PCI-P16R16 Series Cards User Manual

Isolated Digital Input/Output Cards Version 3.2, Oct. 2015

SUPPORT

This manual relates to the following boards: PCI-P8R8, PCI-P8R8U, PCI-P16R16, PCI-P16R16U, PCI-P16C16, PCI-P16C16U, PCI-P16POR16, PCI-P16POR16U, PEX-P8POR8i and PEX-P16POR16i.

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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CONTACT US

If you have any questions, feel to contact us by email at:
service@icpdas.com or service.icpdas@gmail.com
We will respond to you within 2 working days.

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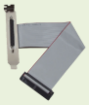
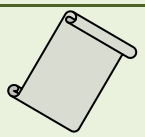
Packing List

The shipping package should contain the following items:

	One of the following PCI cards: PCI-P8R8 PEX-P8POR8i PCI-P8R8U	PCI-P16R16 PCI-P16R16U PCI-P16C16 PCI-P16C16U PCI-P16POR16 PCI-P16POR16U PEX-P16POR16i
	One CA-4002 D-sub connector	Two CA-4002 D-sub Connectors
	-	One CA-4037W Cable
	One printed Quick Start Guide	
	One Software Utility CD	

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

Related Information

- For more information related to individual cards, refer to the Product Page on the ICP DAS website for the respective device.

  PCI-P16POR16/P16POR16U and PEX-P16POR16i/PEX-P8POR8i:
  http://www.icpdas.com/root/product/solutions/pc_based_io_board/pci/pci-p16por16.html

  PCI-P16C16/P16C16U:
  http://www.icpdas.com/root/product/solutions/pc_based_io_board/pci/pci-p16c16.html

  PCI- PCI-P8R8/P8R8U/P16R16/P16R16U/:
  http://www.icpdas.com/root/product/solutions/pc_based_io_board/pci/pci-p8r8.html

- More information related to the Hardware Manual, Datasheet and QuickStart of PCI-P16R16 Series cards can be found in the \NAPDOS\PCI\PCI-P16R16\Manual\ folder on the companion CD, or can be downloaded from:
  http://ftp.icpdas.com/pub/cd/iocard/pci/napdos/pci/pci-p16r16/manual/

- The drivers for use with **Windows NT/95/98 and 32-bit version of Windows** can be found in the \NAPDOS\PCI\PCI-P16R16\DLL_OCX\ folder on the companion CD, or can be downloaded from:
  http://ftp.icpdas.com/pub/cd/iocard/pci/napdos/pci/pci-p16r16/dll_ocx/

- The User Manual for the Classic Driver for PCI-P16R16 Series Cards can be found in the \NAPDOS\PCI\PCI-P16R16\Manual\ folder on the companion CD, or can be downloaded from:
  http://ftp.icpdas.com/pub/cd/iocard/pci/napdos/pci/pci-p16r16/manual/

- More information related to the **UniDAQ SDK Driver for 64-bit version of Windows** can be found in the \NAPDOS\PCI\UniDAQ\ folder on the companion CD, or can be downloaded from:
  http://ftp.icpdas.com/pub/cd/iocard/pci/napdos/pci/unidaq/

1. Introduction

The following is an overview of the PCI-P8R8/P16R16, PCI-P16C16, PCI-P16POR16/P16POR16U and PEX-P8POR8i/P16POR16i Series cards, including the number and type of input and output channels.

Model	Isolated Digital Input	Output Type
PCI-P8R8 **PCI-P8R8U**	8 channels	8 Relay Output channels
PCI-P16R16 **PCI-P16R16U**	16 channels	16 Relay Output channels
PCI-P16C16 **PCI-P16C16U**	16 channels	16 Open Collector Output channels
PEX-P8POR8i	8 channels	8 PhotoMOS-Relay Output channels
PCI-P16POR16 **PCI-P16POR16U**	16 channels	16 PhotoMOS-Relay Output channels
PEX-P16POR16i	16 channels	16 PhotoMOS-Relay Output channels

➢ PCI-P8R8U/P16R16U, PCI-P8R8/PCI-P16R16

The PCI-P8R8U/P16R16U universal PCI card supports 3.3 V/5 V PCI bus while the PCI-P8R8/P16R16 supports 5 V PCI bus and Plug and Play functionality so that the I/O address is automatically assigned rather than needing to be set manually. These cards contain 8/16 photo-coupler Digital Input channels that provide 5000 V_{rms} isolation protection, allowing the input signals to be completely floated so as to prevent ground loops. They are also equipped with 8/16 Relay Output channels that can be used to control the ON/OFF state of external devices, drive external relays or small power switches, or activate alarms, etc.

➢ PCI-P16C16/P16C16U

The PCI-P16C16U universal PCI card supports 3.3 V/5 V PCI bus while the PCI-P16C16 supports 5 V PCI bus and Plug and Play functionality so that the I/O resources are automatically assigned from the BIOS. This card contains 16 optically-isolated Digital Input channels and 16 open collector (Sink, NPN) Digital Output channels. The Digital Input channels provide 5000 V_{rms} isolation protection that allows the input signals to be completely floated so as to prevent ground loops and isolates the host computer from potentially damaging voltage spikes. The open collector Digital Output channels are

typically used for alarm and warning notifications, control of signal Output, control of external circuits that require a higher voltage level, and signal transmission applications, etc. The PCI-P16C16 series card contains a single DB-37 connector and a single 40-pin box header, and is shipped with a 40-pin to DB-37 flat cable for easy wiring.

➢ PCI-P16POR16/P16POR16U and PEX-P8POR8i/P16POR16i

The PEX-P8POR8i/P16POR16i and PCI-P16POR16U series card is the new generation product that ICP DAS provides to meet RoHS compliance requirement. The PCI-P16POR16U card is designed as a drop-in replacement for the PCI-P16POR16, while the PEX-P16POR16i card is designed as easy replacement for the PCI-P16POR16. Users can replace the PCI-P16POR16 by the PEX-P16POR16i and PCI-P16POR16U directly without software/driver modification.

The PCI-P16POR16 is a PCI card supporting both the 5 V PCI bus. The PCI-P16POR16U Universal PCI card supports both 5 V and 3.3 V while the PEX-P8POR8i/P16POR16i is a PCI Express card. These cards provide 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 PCI-P16POR16/P16POR16U series card provides 5000 V_{rms} and PEX-P8POR8i/P16POR16i series card provide 2000 V_{DC} for DI channel 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. These cards 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 PCI-P16POR16U and PEX-P8POR8i/P16POR16i series card also adds a Card ID switch on-board. Users can set Card ID and then recognizes the board by the ID via software when using two or more cards in one computer.

1.1 Features

The following is an overview of the features provided by PCI-P16R16 Series cards.

Model	PCI-P8R8	PCI-P8R8U	PCI-P16R16	PCI-P16R16U	PCI-P16C16	PCI-P16C16U
Bus Type	5 V PCI	Universal PCI	5 V PCI	Universal PCI	5 V PCI	Universal PCI
Common Features	• Optically-isolated Digital Input • AC/DC Digitally-signed Input • AC Digital Input with Filter configurable via Jumper Settings					
Input Channels	8		16		16	
Input Type	Optically-isolated Digital Input					
Output Channels	8		16		16	
Output Type	Relay Output				Transistor (Open Collector)	
LED Indicators	-		-		External Power Status	

Model	PCI-P16POR16	PCI-P16POR16U	PEX-P8POR8i	PEX-P16POR16i
Bus Type	5 V PCI	Universal PCI	PCI Express x1	
Common Features	• Optically-isolated Digital Input • AC/DC Digitally-signed Input • AC Digital Input with Filter configurable via Jumper Settings			
Input Channels	16	16	8	16
Input Type	Optically-isolated Digital Input			
Output Channels	16	16	8	16
Output Type	PhotoMOS Relay			
LED Indicators	Output Status			

1.2 Specifications

The following is an overview of the specifications for the various models in the PCI-P16R16 Series.

1.2.1 PCI-P8R8(U)/P16R16(U)

Model		PCI-P8R8	PCI-P8R8U	PCI-P16R16	PCI-P16R16U
Digital Input					
Isolation Voltage		5000 V_{rms} (Photo-coupler)			
Channels		8		16	
Input Voltage	Logic 1	AC/DC +5 ~ +24 V (AC 50 Hz ~ 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, 4 SPST		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 @ 500 V_{DC}			
Lifetime		Mechanical: 5000000 ops. Electrical: 100000 ops.			
General					
Bus Type		5 V PCI, 32-bit, 33 MHz	3.3 V/5 V Universal PCI, 32-bit, 33 MHz	5 V PCI, 32-bit, 33 MHz	3.3 V/5 V Universal PCI, 32-bit, 33 MHz
Data Bus		16-bit			
Card ID		No	Yes (4-bit)	No	Yes (4-bit)
I/O Connector		Female DB-37 x 1		Female DB-37 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			

1.2.2 PCI-P16C16(U)

Model		PCI-P16C16U	PCI-P16C16
Digital Input			
Isolation Voltage		5000 V_{rms} (Photo-coupler)	
Channels		16	
Input Voltage	Logic 1	AC/DC +5 ~ +24 V (AC 50 Hz ~ 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 V_{rms}	
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		3.3 V/5 V Universal PCI, 32-bit, 33 MHz	5 V PCI, 32-bit, 33 MHz
Data Bus		16-bit	
Card ID		Yes (4-bit)	No
I/O Connector		Female DB-37 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	

1.2.3 PCI-P16POR16(U) and PEX-P8POR8i/P16POR16i

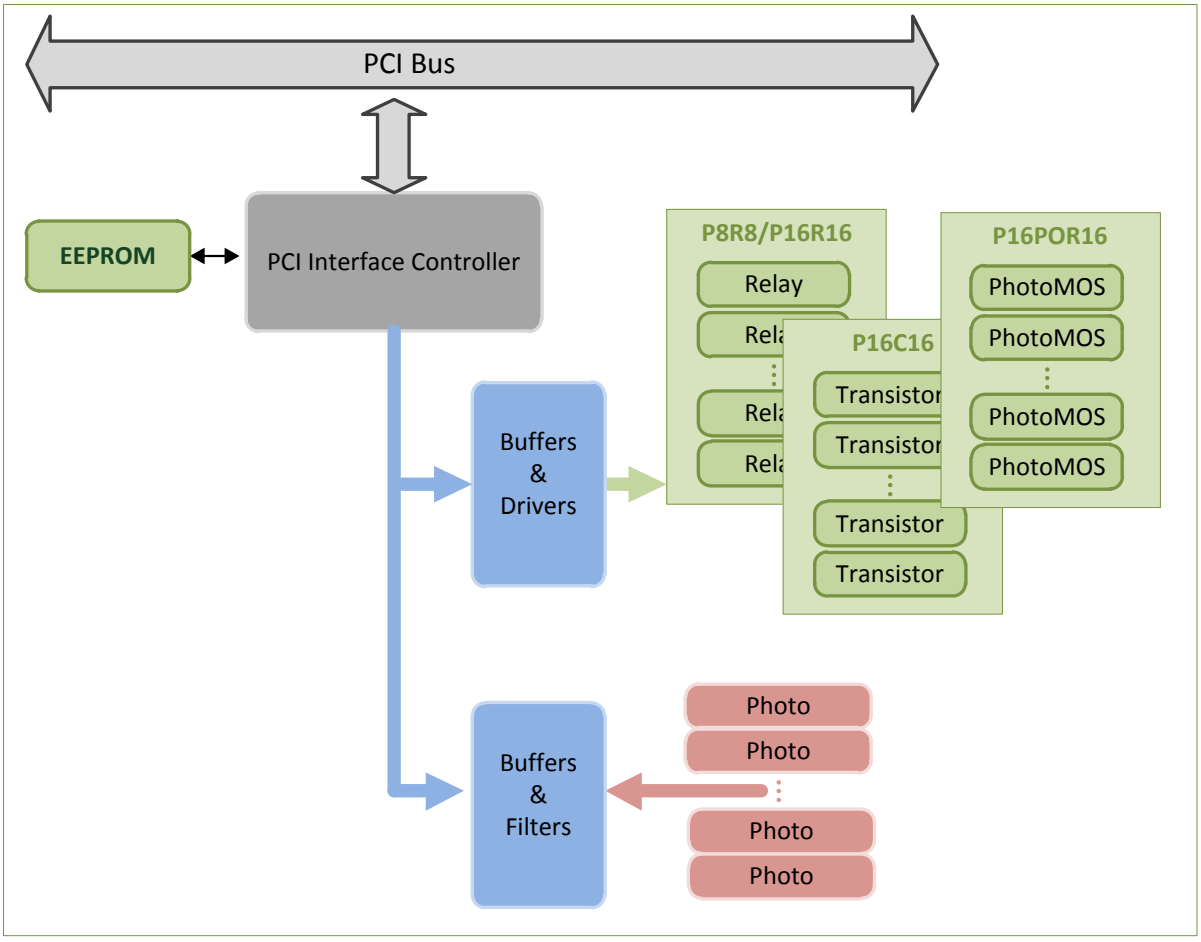
Model		PCI-P16POR16	PCI-P16POR16U	PEX-P8POR8i	PEX-P16POR16i
Digital Input					
Isolation Voltage		5000 V_{rms} (Photo-coupler)		2000 V_{DC} (Photo-coupler)	
Channels		16	16	8	16
Input Voltage	Logic 1	AC/DC +5 ~ +24 V (AC 50 Hz ~ 1 kHz)			
	Logic 0	AC/DC 0 ~ +1 V			
Input Impedance		1.2 KΩ, 1 W		1.2 KΩ, 0.5 W	
Response Speed		Without Filter: 50 kHz (Typical) With Filter: 0.455 kHz (Typical)			
Relay Output					
Channels		16	16	8	16
Relay Type		PhotoMOS Relay (Form A)			
Contact Rating		Load Voltage: 300 V (AC peak or DC) Load Current: 130 mA			
Operating Time		0.7 ms (Typical)			
Release Time		0.05 ms (Typical)			
Insulation Resistance		1000 MΩ @ 500 V_{DC}			
Electrical Endurance (Resistive load)		Long Life and No Spike			
Special					
LED Indicators		Output Status			
General					
Bus Type		5 V PCI, 32-bit, 33 MHz	3.3 V/5 V Universal PCI, 32-bit, 33 MHz	PCI Express x1	
Data Bus		16-bit			
Card ID		No	Yes (4-bit)	Yes (4-bit)	
I/O Connector		Female DB-37 x 1 40-pin Box Header x 1		Female DB-37 x 1	Female DB-37 x 1 40-pin Box Header x 1
Dimensions (L x W x D)		183 mm x 105 mm x 22 mm		118 mm x 113 mm x 22 mm	173 mm x 113 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 Applications

- Factory Automation
- Laboratory Automation
- Communication Switching
- Security Control
- Product Testing
- Energy Management

1.4 Block Diagram

The following is the block diagram for PCI-P16R16 Series cards.



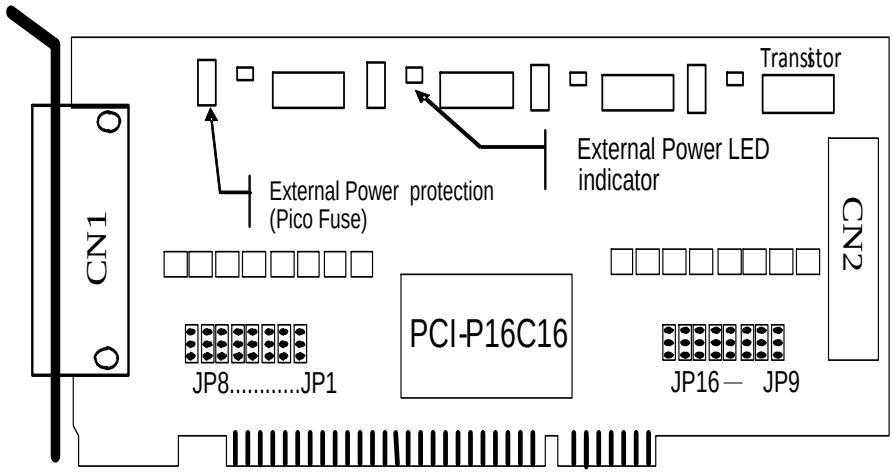
2. Hardware Configuration

2.1 Board Layout

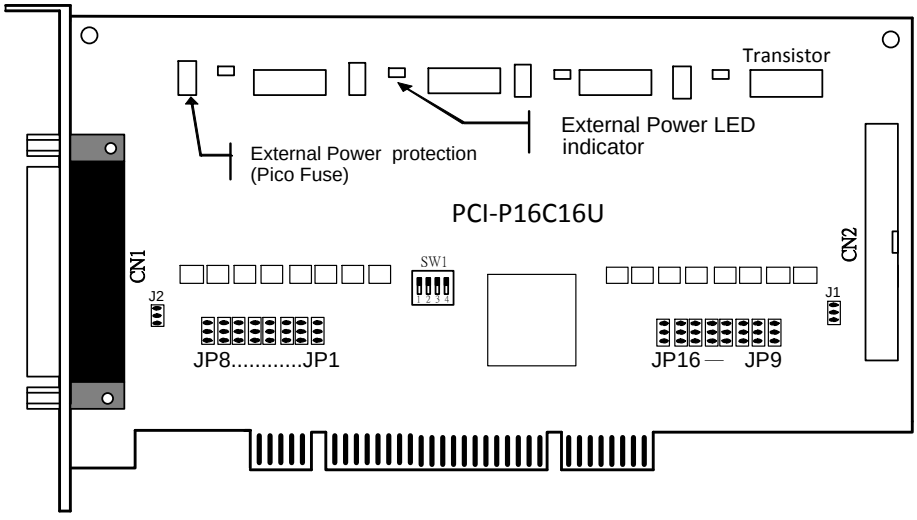
The following is an overview of the board layout for each of the PCI-P16R16 Series cards.

2.1.1 PCI-P16C16(U)

➢ PCI-P16C16



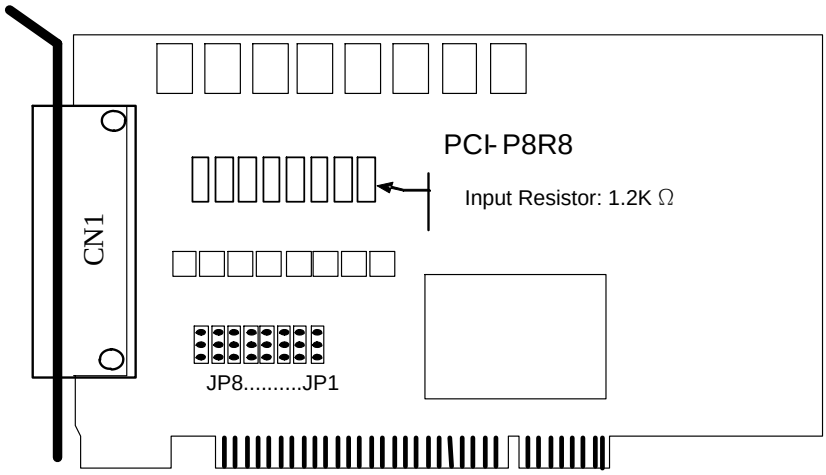
➢ PCI-P16C16U



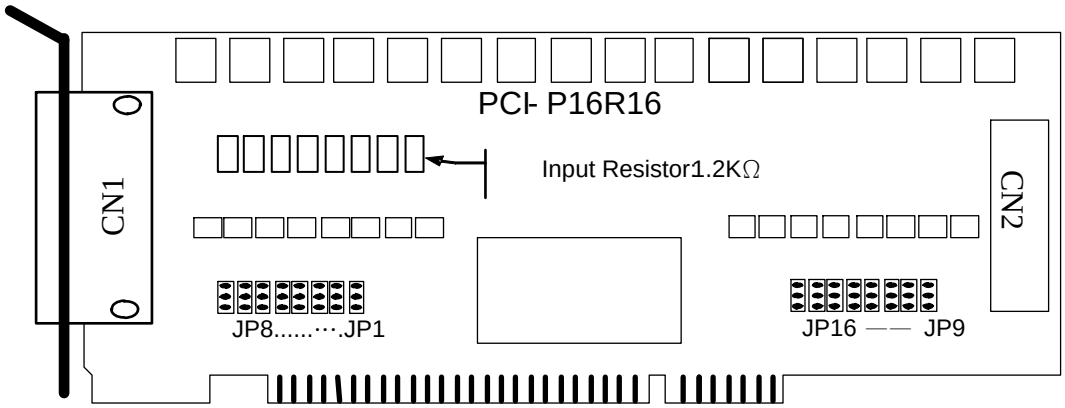
CN1	The Connector for Digital I/O channels 0 to 7 on PCI-P16C16 Series Cards	Refer to Section 2.4.2
JP1 - JP8	Used to select whether the input signals for Digital Input channels 0 to 7 on CN1 are set to AC or DC	Refer to Section 2.2.1
CN2	The Connector for Digital I/O channels 8 to 15 on PCI-P16C16 Series Cards	Refer to Section 2.4.2
JP9 – JP16	Used to select whether the input signals for Digital Input channels 8 to 15 on CN2 are set to AC or DC	Refer to Section 2.2.1
SW1	The Card ID DIP Switch for PCI-P16C16U only	Refer to Section 2.3
J1, J2	Used to set the Ground Isolation Protection for PCI-P16C16U only	Refer to Section 2.2.2

2.1.2 PCI-P8R8/PCI-P16R16

➢ PCI-P8R8



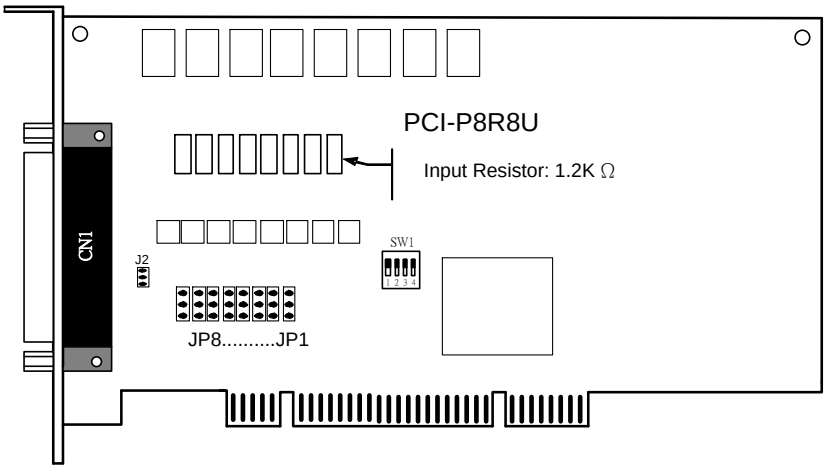
➢ PCI-P16R16



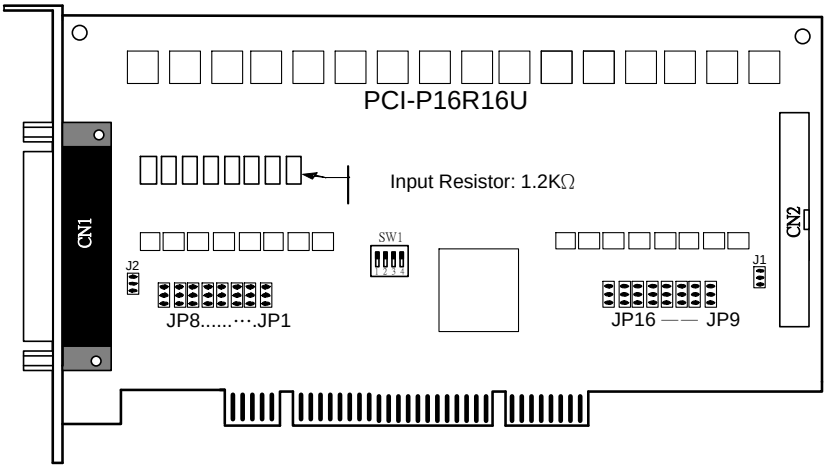
CN1	The Connector for Digital I/O channels 0 to 7 on PCI-P8R8/P16R16 Series Cards	Refer to Section 2.4.1
JP1 - JP8	Used to select whether the input signals for Digital Input channels 0 to 7 on CN1 are set to AC or DC	Refer to Section 2.2.1
CN2	The Connector for Digital I/O channels 8 to 15 on PCI-P16R16 Series Cards	Refer to Section 2.4.1
JP9 – JP16	Used to select whether the input signals for Digital Input channels 8 to 15 on CN2 are set to AC or DC	Refer to Section 2.2.1

2.1.3 PCI-P8R8U/P16R16U

➢ PCI-P8R8U



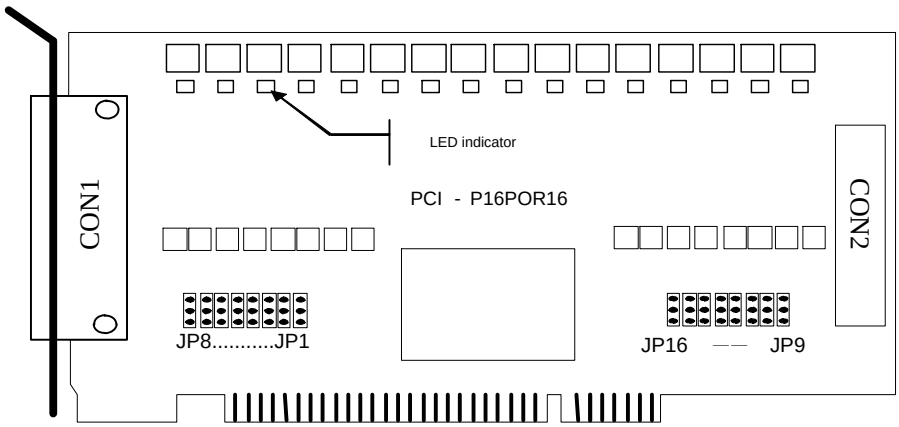
➢ PCI-P16R16U



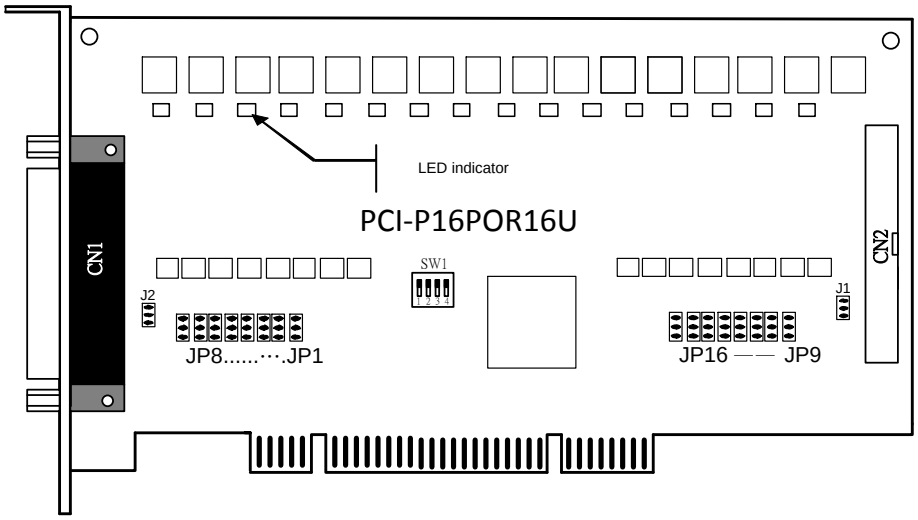
CN1	The Connector for Digital I/O channels 0 to 7 on PCI-P8R8U/P16R16U Series Cards	Refer to Section 2.4.1
JP1 - JP8	Used to select whether the input signals for Digital Input channels 0 to 7 on CN1 are set to AC or DC	Refer to Section 2.2.1
CN2	The Connector for Digital I/O channels 8 to 15 on PCI-P16R16U Series Cards	Refer to Section 2.4.1
JP9 – JP16	Used to select whether the input signals for Digital Input channels 8 to 15 on CN2 are set to AC or DC	Refer to Section 2.2.1
SW1	The Card ID DIP Switch	Refer to Section 2.3
J1, J2	Used to set the Ground Isolation Protection	Refer to Section 2.2.2

2.1.4 PCI-P16POR16(U)

➢ PCI-P16POR16



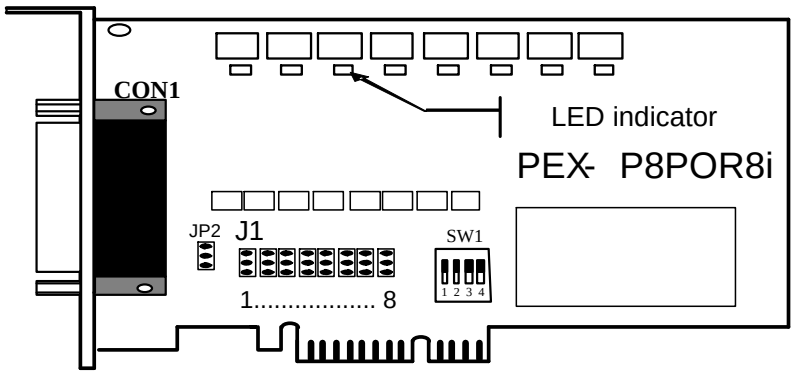
➢ PCI-P16POR16U



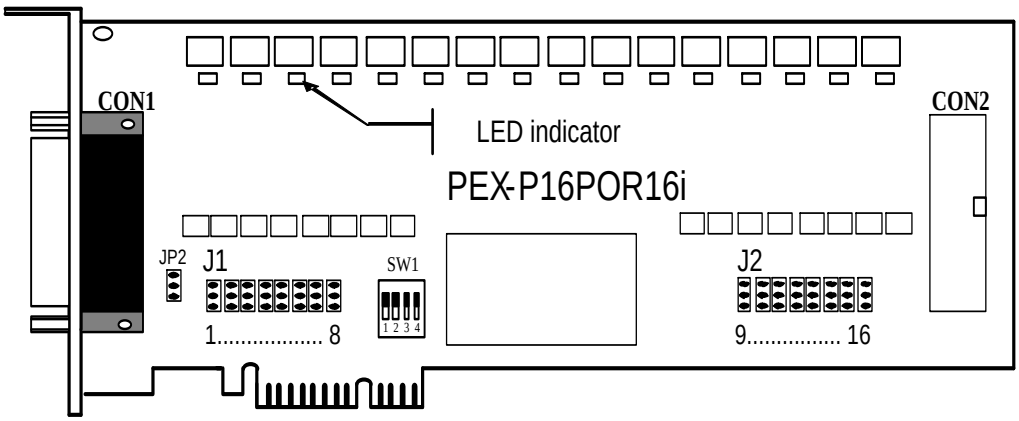
CON1	The Connector for Digital I/O channels 0 to 7 on PCI-P16POR16 Series Cards	Refer to Section 2.4.3
JP1 - JP8	Used to select whether the input signals for Digital Input channels 0 to 7 on CN1 are set to AC or DC	Refer to Section 2.2.1
CON2	The Connector for Digital I/O channels 8 to 15 on PCI-P16POR16 Series Cards	Refer to Section 2.4.3
JP9 – JP16	Used to select whether the input signals for Digital Input channels 8 to 15 on CN2 are set to AC or DC	Refer to Section 2.2.1
J1, J2	Used to set the Ground Isolation Protection for PCI-P16POR16U only	Refer to Section 2.2.2
SW1	The Card ID DIP Switch for PCI-P16POR16U only	Refer to Section 2.3

2.1.5 PEX-P8POR8i/PEX-P16POR16i

- PEX-P8POR8i



- PEX-P16POR16i



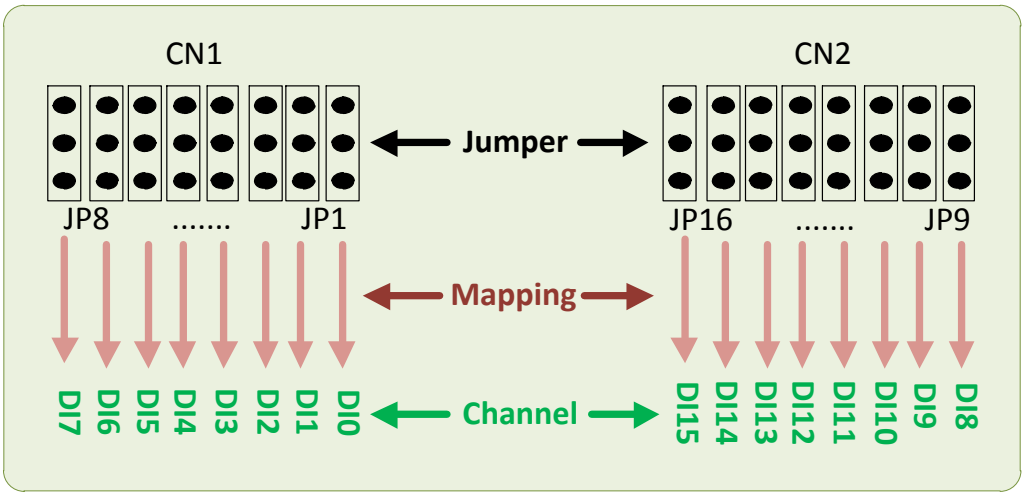
CON1	The Connector for Digital I/O channels 0 to 7 on PEX-P8POR8i/P16POR16i Series Cards	Refer to Section 2.4.3
J1	Used to select whether the input signals for Digital Input channels 0 to 7 on CON1 are set to AC or DC	Refer to Section 2.2.1
CON2	The Connector for Digital I/O channels 8 to 15 on PCI-P16R16i Series Cards	Refer to Section 2.4.3
J2	Used to select whether the input signals for Digital Input channels 8 to 15 on CN2 are set to AC or DC	Refer to Section 2.2.1
JP2	Used to set the Ground Isolation Protection	Refer to Section 2.2.2
SW1	The Card ID DIP Switch	Refer to Section 2.3

2.2 Jumper Settings

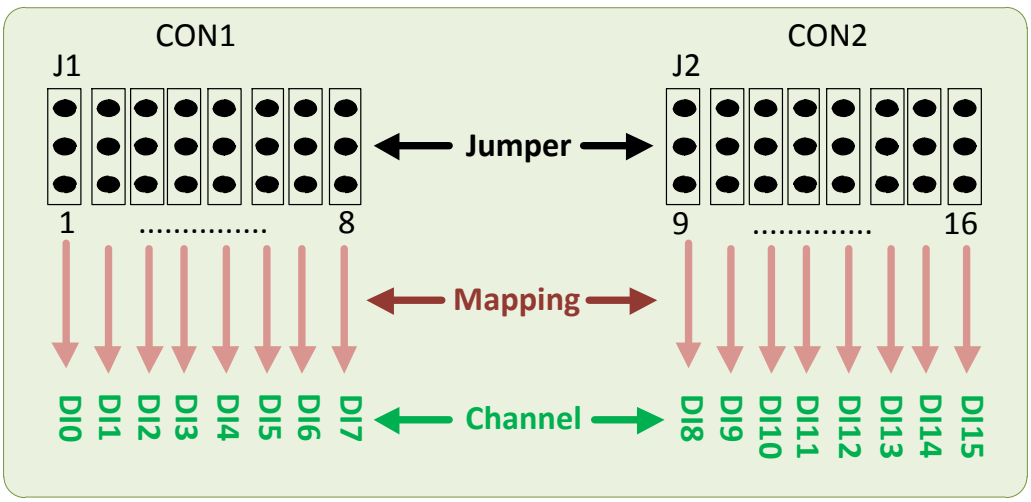
2.2.1 Input Signal Type

The configuration for the I/O card can be adjusted simply by setting the position of the jumpers on the card. Each Digital Input channel can be configured as a single-pole, RC filter with a time constant of 1.2 ms by setting the respective jumper. The Figures shown below provides an overview of the mapping for each Digital Input channel and the corresponding jumper position.

- Jumper Settings for CN1 and CN2 on PCI-P8R8/P16R16, PCI-P8R8U/P16R16U, PCI-P16C16/P16C16U and PCI-P16POR16/P16POR16U Series cards:



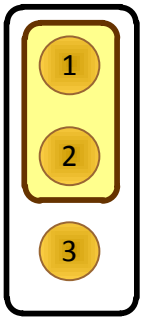
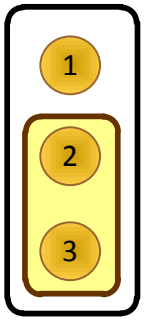
- Jumper Settings for CON1 and CON2 on PEX-P8POR8i/P16POR16i Series cards:



➢ Jumper Mapping for the Digital Input Channels on PCI and PEX Series cards:

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

The following illustrates the jumper positions used to select the Digital Input type:

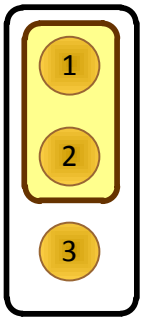
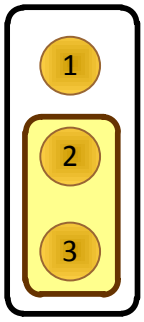
Without Filter For DC Signals (Default)	With AC Filter For AC Signals
	

If **AC Input Signals** are to be used, ensure that the **AC FILTER** is activated by connecting pins 2 and 3 of the corresponding jumpers. When using **DC input signals**, activating the **AC FILTER** is optional. If the signal response for the DC input is less than 20 μs, the AC Filter can be set to OFF. If a slow response is desired (about 5 to 10 ms) in order to reject noise or contact bouncing, connect pins 2 and 3 to activate the **AC FILTER**. The default position is “Without Filter For DC Signals”.

2.2.2 Ground Isolation Protection Jumper

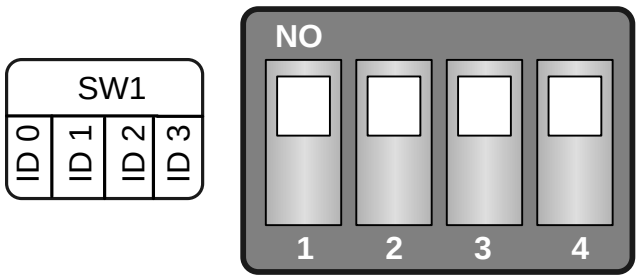
Jumper J1, J2 (PCI-P8R8U/P16R16U/P16POR16U/P16C16U) and JP2 (PEX-P8POR8i/P16PoR16i) are used to select whether the ground protection is configured as isolated or non-isolated. Ground isolation protection can be enabled by connecting pins 1 and 2 on Jumper J1, J2 and JP2, which is the default position, as shown in the figure below. However, if the ground is to be non-isolated, then pins 2 and 3 on Jumper J1, J2 and JP2 should be connected. *Note that this feature is only available on PCI-P16C16U, PCI-P16POR16U, PCI-P8R8U/P16R16U and PEX-P8POR8i/P16POR16i Series cards.*

The figure below illustrates the jumper positions used to select the Ground Isolation type:

GND Isolation Protection (Default)	GND Non-Isolated
	

2.3 Card ID Switch (SW1)

The PEX-P8POR8i/P16POR16i, PCI-P8R8U/P16R16U, PCI-P16POR16U and PCI-P16C16U Series cards includes an onboard Card ID DIP Switch (SW1) that enables the card to be recognized via software if two or more cards are installed in the same computer. The default Card ID is 0x0 in hexadecimal format. For more detailed information regarding the positions of the SW1 DIP Switch for the different Card ID settings, refer to the table below. *Note that the Card ID Switch is only available on PEX-P8POR8i/P16POR16i, PCI-P8R8U/P16R16U, PCI-P16POR16U and PCI-P16C16U Series cards.*



(Default Settings)

Card ID (Hex)	1 ID0	2 ID1	3 ID2	4 ID3
(*) 0x0	ON	ON	ON	ON
0x1	**OFF**	ON	ON	ON
0x2	ON	**OFF**	ON	ON
0x3	**OFF**	**OFF**	ON	ON
0x4	ON	ON	**OFF**	ON
0x5	**OFF**	ON	**OFF**	ON
0x6	ON	**OFF**	**OFF**	ON
0x7	**OFF**	**OFF**	**OFF**	ON
0x8	ON	ON	ON	**OFF**
0x9	**OFF**	ON	ON	**OFF**
0xA	ON	**OFF**	ON	**OFF**
0xB	**OFF**	**OFF**	ON	**OFF**
0xC	ON	ON	**OFF**	**OFF**
0xD	**OFF**	ON	**OFF**	**OFF**
0xE	ON	**OFF**	**OFF**	**OFF**
0xF	**OFF**	**OFF**	**OFF**	**OFF**

(*) Default Settings; OFF → 1; ON → 0

2.4 Pin Assignments

The following is an overview of the pin assignments for PCI-P16R16 Series cards.

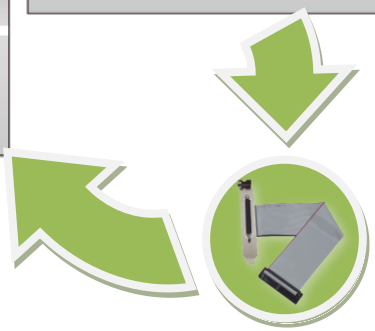
2.4.1 PCI-P8R8(U)/P16R16(U)

Pin Assignment CN2	Pin Assignment CN1	Terminal No.	Terminal No.	Pin Assignment CN1	Pin Assignment CN2
NO_8	NO_0	01	20	NO_3	NO_11
COM_8	COM_0	02	21	COM_3	COM_11
NC_8	NC_0	03	22	NC_3	NC_11
NO_9	NO_1	04	23	NO_4	NO_12
COM_9	COM_1	05	24	COM_4	COM_12
NC_9	NC_1	06	25	NO_5	NO_13
NO_10	NO_2	07	26	COM_5	COM_13
COM_10	COM_2	08	27	NO_6	NO_14
NC_10	NC_2	09	28	COM_6	COM_14
NO_15	NO_7	10	29	GND	GND
COM_15	COM_7	11	30	DIB_0	DIB_8
DIA_0	DIA_0	12	31	DIB_1	DIB_9
DIA_1	DIA_1	13	32	DIB_2	DIB_10
DIA_2	DIA_2	14	33	DIB_3	DIB_11
DIA_3	DIA_3	15	34	DIB_4	DIB_12
DIA_4	DIA_4	16	35	DIB_5	DIB_13
DIA_5	DIA_5	17	36	DIB_6	DIB_14
DIA_6	DIA_6	18	37	DIB_7	DIB_15
DIA_7	DIA_7	19			

CN1 (Female DB-37)

Pin Assignment	Terminal No.		Terminal No.	Pin Assignment
NO_8	01		02	NO_11
COM_8	03		04	COM_11
NC_8	05		06	NC_11
NO_9	07		08	NO_12
COM_9	09		10	COM_12
NC_9	11		12	NO_13
NO_10	13		14	COM_13
COM_10	15		16	NO_14
NC_10	17		18	COM_14
NO_15	19		20	GND
COM_15	21		22	DIB_8
DIA_8	23		24	DIB_9
DIA_9	25		26	DIB_10
DIA_10	27		28	DIB_11
DIA_11	29		30	DIB_12
DIA_12	31		32	DIB_13
DIA_13	33		34	DIB_14
DIA_14	35		36	DIB_15
DIA_15	37		38	N/A
N/A	39		40	N/A

CN2 (40-pin box header)
(PCI-P16R16/P16R16U only)



Extension Cable (CA-4037W):
Conversion from DB-40-pin to DB-37-pin

Notes:

NO:	Normally Open	**DIA:**	Digital Input (Point A)
COM:	Common	**DIB:**	Digital Input (Point B)
NC:	Normally Closed		

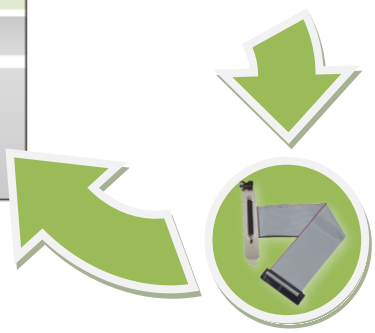
2.4.2 PCI-P16C16(U)

Pin Assign-ment CN2	Pin Assign-ment CN1	Terminal No.	Terminal No.	Pin Assign-ment CN1	Pin Assign-ment CN2
OUT_8	OUT_0	01	20	Ext. Power 1	Ext. Power 3
OUT_9	OUT_1	02	21	Ext. Power1	Ext. Power3
OUT_10	OUT_2	03	22	GND_1	GND_3
OUT_11	OUT_3	04	23	GND_1	GND_3
OUT_12	OUT_4	05	24	Ext. Power2	Ext. Power4
OUT_13	OUT_5	06	25	Ext. Power2	Ext. Power4
OUT_14	OUT_6	07	26	GND_2	GND_4
OUT_15	OUT_7	08	27	GND_2	GND_4
N/A	N/A	09	28	N/A	N/A
N/A	N/A	10	29	N/A	N/A
N/A	N/A	11	30	DIB_0	DIB_8
DIA_8	DIA_0	12	31	DIB_1	DIB_9
DIA_9	DIA_1	13	32	DIB_2	DIB_10
DIA_10	DIA_2	14	33	DIB_3	DIB_11
DIA_11	DIA_3	15	34	DIB_4	DIB_12
DIA_12	DIA_4	16	35	DIB_5	DIB_13
DIA_13	DIA_5	17	36	DIB_6	DIB_14
DIA_14	DIA_6	18	37	DIB_7	DIB_15
DIA_15	DIA_7	19			

CN1(Female DB-37)

Pin Assign-ment	Terminal No.		Terminal No.	Pin Assign-ment
DO_8	01		02	Ext. Power3
DO_9	03		04	Ext. Power3
DO_10	05		06	GND3
DO_11	07		08	GND3
DO_12	09		10	Ext. Power4
DO_13	11		12	Ext. Power4
DO_14	13		14	GND4
DO_15	15		16	GND4
N/A	17		18	N/A
N/A	19		20	N/A
N/A	21		22	DIB_8
DIA_8	23		24	DIB_9
DIA_9	25		26	DIB_10
DIA_10	27		28	DIB_11
DIA_11	29		30	DIB_12
DIA_12	31		32	DIB_13
DIA_13	33		34	DIB_14
DIA_14	35		36	DIB_15
DIA_15	37		38	N/A
N/A	39		40	N/A

CN2(40-pin box header)



Extension Cable (CA-4037W):
Conversion from DB-40-pin to DB-37-pin

Notes:

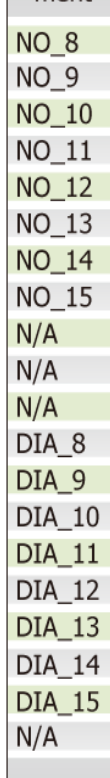
Ext. Power:	External Power Input
GND:	External Power Ground
OUT:	Open Collector Output
DIA:	Digital Input (Point A)
DIB:	Digital Input (Point B)

2.4.3 PCI-P16POR16(U) and PEX-P8POR8i/P16POR16i

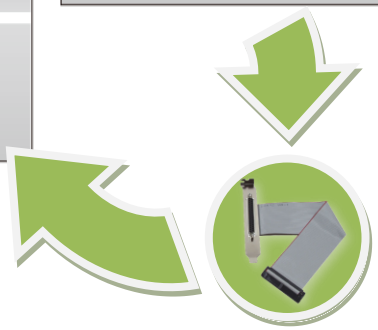
Pin Assign-ment CON2	Pin Assign-ment CON1	Terminal No.	Pin Assign-ment CON1	Pin Assign-ment CON2
NO_8	NO_0	01	20	CM_0	CM_8
NO_9	NO_1	02	21	CM_1	CM_9
NO_10	NO_2	03	22	CM_2	CM_10
NO_11	NO_3	04	23	CM_3	CM_11
NO_12	NO_4	05	24	CM_4	CM_12
NO_13	NO_5	06	25	CM_5	CM_13
NO_14	NO_6	07	26	CM_6	CM_14
NO_15	NO_7	08	27	CM_7	CM_15
N/A	N/A	09	28	N/A	N/A
N/A	N/A	10	29	GND	GND
N/A	N/A	11	30	DIB_0	DIB_8
DIA_8	DIA_0	12	31	DIB_1	DIB_9
DIA_9	DIA_1	13	32	DIB_2	DIB_10
DIA_10	DIA_2	14	33	DIB_3	DIB_11
DIA_11	DIA_3	15	34	DIB_4	DIB_12
DIA_12	DIA_4	16	35	DIB_5	DIB_13
DIA_13	DIA_5	17	36	DIB_6	DIB_14
DIA_14	DIA_6	18	37	DIB_7	DIB_15
DIA_15	DIA_7	19			

CON1 (Female DB-37)

Pin Assign-ment	Terminal No.		Pin Assign-ment
NO_8	01	02	CM_8
NO_9	03	04	CM_9
NO_10	05	06	CM_10
NO_11	07	08	CM_11
NO_12	09	10	CM_12
NO_13	11	12	CM_13
NO_14	13	14	CM_14
NO_15	15	16	CM_15
N/A	17	18	N/A
N/A	19	20	GND
N/A	21	22	DIB_8
DIA_8	23	24	DIB_9
DIA_9	25	26	DIB_10
DIA_10	27	28	DIB_11
DIA_11	29	30	DIB_12
DIA_12	31	32	DIB_13
DIA_13	33	34	DIB_14
DIA_14	35	36	DIB_15
DIA_15	37	38	N/A
N/A	39	40	N/A

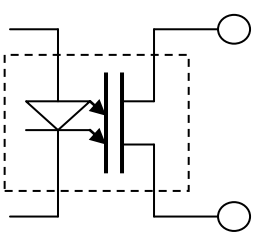


CON2 (40-pin box header)
(PCI-P16POR16/PEX-P16POR16i only)



Extension Cable (CA-4037W):
Conversion from DB-40-pin to DB-37-pin

Notes:



DIA: Digital Input (Point A)

DIB: Digital Input (Point B)

3 Hardware Applications

Model	Input	Output
PCI-P8R8/P8R8U	Optical Isolation	Relay
PCI-P16R16/P16R16U	Optical Isolation	Relay
PCI-P16C16/P16C16U	Optical Isolation	Transistor (Open Collector)
PCI-P16POR16/P16POR16U	Optical Isolation	PhotoMOS Relay
PEX-P8POR8i	Optical Isolation	PhotoMOS Relay
PEX-P16POR16i	Optical Isolation	PhotoMOS Relay

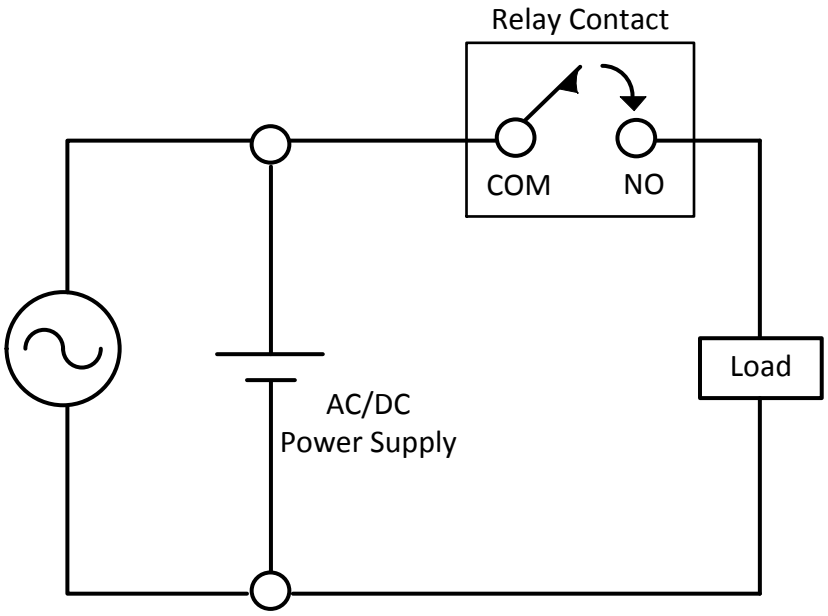
3.1 Relay Output

For PCI-P8R8/P16R16 and PCI-P8R8U/P16R16U Series Cards Only

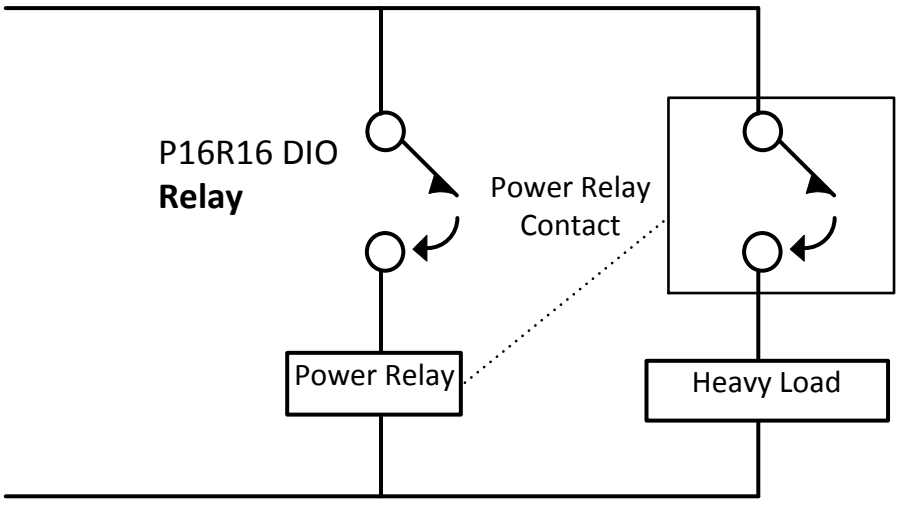
Whenever data is written to the output control register, the Relays will switch to either **Normally Closed (NC)** or **Normally Open (NO)**, as specified by the control code. A “1” in the control register will energize the corresponding Relay, which will then switch from **Common (COM)** to NO. A “0” in the control register will turn off the corresponding Relay, which will then be switched from COM to NC. The control register will be set to NC mode when the board is first powered-on. Hardware reset signal or a programmable reset signal will also switch the Relay to NC.

The following figures illustrate how to use the Relay.

- Basic Relay Circuitry: (Current Rating < 0.3A):



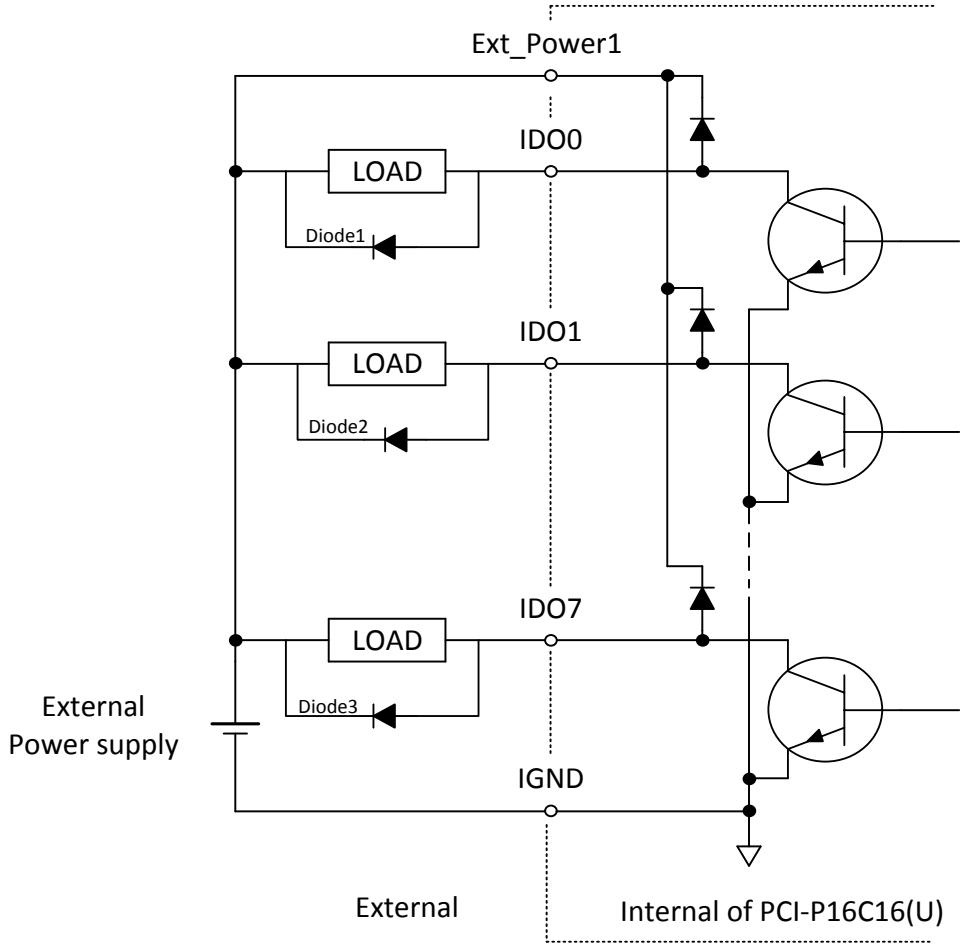
- The Relay Circuit for Heavy Load Applications (Current Rating > 0.3 A):



3.2 Open Collector Output

For PCI-P16C16/P16C16U Series Cards Only

PCI-P16C16 Series cards provide 16 open collector output channels with 4 channels per common power. Each common power is designed to include fuse protection and LED status indicators.



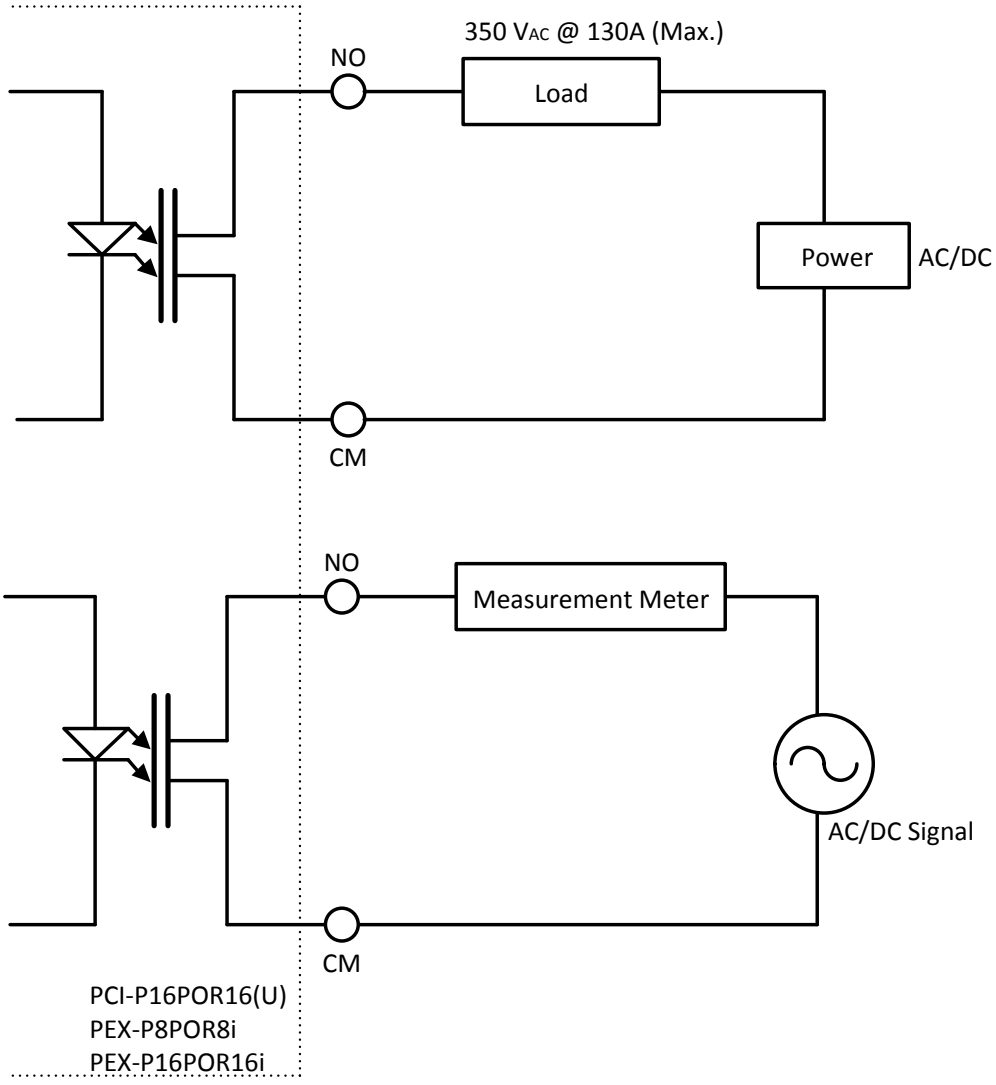
(Recommend : It Is necessary to connect a diode1 (..3..) . In the External Device end as means of preventing damage form the counter emf . If your Device Is Inductive Load , Ex. Relay ⋯)

3.3 PhotoMOS Relay Output

For PEX-P8POR8i/P16POR16i and PCI-P16POR16/P16POR16U Series Cards

Only

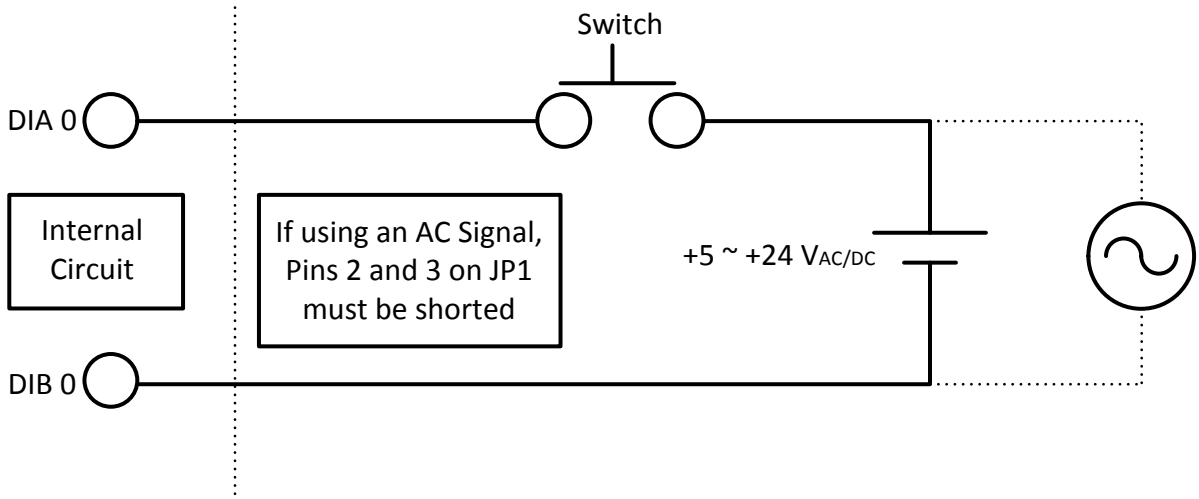
The PEX-P8POR8i/P16POR16i and PCI-P16POR16/P16POR16U Series cards contain 8/16 normally open, Form A PhotoMOS Relay Output channels. The cards can be used to help to eliminate ground-loop problems and isolate the computer from potentially damaging voltage spikes. PEX-P8POR8i/P16POR16i and PCI-P16POR16/P16POR16U Series cards can be used to switch loads of up to 350 V_{AC} at 130 mA.



3.4 Isolated Input

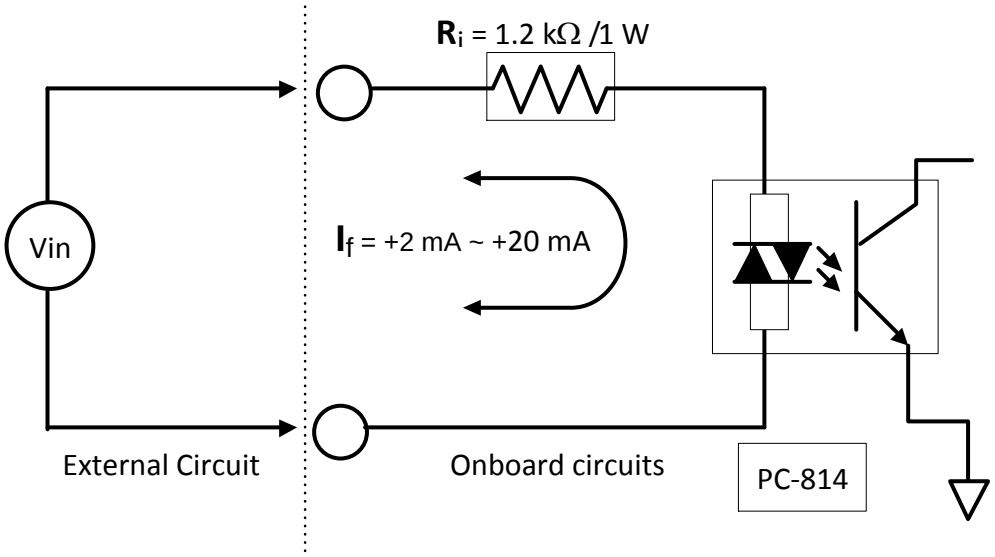
For PCI-P8R8/P16R16, PCI-P16C16, PCI-P16POR16 and PEX-P8POR8i/P16POR16i Series Cards

The status of the Digital Input for the photo-couple (isolation input) can be determined by reading the isolation input register. The figure below is an illustration of a basic Digital Input circuit.



Although the normal input voltage range is from +5 to +24 V_{AC} or V_{DC}, it can still be increased to a larger range by integrating a suitable external resistor. The following figure shows how to connect to a larger input. Note that the input current should be limited to between +2 mA and +20 mA, as too large an input current will burn the internal resistor **R**i, while too low an input current will not be strong enough to activate the photo-coupler isolator.

To ensure that the circuit will operate as expected, first calculate the input voltage and the current, and then replace **R**i with a suitable resistor.



The following is an example of how to calculate an approximate value for the resistor:

If **Vin = 120 V** and the photo-coupler turn-on voltage is ignored, the calculation will be as follows:

Vin = 120 (V), $\mathbf{I_f}$ =10 (mA), **Ri = Vin/** $\mathbf{I_f}$

Vin /$\mathbf{I_f}$ = **Ri**

120 (V) / 0.01 (A) = 12000 (Ω)

If resistor **Ri** is replaced with a 12 kΩ resistor, the power consumption for **Ri** can be calculated as follows:

$\mathbf{P = I^2 R_{ex}}$

$\mathbf{= (10\ mA)^2 * 12\ k\Omega}$

= 1.2 W

Therefore, the power consumption will be **1.2 W**, although choosing **1.5 or 2 W** would be better. Thus, a **12 kΩ/2 W** resistor can be used to replace resistor **Ri**.

4 Hardware Installation

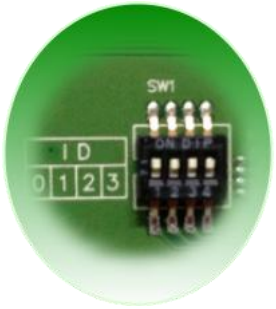
Note:
It is recommended that the driver is installed before installing the hardware as the computer may need to be restarted once the driver is installed in certain operating systems, such as Windows 2000 or Windows XP, etc. Installing the driver first helps reduce the time required for installation and restarting the computer.

To install the PCI-P16R16 Series cards, follow the procedure described below:

Step 1: Install the driver for the DAQ card on your computer.

For detailed information about installing the driver, refer to Chapter 5 Software Installation.

Step 2: For PEX-P8POR8i/P16POR16i, PCI-P8R8U/P16R16U, PCI-P16POR16U and PCI-P16C16U Series cards, configure the Card ID using the DIP Switch (SW1). This step can be skipped for other cards.

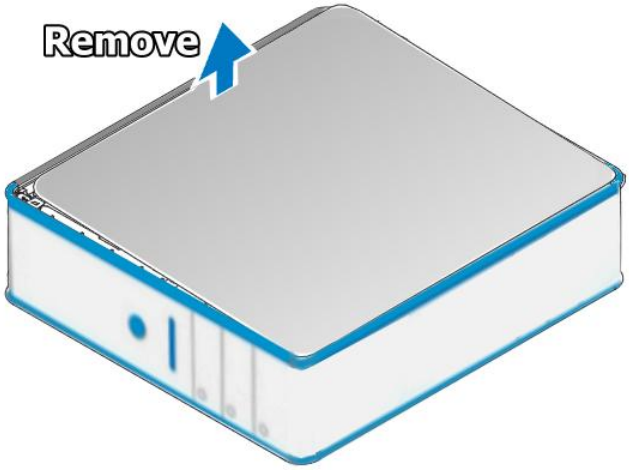


For detailed information about the Card ID, refer to Section 2.3 Card ID Switch (SW1).

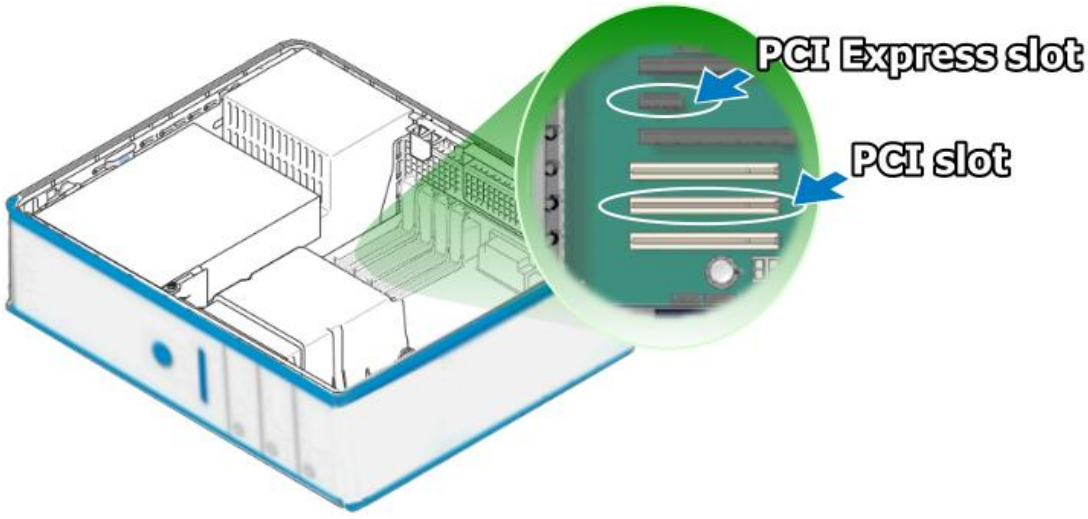
Note: The Card ID function is only supported on PCI-P16C16U, PCI-P16POR16U, PCI-P8R8U/P16R16U and PEX-P8POR8i/P16POR16i Series cards.

Step 3: Shut down and switch off the power to the computer, and then disconnect the power supply.

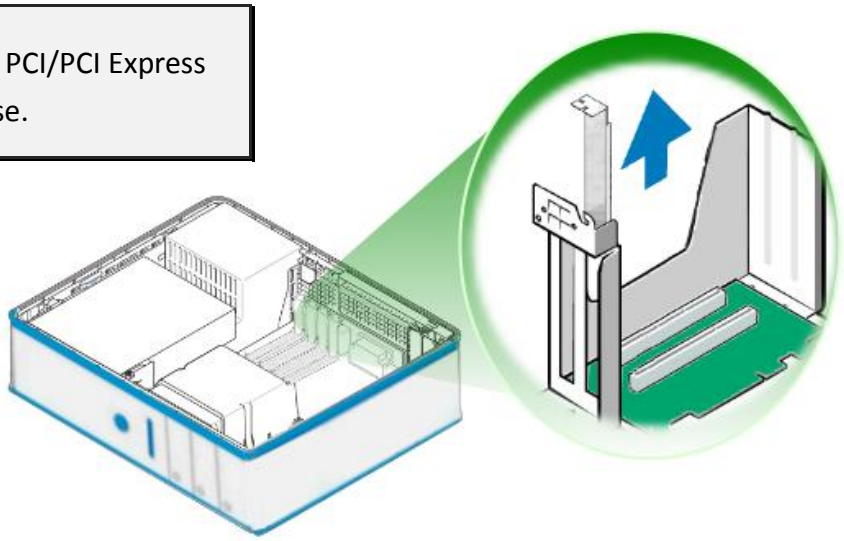
Step 4: Remove the cover from the computer.

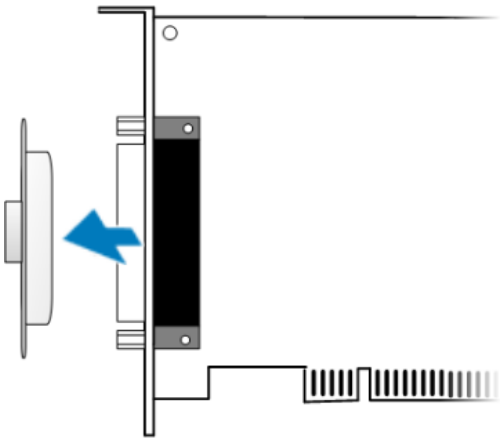


Step 5: Select a vacant PCI/PCI Express slot.



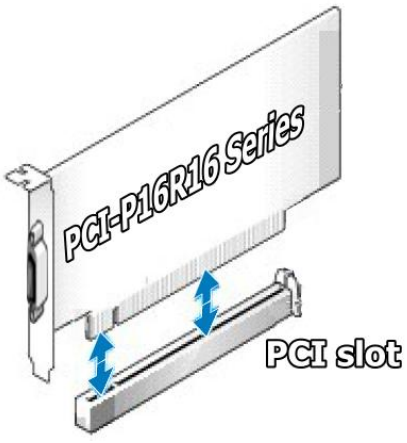
Step 6: Unscrew and remove the PCI/PCI Express slot cover from the computer case.

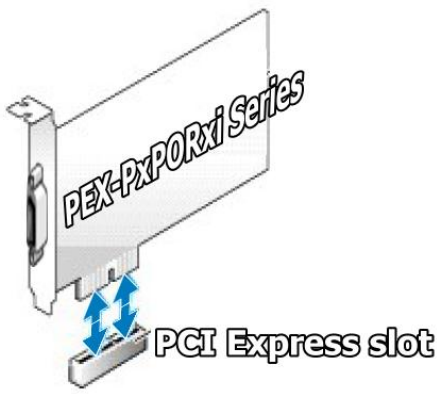


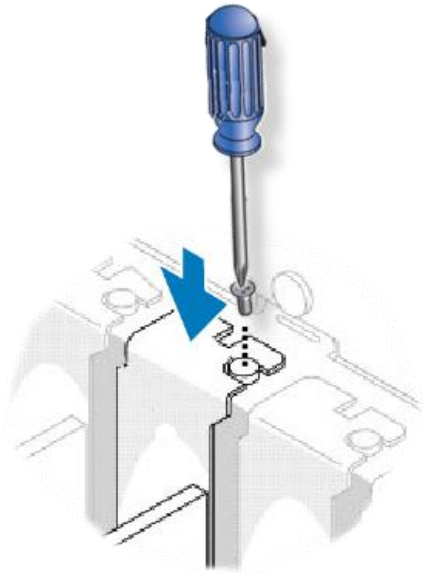


Step 7: Remove the connector cover form the DAQ card.

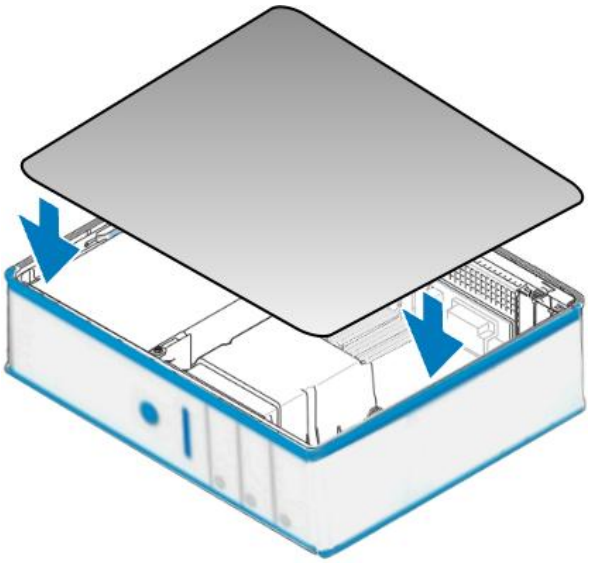
Step 8: Carefully insert the DAQ card into the PCI/PCI Express slot by gently pushing down on both sides of the card until it slides into the PCI connector.







Step 9: Confirm that the card is correctly inserted in the motherboard, and then secure the DAQ card in place using the retaining screw that was removed in Step 6.



Step 10: Replace the covers on the computer.

Step 11: Re-attach any cables, insert the power cord and then switch on the power to the computer.

Once the computer reboots, follow any message prompts that may be displayed to complete the Plug and Play installation procedure. Refer to Chapter 5 Software Installation for more information.

5 Software Installation

This chapter provides a detailed description of the process for installing the driver for the PCI-P16R16 Series card as well as how to verify whether the PCI-P16R16 Series card was properly installed. PCI-P16R16 Series cards can be used on DOS, Linux and Windows 2000 and 32-/64-bit version of Windows XP/2003/Vista/7/8 based systems, and the drivers are fully Plug and Play compliant for easy installation.

5.1 Obtaining/Installing the Driver Installer Package

The driver installation package for PCI-P16R16 Series cards can be found on the companion CD-ROM, or can be obtained from the ICP DAS FTP web site. Install the appropriate driver for your operating system. The location and website addresses for the installation package are indicated below.

➢ **UniDAQ Driver/SDK**

Operating System	**Windows 2000, 32/64-bit Windows XP, 32/64-bit Windows 2003, 32/64-bit Windows Vista, 32/64-bit Windows 7, 32/64-bit Windows 2008, and 32/64-bit Windows 8**
Driver Name	**UniDAQ Driver/SDK (unidaq_win_setup_xxxx.exe)**
CD-ROM	CD:\\ NAPDOS\PCI\UniDAQ\DLL\Driver\
Web site	http://ftp.icpdas.com/pub/cd/iocard/pci/napdos/pci/unidaq/dll/driver/
Installing Procedure	Please follow the following steps to setup software: **Step 1:** Double click the **UniDAQ_Win_Steupxxx.exe** to setup it. **Step 2:** When the Setup Wizard screen is displayed, click the **Next>** button. **Step 3:** When the Information screen is displayed, click the **Next>** button.

Installation Procedure	**Step 4:** Select the folder where the drivers are to install. The **default path is C:\ICPDAS\UniDAQ**. But if you wish to install the drivers to a different location , click the **"Browse…"** button and select the relevant folder and then click the **Next>** button. **Step 5:** When the Select Components screen is displayed, check PCI-P16R16 series board on the list, then click the **Next>** button. **Step 6:** When the Select Additional Tasks screen is displayed, click the **Next>** button. **Step 7:** When the Download Information screen is displayed, click the **Next>** button. **Step 8:** Select the item **"Yes, restart the computer now"**, press the **Finish** button. System will reboot. For more detailed information about how to install the UniDAQ driver, refer to "Section 2.2 Install UniDAQ Driver DLL" of the UniDAQ Software Manual, which can be found in the \NAPDOS\PCI\UniDAQ\Manual\ folder on the companion CD, or can be downloaded from: http://ftp.icpdas.com/pub/cd/iocard/pci/napdos/pci/unidaq/manual/

➢ **PCI-P16R16 Series Classic Driver**

Operating System	**Windows 95/98/ME, Windows NT, Windows 2000, 32-bit Windows XP, 32-bit Windows 2003, 32-bit Windows Vista, 32-bit Windows 7 and 32-bit Windows 8**
Driver Name	**PCI-P16R16 Series Classic Driver** The name of the driver depending on the platform being used. The setup files for the relevant operating system can be found in the **Win98, WinNT or Win2K_XP_7** folders.
CD-ROM	CD:\\NAPDOS\PCI\PCI-P16R16\DLL_OXC\
Web site	http://ftp.icpdas.com/pub/cd/iocard/pci/napdos/pci/pci-p16r16/dll_ocx/
Installing Procedure	Please follow the following steps to setup software: **Step 1:** Double click the **PCI-P16R16 Series Classic Driver** to setup it. **Step 2:** When the Setup Wizard screen is displayed, click the **Next>** button. **Step 3:** Select the folder where the drivers are to install. The **default path is C:\DAQPro\PCI-P16R16_Winxxx**. But if you wish to install the drivers to a different location , click the **"Browse…"** button and select the relevant folder and then click the **Next>** button. **Step 4:** Select the item **"No, I will restart my computer later"**, press the **Finish** button. For detailed information about how to install the Classic Driver for PCI-P16R16 Series cards, refer to the PCI-P16R16 Series Classic Driver DLL Software, which can be found in the \NAPDOS\PCI\PCI-P16R16\Manual\ folder on the companion CD, or can be downloaded from: http://ftp.icpdas.com/pub/cd/iocard/pci/napdos/pci/pci-p16r16/manual/

➢ **Linux Driver**

Operating System	**Linux Kernel 2.4.x/2.6.x/3.12.x**
Driver Name	**lxpci.tar.gz**
CD-ROM	CD:\\NAPDOS\Linux\
Web site	http://ftp.icpdas.com/pub/cd/iocard/pci/napdos/linux/
Installing Procedure	For detailed information about how to install the Linux driver, refer to the readme.txt file that can be found in the **\NAPDOS\Linux** folder on the companion CD.

5.2 Plug and Play Driver Installation

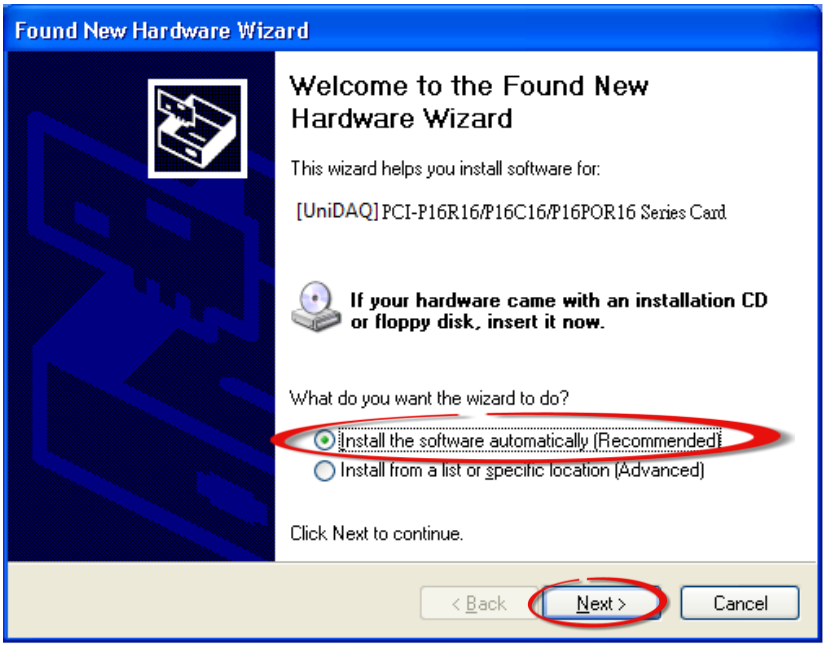
Step 1: Correctly shut down and power off your computer and disconnect the power supply, and then install the PCI-P16R16 Series board into the computer.

For detailed information about the hardware installation of the PCI-P16R16 Series board, refer to Chapter 4 Hardware Installation.

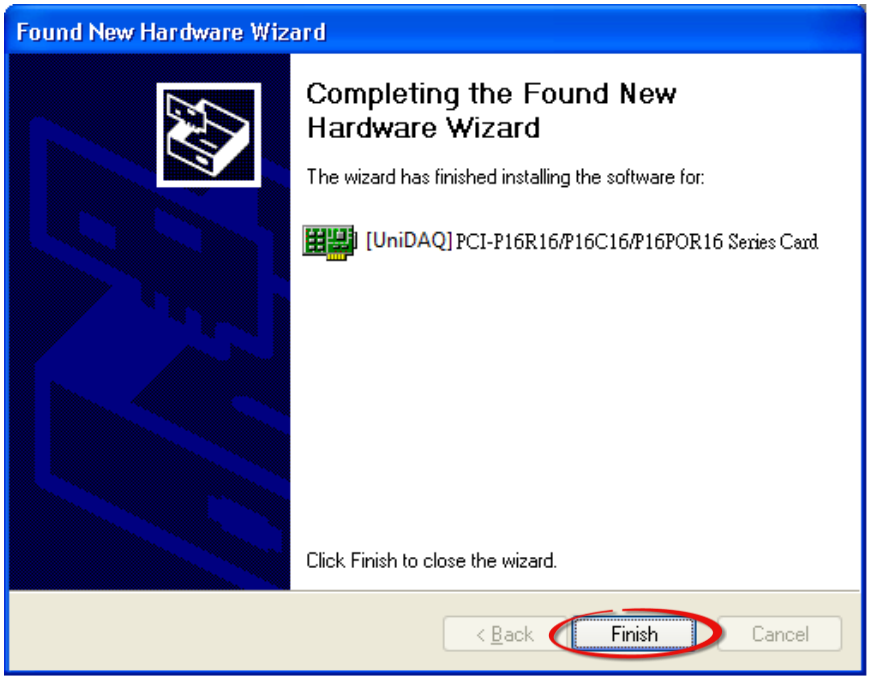
Step 2: Power on the computer and complete the Plug and Play installation**.**

Note: More recent operating systems, such as Windows 7/8 will automatically detect the new hardware and install the necessary drivers etc., so Steps 3 to 5 can be skipped.

Step 3: Select **"Install the software automatically [Recommended]"** and click the **"Next>"** button.



Step 4: Click the **"Finish"** button.



Step 5: Windows pops up **"Found New Hardware"** dialog box again.

5.3 Verifying the Installation

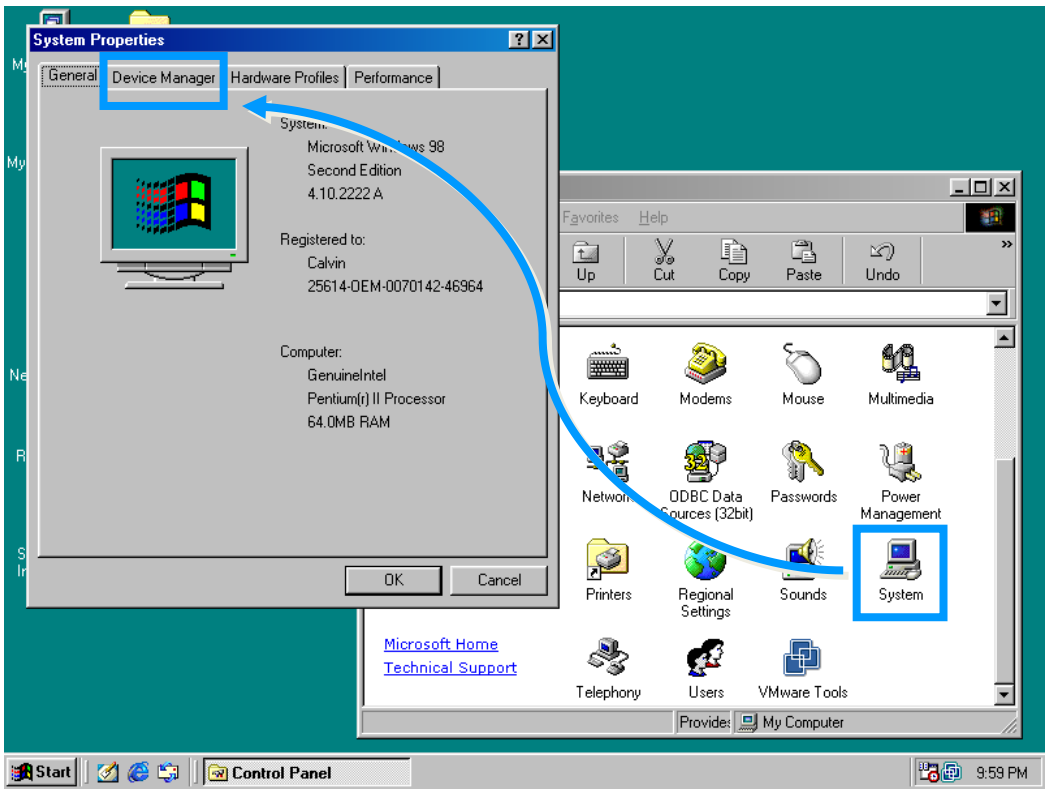
To verify that the driver was correctly installed, use the Windows **Device Manager** to view and update the device drivers installed on the computer, and to ensure that the hardware is operating correctly. The following is a description of how access the Device Manager in each of the major versions of Windows. Refer to the appropriate description for the specific operating system to verify the installation.

5.3.1 Accessing Windows Device Manager

■ Windows 95/98/ME

Step 1: Either right-click the **"My Computer"** icon on the desktop and then click **"Properties"**, or open the **"Control Panel"** and double-click the **"System"** icon to open the System Properties dialog box.

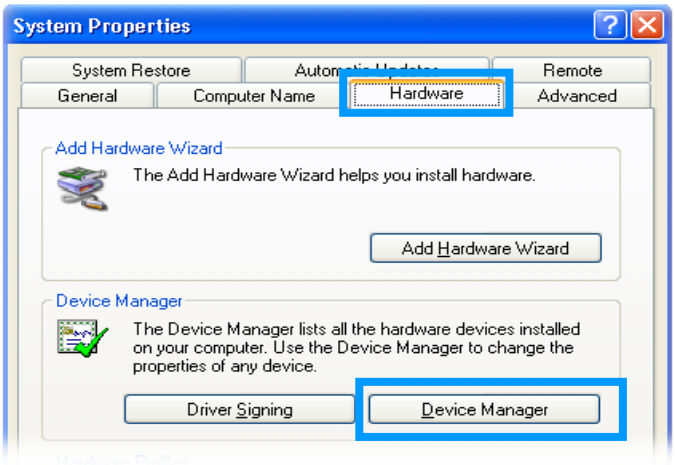
Step 2: In the **System Properties** dialog box, click the "**Device Manager**" tab.



■ Windows 2000/XP

Step 1: Click the "**Start**" button and then point to "**Settings**" **and click** "**Control Panel**". Double-click the "**System**" icon to open the **"System Properties"** dialog box.

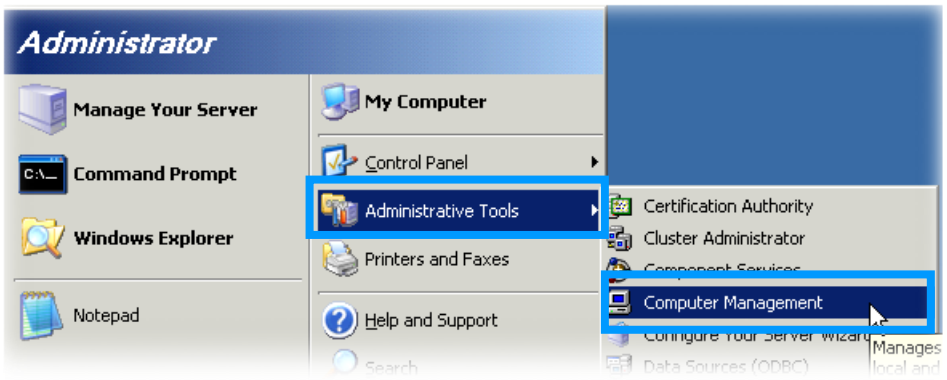
Step 2: Click the "**Hardware**" tab and then click the "**Device Manager**" button.



■ Windows Server 2003

Step 1: Click the **"Start"** button and point to **"Administrative Tools"**, and then click the **"Computer Management"** option.

Step 2: Expand the **"System Tools"** item in the console tree, and then click **"Device Manager"**.



■ Windows Vista/7

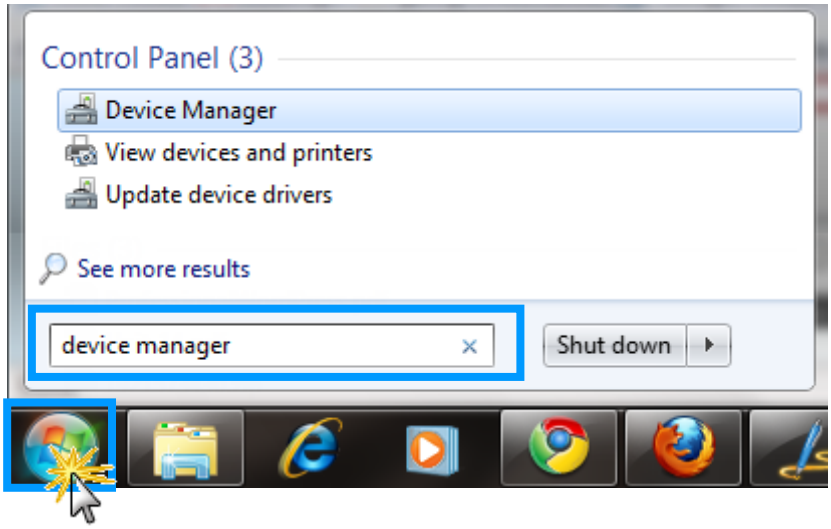
Step 1: Click the **"Start"** button, and then click **"Control Panel"**.

Step 2: Click **"System and Maintenance"**, and then click **"Device Manager"**.

Alternatively,

Step 1: Click the **"Start"** button.

Step 2: In the **Search field,** type **Device Manager** and then press Enter.



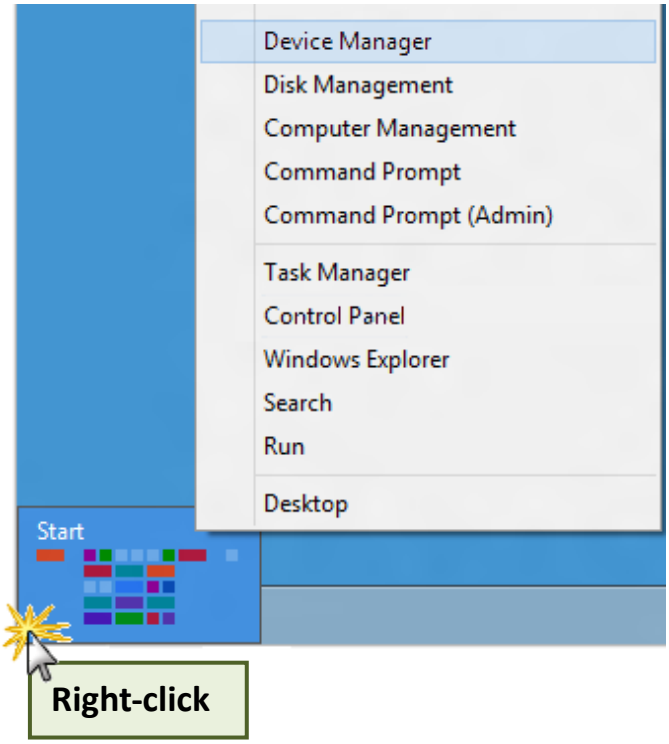
Note that Administrator privileges are required for this operation. If you are prompted for an administrator password or confirmation, enter the password or provide confirmation by clicking the "Yes" button in the User Account Control message.

■ Windows 8

Step 1: To display the **Start screen icon** from the desktop view, hover the mouse cursor over the **bottom-left corner** of screen.

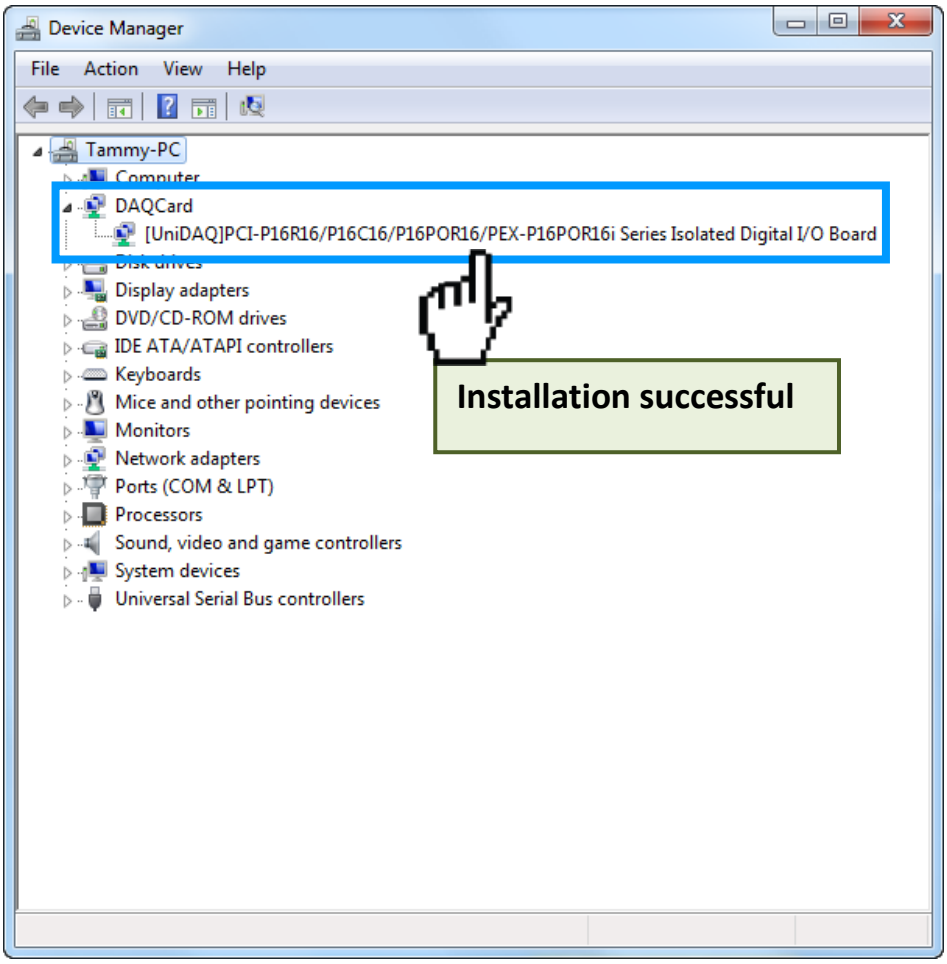
Step 2: **Right-click** the Start screen icon and then click "**Device Manager"**.

Alternatively, press **[Windows Key] +[X]** to open the Start Menu, and then select Device Manager from the options list.



5.3.2 Check the Installation

Check that the PCI-P16R16 Series card is correctly listed in the Device Manager, as illustrated below.



6 Testing the PCI-P16R16 Series Card

This chapter provides detailed information about the “Self-Test” process, which is used to confirm that the PCI-P16R16 Series card is operating correctly. Before beginning the “Self-Test” process, ensure that both the hardware and driver installation procedures are fully completed. For detailed information about the hardware and driver installation, refer to Chapter 4 Hardware Installation and Chapter 5 Software Installation.

6.1 Self-Test Wiring

The following is a description of how to configure the wiring in order to perform the “Self-Test” procedures for the Digital Input and Digital Output. Refer to the appropriate descriptions for PCI-P16R16 Series cards in Sections 6.1.1 to 6.1.3 for more detailed information.

Before beginning the “Self-Test” procedure, ensure that the following items are available:

☑ A CA-3710 Cable
(Optional, Website: http://www.icpdas.com/products/Accessories/cable/cable_selection.htm)

☑ A DN-37 Terminal Board
(Optional, Website:
http://www.icpdas.com/root/product/solutions/pc_based_io_board/daughter_boards/dn-37.html)

☑ An External power supply device, such as the DP-665
(Optional, Website:
http://www.icpdas.com/root/product/solutions/accessories/power_supply/dp-665.html)

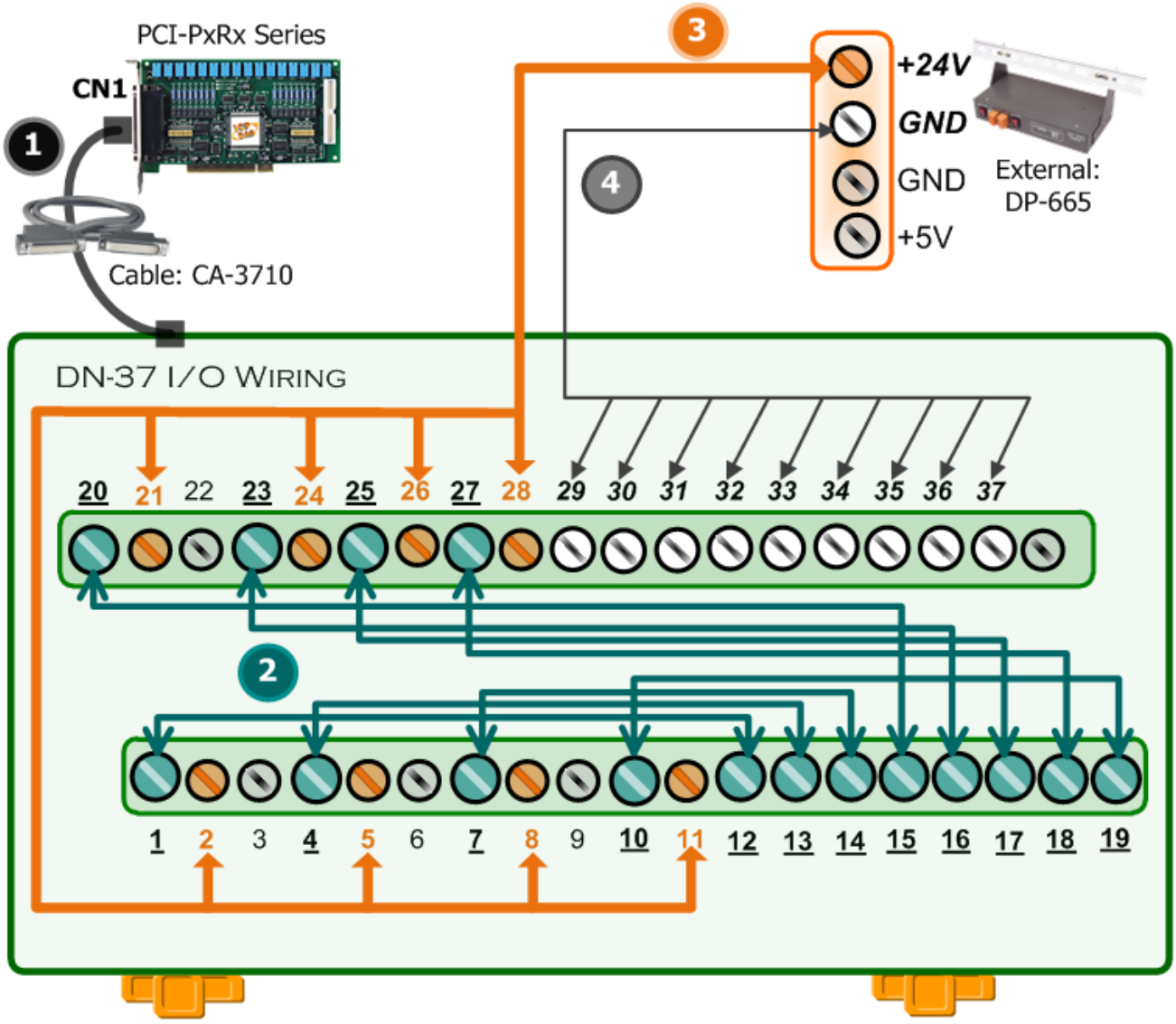
6.1.1 PCI-P8R8(U)/P16R16(U) Test Wiring

Step 1: Connect the DN-37 to the CN1 connector on the board using the CA-3710 cable.

Step 2: Connect the **NO(0…7) pins** to the **DIA(0…7) pins**.
(i.e., connect Pin1/4/7/20/23/25/27/10 to Pin12/13/14/15/16/17/18/19)

Step 3: Connect the **External Power Supply (+24 V)** to the **COM0…COM7 pins** (Pin2/5/8/21/24/26/28/11) .

Step 4: Connect the **External Power Supply GND** to the **DIB0…DIB7 pins**(Pin30/31/32/33/34/35/36/37).
Connect the **External Power Supply GND** to the **GND pin** (Pin29).



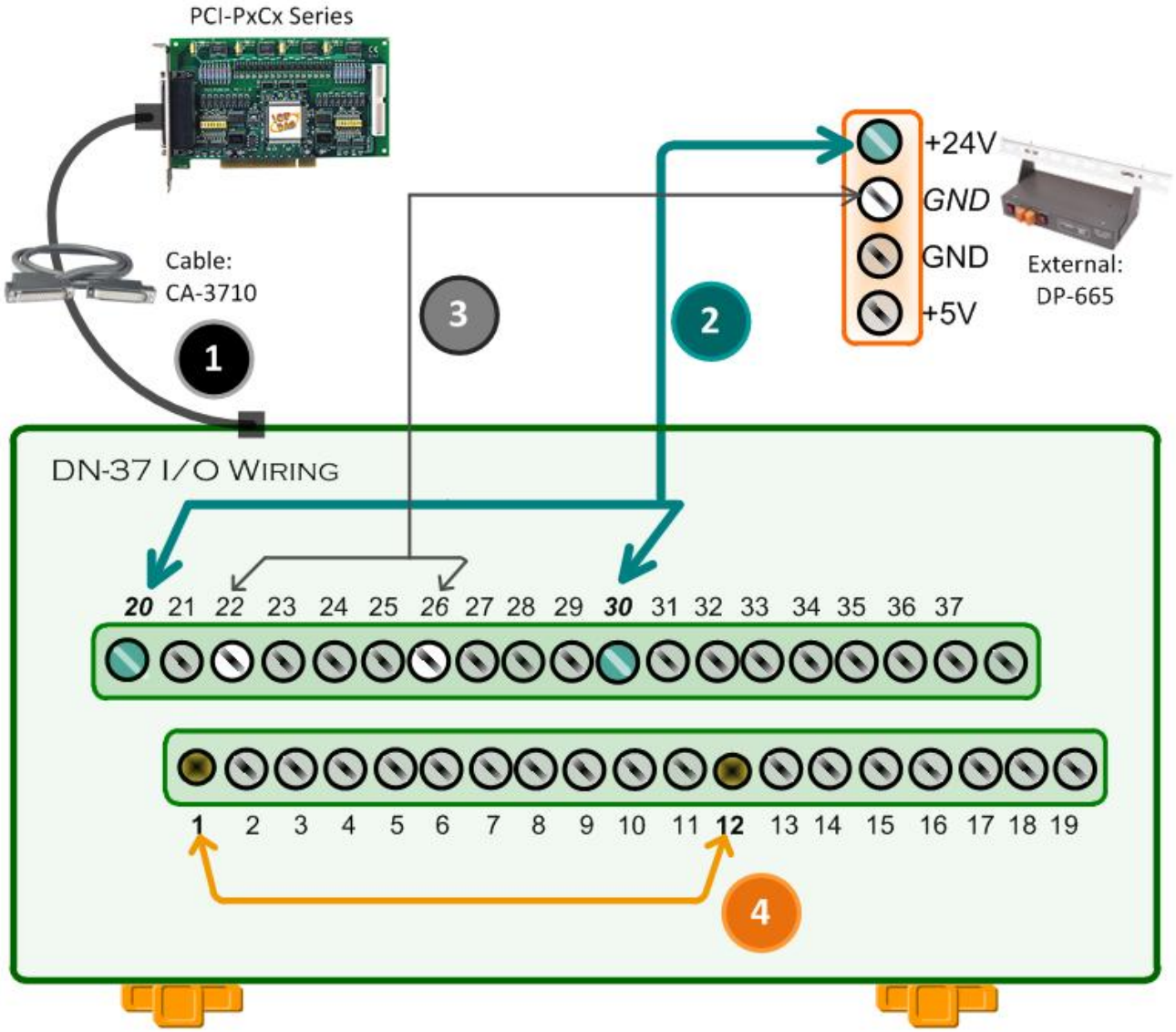
6.1.2 PCI-P16C16(U) Test Wiring

Step 1: Connect the DN-37 to the CN1 connector on the board using the CA-3710 cable.

Step 2: Connect the **External Power Supply (+24 V)** to the **CON1.Ext.Power1 pin** (Pin20) and the **CON1.DIB0 pin** (Pin30).

Step 3: Connect the **External Power Supply GND** to the **CON1.GND1 pin** (Pin22) and **CON1.GND2 pin** (Pin26).

Step 4: Connect the **CON1.OUT0 pin** (Pin1) to the **CON1.DIA0 pin** (Pin12).



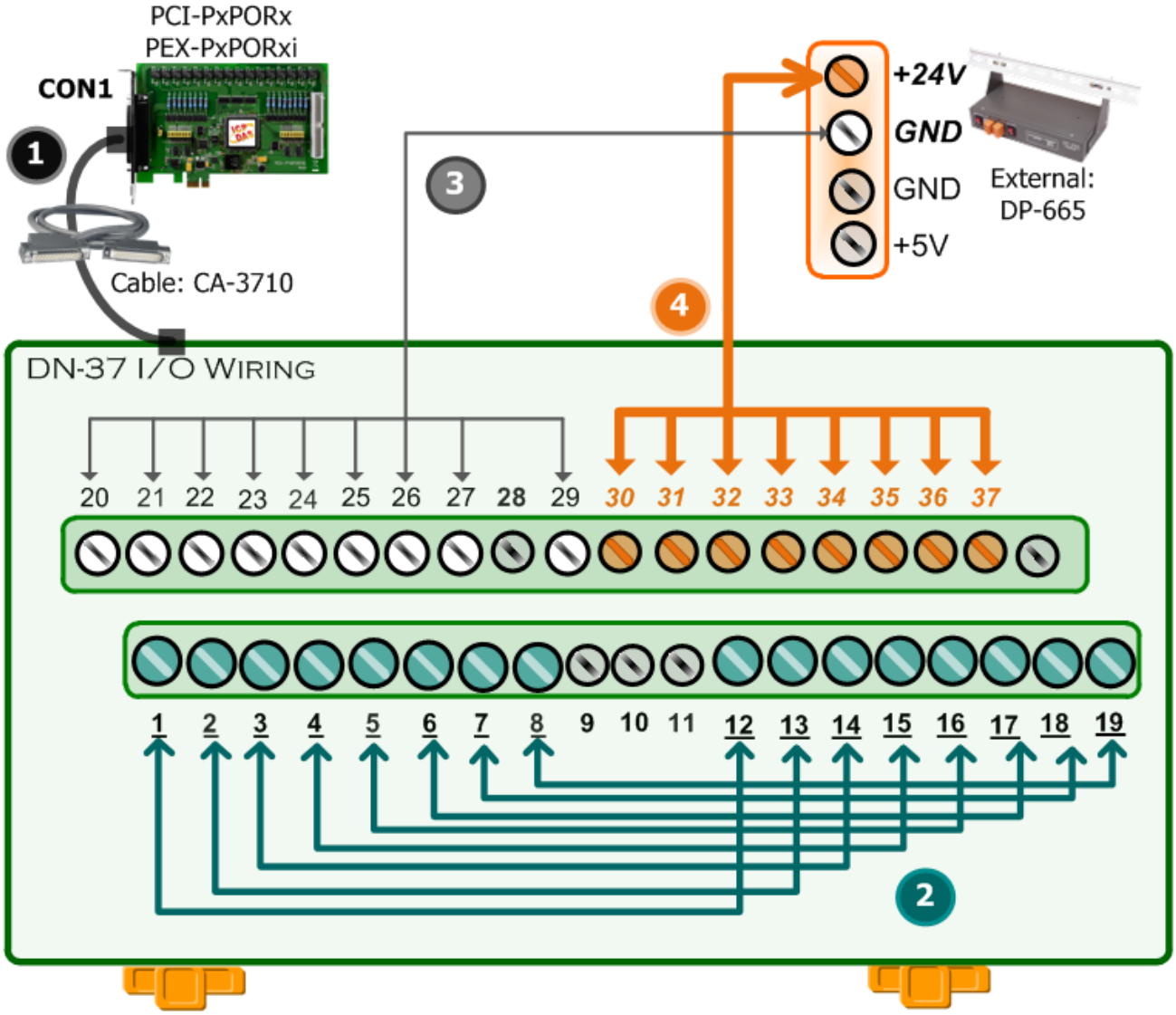
6.1.3 PCI-P16POR16(U) and PEX-P8POR8i/P16POR16i Test Wiring

Step 1: Connect the DN-37 to the **CON1** connector on board using the CA-3710 cable.

Step 2: Connect the **NO(0…7) pins** to the **DIA(0…7) pins**.
(i.e., connect Pin1/2/3/4/5/6/7/8 to Pin12/13/14/15/16/17/18/19)

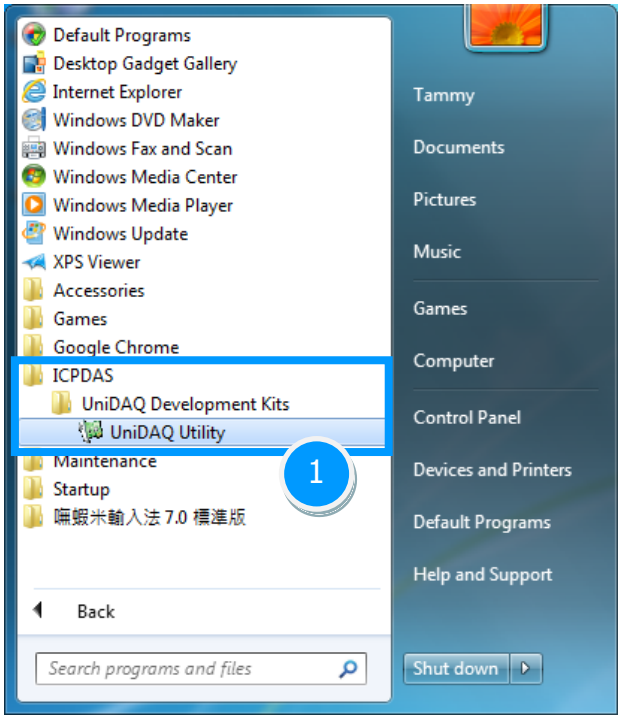
Step 3: Connect the **External Power Supply GND** to the **CM0…CM7 pins** (Pin20/21/22/23/24/25/26/27).
Connect the **External Power Supply GND** to the **GND pin** (Pin29).

Step 4: Connect the **External Power Supply (+24 V)** to the **DIB0…DIB7 pins** (Pin30/31/32/33/34/35/36/37).



6.2 Execute the Test Program

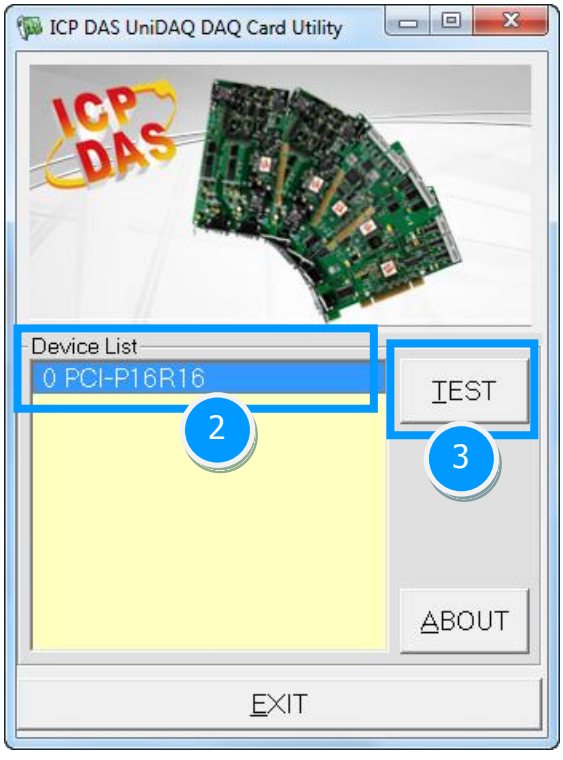
After installation, the UniDAQ Utility will be located in the default folder (C:\ICPDAS\UniDAq\Driver\). Use the procedure described below to perform the "Self-Test".



Step 1: In Windows 7, click the "**Start**" button point to **"All Programs"** and then click the **"ICPDAS"** folder. Point to **"UniDAQ Development Kits"**and then click the **"UniDAQ Utility**" to execute the UniDAQ Utility Program.

Step 2: Confirm the PCI-P16R16 Series card has been successfully installed in the Host system. Note that the device numbers start from 0.

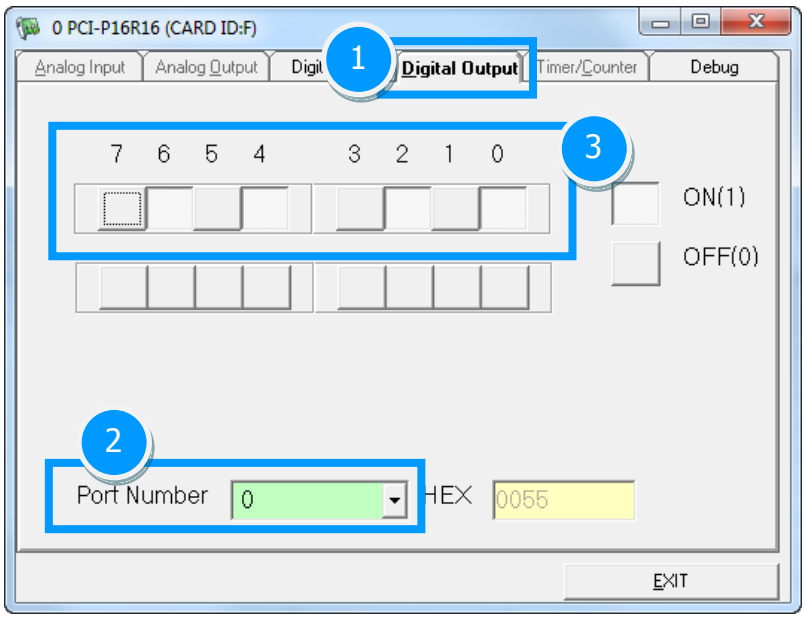
Step 3: Click the **"TEST"** button to start the test.



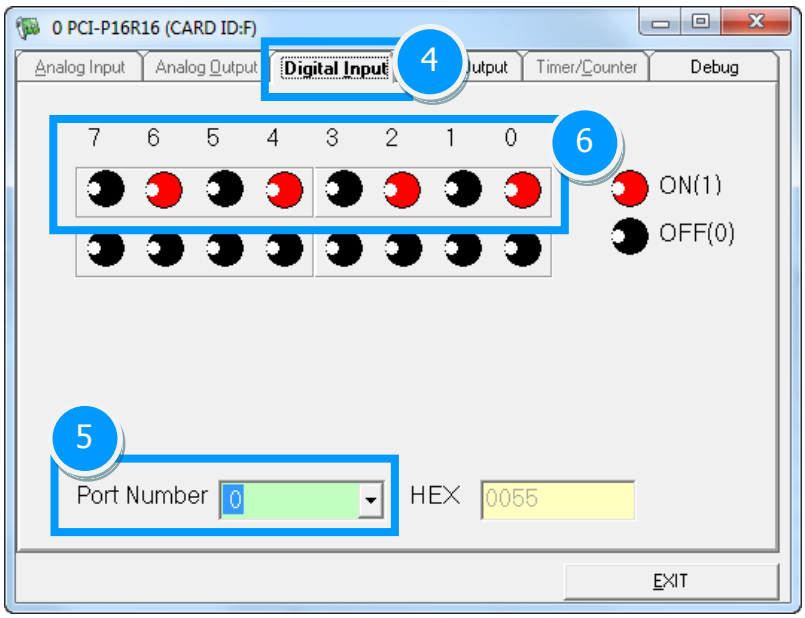
6.2.1 PCI-P8R8(U)/P16R16(U)/P16POR16(U) and PEX-P8POR8i/P16POR16i

Step 4: Check the results of the **Digital Input/Output** functions test result.

1. Click the **"Digital Output"** tab.
2. Select **"Port0"** from the **"Port Number"** drop-down menu.
3. Checkmark in **channels 0, 2, 4 and 6**.



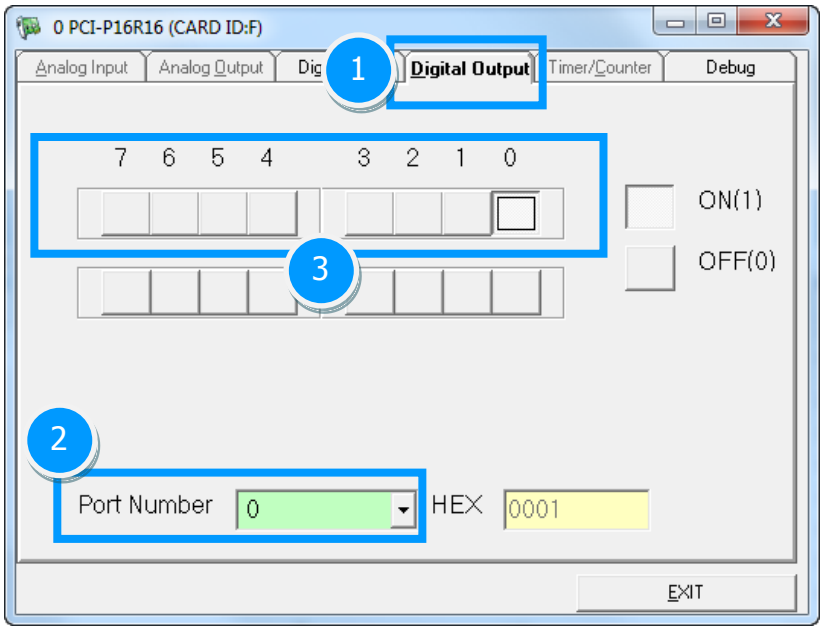
4. Click the **"Digital Input"** tab.
5. Select **"Port0"** from the **"Port Number"** drop-down menu.
6. The corresponding DI indicators will turn **red** when the corresponding DO channels 0, 2, 4 and 6 are **ON**.



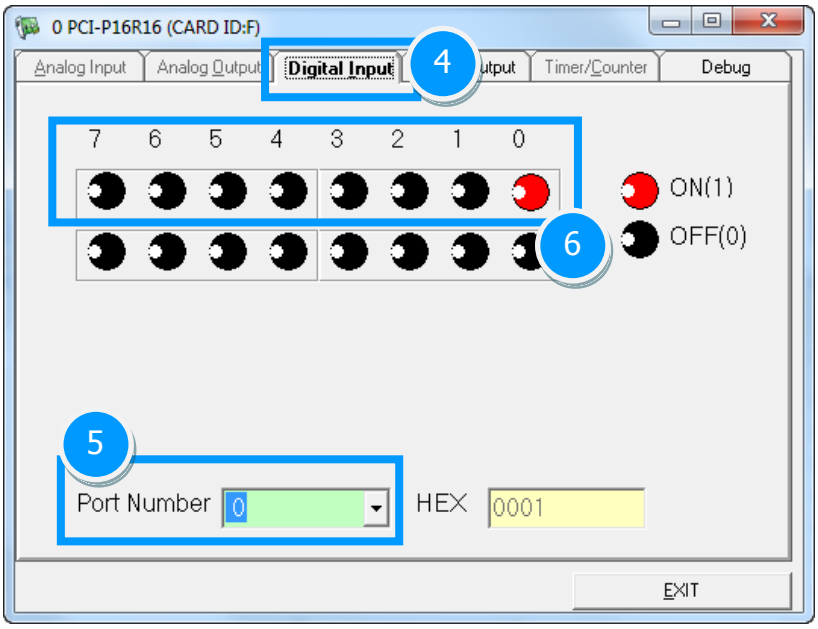
6.2.2 PCI-P16C16(U)

Step 4: Check the results of the **Digital Input/Output** functions test.

1. Click the **"Digital Output"** tab.
2. Select **"Port0"** from the **"Port Number"** drop-down menu.
3. Check the checkboxes for **channels 0**.



4. Click the **"Digital Input"** tab.
5. Select **"Port0"** from the **"Port Number"** drop-down menu.
6. The DI indicators will turn **red** when the corresponding DO channel 0 is **ON**.



7 I/O Control Registers

7.1 Determining the I/O Address

During the power-on stage, the Plug and Play BIOS will assign an appropriate I/O address to each PCI-P16R16 Series card installed in the system. Each card includes four fixed ID numbers that are used to identify the card, and are indicated below:

Model	PCI-P8R8 PCI-P8R8U PEX-P8POR8i	PCI-P16R16 PCI-P16R16U PCI-P16C16 PCI-P16C16U PCI-P16POR16 PCI-P16POR16U PEX-P16POR16i
Vendor ID	0x1234	0x1234
Device ID	0x0808	0x1616
Sub-Vendor ID	0x0000	0x0000
Sub-Device ID	0x0000	0x0000

7.1.1 PIO_PISO Utility

The PIO_PISO Utility is a useful tool that is applicable to all PIO/PISO Series cards. The Utility can be used to detect all ICPDAS I/O cards installed in the system and display detailed information for the card. Detail of how to identify the ICPDAS PCI-P16R16 Series card based on the **Sub-vendor, Sub-device and Sub-Aux ID** information are provided in the table in Section 7.1 above. The Utility is also useful for testing whether the Plug and Play driver functions for the PIO or PISO Series card were successfully initialized when the computer was booted up. If the card is not detected correctly, install the card into a different PCI slot and reboot the computer.

The PIO_PISO Utility can be used to obtain the following information:

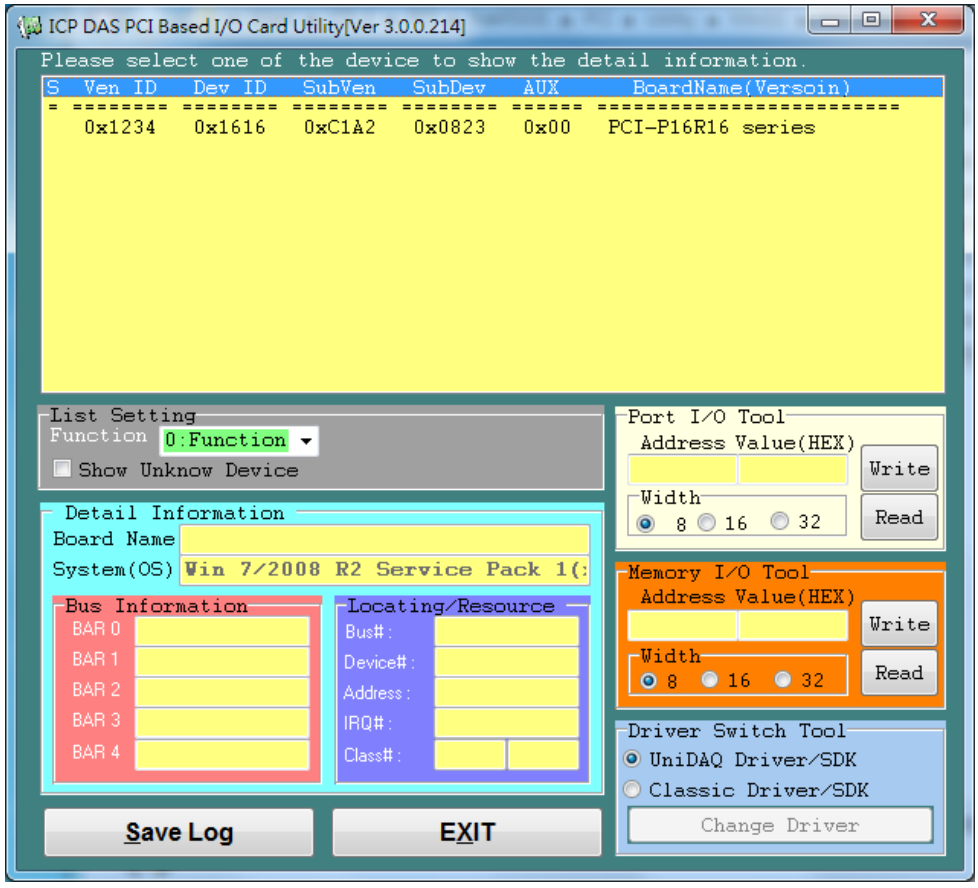
- A list of all PIO/PISO cards currently installed in the system
- A list of all resources allocated to each PIO/PISO card
- A list of the wSlotBus and wSlotDevice information that can be used for identification of specific PIO/PISO cards

➢ For Windows Operating Systems

The installation files for the **PIO_PISO Utility for Windows** can be obtained from:

	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 system will be displayed, as illustrated below:



➢ For DOS

The installation files for the **PIO_PISO Utility for DOS** can be obtained from:

CD:\NAPDOS\PCI\Utility\DOS\

http://ftp.icpdas.com/pub/cd/iocard/pci/napdos/pci/utility/dos/

The following is the source code for the PIO_PISO DOS program:

```
/* ------------------------------------------------------------------------ */
/* Detect all PIO_PISO series cards installed in this system */
/* Step 1: Install all PIO_PISO cards into the PC            */
/* Step 2: Run the PIO_PISO.EXE                              */
/* ------------------------------------------------------------------------ */

#include "PIO.H"

WORD wBase,wIrq;
WORD wBase2,wIrq2;

int main()
{
int    i,j,j1,j2,j3,j4,k,jj,dd,j11,j22,j33,j44;
WORD wBoards,wRetVal;
WORD wSubVendor,wSubDevice,wSubAux,wSlotBus,wSlotDevice;
char c;
float ok,err;

clrscr();
wRetVal=PIO_DriverInit(&wBoards,0xff,0xff,0xff);      /*for PIO-PISO */
printf("\nThrer are %d PIO_PISO Cards in this PC",wBoards);
if (wBoards==0 ) exit(0);

printf("\n-----------------------------------------------------");
for(i=0; i<wBoards; i++)
     {
     PIO_GetConfigAddressSpace(i,&wBase,&wIrq,&wSubVendor,
                         &wSubDevice,&wSubAux,&wSlotBus,&wSlotDevice);

     printf("\nCard_%d:wBase=%x,wIrq=%x,subID=[%x,%x,%x],
                         SlotID=[%x,%x]",i,wBase,wIrq,wSubVendor,wSubDevice,
                         wSubAux,wSlotBus,wSlotDevice);
     printf(" --> ");
     ShowPioPiso(wSubVendor,wSubDevice,wSubAux);
     }

PIO_DriverClose();
}
```

7.2 I/O Address Mapping

The first 16 double words of the configuration space for a PCI device are referred to as the device's configuration region. Within these 16 (0-15) double words, the double words 04, 05, 06, 07, 08 and 09 are referred to as Base Address0, Base Address1, Base Address2, Base Address3, Base Address4 and Base Address5. More detailed information about these 16 double words can be found by referring to the book **Plug & Play System Architecture** (Tom Shanley-MindShare Inc., Addison-Wesley Publishing Company, 1995).

These Base Addresses are utilized as control registers and/or I/O registers for many data acquisition boards. On PCI-P16R16 Series cards, Base Address2 is utilized as the base address for the Digital Input and Digital Output.

The address of each register can be determined by simply adding the offset value to the base address of the corresponding section. More detailed descriptions of each register can be found in the following sections and also in the PCI-P16R16 Series Classic Driver software manual, can be downloaded from: http://ftp.icpdas.com/pub/cd/iocard/pci/napdos/pci/pci-p16r16/manual/. The following is an overview of the registers for PCI-P16R16 Series cards and their function:

➢ **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 DO Readback	R	16-bit
	0x3C	Read Card ID	R	16-bit

Note: For detailed information related to the program code used to read the configuration space (Base Addresses 0 to 5) information for PCI-P16R16 Series cards, refer to Appendix A2. Configuration Address Space Program Code.

7.2.1 Digital Input/Digital Output

The following is a sample of the code used to access the Digital Input/Output functions on PCI-P16R16 Series cards:

```
// DIO functions for PCI-P16R16(U)/P16C16(U)/P16POR16(U) and PEX-P16POR16i Series cards

void      P16R16_DO(WORD BaseAddr, WORD wOutData)
{
          outport (BaseAddr, wOutData);
}

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

```
// DIO functions for PCI-P8R8(U) and PEX-P8POR8i Series cards

void      P8R8_DO(WORD BaseAddr, WORD wOutData)
{
          outportb(BaseAddr, wOutData);
}

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

Note: For detailed information related to the Digital I/O program code used for PCI-P16R16 Series cards, refer to Appendix A1. Digital I/O Functions Program Code.

7.2.2 DO Readback Register

The DO Readback register is used to read the Digital Output value and the format is as follows:

- **(Read) BaseAddr +0x0C**

Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0

The following is a sample of the code used to read the Digital Output:

```
// DO Readback function for PCI-P16POR16U and PEX-P8POR8i/P16POR16i Series cards

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

Note that the DO Readback function is only supported by PEX-P8POR8i/P16POR16i Series cards (Version 1.0 or above).

7.2.3 Card ID Register

The Card ID register is used to read the Card ID that was set using DIP Switch SW1 (See Section 2.3 for more details), and the format is as follows:

- **(Read) BaseAddr +0x3C**

x	x	x	x	Bit3	Bit2	Bit1	Bit0

The following is a sample of the code used to read the Card ID:

```
// Card ID function for PEX-P8POR8i/P16POR16i, PCI-P8R8U/P16R16U, PCI-P16POR16U and
PCI-P16C16U Series cards

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

Note that the Card ID function is only supported by PEX-P8POR8i/P16POR16i (Version 1.0 or above), PCI-P8R8U/P16R16U, PCI-P16POR16U and PCI-P16C16U Series cards.

8 Demo Programs

PCI-P16R16 Series card provides Digital Input/Output demo programs, together with the source code for the library, that can be used in either a Windows or a DOS environment, based on a variety of programming languages, including TC/BC/MSC (DOS), Borland C++, Delphi, Visual Basic, Visual C, VB.NET 2005, and C#.NET2005, etc. (Windows).

Detailed information about the demo programs is provided below.

Sample Program	UniDAQ SDK/Driver	PCI-P16R16 Series Class Driver	DOS
TC	-	-	✓
BC	-	-	✓
MSC	-	-	✓
Borland C++ Builder 3	-	✓	-
Borland C++ Builder 6			-
Delphi 3	-	✓	-
Delphi 6	✓	-	-
Visual Basic 6	✓	✓	-
Visual C++ 6	✓	✓	-
VB.NET 2005 (32-bit)	✓	✓	-
VB.NET 2005 (64-bit)	✓	-	-
C#.NET 2005 (32-bit)	✓	✓	-
C#.NET 2005 (64-bit)	✓	-	-
VC.NET 2005 (32-bit)	✓	-	-
VC.NET 2005 (64-bit)	✓	-	-
MATLAB	✓	-	-
LabVIEW	✓	✓	-

Appendix

A1. Digital I/O Functions Program Code

- The code used to access the Digital Input/Output functions for PCI-P8R8/P8R8U and PCI-P16R16/P16R16U Series cards is 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;
}
```

A2. Configuration Address Space Program Code

- The following code can be used to read the six base addresses for PCI-P16R16 and PCI-P8R8. This code is based on the PCI **Plug and Play** mechanism 2.

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

   wTotalBoards=0;     /* Initial number of boards 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 Board Type Name ID --------*/
  wConfigSpace[wTotalBoards][6]=TYPE_P16R16;
```

```
/*-----------------------------------------*/
        wTotalBoards++;    /* Increment number of boards */
        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 Board Type Name ID --------*/
              wConfigSpace[wTotalBoards][6]=TYPE_P8R8;

              wTotalBoards++;    /* Increment the number of boards */
              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);
 }
```