PCI-P16R16 Series

Includes PCI-P8R8/P16R16, PCI-P8POR8/P16POR16, PCI-P16C16 and PEX-P8POR8i/P16POR16i

User Manual

Version 2.8
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Warranty

All products manufactured by ICP DAS are warranted against defective materials for a period of one year from the date of delivery to the original purchaser.

Warning

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1 . Introduction

Model Number	Isolated Digital Input	Output Type
PCI-P8R8	8 Channel	8 Channel Relay Output
PCI-P16R16	16 Channel	16 Channel Relay Output
PCI-P16C16	16 Channel	16 Channel Open Collector Output
PCI-P8POR8 PEX-P8POR8i	8 Channel	8 Channel PhotoMos-Relay Output
PCI-P16POR16 PEX-P16POR16i	16 Channel	16 Channel PhotoMos-Relay Output

- ***PCI-P8R8/PCI-P16R16***

The PCI-P16R16/PCI-P8R8 is a PCI card supporting 5 V PCI bus and "Plug & Play" feature to get I/O address automatically without manually setting. This card contains 16/8 photo coupler digital input channels that provide 5000 Vrms isolation protection, allowing the input signals to be completely floated so as to prevent ground loops. They are also equipped with 16/8 relay output channels to enable the control of the ON/OFF state of external devices, drive external relays or small power switches, or activate alarms, etc.

- ***PCI-P16C16***

The PCI-P16C16 is a 5 V PCI card that support “Plug & Play” functionality to automatically obtain I/O resources from the BIOS. This card contains 16 optically isolated digital input channels and 16 open collector (sink, NPN) digital output channels. The DI channels provide 5000 Vrms isolation protection that allows the input signals to be completely floated so as to prevent ground loops and isolate the host computer from damaging voltages. The open collector output (DO) channels are typically used for alarm and warning notification, control of signal output, control of external circuits that require a higher voltage level, and signal transmission applications, etc. The PCI-P16C16 contains a single DB-37 connector and a single 40-pin box header and includes a 40-pin to DB-37 flat cable for easy wiring.

- ***PCI-P8POR8/P16POR16 and PEX-P8POR8i/P16POR16i***

The PCI-P8ROR8/P16POR16 supports 5 V PCI bus while the PEX-P8POR8i/P16POR16i supports PCI Express bus. Each contain 8 or 16 optically isolated input channels and 8 or 16 PhotoMos relay output channels. Both the isolated DI channels and the PhotoMos relay channels use a short optical transmission path to transfer an electronic signal between elements of a circuit and keep them electrically isolated. The DI channels provide 5000 Vrms isolation protection, allowing the input signals to be completely floated so as to cut down ground loops, block voltage spikes, and isolate the host computer from damaging voltages. PhotoMos relays are used where it is necessary to control a circuit using a low-power signal (with complete electrical isolation between the control and controlled circuits), or where several circuits must be controlled by one signal.

The PCI-P8POR8/P16POR16 and PEX-P8POR8i/P16POR16i can be used in various applications, such as controlling the ON/OFF state of external devices, driving external relays or small power switches, activating alarms, contact closure, sensing external voltages or switches, etc. The card can be installed in PCI/PCI Express slot and supports true "Plug & Play", with two DB-37 connectors provided for easy wiring.

1.1 Features and Applications

1.1.1. Features

	PCI-P8R8	PCI-P16R16	PCI-P16C16
Bus Type	5 V PCI Bus		
Common Features	● Optically Isolated Digital Input ● AC/DC Digital Signed Input ● AC Digital Input With Filter By Jumper Setting		
Input Channel	8	16	16
Input Type	Optically Isolated Digital Input		
Output Channel	8	16	16
Output Type	Relay Output		Transistor (Open Collector)
Led Indicators	None		External Power status

Table 1-1: Features of PCI-P8R8/P16R16/P16C16 card

	PCI-P8POR8	PCI-P16POR16	PEX-P8POR8i	PEX-P16POR16i
Bus Type	5 V PCI Bus		PCI Express x 1	
Common Features	● Optically Isolated Digital Input ● AC/DC Digital Signed Input ● AC Digital Input With Filter By Jumper Setting			
Input Channel	8	16	8	16
Input Type	Optically Isolated Digital Input			
Output Channel	8	16	8	16
Output Type	PhotoMos Relay			
Led Indicators	Output Status			

Table 1-2: Features of PCI-P8POR8/P16POR16 and PEX-P8POR8i/P16POR16i card

1.1.2. Applications

- Factory automation
- Laboratory automation
- Communication switching
- Security control
- Product test
- Energy management

1.2 Block Diagram

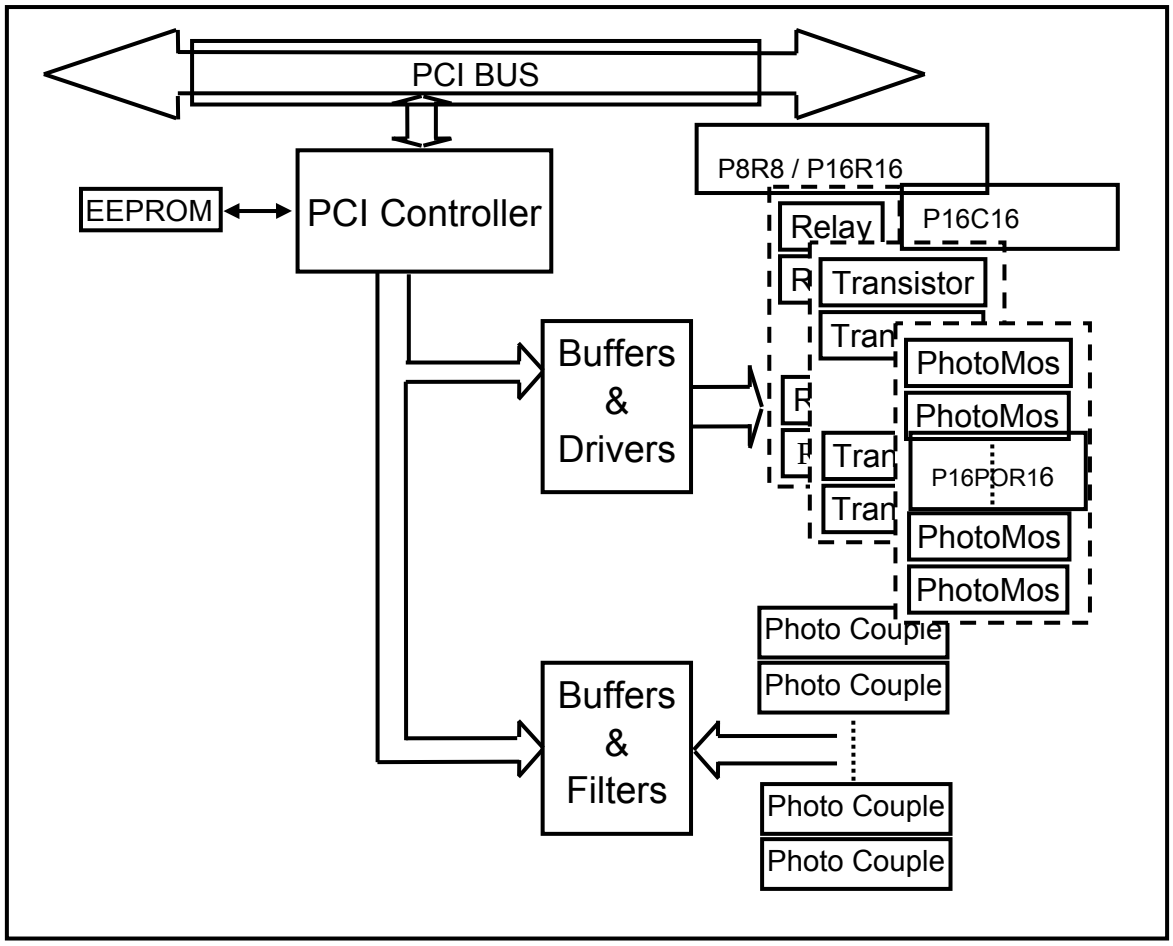


Figure 1-1: Functional Block diagram.

1.3 Specifications

1.3.1 PCI-P8R8/P16R16

Model Name	PCI-P8R8	PCI-P16R16
Digital Input		
Isolation Voltage	3750 Vrms (Photo-couple)	
Channels	8	16
Input Voltage	Logic 1:AC/DC 5 ~ 24 V(AC 50 ~ 1 kHz) Logic 0: AC/DC 0 ~ 1 V	
Response Speed	Without Filter: 50 kHz (Typical) With Filter: 0.455 kHz (Typical)	
Relay Output		
Channels	8	16
Relay Type	4 SPDT 4SPST	8 SPDT 8 SPST
Contact Rating	AC:120 V@0.5 A DC: 24 V@1 A	
Operating Time	5 ms (typical)	
Release Time	10 ms (typical)	
Insulation Resistance	1000 MΩ	
Life	Mechanical: 5000000 ops. Electrical: 100000 ops.	
General		
Bus Type	5 V PCI, 32-bit, 33 MHz	
Data Bus	16-bit	
Card ID	No	
I/O Connector	Female DB37 x 1	Female DB37 x 1 40-pin box header x 1
Dimensions (L x W x D)	183 mm x 105 mm x 22 mm	
Power Consumption	500 mA @ +5 V	800 mA @ +5 V
Operating Temperature	0 ~ 60 °C	
Storage Temperature	-20 ~ 70 °C	
Humidity	5 ~ 85% RH, non-condensing	

1.3.2 PCI-P16C16

Model Name	PCI-P16C16
Digital Input	
Isolation Voltage	3750 Vrms (Photo-couple)
Channels	16
Input Voltage	Logic 1:AC/DC 5 ~ 24 V(AC 50 ~ 1 kHz) Logic 0: AC/DC 0 ~ 1 V
Response Speed	Without Filter: 50 kHz (Typical) With Filter: 0.455 kHz (Typical)
Digital Output	
Isolation Voltage	3750 Vrms
Channels	16
Compatibility	Transistor(Open Collector)
Output Capability	DC:600 mA/+30 V for one channel @ 100% duty
Response Speed	1 kHz (Typical)
General	
Bus Type	5 V PCI, 32-bit, 33 MHz
Data Bus	16-bit
Card ID	No
I/O Connector	Female DB37 x 1 40-pin box header x 1
Dimensions (L x W x D)	183 mm x 105 mm x 22 mm
Power Consumption	800 mA @ +5 V
Operating Temperature	0 ~ 60 °C
Storage Temperature	-20 ~ 70 °C
Humidity	5 ~ 85% RH, non-condensing

1.3.3 PCI-P8POR8/P16POR16 and PEX-P8POR8i/ P16POR16i

Model Name		PCI-P8POR8	PCI-P16POR16	PEX-P8POR8i	PEX-P16POR16i
Digital Input					
Isolation Voltage		3750 Vrms (Photo-couple)			
Channels		8	16	8	16
Input Voltage		Logic 1:AC/DC 5 ~ 24 V(AC 50 ~ 1 kHz) Logic 0: AC/DC 0 ~ 1 V			
Response Speed		Without Filter: 50 kHz (Typical) With Filter: 0.455 kHz (Typical)			
Relay Output					
Channels		8	16	8	16
Relay Type		PhotoMos Relay (Form A)			
Contact Rating		AC:350 V/130 mA (Peak AC)			
Operating Time		0.7 ms (typical)			
Release Time		0.05 ms (typical)			
Insulation Resistance		23 Ω			
Special					
LED Indicators		Output status			
General					
Bus Type		5 V PCI, 32-bit, 33 MHz		PCI Express x1	
Data Bus		16-bit			
Card ID		No		Yes (4-bit)	
I/O Connector	Female DB37	1	1	1	1
	40-pin box header	-	1	-	1
Dimensions (L x W x D)		183 mm x 105 mm x 22 mm			
Power Consumption		800 mA @ +5 V			
Operating Temperature		0 ~ 60 °C			
Storage Temperature		-20 ~ 70 °C			
Humidity		5 ~ 85% RH, non-condensing			

1.4 Product Check List

The shipping package includes the following items:

- One PCI boards as follows:
  - PCI-P8R8/PCI-P16R16
  - PCI-P16C16
  - PCI-P8POR8/PCI-P16POR16
  - PEX-P8POR8i/PEX-P16POR16i
- One software utility PCI CD.
- One Quick Start Guide.

It is recommended that you read the Quick Start Guide first. All the necessary and essential information is given in the Quick Start Guide, including:

- Where to get the software driver, demo programs and other resources.
- How to install the software.
- How to test the card.

Attention!

If any of these items is missing or damaged, contact the dealer from whom you purchased the product. Please save the shipping materials and carton in case you need to ship or store the product in the future.

1.5 Hardware Configuration

This chapter describes how to unpack this I/O card and how to install it to your system. Both the unpacking information and the jumper settings are described in the following text. This manual should be carefully read before installation.

1.5.1 Unpacking

This I/O card was well-tested and inspected both mechanically and electrically before shipping. It was free of marks and scratches our quality delivery policy requires that all equipment be in perfect order before delivery. However, some unconditional damages may occur while unpacking!! Please read this section before unpacking the card. Feel free to contact your carrier and retain your carton in case there is error.

CAUTION:
This card contains sensitive electronic components that can be easily damaged by static electricity.

1. This card should be packed with an anti-static mat.
2. The user should wear an anti-static wristband, grounded at the same point to the anti-static mat.
3. Inspect the carton for obvious damage. Either shipping or handing may cause damages!! Be sure there are no shipping and handing damages on the card before using.
4. After opening the carton, place the system board handle on a grounded anti-static surface and let the component side up.

CAUTION: Do not apply power to the board if it has been damaged!

5. You are now ready to install your card.

1.5.2 Board Layout

- **PCI-P8R8/P16R16 Board Layout**

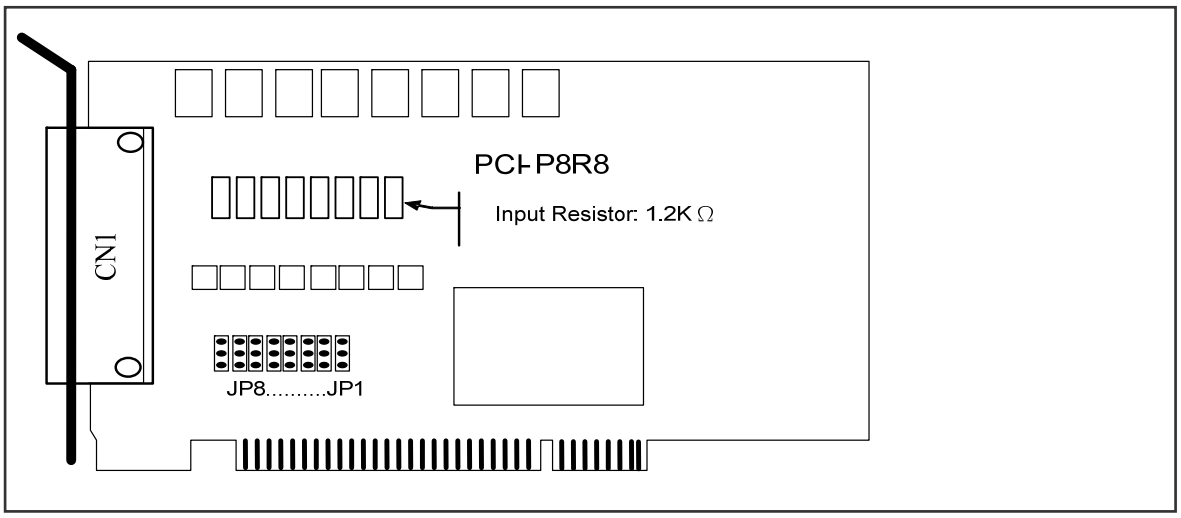


Figure 1-2: PCI–P8R8 Layout

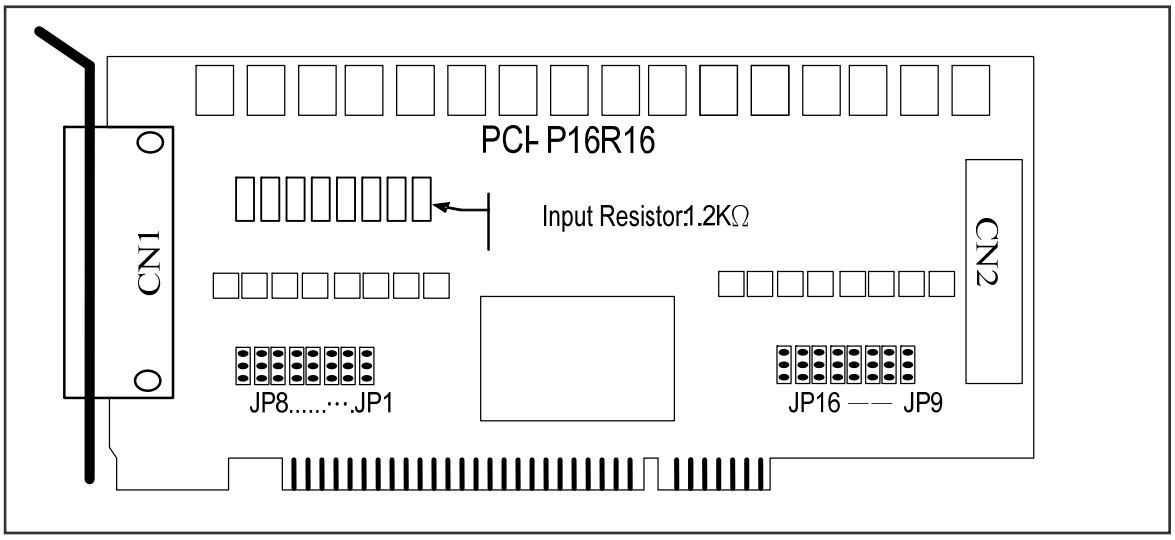


Figure 1-3: PCI–P16R16 Board Layout

Note:

CN1	D/I/O channel 0~7 for PCI-P8R8/P16R16.
JP1 ~ JP8	Select the input AC or DC signals of D/I channel 0 ~ 7 for CN1.
CN2	D/I/O channel 8~15 for PCI-P16R16.
JP9 ~ JP16	Select the input AC or DC signals for D/I channel 8 ~ 15 for CN2.

■ PCI-P16C16 Board Layout

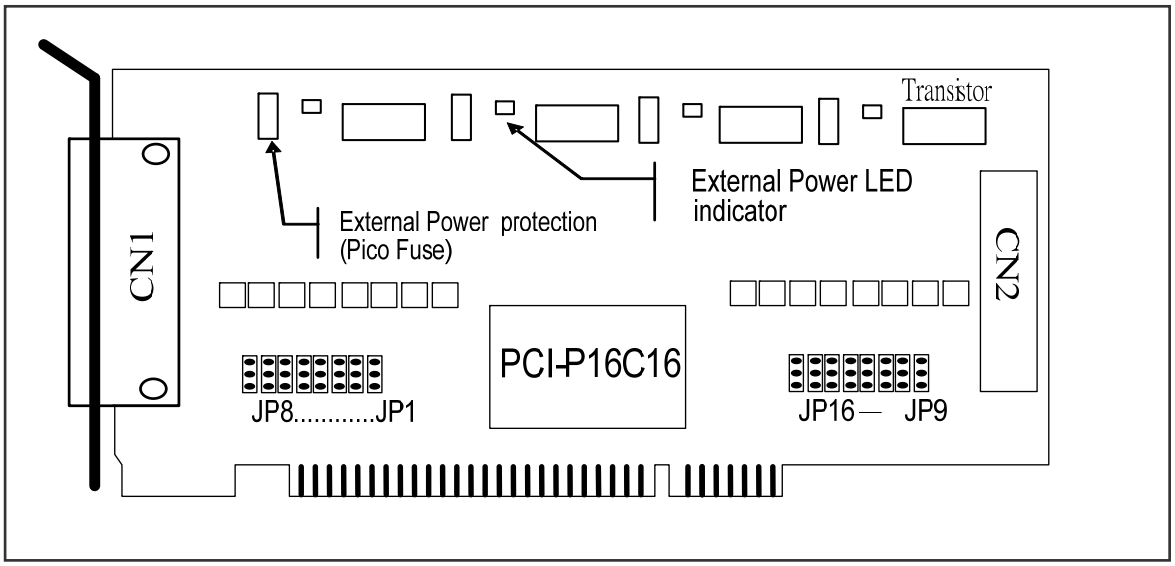


Figure 1-4: PCI-P16C16 Layout

Note:

CN1	D/I/O channel 0~7 for PCI-P16C16.
JP1 ~ JP8	Select the input AC or DC signals of D/I channel 0 ~ 7 for CN1.
CN2	D/I/O channel 8~15 for PCI-P16C16.
JP9 ~ JP16	Select the input AC or DC signals for D/I channel 8 ~ 15 for CN2.

■ PCI-P8POR8/P16POR16 Board Layout

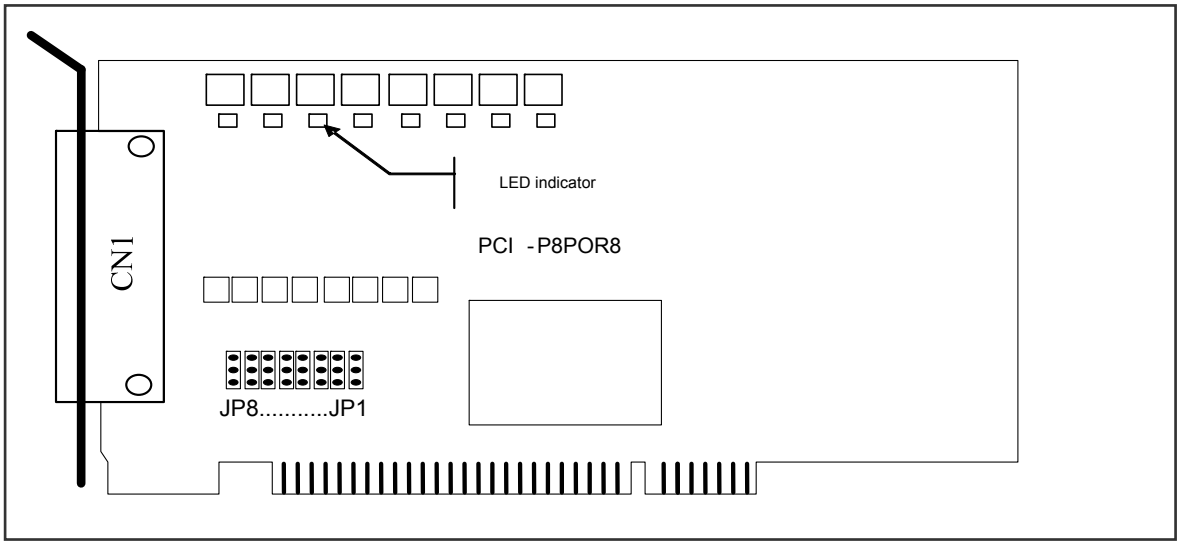


Figure 1-5: PCI-P8POR8 Layout

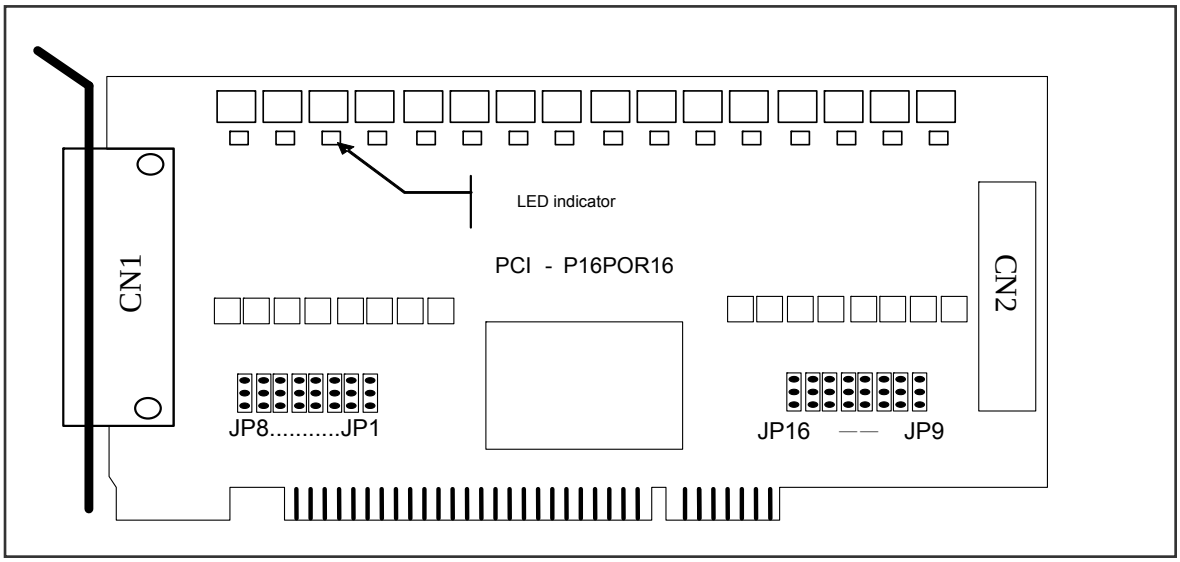


Figure 1-6: PCI-P16POR16 Layout

Note:

CN1	D/I/O channel 0~7 for PCI-P8POR8/P16POR16.
JP1 ~ JP8	Select the input AC or DC signals of D/I channel 0 ~ 7 for CN1.
CN2	D/I/O channel 8~15 for PCI-P16POR16.
JP9 ~ JP16	Select the input AC or DC signals for D/I channel 8 ~ 15 for CN2.

■ PEX-P8POR8i/P16POR16i Board Layout

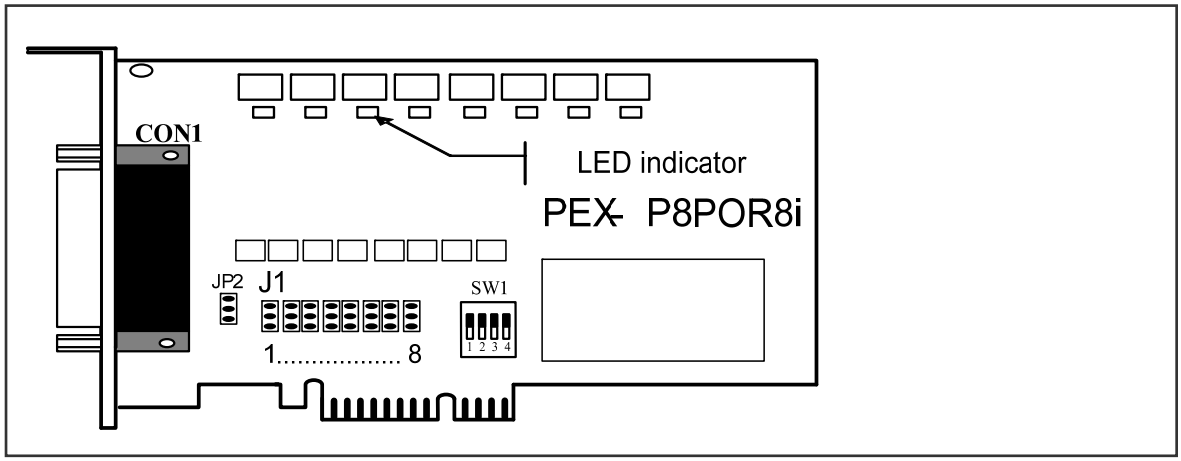


Figure 1-7: PEX-P8POR8i Board Layout

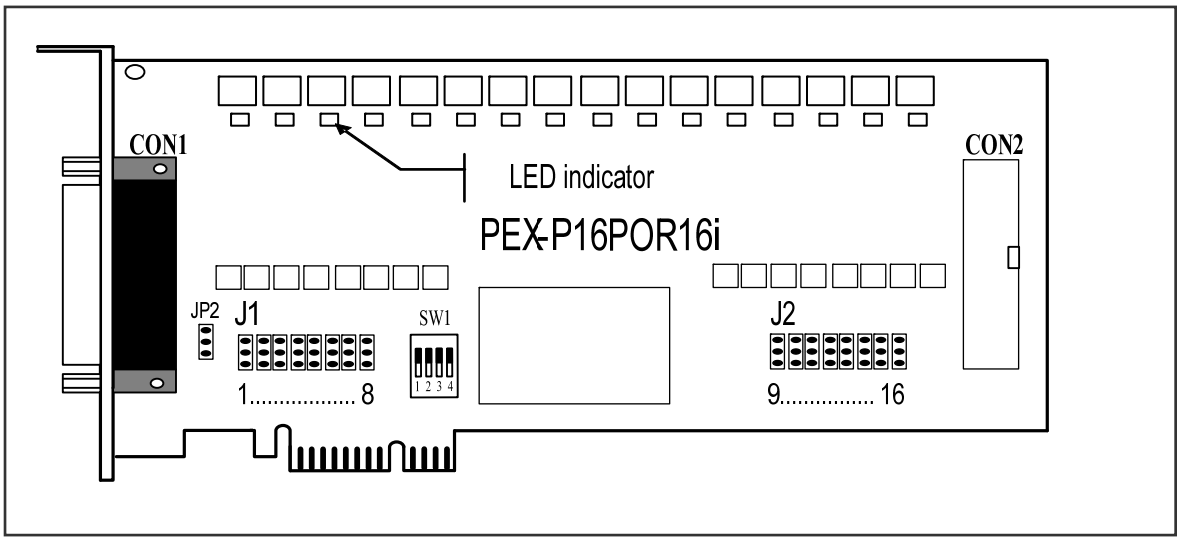


Figure 1-8: PEX-P16POR16i Board Layout

Note:

CON1	D/I/O channel 0~7 for PEX-P8POR8i/P16POR16i.
J1	Select the input type AC or DC signals for D/I channel 0 ~ 7.
CON2	D/I/O channel 8~15 for PEX-P16POR16i.
J2	Select the input type AC or DC signals for D/I channel 8 ~ 15.
JP2	Ground isolated protection
SW1	Card ID dip-switch

1.5.3 Jumper Settings

■ **Input signal type:**

You can change the I/O card configuration simply by setting the jumpers on this board. Each digital input channel can be jumper-configured as a single-pole, RC filter with a time constant of 1.2 ms. The Figure 1-9 , Figure 1-10 and Table 1-2 listed below shows each digital input channel and the corresponding jumper.

- **PCI-P8R8/P16R16/P16C16/P8POR8/P16POR16:**

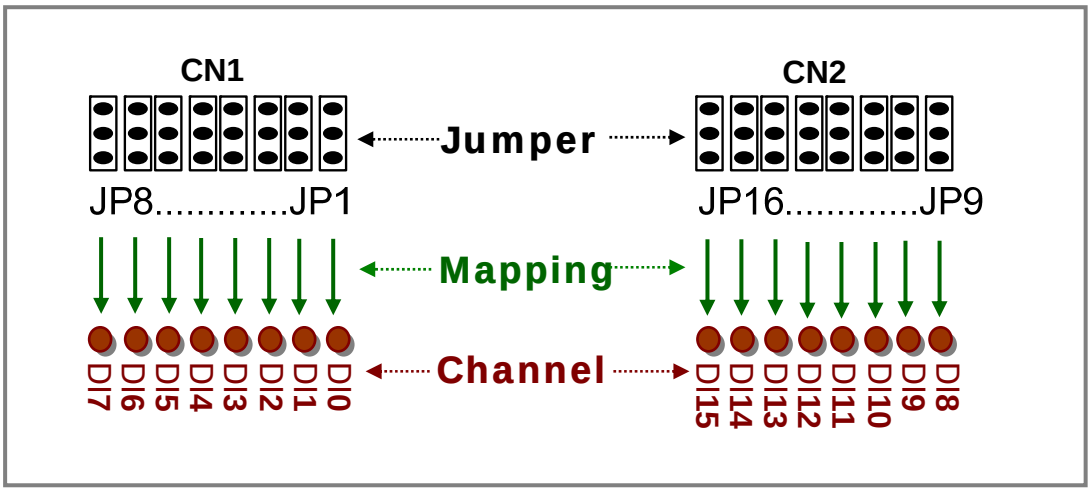


Figure 1-9: PCI Series Jumper Settings

- **PEX-P8POR8i/P16POR16i:**

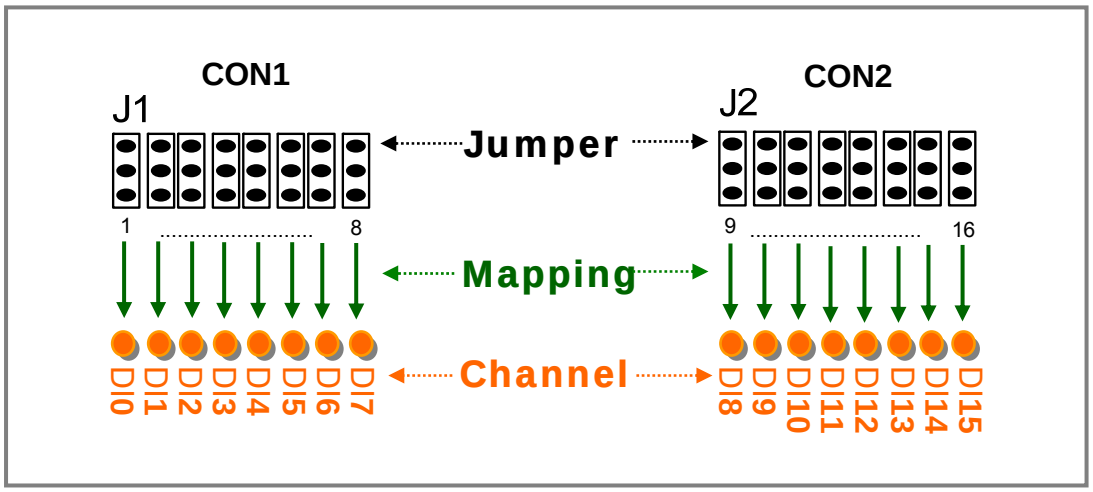


Figure 1-10: PEX Series Jumper Settings

- Jumper Mapping Digital Input Channel Table:

Jumper			Channel	Jumper			Channel
PCI series	PEX series			PCI series	PEX series		
JP1	J1	1	DI0	JP9	J2	9	DI8
JP2		2	DI1	JP10		10	DI9
JP3		3	DI2	JP11		11	DI10
JP4		4	DI3	JP12		12	DI11
JP5		5	DI4	JP13		13	DI12
JP6		6	DI5	JP14		14	DI13
JP7		7	DI6	JP15		15	DI14
JP8		8	DI7	JP16		16	DI15

Table 1-2: Jumper assignment

The figure below shows how to select the digital input type:

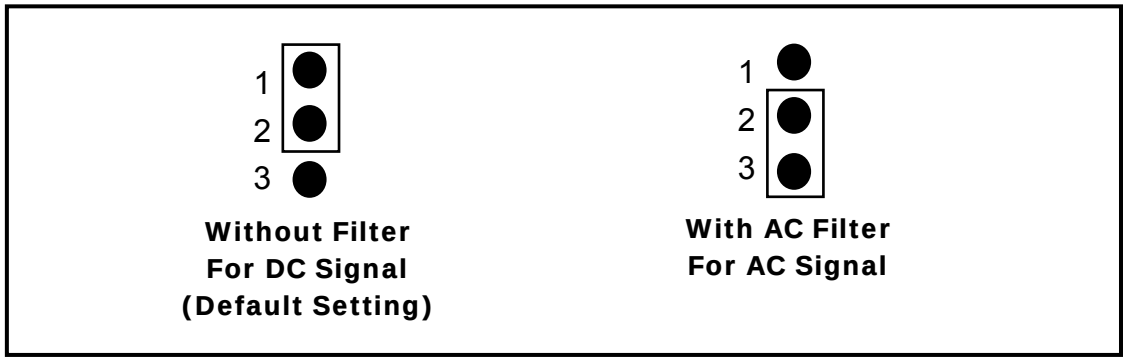


Figure 1-11: Jumper Settings

If you are using AC input signals, you must short AC FILTER pin2-3 of the corresponding jumpers. If you are using DC input signals, the AC FILTER is optional. If the DC input signal response is less than 20 μs, set the filter to off. If you want a slow response (about 5 to 10 ms) to reject either noise or contact bouncing, short AC FILTER Pin2-3.

- **JP2: Ground isolated protection jumper for PEX-P8POR8i/P16POR16i only**

This JP2 jumper is used to select the isolated or non-isolated of ground for PEX-P8POR8i/P16POR16i only. As shown in Figure 1-7, the user needs to connect Pin1-2 to obtain the ground isolation protection, which is the default setting. However, for the ground non-isolation, the Pin2-3 for the JP2 jumper should be connected.

The figure below shows how to select the ground isolation type:

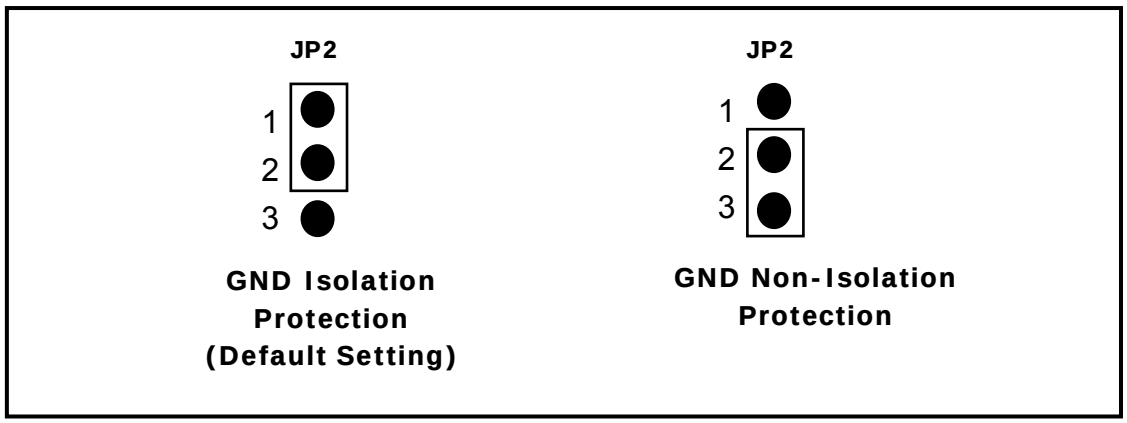
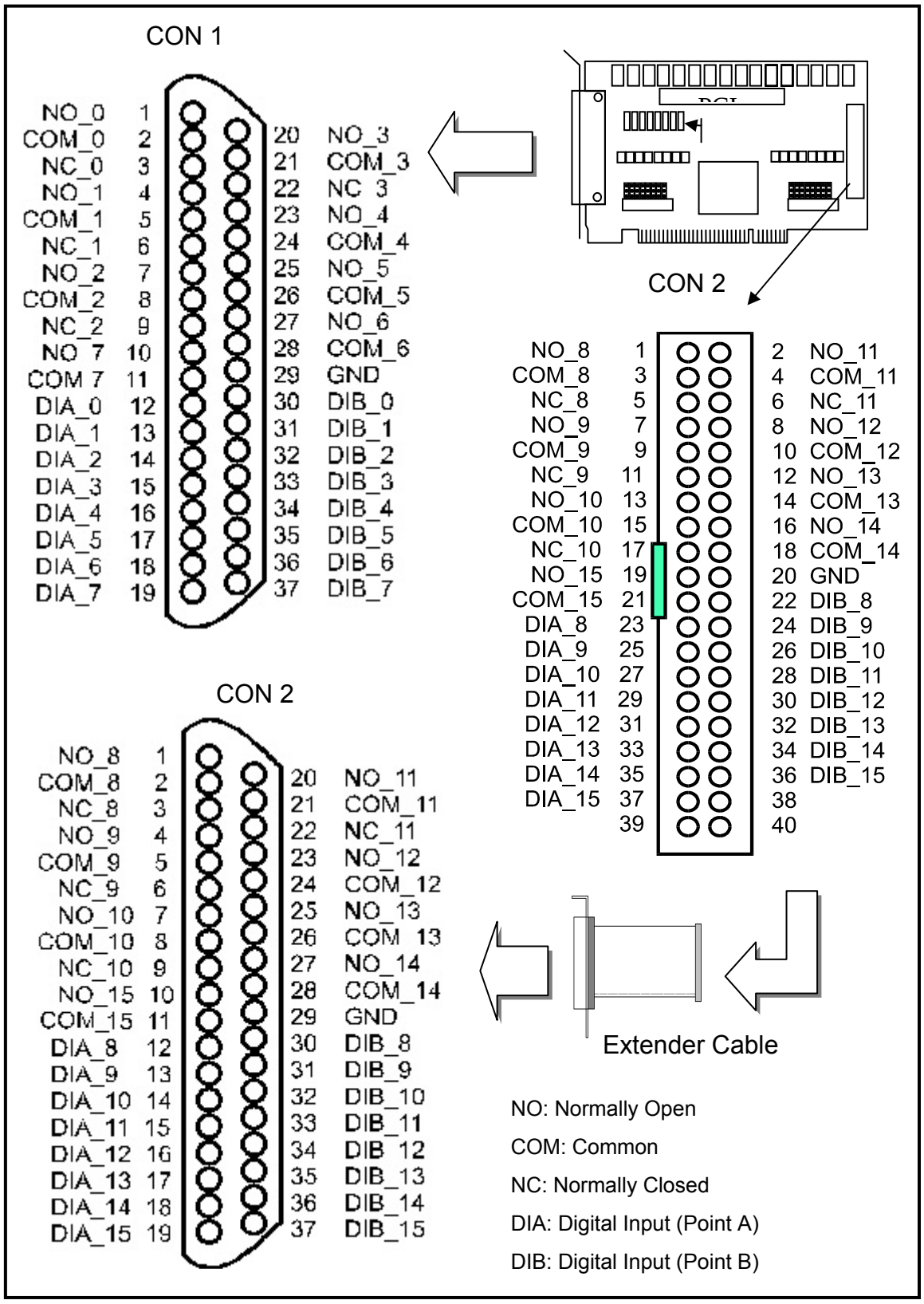


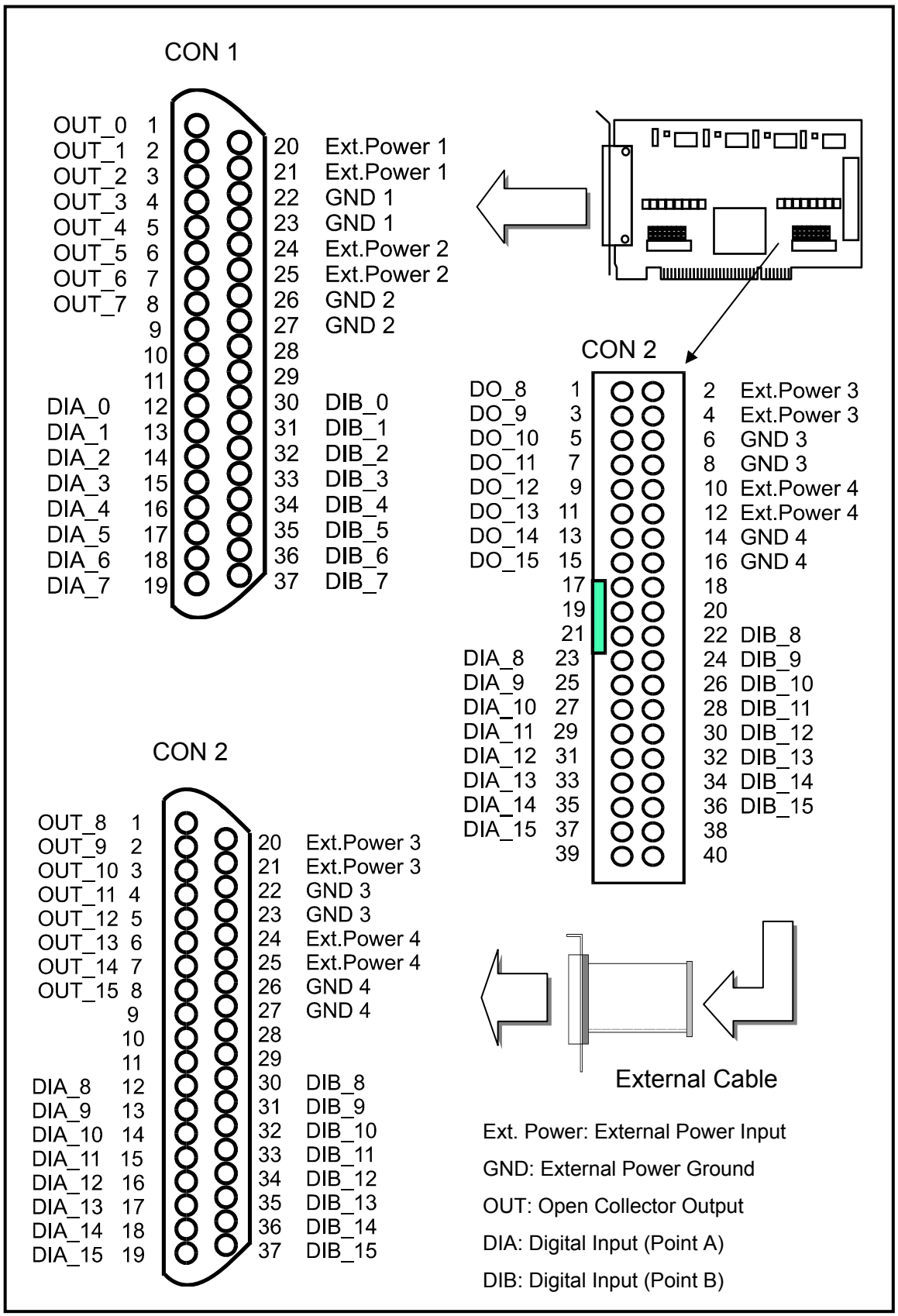
Figure 1-12: Jumper Settings

1.6 Pin Assignments

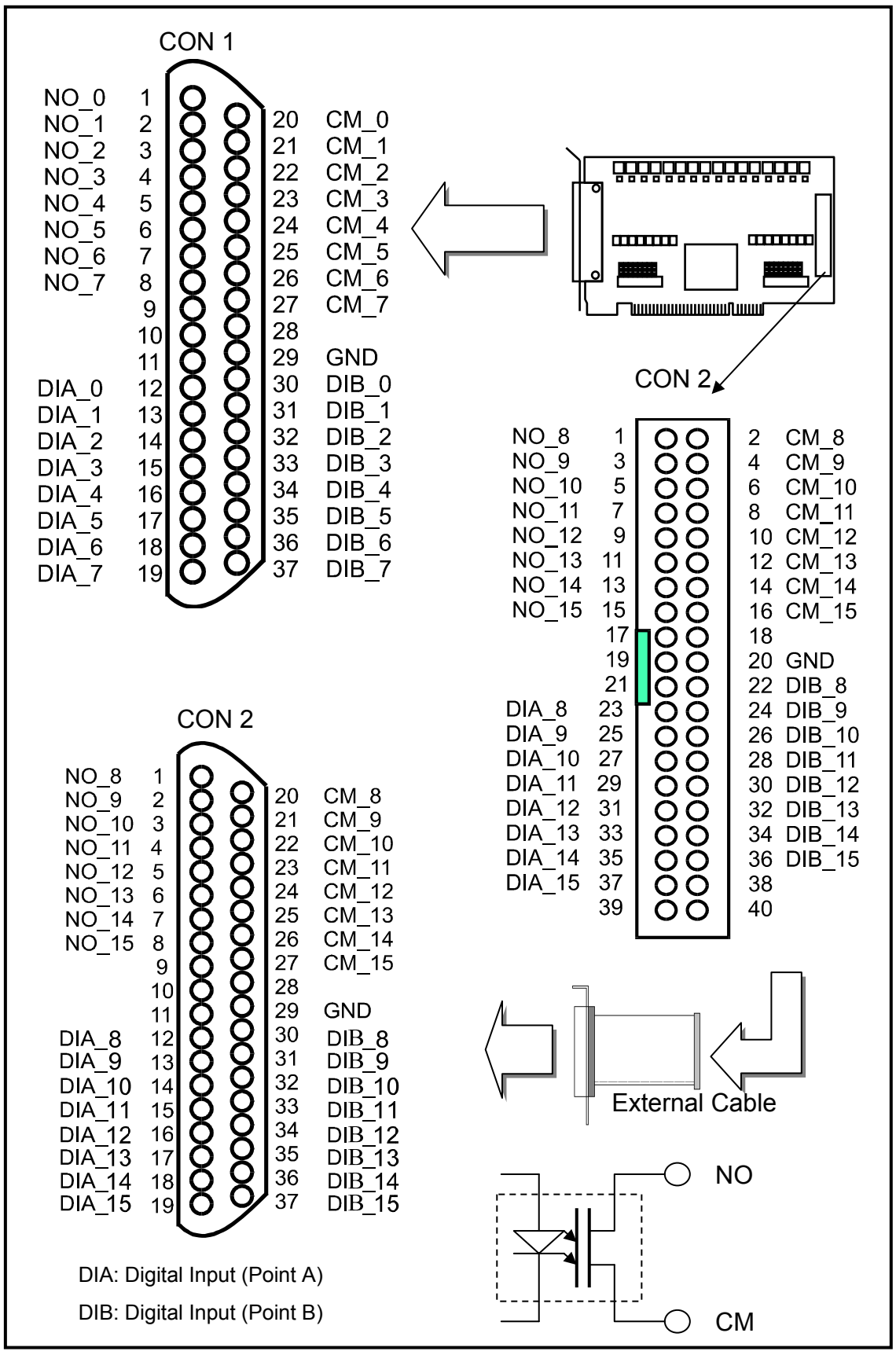
1.6.1 PCI-P8R8/P16R16



1.6.2 PCI-P16C16



1.6.3 PCI-P8POR8/P16POR16i and PEX-P8POR8i/P16POR16i



2 . Hardware Applications

Model Number	OUTPUT	INPUT
PCI-P8R8 PCI-P16R16	Relay Output	Optical isolation
PCI-P16C16	Transistor Output (Open Collector)	Optical isolation
PCI-P8POR8 PCI-P16POR16 PEX-P8POR8i PEX-P16POR16i	PhotoMos Relay Output	Optical isolation

2.1 Relay Output

- ***For PCI-P8R8/P16R16 Only***

Whenever data is written data to the output control register, the relays will switch to NC or NO as specified by the control code. A '1' in the control register will energize the corresponding relay. The relay will switch from COM to NO (normally open). A '0' in the control register will turn off the corresponding relay and the relay will be switch from COM to NC (normally closed). The control register powers-on in NC mode. Hardware reset signal or programmable reset signal will also turn the relay to NC. The following figures show how to use the relay.

Basic Circuitry: (Current Rating < 0.3 A):

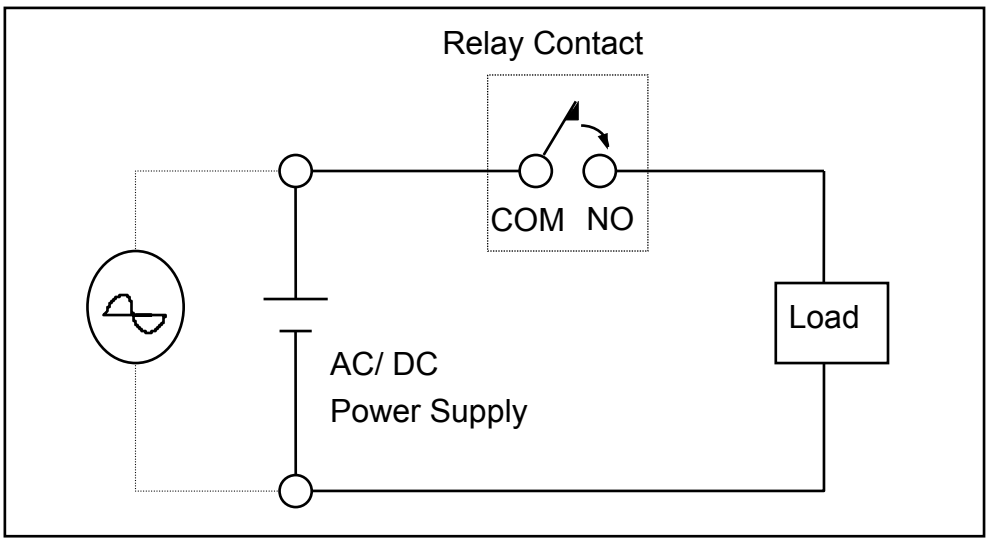


Figure 2-1: Basic Relay Circuit

Heavy Loading Application (> 0.3 A) :

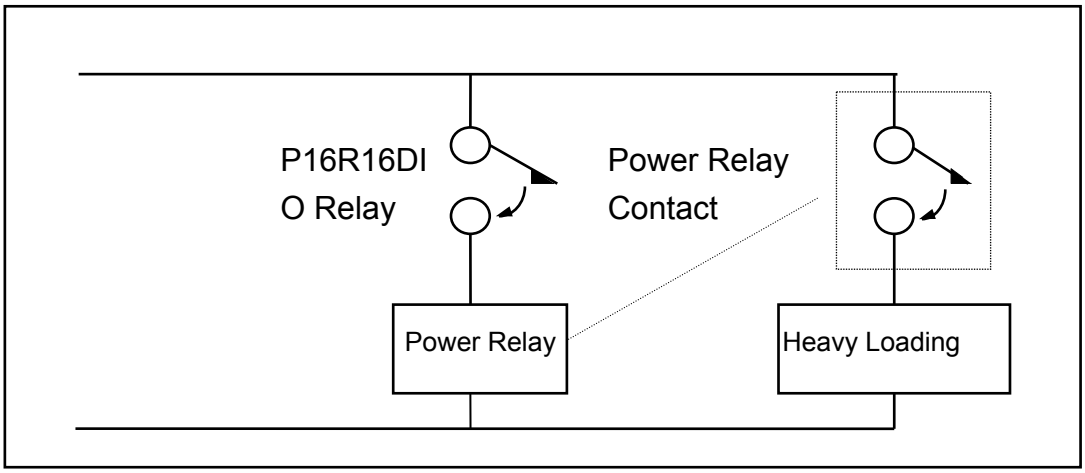
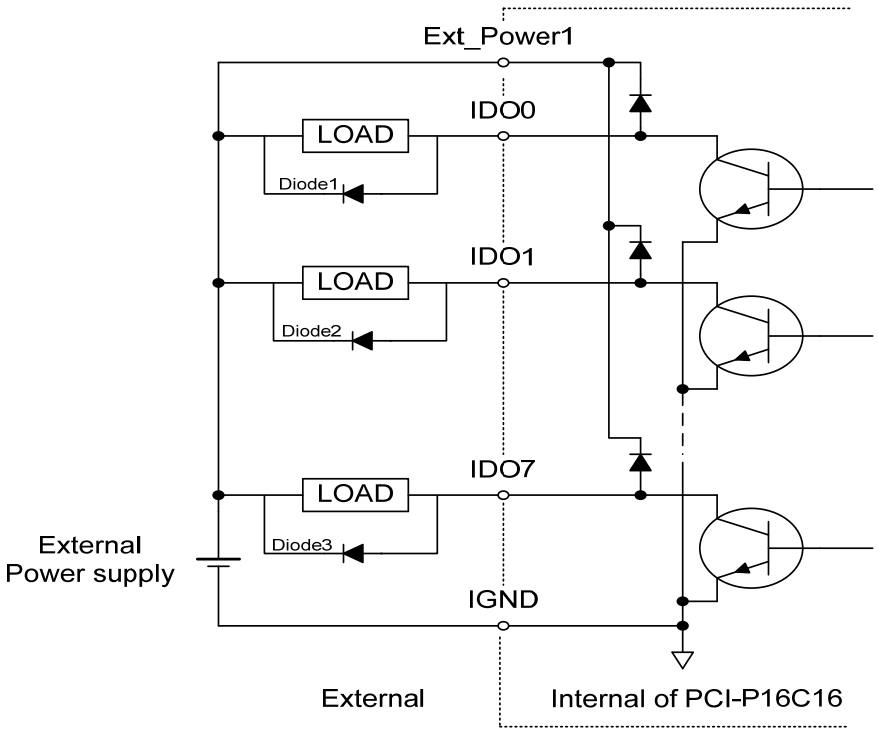


Figure 2-3. Heavy load relay circuit.

2.2 Open Collector Output

- ***For PCI-P16C16 Only***

The PCI-P16C16 provides 16-channel open collector outputs and 4 channels per common power. Each common power has designed fuse protection and LED indicated status.

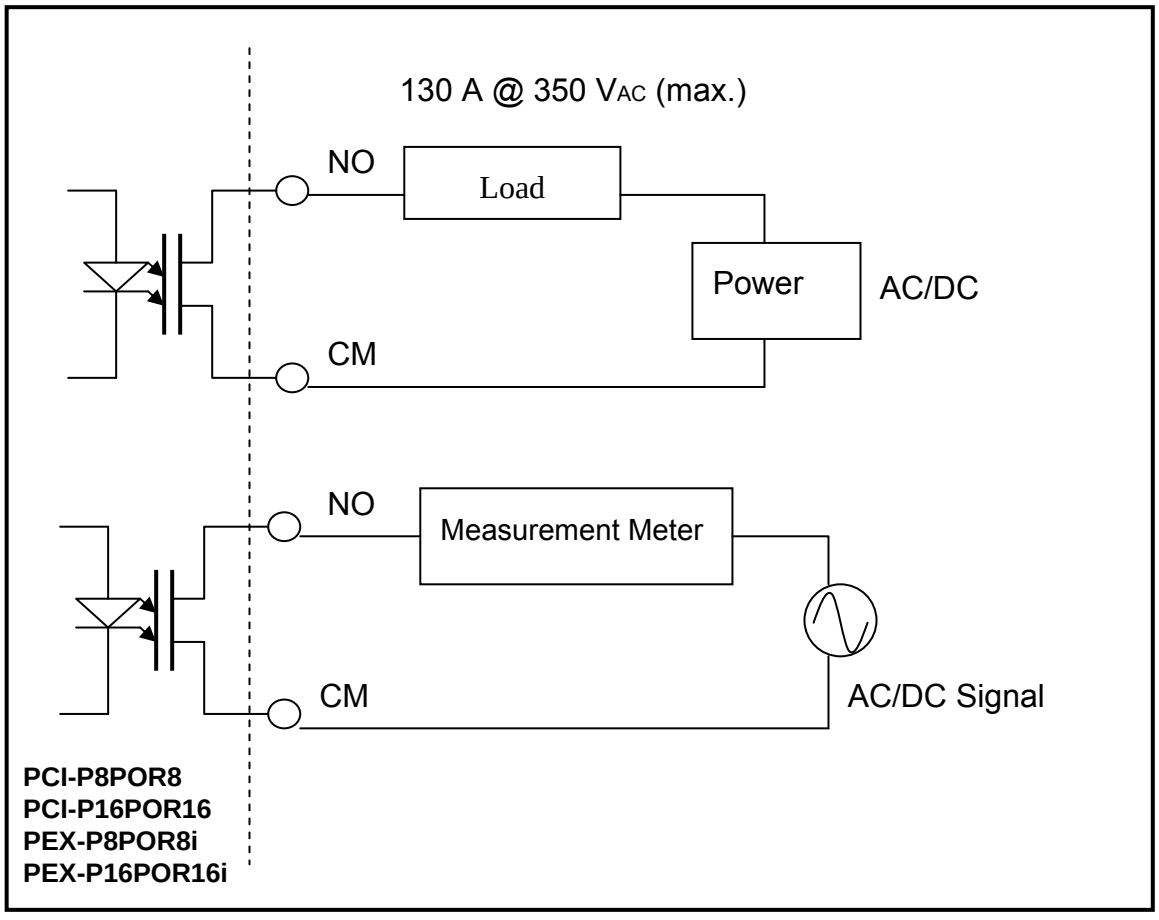


(Recommend : It Is necessary to connect a diode1 (..3..) . In the External Device end as means of preventing damage form the counter emf . If your Device Is Inductive Load , Ex. Relay ⋯)

2.3 PhotoMos Relay Output

- ***For PCI-P8POR8/P16POR16 and PEX-P8POR8i/P16POR16i Only***

The PCI-P8POR8/P16POR16 and PEX-P8POR8i/P16POR16i includes 8/16 normally open, form A, PhotoMOS relays. The board can eliminate ground-loop problems and isolate the computer from damaging voltages. Use the PCI-P8POR8/P16POR16 and PEX-P8POR8i/P16POR16i to switch loads, up to 350 V_{AC} and 130 mA.



2.4 Isolated Input

- ***For PCI-P8R8/P16R16/P16C16/P8POR8/P16POR16 and PEX-P8POR8i/P16POR16i***

Reading the isolation input register will give the digital input state of the photo-couple (isolation input). Figures 2-3 and 2-4 show the basic circuit of the digital input.

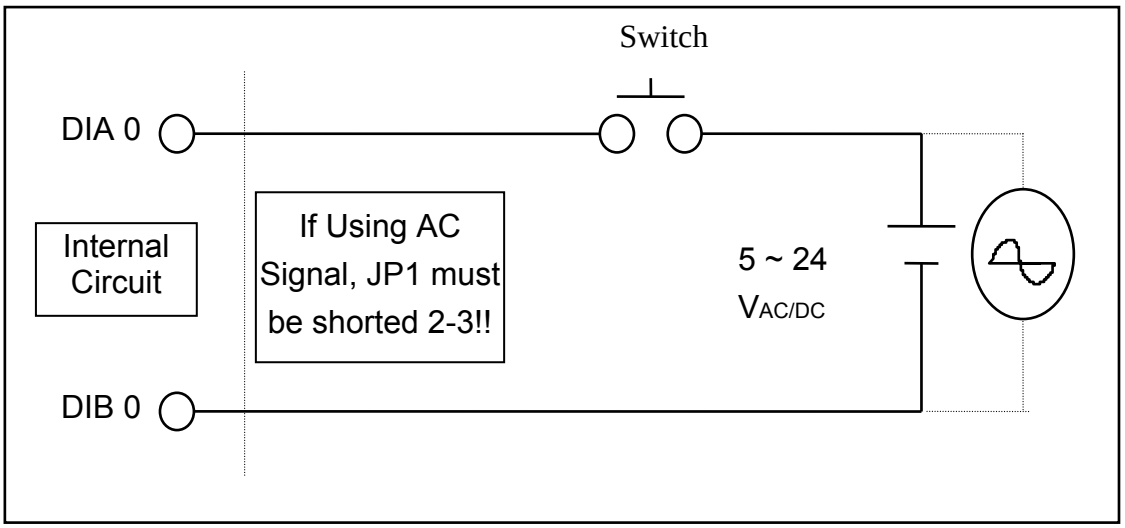


Figure 2-3. Basic Digital Input Circuit.

Although the normal input voltage range is 5 to 24 V_{AC} or V_{DC}, the input can still be changed to a larger range by choosing suitable external resistors. The following figure shows how to connect to a larger input. Please note that the input current should be limited between 2 mA to 20 mA; too large an input current will burn down the internal resistor Ri, while too low of an input current will not active the photo-coupler isolator. Calculate input voltage and current, then replace resister Ri.

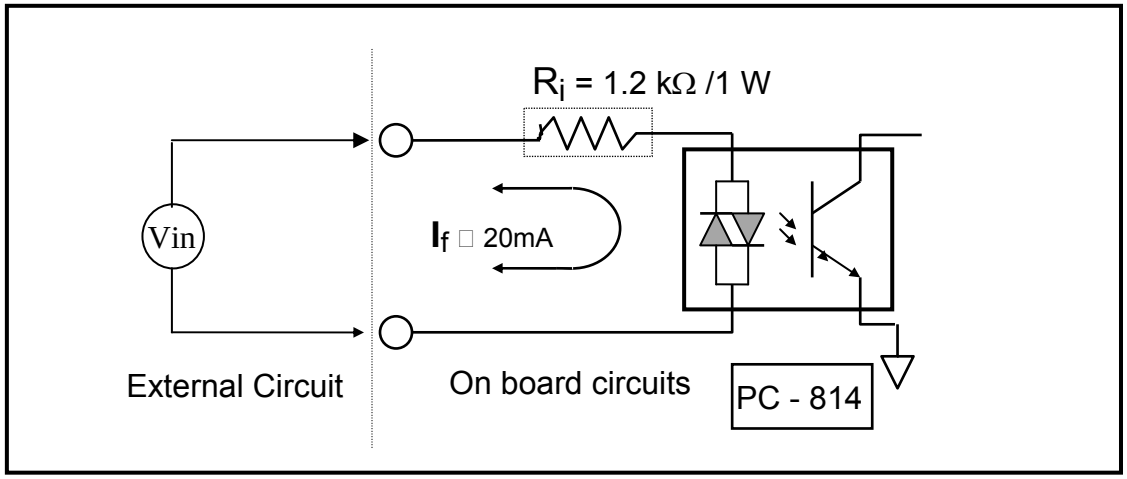


Figure 2-4. Isolated Digital Input

$$I_f = 2 \text{ mA} \sim 20 \text{ mA}$$

A rough estimate:

if Vin = 120 V and we ignore photo-coupler turn-on voltage.

We'll get:

Vin / I_f = Ri

Vin = 120(V) , I_f =10(mA) , Ri = Vin/ I_f

120(V) / 0.01 (A) = 12000 (Ω)

If you replace 12 kΩ as resistor Ri, we can calculate the power consumption of Ri as follows:

$P = I^2 R_{ex} = (10 \text{ mA})^2 * 12 \text{ K}\Omega = 1.2 \text{ W}$

The power consumption is 1.2 watts, but choosing 1.5 or 2 watts is better.
Thus, we can choose a 12 K/2 W resistor to replace the resistor Ri.

3 . Software Installation Guide

The PCI-P8R8/P16R16/P16C16/P8POR8/P16POR16 and PEX-P8POR8i/ P16POR16i series can be used in DOS and Windows 98/NT/2K and 32-bit/64-bit Windows XP/2003/Vista/7. The recommended installation procedure for windows is given in Sec. 3.1 ~ 3.2. Or refer to Quick Start Guide (CD:\NAPDOS\PCI\PCI-P16R16\ Manual\QuickStart\).
http://ftp.icpdas.com/pub/cd/iocard/pci/napdos/pci/pci-p16r16/manual/quickstart/

3.1 Software Installing Procedure

- UniDAQ SDK driver (32-bit/64-bit Windows XP/2003/Vista/7):

Step 1: Insert the companion CD into the CD-ROM drive and after a few seconds the installation program should start automatically. If it doesn't start automatically for some reason, double-click the **AUTO32.EXE** file in the **NAPDOS** folder on this CD.

Step 2: Click the item: "**PCI Bus DAQ Card**".

Step 3: Click the item: "**UniDAQ**".

Step 4: Click the item: "**DLL for Windows 2000 and XP/2003/Vista 32-bit**".

Step 5: Double-Click "**UniDAQ_Win_Setup_x.x.x.x_xxxx.exe**" file in the **Driver** folder.

- Windows driver (Windows 98/NT/2K and 32-bit Windows XP/2003/Vista/7):

Step 1: Insert the companion CD into the CD-ROM drive and after a few seconds the installation program should start automatically. If it doesn't start automatically for some reason, double-click the **AUTO32.EXE** file in the **NAPDOS** folder on this CD.

Step 2: Click the item: "**PCI Bus DAQ Card**".

Step 3: Click the item: "**PCI-P16R16/PCI-P8R8**".

Step 4: Click the item "**DLL and OCX for Windows 98/NT/2K/XP/2003**".

Step 5: Choose the Win2K_XP, Win98 or WinNT folders for setup according to your PC platform and then double-Click "**.exe**" to install driver.

The setup program will then start the driver installation and copy the relevant files to the specified directory and register the driver on your computer. The directory where the drive is stoned is different for different windows versions, as shown below.

- **Windows 64-bit Windows XP/2003/Vista/7:**

The UniDAQ.DLL file will be copied into the C:\WINNT\SYSTEM32 folder
The NAPWNT.SYS and UniDAQ.SYS files will be copied into the C:\WINNT\SYSTEM32\DRIVERS folder

For more detailed UniDAQ.DLL function information, please refer to UniDAQ SDK user manual (CD:\NAPDOS\PCI\UniDAQ\Manual\)**.** http://ftp.icpdas.com/pub/cd/iocard/pci/napdos/pci/unidaq/maunal/

- **Windows NT/2K and 32-bit Windows XP/2003/Vista/7:**

The P16R16.DLL file will be copied into the C:\WINNT\SYSTEM32 folder
The NAPWNT.SYS and P16R16.SYS files will be copied into the C:\WINNT\SYSTEM32\DRIVERS folder

- **Windows 95/98/ME:**

The P16R16.DLL and Nappci.Vxd files will be copied into the C:\Windows\SYSTEM folder

For more detailed P16R16.DLL function information, please refer to "PCI-P16R16 Series Software Manual.pdf" (CD:\NAPDOS\PCI\PCI-P16R16\Manual\)**.** http://ftp.icpdas.com/pub/cd/iocard/pci/napdos/pci/pci-p16r16/manual/

3.2 PnP Driver Installation

Power off the computer and install the PCI-P8R8/P16R16/P16C16/ P8POR8P16POR16 and PEX-P8POR8i/P16POR16i cards. Turn on the computer and Windows 98/ME/2K and 32-bit/64-bit Windows XP/2003/Vista/7 should automatically defect the new PCI device(s) and then ask for the location of the driver files for the hardware. If a problem is encountered during installation, refer to the PCI-P16R16_PnP_Driver_Installation.pdf (CD:\NAPDOS\PCI\PCI-P16R16\Manual\) for more information.

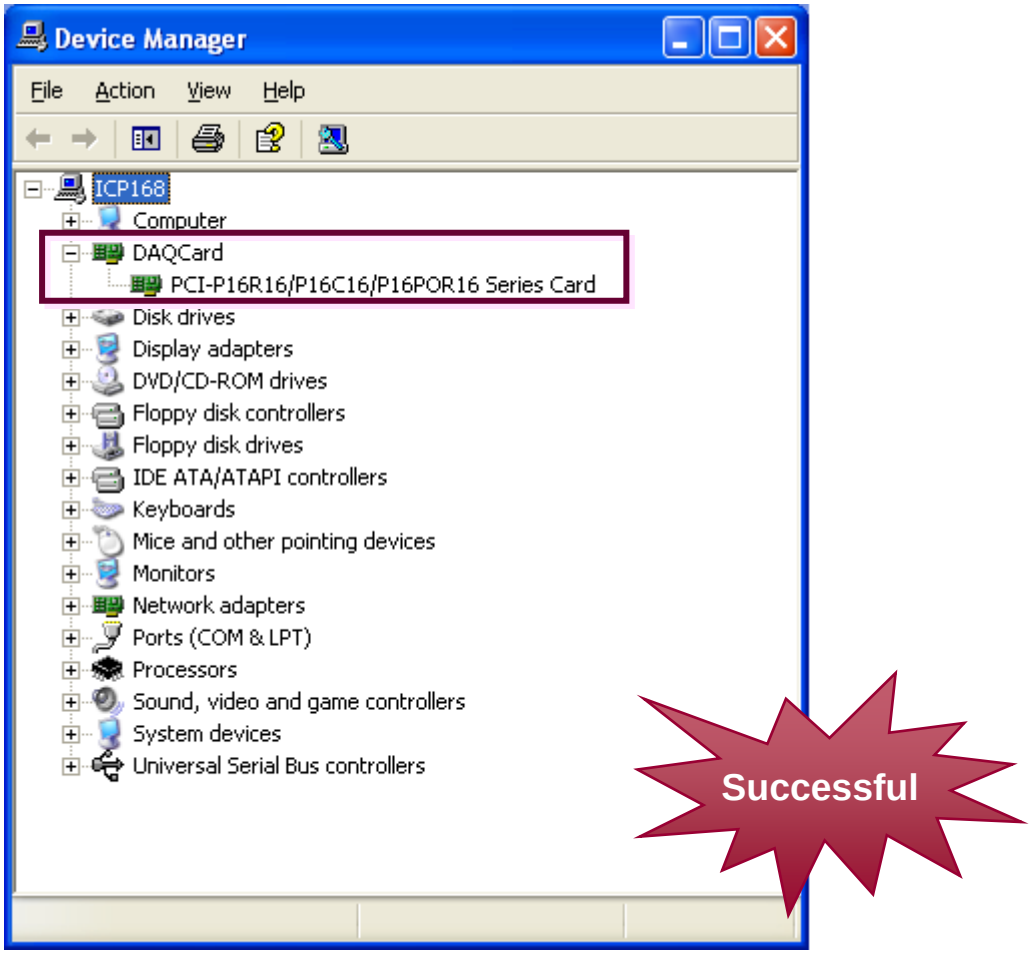
3.3 Confirm the Successful Installation

Make sure the PCI-P8R8/P16R16/P16C16/P8POR8P16POR16 and PEX-P8POR8i/P16POR16i card installed are correct on the computer as follows:

Step 1: Select **"Start"** → **"Control Panel"** and then double click the **"System"** icon on Windows.

Step 2: Click the **"Hardware"** tab and then click the **"Device Manager"** button.

Step 3: Check the PCI-P8R8/P16R16/P16C16/ P8POR8P16POR16 and PEX-P8POR8i/P16POR16i card which listed correctly or not, as illustrated below.



4 . I/O Control Register

4.1 How to find the I/O Address

The Plug&Play BISO assigns a proper I/O address to every PCI-P8R8/P16R16/ P16C16/P8R8/P16POR16 and PEX-P8POR8i/P16POR16i card in the power-on stage. The IDs of PCI-P8R8/P16R16/ P16C16/P8R8/P16POR16 and PEX-P8POR8i/P16POR16i are as follows:

Model Name	PCI-P8R8 PCI-P8POR8 PEX-P8POR8i	PCI-P16R16 PCI-P16C16 PCI-P16POR16 PEX-P16POR16i
Vendor ID	0x1234	0x1234
Device ID	0x0808	0x1616
Sub Vendor ID	0x0000	0x0000
Sub Device ID	0x0000	0x0000

We provide the following necessary functions:

1. PCI_DriverInit (&wBoards)

This function detects how many PCI-P8R8/P16R16 series cards are installed in the system, and also records all their I/O resources information in the library. The function is implemented based on the PCI Plug & Play mechanism. Please refer to “PCI-P16R16 Series Software Manual”.

2. PCI_GetConfigAddressSpace(wBoards, &wTypeID, &wAddress0, &wAddress1, &wAddress2, &wAddress3,&wAddress4,&wAddress5);

Use this function to get I/O resources information of a PCI-P8R8/P16R16 series card installed in this system. Then the application program can control all functions of PCI-P8R8/P16R16 series card directly. Please refer to “PCI-P16R16 Series Software Manual”.

Note: The PCI-P8R8/P16R16 series card is to use the BAR 2 (&wAddress2) to control all functions, please refer to Sec. 4.2 The I/O Address Map.

The First 16 double words of a PCI device's configuration space are referred to as the device's configuration region. Within these the 16 (0-15) double words, the 04, 05, 06, 07, 08 and 09 double words are referred to as Base Address0, Base Address1, Base Address2, Base Address3, Base Address4 and Base Address5. For more detailed information for about these 16 double words, please referring the book titled ***PLUG AND PLAY SYSTEM ARCHITECTURE*** (written by Tom Shanley, Addison-Wesley Publish Company, 1995). These base addresses are utilized as control register and/or I/O register for many data acquisition boards. On PCI-P16R16 and PCI-P8R8 series boards, the base address2 is utilized as the base address of digital input and digital output. So the Digital I/O functions for PCI-P16R16 and PCI-P8R8 series are coded as follows:

```
#define WORD    unsigned int
#define UCHAR  unsigned char
void   P16R16_DO(WORD BaseAddr, WORD wOutData)
{
    outport(BaseAddr,wOutData);
}
WORD   P16R16_DI(WORD BaseAddr)
{
     WORD DigitalIn;
   DigitalIn=inport(BaseAddr);
   return DigitalIn;
}
void   P8R8_DO(WORD BaseAddr, WORD wOutData)
{
    outportb(BaseAddr,wOutData);
}
UCHAR  P8R8_DI(WORD BaseAddr)
{
   UCHAR DigitalIn;
   DigitalIn=inportb(BaseAddr);
   return DigitalIn;
}
```

Please refer to the following program code to get these six base addresses for PCI-P16R16 and PCI-P8R8. These codes are based on PCI ***Plug & Play*** mechanism 2.

```
/*******************************************************/
/* Reading PCI card's configuration address space      */
/*******************************************************/
WORD   GetAddress(void)
{
 DWORD   dConfigAddress,dBaseAddress;
 WORD    HiWord,LoWord;
 WORD    ReturnCode;
 UCHAR   Bus,Device,Function,WhichLong;
 WORD    VendorID,DeviceID;
 WORD    wIrqNumber;

 wTotalBoards=0;   /* initial board number is 0 */
 Bus=0;
 for(Bus=0; Bus<10;  Bus++)
 {
  Function=0;
  WhichLong=1;
  for(Device=0;  Device<32;  Device++)
  {
    WhichLong=0;
    WriteAddress(Bus,Device,Function,WhichLong);
    VendorID=inport(0xcfc);
    DeviceID=inport(0xcfe);

    if( VendorID==0x1234 && DeviceID==0x1616 )
    {  /*---------- PCI-P16R16 -------------*
     WhichLong=4;     // Base Address 0
          WriteAddress(Bus,Device,Function,WhichLong);
     dBaseAddress=_inpd(0xcfc);
          wBaseAddr0=(WORD)(dBaseAddress&0xfffe);
           wConfigSpace[wTotalBoards][0]=wBaseAddr0;
```

```
        /*---------------------------------------*/
    WhichLong=5;       /* Base Address 1 */
    WriteAddress(Bus,Device,Function,WhichLong);
    dBaseAddress=_inpd(0xcfc);
    wBaseAddr1=(WORD)(dBaseAddress&0xfffe);
    wConfigSpace[wTotalBoards][1]=wBaseAddr1;

/*---------------------------------------*/
      WhichLong=6;     /* Base Address 2 */
WriteAddress(Bus,Device,Function,WhichLong);
      dBaseAddress=_inpd(0xcfc);
wBaseAddr2=(WORD)(dBaseAddress&0xfffe);
      wConfigSpace[wTotalBoards][2]=wBaseAddr2;

      /*---------------------------------------*/
WhichLong=7;    /* Base Address 3 */
      WriteAddress(Bus,Device,Function,WhichLong);
dBaseAddress=_inpd(0xcfc);
      wBaseAddr3=(WORD)(dBaseAddress&0xfffe);
wConfigSpace[wTotalBoards][3]=wBaseAddr3;

      /*---------------------------------------*/
WhichLong=8;     /* Base Address 4 */
      WriteAddress(Bus,Device,Function,WhichLong);
dBaseAddress=_inpd(0xcfc);
      wBaseAddr4=(WORD)(dBaseAddress&0xfffe);
wConfigSpace[wTotalBoards][4]=wBaseAddr4;

      /*---------------------------------------*/
WhichLong=9;     /* Base Address 5 */
      WriteAddress(Bus,Device,Function,WhichLong);
dBaseAddress=_inpd(0xcfc);
      wBaseAddr5=(WORD)(dBaseAddress&0xfffe);
wConfigSpace[wTotalBoards][5]=wBaseAddr5;

      /*---------- store the type name ID --------*/
wConfigSpace[wTotalBoards][6]=TYPE_P16R16;
```

```
        /*----------------------------------------*/
  wTotalBoards++;  /* increment board number */
  wGetAddress=1;
 }

 if( VendorID==0x1234 && DeviceID==0x0808 )
 {  /*---------- PCI-P8R8 -----------*/
        WhichLong=4;     /* Base Address 0 */
  WriteAddress(Bus,Device,Function,WhichLong);
        dBaseAddress=_inpd(0xcfc);
  wBaseAddr0=(WORD)(dBaseAddress&0xfffe);
        wConfigSpace[wTotalBoards][0]=wBaseAddr0;

  /*----------------------------------------*/
        WhichLong=5;     /* Base Address 1 */
  WriteAddress(Bus,Device,Function,WhichLong);
        dBaseAddress=_inpd(0xcfc);
  wBaseAddr1=(WORD)(dBaseAddress&0xfffe);
        wConfigSpace[wTotalBoards][1]=wBaseAddr1;

  /*----------------------------------------*/
        WhichLong=6;     /* Base Address 2 */
  WriteAddress(Bus,Device,Function,WhichLong);
        dBaseAddress=_inpd(0xcfc);
  wBaseAddr2=(WORD)(dBaseAddress&0xfffe);
        wConfigSpace[wTotalBoards][2]=wBaseAddr2;

  /*----------------------------------------*/
        WhichLong=7;    /* Base Address 3 */
  WriteAddress(Bus,Device,Function,WhichLong);
        dBaseAddress=_inpd(0xcfc);
  wBaseAddr3=(WORD)(dBaseAddress&0xfffe);
        wConfigSpace[wTotalBoards][3]=wBaseAddr3;

  /*----------------------------------------*/
        WhichLong=8;     /* Base Address 4 */
  WriteAddress(Bus,Device,Function,WhichLong);
  dBaseAddress=_inpd(0xcfc);
   wBaseAddr4=(WORD)(dBaseAddress&0xfffe);
  wConfigSpace[wTotalBoards][4]=wBaseAddr4;
```

```
            /*----------------------------------------*/
            WhichLong=9;      /* Base Address 5 */
        WriteAddress(Bus,Device,Function,WhichLong);
        dBaseAddress=_inpd(0xcfc);
             wBaseAddr5=(WORD)(dBaseAddress&0xfffe);
            wConfigSpace[wTotalBoards][5]=wBaseAddr5;

            /*---------- store the type name ID --------*/
             wConfigSpace[wTotalBoards][6]=TYPE_P8R8;

        wTotalBoards++;  /* increment board number */
             wGetAddress=1;
      }
    }
  }
   if( wTotalBoards>16 )
     return( NotFoundBoard );
   else
     return( NoError );
}

void  WriteAddress(UCHAR bBus, UCHAR bDevice, UCHAR bFunction, UCHAR
bWhichLong)
{
   DWORD   dOutData;
   WORD    HiWord,LoWord;
   UCHAR    HiByte,LoByte;

   HiWord=0x8000|bBus;
   HiByte=(bDevice<<3)|bFunction;
   LoByte=(bWhichLong<<2) & 0xfc;
   LoWord=( (WORD)HiByte<<8 )|LoByte;
   dOutData=( (DWORD)HiWord<<16 ) | LoWord;
   _outpd(0xcf8,dOutData);
}
```

4.2 The I/O Address Map

The I/O address for PIO/PISO series cards is automatically assigned by the ROM BIOS of the main board. The I/O address can also be re-assigned by user. **It is strongly recommended that users don't change the I/O address. The Plug & Play BIOS will assign the proper I/O address to each PIO/PISO series card.** The detailed I/O register address mapping for the PCI-P8R8/P16R16/P16C16/P8POR8/P16POR16 and PEX-P8POR8i/P16POR16i card is as follows:

BAR 2: DI/DO Register

Bar No.	Offset	Register Function Script		
		Name	Operation	Access
2 (DIO)	0x00	DI Port	R	16-bit
	0x00	DO Port	W	16-bit
	0x0C	Read D/O Readback	R	16-bit
	0x3C	Read Card ID	R	16-bit

4.2.1 Digital Output/Digital Input

The sample code of DI/DO is given as follows:

```
// DI/DO function of PCI-P16R16/P16C16/P16POR16 and PEX-P16POR16i series
void   P16R16_DO(WORD BaseAddr, WORD wOutData)
{
    outport (BaseAddr, wOutData);
}

WORD   P16R16_DI(WORD BaseAddr)
{
     DigitalIn=inportb(BaseAddr);
 }

// DI/DO function of PCI-P8R8 /P8POR8 and PEX-P8POR8i series
void   P8R8_DO(WORD BaseAddr, WORD wOutData)
{
    outportb(BaseAddr, wOutData);
}
```

```
UCHAR  P8R8_DI(WORD BaseAddr)
{
   DigitalIn=inportb(BaseAddr);
}
```

4.2.2 D/O Readback Register

The format of the D/O readback register is given as follows:

BaseAddr +0x0C

Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0

The sample code of reading the given as follows:

```
// D/O Readback function of PEX-P8POR8i and PEX-P16POR16i

      DigitalIn=inportb(BaseAddr+0x0C);
```

4.2.3 Card ID Register

The format of the Card ID register is given as follows:

BaseAddr +0x3C

X	X	X	X	Bit3	Bit2	Bit1	Bit0

It can be used to read the card ID set from SW1 switch

The sample code of reading the given as follows:

```
// Card ID function of PEX-P8POR8i and PEX-P16POR16i

       *wID=inportb(BaseAddr+ 0x3C)&0x000f;
```

Note:

1. **Refer to Sec. 4.1 for more information regarding BaseAddr.**
2. **The Card ID and D/O Readback function is only supported by the PEX-P8POR8i and PEX-P16POR16i (Ver1.0 or above)**

5 Demo Programs

5.1 Demo Programs for Windows

Please note that none of the demo programs will work normally if the DLL driver has not been installed correctly. During the DLL driver installation process, the install shield will register the correct kernel driver to the operating system and copy the DLL driver and demo programs to the correct location depending on the driver software package you have selected (Win98/Me/NT/2000 and 32-bit Win XP/2003/Visa/7). After installing the driver, the related demo programs, development library and declaration header files for the different development environments will be available in the following folders.

The demo program is contained in:

CD:\NAPDOS\PCI\PCI-P16R16\DLL_OCX\Demo\
http://ftp.icpdas.com/pub/cd/iocard/pci/napdos/pci/pci-p16r16/dll_ocx/demo/

- BCB 3 → For Borland C++ Builder 3
  P16R16.H → Header files
  P16R16.LIB → Linkage library for BCB
- Delphi3 → For Delphi 3
  P16R16.PAS → Declaration files
- VB6 → For Visual Basic 6
  P16R16.BAS → Declaration files
- VC6 → For Visual C++ 6
  P16R16.H → Header files
  P16R16.LIB → Linkage library for VC6
- VB.NET2005 → For VB.NET2005
  P16R16.vb → Declaration files
- CSharp2005 → For C#.NET2005
  P16R16.cs → Declaration files

A list of available demo programs is as follows:

- DIO: D/I/O demo

5.2 Demo Programs for DOS

The related DOS software and demos are located on the CD as below:

CD:\NAPDOS\PCI\PCI-P16R16\dos\
http://ftp.icpdas.com/pub/cd/iocard/pci/napdos/pci/pci-p16r16/dos/

After installing the software, the following drivers will be installed onto your hard disk:

- Demo code, Lib for Borland C++
  ...\P16R16\BC\HUGE\DEMO → huge mode demo programs.
  ...\P16R16\BC\HUGE\LIB → huge mode library, P16R16H.LIB
  ...\P16R16\BC\LARGE\DEMO → large mode demo programs
  ...\P16R16\BC\LARGE\LIB → large mode library, P16R16L.LIB

- Demo code, Lib for MSC
  ...\P16R16\MSC\HUGE\DEMO → huge mode demo programs
  ...\P16R16\MSC\HUGE\LIB → huge mode library, P16R16H.LIB
  ...\P16R16\MSC\LARGE\DEMO → large mode demo programs
  ...\P16R16\MSC\LARGE\LIB → large mode library, P16R16L.LIB

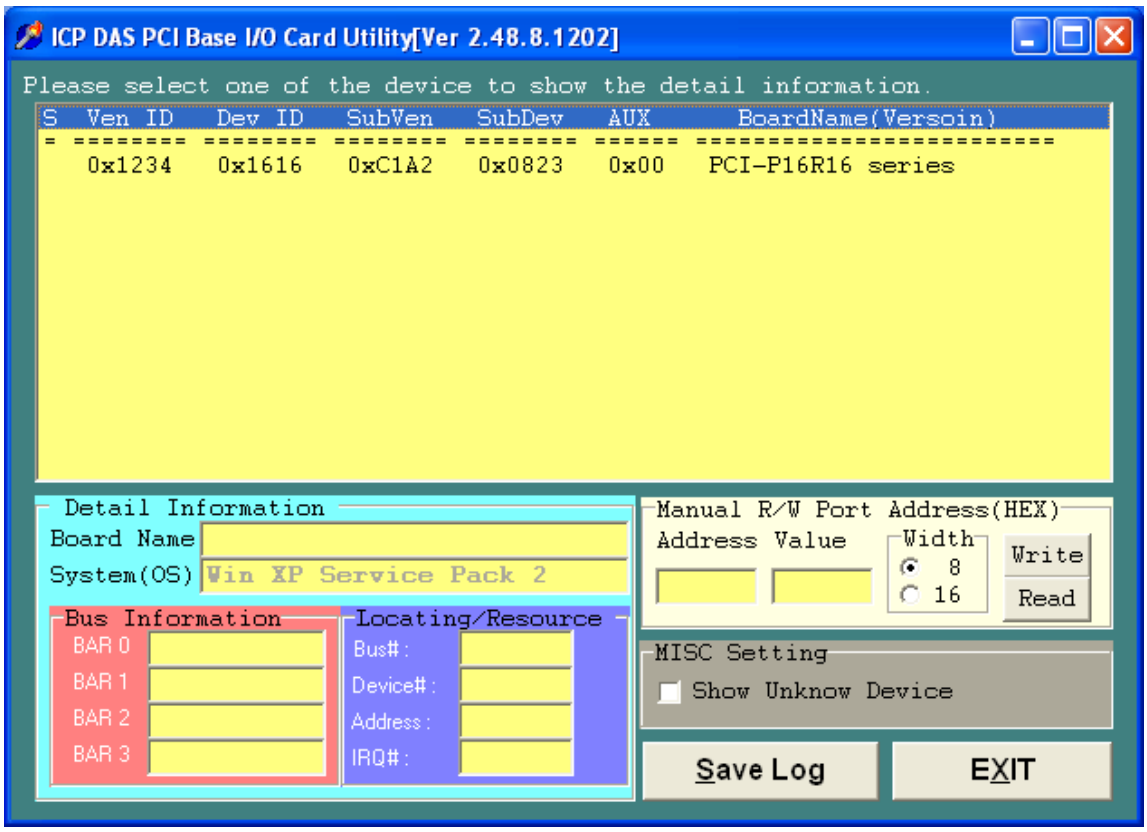
- Demo code, Lib for TC
  ...\P16R16\TC\HUGE\DEMO → huge mode demo programs
  ...\P16R16\TC\HUGE\LIB → huge mdoe library, P16R16H.LIB
  ...\P16R16\TC\LARGE\DEMO → large mode demo programs
  ...\P16R16\TC\LARGE\LIB → large mode library, P16R16H.LIB

Please see readme.txt in sub-directory of DEMO and LIB for further information.

5.3 PIO_PISO.EXE for Windows

The PIO_PISO.exe utility is located on the CD as below and is useful for all PIO/PISO series cards.
CD:\NAPDOS\PCI\Utility\Win32\PIO_PISO\
http://ftp.icpdas.com/pub/cd/iocard/pci/napdos/pci/utility/win32/pio_piso/

After executing the utility, detailed information for all PIO/PISO cards that are installed in the PC will be shown, as illustrated below:



Note: The PIO_PISO.EXE application is valid for all PIO/PISO cards. The user can execute the PIO_PISO.EXE file to retrieve the following information:

- List all PIO/PISO cards installed in the PC
- List the resources allocated to each PIO/PISO card
- List the wSlotBus and wSlotDevice details for identification of specific PIO/PISO cards. (Refer to Sec. 4.1 for more information)