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NuDAQ®
PCI-7258
PhotoMos Relay Cards
User's Guide



Recycled Paper

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Detail Description			
Suggestions to ADLINK			

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How to Use This Guide

This manual is intended to assist users to configure the PCI-7258 PhotoMos Relay Card. It is divided into 5 chapters.

Chapter 1, **"Introduction"**, gives an overview of the product features, applications, and specifications.

Chapter 2, **"Getting Started"**, describes how to install the PCI-7258. The Board ID switch and connectors' pin assignments are also described.

Chapter3, **"Registers"**, describes the registers that are available to the PCI-7258. The information is important for programmers who want to control the hardware with low level programming languages.

Chapter 4, **"Operation Theory"**, describes how to operate the PCI-7258. The PhotoMos relay and isolated digital input are introduced. Some programming concepts are also described.

Chapter 5, **"C/C++ libraries"**, describes the software utility and the software libraries of the PCI-7258. This chapter also outlines basic requirements for programming your own software application.

1

Introduction

The PCI-7258 PhotoMos relay card is a basic Digital I/O card for PCI bus computers used in industrial applications.

This PCI-7258 provides 32 PhotoMos relay actuators and 2 opto-isolated digital inputs. All relays are of Form A type and is very suited for constant ON/OFF control devices.

Other useful feature includes the Board ID. It is convenient for board identification when two or more PCI-7258 cards are in a system. All I/O signals are routed via a 68-pin SCSI connector.

1.1 Features

The PCI-7258 PhotoMos relay actuator and D/I Card provides the following advanced features:

- 32-bit PCI-Bus, Plug and Play
- 32 PhotoMos relay actuator outputs
- 2 opto-isolated digital inputs
- On-board relay driving circuits
- Digital input channel 0 & 1 interrupt
- Board ID

1.2 Applications

- Industrial ON/OFF control
- Energy management
- Laboratory automation
- Industrial automation
- Switch contact status sensing, limit switch monitoring,
- Integrate with A/D and D/A cards to implement a data acquisition & control system

1.3 Specifications

♦ **Digital input**

- **Input channels:** 2
- **Photo-coupler:** PC-3H4
- **Input current:**
  - ✓ 10 mA rated
  - ✓ 50 mA max. for isolated input

- **Input Voltage:**
  - ✓ Up-to 24 V_{DC} or 24V_{AC}
  - ✓ Logic Low: 0~2V
  - ✓ Logic High 5~24V
- **Input impedance:** 2.4 KΩ / 0.5W
- **Isolated voltage:** 2,500 V_{rms} channel-to-system

♦ **Relay Output**

- **Output channels:** 32
- **Relay type:** 32 SPST (Form A)
- **Load voltage (peak AC):** 350V
- **Continuous load current (peak AC):** 0.12A
- **Peak load current:** 0.3A
- **I/O isolation voltage:** 1,500 V AC
- **Output turn on resistance (typical):** 17Ω
- **Output off state leakage current (Maximum):** 1 μA
- **Turn on time (typical):** 0.23 ms
- **Turn off time (typical):** 0.04 ms

♦ **General Specifications**

- **Bus:** 32-bit PCI bus
- **Dimension:** 174 mm x 106 mm, standard PCI half size
- **Operating temperature:** 0 ~ 60 °C
- **Storage temperature:** -20 °C ~ 80 °C
- **Humidity:** 5 to 95% non-condensing

♦ **Power Consumption**

- +5V @ 380 mA (All relays energized)

1.4 Software Support

ADLINK provides versatile software drivers and packages for users' different approach to building a system. ADLINK not only provides programming libraries such as DLL for most Windows based systems, but also provide drivers for other software packages such as LabVIEW®, VEE™, InTouch™, InControl™, ISaGRAF™, and so on.

All software options are included in the ADLINK CD. Non-free software drivers are protected with licensing codes. Without the software code, you can install and run the demo version for two hours for trial/demonstration purposes. Please contact ADLINK dealers to purchase the formal license.

1.4.1 Programming Library

For customers who are writing their own programs, we provide function libraries for many different operating systems, including:

- DOS Library: Borland C/C++ and Microsoft C++. Functional descriptions are included in this user's guide
- PCIS-DASK: Include device drivers and DLL for Windows 98, Windows NT and Windows 2000. DLL is binary compatible across Windows 98, Windows NT and Windows 2000. That means all applications developed with PCIS-DASK are compatible across Windows 98, Windows NT and Windows 2000. The developing environment can be VB, VC++, Delphi, BC5, or any Windows programming language that allows calls to a DLL. The user's guide and function reference manual of PCIS-DASK are in the CD. Please refer the PDF manual files under \\Manual_PDF\Software\PCIS-DASK

The above software drivers are shipped with the board. Please refer to the "Software Installation Guide" for installation procedures.

1.4.2 PCIS-LVIEW: LabVIEW® Driver

PCIS-LVIEW contains the VIs, which is used to interface with NI's LabVIEW® software package. The PCIS-LVIEW supports Windows 95/98/NT/2000. The LabVIEW® drivers is shipped free with the board. You can install and use them without a license. For more information about PCIS-LVIEW, please refer to the user's guide in the CD. (\\Manual_PDF\Software\PCIS-LVIEW).

1.4.3 PCIS-VEE: VEE Driver

The PCIS-VEE includes user objects, which are used to interface with the VEE software package. PCIS-VEE supports Windows 95/98/NT. The VEE drivers are shipped free with the board. You can install and use them without a license. For more information about PCIS-VEE, please refer to the user's guide in the CD. (\\Manual_PDF\Software\PCIS-VEE).

1.4.4 PCIS-OCX: ActiveX Controls

We suggest users who are familiar with ActiveX controls and VB/VC++ programming use the PCIS-OCX ActiveX control components library to develop their applications. PCIS-OCX is designed for Windows 98/NT/2000. For more information about PCIS-OCX, please refer to the user's guide in the CD. (\Manual_PDF\Software\PCIS-OCX\PCIS-OCX.PDF).

The above software drivers are shipped with the board. Please refer to the "***Software Installation Guide***" for installation procedures.

ADLINK also supply an ActiveX control software called *DAQBench*. DAQBench is a collection of ActiveX controls for measurement and automation applications. With DAQBench, you can develop custom user interfaces to display and analyze data you acquired or received from other sources, or integrate with popular applications or data sources. For more information about DAQBench, please refer to the user's guide in the CD. (\Manual_PDF\Software\DAQBench\DAQBenchManual.PDF). There is a free 4-hour evaluation version of DAQBench available in the CD. DAQBench is not free. Please contact ADLINK dealers or ADLINK to purchase the software license.

1.4.5 PCIS-DDE: DDE Server and InTouch™

DDE stands for Dynamic Data Exchange. The PCIS-DDE includes the PCI cards' DDE server. The PCIS-DDE server is free and is included in the ADLINK CD. The DDE server can be used in conjunction with any DDE client under Windows 98/NT/2000.

1.4.6 PCIS-ISG: ISaGRAF™ driver

The ISaGRAF Workbench is an IEC1131-3 SoftPLC control development environment. The PCIS-ISG includes ADLINK product drivers for ISaGRAF under Windows NT environment. The PCIS-ISG is included in the ADLINK CD. It is not free. Please contact ADLINK dealers or ADLINK to purchase the license.

1.4.7 PCIS-ICL: InControl™ Driver

PCIS-ICL is the InControl driver, which supports Windows NT. The PCIS-ICL is included in the ADLINK CD. It is not free and requires a license. Please contact ADLINK dealers or ADLINK to purchase the license.

1.4.8 PCIS-OPC: OPC Server

PCIS-OPC is an OPC server, which can be used to link with other OPC clients. There are many software packages on the market that can provide the OPC clients. The PCIS-OPC supports Windows 98, NT, and 2000. It is not free. Please contact ADLINK dealers or ADLINK to purchase the license.

2

Getting Started

This chapter describes how to install and setup the PCI-7258. The contents in the package and unpacking information that you should be aware of are outlined first.

2.1 What you have

In addition to the User's Manual, the package should include the following items:

- PCI-7258 PhotoMos relay cards
- ADLINK Software CD
- Software Installation Guide

If any of these items are missing or damaged, contact ADLINK or the dealer from whom you purchased the product. Save the shipping materials and carton in case you want to ship or store the product in the future.

2.2 Unpacking

The card contains electro-static sensitive components that can be easily be damaged by static electricity.

Therefore, the card should be handled on a grounded anti-static mat. The operator should be wearing an anti-static wristband, grounded at the same point as the anti-static mat.

Inspect the card module carton for obvious damages. Shipping and handling may cause damage to your module. Be sure there are no shipping and handling damages on the modules carton before continuing.

After opening the card module carton, extract the system module and place it only on a grounded anti-static surface with component side up.

Again, inspect the module for damages. Press down on all the socketed IC's to make sure that they are properly seated. Do this only with the module place on a firm flat surface.

Note: DO NOT ATTEMPT TO INSTALL A DAMAGED BOARD IN THE COMPUTER.

You are now ready to install your card.

2.3 PCB Layout

The location of the connectors and switches on the PCI-7258 are shown in figure 1 below. Descriptions are outline in the proceeding sections.

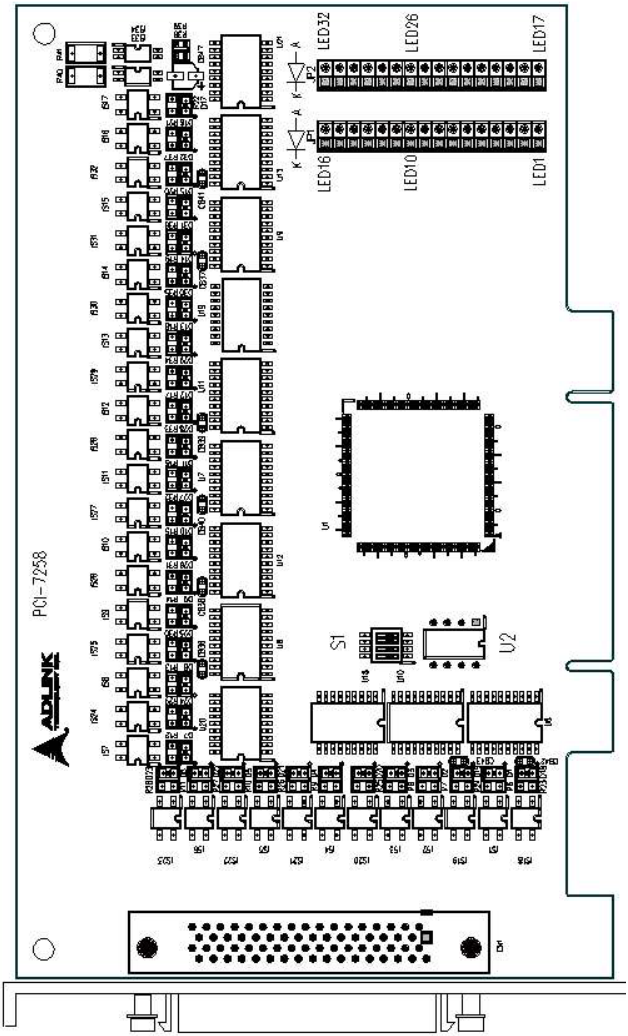


Figure 1: PCI-7258 PCB Layout

2.4 External LED

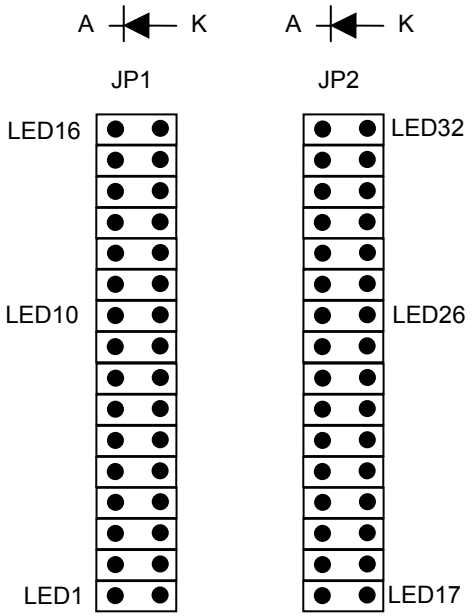


Figure 2: PCI-7258 External LED connector

The PCI-7258 card is designed with 32 LEDs, each indicating the operation status of the 32 relays. In addition, there are also 32 external LED connectors available for users' to use as so pleases. Utilizing the external LEDs connecting to JP1 or JP2, users can have a visual status of each relay displayed on a chassis, panel or on any apparatus. Only LED's with a forward voltage (V_f) lower than 2V will operate. Each external LED connector has a current limiting resistor (330Ω) connected to the +5V supply, therefore external current limiting circuitry for external LED's are not necessary.

The direction of the external LED's connection is shown in Figure 2. Before connecting a LED to a connector, make sure the LED's orientation is correct.

2.5 Board ID

When two or more data acquisition cards are installed in a system, it can be tedious trying to identify a specific card. For easier identification, the PCI-7258 implemented a Board ID function. By setting the Dipswitch located at S1, users can assign an ID address to a specific card and access the card through software programming. For more details about the Board ID in programming, please refer to chapter 5. Table 1 below shows all dipswitch setting conditions.

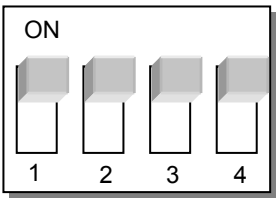


Figure 3: Board ID Dipswitch

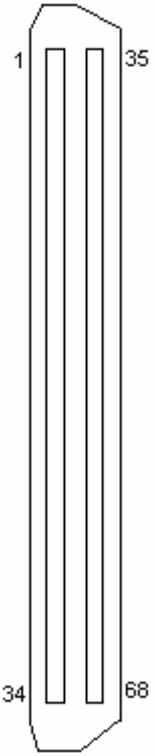
Board ID	Switch No.			
	1	2	3	4
0 (default)	1	1	1	1
1	0	1	1	1
2	1	0	1	1
3	0	0	1	1
4	1	1	0	1
5	0	1	0	1
6	1	0	0	1
7	0	0	0	1
8	1	1	1	0
9	0	1	1	0
10	1	0	1	0
11	0	0	1	0
12	1	1	0	0
13	0	1	0	0
14	1	0	0	0
15	0	0	0	0

Table 1. Board ID Setting Conditions

Note: 1=on, 0=off

2.6 Connector Pin Assignments

The PCI-7258 card is equipped with a 68-pin SCSI connector (CN1). Figure 3 defines the pin assignment for the connector.



NO1	1	35	NO18
COM1	2	36	COM18
NO2	3	37	NO19
COM2	4	38	COM19
NO3	5	39	NO20
COM3	6	40	COM20
NO4	7	41	NO21
COM4	8	42	COM21
NO5	9	43	NO22
COM5	10	44	COM22
NO6	11	45	NO23
COM6	12	46	COM23
NO7	13	47	NO24
COM7	14	48	COM24
NO8	15	49	NO25
COM8	16	50	COM25
NO9	17	51	NO26
COM9	18	52	COM26
NO10	19	53	NO27
COM10	20	54	COM27
NO11	21	55	NO28
COM11	22	56	COM28
NO12	23	57	NO29
COM12	24	58	COM29
NO13	25	59	NO30
COM13	26	60	COM30
NO14	27	61	NO31
COM14	28	62	COM31
NO15	29	63	NO32
COM15	30	64	COM32
NO16	31	65	DIO
COM16	32	66	DI1
NO17	33	67	DIGND0
COM17	34	68	DIGND1

Figure 4: Pin Assignment of PCI-7258 CN1

Legend:

NO x: Relay normal open pin x, x = 1~32

COM x: Relay common pin x, x = 1~32

DI x: Digital input pin x, x = 0~1

DIGND x: Digital input ground pin x, x = 0~1

2.7 Termination Board Connection

The available termination board for the 68-pin SCSI connector is the DIN-68S/1S. The DIN-68S/1S is a general-purpose 68-pin screw terminal with a DIN socket. It is also equipped with a 68-pin SCSI cable that allows for easy installation of the PCI-7258.

3

Registers

Detailed descriptions of the registers are specified in this chapter. This information is useful for programmers who wish to handle the card with low-level programming. However, we suggest users to have an understanding of the PCI interface before starting any low-level programming.

3.1 I/O Address Map

The PCI-7258 registers are all 16-bits long. Users can access these registers by 16-bit I/O instructions only. The controls for the relays and status of the isolated inputs are by means of accessing these registers. The following table shows the registers mapping addresses; the addresses are offset relative to the base address.

Offset	Write	Read
0x00h	Relay Output CH. 1~16	Relay Output Read back CH.1~16
0x02h	Relay Output CH. 17~32	Relay Output Read back CH.17~32
0x04h	---	Isolated Input CH. 0, 1
0x08h	Clear IRQ	---

Table 2. Registers Address Map

3.2 Relay Output Control Register

There are 32 PhotoMos relays on the PCI-7258; each bit of the register corresponds to a relay channel. Writing “1” to the register will cause the relay to close and “0” will cause it to open.

Address: BASE + 0x00

Attribute: Write

7	6	5	4	3	2	1	0
RLY8	RLY7	RLY6	RLY5	RLY4	RLY3	RLY2	RLY1
15	**14**	**13**	**12**	**11**	**10**	**9**	**8**
RLY16	RLY15	RLY14	RLY13	RLY12	RLY11	RLY10	RLY9

Address: BASE + 0x02

Attribute: Write

7	**6**	**5**	**4**	**3**	**2**	**1**	**0**
RLY24	RLY23	RLY22	RLY21	RLY20	RLY19	RLY18	RLY17
15	**14**	**13**	**12**	**11**	**10**	**9**	**8**
RLY32	RLY31	RLY30	RLY29	RLY28	RLY27	RLY26	RLY25

RLYx: relay output channel x, x=1~32

3.3 Relay Output Read Back Register

The status of the PhotoMos relay can be read back from the readback register. If the relay is in the close position, the corresponding bit value is '1'. If the relay is open, then the bit value is '0'.

Address: BASE + 0x00

Attribute: Read

7	6	5	4	3	2	1	0
RBK8	RBK7	RBK6	RBK5	RBK4	RBK3	RBK2	RBK1
15	14	13	12	11	10	9	8
RBK16	RBK15	RBK14	RBK13	RBK12	RBK11	RBK10	RBK9

Address: BASE + 0x02

Attribute: Read

7	6	5	4	3	2	1	0
RBK24	RBK23	RBK22	RBK21	RBK20	RBK19	RBK18	RBK17
15	14	13	12	11	10	9	8
RBK32	RBK31	RBK30	RBK29	RBK28	RBK27	RBK26	RBK25

RBKx: Read back data of relay x, x=1~32

3.4 Isolated Digital Input Register

There are 2 isolated input channels on PCI-7258 card. The status of the 2 channels can be read from the isolated input register. Each bit corresponds to each channel. A “1” means the input logic is high and “0” means the input logic is low.

Address: BASE + 0x04

Attribute: Read

7	6	5	4	3	2	1	0
---	---	---	---	---	---	DI1	DI0
15	14	13	12	11	10	9	8
---	---	---	---	---	---	---	---

DIx: isolated digital input channel x, x=0, 1

3.5 Clear IRQ register

The PCI-7258 has two interrupt sources for the digital input channels 0 and 1. Writing anything to this register will clear the interrupt request.

Address: BASE + 0x08

Attribute: Write

7	**6**	**5**	**4**	**3**	**2**	**1**	**0**
---	---	---	---	---	---	---	---
15	**14**	**13**	**12**	**11**	**10**	**9**	**8**
---	---	---	---	---	---	---	---

3.6 Handling PCI Controller Registers

The PCI bus controller adopted in PCI-7258 is the PCI-9030, which is provided by PLX technology Inc. When users attempt to handle low-level programming, some registers in the PCI-9030 should be noticed. The interrupt control register (INTCSR; 0x4Ch) of the PCI-9030 takes charge of all interrupt information from the local bus to PCI bus. When users want to develop their own interrupt function driver, both interrupt registers in the PCI-9030 and in PCI-7258 have to work together. For more information about the interrupt control register in the PCI-9030, refer to the PCI-9030 data book.

With the PCI-7258 software function library, ADLINK has provided simple and easy-to-use functions to handle the procedures of interrupts. Using these functions, users are not required to know about the interrupt register in the PCI controller. Hence, we recommend users use these functions instead of developing your own interrupt functions. For more information about the PCI-7258 function library, refer to Chapter 5.

4

Operation Theory

4.1 PhotoMos Relay Output

The PhotoMos relay has LED inputs and MOSFET outputs that provide input-output isolation. When a signal current flows into the LED input pin, the emitted light from the LED is detected by the photoelectric element (solar cell), which is mounted opposite to the LED. The photoelectric element then converts the received light to a voltage, which charges the MOSFET gate on the output side. When the voltage reaches a preset voltage value, the MOSFET begins to conduct and turns on the load. The simplified circuit of PhotoMos relay is shown in figure 4 below.

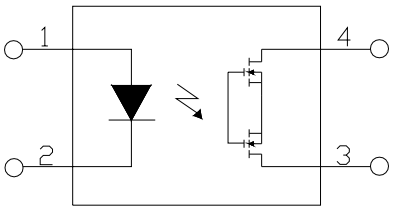


Figure 5: PhotoMos relay schematic

The PhotoMos relay incorporates the advantages of both a semiconductor and an electro-mechanical relay. The PhotoMos relay utilizes the MOSFET as a switch instead of the mechanical contact. Thus the contact resistance remains stable through the life of the relay. Furthermore, dithering problems is eliminated.

The PCI-7258 is equipped with 32 PhotoMos relays, which are all form A type. The load voltage can either be AC or DC. The basic wiring diagram is shown in figure 5 below.

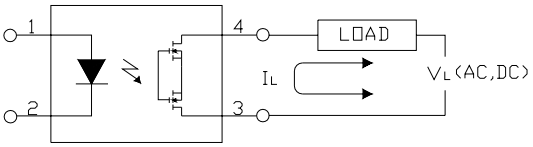


Figure 6: PhotoMos relay wiring diagram

If an inductive load is connected, the spike voltage may exceed the relay's maximum rating. To protect the components, user should add a diode in the circuit. A typical protection circuit is shown below.

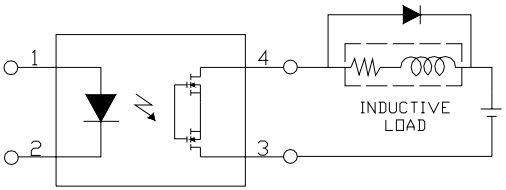


Figure 7: Protection circuit for an Inductive load

4.2 Isolated Digital Input

The PCI-7258 contains 2 opto-isolated digital input channels. The circuit diagram of the isolated input channel is shown below.

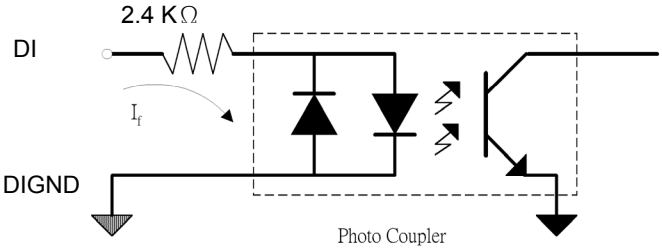


Figure 8: Photo-Coupler

The digital input is routed through a photo-coupler (PC3H4), so that the connections are not polarity sensitive whether using positive or negative voltages. The PCI-7258 digital input has an inline 2.4kΩ resistor and the input voltage can ranges from 0 to 24V.

4.3 Interrupt Architecture

PCI-7258 has a powerful dual interrupt routing scheme and the interrupt sources are on the digital input channels 0 and 1. Using these interrupts will make handling complicated digital information much easier and relief your computer from the heavy burden of dealing with digital input data. Note that dual interrupts does not mean the card occupies two IRQ levels. The interrupt will occur only when digital input level changes from 0 to 1. In other words, the interrupt condition occurs on the **rising edge,** triggered on the DI channel. Be sure to clear the interrupt request after handling the ISR or the next interrupt request will not be received normally. For more information about the interrupt operation, refer to section 5.6.

5

C/C++ DOS Libraries

This chapter describes the software libraries for operating this card. The function prototypes and useful constants are defined in the header files located in the LIB and INCLUDE directory.

5.1 Programming Guide

5.1.1 Naming Convention

The functions of the NuDAQ PCI or NuIPC CompactPCI card software drivers uses full-names to represent the functions' real meaning. The naming convention rules are:

_{hardware_model}_{action_name}. **e.g. `_7258_Initial().`**

All functions in the PCI-7258 drivers are with 7258 as {hardware_model}.

5.1.2 Data Types

We have defined some data types in the ACL_PCI.h header file. These data types are used by the NuDAQ Cards' library. We suggest you use these data types in your application programs. The following table shows the data type names and their range.

Type Name	Description	Range
U8	8-bit ASCII character	0 to 255
I16	16-bit signed integer	-32768 to 32767
U16	16-bit unsigned integer	0 to 65535
I32	32-bit signed integer	-2147483648 to 2147483647
U32	32-bit single-precision floating-point	0 to 4294967295
F32	32-bit single-precision floating-point	-3.402823E38 to 3.402823E38
F64	64-bit double-precision floating-point	-1.797683134862315E308 to 1.797683134862315E309
Boolean	Boolean logic value	TRUE, FALSE

Table 3. Data Types and Range

5.2 _7258 Initial

@ Description

The PCI-7258 cards are initialized according to the card number. Because the PCI-7258 is designed with the PCI bus architecture and meets the plug and play specifications, the ***IRQ*** and ***base_address*** (pass-through address) are assigned by system BIOS directly. Every PCI-7258 card has to be initialized by this function before using any other functions.

@ Syntax

U16 _7258_Initial (U16 *existCards, PCI_INFO *pciInfo)

@ Argument

existCards: The number of installed PCI-7258 cards. The returned value shows how many PCI-7258 cards are installed in the system.

pciInfo: This structure stores the PCI bus plug and play initialization information which is determined by PnP BIOS. The PCI_INFO structure is defined in the ACL_PCI.H header file. The base I/O addresses and the interrupt channel number are stored in the pciinfo, which is used for reference.

@ Return Code

ERR_NoError, ERR_PCIBiosNotExist, ERR_BoardNoInit, ERR_InvalidBoardNumber

5.3 _7258_DO

@ Description

@ Syntax

U16 _7258_DO (U16 boardID, U16 Group, U16 doData)

@ Argument

boardID: Board ID for the specific board.

Group: group 0 represents DO channel 1~16, group 1 represents DO channel 17~32.

doData: value which will be written to digital output port.

@ Return Code

ERR_NoError, ERR_BoardNoInit, ERR_InvalidDOChannel

5.4 _7258_DO_Read_Back

@ Description

This function is used to read data back from the digital output port controlled by the 7258_DO function. You can read back all relay status (close or open) by using this function.

@ Syntax

U16 _7258_DO_Read_Back (U16 boardID, U16 Group, U16 *doReadBackData)

@ Argument

boardID : Board ID for the specific board.

Group: group 0 represents DO channel 1~16, group 1 represents DO channel 17~32.

diReadBackData : Value read back from digital output port. ‘0’ represents the PhotoMos relay is under open condition and ‘1’ represents the PhotoMos relay is under close condition.

@ Return Code

ERR_NoError, ERR_BoardNoInit, ERR_InvalidDOChannel

5.5 _7258_DI

@ Description

This function is used to read data from the digital input port. There are 2 bits in the Isolated Digital Input Register for digital inputs purposes. You can read the input data by using this function.

@ Syntax

U16 _7258_DI (U16 boardID, U16 *diData)

@ Argument

boardID : Board ID for the specific board.

diData : return 16-bit value from digital input port. Only last 2 bit data are valid.

@ Return Code

ERR_NoError, ERR_BoardNoInit

5.6 _7258_INT_Control

@ Description

This function is used to control the interrupt source of the PCI-7258. The interrupt source can be the digital input of channel 0, 1 or both.

@ Syntax

U16 _7258_INT_Control (U16 boardID, U16 int1Flag, U16 int2Flag)

@ Argument

boardID: Board ID for the specific board.

Int1Flag: Digital input channel 0 interrupt control, “1” enable and “0” disable.

Int2Flag: Digital input channel 1 interrupt control, “1” enable and “0” disable.

@ Return Code

ERR_NoError, ERR_BoardNoInit

5.9 _7258_CLR_IRQ

@ Description

This function is used to clear the interrupt request.

@ Syntax

U16 _7258_CLR_IRQ (U16 boardID)

@ Argument

boardID: Board ID for the specific board.

@ Return Code

ERR_NoError, ERR_BoardNoInit

5.10 _7258_GET_IRQ_Status

@ Description

This function is used to obtain the interrupt status.

@ Syntax

U16 _7258_GET_IRQ_Status (U16 boardID, U16 *int1Status, U16 *int2Status)

@ Argument

boardID: Board ID for the specific board.

Int1Status: interrupt source 0 status, “1” represents interrupt request assert and “0” represents interrupt request de-assert.

Int2Status: interrupt source 1 status, “1” represents interrupt request assert and “0” represents interrupt request de-assert.

@ Return Code

ERR_NoError, ERR_BoardNoInit

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