PCL-727

12-ch Analog Output ISA Card with 32-ch DI/O

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 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.
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.

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.

FCC Class A

Note: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

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

Safety Instructions

1. Read these safety instructions carefully.
2. Keep this User's Manual for later reference.
3. Disconnect this equipment from any AC outlet before cleaning. Use a damp cloth. Do not use liquid detergents for cleaning.
4. For plug-in equipment, the power outlet socket must be located near the equipment and must be easily accessible.
5. Keep this equipment away from humidity.
6. Put this equipment on a reliable surface during installation. Dropping it or letting it fall may cause damage.
7. The openings on the enclosure are for air convection. Protect the equipment from overheating. DO NOT COVER THE OPENINGS.
8. Make sure the voltage of the power source is correct before connecting the equipment to the power outlet.
9. Position the power cord so that people cannot step on it. Do not place anything over the power cord.
10. All cautions and warnings on the equipment should be noted.
11. If the equipment is not used for a long time, disconnect it from the power source to avoid damage by transient overvoltage.
12. Never pour any liquid into an opening. This may cause fire or electrical shock.
13. Never open the equipment. For safety reasons, the equipment should be opened only by qualified service personnel.
14. If one of the following situations arises, get the equipment checked by service personnel:

a. The power cord or plug is damaged.

b. Liquid has penetrated into the equipment.

c. The equipment has been exposed to moisture.

d. The equipment does not work well, or you cannot get it to work according to the user's manual.

e. The equipment has been dropped and damaged.

f. The equipment has obvious signs of breakage.

15. DO NOT LEAVE THIS EQUIPMENT IN AN ENVIRONMENT WHERE THE STORAGE TEMPERATURE MAY GO BELOW -20° C (-4° F) OR ABOVE 60° C (140° F). THIS COULD DAM-

AGE THE EQUIPMENT. THE EQUIPMENT SHOULD BE IN A CONTROLLED ENVIRONMENT.

16. CAUTION: DANGER OF EXPLOSION IF BATTERY IS INCORRECTLY REPLACED. REPLACE ONLY WITH THE SAME OR EQUIVALENT TYPE RECOMMENDED BY THE MANUFACTURER, DISCARD USED BATTERIES ACCORDING TO THE MANUFACTURER'S INSTRUCTIONS.

The sound pressure level at the operator's position according to IEC 704-1:1982 is no more than 70 dB (A).

DISCLAIMER: This set of instructions is given according to IEC 704-1. Advantech disclaims all responsibility for the accuracy of any statements contained herein.

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.

Contents

CHAPTER 1

Introduction

This chapter contains information on the PCL-727 and instruction on card configuration in order to match your application and prepare it for installation on your system.

Sections include:

- Features
- Specifications
- Applications
- Installation Guide
- Software Overview

Chapter 1 Introduction

The PCL-727 provides 12 analog output channels on a single PC-BUS add-on card. Each channel can be set individually to any of the following ranges: 0 to 5V, 0 to 10V, +/-5V and 4 to 20mA current output. Designed for rugged environment, the PCL-727 is an ideal and economical solution for industrial application requiring multiple analog voltage and/or current output channels.

In addition to the analog output, PCL-727 also provides 16 channels of digital output and 16 channels of input. The D/I and D/O ports are TTL compatible and designed to be fully compatible with the available daughter boards those offer convenient solution to industrial ON/OFF control and sensing application. These daughter boards include PCLD-782 Isolated D/I Board, PCLD-785 Relay Output Board and PCLD-786 SSR & Relay Driver Board.

1.1 Features

- 12 D/A output channels.
- 12 bit resolution, double buffered D/A converters.
- Multiple voltage ranges: +/- 5V, 0 to 10V, 0 to 5V and 4 to 20 mA current loop (sink).
- All D/A outputs will be at 0 volt initial state after RESET or POWER-ON at either bipolar or unipolar mode.
- 16 digital input and 16 digital output channels. They are all TTL compatible.
- D/I and D/O ports are fully compatible with the valid PC-LabCard daughter boards:
  - PCLD-782B 24-channel opto-isolated D/I board.
  - PCLD-785B 24-channel relay output board.
  - PCLD-786 8 channel SSR output & 8 channel relay driver board.
- Furnished utility software disk contains
  - Calibration program.
  - Demonstration program.
  - Program examples.
- Screw terminal board (PCLD-880) available for D/A output signal wiring.

1.2 Specifications

1.2.1 Analog Output

Channels: 12 channels

Resolution: 12 Bits. Double buffered

Output range: 0 to +5V (unipolar)

0 to +10V (unipolar)

+/- 5V (bipolar)

4 to 20mA current loop (sink)

Reference voltage:

Internal: +5V (+/- 0.05V)

Conversion type: 12 bit monolithic multiplying

Analog devices: AD5582

Linearity: +/- 3 LSB

Temperature draft: 0.5 PPM/deg C full scale range

Settling time: 70 us max.

Current loop: 4 to 20 mA constant current sink

Voltage output drive: +/- 5mA max. (for +/- 12V PC supply)
+/- 3mA max. (for +/- 15V embedded supply)

Current loop excitation voltage: Minimum +8V, maximum 36V for 4 to 20mA current loop

Reset (power-on status): All D/A channels will be at 0 volt output after reset or power-on, either bipolar or unipolar mode

1.2.2 Digital Input

Channel: 16 bits

Level: TTL compatible

Input low: 0.8V max.

Input high: 2.0V min.

Input load: 0.4mA max. at 0.5V (low)
0.05mA max. at 2.7V (high)

1.2.3 Digital Output

Channel: 16 bits

Level: TTL compatible

Output low: 0.5V max. when sink 8mA

Output high: 2.4V min. when source 0.4mA

1.2.4 General Specifications

Power consumption: +5V: 500mA typ., 1A max.

+12V: 50mA typ., 110mA max.

-12V: 14mA typ., 90mA max.

I/O connector: 20-pin post header for Digital I/O ports

37-pin D-type connector for D/A output port

I/O base address: Requires 16 consecutive address locations. Base address definable by the DIP switches for address line A8 - A5 (Factory setting is hex 2C0).

Operating Temp.: 0 to +50°C (0 to +122°F)

Storage Temp.: -20 to +65°C (-4 to +149°F)

Weight: 220 gms

1.3 Applications

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

1.4 Installation Guide

Before you install your PCL-727 card, please make sure you have the following necessary components:

- PCL-727 DA&C card
- PCL-727 User Manual
- Driver software Advantech DLL drivers (in the companion CD-ROM)
- PC or workstation with a ISA-bus slot

Some other optional components are also available for enhanced operation: ActiveDAQ, ActiveDAQ Pro, LabView or other 3rd-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 gives users an overview of the software and hardware installation procedure:

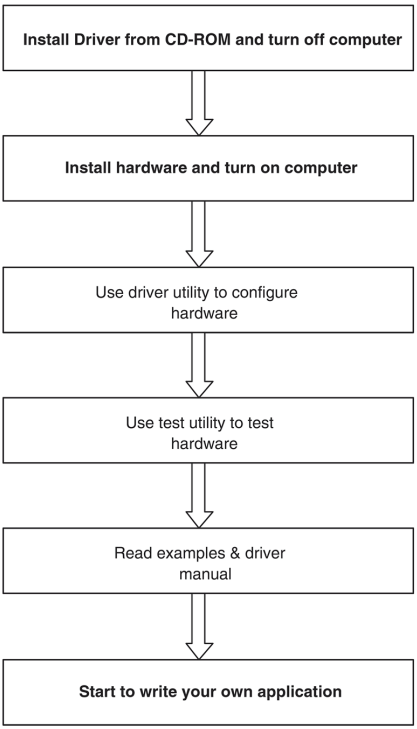


Figure 1.1: Installation Flow Chart

1.5 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 PCL-727 card:

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

Programming Choices for DA&C Cards

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

Device Drivers

Advantech Device Driver software is included on the companion CD-ROM at no extra charge. It also comes with all Advantech DA&C cards. Advantech's Device Drivers features a complete I/O function library to help boost your application performance. Advantech Device Drivers for Win 2000/XP works seamlessly with development tools such as Visual C++, Visual Basic, Borland C++ Builder and Borland 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. But since register-level programming requires much effort and time, it is strongly recommend to use the Advantech Device Drivers instead.

CHAPTER 2

Installation

This chapter contains a package item checklist, proper instructions for unpacking and step-by-step procedures for card installation.

Sections include:

- Unpacking
- Driver Installation
- Hardware Installation
- Device Configuration

Chapter 2 Installation

2.1 Unpacking

After receiving your PCL-727 package, please inspect its contents first. The package should contain the following items:

- PCL-727 card
- Companion CD-ROM (Device Drivers included)
- User Manual

The PCL-727 cards harbor 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 during 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 I you have to remove the card from a PC or transport it elsewhere.

2.2 Driver Installation

We recommend you install the driver before you plug the PCL-727 into your system, since this will guarantee a smooth installation process.

The Advantech Device Drivers Setup program for the PCL-727 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:

1. Insert the companion CD-ROM into your CD-ROM drive.
2. The Setup program will be launched automatically if you have the autoplay function enabled on your system. When the Setup Program is launched, the Setup Screen will appear.

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

Figure 2.1: Advantech Automation Software Setup

3. First, install the Advantech Device Manager.
4. Select the "**Individual Drivers**" to install the specific device driver then just follow the installation instructions step by step to complete your device driver installation and setup.

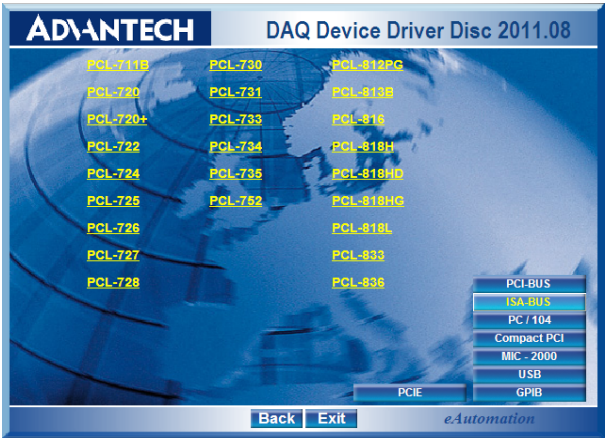


Figure 2.2: Different Options for Driver Setup

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

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

2.3 Hardware Installation

Note: Make sure you have installed the driver and Advantech Device Manager before you install the card (please refer to chapter 2.2 Driver Installation)

After the Device Drivers installation is completed you can install the PCL-727 card into any ISA slot on your computer. 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. However, it is suggested that you refer to the computer's user manual or related documentation if you have any doubts. Please follow the steps below to install the card.

1. Turn off your computer and unplug the power cord and cables.
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 PCL-727 card into a ISA slot. Hold the card only by its edges and carefully align it with the slot. Insert the card firmly into place.
6. Fasten the bracket of the ISA card on the back panel rail of the computer with screws.
7. Connect appropriate accessories (20-pin flat cable and DB 37-pin cable wiring terminals, etc. if necessary) to the ISA 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.

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.

CHAPTER 3

Signal Connections

This chapter provides useful information about how to connect input and output signals to the PCL-727 via the I/O connector.

Sections include:

- Overview
- Switch & Jumper Settings
- Signal Connections

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 on how to connect input and output signals to the PCL-727 via the I/O connector.

3.2 Switch & Jumper Settings

The PCL-727 card has two function jumper settings.

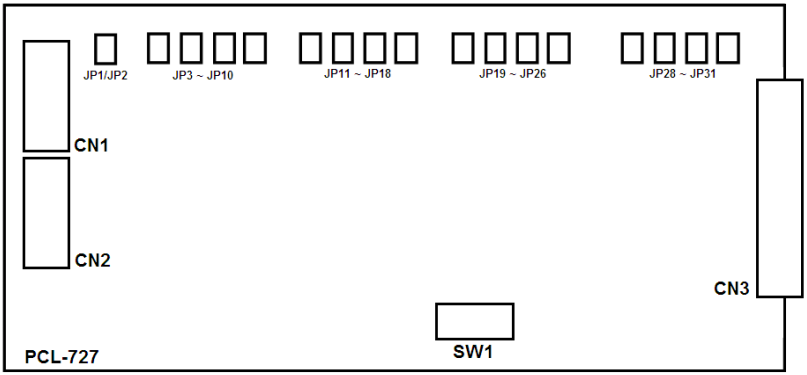


Figure 3.1: Card Connectors, Jumpers & Switches

Location	Description
CN1	IDC-20 pin connector for digital output channels
CN2	IDC-20 pin connector for digital output channels
CN3	DB 37-pin connector for analog output channels
JP1~JP2	Output power supply selection
JP3~JP26	Output range selection
JP28~JP31	Voltage/Current output mode selection (Only for D/A CH8 ~ CH11)

3.2.1 Base Address Selection

Switch name: SW1 position 1 to 4

Most PC peripheral devices and interface cards are controlled through the input/output (I/O) ports. These ports are addressed using the I/O port address space. Check the PC I/O port address in Device Manager and locate the appropriate addresses for different devices.

The I/O port base address for the PCL-727 is selectable via an 4 position DIP switch. The PCL-727 requires 16 consecutive address locations in the I/O space. Valid addresses are from hex 200 to hex 3F0, however you might have used some of these addresses for other devices. Your PCL-727 base address switch setting is set to hex 2C0 in the factory. If you need to adjust it to some other address range, the switch settings for various base addresses are illustrated as below:

Table 3.1: Switch Position Summary

I/O Address Range (Hex)	Switch Position				
		1	2	3	4
	A9	A8	A7	A6	A5
----------(Fixed)----------					
200-20F	1	0	0	0	0
210-21F	1	0	0	0	0
220-22F	1	0	0	0	0
.....					
2C0-2CF*	1	0	1	1	0
.....					
300-30F	1	1	0	0	0
.....					
3F0-3FF	1	1	1	1	1

Note: *- ON=0, OFF=1*

- A5...A9 corresponds to PC bus address lines

*- * means factory setting*

3.2.2 Output Range and Mode Selection

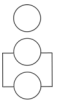
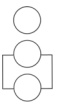
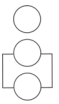
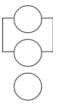
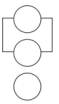
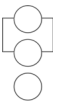
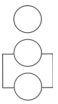
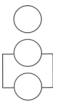
Jumper name: JP3 to JP26, JP28 to JP31

There are two jumpers for each D/A conversion channel to select unipolar, bipolar and current output ranges. The jumpers used for each of the 12 channels, along with typical jumper settings, are shown below.

Table 3.2: Channel Jumper Settings

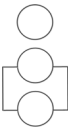
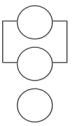
CH.	JP-n	JP-m
0	JP3	JP4
1	JP5	JP6
2	JP7	JP8
3	JP9	JP10
4	JP11	JP12
5	JP13	JP14
6	JP15	JP16
7	JP17	JP18
8	JP19	JP20
9	JP21	JP22
10	JP23	JP24
11	JP25	JP26

Table 3.3: Summary of Jumper Settings

Output Range	JP-n	JP-m
0 to +5V Unipolar		
0 to +10V Unipolar		
-5V to +5V Bipolar		
4 to 20mA Current Sink		

Note: Channels 0 to 7 employ separate D/A output connector pins for voltage and current outputs (see connector pin assignment diagram for D/A connector CN3). Channels 8 to 11 use the same connector pins for both voltage and current outputs. For these channels, voltage/current output must be selected with jumpers JP28 to JP31. Settings for these jumpers are shown below.

Table 3.4: Summary of Jumper Settings

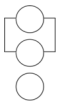
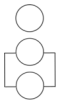
	JP28 ~ JP 31 (CH8 ~ CH11)
Voltage	
Current	

3.2.3 Output Power Supply Selection

Jumper name: JP1 to JP2

D/A outputs may be driven from either the PC +/-12V power supply, or from the embedded +/-15V supply. When the PC's +/-12V supply has an already heavy load, t may not be capable of supplying the full 10V output on the 0 to 10V range. In this case, you should utilize the embedded +/-15V supply. Factory default is for the +/-12V PC supply. Jumper settings are shown below.

Table 3.5: Summary of Jumper Settings

	JP1	JP2
+/-12V PC Supply		
* +/- 15V Embedded Supply		

Note: When the +/-15V embedded supply is used, output drive capability is +/-3mA/.

3.3 Signal Connections

The PCL-727 is equipped with a 37-pin D-type connector, accessible from the rear plate, and two on-board 20-pin insulation displacement connectors. All connectors accommodate the same type of flat cable.

The following diagrams illustrate the pin assignment of each connector.

Connector 1 (CN1) - Digital Output

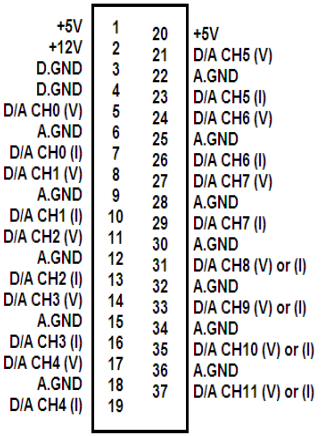
D/O 0	1	2	D/O 1
D/O 2	3	4	D/O 3
D/O 4	5	6	D/O 5
D/O 6	7	8	DI/O 7
D/O 8	9	10	D/O 9
D/O 10	11	12	D/O 11
D/O 12	13	14	D/O 13
D/O 14	15	16	D/O 15
D.GND	17	18	D.GND
+5V	19	20	+12V

Connector 2 (CN2) - Digital Input

D/I 0	1	2	D/I 1
D/I 2	3	4	D/I 3
D/I 4	5	6	D/I 5
D/I 6	7	8	D/I 7
D/I 8	9	10	D/I 9
D/I 10	11	12	D/I 11
D/I 12	13	14	D/I 13
D/I 14	15	16	D/I 15
D.GND	17	18	D.GND
+5V	19	20	+12V

Legend

V OUT	Analog voltage output
I OUT	Analog current output
REF OUT	Reference voltage output
REF IN	Voltage reference input
D/O	Digital output
D/I	Digital input
D.GND	Digital and power supply ground
A.GND	Analog ground
NC	No connection

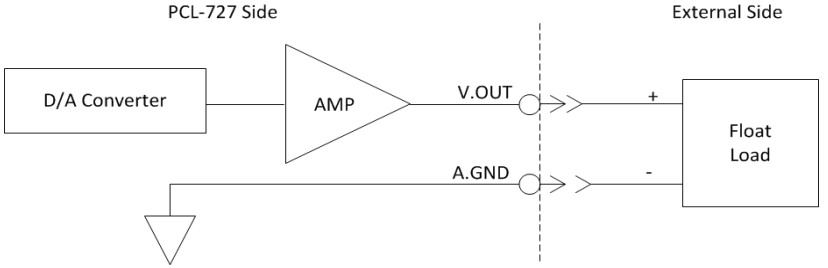


Voltage Output Connections

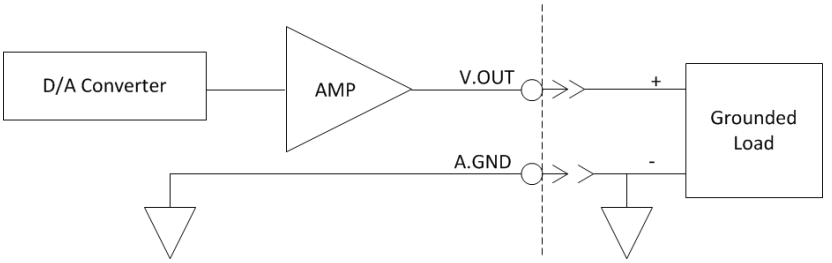
Voltage Connections

The PCL-727 supports 12 channels of D/A voltage output. There is only one output signal wire for each channel. The voltage is referred to the common ground. It is fairly simple to connect a voltage output channel to a floating load.

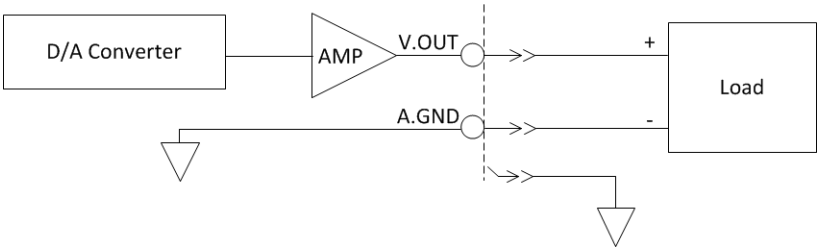
A standard wiring diagram is illustrated below:



For grounded load, the signal should be connected as:

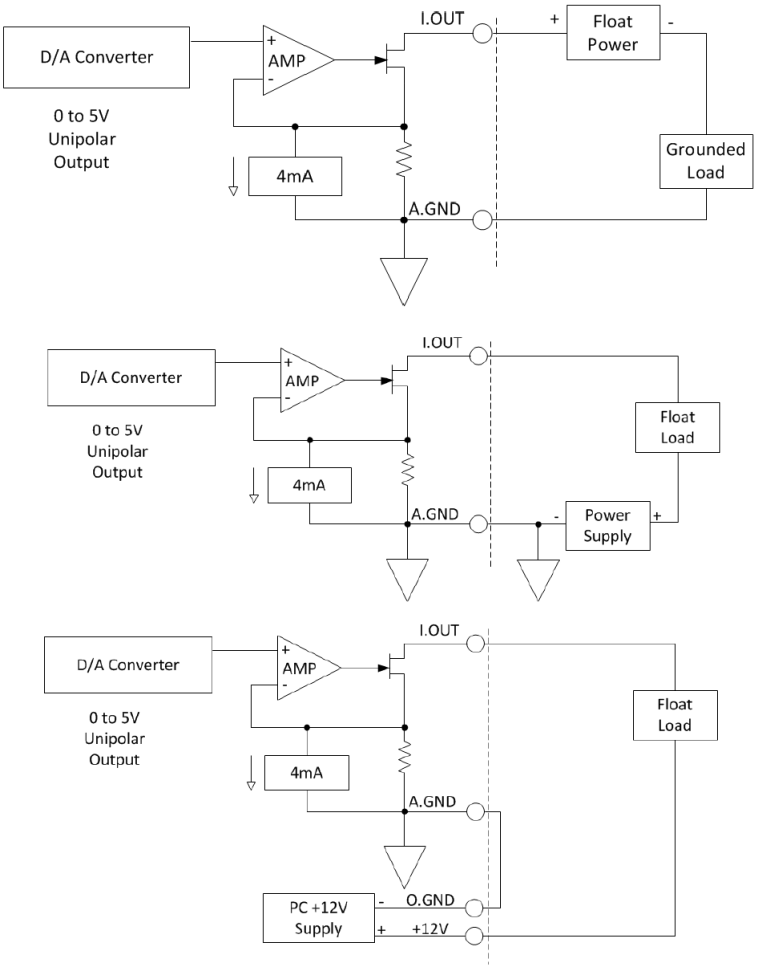


For some differential input loads, an external ground wire is needed and the signal connection is recommended as following:



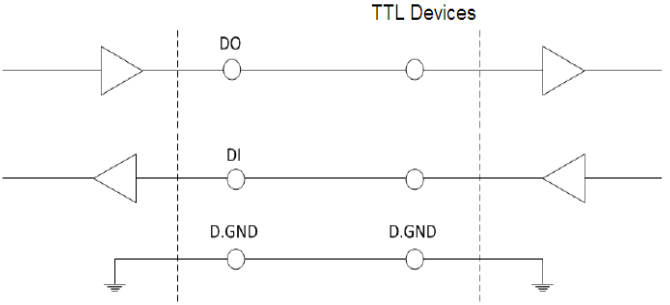
4 to 20 mA Current Output Connections

The PCL-727 provides 12 channels of 4 to 20mA current output. The current loop output utilizes the 0 to 5V(unipolar) voltage output as the driving source and a current drive circuit consists of a power FET, reverse protection diode and a constant current source. The voltage bias of this current output should be within 8 to 36 volts to insure correct operation. A 24 volt power supply is ideal for this application. The PCL-727 also provides internal 12 volt power source for current loop by user's selection. As shown below there are three ways of connecting: grounded load with a floating supply, floating load with a grounded power supply and floating load with internal 12 volt supply:

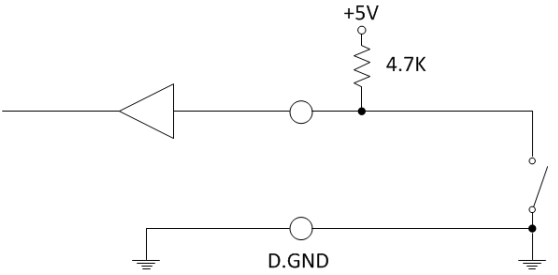


Digital Signal Connection

The PCL-727 has 16 digital input and 16 digital output channels. The digital I/O levels are TTL compatible. To transmit or receive digital signal to/from other TTL devices, the connection is:



To receive an OPEN/SHORT signal from a switch or relay, a pull up resistor must be added to ensure the high level when open.



APPENDIX A

Register Format

Appendix A Register Format

Introduction

The PCL-727 requires 16 consecutive addresses in I/O space. The most important issue in programming the PCL-727 is understanding the meaning of the 16 registers addressable from the selected I/O port base address. A summary map of the functions of each address and the data format of each register are given in the following sections.

I/O Port Address Map

- The following table provides the location of each register and driver relative to the base address, and its usage.

Address	R/W	Usage
BASE +0	W	D/A oh #0 high byte data (bit 0-3)
BASE +1	W	D/A oh #0 low byte data
BASE +2	W	D/A oh #1 high byte data (bit 0-3)
BASE +3	W	D/A oh #1 low byte data
BASE +4	W	D/A oh #2 high byte data (bit 0-3)
BASE +5	W	D/A oh #2 low byte data
BASE +6	W	D/A oh #3 high byte data (bit 0-3)
BASE +7	W	D/A oh #3 low byte data
BASE +8	W	D/A oh #4 high byte data (bit 0-3)
BASE +9	W	D/A oh #4 low byte data
BASE +10	W	D/A oh #5 high byte data (bit 0-3)
BASE +11	W	D/A oh #5 low byte data
BASE +12	W	D/A oh #6 high byte data (bit 0-3)
BASE +13	W	D/A oh #6 low byte data
BASE +14	W	D/A oh #7 high byte data (bit 0-3)
BASE +15	W	D/A oh #7 low byte data
BASE +16	W	D/A oh #8 high byte data (bit 0-3)
BASE +17	W	D/A oh #8 low byte data
BASE +18	W	D/A oh #9 high byte data (bit 0-3)
BASE +19	W	D/A oh #9low byte data
BASE +20	W	D/A oh #10 high byte data (bit 0-3)
BASE +21	W	D/A oh #10 low byte data
BASE +22	W	D/A oh #11 high byte data (bit 0-3)
BASE +23	W	D/A oh #11 low byte data
BASE +24	W	D/O oh 8-15
BASE +25	W	D/O oh 0-7
BASE +0	R	D/I oh 8-15
BASE +1	R	D/I oh 0-7

Legend

D/A -	Analog output
D/O -	Digital output
D/I -	Digital input
D/I -	Digital input
R -	Read operation on that byte
W -	Write operation on that byte

D/A Output Registers

The D/A output registers are write registers using address BASE +0 to Base +25.

BASE +0 (2,4,6,8,10,12,14,16,18,20,22)	D7	D6	D5	D4	D3	D2	D1	D0
D/A # 0 (1,2,3,4,5,6,7,8,9,10,11) High byte	X	X	X	X	DA11	DA10	DA9	DA8
BASE +1 (3,5,7,9,11,13,15,17,19,21,23)	D7	D6	D5	D4	D3	D2	D1	D0
D/A #0 (1,2,3,4,5,6,7,8,9,10,11) Low byte	DA7	DA6	DA5	DA4	DA3	DA2	DA1	DA0

Legend:

DA11 to DAO - Digital to analog data. DA0 is the least significant byte (LSB) and DA11 is the most significant byte (MSB) of the D/A data.

X - Don't care

The D/A circuit utilizes a double buffer technique to eliminate the transient stage between the writing operations of high byte and low byte data. The high byte data (only the lower 4 bits are significant) must be written first and it is then latched into a latch for temporary storage and does not change the analog output. While the low byte is being sent, the high byte data reaches the D/A converter at the same time as the low byte data.

NOTE: THE HIGH BYTE DATA MUST BE SENT FIRST

Digital I/O Registers

The PCL-727 offers 16 digital input channels and 16 digital output channels. The digital input channels use the I/O address BASE +0 and BASE +1. The digital output channels use the I/O address BASE +24 and BASE +25. The data format of each port is as following:

BASE +24	D7	D6	D5	D4	D3	D2	D1	D0
D/O high byte	DO15	DO14	DO13	DO12	DO11	DO10	DO9	DO8
BASE +25	D7	D6	D5	D4	D3	D2	D1	D0
D/O low byte	DO7	DO6	DO5	DO4	DO3	DO2	DO1	DO0
BASE +0	D7	D6	D5	D4	D3	D2	D1	D0
D/I high byte	DI15	DI14	DI13	DI12	DI11	DI10	DI9	DI8
BASE +1	D7	D6	D5	D4	D3	D2	D1	D0
D/I low byte	DI7	DI6	DI5	DI4	DI3	DI2	DI1	DI0

Legend:

DO15 to DO0 - Digital output data. DO7 to DO0 is the low byte data and DO15 to DO7 is the high byte data (MSB) of the digital output port.

DI15 to DI0 - Digital input data. DI7 to DI0 is the low byte data and DI15 to DI7 is the high byte data (MSB) of the digital input port.

Application

D/A Applications

The PCL-727 provides 12 D/A channels which use double buffered 12 bit multiplying D/A converters. The D/A registers are write registers using address BASE +O to BASE +23.

When programming the D/A channels, please note that the most significant byte (high byte data) should be sent first. It is then temporarily held by a register in the D/A and not released to the D/A converter. After the least significant byte (low byte data) is written, the low byte and high byte are added and passed to the D/A converter at the same time. This double buffering process protects the D/A data integrity through a single step update.

The PCL-727 provides an internal precision fixed +5V reference. This voltage is used as D/A input reference.

Connector CN3 supports all signal connections. The pin assignment of this connector is describe in Section 3.3.

The PCL-727 D/A functions can be controlled by writing I/O instructions directly to the register. A commonly used D/A application is clearly illustrated in the demonstration program DEMO01.C provides complete pro-

gramming examples of both single and multiple D/A channel applications.

The following steps illustrate how to program D/A channels 0 to generate a voltage.

1. Output high byte data to port BASE + 0

2. Output low byte data to port BASE + 1

3. D/A channel 0 will output the set voltage

Digital Input and Output

The PCL-727 provides 16 digital input channels and 16 digital output channels. It is fairly straight forward to program the digital input and output channels. Attention should be paid to the pin assignments of connectors CN1 (digital output) and CN2 (digital input).

A reading operation on any of the D/I ports will read in the value of the 8 corresponding digital input channels. To access the D/I ports in C, use the following statement:

VALUE = INPORTB (ADDRESS)

Where ADDRESS is BASE+0 (high byte) or BASE+1 (low byte).

A writing operation to any of the D/O ports will set the desired value of the 8 corresponding digital output channels. To access the D/O ports in C, use the statement shown below:

OUTPORTB (ADDRESS, DATA)

Where ADDRESS is BASE+24 (high byte) or BASE+25 (low byte).

APPENDIX B

Calibration

Appendix B Calibration

In the application of data acquisition and control, it is important to constantly calibrate your measurement device to maintain its accuracy. A calibration program, CALB.EXE, is provided on the PCL-727 software diskette to assist your calibration work.

B.1 VR Assignment

There are 13 variable resistors (VR) on the PCL-727 to allow you making accurate adjustment on D/A channels. The location of each VR is indicated in Section 3.2, Switch and VR Locations. The functions of the VR's are listed below:

VR5 CH0 current offset adjustment (4mA)

VR6 CH1 current offset adjustment (4mA)

VR7 CH2 current offset adjustment (4mA)

VR8 CH3 current offset adjustment (4mA)

VR9 CH4 current offset adjustment (4mA)

VR10 CH5 current offset adjustment (4mA)

VR11 CH6 current offset adjustment (4mA)

VR12 CH7 current offset adjustment (4mA)

VR13 CH8 current offset adjustment (4mA)

VR14 CH9 current offset adjustment (4mA)

VR15 CH10 current offset adjustment (4mA)

VR16 CH11 current offset adjustment (4mA)

VR17 D/A bipolar offset adjustment

B.2 D/A Calibration

A calibration program, CALB.EXE, is provides on the PCL-727 utility disk. The default I/O port address in the program is 2C0. If address 2C0 is already occupied by another device, either replace that device with the PCL-727 or modify the address setting in the CALB.EXE.

Once the calibration program has been loaded and executed, it used the graphic display and prompts to guide you through the calibration process.

In addition to the calibration program, it is necessary to have a 5 1/2 digit multimeter to perform the calibration. A slot extension card will make your access to the VR's easier. The PC-LabCARD product PCL-755A (Slot Extension Card) is an ideal product to support the slot extension.

A standard procedure to calibrate the PCL-727 card is illustrated below:

Step 1: To calibrate the CL-727, the measurement point is TP1. Adjust VR17 for 5V at this point.

Step 2: To adjust the D/A precision 4 mA constant current source, adjust the appropriate VR (VR5 to VR16).

Note: The voltage output GAIN of bipolar mode depends on the GAIN of unipolar mode, so it is not necessary to be adjusted. The current gain depends on a precise fixed resistor and does not need adjustment.