User Manual

PCI-1706U

250 kS/s, 16-bit, Simultaneous
8-ch Universal PCI Multifunction
Card with Multiple Synchronization

ADVANTECH

*e*Automation

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This warranty does not apply to any products which have been repaired or altered by persons other than repair personnel authorized by Advantech, or which have been subject to misuse, abuse, accident or improper installation. Advantech assumes no liability under the terms of this warranty as a consequence of such events.

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1. Collect all the information about the problem encountered. (For example, CPU speed, Advantech products used, other hardware and software used, etc.) Note anything abnormal and list any onscreen messages you get when the problem occurs.

2. Call your dealer and describe the problem. Please have your manual, product, and any helpful information readily available.

3. If your product is diagnosed as defective, obtain an RMA (return merchandize authorization) number from your dealer. This allows us to process your return more quickly.

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5. Write the RMA number visibly on the outside of the package and ship it prepaid to your dealer.

Declaration of Conformity

CE

This product has passed the CE test for environmental specifications when shielded cables are used for external wiring. We recommend the use of shielded cables. This kind of cable is available from Advantech. Please contact your local supplier for ordering information.

Technical Support and Assistance

1. Visit the Advantech web site at http://support.advantech.com where you can find the latest information about the product.
2. Contact your distributor, sales representative, or Advantech's customer service center for technical support if you need additional assistance. Please have the following information ready before you call:
   – Product name and serial number
   – Description of your peripheral attachments
   – Description of your software (operating system, version, application software, etc.)
   – A complete description of the problem
   – The exact wording of any error messages

Packing List

Before setting up the system, check that the items listed below are included and in good condition. If any item does not accord with the table, please contact your dealer immediately.

- PCI-1706U card
- Companion CD-ROM (Driver and SDK included)
- User Manual

Safety Precaution - Static Electricity

Follow these simple precautions to protect yourself from harm and the products from damage.

- To avoid electrical shock, always disconnect the power from your PC chassis before you work on it. Don't touch any components on the CPU card or other cards while the PC is on.
- Disconnect power before making any configuration changes. The sudden rush of power as you connect a jumper or install a card may damage sensitive electronic components.

Contents

Chapter 1

Introduction

This chapter will provide information on the features of the PCI-1706U cards, a quick installation-guide, together with some brief information on software and accessories.

Sections include:

- Features
- Applications
- Installation Guide
- Software Overview
- Device Drivers Programming Roadmap
- Accessories

1.1 Introduction

Thank you for buying the Advantech PCI-1706U.

PCI-1706U is an advanced high-performance multifunction card based on the Universal PCI Bus. With a large FIFO of 8K Sample, the maximum sampling rate of PCI-1706U is up to 250 kS/s with 8 A/D converters simultaneously sampling on each channel. The PCI-1706U has two 12-bit D/A output channels, 16 digital input/output channels, and two 32-bit Time/counter channels so that it can provide specific functions for different application requirements.

1.2 Features

PCI-1706U offers the following main features:

- 8 differential analog inputs
- 8 A/D converters simultaneously sampling
- 16-bit A/D converter, with up to 250kHz sampling rate for each channel
- Programmable gain
- Onboard FIFO memory up to 8K Sample
- Multiple A/D triggering modes
- Programmable pacer/counter
- BoardID™ switch
- Universal PCI Bus (supports 3.3V or 5V PCI bus signals)

Some of the features are described in details from the next page.

1.2.1 16-bit PCI bus Mastering DMA Data Transfer

PCI-1706U card supports PCI bus mastering DMA for high-speed data transfers. By setting a block of memory in the PC, the card performs bus-mastering data transfers without CPU intervention. The CPU is freed to perform other more urgent tasks such as data analysis and graphic manipulation. The function allows users to run all I/O functions simultaneously at full speed without losing data.

1.2.2 8A/D Converters for Simultaneous Sampling

PCI-1706U card is capable of simultaneous sampling with dedicated A/D converter circuit for each analog input channel.

1.2.3 Supports S/W, Internal & External Pacer Triggering

PCI-1706U card supports three kinds of trigger modes for A/D conversion: software triggering, internal pacer triggering and external pacer triggering.

The software trigger can acquire a sample whenever needed, while the internal pacer saves CPU loading by triggering the sampling at a pre-programmed frequency. An external pacer can be used for triggering by external frequency source.

1.2.4 On-board FIFO Memory

There is 8k of FIFO sample memory on PCI-1706U. This is an important feature for faster data transfers and more predictable performance under Windows systems.

1.2.5 Auto Calibration

PCI-1706U card features software auto calibration application. It provides convenient method for user calibration processing.

1.2.6 D/A Output

The PCI-1706U goes further with 2 analog output channels, It is for users to differentiate according to what they really need as the best solution

1.2.7 Digital Inputs and Digital Outputs

The PCI-1706U provides16 digital input channels and 16 digital output channels. Users are left with great flexibility to design and customize their applications according to their specific needs

1.2.8 Onboard Programmable Timer/Counter

PCI-1706U provides a programmable timer counter for generating pacer trigger for the A/D conversion. It includes twoindividual32-bit counters of 10 MHz clock. The two counters are cascaded together to make a 64-bit timer for pacer trigger time base.

1.2.9 BoardID Switch

PCI-1706U has a built-in DIP switch that helps define each card's ID when multiple PCI-1706U cards have been installed on the same PC chassis. The BoardID setting function is very useful when building a system with multiple PCI-1706U cards. With the correct BoardID settings, you can easily identify and access each card during hardware configuration and software programming.

> **Note!** *For detailed specifications of the PCI-1706Ucards, please refer to Appendix A, Specifications.*

1.3 Applications

The following are some of the possible applications of PCI-1706U cards:

- Testing Instruments
- Vibration Testing

1.4 Installation Guide

Before you install your PCI-1706U card, please make sure you have the following necessary components:

- PCI-1706U DA&C card
- PCI-1706U User Manual
- Driver software
  Advantech DAQNavi SDK and drivers (included in the companion CD-ROM)
- Wiring cables
  PCL-10168-1, PCL-10168-2 (optional)
- Wiring board
  ADAM-3968 (optional)
- Computer
  Personal computer or workstation with a PCI-bus slot (running Windows 2000, XP, Vista or Windows 7)

Some optional components are also available for enhanced operation: After you get the necessary components and maybe some of the accessories for enhanced operation of your Multifunction card, you can then begin the installation procedures. Figure 1.1 on the next page provides a concise flow chart for a broad picture of the software and hardware installation procedure:
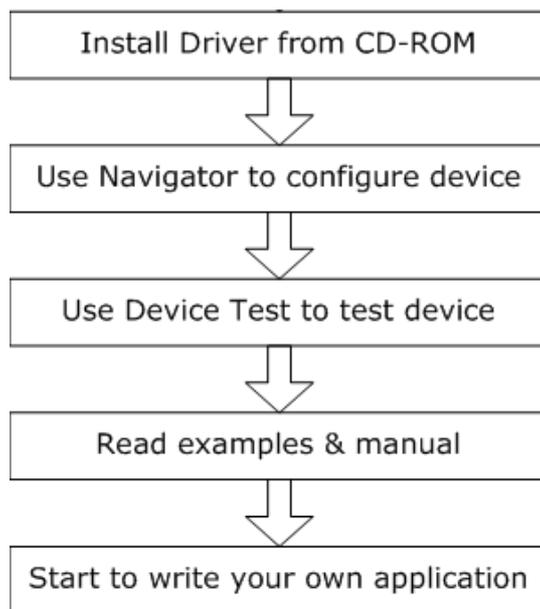
Figure 1.1 Installation Flow Chart

1.5 Software Overview

Advantech offers a rich set of APIs, third-party driver supports and application software to help fully utilize the functions of your PCI-1706U cards:

- Device Drivers (on the companion CD-ROM)
- DAQNavi SDK

1.5.1 Programming Choices for DA&C Cards

You may use Advantech application software such as Advantech Device Drivers. On the other hand, advanced users may choose register-level programming, although it is not recommended due to its laborious and time-consuming nature.

1.5.2 Device Drivers

The Advantech Device Drivers software is included on the companion CD-ROM. It also comes with all Advantech DA&C cards. Advantech's device drivers feature a complete I/O function library to help boost your application performance. The Advantech Device Drivers for Windows 2000, XP, Vista or Windows 7 works seamlessly with development tools such as Visual C++, Visual C#, Visual Basic.NET, Borland C++ Builder and Borland Delphi.

1.6 Device Drivers Programming Roadmap

This section will provide you a roadmap to demonstrate how to build an application from scratch using Advantech Device Drivers with your favorite development tools such as Visual C++, C#, Visual Basic.NET, Delphi and C++ Builder. The step-by-step instructions on how to build your own applications using each development tool will be given in the Device Drivers Manual. Moreover, a rich set of example source code is also given for your reference.

1.6.1 Programming Tools

Programmers can develop application programs with their favorite development tools:

- Visual C++
- Visual C#
- Visual Basic.NET
- Delphi
- C++ Builder

For instructions on how to begin programming in each development tool, Advantech offers a **Tutorial** Chapter in the **Device Drivers Manual** for your reference. Please refer to the corresponding sections in this chapter of the **Device Drivers Manual** to begin your programming efforts. You can also look at the example source code provided for each programming tool.

The **Device Drivers Manual** can be found on the companion CD-ROM. Or if you have already installed the Device Drivers on your system, the **Device Drivers Manual** can be readily accessed through the **Start** button:

Start/Programs/Advantech Automation/DAQNavi/DAQNavi Manuals

The example source codes can be found under the corresponding installation folder such as the default installation path:

C:\Advantech\DAQNavi\Examples

For information about using other function groups or other development tools, please refer to the Device Driver Programming Guide and the Function Reference on the Device Drivers Manual.

1.6.2 Programming with DAQNavi SDK

Advantech DAQNavi SDK offers a rich function library to be utilized in various application programs. This function library consists of numerous APIs that support many development tools, such as Visual C++, C#, Visual Basic.NET, Delphi and C++ Builder.

According to their specific functions or services, the APIs can be categorized into several function groups:

- Device Function
- Analog Input/Output Function
- Digital Input/Output Function
- Counter Function

For the usage and parameters of each function, please refer to the **Function Description** chapter in the **Device Drivers Manual**.

1.6.3 Troubleshooting Device Drivers Error

Driver functions will return a status code when they are called to perform a certain task for the application. When a function returns a code that is not zero, it means the function has failed to perform its designated function. See Device Driver Manual for detailed information about Error Code.

1.7 Accessories

Advantech offers a complete set of accessory products to support the PCI-1706U cards. These accessories include:

1.7.1 Wiring Cables

PCL-10168

The PCL-10168 cable is a 68-pin SCSI shielded cable for PCI-1706U cards

1.7.2 Wiring Boards

ADAM-3968 is a 68-Pin DIN-rail Wiring Board. This terminal module can be readily connected to the Advantech PC-LabCard products and allows easy yet reliable access to individual pin connections for the PCI-1706 cards.

Chapter 2

Installation

2.1 Unpacking

After receiving your PCI-1706U package, please inspect its contents first.

The package should contain the following items:

- PCI-1706U card
- Companion CD-ROM (DLL driver included)
- User Manual

The PCI-1706U cards harbors certain electronic components vulnerable to electrostatic discharge (ESD). ESD could easily damage the integrated circuits and certain components if preventive measures are not carefully paid attention to.

Before removing the card from the antistatic plastic bag, you should take following precautions to ward off possible ESD damage:

- Touch the metal part of your computer chassis with your hand to discharge static electricity accumulated on your body. Or use a grounding strap.
- Touch the anti-static bag to a metal part of your computer chassis before opening the bag.
- Hold the card only by the metal bracket when removing it from the bag.

After taking out the card, you should first inspect the card for any possible signs of external damage (loose or damaged components, etc.). If the card is visibly damaged, please notify our service department or the local sales representative immediately. Avoid installing a damaged card into your system. Also, pay extra caution to the following aspects to ensure proper installation:

- Avoid physical contact with materials that could hold static electricity such as plastic, vinyl and Styrofoam.
- Whenever you handle the card, grasp it only by its edges. DO NOT TOUCH the exposed metal pins of the connector or the electronic components.

> *Note!* *Keep the anti-static bag for future use. You may need the original bag to store the card if you have to remove the card from the PC or transport it elsewhere.*

2.2 Driver Installation

We offer two ways for driver installation:

- Device Auto Installation
- Device Preinstallation
- Device Uninstallation

We suggest you use the device auto Installation. We recommend you to install the card into your system before you install the driver, since this will guarantee a smooth installation process.

2.2.1 Device Auto Installation (Recommended)

You can install the PCI-1706U module in any PCI slot on your computer. Please follow the steps below to install the module on your system.

1. Turn off your computer and unplug the power cord and cables. TURN OFF your computer before installing or removing any components on the computer.
2. Remove the cover of the computer.
3. Remove the slot cover on the back panel of your computer.
4. Touch the metal part on the surface of your computer to neutralize the static electricity that might be on your body.
5. Insert the PCI-1706U card into a PCI slot. Hold the card only by its edges and carefully align it with the slot. Insert the card firmly into place. Use of excessive force must be avoided, otherwise the card might be damaged.
6. Fasten the bracket of the PCI card on the back panel rail of the computer with screws.
7. Connect appropriate accessories(68-pin cable, wiring terminals, etc. if necessary) to the PCI card.
8. Replace the cover of your computer chassis. Re-connect the cables you removed in step 2.
9. Plug in the power cord and turn on the computer.
10. Install PCI-1706U BioDAQ driver for CD-ROM.

    (1) Insert the companion CD-ROM into your CD-ROM drive. The Setup program will be launched automatically if you have the auto play function enabled on your system. When the Setup Program is launched, you'll see the following Setup Screen.

Figure 2.1 The Setup Screen of Advantech Automation Software

(2) Push the "CONTINUE" button to go to the next screen.

Figure 2.2 Contents of the CD

(3) Select the "Installation" option.

Figure 2.3 Select Drivers

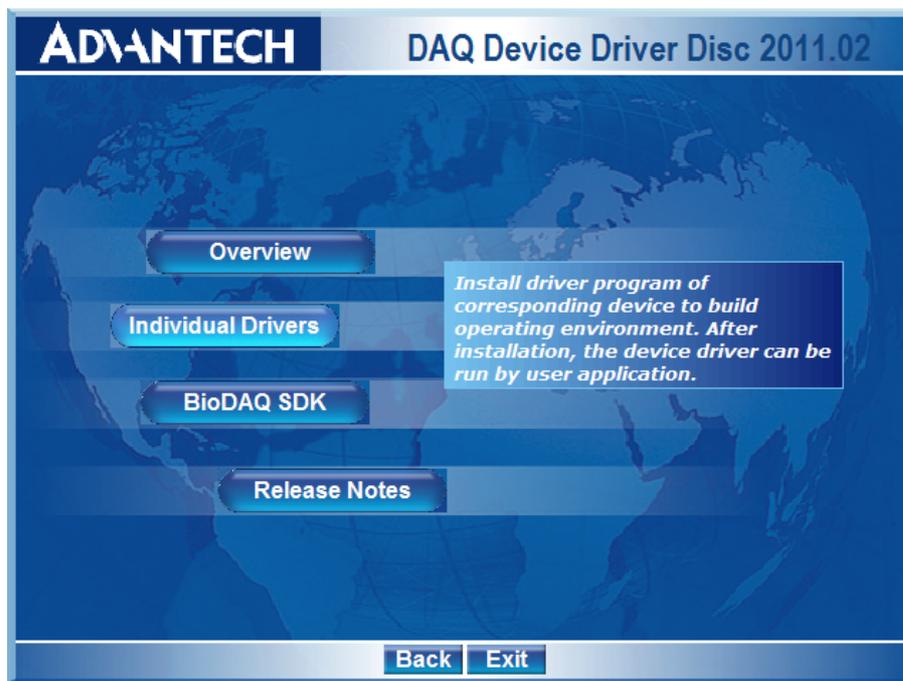(4) Select the "DAQNavi" option.

Figure 2.4 Items of DAQNavi

(5) Select the "Individual Drivers" option. After driver installation, we recommend you to install BioDAQ SDK for further development.
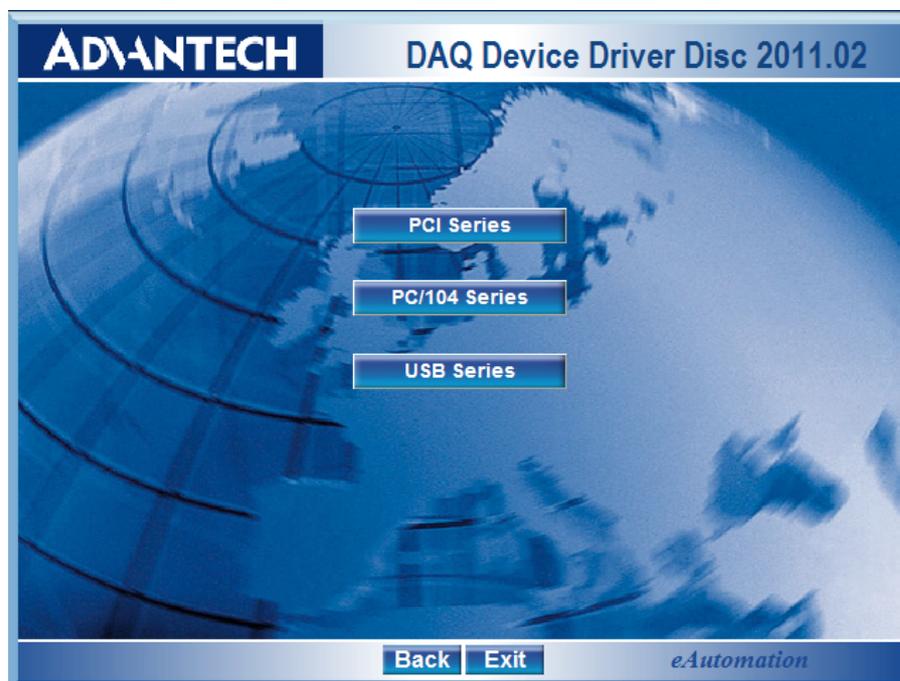

Figure 2.5 Select Device Series
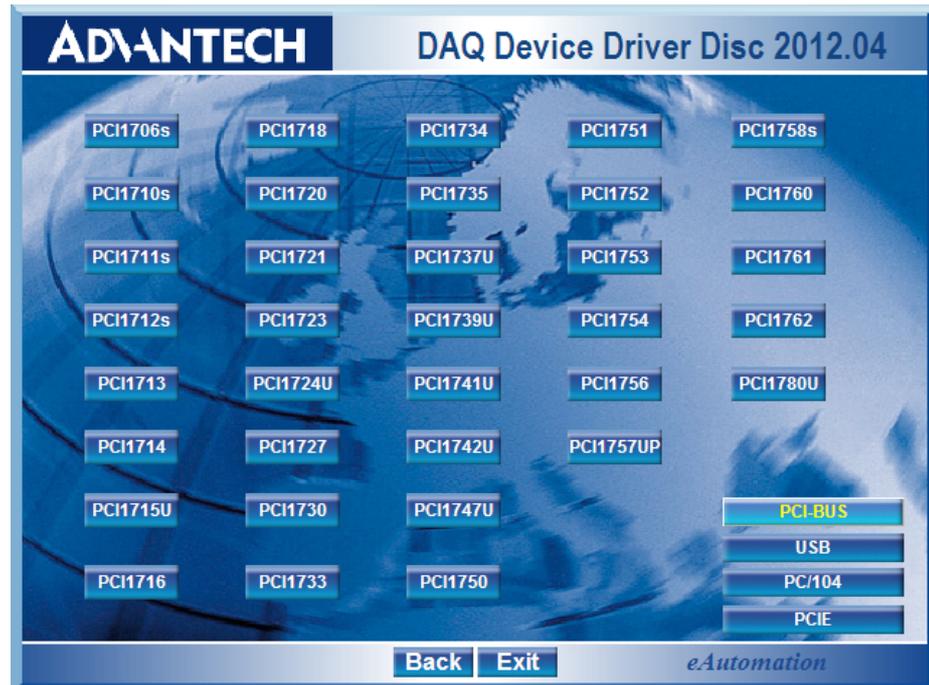
(6) Select the "PCI Series" option.

Figure 2.6 Different Options for Driver Setup

(7) Select the "PCI1706s" option to Run the PCI-1706 BioDAQ Driver package.

Figure 2.7 Driver Install 1
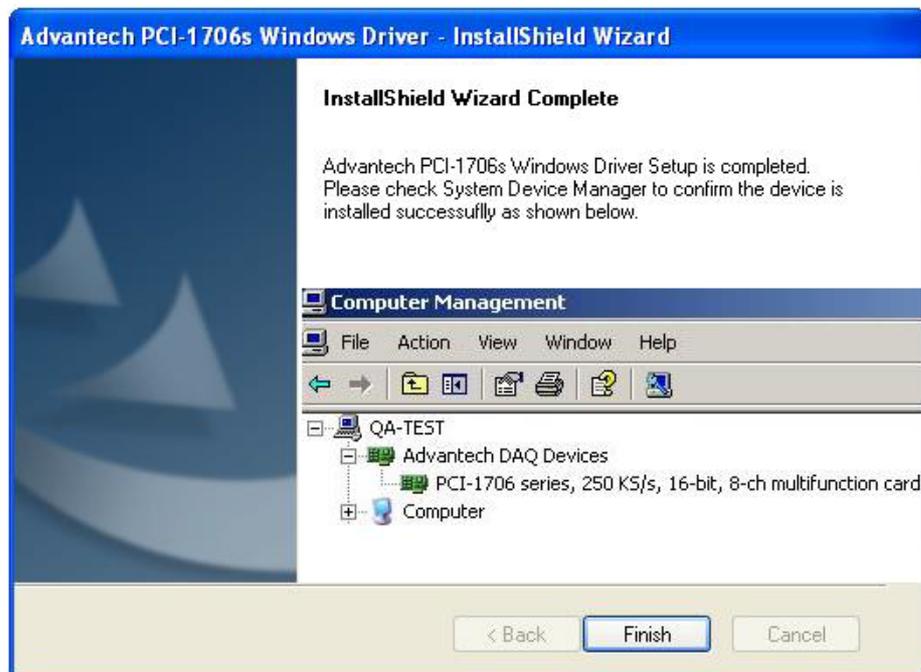
(8) Push the "Next" button to finish step.

Figure 2.8 Driver Installation 2

(9) Click "Finish". The installer detects and installs PCI-1706 device on the system automatically. The device driver files and driver manual can be found at: System disk\Advantech\BioDAQ\Driver\PCI1706s.

11. After the PCI-1706 driver is installed, you can verify whether it is properly installed on your system in the System Device Manager:

    (1) Access the System Device Manager.

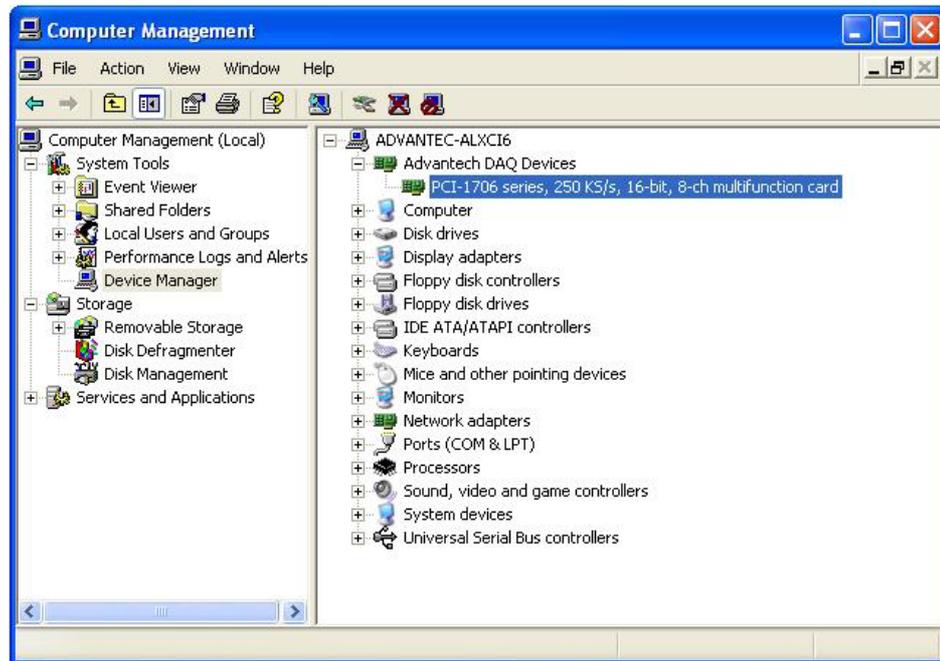   (2) The device name of the PCI-1706 should be listed on the Advantech DAQ Devices tab.

Figure 2.9 The Device Name Listed in the Device Manager

2.2.2 Device Preinstallation

PCI-1706 DAQNavi Driver supply device preinstallation if you install PCI-1706 DAQNavi Driver package from CD-ROM without the PCI-1706 card installed in the System.

1. Install PCI-1706 DAQNavi Driver from CD-ROM.

2. Turn off your computer and unplug the power cord and cables. TURN OFF your computer before installing or removing any components on the computer.

3. Remove the cover of the computer.

4. Remove the slot cover on the back panel of your computer.

5. Touch the metal part on the surface of your computer to neutralize the static electricity that might be on your body.

6. Insert the PCI-1706 card into a PCI slot. Hold the card only by its edges and carefully align it with the slot. Insert the card firmly into place. Use of excessive force must be avoided, otherwise the card might be damaged.

7. Fasten the bracket of the PCI card on the back panel rail of the computer with screws.

8. Connect appropriate accessories(68-pin cable, wiring terminals, etc. if necessary) to the PCI card.

9. Replace the cover of your computer chassis. Re-connect the cables you removed in step 3.

10. Plug in the power cord and turn on the computer.

11. In Windows XP system:
    Access the "System Device Manager". System will recognize PCI device. Right click the PCI device item and select "Update" button to install PCI-1706 driver.
    In Windows 7 system:
    Access the "System Device Manager". System will recognize PCI-1706 device and PCI-1706 will be installed automatically.

> **Note!** *If your card is properly installed, you should see the device name of your card listed on the "System Device Manager". If you do see your device name listed on it but marked with an exclamation sign "!" , it means your card has not been correctly installed. In this case, you can select the device name and press the "Update" button to update driver manually.*

2.2.3 Device Uninstallation:

1. Close the applications of the PCI module.
2. Run the PCI-1706s DAQNavi Driver package, Select the "Remove". The PCI-1706 will be uninstalled.

2.3 Device Setup & Configuration

After your card is properly installed on your system, you can now configure your device using the Device Configuration Program that has itself already been installed during driver installation.

The DAQNavi Driver provides device setting dialog box that allows you to configure your device, and later stores your settings on the system registry. These settings will be used when you call the DAQNavi SDK to manipulate functions of Device Configuration assists to use Advantech DAQ cards more efficiently and easily.

Configuring the Device:

There are two ways to setup device:

2.3.1 DAQNavi Navigator

After DAQNavi SDK installation, you can access DAQNavi Navigator from "Start - Programs - Advantech Automation - DAQNavi - DAQNavi Navigator" and open Navigator window.

Click the "+" on the left to unfold the content. If the software and hardware installation are completed, the PCI-1706U is listed under DAQNavi - Devices - Installed Devices.

Select Device Setting to open PCI-1706U device setting dialog box on the right.

Figure 2.10 Navigator Utility

On the device setting dialog box, you can change default settings of Device, Analog Input, Analog Output, Digital Input/Output and Counter functions.

With the corresponding check box checked, you can click the "Save" button to apply the device setting to the device or store them in the system registry.

If both the "Update Device" and the "Update System Database" are unchecked, the device setting will be lost once the dialog is closed.

2.3.2 System Device Manager

If the software and hardware installation are completed, you will see PCI-1706U name in the System Device Manager.
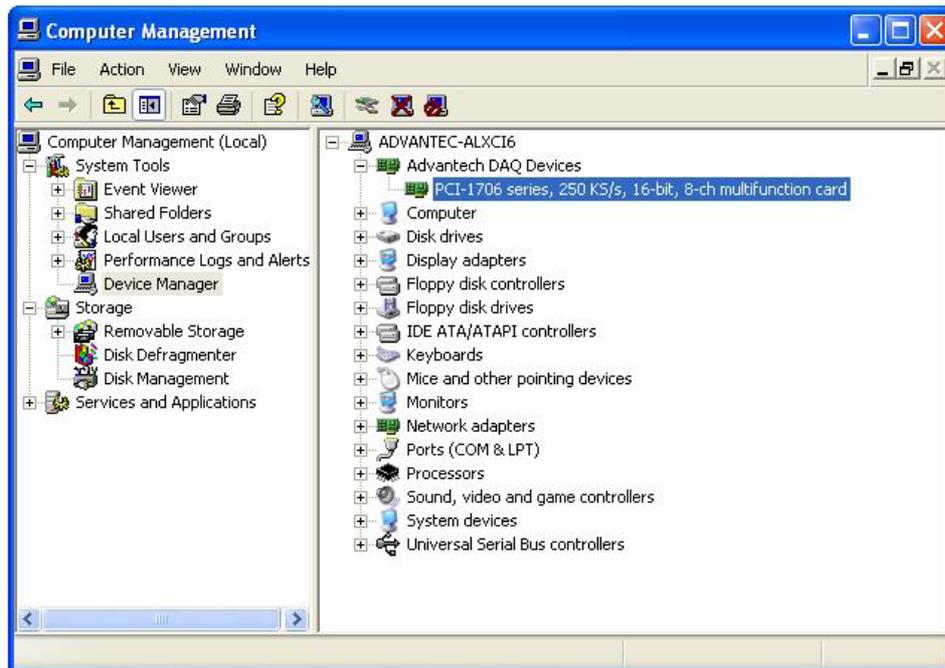

Figure 2.11 Windows Device Manager

On the "Device Manager" window, right click the device name and select "Properties" of PCI-1706U.
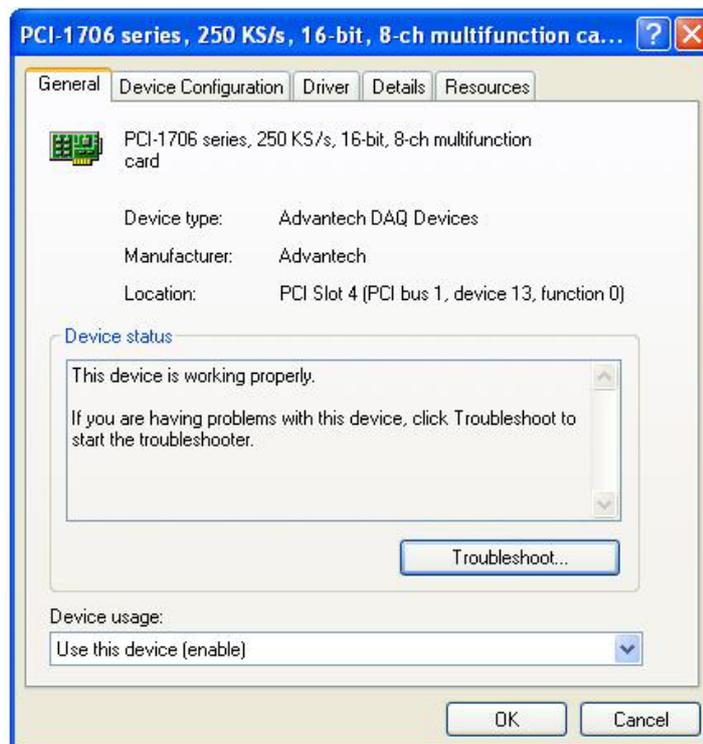

Figure 2.12 Device Property page

Select "Device Configuration" tab. PCI-1706U device driver provides a device setting dialog box for users to set the device property values, and these values will be saved in the system. The device property will be referenced by the device driver functions.
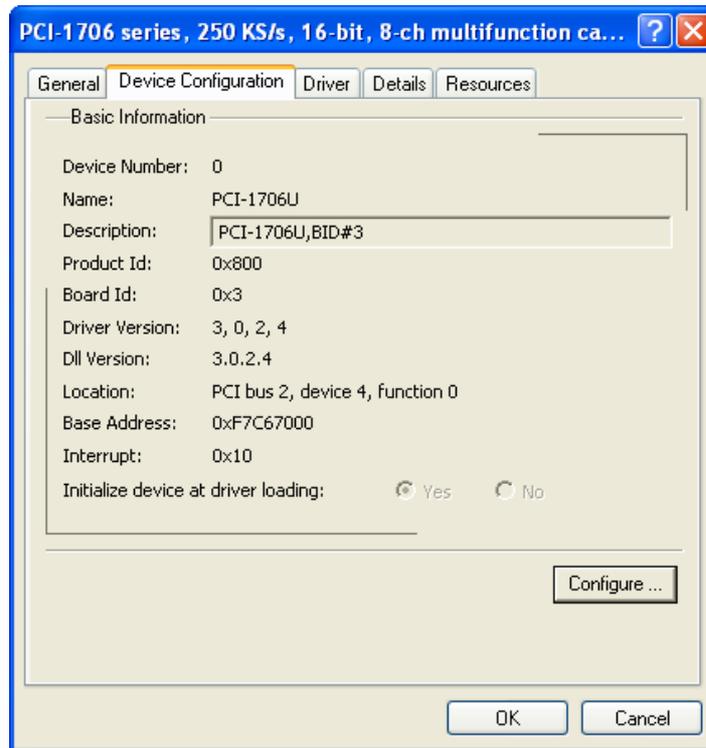

Figure 2.13 Embedded Configuration page

Please click the "Configure" button to configure your device. On the device setting dialog box, you can change default settings of Device, Analog Input, Analog Output, Digital Input/Output and Counter functions.
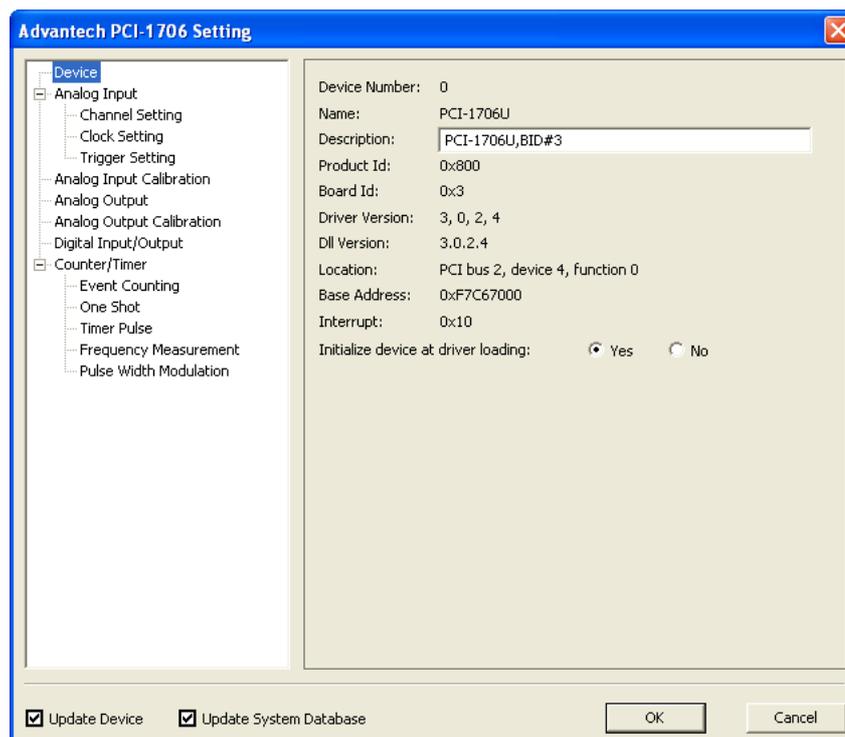

Figure 2.14 Device configuration page

When you check the check box of "Update Device", after click the "OK" button, configuration information will be set into device.

When you check the check box of "Update System Database", after click the "OK" button, configuration information will be set into system registry.

Click the "OK" button to exit the configure dialog and accept the changes.

Click the "Cancel" button to exit the configure dialog without save.

Chapter 3

Signal Connections

This chapter provides useful information about how to connect input and output signals to the PCI-1706U cards via the I/O connector.

Sections include:

- Overview
- Switch and Jumper Settings
- Signal Connections
- Field Wiring Considerations

3.1   Overview:

Maintaining signal connections is one of the most important factors in ensuring that your application system is sending and receiving data correctly.A good signal connection can avoid unnecessary and costly damage to your PC and other hardware devices. This chapter provides useful information about how to connect input and output signals to the PCI-1706U cards via the I/O connector.

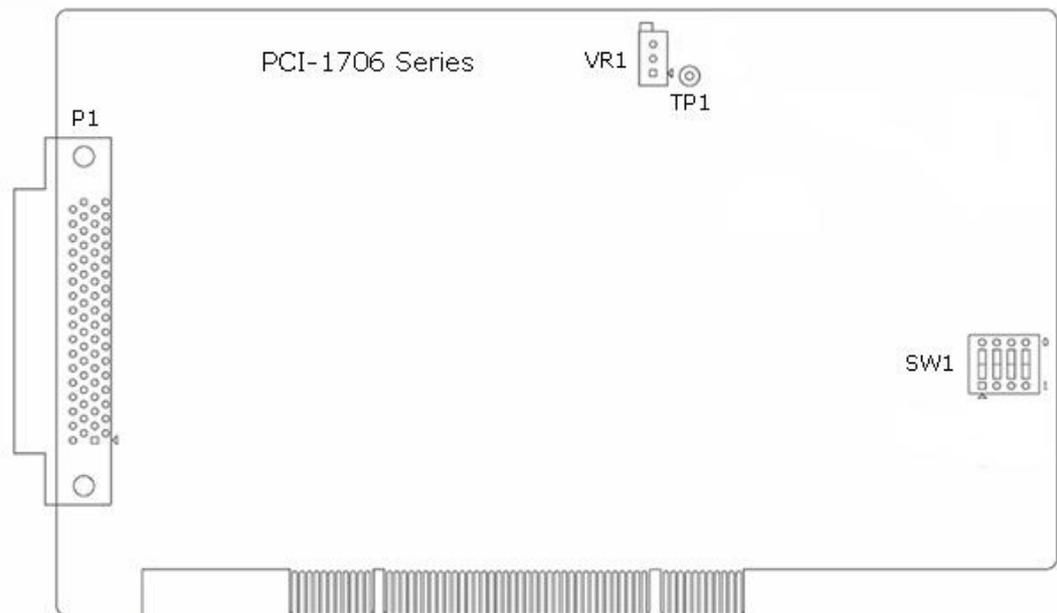## 3.2   Switch and Jumper Settings

Figure 3.1 Connector and Switch Locations

1. **Jumper Settings**
   There is no Jumpers in PCI-1706U.
2. **Setting the BoardID Switch (SW1)**
   The PCI-1706U has a built-in DIP switch (SW1), which is used to define each card's board ID. You can determine the board ID on the register as shown in Table 2.1. When there are multiple cards on the same chassis, this board ID setting function is useful for identifying each card's device number through board ID. We set the PCI-1706U board ID as 0 at the factory. If you need to adjust it to other board ID, set the SW1 by referring to DIP switch setting.

Table 3.1: Board ID Settings				
SW1	3	2	1	0
BoardID	ID3	ID2	ID1	ID0
0*	ON	ON	ON	ON
1	ON	ON	ON	OFF
2	ON	ON	OFF	ON
3	ON	ON	OFF	OFF
4	ON	OFF	ON	ON
5	ON	OFF	ON	OFF
6	ON	OFF	OFF	ON
7	ON	OFF	OFF	OFF
8	OFF	ON	ON	ON
9	OFF	ON	ON	OFF
10	OFF	ON	OFF	ON
11	OFF	ON	OFF	OFF
12	OFF	OFF	ON	ON
13	OFF	OFF	ON	OFF
14	OFF	OFF	OFF	ON
15	OFF	OFF	OFF	OFF

3.3 Signal Connections

Pin Assignment

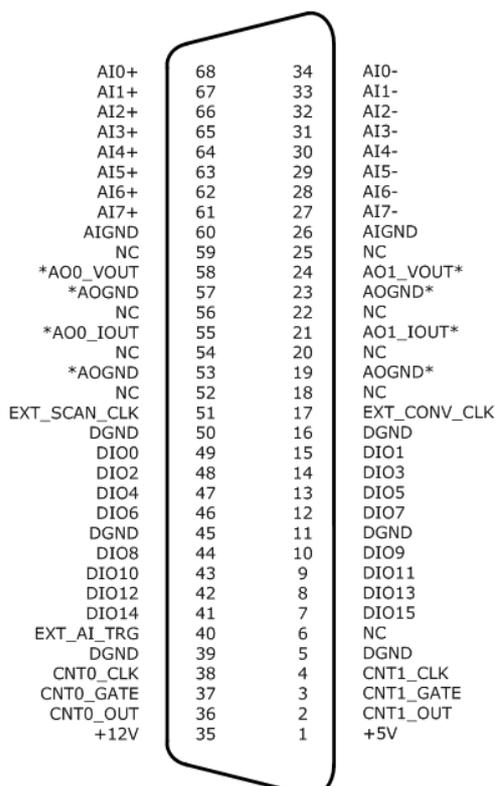Figure 3-2 shows the pin assignments for the 68-pin I/O connector on the PCI-1706U.

Figure 3.2 I/O Connector Pin Assignments for the PCI-1706U Series

3.3.1 I/O Connector Signal Description

Signal Name	Reference	Direction	Description
AI<0..7>+	AGND	Input	Analog positive input channels 0 through 7.
AI<0..7>-	AGND	Input	Analog negative input channels 0 through 7.
AIGND, AOGND	-		Analog GND
AO0_VOUT AO1_VOUT	AGND	Input	Analog voltage output channels 0/1
AO0_IOUT AO1_IOUT	AGND	Input	Analog current output channels 0/1
DIO<0:15>	DGND	Inout	Digital inout channels, direction can be set by software
DGND	-		Digital GND
CNT0_CLK CNT1_CLK	DGND	Input	Counter clock external Input. The clock input of counter can be either external (1Hz to 10MHz) or internal(20MHz), as set by software
CNT0_OUT			
CNT1_OUT	DGND	Output	Counter out
CNT0_GATE			
CNT1_GATE	DGND	Input	Counter gate
EXT_SCAN_CLK	DGND	Input	Scan clock external Input. The Scan clock input can be external (up to 250K), internal (up to 10M)
EXT_CONV_CLK	DGND	Input	Convert clock external Input. The Convert clock input can be external (up to 250K), internal (up to 10M)
EXT_AI_Tri	DGND	Input	AI Trigger external Input. The AI trigger input can be external, Analog, software, as set by software
+12V	DGND	Output	+12 V_{DC} Source
+5V	DGND	Output	+5 V_{DC} Source

3.3.2 Analog Input Connections

3.3.2.1 Instant AI and Buffered AI Channel Connections
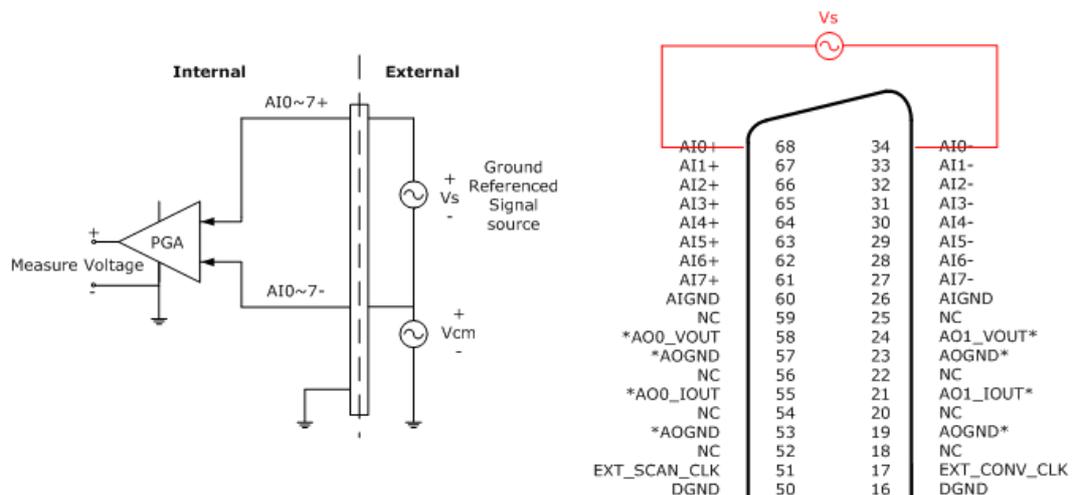

**Figure 3.3 Differential input channel connection -
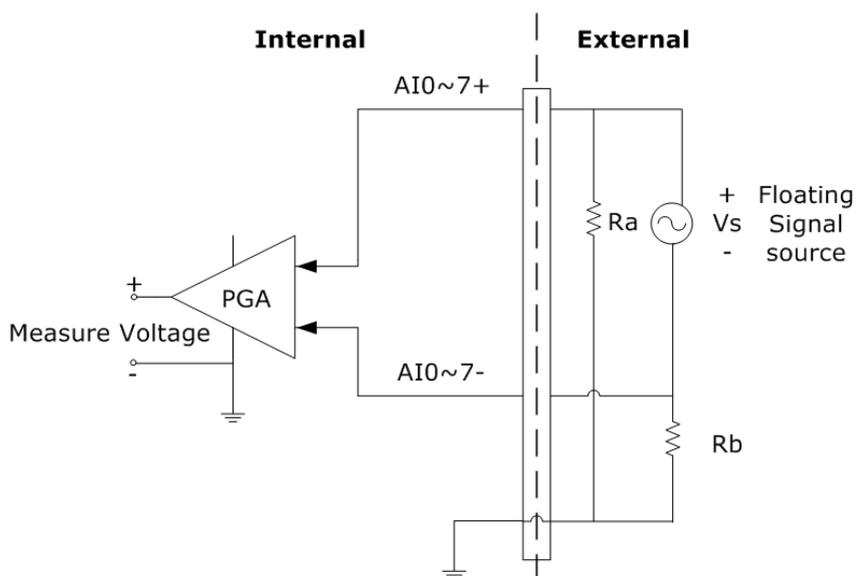ground reference signal source**

**Figure 3.4 Differential input channel connection -
floating signal source**

3.3.2.2 Buffered AI Trigger and CLK Source Connections

The PCI-1706U introduces a double-clock system, with SCAN clock and CONV clock, to generate efficient A/D conversion clocks at dedicated timing. A/D conversion clocks come from internal clock sources or external signals on connector. The CLK has several sources.

Internal A/D clock derived from 32-bit divider

External A/D clock from terminal board

With PCI-1706U, user can define the type of trigger source as rising-edge or falling-edge. The Trigger has several sources.

External digital (TTL) trigger from terminal board
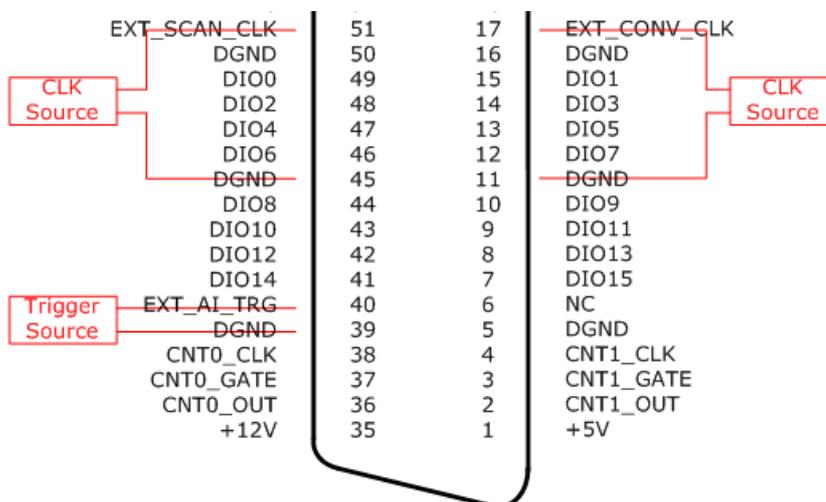
- Soft trigger
- Analog threshold trigger

Figure 3.5 Trigger Source and CLK Source Connection

3.3.3 Analog Output Connections

PCI-1706 provides two analog output channels, AO0 and AO1. Every channel support voltage and current output, and the trigger source support software and External digital (TTL) trigger from terminal board.
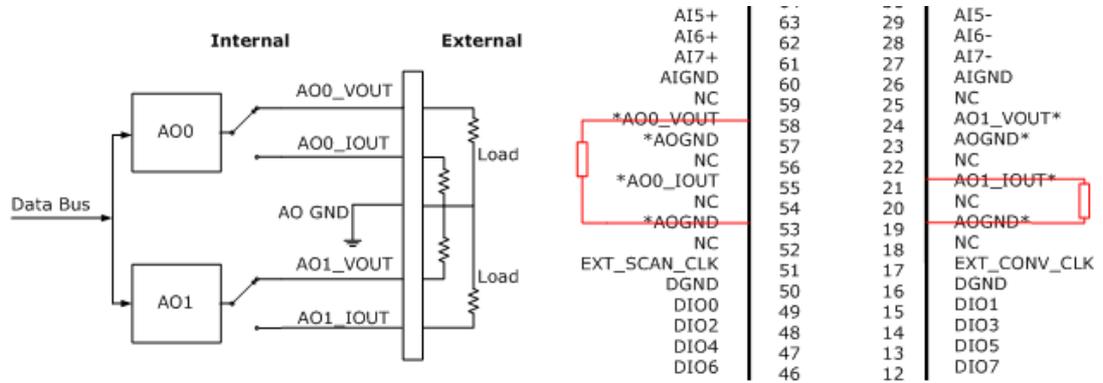

Figure 3.6 Analog Output Channel Connection

3.3.4 Digital Input/Output Connections

PCI-1706 provides 16 channels DIO and the direction can be set by software.
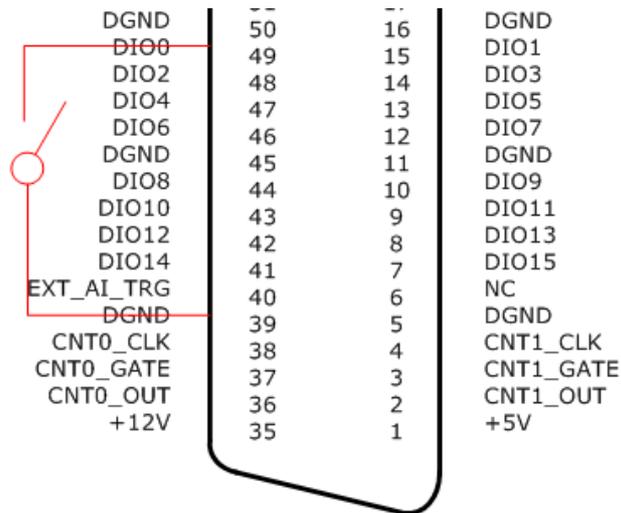
3.3.4.1 Digital Input Channel Connections

Figure 3.7 Digital Input Channel Connections

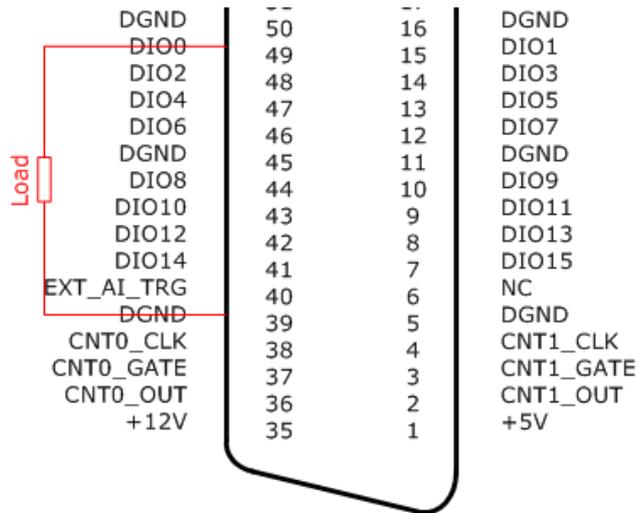### 3.3.4.2 Digital Output Channel Connections

Figure 3.8 Digital Output Channel Connections

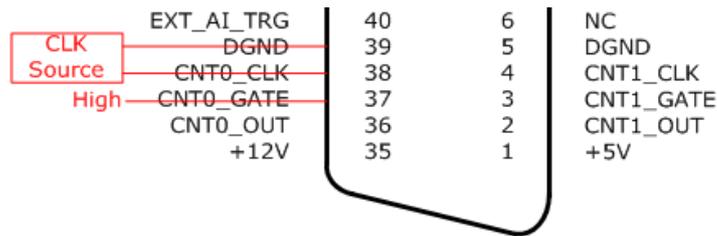## 3.3.5 Counter Connections

3.3.5.1 Event Counter Connection

Figure 3.9 Event Counter Connection
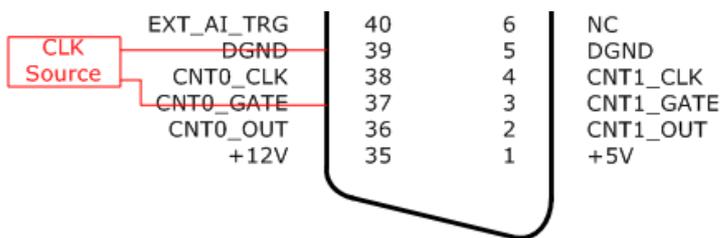
3.3.5.2 Frequency Measurement Connection

Figure 3.10 Frequency Measurement Connection

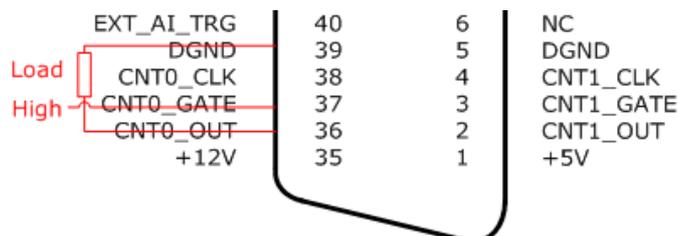### 3.3.5.3 Time Pulse Connection

Figure 3.11 Time Pulse Connection

3.3.5.4 One-shot Connection

When the Gate pin receives a trigger, Counter begin to count using internal clock or external clock. The Out pin output a pulse or Toggled signal after the counter count the number of delay count that can be set by user.
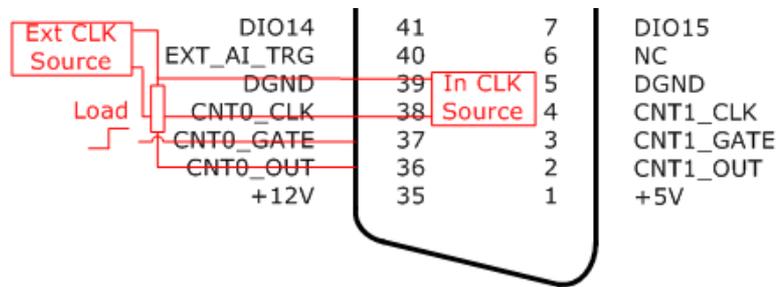

Figure 3.12 One shot Connection
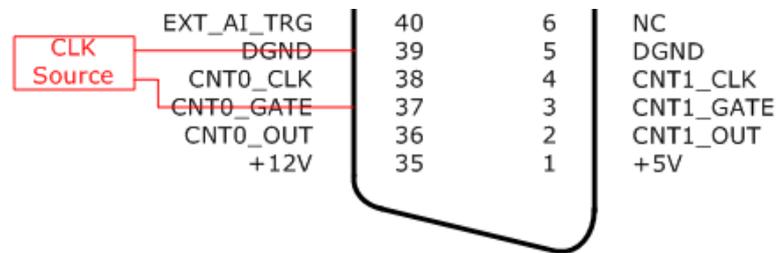
3.3.5.5 PwMeter Connection (PWM_IN)

Figure 3.13 PwMeter Connection (PWM_IN)

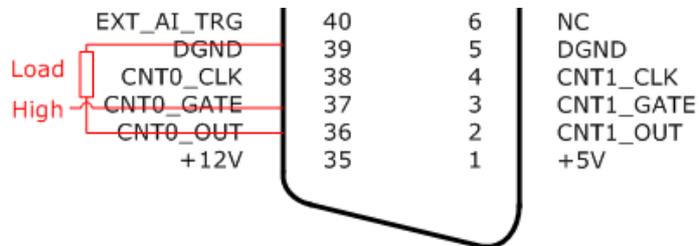#### 3.3.5.6 PwModulator Connection (PWM_OUT)

Figure 3.14 PwModulator Connection (PWM_OUT)

3.4 Field Wiring Considerations

When you use PCI-1706U cards to acquire data from outside, noises in the environment might significantly affect the accuracy of your measurements if due cautions are not taken. The following measures will be helpful to reduce possible interference running signal wires between signal sources and the PCI-1706U card.

- The signal cables must be kept away from strong electromagnetic sources such as power lines, large electric motors, circuit breakers or welding machines, since they may cause strong electromagnetic interference.Keep the analog signal cables away from any video monitor, since it can significantly affect a data acquisition system.

- If the cable travels through an area with significant electromagnetic interference, you should adopt individually shielded, twisted-pair wires as the analog input cable. This type of cable has its signal wires twisted together and shielded with a metal mesh. The metal mesh should only be connected to one point at the signal source ground.

- Avoid running the signal cables through any conduit that might have power lines in it.

- If you have to place your signal cable parallel to a power line that has a high voltage or high current running through it, try to keep a safe distance between them. Alternatively, you can place the signal cable at aright angle to the power line to minimize the undesirable effect.

- The signals transmitted on the cable will be directly affected by the quality of the cable. In order to ensure better signal quality, we recommend that you use the PCL-10168 shielded cable.

Appendix A

Specifications

A.1 General

I/O Connector Type	68-pin SCS-II Female	
Dimensions	175 mm x 100 mm(6.9" x 3.9")	
Power Consumption	Typical	+5 V @ 850 mA
	Max.	+5 V @ 1 A
Temperature	Operation	0~+60°C (32 ~ 140°F) (refer to IEC60068-2-1,2)
	Storage	-20~+70°C (-4 ~ 158°F)
Relative Humidity	Operation	5~85% RH non-condensing (refer to IEC60068-1-2,-3)
	Storage	5~95% RH non-condensing (refer to IEC60068-1-2,-3)
Certification	CE Certified	

A.2 Analog Input

Channels	8 differential analog input channels				
Resolution	16-bit Simultaneous		FIFO Size	8K	
Max. Sampling Rate	250K				
Input range and Gain List	Gain	1	2	4	8
	Range	±10 V	±5 V	±2.5 V	±1.25 V
Drift	Gain	1	2	4	8
	Zero (µV/°C)	2	2	2	2
	Gain (ppm/°C)	10	10	10	10
Small Signal Bandwidth for PGA	Gain	1	2	4	8
	Bandwidth (-3dB)	1.1MHz	1.1MHz	0.9MHz	0.9MHz
Max. Input voltage	±10V		Input Surge Protection	±30V	
Max Common Voltage	±10V				
Input Impedance	18 Mohm				
Trigger Mode	delay-stop-trigger, delay-start-trigger, none-trigger				
Trigger source	Software, External Digital, External Analog,				
Sampling CLK Source	Internal, External, MSI and 32-bit counter				

Accuracy	DC	Gain	1	2	4	8
		Range	±10 V	±5 V	±2.5 V	±1.25 V
		DNLE	±3			
		INLE	±3			
		Offset Error (%FSR)	0.01	0.01	0.02	0.02
		Gain Error (%FSR)	0.04	0.04	0.06	0.08
	AC	SINAD	78.1 dB			
		ENOB	12.68 bits			

External Clock	Logic level	TTL (Low: 0.8 V max. High: 2.0V min.)
	Input impedance	Hi Z
	Input coupled	DC
	Frequency	Up to 10MHz(Max 250k for use)
External Trigger	Logic level	TTL (Low: 0.8 V max. High: 2.0V min.)
	Input impedance	Hi Z
	Input coupled	DC
External Analog Trigger Input	Range	By analog input range
	Resolution	8-bit
	Frequency	Up to 150kHz

A.3 Analog Output

Channels	2	
Resolution	12-bit	
Output Range (Internal Reference)	Voltage	0 ~ +10 V, 0 ~ +5 V -5V ~ +5 V -10 V ~ +10 V
	Current	0 ~ 20 mA, 0 ~ 24 mA, 4 ~ 20 mA
Accuracy	DNLE	±1LSB
	INLE	±1LSB
Gain Error	Adjustable to zero (DC Output)	
Slew Rate	1V/µs, 2mA/µs	
Drift	40ppm/°C (Voltage) 70ppm/°C (Current)	
Driving Capability	5 mA (Voltage), 5 V (Current)	
Max. Update Rate	30K samples /s	
Output Impedance	3 Ohm (max)	
Settling Time	30 µs (Voltage) / 40 µs (Current) (to ±1/2 LSB of FSR)	

A.4 Digital Input/Output

Channels	16	
Input Voltage	Low	0.4 V max.
	High	2.4 V min.
Input Load	Low	0.4 V max. @ -0.2mA
	High	2.7 V min. @ 20 µA
Output Voltage	Low	0.4 V max. @ + 8.0 mA (sink)
	High	2.4 V min. @ -0.4 mA (source)

A.5 Counter/Timer

Channels	2 channels	
Resolution	32-bit	
Compatibility	TTL level	
Base Clock	20 MHz Internal External Clock up to 10 MHz	
Max. Input Frequency	10 M Hz	
Clock Input	Low	0.8 V max.
	High	2.0 V min.
Gate Input	Low	0.8 V max.
	High	2.0 V min.
Counter Output	Low	0.5 V max. @ +24 mA
	High	2.4 V min. @ -15 mA

A.6 Gain Codes

A.6.1 A/D Gain Code

Table A.1: PCI-1706 Analog Input

Input Range	Gain	Gain Code	
		G1	G0
±10 V	1	0	0
±5 V	2	0	1
±2.5 V	4	1	0
±1.25 V	8	1	1

A.6.2 D/A Gain Code

Table A.2: PCI-1706 Analog Output

Output Range	Gain Code		
	G2	G1	G0
0 ~ +5 V	0	0	0
0 ~ +10 V	0	0	1
-5 ~ +5 V	0	1	0
-10 ~ +10 V	0	1	1
4 ~ 20 mA	1	0	1
0 ~ 20 mA	1	1	0
0 ~ 24 mA	1	1	1

Appendix B

Block Diagram

B.1 Block Diagram
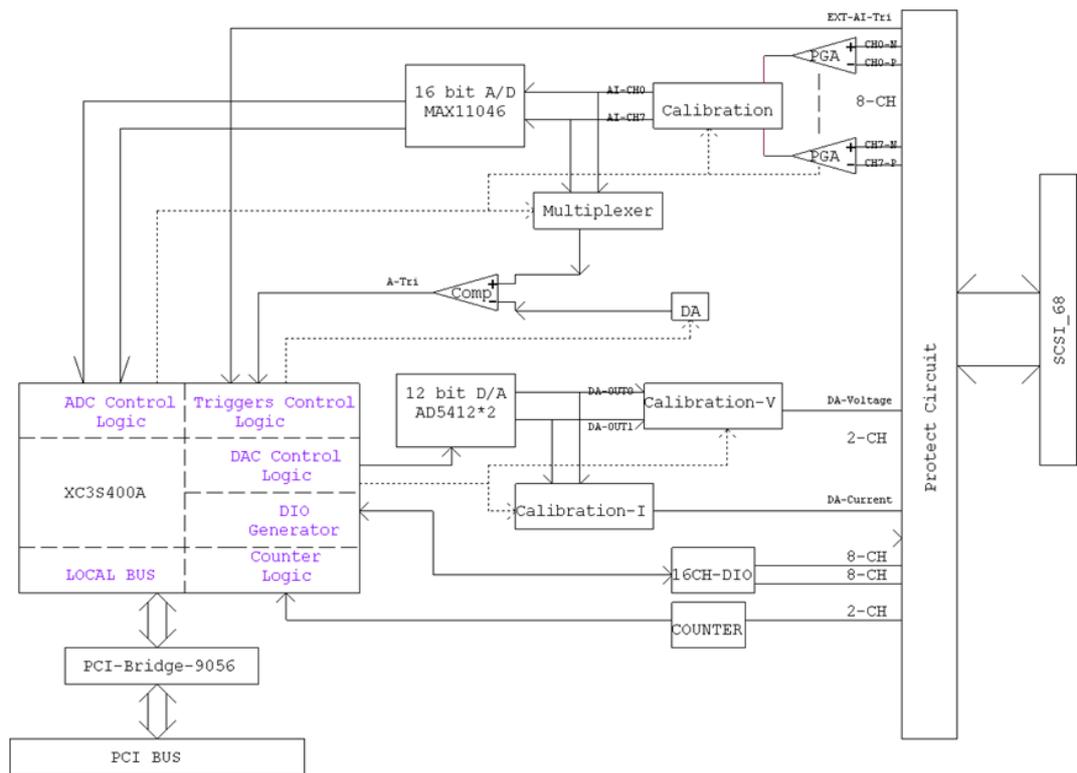
Figure B.1 PCI-1706U Block Diagram

Appendix C

Calibration

This appendix provides brief information on PCI-1706U card calibration.Regular calibration checks are important to maintain accuracy in data acquisition and control applications.
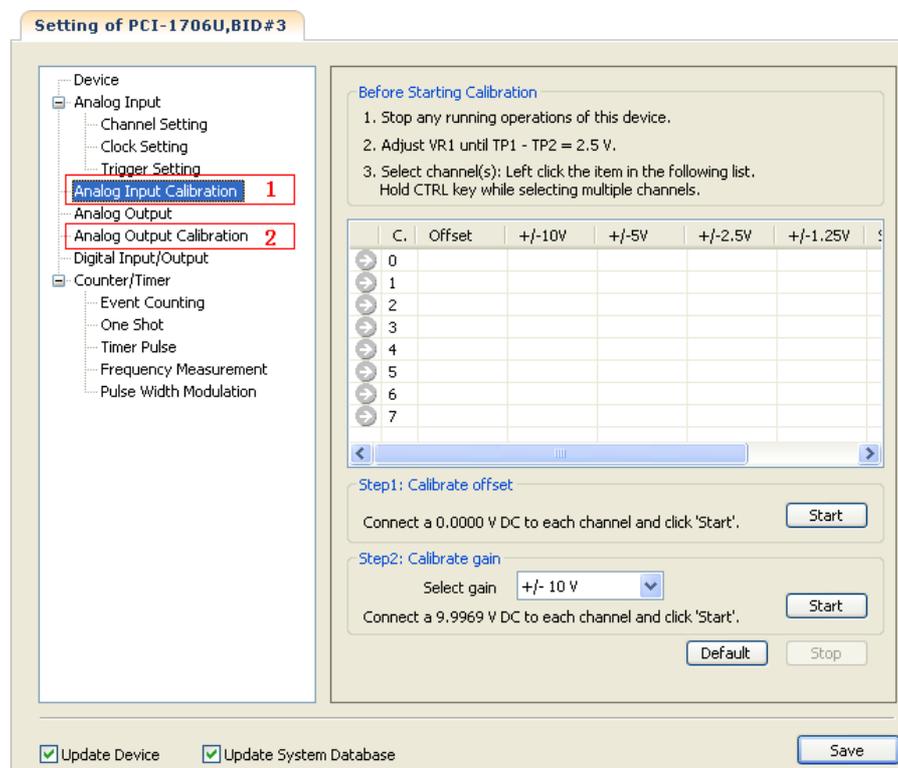
C.1 Calibration

The PCI-1706U has been calibrated at the factory for initial use. You are not required to calibrate the PCI-1706U in normal conditions. However, if in other conditions users need to calibrate the PCI-1706U, users can follow the process list below.

To perform a satisfactory calibration, users need a 6-1/2 digit voltmeter and a low noise standard DC voltage source for the calibration process. It is important that the accuracy after calibration depends on the precision voltmeter's accuracy.

- Auto A/D Calibration
- Auto D/A Calibration

Notice: User should calibrate A/D function first before calibrating D/A function.

Please Click the "Calibration" tab in configuration dialog box and follow the Calibration Instructions to finish your calibration.

Item1: Display Analog Input Calibration (A/D Calibration).
Item2: Display Analog Output Calibration (D/A Calibration).

C.1.1 A/D Calibration Wizard

Introduction:
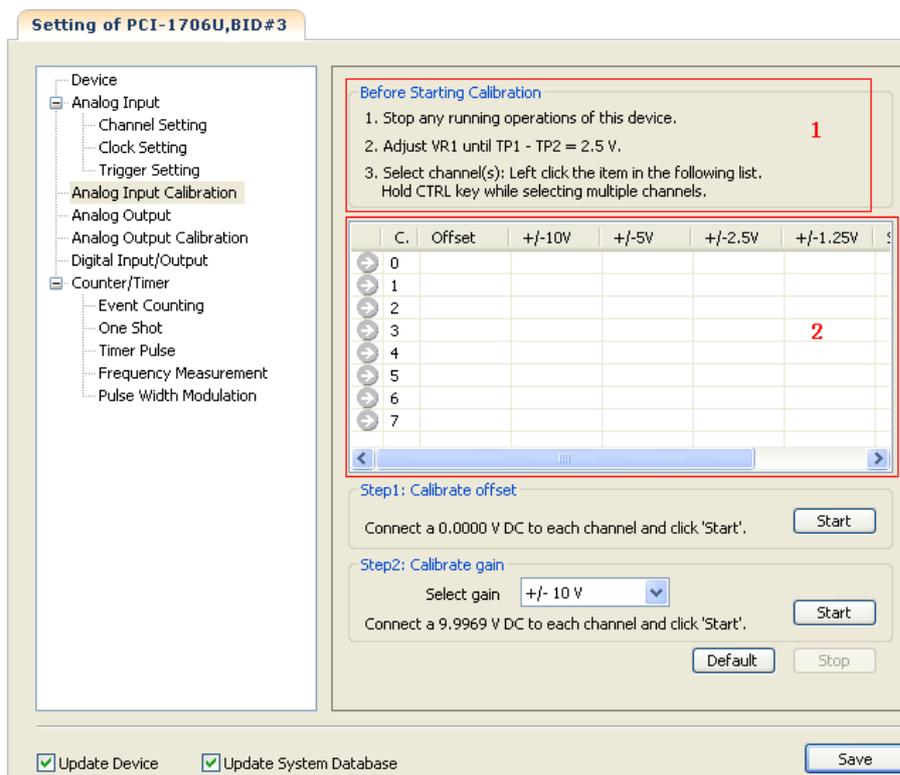
Item 1: Before start calibration, read the instructions:

1. Stop any running operations of the device;
2. Connect your voltmeter to TP1 and AGND, adjust VR1 until the voltage is 2.5 V. (See this page for the position of TP1/VR1.)
3. Select channels in the following list. Hold CTRL key and left chick the list item while selecting multiple channels. All channels are selected for default.

Item 2: Display the calibration status and result during the process.

Step 1: Calibrate offset.
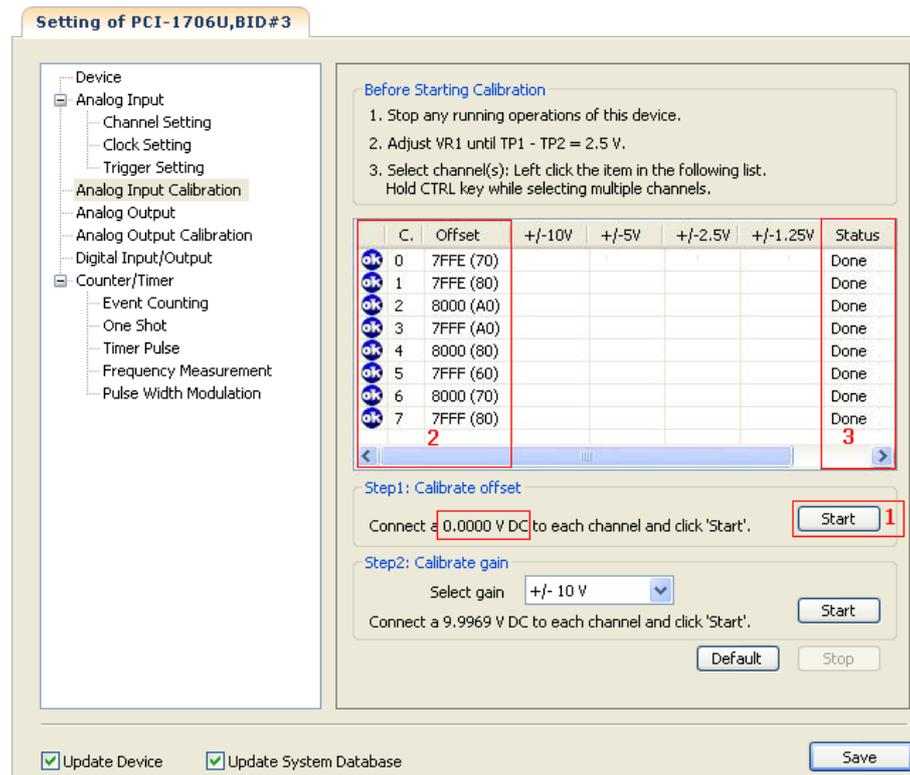
Item 1: Connect a 0V DC to the channel(s) selected above and click Start button.

Item 2: Display some values during calibration process. These values are for internal use, send them to Advantech if calibration fails.

Item 3: Display the calibration result. If success the status is Done otherwise is "Failed".

Step 2: Calibrate gain.
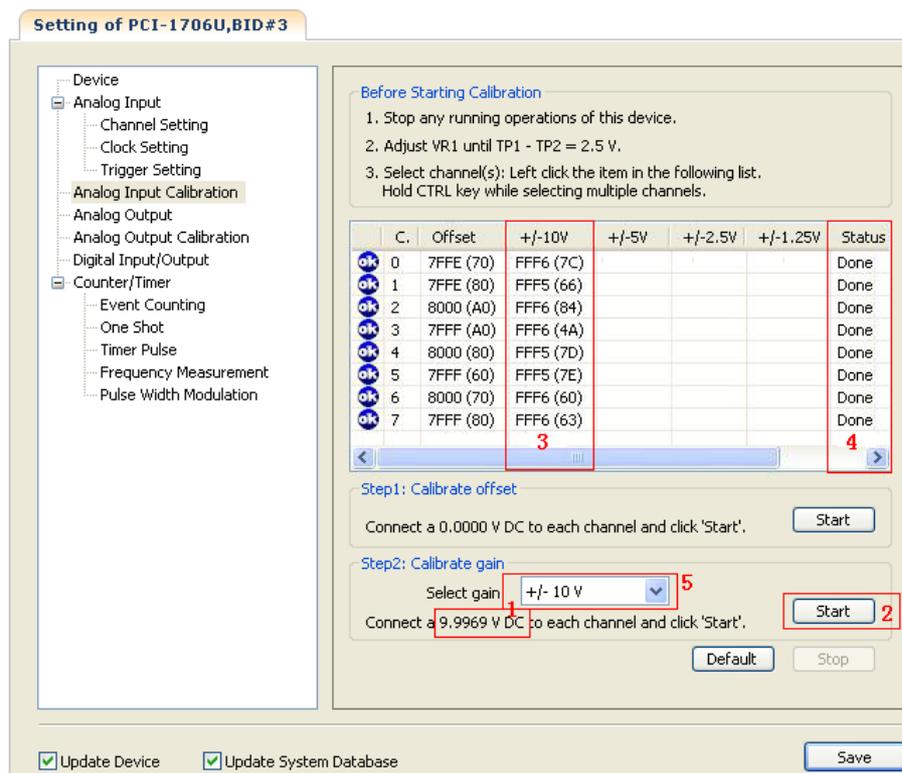
Item 1: Select a gain in the combo box and connect a specific signal to the AI channel(s).

> *Note!* The signal voltage is different at different gain, see the red box marked "1" for the correct value.

Item 2: Click "Start" button to start calibrating.

Item 3: Display some values during calibration process. These values are for internal use, send them to Advantech if calibration fails.

Item 4: Display the calibration result. If success the status is Done otherwise is "Failed".

Item 5: Select another gain to calibrate and repeat the 1-4 above.

Retry calibration:
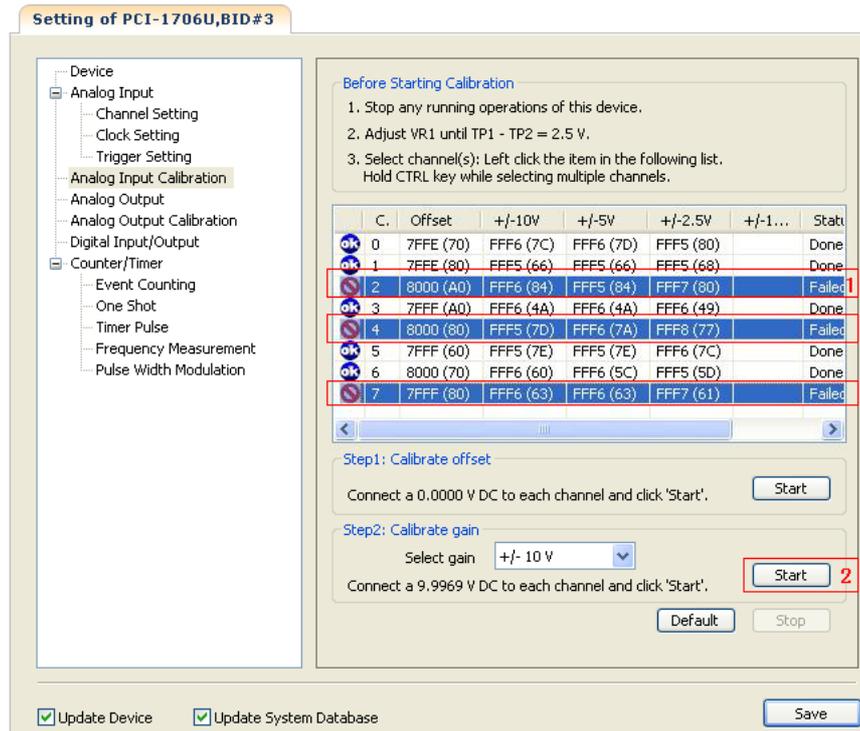
Item 1: Display some channels which fails in calibration process.
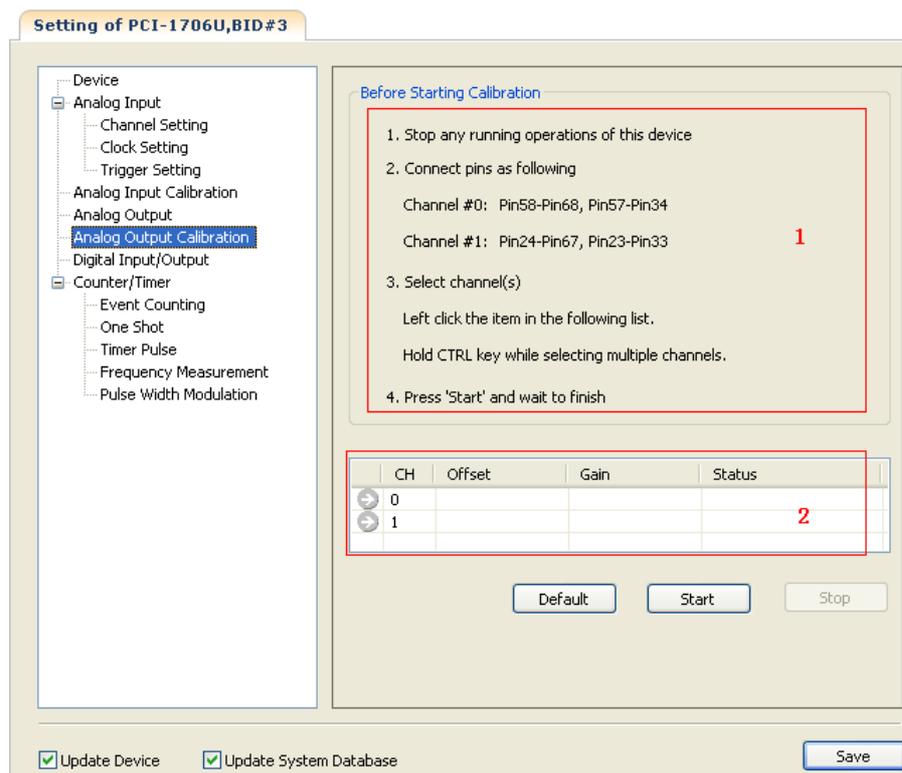**Item 2:** Select the failed channels and re-click "Start" button to try again.

Restore to factory default:
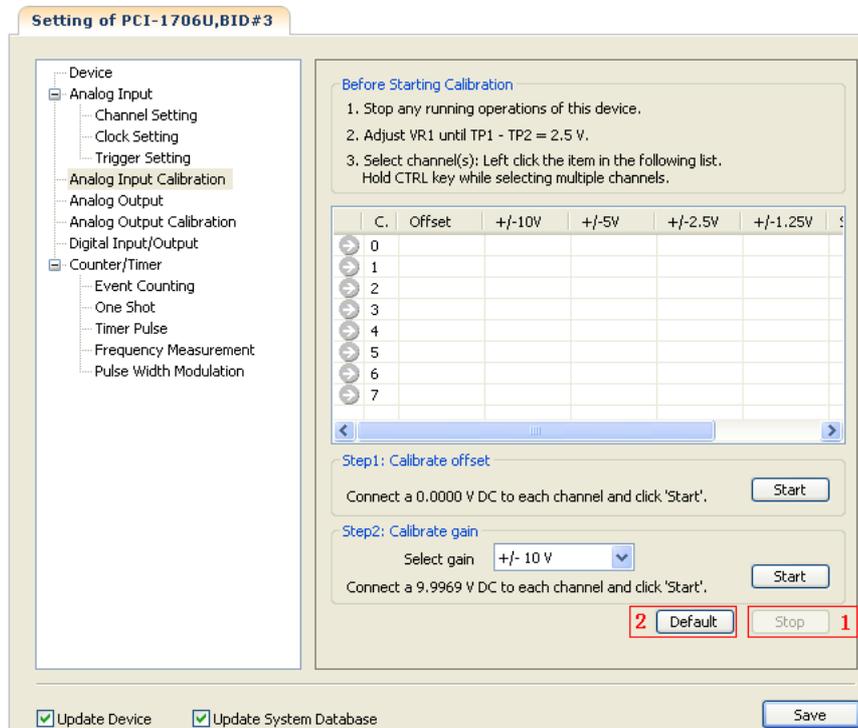
Item 1: Click "Stop" button to stop calibration process.
**Item 2:** Click "Default" button to restore factory settings.

C.1.2 D/A Calibration Wizard

**Item 1:** Before start calibration, read the instructions:

1. Stop any running operations of this device.
2. Connect AO channel 0/1 to AI channel 0/1 as described in the dialog. See this page for pin assignment of the connector.
3. Select channels in the following list. Hold CTRL key and left chick the list item while selecting multiple channels. All channels are selected for default.

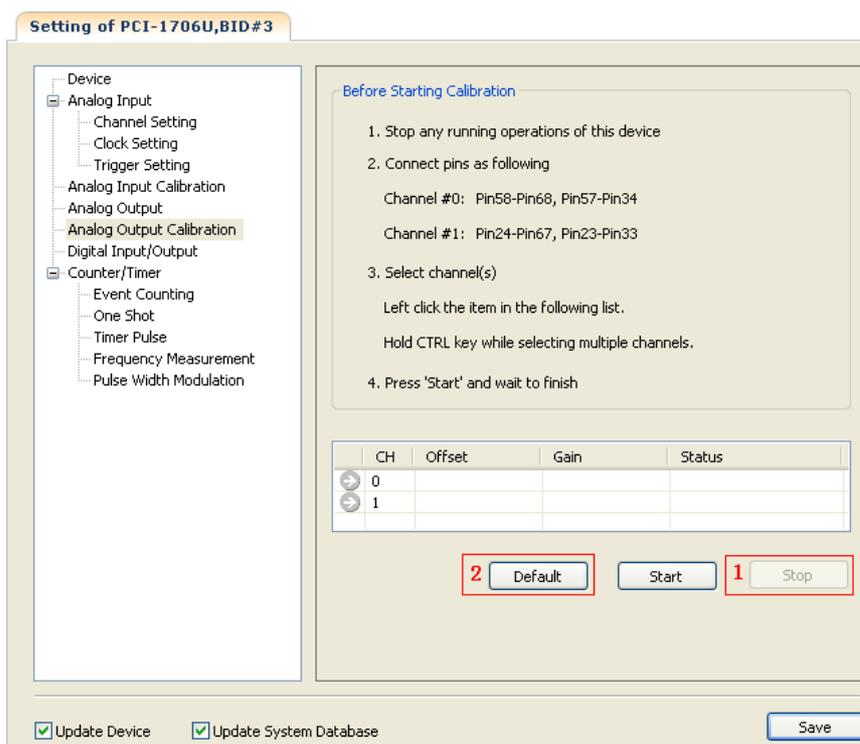**Item 2:** Display the calibration status and result during the process.
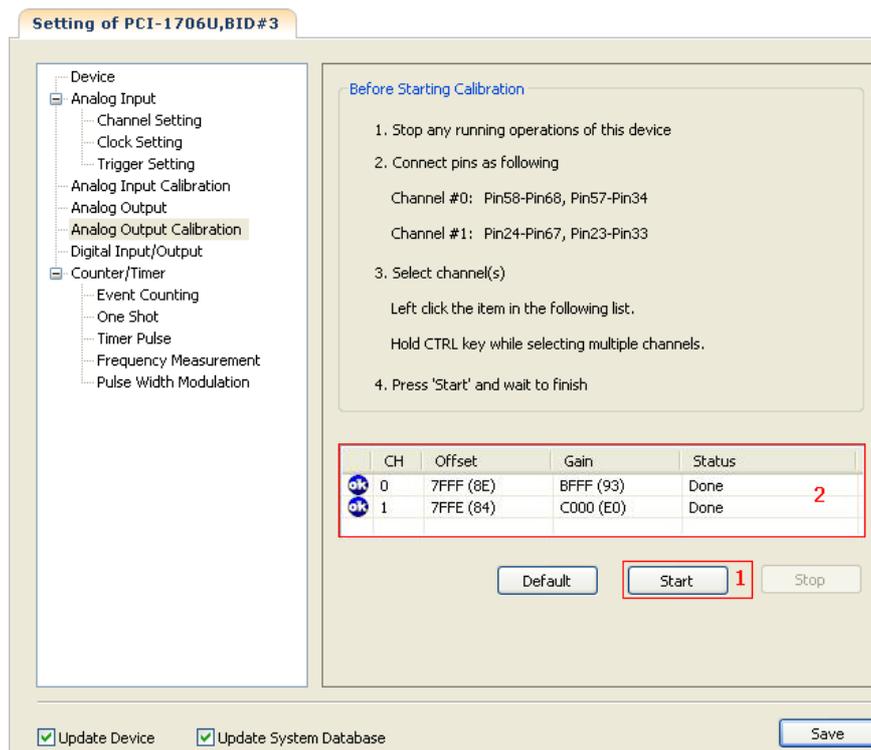
Item 1: Click "Start" button to start D/A calibration process.

Item 2: Display some values during calibration process. These values are for internal use, send them to Advantech if calibration fails.
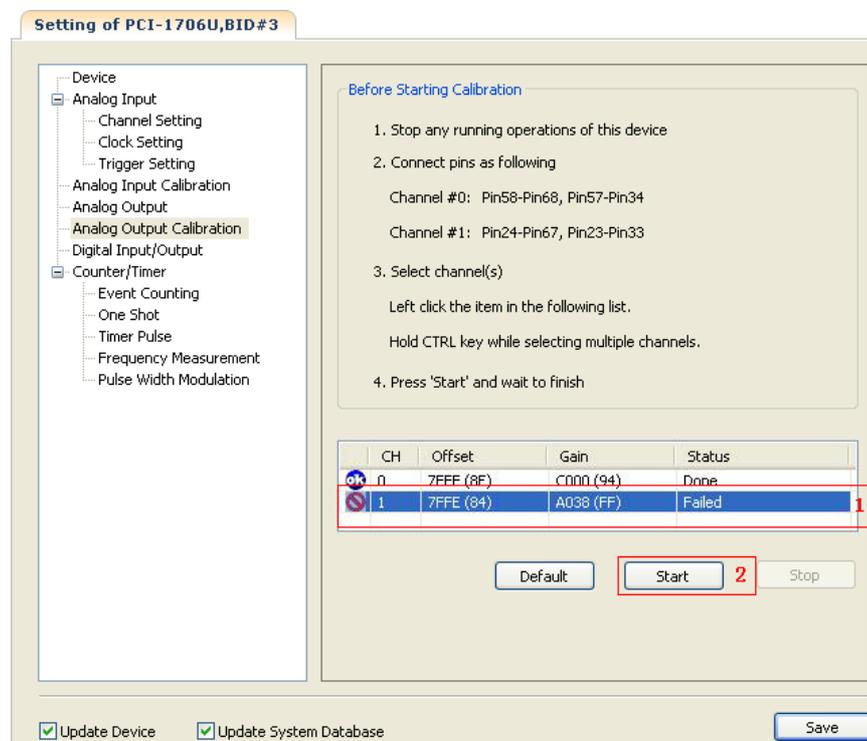
Item 1: Display some channels which fails in calibration process.

Item 2: Select the failed channels and re-click "Start" button to try again.

Item 1: Click "Stop" button to stop calibration process.
Item 2: Click "Default" button to restore factory settings.

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