

PEX-D24/D56 PIO-D24/D56 PIO-D24U/D56U

User Manual

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Warranty

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1. Introduction



The PIO-D24U/D56U and PEX-D24/D56 card is the new generation product that ICP DAS provides to meet RoHS compliance requirement. The new PIO-D24U/D56U card is designed as a drop-in replacement for the PIO-D24/D56, and users can replace the PIO-D24/D56 by the PIO-D24U/D56U and PEX-D24/D56 directly without software/driver modification.

The PIO-D24U/D56U universal PCI card supports 3.3 V/5 V PCI bus while the PEX-D24/D56 supports PCI Express bus. The PIO-D24/D56 and PEX-D24/D56 series consists of three 8-bit bi-direction ports. The 8-bit ports are named as port A (PA), port B (PB) and port C (PC) respectively. All ports are configured as inputs upon power-up or reset. In addition, the PIO-D56/D56U and PEX-D56 provides additional 16-bit digital inputs and 16-bit digital outputs.

The PIO-D24U/D56U and PEX-D24/D56 has a Card ID switch with which users can recognize the board by the ID via software when using two or more PIO-D24U/56U and PEX-D24/D56 cards in one computer.

These cards support various OS versions, such as Linux, DOS, Windows 98/NT/2000 and 32/64-bit Windows 8/7/Vista/2003/XP. DLL and Active X control together with various language sample program 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 to quickly and easily develop their own applications.

1.1 Specifications

1.1.1 PIO-D24/D24U/D56/D56U

Models	PIO-D24	PIO-D24U	PIO-D56	PIO-D56U
Programmable Digital I/O				
Channels	24			
Digital Input				
Digital Input Channels	-		16	
Compatibility	5 V/TTL			
Input Voltage	Logic 0: 0.8 V max. Logic 1: 2.0 V min.			
Response Speed	1 MHz			
Digital Output				
Digital Output Channels	-		16	
Compatibility	5 V/TTL			
Output Voltage	Logic 0: 0.4 V max. Logic 1: 2.4 V min.			
Output Capability	Sink: 64 mA @ 0.8 V Source: 32 mA @ 2.0 V		CON1	Sink: 2.4 mA @ 0.8 V Source: 0.8 mA @ 2.0 V
			CON3	Sink: 64 mA @ 0.8 V Source: 32 mA @ 2.0 V
Response Speed	1 MHz			
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	8-bit			
Card ID	No	Yes(4-bit)	No	Yes(4-bit)
I/O Connector	Female DB37 x 1		Female DB37 x 1 20-pin box header x 2	
Dimensions (L x W x D)	143 mm x 105 mm x 22 mm			
Power Consumption	420 mA @ +5 V		580 mA @ +5 V	
Operating Temperature	0 ~ 60 °C			
Storage Temperature	-20 ~ 70 °C			
Humidity	5 ~ 85% RH, non-condensing			

1.1.2 PEX-D24/D56

Models	PEX-D24	PEX-D56	
Programmable Digital I/O			
Channels	24		
Digital Input			
Digital Input Channels	-	16	
Compatibility	5 V/TTL		
Input Voltage	Logic 0: 0.8 V max. Logic 1: 2.0 V min.		
Response Speed	500 kHz		
Digital Output			
Digital Output Channels	-	16	
Compatibility	5 V/TTL		
Output Voltage	Logic 0: 0.4 V max. Logic 1: 2.4 V min.		
Output Capability	Sink: 64 mA @ 0.8 V Source: 32 mA @ 2.0 V	CON1	Sink: 2.4 mA @ 0.8 V Source: 0.8 mA @ 2.0 V
		CON3	Sink: 64 mA @ 0.8 V Source: 32 mA @ 2.0 V
Response Speed	500 kHz		
General			
Bus Type	PCI Express x 1		
Data Bus	8-bit		
Card ID	Yes(4-bit)		
I/O Connector	Female DB37 x 1	Female DB37 x 1 20-pin box header x 2	
Dimensions (L x W x D)	143 mm x 105 mm x 22 mm		
Power Consumption	420 mA @ +5 V	580 mA @ +5 V	
Operating Temperature	0 ~ 60 °C		
Storage Temperature	-20 ~ 70 °C		
Humidity	5 ~ 85% RH, non-condensing		

1.2 Features

- Support the +5 V PCI bus for PIO-D24/D56
- Support the +3.3 V/+5 V PCI bus for PIO-D24U/D56U
- Support PCI Express x 1 for PEX-D24/D56
- 56/24(PIO-D56/PIO-D24) channels of digital I/O
- Card ID function for PIO-D24U/D56U and PEX-D24/D56
- Bi-direction programmable I/O ports under software control
- All I/O lines buffered on the board
- Eight-bit groups independently selectable for I/O on 24-bit port
- Double side SMD, short card.
- Connect directly to DB-24PR, DB-24PD, DB-24RD, DB-24PRD, DB-16P8R, DB-24POR, DB-24SSR, DB-24C and other OPTO-22 compatible daughter boards
- 4 interrupt sources: PC0,PC1,PC2,PC3
- No base address or IRQ switches to set

1.3 Product Check List

The shipping package includes the following items:

- One PIO-D24/D56 series or PEX-D24/D56 card
- One software utility PCI CD.
- One Quick Start Guide

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

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

Attention!

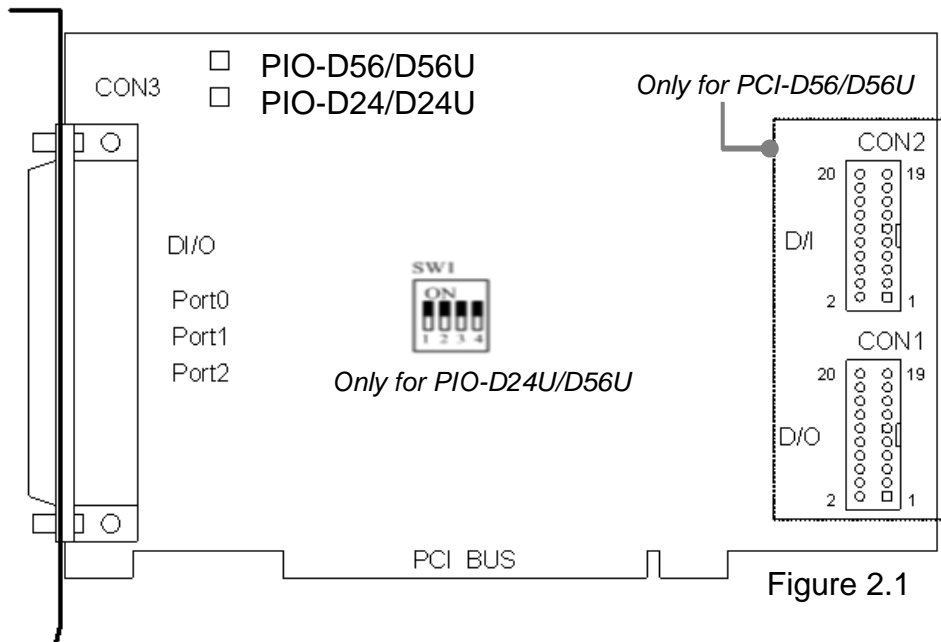
If any of these items is missing or damaged, contact the dealer from whom you purchased the product. Please save the shipping materials and carton in case you need to ship or store the product in the future.

2. Hardware Configuration

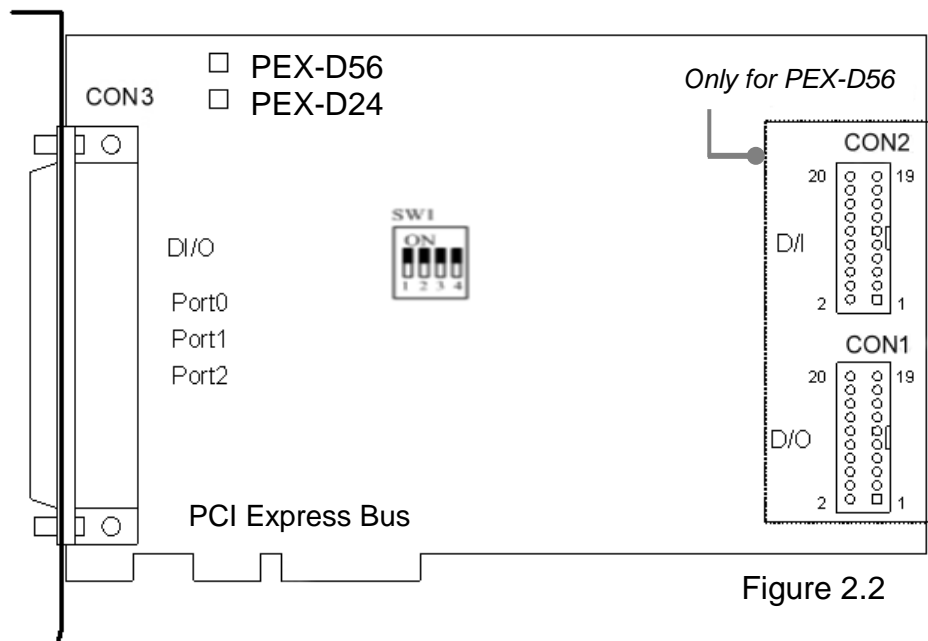


2.1 Board Layout

- The board layout of the PIO-D24/D56 series cards are shown below:



- The board layout of the PEX-D24/D56 cards are shown below:



2.2 I/O Port Location

The PIO-D24/D56 series and PEX-D24/D56 consists of one 24-bit bi-directional port, one 16-bit input port and one 16-bit output port (only for PIO-D56/D56U and PEX-D56). The 24-bit port supports three 8-bit groups, which are PA, PB and PC, respectively. Each 8-bit group can be configured as a D/I or D/O port via the software. Note that when the PC is first turned on or if a reset has been executed, all ports are set as D/I ports. Each I/O port is named as the following table and its location can be found in Figure 2.1 and 2.2:

Table 2.1

Connector		PA0 ~ PA7	PB0 ~ PB7	PC0 ~ PC7
PIO-D24(U) PIO-D56(U) PEX-D24 PEX-D56	CON3 (D/I/O)	Port0	Port1	Port2

Refer to Sec. 2.1 for details of board layout and I/O port location.

Table 2.2

Connector		Description
PIO-D56(U)	CON1	D/O
PEX-D56	CON2	D/I

Refer to Sec. 2.1 for details of board layout and I/O port location.

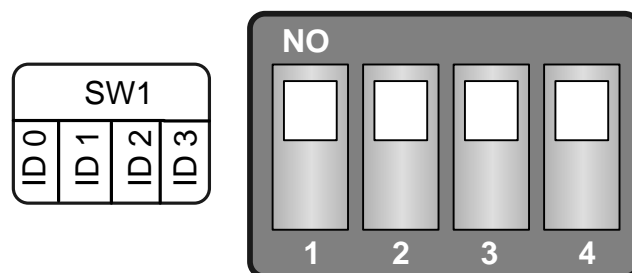


Note:

P2C0, P2C1, P2C2, P2C3 interrupts and of the CON3 connector can be used as an interrupt signal source. Refer to Sec. 2.5 for more information.

2.3 Card ID Switch

The PIO-D24U/D56U and PEX-D24/D56 has a Card ID switch with which users can recognize the board by the ID via software when using two or more PIO-D24U/ 56U and PEX-D24/D56 cards in one computer. The default Card ID is 0x0. For detail SW1 Card ID settings, please refer to Table 2.3.



(Default Settings)

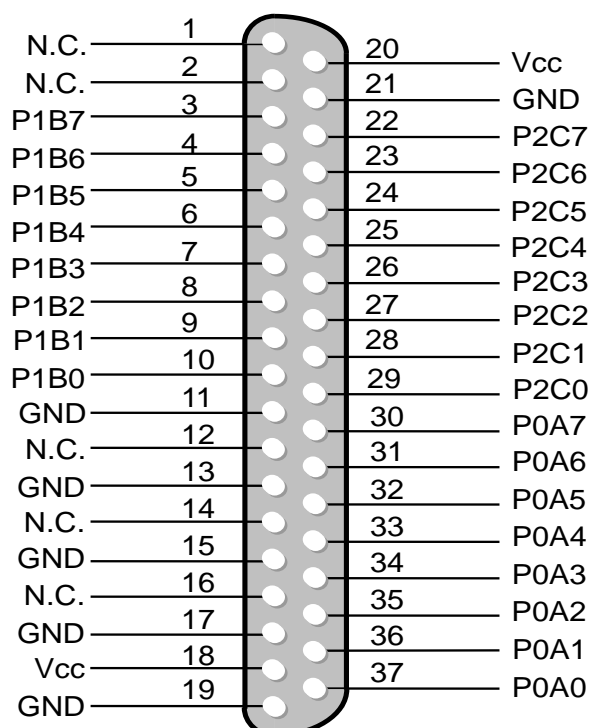
Table 2.3 (*) Default Settings; OFF → 1; ON → 0

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

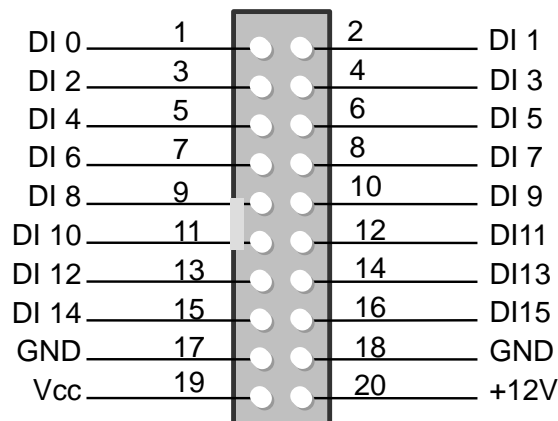
2.4 Pin Assignments

The Pin assignments for all PIO-D24/D56 series and PEX-D24/D56 connectors are listed in Tables 2.3, 2.4 and 2.5. All signal sources for each digital input or output pin (channel) are TTL compatible.

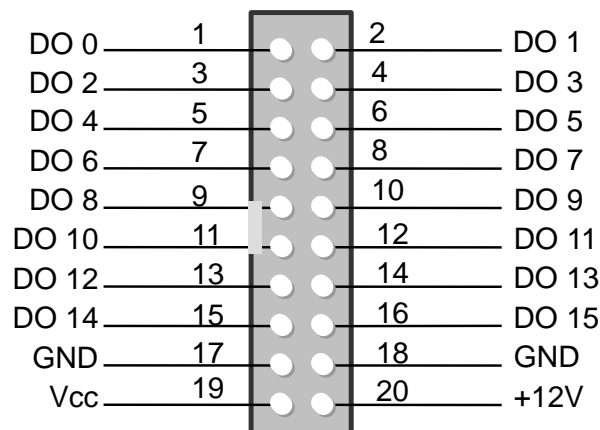
CON3: 37-Pin D-type female connector



CON2: 20-Pin of box header



CON1: 20-Pin of box header



All Signals are TTL Compatible	
High (1)	2.0 ~ 5.0 V (Voltage over 5.0V will damage the device)
None Define	2.0 V ~ 0.8 V
Low(0)	Under 0.8 V

Table 2.4 37-Pin D-type female connector for Port0~Port2

PIO-D24(U)/D56(U) and PEX-D24/D56: CON3 Connector

Pin Number	Description	Pin Number	Description
1	N. C.	20	Vcc
2	N. C.	21	GND
3	P1B7	22	P2C7
4	P1B6	23	P2C6
5	P1B5	24	P2C5
6	P1B4	25	P2C4
7	P1B3	26	P2C3
8	P1B2	27	P2C2
9	P1B1	28	P2C1
10	P1B0	29	P2C0
11	GND	30	P0A7
12	N.C.	31	P0A6
13	GND	32	P0A5
14	N.C.	33	P0A4
15	GND	34	P0A3
16	N.C.	35	P0A2
17	GND	36	P0A1
18	VCC	37	P0A0
19	GND	XXXXXXX	This pin not available

Table 2.5 20-Pin flat-cable headers of D/I for PIO-D56(U) and PEX-D56

PIO-D56(U) and PEX-D56: CON2 Connector

Pin Number	Description	Pin Number	Description
1	DI0	2	DI1
3	DI2	4	DI3
5	DI4	6	DI5
7	DI6	8	DI7
9	DI8	10	DI9
11	DI10	12	DI11
13	DI12	14	DI13
15	DI14	16	DI15
17	GND	18	GND
19	Vcc	20	+12 V

Table 2.6 20-Pin flat-cable headers of D/O for PIO-D56(U) and PEX-D56

PIO-D56(U) and PEX-D56: CON1 Connector

Pin Number	Description	Pin Number	Description
1	DO0	2	DO1
3	DO2	4	DO3
5	DO4	6	DO5
7	DO6	8	DO7
9	DO8	10	DO9
11	DO10	12	DO11
13	DO12	14	DO13
15	DO14	16	DO15
17	GND	18	GND
19	Vcc	20	+12 V

2.5 Enable I/O Operation

When the PC is first powered-on, the operations of all digital I/O channels for each port are disabled. Note that the digital I/O channel for each port is enabled or disabled using the RESET\ signal. Refer to Sec. 3.3.1 for more information. The power-on states for all DI/O ports are 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 registers are all undefined. Refer to Sec. 2.5 for details.

The user must perform an initialization procedure before using these digital I/O ports. The recommended steps are as follows:

Step 1: Determine the address mapping of the PIO/PISO cards.
(Refer to Sec.3.1 for details)

Step 2: Enable all Digital I/O operations. (Refer to Sec. 3.3.1 for details)

Step 3: Select the controlled port for 37-Pin D-type female connector (CON3) to their expected D/I/O states and send their initial values to every D/O port. (Refer to Sec. 3.3.7 and 3.3.9 for details)

For more information regarding the initialization procedure for digital I/O ports, please refer to the DEMO1.C demo program.

2.5.1 D/I/O Port Architecture

Connector		Description
PIO-D24/D56 series PEX-D24/D56	CON3	Programmable Digital I/O

The programmable digital I/O control architecture for the PIO-D24/D56 series and PEX-D24/D56 is illustrated in Figure 2.2. The operation method of control signal is described below.

- When the RESET\ signal is in the Low-state, it means that all D/I/O operations are disabled.
- When RESET\ signal is in the High-state, it means all D/I/O operations are enabled.
- If the D/I/O is configured as a D/I port, the port can accept D/I from external signal sources
- If the D/I/O is configured as a D/O port, the D/O value can be read from the port.
- If D/I/O is configured as a D/I port, sending data to the 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.

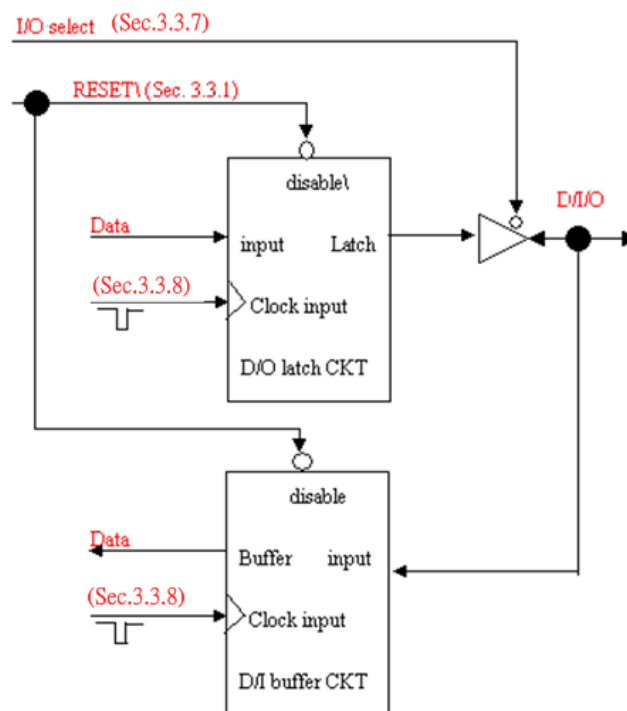


Figure 2.2

2.5.2 D/I Port Architecture

Connector		Description
PIO-D56/D56U PEX-D56	CON2	Digital Input

The digital input control architecture for the PIO-D56/D56U and PEX-D56 is demonstrated in Figure 2.3.

- When the RESET\ signal is in the Low-state, it means that all D/I operations are disabled.
- When RESET\ signal is in the High-state, it means all D/I operations are enabled.

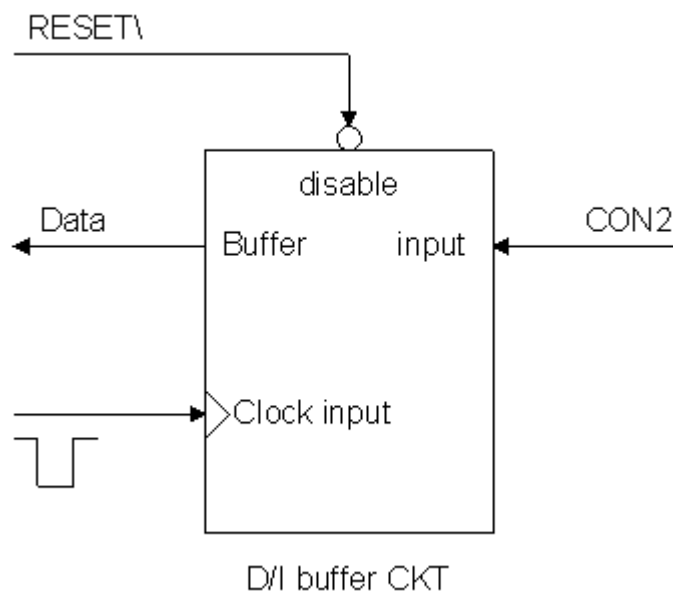


Figure 2.3 D/I Port Architecture

2.5.3 D/O Port Architecture

Connector		Description
PIO-D56/D56U PEX-D56	CON1	Digital Output

The digital output control architecture for the PIO-D56/D56U and PEX-D56 is demonstrated in Figure 2.4.

- When the RESET\ signal is in the Low-state, it means that all D/O operations are disabled.
- When RESET\ signal is in the High-state, it means all D/O operations are enabled.

The power-on states are as follows:

- All DO operations are disabled
- All output latches are cleared to Low-Level

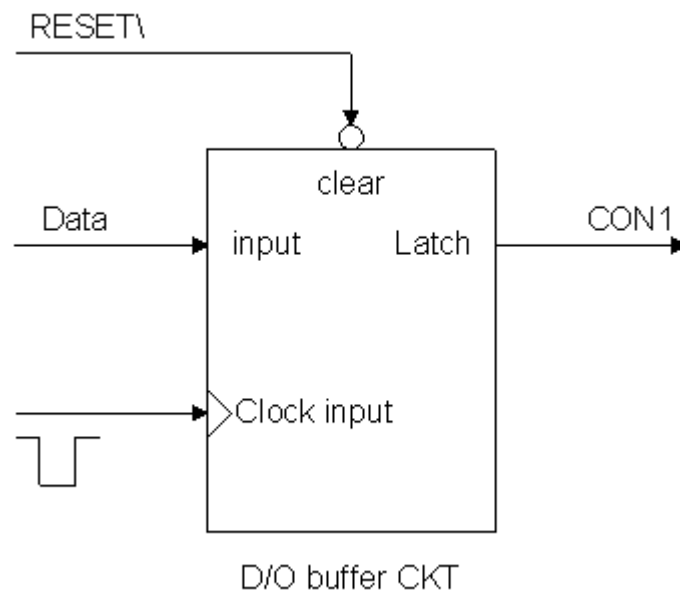


Figure 2.4 D/O Port Architecture

2.6 Interrupt Operation

The P2C0, P2C1, P2C2 and P2C3 interrupts pins of the 37-Pin D-type female connector (CON3) can be used as an interrupt signal source. Refer to Sec. 2.1 for the P2C0/P2C1/P2C2/P2C3 location. The interrupt of the PIO-D24/D56 series and PEX-D24/D56 **is level-triggered and is Active_High**. The interrupt signal can be programmed as either **inverted or non-inverted**. The procedures for how to configure the interrupt signal source are given as follows:

1. Determine whether **the initial level is either High or Low from the signal source**.
2. If the initial state is High, select the **inverted** setting for the interrupt signal source (Section. 3.3.6). If the initial state is Low, select the **non-inverted** setting for the interrupt signal source (Section. 3.3.8)
3. Enable the interrupt function (Section. 3.3.4)
4. If the interrupt signal is active, the interrupt service routine will be automatically started.

Note that DEMO3.C and DEMO4.C are demo programs for a single interrupt source and DEMO5.C is a demo program for four interrupt sources in a 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 is more than one interrupts source, the interrupt service routine needs to identify the active signals as follows: (Refer to DEMO5.C)

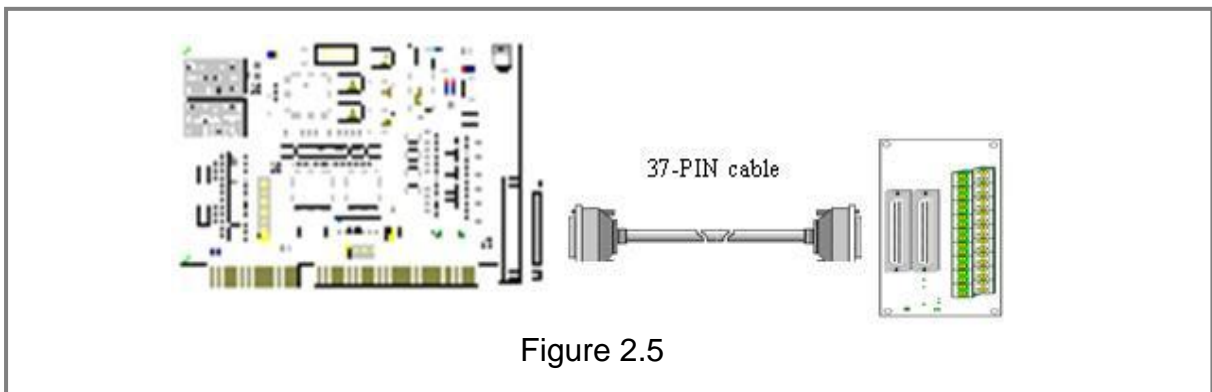
1. Read the new status of the interrupt signal source
2. Compare the new status with the old status to identify the active signals
3. If P2C0 is active, service P2C0 and non-inverter/inverted as the P2C0 signal
4. If P2C1 is active, service P2C1 and non-inverted/inverted as the P2C1 signal
5. If P2C2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

Limitation: if the interrupt signal is too short, the new status may be the same as the old status. In this case, the interrupt signal must be held at active until the interrupt service routine is executed. This hold time is different for different OS versions and can be as short as micro-second or as a long as second. In general, 20 ms is enough for all types of OS.

2.7 Daughter Boards

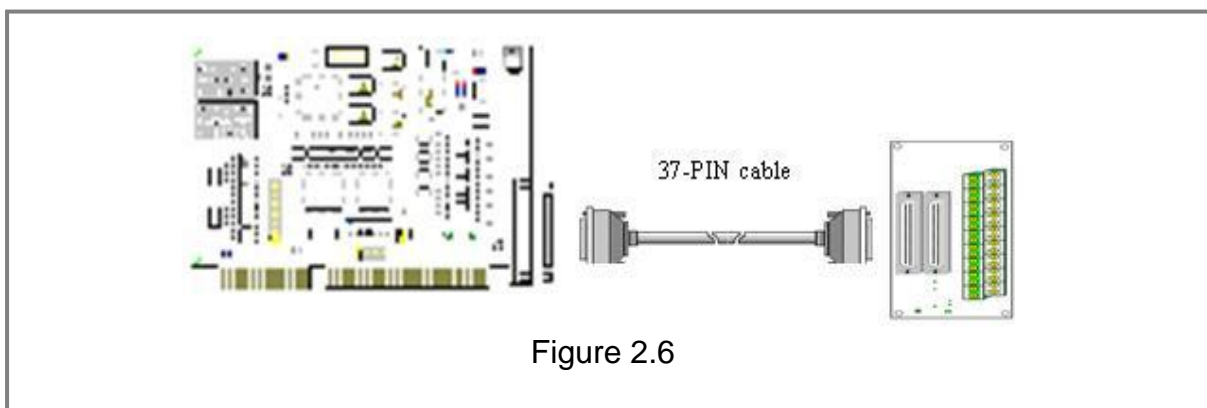
2.7.1 DB-37

The DB-37 is a general-purpose daughter board for D-sub 37-pin devices, and is designed for easy wiring.



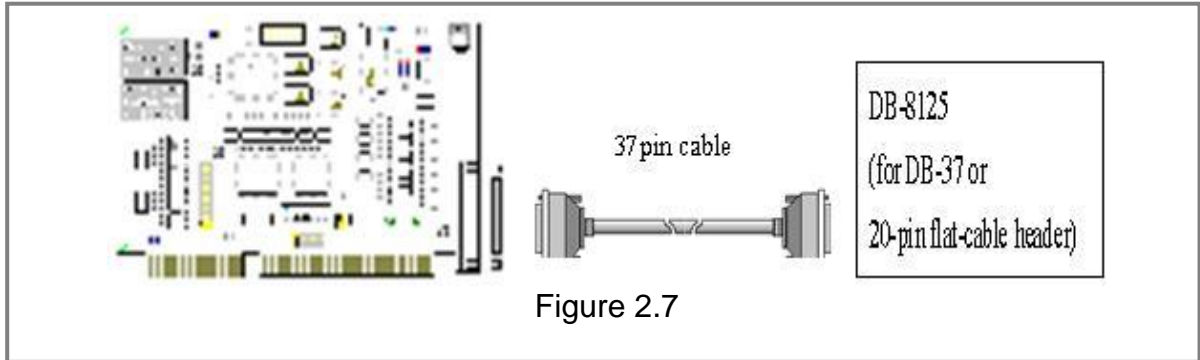
2.7.2 DN-37 and DN-50

The DN-37 is a general-purpose daughter board for the DB-37 using DIN-Rail Mounting. The DN-50 is designed for a 50-pin flat-cable header using DIN-Rail mounting. They are also designed for easy wiring.



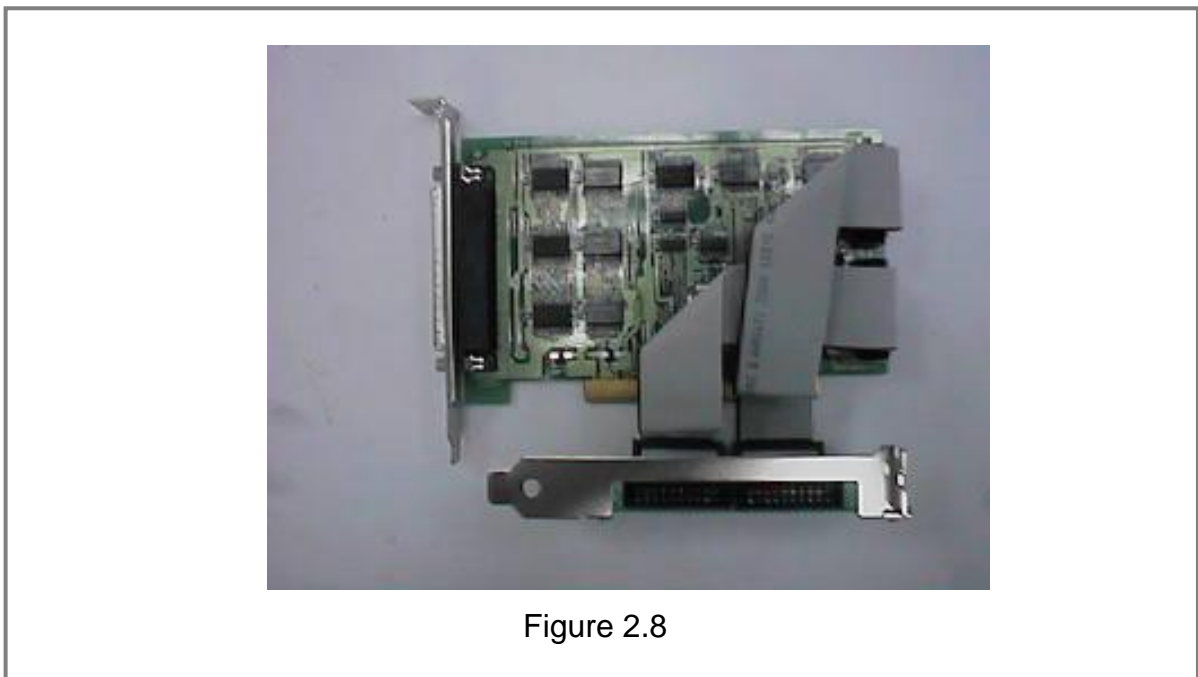
2.7.3 DB-8125

The DB-8125 is a general-purpose screw terminal board and is designed for easy wiring. The DB-8125 uses a single DB-37 header and two 20-pin flat-cable headers.



2.7.4 ADP-20/PCI

The ADP-20/PCI is an extender for the 20-pin header. The one side of the ADP-20/PCI can be connected to a 20-pin header. The other side can be mounted onto the PC chassis as is depicted by the following:



2.7.5 DB-24P, 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. The DB-24P can be used to sense DC signals from TTL levels up to 24 V, or use the DB-24P to sense a wide range of AC signals. This board can also be used 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 2.9. Table 2.6 is comparison of the DB-24P and DB-24PD.

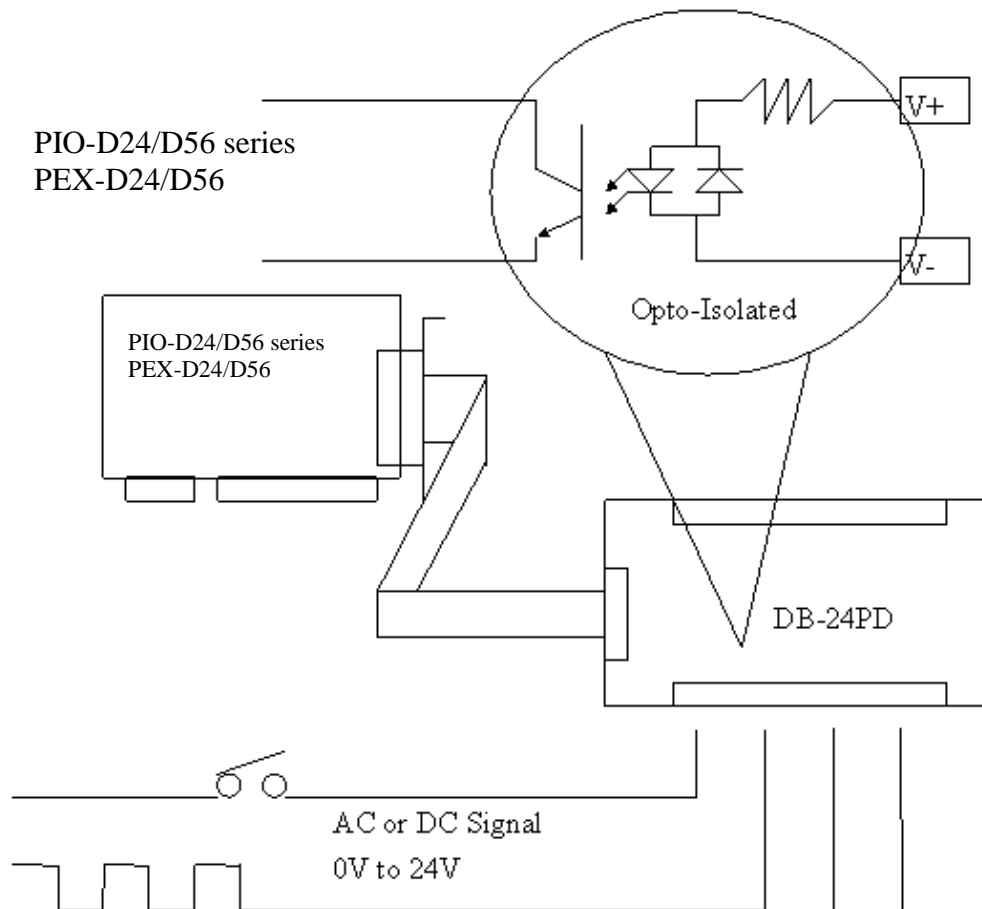


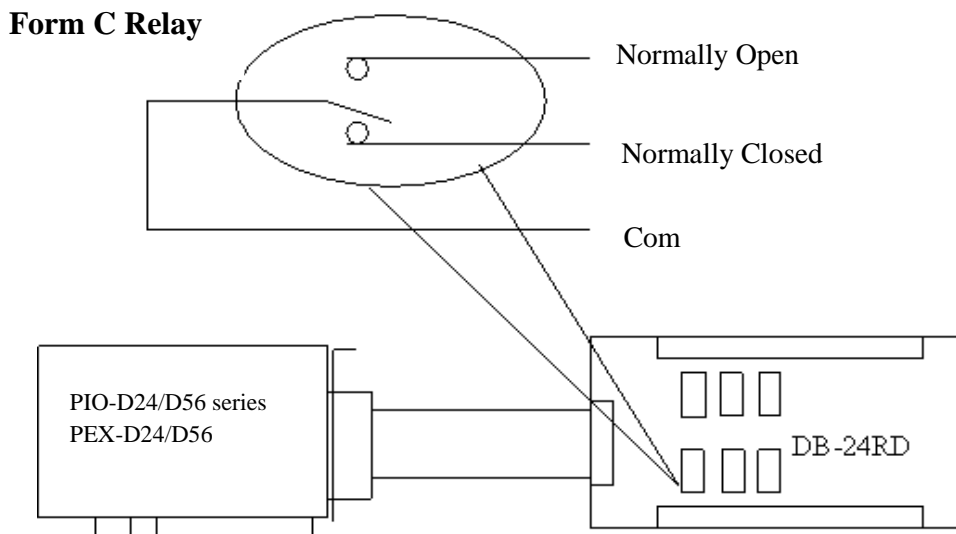
Figure 2.9

Table 2.7

	DB-24P	DB-24PD
50-pin flat-cable header	Yes	Yes
D-sub 37-pin header	No	Yes
Other specifications	Same	

2.7.6 DB-24R, DB-24RD Relay Board

The DB-24R is a 24-channel relay output board consisting of 24 Form-C relays for efficient programmable control of the load switching. The relays are powered 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 is light when their associated relay is activated. The control scheme is illustrated in Figure 2.10 below. Table 2.7 gives a comparison and Table 2.8 gives a description of the daughter boards used in this application.



Notes: Channels: 24 Form C Relay
Relays: Switching of up to 0.5 A at 110 V_{AC} or 1 A at 24 V_{DC}

Figure 2.8

Table 2.8

	DB-24R	DB-24RD
50-pin flat-cable header	Yes	Yes
D-sub 37-pin header	No	Yes
Other specifications	Same	

Table 2.9

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 × Photo MOS Relay (350 V, 0.1 A)
DB-24SSR	24 × SSR (250 V _{AC} , 4 A)
DB-24C	24 × O.C. (30 V, 100 mA)
DB-16P8R	16 × Relay (120 V, 0.5 A) + 8 × isolated input

2.7.7 DB-24PR, DB-24POR, DB-24C

Table 2.10

DB-24PR	24 x Power relay, 5 A/250 V
DB-24POR	24 x Photo MOS relay, 0.1 A/350 V _{AC}
DB-24C	24 x Open Collector, 100 mA per channel, 30 V max.

The DB-24PR is a 24-channel power relay output board consisting of 8 Form-C and 16 Form-A electromechanical relays for efficient programmable control of the load switching. The contact of each relay can allow a 5 A current load at 250 V_{AC}/30 V_{DC}. The relay is powered by applying a 5 voltage signal to the associated relay channel on the 20-pin flat-cable connector (only uses 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 is light when their associated relay is activated. To avoid overloading your PC's power supply, this board needs a +12 V_{DC} or +24 V_{DC} external power supply, as shown in Figure 2.11.

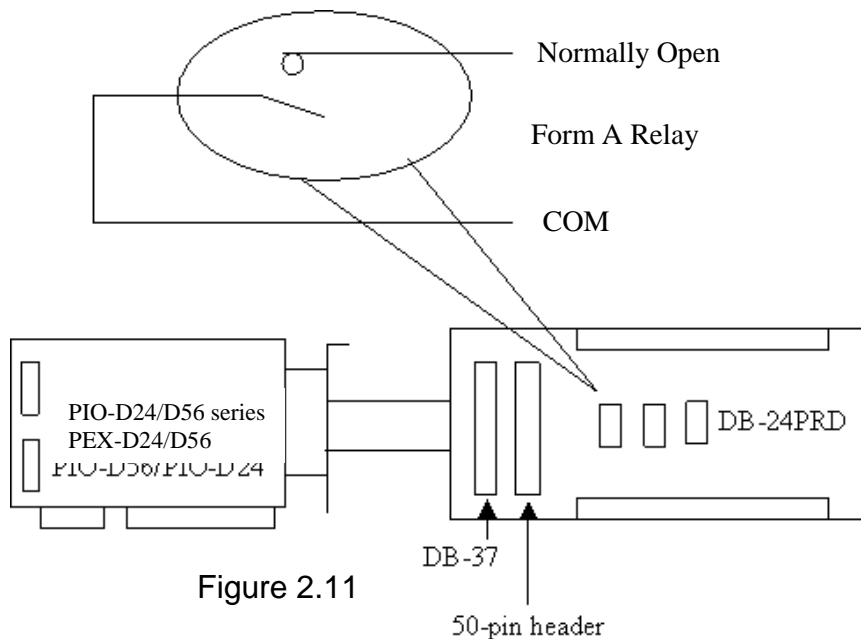


Figure 2.11



Notes:

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

2.7.8 Daughter Board Comparison Table

Table 2.10 lists a comparison for the daughter board applications using PIO/PISO series cards.

Table 2.11

	20-pin flat-cable	50-pin flat-cable	D-sub 37-pin
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-24PRD	No	Yes	Yes
DB-24POR	Yes	Yes	Yes
DB-24SSR	No	Yes	Yes



Note:

There is no 50-pin flat cable header in the PIO-D24/D56 series and PEX-D56/D24. The PIO-D24/D56 series and PEX-D56/D24 has one DB-37 connector and two 20 pin flat-cable headers (only for PIO-D56(U)/PEX-D56).

3. I/O Control Register



3.1 How to Find the I/O Address

The Plug & Play BIOS will assign an appropriate I/O address to each PIO/PISO series card during the power-on stage. The fixed IDs of the PIO-D24/D56 series and PEX-D24/D56 cards are as following:

For PIO-D24U/D56U and PEX-D24/D56

Rev 1.0 or above

Vendor ID	0xE159
Device ID	0x0001
Sub-vendor ID	0x8080 0xC080
Sub-device ID	0x01
Sub-aux ID	0x40

For PIO-D24

Rev 1.0~Rev 5.0

Vendor ID	0xE159
Device ID	0x0002
Sub-vendor ID	0x80
Sub-device ID	0x01
Sub-aux ID	0x40

Rev 6.0 or above

Vendor ID	0xE159
Device ID	0x0001
Sub-vendor ID	0x8080 0xC080
Sub-device ID	0x01
Sub-aux ID	0x40

For PIO-D56

<Rev 1.0 ~ Rev 4.0>

Vendor ID	0xE159
Device ID	0x0002
Sub-vendor ID	0x80
Sub-device ID	0x01
Sub-aux ID	0x40

Rev 5.0 or above

Vendor ID	0xE159
Device ID	0x0001
Sub-vendor ID	0x8080 0xC080
Sub-device ID	0x01
Sub-aux ID	0x40

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 figure 3.1. Details of how to identify the PIO series cards of ICPDAS data acquisition boards based on the **Sub-vendor**, **Sub-device** and **Sub-Aux ID** are given in Table 3-1.

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/

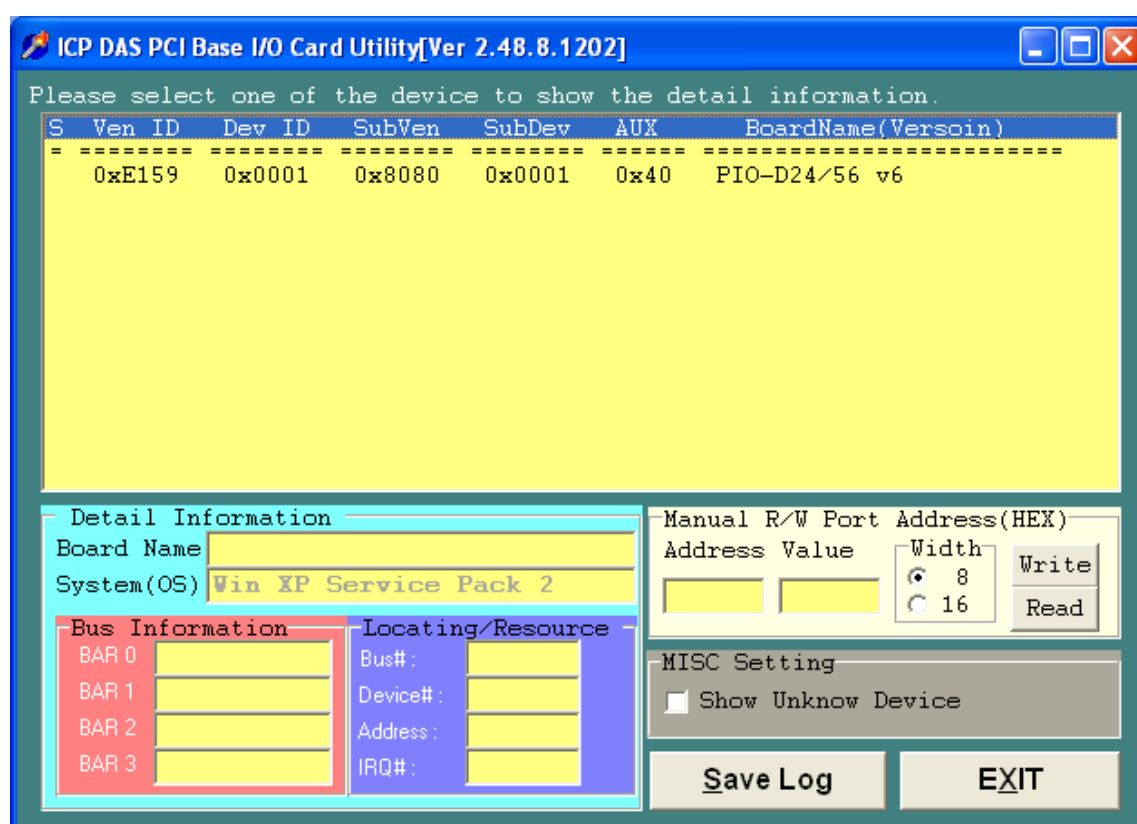


Figure 3.1

Table 3-1

PIO/PISO series card	Description	Sub_Vendor	Sub_Device	Sub_AUX
PIO-D168	168 * DIO	9880	01	50
PIO-D168A	168 * DIO	80	01	50
PIO-D144(REV4.0)	144 * D/I/O	80 (5C80)	01	00
PIO-D96 (REV4.0)	96 * D/I/O	80 (5880)	01	10
PIO-D64 (REV2.0)	64 * D/I/O	80 (4080)	01	20
PIO-D56 (REV5.0)	24 * D/I/O + 16 * D/I+16*D/O	80 (8080)	01	40
PIO-D48 (REV2.0)	48 * D/I/O	80 (0080)	01	30
PIO-D24 (REV6.0)	24 * D/I/O	80 (8080)	01	40
PIO-821	Multi-function	80	03	10
PIO-DA16	16 * D/A	80	04	00
PIO-DA8	8 * D/A	80	04	00
PIO-DA4	4 * D/A	80	04	00
PISO-C64	64 * isolated D/O (Current sinking)	80	08	00
PISO-A64	64 * isolated D/O (Current sourcing)	80	08	50
PISO-P64	64 * isolated D/I	80	08	10
PISO-P32C32	32* isolated D/O (Current sinking) + 32* isolated D/I	80	08	20
PISO-P32A32	32*isolated DO (Current sourcing) + 32* isolated D/I	80	08	70
PISO-P8R8	8* isolated D/I + 8 * 220 V relay	80	08	30
PISO-P8SSR8AC	8* isolated D/I + 8 * SSR /AC	80	08	30
PISO-P8SSR8DC	8* isolated D/I + 8 * SSR /DC	80	08	30
PISO-730	16*DI + 16*D/O + 16* isolated D/I + 16*isolated D/O (Current sinking)	80	08	40
PISO-730A	16*DI + 16*D/O + 16* isolated D/I + 16*isolated D/O (Current sourcing)	80	08	80
PISO-813	32 * isolated A/D	80	0A	00
PISO-DA2	2 * isolated D/A	80	0B	00

**Note:**

If your board is a different version, it may also have different Sub IDs. However this will present no actual problem. No matter which version of the board you select, we offer the same function calls.

3.2 The Assignment of I/O Addresses

The Plug & Play BIOS will assign an appropriate I/O address to the PIO/PISO series card. If there is only one PIO/PISO board, the board will be identified 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/PISO series cards in one PC system. Details of how to locate and identify card_0 and card_1 are provided below:

The simplest way to identify which card is card_0 is to use the wSlotBus and wSlotDevice functions as follows:

Step 1: Remove all PIO-D24/D56 or PEX-D24/D56 series cards from the PC.

Step 2: Install a single PIO-D24/D56 or PEX-D24/D56 series card into the PCI_slot1 in the PC, then run PIO_PISO.EXE and record the wSlotBus1 and wSlotDevice1 information.

Step 3: Remove all PIO-D24/D56 or PEX-D24/D56 series cards from the PC.

Step 4: Install a single PIO-D24/D56 or PEX-D24/D56 series cards into the PCI_slot2 in the PC, then run PIO_PISO.EXE and record the wSlotBus2 and wSlotDevice2 information.

Step 5: Repeat Steps 3 and 4 for all PCI_slots and record all wSlotBus and wSlotDevice information.

The records may be similar to the following table:

Table 3-2

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 is used to record all the wSlotBus and wSlotDevice information for the PC. These values will be mapped to this PC's physical slots and this mapping will not be changed for any PIO/PISO cards. Therefore, this information can be used to identify the specific PIO/PISO card using the following steps:

Step 1: Using the wSlotBus and wSlotDevice information from Table 3-2, enter the board number into the PIO_GetConfigAddressSpace(...) function to get the information for a specific card information, especially wSlotBus and wSlotDevice details.

Step 2: Identify the specific PIO/PISO card by comparing the data of the wSlotBus and wSlotDevice from Step 1.



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

3.3 The I/O Address Map

The I/O address of the PIO/PISO series card is automatically assigned by the main board ROM BIOS. The I/O address can also be re-assigned by the user, but It is strongly recommended that the I/O address is not changed by user. The Plug & Play BIOS will assign an appropriate I/O address to each PIO/PISO series card. The I/O addresses of the PIO-D24/D56 and PEX-D24/D56 series cards are as follows, and are based on the base address of each card.

Table 3-3

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 Port0	write Port0
Wbase+0xc4	read Port1	write Port1
Wbase+0xc8	read Port2	write Port2
Wbase+0xcc	Read Card ID	Port0~Port2 configuration
Wbase+0xd0	read CON2 Low byte (only for PIO-D56(U) and PEX-D56)	write CON1 Low byte (only for PIO-D56(U) and PEX-D56)
Wbase+0xd4	read CON2 high byte (only for PIO-D56(U) and PEX-D56)	write CON1 high byte (only for PIO-D56(U) and PEX-D56)

Note: Wbase+0xd0 and Wbase+0xd4 are only for PIO-D56(U) and PEX-D56 series.

3.3.1 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 is first powered-on, the RESET\ signal is in the Low-state. **This will disable all D/I/O operations.** The user has to set the RESET\ signal to the High-state before performing any D/I/O commands.

outportb (wBase,1); /*RESET\=High → all D/I/O operations are enable */

outportb (wBase,0); /*RESET\=Low → all D/I/O operations are disable now */

3.3.2 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 powered-on, all Aux signals are in the Low-state. All Aux are designed as D/I operations for all PIO/PISO series cards.

3.3.3 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 as D/O operations, the output state is controlled by this register. This register is designed for use with future extensions. Therefore, do not use this register.

3.3.4 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 as a interrupt signal (Default).

EN0=1→ Enable P2C0 as a interrupt signal

```
outp(wBase+5,0);      /* Disable interrupt */
outp(wBase+5,1);      /* Enable interrupt P2C0 */
outp(wBase+5,0x0f);   /* Enable interrupt P2C0, P2C1, P2C2, and P2C3 */
```

3.3.5 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 the DEMO5.C file for more information. Aux 0~3 are used as interrupt sources. The interrupt service routine must read this register to identify the interrupt source. Refer to Sec. 2.5 for more information.

3.3.6 Read Card ID Register

(Read): wBase+0xcc

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	ID3	ID2	ID1	ID0	Port2	Port1	Port0

```
wCardID = inportb(wBase+0xcc) >>3;      /* Read Card ID */
```



Note: The Card ID function is only supported by the PIO-D24U/D56U and PEX-D24/D56 (Ver1.0 or above)

3.3.7 I/O Selection Control Register

(Write): wBase+0xcc

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	ID3	ID2	ID1	ID0	Port2	Port1	Port0

This registers provide the function for configuration the digital input/output ports of the PIO/PISO series cards. Every I/O port can be programmed to either 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.

Port? = 1 → this port is used as a D/O port

Port? = 0 → this port is used as a D/I port

```
outportb(wBase+0xcc,0x00); /* Set Port 0/1/2 as D/I port */
```

```
outportb(wBase+0xcc,0x04); /* Set Port0/1 as D/I port */
                          /* Set Port2 as D/O port */
```

3.3.8 Interrupt Polarity Control 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 that is used to control whether the interrupt signal source is inverted or non-inverted. A detailed application example is shown below.

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

```
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,0x0e); /*Select the inverted input of P2C0 */
                          /*Select the non-inverted input P2C1/2/3 */
outportb(wBase+0x2a,0x0c); /*Select the inverted input of P2C0/1 */
                          /*Select the non-inverted input P2C2/3 */
```

Refer to Sec. 2.5 and DEMO5.C for more information.

3.3.9 Read/Write 8-bit data Register

(Read/Write):wBase+0xc0/0xc4/0xc8/0xd0/0xd4

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-D24/D56 and PEX-D24/D56 series contains 5/3 8-bit I/O ports, and each I/O port can be configured as either a 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.

```

outputb(wBase+0xc0,Val); /*Write to port-0 */
Val=inportb(wBase+0xc0); /*Read from port-0*/

outputb(wBase+0xcc,0x07); /*Set Port0~Port2 as DO port */
outputb(wBase+0xc0,i1); /*Write to Port0 */
outputb(wBase+0xc4,i2); /*Write to Port1 */
outputb(wBase+0xc8,i3); /*Write to Port2 */

outputb(wBase+0xcc,0x01); /*Set Port0 as DO port */
/*port1~Port2 as DI port */
outputb(wBase+0xc0,i1); /*Write to Port0 */
j2=inportb(wBase+0xc4); /*Read Port1 */
j3=inportb(wBase+0xc8); /*Read Port2 */

L=inportb(wBase+0xd0); /*Read CON2 Low byte */
H=inportb(wBase+0xd4); /*Read CON2 High byte */
Val=(H<<8)+L ; /*Val is 16 bit data */

outputb(wBase+0xd0,Val); /*Write to CON1 Low byte */
outputb(wBase+0xd4,(Val>>8)); /*Write to CON1 high byte */

```



Note: Make sure the I/O port configuration (DI or DO) before read/write the data register (wBase+0xc0/0xc4/0xc8), refer to Sec.3.3.7 and Table 3.3 for more information.

4. Software Installation

The PIO-D24/D56 and PEX-D24/D56 series can be used in DOS and Windows 98/ME/NT/2K and 32-bit/64-bit Windows XP/2003/Vista/7. The recommended installation procedure for windows is given in Sec. 4.1 ~ 4.2. Or refer to Quick Start Guide (CD:\NAPDOS\PCI\PIO-DIO\Manual\QuickStart\).

<http://ftp.icpdas.com/pub/cd/iocard/pci/napdos/pci/pio-dio/manual/quickstart/>

4.1 Software Installing Procedure

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

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

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

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

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

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

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

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

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

Step 3: Click the item: "**PIO-DIO**".

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

Step 5: Double-Click "**PIO_DIO_Win_vxxx.exe**" file in the **Driver** folder.

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

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

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



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

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

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

■ **Windows 95/98/ME:**

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



For more detailed PIODIO.DLL function information, please refer to "PIO-DIO DLL Software Manual.pdf(CD:\NAPDOS\PCI\PIO-DIO\Manual\)".
<http://ftp.icpdas.com/pub/cd/iocard/pci/napdos/pci/pio-dio/manual/>

4.2 PnP Driver Installation

Power off the computer and install the PIO-D24/D56 and PEX-D24/D56 series cards. Turn on the computer and Windows 98/Me/2K and 32-bit/64-bit Windows XP/2003/Vista/7 should automatically detect the new PCI device(s) and then ask for the location of the driver files for the hardware. If a problem is encountered during installation, refer to the PnPinstall.pdf file for more information.

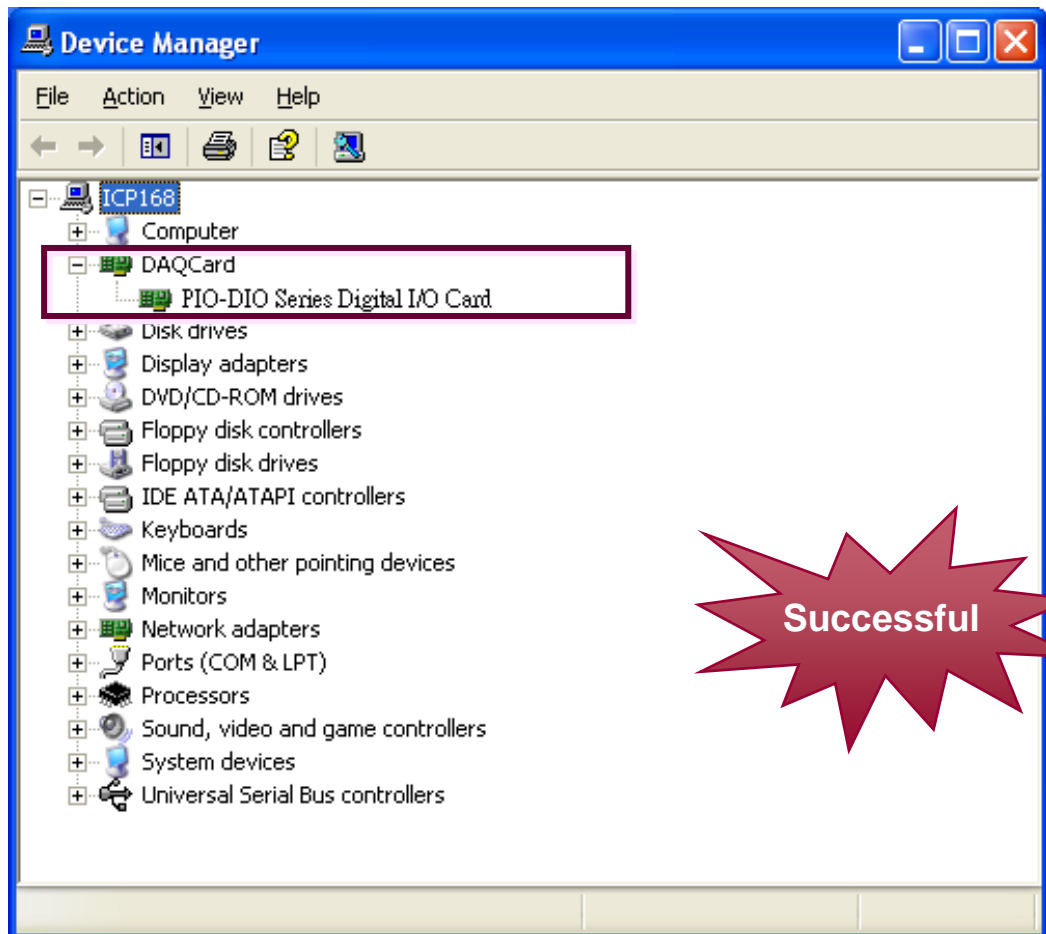
4.3 Confirm the Successful Installation

Make sure the PIO-D24/D56 or PEX-D24/D56 series cards installed are correct on the computer as follows:

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

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

Step 3: Check the PIO-DIO series card which listed correctly or not, as illustrated below.



5. Demo Programs for Windows



None of the demo programs will function correctly if the DLL driver is not properly installed. During the DLL driver installation process, the Install Shield software will register the correct kernel driver to the operating 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-bit Windows XP/2003/Vista/7). After the drivers are installed, the relevant demo programs, development libraries and declaration header files for the different development environments will be available in the following locations.

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/

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

A list of available demo programs is as follows:

DIO: Digital input and output

DIO_2: Digital input and output (only for PIO-D56(U)/PEX-D56)

INT: Interrupt test

INTAPC: Interrupt test



Appendix A. Related DOS Software

A1. Where is the related software

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

CD:\NAPDOS\PC\PIO-DIO\dos\

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

- TC*. * → for Turbo C 2.xx or above
- TC\LIB*. * → for TC library
- TC\DEMO*. * → for TC demo programs
- TC\DIAG*. * → for TC diagnostic programs

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

- MSC*. * → for MSC 5.xx or above
- MSC\LIB\PIO.H → MSC declaration file
- MSC\LIB\MSCPIO_L.LIB → MSC large model library file
- MSC\LIB\MSCPIO_H.LIB → MSC huge model library file

- BC*. * → for BC 3.xx or above
- BC\LIB\PIO.H → BC declaration file
- BC\LIB\BCPIO_L.LIB → BC large model library file
- BC\LIB\BCPIO_H.LIB → BC huge model library file

The list of demo programs:

DEMO1: D/O for CON1

DEMO2: D/I/O for CON1 ~ CON3

DEMO3: Interrupt of P2C0 (Initial low and active high)

DEMO4: Interrupt of P2C0 (Initial high and active low)

DEMO5: 4 interrupt sources

A2. DOS LIB Functions

A2-1. ErrorCode and ErrorString Code Table

Table A.1

Error Code	Error ID	Error String
0	NoError	OK (No error)
1	Driver HandleError	Error opening the device driver
2	DriverCallError	An error occurred while calling the driver functions
3	FindBoardError	Can't find the board on the system
4	TimeOut	Timeout
5	ExceedBoardNumber	Invalid board number (Valid range: 0 to TotalBoards -1)
6	NotFoundBoard	Can't detect the board on the system

A2-2. PIO_DriverInit

■ **Description:**

This function is used to detect all PIO/PISO series card in the system and is implemented based on the PCI Plug & Play mechanism. The function will locate/identify all PIO/PISO series cards installed in this system and save the resource information in the library.

■ **Syntax:**

WORD **PIO_DriverInit**(WORD *wBoards, WORD wSubVendorID, WORD wSubDeviceID, WORD wSubAuxID)

■ **Parameters:**

WBoards	[Output]	The number of boards found in this PC
wSubVendorID	[Input]	SubVendor ID of the board
wSubDeviceID	[Input]	SubDevice ID of the board
wSubAuxID	[Input]	SubAux ID of the board

■ **Returns:**

Refer to "Table A.1".

A2-3. PIO_GetConfigAddressSpace

- **Description:**

This function can be used to save the resource information all PIO/PISO cards installed in the system. The application program can then control all the functions of the PIO/PISO series card directly.

- **Syntax:**

WORD PIO_GetConfigAddressSpace(wBoardNo,*wBase,*wlrq,
wSubVendor, *wSubDevice, *wSubAux, *wSlotBus, *wSlotDevice)

- **Parameters:**

wBoardNo	[Input]	The board number
wBase	[Output]	The base address of the board
wlrq	[Output]	The IRQ number that the board using
wSubVendor	[Output]	Sub Vendor ID
wSubDevice	[Output]	Sub Device ID
wSubAux	[Output]	Sub Aux ID
wSlotBus	[Output]	Slot Bus number
wSlotDevice	[Output]	Slot Device ID

- **Returns:**

Refer to "Table A.1".

A2-4. PIO_GetDriverVersion

- **Description:**

This function is used to obtain the version number of PIODIO driver.

- **Syntax:**

WORD PIO_GetDriverVersion(WORD *wDriverVersion)

- **Parameters:**

wDriverVersion	[Output]	wDriverVersion address
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- **Returns:**

Refer to "Table A.1".

A2-5. ShowPIOPIISO

- **Description:**

This function can be used to display a text string indicating the special Sub_ID. This text string is the same as that defined in PIO.H.

- **Syntax:**

WORD **ShowPIOPIISO(wSubVendor, wSubDevice, wSubAux)**

- **Parameters:**

wSubVendor	[Input]	SubVendor ID of the board
wSubDevice	[Input]	SubDevice ID of the board
wSubAux	[Input]	SubAux ID of the board

- **Returns:**

Refer to "Table A.1".