PIO-D144/D168 Series Card
User Manual

144/168-channel OPTO-22 compatible DIO board   Version 3.1, Jul. 2013

SUPPORTS

Board includes PIO-D144, PIO-D144U, PIO-D144LU, PIO-D168, PIO-D168A and PIO-D168U.

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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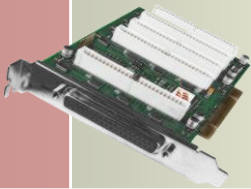Email: service@icpdas.com, service.icpdas@gmail.com

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1. Introduction

The PIO-D144(L)U/D168U card is a new generation product provided by ICP DAS to meet RoHS compliance requirements. The new PIO-D144(L)U/D168U card is designed as a drop-in replacement for the PIO-D144/D168, and users can directly replace the PIO-D144/D168 with the PIO-D144(L)U/D168U without the need for software/driver modification.

The PIO-D144(L)U/D168U universal PCI card supports the 3.3 V/5 V PCI bus, while the PIO-D144/D168 supports the 5 V PCI bus. These cards provide 144/168 TTL digital I/O lines, and these lines are grouped into eighteen 8-bit bi-directional ports. Every three ports on a connector are grouped and named as Port A (PA), Port B (PB) and Port C (PC), respectively. All ports are configured as inputs upon power-up or reset.

The PIO-D144(L)U/D168U also includes an onboard Card ID switch. Once the Card ID is set, the board can be identified by the software when using more than one PIO-D144(L)U/D168U cards in a single computer based on the ID.

These cards support various OS versions, such as Linux, DOS, Windows 98/NT/2000 and 32-bit/64-bit Windows XP/2003/Vista/7/8. DLL and Active X control together with various language sample programs based on Turbo C++, Borland C++, Microsoft C++, Visual C++, Borland Delphi, Borland C++ Builder, Visual Basic, C#.NET, Visual Basic.NET and LabVIEW are provided in order to help users quickly and easily develop their own applications.

1.1 Packing List

The shipping package includes the following items:

- One PIO-D144/D168 series card hardware
- One printed Quick Start Guide
- One software utility CD
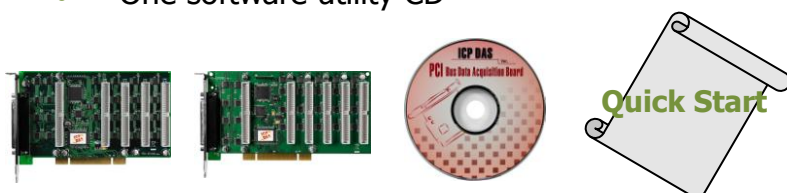
Quick Start

1.2 Features

- Support the +5V PCI bus for PIO-D144/168
- Support the +3.3/+5 V PCI bus for PIO-D144U/D144LU/D168U
- 144 channels of digital I/O for PIO-D144 series
- 168 channels of digital I/O for PIO-D168 series
- Bi-direction programmable I/O ports under software control
- Output status Readback function
- Each port consists of three 8-bit ports, PA, PB and PC in every connector
- Connects directly to DB-24P, DB-24R, DB-24PR, DB-24SSR, DB-24POR any other OPTO-22 Compatible daughter boards
- 4 Interrupt source: P2C0, P2C1, P2C2, P2C3
- Card ID function for PIO-D144(L)U/D168U
- PIO-D144 series: Five 50-pin flat cable connectors and one 37-pin connector
- PIO-D168 series: Six 50-pin flat cable connectors and one 37-pin connector
- DIO response time is about 0.77 μs (1.3 MHz max.)
- Double side SMT, short card, power saving

1.3   Specifications

1.3.1   PIO-D144/D144U/D144LU

Model Name	PIO-D144	PIO-D144U	PIO-D144LU
Programmable Digital I/O			
Channels	144		
Digital Input			
Compatibility	5 V/TTL		5 V/CMOS
Input Voltage	Logic 0: 0.8 V max. Logic 1: 2.0 V min.		
Response Speed	1.2 MHz (Typical)		
Digital Output			
Compatibility	5 V/TTL		5 V/CMOS
Output Voltage	Logic 0: 0.4 V max. Logic 1: 2.4 V min.		Logic 0: 0.1 V max. Logic 1: 4.4 V min.
Output Capability	Sink: 64mA @ 0.8 V Source: 32 mA @ 2.0 V		Sink: 6 mA @ 0.33 V Source: 6 mA @ 4.77 V
Response Speed	1.2 MHz (Typical)		
General			
Bus Type	5 V PCI, 32-bit, 33 MHz	3.3 V/5 V Universal PCI, 32-bit, 33 MHz	
Data Bus	8-bit		
Card ID	No	Yes(4-bit)	
I/O Connector	Female DB37 x 1 50-pin box header x 5		
Dimensions (L x W x D)	180 mm x 105 mm x 22mm		
Power Consumption	600 mA @ +5 V		
Operating Temperature	0 ~ 60 °C		
Storage Temperature	-20 ~ 70 °C		
Humidity	5 ~ 85% RH, non-condensing		

1.3.2   PIO-D168/D168U

Model Name	PIO-D168	PIO-D168U
Programmable Digital I/O		
Channels	168	
Digital Input		
Compatibility	5 V/TTL	
Input Voltage	Logic 0: 0.8 V max. Logic 1: 2.0 V min.	
Response Speed	1.2 MHz (Typical)	
Digital Output		
Compatibility	5 V/TTL	
Output Voltage	Logic 0: 0.4 V max. Logic 1: 2.4 V min.	
Output Capability	Sink: 64mA @ 0.8 V Source: 32 mA @ 2.0 V	
Response Speed	1.2 MHz (Typical)	
General		
Bus Type	5 V PCI, 32-bit, 33 MHz	3.3 V/5 V Universal PCI, 32-bit, 33 MHz
Data Bus	8-bit	
Card ID	No	Yes(4-bit)
I/O Connector	Female DB37 x 1 50-pin box header x 6	
Dimensions (L x W x D)	200 mm x 105 mm x 22mm	
Power Consumption	1300 mA @ +5 V	
Operating Temperature	0 ~ 60 °C	
Storage Temperature	-20 ~ 70 °C	
Humidity	5 ~ 85% RH, non-condensing	

2. Hardware Configuration

2.1 Board Layout
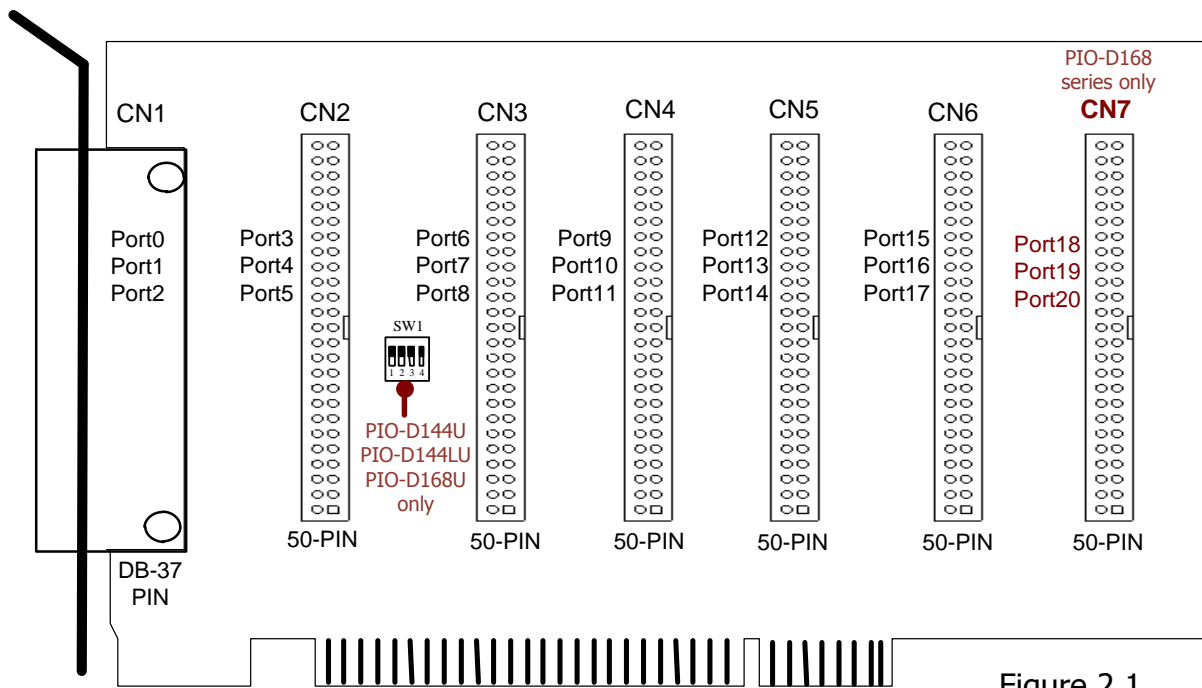
Figure 2.1

Note:

PIO-D144	CN1	**Digital Input/Output Port0 – Port2**
PIO-D144U	CN2	Digital Input/Output Port3 – Port5
PIO-D144LU	CN3	Digital Input/Output Port6 – Port8
PIO-D168	CN4	Digital Input/Output Port9 – Port11
PIO-D168U	CN5	Digital Input/Output Port12 – Port14
	CN6	Digital Input/Output Port15 – Port17
PIO-D168/D168U	CN7	Digital Input/Output Port18 – Port20
PIO-D144(L)U PIO-D168U	SW1	Card ID function

2.2   I/O Port Location

There are 18/21 8-bit I/O ports in the PIO-D144/D168 series. Every port can be independently configured as a D/I or D/O port. When the PC is first powered-on, all ports are set as Digital input ports. Therefore, the user needs to configure these ports as either digital input or output ports before using then in an application. Each I/O port is named as the following table and its location can be found in Figure 2.1.

Table 2.1

Model Name/Connector		PA0 ~ PA 7	PB0 ~PB7	PC0 ~ PC7
PIO-D144 series **PIO-D168 series**	**CN1**	Port0	Port1	Port2
	CN2	Port3	Port4	Port5
	CN3	Port6	Port7	Port8
	CN4	Port9	Port10	Port11
	CN5	Port12	Port13	Port14
	CN6	Port15	Port16	Port17
PIO-D168 series	**CN7**	Port18	Port19	Port20

Refer to Sec. 2.1 for the board layout and I/O port locations.

Note!! Each P2C0, P2C1, P2C2 and P2C3 can be used as an interrupt signal source. Refer to Sec. 2.7 for more information.

2.3   Card ID Switch

The PIO-D144(L)U and PIO-D168U has a Card ID switch (SW1) with which users can recognize the board by the ID via software when using two or more PIO-D144(L)U and PIO-D168U cards in one computer. The default Card ID is 0x0. For detail SW1 Card ID settings, please refer to Table 2.2.
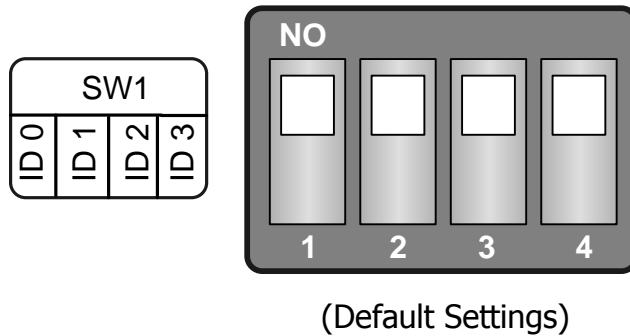
(Default Settings)

Table 2.2   (*) Default Settings; OFF → 1; ON → 0

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

2.4 Pin Assignments

The Pin assignments for all connectors on the PIO-D144 and PIO-D168 series are represented in Figure 2-2. All signal sources for each digital input or output pin (channel) is TTL compatible. **Note: CN7 (Port8 ~ Port20) is only for the PIO-D168 series.**

- CN1: 37-pin D-type female connector (for Port0, Port1, Port2).
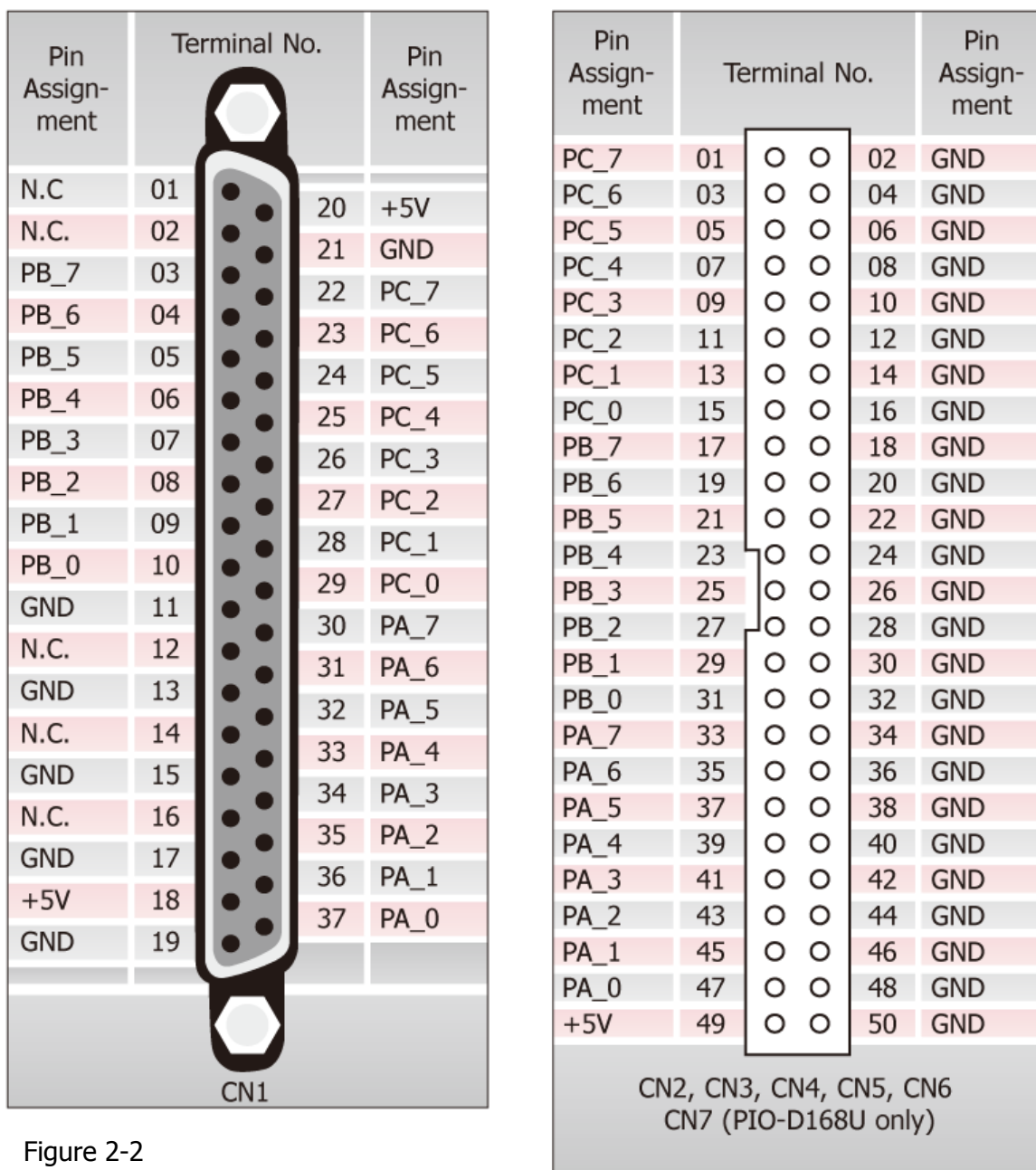- CN2/CN3/CN4/CN5/CN6/CN7: 50-pin flat-cable connector (for Port3 ~ Port20).

Pin Assignment	Terminal No.		Pin Assignment
N.C	01		
N.C.	02	20	+5V
PB_7	03	21	GND
PB_6	04	22	PC_7
PB_5	05	23	PC_6
PB_4	06	24	PC_5
PB_3	07	25	PC_4
PB_2	08	26	PC_3
PB_1	09	27	PC_2
PB_0	10	28	PC_1
GND	11	29	PC_0
N.C.	12	30	PA_7
GND	13	31	PA_6
N.C.	14	32	PA_5
GND	15	33	PA_4
N.C.	16	34	PA_3
GND	17	35	PA_2
+5V	18	36	PA_1
GND	19	37	PA_0

CN1

Pin Assignment	Terminal No.		Pin Assignment
PC_7	01	02	GND
PC_6	03	04	GND
PC_5	05	06	GND
PC_4	07	08	GND
PC_3	09	10	GND
PC_2	11	12	GND
PC_1	13	14	GND
PC_0	15	16	GND
PB_7	17	18	GND
PB_6	19	20	GND
PB_5	21	22	GND
PB_4	23	24	GND
PB_3	25	26	GND
PB_2	27	28	GND
PB_1	29	30	GND
PB_0	31	32	GND
PA_7	33	34	GND
PA_6	35	36	GND
PA_5	37	38	GND
PA_4	39	40	GND
PA_3	41	42	GND
PA_2	43	44	GND
PA_1	45	46	GND
PA_0	47	48	GND
+5V	49	50	GND

CN2, CN3, CN4, CN5, CN6
CN7 (PIO-D168U only)

Figure 2-2

2.5   Enable I/O Operation

When the PC is first turned on, all operations involved with digital I/O channels are disabled. Note that the digital I/O channel of each port is enabled or disabled by the RESET\ signal, refer to Sec. 6.3.1 for more information related to this. The power-on states for all DI/O ports are given as follows:

- D/I/O operations for each port are disabled.
- D/I/O ports are all configured as Digital input ports.
- D/O latch register outputs are all high impedance. (Refer to Sec. 2.6)

The user has to perform some initialization before using these digital I/O ports. The recommended steps are given below:

Step 1: Find the address-mapping for PIO/PISO cards. (Refer to Sec.6.1)

Step 2: Enable all Digital I/O operations. (Refer to Sec. 6.3.1).

Step 3: Select the controlled port. (Refer to Sec. 6.3.8).

Step 4: Send initial value to the D/O latch register for the controlled port (Refer to Sec. Sec. 2.6 and Sec. 6.3.7).

Step 5: Repeat Steps 3 and 4 to initialize the other D/O ports.

Step 6: Configure all digital I/O ports to their expected D/I or D/O function (Refer to Sec. 6.3.9)

For more information on the initial procedure for digital I/O ports, please refer to the DIO demo program.

2.6 D/I/O Architecture

The digital I/O control architecture for the PIO-D144/D168 series is demonstrated in Figure 2.3. The operation method used for the control signal is presented below.

- RESET\ is in the Low-state → all D/I/O operation is disabled
- RESET\ is in the High-state → all D/I/O operation is enabled.
- If D/I/O is configured as a D/I port → D/I= external input signal
- If D/I/O is configured as a D/O port → D/I = read back D/O

If the D/I/O is configured as a D/I port → sending data to a Digital input port will only change the D/O latch register. The latched data will be output when the port is configured as digital output and is activated right away.
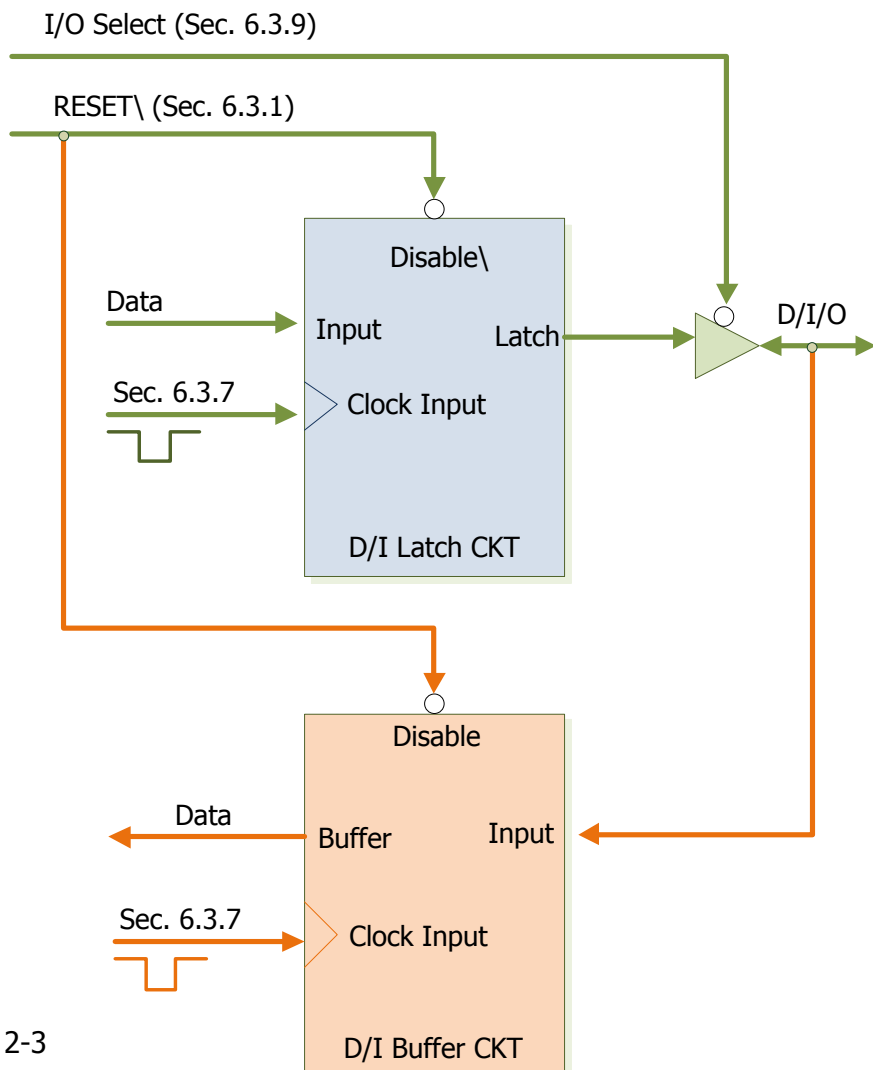

Figure 2-3

2.7　Interrupt Operation

The P2C0, P2C1, P2C2 and P2C3 interrupts pins of the CN1 connector can be used as interrupt signal source. Refer to Sec. 2.1 and Sec. 2.4 for P2C0/P2C1/P2C2/P2C3 location. The interrupt of PIO-D144 and PIO-d168 series is **level-trigger and Active_High**. The interrupt signal can be programmable as **inverted or non-inverted**. The procedures for how to configure the interrupt signal source are given as follows:

1. Make sure **the initial level is high or Low from the signal source**.
2. If the initial state is High, please select the **inverted** setting for interrupt signal source (Sec. 6.3.6). If the initial state is Low, please select the **non-inverted** setting for interrupt signal source (Sec. 6.3.6)
3. Enable the interrupt function (Sec. 6.3.4)
4. If the interrupt signal is active, the interrupt service routine will be started up.

Note that DEMO3.C and DEMO4.C are demo programs for a single interrupt source and DEMO5.C is the demo program for four interrupt sources in the DOS operating system. If only one interrupt signal source is used, the interrupt service routine does not need to identify the interrupt source. (Refer to DEMO3.C and DEMO4.C). However, if there are more than one interrupt source, the interrupt service routine has to identify the active signals in the following manner: (refer to DEMO5.C)

1. Read the new status of the interrupt signal sources.
2. Compare the new status with the old status to identify the active signals.
3. If P2C0 is active, service P2C0 and non-inverter/inverted the P2C0 signal.
4. If P2C1 is active, service P2C1 and non-inverted/inverted the P2C1 signal.
5. If P2C2 is active, service P2C2 and non-inverted/inverted the P2C2 signal.
6. If P2C3 is active, service P2C3 and non-inverted/inverted the P2C3 signal.
7. Update the interrupt status.

Limitation!!

If the interrupt signal is too short, the new status may be the same as the old status. So the interrupt signal must be held active until the interrupt service routine has been executed. This hold time is different for differing operating systems. The hold time can be as short as a micro-second or as long as 1 second. In general, 20 ms is enough for all O.S.

3. Hardware Installation

Note!!

It's recommended to install driver first, since some operating system (such as Windows 2000) may ask you to restart the computer again after driver installation. This reduces the times to restart the computer.

To install your PIO-D144 and PIO-D168 series card, complete the following steps:

Step 1: Installing PIO-D144/D168 series card driver on your computer first.

For detailed information about the driver installation, please refer to Chapter 4 Software Installation.

Step 2: Configuring Card ID by the SW1 DIP-Switch for PIO-D144(L)U and PIO-D168U only.

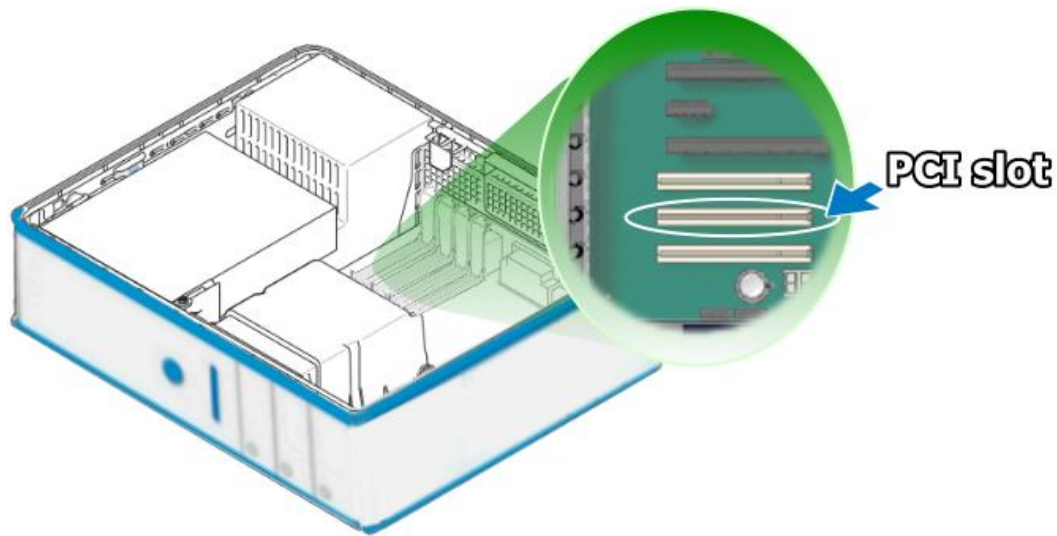For detailed information about the card ID (SW1), please refer to Sec. 2.3 Car ID Switch .

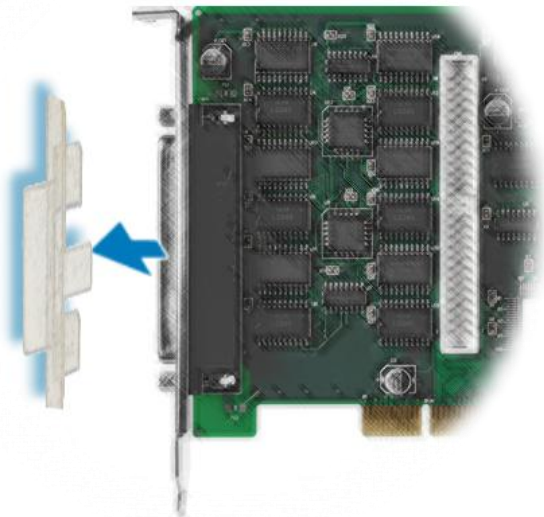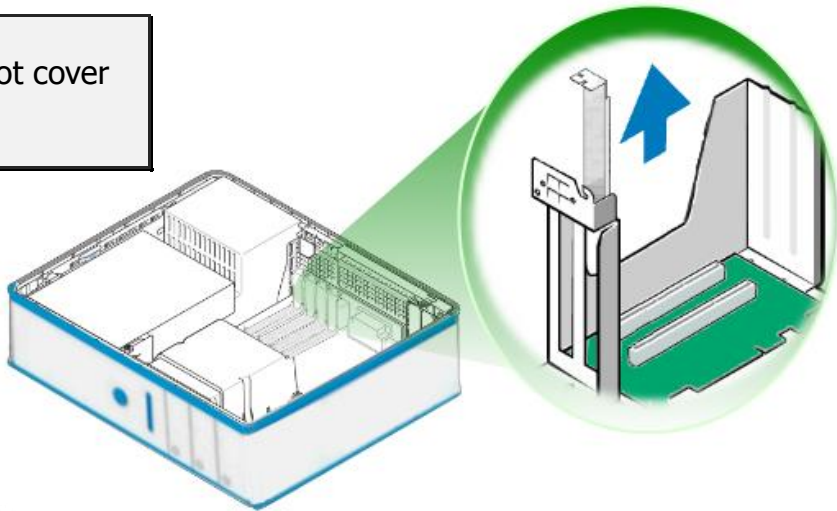Step 3: Shut down and power off your computer.

Step 4: Remove all covers from the computer.
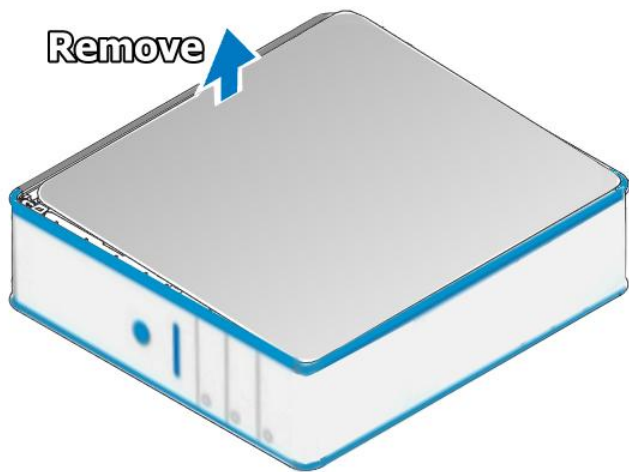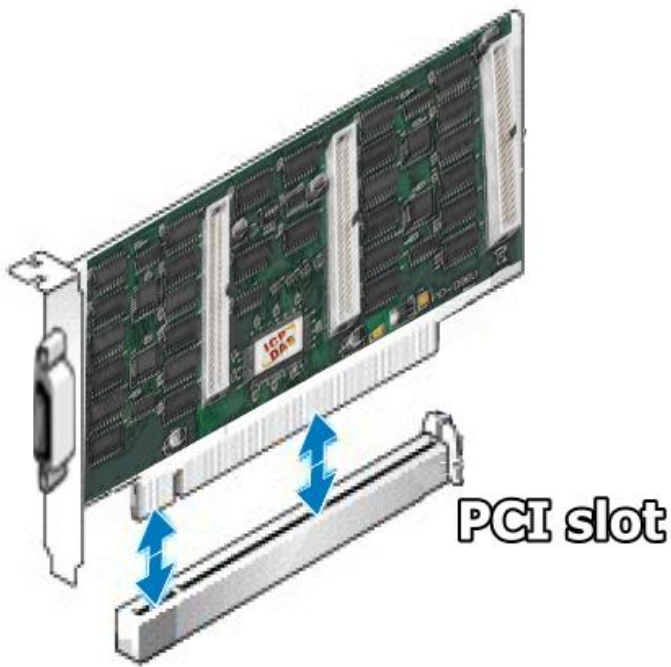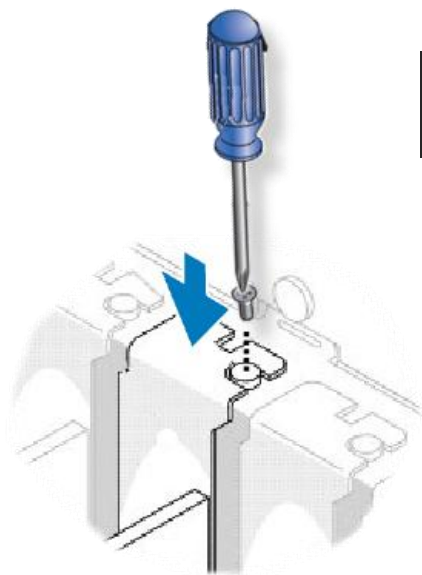

Step 5: Select an empty PCI slot.

Step 6: Remove the PCI slot cover form the PC.

Step 7: Remove the connector cover form the PIO-D144/D168 series card.

Step 8: Carefully insert your PIO-D144/D168 series card into the PCI slot.
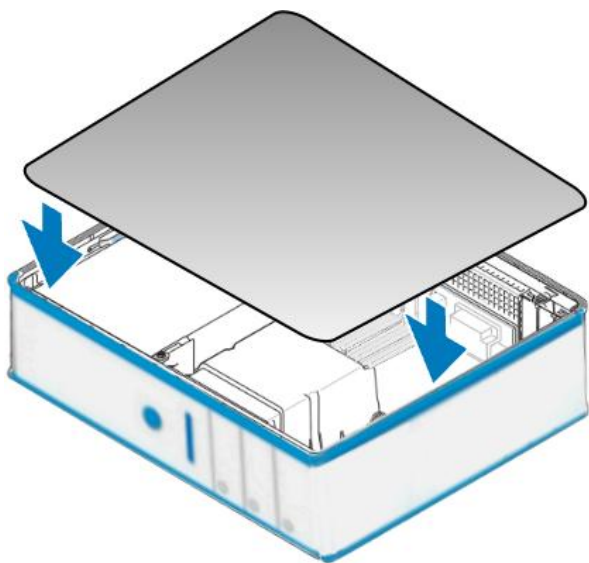
PCI slot

Step 9: Tighten the captive Phillips screw.

Confirm the PIO-D144/D168 series card is mounted on the motherboard.

Step 10: Replace the computer cover.

Step 11: Power on the computer.

Follow the prompt message to finish the Plug&Play steps, please refer to Chapter 4 Software Installation.

4. Software Installation

The PIO-D144/D168 series can be used in DOS, Linux and Windows 98/NT/2K and 32-bit/64-bit Windows XP/2003/Vista/7/8. This chapter shows you the detail steps to install these drivers. The recommended installation procedure for **Windows** is given in Sec. 4.1 ~ 4.3. or refer to Quick Start Guide (CD:\NAPDOS\PCI\PIO-DIO\Manual\QuickStart\).

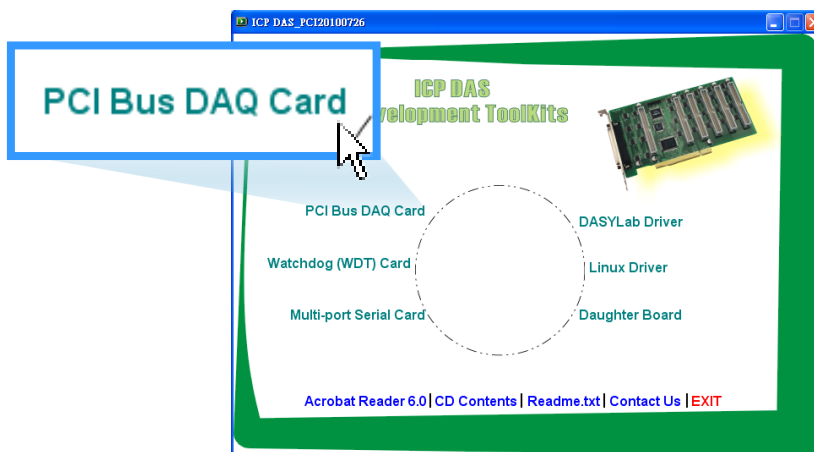## 4.1 Driver Installing Procedure

Follow these steps:

Step 1: Run the companion CD.
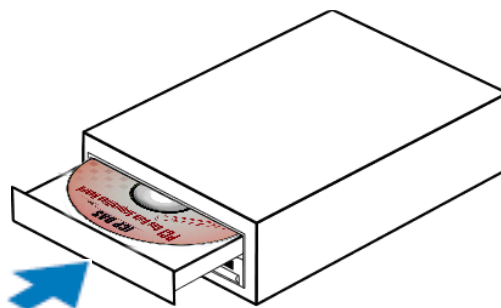
Insert the companion CD into the CD-ROM driver and wait a few seconds until the installation program starts automatically. If it does not start automatically for some reason, then please double-click the file **\NAPDOS\AUTO32.EXE** on the CD.

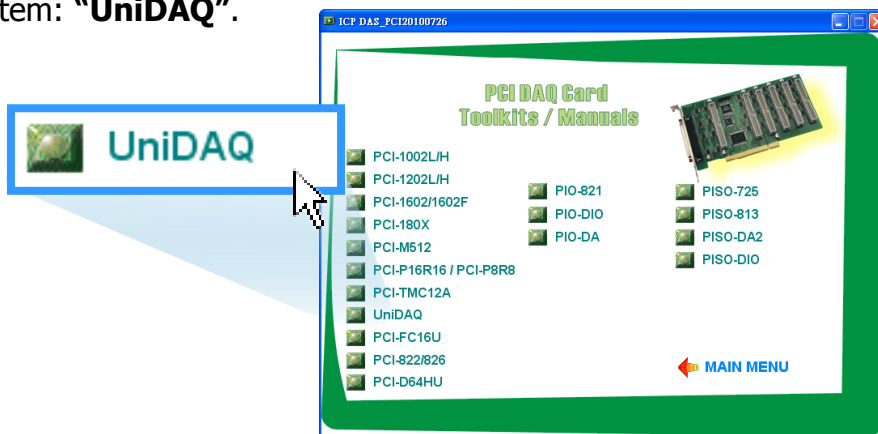| Step 2: Click the item: PCI Bus DAQ Card. |
| --- |

Step 3: Please install the appropriate driver for your OS.
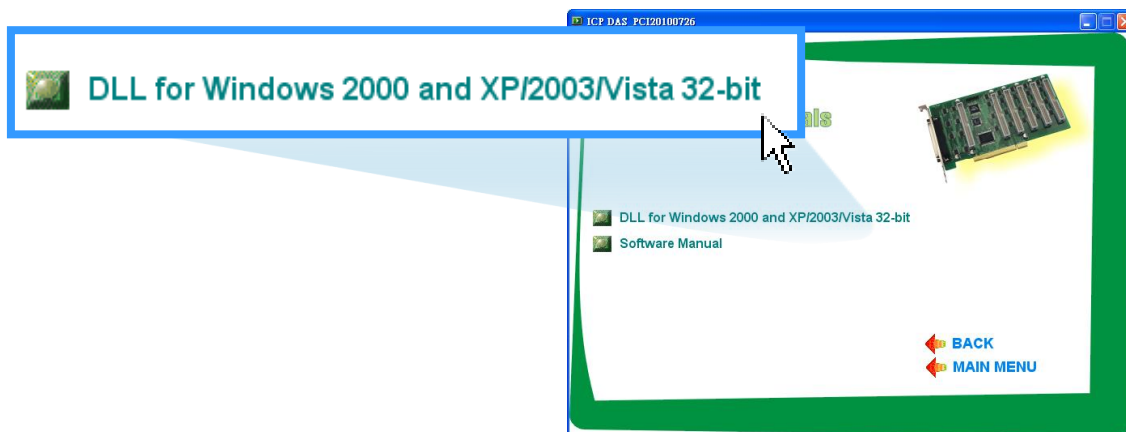
4.1.1 UniDAQ SDK Driver

(32-bit/64-bit Windows XP/ 2003/ Vista/7 and Windows 8)

1. Click the item: **"UniDAQ"**.

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

3. Double-Click **"UniDAQ_Win_Setup_x.x.x.x_xxxx.exe"** file in the **"Driver"** folder.
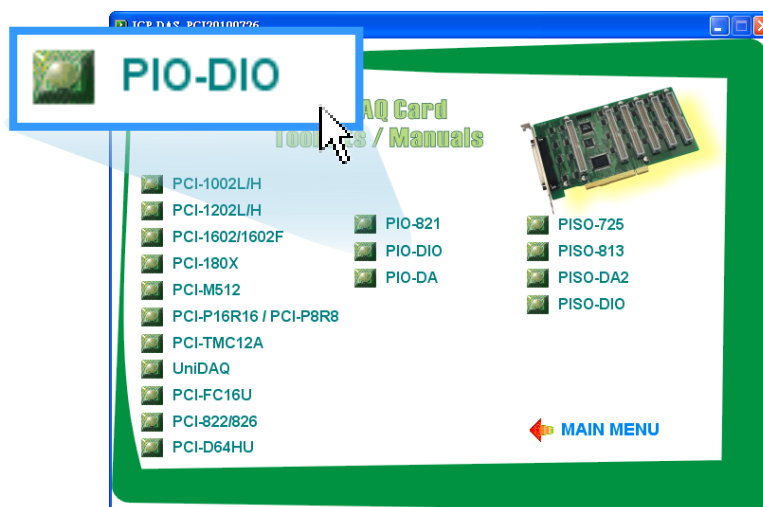
4. Click the **"Next>"** button to start the installation.

5. Check your DAQ Card is or not on supported list, Click the **"Next>"** button.

6. Select the installed folder, the default path is C:\ICPDAS\UniDAQ, confirm and click the **"Next>"** button.

7. Check your DAQ card on list, then click the **"Next>"** button.

8. Click the **"Next>"** button on the **Select Additional Tasks** window.

9. The demo program can be obtained from the following link and then click the **"Next>"** button.

10. Select **"No, I will restart my computer later"** and then click the **"Finish"** button. *Note: After clicking the "Finish" button, please skip to Sec. 4.2 continues to complete the installation*

For detailed information about the UniDAQ driver installation, please refer to UniDAQ DLL Software Manual. The user manual is contained in: CD:\NAPDOS\PCI\UniDAQ\Manual\
http://ftp.icpdas.com/pub/cd/iocard/pci/napdos/pci/unidaq/manual/

4.1.2 PIO-DIO Series Classic Driver

(Windows 98/NT/2K and 32-bit Windows XP/2003/Vista/7/8)

1. Click the item: **"PIO-DIO"**.

2. Click the item: **"DLL and OCX for Windows 98/NT/2K/XP/2003"**.
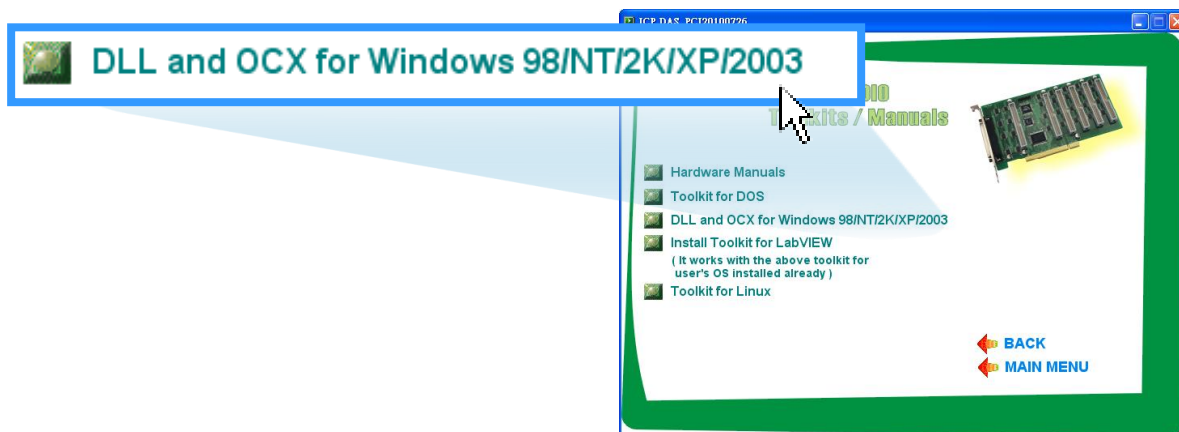
3. Double-Click **"PIO_DIO_Win_Vxxx.exe"** file in the **"Driver"** folder.

PIO_DIO_Win_v212.exe

4. Click the **"Next>"** button to start the installation on the **Setup-PIO_DIO_Win** window.
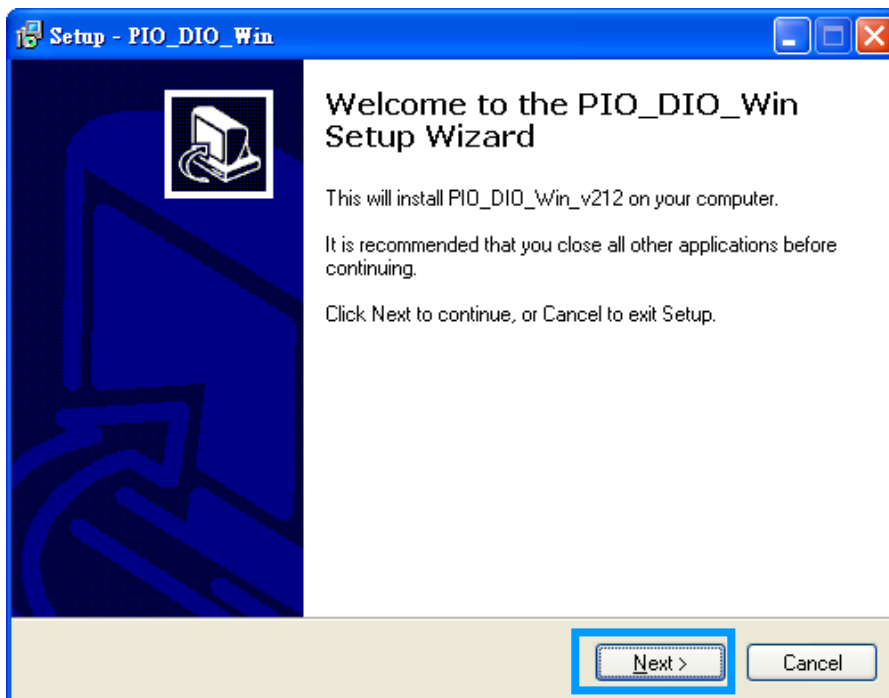
5.   Click the **"Next>"** button to install the driver into the **default** folder.
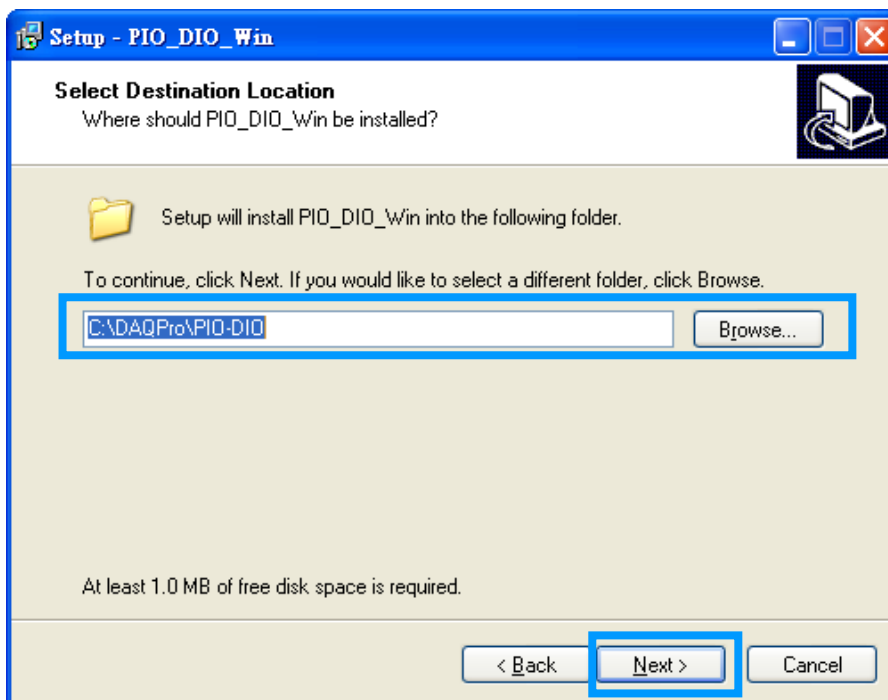
6.   Click the **"Install"** button to continue the installation.
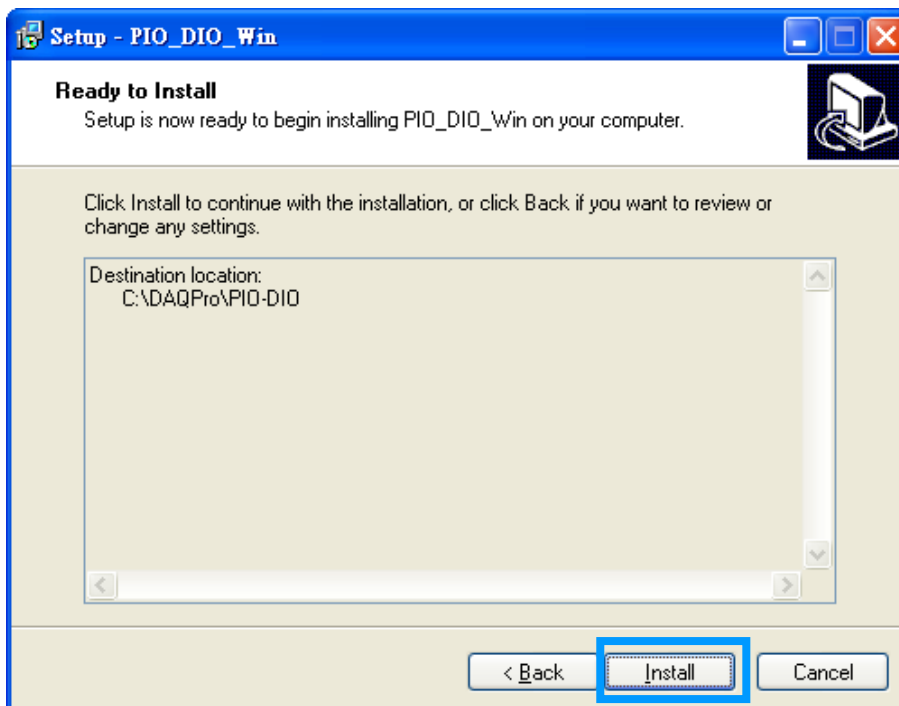
7. Selection **"No, I will restart my computer later"** and then click the **"Finish"** button.
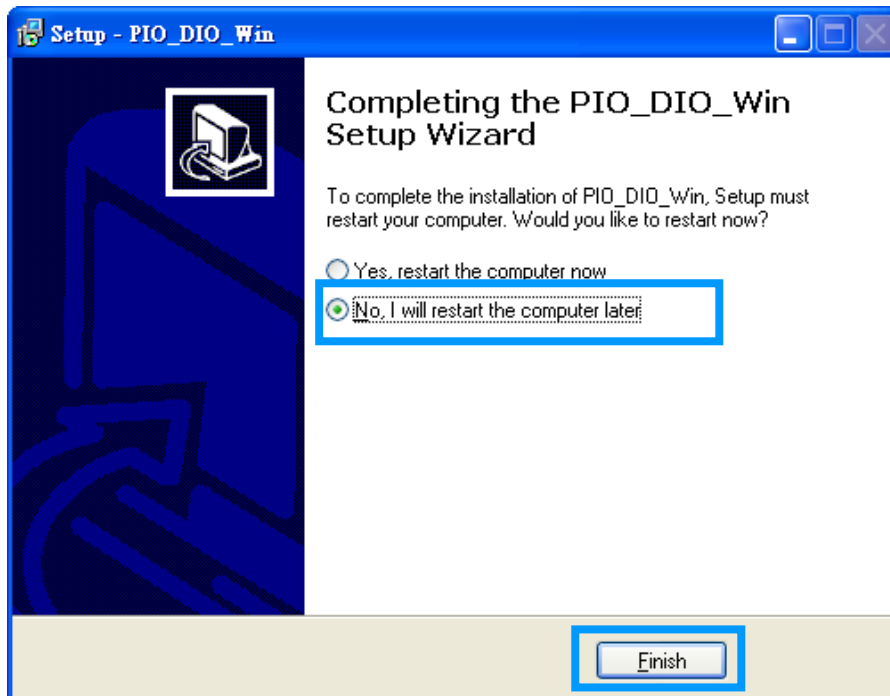
4.2 PnP Driver Installation

Step 1: Turn off the computer and install the PIO-D144/D168 series card into the computer.

For detailed information about the hardware installation of PIO-D144/D168 series card, please refer to Chapter 3 Hardware Installation.
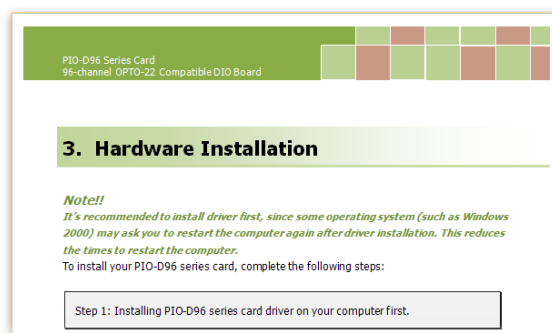
Step 2: Power on the computer and system should find the new card and then continue to finish the Plug&Play steps.

Note: Some Windows OS will load the driver automatically to complete the installation at boot.

Step 3: Select **"Install the software automatically [Recommended]"** and click the **"Next>"** button.
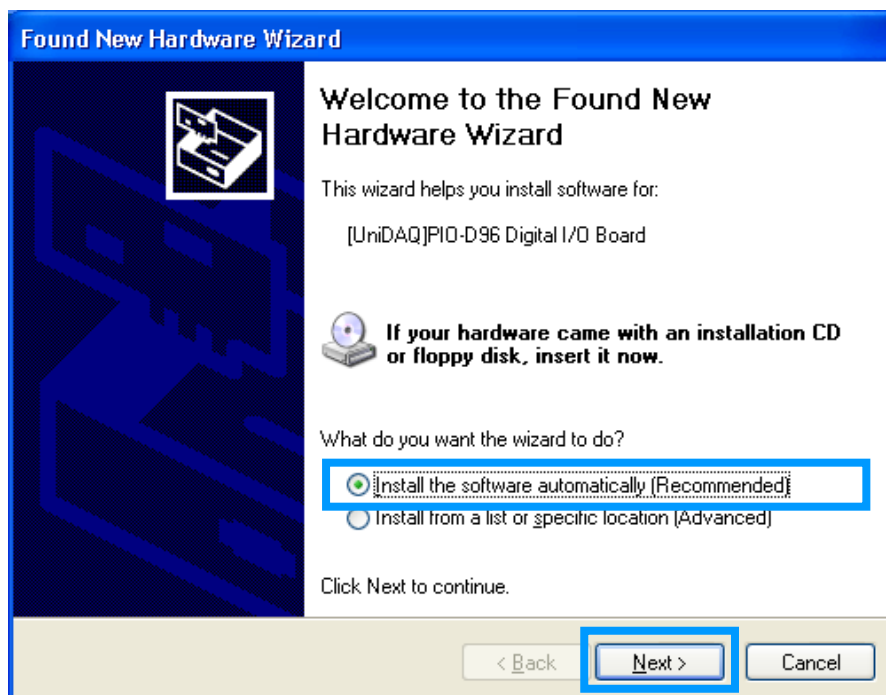
Step 4: Click the **"Finish"** button.
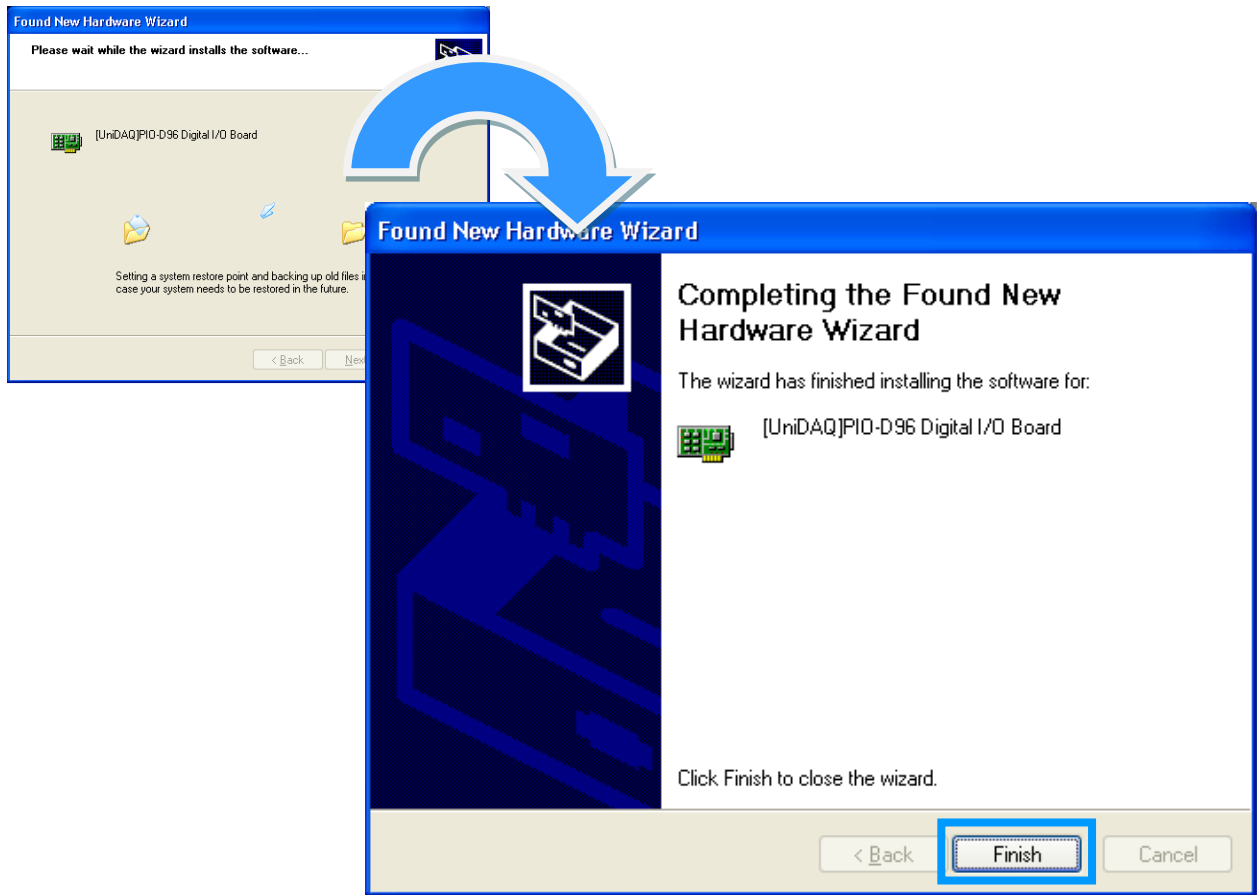
Step 5: Windows pops up **"Found New Hardware"** dialog box again.

Complete

4.3   Confirm the Successful Installation

Make sure the PIO-D144/D168 series cards installed are correct on the computer as follows:

Step 1: Select the **"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 PIO-D144/D168 series card which listed correctly or not, as illustrated below.
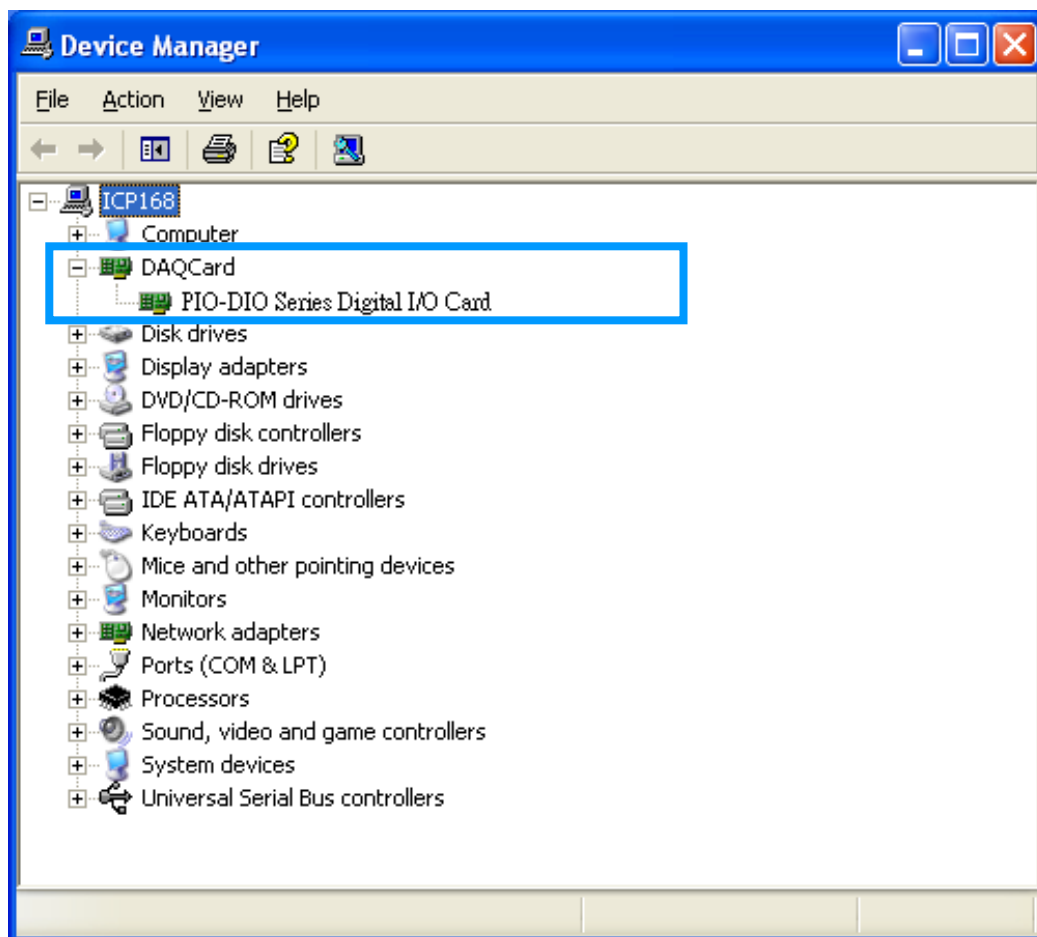
5. Testing PIO-DIO Series Card

This chapter can give you the detail steps about self-test. In this way, user can confirm that PIO-D144/D168 series card well or not. Before the self-test, you must complete the hardware and driver installation. For detailed information about the hardware and driver installation, please refer to Chapter 3 Hardware Installation and Chapter 4 Software Installation.

5.1 Self-Test Wiring

Step 1: Use the DN-37 (optional) to connect the CN1 on the board.
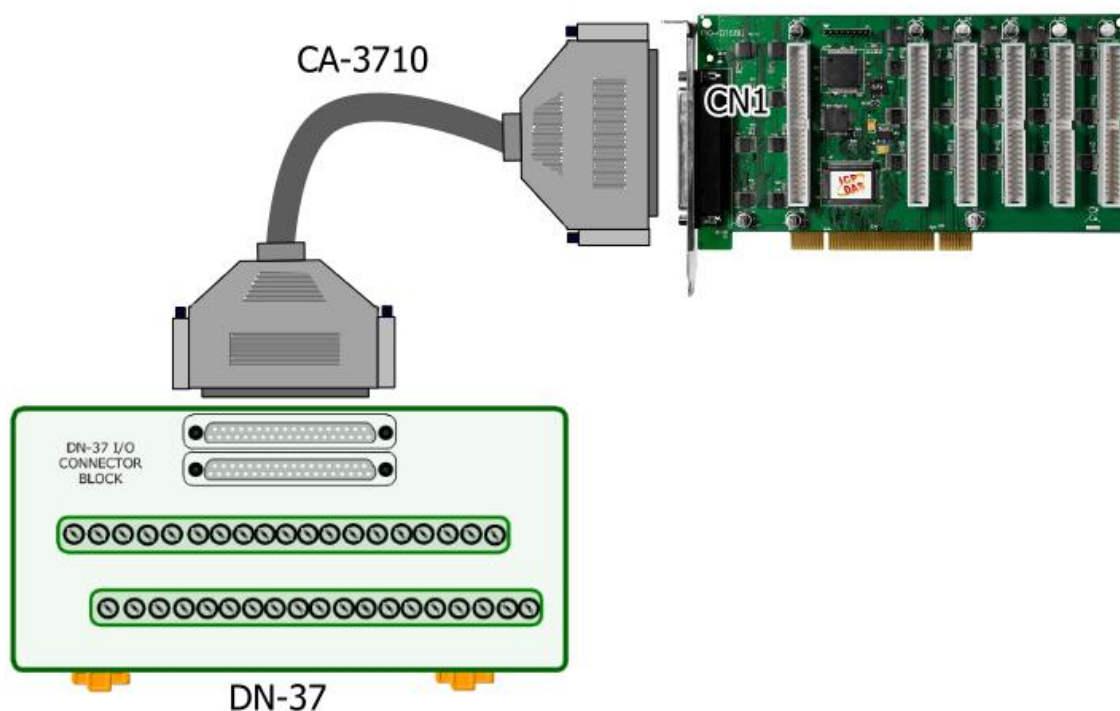
Step 2: Connect the Port0 (PA0 ~ PA7) with Port1 (PB0 ~ PB7).
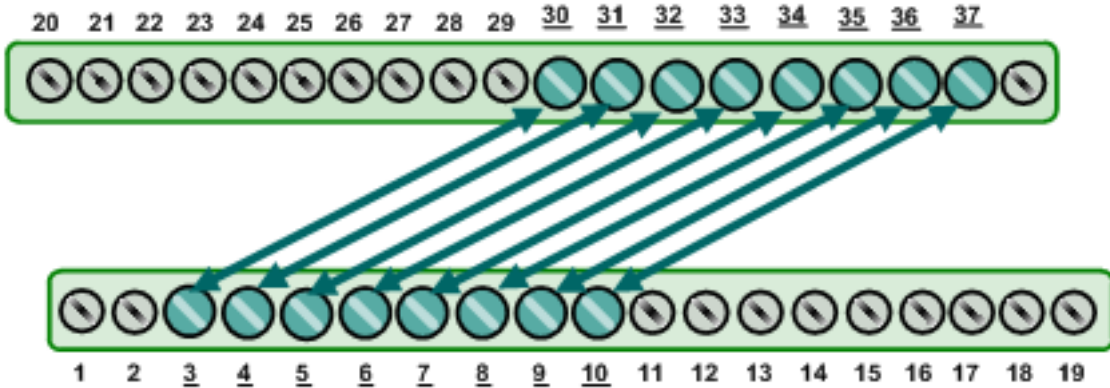
5.2   Execute the Test Program

The following example use UniDAQ driver to perform self-test. If you install the PIO-DIO series classic driver, please refer to Quick Start Guide of the PIO-D144/D168 (http://ftp.icpdas.com/pub/cd/iocard/pci/napdos/pci/pio-dio/manual/quickstart/classic/pio-d144_168_quickstart_eng.pdf) to execute the self-test.

Step 1: Execute the UniDAQ Utility Program. The UniDAQ Utility.exe will be placed in the default path after completing installation.

    Default Path: C:\ICPDAS\UniDAQ\Driver\
    Double click the "UniDAQUtility.exe"

Double-Click
1

UniDAQUtility

Click this button to start test.
3

Confirm the PIO-D144 or PIO-D168 series card had successfully installed to PC. It starts from 0.
2
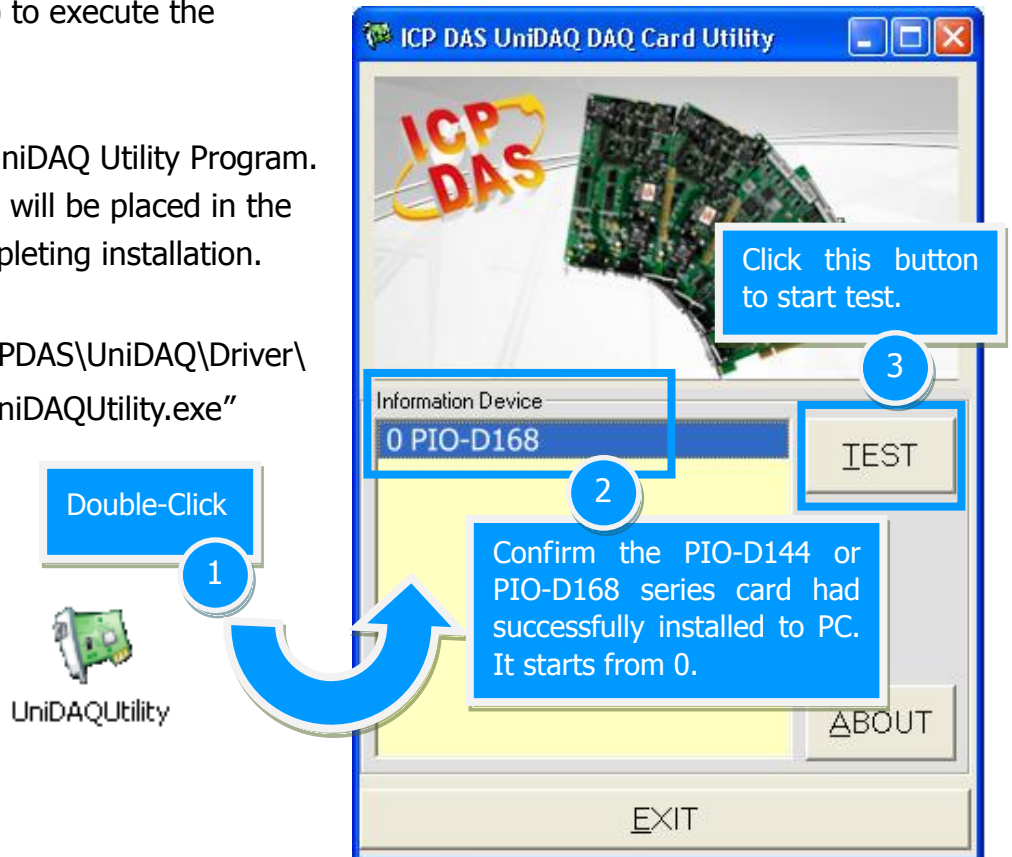
Step 2: Get DIO function test result.

Click "Digital Output" item.

1

0 PIO-D168 (CARD ID:0)

Analog Input | Analog Output | Digital Input | **Digital Output** | Timer/Counter | Debug

7 6 5 4   3 2 1 0

ON(1)

OFF(0)

3 Check channel 0, 2, 4, 6

Select the "Port 1"

2

Port Number 1 ▼ HEX 55

EXIT

Click "Digital Input" item.

4

0 PIO-D168 (CARD

Analog Input | Analog Output | **Digital Input** | Digital Output | Timer/Counter | Debug

7 6 5 4 3 2 1 0

ON(1)

OFF(0)

6

The corresponding D/I becomes black for channel 0, 2, 4, 6 of D/O is ON.

Complete

Select the "Port 0"

5

Port Number 0 ▼ HEX 55

EXIT

6. I/O Control Register

6.1 How to Find the I/O Address

The plug&play BIOS will assign a proper I/O address to every PIO/PISO series card in the power-on stage. The fixed IDs for the PIO-D144/D168 series cards are given as follows:

Table 6-1:

PIO-D144/D144(L)U			
Rev 1.0 ~ Rev 3.0		Rev 4.0 or above	
Vendor ID	0xE159	Vendor ID	0xE159
Device ID	0x0002	Device ID	0x0001
Sub-Vendor ID	0x80	Sub-Vendor ID	0x5C80, 0x1C80
Sub-Device ID	0x01	Sub-Device ID	0x01
Sub-Aux ID	0x10	Sub-Aux ID	0x00

Table 6-2:

PIO-D168/D168A/D168U			
PIO-D168A		PIO-D168(U)	
Vendor ID	0xE159	Vendor ID	0xE159
Device ID	0x0002	Device ID	0x0001
Sub-Vendor ID	0x80	Sub-Vendor ID	0x9880
Sub-Device ID	0x01	Sub-Device ID	0x01
Sub-Aux ID	0x50	Sub-Aux ID	0x50

The PIO_PISO.EXE utility program will detect and present all information for PIO/PISO cards installed in the PC, as shown in the following Figure6-1. Details of how to identify the PIO-D96 series cards of ICPDAS data acquisition boards based on the **Sub-vendor**, **Sub-device** and **Sub-Aux ID** are given in Table 6-1 and 6-2.

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/

Figure 6-1:
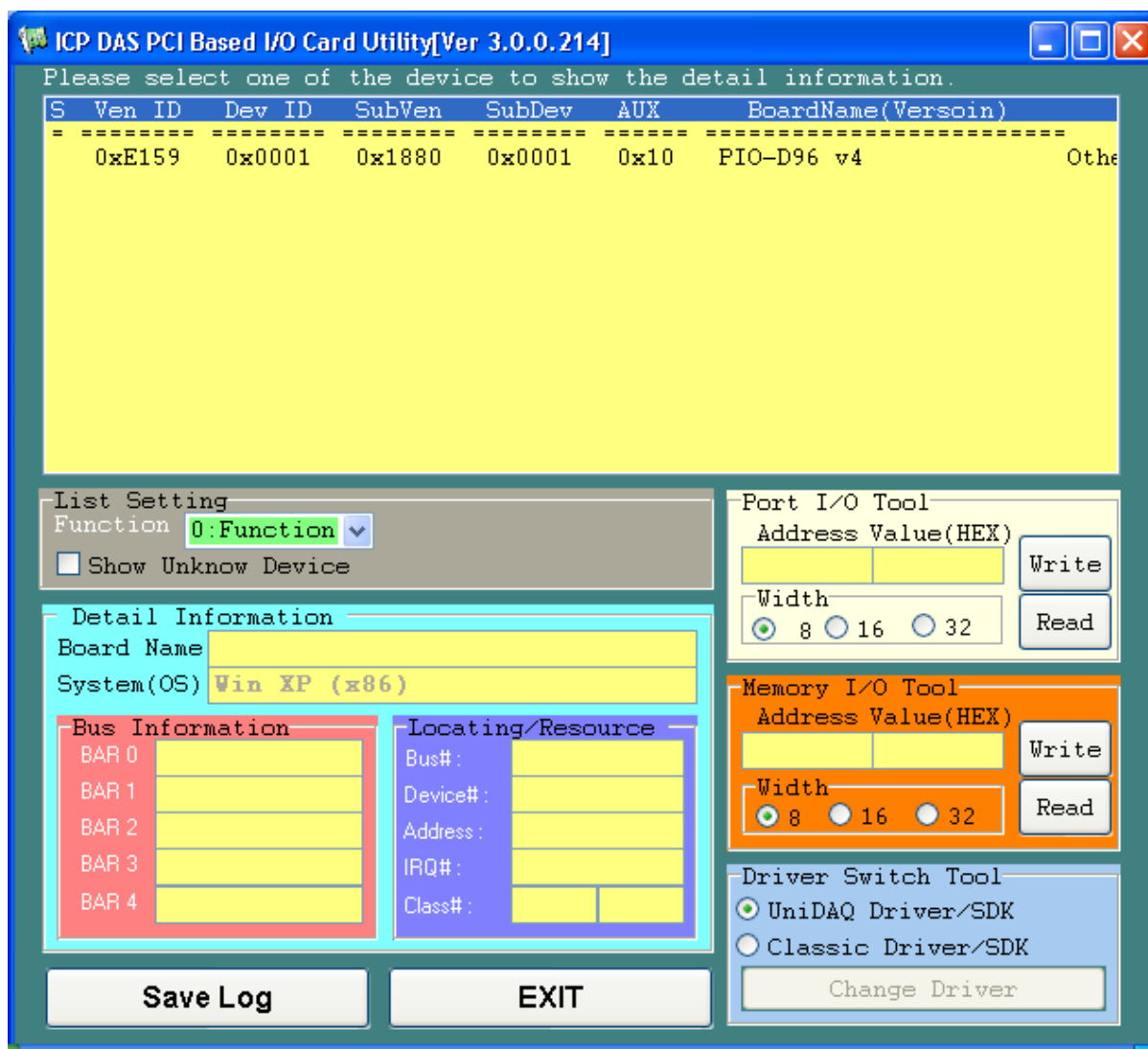
6.2 The Assignment of I/O Address

The Plug&Play BIOS will assign the proper I/O address to a PIO/PISO series card. If there is only one PIO/PISO board, the user can identify the board as card_0. If there are two PIO/PISO boards in the system, it is very difficult to identify which board is card_0. The software driver can support a maximum of 16 boards. Therefore, the user can install 16 PIO/PSIO series cards onto one PC system. The methods used to find and identify card_0 and card_1 is demonstrated below.

The simplest way to identify which card is card_0 is to use wSlotBus and wSlotDevice in the following manner:

Step 1: Remove all PIO-D144/D168 series boards from the PC.

Step 2: Install one PIO-D144/D168 series into the PC's PCI_slot1, run PIO_PISO.EXE. Then record the wSlotBus1 and wSlotDevice1 information.

Step 3: Remove all PIO-D144/D168 series boards from the PC.

Step 4: Install one PIO-D144/D168 series into the PC's PCI_slot2 and run PIO_PISO.EXE. Then record the wSlotBus2 and wSlotDevice2 information.

Step 5: Repeat Steps(3) and (4) for every PCI_slot and record all information from wSlotBus and wSlotDevice.

The records may look similar to the table follows:

Table 6-3:

PC's PCI Slot	WslotBus	WslotDevice
Slot_1	0	0x07
Slot_2	0	0x08
Slot_3	0	0x09
Slot_4	0	0x0A
PCI-BRIDGE		
Slot_5	1	0x0A
Slot_6	1	0x08
Slot_7	1	0x09
Slot_8	1	0x07

The above procedure will record all the wSlotBus and wSlotDevice information on a PC. These values will be mapped to this PC's physical slot and this mapping will not be changed for any PIO/PISO cards. Therefore, this information can be used to identify the specified PIO/PISO card by following steps:

Step1: Using the wSlotBus and wSlotDevice information from Table 6-3.

Step2: Enter the board number into PIO_GetConfigAddressSpace(…) function to get the information for a specific card, especially the wSlotBus and wSlotDevice details.

Step3: Identify the specific PIO/PISO card by comparing the data of the wSlotBus and wSlotDevice from Step1 and Step2.

Note: that normally the card installed in slot 0 is card0 and the card installed in slot1 is card1 for PIO/PISO series cards.

6.3   The I/O Address Map

The I/O address for PIO-D144/D168 series cards are automatically assigned by the main board ROM BIOS. The I/O address can also be re-assigned by the user. It is strongly recommended that users do not change the I/O address. The Plug & Play BIOS will effectively perform the assignment of proper I/O addresses to each PIO-D144/D168 series card. The I/O address for the PIO-D144/D168 series card are given in the table below, all of which are based on the base address of each card.

Table 6-4: Refer to Sec. 6.1 for more information about wBase.

Address	Read	Write
wBase+0	Reserved	RESET\ Control Register
wBase+2	Reserved	Aux control register
wBase+3	Aux data register	Aux data register
wBase+5	Reserved	INT mask control register
wBase+7	Aux pin status register	Reserved
wBase+0x2a	Reserved	INT polarity control register
wBase+0xc0	Read D/O Readback / Read 8-bit data from the D/I port	Write 8-bit data to the D/O port
wBase+0xc4	Reserved	Select the active I/O port
wBase+0xc8	Reserved	I/O Port 0-5 direction control
wBase+0xcc	Reserved	I/O Port 6-11 direction control
wBase+0xd0	Reserved	I/O Port 12-17 direction control
wBase+0xd4	Reserved	I/O Port 18-20 direction control **(for PIO-D168 Series only)**
wBase+0xf0	Read Card ID	Reserved

6.3.1 RESET\ Control Register

(Write): wBase+0

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	RESET\

When the PC's power is first turned on, RESET\ signal is in a Low-state. **This will disable all D/I/O operations.** The user has to set the RESET\ signal to a High-state before any D/I/O command applications are initiated.

> For example:
> outportb (wBase,1);   /* RESET\=High → all D/I/O are enable now */
> outportb (wBase,0);   /* RESET\=Low → all D/I/O are disable now */

6.3.2 AUX Control Register

(Write): wBase+2

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Aux7	Aux6	Aux5	Aux4	Aux3	Aux2	Aux1	Aux0

Aux?=0→ this Aux is used as a D/I
Aux?=1→ this Aux is used as a D/O

When the PC is first turned on, all Aux signals are in a Low-state. All Aux are designed as D/I for all PIO/PISO series cards.

6.3.3 Aux Data Register

(Read/Write): wBase+3

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Aux7	Aux6	Aux5	Aux4	Aux3	Aux2	Aux1	Aux0

When the Aux is used for D/O, the output state is controlled by this register. This register is designed for feature extension. Therefore, do not use this register.

6.3.4 INT Mask Control Register

(Write): wBase+5

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	0	0	0	EN3	EN2	EN1	EN0

EN0=0→ Disable P2C0 of CN1 as an interrupt signal (Default).
EN0=1→ Enable P2C0 of CN1 as an interrupt signal

For example:
outportb(wBase+5,0);   /*Disable interrupt */
outportb(wBase+5,1);   /* Enable interrupt P2C0 */
outportb(wBase+5,0x0f);   /* Enable interrupt P2C0, P2C1,P2C2,P2C3 */

6.3.5 Aux Status Register

(Read): wBase+7

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Aux7	Aux6	Aux5	Aux4	Aux3	Aux2	Aux1	Aux0

Aux0=P2C0, Aux1=P2C1, Aux2=P2C2, Aux3=P2C3, Aux7~4=Aux-ID. Refer to DEMO5.C for more information. The Aux 0~3 are used as interrupt source. The interrupt service routine has to read this register to identify the interrupt source. Refer to Sec. 2.7 for more information.

6.3.6 Interrupt Polarity Register

(Write): wBase+0x2A

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	0	0	0	INV3	INV2	INV1	INV0

This register provides a function to control invert or non-invert for the interrupt signal source. A detailed application example is given below.

INV0=1→ select the non-inverted signal from P2C0
INV0=0→ select the inverted signal from P2C0

```
For example:
outportb(wBase+0x2a,0x0f);   /* select the non-inverted input P2C0/1/2/3 */
outportb(wBase+0x2a,0x00);   /* select the inverted input of P2C0/1/2/3 */
outportb(wBase+0x2a,1);      /* select the non-inverted input of P2C0 */
                             /* select the inverted input P2C1/2/3 */


outportb(wBase+0x2a,3);      /* select the non-inverted input of P2C0/1 */
                             /* select the inverted input P2C2/3 */
```

Refer to Sec. 2.7 and DEMO5.C (DOS) for more information.

6.3.7 Read/Write 8-bit Data Register

(Read/Write): wBase+0xc0

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
D7	D6	D5	D4	D3	D2	D1	D0

The PIO-D144/D168 series contains 18/21 8-bit I/O ports, and each I/O port can be configured as either D/I or a D/O port.   The user can send/receive digital data to/from this register for digital input or output.   Note that all ports are set as D/I ports when the PC is first powered-on.

```
  For example:
  outportb(wBase+0xc0,Val);       /* write to D/O Port0 */
  Val=inportb(wBase+0xc0);        /* read from D/I Port0 or read a D/O Readback */
```

Note: Ensure that the I/O port configuration is set to either D/I or D/O before attempting to read/write from the to data register. (Refer to Sec.6.3.9)

6.3.8 Active I/O Port Control Register

(Read/Write): wBase+0xc4

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
D7	D6	D5	D4	D3	D2	D1	D0

The PIO-D144/D168 series contains 18/21 8-bit I/O ports, but only one I/O port can be activated at a time. The following example is a demonstration of how to activate the port of the PIO series card.

```
  For example:
  outportb(wBase+0xc4, 0);        /* I/O port0 is now active */
  outportb(wBase+0xc4, 1);        /* I/O port1 is now active */
  outportb(wBase+0xc4, 17);       /* I/O port17 is now active */
  outportb(wBase+0xc4, 20);       /* I/O port20 is now active */
```

6.3.9 I/O Selection Control Register

(Write): wBase+0xc8

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	0	Port5	Port4	Port3	Port2	Port1	Port0

(Write): wBase+0xcc

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	0	Port11	Port10	Port9	Port8	Port7	Port6

(Write): wBase+0xd0

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	0	Port17	Port16	Port15	Port14	Port13	Port12

(Write): wBase+0xd4

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	0	0	0	0	Port20	Port19	Port18

Port?=1→ This   port is used as a D/I port
Port?=0→ This   port is used as a D/O port

These registers provide the function for configuring the digital input/output ports of the PIO/PISO series cards. Each I/O port can be programmed as a D/I or a D/O port. Note that all ports are set as D/I ports when the PC is first powered-on. For detailed information about the I/O ports location, please refer to Sec. 2.2.

For example:
outportb(wBase+0xc8,0);   /* Port0 to Port5 are all D/O ports   */
outportb(wBase+0xcc,0x3f);   /* Port6 to Port11 are all D/I ports   */
outportb(wBase+0xd0,0x38);   /* Port12 to Port14 are all D/O ports   */
                                 /* Port15 to Port17 are all D/I ports   */

6.3.10 Card ID Register

(Read): wBase+0xf0

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	0	0	0	ID3	ID2	ID1	ID0

For example:

wCardID = inportb(wBase+0xf0);   /* read Card ID */

Note: The Card ID function is only supported by the PIO-D144(L)U and PIO-D168U (Ver. 1.0 or above)

7. Demo Programs

7.1 Demo Program for Windows

All demo programs will not work properly if the DLL driver has not been installed correctly. During the DLL driver installation process , the install-shields will register the correct kernel driver to the operation system and copy the DLL driver and demo programs to the correct position based on the driver software package you have selected (Win98/Me/NT/2K and 32-/64-bit winXP/2003/Vista/7/8). Once driver installation is complete, the related demo programs and development library and declaration header files for different development environments will be presented as follows.

■ **Demo Program for PIO-DIO Series Classic Driver**

The demo program is contained in:
CD:\NAPDOS\PCI\PIO-DIO\DLL_OCX\Demo\
http://ftp.icpdas.com/pub/cd/iocard/pci/napdos/pci/pio-dio/dll_ocx/demo/

⊕ BCB4 → for Borland C++ Builder 4 PIODIO.H → Header files PIODIO.LIB → Linkage library for BCB only	⊕ Delphi4 → for Delphi 4 PIODIO.PAS → Declaration files
⊕ VC6 → for Visual C++ 6 PIODIO.H → Header files PIODIO.LIB → Linkage library for VC only	⊕ VB6 → for Visual Basic 6 PIODIO.BAS → Declaration files
⊕ VB.NET2005 → for VB.NET2005 PIODIO.vb → Visual Basic Source files	⊕ CSharp2005 → for C#.NET2005 PIODIO.cs → Visual C# Source files

For detailed information about the DLL function of the PIO-D144/D168 series, please refer to PIO-DIO DLL Software Manual (CD:\NAPDOS\PCI\PIO-DIO\Manual\)

■ Demo Program for UniDAQ SDK Driver

The demo program is contained in:
CD:\NAPDOS\PCI\UniDAQ\DLL\Demo\
http://ftp.icpdas.com/pub/cd/iocard/pci/napdos/pci/unidaq/dll/demo/

⊕ BCB6 → for Borland C^{++} Builder 6
UniDAQ.H → Header files
UniDAQ.LIB → Linkage library for BCB only

⊕ Delphi6 → for Delphi 6
UniDAQ.PAS → Declaration files

⊕ VB6 → for Visual Basic 6
UniDAQ.BAS → Declaration files

⊕ CSharp2005 → for C#.NET2005
UniDAQ.cs → Visual C# Source files

⊕ VC6 → for Visual C^{++} 6
UniDAQ.H → Header files
UniDAQ.LIB → Linkage library for VC only

⊕ VB.NET2005 → for VB.NET2005
UniDAQ.vb → Visual Basic Source files

⊕ VC.NET2005 → for VC.NET2005 (32-bit)
UniDAQ.H → Header files
UniDAQ.LIB → Linkage library for VC only

⊕ VC.NET2005 → for VC.NET2005 (64-bit)
UniDAQ.H → Header files
UniDAQ.LIB → Linkage library for VC only

For detailed information about the DLL function and demo program of the UniDAQ, please refer to UniDAQ DLL Software Manual (CD:\NAPDOS\PCI\UniDAQ\Manual\)

7.2   Demo Program for DOS

The demo program is contained in:

CD:\NAPDOS\PCI\PIO-DIO\DOS\D144\PIOD144\

CD:\NAPDOS\PCI\PIO-DIO\DOS\D168\PIOD168\

http://ftp.icpdas.com/pub/cd/iocard/pci/napdos/pci/pio-dio/dos/

<div>

⊕   \TC*.*   → for Turbo C 2.xx or above

</div>

<div>

⊕   \TC\LIB*.*   → for TC Library

⊕   \TC\DEMO*.*   → for TC demo program

⊕   \TC\DIAG*.*   → for TC diagnostic program

⊕   \TC\LIB\PIO.H   → TC Declaration File

⊕   \TC\LIB\TCPIO_L.LIB   → TC Large Model Library File

⊕   \TC\LIB\TCPIO_H.LIB   → TC Huge Model Library File

</div>

For detailed information about the DLL function of the DOS, please refer to PIO-DIO

DLL Software Manual (CD:\NAPDOS\PCI\PIO-DIO\Manual\)

Appendix: Daughter Board

A1. DB-37, DN-37 and DN-50

■ **DB-37:** The DB-37 is a general purpose daughter board for D-sub 37 pins. It is designed for easy wire connection via pin-to-pin.
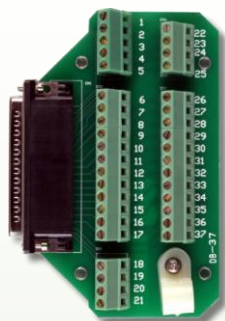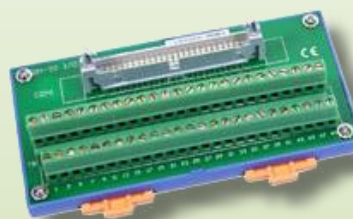

DB-37

■ **DN-37 and DN-50:** The DN-37 is a general purpose daughter board for DB-37 pins with DIN-Rail Mountings. The DN-50 is designed for 50-pin flat-cable headers win DIN-Rail mountings. They are also designed for easy wire connection via pin-to-pin.
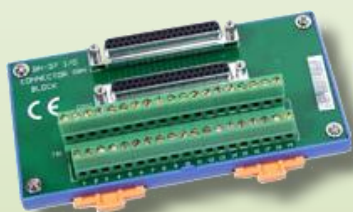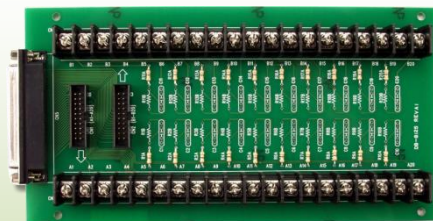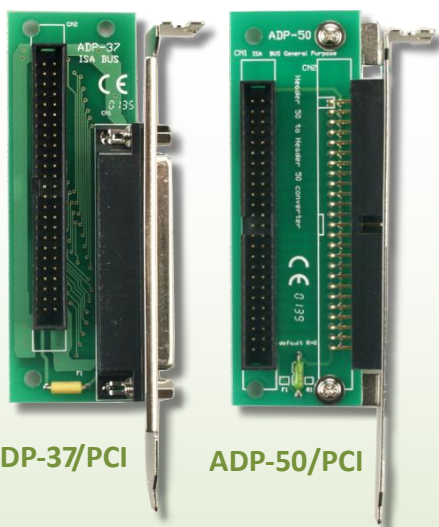

DN-37

DN-50

A2. DB-8125

The DB-8125 is a general purpose screw terminal board. It is designed for easy wire connection. The DB-8125 consists of one DB-37 and two 20-pin flat-cable headers.

DB-8125

## A3. ADP-37/PCI and ADP-50/PCI

ADP-37/PCI   **ADP-50/PCI**

The ADP-37/PCI and ADP-50/PCI are extender for the 50-pin header. The one side of the ADP-37/PCI or the ADP-50/PCI can be connected to a 50-pin header. Note: that ADP-37/PCI is 50-pin header to DB-37 extender and ADP-50/PCI is 50-pin header to 50-pin header extender.

The other side can be mounted onto the PC chassis as is depicted by the following:
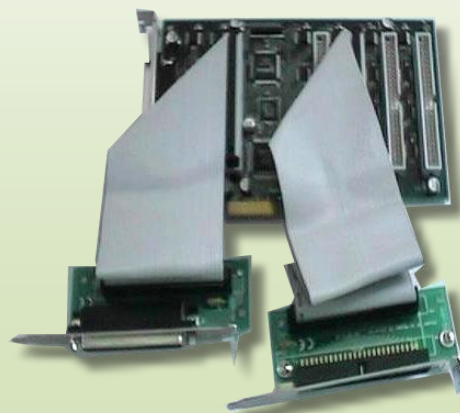
A4. DB-24P and DB-24PD Isolated Input Board

The DB-24P is a 24-channel isolated digital input daughter board. The optically isolated inputs of the DB-24P consist of a bi-directional optocoupler with a resistor for current sensing. You can use the DB-24P to sense DC signals from TTL levels up to 24 V or use the DB-24P to sense a wide range of AC signals. You can also use this board to isolate the computer from large common-mode voltage, ground loops and transient voltage spikes that often occur in industrial environments, as shown in Figure A4-1. Table A4-1 is the comparison of DB-24P and DB-24PD.
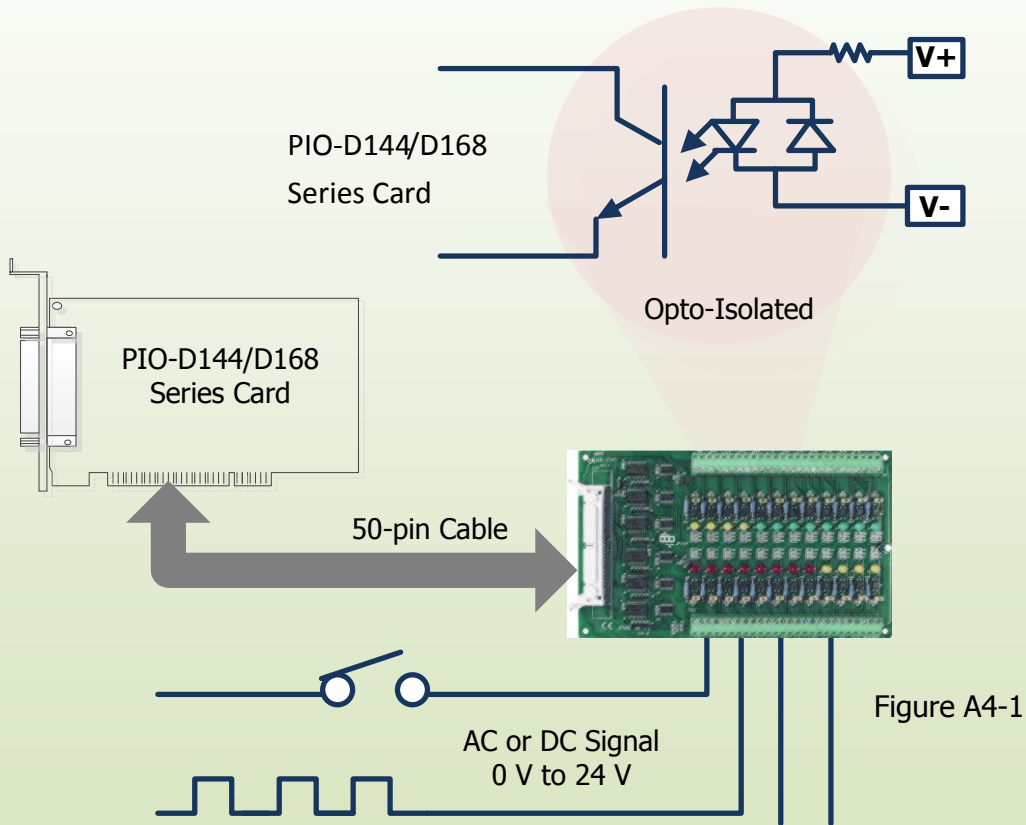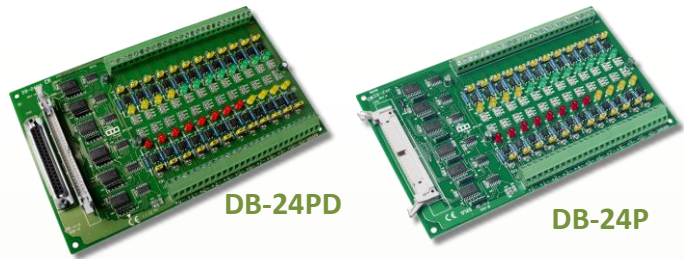

Figure A4-1

Table A4-1:

	DB-24P	DB-24PD
50-pin Flat-Cable Header	Yes	Yes
D-sub 37-pin Header	No	Yes
Other Specifications	Same	

A5. DB-24R and DB-24RD Relay Board

The DB-24R, 24-channel relay output board, consists of 24 form-C relays for efficiently controlling the switch with the use of an appropriately loaded program. The relays are energized by applying a 12 V/24 V voltage signal to the appropriate relay channel on the 50-pin flat-cable connector. There are 24 enunciator LEDs for each relay channel and the LED light will go on when their associated relay has been activated. The control scheme is illustrated below.
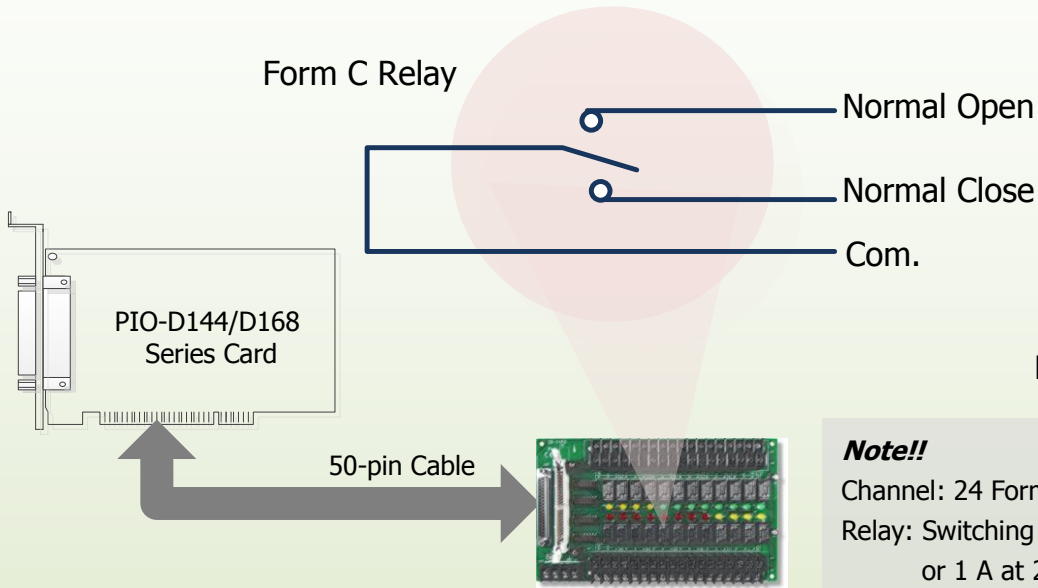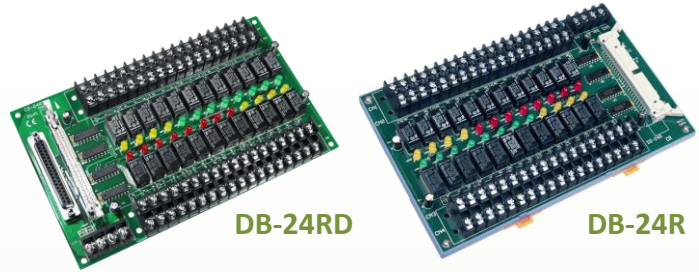
DB-24RD   DB-24R

Form C Relay

Normal Open

Normal Close

Com.

PIO-D144/D168
Series Card

Figure A5-1

50-pin Cable

Note!!
Channel: 24 Form C Relay
Relay: Switching up to 0.5 A at 110 V_{AC}
or 1 A at 24 V_{DC}

Table A5-1:

	DB-24R	DB24RD
50-pin Flat-Cable Header	Yes	Yes
D-sub 37-pin Header	No	Yes
Other Specifications	Same	

Table A5-2:

DB-24R, DB-24RD	24 * Relay (120 V, 0.5 A)
DB-24PR, DB-24PRD	24 * Power Relay (250 V, 5 A)
DB-24POR	24 * PhotoMOS Relay (350 V, 0.1 A)
DB-24SSR	24 * SSR (250 V_{AC}, 4 A)
DB-24C	24 * Open Collector (30 V, 100 mA)
DB-16P8R	16 * Relay (120 V, 0.5 A) + 8 * Isolated Input

A6. DB-24PR, DB-24POR and DB-24C

The DB-24PR, 24-channel power relay output board, consists of 8 form-C and 16 form-A electromechanical relays for efficiently controlling the switch with the use of an appropriately loaded program. The contact of each relay can allow 5 A current load at 250 V_{AC}/30 V_{DC}. The relay is energized by applying a 5 voltage signal to the associate relay channel on the 20-pin flat-cable connector (just used 16 relays) or 50-pin flat-cable connector (OPTO-22 compatible, for DIO-24 series). 24 enunciator LEDs for indicating the status of for each relay and the corresponding LED light will go on when their associated relay has been activated. To avoid overloading your PC's power supply, this board needs a +12 V_{DC} or +24V_{DC} external power supply, as shown in Figure A6-1.
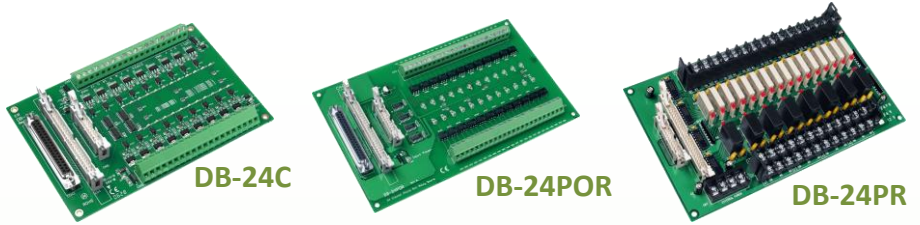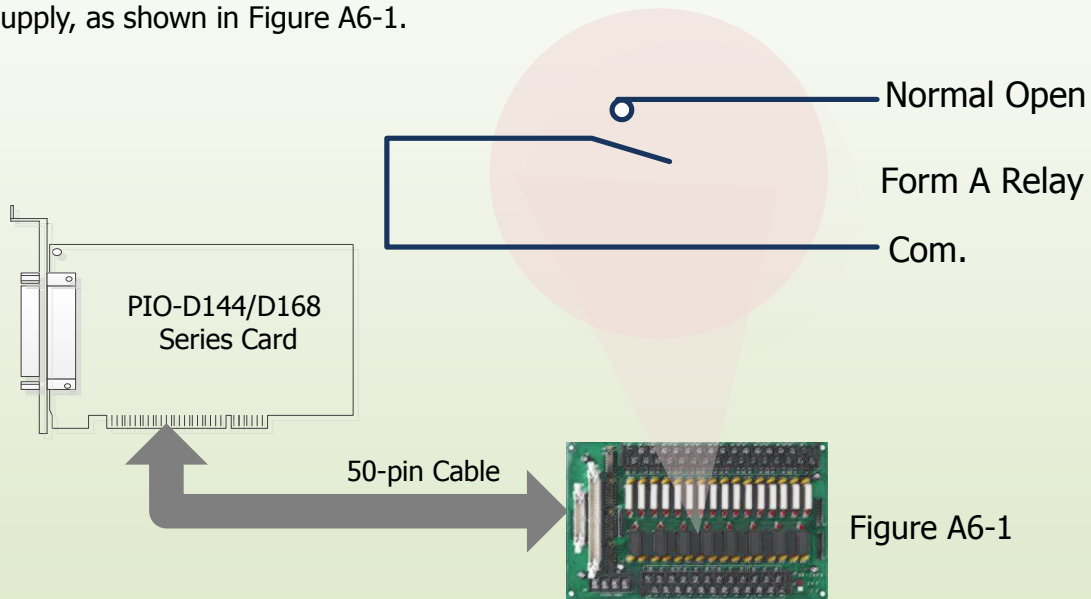
DB-24C   DB-24POR   DB-24PR

Normal Open

Form A Relay

Com.

PIO-D144/D168
Series Card

50-pin Cable

Figure A6-1

Table A6-1:

DB-24PR	24 * Power Relay, 5A/250 V
DB-24POR	24 * PhotoMOS Relay, 0.1 A/350 V_{AC}
DB-24C	24 * Open Collector, 100 mA per channel, 30 V max.

Note!!
1. 50-Pin connector (OPTO-22 compatible) for DIO-24/48/144, PIO-D144/D96/D56/D48/D24/D168.
2. 20-Pin connector for 16 channel digital output (A-82X, A-62X, DIO-64, ISO-DA16/DA8).
3. Channel: 16 Form A Relay, 8 Form C Relay.
4. Relay: switching up to 5 A at 110 V_{AC}/5 A at 30 V_{DC}.

A7. Daughter Boards Comparison Table

Table A7-1 is the comparison table for the daughter application of PIO/PISO series cards.

Table A7-1:

I/O Card	-	PIO-D144/D168 Series	
Cable/ Daughter Boards	20-Pin Flat-Cable	50-Pin Flat-Cable	37-Pin D-sub
DB-37	NO	NO	**Yes**
DN-37	NO	NO	**Yes**
ADP-37/PCI	NO	**Yes**	**Yes**
ADP-50/PCI	NO	**Yes**	NO
DB-24P	NO	**Yes**	NO
DB-24PD	NO	**Yes**	**Yes**
DB-16P8R	NO	**Yes**	**Yes**
DB-24R	NO	**Yes**	NO
DB-24RD	NO	**Yes**	**Yes**
DB-24C	**Yes**	**Yes**	**Yes**
DB-24PR	**Yes**	**Yes**	NO
DB-24PRD	NO	**Yes**	**Yes**
DB-24POR	**Yes**	**Yes**	**Yes**
DB-24SSR	NO	**Yes**	**Yes**