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GPIO-SCSI-A

Getting Started with Your GPIB-SCSI-A and the NI-488.2M™ Software for the Sun SPARCstation

June 1994 Edition

Part Number 320422-01

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

Federal Communications Commission

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

1. This device may not cause harmful interference in commercial environments.
2. This device must accept any interference received, including interference that may cause undesired operation.

Canadian Department of Communications

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

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

Instructions to Users

These regulations are designed to provide reasonable protection against harmful interference from the equipment to radio reception in commercial areas. Operation of this equipment in a residential area is likely to cause harmful interference, in which case the user will be required to correct the interference at his own expense.

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

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.

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About This Manual

This manual contains instructions for installing and configuring the National Instruments GPIB-SCSI-A and NI-488.2M multitasking software for use with the Sun SPARCstation running under SunOS 4.1 or higher operating system. This manual is meant to be used with the *NI-488.2M Software Reference Manual*.

This manual assumes that you have a general knowledge of the Sun SPARCstation running SunOS and the General Purpose Interface Bus (GPIB).

Organization of This Manual

This manual is organized as follows:

- Chapter 1, *Introduction*, lists what you need to get started and optional equipment you can order, gives instructions for inspecting your GPIB-SCSI-A, and briefly describes the hardware and the NI-488.2M software.
- Chapter 2, *Hardware Configuration and Installation*, describes how to configure the GPIB-SCSI-A and how to connect the GPIB-SCSI-A to the Sun SPARCstation.
- Chapter 3, *Software Installation and Configuration*, lists all the files located on the distribution disk, and contains step-by-step instructions for installing and configuring your NI-488.2M software, verifying the installation of your NI-488.2M software, and using the NI-488.2M software with your GPIB application program.
- Appendix A, *Hardware Specifications*, lists the electrical, environmental, and physical specifications of the GPIB-SCSI-A and the recommended operating conditions.
- Appendix B, *Troubleshooting*, suggests some areas to check if you have problems installing the GPIB-SCSI-A Controller and/or the NI-488.2M software after going through Chapter 2 and Chapter 3.

About This Manual

- Appendix C, *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.

bold	Bold text indicates LEDs.
<i>italic</i>	Italic text denotes emphasis, a cross reference, or an introduction to a key concept.
<i>bold italic</i>	Bold italic text denotes a note, caution, or warning.
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, device names, functions, variables, and filenames, and for statements and comments taken from program code.
<>	Angle brackets enclose the name of a key on the keyboard—for example, <Delete>.
-	A hyphen between two or more key names enclosed in angle brackets denotes that you should simultaneously press the named keys. For example, <Control-Alt-Delete>.
<Enter>	Key names are capitalized.

IEEE 488
IEEE 488.2

IEEE 488 and IEEE 488.2 refer to the ANSI/IEEE Standard 488.1-1987 and the ANSI/IEEE Standard 488.2-1987, respectively, which define the GPIB.

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

Related Documentation

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

- *GPIB-SCSI-A User Manual*, National Instruments Corporation
- ANSI X3.131-1986, *Small Computer System Interface (SCSI)*
- ANSI/IEEE Standard 488.1-1987, *IEEE Standard Digital Interface for Programmable Instrumentation*
- ANSI/IEEE Standard 488.2-1987, *IEEE Standard Codes, Formats, Protocols, and Common Commands*
- *SPARCstation Installation Guide*, Sun Microsystems, Inc., Mountain View, California 94043
- *SPARCstation SunOS 4.1.1 Sun-4c Release Notes*, Sun Microsystems, Inc., Mountain View, California 94043
- *SunOS 4.1.1 Release Notes*, Sun Microsystems, Inc., Mountain View, California 94043

Customer Communication






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

Chapter 1

Introduction

This chapter lists what you need to get started and optional equipment you can order, gives instructions for inspecting your GPIB-SCSI-A, and briefly describes the hardware and the NI-488.2M software.

What You Need to Get Started

-  One of the following boxes:
 - GPIB-SCSI-A, 100 to 120 VAC
 - GPIB-SCSI-A, 220 to 240 VAC
-  One of the following power cords:
 - U.S.A. standard power cord
 - Switzerland power cord
 - Australian power cord
 - Universal European power cord
 - North American power cord
 - U.K. power cord
-  Standard 50-pin SCSI-1 terminator
-  Type SCSI-G Cable:
 - GPIB-SCSI-A (50-pin SCSI-1) to Sun SPARCstation (SCSI-2 50-pin)—1 m
-  One of the following software media:
 - 3.5 in. *NI-488.2M Distribution Disk for GPIB-SCSI-A Sun SPARCstation SunOS 4.1.2 Driver and C Interface*
 - or
 - NI-488.2M Distribution Streaming Tape for GPIB-SCSI-A Sun SPARCstation SunOS 4.1.2 Driver and C Interface*

Optional Equipment

You can call National Instruments to order the following optional equipment.

- Rack-Mount Kit
 - Single (1 unit)
 - Dual (2 units)
 - Double-Shielded SCSI Cable
 - GPIB-SCSI-A (50-pin Champ) to SCSI-1 (50-pin Champ)—1 m
 - Shielded GPIB Cables*
 - GPIB Type X1 Cable (1 m, 2 m, 4 m, or 8 m)
 - GPIB Type X2 Cable (1 m, 2 m, 4 m, or 8 m)
- * To meet FCC emission limits for a Class A device, you must use a shielded (Type X1 or X2) GPIB cable. Operating this equipment with a non-shielded GPIB cable may cause interference to radio and television reception in commercial areas.

Inspection

Before you install the GPIB-SCSI-A, inspect the shipping container and its contents for damage. Retain the packaging material for possible inspection or for reshipment.

If the equipment appears to be damaged, do not attempt to operate it. Contact National Instruments for instructions. If the damage appears to have been caused in shipment, file a claim with the carrier.

Hardware Description

The GPIB-SCSI-A is a high-performance interface product that transparently handles data transfers between the SCSI and the GPIB. It is actually an 8-bit microcomputer that operates as a full-function IEEE 488.2/SCSI Controller. It can turn any computer with a SCSI port into a GPIB Talker/Listener/Controller or can make any device on the SCSI bus look like a GPIB device.

The GPIB-SCSI-A has all the software and logic required to implement the physical and electrical characteristics of the ANSI/IEEE Standard 488.2-1987 and the ANSI Standard X3T9.2. It is able to interpret and execute commands that you send to it over the GPIB or SCSI ports and perform all necessary GPIB-to-SCSI protocol conversions.

Software Description

The NI-488.2M software is a comprehensive package consisting of a multitasking driver and programs that transform a Sun SPARCstation running SunOS 4.1.1 or higher into a GPIB Controller with complete communications and bus management capabilities. The NI-488.2M software includes the following items:

- C language interface
- interactive control utility (`ibic`)
- automatic installation program (`instgplib`)
- programs to test the software installation (`ibtsta`, `ibtstb`)
- interactive software configuration utility (`ibconf`)

Chapter 2

Hardware Configuration and Installation

This chapter describes how to configure the GPIB-SCSI-A and how to connect the GPIB-SCSI-A to the Sun SPARCstation.

Figure 2-1 shows the rear panel of the GPIB-SCSI-A.

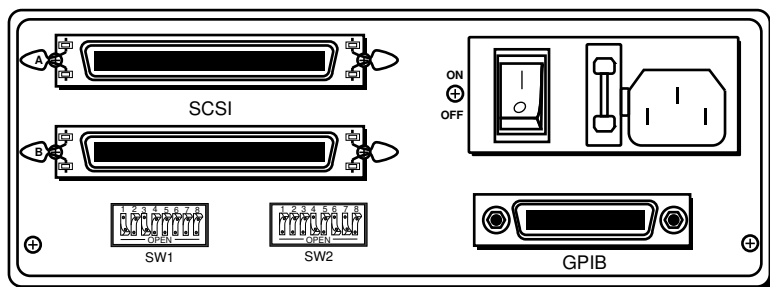


Figure 2-1. GPIB-SCSI-A Rear Panel

Configuring the Hardware

The hardware configurations of the SCSI ID (Target ID) and the GPIB primary address must match the software configuration in the system configuration files and the NI-488.2M software.

There are two basic steps to configure the GPIB-SCSI-A.

1. Verify the voltage requirement.
2. Configure the operating characteristics.

These steps are described in more detail in the following paragraphs.

Step 1. Verify the Voltage Requirement

The GPIB-SCSI-A is shipped from the factory with either a 100 to 120 V or a 220 to 240 V power supply. Verify that the voltage on the power supply matches the voltage that is supplied in your area.

Caution: *Operating the GPIB-SCSI-A at any voltage other than the one specified on the rear panel could damage the unit. Replacement fuses must be the proper type and rating. See Appendix A, Hardware Specifications, for fuse information.*

Step 2. Configure the Operating Characteristics

The GPIB-SCSI-A is shipped from the factory configured to operate in SCSI (S) mode. Optional parity checking on the SCSI port is disabled. The SCSI ID that the GPIB-SCSI-A responds to is set at 5, and the primary GPIB address is set at 0. Additionally, the GPIB-SCSI-A kit is shipped from the factory with a SCSI terminator installed. Depending on your system, you may want to remove it.

Note: *The only parameters available for configuration with this kit are the SCSI ID and the GPIB address. Do not change any other switch settings from the factory default settings.*

The factory default setting of the GPIB-SCSI-A Target ID is 5. To confirm that a Target ID of 5 is available in your system, enter the SunOS `dmesg` command to print out the startup messages from the last time you booted. Among these messages are the devices found on the SCSI bus and their respective Target ID numbers. If a Target ID of 5 is not available in your system, select an unused Target ID (a number between 0 and 7) and set the appropriate switch to that Target ID number (refer to *Configuration Switch Settings for SW1* later in this chapter). Typically, Targets 1 and 3 are used by the internal disks, Target 4 is used by a tape drive (if you have a tape drive), and Target 0 is used by an external disk drive. Target 7 is always used by the Sun central processing unit.

Configuration Switch Settings for SW1

The DIP switch at location SW1 on the rear panel (see Figure 2-1) is used to configure the power-on primary GPIB address and SCSI ID of the GPIB-SCSI-A.

Figure 2-2 shows the factory default settings.

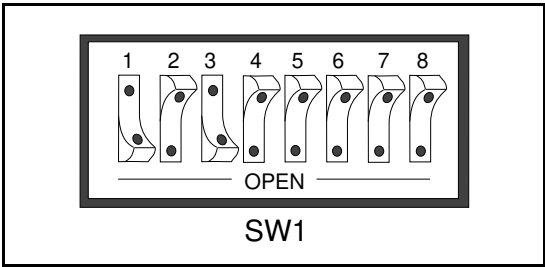


Figure 2-2. SW1 Default Mode Switch Settings

In Figure 2-2 switches 1 through 3 are ON, OFF, ON, respectively, selecting the SCSI ID of 5. Switches 4 through 8 are OFF, indicating that the GPIB primary address of the GPIB-SCSI-A is 0.

Tables 2-1 and 2-2 show the possible configurations of the eight switches and what each configuration indicates. Factory default settings are in ***bold italics***.

Table 2-1. Configuration Parameters for SW1 Switches 1 through 3

Switches			Indication
1	2	3	
OFF	OFF	OFF	SCSI ID of 0
OFF	OFF	ON	SCSI ID of 1
OFF	ON	OFF	SCSI ID of 2
OFF	ON	ON	SCSI ID of 3
ON	OFF	OFF	SCSI ID of 4
<i>ON</i>	<i>OFF</i>	<i>ON</i>	<i>SCSI ID of 5</i>
ON	ON	OFF	SCSI ID of 6
ON	ON	ON	SCSI ID of 7

Table 2-2. Configuration Parameters for Switches 4 through 8

Switches					Indication
1	2	3	4	5	
OFF	OFF	OFF	OFF	OFF	GPIB Primary address 0
OFF	OFF	OFF	OFF	ON	GPIB Primary address 1
OFF	OFF	OFF	ON	OFF	GPIB Primary address 2
OFF	OFF	OFF	ON	ON	GPIB Primary address 3
OFF	OFF	ON	OFF	OFF	GPIB Primary address 4
OFF	OFF	ON	OFF	ON	GPIB Primary address 5
OFF	OFF	ON	ON	OFF	GPIB Primary address 6
OFF	OFF	ON	ON	ON	GPIB Primary address 7
OFF	ON	OFF	OFF	OFF	GPIB Primary address 8
OFF	ON	OFF	OFF	ON	GPIB Primary address 9
OFF	ON	OFF	ON	OFF	GPIB Primary address 10
OFF	ON	OFF	ON	ON	GPIB Primary address 11
OFF	ON	ON	OFF	OFF	GPIB Primary address 12
OFF	ON	ON	OFF	ON	GPIB Primary address 13
OFF	ON	ON	ON	OFF	GPIB Primary address 14
OFF	ON	ON	ON	ON	GPIB Primary address 15
ON	OFF	OFF	OFF	OFF	GPIB Primary address 16
ON	OFF	OFF	OFF	ON	GPIB Primary address 17
ON	OFF	OFF	ON	OFF	GPIB Primary address 18
ON	OFF	OFF	ON	ON	GPIB Primary address 19
ON	OFF	ON	OFF	OFF	GPIB Primary address 20
ON	OFF	ON	OFF	ON	GPIB Primary address 21
ON	OFF	ON	ON	OFF	GPIB Primary address 22
ON	OFF	ON	ON	ON	GPIB Primary address 23
ON	ON	OFF	OFF	OFF	GPIB Primary address 24
ON	ON	OFF	OFF	ON	GPIB Primary address 25
ON	ON	OFF	ON	OFF	GPIB Primary address 26
ON	ON	OFF	ON	ON	GPIB Primary address 27
ON	ON	ON	OFF	OFF	GPIB Primary address 28
ON	ON	ON	OFF	ON	GPIB Primary address 29
ON	ON	ON	ON	OFF	GPIB Primary address 30
ON	ON	ON	ON	ON	GPIB Primary address 0

Configuration Switch Settings for SW2

The DIP switch at location SW2 on the rear panel (see Figure 2-1) is used to configure the mode of operation for the GPIB-SCSI-A. These switch settings *do not* need to be changed for use with the SPARCstation. Figure 2-3 shows the factory default settings. Make sure that these switches are set as shown in Figure 2-3. If they are not, set these switches as indicated.

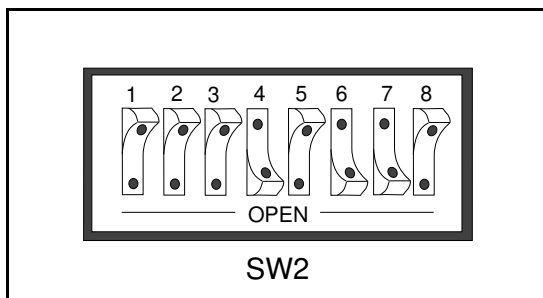


Figure 2-3. SW2 Default Mode Switch Settings

Switch 8 is OFF, indicating that the GPIB-SCSI-A is operating in S mode. Switch 7 is ON, indicating that the GPIB-SCSI-A will neither notice nor report SCSI parity errors. Switch 6 is ON, indicating that the GPIB-SCSI-A will buffer data during data transfer commands. Switch 5 is OFF, indicating that the GPIB-SCSI-A will complete all data requests to the exact count specified. Switch 4 is ON, indicating that double buffering is used. Switches 1 through 3 are OFF because they are reserved.

Table 2-3 and the subsequent paragraph describe the factory default configurations of the eight switches.

Table 2-3. Factory Default Configurations for SW2

Switch	Position	Indication
8	OFF	Operating in S (SCSI) mode.
7	ON	GPIO-SCSI-A will neither notice nor report SCSI parity errors.
6	ON	GPIO-SCSI-A will buffer data during data transfer commands.
5	OFF	GPIO-SCSI-A will complete all data requests to the count specified.
4	ON	Double buffering is enabled.
1-3	OFF	Reserved and should remain OFF.

Using SCSI Terminating Resistors

Because of its high-speed capabilities, the SCSI bus is sensitive to the electrical characteristics of the SCSI cabling. When a signal is sent through the SCSI bus, it bounces back and creates echoes along the cabling. Any device in the middle of the daisy-chained SCSI bus receives these signal echoes. You should use terminating resistor packs to prevent echoes and ensure proper termination of a signal. Read the documentation for each device in your system to find out what kind of termination it provides.

If your GPIO-SCSI-A is located at the end of a SCSI bus, you can prevent echoes by leaving the terminating resistor pack installed on one of the ports on the rear panel of the GPIO-SCSI-A. Also, ensure that the device at the other end of the SCSI bus (for example, the SCSI host in Figure 2-4) has a terminating resistor installed. Remove the terminating resistor packs on all devices except for the two at each end, because SCSI signals are not reliably passed along the SCSI bus after they reach a device with a terminator.

Caution: *Never connect more than two sets of terminating resistors on a SCSI bus because more than two sets might overload the signals and generate errors.*

Figure 2-4 shows where to install terminating resistors if the GPIB-SCSI-A is located at the end of a system.

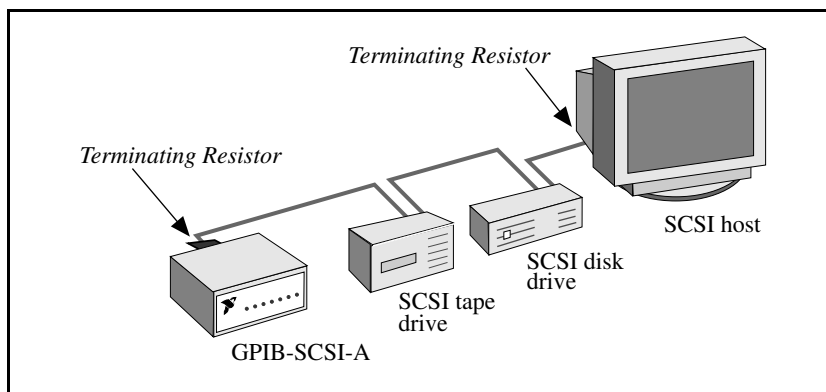


Figure 2-4. Location of Terminating Resistors for GPIB-SCSI-A at End of SCSI Bus

If your GPIB-SCSI-A is not located at the end of the SCSI bus, remove the terminating resistor pack from the rear panel of the GPIB-SCSI-A. Also ensure that all other devices in the middle of the bus (for example, the SCSI disk drive in Figure 2-5) do not have terminating resistors installed. The devices at each end of the SCSI bus should have terminating resistors installed.

Figure 2-5 shows where to install terminating resistors if the GPIB-SCSI-A is at a location other than the end of a system.

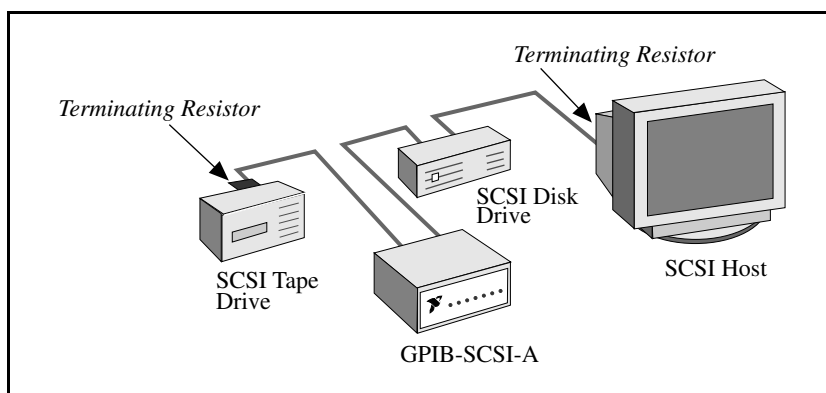


Figure 2-5. Location of Terminating Resistors for GPIB-SCSI-A Not at End of SCSI Bus

Connecting the Hardware

The following are general instructions for connecting the GPIB-SCSI-A to the Sun SPARCstation. Consult the chapter on installing external drives in the installation guide that came with your SPARCstation for specific instructions and warnings.

There are two methods for connecting the GPIB-SCSI-A to the Sun SPARCstation. One method is connecting the GPIB-SCSI-A directly to the SPARCstation system unit by using a cable with the proper connectors at each end. The other method is daisy-chaining. *Daisy-chaining* is a means of connecting a number of SCSI devices to a host; thereby, a single port on the host can serve a variable number of devices. Daisy-chaining is the suggested method for connecting the GPIB-SCSI-A to the Sun SPARCstation.

Whether you are using a direct connection or daisy-chaining, there are three basic steps to connecting the GPIB-SCSI-A.

1. Shut down your system and turn off your computer.
2. Connect the cables.
3. Switch on your GPIB-SCSI-A and power on your system.

Step 1. Shut Down the System

Complete the following steps to shut down your system:

1. Enter the `shutdown` command and turn off your computer. (You need super-user privilege to do a shutdown.)
2. Unplug the power cord from the power outlet.

Step 2. Connect the Cables

Caution: *Never connect or disconnect SCSI cables when any device (computer, tape drive, GPIB-SCSI-A, and so on) is powered on. Doing so can cause fuses to blow inside the GPIB-SCSI-A and inside other SCSI devices that supply termination power (TERMPWR) to the SCSI bus.*

Complete the following steps to connect the cables:

1. Connect the SCSI cable to the GPIB-SCSI-A and securely fasten it. Connect the other end to your SCSI system. Be sure to use only shielded SCSI cables and follow all ANSI X3T9.2 cabling restrictions.
2. Connect the GPIB cable to the GPIB-SCSI-A and tighten the thumb screws on the connector. Connect the other end to your GPIB system. Be sure to follow all IEEE 488 cabling restrictions, and use only shielded GPIB cables.
3. Plug in the power cord into an AC outlet of the correct voltage.

Step 3. Switch On Your GPIB-SCSI-A and Power On Your System

Complete the following steps to switch on your GPIB-SCSI-A and power on your system:

1. Switch on your GPIB-SCSI-A by using the rocker switch on the rear panel. The **POWER** LED should come on immediately and the **READY** LED indicator on the front panel should come on after the

GPB-SCSI-A has passed its power-on self-test, indicating the unit is ready for operation.

If the **READY** LED indicator does not come on within ten seconds after the unit is powered on, recheck all connections and switch settings and retry the power-on sequence. If the **READY** LED still fails to come on, fill out the configuration forms in Appendix C, *Customer Communication*, before you contact National Instruments for support.

2. Plug the power cords of the SPARCstation and any other SCSI equipment into a power outlet and power on all devices.

Chapter 3

Software Installation and Configuration

This chapter lists all the files located on the distribution disk, and contains step-by-step instructions for installing and configuring your NI-488.2M software, verifying the installation of your NI-488.2M software, and using the NI-488.2M software with your GPIB application program.

Step 1. Prepare for Installation

Before you install the NI-488.2M software, consider the following:

- You must have super-user privilege.
- All the software needed for adding a device driver is in the *sys package*, which is optional software shipped with your Sun computer. This software package must already be installed. Install this software now if you have not already done so (refer to your *SunOS 4.1.2 Release Notes* to install the *sys package*).
- The *NI-488.2M Distribution Disk for GPIB-SCSI-A Sun SPARCstation SunOS 4.1.2 Driver and C Interface* is in *BAR* format.

The *NI-488.2M Distribution Streaming Tape for GPIB-SCSI-A Sun SPARCstation SunOS 4.1.2 Driver and C Interface* is in *TAR* format.

Note: *The disk and streaming tape are referred to as the NI-488.2M distribution media throughout the remainder of this manual.*

Review the files contained on the NI-488.2M distribution media. The files are as follows:

<code>gpib.o</code>	NI-488.2M driver for GPIB-SCSI-A
<code>cib.c</code>	C language library
<code>ugpib.h</code>	Include file for user programs
<code>ibtsta</code>	Installation test part A
<code>ibtstb</code>	Installation test part B
<code>ibic</code>	Interactive control utility
<code>ibconf</code>	Software configuration utility
<code>instgpib</code>	Install shell script

Step 2. Install the NI-488.2M Software

Follow these procedures to install the NI-488.2M GPIB-SCSI-A software.

Set Up a Working Directory

1. Log on as super-user (`root`).
2. Create a working directory (for example, `/usr/gpib`) and change to that directory.
3. Copy the files from the NI-488.2M distribution media to this directory using the appropriate command.
 - For the floppy disk, use the `BAR` command by entering:

```
bar xvf /dev/rfd0c
```
 - For the QIC-24 streaming tape, use the `TAR` command by entering:

```
tar xvf /dev/rst8
```

Install the Driver

You can install the driver automatically or manually.

Installing the Driver Automatically

The interactive program `instgpib` installs the driver for you. The `instgpib` program prompts you for a Target ID number for the NI-488.2M software. You must select the Target ID number that you set using switches 1, 2, and 3 of the GPIB-SCSI-A DIP switch SW1 (refer to *Configuring the Hardware* in Chapter 2). Set these switches before you start `instgpib`.

Run `instgpib` in your working directory and follow the instructions in the shell script. Enter the following command:

```
./instgpib
```

Installing the Driver Manually

To install the driver manually, you must install the utility files, the C library, and the driver, as well as build a new SunOS UNIX kernel. The following procedures contain step-by-step instructions for installing the driver manually.

Install the Utility Files

Complete the following three steps to install the utility files.

1. Copy the file `ugpib.h` to `/usr/include/sys`.

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

2. Copy the file `gpib.o` to `/sys/sun4c/OBJ`.

```
cp gpib.o /sys/sun4c/OBJ
```

3. Copy 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
```

Install the C Library

The file `cib.c` should be compiled and converted into a library. This procedure is necessary because the *NI-488.2M 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 /lib/libgpib.a cib.o
ranlib /lib/libgpib.a
```

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

Install the Driver into the System

To build a new kernel with the NI-488.2M driver, use the following three configuration files. Filenames for the Sun SPARCstation 630MP series are in parentheses.

- `/sys/sun/conf.c`
- `/sys/sun4c/conf/files`
- (• `/sys/sun4m/conf/files`)
- `/sys/sun4c/conf/GENERIC`
- (• `/sys/sun4m/conf/GENERIC`)

You must edit these files to add information about the NI-488.2M driver.

Build a New SunOS 4.1.2 UNIX Kernel

To build a new SunOS 4.1.2 UNIX kernel with the NI-488.2M driver installed, complete the following steps. Notice that steps 2, 5, and 8 differ depending on whether you are using one or two GPIB-SCSI-A boxes.

1. Change to the `/sys/sun` directory and edit the file `conf.c`. Find the block of function definitions preceding the character device table `cdevsw` and type in the following lines:

```
#include "ib.h"
#if NIB > 0
int ibopen(), ibclose(), ibread(), ibwrite(),
                                                    ibioctl();
#else
#define ibopen          nodev
#define ibclose          nodev
#define ibread          nodev
#define ibwrite          nodev
#define ibioctl          nodev
#endif
```

The file `ib.h` is created automatically by the system in step 6. It will contain the following single line:

```
#define NIB 1
```

where 1 is the number of GPIB-SCSI-A boxes configured in the UNIX kernel.

At the end of the character device table `cdevsw` in `conf.c`, type in the following lines:

```
{ ibopen,    ibclose,    ibread,    ibwrite,    /* xx */
  ibioctl,   nodev,      seltrue,   0,
  0,
},
```

Note: *This table has the same structure as the character device table `cdevsw` in `/usr/include/sys/conf.h`.*

Each device in the system has a unique major device number. To determine the major device number of the GPIB-SCSI-A, choose the number after the largest device number currently in your system. The GPIB-SCSI-A and its attached devices use the same major device number.

In this example, the major device number is *xx*, as shown in the comment */* xx */* previously.

2. Enter the following command, replacing *xx* with your major device number from step 1, to create a special node for device *gpib0*.

```
mknod /dev/gpib0 c xx 255
```

Note: *If you are using two GPIB-SCSI-A boxes, the device node /dev/gpib1 for the second box gpib1 is created when you run **ibconf** later in the software installation.*

3. Change to the */sys/sun4c/conf* directory and edit the file *files*. Enter the following line after the line *scsi/targets/sd.c* optional *sd scsibus*.

```
scsi/targets/gpib.c optional ib scsibus
```

4. Change to */sys/sun4c/conf* and create a configuration file named *GPIB* by copying an existing configuration. *GENERIC* is the default generic Sun configuration file. If you already have a local configuration different from *GENERIC*, enter the following command to copy it.

```
cp GENERIC GPIB
```

If you do not know the name of the system configuration, enter the *dmesg* command to print out the startup messages from the last time your system booted. Among these messages is the message *SunOS Release 4.1.2 (xxx) #No:.* If the name in the parentheses is the name of your machine, *GENERIC* is the configuration. If the name in the parentheses is not the name of your machine, use the name in the parentheses as your local configuration.

5. Edit the file *GPIB*.

- If you are using one GPIB-SCSI-A, type in the following line after the line `scsibus0 at esp #declare first scsi bus`.

```
device ib0 at scsibus0 target X lun 0
                                #GPIB-SCSI-A device
driver
```

Replace *X* with the Target ID set in the GPIB-SCSI-A hardware configuration.

- If you are using two GPIB-SCSI-A boxes, type in the following lines after the line `scsibus0 at esp #declare first scsi bus`.

```
device ib0 at scsibus0 target X lun 0
                                #GPIB-SCSI-A device
driver
device ib1 at scsibus0 target Y lun 0
                                #GPIB-SCSI-A device
driver
```

Replace *X* and *Y* with the Target IDs set in the GPIB-SCSI-A hardware configuration.

Note: *X and Y are the SCSI IDs of the GPIB-SCSI-A boxes and must be different.*

6. Create the new system and be sure to save the old version of `/vmunix` by entering the following commands.

```
config GPIB
cd ../GPIB
make
cp /vmunix /vmunix.old
cp vmunix /vmunix
```

7. The new UNIX kernel, `/vmunix`, is ready to be started. Shutdown the system by entering the following command:

```
shutdown -h now
```

8. When the reboot prompt `>` appears on the screen, enter the following command to reboot the system with the new kernel.

```
b /vmunix
```

- If you are using one GPIB-SCSI-A, the following message about the GPIB-SCSI-A appears on your screen if the software and the hardware are installed correctly.

```
ib0:  <N.I. GPIB-SCSI-A>
ib0:  at esp0 target X lun 0
GPIB-SCSI-A controller is configured for
disconnection/reconnection
```

(X is the GPIB-SCSI-A Target ID number.)

- If you are using two GPIB-SCSI-A boxes, the following message about the GPIB-SCSI-As will appear on your screen if the software and the hardware are installed correctly.

```
ib0:  <N.I. GPIB-SCSI-A>
ib0:  at esp0 target X lun 0
GPIB-SCSI-A controller is configured for
disconnection/reconnection
ib1:  <N.I. GPIB-SCSI-A>
ib1:  at esp0 target Y lun 0
GPIB-SCSI-A controller is configured for
disconnection/reconnection
```

(X and Y are the GPIB-SCSI-A Target ID numbers.)

The following message appears on your screen if the system cannot communicate with the GPIB-SCSI-A or GPIB-SCSI-As.

```
ib_findslave: failed, scsi_slave returned 0x2
```

Refer to the *Hardware* section in Appendix B, *Troubleshooting*, if you get this error message. After completing the troubleshooting steps in the *Hardware* section, reboot your system.

Step 3. Configure the Software with `ibconf`

You might want to view or change some of the default software parameters. The software configuration utility `ibconf` allows you to change these

software parameters. If you changed the default settings of the GPIB-SCSI-A, such as the GPIB primary address, you must make a corresponding change to the default parameters shown in `ibconf`. Even if the default parameters are acceptable, you must run `ibconf` to create the special files needed by the software. You must have super-user privilege to run `ibconf`.

`ibconf` is largely self-explanatory and contains help screens that explain all commands and options. For more information on using `ibconf`, refer to Chapter 2, *Installation and Configuration of NI-488.2M Software* in the *NI-488.2M Software Reference Manual*.

The command to access `ibconf` is as follows:

```
ibconf [unix_kernel]
```

where `unix_kernel` can be any UNIX kernel with the NI-488.2M driver installed. The default UNIX kernel is `/vmunix`.

To give Read/Write nonsuper-user access to the bus, execute the following UNIX commands after you execute `ibconf`:

```
chmod 666 /dev/dev*
chmod 666 /dev/gpib
```

Make any necessary configuration changes and save the current configuration by entering `y` before exiting `ibconf`. Even if you have not made any changes to the configuration settings, you should still enter 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. Reboot the system now.

Step 4. Verify the Software 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 entering the following command.

```
ibtsta
```

If the UNIX kernel booted has a name different from `/vmunix`, enter the full pathname when prompted.

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

```
ibtstb
```

If an error occurs in `ibtsta` or `ibtstb`, refer to Appendix B, *Troubleshooting*.

If no error occurs, the NI-488.2M driver is installed correctly.

Using the NI-488.2M Software with Your Application Program

After the driver software is installed and verified successfully, follow these guidelines to proceed with development of your NI-488.2M application software.

- The file `cib.c` is the interface between your C language application program and the operating system entry points to the NI-488.2M driver. The functions available in `cib.c` are described in detail in the *NI-488.2M 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` as shown in the following examples:

```
cc test.c cib.o
```

or

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

- The application program must include the following header file:

`<sys/ugplib.h>`

- The NI-488.2M functions are compatible with any other NI-488.2M functions used with other National Instruments products, except for the functions `ibdma` and `ibsgnl`.
- The best way to learn the NI-488.2M functions and the device-specific commands of your instruments is to use the interactive control program `ibic`. By using `ibic`, you can control instruments from the keyboard one step at a time. For information on using `ibic`, refer to Chapter 2, *Installation and Configuration of NI-488.2M Software* in the *NI-488.2M Software Reference Manual*.

Appendix A

Hardware Specifications

This appendix lists the electrical, environmental, and physical characteristics of the GPIB-SCSI-A and the recommended operating conditions.

Table A-1. Electrical Characteristics

Characteristic	Specification
Power Supply Unit	100 to 120 VAC \pm 10%, 50 to 60 Hz or 220 to 240 VAC \pm 10%, 50 to 60 Hz
Current	100 to 120 VAC, 90 mA 220 to 240 VAC, 45 mA
Fuse Rating and Type	100 to 120 VAC, 200 mA, UL/CSA approved 220 to 240 VAC, 125 mA, IEC approved

Table A-2. Environmental Characteristics

Characteristic	Specification
Operating Temperature	0° to 40° C
Storage Temperature	-20° to 70° C
Relative Humidity	10% to 90% noncondensing conditions
EMI	FCC Class A Verified

Table A-3. Physical Characteristics

Characteristic	Specification
Case Size	2.934 in. by 7.489 in. by 9.88 in. (74.5 mm by 190.2 mm by 250.9 mm)
Case Material	All metal enclosure
Rack Mounting	Single or dual kits available
Weight	4 lb (1.81 kg)

Appendix B

Troubleshooting

This appendix suggests some areas to check if you have problems installing the GPIB-SCSI-A Controller and/or the NI-488.2M software after going through Chapter 2 and Chapter 3.

If you still have problems after completing the steps in this appendix, complete the *GPIB-SCSI-A Hardware and Software Configuration Form* in Appendix C, *Customer Communication*, and then call National Instruments for technical support.

Hardware

Warning: *The GPIB-SCSI-A contains circuitry which operates with hazardous voltages. Do not open the unit unless instructed by National Instruments. Remove the power cord before opening the unit.*

- The GPIB-SCSI-A Controller must be securely connected to the SCSI cable. If the GPIB-SCSI-A is the last device on the SCSI bus, make sure that you have placed the terminating resistor pack on one of the SCSI ports on the rear panel of the GPIB-SCSI-A to terminate the SCSI bus. (See *Using SCSI Terminating Resistors* in the *Configuring the Hardware* section of Chapter 2 for more information.)
- The SW1 DIP switch settings on the GPIB-SCSI-A Controller should be set to the correct SCSI ID (Target ID) and the correct GPIB primary address. Refer to Chapter 2, the section entitled *Configuration Switch Settings for SW1* for more information.
- The SW2 DIP switch should be set to the factory default configuration as described in Chapter 2, the section entitled *Configuration Switch Settings for SW2*.
- Check the fuse.

Warning: *Replacement fuses must be of the proper type and rating. See Appendix A, Hardware Specifications, for fuse information.*

- The GPIB-SCSI-A must be powered on.

Software

- The file `gpib.o` should be copied to `/sys/sun4c/OBJ` for a Sun SPARCstation machine.
- In the `/sys/sun/conf.c` file, the major device number chosen must be unique.
- The major device number chosen in the previous step must be the one used for creating the node for `gpib0`.
- The Target ID number used in the configuration file `GPIB` must be unique, and match the GPIB-SCSI-A hardware switch setting.

Appendix C

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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Technical support fax: (800) 328-2203
(512) 794-5678

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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	056/27 00 25
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 _____

GPIB-SCSI-A 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

- GPIB-SCSI-A Model _____
- NI-488.2M Software Revision Number on Distribution Media _____
- SW1 Switch Setting _____
- SW2 Switch Setting _____
- Terminating Resistor Pack Installed (yes or no) _____

Other Products

- SunOS Version _____
- Other SCSI devices in System _____
- Application Programming Language _____

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 GPIB-SCSI-A and the NI-488.2M
TM Software for the Sun SPARCstation**

Edition Date: **June 1994**

Part Number: **320422-01**

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

[illegible]

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Glossary

Prefix	Meaning	Value
m-	milli-	10 ⁻³
k-	kilo-	10 ³
M-	mega-	10 ⁶

°	degrees
%	percent
A	amperes
ANSI	American National Standards Institute
C	Celsius
CSA	Canadian Standards Association
DIP	dual inline package
DMA	direct memory access
EMI	electromagnetic interference
FCC	Federal Communications Commission
g	grams
GPIO	General Purpose Interface Bus
Hz	hertz
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronic Engineers
in.	inches
lb	pounds
LED	light-emitting diode
m	meters
MB	megabytes of memory
RAM	random-access memory
SCSI	Small Computer System Interface (bus)
UL	Underwriters Laboratories
V	volts
VAC	volts alternating current
VDC	volts direct current