



**ADLINK**  
TECHNOLOGY INC.

**LPCI-3488A and USB-3488A**  
IEEE488 GPIB Interface Card Series  
**User's Manual**

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Recycled Paper

**Advance Technologies; Automate the World.**



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# 1 Introduction

## 1.1 Overview

ADLINK's LPCI-3488A and USB-3488A 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 Instruments<sup>1</sup> software and VISA support, the LPCI-3488A and USB-3488A offer the best compatibility with your existing applications and instrument drivers.

### 1.1.1 Performance

ADLINK's expertise in PCI 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. 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.

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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 NI<sup>1</sup>'s GPIB-32.DLL. All programs written based on the GPIB-32.DLL library can be executed with LPCI-3488A and USB-3488A without any modification. VISA library is also supported to ensure compatibility with applications utilizing VISA. The ADLINK LPCI-3488A and USB-3488A 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-488.2<sup>1</sup> driver software
- ▶ Supports industrial-standard VISA Library
- ▶ Interactive utility for testing and diagnostics
- ▶ Fully low-profile MD1 PCB compliant

### 1.2.2 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

- ▷ USB-3488A

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

Table 1-2: Power Requirements, USB-3488A

- ▶ Dimensions (not including connectors):
  - ▷ LPCI-3488A: 120 mm x 64 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-3488A and USB-3488A 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 GPIB Driver CD. Please refer to the Software Installation section (2.6), on page 16 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 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-3488A and USB-3488A 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

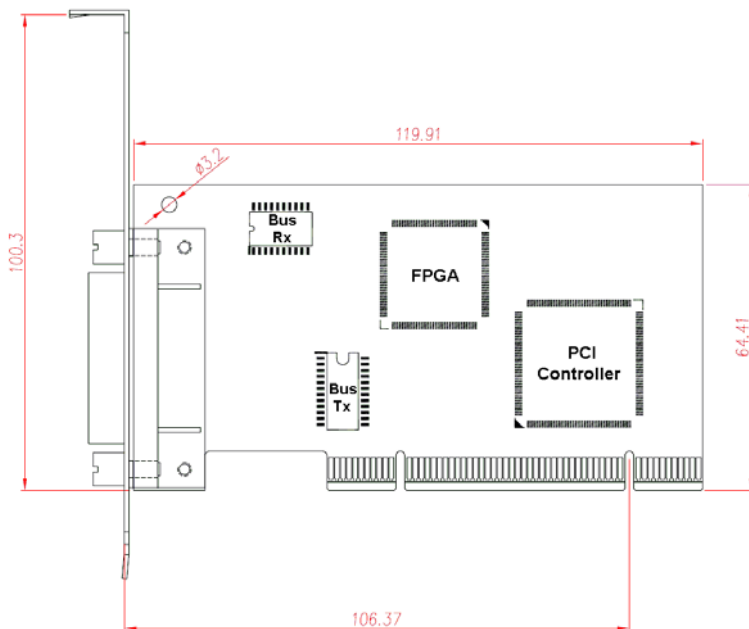
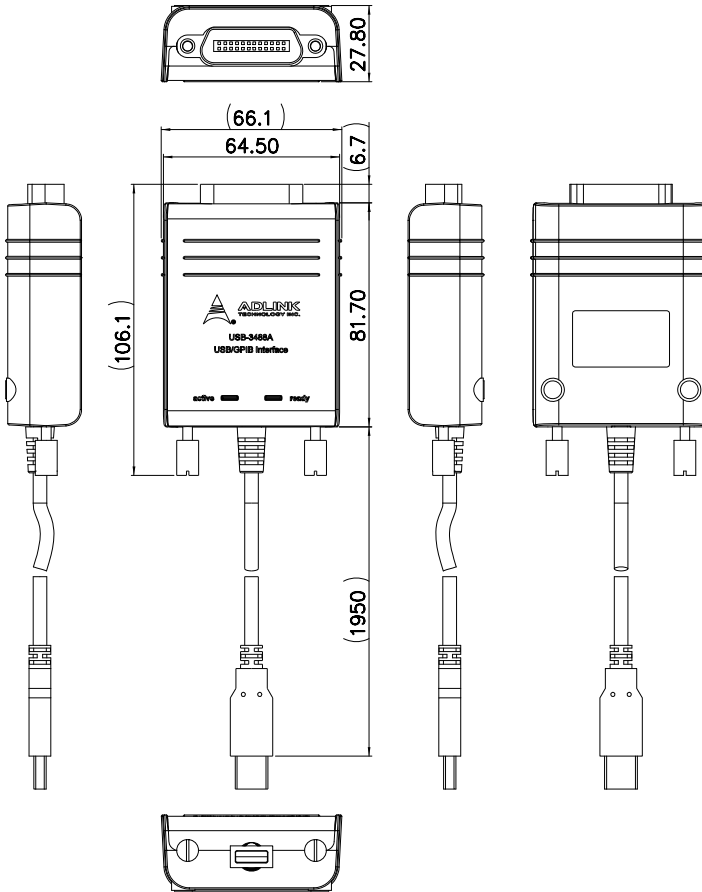


Figure 2-1: PCB Layout of the LPCI-3488A

## 2.3.2 USB-3488A



**Figure 2-2: 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 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 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 16.

### **2.5.2 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.

### 2.5.3 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.

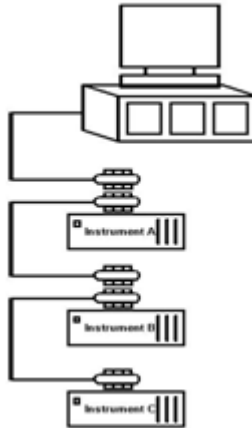
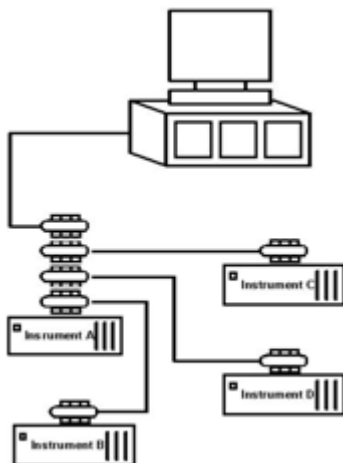
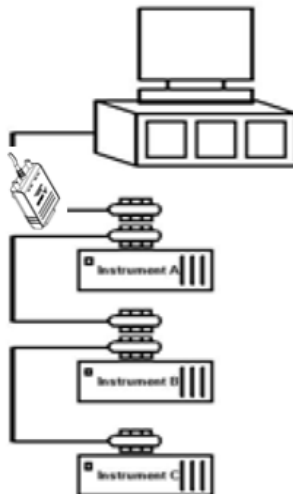


Figure 2-3: LPCI-3488A Linear Connection Configuration



**Figure 2-4: LPCI-3488A Star Connection Configuration**



**Figure 2-5: USB-3488A Linear Connection Configuration**

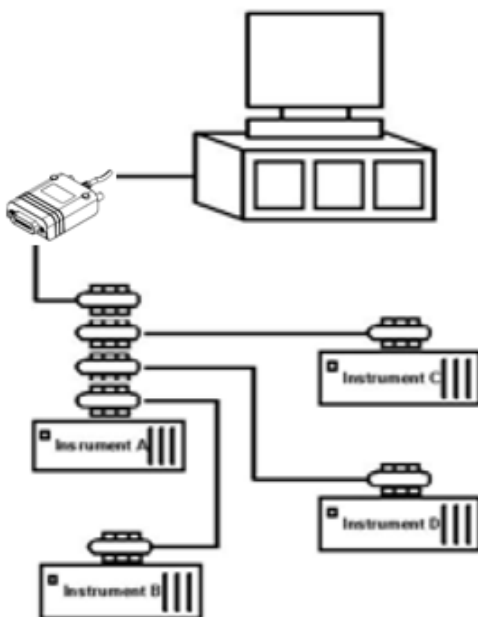


Figure 2-6: USB-3488A Star Connection Configuration

## 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 LabVIEW<sup>1</sup>, LabWindow/CVI<sup>2</sup>, 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](http://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-3488A and USB-3488A.

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

### 2.6.1 Driver Installation

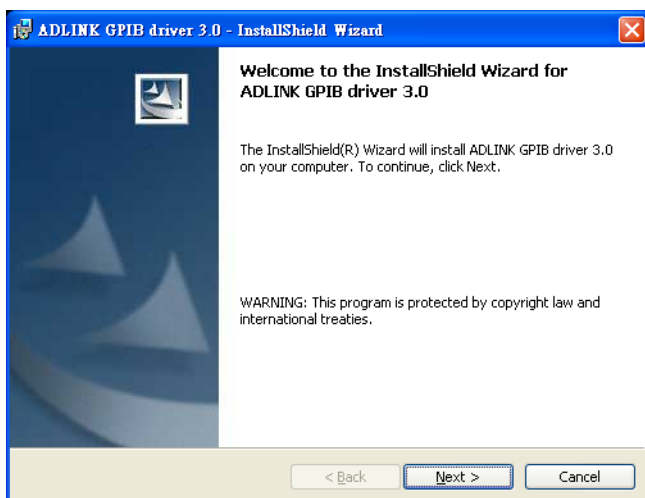
**For Windows 98/2000/XP/Vista users:**

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.

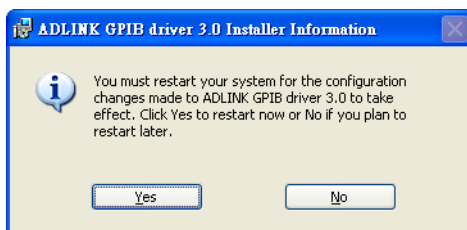
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1. LabVIEW is a trademark of National Instruments Corporation  
2. LabWindow/CVI is a trademark of National Instruments Corporation





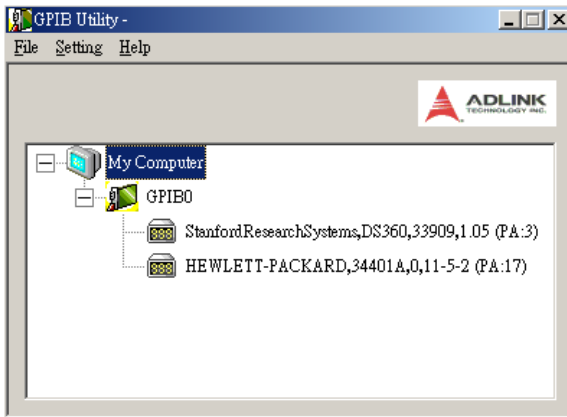
### 3. Reboot the system to complete setup



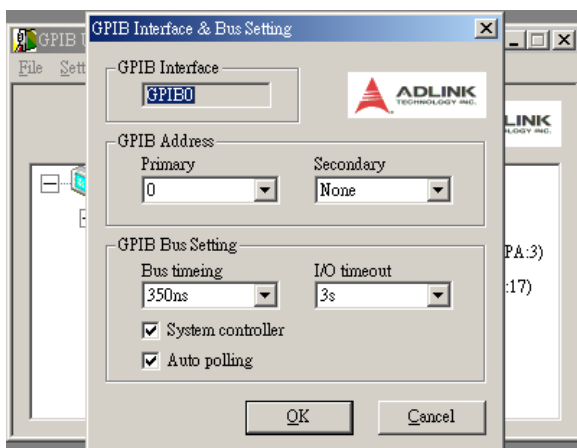
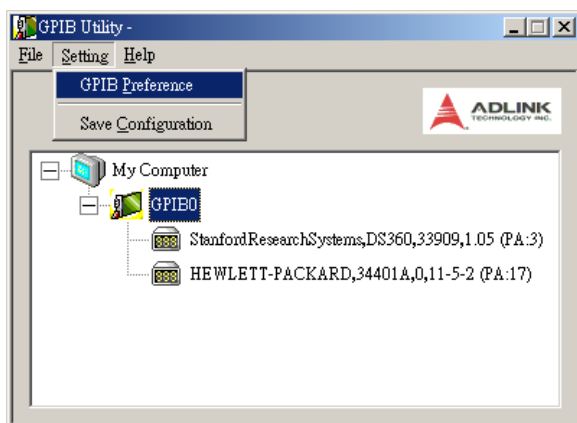
## 2.6.2 Using the ADLINK GPIB Utility

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`.

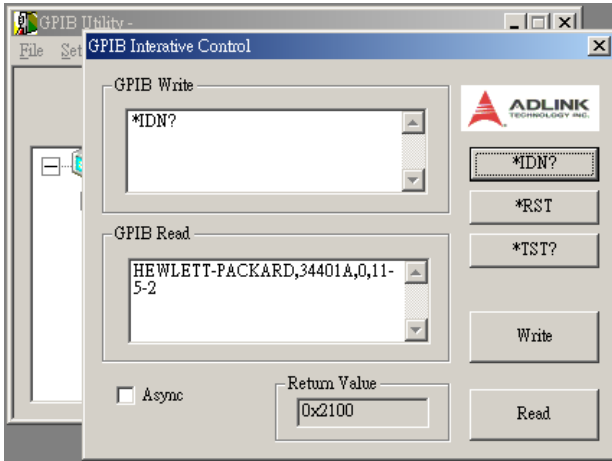
1. Launch GPIB Utility.exe. A window appears to show all installed GPIB interfaces and instruments



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.

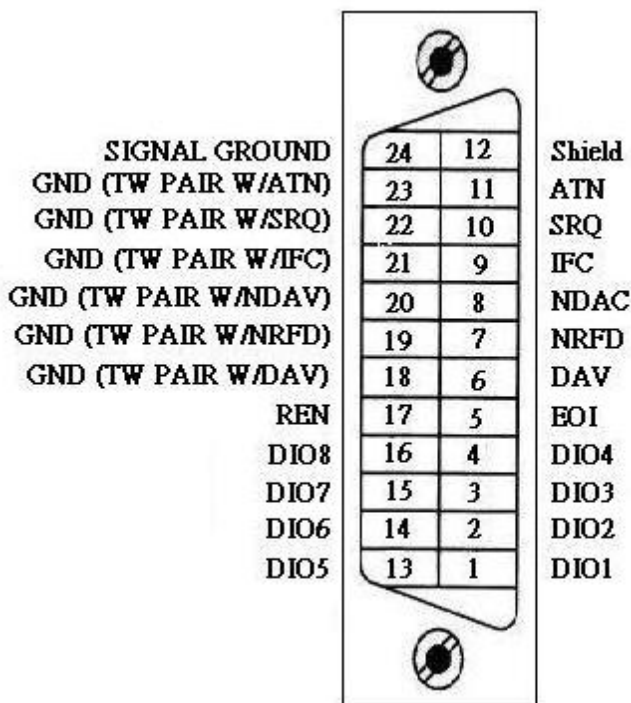


Figure 3-1: Standard GPIB Connector

GPIB BUS	Type	Function		Pin	
24 lines	16 signal lines	8 data lines		No.	Description
				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

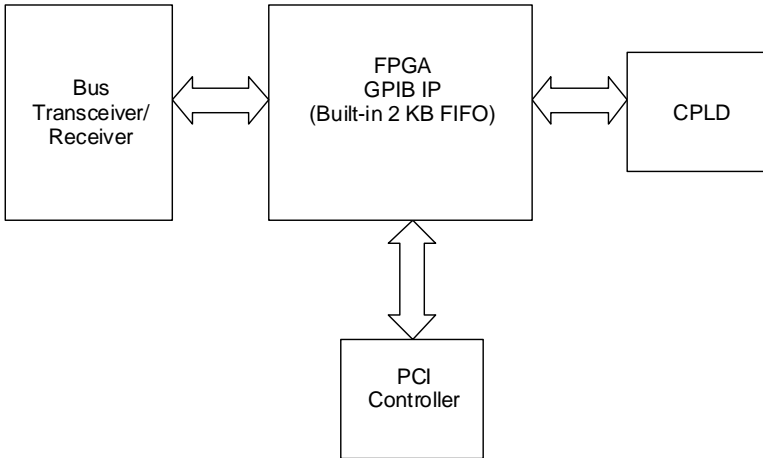
Five system management lines manage the flow of control and data bytes across the interface.

- ▶ **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 inter-connected 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 GPIB interface card includes 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**

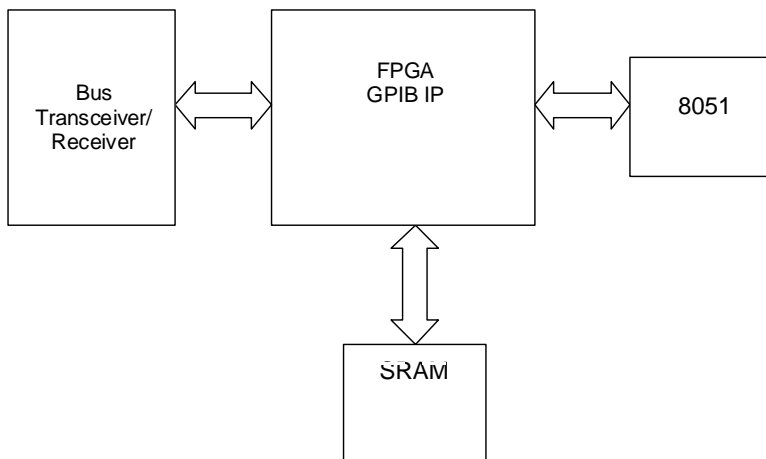
The FIFO can buffer data from the master (either from the PCI controller or external device) when the target is busy. Efficiency is thus significantly improved when transferring large blocks of data.



### 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**

