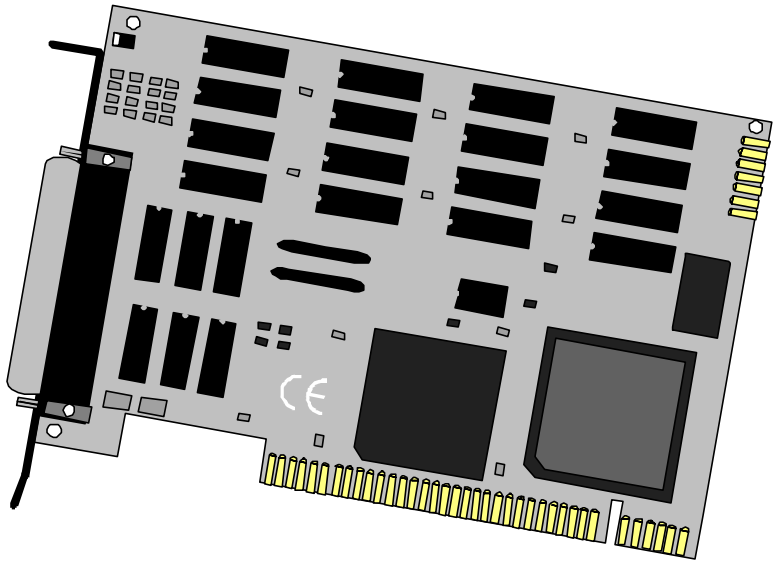
SEALEVEL
SYSTEMS INCORPORATED

DIO-32.PCI ™
USER MANUAL



Part # 8004

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Introduction

Overview

The **DIO-32.PCI** provides 16 reed relays that can latch power, data or other electronic signals for control applications and 16 optically isolated inputs to allow monitoring of off board switch closures, relays or for any other general purpose monitoring needs. The **DIO-32.PCI** is PCI 2.1 bus compliant. Addressing, data and control signals are TTL compatible.

What's Included

The **DIO-32.PCI** is shipped with the following items. If any of these items are missing or damaged, contact the supplier.

- **DIO-32.PCI** Interface Adapter
- Sealevel Systems' Software

Installation

Card Setup

The **DIO-32.PCI** is a fully compliant PCI 'Plug and Play' adapter. All card resources (i.e. I/O address and IRQ) are auto-assigned by either your system BIOS or your 'Plug and Play' operating system.

For Windows Users

Choose **Install Software** at the beginning of the CD and select the **Digital I/O** software drivers and install **SeaIO.System Installation**.

The **DIO-32.PCI** can be installed in any of the PCI expansion slots.

1. Turn off PC power. Disconnect the power cord.
2. Remove the PC case cover.
3. Locate an available PCI slot and remove the blank metal slot cover.
4. Gently insert the **DIO-16.PCI** into the slot. Make sure that the adapter is seated properly.
5. Replace the screw.
6. Replace the cover.
7. Connect the power cord. Installation is complete.

Technical Description

The **DIO-32.PCI** provides four parallel input/output (I/O) ports. The ports are organized as ports A, B, C, and D. Port A and B are input ports interfaced to optically-isolated inputs, while ports C and D are reed relay output ports. Assuming an I/O address of 300 Hex the following table shows the Port Addresses.

Base Address	Hex	Decimal	Mode
Port A Address	300	768	Input Port (Opto Input)
Port B Address	301	769	Input Port
Port C Address	302	770	Output Port (Reed Relays)
Port D Address	303	771	Output Port

Features

- Selectable I/O port addressing from 100H - 3FFH
- 2 sets SPST relays with each set having 8 relays
- 2 eight bit input ports
- DB-37 male connector for relay outputs
- DB-37 female connector for optically isolated inputs
- Highly reliable 10 VA DIP reed relays utilized
- Multiple adapters can reside in same computer
- All address, data and control signals are TTL compatible

Input Ports

Ports A and B are 8 bit input ports connected to optically isolated input sensors. Each sensor can be used to interface a voltage input and then sense whether the voltage is on or off. Each sensor is isolated (with respect to a common ground) from every other sensor, and also isolated with respect to the host PC ground. This means that signals such as low-level AC line voltage, motor servo voltage, and control relay signals can be 'sensed', or read by the PC, without the risk of damage due to ground loops or ground faults.

Each sensor input pair has a current limiting resistor that is used to limit the input current to the opto-isolator. The opto-isolator has two 'back-to-back' diodes internally. This allows AC or DC signals to be sensed, regardless of polarity. When the applied voltage is high enough to cause the led in the opto-isolator to turn-on, the output of the opto-isolator goes low (0 volts) and the signal is read as a low logic level (binary 0) by the PC. When the input signal is too low to turn on the opto-isolator, the output goes high and the port bit is read by the PC as a high logic level (binary 1).

The input impedance of each isolated input is approximately 560 ohms (factory default). The opto-isolator requires approximately 3 mA to turn on. The maximum input current is 60 mA. Two things to consider when selecting the input resistor. The first is turn on voltage for the circuit to sense, and second is the maximum input voltage. Maximum input voltage must not provide too much power to the input resistor, and must also not overdrive the opto-isolator input current specification. The following formulas apply:

Turn on current: 3 mA
Isolator diode drop: 1.1 V
Resistor power Max: .25 W

Turn on Voltage = diode drop + (turn on current) x (resistance)
Or :

$$1.1 + (.003) \times R$$

Maximum voltage = square root of (.25 (resistor value))

The following table shows four common input resistors and the ranges associated with each .

Input Resistor (Ohms)	Value Turn-On (Volts)	Max Input Range (Volts)	Max Current (mA)
220	1.76	7	27
560	2.8	12	20
1K	4.1	16	15
2.2K	7.7	24	10

The maximum input voltage can be increased by increasing the input resistor accordingly. Because socketed DIP resistor networks are utilized, they can easily be replaced with a different value. This can be done at the factory, if necessary. The input circuits are not intended for monitoring 120 volt AC circuits. In addition to being too high a voltage for the circuits, it is dangerous to have that high a voltage on the card.

Sensor Input Ports Pin Assignments

(DB-37 Female Labeled as Input)

Port A Bit	P1	Port B Bit	P1
0	18,37	0	10,29
1	17,36	1	9, 28
2	16,35	2	8,27
3	15,34	3	7,26
4	14,33	4	6,25
5	13,32	5	5,24
6	12,31	6	4,23
7	11,30	7	3,22
Ground	2,20,21		
+ 12 Volts	19		
+ 5 Volts	1		

Output Ports (Reed Relay)

Reed relays provide very high quality, long life, low current (10 Watt maximum), dry contact switch closures. Reed relays are not suited for high current applications, and can be destroyed by inductive load switching, where a spark occurs across the contacts internally. The relays are normally open, and close when energized. Each relay can be individually energized by writing a '1' to the proper port bit.

Relay Specifications

- Contact Power Ratings: 10 Watts Maximum
- Contact Voltage Maximum: 100 Volts DC or AC Maximum
- Contact Current Maximum: .5 Amps DC or AC RMS
- Contact Resistance, Initial: .15 Ohms
- Rated Life:
  Low Load: 200 Million Closures
  Maximum Load: 100 Million Closures
- Contact Speed:
  Operate: .5 mS
  Release: .5 mS
  Bounce: .5 mS
- Maximum Operating Speed: 600 Hertz

Output Ports (Reed Relay) Pin Assignments

(DB-37 Male Labeled as Output)

Port C Bit	Relay	P2 Pin	Port D Bit	Relay	P2 Pin
0	K16	2,20	0	K8	10,28
1	K15	3,21	1	K7	11,29
2	K14	4,22	2	K6	12,30
3	K13	5,23	3	K5	13,31
4	K12	6,24	4	K4	14,32
5	K11	7,25	5	K3	15,33
6	K10	8,26	6	K2	16,34
7	K9	9,27	7	K1	17,35
Ground	18,36,37				
+ 5 Volts	19				
+ 12 Volts	1				

Software

The **DIO-32.PCI** ships with Sealevel Systems' SeaI/O suite of Windows 95/98/NT drivers. SeaI/O provides the user with a consistent and straightforward API, allowing the developer to concentrate on the details of the application as opposed to low level driver development. Popular development environments, including Visual C++, Visual Basic, and Delphi, are supported for application development. SeaI/O includes a utility for configuring the driver parameters under Windows 95/98 and Windows NT, further simplifying installation.

For DOS, QNX, Linux and other operating systems, please refer to the software included with your card.

Programming

Application Programmers Interface (API)

Most modern operating systems do not allow direct hardware access. The SeaIO driver and API have been included to provide control over the hardware in Windows and Linux environments.

The purpose of this section of the manual is to help the customer with the mapping of the API to the actual inputs and relays for the 8004 specifically. Complete documentation of the API can be found in its accompanying help file.

Interrupts

Interrupt sampling can be set up in the API. Port A bit zero is the interrupt source. Refer to the API help file for more detailed information.

Relative Addressing vs. Absolute Addressing

The SeaIO API makes a distinction between "absolute" and "relative" addressing modes. In absolute addressing mode, the Port argument to the API function acts as a simple byte offset from the base I/O address of the device. For instance, Port #0 refers to the I/O address base + 0; Port #1 refers to the I/O address base + 1.

Relative addressing mode, on the other hand, refers to input and output ports in a logical fashion. With a Port argument of 0 and an API function meant to output data, the first (0^{th}) output port on the device will be utilized. Likewise, with a Port argument of 0 and an API function designed to input data, the first (0^{th}) input port of the device will be utilized.

In all addressing modes, port numbers are zero-indexed; that is, the first port is port #0, the second port is #1, the third #2, and so on.

Tables : API Port/bit reference numbers for Absolute and Relative Addressing
R = Read
W = Write
R/W = Read or Write

Port	API Port # Absolute Address (function)	API Port # Relative Address (function)	Port Type
A	0 (R)	0 (R)	Input Port (Opto Input)
B	1 (R)	1 (R)	Input Port
C	2 (R/W)	0 (W)	Output Port (Reed Relays)
D	3 (R/W)	1 (W)	Output Port

API Bit # Absolute Address (function)	API Bit # Relative Address (function)	Port Bit
0 (R)	0 (R)	A0 - Input
1 (R)	1 (R)	A1 - Input
2 (R)	2 (R)	A2 - Input
3 (R)	3 (R)	A3 - Input
4 (R)	4 (R)	A4 - Input
5 (R)	5 (R)	A5 - Input
6 (R)	6 (R)	A6 - Input
7 (R)	7 (R)	A7 - Input
8 (R)	8 (R)	B0 - Input
9 (R)	9 (R)	B1 - Input
10 (R)	10 (R)	B2 - Input
11 (R)	11 (R)	B3 - Input
12 (R)	12 (R)	B4 - Input
13 (R)	13 (R)	B5 - Input
14 (R)	14 (R)	B6 - Input
15 (R)	15 (R)	B7 - Input
16 (R/W)	0 (W)	C0 - Output
17 (R/W)	1 (W)	C1 - Output
18 (R/W)	2 (W)	C2 - Output
19 (R/W)	3 (W)	C3 - Output
20 (R/W)	4 (W)	C4 - Output
21 (R/W)	5 (W)	C5 - Output
22 (R/W)	6 (W)	C6 - Output
23 (R/W)	7 (W)	C7 - Output
24 (R/W)	8 (W)	D0 - Output
25 (R/W)	9 (W)	D1 - Output
26 (R/W)	10 (W)	D2 - Output
27 (R/W)	11 (W)	D3 - Output
28 (R/W)	12 (W)	D4 - Output
29 (R/W)	13 (W)	D5 - Output
30 (R/W)	14 (W)	D6 - Output
31 (R/W)	15 (W)	D7 - Output

Direct Hardware Control

In systems where the users program has direct access to the hardware (DOS) the table below gives the mapping and functions that the 8004 provide. The address of each eight-bit port is calculated as shown in the table on the following page, the cards base address plus an offset.

Reading the Inputs (direct) :

The inputs are active Low. If no voltage is applied across one of the differential inputs it returns a one on that bit. If an AC or DC voltage (of sufficient magnitude, covered above) is applied it returns a zero on that bit.

Reading the Outputs (relays) (direct) :

The relay ports return the ones complement of the value that is currently being used to drive the relays. When using the API the value is returned not the complement of the value.

Writing the Outputs (relays) (direct) :

The output ports are the only ports that can be written. The relays on a standard 8004 are normally open. To close a relay a one must be written to the appropriate bit.

Interrupts

Interrupts can be set up as shown on the following page. Port A bit zero is the interrupt source.

R = Read
W = Write
R/W = Read or Write

Function Available	Port	Address Hex	Port Type
R	A	Base + 0	Input Port (Opto Input)
R	B	Base + 1	Input Port
R/W	C	Base + 2	Output Port (Reed Relays)
R/W	D	Base + 3	Output Port

Register Description

Address	Mode	D7	D6	D5	D4	D3	D2	D1	D0
Base+0	R	PAD7	PAD6	PAD5	PAD4	PAD3	PAD2	PAD1	PAD0
Base+1	R	PBD7	PBD6	PBD5	PBD4	PBD3	PBD2	PBD1	PBD0
Base+2	R/W	PCD7	PCD6	PCD5	PCD4	PCD3	PCD2	PCD1	PCD0
Base+3	R/W	PDD7	PDD6	PDD5	PDD4	PDD3	PDD2	PDD1	PDD0
Base+4	R	{0}	{0}	{0}	{0}	{0}	{0}	{0}	{0}
Base+5	R/W	IRQEN	IRQST	{0}	{0}	{0}	{0}	IRC1	IRC0
Base+6	R	{0}	{0}	{0}	{0}	{0}	{0}	{0}	{0}
Base+7	R	{0}	{0}	{0}	{0}	{0}	{0}	{0}	{0}

Note: All ports are set to input after reset or power up. Interrupt source is Base+0 bit D0. When selecting the Interrupt Mode, always disable interrupts prior to changing or setting states. This will help prevent inadvertent or un-expected interrupts from occurring. When using the high and low level interrupts, a change in state of the input must occur before the interrupt can be cleared. The device providing the input to Base +0, bit D0 must do this.

PAD0-7 = Port A (Base+0)
PBD0-7 = Port B (Base+1)
PCD0-7 = Port C (Base+2)
PDD0-7 = Port D (Base+3)

IRC0-1= Interrupt Mode select (Base+5)

IRC1	IRC0	
0	0	low level
0	1	high level
1	0	falling edge
1	1	rising edge

IRQEN = enable interrupts (Base+5)
0 = disabled
1 = enabled (disabled after reset or power up).

IRQST = interrupt status (Base+5)
1 = interrupt pending (reading the bit clears interrupt). Bit can not be written.

Specifications

Environmental Specifications

Specification	Operating	Storage
Temperature Range	0º to 50º C (32º to 122º F)	-20º to 70º C (-4º to 158º F)
Humidity Range	10 to 90% R.H. Non-Condensing	10 to 90% R.H. Non-Condensing

Power Consumption

Supply line	+12 VDC	+5 VDC
Rating	Optional Use	450mA

Mean Time Between Failures (MTBF)

MTBF is calculated as greater than 150,000 hours, **excluding relays**. Relay Life expectancy is dependent on actual application usage.

Physical Dimensions

Board length	6.00 inches	(15.24 cm)
Board Height including Goldfingers	4.2 inches	(10.668 cm)
Board Height excluding Goldfingers	3.825 inches	(9.716 cm)

Note: Please see Appendix D for board layout and dimensions.

Appendix A - Troubleshooting

Following these simple steps can eliminate most common problems without the need to call Technical Support.

1. Install software **first**. After installing the software then proceed to adding the hardware. This places the required installation files in the correct locations.

2. Identify all I/O adapters currently installed in your system. This includes your on-board serial ports, controller cards, sound cards etc. The I/O addresses used by these adapters, as well as the IRQ (if any) should be identified.

3. Ensure that there is no conflict with currently installed adapters. No two adapters can occupy the same I/O address and may not be allowed to share IRQs.

4. Make sure the Sealevel Systems adapter is securely installed in a motherboard slot.

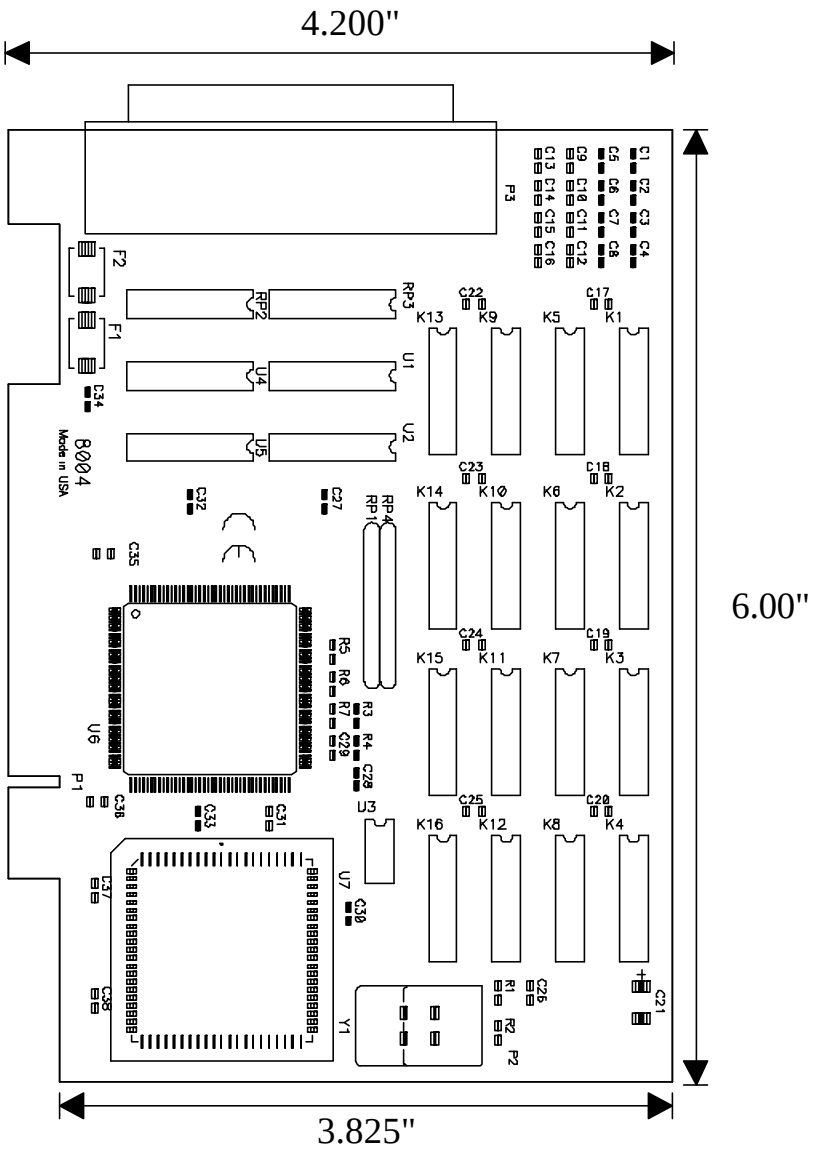
Appendix B - How To Get Assistance

Please refer to Troubleshooting Guide prior to calling Technical Support.

1. Read this manual thoroughly before attempting to install the adapter in your system.
2. When calling for technical assistance, please have your user manual and current adapter settings. If possible, please have the adapter installed in a computer ready to run diagnostics.
3. Sealevel Systems maintains a Home page on the Internet. Our home page address is www.sealevel.com. The latest software updates, and newest manuals are available via our FTP site that can be accessed from our home page.
4. Technical support is available Monday to Friday from 8:00 a.m. to 5:00 p.m. eastern time. Technical support can be reached at (864) 843-4343.

RETURN AUTHORIZATION MUST BE OBTAINED FROM SEALEVEL SYSTEMS BEFORE RETURNED MERCHANDISE WILL BE ACCEPTED. AUTHORIZATION CAN BE OBTAINED BY CALLING SEALEVEL SYSTEMS AND REQUESTING A RETURN MERCHANDISE AUTHORIZATION (RMA) NUMBER.

Appendix C - Silk-Screen



Appendix D - Compliance Notices

Federal Communications Commission Statement

FCC - This equipment has been tested and found to comply with the limits for 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 such case the user will be required to correct the interference at his own expense.

EMC Directive Statement

Products bearing the CE Label fulfill the requirements of the EMC directive (89/336/EEC) and of the low-voltage directive (73/23/EEC) issued by the European Commission.

To obey these directives, the following European standards must be met:

- **EN55022 Class A** - "Limits and methods of measurement of radio interference characteristics of information technology equipment"
- **EN55024**-'Information technology equipment Immunity characteristics Limits and methods of measurement.
- **EN60950 (IEC950)** - "Safety of information technology equipment, including electrical business equipment"

Warning

This is a Class A Product. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.

Always use cabling provided with this product if possible. If no cable is provided or if an alternate cable is required, use high quality shielded cabling to maintain compliance with FCC/EMC directives.

Warranty

Sealevel Systems, Inc. provides a lifetime warranty for this product. Should this product fail to be in good working order at any time during this period, Sealevel Systems will, at it's option, replace or repair it at no additional charge except as set forth in the following terms. This warranty does not apply to products damaged by misuse, modifications, accident or disaster.

Sealevel Systems assumes no liability for any damages, lost profits, lost savings or any other incidental or consequential damage resulting from the use, misuse of, or inability to use this product. Sealevel Systems will not be liable for any claim made by any other related party.

RETURN AUTHORIZATION MUST BE OBTAINED FROM SEALEVEL SYSTEMS BEFORE RETURNED MERCHANDISE WILL BE ACCEPTED. AUTHORIZATION CAN BE OBTAINED BY CALLING SEALEVEL SYSTEMS AND REQUESTING A RETURN MERCHANDISE AUTHORIZATION (RMA) NUMBER.

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Technical Support is available from 8 a.m. to 5 p.m. Eastern time.
Monday - Friday

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