



ADLINK
TECHNOLOGY INC.

LPCI-/USB-3488A, PXI-3488
IEEE488 GPIB Interface Card Series
User's Manual

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Recycled Paper

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Getting Service from ADLINK

Contact us should you require any service or assistance.

ADLINK Technology Inc.

Address: 9F, No.166 Jian Yi Road, Chungho City,
Taipei County 235, Taiwan
台北縣中和市建一路 166 號 9 樓

Tel: +886-2-8226-5877
Fax: +886-2-8226-5717
Email: service@adlinktech.com

Ampro ADLINK Technology Inc.

Address: 5215 Hellyer Avenue, #110, San Jose, CA 95138, USA

Tel: +1-408-360-0200
Toll Free: +1-800-966-5200 (USA only)
Fax: +1-408-360-0222
Email: info@adlinktech.com

ADLINK Technology Beijing

Address: 北京市海淀区上地东路 1 号盈创动力大厦 E 座 801 室
(100085)
Rm. 801, Power Creative E, No. 1, B/D
Shang Di East Rd., Beijing 100085, China

Tel: +86-10-5885-8666
Fax: +86-10-5885-8625
Email: market@adlinktech.com

ADLINK Technology Shanghai

Address: 上海市漕河泾高科技开发区钦江路 333 号 39 幢 4 层
(200233)

Tel: +86-21-6495-5210
Fax: +86-21-5450-0414
Email: market@adlinktech.com

ADLINK Technology Shenzhen

Address: 深圳市南山区科技园南区高新南七道 数字技术园
A1 栋 2 楼 C 区 (518057)
2F, C Block, Bld. A1, Cyber-Tech Zone,
Gao Xin Ave. Sec 7, High-Tech Industrial Park S.,
Shenzhen, 518054 China

Tel: +86-755-2643-4858
Fax: +86-755-2664-6353
Email: market@adlinktech.com



ADLINK Technology Inc. (German Liaison Office)

Address: Nord Carree 3, 40477 Duesseldorf, Germany

Tel: +49-211-495-5552

Fax: +49-211-495-5557

Email: emea@adlinktech.com

ADLINK (French Liaison Office)

Address: 15 rue Emile Baudot, 91300 MASSY Cedex, France

Tel: +33 (0) 1 60 12 35 66

Fax: +33 (0) 1 60 12 35 66

Email: france@adlinktech.com

ADLINK Technology Japan Corporation

Address: 151-0072 東京都渋谷区幡ヶ谷

1-1-2 朝日生命幡ヶ谷ビル 8F

Asahiseimei Hatagaya Bldg. 8F

1-1-2 Hatagaya, Shibuya-ku, Tokyo 151-0072, Japan

Tel: +81-3-4455-3722

Fax: +81-3-5333-6040

Email: japan@adlinktech.com

ADLINK Technology Inc. (Korean Liaison Office)

Address: 서울시 강남구 논현동 60-12 동성빌딩 4층 402호

No.402, Dongsung B/D, 60-12, Nonhyeon-Dong

Gangnam-gu, Seoul, 135-010, Korea.

Tel: +82-2-2057-0565

Fax: +82-2-2057-0563

Email: korea@adlinktech.com

ADLINK Technology Singapore Pte Ltd.

Address: 84 Genting Lane #07-02A, Cityneon Design Centre,
Singapore 349584

Tel: +65-6844-2261

Fax: +65-6844-2263

Email: singapore@adlinktech.com

ADLINK Technology Singapore Pte Ltd. (Indian Liaison Office)

Address: No. 1357, "Anupama", Sri Aurobindo Marg, 9th Cross,

JP Nagar Phase I, Bangalore - 560078, India

Tel: +91-80-65605817

Fax: +91-80-22443548

Email: india@adlinktech.com

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1 Introduction

1.1 Overview

ADLINK's LPCI-/USB-3488A and PXI-3488 GPIB controller interface cards are fully compatible with the IEEE488.2 instrumentation control and communication standard and are capable of controlling up to 14 stand-alone instruments via IEEE488 cables. The LPCI-3488A and USB-3488A are designed to meet the requirements for high performance and maximum programming portability. They were developed using ADLINK's intellectual property in FPGAs which incorporates the GPIB controller, provides reliable GPIB bus control capability, and supports a transfer rate up to 1.5 MB/s. With APIs that are compatible with National Instruments¹ software and VISA support, the LPCI-/USB-3488A and PXI-3488 offer the best compatibility with your existing applications and instrument drivers.

1.1.1 Performance

ADLINK's expertise in PCI and PXI interface cards was leveraged when developing these newly designed GPIB interface card. The LPCI-3488A, which is the low-profile PCI form factor, supports both 3.3 V and 5 V PCI buses and can be adapted to most industrial and desktop computers. The PXI-3488 is compliant with PXI specification Rev. 2.0 and can be used with most PXI and CompactPCI system. A 2 KB FIFO is placed between the GPIB bus and PCI controller to buffer GPIB read/write operations. This FIFO eliminates the gap between the slow GPIB bus (~1.5 MB/s) and the fast PCI bus (132 MB/s), and dramatically increases overall system performance. ADLINK USB-3488A equipped with 32 KB FIFO to the read/write operations, the maximum transfer rates of more than 1.2 MB/s.

1. National Instruments is a registered trademark of National Instruments Corporation

1.1.2 Compatibility

ADLINK's GPIB interface solutions are delivered with complete software support, including a driver API set that is fully binary compatible with NI¹'s GPIB-32.DLL. All programs written based on the GPIB-32.DLL library can be executed with LPCI-/USB-3488A or PXI-3488 without any modification. VISA library is also supported to ensure compatibility with applications utilizing VISA. The ADLINK LPCI-/USB-3488A and PXI-3488 thus provides the "Plug and Play" compatibility with all your existing applications.

1. NI is a registered trademark of National Instruments Corporation

1.2 Features

1.2.1 LPCI-3488A

The LPCI-3488A IEEE 488 GPIB interface card provides the following advanced features:

- ▶ Fully compatible with the IEEE 488 standard
- ▶ Up to 1.5 MB/s data transfer rates
- ▶ Built-in 2 KB FIFO for read/write operations
- ▶ Provides APIs compatible with NI-488.2¹ driver software
- ▶ Supports industrial-standard VISA Library
- ▶ Interactive utility for testing and diagnostics
- ▶ Fully low-profile MD1 PCB compliant

1.2.2 PXI-3488

The PXI-3488 IEEE 488 GPIB interface card provides the following advanced features:

- ▶ PXI specifications Rev. 2.0 compliant
- ▶ 3U Eurocard form factor, CompactPCI compliant (PICMG 2.0 R3.0)
- ▶ Fully compatible with the IEEE 488 standard
- ▶ Up to 1.5 MB/s data transfer rates
- ▶ Built-in 2 KB FIFO for read/write operations
- ▶ Provides APIs compatible with NI-488.2¹ driver software
- ▶ Supports industrial-standard VISA Library
- ▶ Interactive utility for testing and diagnostics

1. NI-488.2 is a trademark of National Instruments Corporation.

1.2.3 USB-3488A

The USB-3488A IEEE 488 GPIB interface card provides the following advanced features:

- ▶ Fully compatible with the IEEE-488 standard
- ▶ Easy GPIB connectivity and GPIB connections for laptop computer
- ▶ Plug and Play interface; No GPIB cable required for instrument connection
- ▶ APIs compatible with NI-488.2 driver software
- ▶ Fully IEEE 488.1 and 488.2 compatible
- ▶ Fully industry-standard VISA library compatible
- ▶ On-board FIFO for read/write operations
- ▶ Maximum GPIB transfer rates Up to 1.2 MB/s
- ▶ 2 m USB cable attached
- ▶ RoHS compliant
- ▶ USB 2.0 compatible
- ▶ No external power required

1.3 Specifications

1.3.1 GPIB Bus Properties

- ▶ Up to 14 instruments can be connected to one controller
- ▶ Maximum 1.5 MB/s 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

1.3.2 Certifications

- ▶ EMC/EMI: CE, FCC Class A

1.3.3 General Specifications

- ▶ I/O Connector: IEEE 488 standard 24-pin connector
- ▶ Operating temperature: 0 to 55°C
- ▶ Storage temperature: -20 to 80°C at 10 to 90% humidity
- ▶ Relative humidity: 10 to 90%, non-condensing
- ▶ Power requirements
 - ▷ LPCI-3488A

+5 V
250 mA (typical) 300 mA (maximum)

Table 1-1: Power Requirements, LPCI-3488A

- ▷ PXI-3488

+5 V
250 mA (typical) 300 mA (maximum)

Table 1-2: Power Requirements, PXI-3488

- ▷ USB-3488A

+5V
190 mA (typical) 500 mA (maximum)

Table 1-3: Power Requirements, USB-3488A

- ▶ Dimensions (not including connectors):
 - ▷ LPCI-3488A: 120 mm x 64 mm
 - ▷ PXI-3488: 160 mm x 100 mm
 - ▷ USB-3488A : 81.6 mm (L) x 61.5 mm (W) x 27.8 mm (H)
- ▶ Vibration Test
 - ▷ USB-3488A
 - ▷ Operating: 1 G 3 axes
 - ▷ non-operating: 2.5 G 3 axes

1.4 Software Support

The ADLINK LPCI-/USB-3488A and PXI-3488 GPIB interface cards provide a device driver package: ADL-GPIB for Windows 98/2000/XP/Vista. The AD-GPIB driver package also provides a diagnostic utility to test GPIB interface cards, as well as programming samples and source code examples for Microsoft Visual C++. The ADL-GPIB driver package can be found in the included All-in-one CD. Please refer to the Software Installation section (2.6), on page 21 for detailed software installation instructions.

For other OS support, please contact ADLINK for more information.

2 Installation

This chapter outlines the contents of package, describes unpacking information, and describes how to install the hardware and software.

2.1 Contents of Package

2.1.1 LPCI-3488A

The LPCI-3488A includes the following items:

- ▶ LPCI-3488A
- ▶ An additional low-profile bracket
- ▶ ADLINK GPIB Driver CD
- ▶ This User's Manual

2.1.2 PXI-3488

The PXI-3488 includes the following items:

- ▶ PXI-3488
- ▶ ADLINK GPIB Driver CD
- ▶ This User's Manual

2.1.3 USB-3488A

The USB-3488A includes the following items:

- ▶ USB-3488A USB/GPIB with built-in 2m cable
- ▶ ADLINK GPIB Driver CD
- ▶ This User's Manual

If any of these items are missing or damaged, contact your ADLINK dealer. Please save the shipping materials and carton to ship or store the product if needed.

2.2 Unpacking

Both the LPCI-/USB-3488A and PXI-3488 contain electrostatic sensitive components that can be easily be damaged by static electricity.

Therefore, these modules should be handled 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.

Inspect the module for obvious damage. Shipping and handling may cause damage to the module. Be sure there is no shipping and handling damage on the module before continuing.

Note: DO NOT APPLY POWER TO THE CARD IF IT HAS BEEN DAMAGED.

2.3 Mechanical Drawing

2.3.1 LPCI-3488A

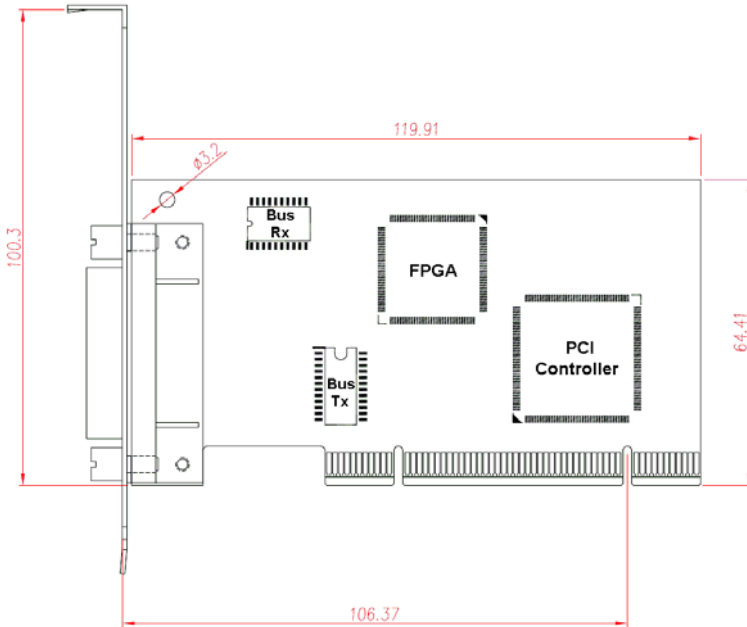


Figure 2-1: PCB Layout of the LPCI-3488A

2.3.2 PXI-3488

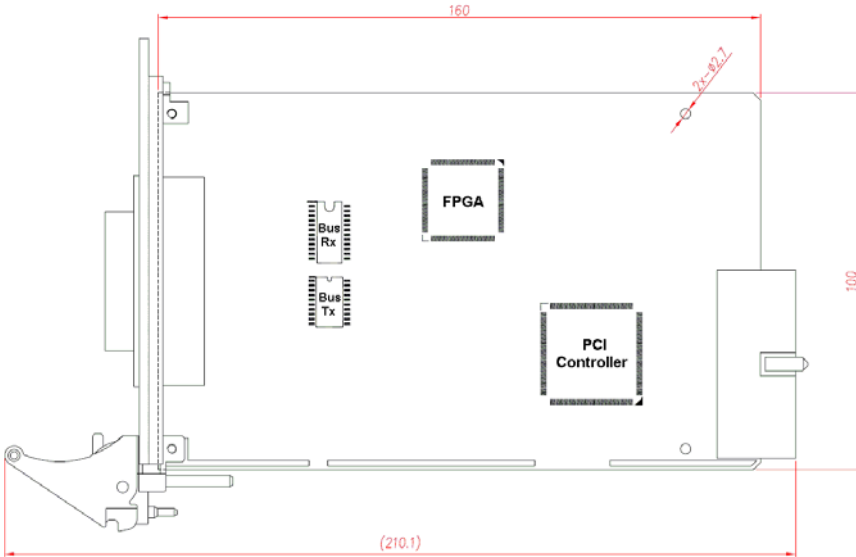


Figure 2-2: PCB Layout of the PXI-3488

The ADLINK PXI-3488 is packaged in a Eurocard form factor compliant with the PXI Specification and measuring 160 mm in length and 100 mm in height (not including connectors). The IEEE488 standard 24-pin connector is located at the front panel and the J1 IEC connectors in the rear are used to link the chassis backplane. With its modular, rugged, and high shock resistant mechanical features, the IEEE488 GPIB Interface module functions exceptionally well in harsh environment applications.

2.3.3 USB-3488A

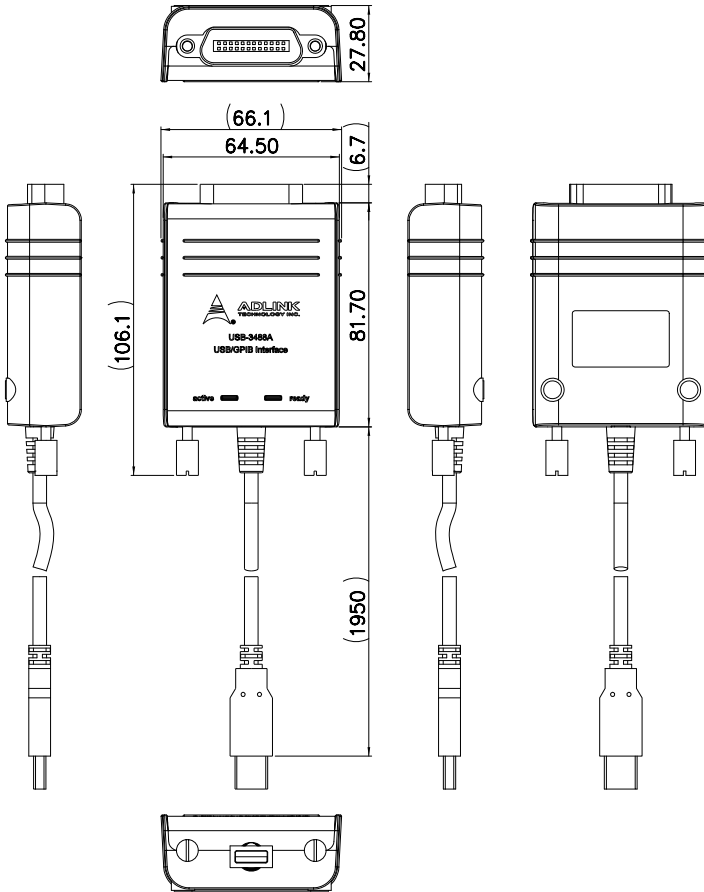


Figure 2-3: Layout of the USB-3488

The ADLINK USB-3488A is assembled with top and bottom cases, The USB-3488A GPIB interface provides a direct connection between the USB port on a desktop and laptop computer to GPIB instrumen. With the USB-3488A GPIB interface and its USB Plug and Play feature, GPIB instruments can be connected and disconnected without having to shut down the computer. No external power supplies are necessary. The USB-3488A GPIB interface is equipped with a 2meter USB cable that is USB 2.0 compliant.

2.4 PCI Configuration

2.4.1 Plug and Play

As a plug-and-play component, the card requests an interrupt number via its PCI controller. The system BIOS 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 is acknowledged by the system.

2.4.2 Configuration

Board configuration is accomplished on a board-by-board basis for all PCI/PXI boards in the chassis. Because configuration is controlled by the system and software, there is no jumper setting required for base-address, DMA, and interrupt IRQ.

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

2.4.3 Troubleshooting

If the system doesn't boot or you experience erratic operation with the PCI/PXI board in place, it's likely caused by an interrupt conflict (perhaps the BIOS settings are 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.

2.5 Hardware Installation

2.5.1 LPCI-3488A Installation Procedures

Please follow the instructions to install LPCI-3488A in your system.

1. Turn off the computer
2. Turn off all accessories (printer, modem, monitor, etc.) connected to the computer.
3. Open the computer case.
4. Select a 32-bit PCI slot. PCI slots are shorter than ISA or EISA slots, and are usually white or ivory.
5. Before handling the PCI cards, discharge any static buildup on your body by touching the metal case of the computer. Hold the edge of the board and do not touch the components.
6. Position the board into the selected PCI slot.
7. Secure the card in place at the rear panel of the system.
8. Replace the computer case cover.

Turn on the computer, and install the software according to the instructions in the Software Installation section (2.6), on page 21.

2.5.2 PXI-3488 Installation Procedures

Please follow the instructions to install the PXI-3488 into your PXI chassis.

1. Turn off the system.
2. Align the module's edge with the card guide in the PXI chassis.
3. Slide the module into the chassis, until resistance is felt from the PXI connector
4. Push the ejector upwards and fully insert the module into the chassis.
5. Once inserted, a "click" can be heard from the ejector latch.
6. Tighten the screw on the front panel.

Turn on the computer, and install the software according to the instructions in the Software Installation section (2.6), on page 21.

2.5.3 USB-3488A Installation Procedures

Please follow the instructions to install USB-3488A in your system.

1. Connect USB-3488A to any USB Port
2. After several seconds, the "Ready" LED become Green, USB-3488A is ready for work.

if you use USB-3488A with a USB Hub, we suggest you to have an independent power for the Hub.

2.5.4 Cabling

The following connection configuration can ensure that the GPIB throughput achieves optimal performance. These configurations include the number of instruments and cable distances:

- ▶ Cable lengths should be no longer than 4 meters (2 meter lengths maximum is suggested).
- ▶ The total GPIB BUS distance should be less than 20 meter.
- ▶ The total number of devices must less than 15 (including computer itself), and at least two-thirds ($2/3$) of the devices are powered on.

Devices can be connected in a linear configuration, star configuration, or combination the two. The following figures show both linear and star connections.

Note: For a star connection, the total current load will be less if there are less than three cable connections on an individual instrument.

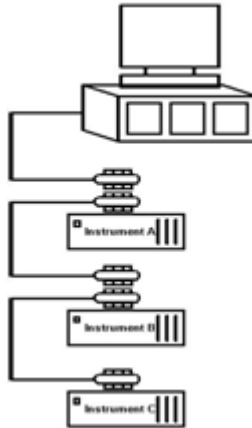


Figure 2-4: LPCI-3488A Linear Connection Configuration

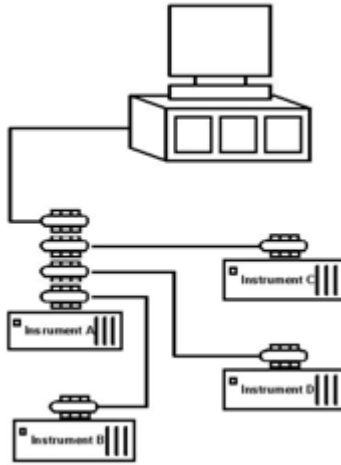


Figure 2-5: LPCI-3488A Star Connection Configuration

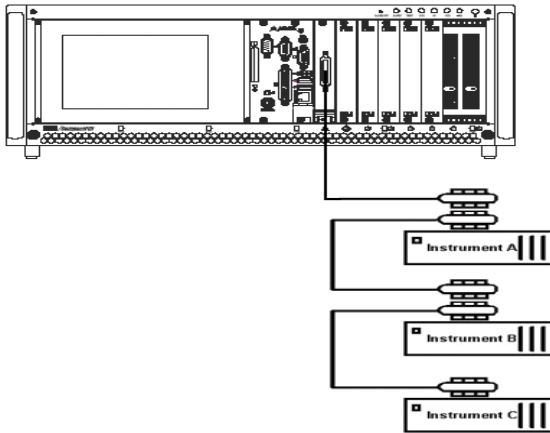


Figure 2-6: PXI-3488 Linear Connection Configuration

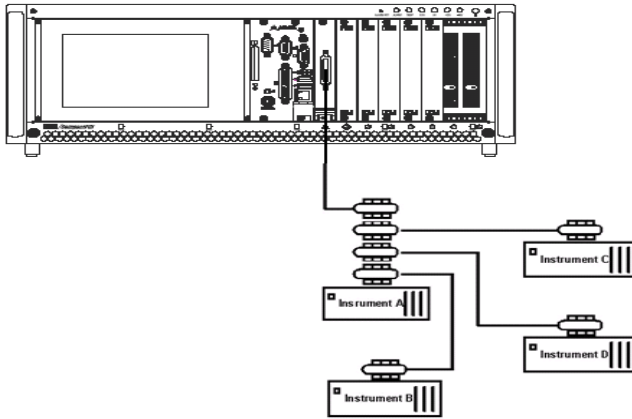


Figure 2-7: PXI-3488 Star Connection Configuration

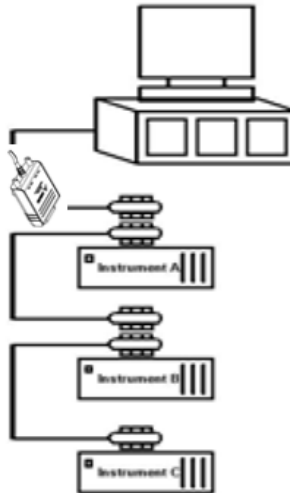


Figure 2-8: USB-3488A Linear Connection Configuration

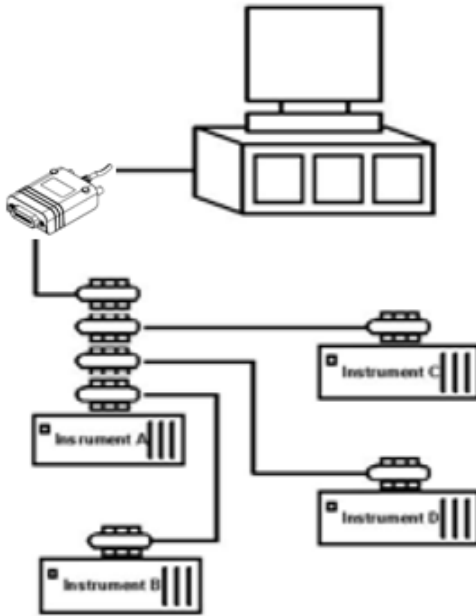


Figure 2-9: USB-3488A Star Connection Configuration

2.6 Software Installation

ADLINK GPIB interface cards are delivered with an ADL-GPIB driver package for Windows 98/2000/XP/Vista. The ADL-GPIB is designed to be fully compatible with your current applications and includes APIs and a binary-compatible gpib-32.dll for users using LabVIEW¹, LabWindow/CVI², VC++, VB, and Delphi. ADLINK GPIB interface cards also adequately support VISA to work with most available instrument drivers. Please visit the ADLINK web-site (www.adlinktech.com) to download the latest version of ADL-GPIB.

Note: You must install ADL-GPIB revision 3.0 or later to use the LPCI-/USB-3488A and PXI-3488.

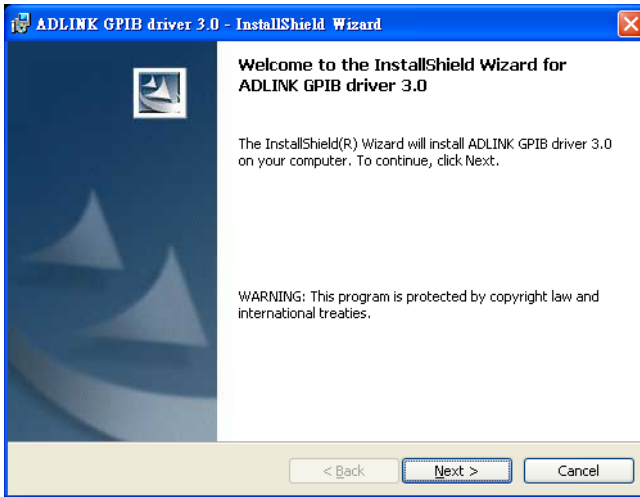
This section will illustrate the procedure to install the ADL-GPIB driver package.

2.6.1 Driver Installation

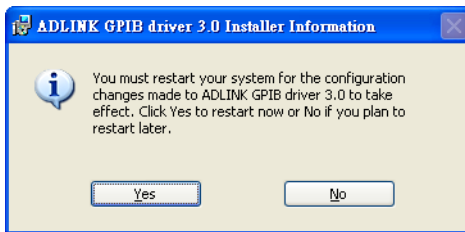
For Windows 98/2000/XP/Vista users:

1. Insert the ADLINK GPIB Driver CD.
2. Execute `x:\Software Package\ADL-GPIB\Setup.exe` to launch the setup program. (x: denotes your CD-ROM drive). A InstallShield® wizard appears to guide you through the setup procedure.

1. LabVIEW is a trademark of National Instruments Corporation
2. LabWindow/CVI is a trademark of National Instruments Corporation



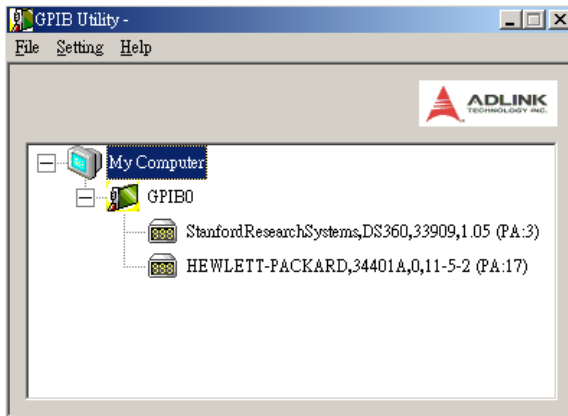
3. Reboot the system to complete setup



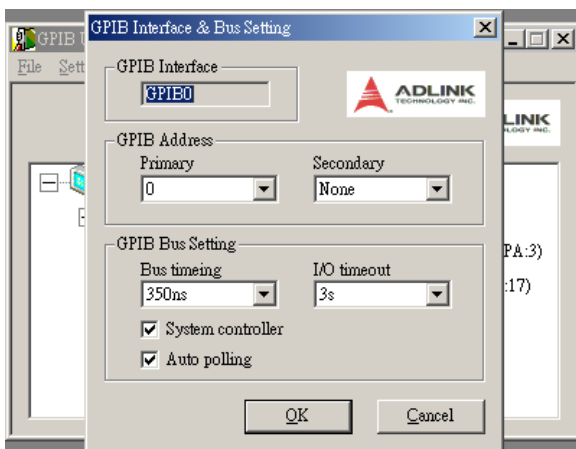
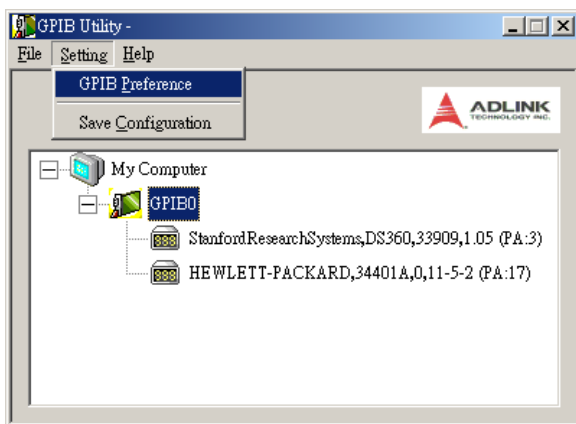
2.6.2 Using the ADLINK GPIB Utility

The ADL-GPIB driver package also provides an “ADLINK GPIB Utility” utility program to diagnose and verify GPIB connections. It is located on the GPIB Driver: `x:\ADLINK\ADL-GPIB\Utility\GPIB Utility.exe`.

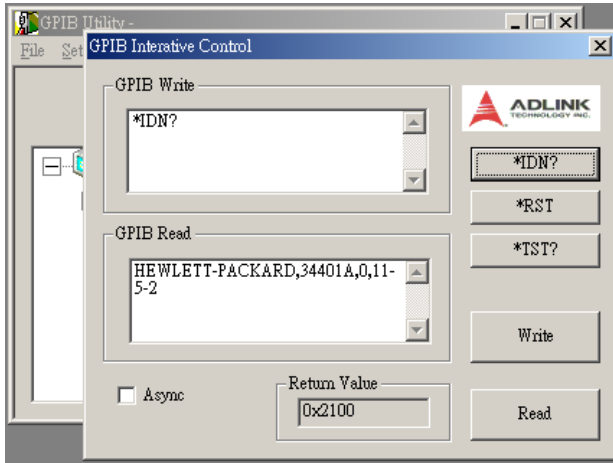
1. Launch GPIB Utility.exe. A window appears to show all installed GPIB interfaces and instruments



2. Click on a GPIB interface (GPIB0, GPIB1, etc.) and select “**Setting**” > “**GPIB Preference**”. A “*GPIB Interface & Bus Setting*” dialog appears to enable configuration of the GPIB interface.



3. Double click on a connected GPIB instrument. A “*GPIB Interactive control*” dialog appears to allow write command strings to be inputted into the GPIB instrument and read the result.



3 Operation Theory

This chapter describes the operation theory of GPIB bus and the basic architecture of ADLINK's GPIB interface cards.

3.1 Connection Configuration

The GPIB bus has 24 lines which are divided into 16 signal lines and 8 ground return or shield drain lines. The 16 signal lines can be divided into 8-bit parallel data transfer bus and 8 control lines. The 8 control lines contain 5 system management lines and 3 handshake lines.

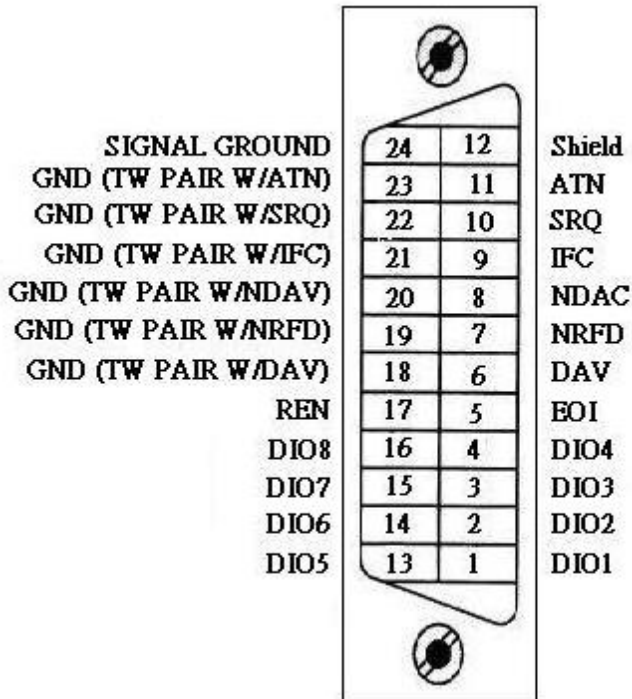


Figure 3-1: Standard GPIB Connector

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		

Table 3-1: GPIB Bus

3.1.1 Data Lines

DIO1 to DIO8 carry both data and command messages. All commands and most data use 7-bit ASCII codes, the 8th bit, DIO8, is either unused or used as a parity check.

3.1.2 Handshake Lines

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

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

3.1.3 System Management Lines

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 multi-byte transfer sequence or used 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 DIO 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.

3.2 Block Diagram

3.2.1 ADLINK GPIB Interface Cards Block Diagram

ADLINK's LPCI-3488A and PXI-3488 GPIB interface cards include a 2 KB FIFO inside the FPGA IP to maximize data transfer rates. Its state-of-the-art state machine in the CPLD coordinates the data flow between the PCI controller, FIFO and GPIB bus.

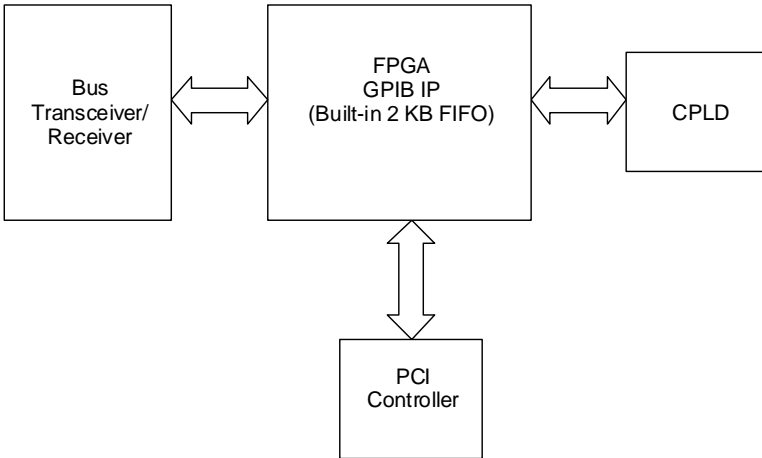


Figure 3-2: Block Diagram of ADLINK GPIB Interface Cards

The FIFO can buffer data from the master (either from the PCI controller or external device) when the target is busy. Efficiency is thus significantly improved when transferring large blocks of data.

3.2.2 ADLINK USB-3488A GPIB Interface Block Diagram

The ADLINK USB-3488A GPIB interface include a 32 KB FIFO to maximize data transfer rates.

Its state-of-the-art state machine in the the 8051 coordinates the data flow between the USB Bus, FIFO and GPIB bus.

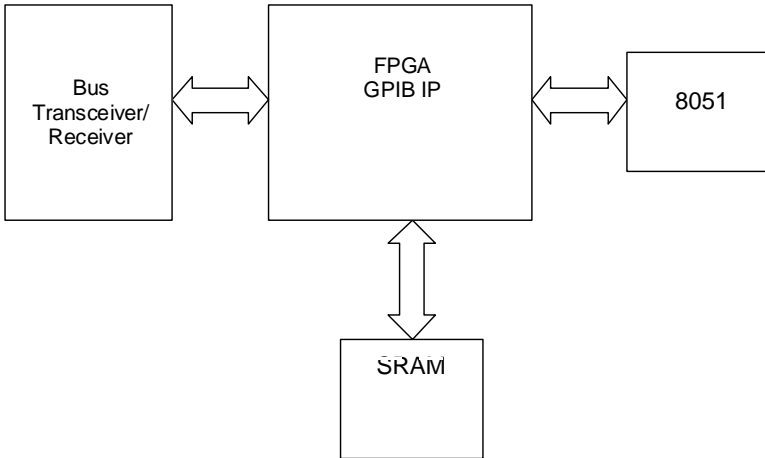


Figure 3-3: Block Diagram of ADLINK USB-3488A GPIB Interface

