

User's Guide

<http://www.omega.com>
e-mail: info@omega.com

PCI-PDISO16

EC Declaration of Conformity

<u>PCI-PDIS016</u>	<u>High output digital I/O board</u>
Part Number	Description

to which this declaration relates, meets the essential requirements, is in conformity with, and CE marking has been applied according to the relevant EC Directives listed below using the relevant section of the following EC standards and other normative documents:

EU EMC Directive 89/336/EEC : Essential requirements relating to electromagnetic compatibility.

EU 55022 Class B : Limits and methods of measurements of radio interference characteristics of information technology equipment.

EN 50082-1: EC generic immunity requirements.

IEC 801-2 : Electrostatic discharge requirements for industrial process measurement and control equipment.

IEC 801-3 : Radiated electromagnetic field requirements for industrial process measurements and control equipment.

IEC 801-4 : Electrically fast transients for industrial process measurement and control equipment.

Carl Haapaoja, Director of Quality Assurance

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Chapter 1: INTRODUCTION

1.1 General Description

The PCI-PDISO16 is a 16 channel isolated input, 16 channel relay output interface board for PCI compatible computers. The PCI-PDISO16 is designed for control and sensing applications where a few points of high voltage need to be sensed or controlled.

WARNING!

High voltages will be present on the PCI-PDISO16 board when you have connected high voltage inputs or outputs to the PCI-PDISO16 connector. Use extreme caution! Never handle the PCI-PDISO16 when signals are connected to the board through the connector.

DO NOT REMOVE THE PROTECTIVE PLATES FROM THE PCI-PDISO16.

The outputs are 16 FORM C electromechanical relays. The contacts are rated at 6A @ 120V A.C. or 28V D.C., resistive load. The relays are controlled by writing to two 8 bit ports. The state of the relays may be determined by a read from the control port address.

There are 16 individual, optically isolated (500V) inputs that may be read back as two 8-bit bytes. The inputs are not polarity sensitive and may be driven by either A.C. (50 - 1000 Hz) or D.C. in the range 5V - 24V. Each input has a software enabled low-pass filter with a time constant of 5mS (200Hz).

Although requiring only six 8 bit ports, the PCI-PDISO16 occupies 8 addresses. Programming is accomplished by writes and reads to the 8-bit ports. Each bit indicates the state of an input, controls an output or sets the condition of one of the input filters. The PCI-PDISO16 board is also compatible with optional UniversalLibrary software package.

Chapter 5: SPECIFICATIONS

Relay Specifications

Number	16
Contact Configuration	16 form C, OP0-OP15
Contact Rating	6A @ 120VAC or 28VDC resistive
Contact Type	Gold overlay silver
Contact Resistance	100 milliohms max
Operate Time	20 milliseconds
Release Time	10 milliseconds max
Vibration	10 to 55 Hz (Dual amplitude 1.5mm)
Shock	10G (11 milliseconds)
Dielectric Isolation	500V (1 minute)
Life Expectancy	10 million mechanical operations, min

Isolated Inputs

Number	16
Voltage Range	
DC	5-24V (Not TTL compatible)
AC	5-24V (50-1000Hz)
Isolation	500V
Resistance	470 Ohms min
Response	
w/o filter	20 uS
w/ filter	5 mS
Filters	
Time constant	5ms (200Hz)
Filter control	Each input individually programmable
Power-up /reset	Filters off

Environmental

Operating temperature range	0 to 70°C
Storage temperature range	-40 to 100°C
Humidity	0 to 90% non-condensing

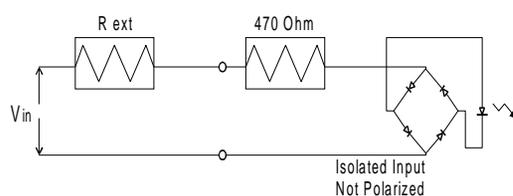
Power consumption

Icc: All relays off	0.7A typical
All relays on	2.0A typical

Resistance	470 ohm min
Response	20 uSeconds w/o filter, 5 milliseconds w/ filter

4.4 Input Range Extension

It is possible to extend the input range beyond the 5-24V specified by adding an external resistor. Shown here is the resistor and the equations used to calculate resistor values for a given V_{in} .



For higher voltages let: $R_{ext} = (80 \times V_{in}) - 470$

Note that the power dissipated in R_{ext} may be significant.

$$\text{Power dissipated in } R_{ext} = \frac{(V_{in})^2 \times R_{ext}}{(R_{ext} + 470)^2}$$

1.2 Accessories

The PCI-PDISO16 is a digital I/O board with signal conditioning installed. Most accessory boards are intended to provide signal conditioning or easy to access signal termination. In general, the PCI-PDISO16 will not require additional signal conditioning.

We **do not recommend** the use of exposed screw terminal boards with the PCI-PDISO16 if user field voltages greater than 24 Volts are present. The use of a screw terminal board with high voltage inputs or outputs will expose you (and others) to those high voltage signals.

We recommend the construction of a safe, fully insulated cable to carry signals between your equipment and the PCI-PDISO16 connector, or that any screw terminal board used be fully enclosed in an insulated, protected box.

Chapter 2: INSTALLATION

2.1 Windows 95

The PCI-PDISO16 board is completely plug and play. Simply follow the steps shown below to install your PCI-PDISO16 hardware

1. Turn your computer off, unplug it, open it up and insert the PCI-PDISO16 into any available PCI slot.

2. Close your computer up, plug it back in and turn it on.

3. Windows 95 will automatically detect the board as it starts up. If the board's configuration file is already on the system, it will load without user interaction. If the configuration file is not detected, you will be prompted to insert the disk containing it. The required file is on the InstaCal disk you received with your board. The appropriated file will then be automatically loaded and the PCI board will appear in the Device Manager under DAS components.

4. Open "Control Panel" and start "Add/Remove Programs". Insert the *InstaCal* disk (if it's not already in your floppy drive) and click install.

You will then be prompted for some information. Follow the instructions and if possible accept the defaults. If this is your first installation, we urge you to accept the defaults. It will be easier to assist you in the event of trouble with default settings.

If you have purchased the Universal Library programmers library, the INSTALL.EXE program will install all the software required to run the PCI-PDISO16 as well as *UniversalLibrary* programming language support.

When you have completed this part of the installation, please proceed to section "2.3, Run *InstaCal*".

2.2 DOS and/or Windows 3.1

Most users are now installing boards on systems with Windows 95 or higher operating systems. However, if you wish to install the PCI-PDISO16 board in a machine running Windows 3.1 and/or DOS please refer the section below.

The software is easy to install. First, insert the disk labeled *InstaCal* into a floppy drive.

DOS installation

WARNING!

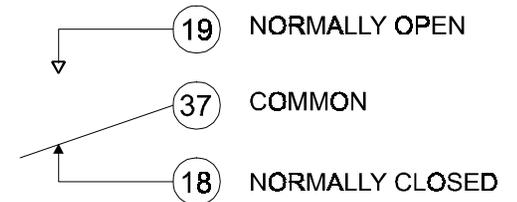
High voltages will be present on the PCI-PDISO16 board when you have connected high voltage inputs or outputs to the PCI-PDISO16 connector. Use extreme caution! Never handle the PCI-PDISO16 when signals are connected to the board through the connector.

DO NOT REMOVE THE PROTECTIVE PLATES FROM THE PCI-PDISO16.

4.2 Form C Relay Configuration

Shown here is the schematic for a form C relay.

The form C relay has a COMMON, normally open (NO) and normally closed (NC) contact.



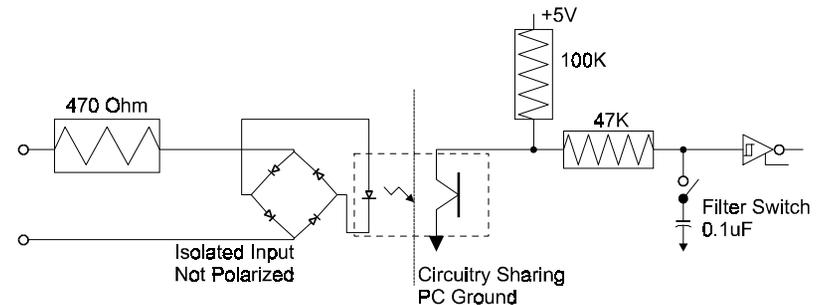
When a 0 is written to the output, the common and NC are in contact.

When a 1 is written to the output the common and NO are in contact.

FORM C RELAY

4.3 Isolated Input Configuration

There are 8 isolated input channels. The schematic of a single channel is shown here.



The signals are routed through a bridge rectifier so that the inputs are not polarity sensitive. The specifications for an input are:

Range 5-24VDC or 5-24VAC (50-1000Hz) NOT TTL compatible.
Isolation 500V

Chapter 4: CONNECTIONS & I/O INTERFACE

This short, simple introduction to the electronics most often needed by digital I/O board users covers a few key concepts. They are:

Connector diagram.

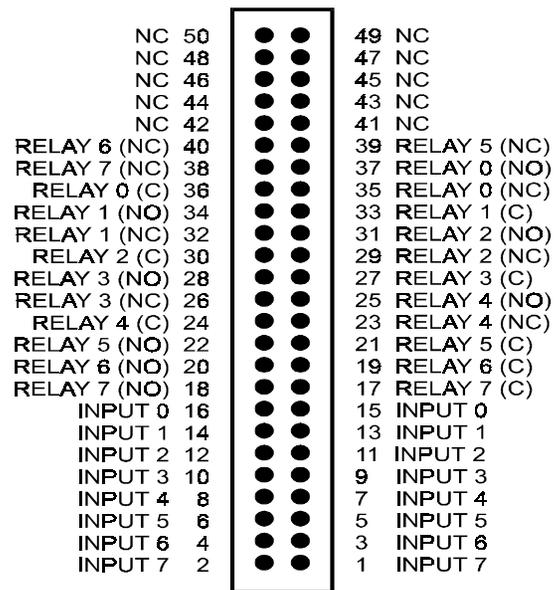
FORM C relay outputs.

Isolated inputs.

Adding a resistor to expand the range of the isolated inputs.

4.1 Connector Diagram

The PCI-PDISO16 use two 50-pin connectors for signal I/O. The pin-outs of the connector are shown below.



If you are installing the board from DOS, type (drive A: is used in this example):

```
A:INSTALL
```

Windows 3.x installation

If you are installing from one of the Windows 3.x, use the RUN function and

```
RUN A:\INSTALL.EXE (assuming the disk is in your A: drive)
```

You will then be prompted for some information. Please follow the instructions and if possible accept the defaults. If this is your first installation, we urge you to accept the defaults. It will be easier to assist you in the event of trouble if you accept the defaults.

If you have purchased the Universal Library programmers library for DOS, Windows and Windows 95, the INSTALL.EXE program will install all the software required to run the PCI-PDISO16 as well as UniversalLibrary programming language support.

When have completed this part of the installation, please proceed to section “2.3, Run InstaCal”.

2.3 Run InstaCal

Prior to starting InstaCAL, reboot your computer so the various changes made to your start up files are active.

From the DOS prompt you may start InstaCAL by simply typing: *InstaCal* and hitting enter.

From Window 3.x, use the file manager to find InstaCAL.exe. It should be on your main hard drive in a directory called C:\CB. (if C:\ is your main hard drive). To launch InstaCAL, simply double click on the file InstaCAL.exe. Now please proceed to section 2.3 and complete your installation.

From Win95, use “Start: Run”, type instacal at the prompt and click OK.

InstaCal is the Installation, Calibration and Test software supplied with all I/O boards. If you have a PCI board installed in a PCI slot in your computer, the first message InstaCal displays is

```
PCI BoardType Detected
A PCI-PDISO16 has been detected in Slot #
```

A dialog box opens asking you if you wish to install the software configuration for a PCI-PDISO16. You should choose yes.

Two additional dialog boxes will open. One shows the boards currently installed in your configuration file, the second allows you to choose a board number to assign to the PCI-PDISO16. If this is your first installation simply hit enter to accept the default of BOARD 0.

If you have other boards already installed, choose a board number not currently in use. InstaCAL will do the rest of the initial installation of your PCI board selecting addresses and other system resource settings which are not your choice to select. *In PCI systems, these settings are assigned by the plug & play system software.*

InstaCal help is available by pressing the F1 function key. Most of InstaCal is intuitively obvious and for that reason there is no user's manual for InstaCal.

The only user selectable option on the PCI-PDISO16 is the configuration of the input filters. InstaCal allows you to set the filter state. The default condition is disabled.

The PCI-PDISO16 requires eight I/O addresses. The addresses are allocated by the PCI plug & play procedure and may not be modified. If you have installed ISA bus boards in the past you are familiar with the need to select a base address and interrupt level. On PCI systems this is not of concern to you. It is not up to you to select a base address and ensure that it does not conflict with an installed port. In PCI systems, the operating software and installation software do the selection and checking for you.

The program InstaCal selects and sets the I/O address from the range of available addresses. The address and other information is stored in the configuration file CB.CFG. This file is accessed by the Universal Library for programmers. Note also that the Universal Library is the I/O board interface for packaged applications such as Labtech Notebook and HP-VEE, therefore the InstaCal settings must be made in order for these and other applications to run.

The board's base address is also stored in the system software. Once InstaCal installation software is run, other programming methods such as direct IN and OUT statements can write and read the PCI-PDISO16 registers by reference to the base address and the offset from base address corresponding to the chart of registers located elsewhere in this manual.

But a word of warning is in order here. Direct writes to the addresses simply by reference to the base address of the PCI-PDISO16 I/O registers is not advised. Since the addresses assigned by the PCI plug & play software are not under your control, there is no way to guarantee that your program will run in any other computer.

Not only that, but if you install another PCI board in a computer after the PCI-PDISO8 addresses have been assigned, those addresses may be moved by the plug & play software when the second board is installed. It is best to use a library such as

BIT No.	7	6	5	4	3	2	1	0
HEX Value	80	40	20	10	8	4	2	1
DECIMAL	128	64	32	16	8	4	2	1

3.4 Input Filter Control Registers

Register Address: Base Address + 3 (port A) or Base Address + 6 (port B)

READ: No function

WRITE: Filter selection 1 = Filter enabled, 0 = Filter disabled

FILTER #	IP7	IP6	IP5	IP4	IP3	IP2	IP1	IP0
BIT No.	7	6	5	4	3	2	1	0
HEX Value	80	40	20	10	8	4	2	1
DECIMAL	128	64	32	16	8	4	2	1

Microsoft Basic though the logic used is easily translated to any programming language.

```
INPBYTE% = INP(BADR+1)
INP7% = INPBYTE% AND &H80
IF INP7% <> 0 THEN ISOINP$ = "ON" ELSE ISOINP$ = "OFF"
```

The code above shows how to determine the state of a particular input. It is this type of logical bit testing that is required to check inputs independently.

3.2 Output Registers

The output register is located at the PCI-PDISO16 Base Address + 0 (port A) and Base Address + 4 (port B).

WRITE = CONTROL: Write a byte to the register to control the relays. A one in the relay bit position turns the relay on.

READ = STATUS: Read the status of the relay control register. A one in the relay bit position indicates the relay is on.

ON & OFF for FORM C RELAYS:

On means that FORM C relay common is in contact with the Normally Open contact. Off means that FORM C relay common is in contact with the normally closed contact.

RELAY	OP7	OP6	OP5	OP4	OP3	OP2	OP1	OP0
BIT No.	7	6	5	4	3	2	1	0
HEX Value	80	40	20	10	8	4	2	1
DECIMAL	128	64	32	16	8	4	2	1

3.3 Input Registers

The isolated input register is located at the PCI-PDISO16 Base Address + 1 (port A) and Base Address + 5 (port B).

WRITE = NO FUNCTION

READ = STATUS: Read the status of the isolated inputs. A one in the input bit position indicates that a voltage is present at the input.

INPUT #	IP7	IP6	IP5	IP4	IP3	IP2	IP1	IP0
----------------	------------	------------	------------	------------	------------	------------	------------	------------

Universal Library or a program such as HP-VEE to make measurements with your PCI-PDISO8.

2.4 Testing The Installation

After you have run the install program and set your base address with InstaCal, it is time to test the installation. The following section describes the InstaCal procedure to test that your board is properly installed.

With InstaCal running, choose the *TEST* item on the main menu.

- a. Select the board you just installed
- b. Select **Internal Test**
- c. The internal control registers of the board will then be tested. If this test is successful, your board is installed correctly.
- d. If the **Internal Test** is completed successfully, you may want to check that the I/O pins are working correctly. To check this select **External Test** and follow the instruction provided. This will require an external voltage source and an ohmmeter.

2.5 AC INPUT FILTER

The inputs are 8 individual, optically isolated (500V) inputs that may be read back as a single byte. The inputs are not polarity sensitive and may be driven by either A.C. (50 - 1000 Hz) or D.C. in the range 5V - 24. Each input has a software enabled/disabled low-pass filter with a time constant of 5mS (200Hz).

The input filters are described and set by InstaCAL. The filter must be used for A.C. inputs and should be used for almost all D.C. inputs. Unless you have reason to turn off a filter, we recommend it be enabled.

Chapter 3: PROGRAMMING

3.1 Address Register Map

The PCI-PDISO16 is easy to program. two 8-bit registers are written to control the 16 relays, two 8-bit registers are read to monitor the 16 digital inputs and two 8-bit registers are written to enable/disable the low pass filters on the inputs. The board is configured as two independent 8-bit I/O ports. Each of the 8-bit ports uses distinct I/O addresses and connectors. For descriptive purposes we will call them I/O Port A and I/O Port B. The overall address/register map is shown below: group

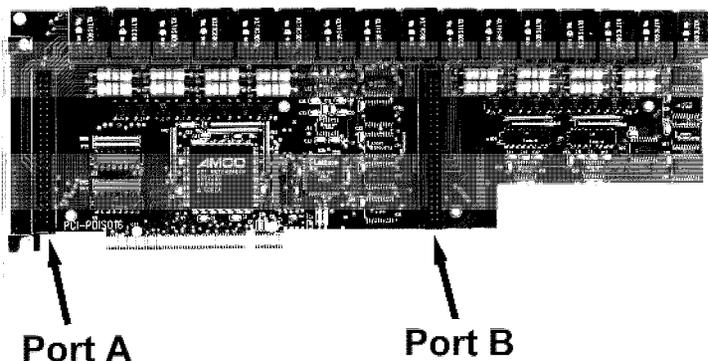
PORT A (see diagram for connector location)

BASE ADDRESS	Relay Output	Read/Write
BASE + 1	Isolated Inputs	Read Only
BASE + 2	Filter Control	Write Only
BASE + 3	Not Used*	

PORT B (see diagram for connector location)

BASE + 4	Relay Output	Read/Write
BASE + 5	Isolated Inputs	Read Only
BASE + 6	Filter Control	Write Only
BASE + 7	Not Used*	

*Although the PCI-PDISO16 decodes eight addresses, only six are used.



The registers are written to and read from as single 8-bit bytes. Each bit controls an output or represents the state of a device or input. Registers are read left to right. The leftmost bit being the most significant bit. Following this format bit 7, of BASE+0 corresponds to relay 7 and bit 0 to relay 0.

To construct a control word, use the following table:

BIT No.	<u>7</u>	<u>6</u>	<u>5</u>	<u>4</u>	<u>3</u>	<u>2</u>	<u>1</u>	<u>0</u>
HEX Value	80	40	20	10	8	4	2	1
DECIMAL	128	64	32	16	8	4	2	1

To assemble a control byte:

<u>RELAY</u>	<u>HEX</u>	<u>ON=1</u>	<u>WEIGHT</u>	<u>DECIMAL</u>	<u>ON=1</u>	<u>WEIGHT</u>
OP7	80	1	80	128	1	128
OP6	40	0	0	64	0	0
OP5	20	1	20	32	1	32
OP4	10	0	0	16	0	0
OP3	8	1	8	8	1	8
OP2	4	0	0	4	0	0
OP1	2	1	2	2	1	2
OP0	1	1	1	1	1	1
			AB			171

The isolated inputs are read in this format as well. To disassemble the byte and determine the state of the isolated inputs or the relay read back register, perform the following operation in software:

<u>INPUT/RELAY</u>	<u>HEX</u>	<u>DECIMAL</u>
IP7/OP7	80	128
IP6/OP6	40	64
IP5/OP5	20	32
IP4/OP4	10	16
IP3/OP3	8	8
IP2/OP2	4	4
IP1/OP1	2	2
IP0/OP0	1	1

Perform an AND operation for each bit to see if it is on.. In this example the variable INPBYTE% is the isolated input byte read from BASE+1. This example is in