

User Manual

# PCIE-1824/1824L

16-bit, 32/16-ch Analog Output  
PCI Express Card

**ADVANTECH**

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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

1. Visit the Advantech web site at <http://support.advantech.com.tw/> where you can find the latest information about the product.
2. Contact your distributor, sales representative, or Advantech's customer service center for technical support if you need additional assistance. 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, Contact your dealer immediately.

- PCIE-1824 card
- Startup or User Manual

## 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.



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# Chapter 1

## Introduction

This chapter introduces PCIe-1824 and its typical applications. Sections include:

- Features
- Applications
- Installation Guide
- Software Overview
- Roadmap
- Accessories

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PCIE-1824 is a high-density multiple channel analog card for the PCIE bus, where each analog output channel is equipped with a 16-bit DAC. It features optional voltages, current output and a Board ID switch. PCIE-1824 is an ideal solution for industrial applications where multiple analog output channels are required.

## 1.1 Features

- 32 high-density analog output channels
- Flexible Output Range:  $\pm 10$  V, 0 ~ 20 mA and 4 ~ 20 mA
- Synchronized output function
- Keep output values when hot system reset
- High ESD protection (2,000 V<sub>DC</sub>)
- Board ID switch

PCIE-1824 offers the following main features:

### Keeps Output Values After System Reset

Users can independently set the 32 outputs to different ranges:  $\pm 10$  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 PCIE-1824 can either retain the last analog output values, or return to its default configuration, depending on the jumper setting. This practical function eliminates dangers caused by improper operation during unexpected system resets.

### BoardID Switch

The PCIE-1824 has a built-in DIP switch that helps define each card's ID when multiple PCIE-1824 cards have been installed on the same PC chassis. The BoardID setting function is very useful when building a system with multiple PCIE-1824 cards. With the correct BoardID settings, you can easily identify and access each card during hardware configuration and software programming.

**Note!** For detailed specifications and operations of PCIE-1824, please refer to Appendices A.



## 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 PCIE-1824 card, please make sure you have the following necessary components:

- PCIE-1824 card
- PCIE-1824 User Manual
- Driver software Advantech DAQNav software (available for download from the Advantech website)

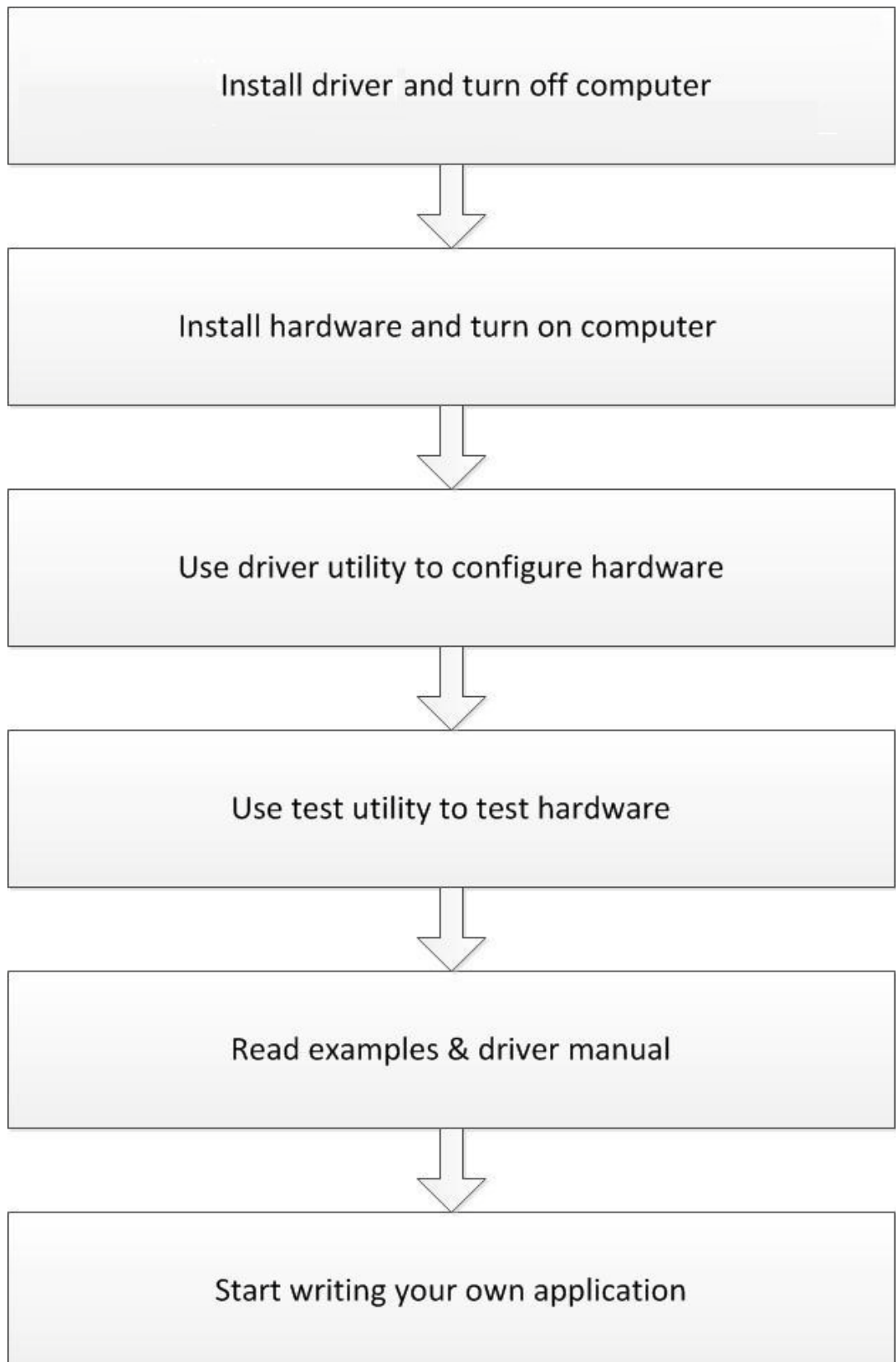


- Personal computer or workstation with a PCI Express interface (running Windows 10, 8 and 7)
- Shielded Cable PCL-10162 (optional)
- Wiring Board ADAM-3962 (optional)

Other optional components are also available for enhanced operation:

- DAQ Navi, LabView or other 3rd-party software

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 you 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 PCIE-1824 card:

- Device Drivers
- Advantech DAQNav

### DAQNav Software

Advantech's DAQNav software includes device drivers and a software development kit (SDK), which features a comprehensive I/O function library to boost application performance. This software can be downloaded from the Advantech website (at [www.advantech.com](http://www.advantech.com)). The Advantech DAQNav software for Windows XP/7/8/10 (desktop mode) works seamlessly with most major development tools, including Visual Studio.NET, Visual C++, Visual Basic, and Borland Delphi.

## 1.5 DAQNav Device Driver Programming Roadmap

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

### Programming Tools

Programmers can develop application programs with their favorite development tools:

- Visual Studio.NET
- Visual C++ and Visual Basic
- Delphi
- C++ Builder

For instructions on how to begin programming work in each development tool, Advantech offers a Tutorial Chapter in the *DAQNav SDK Manual* for your reference. Please refer to the corresponding sections in this chapter on the *DAQNav SDK Manual* to begin your programming efforts. You can also look at the example source code provided for each programming tool; examples can help jump-start a project.

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

***Start/Programs/Advantech Automation/DAQNav/DAQNav Manuals/DAQNav SDK Manual***

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

***Advantech\DAQNav\Examples***

For information about using other function groups or other development tools, please refer to the Using DAQNav SDK chapter in the DAQNav SDK Manual, or the video tutorials in the Advantech Navigator.

### Programming with DAQNav Device Drivers Function Library

Advantech DAQNav Device Drivers offer a rich function library that can be utilized in various application programs. This function library consists of numerous APIs that

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support many development tools, such as Visual Studio, NET, Visual C++, Visual Basic, Delphi and C++ Builder.

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

- Analog Input Function Group
- 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 *Using DAQNav* SDK chapter in the *DAQNav* SDK Manual.

#### **Troubleshooting DAQNav** 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, you can check the error code and error description within the Error Control of each function in the DAQNav SDK Manual.

## **1.6 Accessories**

Advantech offers a complete set of accessory products to support the PCIE-1824 card. These accessories include:

#### **Wiring Cables**

- **PCL-10162-1E** DB62 Shielded Cable, 1 m
- **PCL-10162-3E** DB62 Shielded Cable, 3 m

#### **Wiring Boards**

- **ADAM-3962-AE** DB62 DIN-rail Wiring Board

# Chapter 2

## Installation

This chapter provides a packing 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 & Configuration

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## 2.1 Unpacking

After receiving your PCIE-1824 package, inspect the contents. The package should include the following items:

- PCIE-1824 card
- Startup Manual

The PCIE-1824 card has 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 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 from the bag.

After taking out the card, you should first:

- Inspect the card for any possible signs of external damage (loose or damaged components, etc.). If the card is visibly damaged, please notify our service department or our local sales representative immediately. Do not install a damaged card into your system.

Also pay extra attention to the following things 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 a PC or transport it elsewhere.*



## 2.2 Driver Installation

We recommend installing the driver before installing the PCIE-1824 card to ensure smooth operation.

The Advantech DAQNav Setup program for the PCIE-1824 card can be downloaded from the Advantech website.

## 2.3 Hardware Installation

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



After the Device Drivers installation is completed, you can install the PCIE-1824 card in your computer. 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 in your system.

1. TURN OFF your computer and unplug the power cord and cables. Do this 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 any static electricity that might be on your body.
5. Insert the PCIE-1824 card into the PCI Express interface. 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. Connect appropriate accessories (DB62 shielded cable, wiring terminals, etc., if necessary) to the card.
7. Replace the cover of your computer chassis. Re-connect the cables you removed in step 1.
8. 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 Navigator* 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 & Configuration

The *Advantech Navigator* 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. Take the following PCIE-1824 details as an example.

### Setting Up the Device

1. To install the I/O device for your card, first run the *Advantech Navigator* program (by accessing *Start/Programs/Advantech Automation/Navigator for DN4*).
2. You can then view the device(s) already installed on your system (if any) in the Installed Devices list box. If the software and hardware installation are completed, you will see PCIE-1824 card in the Installed Devices list.

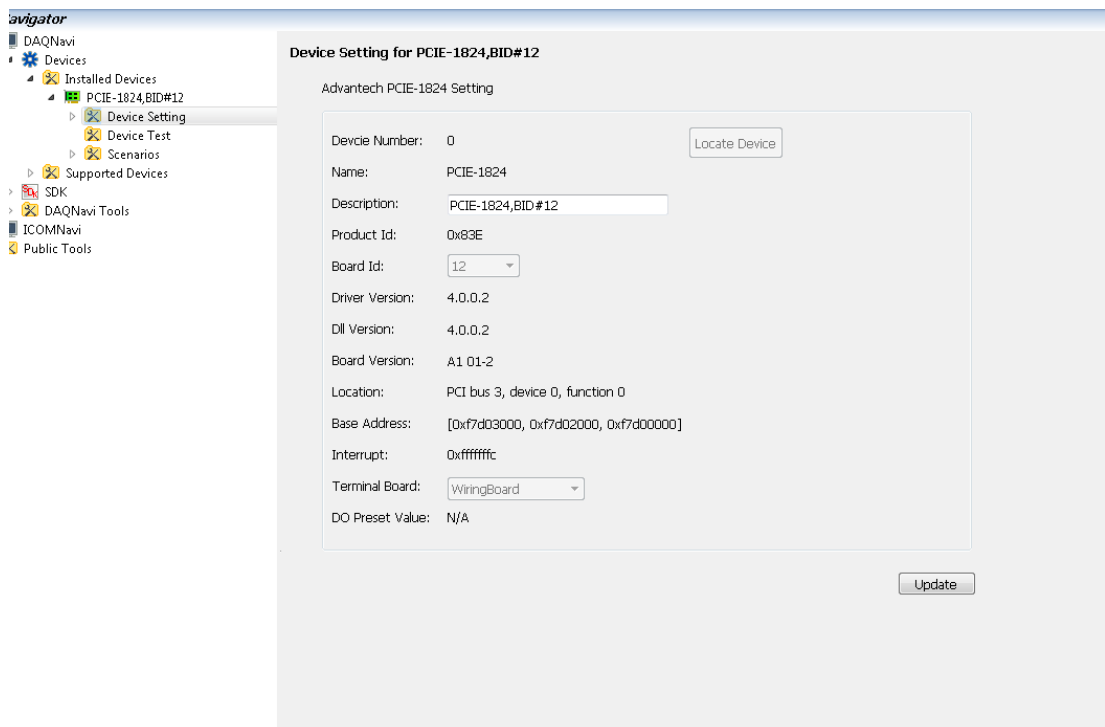


Figure 2.1 PCIE-1824 Device Settings



## Configuring the Device

- Go to Device Setting to configure your device. Here you can configure the analog output of PCIE-1824.

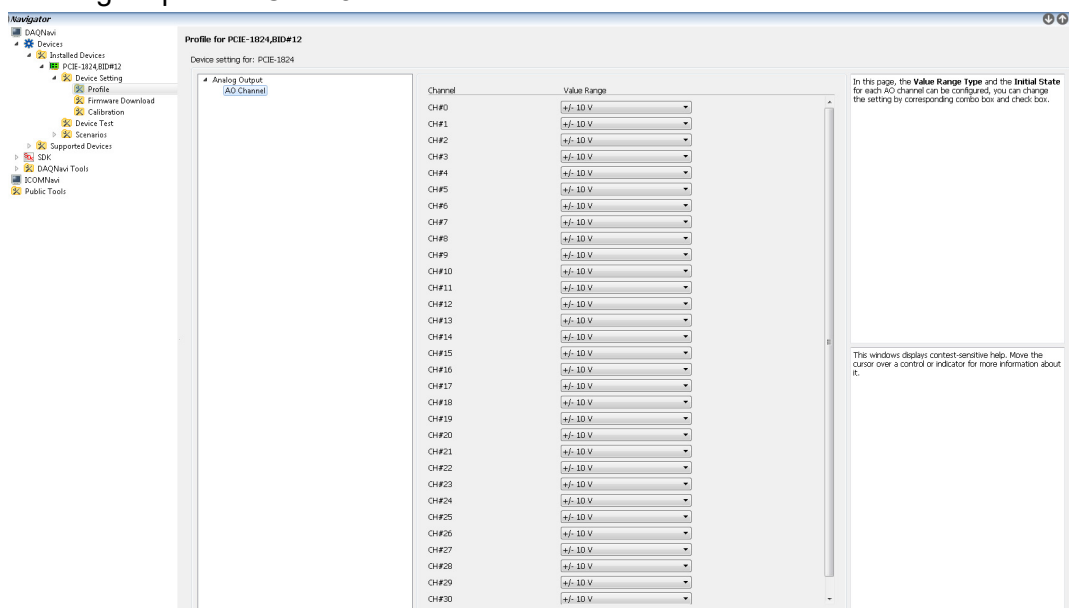


Figure 2.2 The Device Setting Page

- After your card is properly installed and configured, you can go to the *Device Test* page to test the hardware using the testing utility supplied.

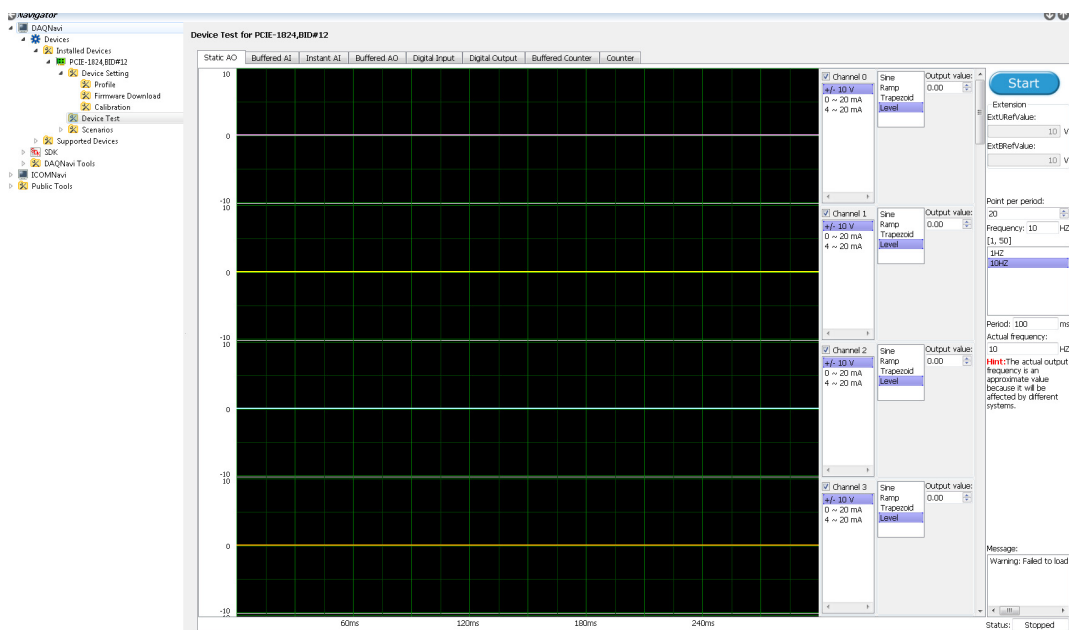


Figure 2.3 PCIE-1824 Device Testing

For more detailed information, please refer to the DAQNavigator SDK Manual or the User Interface Manual in the Advantech Navigator.



# Chapter 3

## Signal Connections

This chapter provides useful information about how to connect input and output signals to the PCIE-1824 card via the I/O connector.

Sections include:

- Overview
- Board ID Settings
- Signal Connections
- Field Wiring Considerations

## 3.1 Overview

Maintaining signal connections is one of the most important factors in ensuring that your application system is sending and receiving data correctly. A good signal connection can avoid unnecessary and costly damage to your PC and other hardware devices. This chapter provides useful information about how to connect input and output signals to the PCIE-1824 card via the I/O connector.

## 3.2 Switch and Jumper Settings

Please refer to Figure 3.1 for jumper and switch locations on PCIE-1824.



**Figure 3.1 Connector and Switch Locations**

### 3.2.1 Board ID (SW1)

The PCIE-1824 has a built-in DIP switch (SW1), which is used to define each card's board ID. When there are multiple cards on the same chassis, this board ID switch is used to set each card's device number.

After setting each PCIE-1824, you can identify each card in system with different device numbers. The default value of board ID is 0 and if you need to adjust it to other value, please set the SW1 by referring to Table 3.1.

**Table 3.1: Board ID configuration**

SW1				
1	2	3	4	Board ID
ON	ON	ON	ON	0
ON	ON	ON	OFF	1
ON	ON	OFF	ON	2
ON	ON	OFF	OFF	3
ON	OFF	ON	ON	4
ON	OFF	ON	OFF	5
ON	OFF	OFF	ON	6
ON	OFF	OFF	OFF	7
OFF	ON	ON	ON	8
OFF	ON	ON	OFF	9
OFF	ON	OFF	ON	10
OFF	ON	OFF	OFF	11
OFF	OFF	ON	ON	12
OFF	OFF	ON	OFF	13
OFF	OFF	OFF	ON	14
OFF	OFF	OFF	OFF	15

### 3.2.2 Power On Configuration(JP2)

The default configuration after power on and hardware reset is to set all the analog input and analog output channels to open status (output voltage equals zero) so that external devices will not be damaged when the system starts or resets. When the system is hot reset, then the status of isolated digital output channels are selected by jumper JP2. Table 3.2 shows the possible configurations of jumper JP2.

**Table 3.2: Keep last status jumper configuration.**

JP2	Description
(1:2)	Keep last status after hot reset
(2:3)	Not keep last status after hot reset

## 3.3 Signal Connections

### Pin Assignments

The I/O connector on the PCIE-1824 is a 62-pin connector that enables you to connect to accessories with the PCL-10162 shielded cable.

Figure 3.2 shows the pin assignments for the 62-pin I/O connector on the PCIE-1824, and Table 3.3 shows its I/O connector signal description.

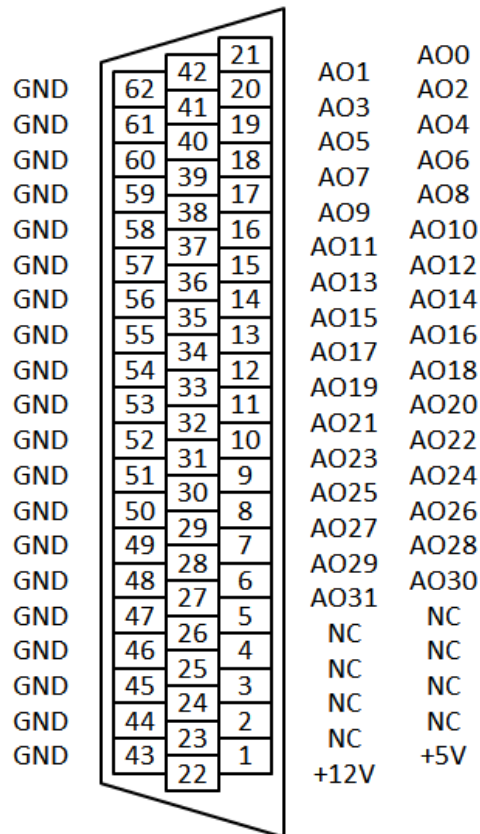


Figure 3.2 62-pin I/O Connector Pin Assignments

### 3.3.1 I/O Connector Signal Description

Pin Name	Type	Pin#	Description
<b>Analog Output</b>			
AO0	O	21	Analog output channel 0
AO1	O	42	Analog output channel 1
AO2	O	20	Analog output channel 2
AO3	O	41	Analog output channel 3
AO4	O	19	Analog output channel 4
AO5	O	40	Analog output channel 5
AO6	O	18	Analog output channel 6
AO7	O	39	Analog output channel 7
AO8	O	17	Analog output channel 8
AO9	O	38	Analog output channel 9
AO10	O	16	Analog output channel 10
AO11	O	37	Analog output channel 11
AO12	O	15	Analog output channel 12
AO13	O	36	Analog output channel 13
AO14	O	14	Analog output channel 14
AO15	O	35	Analog output channel 15
AO16	O	13	Analog output channel 16
AO17	O	34	Analog output channel 17
AO18	O	12	Analog output channel 18
AO19	O	33	Analog output channel 19
AO20	O	11	Analog output channel 20
AO21	O	32	Analog output channel 21
AO22	O	10	Analog output channel 22
AO23	O	31	Analog output channel 23
AO24	O	9	Analog output channel 24
AO25	O	30	Analog output channel 25
AO26	O	8	Analog output channel 26
AO27	O	29	Analog output channel 27
AO28	O	7	Analog output channel 28
AO29	O	28	Analog output channel 29
AO30	O	6	Analog output channel 30
AO31	O	27	Analog output channel 31
<b>Power and Ground</b>			
+12V	-	22	+12 V power supply for external use
+5V	-	1	+5 V power supply for external use
GND	-	43 ~ 63	Ground
<b>Others</b>			
NC	-	2 ~ 5, 23 ~ 26	No connect.

### 3.3.2 Analog Output Connections

The PCIE-1824 provides 32 channels of analog output (AO) signal generation with output ranges of  $\pm 10$  V, 0 ~ 20 mA, and 4 ~ 20 mA. The output range of each channel can be configured independently by software.

#### 3.3.2.1 Voltage Output

For voltage output range ( $\pm 10$  V), the output configuration is single-ended. Signal connection is shown in Figure 3.3, and the minimum load resistance ( $R_L$ ) is 1 k $\Omega$ .

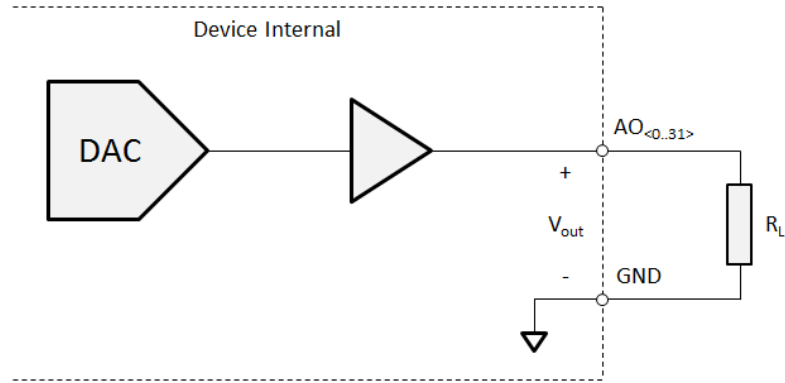


Figure 3.3 Voltage output signal connections

#### 3.3.2.2 Current Output

For current output ranges (0 ~ 20 mA and 4 ~ 20 mA), current flows into the device (sink), and user must provide external power supply to the load. Signal connection is shown in the picture below.

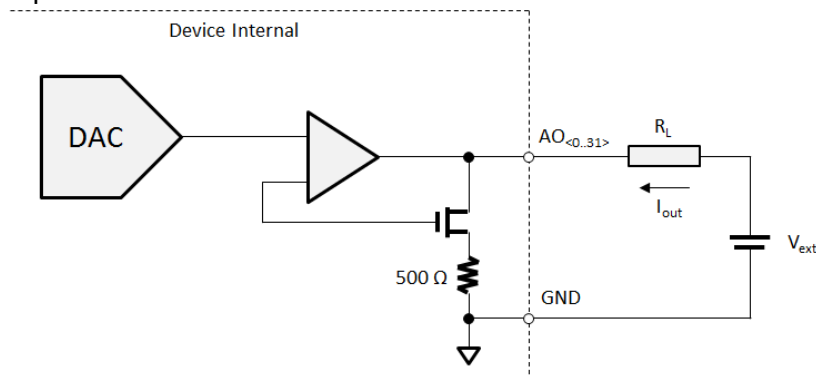


Figure 3.4 Current output signal connection

The maximum allowable load resistance ( $R_L$ ) can be calculated as follows.

$$R_{L,max} = \frac{V_{ext}}{20 \text{ mA}} - 0.5 \text{ k}\Omega$$

$V_{ext}$  is the external power supply in volts, which must not exceed 30 V.



## 3.4 Field Wiring Considerations

When using a data acquisition devices to acquire signals from or generate signals to the outside world, noises and electromagnetic interferences from the outside world may significantly affect the results if precautions are not taken. The following instructions may be helpful to reduce these unwanted effects.

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

If the cable needs to unavoidably go through an area with significant electromagnetic interference, a shielded cable with twisted-pair wires should be used.

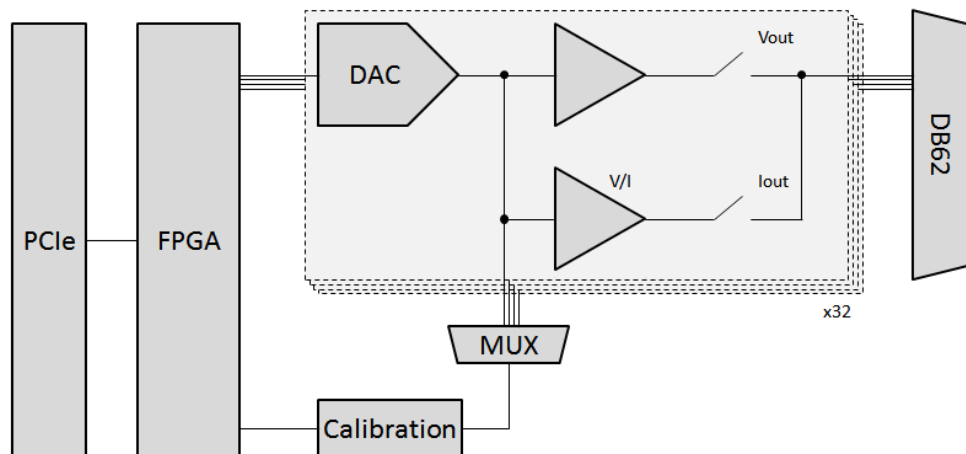
Try to place the cable at a right angle to the nearby power lines to minimize any undesirable effects.



# Appendix **A**

## Specifications

## A.1 Function Block



## A.2 Analog Output

<b>Channels</b>	32, can be enabled/disabled each channel independently by software
<b>Output configuration</b>	Single-ended
<b>Output range</b>	$\pm 10\text{ V}/0 \sim 20\text{ mA}/4 \sim 20\text{ mA}$ (sink), software selectable per channel
<b>D/A converter (DAC) resolution</b>	16 bits
<b>Update rates</b>	Static update
<b>Minimum load for voltage output</b>	1 k $\Omega$
<b>Maximum external power for current output</b>	30 V
<b>Internal resistor</b>	500 $\Omega$
<b>Power-up glitch removal</b>	Yes
<b>Auto-calibration</b>	Yes

## A.3 Voltage Output Accuracy

<b>Gain error</b>	
Operating temperature within 5 °C of last auto-calibration temperature	< $\pm 0.01\%$
Over full operating temperature range	< $\pm 0.03\%$
<b>Offset error</b>	
Operating temperature within 5 °C of last auto-calibration temperature	< $\pm 1\text{ mV}$
Over full operating temperature range	< $\pm 3\text{ mV}$

## A.4 Current Output Accuracy

<b>Gain error</b>	
Operating temperature within 5°C of last auto-calibration temperature	<±0.05%
Over full operating temperature range	<±0.15%
<b>Offset error</b>	
Operating temperature within 5°C of last auto-calibration temperature	<±2.5 µA
Over full operating temperature range	<±10 µA

## A.5 Dynamic Performance

<b>Slew rate</b>	0.7 V/µs
<b>Output noise</b>	0.2 mVRMS
<b>Channel to channel DC crosstalk</b>	0.22 mV, measured channel at midscale, adjacent channel at full scale
<b>Settling time</b>	100 µs

## A.6 Power Output

+5 V	200 mA max.
+12 V	100 mA max.

## A.7 General

I/O Connector Type	62-pin D-sub	
Dimensions	167 × 100 mm <sup>2</sup> (6.6 × 3.9 in. <sup>2</sup> )	
Power Consumption	Typical	3.3 V @ 350 mA, 12 V @ 350 mA
	Max.	3.3 V @ 370 mA, 12 V @ 1000 mA
Temperature	Operating	0~60°C (32~140°F)
	Storage	-40 ~ 70°C (-40 ~ 158°F)
Relative Humidity	Operating	10~90%RH non-condensing
	Storage	5~95%RH non-condensing
Certifications	CE/FCC certified	

## [www.advantech.com](http://www.advantech.com)

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