PCI-FC16U Series Board User Manual

16-ch Counter/Frequency Board with 32-ch Programmable DIO

Version 1.1, Oct. 2015

Support

This manual relates to the following boards: PCI-FC16U.

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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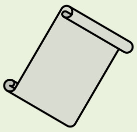
Packing List

The shipping package should contain the following items:

	One PCI-FC16U Series Board
	One printed Quick Start Guide
	One Software Utility CD
	One CA-4002 D-Sub Connector

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.

1. Introduction

The PCI-FC16U User Manual contains information about using the ICP DAS PCI-FC16U Series multifunction board with UniDAQ. PCI-FC16U board feature up to 16 Counter/Frequency channels and 32 Programmable Digital Input/Output channels. This chapter provides basic information you need to get started using your PCI-FC16U board.

1.1 Overview

The PCI-FC16U is a 32-bit hardware-type high-speed Counter/Frequency board that supports both the 3.3 V and the 5 V Universal PCI bus. The card provides 16 channels that can be individually configured for either frequency measurement or up-counter applications, and can support high-frequency signals up to 250 kHz. The PCI-FC16U board also includes 32 programmable Digital I/O channels.

The PCI-FC16U board includes an onboard Card ID switch that enables the board to be easily recognized via software if two or more boards are installed in the same computer. The pull-high/pull-low resistors allow the DI status to be predefined as either high or low instead of remaining floating if the DI channels are disconnected or interrupted.

The PCI-FC16U board supports a variety of operating systems, such as DOS, Windows 2000, 32/64-bit Windows XP/2003/2008/Vista/7 and Windows 8. ICP DAS also provides a DLL and Active X control for the PCI-FC16U, together with sample programs in various languages, including Turbo C++, Borland C++, Visual C++, Borland Delphi, Borland C++ Builder, Visual Basic, C#.NET, Visual Basic.NET and LabVIEW, enabling help users to quickly and easily develop their custom applications.

1.2 Features

The following is an overview of the general features provided by the PCI-FC16U board. Refer to Section 1.3 for more details.

- Universal PCI Interface supports both the 5 V and the 3.3 V PCI bus
- Supports Card ID (SMD Switch)
- 16-channel Up Counter or Frequency Measurement.
  (Pulse Width = 2 μs Min.)
- Digital Filter: 1 ~ 32767 (μs)
- 32 Programmable Digital I/O Channels
- Pull-high and Pull-low Resistors for DI Channels
- +/- 2 kV ESD Protection for each channels

1.3 Applications

- Counter Measurement
- Frequency Measurement

1.4 Specifications

The following is an overview of the specifications for the various models in the PCI-FC16U

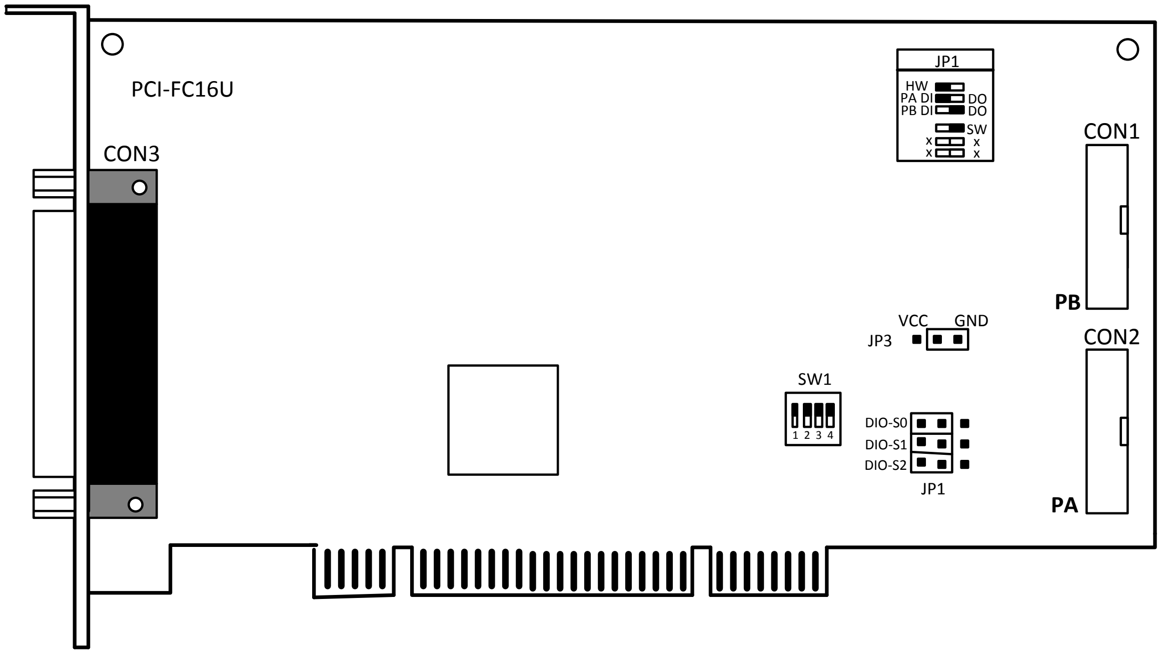
Model		PCI-FC16U
Counter/Frequency		
Mode	Counter & Frequency	16-ch Up Counter
		16-ch Frequency
	Digital Noise Filter	1 ~ 32767 µs
Isolated Input Level	ON Voltage Level	+4.5 V_{DC} ~ +30 V_{DC}
	OFF Voltage Level	+1 V_{DC} Max.
Min. Pulse Width		2 µs
Input Frequency		**1 Hz ~ (typically) 250 kHz (both counter mode and frequency mode)** where 250 kHz is calculated as followings: Supposed that duty cycle = 50%, refer to Minimum Pulse Duration of High Level, we have pulse period = 2 µs x 2 = 4 µs, which is 250 kHz as a max.
		Max. Frequency: Refer to Min. Pulse Duration of High Level, Max. Frequency is highly affected by duty cycle.
		Frequency Accuracy = **± 0.4 %**
EEPROM		128 KB
Isolated Voltage		2500 V_{DC}
ESD Protection		2 kV (Contact for each channel)
Programmable I/O		
Channels		32
Digital Input		
Compatibility		5 V/TTL
Input Voltage		Logic 0: 0.8 V (Max.) Logic 1: 2.0 V (Min.)
Pull-high/low		Yes
Response Speed		1.0 MHz (Typical)

Model	PCI-FC16U
Digital Output	
Compatibility	5 V/TTL
Output Voltage	Logic 0: 0.4 V (Max.) Logic 1: 2.4 V (Min.)
Output Capability	Sink: 2.4 @ 0.8 V Source: 0.8 @ 2.0 V
Response Speed	1.0 MHz (Typical)
General	
Bus Type	3.3 V/ 5 V Universal PCI, 32-bit, 33 MHz
Data Bus	16it
Card ID	Yes (4-bit)
I/O Connector	Female DB37 x 1 20-pin box header x 2
Dimensions (L x W x D)	170 mm x 88 mm x 22 mm
Power Consumption	700 mA @ 5 V Max.
Operating Temperature	0 ~ 60 °C
Storage Temperature	-20 ~ 70 °C
Humidity	5 ~ 85% RH, Non-condensing

2 Hardware Configuration

2.1 Board Layout

The following is an overview of the board layout for each of the PCI-FC16U board.

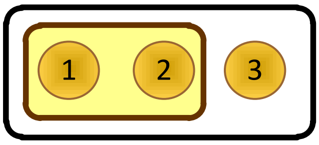
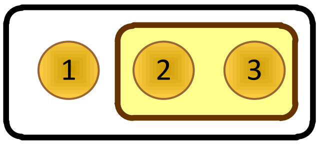


CON1	The terminal for PB. Refer to Section 2.5 “Pin Assignments”
CON2	The terminal for PA. Refer to Section 2.5 “Pin Assignments”
CON3	The terminal for Counter/Frequency. Refer to Section 2.5 “Pin Assignments”
JP1	Digital Input/Output Mode Settings. Refer to Section 2.2.1 “JP1 (Digital I/O Mode)”
JP3	Digital Input Pull-high/low Settings. Refer to Section 2.2.2 “JP3 (DI Pull-high/low)”
SW1	DIP Switch used to configure the Board ID. Refer to Section 2.3 “Card ID Switch (SW1)”

2.2 Jumper Settings

2.2.1 JP1: Digital I/O Mode

Jumper JP1 is used to configure the Digital I/O direction mode as either **Software Programmable (short pins 2 and 3)** or **Jumper Selectable (short pins 1 and 2)**. The default setting is Jumper Selectable Mode.

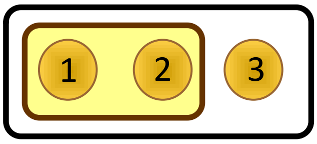
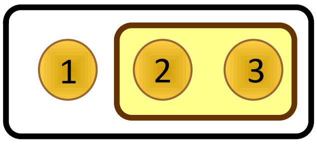
JP1	Jumper Selectable (Default)	Software Programmable
DIO-S0	HW  SW	HW  SW

Software Programmable Mode:

Refer to Section 6.3 "Bar1: Digital I/O Registers" for details of how to configure Port A (PA) and Port B (PB) when the DIO-S0 jumper is set to Software Programmable Mode. The DIO-S1 and DIO-S2 jumpers are not used when the DIO-S0 jumper is set to Software Program Mode.

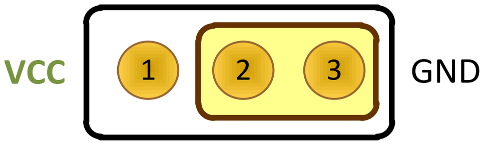
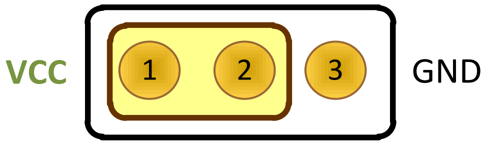
Jumper Selectable Mode:

DIO-S1 (Port A, PA) and DIO-S2 (Port B, PB) are used to configure the I/O ports as either DI (short pins 1 and 2) or DO (Short pins 2 and 3), when the DIO-S0 Jumper is set to Jumper Selectable Mode. The default Settings is DI.

JP1	DIO-S0 is Jumper Selectable Mode	
	DI **(Default)**	**DO**
DIO-S1 (Port A) **DIO-S2 (Port B)**		

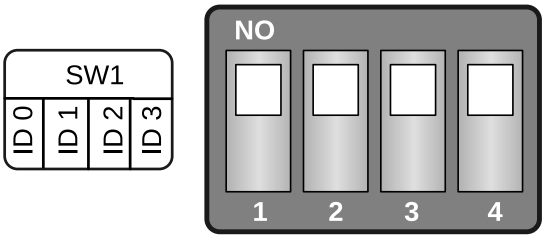
2.2.2 JP3: Digital Input Pull-high/low

Jumper JP3 is used to set the Digital Input to either Pull-high or Pull-low. Shorting pins 1 and 2 will set the Digital I/O to Pull-high. To set the Digital I/O to Pull-low, pins 2 and 3 should be shorted. The default setting is Pull-low.

Jumper	Pull-low (Default)	Pull-high
JP3		

2.3 Card ID Switch (SW1)

The PCI-FC16U includes an onboard Card ID switch (SW1) that enables the board to be recognized via software if two or more boards are installed in the same computer. The default Card ID is 0x0. For more details regarding the SW1 Card ID settings, refer to the table below.



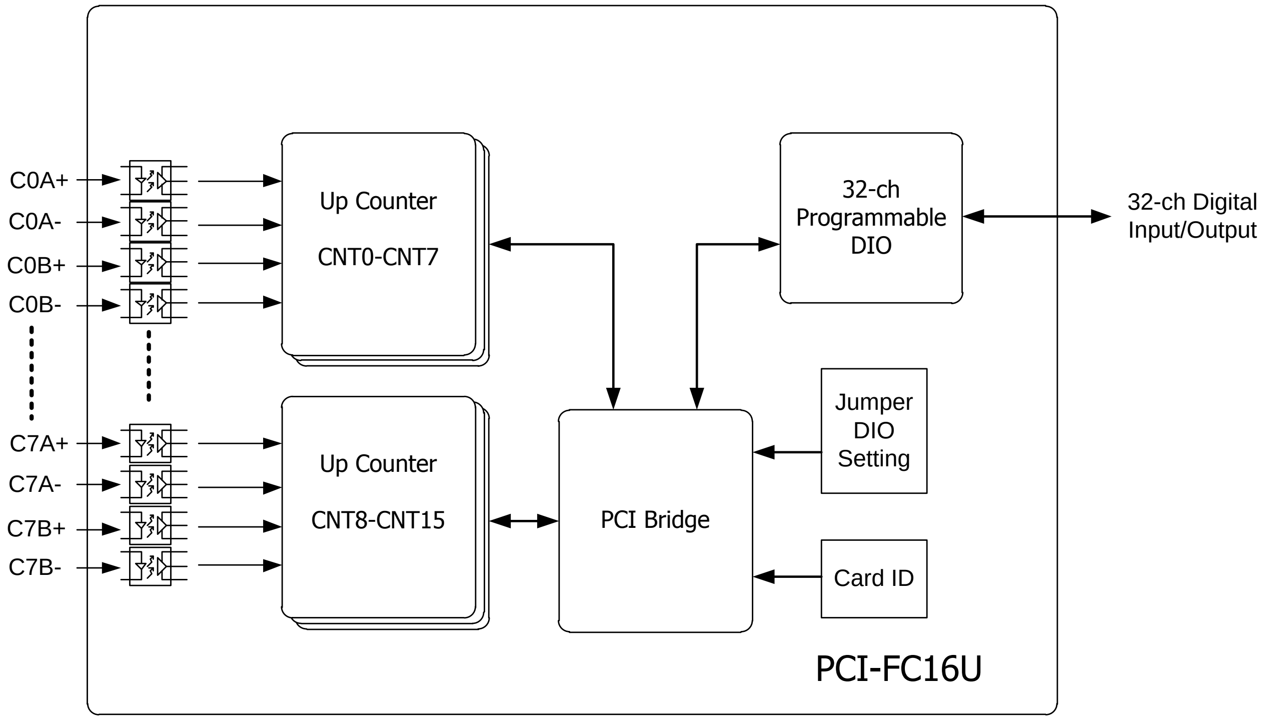
(Default Settings)

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 System Block Diagram

- The following is the block diagram for the PCI-FC16U:



2.5 Pin Assignments

Pin Assign-ment	Terminal No.	Terminal No.	Pin Assign-ment
C0+	01	20	C0-
C1+	02	21	C1-
C2+	03	22	C2-
C3+	04	23	C3-
C4+	05	24	C4-
C5+	06	25	C5-
C6+	07	26	C6-
C7+	08	27	C7-
N.C.	09	28	N.C.
C8+	10	29	C8-
C9+	11	30	C9-
C10+	12	31	C10-
C11+	13	32	C11-
C12+	14	33	C12-
C13+	15	34	C13-
C14+	16	35	C14-
C15+	17	36	C15-
N.C.	18	37	N.C.
N.C.	19		

CON3

Pin Assign-ment	Terminal No.	Terminal No.	Pin Assign-ment
PB 0	01	02	PB 1
PB 2	03	04	PB 3
PB 4	05	06	PB 5
PB 6	07	08	PB 7
PB 8	09	10	PB 9
PB 10	10	12	PB 11
PB 12	12	14	PB 13
PB 14	14	16	PB 15
GND	16	18	GND
+5V	18	20	+12V

CON1

Pin Assign-ment	Terminal No.	Terminal No.	Pin Assign-ment
PA 0	01	02	PA 1
PA 2	03	04	PA 3
PA 4	05	06	PA 5
PA 6	07	08	PA 7
PA 8	09	10	PA 9
PA 10	11	12	PA 11
PA 12	13	14	PA 13
PA 14	15	16	PA 15
GND	17	18	GND
+5V	19	20	+12V

CON2

Note:

1. *“N.C.” is the abbreviation of “Not Connected”.*
2. *CON1 and CON2 are TTL Compatible.*

3 Hardware Installation

Note:

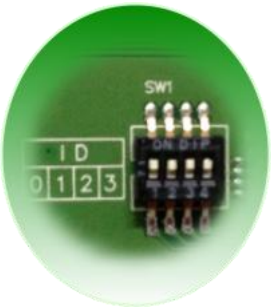
It is recommended that the driver is installed before installing the hardware as the computer may need to be restarted once the driver is installed in certain operating systems, such as Windows 2000 or Windows XP, etc. Installing the driver first helps reduce the time required for installation and restarting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

To install the PCI-FC16U board, follow the procedure described below:

Step 1: Install the driver for the PCI-FC16U board on your computer.

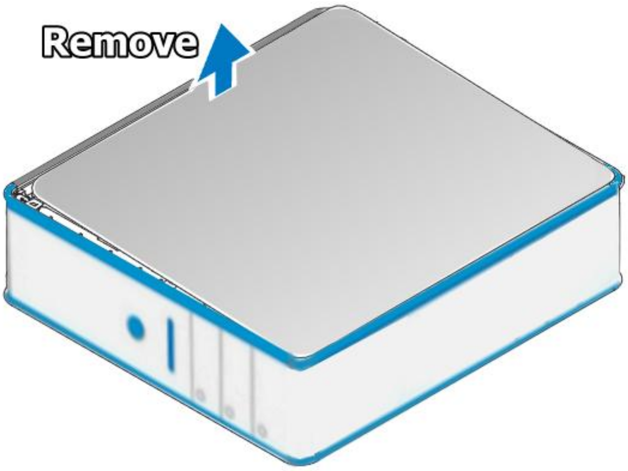
For detailed information about installing the driver, refer to Chapter 4 Software Installation.

Step 2: Configure the Card ID using the DIP Switch (SW1).



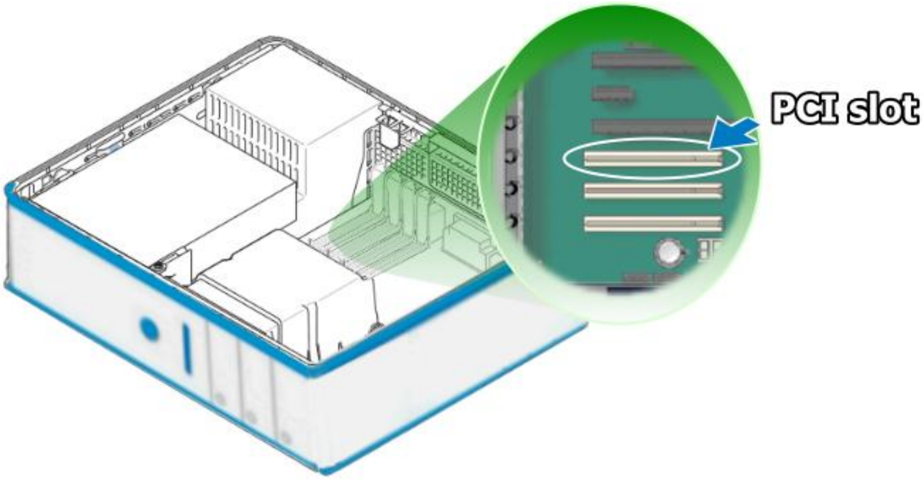
For detailed information about the Card ID, refer to Section 2.3 Card ID Switch (SW1).

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

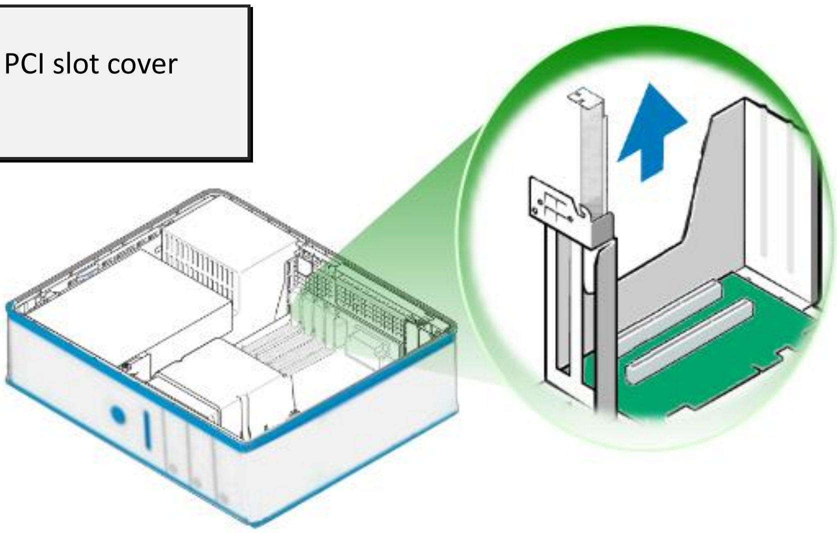


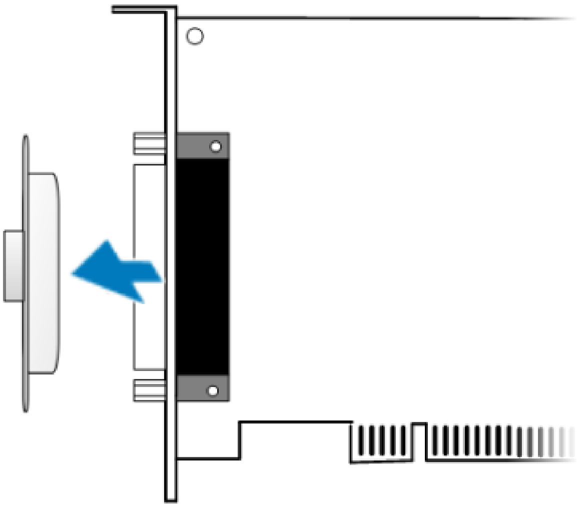
Step 4: Remove the cover from the computer.

Step 5: Select a vacant PCI slot.



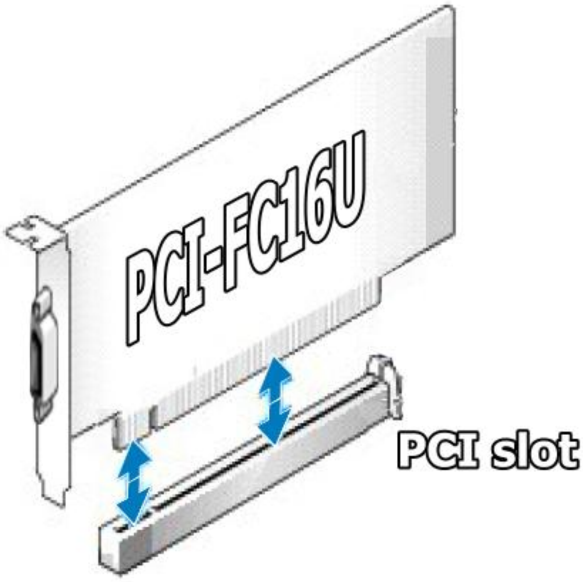
Step 6: Unscrew and remove the PCI slot cover from the computer case.

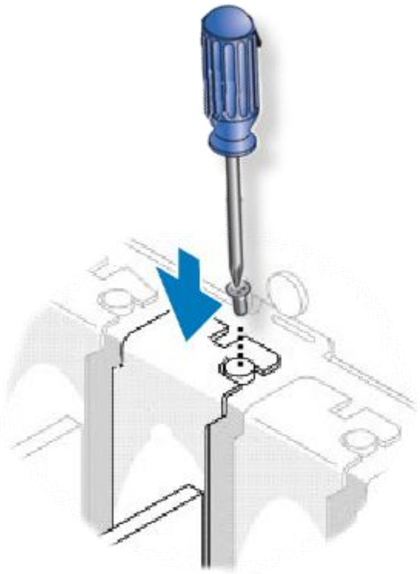




Step 7: Remove the connector cover from the PCI-FC16U board.

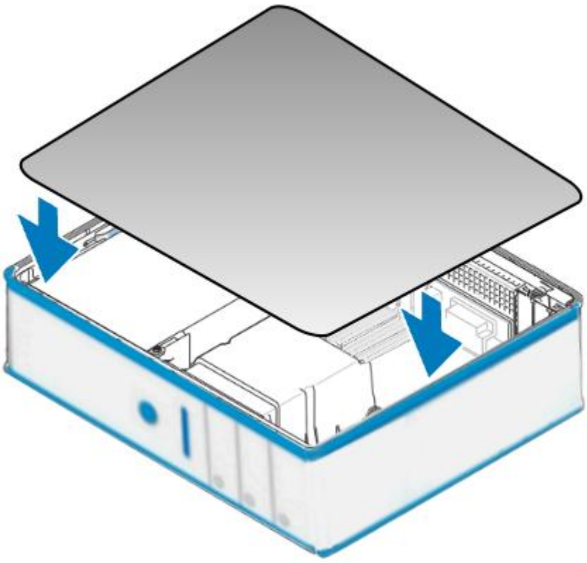
Step 8: Carefully insert the PCI-FC16U board into the PCI slot by gently pushing down on both sides of the card until it slides into the PCI connector.





Step 9: Confirm that the card is correctly inserted in the motherboard, and then secure the PCI-FC16U board 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 4 Software Installation for more information.

4 Software Installation

This chapter provides a detailed description of the process for installing the driver for the PCI-FC16U board as well as how to verify whether the PCI-FC16U board was properly installed. PCI-FC16U board can be used on DOS, Linux and Windows 2000 and 32/64-bit versions of Windows XP/2003/2008/7/8 based systems, and the drivers are fully Plug and Play compliant for easy installation.

4.1 Obtaining/Installing the Driver Installer Package

The driver installation package for PCI-FC16U board 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 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	To install the UniDAQ driver, follow the procedure described below. **Step 1:** Double-click the **UniDAQ_Win_Setupxxx.exe** icon to begin the installation process. **Step 2:** When the “Welcome to the ICP DAS UniDAQ Driver Setup Wizard” screen is displayed, click the **“Next>”** button to start the installation.

Installation Procedure	**Step 3:** On the “Information” screen, verify that the DAQ card is included in the list of supported devices, then click the **“Next>”** button. **Step 4:** On the “Select Destination Location” screen, click the **“Next>”** button to install the software in the default folder, **C:\ICPDAS\UniDAQ**. **Step 5:** On the “Select Components” screen, verify that the DAQ Card is in the list of device, and then click the **“Next>”** button to continue. **Step 6:** On the “Select Additional Tasks” screen, click the **“Next>”** button to continue. **Step 7:** On the “Download Information” screen, click the **“Next>”** button to continue. **Step 8:** Once the installation has completed, click **“No, I will restart my computer later”**, and then click the **“Finish”** button. 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/

4.2 Plug and Play Driver Installation

16-ch Counter/Frequency Board
with 32-ch Programmable DIO

3 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-FC16U board, follow the procedure described below:

Step 1: Install the driver for the PCI-FC16U board on your computer.

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

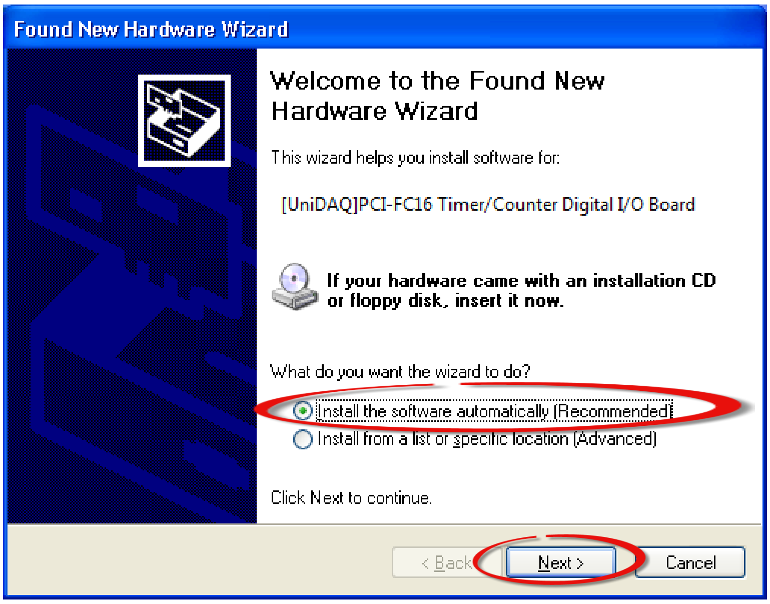
Step 1: Correctly shut down and power off your computer and disconnect the power supply, and then install the PCI-FC16U board into the computer.

For detailed information about the hardware installation of the PCI-FC16U board, refer to Chapter 3 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.



Welcome to the Found New Hardware Wizard

This wizard helps you install software for:

[UniDAQ]PCI-FC16 Timer/Counter Digital I/O Board

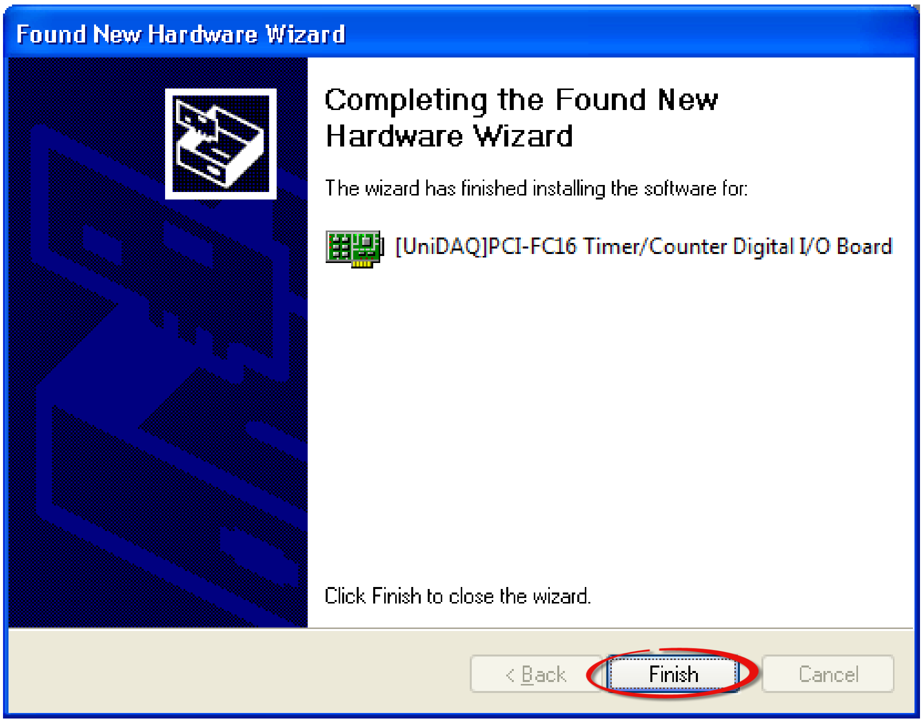
If your hardware came with an installation CD or floppy disk, insert it now.

What do you want the wizard to do?

● Install the software automatically (Recommended)
○ Install from a list or specific location (Advanced)

Click Next to continue.

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



Found New Hardware Wizard

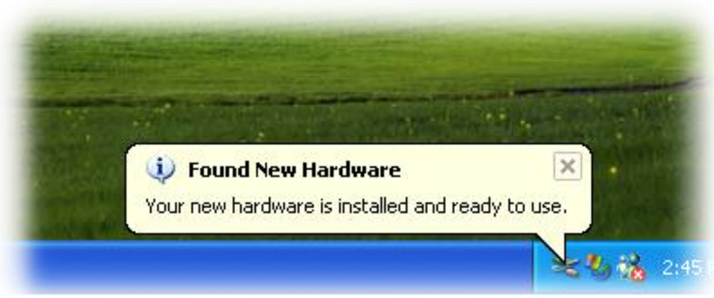
Completing the Found New Hardware Wizard

The wizard has finished installing the software for:

[UniDAQ]PCI-FC16 Timer/Counter Digital I/O Board

Click Finish to close the wizard.

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



Found New Hardware

Your new hardware is installed and ready to use.

4.3 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.

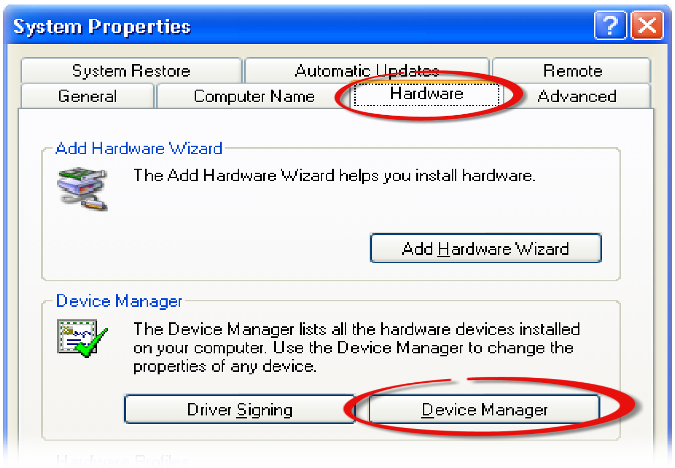
4.3.1 Accessing Windows Device Manager

➢ **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.



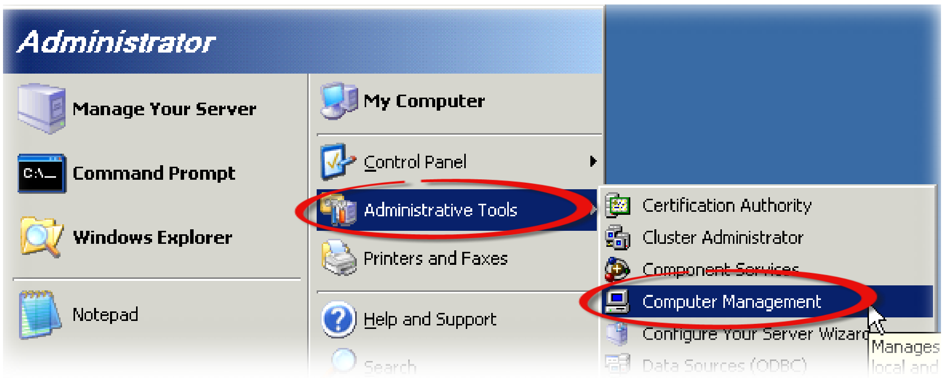
The Add Hardware Wizard helps you install hardware.

The Device Manager lists all the hardware devices installed on your computer. Use the Device Manager to change the properties of any device.

- **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 7**

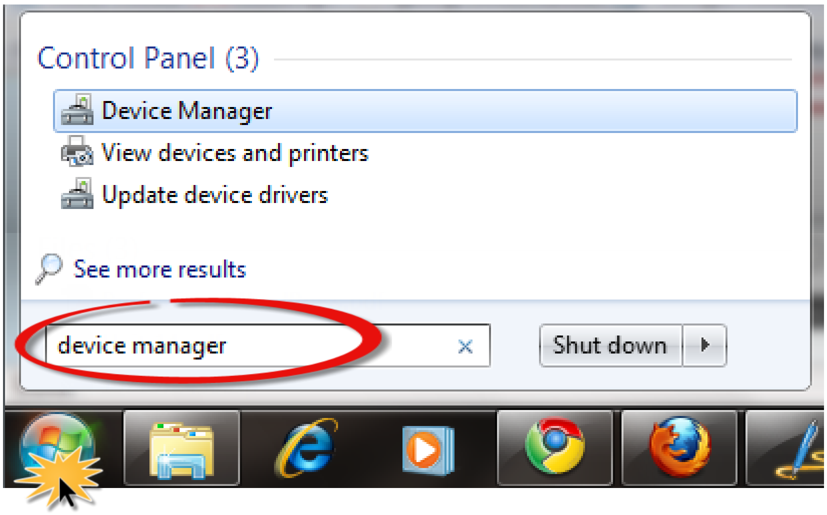
Step 1: Click the **"Start"** button, and then click **"Control Panel"**.

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.



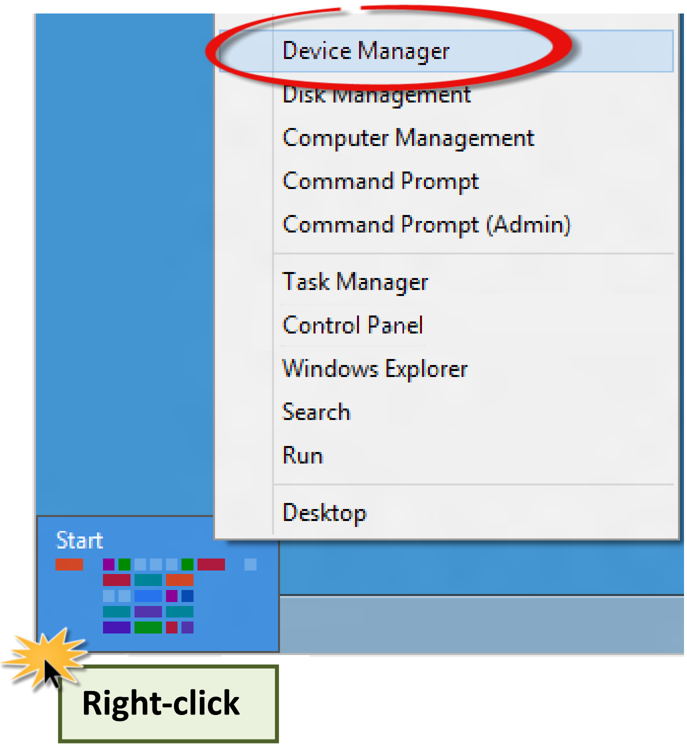
Note that Administrator privileges are required for this operation. If you are prompted for an administrator password or confirmation, enter the password or provide confirmation by clicking the "Yes" button in the User Account Control message.

- **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.

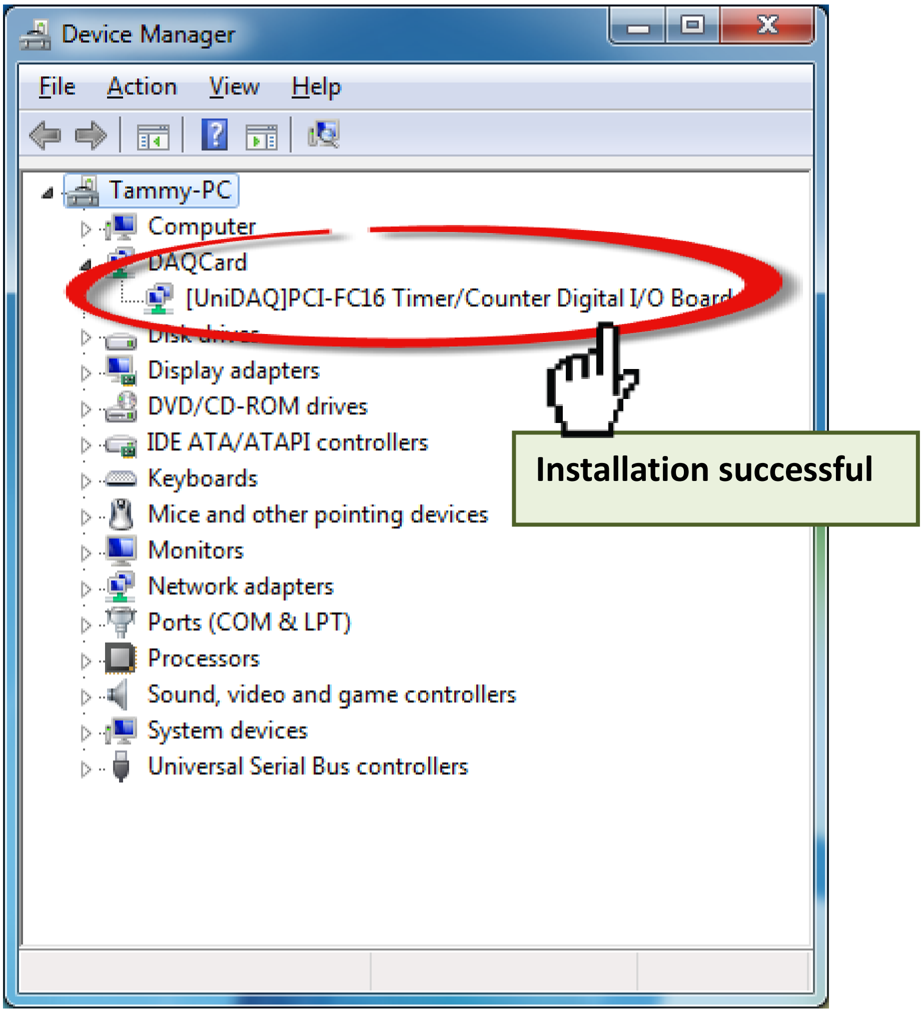
Step 2: **Right-click** the Start screen icon and then click "**Device Manager**".

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



4.3.2 Check the Installation

Check that the PCI-FC16U board is correctly listed in the Device Manager, as illustrated below.



Installation successful

5 Testing the PCI-FC16U Board

This chapter provides detailed information about the "Self-Test" process, which is used to confirm that the PCI-FC16U board 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 3 Hardware Installation and Chapter 4 Software Installation.

5.1 Self-Test Wiring

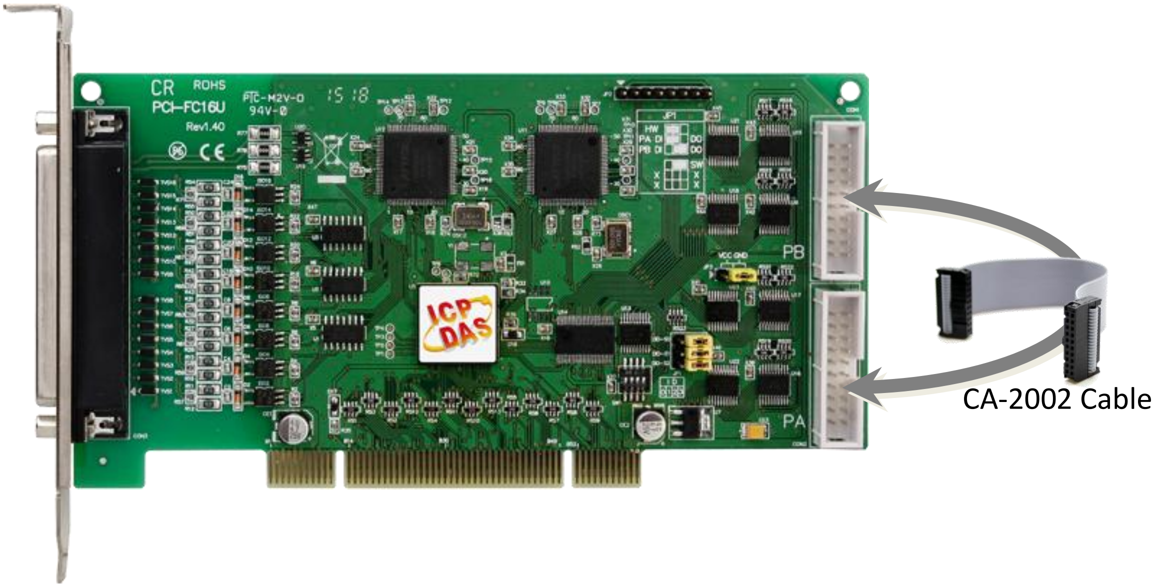
Before beginning the "Self-Test" procedure, ensure that the following items are available:

☑ A CA-2002 Cable
(Optional, Website: http://www.icpdas.com/products/Accessories/cable/cable_selection.htm)

➢ Wiring for the Digital Input/Output Test:

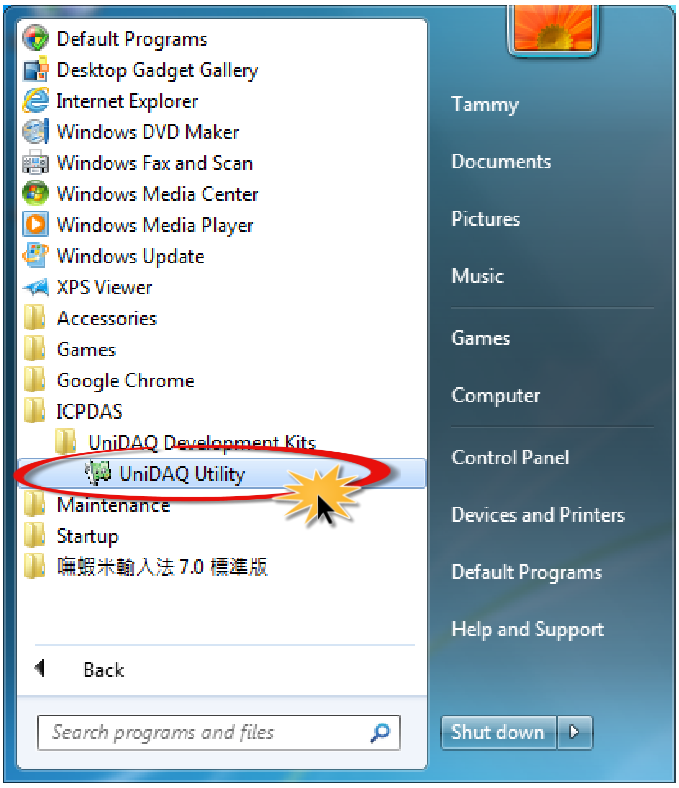
Step 1: Keep set the JP1 jumper to **"SW" position** (See Section 4 Jumper Settings).

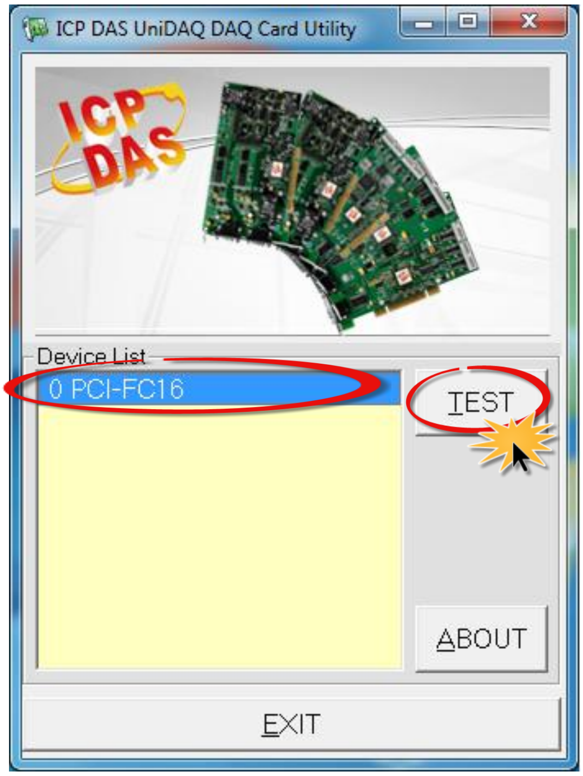
Step 2: Connect the **CON1** to **CON2** on the PCI-FC16U board using the **CA-2002** cable (optional).



5.2 Execute the Test Program

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.



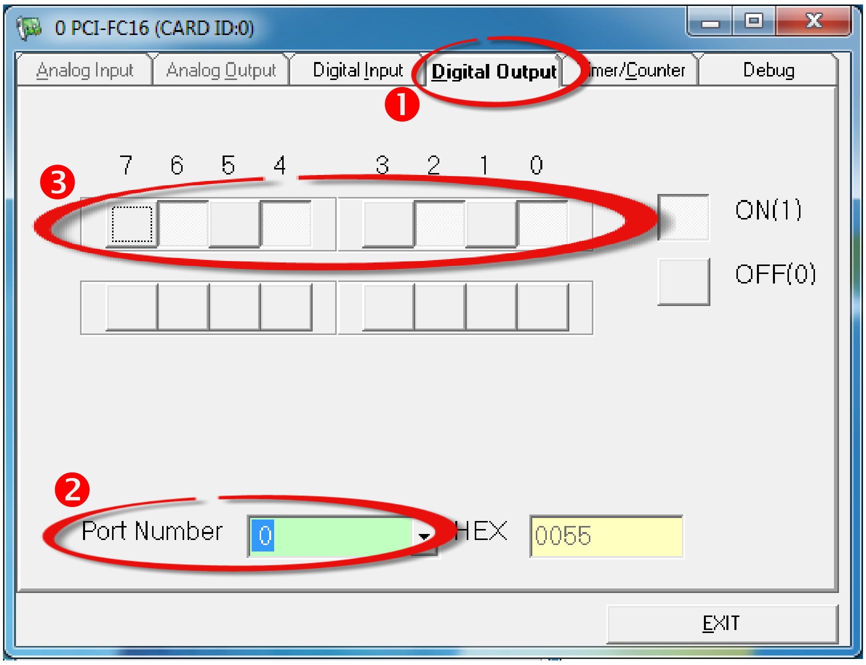


Step 2: Confirm that the PCI-FC16U board has been successfully installed in the Host system. Note that the device numbers start from 0.

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

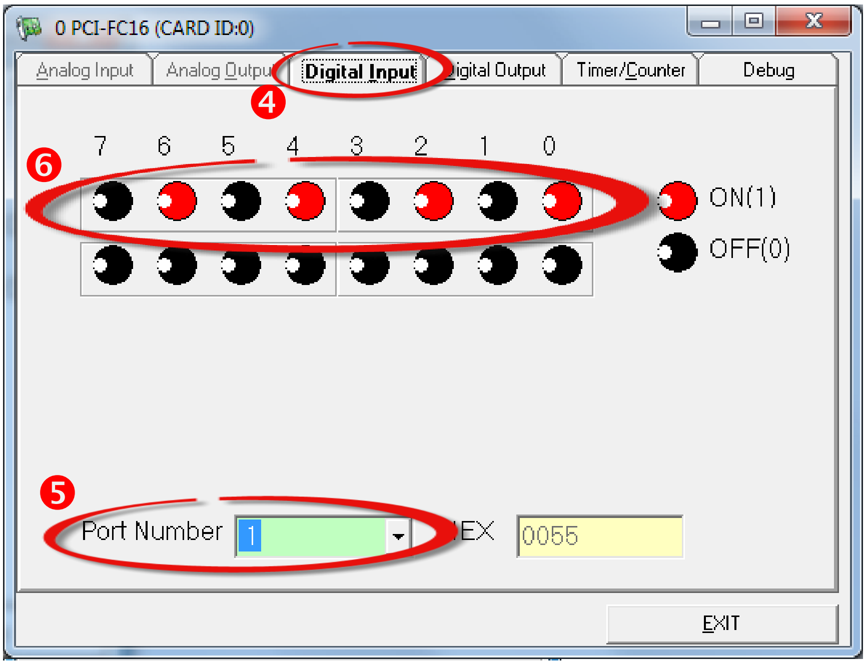
Step 4: Check the results of the **Digital Input/Output** functions test.

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



Port Number 0 HEX 0055

4. Click the **"Digital Input"** tab.
5. Select **"Port1"** from the **"Port Number"** drop-down menu.
6. The DI indicators will turn **red** when the corresponding DO channels 0, 2, 4 and 6 are **ON**.



Port Number 1 EX 0055

6 I/O Register Addresses

6.1 Hardware ID

During the power-on stage, the Plug and Play BIOS will assign an appropriate I/O address to each PCI-FC16U board installed in the system. Each card includes four fixed ID numbers that are used to identify the card, and are indicated below:

Model	PCI-FC16U
Vendor ID (HEX)	0x10B5
Device ID (HEX)	0x3001
Sub-Vendor ID (HEX)	0x00FC
Sub-Device ID (HEX)	0x0016

6.2 I/O Address Mapping

An overview of the registers for the PCI-FC16U board is given below. The address of each register can be determined by simply adding the offset value to the base address of the corresponding Bar number. More detailed descriptions of each register can be found in the following.

Bar No.	Offset	Register Function Description	
		Read	Write
1 (DIO)	00H	Read Digital I/O Port A	Write Digital I/O Port A
	04H	Read Digital I/O Port B	Write Digital I/O Port B
	0CH	Get DIO Jumper Status and Card ID	Set Port A and Port B Configuration
2 (Timer0)	20H	Read Channel Mode	Set Channel Mode
	24H	Read Speed Mode	Set Speed Mode
	40H	Read Counter Value (bit 0 to 7)	Select Channel
	44H	Read Counter Value (bit 8 to 15)	Latch Channel
	48H	Read Counter Value (bit 16 to 23)	N/A
	4CH	Read Counter Value (bit 24 to 31)	Clear the Channel
3 (Timer1)	20H	Read Channel Mode	Set Channel Mode
	24H	Read Speed Mode	Set Speed Mode
	40H	Read Counter Value (bit 0 to 7)	N/A
	44H	Read Counter Value (bit 8 to 15)	N/A
	48H	Read Counter Value (bit 16 to 23)	N/A
	4CH	Read Counter Value (bit 24 to 31)	Clear the Channel

Note: The length of the register is 16-bits.

6.3 Bar 1: Digital I/O Registers

6.3.1 Read/Write 16-bit Data for Port A/B

- (Read/Write) wBaseDIO+0x00 **Read/Write 16-bit Data for Port A**
- (Read/Write) wBaseDIO+0x04 **Read/Write 16-bit Data for Port B**

Bit	F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
Data	DF	DE	DD	DC	DB	DA	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0

That is 16-bit I/O ports in the PCI-FC16U. This I/O port can be configured as DI or DO port. Each port is easy to read/write by access his owns data register.

For Example:

```
outpw(wBaseDIO+0x0,wDoValue);          // Control the DO states
wDiValue = inpw(wBaseDIO+0x0);         // Read the DI states
```

6.3.2 Input/Output Selection Control

- (Write) wBaseDIO+0x0C **I/O Selection Control**

Bit	1	0
Data	Port B	Port A

This register provides the function for configuration Digital Input/Output port of the PCI-FC16U. Every I/O port can be programmed as DI or DO port.

Note that all ports are used as DI ports when the PC is first turned on and S2 for jumper JP1 must set to "Soft" position (See Section 2.2.1 "JP1: Digital I/O Mode" for detail information).

Port x = 1 → This port is used as a DO port
Port x = 0 → This port is used as a DI port

6.3.3 Read Card ID and DIO Jumper Settings

- (Read) wBaseDIO+0x0C **Read Card ID and DIO Jumper Settings**

Bit	F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
Data	x	x	x	x	x	S0	S1	S2	x	x	x	x	ID3	ID2	ID1	ID0

This register reads the Card ID (SW1) and DIO jumper JP1 settings (See Section 2.3 "Card ID Switch (SW1)" and Section 2.2.1 "JP1: Digital I/O Mode" for detail information)

For Example:

wCardID = inportb(wBaseDIO+0x0C)&0xF; *// Read Card ID number*

wJumper = (inportb(wBaseDIO+0xC)>>8)&0x7;

				DIO Port Configuration		
wJumper	**S0**	**S1**	**S2**	**JP1-S0**	**Port A**	**Port B**
0x0	0	x	x	SW	x	x
0x4	1	0	0	HW	DI	DI
0x5	1	0	1	HW	DI	DO
0x6	1	1	0	HW	DO	DI
0x7	1	1	1	HW	DO	DO

6.4 Bar 2 and Bar3: Timer Registers

6.4.1 Get/Set Channel Mode

- (Read/Write) wBaseTimer0+0x20 **Get/Set channel mode (channel 0 to 7)**
- (Read/Write) wBaseTimer1+0x20 **Get/Set channel mode (channel 8 to 15)**

Bit	F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
Data	x	x	x	x	x	x	x	x	S7	S6	S5	S4	S3	S2	S1	S0

This register is used to get/set the channel configuration mode.

S x = 1 → This channel is used as a frequency channel

S x = 0 → This channel is used as a counter channel

Data	S7	S6	S5	S4	S3	S2	S1	S0
Bar 2 (wBase Timer0)	CH7	CH6	CH5	CH4	CH3	CH2	CH1	CH0
Bar 3 (wBase Timer1)	CH15	CH14	CH13	CH12	CH11	CH10	CH8	CH8

6.4.2 Get/Set Speed Mode

- (Read/Write) wBaseTimer0+0x24 **Get/Set speed mode (channel 0 to 7)**
- (Read/Write) wBaseTimer1+0x24 **Get/Set speed mode (channel 8 to 15)**

Bit	F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
Data	x	x	x	x	x	x	x	x	S7	S6	S5	S4	S3	S2	S1	S0

This register is used to get/set the speed mode for frequency channel.

S x = 0 → Set to low speed mode (1 Hz ~ 1 kHz)

S x = 1 → Set to high speed mode (1 kHz ~ 250 kHz)

Data	S7	S6	S5	S4	S3	S2	S1	S0
Bar 2 (wBase Timer0)	CH7	CH6	CH5	CH4	CH3	CH2	CH1	CH0
Bar 3 (wBase Timer1)	CH15	CH14	CH13	CH12	CH11	CH10	CH8	CH8

6.4.3 Write/Read Data

- (Write) wBaseTimer0+0x40 **Select channel 0 to 7**
- (Write) wBaseTimer1+0x40 **Select channel 8 to 15**

Bit	F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
Data	x	x	x	x	X	x	x	X	D7	D 6	D 5	D 4	D 3	D 2	D 1	D 0

- (Write) wBaseTimer0+0x44 **Latch channel 0 to 7**
- (Write) wBaseTimer1+0x44 **Latch channel 8 to 15**

Bit	F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
Data	x	x	x	x	x	x	x	X	D7	D 6	D 5	D 4	D 3	D 2	D 1	D 0

- (Read) wBaseTimer0+0x40/0x44/0x48/0x4C **Read Data (channel 0 to 7)**
- (Read) wBaseTimer1+0x40/0x44/0x48/0x4C **Read Data (channel 8 to 15)**

Bit	F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
Data	x	x	x	x	x	x	x	X	D7	D 6	D 5	D 4	D 3	D 2	D 1	D 0

This register is used to get the value for frequency/counter channel.

For Example:

```
outw(wBase+0x40,0x08|(wChannel%8));      //Select Channel
outw(wBase+0x44,0x00|(wChannel%8));      //Latch Channel

A = inpw(wBase+0x40);                //Get the count value (bit 0 ~7)
B = inpw(wBase+0x44);                //Get the count value (bit 8 ~15)
C = inpw(wBase+0x48);                //Get the count value (bit 16 ~ 23)
D = inpw(wBase+0x4C);                //Get the count value (bit 24 ~ 31)
Value = (A<<24)|(B<<16)|(C<<8)|D      // Get the 32-bit count value
```

7 DOS Lib Function Description

All of the functions provided for PCI-FC16U are listed below in Sections 7.1 to 7.4. This list of functions is expanded on in the text that follows. However, in order to make a clear and simplified description of the functions, the attributes of the input and output parameters for every function is indicated as [input] and [output] respectively, as shown in following table. Furthermore, the error code of all functions supported by PCI-FC16U is also listed in Section 7.1 "Error Code Table".

Keyword	Parameter must be set by the user **before** calling the function	Data/value from this parameter is retrieved **after** calling the function
[Input]	**Yes**	No
[Output]	No	**Yes**
[Input, Output]	**Yes**	**Yes**

7.1 Error Code Table

For the most errors, it is recommended to check:

1. Does the device driver installs successful?
2. Does the card have plugged?
3. Does the card conflicts with other device?
4. Close other applications to free the system resources.
5. Try to use another slot to plug the card.
6. Restart your system to try again.

The return codes are defined as follows:

Error Code	ID	Error String
0	NoError	OK! No Error!
1	DriverHandleError	Device driver opened error
2	DriverCallError	Got the error 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 TotalBoard-1)
6	NotFoundBoard	Can’t detect the board on the system
7	InvalidChannel	Invalid channel number
8	AIQueueError	Driver buffer error
9	FIFOError	Device FIFO error
10	InvalidEEPBlock	Invalid EEPROM Block
11	InvalidEEPAddr	Invalid EEPROM Address
12	InvalidCfgCode	Invalid Gain Code

7.2 Driver Function

PCIFC16_DriverInit

This function can detect all the PCI-FC16U cards in the system. It is implemented based on the PCI Plug and Play mechanism. It will find all the PCI-FC16U cards installed in this system and save all their resources into the library.

- **Syntax:**

  WORD **PCIFC16_DriverInit**(WORD ***wBoards**);

- **Parameters:**

  wBoards

  [Output] Number of boards found in this PC

- **Returns:**

  Refer to Section 7.1 “Error Code Table”.

PCIFC16_DriverClose

Release the PCI-FC16U driver resource.

- **Syntax:**

  WORD **PCIFC16_DriverClose**(void);

- **Parameters:**

  None

- **Returns:**

  Refer to Section 7.1 “Error Code Table”.

PCIFC16_GetConfigAddressSpace

The user can use this function to save the resources found on all the PCI-FC16U Cards installed on the system. Then the application program can control all the PCI-FC16U cards functions directly.

- **Syntax:**

```
WORD PCIFC16_GetConfigAddressSpace (WORD wBoardNo,
                                    WORD *wBaseAddr,
                                    WORD *wBaseDIO,
                                    WORD *wBaseTimer0,
                                    WORD *wBaseTimer1,
                                    WORD *wIrqNo,
                                    WORD *wModelD,
                                    WORD *wCardID
                                    );
```

- **Parameters:**

wBoardNo

[Input] The Board number for PCI-FC16U board. (Start from 0)

wBaseAddr

[Output] The section 0 base address of the board

wBaseDIO

[Output] The section 1 base address of the board

wBaseTimer0

[Output] The section 2 base address of the board

wBaseTimer1

[Output] The section 3 base address of the board *wIrqNo*

[Output] The IRQ number that the board using

wModeID

[Output] Get the Model ID number, 0xFC16 is PCI-FC16U

wCardID

[Output] Get the Card ID number

- **Returns:**

  Refer to Section 7.1 “Error Code Table”.

7.3 Digital I/O Function

PCIFC16_SetDIOMode32

Set the Digital Input/Output Port for the Port A and Port B.

- **Syntax:**

```
WORD   PCIFC16_SetDIOMode32(WORD wBoardNO,
                            WORD wDirection
                            );
```

- **Parameters:**

wBoardNo

[Input] The Board number for PCI-FC16U board. (Start from 0)

wDirection

[Input] Set the Digital Input/Output Port to DI or DO Port, as follow:

Bit 1 (Port B)	Bit 0 (Port A)	***wDirection***
Input	Input	0
Output	Output	1

- **Returns:**

Refer to Section 7.1 “Error Code Table”.

PCIFC16_WriteDO

Send the 16-bit data to the specified I/O port

- **Syntax:**

```
WORD    PCIFC16_WriteDO (WORD wBoardNO,
                         WORD wPortNo,
                         WORD wValue
                         );
```

- **Parameters:**

wBoardNo

[Input] The Board number for PCI-FC16U board. (Start from 0)

wPortNo

[Input] Port Number (Port A is 0, Port B is 1), as follow:

	wPortNo
Port A	0
Port B	1

wValue

[Input] 16-bit data send to I/O port

- **Returns:**

Refer to Section 7.1 “Error Code Table”.

PCIFC16_ReadDI

Reads the 16-bit data from specified I/O port

- **Syntax:**

```
WORD    PCIFC16_ReadDI (WORD wBoardNO,
                        WORD wPortNo,
                        WORD *wValue
                        );
```

- **Parameters:**

wBoardNo

[Input] The Board number for PCI-FC16U board. (Start from 0)

wPortNo

[Input] Port Number (Port A is 0, Port B is 1), as follow:

	wPortNo
Port A	0
Port B	1

wValue

[Output] 16-bit data, receive from I/O port

- **Returns:**

Refer to Section 7.1 “Error Code Table”.

7.4 Counter/Frequency Function

PCIFC16_SetChannelMode

This function set the channel mode for Counter/Frequency channel.

- **Syntax:**

```
WORD    PCIFC16_SetChannelMode (WORD wBoardNO,
                                WORD wChannel,
                                WORD wMode,
                                WORD wDelayMs
                                );
```

- **Parameters:**

wBoardNo

[Input] The Board number for PCI-FC16U board. (Start from 0)

wChannel

[Input] User set the channel number of Counter/Frequency, while wChannel is 0 that is first channel, and wChannel is 1 that is second channel. And so on.

wMode

[Input] Set channel mode, as follow:

Mode	***wMode***
Frequency (1 Hz ~ 1 kHz)	0x02
Up Counter	0x03
Frequency (1 kHz ~ 250 kHz)	0x12

wDelayMs

[Input] The channel must have delay time on frequency modes that depend on source frequency. The default settings is 1 ms.

- **Returns:**

Refer to Section 7.1 "Error Code Table".

PCIFC16_ReadFrequency

This function could read frequency from signal.

- **Syntax:**

```
WORD    PCIFC16_ReadFrequency (WORD wBoardNO,
                               WORD wChannel,
                               WORD *fValue,
                               DWORD dwTimeOutMs,
                               WORD *wStatus
                                 );
```

- **Parameters:**

wBoardNo
[Input] The Board number for PCI-FC16U board. (Start from 0)

wChannel
[Input] User set the channel number of Counter/Frequency, while wChannel is 0 that is first channel, and wChannel is 1 that is second channel. And so on.

**fValue*
[Output] Get the read Frequency data.

dwTimeOutMs
[Input] Set the timeout for Counter/Frequency. The default settings is 1 ms.
The unit is ms.

wStatus
[Output] Get the Counter/Frequency status.

Status	***wStatus***
Ready	0
Timeout	1
Launch	2

- **Returns:**

Refer to Section 7.1 “Error Code Table”.

PCIFC16_ReadCounter

This function could read the counter/frequency data.

- **Syntax:**

```
WORD    PCIFC16_ReadCounter (WORD wBoardNO,
                             WORD wChannel,
                             DWORD dwDataCount
                             );
```

- **Parameters:**

wBoardNo

[Input] The Board number for PCI-FC16U board. (Start from 0)

wChannel

[Input] User set the channel number of Counter/Frequency, while wChannel is 0 that is first channel, and wChannel is 1 that is second channel. And so on.

dwDataCount

[Input] Get the read Counter data.

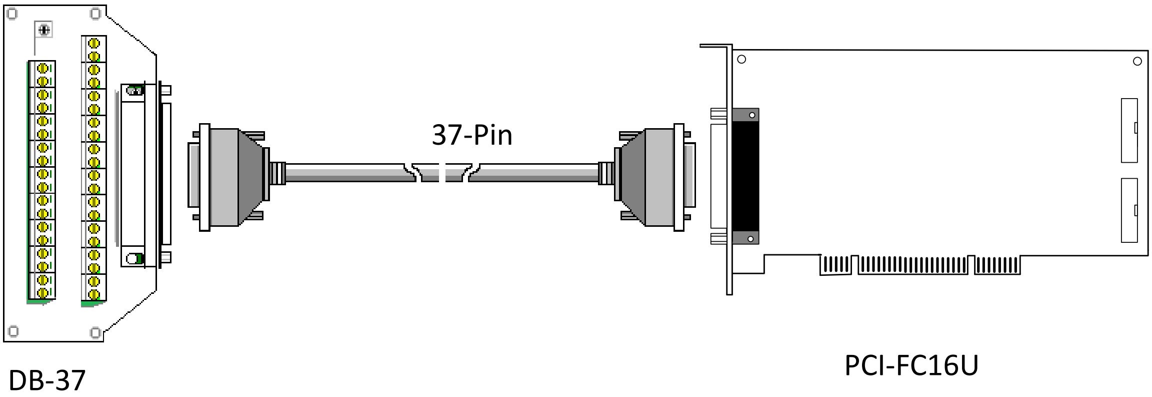
- **Returns:**

Refer to Section 7.1 “Error Code Table”.

Appendix: Daughter Boards

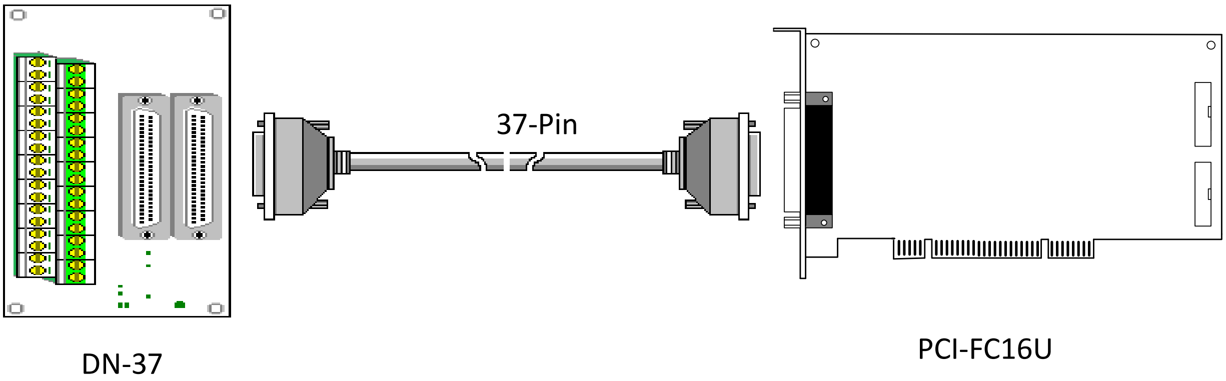
DB-37

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.



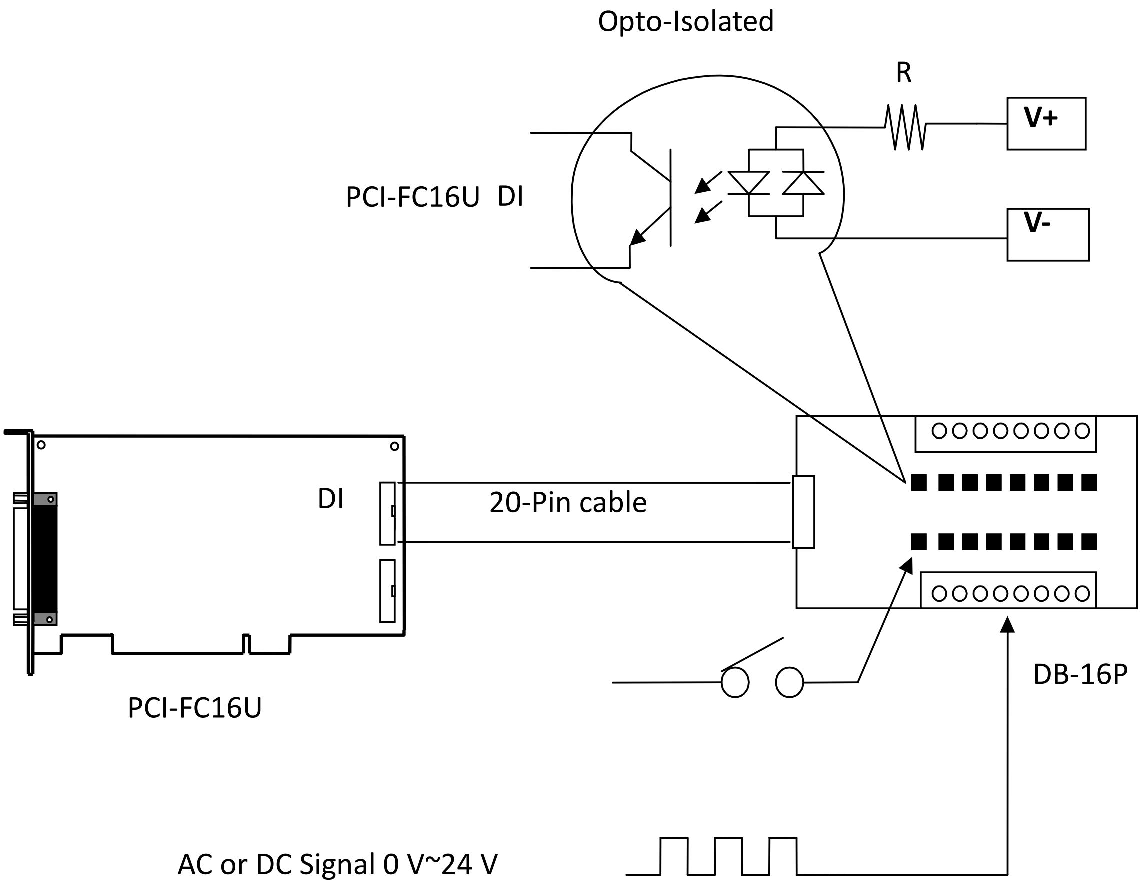
DN-37

The DN-37 is a general purpose daughter board for DB-37 pins with DIN-Rail Mountings. They are also designed for easy wire connection via pin-to-pin.



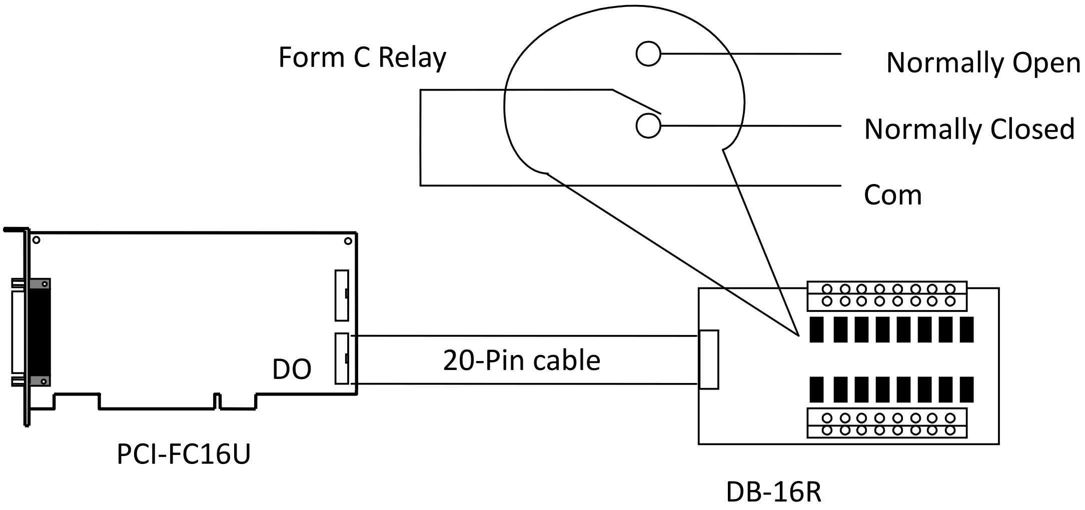
DB-16P Isolated Input Board

The DB-16P is a 16-channel isolated digital input daughter board. The optically isolated inputs of the DB-16P are consisted of are bi-directional optocoupler with resistor for current sensing. You can use the DB-16P to sense DC signal from TTL levels up to 24 V or use the DB-16P to sense a wide range of AC signals. You can use this board to isolate the computer from large common-mode voltage, ground loops and transient voltage spike that often occur in industrial environments.



DB-16R Relay Board

The DB-16R, 16-channel relay output board, consists of 16 Form C relays for efficient switching of load by programmed control. It is connector and functionally compatible with 785 series board but with industrial type terminal block. The relay is energized by applying 5 voltage signal to the appropriate relay channel on the 20-pin flat connector. There are 16 enunciator LEDs for each relay, light when their associated relay is activated. To avoid overloading your PC's power supply, this board provides a screw terminal for external power supply.



Note: Relay controls load up to 0.5 A @ 110 V_{AC} or 1A @ 24 V_{DC}