PCI-1723

16-bit, 8-ch., Non-Isolated Analog Output Card

User Manual

Acknowledgements

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Product Warranty (2 years)

Advantech warrants to you, the original purchaser, that each of its products will be free from defects in materials and workmanship for two years from the date of purchase.

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.

Because of Advantech's high quality-control standards and rigorous testing, most of our customers never need to use our repair service. If an Advantech product is defective, it will be repaired or replaced at no charge during the warranty period. For out-of-warranty repairs, you will be billed according to the cost of replacement materials, service time and freight. Please consult your dealer for more details.

If you think you have a defective product, follow these steps:

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 on screen 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.
4. Carefully pack the defective product, a fully-completed Repair and Replacement Order Card and a photocopy proof of purchase date (such as your sales receipt) in a shippable container. A product returned without proof of the purchase date is not eligible for warranty service.
5. Write the RMA number visibly on the outside of the package and ship it prepaid to your dealer.

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

Step 1. Visit the Advantech web site at **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

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.

Before you install your PCI-1723 card, please make sure you have the following necessary components:

- PCI-1723 DA&C card
- PCI-1723 User's Manual
- Advantech DLL drivers (Included in the companion CD-ROM)
- Wiring cable PCL-10168 (option)
- Wiring board ADAM-3968 (option)
- Personal computer or workstation with a PCI-bus slot (running Windows 2000/95/ 98/NT/ME/XP)

Contents

CHAPTER 1

Introduction

This chapter gives background information on the PCI-1723.

Sections include:

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

Chapter 1 Introduction

Thank you for buying the Advantech PCI-1723. The PCI-1723 is a non-isolated multiple channels analog output card for PCI bus, and each analog output channel is equipped with a 16-bit, double-buffered DAC. It features an auto-calibration function and Board ID.

The PCI-1723 is an ideal solution for industrial applications where multiple analog output channels are required.

The following sections of this chapter will provide further information about features of the multifunction cards, a Quick Start for installation, together with some brief information on software and accessories for the PCI-1723 card.

1.1 Features

- Auto calibration function
- A 16-bit DAC is equipped for each of the analog output channels
- Flexible output range: ±10 V, 0 ~ 20 mA, 4 ~ 20 mA
- Synchronized output function
- Output values kept after system hot reset
- 2-port (16-channel) user-defined digital input/output
- Board ID

The Advantech PCI-1723 offers the following main features:

Auto-Calibration Function

The PCI-1723 provides an auto-calibration function by using a calibration utility. The built-in calibration circuitry of the PCI-1723 corrects gain and offset errors in analog output channels, thereby eliminating the need for external equipment and user adjustments.

Flexible Voltage Output Range

The PCI-1723 provides a fixed voltage output range of °”10 V to fulfill your flexible range needed applications. Users can define the specific voltage output range and output data format via the enclosed software utility and driver.

Keeping Output Values After System Reset

Users can independently set the eight outputs to different ranges: °”10 V, 0 ~ 20 mA or 4 ~ 20 mA, and all ranges are software selectable. When the system is hot reset (power not shut down), the PCI-1723 can either retain the last analog output values, or return to its default configuration, depending on the jumper setting. This practical function eliminates danger caused by improper operation during unexpected system reset.

Board ID

The PCI-1723 has a built-in DIP Switch that helps define each card's ID when multiple PCI-1723 cards have been installed on the same PC chassis. The board ID setting function is very useful when users build their system with multiple PCI-1723 cards. With correct Board ID settings, you can easily identify and access each card during hardware configuration and software programming.

Note: *For detailed specifications of the PCI-1723, please refer to Appendix A, Specifications.*

1.2 Applications

- Process control
- Programmable voltage source
- Programmable current sink
- Servo control
- Multiple loop PID control

1.3 Installation Guide

Before you install your PCI-1723 card, please make sure you have the following necessary components:

- PCI-1723 DA&C card
- PCI-1723 User's Manual
- Advantech DLL drivers (Included in the companion CD-ROM)
- Wiring cable PCL-10168 (option)
- Wiring board ADAM-3968 (option)
- Personal computer or workstation with a PCI-bus slot (running Windows 2000/95/ 98/NT/ME/XP)

Some other optional components are also available for enhanced operation such as application software ActiveDAQ, GeniDAQ and other third-party software packages

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 procedure. Figure 1-1 on the next page provides a concise flow chart to give users a broad picture of the software and hardware installation procedures:

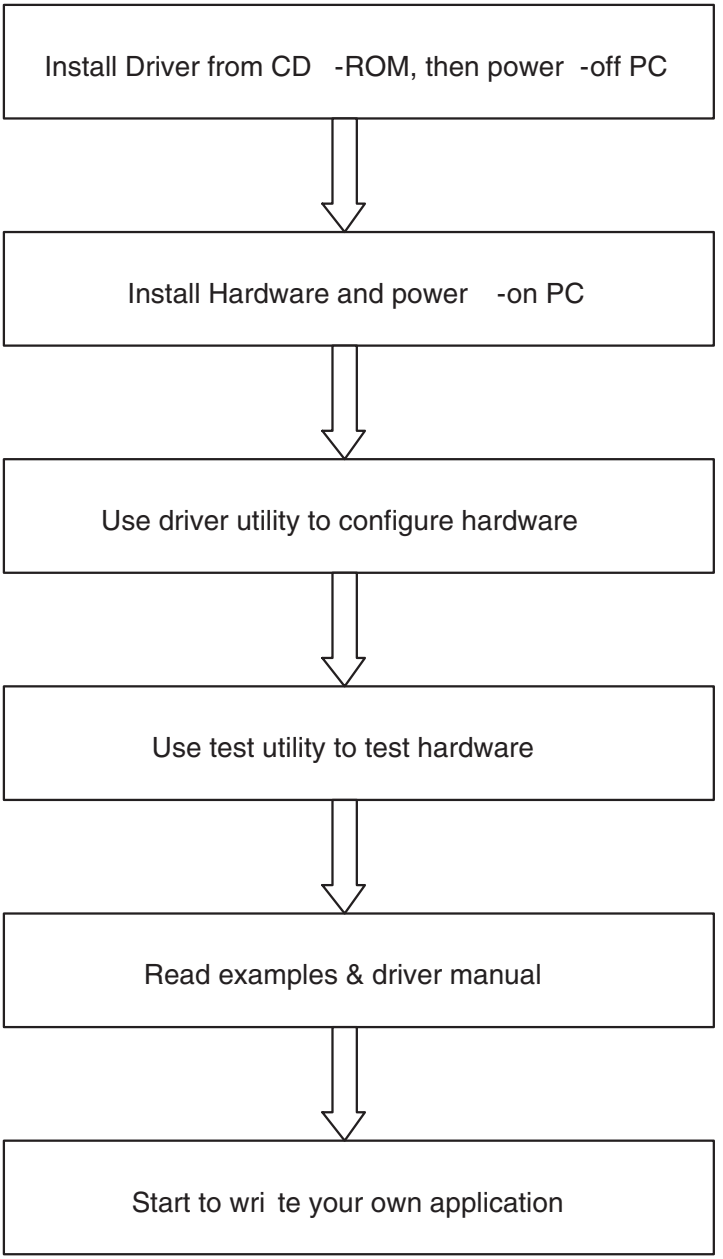


Figure 1.1: Installation Flow Chart

1.4 Software Overview

Advantech offers a rich set of DLL drivers, third-party driver support and application software to help fully exploit the functions of your PCI-1723 card:

- Device Drivers (on the companion CD-ROM)
- LabVIEW driver
- Advantech ActiveDAQ
- Advantech GeniDAQ

Programming choices for DA&C cards: You may use Advantech application software such as Advantech Device Drivers. On the other hand, advanced users are allowed another option for register-level programming, although not recommended due to its laborious and time-consuming nature.

Device Drivers

The Advantech Device Drivers software is included on the companion CD-ROM at no extra charge. It also comes with all the Advantech DA&C cards. Advantech's Device Drivers features a complete I/O function library to help boost your application performance. The Advantech Device Drivers for Windows 2000/95/98/NT/ME/XP works seamlessly with development tools such as Visual C++, Visual Basic, Inprise C++ Builder and Inprise Delphi.

Register-Level Programming

Register-level programming is available for experienced programmers who find it necessary to write code directly at the level of the device register. Since register-level programming requires much effort and time, we recommend that you use the Advantech Device Drivers instead. However, if register-level programming is indispensable, you should refer to the relevant information in *Appendix C, Register Structure and Format*, or to the example codes included on the companion CD-ROM.

1.5 Device Driver 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++, Visual Basic, 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.

Programming Tools

Programmers can develop application programs with their favorite development tools:

- Visual C++
- Visual Basic
- Delphi
- C++ Builder

For instructions on how to begin programming works 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 on the *Device Drivers Manual* to begin your programming efforts. You can also look at the example source code provided for each programming tool, since they can get you very well oriented.

The *Device Drivers Manual* can be found on the companion CD-ROM. Alternatively, 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 Device Driver V2.0/Device Driver Manual

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

\Program Files\Advantech\ADSAPI\Examples

For information about using other function groups or other development tools, please refer to the *Creating Windows 95/NT/2000 Application with Device Drivers* chapter and the *Function Overview* chapter on the *Device Drivers Manual*.

Programming with Device Drivers Function Library

Advantech Device Drivers offer a rich function library that can be utilized in various application programs. This function library consists of numerous APIs that support many development tools, such as Visual C++, Visual Basic, Delphi and C++ Builder.

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

- Analog Output Function Group
- Digital Input/Output Function Group
- Counter Function Group
- Port Function Group (direct I/O)
- Event Function Group

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

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. To troubleshoot the Device Drivers error, you can pass the error code to DRV_GetErrorMessage function to return the error message. Alternatively, you can refer to the *Device Drivers Error Codes* Appendix in the *Device Drivers Manual* for a detailed listing of Error Codes, Error IDs and the Error Messages.

1.6 Accessories

Advantech offers a complete set of accessory products to support the PCI-1723 card. These accessories include:

Wiring Cable PCL-10168

The PCL-10168 shielded cable is specially designed for PCI-1723 cards to provide high resistance to noise. To achieve a better signal quality, the signal wires are twisted in such a way as to form a “twisted-pair cable,” reducing cross talk and noise from other signal sources. Furthermore, its analog and digital lines are separately sheathed and shielded to neutralize EMI/EMC problems.

Wiring Board ADAM-3968

The ADAM-3968 is a 68-pin SCSI wiring terminal module for DIN-rail mounting. This terminal module can be readily connected to the Advantech PC-Lab cards and allow easy yet reliable access to individual pin connections for the PCI-1723 card.

CHAPTER 2

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

After receiving your PCI-1723 package, please inspect its contents first. The package should contain the following items:

- PCI-1723 card
- Companion CD-ROM (Device Drivers included)
- User Manual

The PCI-1723 card 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

We recommend you to install the driver before you install the PCI-1723 card into your system, since this will guarantee a smooth installation process.

The Advantech Device Drivers Setup program for the PCI-1723 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: Advantech Automation Software Setup

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 *Device Drivers* option.

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

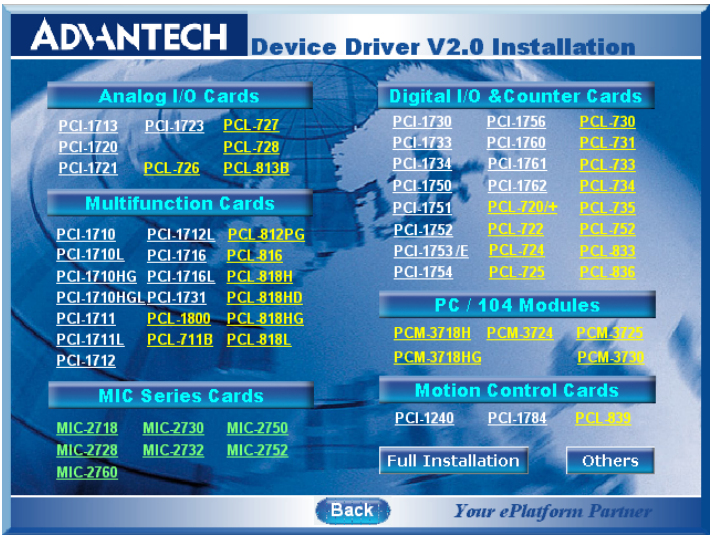


Figure 2.2: Options for Driver Setup

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 Device Drivers V2.0/Device Drivers Manual

2.3 Hardware Installation

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-1723 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-1723 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.

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-1723 card is installed, you can verify whether it is properly installed on your system in the *Device Manage*r:

1. Access the *Device Manager* through *Control Panel/System/Device Manage*r.
2. The *device name* of the PCI-1723 should be listed on the *Device Manager* tab on the System *Property* Page.

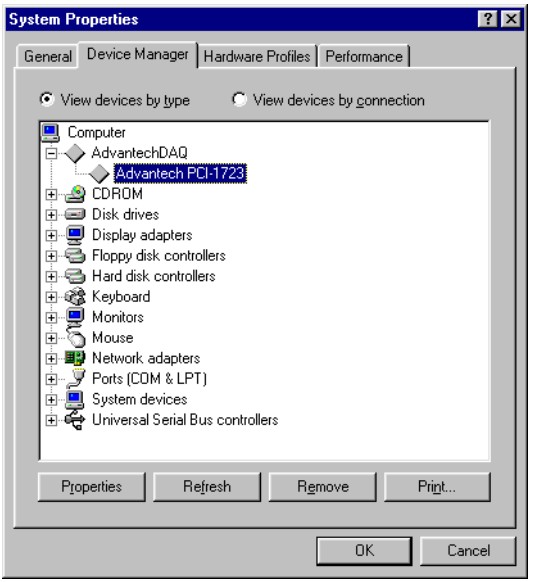


Figure 2.3: Device Name on Device Manager

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 Device Driver V2.0).*

2. You can then view the device(s) already installed on your system (if any) on the Installed Devices list box. Since you have not installed any device yet, you might see a blank list such as the one below (Fig. 2-4).

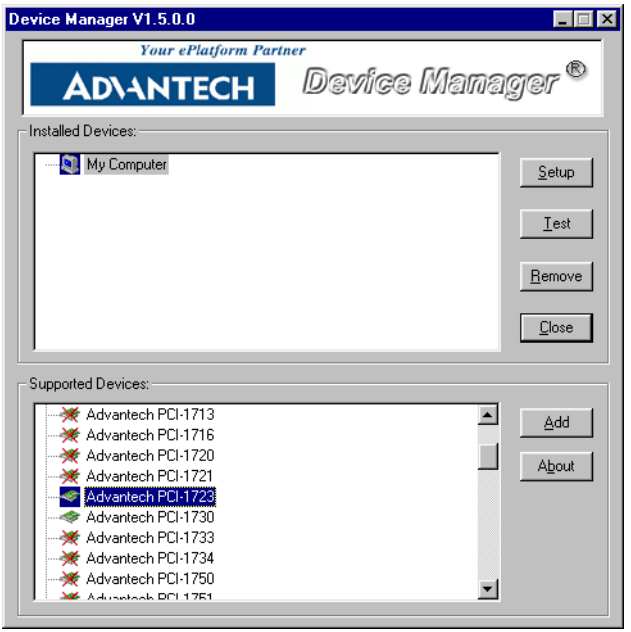


Figure 2.4: Device Manager Dialog Box

3. Scroll down the List of Devices box to find the device that you wish to install, then click the Add… button to evoke the Device(s) found dialog box such as one shown in Fig. 2-5. The Device(s) found dialog box lists all the installed devices on your system. Select the device you want to configure from the list box and press the OK button. After you have clicked OK, you will see a Device Setting dialog box such as the one in Fig. 2-6.

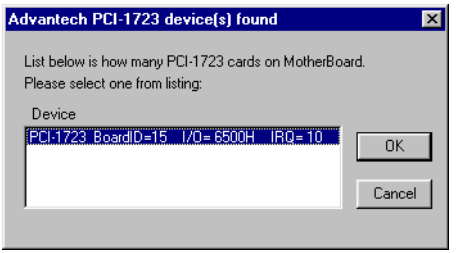


Figure 2.5: "Device(s) Found" Dialog Box

2.4.2 Configuring the Device

4. On the Device Setting dialog box (Fig. 2-6), you can configure the voltage output range for the 8 D/A channels.

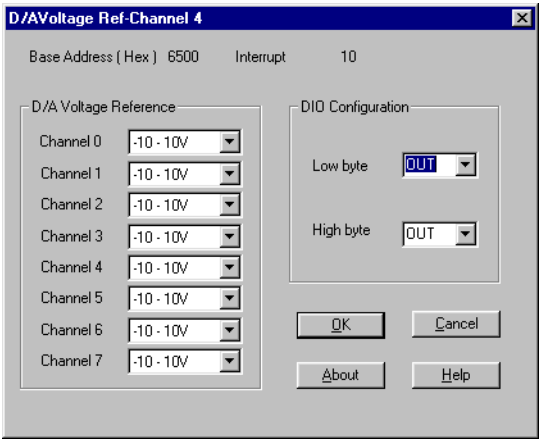


Figure 2.6: Device Setting Dialog Box

When selected as External, the external reference voltage determines the output voltage range in the following way: By inputting an external reference voltage: -xV, where |x| <= 10, you will get a output voltage range: 0 to xV.

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

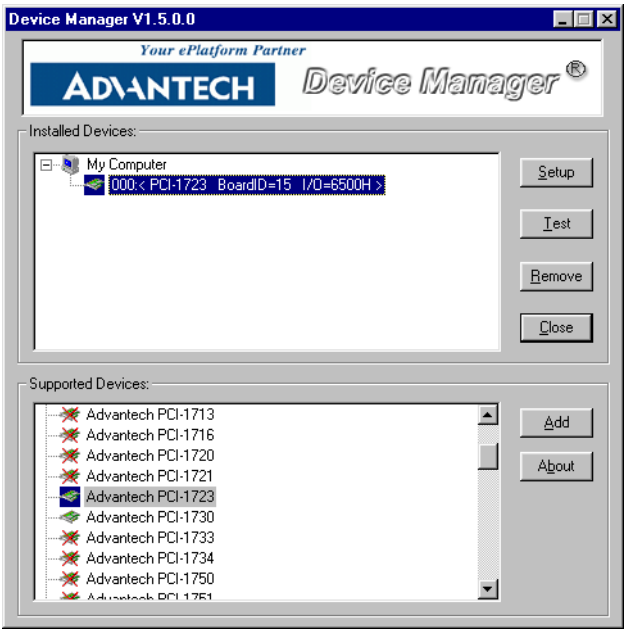


Figure 2.7: Device Name on the List of Devices Box

Note: *As we have noted, the device name "000:PCI-1723 BoardID=0 I/O=6500H" begins with a device number "000", which is specifically assigned to each card. The device number is passed to the driver to specify which device you wish to control.*

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 examples on the CD-ROM to speed up your programming.

CHAPTER 3

Signal Connections

This chapter gives an overview of the signal connections of PCI-1723.

Sections include:

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

Chapter 3 Signal Connections

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-1723 via the I/O connector.

3.2 Switch and Jumper Settings

The PCI-1723 card has one function switch and five jumper settings.

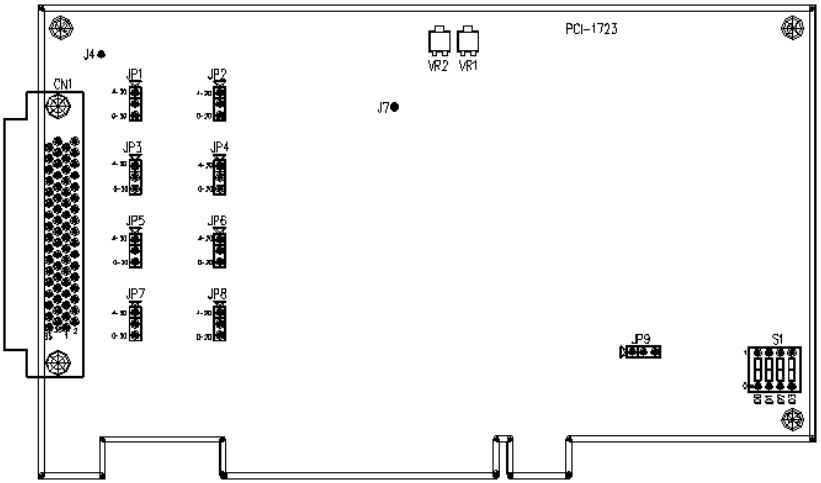


Figure 3.1: Card Connector, Jumper & Switches

3.2.1 JP9

	Keep last status after hot reset.
	Default configuration.

3.2.2 JP1~JP8

	4~20 mA
	0~20 mA

3.2.3 Setting the Time to Reset Analog Outputs

Some users will want the capability of clearing each analog output when the system (or PC) issues a reset signal on the PCI bus. Some users will want to clear their analog output only as part of system power-on.

The PCI-1723 satisfies both these needs by providing jumper JP1. Depending on the application, this capability may allow analog outputs to be "ZERO" without requiring a complete shutdown of processes controlled by the card.

Complete loss of power to the chip clears the chip memory. Thus, no matter how JP1 is set, if the power to the PCI-1723 is disconnected, the analog output initial power-on state will be "ZERO".

3.2.4 Board ID setting

ID3	ID2	ID1	ID0	Board ID
1	1	1	1	0
1	1	1	0	1
1	1	0	1	2
1	1	0	0	3
1	0	1	1	4
1	0	1	0	5
1	0	0	1	6
1	0	0	0	7
0	1	1	1	8
0	1	1	0	9
0	1	0	1	10
0	1	0	0	11
0	0	1	1	12
0	0	1	0	13
0	0	0	1	14
0	0	0	0	15

Note: On: 1, Off: 0

3.3 Signal Connections

3.3.1 Pin Assignment

Figure 3-2 shows the pin assignments for the 68-pin I/O connector on the PCI-1723.

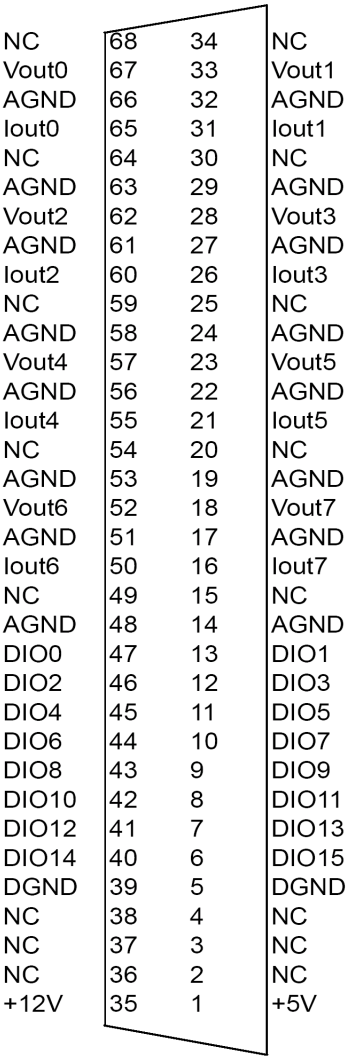


Figure 3.2: I/O Connector Pin Assignments

3.3.2 I/O Connector Signal Descriptions

Table 3.1: I/O Connector Signal Descriptions

Signal Name	Reference	Direction	Description
Vout<0..3>	AGND	Output	Voltage Output, Channels 0 through 3.
Iout<0..3>	AGND	Output	Current Output, Channels 0 through 3.
AGND	-	-	Analog Ground. The two ground references (AGND and DGND) are connected together on the PCI-1723 card.
DI0<0..15>	DGND	-	Digital Input / Output signals. These pins are digital input / Output channel 0 to 15.
DGND	-	-	Digital Ground. The two ground references (AGND and DGND) are connected together on the PCI-1723 card.
+12V	DGND	Output	+12 VDC Source (from PCI bus directly with FUSE protection).
+5V	DGND	Output	+5 VDC Source (from PCI bus directly with FUSE protection).

3.3.3 Analog Output Connection

The PCI-1723 provides eight D/A output channels, Vout_0 ~ Vout_7 and Iout_0 ~ Iout_7.

Voltage Mode:

Figure 3-3 shows how to make analog output and external reference input connections on the PCI-1723.

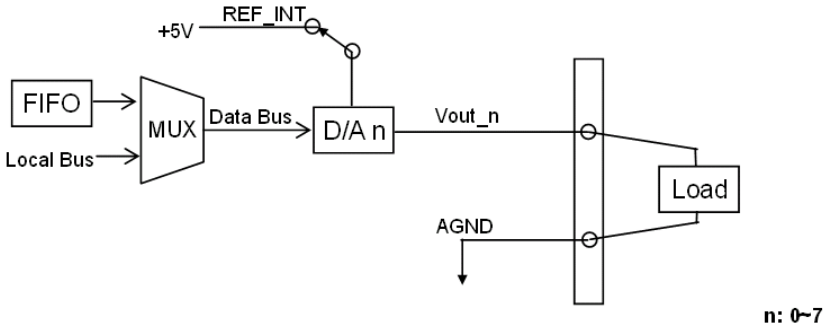


Figure 3.3: Voltage Mode Connections

Current Mode (Sink type):

Caution: The external voltage should be under 30 V

Ri: Internal resistor = 249 ohm

Vext: External voltage

Isink: The controlled current output (0~20 mA)

Since Isink = Vext / (Ri+RL), RL cannot be higher than | Vext/Imax | - Ri

For Example: Vext = 24 V, Imax = 20 mA

RL max = | 24 V / 20 mA | - 249 = 951 (ohm)

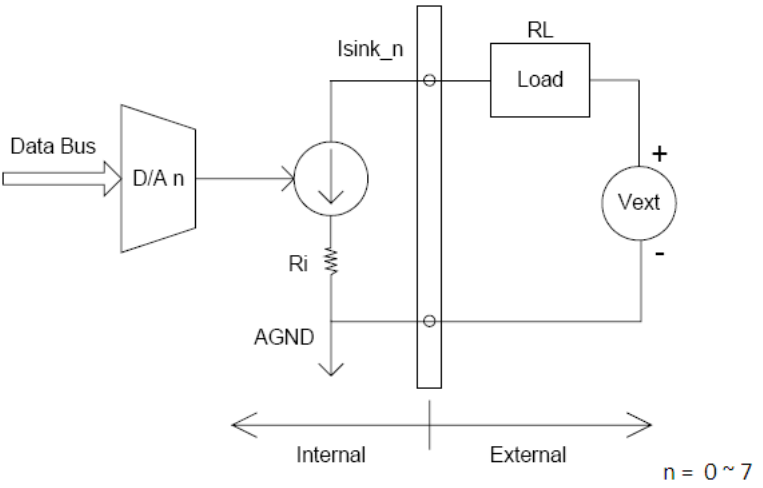


Figure 3.4: Current Mode Connection

3.4 Field Wiring Considerations

When you use the PCI-1723 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-1723.

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 a right 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

This appendix provides information on the specifications of PCI-1723.

Sections include:

- Analog Output
- Digital Input/Output
- General

Appendix A Specifications

A.1 Analog Output

Channels	8	
Resolution	16-bit	
Operation mode	Single output, Synchronized output	
Output Range (Internal Reference only)	-10 ~+10 V, 0 ~ 20 mA, 4 ~ 20 mA	
Driving Capability	5 mA	
Accuracy	Relative	±6 LSB
	Differential Non-linearity	±6 LSB (monotonic)
Offset	< 6 LSB	
Output Impedance	0.1 max.	
Throughput	PC dependent, Software update (direct AO)	
Settling time	50 us (to °”6 LSB of FSR)	

A.2 Digital Input /Output

Input Channels	16 (bi-directional)	
Number of ports	2	
Input Voltage	Low	0.8 V max.
	High	2.0 V min.
Output Voltage	Low	0.5 V max. @ +24 mA (sink)
	High	2.0 V min. @ -15 mA (source)

A.3 General

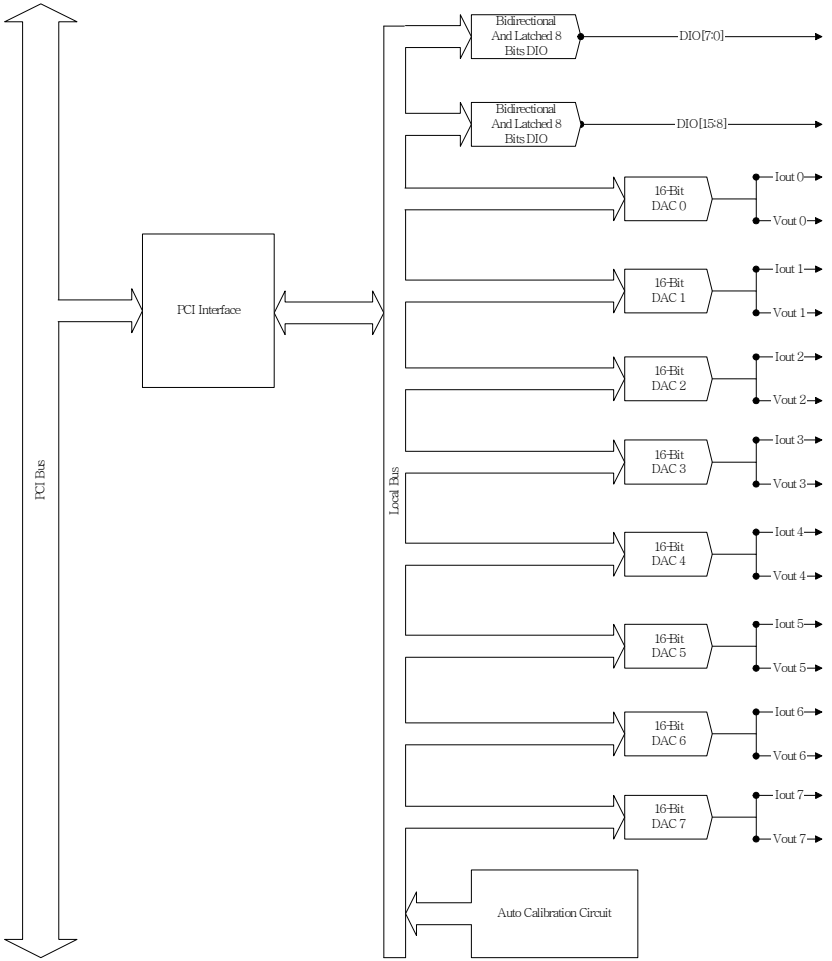
I/O Connector Type	68-pin SCSI-II female	
Dimensions	175 x 100 mm (6.9" x 3.9")	
Power Consumption	Typical	+5 V @ 850 mA, +12 V @ 600 mA
	Max.	+5 V @ 1 A, +12 V @ 700 mA
Temperature	Operation	0 ~ 60°C (32 ~158°F) (refer to IEC 68-2-1,2)
	Storage	-20~85°C (-4~185°F)
Relative Humidity	5~95% RH non-condensing (refer to IEC 68-2-3)	
Certifications	CE certified	

APPENDIX B

Block Diagram

This appendix shows the block diagram for PCI-1723.

Appendix B Block Diagram



APPENDIX C

Register Structure & Format

This chapter provides information on the system settings of UNO-2052.

Sections include:

- Board Connectors and Jumpers
- RS-232 Standard Serial Port
- CAN Serial Port
- Ethernet RJ-45 Connector
- Phoenix Power Connector (PWR)
- PS/2 Keyboard and Mouse Connector
- USB Connector
- VGA Display Connector
- CompactFlash Master/Slave Jumper Setting

Appendix C Register Structure & Format

C.1 Overview

The PCI-1723 is delivered with an easy-to-use 32-bit Device Drivers for user programming under the Windows 2000/95/98/NT/ME/XP operating system. We advise users to program the PCI-1723 using the 32-bit Device Drivers provided by Advantech to avoid the complexity of low-level registry programming.

The most important consideration in programming the PCI-1723 the 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.

C.2 I/O Port Address Map

The PCI-1723 requires 32 consecutive 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 C-1 shows the function of each register of the PCI-1723 or driver and its address relative to the card's base address.

Table C.1: PCI-1723 Register Format

Base Adr. +HEX		**PCI-1723 Register Format**															
		15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
00 H	W	D/A channel 0 output data															
		DA 15	DA 14	DA 13	DA 12	DA 11	DA 10	DA 9	DA 8	DA 7	DA 6	DA 5	DA 4	DA 3	DA 2	DA 1	DA 0
	R	D/A channel 0 latch data															
		DA 15	DA 14	DA 13	DA 12	DA 11	DA 10	DA 9	DA 8	DA 7	DA 6	DA 5	DA 4	DA 3	DA 2	DA 1	DA 0
02 H	W	D/A channel 1 output data															
		DA 15	DA 14	DA 13	DA 12	DA 11	DA 10	DA 9	DA 8	DA 7	DA 6	DA 5	DA 4	DA 3	DA 2	DA 1	DA 0
	R	D/A channel 1 latch data															
		DA 15	DA 14	DA 13	DA 12	DA 11	DA 10	DA 9	DA 8	DA 7	DA 6	DA 5	DA 4	DA 3	DA 2	DA 1	DA 0
04 H	W	D/A channel 2 output data															
		DA 15	DA 14	DA 13	DA 12	DA 11	DA 10	DA 9	DA 8	DA 7	DA 6	DA 5	DA 4	DA 3	DA 2	DA 1	DA 0
	R	D/A channel 2 latch data															
		DA 15	DA 14	DA 13	DA 12	DA 11	DA 10	DA 9	DA 8	DA 7	DA 6	DA 5	DA 4	DA 3	DA 2	DA 1	DA 0
06 H	W	D/A channel 3 output data															
		DA 15	DA 14	DA 13	DA 12	DA 11	DA 10	DA 9	DA 8	DA 7	DA 6	DA 5	DA 4	DA 3	DA 2	DA 1	DA 0
	R	D/A channel 3 latch data															
		DA 15	DA 14	DA 13	DA 12	DA 11	DA 10	DA 9	DA 8	DA 7	DA 6	DA 5	DA 4	DA 3	DA 2	DA 1	DA 0
08 H	W	D/A channel 4 output data															
		DA 15	DA 14	DA 13	DA 12	DA 11	DA 10	DA 9	DA 8	DA 7	DA 6	DA 5	DA 4	DA 3	DA 2	DA 1	DA 0
	R	D/A channel 4 latch data															
		DA 15	DA 14	DA 13	DA 12	DA 11	DA 10	DA 9	DA 8	DA 7	DA 6	DA 5	DA 4	DA 3	DA 2	DA 1	DA 0
0A H	W	D/A channel 5 output data															
		DA 15	DA 14	DA 13	DA 12	DA 11	DA 10	DA 9	DA 8	DA 7	DA 6	DA 5	DA 4	DA 3	DA 2	DA 1	DA 0
	R	D/A channel 5 latch data															
		DA 15	DA 14	DA 13	DA 12	DA 11	DA 10	DA 9	DA 8	DA 7	DA 6	DA 5	DA 4	DA 3	DA 2	DA 1	DA 0

Table C.1: PCI-1723 Register Format

0C H	W	D/A channel 6 output data														
		DA 15	DA 14	DA 13	DA 12	DA 11	DA 10	DA 9	DA 8	DA 7	DA 6	DA 5	DA 4	DA 3	DA 2	DA 1	DA 0
	R	D/A channel 6 latch data														
		DA 15	DA 14	DA 13	DA 12	DA 11	DA 10	DA 9	DA 8	DA 7	DA 6	DA 5	DA 4	DA 3	DA 2	DA 1	DA 0
0E H	W	D/A channel 7 output data														
		DA 15	DA 14	DA 13	DA 12	DA 11	DA 10	DA 9	DA 8	DA 7	DA 6	DA 5	DA 4	DA 3	DA 2	DA 1	DA 0
	R	D/A channel 7 latch data														
		DA 15	DA 14	DA 13	DA 12	DA 11	DA 10	DA 9	DA 8	DA 7	DA 6	DA 5	DA 4	DA 3	DA 2	DA 1	DA 0
10 H	W	N/A														
	R	Board ID														
		0	0	0	0	0	0	0	0	0	0	0	0	BD3	BD2	BD1	BD0
12 H	W	All D/A channels synchronized setting														
		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	SYNC
	R	All D/A channels synchronized status														
		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	SYNC
14 H	W	DAC range and calibration mode														
		X	X	X	X	X	X	X	SELF	X	X	R1	R0	$\overline{OG}$	CH2	CH1	CH0
	R	DAC range and calibration status														
		BUSY	INIT	X	X	X	X	X	SELF	IDX1	IDX0	R1	R0	$\overline{OG}$	CH2	CH1	CH0
16 H	W	SADC control command for calibration function														
		X	X	X	X	X	X	X	X	X	X	X	X	X	CS	DAT	CLK
	R	SADC control status for calibration function														
		X	X	X	X	X	X	X	X	X	X	X	X	X	CS	DAT	CLK

18H	W	Calibration parameter strobe															
		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	R	N/A															
1AH	W	Digital I/O port setting															
		X	X	X	X	X	X	X	X	X	X	X	X	X	X	HDIO	LDIO
	R	Digital I/O port mode															
		0	0	0	0	0	0	0	0	0	0	0	0	0	0	HDIO	LDIO
1CH	W	Write digital output command															
		D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0
	R	Read digital input data															
		D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0
1EH	W	Write calibration command															
		X	X	X	X	X	X	X	X	D7	D6	D5	D4	D3	D2	D1	D0
	R	Read calibration status															
		0	0	0	0	0	0	0	0	D7	D6	D5	D4	D3	D2	D1	D0

Table C-1 PCI-1723 register format (Part 3)

Base Address + HEX		PCI-1723 Register Format															
		15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
20 H	W	Synchronized strobe															
		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	R	N/A															
22 H	W	Reset all D/A channels strobe															
		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	R	N/A															
24 H	W	Reset the calibration controller strobe															
		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	R	N/A															
26 H	W	Change D/A channels output type strobe															
		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	R	N/A															
28 H	W	Select the calibration Ref_V															
		X	X	X	X	X	X	X	X	X	X	X	X	X	X	REF_A1	REF_A0
	R	N/A															

C.3 D/A ch output data — BASE+00H~0EH

Table C-2 Register for D/A Channels Output Data

Base Addr.		15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
00H	W	D/A channel 0 output data															
		DA15	DA14	DA13	DA12	DA11	DA10	DA9	DA8	DA7	DA6	DA5	DA4	DA3	DA2	DA1	DA0
02H	W	D/A channel 1 output data															
		DA15	DA14	DA13	DA12	DA11	DA10	DA9	DA8	DA7	DA6	DA5	DA4	DA3	DA2	DA1	DA0
04H	W	D/A channel 2 output data															
		DA15	DA14	DA13	DA12	DA11	DA10	DA9	DA8	DA7	DA6	DA5	DA4	DA3	DA2	DA1	DA0
06H	W	D/A channel 3 output data															
		DA15	DA14	DA13	DA12	DA11	DA10	DA9	DA8	DA7	DA6	DA5	DA4	DA3	DA2	DA1	DA0
08H	W	D/A channel 4 output data															
		DA15	DA14	DA13	DA12	DA11	DA10	DA9	DA8	DA7	DA6	DA5	DA4	DA3	DA2	DA1	DA0
0AH	W	D/A Channel 5 output data															
		DA15	DA14	DA13	DA12	DA11	DA10	DA9	DA8	DA7	DA6	DA5	DA4	DA3	DA2	DA1	DA0
0CH	W	D/A channel 6 output data															
		DA15	DA14	DA13	DA12	DA11	DA10	DA9	DA8	DA7	DA6	DA5	DA4	DA3	DA2	DA1	DA0
0EH	W	D/A channel 7 output data															
		DA15	DA14	DA13	DA12	DA11	DA10	DA9	DA8	DA7	DA6	DA5	DA4	DA3	DA2	DA1	DA0

DA15 ~ DA0 D/A channel output data

DA0 the least significant bit (LSB) of the D/A data

DA15 the most significant bit (MSB)

C.4 D/A ch latch data — BASE+00H~0EH

Table C-3 Register for D/A Channels Latch Data

Base Addr.		15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
00H	R	D/A channel 0 latch data															
		DA15	DA14	DA13	DA12	DA11	DA10	DA9	DA8	DA7	DA6	DA5	DA4	DA3	DA2	DA1	DA0
02H	R	D/A channel 1 latch data															
		DA15	DA14	DA13	DA12	DA11	DA10	DA9	DA8	DA7	DA6	DA5	DA4	DA3	DA2	DA1	DA0
04H	R	D/A channel 2 latch data															
		DA15	DA14	DA13	DA12	DA11	DA10	DA9	DA8	DA7	DA6	DA5	DA4	DA3	DA2	DA1	DA0
06H	R	D/A channel 3 latch data															
		DA15	DA14	DA13	DA12	DA11	DA10	DA9	DA8	DA7	DA6	DA5	DA4	DA3	DA2	DA1	DA0
08H	R	D/A channel 4 latch data															
		DA15	DA14	DA13	DA12	DA11	DA10	DA9	DA8	DA7	DA6	DA5	DA4	DA3	DA2	DA1	DA0
0AH	R	D/A channel 5 latch data															
		DA15	DA14	DA13	DA12	DA11	DA10	DA9	DA8	DA7	DA6	DA5	DA4	DA3	DA2	DA1	DA0
0CH	R	D/A channel 6 latch data															
		DA15	DA14	DA13	DA12	DA11	DA10	DA9	DA8	DA7	DA6	DA5	DA4	DA3	DA2	DA1	DA0
0EH	R	D/A channel 7 latch data															
		DA15	DA14	DA13	DA12	DA11	DA10	DA9	DA8	DA7	DA6	DA5	DA4	DA3	DA2	DA1	DA0

DA15 ~ DA0 D/A channel latch data

DA0 the least significant bit (LSB) of the D/A data

DA15 the most significant bit (MSB)

C.5 Board ID — BASE+10H

The PCI-1723 offers Board ID register BASE+10H. With correct Board ID settings, users can easily identify and access each card during hardware configuration and software programming.

Table C-4 Register for Board ID

Base Addr.		15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
10H	R	Board ID															
		0	0	0	0	0	0	0	0	0	0	0	0	BD3	BD2	BD1	BD0

BD3 ~ DB0 Board ID

BD0 LSB of the Board ID

BD3 MSB of the Board ID

BD3	BD2	BD1	BD0	Board ID
1	1	1	1	15
1	1	1	0	14
1	1	0	1	13
1	1	0	0	12
1	0	1	1	11
1	0	1	0	10
1	0	0	1	9
1	0	0	0	8
0	1	1	1	7
0	1	1	0	6
0	1	0	1	5
0	1	0	0	4
0	0	1	1	3
0	0	1	0	2
0	0	0	1	1
0	0	0	0	0

C.6 All D/A Ch Synchronized Settings — BASE+12H

The PCI-1723 provides an innovate function in which all D/A channels can output their data in synchronization.

Table C-5 Register for all D/A channels synchronized setting

Base Addr.		15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
12 H	W	All D/A channels synchronized setting															
		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	SYNC

SYNC D/A channels output synchronous

0 Disable (all D/A channels output directly)

1 Enable

Note:

Be sure to enable the synchronize function by writing the value to this register first. Next, write the specific data into BASE+00H ~ 0FH. Lastly, write any value to BASE+12H to synchronize all D/A channels.

On the other hand, it you did not enable the synchronize function by writing the value to this register first, all the specific data which was written to BASE+00H ~ 0FH will be output immediately!

C.7 All D/A Ch Synchronized Status — BASE+12H

Table C-6 Register for All D/A Channels Synchronized Status

Base Addr.		15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
12 H	R	All D/A channels synchronized status															
		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	SYNC

SYNC D/A channels output synchronous

0 Disable (all D/A channels output directly)

1 Enable

C.8 DAC Range & Calibration Mode — BASE+14H

Table C-7 Register for DAC Range and Calibration Mode

Base Addr.		15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
14 H	W	DAC range and calibration mode															
		X	X	X	X	X	X	X	SELF	X	X	R1	R0	O_G	CH2	CH1	CH0

CH2 ~ CH0 Select D/A channel

000	Channel 0
001	Channel 1
010	Channel 2
011	Channel 3
100	Channel 4
101	Channel 5
110	Channel 6
111	Channel 7
O_G	Calibrate gain or offset
0	Gain
1	Offset

R1 ~ R0 Select D/A range

00	± 10V
01	N/A
10	0 ~ 20 mA
11	4 ~ 20 mA
SELF	Select normal or self-system calibration
0	Normal calibration
1	Self-system offset calibration

Note: *Once you want to change the range of the specific channel, be sure to write the value to this register first. After that, write any value to BASE+26H to strobe the change.*

C.9 DAC Range & Calibration Status — BASE+14H

Table C-8 Register for DAC range and calibration status

Base Addr.		15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
14 H	R	DAC range and calibration status															
		BUSY	INIT	X	X	X	X	X	SELF	IDX1	IDX0	R1	R0	O_G	CH2	CH1	CH0

CH2 ~ CH0 Select D/A channel

000	Channel 0
001	Channel 1
010	Channel 2
011	Channel 3
100	Channel 4
101	Channel 5
110	Channel 6
111	Channel 7
O_G	Calibrate gain or offset
0	Gain
1	Offset

R1 ~ R0 Select D/A range

00	± 10V
01	N/A

10	0 ~ 20 mA
11	4 ~ 20 mA
SELF	Select normal or self-system calibration
0	Normal calibration
1	Self-system offset calibration
INIT	Initial the calibration controller
0	Idle
1	Processing
BUSY	Calibration controller busy flag
0	Idle
1	Busy
IDX1 ~ IDX0	Calibration procedure index
00	Read/Write calibration status
01	Write calibration parameter
10	Change D/A channels output type and reload the parameters
11	N/A

C.10 SADC Control Command for Calibration Function— BASE+16H

The PCI-1723 uses SADC (serial analog to digital converter) for the calibration function. Please refer to the Burr-Brown ADS7822 data sheet for the chipset detailed information (CD-ROM:\Documents\Component Specification\ ADS7822.PDF).

Table C-9 Register for SADC control command for calibration function

Base Addr.		15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
16 H	W	SADC control command for calibration function															
		X	X	X	X	X	X	X	X	X	X	X	X	X	CS	DAT	CLK

CS SADC chip select (active low)

DAT SADC serial data

CLK SADC clock

C.11 SADC Control Status for Calibration Function— BASE+16H

Table C-10 Register for SADC control for calibration function

Base Addr.		15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
16 H	R	SADC control status for calibration function															
		X	X	X	X	X	X	X	X	X	X	X	X	X	CS	DAT	CLK

CS SADC chip select (active low)

DAT SADC serial data

CLK SADC clock

C.12 Calibration Parameter Strobe — BASE+18H

Write any values to BASE+18H after finishing the calibration procedure to save all the D/A channels' parameters into the EEPROM.

Table C-11 Register for calibration parameter strobe

Base Addr.		15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
18 H	W	Calibration parameter strobe															
		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

Note: *If you want to calibrate the range of the specific channel, be sure to write the value to BASE+14H first. Next, write the data to BASE+1EH for calibration purposes. Lastly, write the value to this register to strobe the parameters into EEPROM.*

C.13 Digital I/O setting — BASE+1AH

Table C-12 Register for digital I/O port setting

Base Addr.		15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
1AH	W	Digital I/O port setting															
		X	X	X	X	X	X	X	X	X	X	X	X	X	X	HDIO	LDIO

LDIO	Setting the Low byte DIO port
0	Output
1	Input
HDIO	Setting the High byte DIO port
0	Output
1	Input

Note:

The port that is setup as output supports ‘read back’ function.

The port that setup as input supports ‘mask’ function.

Above registries must be accessed by one word at a time.

C.14 Digital I/O port mode — BASE+1AH

Table C-13 Register for digital I/O port modes

Base Addr.		15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
1AH	R	Digital I/O port mode															
		0	0	0	0	0	0	0	0	0	0	0	0	0	0	HDIO	LDIO

LDIO	Status of the Low byte DIO port
0	Output
1	Input
HDIO	Status of the High byte DIO port
0	Output
1	Input

C.15 Write Digital Output Command — BASE+1CH

Table C-14 Register for write digital output command

Base Addr.		15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
1CH	W	Write digital output command															
		D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0

D15 ~ D0 Digital output data

D0	LSB of the output data
D15	MSB of the output data

C.16 Read Digital Input Data — BASE+1CH

Table C-15 Register for Read Digital Input Data

Base Addr.		15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
1CH	R	Read digital input data															
		D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0

D15 ~ D0 Digital input data

D0 LSB of the input data

D15 MSB of the input data

C.17 Write Calibration Command — BASE+1EH

Table C-16 Register for write calibration command

Base Addr.		15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
1EH	W	Write calibration command															
		X	X	X	X	X	X	X	X	D7	D6	D5	D4	D3	D2	D1	D0

D7 ~ D0 Calibration result data

D0 the least significant bit (LSB) of the data

D7 the most significant bit (MSB)

Note: If you want to calibrate the range of the specific channel, be sure to write the value to BASE+14H first. Next, write the data to this register for calibration purposes. Lastly, write the value to BASE+18H to strobe the parameters into EEPROM.

C.18 Read calibration status — BASE+1EH

Table C-17 Register for read calibration status

Base Addr.		15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
1EH	R	Read calibration status															
		0	0	0	0	0	0	0	0	D7	D6	D5	D4	D3	D2	D1	D0

D7 ~ D0 Calibration result data

D0 the least significant bit (LSB) of the data

D7 the most significant bit (MSB)

C.19 Synchronized Strobe — BASE+20H

Write any values to BASE+20H to synchronize all D/A channels.

Table C-18 Register for synchronized strobe

Base Addr.		15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
20 H	W	Synchronized strobe															
		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

Note: *Be sure to enable the synchronize function by writing the value to BASE+12H first. Next, write the specific data into BASE+00H ~ 0FH. Lastly, write any value to this register to synchronize all D/A channels.*

On the other hand, it you did not enable the synchronize function by writing the value to BASE+12H first, all the specific data which was written to BASE+00H ~ 0FH will be output immediately!

C.20 Reset all D/A channels strobe — BASE+22H

Write any values to BASE+22H to reset all D/A channels.

Table C-19 Register for reset all D/A channels strobe

Base Addr.		15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
22 H	W	Reset all D/A channels strobe															
		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

C.21 Reset the calibration controller strobe — BASE+24H

Write any values to BASE+24H to reset the calibration controller.

Table C-20 Register for reset the calibration controller strobe

Base Addr.		15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
24 H	W	Reset the calibration controller strobe															
		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

C.22 Change D/A channels output type strobe — BASE+26H

Write any values to BASE+26H to change D/A channel output type.

Table C-21 Register for change D/A channels output type strobe

Base Addr.		15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
26 H	W	Change D/A channels output type strobe															
		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

Note: *Once you want to change the range of the specific channel, be sure to write the value to BASE+14H first. After that, write any value to this register to strobe the change.*

C.23 Select the calibration Ref_V — BASE+28H

Table C-22 Register for select the calibration Ref_V

Base Addr.		15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
28 H	W	Select the calibration Ref_V															
		X	X	X	X	X	X	X	X	X	X	X	X	X	X	REF_A1	REF_A0

REF_A1 ~ REF_A0 Ref_V (reference voltage) index

00 -10 V

01 0 V

10 N/A

11 +10 V

C.24 Summary

Calibrate the range of the specific channel

Step 1: BASE+14H

Step 2: BASE+1EH

Step 3: BASE+18H

Change the range of the specific channel

Step 1: BASE+14H

Step 2: BASE+26H

Synchronized output channel

Step 1: BASE+12H

Step 2: BASE+00H ~ 0FH

Step 3: BASE+20H