INDUSTRIAL COMPUTER SOURCE®

Model DIO24-P
Product Manual

MANUAL NUMBER : 00431-024-13B

INDUSTRIAL COMPUTER SOURCE® http:/www.indcompsrc.com

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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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Current Revision 13B

September 1997

Chapter 1: Introduction

Description

The DIO24-P parallel digital I/O card provides 24 TTL/DTL compatible digital I/O lines, interrupt input and enable lines and external connections to the IBM PC bus power supplies. It is a flexible interface for parallel input/output devices such as instruments and displays and user contructed systems and equipment.

24 digital I/O lines are provided through an 8255-5 programmable peripheral interface (PPI) IC. These 24 lines are divided into three 8-bit ports, PA, PB, and PC. The PC port may also be further divided into two 4-bit ports PC-Upper and PC-Lower. Each of the ports may be configured as an input or an output by software control according to the contents of a write only register in the 8255. Each port may be read as well as written to. In addition, the 8255 has other modes of operation that allow unidirectional and bidirectional strobed I/O where the PC ports are used for control of data transfer and interrupt generation, etc. Refer to the 8255 data sheet located at the back of this manual for a complete technical description and summary of the various operating modes of the 8255.

Interrupt handling is via a tristate driver with separate enable (interrupt enable - active low). This may be connected to any of the interrupt levels 2-7 available on the IBM PC bus by means of a plug type jumper on the board. Handling of an interrupt is controlled by the 8259 interrupt controller on the PC and this is set by the BIOS on system initialization to respond to their requirements and set up corresponding interrupt handlers.

Power from the computer bus is available on the connector. Users should observe the current capacity limits of the bus. 1A fuses are provided on all power outputs.

The board format is half-size and will fit in any full or half-length slot in a PC/XT/AT or compatible computer running at any clock speed. Various termination boards are available such as the Industrial Computer Source Model UTB-K.

Features

- 24 Channels of Digital Input/Output
- Four and Eight Bit Ports Independently Selectable for I/O
- Unidirectional/Bidirectional Strobed I/O
- Hysteresis on I/O Lines
- Interrupt Handling

Applications

- Security Systems, Energy Management
- Relay Monitoring and Control
- Parallel Data Transfer to PC
- Sensing Switches or Signals, or TTL, DTL, CMOS Logic
- Driving Indicator Lights or Recorders

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 DIO24-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.

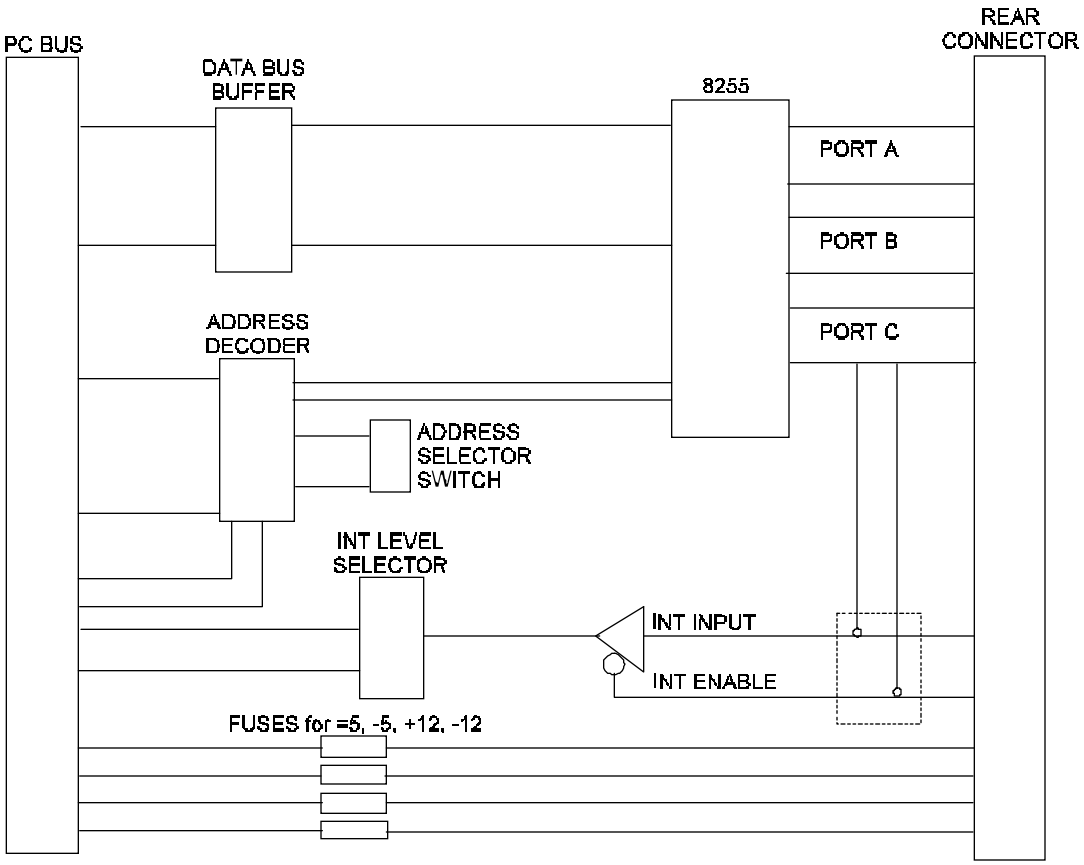


Figure 1: DIO24-P Block Diagram

Specifications

Size:

Half Slot

Environmental:

Operating Temperature:

0-60 deg. C

Storage Temperature:

-50 to +120 deg. C

Humidity:

0 to 90% non-condensing

Inputs and Outputs

Input/Output Lines:

24

Input Logic Low Voltage:

-0.5V Min to 0.8V Max

Input Logic High Voltage:

2.0V Min to 5.0V Max

Input Load Current:

-10uA Min to +10uA Max

Input Low Current, Interrupt Inputs:

-0.4mA

Input High Current, Interrupt Inputs:

20uA

Output Low Voltage:

0.45V Max

Output Low Current:

sink 1.7mA

Output High Voltage:

2.4V Min

Output High Current:

source 200uA

All outputs and inputs are TTL/DTL compatible and outputs will drive 1 standard TTL load or 4 LSTTL loads. CMOS compatiblity can be obtained by connecting a 10k Ohm pullup resistor from the input or output to +5V.

I/O Address Requirement:

4 Bytes

I/O Connector:

DB37 Male

Power Requirements:

170mA typical at +5V

Agency Approvals

CE Conformity with:

EU EMC Directive 89/336/EEC

EU Low Voltage Directive 72/23/EEC

CE

Chapter 2: Installation

Hardware Installation

The DIO24-P functions as a part of a complete computer monitoring or controlling system.

NOTE:

Installing or removing the DIO24-P board with power applied may cause physical damage to the DIO24-P, the computer or both. Turn off the power before installing or removing the I/O boards.

The DIO24-P requires 4 consecutive address locations in the I/O space. Some I/O address locations will be occupied by internal I/O and your other peripheral cards. To provide flexibility in avoiding conflict with these devices, the I/O board address can be set by the base address DIP switch to be on a 4-byte boundary anywhere in the decoded I/O space. This I/O address space extends from decimal 256 to 1023 (Hex 100 to 3FF) which is many times larger than is ever likely to be fully occupied. Such a large space also allows use of more than one DIO24-P in the same computer. Some of the address locations commonly used are listed in the table that follows. Refer to the "IBM Technical Reference Manual" for additional details.

ADDRESS	DEVICE	ADDRESS	DEVICE
000-0FF	Internal I/O	378-37F	Parallel Printer
1F0-1FF	Hard Disk (AT)	380-38F	SDLC Comm.
200-20F	Game Port	3A0-3AF	SDLC Comm
210-217	Expansion Unit	3B0-3BB	Mono Display
220-24F	Reserved	3BC-3BF	Parallel Printer
278-27F	Parallel Printer	3C0-3CF	Reserved
2F0-2F7	Reserved	3D0-3DF	Color Graphics
2F8-2FF	Serial Port	3E0-3E7	Reserved
300-31F	Prototype Card	3F0-3F7	Floppy Disk
320-32F	Hard Disk (XT)	3F8-3FF	Serial Port

This covers the standard IBM I/O options, but if you have other I/O peripherals e.g. special hard disk drives, special graphics boards, prototype cards, other analog and digital I/O etc., they may be using other I/O addresses. Memory addressing is separate from I/O addressing so there is no possible conflict with any add-on memory that you may have in your computer.

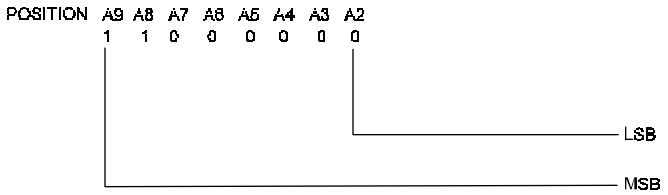
Usually, a good choice is to put the DIO24-P at base address Hex 280 (decimal 640) or Hex 300 (decimal 768). Note that the IBM Prototype card is address at Hex 300 and would conflict if installed.

Setting Base Address

It is easier to think in hexadecimal when determining I/O address. This avoids the decimal-to-hex or decimal-to-binary conversion required to set the switch. The following example shows how to set the switches:

1. Desired I/O address: &Hex 300
2. Binary value of address &Hex number

   &Hex 300 = 0011 0000 0000 Binary
3. Set switches with ON = 0 and OFF = 1. The lower 2 bits are factory set and are discarded while the upper two bits are always 0 and are not provided for on the switch. The switch is then set to (for Hex 300):



The switch positions mirror the bit pattern above with OFF = 1 = DOWN.

Interrupts

The DIO24-P provides for input channels 22 and 23 to generate hardware interrupts. These interrupts can be directed to any of the Interrupt Request Lines (IRQ 2, 3, 4, 5, 6, and 7) available on the 8-bit PC/XT/AT I/O expansion bus.

Pin 1 (Channel 23 is configured as an INTERRUPT INPUT and Pin 3 (Channel 22) is the INTERRUPT ENABLE on the DB37 connector. To use the interrupts, simply insert the appropriate IRQ jumper to select the desired interrupt channel. To determine which input generated the interrupt, read Port C Upper, bits 6 and 7, to read the current state of the inputs.

Jumper block J2 allows the user to “customize” the interrupt inputs to use pins 1 and 2 of the I/O connector. These jumpers are not normally used and interested users are directed to the schematic for additional details.

You should be aware that an interrupt will be generated if the IRQ jumper is inserted and Port C Upper is used as an output. This feature could be used to test an interrupt routine without external connections being required.

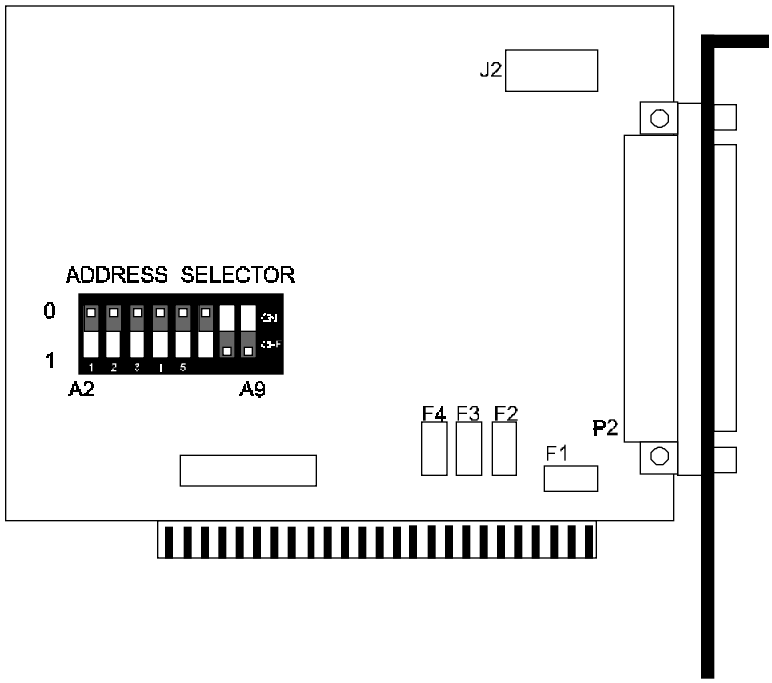


Figure 2: DIO24 Layout

Connector Pin Assignments

All digital I/O is through a standard DB37 male connector. A listing of all pinouts is shown on the schematic included in this manual.

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Chapter 3: Programming

The DIO24-P uses the 8255 PPI to provide the 24 bits of input and output. These I/O are divided into three ports, A, B, and C. Port C is further divided into two 4-bit ports, C-Lower and C-Upper.

The 8255 provides a Control Register at the card's base address+3. This is a write only, 8-bit register and is used to set the Mode and Direction of these 4 ports. On power-up or reset, all 24 I/O lines are set as inputs. The 8255 should be configured by writing to the Control Register before the chip's ports are accessed, even as inputs.

Register Access

The DIO24-P is mapped into 4 bytes on any four byte boundary in the IBM I/O space. The address definitions are:

BASE ADDRESS+	0	Port A	Read/Write
	1	Port B	Read/Write
	2	Port C	Read/Write
	3	Control Register	Write Only

To access the board from BASIC, for example:

1. Determine which ports are to be used for input and which for output. Determine the proper bit pattern to write to the Control Register as discussed in the following section.

   For example, a configuration of:

Port A	Input
Port B	Output
Port C-Upper	Input
Port C-Lower	Output

   would have a bit pattern of 1001 1000 (Hex 98). Use the BASIC OUT command to write to the Command Register:

   ```
   10 BASEADDR = &H300
   20 OUT BASEADDR+3, &H98
   ```

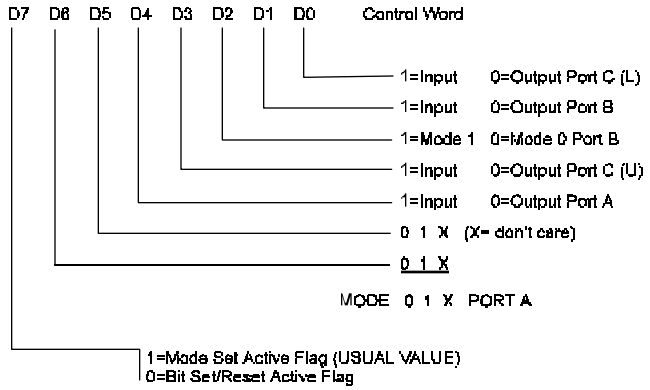
2. Port A and the upper 4 bits of Port C would be input ports and would be read. Port B and the lower 4 bits of Port C would be outputs and would be written to:

   ```
   30 X=INP(BASEADDR):Y=INP(BASEADDR+2)        'READ PORTS A,C
   40 PRINT X,Y                                'PRINT THE VALUES
   50 OUT BASEADDR+1,255                       'TURNON ALL PORT B
   60 OUT BASEADDR+2,15                        'TURNON 4 BITS OF C
   ```

Control Register

The 8255 has several input/output modes and the user is directed to the 8255 data sheet, included with this manual, for complete programming details. The following information will provide sufficient information for the majority of users.

Before the 8255 can be used, it must be configured. Each of the 8-bit ports A, B, and C can be selected as input or output ports and port C can also be selected as a control port. Note that the 8255 power-up default mode is with all ports configured for inputs and the chip can be used in that mode, although it is a good practice to "reconfigure" the chip for this mode even if that is the one you intend to use.



8255 Mode Definition Format

Modes of Operation

The 8255 offers 3 MODES of operation as set by bits 3, 6 and 7. Bit 3 sets the mode for port B and bits 6 & 7 for port A. Port C has no independent modes. The modes are described below (Mode 1 and 2 descriptions are provided for information only):

MODE 0 - Basic Input/Output - This is the standard PCDIO mode

MODE 1 - Strobed Input/Output

MODE 2 - Bi-directional Bus

Mode 0

This functional configuration provides simple input and output operations for each of the three ports. No "handshaking" is required, data is simply written to or read from a specified port.

Mode 0 Basic Functional Definitions:

- Two 8-bit ports and two 4-bit ports
- Any port can be input or output
- Outputs are latched
- Inputs are not latched
- 16 different Input/Output combinations are possible in this mode

Mode 1

This functional configuration provides a means for transferring I/O data to or from a specified port in conjunction with strobes or “handshaking” signals. In Mode 1, Port A and Port B use the lines on Port C to generate or accept these “handshaking” signals.

Mode 1 Basic Functional Definitions

- Two Groups (Group A and Group B)
- Each group contains one 8-bit data port and one 4-bit control/data port
- The 8-bit data port can be either input or output. Both inputs and outputs are latched
- The 4-bit port is used for control and status of the 8-bit data port

Mode 2

This functional configuration provides a means for communicating with a peripheral device or structure on a single 8-bit bus for both transmitting and receiving data (bidirectional bus I/O). “Handshaking” signals are provided to maintain proper bus flow discipline in a similar manner to MODE 1. Interrupt generation and enable/disable functions are also available.

Mode 2 Basic Functional Definitions

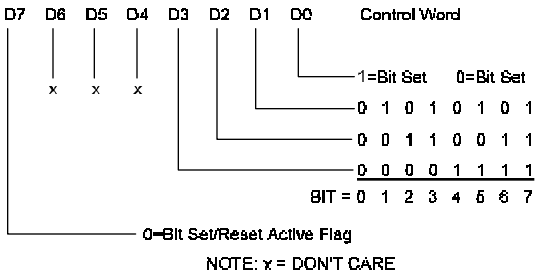
- Used in Group A only
- One 8-bit, bidirectional bus port (Port A) and a 5-bit control port (Port C)
- Both inputs and outputs are latched
- The 5-bit control port (Port C) is used for control and status for the 8-bit, bi-directional bus port (Port A)

Bit Set/Reset

Any of the eight bits of Port C can be Set or Reset using a single OUTput instruction. This feature reduces software requirements in control-based applications.

When Port C is being used as status/control for Port A or B, these bits can be set or reset by using the Bit Set/Reset operation just as if they were data output ports.

Bit 7 controls the Bit Set/Reset function. When bit 7=1 the port is a control port. When set to 0 the Bit Set/Reset function is used.



Bit Set/Reset Format

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

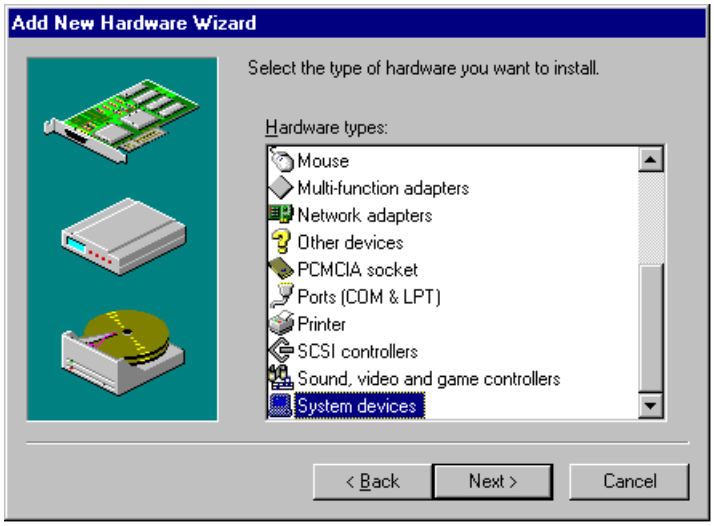
This driver allows developers to write Win95 programs which access hardware I/O ports and physical memory.

Installing the Windows 95 PeekPoke Driver

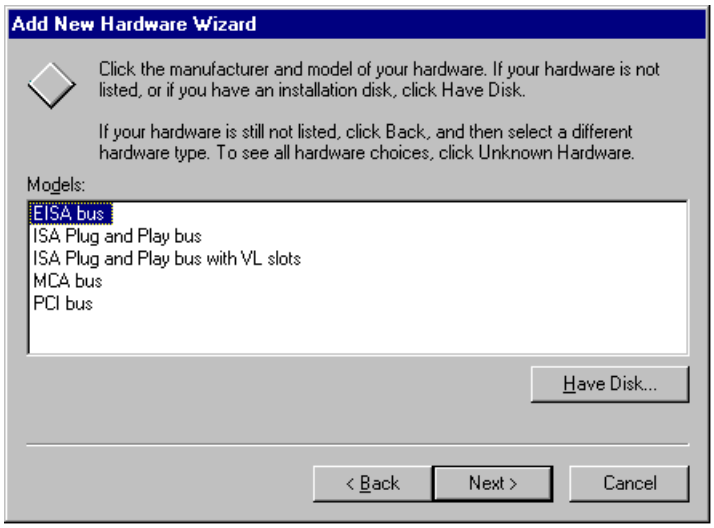
- From the Start Menu, select Settings->Control Panel.
- From the Control Panel, select Add New Hardware.

- Click the Next button.

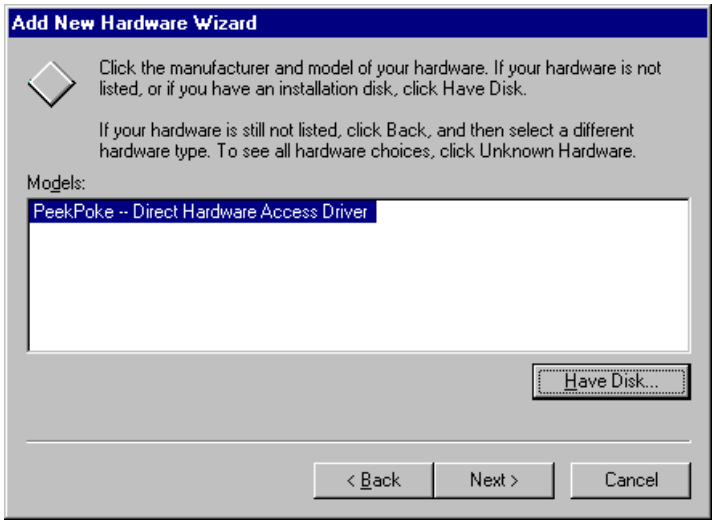
- Answer “No” to the question, “Do you want Windows to search for you new hardware?”
- Press the Next button.



- 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.

Appendix A: 8255 Data Sheet

The 8255 Data Sheet is available on request. Please contact Industrial Computer Source Automated Literature Request Line at 1-619-677-0877 ext. 3241.

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Declaration of Conformity

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

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declares, that the product:

DIO24-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

While we have tried to assure this manual is error free, it is a fact of life that works of man have errors. We request you to detail any errors you find on this BUG REPORT and return it to us. We will correct the errors/problems and send you a new manual as soon as available. Please return to:

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Product: **DIO24-P**

Manual Revision: **00431-024-13B**

Please list the page numbers and errors found. Thank you!