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Getting Started with Your GPIB-1014 Series Board and the NI-488M™ Software for Themis

For GPIB-1014, GPIB-1014D, GPIB-1014DP, and GPIB-1014P Boards

December 1993 Edition

Part Number 320678-01

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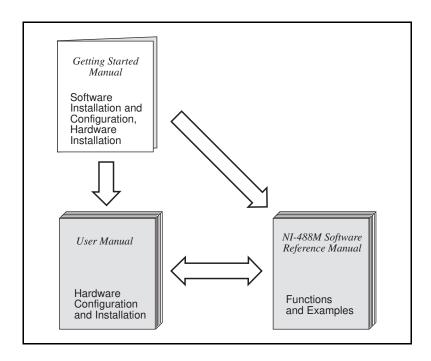## Appendix
Customer Communication

About This Manual

This manual contains instructions for installing and configuring your National Instruments GPIB-1014 series interface board and NI-488M software for use with the Themis Sparc 2LC running SunOS 4.1.2 or higher. For specific information about the GPIB-1014, GPIB-1014D, GPIB-1014DP, or GPIB-1014P board, refer to the appropriate user manual for that board.

The material in this manual is intended for users who have super-user privilege (can log in as `root`). This manual assumes that all the software needed for adding device drivers is already installed. This manual also assumes that the user has already received a GPIB-1014 series board along with a user manual for that board.

How to Use This Manual Set

Use the *Getting Started with Your GPIB-1014 Series Board and the NI-488M Software for Themis* manual (part number 320678-01) to install and configure your NI-488M software for Themis.

Use the *NI-488M Software Reference Manual* (part number 320062-01) to program the GPIB. This manual describes all NI-488 function calls for the C language and gives a GPIB programming example.

Use the appropriate user manual to configure and install the GPIB-1014 series board. The user manual also contains detailed information about board specifications, operation, and programming.

Organization of This Manual

This manual is organized as follows:

- Chapter 1, *Introduction*, explains how to use this manual, lists what you need to get started, and includes a brief description of the NI-488M software and the GPIB-1014 series boards.

- Chapter 2, *Software Installation and Configuration*, contains a list of software components and instructions for installing and configuring your NI-488M software.

- Chapter 3, *Hardware Configuration and Installation*, contains general instructions for installing and configuring your GPIB-1014 series board.

- Chapter 4, *Installation Verification and Troubleshooting*, describes how to verify the installation of your software and hardware and how to troubleshoot problems.

- Chapter 5, *Using Your NI-488M Software*, describes the `ibic` utility and lists some programming considerations.

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

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

Conventions Used in This Manual

The following conventions are used in this manual.

italic	Italic text denotes emphasis, a cross reference, or an introduction to a key concept.
bold italic	Bold italic text denotes a note, caution, or warning.

`monospace`	Lowercase text in this font denotes text or characters that are to be literally input from the keyboard, sections of code, programming examples, and syntax examples. This font is also used for the proper names of disk drives, paths, directories, programs, subprograms, subroutines, device names, functions, variables, filenames, and extensions, and for statements and comments taken from program code.
`bold monospace`	Bold text in this font denotes the messages and responses that the computer automatically prints to the screen.
`italic monospace`	Italic lowercase text in this font denotes that you must supply the appropriate words or values in the place of these items.
NI-488M	NI-488M is used throughout this manual to refer to the NI-488M software for the SunOS 4.1.2 or higher UNIX operating system unless otherwise noted.
GPIB-1014 series	GPIB-1014 series is used throughout this manual to refer to one of the GPIB-1014, GPIB-1014D, GPIB-1014DP, or GPIB-1014P interface boards unless otherwise noted.
UNIX	UNIX is used throughout this manual to refer to the SunOS 4.1.2 or higher UNIX 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.

- *GPIB-1014 User Manual*, National Instruments Corporation (part number 320030-01)

- *GPIB-1014D User Manual,* National Instruments Corporation (part number 320140-01)

- *GPIB-1014DP User Manual,* National Instruments Corporation (part number 320049-01)

- *GPIB-1014P User Manual*, National Instruments Corporation (part number 320026-01)

- Sun System manuals for the SunOS 4.1.2 or higher operating system

Customer Communication

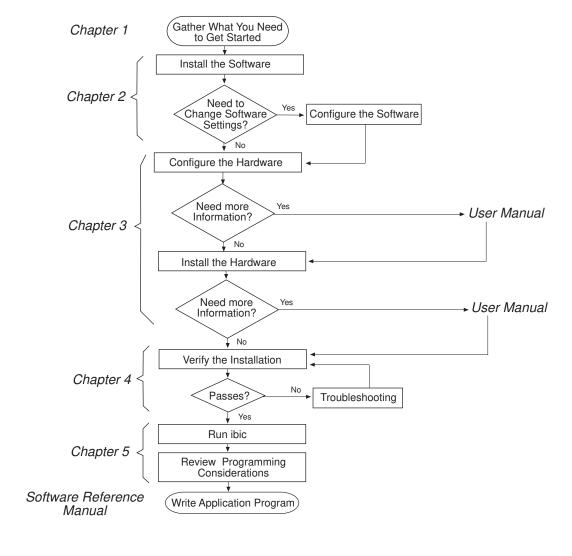National Instruments wants to receive your comments on our products and manuals. We are interested in the applications you develop with our products, and we want to help if you have problems with them. To make it easy for you to contact us, this manual contains comment and configuration forms for you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

Chapter 1
Introduction

This chapter explains how to use this manual set, lists what you need to get started, and includes a brief description of the NI-488M software and the GPIB-1014 series boards.

How to Use This Manual

Chapter 1	Gather What You Need to Get Started
	↓
	Install the Software
Chapter 2	Need to Change Software Settings? — Yes → Configure the Software
	No ↓
	Configure the Hardware
Chapter 3	Need more Information? — Yes → *User Manual*
	No ↓
	Install the Hardware
	Need more Information? — Yes → *User Manual*
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Chapter 4	Verify the Installation
	Passes? — No → Troubleshooting
	Yes ↓
Chapter 5	Run ibic
	Review Programming Considerations
Software Reference Manual	Write Application Program

What You Need to Get Started

❏ One of the following GPIB-1014 series boards:

GPIB-1014 board–Revision F or higher (part number 180155-*xx*)

GPIB-1014D board–Revision C or higher (part number 180830-*xx*)

GPIB-1014DP board–Revision E or higher (part number 180270-*xx*)

GPIB-1014P board–Revision E or higher (part number 180150-*xx*)

where *xx* designates the board type as referenced in the user manual for each board.

❏ NI-488M software for SunOS/Themis on 3.5 in. disk (part number 422923-96)

Software Description

The NI-488M software consists of a multitasking driver and utilities that transform a Themis Sparc 2LC running SunOS 4.1.2 or higher into a GPIB Controller with complete communications and bus management capabilities.

The NI-488M driver supports up to four GPIB-1014 series boards.

Hardware Description

The GPIB-1014 series board is fully compatible with the ANSI/IEEE Standard 488.1-1987. You can use standard GPIB cables to connect each GPIB port with up to 14 instruments. If you want to use more than 14 instruments, you can order a bus extender or expander from National Instruments. However, because the GPIB-1014D and GPIB-1014DP boards each have two GPIB ports, you can connect up to 28 instruments to those boards without the need for a bus extender or expander. Refer to the user manual that came with your GPIB-1014 series board for more information about the hardware specifications and operating conditions for your board.

Chapter 2
Software Installation and Configuration

This chapter contains a list of software components and instructions for installing and configuring your NI-488M software.

NI-488M Software Components

The NI-488M distribution software contains the following files in `tar` format.

- `gpib4rf.o` is the NI-488M driver for the GPIB-1014 series.

- `cib.c` is the C language interface library.

- `ugpib.h` is the include file for user programs.

- `ibtsta*` tests the software installation, where `*` represents the GPIB-1014 series board number.

- `ibic` is the interactive control utility.

- `ibconf` is the software configuration utility.

- `gpib.install` is the installation shell script.

Install the Software

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

Step 1. 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 distribution files to your directory by entering the following command:

```
bar xvf /dev/rfd0c
```

Step 2. Installation

A. Automatic Installation

To automatically install your NI-488M software, enter the following command:

```
./gpib.install
```

After the installation is complete, skip to Step 3 to reboot your computer.

B. Manual Installation

To manually install your NI-488M software, follow the remaining steps in this section to install the utility files and the C library, and load the NI-488M driver.

Install the Utility Files

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

2. Copy the file `gpib4rf.o` to `/sys/sun4rf/OBJ/gpib.o`.

3. Copy the files `ibic` and `ibconf` to a directory in the command search path (for example, `/bin` or `/usr/bin`).

Install the C Library

To install the C library, compile and convert the file `cib.c`. This procedure is necessary if you are compiling your application with the `-lgpib` option. To compile the file `cib.c` and create a C language library, enter the following commands.

```
cc -c cib.c
ar r /lib/libgpib.a cib.o
ranlib /lib/libgpib.a
```

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

<u>Load the NI-488M Driver</u>

The following steps build a new SunOS 4.1.2 UNIX kernel with the NI-488M driver installed.

1. Change to `/sys/sun` directory and edit the file `conf.c`. Find the block of function definitions preceding the character device table *cdevsw* and add 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
   ```

   At the end of the character device table *cdevsw,* located in the file `conf.c`, add the following lines:

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

   where *xx* is the major device number. To determine the major device number of the GPIB-1014 series board, choose the number after the largest device number currently in your system. All GPIB-1014 series boards and devices use the same device number.

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

2. Use 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
   ```

3. Change to `/sys/sun4rf/conf`. Edit the file `files`. Add the following line:

   ```
   sundev/gpib.c  optional ib device-driver
   ```

4. 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`, copy it instead.

   ```
   cp GENERIC GPIB
   ```

5. The NI-488M driver is set up so that `ib0` and `ib1` are DMA boards (GPIB-1014 or GPIB-1014D), and so that `ib2` and `ib3` are PIO boards (GPIB-1014DP or GPIB-1014P). Add the following line to the end of the file:

    ```
    device ib0 at vme16d16 ? csr 0x2000 priority 2 vector ibintr
    0xC8
    ```

    This line configures a DMA board at VME address 0x2000, interrupt level 2, and interrupt vector 0xC8. To configure an additional PIO board, use the following line:

    ```
    device ib2 at vme16d16 ? csr 0x2400 priority 2 vector ibintr
    0xCA
    ```

    This board can use the same interrupt level, but it must use a different interrupt vector and VME address.

6. Create the new kernel, `/vmunix`, and be sure to save the old version of `/vmunix` as shown in the following example.

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

    The file `ib.h` is automatically created by the system and contains the single line:

    ```
    #define NIB x
    ```

    where x is the number of GPIB-1014 series boards configured in the UNIX kernel.

Step 3. Reboot the System

Reboot your computer to start using the new UNIX kernel `/vmunix`. Halt the system by entering the following command:

```
halt
```

then restart the system.

After you have installed your software, you might want to view or modify the driver configuration. Refer to the next section for instructions on running the configuration utility `ibconf`. If you do not need to run `ibconf`, refer to Chapter 4, *Installation Verification and Troubleshooting*, for instructions on verifying the hardware and software installation.

Configure the Software with ibconf

`ibconf` is an interactive utility you can use to examine or modify the configuration of the driver. You must run `ibconf` if you changed any of the hardware default settings. You also might want to run `ibconf` to change configuration options such as device names or timeout values.

To run `ibconf`, enter the following command:

```
ibconf /vmunix
```

where `/vmunix` can be any UNIX kernel with the NI-488M driver installed. Refer to the *NI-488M Software Reference Manual* for more details.

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/gpib0
```

After the software is installed and configured, you should verify the installation as described in Chapter 4, *Installation Verification and Troubleshooting*.

Chapter 3
Hardware Configuration and Installation

This chapter contains general instructions for installing and configuring your GPIB-1014 series board.

Configure the Hardware

Use the following procedures to configure the GPIB-1014 series board.

1. Set up privileged access upon power up.

2. Set up the same base address as in the software configuration.

3. For the GPIB-1014P and GPIB-1014DP boards, set up the interrupt level and interrupt vector.

Refer to the user manual that came with your GPIB-1014 series board for more detailed information about configuration.

Install the Hardware

1. Turn the power off and remove the rear panel of the computer to gain access to the VME slots.

2. Install the GPIB-1014 series board into an empty slot. Use a slot that is higher than 6 (7 through 12) if the computer has 12 slots.

    Note: *Each board must be installed in a VME slot without the P2 connector wired.*

3. Open the VME chassis and remove all jumpers for the slot you are using for the GPIB-1014 series board.

4. Reattach the front and rear panels.

Refer to the user manual that came with your GPIB-1014 series board for more detailed information about installation.

Chapter 4
Installation Verification and Troubleshooting

This chapter describes how to verify the installation of your software and hardware and how to troubleshoot problems.

Run the Software Diagnostic Program

1. Restart your computer. For each board you installed, the following message appears on the screen:

    ib* at vme16d16 0x2000 pri 2 vector 0xc8

    where `*` designates the board installed, 0 through 3. If the message does not appear, check that the GPIB-1014 series address jumper settings are the same as the settings that appear in the `ibconf` utility.

2. Change to the `/usr/gpib` directory and run `ibtsta*` on each board you installed. `ibtsta*` tests the corresponding board `ib*`. For example, to test `ib0`, use the following command:

    ```
    ibtsta0
    ```

    Follow the instructions that appear on the screen and jot down any errors that occur.

Troubleshooting

This section suggests areas to check if you still have problems installing the board and/or software after going through the steps in Chapter 2, *Software Installation and Configuration,* or Chapter 3, *Hardware Configuration and Installation.* If you still have problems after completing the following steps, complete the appropriate forms in the Appendix, *Customer Communication*, and then contact National Instruments for technical support.

Hardware

1. Make sure the GPIB-1014 series board is the correct revision.

2. Make sure the GPIB-1014 series board is positioned securely in its slot.

3. Check that the jumper setting on the board is set to the correct VME base address. The base address should be the same as in the software configuration.

4. Make sure all the jumpers for the GPIB-1014 series board slot are removed. Refer to the user manual that came with your board for more information.

Software

1. Make sure the file `gpib4rf.o` is in `/sys/sun4rf/OBJ/gpib.o`.

2. Make sure the major device number in the `/sys/sun/conf.c` file is unique.

3. Make sure the major device number is also used for creating the node for `gpib0`.

Chapter 5
Using Your NI-488M Software

This chapter describes the `ibic` utility and lists some programming considerations.

Introduction to ibic

The Interface Bus Interactive Control utility `ibic` comes with your NI-488M software. You can use `ibic` to enter NI-488M functions interactively and display the results of the function calls automatically. Without writing an application, you can use `ibic` to:

• Verify GPIB communication with your device quickly and easily.

• Learn the syntax of the NI-488M functions before writing your application.

• Become familiar with the commands of your device.

• Receive data from your GPIB device.

• Learn new NI-488M functions before integrating them into your application.

Programming Considerations

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

• You must link the object file `cib.o` with your compiled source code.

• You must include the header file `ugpib.h` in your source code.

Refer to the *NI-488M Software Reference Manual* for more information about functions.

Appendix
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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Norway	03 846866	03 846860
Spain	91 640 0085	91 640 0533
Sweden	08 730 49 70	08 730 43 70
Switzerland	056 27 00 20	056 27 00 25
U.K.	0635 523545	0635 523154

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Technical Support Form

Photocopy this form and update it each time you make changes to your software or hardware, and use the completed copy of this form as a reference for your current configuration. Completing this form accurately before contacting National Instruments for technical support helps our applications engineers answer your questions more efficiently.

If you are using any National Instruments hardware or software products related to this problem, include the configuration forms from their user manuals. Include additional pages if necessary.

Name _____

Company _____

Address _____

_____

Fax (___)_____   Phone (___)_____

Computer brand _____   Model _____   Processor _____

Operating system _____

Speed _____MHz   RAM _____MB   Display adapter _____

Mouse _____yes _____no   Other adapters installed _____

Hard disk capacity _____MB   Brand _____

Instruments used _____

National Instruments hardware product model _____   Revision _____

Configuration _____

National Instruments software product _____   Version _____

Configuration _____

The problem is _____

_____

_____

_____

_____

List any error messages _____

_____

_____

_____

The following steps will reproduce the problem _____

_____

_____

_____

GPIB-1014 Series Hardware and Software Configuration Form

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

National Instruments Products

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

  GPIB-1014 Revision _____

  GPIB-1014D Revision _____

  GPIB-1014DP Revision _____

  GPIB-1014P Revision _____

- Hardware Settings:

	Base I/O Address	Interrupt Request Line	DMA Channel
GPIB-1014	_____	_____	_____
GPIB-1014D	_____	_____	_____
GPIB-1014DP	_____	_____	_____
GPIB-1014P	_____	_____	_____

- Software Settings:

	Base I/O Address	Interrupt Vector Number	DMA Channel
gpib0	_____	_____	_____
gpib1	_____	_____	_____
gpib2	_____	_____	_____
gpib3	_____	_____	_____

Other Products

- Application Programming Language Version_____

- Computer Make and Model_____

- Microprocessor _____

- Clock Frequency _____

- Type of Video Board Installed _____

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

Board Type	Base I/O Address	Interrupt Level	DMA Channel
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____

Documentation Comment Form

National Instruments encourages you to comment on the documentation supplied with our products. This information helps us provide quality products to meet your needs.

Title: **Getting Started with Your GPIB-1014 Series Board and the NI-488M™ Software for Themis**

Edition Date: **December 1993**

Part Number: **320678-01**

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

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

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Glossary

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

ANSI	American National Standards Institute
DMA	direct memory access
GPIB	General Purpose Interface Bus
Hz	hertz
IEEE	Institute of Electrical and Electronic Engineers
in.	inches
kernel	The set of programs in an operating system that implement basic system functions
MB	megabytes of memory
PIO	programmed I/O
RAM	random-access memory