

## **PCI-1720**

**4-ch Isolated Analog Output  
Card**

## **PCI-1720U**

**4-ch Isolated Analog Output  
Card with Universal PCI Bus**

## **User Manual**

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2. Call your dealer and describe the problem. Please have your manual, product, and any helpful information readily available.
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5. Write the RMA number visibly on the outside of the package and ship it prepaid to your dealer.

## **CE Notification**

PCI-1720 and PCI-1720U have 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**

- Step 1. Visit the Advantech web site at **[www.advantech.com/support](http://www.advantech.com/support)** where you can find the latest information about the product.
- Step 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

## **Safety Precaution - Static Electricity**

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

1. 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.
2. 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.

## **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.

1x PCI-1720 or PCI-1720Ucard

1x Companion CD-ROM (DLL driver included)

1x User Manual (this manual)

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CHAPTER

1

## General Information

# Chapter 1 General Information

## 1.1 Introduction

---

PCI-1720 cards are isolated analog output cards. They provide four 12-bit analog output channels with isolation protection of 2,500 V DC between the outputs and the PCI bus. This is ideal for industrial applications where high-voltage protection is required. PCI-1720U is also equipped with a universal PCI interface.

### Keeping the Output Settings and Values after System Reset

The four outputs can be set independently to different ranges: 0 to +5 V, 0 to +10 V,  $\pm 5$  V,  $\pm 10$  V, 0 to 20 mA (sink) or 4 to 20 mA (sink). When the system is hot reset (the power is not shut off), PCI-1720 cards can either retain the last analog output settings and values, or return to its default configuration based on its jumper setting. This practical function eliminates danger caused by misoperation during unexpected system resets.

### PCI-bus Plug & Play

The PCI-1720 cards use a PCI controller to interface the cards to the PCI bus. The controller fully implements the PCI bus specification Rev 2.1. All bus relative configurations, such as base address and interrupt assignment, are automatically controlled by software.

## 1.2 Features

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- Four 12-bit D/A output channels
- Multiple output ranges
- 2500 V<sub>DC</sub> isolation between the outputs and the PCI bus
- Keeps the output settings and values after system reset
- One 37-pin D-type connector for easy wiring
- BoardID switch
- Universal PCI Bus (PCI-1720U only)
- Glitch-free power up

## 1.3 Applications

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- Process control
- Programmable voltage source
- Programmable current sink
- Servo control

## 1.4 Specifications

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### D/A Output

- **Channels:** 4 isolated D/A channels
- **Resolution:** 12 bits
- **Output Ranges:** Unipolar: 0 ~ +5 V, 0 ~ +10 V  
Bipolar:  $\pm 5$  V,  $\pm 10$  V  
Current loop (sink): 0 ~ 20 mA, 4 ~ 20 mA
- **Throughput:** 500 kHz
- **Accuracy:**  $\pm 0.024\%$
- **Isolation Voltage:** 2,500 V DC between the outputs and the PCI bus
- **Output Current:**  $\pm 5$  mA max.
- **Current Loop Excitation Voltage:** 50 V max.
- **On-board 12 V<sub>DC</sub> Excitation Voltage:** (80 mA max.)

### Power Consumption

- +5 V @ 350 mA (typical), 500mA (Max.)
- +12V @ 200 mA (typical), 350mA (Max.)

### Physical

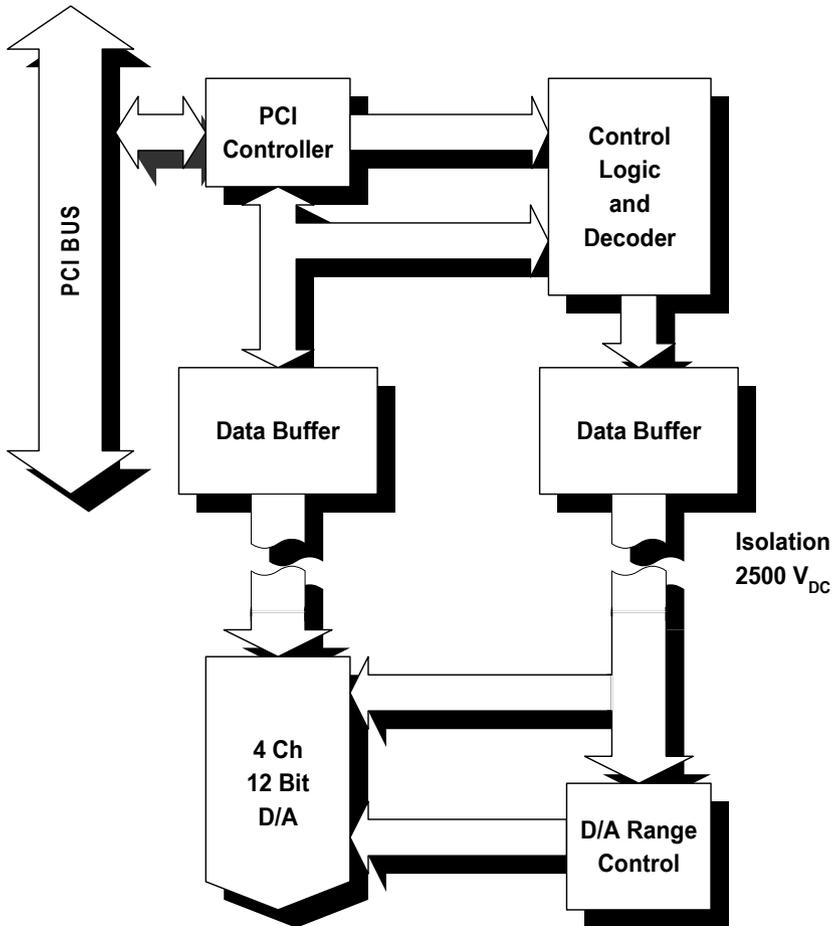
- **Connector:** 37-pin D-type connector
- **Dimensions:** 175 x 100 mm (6.9" x 3.9")

## Environment

- **Operating Temperature:** 0 ~ 60° C (32 ~ 140° F)
- **Storage Temperature:** -20 ~ 70° C (-4 ~ 158° F)
- **Operating Humidity:** 5 ~ 95 % RH non-condensing (refer to IEC 68-2-3)
- **MTBF:** over 71,280 hrs @ 25° C, grounded, fixed environment

## 1.5 Block Diagram

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## Installation

This chapter gives users a package item checklist, proper instructions for unpacking and step-by-step procedures for both driver and card installation.

Sections include:

- Unpacking
- Driver Installation
- Hardware Installation
- Device Setup and Configuration

# Chapter 2 Installation

## 2.1 Unpacking

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After receiving your PCI-1720 package, please inspect its contents first. The package should contain the following items:

- PCI-1720 or PCI-1720U card
- Companion CD-ROM (Device Drivers included)
- User Manual

PCI-1720 cards harbors certain electronic components vulnerable to *electrostatic discharge* (ESD). ESD can easily damage the integrated circuits and certain components if preventive measures are ignored.

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

- Touch the metal part of your computer chassis with your hand to discharge the static electricity accumulated on your body. Alternatively, one can also use a grounding strap.
- Touch the anti-static bag to a metal part of your computer chassis before opening the bag.
- Take hold of the card only by the metal bracket when removing it out of 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 our local sales representative immediately. Do not install 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 might need the original bag to store the card if you have to remove the card from PC or transport it elsewhere.*

## 2.2 Driver Installation

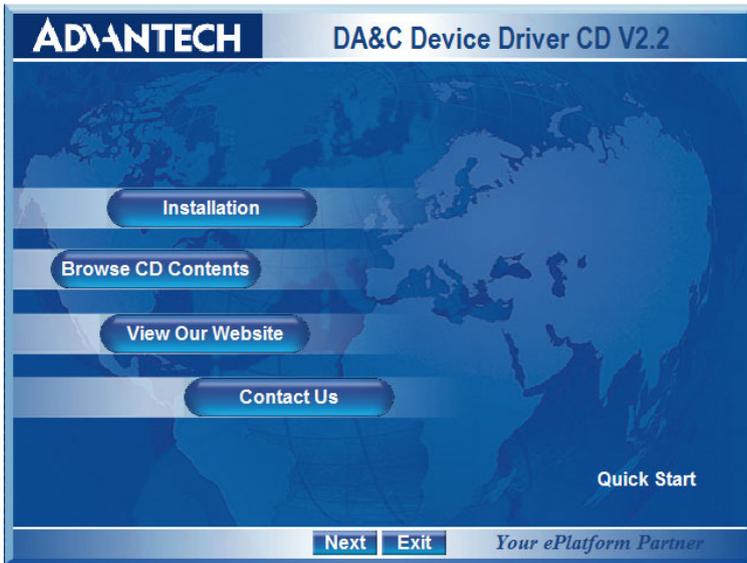
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We recommend you to install the driver before you install the PCI-1720 card into your system, since this will guarantee a smooth installation process.

The Advantech Device Drivers Setup program for the PCI-1720 card is included in the companion CD-ROM that is shipped with your DA&C card package. Please follow the steps below to install the driver software:

Step 1: Insert the companion CD-ROM into your CD-ROM drive.

Step 2: The Setup program will be launched automatically if you have the autoplay function enabled on your system. When the Setup Program is launched, you will see the following Setup Screen.

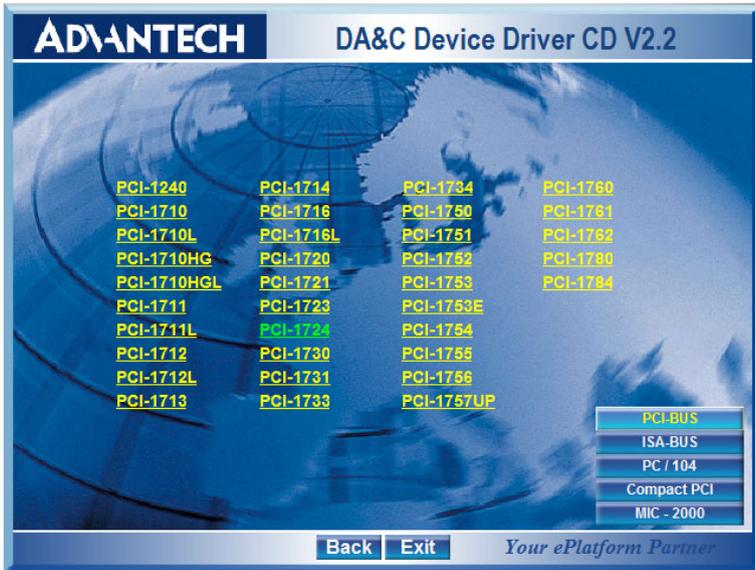


**Figure 2.1: Setup Screen of Advantech Automation Software**

**Note:** If the autoplay function is not enabled on your computer, use Windows Explorer or Windows Run command to execute *SETUP.EXE* on the companion CD-ROM.

Step 3: Select the *Individual Driver* option.

Step 4: Select the specific device then just follow the installation instructions step by step to complete your device driver installation and setup.



**Figure 2.2: Different Options for Driver Setup**

For further information on driver-related issues, an online version of the *Device Drivers Manual* is available by accessing the following path:

Start/Programs/Advantech Automation/Device Manager/Device Driver's Manual

## 2.3 Hardware Installation

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Make sure you have installed the driver first before you install the card (please refer to *2.2 Driver Installation*).

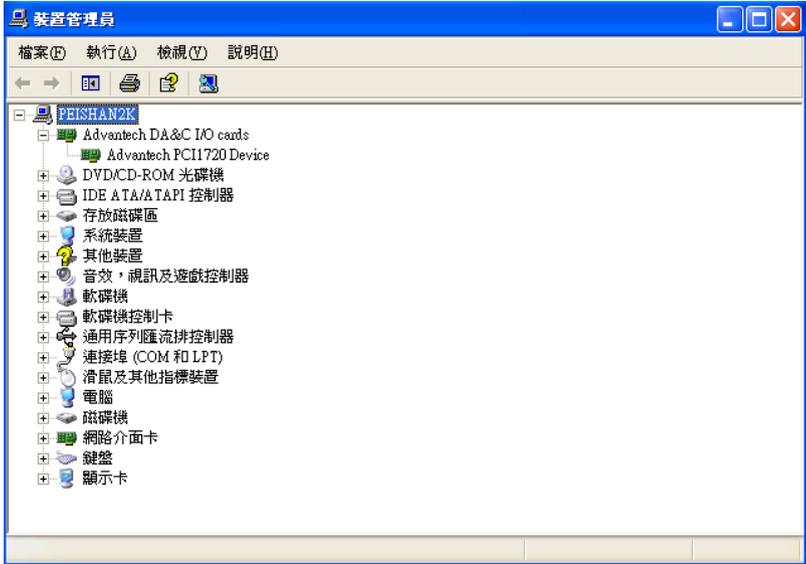
After the Device Drivers installation is completed, you can then install the PCI-1724U card into any PCI slot on your computer. However, it is suggested that you refer to the computer user's manual or related documentation if you have any doubt. Please follow the steps below to install the card onto 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 your 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-1724U 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 (62-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.

**Note:** *In case you installed the card without installing the Device Drivers first, Windows 95/98/ME will recognize your card as an "unknown device" after rebooting, and will prompt you to provide the necessary driver. You should ignore the prompting messages (just click the Cancel button) and set up the driver according to the steps described in 2.2 Driver Installation.*

After the PCI-1724U card is installed, you can verify whether it is properly installed on your system in the *Device Manager*:

1. Access the *Device Manager* through *Control Panel/System/Device Manager*.
2. The *device name* of the PCI-1724U should be listed on the *Device Manager* tab on the *System Property* Page.



**Figure 2.3: The Device Name Listed on the Device Manager**

If your card is properly installed, you should see the device name of your card listed on the Device Manager tab. 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, remove the card device from the Device Manager by selecting its device name and press the Remove button. Then go through the driver installation process again.

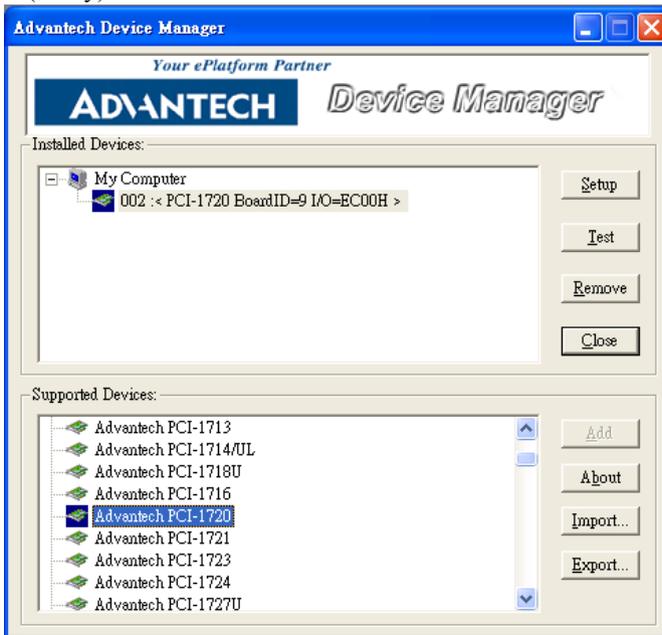
After your card is properly installed on your system, you can now configure your device using the *Advantech Device Manager* Program that has itself already been installed on your system during driver setup. A complete device installation procedure should include *device setup, configuration* and *testing*. The following sections will guide you through the Setup, Configuration and Testing of your device.

## 2.4 Device Setup and Configuration

The *Advantech Device Manager* program is a utility that allows you to set up, configure and test your device, and later stores your settings on the system registry. These settings will be used when you call the APIs of Advantech Device Drivers.

### 2.4.1 Setting Up the Device

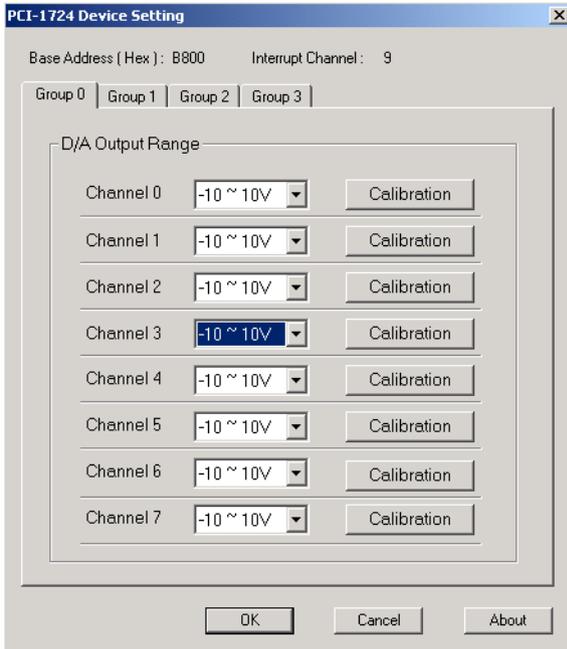
1. To install the I/O device for your card, you must first run the *Device Installation* program (by accessing *Start/Programs/ Advantech Automation/Device Manager*).
2. You can then view the device(s) already installed on your system (if any) on the Installed Devices list box.



**Figure 2.4: The Device Manager Dialog Box**

## 2.4.2 Configuring the Device

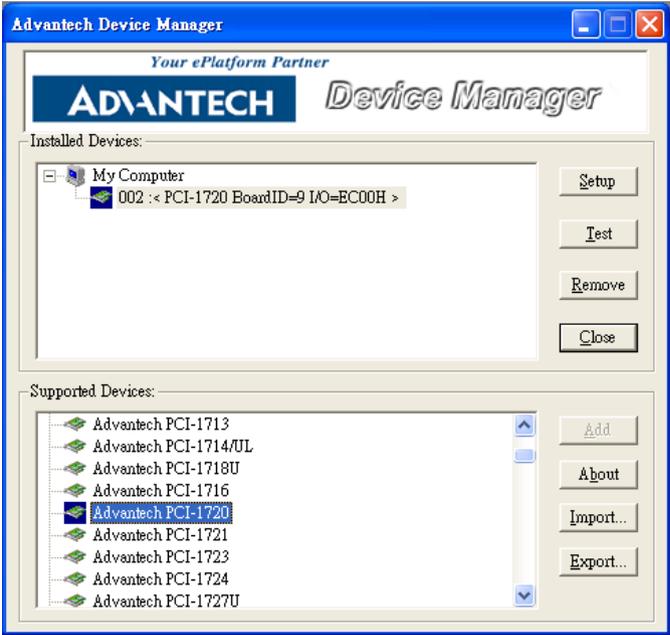
3. In the Device Setting dialog box (Fig.2-5), you can calibrate the voltage output range for the 8 D/A channels in 4 groups. For more detailed information, please refer to Appendix D Calibration Utility.



**Figure 2.5: The Device Setting dialog box**

**Note:** Users have three options for the output voltage ranges and current ranges:  $-10 \sim 10$  V,  $0 \sim 20$  mA and  $4 \sim 20$  mA.

4. After you have finished configuring the device, click OK and the device name will appear in the Installed Devices box as seen below:



**Figure 2.6: Device Name Appearing on the List of Devices Box**

After your card is properly installed and configured, you can click the **Test...** button to test your hardware by using the testing utility supplied. For more detailed information, please refer to Chapter 2 of the Device Drivers Manual.

You can also find the rich examples on the CD-ROM to speed up your programming.



CHAPTER  
**3**

**Jumpers and I/O  
Connectors**

# Chapter 3 Jumpers and I/O Connectors

PCI-1720 cards are Plug & Play compatible, i.e. the system BIOS assigns the system resources such as the base address and the interrupt number automatically. There are only 2 functions with 5 jumpers to configure to your applications requirements. The following sections offer the necessary information for setting the PCI-1720 card's jumpers. You may need to refer to the figure below for help in identifying jumper locations.

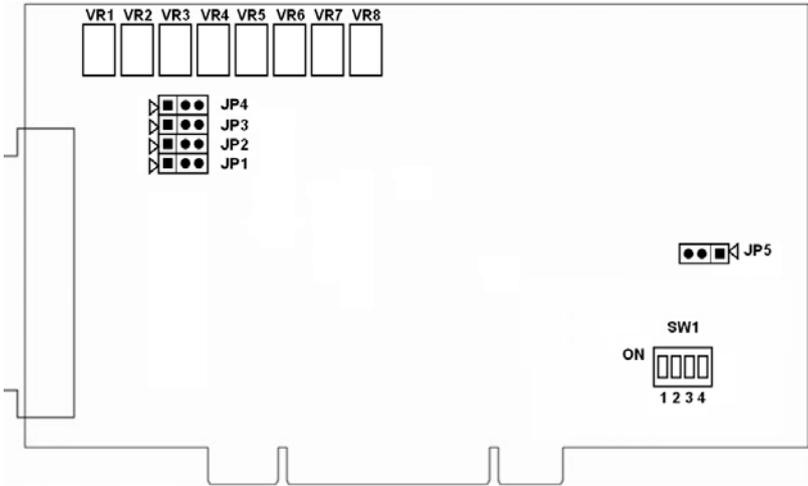


Figure 3.1: Jumper Locations (SW1 is only for PCI-1720U)

## 3.1 Jumper Settings

### 3.1.1 Using Jumpers to Set Current Sink Ranges

Jumpers JP1 to JP4 are used to select each channel's current sink range, either 4 ~ 20 mA or 0 ~ 20 mA. Jumpers JP1 to JP4 correspond with D/A channel 0 to channel 3 respectively. In order to use the current sink range, you have to set the PCI-1720U output voltage range to 0 ~ 5 V. The figure below shows the correct jumper settings for the current sink range.

#### JP1 to JP4

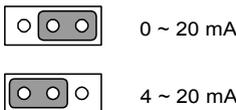


Figure 3.2: Jumper Settings for Current Sink Range

*Note! In order to maintain accurate outputs for your field applications, it is important that you calibrate the PCI-1720U's variable resistors (VRs) from time to time. Calibration instructions are provided in Appendix A.*

### **3.1.2 Jumper JP5 Setting for the Reset State**

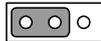
Jumper JP5 gives the PCI-1720U a new and valuable capability. With JP5 enabled, the PCI-1720U “memorizes” all D/A output settings and output values, and, in the event of a “hot” reset, i.e., the power is not shut off, the settings and output values present at each channel just prior to reset are still maintained. This feature is very useful for field applications. For example, it may allow a computer be “hot” reset without requiring the whole control system to shutdown. (Since output values are left unchanged.)

Complete loss of power to the card clears all settings and output values even if JP5 is enabled; i.e. if the power to the card is disconnected, the card's initial power-on state will be the default state. The default state is the output range for all channels is 0~5V and all the output values are 0V. When jumper JP5 is disabled, power-off or “hot” reset results in outputs returning to their default state.

#### **JP5**



Keeps last status after reset



Loads default while reset

**Figure 3.3: Jumper JP5 Setting for the Reset State**

## 3.2 Connector and Pin Assignments

---

PCI-1720 cards use one DB-37 female connector, which is located on the card at CN1 (see Figure 3-1) and connects D/A signals to external devices. The following figure shows the pin assignments of the connector.

NC	1		
		20	NC
+12 Vout	2		
		21	NC
AGND	3		
		22	NC
AGND	4		
		23	NC
Vout 0	5		
		24	NC
AGND	6		
		25	NC
Isink 0	7		
		26	NC
Vout 1	8		
		27	NC
AGND	9		
		28	NC
Isink 1	10		
		29	NC
Vout 2	11		
		30	NC
AGND	12		
		31	NC
Isink 2	13		
		32	NC
Vout 3	14		
		33	NC
AGND	15		
		34	NC
Isink 3	16		
		35	NC
NC	17		
		36	NC
NC	18		
		37	NC
NC	19		

**Figure 3.4: Pin Assignment**

### 3.2.1 Signal Descriptions of I/O Connector

Signal Name	Reference	Direction	Description
VOUT<0...3>	AGND	Output	Analog Voltage Output Channels 0 through 3. These pins supply the voltage outputs for the analog outputs.
ISINK<0...3>	AGND	Input	Current Sink Channels 0 through 3. These pins provide the current loop sink input.
+12 V OUT	AGND	Output	+12 VDC Source. This pin is a +12 V DC power supply (80mA max.) for current loop exciting voltage.
AGND	-	-	Analog Ground. The analog output voltage and +12 VDC source are referenced to these pins.
NC	-	-	No Connection to pin

### 3.3 Setting the BoardID Switch (SW1)

BoardID settings are used to get the board's unique identifier. The PCI-1720 cards have a built-in DIP switch (SW1), which is used to define each card's unique identifier. You can determine the unique identifier in the register as shown in Table 3.2. When there are multiple identical cards in the same chassis, the BoardID switch helps differentiating the boards by identifying each card's device number with the switch setting. This unique identifier has been set to 0 with the BoardID switch at the factory. If you need to adjust it to other numbers, set SW1 by referring to DIP switch setting.

**Table 3.1: Board ID Setting (SW1)**

<b>SW1</b>	<b>3</b>	<b>2</b>	<b>1</b>	<b>0</b>
<b>BoardID</b>	<b>ID3</b>	<b>ID2</b>	<b>ID1</b>	<b>ID0</b>
<b>0 (default)</b>	ON	ON	ON	ON
<b>1</b>	ON	ON	ON	OFF
<b>2</b>	ON	ON	OFF	ON
<b>3</b>	ON	ON	OFF	OFF
<b>4</b>	ON	OFF	ON	ON
<b>5</b>	ON	OFF	ON	OFF
<b>6</b>	ON	OFF	OFF	ON
<b>7</b>	ON	OFF	OFF	OFF
<b>8</b>	OFF	ON	ON	ON
<b>9</b>	OFF	ON	ON	OFF
<b>10</b>	OFF	ON	OFF	ON
<b>11</b>	OFF	ON	OFF	OFF
<b>12</b>	OFF	OFF	ON	ON
<b>13</b>	OFF	OFF	ON	OFF
<b>14</b>	OFF	OFF	OFF	ON
<b>15</b>	OFF	OFF	OFF	OFF

### 3.3.1 Identity Register

You can determine the identity in the register as shown in the table below.

**Table 3.2: Identity Register of PCI-1720U**

<b>Base+20</b>	3	2	1	0
<b>Abbreviation</b>	ID3	ID2	ID1	ID0

**Note:**

ID0: The least significant bit (LSB) of identifier

ID3: The most significant bit (MSB) of identifier



CHAPTER **4**

**Register Structure and  
Format**

# Chapter 4 Register Structure and Format

## 4.1 Overview

---

PCI-1720 cards are delivered with an easy-to-use 32-bit DLL driver for user programming under Windows 98, 2000 and XP operating systems. We advise users to program the card using the 32-bit DLL driver provided by Advantech to avoid the complexity of low-level programming by register.

The most important consideration in programming the PCI-1720 cards at register level is to understand the function of the card's registers. The information in the following sections is provided only for users who would like to do their own low-level programming.

## 4.2 I/O Port Address Map

PCI-1720 cards require 12 addresses in the PC's I/O space. The address of each register is specified as an offset from the card's base address. For example, BASE + 0 is the card's base address and BASE + 7 is the base address plus seven bytes. Table 4.1 shows the function of each register and its address relative to the card's base address

**Table 4.1: PCI-1720U Register Format and Function Description**

Base Address + Decimal	7	6	5	4	3	2	1	0	Function Description	R/W	
+0	D7	D6	D5	D4	D3	D2	D1	D0	D/A output channel 0	W	
+1					D11	D10	D9	D8			
+2	D7	D6	D5	D4	D3	D2	D1	D0	D/A output channel 1	W	
+3					D11	D10	D9	D8			
+4	D7	D6	D5	D4	D3	D2	D1	D0	D/A output channel 2	W	
+5					D11	D10	D9	D8			
+6	D7	D6	D5	D4	D3	D2	D1	D0	D/A output channel 3	W	
+7					D11	D10	D9	D8			
+8									D/A voltage range and polarity	R/W	
+9									Synchronized output prompt register	W	
+15									SC0	Synchronized output control bit	R/W
+20					D3	D2	D1	D0	BoardID Register	R	

\* "R" means readable and "W" means writable

### 4.2.1 D/A Output Channel 0 to 3

The write-only registers of BASE + 2(n) and BASE + (2(n) + 1) accept data for D/A output channel n (n = 0, 1, 2, 3)

**Table 4.2: Register for D/A Data**

Base Address + decimal	Data								Function Description	R/W
	7	6	5	4	3	2	1	0		
+2(n)	D7	D6	D5	D4	D3	D2	D1	D0	D/A output channel n	W
+(2(n)+1)					D11	D10	D9	D8		

**D11 ~ D0** Digital to Analog data. D0 is the LSB (Least Significant Bit) and D11 is the MSB (Most Significant Bit) of the D/A data.

*Note!* To write D/A data, write the low byte first, then write the high byte.

### 4.2.2 D/A Voltage Range and Polarity

The read-writable register of BASE + 8 allows users to set the D/A voltage range and polarity.)

**Table 4.3: Register for D/A Voltage Range and Polarity**

Base Address + decimal	Data								Function Description	R/W
	7	6	5	4	3	2	1	0		
+8	DA3_U/B	DA3_5/10	DA2_U/B	DA2_5/10	DA1_U/B	DA1_5/10	DA0_U/B	DA0_5/10	D/A voltage range and polarity	R/W

**Table 4.4: Output Range of D/A Channel n**

D An_U/B	D An_5/10	D/A channel n output range
0	0	0 to +5 V
0	1	0 to +10 V
1	0	-5 to +5 V
1	1	-10 to +10 V

\* n = 0,1,2,3.

### 4.2.3 Synchronized Output Prompt Register

During normal operation, the card will accept digital values one at a time from the host PC, convert these values to analog values, and immediately output these analog values from the channels directed by the host PC.

However, the cards have the capability to store each analog value in its proper channel buffer as it is generated, then simultaneously output one analog value from each of its four channels on receipt of a synchronizing character. Any character can act as a synchronizing character, but it must be written to the BASE + 9 register to prompt synchronized output.

### 4.2.4 Synchronized Output Control Bitt

**Table 4.5: Synchronized Output Control Bit**

Base Address + decimal	Data								Function Description	R/W
	7	6	5	4	3	2	1	0		
+15								SC0	Synchronized output control bit	R/W

The register BASE + 15 stores the synchronized output control bit. When the SC0 bit is set to 1, the synchronized data output function is enabled and analog values will not be output until a character is written to the BASE + 9 register. When the SC0 bit is set to 0, the synchronized data output function is disabled. Analog data output occurs as soon as an output channel receives an element of output data.

### 4.3 Unipolar and Bipolar Binary Code Tables

**Table 4.6: Unipolar Binary Code Table**

Digital Input Code			Examples of Analog Output Voltage
MSB		LSB	
1111	1111	1111	Vref (4095/4096)
1000	0000	0001	Vref (2049/4096)
1000	0000	0000	Vref (2048/4096)
0111	1111	1111	Vref (2048/4096)
0000	0000	0001	Vref (1/4096)
0000	0000	0000	Vref (0/4096)

- Notes:
1. Vref is the reference source voltage that you selected. Vref is +5 V or +10 V.
  2. Nominal full scale is given by  $FS = Vref ( 4095/4096)$ .
  3. Nominal LSB magnitude is given by  $LSB = Vref ( 1/4096)$ .

**Table 4.7: Bipolar Binary Code Table**

Digital Input Code			Examples of Analog Output Voltage
MSB		LSB	
1111	1111	1111	Vref (2047/2048)
1000	0000	0001	Vref (1/2048)
1000	0000	0000	0
0111	1111	1111	-Vref (1/2048)
0000	0000	0001	-Vref (2047/2048)
0000	0000	0000	-Vref (2048/2048)

- Notes:
1. Vref is the reference source voltage that you selected. Vref is +5 V or +10 V.
  2. Nominal full scale is given by  $FS = Vref ( 2047/2048)$ .
  3. Nominal LSB magnitude is given by  $LSB = Vref ( 1/2048)$ .

CHAPTER  
**5**

**Signal Connections**

# Chapter 5 Signal Connections

## 5.1 Overview

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Making correct signal connections is important for accurate data transmissions. Since most data acquisition applications involve some form of voltage measurement, making a sound signal connection will also protect your equipment against possible damage. This chapter shows you how to make proper signal connections.

## 5.2 D/A Voltage Output Connections

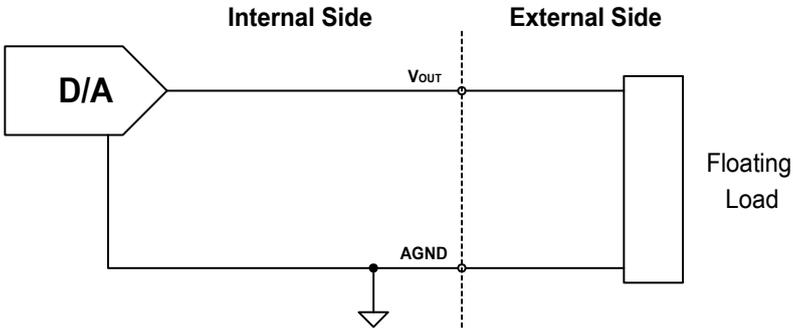
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PCI-1720 cards support four channels of D/A voltage output. Only one output signal wire is used with each channel. The voltage output is referenced to a common ground (AGND).

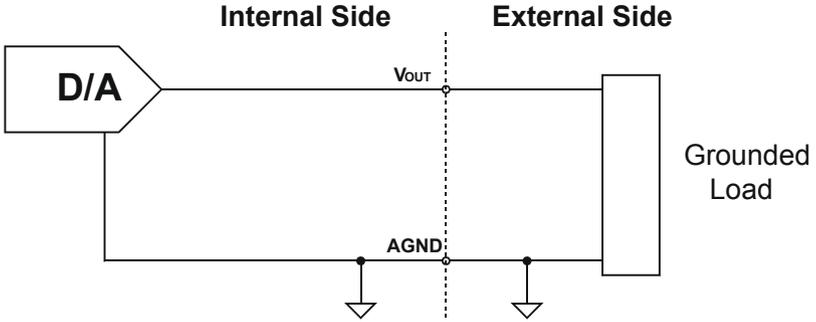
There are three types of voltage output connections:

1. Floating load.
2. Grounded load.
3. Differential load with ground.

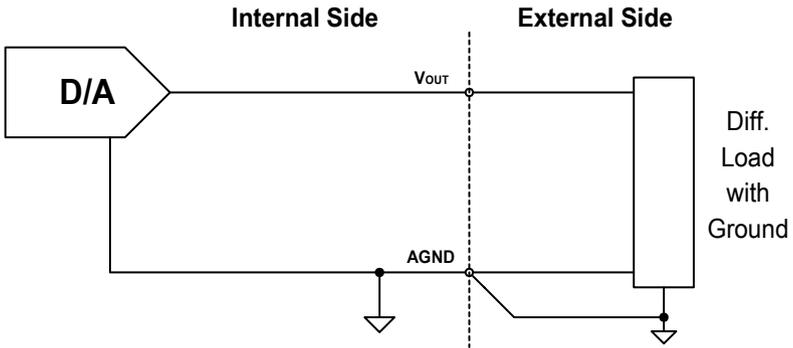
They are shown in the following illustrations.



**Figure 5.1: Floating-load Connection for D/A Voltage Output**



*Figure 5.2: Grounded-load Connection for D/A Voltage Output*



*Figure 5.3: Differential-load Connection for D/A Voltage Output*

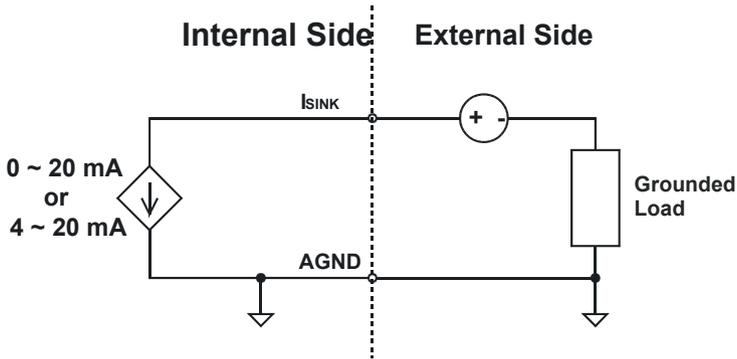
## 5.3 Current Sink Connections

The PCI-1720 cards' current loop output uses a 0 to +5 V (unipolar) voltage output as each channel's driving source. Current drive circuits consist of a power field-effect transistor (FET). The current output's voltage bias must be less than 50 V for accurate results. The card also provides an internal +12 V power source for current loop excitation.

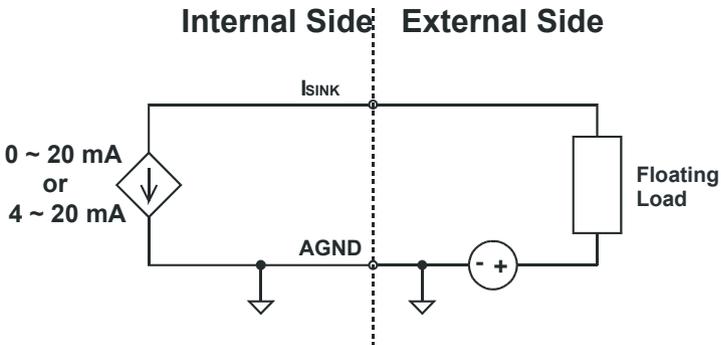
You can use three types of current sink connections:

1. Grounded load with a floating power supply.
2. Floating load with a grounded power supply.
3. Floating load with an internal +12 V power supply.

These are shown in the following illustrations.



*Figure 5.4: Grounded-load connection with a floating power supply*



*Figure 5.5: Floating-load connection with a grounded power supply*

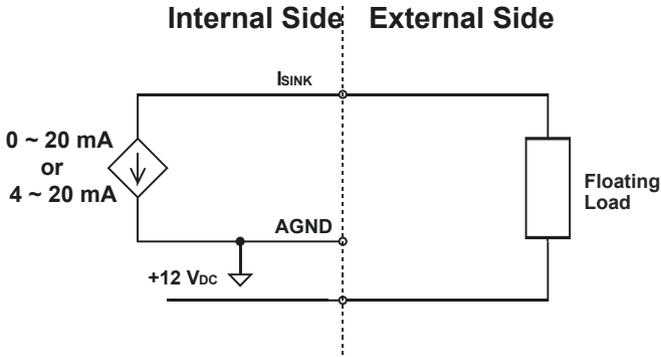


Figure 5.6: Floating-load Conn. with an Internal +12 VDC Power Supply

## 5.4 Current Sink Load and Power Supply

You have to select the current sink load and power supply carefully. The current sink circuitry of the PCI-1720 cards is as shown below.

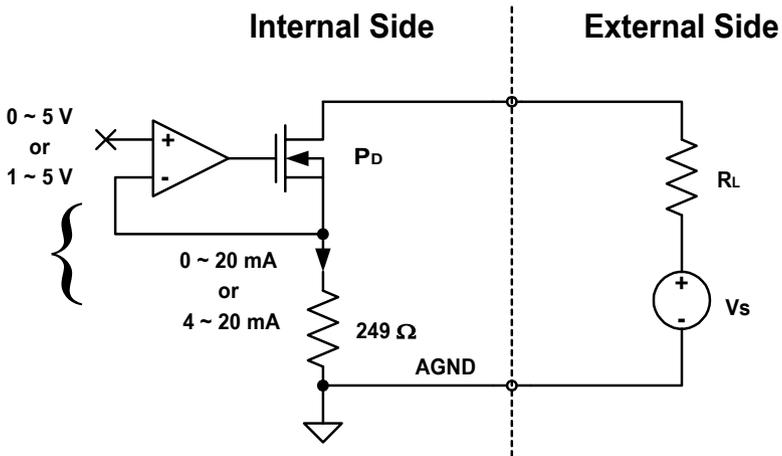


Figure 5.7: Current Sink Circuitry

**where**

VS: Power supply voltage of current sink.

RL: Load of current sink.

PD: Power dissipation of FET.

When you determine VS and RL, three conditions must be satisfied.

$$VS > (RL + 249) (0.02)$$

$$VS \leq 50$$

$$PD = (VS - (RL + 249) \times 0.02) \times 0.02 < 0.2$$

**Example 1**

If you use the internal power supply  $VS = +12\text{ V}$ , RL must be less than 351 W ( $12 / 0.02 - 249 > RL$ ). Select  $RL = 200\text{ W}$ ,  $PD = 0.0604 < 0.2$  OK!

**Example 2**

If you use the external power supply  $VS = +40\text{ V}$ , RL must be less than 1.75 kW ( $40 / 0.02 - 249 > RL$ ).

Select  $RL = 200\text{ W}$ ,  $PD = 0.62 > 0.2$  fail!

Reselect  $RL = 1\text{ kW}$ ,  $PD = 0.3 > 0.2$  fail!

Reselect  $RL = 1.5\text{ kW}$ ,  $PD = 0.1 < 0.2$  OK!

# APPENDIX A

## Calibration

This appendix provides brief information on PCI-1720 cards calibration. Regular calibration checks are important to maintain accuracy in data acquisition and control applications.

# Appendix A Calibration

## A.1 Overview

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PCI-1720 cards are calibrated at the factory for initial use. However, a recalibration of the analog analog outputs is recommended:

1. Every six months.
2. Everytime the analog output range is changed.

We provide a calibration program on the companion CD-ROM. The calibration programs make calibration easier. With a variety of prompts and graphic displays, these programs will lead you through the calibration and setup procedures, showing you all the correct settings and adjustments.

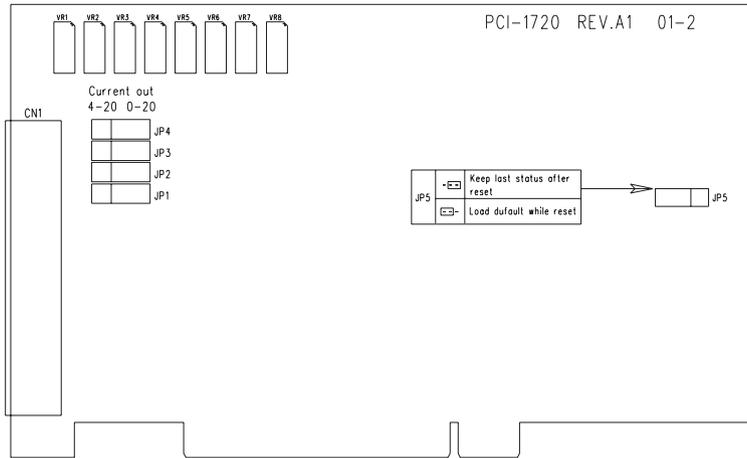
Note: If you installed the program to another directory, you can find these programs in the corresponding subfolders in your destination directory.

To perform a satisfactory calibration, you will need a 4½-digit digital multi-meter and a voltage calibrator or a stable, noise-free DC voltage source.

*Note*            *Before you calibrate the D/A function, you must turn on the power at least 15 minutes to make sure the DA&C card is already stable.*

## A.2 Starting Calibration

PCI-1720 cards use eight variable resistors (VRs), two for each channel, which allow you to calibrate each of the card's four output channels. The following information outlines the function of each VR. Refer to the illustration shown below for the locations of the VRs.



**Figure A.1: PCI-1720U VR assignment**

VR1 Channel 0's full scale (gain) adjustment.

VR2 Channel 1's full scale (gain) adjustment.

VR3 Channel 2's full scale (gain) adjustment.

VR4 Channel 3's full scale (gain) adjustment.

VR5 Channel 0's offset adjustment.

VR6 Channel 1's offset adjustment.

VR7 Channel 2's offset adjustment.

VR8 Channel 3's offset adjustment.

You should use a precision voltmeter/ammeter to obtain accurate readings when calibrating the card. Standard procedures for performing a calibration are given below.

## **A.3 Unipolar Output Calibration**

---

1. Select an appropriate output range for the channel to be calibrated.
2. Set all digital input codes to 0. Then adjust VR<sub>n</sub> (n = 5, 6, 7, 8 depending on what channel is to be calibrated, see prior page) until your voltmeter's reading is 0.000 volts.
3. Set all digital input codes to 1 (see Unipolar Binary Code Table in Section 4.3). Now, adjust VR<sub>n</sub> (n = 1, 2, 3, 4 depending on what channel is to be calibrated, see prior page) until your voltmeter shows a reading equal to the output voltage shown in the Unipolar Binary Code Table in Section 4.3.
4. Repeat steps 2 and 3 until both of them are satisfied.

## **A.4 Bipolar Output Calibration**

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1. Select an appropriate output range for the channel to be calibrated.
2. Set all digital input codes to 100000000000. Adjust VR<sub>n</sub> (n = 5, 6, 7, 8 depending on what channel is to be calibrated, see prior page) until your voltmeter's reading is 0.000 volts.
3. Set all digital input codes to 1 (see Bipolar Binary Code Table in Section 4.3). Now, adjust VR<sub>n</sub> (n = 1, 2, 3, 4 depending on what channel is to be calibrated, see prior page) until your voltmeter shows a reading equal to the output voltage shown in the Bipolar Binary Code Table in Section 4.3.
4. Repeat steps 2 and 3 until both of them are satisfied.

## **A.5 Current Sink Calibration**

---

1. Select the 0 ~ +5 V (unipolar) output range for the channel to be calibrated.
2. Set all digital input codes to 0. Then adjust VR<sub>n</sub> (n = 5, 6, 7, 8 depending on what channel is to be calibrated, see prior page) until your ammeter's reading is 0.00 mA or 4.00 mA (Depending on jumper setting JP1 to JP4, see Section 3.1.1).
3. Set all digital input codes to 1. Now, adjust VR<sub>n</sub> (n = 1, 2, 3, 4 depending on what channel is to be calibrated, see prior page) until your ammeter shows a reading equal to 20.00 mA.
4. Repeat steps 2 and 3 until both of them are satisfied.