KPCI-488LPA GPIB Controller Interface Card

Quick Start Guide

KPCI-488LPA-903-01 Rev. A / December 2008

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WARRANTY

Keithley Instruments, Inc. warrants this product to be free from defects in material and workmanship for a period of one (1) year from date of shipment.

Keithley Instruments, Inc. warrants the following items for 90 days from the date of shipment: probes, cables, software, rechargeable batteries, diskettes, and documentation.

During the warranty period, Keithley Instruments will, at its option, either repair or replace any product that proves to be defective.

To exercise this warranty, write or call your local Keithley Instruments representative, or contact Keithley Instruments headquarters in Cleveland, Ohio. You will be given prompt assistance and return instructions. Send the product, transportation prepaid, to the indicated service facility. Repairs will be made and the product returned, transportation prepaid. Repaired or replaced products are warranted for the balance of the original warranty period, or at least 90 days.

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This warranty does not apply to defects resulting from product modification without Keithley Instruments' express written consent, or misuse of any product or part. This warranty also does not apply to fuses, software, non-rechargeable batteries, damage from battery leakage, or problems arising from normal wear or failure to follow instructions.

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Model KPCI-488LPA
GPIB Controller Interface Card
Quick Start Guide

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Document Number: KPCI-488LPA-903-01 Rev. A / December 2008

KEITHLEY

Safety Precautions

The following safety precautions should be observed before using this product and any associated instrumentation. Although some instruments and accessories would normally be used with non-hazardous voltages, there are situations where hazardous conditions may be present.

This product is intended for use by qualified personnel who recognize shock hazards and are familiar with the safety precautions required to avoid possible injury. Read and follow all installation, operation, and maintenance information carefully before using the product. Refer to the user documentation for complete product specifications.

If the product is used in a manner not specified, the protection provided by the product warranty may be impaired.

The types of product users are:

Responsible body is the individual or group responsible for the use and maintenance of equipment, for ensuring that the equipment is operated within its specifications and operating limits, and for ensuring that operators are adequately trained.

Operators use the product for its intended function. They must be trained in electrical safety procedures and proper use of the instrument. They must be protected from electric shock and contact with hazardous live circuits.

Maintenance personnel perform routine procedures on the product to keep it operating properly, for example, setting the line voltage or replacing consumable materials. Maintenance procedures are described in the user documentation. The procedures explicitly state if the operator may perform them. Otherwise, they should be performed only by service personnel.

Service personnel are trained to work on live circuits, perform safe installations, and repair products. Only properly trained service personnel may perform installation and service procedures.

Keithley Instruments products are designed for use with electrical signals that are rated Measurement Category I and Measurement Category II, as described in the International Electrotechnical Commission (IEC) Standard IEC 60664. Most measurement, control, and data I/O signals are Measurement Category I and must not be directly connected to mains voltage or to voltage sources with high transient over-voltages. Measurement Category II connections require protection for high transient over-voltages often associated with local AC mains connections. Assume all measurement, control, and data I/O connections are for connection to Category I sources unless otherwise marked or described in the user documentation.

Exercise extreme caution when a shock hazard is present. Lethal voltage may be present on cable connector jacks or test fixtures. The American National Standards Institute (ANSI) states that a shock hazard exists when voltage levels greater than 30V RMS, 42.4V peak, or 60VDC are present. A good safety practice is to expect that hazardous voltage is present in any unknown circuit before measuring.

Operators of this product must be protected from electric shock at all times. The responsible body must ensure that operators are prevented access and/or insulated from every connection point. In some cases, connections must be exposed to potential human contact. Product operators in these circumstances must be trained to protect themselves from the risk of electric shock. If the circuit is capable of operating at or above 1000V, no conductive part of the circuit may be exposed.

Do not connect switching cards directly to unlimited power circuits. They are intended to be used with impedance-limited sources. NEVER connect switching cards directly to AC mains. When connecting sources to switching cards, install protective devices to limit fault current and voltage to the card.

Before operating an instrument, ensure that the line cord is connected to a properly-grounded power receptacle. Inspect the connecting cables, test leads, and jumpers for possible wear, cracks, or breaks before each use.

When installing equipment where access to the main power cord is restricted, such as rack mounting, a separate main input power disconnect device must be provided in close proximity to the equipment and within easy reach of the operator.

For maximum safety, do not touch the product, test cables, or any other instruments while power is applied to the circuit under test. ALWAYS remove power from the entire test system and discharge any capacitors before: connecting or disconnecting cables or jumpers, installing or removing switching cards, or making internal changes, such as installing or removing jumpers.

Do not touch any object that could provide a current path to the common side of the circuit under test or power line (earth) ground. Always make measurements with dry hands while standing on a dry, insulated surface capable of withstanding the voltage being measured.

The instrument and accessories must be used in accordance with its specifications and operating instructions, or the safety of the equipment may be impaired.

Do not exceed the maximum signal levels of the instruments and accessories, as defined in the specifications and operating information, and as shown on the instrument or test fixture panels, or switching card.

When fuses are used in a product, replace with the same type and rating for continued protection against fire hazard.

Chassis connections must only be used as shield connections for measuring circuits, NOT as safety earth ground connections.

If you are using a test fixture, keep the lid closed while power is applied to the device under test. Safe operation requires the use of a lid interlock.

If a screw is present, connect it to safety earth ground using the wire recommended in the user documentation.

The symbol on an instrument indicates that the user should refer to the operating instructions located in the user documentation.

The symbol on an instrument shows that it can source or measure 1000V or more, including the combined effect of normal and common mode voltages. Use standard safety precautions to avoid personal contact with these voltages.

The symbol on an instrument shows that the surface may be hot. Avoid personal contact to prevent burns.

The symbol indicates a connection terminal to the equipment frame.

If this symbol is on a product, it indicates that mercury is present in the display lamp. Please note that the lamp must be properly disposed of according to federal, state, and local laws.

The **WARNING** heading in the user documentation explains dangers that might result in personal injury or death. Always read the associated information very carefully before performing the indicated procedure.

The **CAUTION** heading in the user documentation explains hazards that could damage the instrument. Such damage may invalidate the warranty.

Instrumentation and accessories shall not be connected to humans.

Before performing any maintenance, disconnect the line cord and all test cables.

To maintain protection from electric shock and fire, replacement components in mains circuits - including the power transformer, test leads, and input jacks - must be purchased from Keithley Instruments. Standard fuses with applicable national safety approvals may be used if the rating and type are the same. Other components that are not safety-related may be purchased from other suppliers as long as they are equivalent to the original component (note that selected parts should be purchased only through Keithley Instruments to maintain accuracy and functionality of the product). If you are unsure about the applicability of a replacement component, call a Keithley Instruments office for information.

To clean an instrument, use a damp cloth or mild, water-based cleaner. Clean the exterior of the instrument only. Do not apply cleaner directly to the instrument or allow liquids to enter or spill on the instrument. Products that consist of a circuit board with no case or chassis (e.g., a data acquisition board for installation into a computer) should never require cleaning if handled according to instructions. If the board becomes contaminated and operation is affected, the board should be returned to the factory for proper cleaning/servicing.

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Introduction

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Introduction

This section contains general information about the Keithley Instruments Model KPCI-488LPA GPIB Controller Interface Card.

If you have any questions after reviewing this information, contact your local Keithley Instruments representative or call one of our applications engineers. Find current contact information at www.keithley.com.

Overview

Keithley Instruments' Model KPCI-488LPA GPIB Controller Interface Card is fully compatible with the IEEE488.2 instrumentation control and communication standard. The interface card is capable of controlling up to 14 stand-alone instruments via IEEE488 cables. Designed to meet the requirements for high performance and maximum programming portability, the 1KB on-board FIFO buffer (First In First Out) and block transfer mode provide up to 1.5MB per second GPIB transfer rate.

With the Keithley Command Compatible driver, the National Instruments™ (NI)[1] Command Compatible driver, and VISA support (Virtual Instrument Software Architecture), the Model KPCI-488LPA provides extensive compatibility with your existing applications and instrument drivers.

Performance

This newly-designed Model KPCI-488LPA GPIB Controller Interface Card supports both 3.3V and 5V PCI buses and can be adapted to most industrial and desktop computers. An on-board 1KB FIFO is placed between the GPIB bus and PCI controller to buffer GPIB read/write operations. The FIFO eliminates the gap between the slower GPIB bus (which is about 1.5MB per second) and the fast PCI bus (132MB per second), dramatically increasing overall system performance.

Compatibility

The Model KPCI-488LPA provides complete software support, including a driver API (application program interface) that is command compatible with Keithley Instruments' and Capital Equipment Corporations' IEEE_32M.DLL, and a driver API that is NI command compatible with GPIB32.DLL (programs written based on these DLL's can be executed on the Model KPCI-488LPA without any major modification, often no modifications at all). Industry-standard VISA libraries are also supported to ensure compatibility with applications utilizing VISA. Through design, the Model KPCI-488LPA is plug-and-play compatible with your existing applications.

Features

The Model KPCI-488LPA GPIB Controller Interface Card provides the following advanced features:

- Fully compatible with the IEEE488.2 standard
- Supports a 32-bit 3.3V or 5V PCI bus
- Up to 1.5MB per second data transfer rates
- On-board 1KB FIFO for read/write operations
- Command compatible driver API for Keithley Instruments, NI, and VISA.
- Interactive utility for testing and diagnostics
- Compact, half-size printed circuit board

1. National Instruments™ and NI are trademarks of the National Instruments Corporation.

Manual addenda

Any improvements or changes concerning the Model KPCI-488LPA or manual will be explained in an addendum included with the manual. Be sure to note these changes and incorporate them into the manual.

Safety symbols and terms

The following symbols and terms may be found on the Model KPCI-488LPA or used in this manual:

The symbol indicates that the user should refer to the operating instructions located in the manual.

The symbol shows that high voltage may be present on the terminal(s). Use standard safety precautions to avoid personal contact with these voltages.

The **WARNING** heading used in this manual explains dangers that might result in personal injury or death. Always read the associated information very carefully before performing the indicated procedure.

The **CAUTION** heading used in this manual explains hazards that could damage the switch. Such damage may invalidate the warranty.

Specifications

A specification overview is presented below. Check the Keithley Instruments website (www.keithley.com) for latest updates to the specifications.

GPIB bus properties

- Up to 14 instruments can be connected to one controller
- Maximal 1.5MB per second data transfer rate
- Cable length:
  - 2 meters between each instrument (suggested)
  - 20 meters total cable length
- Data transfer mode: 8 bits parallel
- Handshake: 3-wire handshake, reception of each data byte is acknowledged

Certificates

EMC/EMI: CE, FCC Class A

General specifications

- I/O connector: IEEE488 standard 24-pin connector
- Operating temperature: 0°C to 55ºC
- Storage temperature: -20°C to 80ºC at 10% to 90% humidity
- Relative humidity: 10% to 90%, non-condensing

Table 1-1
Power requirements

Voltage	Current
+5V	250mA (typical)

- Dimensions (not including connectors): 135mm x 107mm

Unpacking and inspection

CAUTION **The Model KPCI-488LPA contains electro-static sensitive components that can easily be damaged by static electricity. Handle the module on a grounded anti-static mat. The operator should be wearing an anti-static wristband, grounded at the same point as the anti-static mat.**

Inspection for damage

The Model KPCI-488LPA was carefully inspected electrically and mechanically before shipment. After unpacking all items from the shipping carton, check for any obvious signs of physical damage that may have occurred during transit. Report any damage to the shipping agent immediately. Save the original packing carton for possible future shipment.

Shipment contents

The following items are included with every Model KPCI-488LPA order:

- Model KPCI-488LPA
- An additional low-profile PCI bracket
- A CD (KPCI-488LPA-950-01) that contains the following software and manuals:
  - Drivers and control software
  - Quick Start Guide (KPCI-488LPA-903-01)
  - Reference Manual (KPCI-488LPA-901-01)

Instruction manual

The product CD-ROM contains this Quick Start Guide and a Reference Manual for the Model KPCI-488LPA. The reference manual provides programming information on Keithley Command Compatible functions and NI command compatible functions (syntax as well as examples in C/C++, Visual Basic, etc.).

Always check the Keithley Instruments website (www.keithley.com) for the latest revision of the manual. The latest manual can be downloaded (in PDF format) from the website.

Repacking for shipment

Should it become necessary to return the Model KPCI-488LPA for repair, carefully pack the unit in its original packing carton or the equivalent, and follow these instructions:

- Call the Repair Department for a Return Material Authorization (RMA) number. Call the Repair Department toll-free at 1-800-552-1115 (US only). Outside of the US, Worldwide Service Centers contact information is available at www.keithley.com.
- Advise as to the warranty status of the Model KPCI-488LPA.
- Write ATTENTION REPAIR DEPARTMENT and the RMA number on the shipping label.
- Fill out and include the Service Form located at the back of this manual.

Software support

The Model KPCI-488LPA provides device drivers for Windows® XP/2000/Vista operating systems. The Keithley Instruments GPIB driver package provides a diagnostic utility to test your Model KPCI-488LPA GPIB card, as well as programming samples and source codes for Microsoft® Visual Basic and Visual C++. The Model KPCI-488LPA also offers support for National Instruments™ LabVIEW™ and LabWindows/CVI™. Find the Keithley Instruments GPIB driver package located on the supplied CD. Refer to Software installation description in Section 2 for detailed software installation instructions. Refer to Section 3 for a description of the operational theory of a GPIB (General Purpose Interface Bus) and the basic architecture of Keithley Instruments Model KPCI-488LPA GPIB interface card. Contact Keithley Instruments for other operating system support.

For LabVIEW™ and LabWindows/CVI™ support, Keithley Instruments recommends the installation of the NI Command Compatible Driver. For LabVIEW programmers, Keithley Instruments supplies a set of LabVIEW GPIB VIs that are optimized for use with the KPCI-488LPA.

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Section 2

Installation and configuration

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Introduction

This section describes unpacking information and describes how to install the Model KPCI-488LPA. To install the Model KPCI-488LPA in a system, after reviewing the Software installation description and Installation requirements, complete (in this order):

1. Driver installation
2. Hardware installation
3. Cabling

See Using the Keithley GPIB Configuration Utility and Using the Keithley Instruments KPCI-488LPA Diagnostic Tool for information on using these supplied utilities.

WARNING ***The procedures in this section are intended only for qualified service personnel. Do not perform these procedures unless you are qualified to do so. Failure to recognize and observe normal safety precautions could result in personal injury or death.***

CAUTION **The Model KPCI-488LPA contains electro-static sensitive components that can easily be damaged by static electricity. Handle the module on a grounded anti-static mat. The operator should be wearing an anti-static wristband, grounded at the same point as the anti-static mat.**

CAUTION **Do not apply power to the card if it has been damaged.**

Software installation description

This section describes the software installation for the Keithley Instruments Model KPCI-488LPA. Driver installation is outlined along with information on using the Keithley GPIB Configuration Utility and the KPCI-488LPA Diagnostic Tool.

The Keithley Instruments Model KPCI-488LPA is delivered with a GPIB driver package that supports Windows® XP/2000/Vista Operating Systems. The KPCI-488LPA drivers are designed to be command compatible with your current applications. They provide both Keithley Command Compatible[1] and NI[2] command compatible APIs[3] and software support for program developers using Microsoft® programming languages like Visual Basic®, Visual C, as well as LabVIEW™ and LabWindows/CVI™.[4] The KPCI-488LPA also supports industry-standard VISA[5] libraries. Refer to the Keithley Instruments Model KPCI-488LPA Reference Manual (KPCI-488LPA-901-01) for complete function and programming information.

1. Derived from the Capital Equipment Corporation (CEC) command set.
2. National Instruments™ and NI™ are trademarks of the National Instruments Corporation. Other brand names are trademarks or registered trademarks of their respective holders.
3. API—Application Program Interface
4. CVI—C for Virtual Instrumentation
5. VISA—Virtual Instrument Software Architecture

Installation requirements

Review the following list of important requirements that must be taken into account prior to installing the Model KPCI-488LPA:

I. The KPCI-488LPA is *not* compatible with Dynamic Link Libraries (DLL) from other IEEE interface board suppliers. Due to the KPCI-488LPA's command compatibility with National Instruments™ and Capital Equipment Corporation (CEC), the installation program for the KPCI-488LPA will install a DLL that has the same name as those provided by National Instruments (**GPIB32.DLL**) and CEC (and previous Keithley) interfaces (**IEEE_32M.DLL**). **For proper installation of the KPCI-488LPA hardware and software, you must remove any existing GPIB interfaces from your PC and uninstall any currently installed GPIB drivers.** Failure to uninstall any existing GPIB drivers before installing the KPCI-488LPA command compatible drivers can, and likely will cause system problems.

II. **For LabVIEW™ and LabWindows/CVI™ support, Keithley Instruments recommends the installation of the NI Command Compatible Driver.** For LabVIEW programmers, Keithley Instruments supplies a set of LabVIEW GPIB VIs that are optimized for use with the KPCI-488LPA.

The procedure to install the KPCI-488LPA driver package and utilities is outlined in Driver installation.

Driver installation

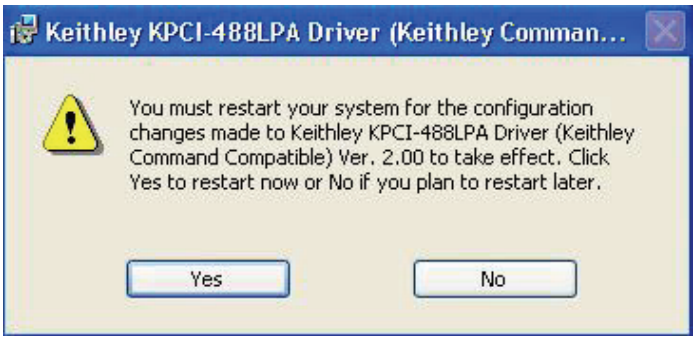
Use the following procedure as a guideline to install the GPIB Driver Package on your computer:

1. Insert the Keithley Instruments driver CD.
2. Allow the CD to auto run and begin the setup program. If setup does not start, open the CD using Windows Explorer and execute **setup.exe** to launch the setup program. When setup executes, the screen shown in Figure 2-1 will open.
3. Follow the InstallShield® Wizard prompts to complete the setup procedure.

Figure 2-1
InstallShield® Wizard

4. You may choose to install the Keithley Command Compatible Driver or the NI command compatible driver. Refer to Model KPCI-488LPA Reference Manual (KPCI-488LPA-901-01) for available functions of either compatible driver.
5. When setup finishes, please reboot your system.

Figure 2-2
Restart system



Hardware installation

CAUTION **The Model KPCI-488LPA contains electro-static sensitive components that can easily be damaged by static electricity. Handle the module on a grounded anti-static mat. The operator should be wearing an anti-static wristband, grounded at the same point as the anti-static mat.**

NOTE *Install software **before** installing the hardware (refer to Software installation description).*

Installation procedure

The following instructions outline Model KPCI-488LPA installation:

1. Turn off your computer.
2. Turn off all accessories (printer, modem, monitor, etc.) connected to your computer.
3. Open your computer case.
4. Select a 32-bit PCI slot.
5. Before handling the PCI cards, discharge any static buildup on your body by touching the metal case of the computer. Hold the edge and do not touch the components.
6. Position the board into the PCI slot you selected.
7. Secure the card in place at the rear panel of the system.
8. Put your computer's case back on.

After completing the hardware installation procedure, install cables as desired (refer to Cabling for information).

PCI configuration

Plug-and-play

As a plug-and-play component, the card requests an interrupt number via its PCI controller (Peripheral Component Interconnect). The system BIOS (Basic Input Output System) responds with an interrupt assignment based on the card information and on known system parameters. These system parameters are determined by the installed drivers and the hardware load seen by the system.

Configuration

The board configuration is done on a board-by-board basis for all PCI boards on your system. Because configuration is controlled by the system and software, there is no jumper setting required for base-address, DMA (Direct Memory Access), and interrupt IRQ (Interrupt Request).

The configuration is subject to change with every boot of the system as new boards are added or removed.

Troubleshooting

If your system doesn't boot or if you experience erratic operation with your PCI board in place, it's likely caused by an interrupt conflict (perhaps the BIOS setup is incorrectly configured). In general, the solution — once you determine it is not a simple oversight — is to consult the BIOS documentation that comes with your system or computer.

In Windows 2000, WinXP, or Vista, if your KPCI-488LPA shows up in Device Manager, but has an error code which indicates that **no resources are in use**, a simple change in the BIOS may resolve the matter. The BIOS setting for **Plug-and-Play Aware OS** should be set to NO. This setting will allow the PnP BIOS and motherboard chipset hardware to assign hardware resources to cards such as the KPCI-488LPA. Windows 2000, WinXP, or Vista will then make use of these assigned resources.

Cabling

For optimal GPIB throughput, adhere to the following bulleted cabling guidelines. These cabling guidelines include instrument number and cable distance:

- The longest distance between two devices is 4 meters; the average GPIB bus distance between all devices should be less than 2 meters.
- The total GPIB bus distance should be less than 20 meters.
- The total number of connected devices must be less than 15 (including computer itself), with at least two-thirds of the devices powered on (in a power-on status).

Users can connect devices in a linear configuration (refer to Figure 2-3), star configuration (refer to Figure 2-4), or combination of the two configurations.

NOTE *To lower the total current load of the configuration, limit the number of cable connections on each individual instrument to three or less. For example, to lower the required current load when using the configuration shown in Figure 2-4, reduce the number of connections on Instrument A. Move one of the cable connections from Instrument A to a different instrument, thus making this configuration into a combination of linear and star configurations.*

Figure 2-3
Linear connection configuration

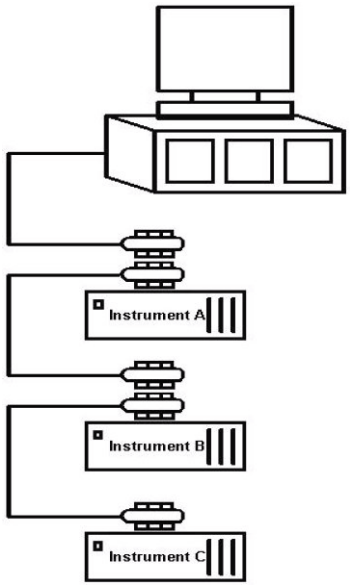
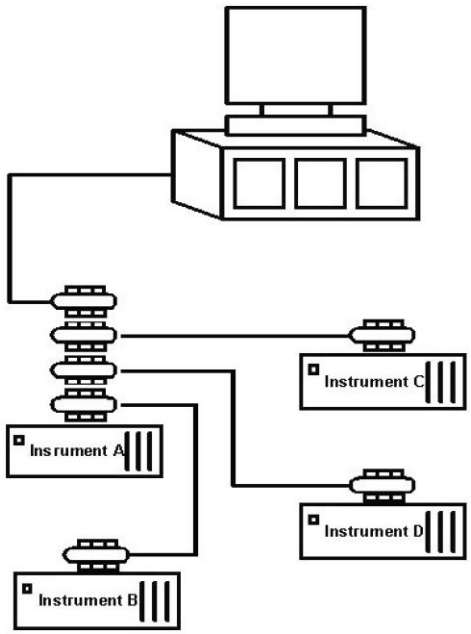


Figure 2-4
Star connection configuration



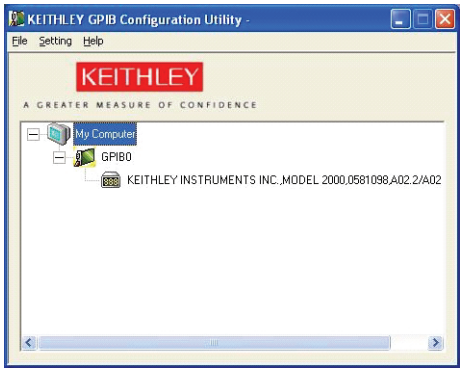
Using the Keithley GPIB Configuration Utility

The driver package provides a configuration utility program (Keithley Instrument's GPIB Configuration Utility) to let you configure the KPCI-488LPA's bus address, bus timing, I/O timeout, whether the board is a system controller, and to enable auto-polling.

To launch the configuration utility:

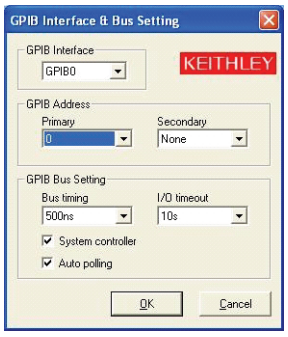
1. From Windows® **Start**, select **All Programs**.
2. From the programs selection, select **Keithley Instruments** => **KPCI-488LPA** => **KPCI-488LPA Configuration Utility**. The utility window as shown in Figure 2-5 will open.

Figure 2-5
Keithley GPIB Configuration Utility



Double-clicking on the interface icon such as GPIB0 as shown in Figure 2-5 opens up the KPCI-488LPA configuration dialog window as shown in Figure 2-6. From this dialog window, you can set a variety of parameters for operating your interface board.

Figure 2-6
GPIB Interface & Bus Setting



If you change any settings, press **OK** to set the changes. Make sure to save configuration changes by going to: **Setting** => **Save Configuration** in the KPCI-488LPA Configuration Utility window.

Using the Keithley Instruments KPCI-488LPA Diagnostic Tool

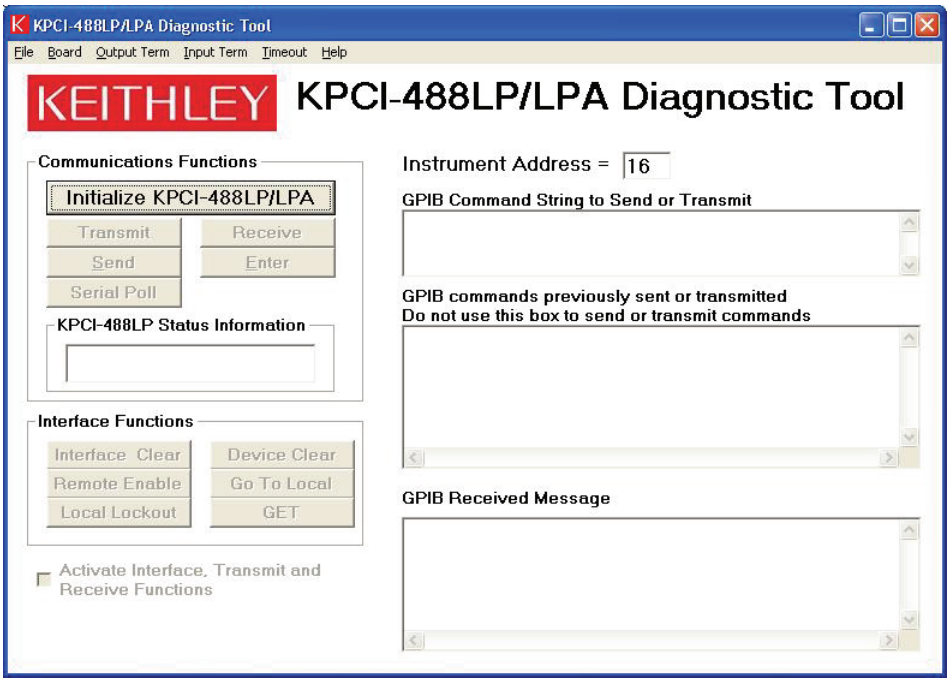
The KPCI-488LPA Diagnostic Tool lets you communicate with any GPIB instrument by writing command strings to your instrument and reading the results.

To launch the diagnostic tool:

1. From Windows® **Start**, select **All Programs**.
2. From the programs selection, select Keithley Instruments => KPCI-488LPA => KPCI-488LPA Diagnostic Tool.

The diagnostic tool window as shown in Figure 2-7 will open.

Figure 2-7
Keithley KPCI-488LPA Diagnostic Tool



Prior to communicating with your instrument using the KPCI-488LPA Diagnostic Tool, press the **Initialize KPCI-488LPA** button and set the required parameters. This must be done before any of the other feature buttons are enabled.

Type command strings to send to your instrument into the **GPIB Command String to Send or Transmit** box. Data returned from the instrument will be displayed in the **GPIB Received Message** box. All data strings that you send to instruments will be logged in the **GPIB commands previously sent or transmitted** box.

Section 3

Using a GPIB

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Introduction

This section describes the operational theory of a GPIB (General Purpose Interface Bus) and the basic architecture of Keithley Instruments Model KPCI-488LPA GPIB Controller Interface Card.

GPIB connection configuration

The GPIB has 24 lines (refer to Figure 3-1). These lines can be divided into 16 signal lines and 8 ground-return or shield-drain lines (refer to Table 3-1). The 16 signal lines can be divided into a set of 8 parallel (8-bit) data transfer bus lines and a set of 8 control lines. These 8 control lines contain 5 system management lines and 3 handshake lines.

Figure 3-1
Standard GPIB connector

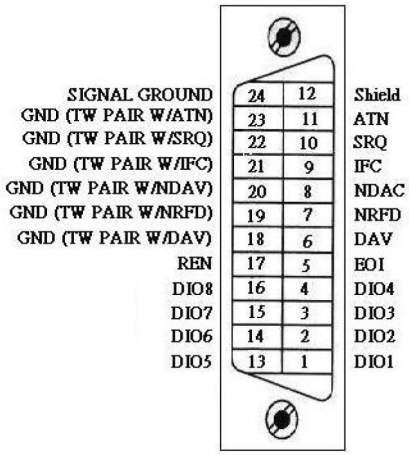


Table 3-1
GPIB connector line

GPIB BUS	Type	Function		Pin	
				No.	Description
24 lines	16 signal lines	8 data lines		1	DIO1
				2	DIO2
				3	DIO3
				4	DIO4
				13	DIO5
				14	DIO6
				15	DIO7
				16	DIO8
		8 control lines	5 system management lines	5	EOI
				9	IFC
				10	SRQ
				11	ATN
				17	REN
			3 handshake lines	6	DAV
				7	NRFD
				8	NDAC
	8 ground lines	1 shield drain line		12	SHIELD
		7 ground return lines		18	GND
				19	GND
				20	GND
				21	GND
				22	GND
				23	GND
				24	SIGNAL GROUND

Data lines

DIO1 to DIO8 carry both data and command messages. All commands (and most data) use 7-bit ASCII code; the 8th bit (DIO8), is either unused or used for parity check.

Handshake lines

Three handshake lines control the transfer of data/messages between devices:

- **DAV (Data Valid)**: used to indicate the availability and validity of information on the DIO signal lines.
- **NRFD (Not Ready For Data)**: used to indicate readiness of device(s) to accept data.
- **NDAC (Not Data Accepted)**: used to indicate acceptance of data by device.

System management lines

The following five system management lines manage the flow of control and data bytes across the interface:

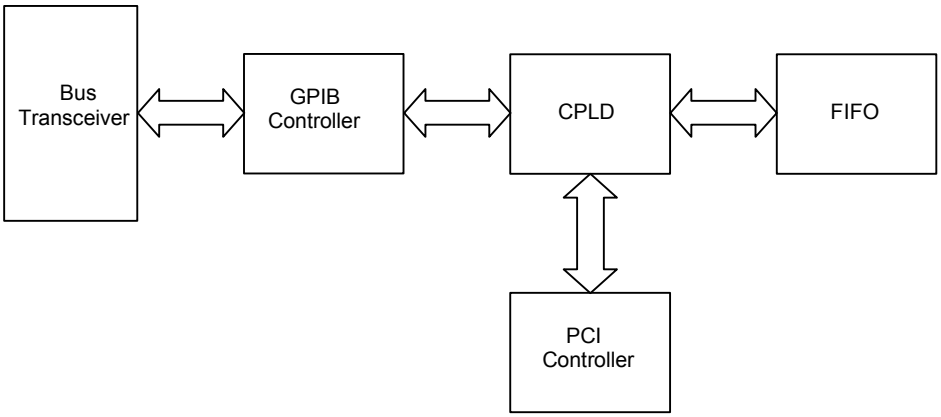
- **EOI (End or Identify)**: used (by a talker) to indicate the end of a multiple-byte transfer sequence or, in conjunction with **ATN** (by a controller), to execute a polling sequence.
- **IFC (Interface Clear)**: used (by a controller) to place the interface system, portions of which are contained in all interconnected devices, in a known quiescent state.
- **SRQ (Service Request)**: used by a device to indicate the need for attention and to request an interruption of the current sequence of events.
- **ATN (Attention)**: used (by a controller) to specify how data on the Digital I/O signal lines are to be interpreted, and which devices must respond to the data.

- **REN (Remote Enable)**: used (by a controller) in conjunction with other messages to enable or disable one or more local controls that have corresponding remote controls.

Model KPCI-488LPA block diagram

Keithley Instruments Model KPCI-488LPA has a 1KB on-board FIFO buffer (First In First Out) to maximize the data transfer rate (refer to Figure 3-2). Its state-of-the-art CPLD (Complex Programmable Logical Device) coordinates the data flow between PCI controller (Peripheral Component Interconnect), FIFO buffer, and GPIB bus.

Figure 3-2
Model KPCI-488LPA block diagram



The FIFO can buffer data from the master (either from the Model KPCI-488LPA controller or external device) when the target is busy. Therefore, the efficiency will be significantly improved when transferring large blocks of data.

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Service Form

Model No. _____ **Serial No.** _____ **Date** _____

Name and Telephone No. _____

Company _____

List all control settings, describe problem and check boxes that apply to problem. _____

_____

_____

❑ Intermittent
❑ Analog output follows display
❑ Particular range or function bad; specify _____
❑ IEEE failure
❑ Obvious problem on power-up
❑ Batteries and fuses are OK
❑ Front panel operational
❑ All ranges or functions are bad
❑ Checked all cables

Display or output (check one)

❑ Drifts
❑ Unable to zero
❑ Unstable
❑ Will not read applied input
❑ Overload

❑ Calibration only
❑ Certificate of calibration required
❑ Data required

(attach any additional sheets as necessary)

Show a block diagram of your measurement system including all instruments connected (whether power is turned on or not). Also, describe signal source.

Where is the measurement being performed? (factory, controlled laboratory, out-of-doors, etc.)

_____

_____

What power line voltage is used? _____ Ambient temperature?°F _____

Relative humidity? _____ Other? _____

Any additional information. (If special modifications have been made by the user, please describe.)

_____

_____

Be sure to include your name and phone number on this service form.

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12/06