Controller
330 to 332	Adaptec SCSI Card
333 to 347	
348 to 357	DCA 3278
358 to 35F	
360 to 363	PC Network (low address)
364 to 367	Reserved
368 to 36B	PC Network (high address)
36C to 36F	Reserved
370 to 377	
378 to 37F	PC, AT Parallel Printer Port 1
380 to 38C	SDLC Communications
380 to 389	Bisynchronous (BSC) Communications (alternate)
390 to 393	Cluster Adapter 0
394 to 39F	
3A0 to 3A9	Bisynchronous (BSC) Communications (primary)
3AA to 3AF	
3B0 to 3BF	Monochrome Display/Parallel Printer Adapter 0
3C0 to 3CF	Enhanced Graphics Adapter, VGA
3D0 to 3DF	Color/Graphics Monitor Adapter, VGA
3E0 to 3EF	
3F0 to 3F7	Diskette Controller
3F8 to 3FF	Serial Port 1 (COM1)

Interrupt Selection

The AT-GPIB board can use one of eleven interrupt lines on the PC AT I/O channel. The interrupt line is selected by placing a jumper across the double rows of pins in the interrupt request line selection jumpers, which are located above the I/O slot edge connector on the AT-GPIB (refer to Figure 2-1). To select an interrupt line, place the jumper in the appropriate position. The interrupt lines that the AT-GPIB board can use are IRQ3, 4, 5, 6, 7, 9, 10, 11, 12, 14, and 15. If you install more than one AT-GPIB board in your computer, each board must be configured to use a unique

interrupt request line. The default AT-GPIB board interrupt request levels for the NI-488M software are shown in Table 2-5. You must change the interrupt setting on the hardware to match the software setting.

Table 2-5. Software Default AT-GPIB Interrupt Request Line

Board	Default IRQ Line
First AT-GPIB (`gpib0`)	5
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 (refer to Figure 2-1). Figure 2-3 shows the hardware default interrupt setting and the setting to which you must change your hardware to match the software default interrupt setting.
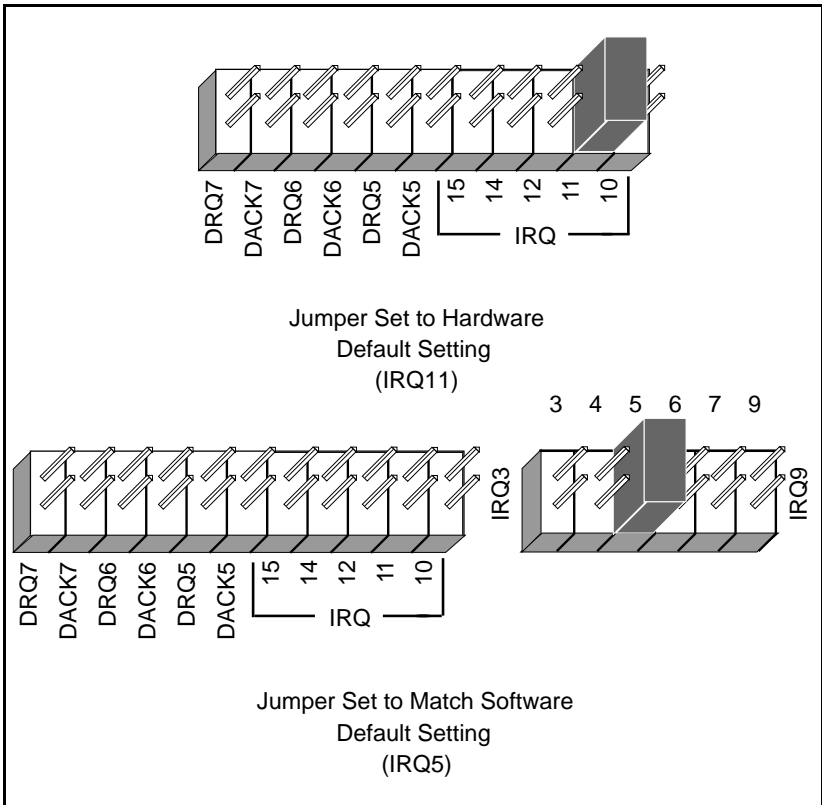
Figure 2-3. Interrupt Jumper Settings

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

If you change the hardware interrupt line to something *other than* IRQ5, make sure that you make a corresponding change to the software interrupt setting as described in Chapter 3, *Software Installation and Configuration*. Also, make sure that you record the new setting on the *AT-GPIB Hardware and Software Configuration Form* in Appendix D, *Customer Communication*.

Possible Conflicts

Table 2-6 lists some of the interrupt levels used by other PC AT plug-in interface boards and adapters. This is by no means a complete list, but it may help in determining possible interrupt conflicts. Symptoms of interrupt conflicts vary widely. At one extreme, conflicts can prevent the computer from booting. At the other extreme, conflicts can cause problems that do not surface until a considerable amount of time has elapsed. When they do surface, the problems can exhibit themselves simply as strange behavior.

National Instruments has made every effort to select a software default interrupt level that will work. However, because of the numerous different interface boards available for use in the PC AT, it is not possible to select an interrupt level that is guaranteed to work in all systems. Therefore, be certain of your system's interrupt assignments before proceeding with installation.

Table 2-6. PC AT Interrupt Assignment Map

IRQ	Device
15	Reserved
14	Fixed Disk Controller
13	Coprocessor
12	Reserved
11	Adaptec SCSI Card

(continues)

Table 2-6. PC AT Interrupt Assignment Map (Continued)

IRQ	Device
10	AT-GPIB board 1 (software default)
9	PC Network (default) PC Network Alt. (default)
8	Real Time Clock
7	Parallel Port 1
6	Diskette Controller Fixed Disk and Diskette Drive
5	Parallel Port 2 AT-GPIB board 0 (software default)
4	Serial Port 1 BSC BSC Alternate SDLC
3	Serial Port 2 BSC BSC Alternate Cluster (Primary) PC Network (default) PC Network Alternate (default) SDLC WD EtherCard+ (default) 3Com EtherLink (default)
2	IRQ8-15 Chain (from interrupt Controller 2)
1	Keyboard Controller Output Buffer Full
0	Timer Channel 0 Output

DMA Channel Selection

The AT-GPIB board is set at the factory to use DMA channel 5 (see
Figure 2-1 for the DMA channel location). The DMA channels supported
by the AT-GPIB board are channels 5, 6, and 7. If you install more than
one AT-GPIB 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 software are shown in Table 2-7. You must change the DMA
channel setting on the hardware to match the software DMA channel
setting.

Table 2-7. Software Default AT-GPIB DMA Channel

Board	Default DMA Channel
First AT-GPIB (`gpib0`)	7
Second AT-GPIB (`gpib1`)	6

Check to determine that the software default DMA channel setting is not
already used by other equipment in your computer. If any equipment in
your computer uses this DMA channel, change the DMA channel of either
the AT-GPIB or the other device.

Note: *DMA channels 5, 6, and 7 are the three 16-bit channels on the
        PC AT I/O channel. The AT-GPIB board 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 2-8.

Table 2-8. DMA Channels for the AT-GPIB

	Signal Lines	
DMA Channel	**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 2-4 shows the hardware default DMA channel setting (DMA channel 5) and the setting to which you must change your hardware to match the software default DMA channel setting (DMA channel 7).
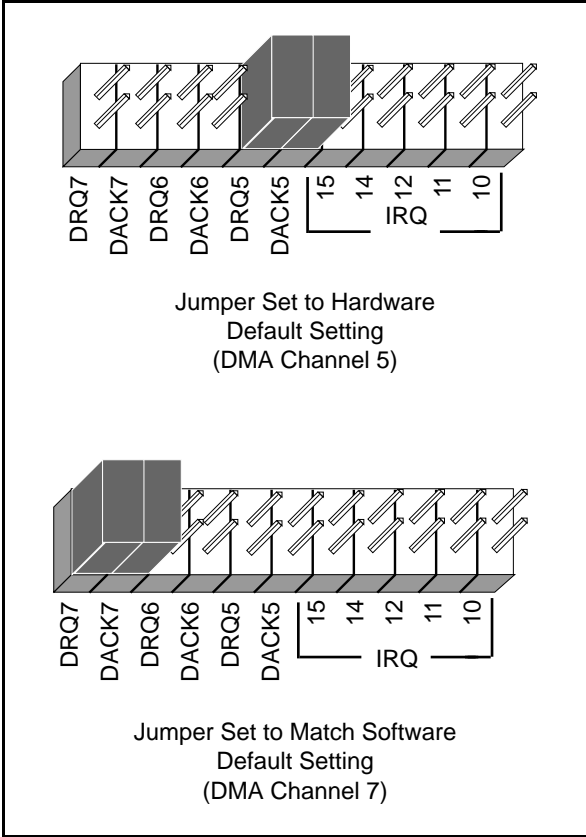
Figure 2-4. DMA Channel Jumper Setting

If you do not want to use DMA for GPIB transfers (the AT-GPIB board alternatively can use programmed I/O GPIB transfers), you can perform one of the following steps:

• Physically disconnect the AT-GPIB board from the DMA channel lines of the PC AT bus by removing the two jumpers. The jumpers can be stored on the board in the positions shown in Figure 2-5. Removing the jumpers disables the ability of the AT-GPIB board 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, *Software Installation and Configuration*.
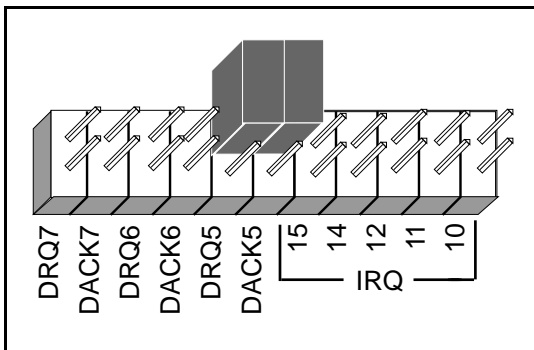
Figure 2-5. DMA Jumper Setting for No DMA Channel

• Logically disconnect the AT-GPIB board from the DMA lines by selecting NONE for the DMA channel of the AT-GPIB board when you run IBCONF (refer to Chapter 3, *Software Installation and Configuration*, 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.

If you change the hardware DMA channel to something *other than* 7, make sure that you make a corresponding change to the software DMA channel as described in Chapter 3, *Software Installation and Configuration*. Also, make sure that you record the new setting on the *AT-GPIB Hardware and Software Configuration Form* in Appendix D, *Customer Communication*.

Table 2-9 lists some of the DMA channels used by other PC AT plug-in interface boards and adapters. This is by no means a complete list, but it may help in determining possible DMA channel conflicts. Symptoms of DMA channel conflicts vary widely. At one extreme, conflicts can prevent the computer from booting. At the other extreme, DMA channel conflicts can sometimes be detected quite easily, because any data transfer operation (ibrd, ibwrt) will time out, with no bytes transferred.

National Instruments has made every effort to select a software default DMA channel that will work. However, because of the numerous different interface boards available for use in the PC AT, it is not possible to select a DMA channel that is guaranteed to work in all systems.

Table 2-9. PC AT 16-Bit DMA Channel Assignment Map

Channel	Device
7	AT-GPIB board 0 (software default)
6	AT-GPIB board 1 (software default)
5	Adaptec SCSI Card
4	Cascade for DMA Controller # 1 (channels 0 through 3)

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 2-6.
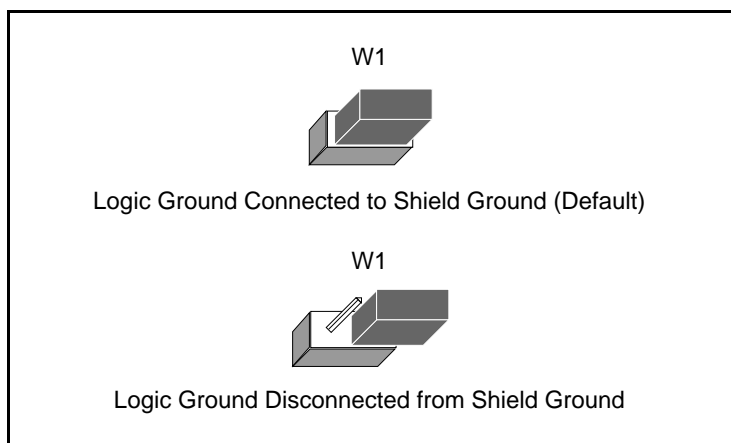
Figure 2-6. Ground Configuration Jumper Settings

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.***

If you change the hardware shield ground from its default position, record
the new setting on the *AT-GPIB Hardware and Software Configuration
Form* in Appendix D, *Customer Communication*.

Step 2. Install the Hardware

Before installing your AT-GPIB board, make sure that the hardware jumpers and switches (base I/O address switch, interrupt jumper, and DMA channel jumper) are set to match the default software settings.

Install the AT-GPIB board by completing the following steps:

1. Turn off your computer.

2. Unplug the power cord.

3. Remove the cover.

4. Plug the AT-GPIB board into an unused 16-bit slot (you may have to remove a blank expansion slot cover bracket).

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

6. Replace the cover.

7. Plug the power cord into the wall outlet.

8. Turn your computer back on.

The AT-GPIB 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 diskette and contains the steps for installing and configuring the NI-488M software. This chapter also contains a description of the software configuration utility, ibconf, and information for getting started with a GPIB application program.

Step 1. Prepare for Software Installation

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

*   You must have super-user privilege.

*   The SCO UNIX *Link Kit* needed for adding device drivers must already be installed. Install the Link Kit now if you have not already done so.

*   The AT-GPIB board must already be installed before you install the device driver software. If you have not installed your AT-GPIB board, refer to Chapter 2, *Hardware Configuration and Installation*, for instructions on how to configure and install your hardware.

*   The *NI-488M Distribution Disk AT-GPIB SCO UNIX System V/386 Handler and C Interface* is in tar format.

    Note: *This diskette is 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:

cib.c	C language library
ugpib.h	Include file for user programs
ibtsta	Installation test part A
ibtstb	Installation test part B
dcsamp.c	Example program for device calls in C
bcsamp.c	Example program for board calls in C

`ibic`	Interactive control utility
`ibconf`	Software configuration utility
`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
`ibinstall`	Install script for the handler
`ibremove`	Remove script for the handler
`ibrmnod`	Utility to remove GPIB device nodes

Step 2. Install the NI-488M Software

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

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.

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

3. Copy the files from the NI-488M distribution diskette to this directory using the `tar` command. Use the following command to copy the files from drive 0 on the 3.5 in. distribution diskette:

    ```
    tar xvf /dev/fd0135ds9
    ```

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.

Step 3. Load the NI-488M Driver

The NI-488M driver supports one or two boards. The first AT-GPIB board
is named gpib0 and the second AT-GPIB board is named gpib1.

Table 3-1 shows the software default settings for the AT-GPIB boards.

Table 3-1. Software Default Settings

	Software Default Settings	
Fields	`gpib0`	`gpib1`
Base I/O Address (hex)	260	240
Interrupt Vector Number	5	10
DMA Channel	7	6

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); therefore, proceed to the next section, *A. Change the Software Settings*.

If you configured your hardware to match the software default settings, skip the next section, *A. Change the Software Settings*, and go to *B. Install the Driver.*

A. Change the Software Settings

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  7
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 7. 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    5     260     27F    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 board. 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, refer to Appendix B, *Special Instructions for Changing the Software Settings*, for special instructions.

B. Install the Driver

The NI-488M driver must be installed and linked into the kernel. It can be installed automatically or manually.

Note: *For easy installation, automatic installation is recommended.*

Automatic Installation

To automatically install the NI-488M driver, go to the working directory that you created earlier in this chapter under the *A. Set Up a Working Directory* section and enter the following command.

```
./ibinstall
```

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

If the automatic installation fails, `ibinstall` displays the error encountered during the installation. If the error indicates a conflict in the hardware or software settings, you may have to change a setting. Refer to Chapter 2, *Hardware Configuration and Installation*, for information on changing the hardware settings. Refer to the beginning of this step (*Step 3. Load the NI-488M Driver*) for information on changing the software settings.

Manual Installation

To install the driver manually, complete the following steps.

1. Copy the `Driver.o,` `Master,` `System,` and `Node` files to the root directory by entering the following commands:

   ```
   cp Driver.o /
   cp Master /
   cp System /
   cp Node /
   ```

2. Change to the root directory by entering the following command:

   ```
   cd /
   ```

3. Install the driver in the kernel by entering the following command:

   ```
   /etc/conf/bin/idinstall -a ib
   ```

4. Create a new UNIX kernel by entering the following command:

   ```
   /etc/conf/bin/idbuild
   ```

5. Restart the system to run on the new kernel by entering the following commands:

   ```
   cd /
   reboot
   ```

Step 4. Configure the Software

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 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`.

Running ibconf

To create the device nodes and/or change the GPIB parameters, simply type `ibconf` at the command prompt.

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`

Exiting 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 `gpib*` and `dev*` 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 /
reboot
```

System Configuration Information

At system startup, when the NI-488M driver is loaded, the I/O address range, interrupt vector, and DMA level is displayed for device "gpib". This information corresponds to the AT-GPIB board installed as gpib0 in the system.

Notice that the interrupt vector number is displayed in *octal*. So, if you selected interrupt vector 10, it is displayed as 12 in octal. A message is also printed along with the configuration information about whether the NI-488M driver was successful in finding the board and installing the driver. If a board is not found at the base I/O address printed, make sure that the base I/O address hardware setting matches the base I/O address selected in ibconf.

Note: *If you would like to see this startup information after the system has booted, simply enter the following command:*

```
/etc/hwconfig
```

Step 5. Verify the Installation

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 typing in the following command:

    ```
    ibtsta
    ```

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

    ```
    ibtstb
    ```

    If no error occurs, the NI-488M driver is installed correctly.

Removing the Driver

You may want to remove the NI-488M software at some time. Remove the NI-488M software according to the following steps:

1. Remove the driver from the kernel automatically or manually.

    *   For automatic removal, go to the working directory that you created earlier in this chapter under the *A. Set Up a Working Directory* section and enter the following command:

        ```
         ./ibremove
        ```

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

    *   For manual removal, enter the following commands:

        ```
        /etc/conf/bin/idinstall -d ib
        /etc/conf/bin/idbuild
        ibrmnod
        ```

2. Restart the system by typing in the following commands:

    ```
    cd /
    reboot
    ```

Developing Your Application

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. To use the NI-488M functions, you must either compile `cib.c` and include the resulting object file during the link phase each time you compile your application, or you can link the GPIB library at compile time. The following examples show both options:

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

  or

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

- Your application program must also include the following header file

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

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

- For descriptions of the NI-488M functions, refer to the *NI-488M Software Reference Manual*.

Appendix A
New NI-488M Functions

This appendix describes three new NI-488M functions included in the
NI-488M software.

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-488 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
Special Instructions for Changing the Software Settings

This chapter contains special instructions for changing the base I/O address, interrupt vector number, and DMA channel software settings.

Using a Base I/O Address Different from the Software Default Setting

If you select a base I/O address other than one of the following for your AT-GPIB board(s):

1C0 hex	340 hex
1E0 hex	360 hex
240 hex	380 hex
260 hex	3A0 hex
320 hex	3C0 hex

you must complete the following steps before installing the NI-488M driver:

1. Decipher the address range of the AT-GPIB board by adding 31 decimal or 1F hex to the base I/O address of the AT-GPIB board.

2. Make a backup copy of the file `/etc/conf/pack.d/sio/space.c`.

3. Examine the structure `sio-brds` in the file `/etc/conf/pack.d/sio/space.c`. The address range of serial boards is defined on the sixth and seventh fields of the lines in the structure.

4. Identify the lines that define an address range that conflicts or overlaps with the I/O address range of the AT-GPIB board. Make sure that you are not using the serial boards defined on the identified lines and delete these lines from the file.

5. Relink the kernel by changing to the directory `/etc/conf/cf.d` and entering the following command:

    `./link_unix`

    This causes the file `/etc/conf/pack.d/sio/space.c` to be recompiled and builds a new kernel.

Using Interrupt Vector Number 11 or DMA Channel 5

The software default for interrupt vector number is 5 and the software default for DMA channel is 7 for the AT-GPIB board. The default SCO UNIX kernel contains the Adaptec SCSI driver, which uses interrupt vector number 11 and DMA channel 5. If you are *not* using an Adaptec SCSI driver, you *can* remove the Adaptec SCSI driver from the SCO UNIX kernel and use interrupt vector number 11 and DMA channel 5 for the AT-GPIB board. To remove the Adaptec SCSI driver from the SCO UNIX kernel, complete the following steps:

1. Bring the system up in single-user mode and log in as root.

2. Make a backup copy of the following files:

    *   `/etc/conf/sdevice.d/ad`
    *   `/etc/conf/sdevice.d/Sdsk`
    *   `/etc/conf/sdevice.d/Stp`
    *   `/etc/conf/cf.d/mdevice`
    *   `/etc/conf/cf.d/mscsi`

3. Edit the file `/etc/conf/sdevice.d/ad` and change the second field from a `Y` to an `N`.

4. Edit the file `/etc/conf/sdevice.d/Sdsk` and change the second field from a `Y` to an `N`.

5. Edit the file `/etc/conf/sdevice.d/Stp` and change the second field from a `Y` to an `N`.

6. Edit the file /etc/conf/cf.d/mdevice. The third field for the ad entry contains the string iHroCc. Remove the r (required) from this field. Also, change the last field for the ad entry from 5 to −1. Similarly, remove the r from the third fields of entries for Sdsk and Stp.

7. Comment out all the entries in the file /etc/conf/cf.d/mscsi by making the first character of each line an asterisk (*).

8. Examine the file /etc/conf/pack.d/Sdsk/stubs.c. It must contain the following lines:

```
struct iobuf *Sdsktab;

Sdskopen() {}
Sdskclose() {}
Sdskread() {}
Sdskwrite() {}
Sdskioctl() {}
Sdskstrategy() {}
Sdskpres() {return (0);}
```

If the file does not contain these lines, edit the file to contain them.

9. Relink the kernel by changing to the directory /etc/conf/cf.d and entering the following command:

```
./link_unix
```

Answer yes to all questions.

10. Reboot the system to run on the new kernel by entering the following commands:

```
cd /
reboot
```

Appendix C
Hardware Specifications

This appendix lists the electrical, environmental, and physical characteristics of the AT-GPIB board and the conditions under which it should be operated.

Table C-1. Electrical Characteristics

Characteristic	Specification
Maximum GPIB Transfer Rate	1.4 Mbytes/s*
Power Requirement (from PC AT I/O channel)	+5 VDC 0.66 A Typical 1.5 A Maximum
* Actual speed may vary considerably from speed shown because of system and instrumentation capabilities.	

Table C-2. Environmental Characteristics

Characteristic	Specification
Operating Environment	
Component Temperature Relative Humidity	0° to 40° C 10% to 90%, noncondensing
Storage Environment	
Temperature Relative Humidity	-20° to 70° C 5% to 90%, noncondensing
EMI	FCC Class B Certified

Table C-3. Physical Characteristics

Characteristic	Specification
Dimensions	10.67 cm by 16.51 cm (4.2 in. by 6.5 in.)
I/O Connector	IEEE 488 Standard 24-pin

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.

Corporate Headquarters
(512) 795-8248
Technical support fax: (800) 328-2203
                                (512) 794-5678

Branch Offices	Phone Number	Fax Number
Australia	(03) 879 9422	(03) 879 9179
Austria	(0662) 435986	(0662) 437010-19
Belgium	02/757.00.20	02/757.03.11
Denmark	45 76 26 00	45 76 71 11
Finland	(90) 527 2321	(90) 502 2930
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
Mexico	95 800 010 0793	95 800 010 0793
Netherlands	03480-33466	03480-30673
Norway	32-848400	32-848600
Singapore	2265886	2265887
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
Taiwan	02 377 1200	02 737 4644
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 _____

(continues)

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 Line	DMA Channel
1st AT-GPIB	_____	_____	_____
2nd AT-GPIB	_____	_____	_____

Software

• NI-488M Software Version Number on Distribution Disk _____
  (Disk Label: *NI-488M Distribution Disk AT-GPIB SCO UNIX System V/386 Handler and C Interface*)

• Software Settings

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

Other Products

- SCO UNIX System V/386 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
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____

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Glossary

Prefix	Meaning	Value
m- μ- n- k- M-	milli- micro- nano- kilo- mega-	10^{-3} 10^{-6} 10^{-9} 10^{3} 10^{6}

°	degrees
%	percent
A	amperes
ATN	Attention
BSC	Bisynchronous Communications
DAV	Data Valid
DMA	direct memory access
EMI	electromagnetic interface
EOI	End or Identify
EOS	End of String
FCC	Federal Communications Commission
GPIB	General Purpose Interface Bus
hex	hexadecimal
Hz	hertz
IEEE	Institute of Electrical and Electronic Engineers
IFC	Interface Clear
in.	inches
I/O	input/output
IRQ	Interrupt Request
m	meters
MB	megabytes of memory
NDAC	Not Data Accepted Bit
NRFD	Not Ready For Data Bit
REN	Remote Enable
SCSI	Small Computer System Interface
s	seconds
SRQ	Service Request
VDC	volts direct current
VGA	video graphics array