



ACCES I/O PRODUCTS INC
10623 Roselle Street, San Diego, CA 92121
Tel. (619)550-9559 FAX (619)550-7322

DIGITAL INPUT/OUTPUT CARD

IOD-24

USER MANUAL

NOTICES

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INSTALLING THE CARD

Before installing the card carefully read the ADDRESS SELECTION and OPTION SELECTION Sections of this manual and configure the card according to your requirements. Use the special software program called SETUP provided with the card. It supplies visual aids to configure all areas of the board.

Be especially careful with address selection. If the addresses of two installed functions overlap, you will experience unpredictable computer behavior. If unsure what locations are available, you can use the FINDBASE program to locate blocks of available addresses.

To install the card:

1. Remove power from the computer.
2. Remove the computer cover.
3. Remove blank I/O backplate.
4. Install jumpers for selected options. See OPTION SELECTION section of this manual.
5. Select the base address on the card. See ADDRESS SELECTION section of this manual.
6. Install the card in an I/O expansion slot. *Make sure that the card mounting bracket is properly screwed into place and that there is a positive chassis ground.*
7. Inspect for proper fit of the card and cables and tighten screws.
8. Replace the computer cover.

A 50-pin connector is provided on the mounting bracket for input/output connections. To ensure that there is minimum susceptibility to EMI and minimum radiation, it is important that the card mounting bracket be properly screwed into place and that there be a positive chassis ground. Also, proper EMI cabling techniques (cable connect to chassis ground at the aperture, shielded twisted pair wiring, etc.) must be used for the input/output wiring.

FUNCTIONAL DESCRIPTION

FEATURES

- 24 Channels of Buffered Digital Input/Output.
- Four and Eight Bit Groups Independently Selectable for I/O.
- Pull-Ups on I/O Lines.
- Bi-Directional Data Transfers Supported.
- Interrupt and Interrupt-Disable Capability.
- OPTO-22 Compatible 50-Pin Connector
- +5 V Supply Available to User.

APPLICATIONS

- Automatic Test Systems
- 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

FUNCTIONAL DESCRIPTION

Model IOD-24 is an economical 24-bit parallel digital input/output card. It is half size and can be installed in either long or short expansion slots of IBM PC/XT/AT or compatible computers. Each I/O line is buffered and capable of sourcing 15 mA or sinking 64 mA.

The card contains a Programmable Peripheral Interface chip type 8255-5 (PPI) which provides computer interface to 24 digital I/O lines. Three 8-bit ports A, B, and C can be configured to function as either inputs, or as output latches. Port C can be also configured as four inputs and four output latches. The card supports mode 0 of the 8255-5 PPI. Also, pull-up resistors on the card assure that all ports are programmed as inputs when power is applied. This assures that there will be no erroneous outputs until the card is initialized by the program.

Two I/O lines can be used to interface User Interrupts to the computer. Interrupts are buffered and are enabled by jumper installation or by a combination of jumper installation and a digital input line. You can use Interrupt levels #2 through #7.

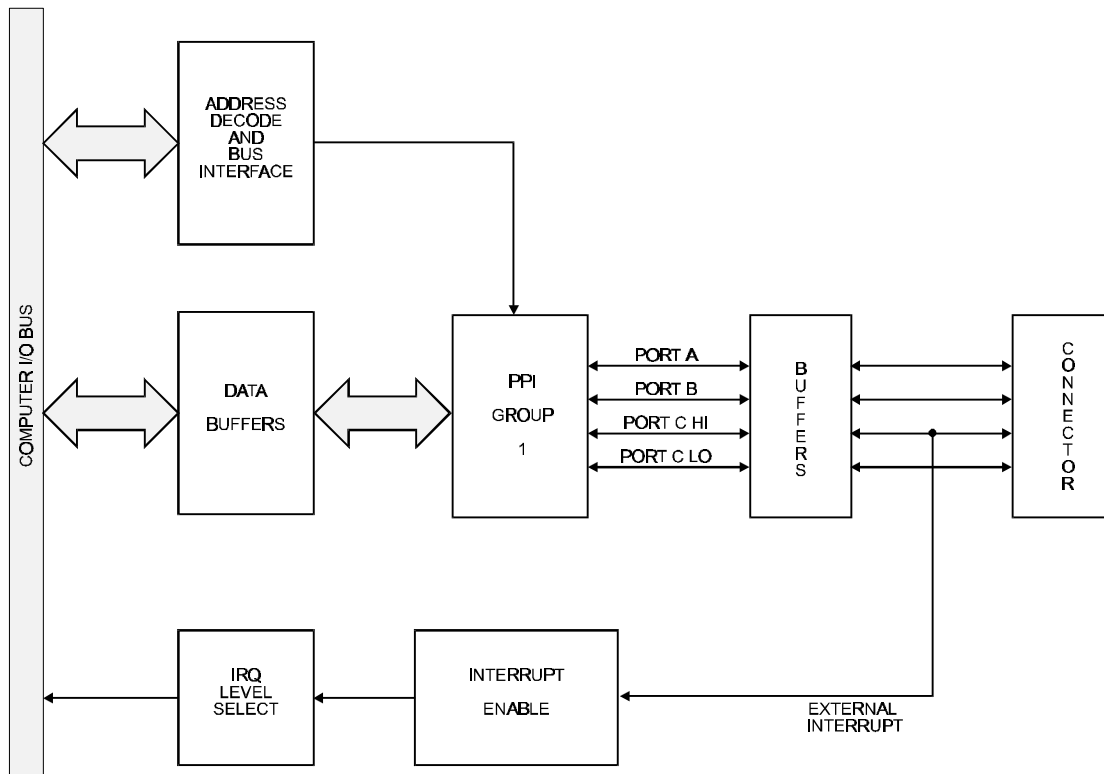
Input/Output wire connections are via a 50-pin connector at the rear of the computer. This provides compatibility with industry-standard module mounting racks from ACCES (A24A), OPTO-22, Gordos, Potter & Brumfield, et al.. Also, the connections are compatible with ACCES model STA-50 Screw Terminal Accessory Boards. Every second conductor of the flat cable is grounded to minimize the effect of crosstalk between signals.

If needed for external circuits, +5 VDC power is available at connector pin 49. There is a 1A fast-blow fuse provided on the card. This helps avoid possible damage to the host computer in the event of a malfunction in those external circuits.

IOD-24 occupies four consecutive bytes of I/O address space. The base address is selectable via a DIP switch anywhere within the range of 000-3FF hex. If in doubt how to select a base address, check your computer reference manual. For additional information about setting the base address of IOD-24, see the ADDRESS SELECTION section of this manual.

Utility software is provided on CD with the IOD-24 card. This software includes an illustrated setup program, and sample programs in C, Quickbasic and Pascal.

IOD-24 BLOCK DIAGRAM



OPTION SELECTION

Refer to the OPTION SELECTION MAP on the next page and the setup program provided on the CD supplied with the card when reading this section of the manual.

SETUP

This program is supplied with the IOD-24 as a tool for you to use in configuring the jumpers on the card. It is a menu-driven program that provides illustrations. You make simple keystrokes to select functions. The illustrations then show how to place the jumpers.

The setup program is a stand-alone program that can be run at any time. It does not require the IOD-24 to be plugged into the computer for any part of the setup. The program is self explanatory with operation instructions and on-line help.

SLOT 8

Install this jumper when the card is located in a short slot of the host computer.

WAIT

Install this jumper when the host computer clock speed is 8Mhz or more. This will automatically assert one wait state when the card is addressed.

INT 2,3,4,5,6,7

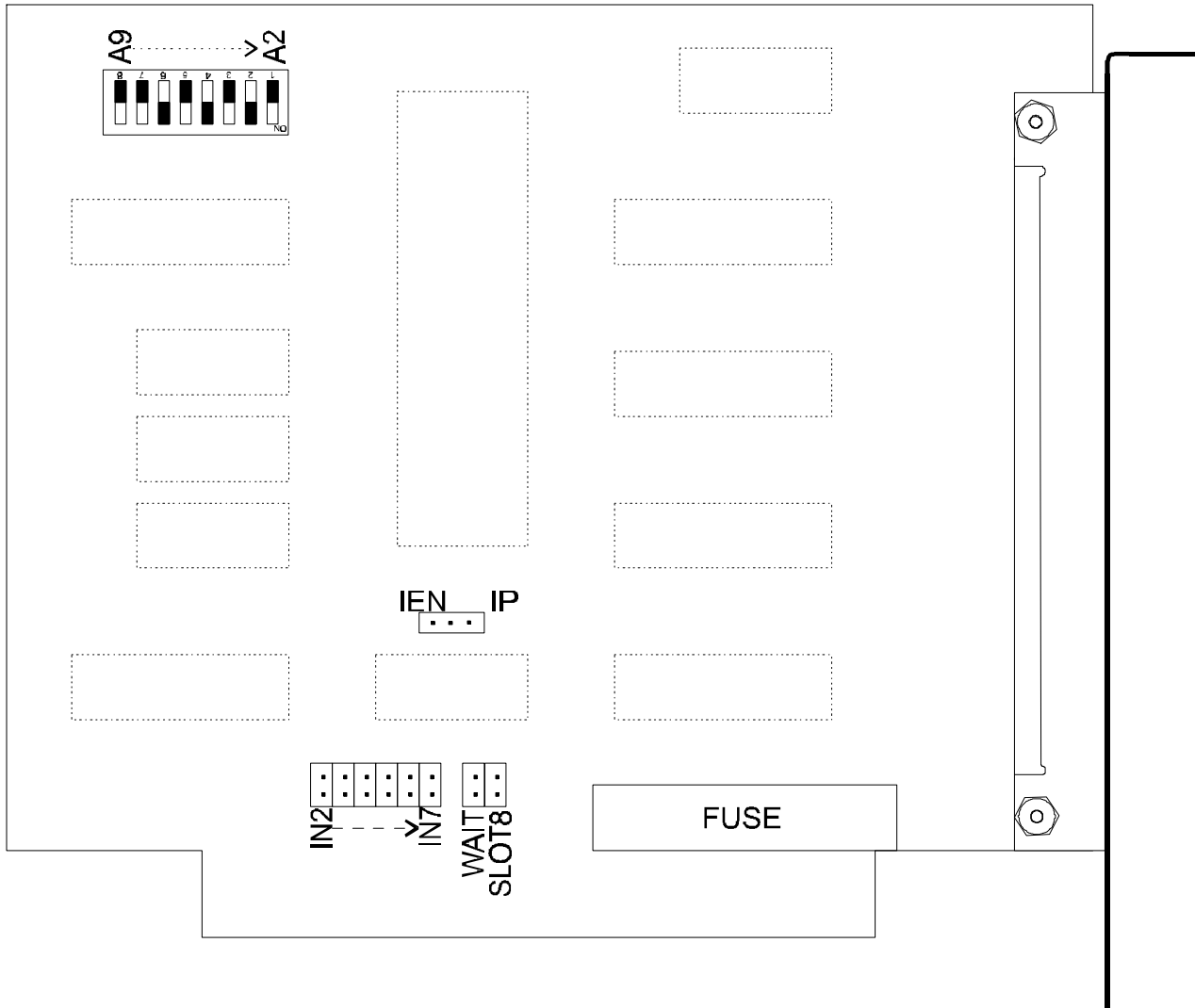
Install the appropriate jumper to select the interrupt level that the card will be working at.

INTERRUPT ENABLE

Install the appropriate jumper to select either disabled, programmable, or always enabled.

The foregoing are the only manual setups necessary to use the IOD-24. Input/Output selection is done via software by writing to a control register in the PPI as described in the PROGRAMMING section of this manual.

IOD-24 OPTION SELECTION MAP



ADDRESS SELECTION

The IOD-24 Digital Input/Output Card occupies four bytes of I/O address space and therefore must start at an address divisible by 4. The base address can be selected anywhere within an I/O address range 100-3FF hex in AT's (except 1F0 through 1F8) and 200-3F0 in XT's. However, two installed options cannot share the same address. If in doubt where to assign the base address, refer to the following tables and the FINDBASE program to find an available address for your system.

STANDARD ADDRESS ASSIGNMENTS FOR 286/386/486 COMPUTERS

Hex Range	Usage
000-01F	DMA Controller 1
020-03F	INT Controller 1, Master
040-05F	Timer
060-06F	8042 (Keyboard)
070-07F	Real Time Clock, NMI Mask
080-09F	DMA Page Register
0A0-0BF	INT Controller 2
0C0-0DF	DMA Controller 2
0F0	Clear Math Coprocessor Busy
0F1	Reset Coprocessor
0F8-0FF	Arithmetic Processor
1F0-1F8	Fixed Disk
200-207	Game I/O
278-27F	Parallel Printer Port 2
2F8-2FF	Asynchronous Comm'n (Secondary)
300-31F	Prototype Card
360-36F	Reserved
378-37F	Parallel Printer Port 1
380-38F	SDLC or Binary Synchronous Comm'n 2
3A0-3AF	Binary Synchronous Comm'n 1
3B0-3BF	Monochrome Display/Printer
3C0-3CE	Local Area Network
3D0-3DF	Color/Graphic Monitor
3F0-3F7	Floppy Diskette Controller
3F8-3FF	Asynchronous Comm'n (Primary)

ADDRESS SETUP switches are marked A2-A9. In order to configure the desired address, assign '1' to all ADDRESS SETUP switches turned OFF, and assign '0' to all ADDRESS SETUP switches turned ON. These 1's and 0's are a binary representation of the base address. This binary representation is then converted to hexadecimal.

Switch Identification	A9	A8	A7	A6	A5	A4	A3	A2
Address Line Controlled	A9	A8	A7	A6	A5	A4	A3	A2

NOTE: Since the lower two bits are used by the 8255 PPI chip, the starting address must have those bits as 0. The starting address must be even and have bits A1 and A0 equal to zero. The following example illustrates switch selection corresponding to hex 2DC (or binary 10 1101 11xx). The "xx" represents address lines A1, and A0 used on the card to select individual registers at the PPI as described in Section 6, PROGRAMMING.

Switch ID (label)	A9	A8	A7	A6	A5	A4	A3	A2
Setup	OFF	ON	OFF	OFF	ON	OFF	OFF	OFF
Binary Representation	1	0	1	1	0	1	1	1
Conversion Multipliers	2	1	8	4	2	1	8	4
Hex Representation	2		D (hex)				C (hex)	

Carefully review the address selection reference table on the preceding page before selecting the card address. If the address of two installed functions is overlapping, you will experience unpredictable computer behavior.

SOFTWARE

ACCES supplies several programs to support the IOD-24 Digital I/O Card and to help you develop your own applications program..The sample programs are in forms suitable for use with, QuickBASIC, C, and Pascal. The programs as follows:

FINDBASE:	Program locates active and available port addresses.
SETUP:	IOD-24 Board Setup Program
BSAMPLES:	<i>SAMPLE1</i> A QuickBasic program that writes a sequence of values to Port A and reads and displays the values in Ports A & B.
	<i>SAMPLE2</i> A QuickBasic program that displays the bits in Ports A & B and, when an interrupt occurs, polls those same bits.
CSAMPLES:	<i>SAMPLE1</i> A "C" program that writes a sequence of values to Port A and reads and displays the values in Ports A & B.
	<i>SAMPLE2</i> A "C" program that displays the bits in Ports A & B and, when an interrupt occurs, polls those same bits.
	<i>EVENT</i> A sample program demonstrating a security system that monitors the status of 16 switches and automatically triggers alarms.
PSAMPLES:	<i>SAMPLE1</i> A "Pascal" program that writes a sequence of values to Port A and reads and displays the values in Ports A & B.
	<i>EVENT</i> A sample program demonstrating a security system that monitors the status of 16 switches and automatically triggers alarms.

SETUP

This program is supplied with the IOD-24 as a tool for you to use in configuring the jumpers on the card. It is menu-driven and provides illustrations on the computer monitor. You make simple keystrokes to select the functions. The illustrations on the monitor then change to show how the jumpers should be placed to effect your choices.

The setup program is a stand-alone program that can be run at any time. It does not require the IOD-24 to be plugged into the computer for any part of the setup. The program is self-explanatory with operation instructions and on-line help.

PROGRAMMING

The IOD-24 is an I/O mapped device that is easily configured from any language and any language can easily perform digital I/O through the card's ports. This is especially true if the form of the data is byte or word wide. All references to the I/O ports would be in absolute port addressing. However, a table could be used to convert the byte or word data ports to a logical reference.

DEVELOPING YOUR APPLICATION SOFTWARE

If you wish to gain a better understanding of the programs in the previous section, then the information in the following paragraphs will be of interest to you. Refer to the data sheets and 8255-5 specification in Appendix A.

The Programmable Peripheral Interface chip (PPI) is addressed using address bits A1 and A0 (See Address Selection, section 4 of this manual.) as follows:

REGISTER ADDRESS SELECTION

ADDRESS	PORT ASSIGNMENT	OPERATION
Base Address	PA Port	Read/Write
Base Address +1	PB Port	Read/Write
Base Address +2	PC Port	Read/Write
Base Address +3	Control Register	Write Only

The IOD-24 card supports operating mode 0 of the 8255-5 PPI. However, it can be factory modified to accommodate modes 1 or 2. Before attempting to use either of those modes, check to assure that the card was ordered with the appropriate modification included.

Mode 0 is the most frequently used mode of operation wherein:

- a. There are two 8-bit ports (A and B) and two 4-bit ports (C Hi and C Lo).
- b. Any port can be configured as an input or an output.
- c. Outputs are latched.
- d. Inputs are not latched.

Mode 1 is used for strobed input/output. In this mode Port A and Port B use the lines of Port C to generate and accept control signals associated with data transfer. See the 8255-5 PPI specification for control line assignments.

Mode 2 is used for bi-directional eight-bit bus applications. See the 8255-5 specification.

The control register at base address +3 is a write-only 8-bit register. It is used to set the mode and direction of the ports. At Power-Up or Reset, all I/O lines are set as inputs. The PPI should be configured during initializing by writing to the control register even if the ports are only going to be used as inputs. Bit assignments in the control register are as follows:

CONTROL REGISTER BIT ASSIGNMENTS

DATA BIT	OPTION SELECTED
D0	Port C (C0-C3) 1 = Input, 0 = Output
D1	Port B 1 = Input, 0 = Output
D2	Mode Selection 1 = Mode 1, 0 = Mode 0
D3	Port C (C4-C7) 1 = Input, 0 = Output
D4	Port A 1 = Input, 0 = Output
D5,D6	Mode Selection 00 = Mode 0, 01 = Mode 1** 1X = Mode 2**
D7	Mode Set Flag 1 = Active

* Note: Mode 1 may be used only if the card has been modified for that mode. It is not possible to modify the IOD-24 for mode 2 operation.

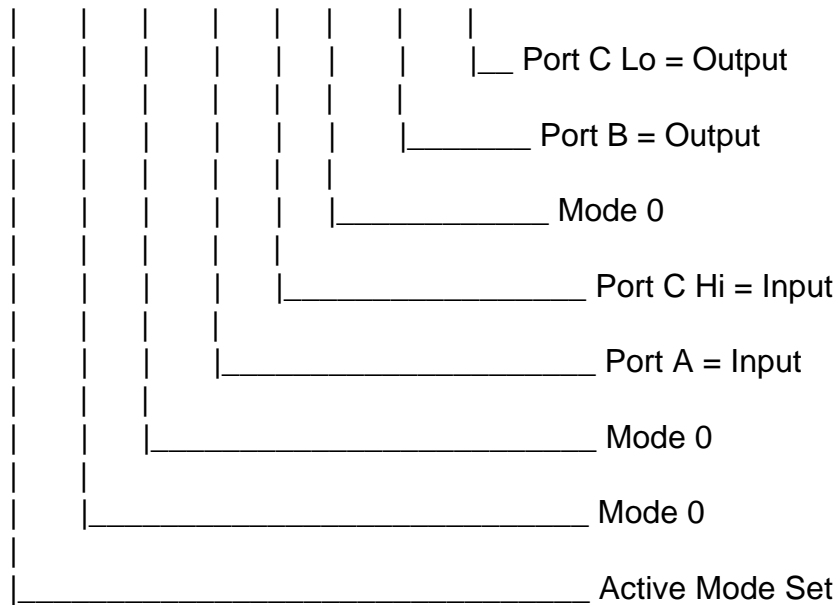
PROGRAMMING EXAMPLE

The following example in BASIC is provided as a guide to assist you in developing your working software. In this example, the card address is 2D0 hex, operation is in Mode 0 and the I/O lines are to be set up as follows:

Port A Input
 Port B Output
 Port C Hi. . . Input
 Port C Lo. . . Output

Configure bits of the control register as follows:

D7	D6	D5	D4	D3	D2	D1	D0
1	0	0	1	1	0	0	0



This corresponds to 98 hex. If the card base address is 2D0 hex, use the C command to write to the control register as follows:

```
BASEADDR=0x2D0;
OUTPORTB(Baseaddr,0x98);
```

To read the inputs at Port A and the upper nybble of Port C, use the C INPUT command:

```
X=INP(BASEADDR)           //Read Port A           X= inportb(Baseaddr);  
Y=INP(BASEADDR+2)/16      //Read Port C Hi       Y= inportb(Baseaddr+2)>>4;
```

To set outputs high (1) at Port B and the lower nybble of Port C:

```
OUTPORTB(Baseaddr +1,0xFF); //Turn on all Port B bits  
OUTPORTB(Baseaddr +2,0x0F); //Turn on all bits of Port C Lo 50
```


CONNECTOR PIN ASSIGNMENTS

A 50-pin ribbon cable header is used for interfacing to I/O. The mating connector is an AMP type 1-746285-0 or equivalent. Connector pin assignments are listed below. Notice that every second line is grounded to minimize crosstalk between signals.

ASSIGNMENT		PIN	ASSIGNMENT	PIN
Port C Hi	PC7 *	1	Ground	2
Port C Hi	PC6	3	"	4
Port C Hi	PC5	5	"	6
Port C Hi	PC4	7	"	8
Port C Lo	PC3 **	9	"	10
Port C Lo	PC2	11	"	12
Port C Lo	PC1	13	"	14
Port C Lo	PC0	15	"	16
Port B	PB7	17	"	18
Port B	PB6	19	"	20
Port B	PB5	21	"	22
Port B	PB4	23	"	24
Port B	PB3	25	"	26
Port B	PB2	27	"	28
Port B	PB1	29	"	30
Port B	PB0	31	"	32
Port A	PA7	33	"	34
Port A	PA6	35	"	36
Port A	PA5	37	"	38
Port A	PA4	39	"	40
Port A	PA3	41	"	42
Port A	PA2	43	"	44
Port A	PA1	45	"	46
Port A	PA0	47	"	48
+5VDC		49	"	50

* This line is an I/O port and also an Interrupt Disable

** This line is an I/O port and also a User Interrupt

SPECIFICATIONS

Features

24 Channels of Buffered Digital Input/Output.
Four and Eight Bit Groups Independently Selectable for I/O.
10K Ω Pull-Ups on I/O Lines.
Bi-Directional Data Transfers Supported.
Interrupt and Interrupt-Disable Capability.
OPTO-22 Compatible 50-Pin Connector
+5 V Supply Available to User.

Digital Inputs

Logic High: 2.0 to 5.0 VDC.
Logic Low: -0.5 to 0.8 VDC.
Input Load (Hi): +20 microamperes.
Input Load (Lo): -200 microamperes.

Digital Outputs

Logic High: 2.5 VDC min., source 15 milliamperes.
Logic Low: 0.5 VDC max., sink 64 milliamperes.

Power Output: +5 VDC from computer bus, fused , 1A fast-blow.

Power Required: +5 VDC at 100 mA typical.

Size: 5.0" Long (127 mm).

Environmental:

Operating Temperature Range: 0 degr. to 60 degr.C.
Storage Temperature Range: -50 degr. to 120 degr.C.
Humidity: 0 to 90% RH, non-condensing.

WARRANTY

Prior to shipment, ACCES equipment is thoroughly inspected and tested to applicable specifications. However, should equipment failure occur, ACCES assures its customers that prompt service and support will be available. All equipment originally manufactured by ACCES which is found to be defective will be repaired or replaced subject to the following considerations.

TERMS AND CONDITIONS

If a unit is suspected of failure, contact ACCES' Customer Service department. Be prepared to give the unit model number, serial number, and a description of the failure symptom(s). We may suggest some simple tests to confirm the failure. We will assign a Return Material Authorization (RMA) number which must appear on the outer label of the return package. All units/components should be properly packed for handling and returned with freight prepaid to the ACCES designated Service Center, and will be returned to the customer's/user's site freight prepaid and invoiced.

COVERAGE

First Three Years: Returned unit/part will be repaired and/or replaced at ACCES option with no charge for labor or parts not excluded by warranty. Warranty commences with equipment shipment.

Following Years: Throughout your equipment's lifetime, ACCES stands ready to provide on-site or in-plant service at reasonable rates similar to those of other manufacturers in the industry.

EQUIPMENT NOT MANUFACTURED BY ACCES

Equipment provided but not manufactured by ACCES is warranted and will be repaired according to the terms and conditions of the respective equipment manufacturer's warranty.

GENERAL

Under this Warranty, liability of ACCES is limited to replacing, repairing or issuing credit (at ACCES discretion) for any products which are proved to be defective during the warranty period. In no case is ACCES liable for consequential or special damage arriving from use or misuse of our product. The customer is responsible for all charges caused by modifications or additions to ACCES equipment not approved in writing by ACCES or, if in ACCES opinion the equipment has been subjected to abnormal use. "Abnormal use" for purposes of this warranty is defined as any use to which the equipment is exposed other than that use specified or intended as evidenced by purchase or sales representation. Other than the above, no other warranty, expressed or implied, shall apply to any and all such equipment furnished or sold by ACCES.

APPENDIX A

PROGRAMMABLE PERIPHERAL INTERFACE

DATA SHEET

The data sheets in this Appendix are provided to help your understanding of the 8255-5 PPI which is made by a number of companies. These sheets are reprinted with permission of Mitsubishi Electric Corp. (Copyright 1987).

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