Model DIO216
Product Manual

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FORWARD

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Chapter 1: Introduction

The Model DIO216 PC-I/O Board provides TTL-compatible Interface Lines and Serial Communication Channels to the IBM-PC, XT, and AT bus-compatible microcomputers. The board features 216 TTL-Level Input/Output Lines (Intel 8255 PIO Format), and 2 RS-232C Serial Ports (Intel 8251A nonconflicting with IBM standard COM ports). The DIO216 is designed for "real-world" interfacing applications to monitor and control on/off events at TTL levels (0 = Off/+5VDC = On). TTL PI/O lines are grouped in twenty seven (27) 8-Bit words designated by software as inputs or outputs. User-selectable addressing allows board to be set at any of 16 port Base Address locations. The RS-232C Serial Ports are provided with Dip Jumper selectable baud rates from 300 to 19.2K Kbaud. Applications for the DIO216 include Process Control, Security, Energy Management, Opto-Isolated Relay Control, and many other "Real-World" uses. Optional ribbon cables with attached connectors are available in 4, 10, and 20 foot lengths.

Applications

- Process Control
- Security Systems
- Energy Management
- Laboratory Processing
- Lighting Control
- Opto-Isolated Relay Operation
- Switch Sensing
- Many Other "Real-World" Applications

Features

- Uses Forty IBM-PC Ports For 216 TTL-I/O and 2-Serial Channels
- Compatible With Popular Opto-Isolator Modules
- Crystal-Controlled Serial Communications Timing
- Supported By A Wide Range Of Software For The IBM-PC/Compatibles
- Includes Sample Configuration and Operation Software On Diskette
- Manual Includes Complete Installation, Service and Applications

Specifications

Parallel I/O Ports

Logical 1 Threshold (Configured as Inputs)	+2.40V Min.
Logical 0 Threshold (Configured as Inputs)	+0.45V Max.
Data Valid Time For Read	200nS. Max.
Data Valid Time For Write	100nS. Min.
Maximum Current (Output Mode)	4.0mA/Channel
Instructions Used	Input & Output
TTL I/O Lines (Intel 8255 PIO Interface)	216 (27 X8Bit Ports)

Operational Modes

Mode 0:	Groups of 12 I/O pins, configured as Input/Output,Groups of 4
Mode 1:	Groups of 8, each group as Input or Output. Handshaking.
Mode 2:	Bidirectional Bus Mode, 8 Lines/Bus Group, 5 Lines/Handshaking.

Connectors Required

9/50-Pin FM Header

Serial I/O Ports

Baud Rates (Dip Jumper Selectable)	300 - 19.2K Baud
Connectors Required	2/DB15 Connectors
Signals Supported (TXD,RXD,DSR,DTR,CTS,RTS)	±12VDC RS232C

General

Power Required	+5VDC,±12VDC
Address Select	16 DIP Locations
Number IBM-PC Ports Used	40
Shipping Weight	2 Lbs.

Optional Ribbon Cable Assemblies are Available From Industrial Computer Source in 4-Foot, 10-Foot, 20-Foot, and Custom Lengths.

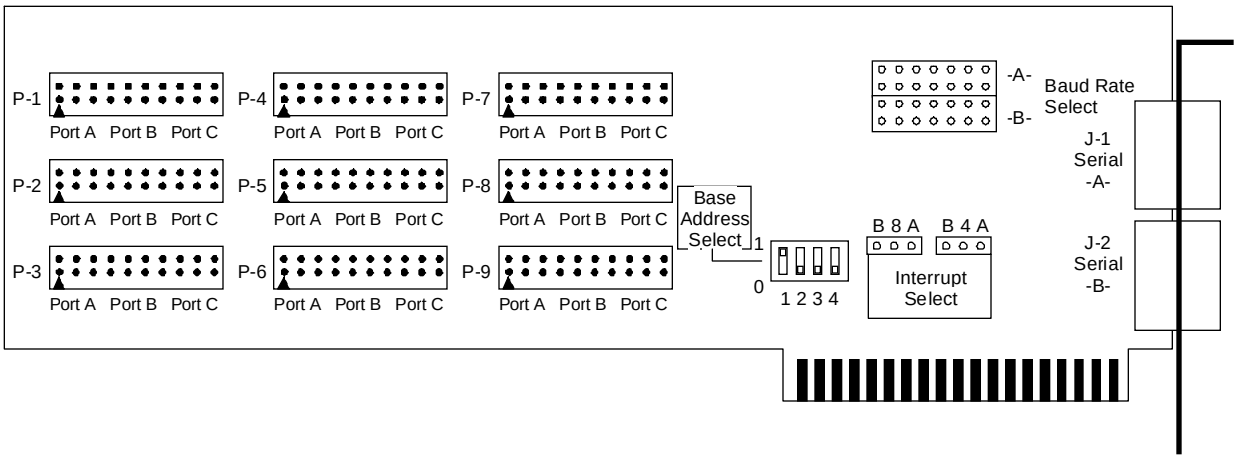

Figure 1-1: DIO216 Board Layout

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Chapter 2: Installation

The DIO216 functions as a part of a complete computer monitoring or controlling system. The card is compatible with IBM PC/XT/AT and compatible computers.

CAUTION

Installing or removing the DIO216 board with power applied may cause physical damage to the plug-in board, the computer or both. Turn off the power before installing or removing I/O boards.

Backing up the Diskette

It is good practice to make a backup copy of the disk before using the software. You can make a straight backup using DISKCOPY but since you will need BASICA and DOS to run the programs, it will save time if you start with the FORMAT /S option. Next copy BASICA.COM onto the backup from your IBM DOS disk using COPY and finally use COPY *.* to copy the ICS Driver Disk files onto the backup.

In step by step sequence:

Insert DOS disk in drive A and a blank disk in drive B. type:

```
A> FORMAT B: /S
```

Insert new disk for backup copy as prompted by the format. Next, when the DOS prompt returns, type:

```
A> COPY BASICA.COM B:
```

Insert Driver Master disk and type:

```
A> COPY *.* B:
```

Hardware Installation

The DIO216 requires 40 (28H) consecutive address locations in 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 64 bit boundary between 200H and 3F0H in the IBM PC decoded I/O space. The I/O address space extends from decimal 256-1023 (Hex 100-3FF) which is many times larger than is ever likely to be fully occupied. Such a large space also allows use of more than one DIO216 in a single computer.

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)

Table 2-1: Standard Address Assignments

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 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 may be in your computer.

Setting the Base Address

Addresses locations are based on the Hex system. Table 2-3 shows how to convert the Hex address to the binary equivalent and shows the correlation between the binary value and switch configurations. Since only address lines A9-A6 are configurable, the range is limited to 200-3C0 in increments of 40 hex. All other address lines shown in Table 2-3 are hard wired and not available to the user.

	A9	**A8**	**A7**	**A6**
200H	ON	OFF	OFF	OFF
240H	ON	OFF	OFF	ON
280H	ON	OFF	ON	OFF
300H	ON	ON	OFF	OFF
340H	ON	ON	OFF	ON
380H	ON	ON	ON	OFF

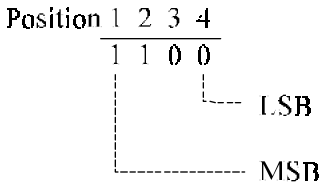
Table 2-2: Sample Addresses for the DIO216

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			ON	ON	OFF	OFF						

Table 2-3: DIO216 Address Selection

Usually, a good choice is to put the DIO216 at base address at Hex 300 (decimal 768).

Therefore, the switch setting for 300H is :



where 1 is On or UP. Note that addresse 300H is reserved for prototype boards. If you have another I/O card installed, insure the address selected for the DIO216 does not conflict.

To obtain the Hex and Dec equivalents of these settings and to calculate the control bytes required for the 8255 control port, use the program supplied with the board, called DIO216.EXE, and follow the instructions given. You may operate the program to obtain the values without the board being installed. This compiled basic program will help you to get familiar with the operation of DIO216.

Baud Rate Selection

The baud rate for each of the two serial ports is selected using jumper blocks A and B labelled BAUD RATE SELECT. Only 1 jumper for each group should be installed. The baud rates are labelled on the board adjacent to the appropriate jumper pair.

Interrupt Selection

Interrupts from the serial ports can be directed to IRQ3 and IRQ4. One jumper block is available each for IRQ3 and IRQ4 with the ability to jumper Port A or Port B on each. Install the jumper in the appropriate location to select the interrupt. Note: the user is responsible for interrupt programming. The standard DOS communication interrupt drivers will not respond to the DIO216 serial ports because the ports are not mapped in the usual COM1 (3F8H) or COM2 (2F8H) locations.

Connectors

The DIO216 includes nine 50 position IDC connectors and 2 DB-9 connectors. The connector numbers and functions are listed below:

P1	50 Pin IDC	24 Input or Output bits (Base Addr + 0, 1, 2, (3)
P2	50 Pin IDC	24 Input or Output bits (Base Addr + 4, 5, 6, (7)
P3	50 Pin IDC	24 Input or Output bits (Base Addr + 8, 9, 10, (11)
P4	50 Pin IDC	24 Input or Output bits (Base Addr + 12, 13, 14, (15)
P5	50 Pin IDC	24 Input or Output bits (Base Addr + 16, 17, 18, (19)
P6	50 Pin IDC	24 Input or Output bits (Base Addr + 20, 21, 22, (23)
P7	50 Pin IDC	24 Input or Output bits (Base Addr + 24, 25, 26, (27)
P8	50 Pin IDC	24 Input or Output bits (Base Addr + 28, 29, 30, (31)
P9	50 Pin IDC	24 Input or Output bits (Base Addr + 32, 33, 34, (35)
J1	DB15 Socket	RS232 Connector (Serial A)
J2	DB15 Socket	RS232 Connector (Serial B)

Since each 8255 is actually a 24-bit device, the I/O may be numbered 0-23 in the following descriptions. If it makes the situation clearer, the ports may be referred to as A, B and C where each provides 8-bits, 0-7.

Connector Pin Assignments

The popular 50 pin ribbon cable header Winchester 86-50-13-2 is used for interfacing to I/O. For mating connector use Winchester 50 pin connector with strain relief part no. 81-50-112 or equivalent. Connector pin assignments listings:

Assignment	Opto Rack Channel		Pin	Pin	Assignment
Port A	PA0	23	1	2	Ground
Port A	PA1	22	3	4	Ground
Port A	PA2	21	5	6	Ground
Port A	PA3	20	7	8	Ground
Port A	PA4	19	9	10	Ground
Port A	PA5	18	11	12	Ground
Port A	PA6	17	13	14	Ground
Port A	PA7	16	15	16	Ground
Port B	PB0	15	17	18	Ground
Port B	PB1	14	19	20	Ground
Port B	PB2	13	21	22	Ground
Port B	PB3	12	23	24	Ground
Port B	PB4	11	25	26	Ground
Port B	PB5	10	27	28	Ground
Port B	PB6	9	29	30	Ground
Port B	PB7	8	31	32	Ground
Port C Low	PC0	7	33	34	Ground
Port C Low	PC1	6	35	36	Ground
Port C Low	PC2	5	37	38	Ground
Port C Low	PC3	4	39	40	Ground
Port C High	PC4	3	41	42	Ground
Port C High	PC5	2	43	44	Ground
Port C High	PC6	1	45	46	Ground
Port C High	PC7	0	47	48	Ground
+5VDC (Not Fused)			49	50	Ground

Table 2-4: Connector Pin Assignments

Note that the 8255 port assignments do not match the OPTO rack channel assignments.

Having attached the cables to the board, you may now route the cables out of the PC chassis. Depending upon the model and make of your unit, you may find cable exit slots in one of three places:

1) Between the rear of the cover and the top rear chassis panel (often found with “flip-top” chassis)
2) Through an empty expansion slot or through the connector cutout on a slot which is occupied by a board which does not protrude through the back panel (such as a memory board)
3) Through a specific cable exit cutout at the side or rear of the PC (found on many “industrial” PCs - often incorporating a cable strain relief)

Note: You may find that folding or bending the ribbon cable at angles to the board will allow you to more easily route the cabling out of the PC chassis - don’t be afraid to bend the ribbon cable a few times.

Serial Connectors

The two serial ports are available on connectors J1 and J2. These are DB15 SOCKET (female) connectors and the mating parts are DB15 PIN (male) connectors. Pin-outs are identical for each port as listed below:

1	+5VDC	8	+12VDC
2	TXD	9	CTS
3	RXD	10	+5VDC
4	DSR	11	RTS
5	DTR	12	N/C
6	-12VDC	13	-12VDC
7	GND	14	GND
		15	+12VDC

Table 2-5: Serial Pin-Outs (J1 and J2)

WARNING

Serial Connections at back panel Jacks P1 and P2 are not standard RS232 connections. The assignments have been changed to fit ±12VDC and +5VDC into the 15 pin connector along with the six signal lines. Damage may be caused to this board or attached peripherals if care is not exercised in making interconnections!

Chapter 3: Programming

Overview

The DIO216 provides 216 software selectable digital I/O ports, and 2 serial ports.

Each of the nine 8255 PIO and 2 Serial 8251 ICs are configured with a single byte each. To read a value in or send a value out through any of the twenty- seven 8-Bit PIO ports or 2 serial channels, select the corresponding port with an input or output instruction accordingly.

The following table lists each of the addresses and corresponding functions. The BASE ADDRESS is the address set by the switch group.

P-1	Base +00 - Port A	P-6	Base +20 - Port A
	Base +01 - Port B		Base +21 - Port B
	Base +02 - Port C		Base +22 - Port C
	Base +03 - Port D		Base +23 - Control Port
P-2	Base +04 - Port A	P-7	Base +24 - Port A
	Base +05 - Port B		Base +25 - Port B
	Base +06 - Port C		Base +26 - Port C
	Base +07 - Control Port		Base +27 - Control Port
P-3	Base +08 - Port A	P-8	Base +28 - Port A
	Base +09 - Port B		Base +29 - Port B
	Base +10 - Port C		Base +30 - Port C
	Base +11 - Control Port		Base +31 - Control Port
P-4	Base +12 - Port A	P-9	Base +32 - Port A
	Base +13 - Port B		Base +33 - Port B
	Base +14 - Port C		Base +34 - Port C
	Base +15 - Control Port		Base +35 - Control Port
P-5	Base +16 - Port A	Serial A	Base +36 - Ser. Data A
	Base +17 - Port B		Base +37 - Ser. Control
	Base +18 - Port C	Serial B	Base +40 - Ser. Data B
	Base +19 - Control Port		Base +41 - Ser. Control

Table 3-1: DIO216 Memory Map

Accessing the Input/Output Ports

Nine 8255 PIO chips are provided offering the user 96 digital I/O. Each of the nine 8255 chips is configured and controlled separately.

Four addresses are required to access each 8255. Each 8255 is divided into three 8-bit ports. In addition, a control register is provided for each port. The DIO216 MEMORY MAP table on the preceding page lists the ports and addresses. The nine 8255 chips are referenced as IC-1 to IC-9.

The 8255 has several input/output modes and the user is directed to the 8255 data sheet 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 be selected as a control port.

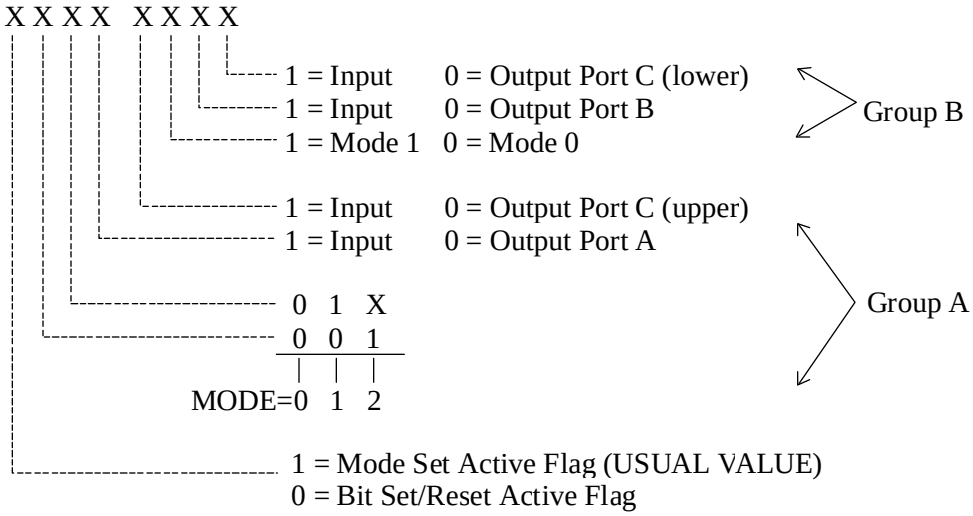


Figure 3-1: 8255 Control Port Definitions

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 0 - Basic Input/Output

MODE 1 - Strobed Input/Output

MODE 2 - Bidirectional 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. This mode is used by a majority of users for simple digital I/O.

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

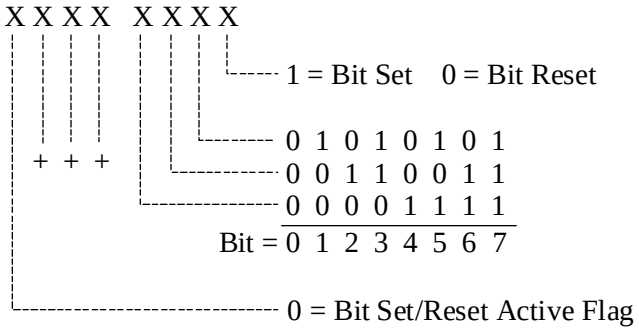
- Used in Group A only
- One 8-bit, bidirectional bus port (Port A) and a 5-bit control port (Port C)
- Both inputs and outputs are latched
- The 5-bit control port (Port C) is used for control and status for the 8-bit, bidirectional bus port (Port A)

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.



Note: + = don't care

Figure 3-2: Bit Set/Reset Assignments

RS232 (8251) Control Port Initialization

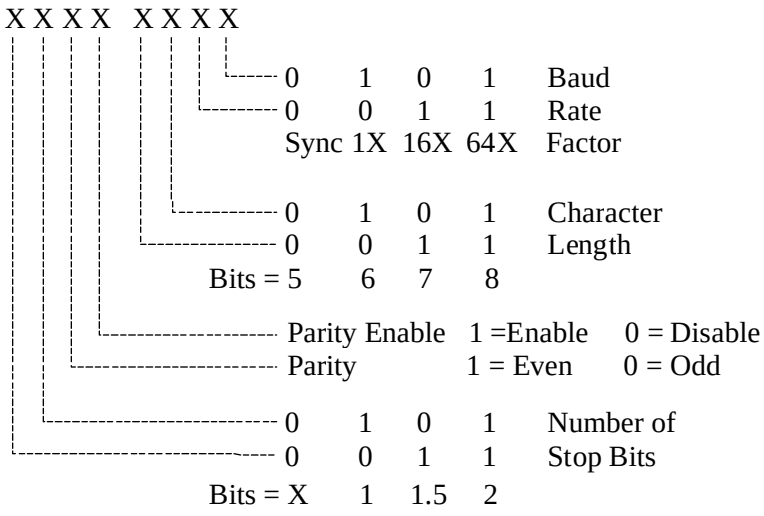
The user is directed to the 8251 data sheet for complete details about programming this chip.

The following BASIC program shows how to initialize the 8251 UART. The user must first send 3 nulls (0) to the appropriate port. Then a HEX 40 resets the chip allowing the MODE byte followed by the CONTROL byte to be written to the port. This example sets up both ports simultaneously.

```
00 ' ***** ROUTINE TO INITIALIZE 8251 USARTS *****
10 OUT BASE+37,0: OUT BASE+41,0              'SEND NULL
20 OUT BASE+37,0: OUT BASE+41,0              'SEND NULL
30 OUT BASE+37,0: OUT BASE+41,0              'SEND NULL
40 OUT BASE+37,&H40: OUT BASE+41,&H40 'SEND RESET
50 OUT BASE+37,&HCE: OUT BASE+41,&HCE 'SEND MODE BYTE
60 OUT BASE+37,&H5: OUT BASE+41,&H5          'SEND CONTROL BYTE
70 A=INP(BSE+36): B=INP(BSE+40)              'CLEAR 8251 NO-1
80 A=INP(BSE+36): B=INP(BSE+40)              'CLEAR 8251 NO-2
```

The Hex CE sent to the MODE byte and 5 sent to the CONTROL bytes are examples only. The user would substitute the appropriate values for a particular communication application.

8251 Mode Byte:



8251 Control Byte:

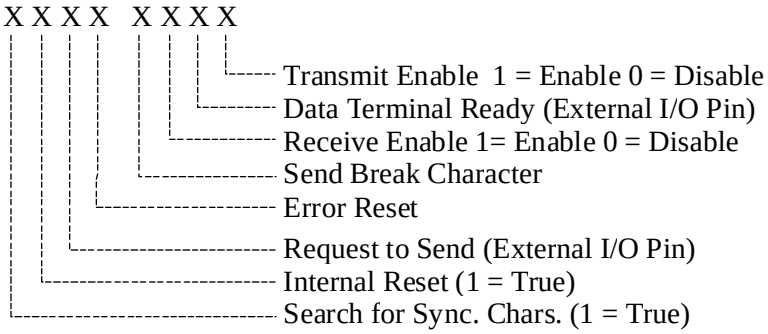


Figure 3-3: 8251 Mode and Command Byte Definition

Using Interrupts

Hardware is not supplied to support the 8255 interrupt modes.

Using the Provided Software with the DIO216

The board is normally provided with configuration and implementation software on IBM-PC-compatible 5.25" diskette, in two forms: DIO216.EXE, an EXEcutable program that may be run immediately from MS-DOS or PC-DOS, and DIO216.BAS, a Basic program that requires a Basic interpreter to run. Both programs are functionally identical, whereas the Basic version has been provided in an ASCII text format, thus allowing the program to be listed or printed through a word processing program. A complete, notated listing of the Basic file can be found at the rear of this manual.

Note: The boards do not need to be present in the PC chassis for these programs to run, however you will need to specify a DIP switch address setting: the boards come set to (1100) from the factory. This setting will work without the board in the PC.

To run DIO216.EXE, simply type “DIO216” [Return]. You will be presented the following screen representation:

```
DIO216 Test Program - 06/09/87 - M.Ragsdale

   IC-1   CNTL PORT+  3  CONFIG WORD:
A:+  0                    B:+  1                    C:+  2
   IC-2   CNTL PORT+  7  CONFIG WORD:
A:+  4                    B:+  5                    C:+  6
   IC-3   CNTL PORT+ 11  CONFIG WORD:
A:+  8                    B:+  9                    C:+ 10
   IC-4   CNTL PORT+ 15  CONFIG WORD:
A:+ 12                    B:+ 13                    C:+ 14
   IC-5   CNTL PORT+ 19  CONFIG WORD:
A:+ 16                    B:+ 17                    C:+ 18
   IC-6   CNTL PORT+ 23  CONFIG WORD:
A:+ 20                    B:+ 21                    C:+ 22
   IC-7   CNTL PORT+ 27  CONFIG WORD:
A:+ 24                    B:+ 25                    C:+ 26
   IC-8   CNTL PORT+ 31  CONFIG WORD:
A:+ 28                    B:+ 29                    C:+ 30
   IC-9   CNTL PORT+ 35  CONFIG WORD:
A:+ 32                    B:+ 33                    C:+ 34
DIP SWITCH SETTING: [1100]
                                    ^
IC-10 PORT=BASE+36/37          IC-11 PORT=BASE+40/41
```

Test Software Initial Screen

This screen is asking for the dip switch address to be set by you. By using the Up and Down Arrow keys, you may scroll through the Setable Addresses which the card may be addressed. If you are using the software without a card in your machine, you may just hit [Return] which will default to the address shown. If you are using the software with a DIO216 installed in your machine, select the same dip switch address that you have set the card to which is in your machine as follows:

You will notice that the first “1” of the binary word 1100 on the center screen is flashing. This is a request to set the Current DIP Switch Setting on the board. This setting corresponds to the base address of the board. As provided from the factory, the DIP switch is set to 1100, as shown on the screen. If you have not altered this setting, simply hit [Return], and the program will establish all board addressing around this setting. If you have modified the DIP switch setting, type the complete switch pattern at this time, using a “1” to indicate Switch On, or “0” to indicate Switch Off. Type all four switch positions (example: “1100”), and hit [Return]. You may use the Backspace key if you misenter a digit. Values other than “1” or “0” will be rejected, and the program will reset the cursor to the first position, so that you may start again.

The software will move on to the screen representation shown on the next page:

```
DIO216 Test Program - 06/09/87 - M.Ragsdale


        IC-1   CNTL PORT+  3  CONFIG WORD: 128D 80H
A:+  0 O 00000000   0D  0H B:+  1 O 00000000   0D  0H C:+  2 O 00000000   0D  0H
>>>>>   IC-2   CNTL PORT+  7  CONFIG WORD: 146D 92H
A:+  4 I 10010111          B:+  5 I 10010111          C:+  6 O 11100000   7D  7H
        IC-3   CNTL PORT+ 11  CONFIG WORD:
A:+  8                      B:+  9                      C:+ 10
        IC-4   CNTL PORT+ 15  CONFIG WORD:
A:+ 12                      B:+ 13                      C:+ 14
        IC-5   CNTL PORT+ 19  CONFIG WORD:
A:+ 16                      B:+ 17                      C:+ 18
        IC-6   CNTL PORT+ 23  CONFIG WORD:
A:+ 20                      B:+ 21                      C:+ 22
        IC-7   CNTL PORT+ 27  CONFIG WORD:
A:+ 24                      B:+ 25                      C:+ 26
        IC-8   CNTL PORT+ 31  CONFIG WORD:
A:+ 28                      B:+ 29                      C:+ 30
        IC-9   CNTL PORT+ 35  CONFIG WORD:
A:+ 32                      B:+ 33                      C:+ 34
                     DIP SWITCH SETTING: [1100]        768D 300H

IC-10 PORT=BASE+36/37 SENT:106 RECV:233\IC-11 PORT=BASE+40/41 SENT:105 RECV:233

Select IC No. 1-9 or -S-ystem
```

Main Screen

If you are running this software without a card in your PC, the values will be random (possibly changing) numbers. This program is written in Interpretive Basic and if you are not running the compiled version (EXE) then it is quite slow. The main purpose is to demonstrate typical techniques to control and setup DIO216. The bottom line is a Menu of the commands which you may use to control or setup your card. Pressing the letter -A- will put you back in the Address Selection mode in which you can change the dip switch Base Address for the card. Pressing the -S- key will dump you back to DOS. First select the IC Number you wish to configure. The command line at the bottom will change to:

```
Select -N-ext IC or -S-ystem  Select Port -A-, -B-, or -C-
```

Now you must select which port (A, B, or C) you wish to configure in the IC you have selected. The command line at the bottom will change to:

```
Select -I-nput/-O-utput
```

You must now select Input or Output for this Port. This completes the configuration or only one port in an 8255 PIO Chip. You must repeat this procedure for all three ports in each IC you wish to use.

Note: Once an IC is fully configured, and the last port you configured was an Output, you can manipulate the Output Bits with the keyboard by pressing any number between 1 and 8. The lower right hand portion of the screen displays the legend, TOGGLE BIT 12345678 ON C. Having configured the chip completely, this feature allows you to individually turn on and off the bits within the parallel port "word". As you turn each output bit on or off, you are causing the voltage present on the corresponding lines to switch between TTL 0 (0 to +0.45VDC), and TTL 1 (+2.40 to +5.00VDC, depending upon loading). Try toggling the output bits on and off, by pressing the number keys at the top of your PC keyboard: 1,2,3,4,5,6,7, or 8. Pressing once will cause the corresponding bit to turn on, and pressing again will cause the bit to turn off.

IMPORTANT

You must first configure the entire chip (all three ports A, B, & C) in order to toggle the Output bits On or Off. Therefore you must configure the ports and then reselect the port you wish to toggle, and then choose Outputs, to obtain the Toggle Bit 1,2,3,4,5,6,7,8 prompt.

At the bottom of the screen just above the command prompts, a display shows values sent out the two serial ports on the card. If you tie serial port -A- to port -B- and -B- to -A- the receive lines should read the same as the send numbers displayed.

Sample Programs

The following program can be used to exercise and test the DIO216. In addition, these program examples can be incorporated in the user's own program.

Many of the code lines listed below are notated for your convenience.

```
3 '"DIO216.BAS" PCIO CARD TEST PROGRAM-DATED 06/29/87-M.RAGSDALE
4 CLS:COLOR 15,0
10 GOTO 4010
- - -
300 '  ***** ROUTINE TO INPUT STRING DATA ON SCREEN IN BRACKETS *****
303 'SE$=$ VALUE/PS$=PROMPT TO PRINT/R%=ROW/MAX=EXPAND TO/CO%=OPT.COL
305 IF CO%=0 THEN CO%=1
306 IF MAX=0 THEN MAX=LEN(SE$)
309 IF LEN(SE$)<MAX THEN SE$=SE$+" ":GOTO 309
312 LOCATE R%,CO%:PRINT PS$"["STRING$(LEN(SE$)," ")"]";
315 C%=CO%+LEN(PS$)+1:GOSUB 324
318 MAX=0
321 RETURN
- - -
324 '  ***** SCREEN EDITOR ROUTINE *****
327 MR=0:MAX%=LEN(SE$):CA%=0:T0=1:LOCATE R%,C%:PRINT SE$;
345 GOTO 360
347 MR=1
348 RETURN'CURSOR UP
351 LEFT=1:RETURN 'CURSOR LEFT
354 RIGHT=1:RETURN 'CURSOR RIGHT
357 RETURN'CURSOR DOWN
360 IF BP=1 THEN RETURN ELSE IF O=0 THEN T0=T0-1
   :IF T0=0 THEN LOCATE R%+RA%,C%+CA%:PRINT MID$(SE$,CA%+1,1);
   :O=1:T1=50:GOTO 366
363 T1=T1-1:IF T1=0 THEN LOCATE R%+RA%,C%+CA%:PRINT "-";:O=0:T0=10
366 B$=INKEY$:IF B$=CHR$(13) THEN LOCATE R%+RA%,C%+CA%
   :PRINT MID$(SE$,CA%+1,1):RETURN
367 IF MR=1 THEN RETURN
369 IF B$=CHR$(8) THEN LEFT=1
372 IF LEFT=1 AND CA%>0 THEN LEFT=0:LOCATE R%+RA%,C%+CA%
   :PRINT MID$(SE$,CA%+1,1);:CA%=CA%-1 ELSE LEFT=0
375 IF RIGHT=1 AND CA%<MAX%-1 THEN RIGHT=0:LOCATE R%+RA%,C%+CA%
   :PRINT MID$(SE$,CA%+1,1);:CA%=CA%+1 ELSE RIGHT=0
378 IF B$<CHR$(32) OR B$>CHR$(125) THEN 360
381 MID$(SE$,CA%+1)=B$:LOCATE R%+RA%,C%+CA%:PRINT B$;
   :IF CA%<MAX%-1 THEN CA%=CA%+1:GOTO 360
```

```
384 GOTO 360
---

500 '*** ROUTINE TO SEND & RECEIVE SERIAL DATA FROM A TO B AND B TO A ***
510 AV=AV+1                                          'ADD ONE TO A VALUE
515 IF AV>255 THEN AV=0                        'CHECK IF OVER 255
520 BV=AV                                      'MAKE CHANNEL B SAME
525 OUT BSE+36,AV                              'SEND AV OUT A
530 OUT BSE+40,BV                              'SEND BV OUT B
535 LOCATE 23,23                               'SET SCREEN LOCATION
537 COLOR 15,0:PRINT"SENT:";                         'PRINT PROMPT
540 COLOR 0,15:PRINT USING"###";AV;                  'VALUE SENT FROM A
545 COLOR 15,0:PRINT" RECV:";                        'PRINT PROMPT
550 COLOR 0,15:PRINT USING"###";INP(BSE+36);         'VALUE RECVD FROM B
555 LOCATE 23,64                               'SET SCREEN LOCATION
557 COLOR 15,0:PRINT"SENT:";                         'PRINT PROMPT
560 COLOR 0,15:PRINT USING"###";BV;                  'VALUE SENT FROM B
565 COLOR 15,0:PRINT" RECV:";                        'PRINT PROMPT
570 COLOR 0,15:PRINT USING"###";INP(BSE+40);         'VALUE RECVD FROM A
599 RETURN
600 LOCATE 23,1:PRINT"IC-10 PORT=BASE+36/37";
610 LOCATE 23,42:PRINT"IC-11 PORT=BASE+40/41";
620 RETURN
- - -
800 ' ***** ROUTINE TO INITIALIZE 8251 USARTS *****
810 OUT BSE+37,0:OUT BSE+41,0                        'SEND NULL
812 OUT BSE+37,0:OUT BSE+41,0                        'SEND NULL
814 OUT BSE+37,0:OUT BSE+41,0                        'SEND NULL
820 OUT BSE+37,&H40:OUT BSE+41,&H40                  'SEND RESET
830 OUT BSE+37,&HCE:OUT BSE+41,&HCE                  'SEND MODE BYTE
840 OUT BSE+37,&H5:OUT BSE+41,&H5                    'SEND CONTROL BYTE
850 A=INP(BSE+36):B=INP(BSE+40)                      'CLEAR 8251 NO-1
860 A=INP(BSE+36):B=INP(BSE+40)                      'CLEAR 8251 NO-2
870 RETURN
900 CLS:FOR SV=0 TO 255:GOSUB 905:NEXT:GOTO 900
905 OUT BSE,SV:PV%=SV:GOSUB 6500:LOCATE 5,1:PRINT INP(BSE+2);PV$
910 OUT BSE+2,SV:PV%=SV:GOSUB 6500:LOCATE 6,1:PRINT INP(BSE);PV$:RETURN
- - -
3000 ' ***** ROUTINE TO CHANGE CARD BASE ADDRESS *****
3020 R%=21                                     'SET SCREEN ROW
3022 CO%=13                                          'SET SCREEN COLUMN
3025 SE$="1100"                                'SET DEFALT VALUE
3030 PS$="DIP SWITCH SETTING: "                      'SET SCREEN PROMPT
3040 GOSUB 300                                       'CALL DATA INPUT ROUTINE
```

```
3045 NG=0                                    'RESET NO GOOD FLAG
3050 FOR DS%=1 TO 4                                'SETUP TEST LOOP
3060 IF MID$(SE$,DS%,1)<>"1" AND MID$(SE$,DS%,1)<>"0" THEN NG=1
3065                                               'CK FOR 1 OR 0 ON ALL 4
3070 NEXT                                    'NEXT DIGIT
3080 IF NG=1 THEN 3000                             'START OVER IF NO GOOD
3100 BSE=0                                   'RESET BASE ADDRESS
3101 IF MID$(SE$,1,1)="1" THEN BSE=BSE+512         'TEST FOR 512 VALUE BIT
3102 IF MID$(SE$,2,1)="1" THEN BSE=BSE+256         'TEST FOR 256 VALUE BIT
3103 IF MID$(SE$,3,1)="1" THEN BSE=BSE+128         'TEST FOR 128 VALUE BIT
3104 IF MID$(SE$,4,1)="1" THEN BSE=BSE+64          'TEST FOR 64 VALUE BIT
3200 LOCATE 21,55                            'SET SCREEN LOCATION
3210 PRINT USING"###";BSE;:PRINT"D "HEX$(BSE);:PRINT "H " 'UPDATE SCREEN
3900 NA=1                                    'SET NEW ADDRESS FLAG TO 1
3905 GOSUB 800                                     'INIT SERIAL IC'S
3910 RETURN
4010 CLS:COLOR 15,0:KEY OFF
4013 GOSUB 7800
4015 PRINT"DIO216 Test Program - 06/09/87 - M.Ragsdale"
4016 PRINT STRING$(79,"=")
4018 GOSUB 600                                                 'PRINT SERIAL PROMPTS
4020 LOCATE 3,1
4023 GOSUB 7800
4025 FOR T%=0 TO 8
4026 APORT$=STR$(0+T%*4):IF LEN(APORT$)<3 THEN APORT$=" "+APORT$
4027 BPORT$=STR$(1+T%*4):IF LEN(BPORT$)<3 THEN BPORT$=" "+BPORT$
4028 CPORT$=STR$(2+T%*4):IF LEN(CPORT$)<3 THEN CPORT$=" "+CPORT$
4029 CNTPORT$=STR$(3+T%*4):IF LEN(CNTPORT$)<3 THEN CNTPORT$=" "+CNTPORT$
4030 PRINT "IC-"CHR$(49+T%)"   CNTL PORT+"CNTPORT$"  CONFIG WORD:"
4040 PRINT "A:+"APORT$;
4050 PRINT "B:+"BPORT$;
4060 PRINT "C:+"CPORT$
4070 NEXT
4080 PRINT
4100 IC$=INKEY$
4101 IF IC$="1" THEN IC=1:GOSUB 4920:GOTO 5100
4102 IF IC$="2" THEN IC=2:GOSUB 4920:GOTO 5200
4103 IF IC$="3" THEN IC=3:GOSUB 4920:GOTO 5300
4104 IF IC$="4" THEN IC=4:GOSUB 4920:GOTO 5400
4105 IF IC$="5" THEN IC=5:GOSUB 4920:GOTO 5500
4106 IF IC$="6" THEN IC=6:GOSUB 4920:GOTO 5600
4107 IF IC$="7" THEN IC=7:GOSUB 4920:GOTO 5700
4108 IF IC$="8" THEN IC=8:GOSUB 4920:GOTO 5800
4109 IF IC$="9" THEN IC=9:GOSUB 4920:GOTO 5900
```

```
4110 GOSUB 6000:GOSUB 7000                                    'UPDATE SCREEN
4111 IF BSE<>0 THEN GOSUB 4910
4115 IF BSE=0 OR IC$="A" OR IC$="a" THEN GOSUB 3000       'CHK FOR ADDR CHANGE
4116 IF IC$="S" OR IC$="s" THEN CLS:COLOR 15,0:SYSTEM
4117 GOSUB 500                                                'SCAN FOR SERIAL PORTS
4119 GOTO 4100
4120 COLOR 15,0:GOSUB 6000:GOSUB 7000:GOSUB 4915:GOSUB 4920
   :IF LM$<>"O" AND LM$<>"o" THEN GOSUB 4960
4122 B$=INKEY$
4123 GOSUB 500                                                'UPDATE SERIAL & INPUTS
4125 IF B$="S" OR B$="s" THEN COLOR 15,0:CLS:COLOR 15,0:SYSTEM
4130 IF B$="A" OR B$="a" THEN P$="A":LOCATE 4+OS,8:COLOR 0,15:
   PRINT "<            ":COLOR 15,0:GOTO 4500
4140 IF B$="B" OR B$="b" THEN P$="B":LOCATE 4+OS,35:COLOR 0,15:
   PRINT "<            ":COLOR 15,0:GOTO 4600
4150 IF B$="C" OR B$="c" THEN P$="C":LOCATE 4+OS,62:COLOR 0,15:
   PRINT "<            ":COLOR 15,0:GOTO 4700
4155 IF B$="N" OR B$="n" THEN GOSUB 4900:GOSUB 4950:GOSUB 4960:GOTO 4100
4157 IF B$>CHR$(48) AND B$<CHR$(57) THEN GOSUB 8000
4160 GOTO 4120
4200 IF AK(IC-1)+BK(IC-1)+CK(IC-1)<>3 THEN GOSUB 4960:GOTO 4120
4204 IF (IO$="O" OR IO$="o") AND AK(IC-1)+BK(IC-1)+CK(IC-1)=3 THEN
   GOSUB 4980 ELSE GOSUB 4960 'PRINT BIT TOGGLE PROMPT ?
4205 COLOR 15,0:INITVAL=128+A(IC-1)+B(IC-1)+C(IC-1):GOSUB 4300
4210 LOCATE 3+OS,44:COLOR 0,15:PRINT USING"###";INITVAL;:PRINT"D"
4215 LOCATE 3+OS,49:PRINT HEX$(INITVAL)"H":COLOR 0,15
4220 GOTO 4120
- - -
4300 '***** ROUTINE TO OUTPUT INITVAL TO CONTROL PORT FOR EACH 8255 *****
4310 IF IC=1 THEN VA=INP(BSE+0):VB=INP(BSE+1):VC=INP(BSE+2)
   :OUT BSE+3,INITVAL:OUT BSE+0,VA:OUT BSE+1,VB:OUT BSE+2,VC
4320 IF IC=2 THEN VA=INP(BSE+4):VB=INP(BSE+5):VC=INP(BSE+6)
   :OUT BSE+7,INITVAL:OUT BSE+4,VA:OUT BSE+5,VB:OUT BSE+6,VC
4330 IF IC=3 THEN VA=INP(BSE+8):VB=INP(BSE+9):VC=INP(BSE+10)
   :OUT BSE+11,INITVAL:OUT BSE+8,VA:OUT BSE+9,VB:OUT BSE+10,VC
4340 IF IC=4 THEN VA=INP(BSE+12):VB=INP(BSE+13):VC=INP(BSE+14)
   :OUT BSE+15,INITVAL:OUT BSE+12,VA:OUT BSE+13,VB:OUT BSE+14,VC
4350 IF IC=5 THEN VA=INP(BSE+16):VB=INP(BSE+17):VC=INP(BSE+18)
   :OUT BSE+19,INITVAL:OUT BSE+16,VA:OUT BSE+17,VB:OUT BSE+18,VC
4360 IF IC=6 THEN VA=INP(BSE+20):VB=INP(BSE+21):VC=INP(BSE+22)
   :OUT BSE+23,INITVAL:OUT BSE+20,VA:OUT BSE+21,VB:OUT BSE+22,VC
4370 IF IC=7 THEN VA=INP(BSE+24):VB=INP(BSE+25):VC=INP(BSE+26)
   :OUT BSE+27,INITVAL:OUT BSE+24,VA:OUT BSE+25,VB:OUT BSE+26,VC
4380 IF IC=8 THEN VA=INP(BSE+28):VB=INP(BSE+29):VC=INP(BSE+30)
```

```
   :OUT BSE+31,INITVAL:OUT BSE+28,VA:OUT BSE+29,VB:OUT BSE+30,VC
4390 IF IC=9 THEN VA=INP(BSE+32):VB=INP(BSE+33):VC=INP(BSE+34)
   :OUT BSE+35,INITVAL:OUT BSE+32,VA:OUT BSE+33,VB:OUT BSE+34,VC
4399 RETURN
4500 GOSUB 4930:GOSUB 4940:GOSUB 4950:IO$=INKEY$
4510 IF IO$="I" OR IO$="i" THEN LM$="":LOCATE 4+OS,8:COLOR 0,15
   :PRINT"I" :COLOR 15,0:PRINT" ":MA(IC-1)=1:GOTO 4530
4520 IF IO$="O" OR IO$="o" THEN LOCATE 4+OS,8:COLOR 0,15:PRINT"O";
   :COLOR 15,0:PRINT " ":MA(IC-1)=0:DA$(IC-1)="00000000":GOTO 4530
4525 GOTO 4500
4530 A(IC-1)=16*MA(IC-1):AK(IC-1)=1:GOTO 4200
4600 GOSUB 4930:GOSUB 4940:GOSUB 4950:IO$=INKEY$
4610 IF IO$="I" OR IO$="i" THEN LM$="":LOCATE 4+OS,35:COLOR 0,15
   :PRINT"I";:COLOR 15,0:PRINT" ":MB(IC-1)=1:GOTO 4630
4620 IF IO$="O" OR IO$="o" THEN LOCATE 4+OS,35:COLOR 0,15:PRINT"O";
   :COLOR 15,0:PRINT" ":MB(IC-1)=0:DB$(IC-1)="00000000":GOTO 4630
4625 GOTO 4600
4630 B(IC-1)=2*MB(IC-1):BK(IC-1)=1:GOTO 4200
4700 GOSUB 4930:GOSUB 4940:GOSUB 4950:IO$=INKEY$
4710 IF IO$="I" OR IO$="i" THEN LM$="":LOCATE 4+OS,62:COLOR 0,15
   :PRINT"I";:COLOR 15,0:PRINT" ":MC(IC-1)=1:GOTO 4730
4720 IF IO$="O" OR IO$="o" THEN LOCATE 4+OS,62:COLOR 0,15:PRINT"O";
   :COLOR 15,0:PRINT " ":MC(IC-1)=0:DC$(IC-1)="00000000":GOTO 4730
4725 GOTO 4700
4730 C(IC-1)=9*MC(IC-1):CK(IC-1)=1:GOTO 4200
4900 COLOR 15,0                                    'SET COLOR
4901 LOCATE 3,1:PRINT"          ":LOCATE 5,1:PRINT"       'COVER ARROWS
4902 LOCATE 7,1:PRINT"         ":LOCATE 9,1:PRINT"     "  'COVER ARROWS
4903 LOCATE 11,1:PRINT" ":LOCATE 13,1:PRINT"    "  'COVER ARROWS
4904 LOCATE 15,1:PRINT" ":LOCATE 17,1:PRINT"   "   'COVER ARROWS
4905 LOCATE 19,1:PRINT" ":RETURN
4910 LOCATE 25,1:COLOR 0,7:PRINT"SELECT IC NO. 1-9 OR S-YSTEM";
   :COLOR 15,0:RETURN
4915 LOCATE 25,1:COLOR 0,7:PRINT"SELECT -N-ext IC OR S-ystem ";
   :COLOR 15,0:RETURN

4920 LOCATE 25,30:COLOR 0,15:PRINT"SELECT PORT -A-,-B-,OR -C-";
    :COLOR 15,0:RETURN
4930 LOCATE 25,1:COLOR 15,0:PRINT"                        ";:RETURN
4940 LOCATE 25,57:COLOR 0,15:PRINT"SELECT -I-nput/-O-utput";
    :COLOR 15,0:RETURN
4950 LOCATE 25,30:COLOR 15,0:PRINT"                       ";:RETURN
4960 LOCATE 25,57:COLOR 15,0:PRINT"                       ";:RETURN
4980 LOCATE 25,57:COLOR 0,15:PRINT"Toggle Bit 12345678 on ";B$;
```

```
     :COLOR 15,0:LM$=IO$:RETURN
5100 GOSUB 4900:LOCATE 3,1:COLOR 0,15:PRINT">>>>>":OS=0:GOTO 4120
5200 GOSUB 4900:LOCATE 5,1:COLOR 0,15:PRINT">>>>>":OS=2:GOTO 4120
5300 GOSUB 4900:LOCATE 7,1:COLOR 0,15:PRINT">>>>>":OS=4:GOTO 4120
5400 GOSUB 4900:LOCATE 9,1:COLOR 0,15:PRINT">>>>>":OS=6:GOTO 4120
5500 GOSUB 4900:LOCATE 11,1:COLOR 0,15:PRINT">>>>>":OS=8:GOTO 4120
5600 GOSUB 4900:LOCATE 13,1:COLOR 0,15:PRINT">>>>>":OS=10:GOTO 4120
5700 GOSUB 4900:LOCATE 15,1:COLOR 0,15:PRINT">>>>>":OS=12:GOTO 4120
5800 GOSUB 4900:LOCATE 17,1:COLOR 0,15:PRINT">>>>>":OS=14:GOTO 4120
5900 GOSUB 4900:LOCATE 19,1:COLOR 0,15:PRINT">>>>>":OS=16:GOTO 4120
- - -
6000 '* ROUTINE TO GET VALUES FROM INPUTS AND DISPLAY THEM ON SCREEN *
6010 FOR ICN=0 TO 8
6020 IF MA(ICN)<>1 THEN 6030
6025 PV%=INP(BSE+0+ICN*4):GOSUB 6500:LOCATE 4+ICN*2,10:COLOR 0,15:PRINT PV$
6030 IF MB(ICN)<>1 THEN 6040
6035 PV%=INP(BSE+1+ICN*4):GOSUB 6500:LOCATE 4+ICN*2,37:COLOR 0,15:PRINT PV$
6040 IF MC(ICN)<>1 THEN 6100
6045 PV%=INP(BSE+2+ICN*4):GOSUB 6500:LOCATE 4+ICN*2,64:COLOR 0,15:PRINT PV$
6100 NEXT
6110 RETURN
- - -
6500 '**** ROUTINE TO CREATE A STRING OF ONE'S AND ZERO'S FROM 8 BIT DATA ****
6505 PV$=""
6510 IF PV%>=128 THEN PV$="1"+PV$:PV%=PV%-128 ELSE PV$="0"+PV$
6520 IF PV%>=64 THEN PV$="1"+PV$:PV%=PV%-64 ELSE PV$="0"+PV$
6530 IF PV%>=32 THEN PV$="1"+PV$:PV%=PV%-32 ELSE PV$="0"+PV$
6540 IF PV%>=16 THEN PV$="1"+PV$:PV%=PV%-16 ELSE PV$="0"+PV$
6550 IF PV%>=8 THEN PV$="1"+PV$:PV%=PV%-8 ELSE PV$="0"+PV$
6560 IF PV%>=4 THEN PV$="1"+PV$:PV%=PV%-4 ELSE PV$="0"+PV$
6570 IF PV%>=2 THEN PV$="1"+PV$:PV%=PV%-2 ELSE PV$="0"+PV$
6580 IF PV%>=1 THEN PV$="1"+PV$ ELSE PV$="0"+PV$
6590 RETURN
- - -
7000 '* UPDATE SCREEN FROM PORT DATA IN MEMORY & OUTPUT TO PORTS *
7010 FOR ICN=0 TO 8
7020 IF MA(ICN)<>0 THEN 7030
7025 DAT$=DA$(ICN):GOSUB 7500:OUT BSE+0+ICN*4,DAT
     :LOCATE 4+ICN*2,10:GOSUB 7700
7030 IF MB(ICN)<>0 THEN 7040
7035 DAT$=DB$(ICN):GOSUB 7500:OUT BSE+1+ICN*4,DAT
     :LOCATE 4+ICN*2,37:GOSUB 7700
7040 IF MC(ICN)<>0 THEN 7100
7045 DAT$=DC$(ICN):GOSUB 7500:OUT BSE+2+ICN*4,DAT
```

```
   :LOCATE 4+ICN*2,64:GOSUB 7700
7100 NEXT
7110 RETURN
7500 '**** ROUTINE TO CREATE 8 BIT DATA FROM A STRING OF 1'S & 0'S IN MEM
7510 DAT=0
7520 IF MID$(DAT$,1,1)="1" THEN DAT=DAT+1
7530 IF MID$(DAT$,2,1)="1" THEN DAT=DAT+2
7540 IF MID$(DAT$,3,1)="1" THEN DAT=DAT+4
7550 IF MID$(DAT$,4,1)="1" THEN DAT=DAT+8
7560 IF MID$(DAT$,5,1)="1" THEN DAT=DAT+16
7570 IF MID$(DAT$,6,1)="1" THEN DAT=DAT+32
7580 IF MID$(DAT$,7,1)="1" THEN DAT=DAT+64
7590 IF MID$(DAT$,8,1)="1" THEN DAT=DAT+128
7600 RETURN
7700 COLOR 0,15:PRINT DAT$;:COLOR 15,0:PRINT" ";:COLOR 0,15
   :PRINT USING"###";DAT;:PRINT"D";:COLOR 15,0:PRINT" ";
   :COLOR 0,15:IF LEN(HEX$(DAT))<2 THEN PRINT " "HEX$(DAT)"H"
   :RETURN ELSE PRINT HEX$(DAT)"H":RETURN
7800 FOR T%=0 TO 8
7810 MA(T%)=2:MB(T%)=2:MC(T%)=2
7820 NEXT:RETURN
8000 '     KEY INTERUPT SERVICE ROUTINES FOR BIT SET/RESET FUNCTION
8005 IF AK(IC-1)+BK(IC-1)+CK(IC-1)<>3 THEN RETURN
8010 IF P$="A" THEN IF MID$(DA$(IC-1),VAL(B$),1)="1"
   THEN MID$(DA$(IC-1),VAL(B$),1)="0" ELSE MID$(DA$(IC-1),VAL(B$),1)="1"
8020 IF P$="B" THEN IF MID$(DB$(IC-1),VAL(B$),1)="1" THEN
   MID$(DB$(IC-1),VAL(B$),1)="0" ELSE MID$(DB$(IC-1),VAL(B$),1)="1"
8030 IF P$="C" THEN IF MID$(DC$(IC-1),VAL(B$),1)="1" THEN
   MID$(DC$(IC-1),VAL(B$),1)="0" ELSE MID$(DC$(IC-1),VAL(B$),1)="1"
8040 RETURN
```

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Chapter 4: Connecting to Isolated Digital I/O Racks

The DIO216 is directly pin compatible with OPTO 22, Gordos, and similar “opto” racks. NOTE that the specification for the drive capability on the 8255 indicates it will not drive the load represented by an OPTO module. However, experience has proven that it is possible.

Pin 49 of each DIO216 connector provides the +5V required to operate the Opto rack. Note that the Opto rack must be jumpered to use the +5V from the DIO216. Operating nine racks from a single DIO216 would present a substantial load on the PC’s power supply. The user should consider an external power supply for large installations.

Opto racks are available in three sizes; 8-position (PB-8), 16-position (PB-16) and 24-position (PB-24). In each case, a 50-pin edge connector can be used to connect to the rack. In the case of the PB-8, this can also be a 26-position edge connector. The following table shows the pin-outs for the various size of opto-rack.

50-Pin Connector	26-Pin Connector	Module Position		
47	23	0	PB-8	PB-24
45	21	1		
43	19	2		
41	17	3		
39	15	4		
37	13	5		
35	11	6		
33	9	7		
31		8	PB-16	
29		9		
27		10		
25		11		
23		12		
21		13		
19		14		
17		15		
15		16		
13		17		
11		18		
9		19		
7		20		
5		21		
3		22		
1		23		

Table 4-1: Opto Rack Pin-Outs

Chapter 5: Repair

The DIO216 incorporates common TTL technology and is readily repaired in case of damage or malfunction. The following information should help with the trouble shooting.

The most common problem is overloading and damaging the 8255 PIO chips. They are not buffered so a problem with an input or output bit can generally be rectified by replacing the appropriate 8255.

Theory of Operation

All references to component numbers are made with respect to the schematic.

The card may be set at any of 16 Base Addresses (forty four addresses are used starting at the Base Address). Address decoding from the PC Bus is provided by IC-13, IC-17, and IC-18 in conjunction with a /IOW or /IOR signal through IC- 12A and IC-U5A to derive a Board Select Pulse at pin 3 or IC-12A. This negative going Board Select Pulse is applied to IC-14 which is used as a single load buffer to the PC Bus and to the gate on IC-15 which along with addresses A2-A5 is used to generate Device Select Pulses for the various Base+ addresses used on the card. IC-1 through IC-9 are 8255 chips (Programmable 3 - 8 bit Parallel Ports). Address lines A0 and A1 are directed to IC-1 through IC-9 to address, along with the chip select pulses, Port -A- (0), Port -B- (1), Port - C- (2), and the Control Port (3) on all 8255's. Address lines A0 and A1 are also directed to IC-10 and IC-11 (8251A USARTS).

A clock is provided for Baud Rate Selection consisting of IC-19 and Divider IC- 20. Baud Rate is selected via jumpers on Male headers. The level shifting for the RS-232 interfaces for IC-10 and IC-11 to J-1 and J-2 respectfully is provided by IC-21 and IC-22.

I/O connections for IC-1 through IC-9 are made on Connectors P-1 through P-9 respectfully. All Odd numbered pins are signal connections (Pins 1 through 47 are TTl Signal Lines - Pin 49 is +5 VDC). All even numbered pins are grounded for shielding and reference connections.

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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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