Model DIO8-P
Product Manual

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FOREWARD

This product manual provides information to install, operate and or program the referenced product(s) manufactured or distributed by Industrial Computer Source. The following pages contain information regarding the warranty and repair policies.

Technical assistance is available at: **1-800-480-0044**.

Manual Errors, Omissions and Bugs: A "Bug Sheet" is included as the last page of this manual. Please use the "Bug Sheet" if you experience any problems with the manual that requires correction.

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Refunds

In order to receive a full refund on a product purchase price, the product must not have been damaged by the customer or by the common carrier chosen by the customer to return the goods, and the product must be returned complete (meaning all manuals, software, cables, etc.) within 30 days of receipt and in as-new and resalable condition. The **Return Procedure** must be followed to assure prompt refund.

Restocking Charges

Product returned *after* 30 days, and *before* 90 days, of the purchase will be subject to a **minimum** 20% restocking charge and any charges for damaged or missing parts.

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One year limited warranty on all products sold with the exception of the "Performance Series" I/O products, which are warranted to the original purchaser, for as long as they own the product, subject to all other conditions below, including those regarding neglect, misuse and acts of God. Within one year of purchase, Industrial Computer Source will repair or replace, at our option, any defective product. At any time after one year, we will repair or replace, at our option, any defective "Performance Series" I/O product sold. This does not include products damaged in shipment, or damaged through customer neglect or misuse. Industrial Computer Source will service the warranty for all standard catalog products for the first year from the date of shipment. After the first year, for products not manufactured by Industrial Computer Source, the remainder of the manufacturer's warranty, if any, will be serviced by the manufacturer directly.

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Shipments not in compliance with this Guarantee and Limited Warranty Return Policy will not be accepted by Industrial Computer Source.

Return Procedure

For any Limited Warranty or Guarantee return, please contact Industrial Computer Source's Customer Service at **1-800-480-0044** and obtain a Return Material Authorization (RMA) Number. All product(s) returned to Industrial Computer Source for service or credit **must** be accompanied by a Return Material Authorization (RMA) Number. Freight on all returned items **must** be prepaid by the customer who is responsible for any loss or damage caused by common carrier in transit. Returns for Warranty **must** include a Failure Report for each unit, by serial number(s), as well as a copy of the original invoice showing date of purchase.

> To reduce risk of damage, returns of product must be in an Industrial Computer Source shipping container. If the original container has been lost or damaged, new shipping containers may be obtained from Industrial Computer Source Customer Service at a nominal cost.

Limitation of Liability

In no event shall Industrial Computer Source be liable for any defect in hardware or software or loss or inadequacy of data of any kind, or for any direct, indirect, incidental, or consequential damages in connection with or arising out of the performance or use of any product furnished hereunder. Industrial Computer Source liability shall in no event exceed the purchase price of the product purchased hereunder. The foregoing limitation of liability shall be equally applicable to any service provided by Industrial Computer Source or its authorized agent.

Some *Sales Items* and *Customized Systems* are **not** subject to the guarantee and limited warranty. However in these instances , any deviations will be disclosed prior to sales and noted in the original invoice. ***Industrial Computer Source reserves the right to refuse returns or credits on software or special order items.***

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Current Revision 5B

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Chapter 1: Introduction

The DIO8-P is a half-size card that provides isolated input and output interface for PC/XT/AT and compatible computers. The card provides eight optically-isolated inputs for AC or DC control signals and eight electromechanical relay outputs. DIO8-P occupies four consecutive addresses in I/O space. Read and write operations are done on an 8-bit-byte oriented basis. The DIO8-P is designed to be CE Compliant when used in a CE Compliant chassis.

Inputs

The isolated inputs can be driven by either AC or DC signals and are not polarity sensitive. Input signals are rectified by a diode bridge and connected across an LED diode of an opto-isolator. A 470-ohm resistor in series dissipates unused power. Standard 12/24 AC control transformer outputs can be accepted as well as DC voltages. The input voltage range is 5 to 24 volts (rms). External resistors connected in series may be used to extend the input voltage range by providing a voltage divider circuit designed to limit the voltage input to the board.

Each input circuit contains a selectable filter that has a 10 millisecond time constant. (Without filtering, the response is 20 µSec.) The filter **must** be selected for AC inputs in order to eliminate response to zero crossings. The filter is also valuable for use with slow DC input signals in a noisy environment. The filter may be switched out for DC inputs in order to obtain faster response. Filters are individually selected by switch S2.

Outputs

The electromechanical relay outputs are comprised of five FORM C SPDT outputs (normally closed) and three FORM A SPST (normally open) type. The relays are all de-energized at power-on. Data to the relays is latched by a write to the base address. On/off status of the relays can be read back by a read at the base address.

Specifications

Digital Inputs

Number of inputs

8

Type

Non-polarized, optically isolated from each other and from the computer. (**not** TTL/CMOS compatible)

Voltage Range

5 to 24V DC or AC (50 to 1000 Hz)

Isolation

500V channel-to-ground or channel-to channel

Input Resistance

470 ohms in series with two diodes and an LED

Response Time

10 mSec w/filter, 20 uSec w/o filter

Relay Outputs

Number of outputs

8

Contact Rating

2A carry current, bifurcated, gold clad, silver palladium

Contact Arrangement

Channels 0-4 are SPDT Form C
Channels 5-7 are SPST Form A

Contact Resistance

Initial 100 milliohms maximum

Contact Life

Mechanical

10 million operations minimum

Electrical

5 million operations minimum at full load

Operating Time

5 milliseconds maximum

Release Time

5 milliseconds maximum

Power

+5VDC @ 0.5A (all relays ON)

Environmental

Ambient Temperature

Operating: 0° to +50°C

Storage

-20° to +70°C

Humidity

0 to 90% (non-condensing)

Weight

Approx. 8 oz.

Agency Approvals

CE Conformity with:

EU EMC Directive 89/336/EEC

EU Low Voltage Directive 72/23/EEC

CE

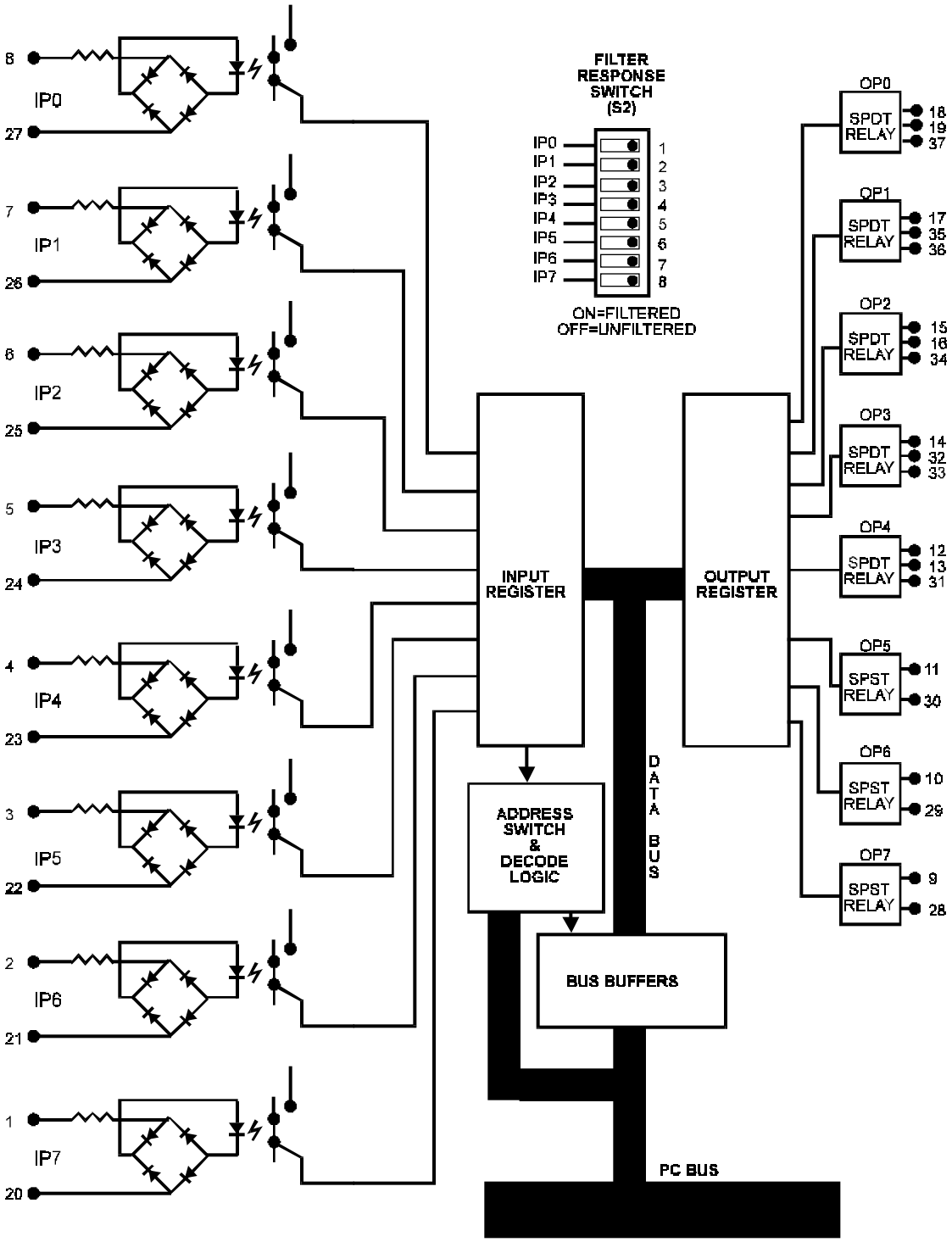


Figure 1: DIO8-P Block Diagram

Chapter 2: Installation

Installation Overview

To do a complete installation, perform the following:

1. Set the base address of the card.
2. Set the filter response switch.
3. Perform the Installation Precheck Procedure.
4. Install the board.

Address Selection

DIO8-P occupies four consecutive addresses in I/O space although only two addresses are used. The base or starting address can be selected anywhere within the I/O address range 000-3FF provided that it does not cause an overlap with other functions. If in doubt about what base address to use, the following table lists standard address assignments, addresses not listed in this table are generally available for I/O boards.

Hex Range	Usage
000-0FF	Internal System - Not Usable
1F0-1FF	AT Hard Disk
200-207	Game Control
278-27F	Parallel Port (LPT2)
238-23B	Bus Mouse
2E8-2EF	Asynchronous Communications (COM4)
2F8-2FF	Asynchronous Communications (COM2)
300-31F	Prototype Card
320-32F	XT Hard Disk
378-37F	Parallel Port (LPT1)
380-38F	SDLC Communications
3A0-3AF	SDLC Communications
3B0-3BB	MDA
3BC-3BF	Alt. Parrallel Port
3C0-3CF	EGA
3DO-3DF	CGA
3E8-3EF	Asynchronous Communications (COM3)
3F0-3F7	Floppy Disk
3F8-3FF	Asynchronous Communications (COM1)

The DIO8-P base address is set up by DIP switch S1. That switch controls address bits A2 through A9. (Lines A1 and A0 are used on the card to control individual registers. How these two lines are used is described in the Programming chapter of this manual.)

To determine how to set these switches for a desired hex-code address, refer to the Address Settings table. If you prefer to determine proper switch settings yourself, first convert the hex-code address to binary form (refer to the Address Values and Switch Settings table). Then, set the corresponding switch to ON for each "0" and set the corresponding switch to OFF for each "1".

The following example illustrates switch selection corresponding to hex 300 (or binary 11 0000 00xx). The "xx" represents address lines A1, and A0 used on the card to select individual registers as described in the Programming section of this manual.

	A9	**A8**	**A7**	**A6**	**A5**	**A4**	**A3**	**A2**
200H	OFF	ON	ON	ON	ON	ON	ON	ON
210H	OFF	ON	ON	ON	ON	OFF	ON	ON
220H	OFF	ON	ON	ON	OFF	ON	ON	ON
300H	OFF	OFF	ON	ON	ON	ON	ON	ON
310H	OFF	OFF	ON	ON	ON	OFF	ON	ON
320H	OFF	OFF	ON	ON	OFF	ON	ON	ON
350H	OFF	OFF	ON	OFF	ON	OFF	ON	ON

Table 1: Address Settings

Address Line	A11	A10	A9	A8	A7	A6	A5	A4	A3	A2	A1	A0
Binary Representation	0	0	1	1	0	0	0	0	0	0	0	0
Hex Representation	3					0			0			
Switch Setting			OFF	OFF	ON	ON	ON	ON	ON			

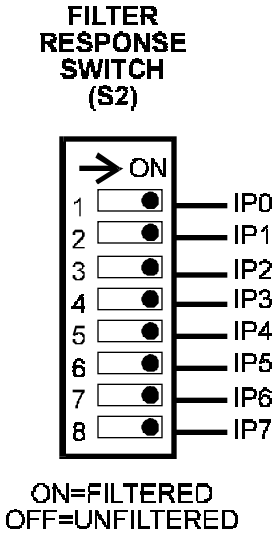
Table 2: Address Values and Switch Settings

ON=0 OFF=1

Note: Gray shading in table means these address lines are not available. Dashes indicate a byte or word boundry. Carefully review the address selection table on the preceding page before selecting the card address. If the addresses of two installed functions overlap, you will experience unpredictable computer behavior.

Filter Responce Switch

DIP switch S2 is used to select input filtering on a channel-by-channel basis. When S2-1 is ON, additional filtering is introduced for input bit 0, S2-2 for bit 1, etc.



This additional filtering provides a slower response. Use it when AC inputs are applied. It may also be used, if necessary, to clean up noisy DC signals.

Installation Precheck Procedure

The installation precheck procedure is designed to help you determine if the address you have selected for the board is actually free for use. In the following example we are testing for an address of hex 300, but any other address may be substitued.

1. Type DEBUG at the DOS prompt and the press the Enter key. The DOS directory must be in your path statement or you must change to the DOS subdirectory before running this application. You get a "-" prompt indicating that you have succesfully entered the DEBUG DOS application.
2. Type **i 300** at the DEBUG "-" prompt and press the Enter key. This reads I/O address H300. DEBUG returns an **FF** if the address is not currently in use. If a value other than **FF** is returned, the address is being used by another board. Try each address in the table on the previous page until an **FF** is returned.

   For information about the various functions available through DEBUG, simply type a **?** at the prompt and press the Enter key.
3. Repeat step 2 for the next three addresses, since the board uses four consecutive addresses. For example, if **300** checked out, check **301**, **302**, and **303**. Each of these addresses should also return an **FF**.
4. Type a **q** and press the Enter key to exit DEBUG.
5. Turn off the computer in preparation for installing the circuit board. If you haven't already done so, set the address switches in accoradance with the directions in the previous section.

Installing the Board

To install the board, perform the following steps:

1. Turn off the computer and remove the cover of the case.
2. Select an empty, standard size slot and remove the screw at the top of the slot's backplate.
3. Remove the backplate.
4. Plug the board into the empty slot. Ensure that the board is firmly seated in the slot.
5. Reinstall the screw removed in step 2. Ensure that the board is securely fastened in place.
6. Reinstall the cover of the case.

How to remain CE Compliant

In order for machines to remain CE compliant, only CE compliant parts may be used. To keep a chassis compliant it must contain only compliant cards, and for cards to remain compliant they must be used in compliant chassis. Any modifications made to the equipment may affect the CE compliance standards and should not be done unless approved in writing by Industrial Computer Source.

The Model DIO8-P is designed to be CE Compliant when used in an CE compliant chassis. Maintaining CE Compliance also requires proper cabling and termination techniques. The user is advised to follow proper cabling techniques from sensor to interface to ensure a complete CE Compliant system. Industrial Computer Source does not offer engineering services for designing cabling or termination systems. Although Industrial Computer Source offers accessory cables and termination panels, it is the user's responsibility to ensure they are installed with proper shielding to maintain CE Compliance.

Chapter 3: Programming

The DIO8-P card occupies four consecutive addresses in PC I/O space but only two addresses are used. The base or starting address is selected during installation and will fall on a four bit boundary. DIO8-P read functions as follows:

I/O ADDRESS	READ
Base +0	Read/Write Relay Output
Base +1	Read Isolated Inputs
Base +2	Not Used
Base +3	Not Used

Digital Inputs

Digital input states are read as a single byte from the port at Base Address +1. Each of the eight bits within the byte corresponds to a particular digital input. A “1” signifies that the input is energized and a “0” signifies that the input is de-energized.

Bit Position	D7	D6	D5	D4	D3	D2	D1	D0
Digital Input	IP7	IP6	IP5	IP4	IP3	IP2	IP1	IP0

Input Examples:

```
BASIC:
BASEADDR=&H300                          ‘Set the I/O address to 300 Hex.
DATAIN%=INP(BASEADDR+1)                 ‘Read data byte into DATAIN%.
IF (DATAIN% AND &H01)=&H01 THEN IP0=1 ‘Using individual bit masks, check the
IF (DATAIN% AND &H02)=&H02 THEN IP1=1 ‘condition of each individual input.
IF (DATAIN% AND &H04)=&H04 THEN IP2=1
IF (DATAIN% AND &H08)=&H08 THEN IP3=1
IF (DATAIN% AND &H10)=&H10 THEN IP4=1
IF (DATAIN% AND &H20)=&H20 THEN IP5=1
IF (DATAIN% AND &H40)=&H40 THEN IP6=1
IF (DATAIN% AND &H80)=&H80 THEN IP7=1
C:
base_addr = 0x300;              /* Sets the I/O address to H300.  */
data_in = inportb(base_addr+1) /* Reads the data byte into data_in.  */
for (x = 0; x < 8; x++) {       /* Check the status of individual bits using */
if (data_in & 0x01 == 0x01)     /* a shiftand mask procedure, rather */
ip[x] = 1;                      /* than 8 separate masks. */
data_in = data_in >> 1;
}
```

Relay Ouputs

At power-up, all relays are initialized in the de-energized state. The current state of the relays can be determined at any time by a **read** operation at the Base Address. The relay outputs are controlled by **writing** to the Base Address. Data is written to all eight relays as a single byte. Each bit within the byte controls a specific relay. A "1" energizes the corresponding relay and a "0" turns it off.

Bit Position	D7	D6	D5	D4	D3	D2	D1	D0
Relay Controlled	OP7	OP6	OP5	OP4	OP3	OP2	OP1	OP0

For example, if bit D5 is turned on by writing hex 20 to the base address, then the relay that controls OP5 is energized, closing the associated normally open contacts. All other relays are-energized and normally-closed contacts are closed while normally open contacts are opened.

Normally Open			**Normally Closed**				
OP0	OP1	OP2	OP3	OP4	OP5	OP6	OP7

0=De-energized (Normally open will be open. Normally closed will be closed.)

1=Energized (Normally open will be closed. Normally closed will be opened.)

Output Examples:

```
BASIC:
BASEADDR=&H300                          ' Set I/O address to H300.
OUT BASEADDR, &H81                      ' Turn on OP0 and OP7, turn off
                                        '  OP1 through OP6.
DATA_IN(BASEADDR)                       ' Turn on OP0 and OP7 without affecting
OUT BASEADDR, &H81 OR DATA_IN           ' OP1 through OP6.
C:
base_addr=0x300;                              /* Set the I/O address to H300*/
outporb(base_addr, 0x81);                     /* Turn on OP0 and OP7, turn off */
                                              /* OP1 through OP6. */
outportb(base_addr, (inportb(base_addr)|0x81)); /* Turn on OP0 and OP7 without */
                                              /* affecting OP1 through OP6 */
```

Peek and Poke Driver for Windows 95/NT

This driver allows developers to write Win32 programs which access hardware I/O ports and physical memory. This should allow easier testing of hardware components since they can be accessed without the use of a specific driver.

It should be noted that this driver will give application level access to areas of the hardware and memory which can quite easily crash the operating system or even corrupt data. Care needs to be taken to only access known memory or I/O ports.

Using The Library

There are two libraries that can be used to ease use of the Peek and Poke driver. They are pplib95.lib and pplibnt.lib. They are used for Windows 95 and Windows NT respectively. These libraries provide I/O routines familiar to those who have used Microsoft compilers in the past.

To use a library, add pplib95.lib or pplibnt.lib to your link, whichever is appropriate for the target OS. Include pplib95.h or pplibnt.h in the C/C++ file you will be accessing the functions from. These libraries are compatible with all Microsoft compilers. NOTE: These libraries are not thread safe.

The following is a list of the functions provided by the library.

Function	Description
BOOL ics_pp_open (void)	Opens the Peek and Poke driver. Returns TRUE if successful. This must be called before any calls are made to the other library functions.
void ics_pp_close (void)	Closes the driver. Should be called before the application exits.
void *ics_pp_make_pointer (int page, int length)	This function is used to allow access to a particular region of physical memory by a Win32 application. page is the starting page of the physical memory. length is the size of the region in pages. For example, for a pointer to a region of physical memory starting at 0xA0000 and 64k long: void *ptr = ics_pp_make_pointer (0xA0, 0x10); The pointer can then be treated as a standard C/C++ pointer. NOTE: Be sure to release this memory region back to the system with a call to ics_pp_release_pointer. (See Below.)
void ics_pp_release_pointer (void *address, int length)	This function is used to release a memory mapping made with ics_pp_make_pointer. It is important to release such pointers back to the system. Failure to do so could affect the way the system runs even after the application has exited. address is the address that was returned by the ics_pp_make_pointer function. length is the size of the mapped region in pages.
int _outp (USHORT port, int data) USHORT _outpw (USHORT port, USHORT data) ULONG _outpl (USHORT port, ULONG data)	These functions output data to the given port. Use _outp for byte width, _outpw for word width, and _outpl for double word width.
Int _inp (USHORT port) USHORT _inpw (USHORT port) ULONG _inpl (USHORT port)	These functions return data input from the given port. Use _inp for byte width, _inpw for word width, and _inpl for double word width.

PeekPoke Driver for Windows NT Installation

This driver allows developers to write WinNT programs which access hardware I/O ports and physical memory.

Installing the Windows NT PeekPoke Driver

Under Windows NT 3.51:

- From the Program Manager, click on File->Run.
- Type a:\setup and press OK.

From Windows NT 4.0

- From the Start Menu, select Run.
- Type a:\setup and press OK.

The InstallShield installer will initialize and run. Follow the on-screen instructions. You will need to provide one piece of information:

- The destination path for the driver files.

When the files are transferred, you will be asked if you want to reboot the computer. The drivers will not work until after a reboot.

PeekPoke Driver for Windows 95 Installation

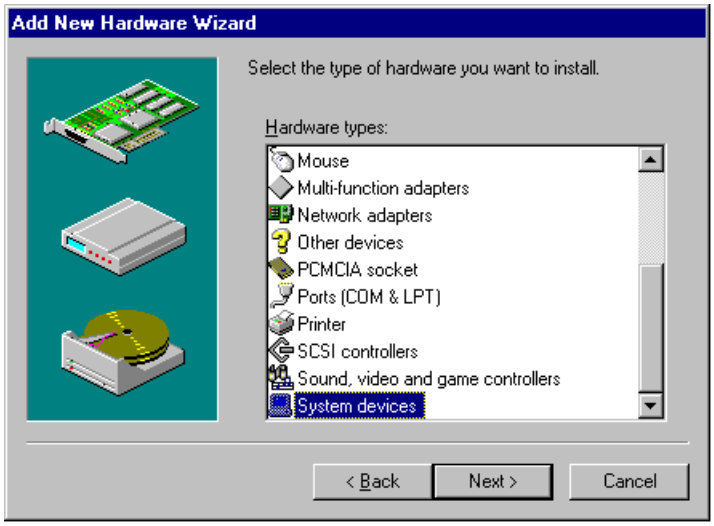
This driver allows developers to write Win95 programs which access hardware I/O ports and physical memory.

Installing the Windows 95 PeekPoke Driver

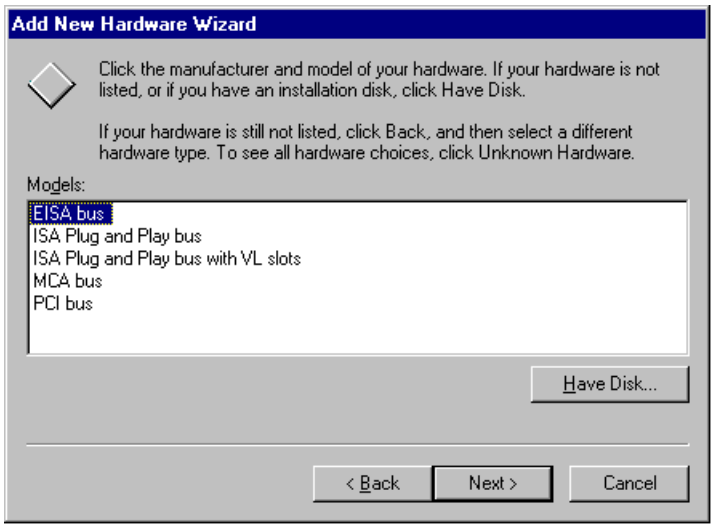
- From the Start Menu, select Settings->Control Panel.
- From the Control Panel, select Add New Hardware.

- Click the Next button.

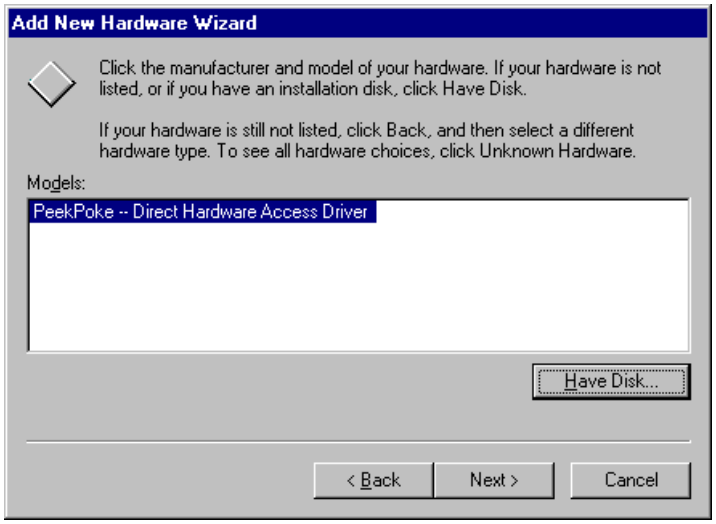
- Answer “No” to the question, “Do you want Windows to search for you new hardware?”
- Press the Next button.



- Scroll the hardware types list down and select the “System devices” type.
- Press the Next button.



- Press the Have Disk button.
- Insert your disk labeled “Windows 95 PeekPoke Driver Disk.”
- Make sure “A:\” is selected as the source.
- Press OK.



- The model "PeekPoke – Direct Hardware Access Driver" should be selected in the Models box.
- Press the Next button.
- Windows 95 will copy the driver's files onto your system.
- Press the Finish button.
- At this point, you will need to shutdown and reboot your machine for the changes to take effect.

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Chapter 4: Connector Pin Assignments

Analog and digital I/O signals are connected to the DIO8-P via a 37-pin D type connector that extends through the back of the computer case. The mating connector is an AMP 747304-1 or equivalent. The wiring may be directly from the signal sources or may be on ribbon cable from screw terminal accessory boards such as the STA-37. Pin assignments are as follows:

Pin	Name	Function
1	IP7	Digital Input Bit 7
2	IP6	Digital Input Bit 6
3	IP5	Digital Input Bit 5
4	IP4	Digital Input Bit 4
5	IP3	Digital Input Bit 3
6	IP2	Digital Input Bit 2
7	IP1	Digital Input Bit 1
8	IP0	Digital Input Bit 0
9	OP7(C)	Bit 7 Relay Common
10	OP6(C)	Bit 6 Relay Common
11	OP5(C)	Bit 5 Relay Common
12	OP4(NC)	Bit 4 Relay, Normally Closed-Contact
13	OP4(NO)	Bit 4 Relay, Noramally Open-Contact
14	OP3(C)	Bit 3 Relay Common
15	OP2(NC)	Bit 2 Relay, Normally Closed-Contact
16	OP2(NO)	Bit 2 Relay, Normally Open-Contact
17	OP1(C)	Bit 1 Relay Common
18	OP0(NC)	Bit 0 Relay, Normally Closed-Contact
19	OP0(NO)	Bit 0 Relay, Normally Open-Contact
20	IP7	Digital Input Bit 7
21	IP6	Digital Input Bit 6
22	IP5	Digital Input Bit 5
23	IP4	Digital Input Bit 4
24	IP3	Digital Input Bit 3
25	IP2	Digital Input Bit 2
26	IP1	Digital Input Bit 1
27	IP0	Digital Input Bit 0
28	OP7(NO)	Bit 7 Relay, Normally Open-Contact
29	OP6(NO)	Bit 6 Relay, Normally Open-Contact
30	OP5(NO)	Bit 5 Relay, Normally Open-Contact
31	OP4(C)	Bit 4 Relay Common
32	OP3(NC)	Bit 3 Relay, Normally Closed-Contact
33	OP3(NO)	Bit 3 Relay, Normally Open-Contact
34	OP2(C)	Bit 2 Relay Common
35	OP1(NC)	Bit 1 Relay, Normally Closed-Contact
36	OP1(NO)	Bit 1 Relay, Normally Open-Contact
37	OP0(C)	Bit 0 Relay Common

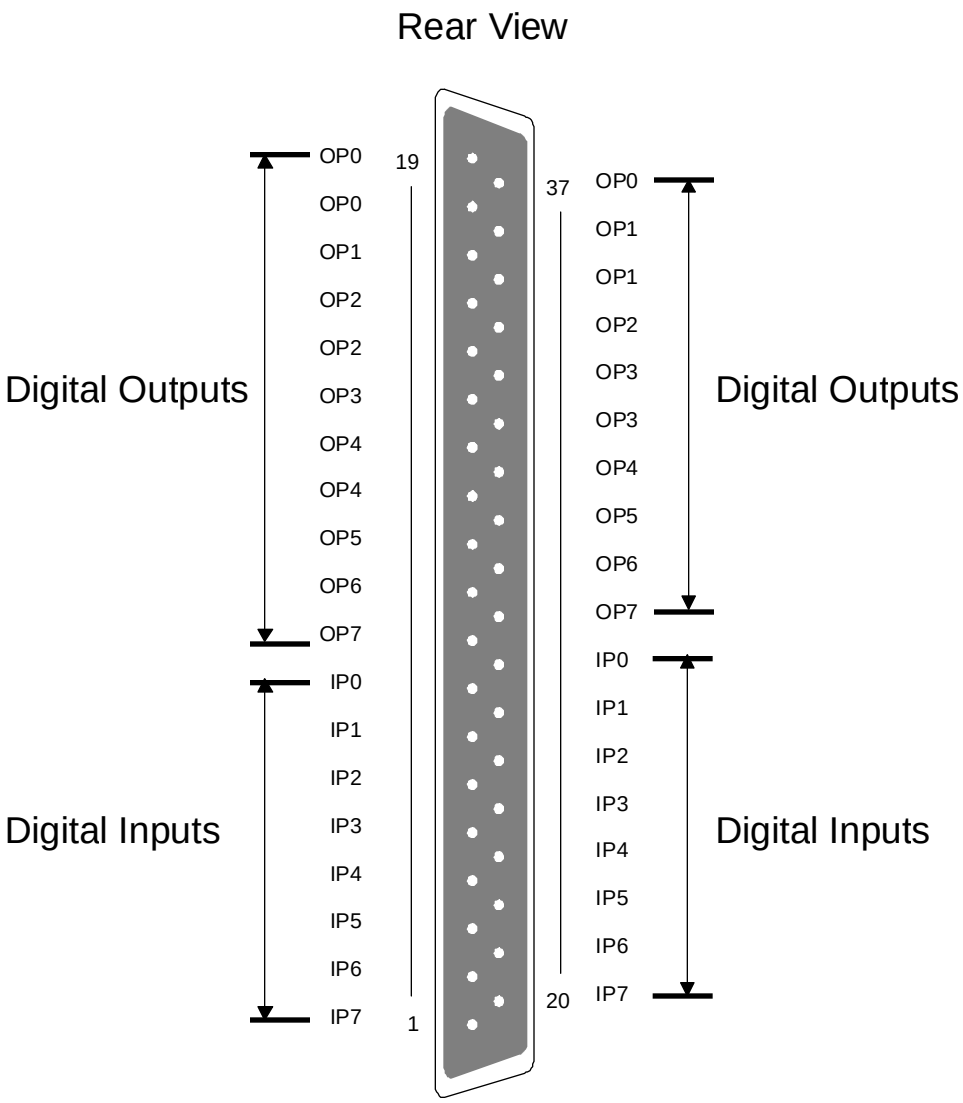

Figure 2: DIO8-P 37-Pin Connector

Declaration of Conformity

(according to ISO/IEC Guide 22 and EN 45014)

INDUSTRIAL COMPUTER SOURCE®

6260 Sequence Drive
San Diego, CA 92121-4371
(800) 523-2320

declares, that the product:

DIO8-P

to which this declaration relates, meets the essential health and safety requirements and is in conformity with the relevant EU Directives listed below:

EU EMC Directive 89/336/EEC
EU Low Voltage Directive 72/23/EEC

using the relevant section of the following EU standards and other normative documents:

EN 50081-1:1992 Emissions, Generic Requirements.
-EN 55022 Measurement of radio interference charateristics of information technology equipment.

EN 50082-2:1995 Immunity, Generic Requirements.
-EN 61000-4-2 Immunity to Electrostatic Discharge.
-ENV 50140 Immunity for radiated RF electromagnetic fields.

EN 50082-1:1992 Immunity, Generic Requirements.
-IEC 801-3:1984 Immunity for radiated electromagnetic fields.
-IEC 801-4:1988 Immunity for AC and I/O lines, fast transient common mode.
-IEC 65A/77B Immunity for AC lines, transients, common, and differential mode.

EN 60950:1992 Safety of Information Technology Equipment.

September 17, 1997
San Diego, CA

Mr. Steven R. Peltier
President & Chief Executive Officer

Information supporting this declaration is contained in the applicable Technical Construction file available from:

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BUG REPORT

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