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Lab Manual on Instrumentation-II

BEX/BCT(III/I)

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The lab manual guides about the laboratory task as per the syllabus of Instrumentation-II for BEX/BCT students of III/I semester

Lab Contents

Lab1: Serial Interfacing with Microprocessor Based System-Null Modem Connection using DB-9 and RS232 Serial Standard

Lab2: Parallel Interfacing with Microprocessor Based System- 82C55 PPI (Programmable Peripheral Interface) with 8085 Microprocessor.

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Lab 5: Design Exercise (Small group Projects)-Basic I/O Device Interfacing like Keyboard, Seven segments, Motors etc.

Marks Distribution:

SN	Particular	Marks Distribution	Remarks
1	Attendance and Lab Discipline	5	Compulsory
2	Lab report	5	Only for Timely Submitted
3	Group Project	7	Compulsory
4	Final lab exam	8	Conducted with Experiments
	Total	**25**	

Lab1: Serial Interfacing with Microprocessor Based System-Null Modem Connection using DB-9 and RS232 Serial Standard

Objectives:

- To become familiar with DB-9 and RS232 standard
- Demonstration of Serial communication between two PCs

Apparatus:

- DB-9 -1pair
- Cat cable
- PCs.

Theory:

The serial port is harder to interface than the parallel port. In most cases, device you connect to the serial port will need the serial transmission converted back to parallel so that it can be used easily. This can be done using the UART. On the software side of things, there are many more registers that you have to attend than a standard parallel port (SPP).

Advantages of serial data transfer over parallel:

1. Serial can be longer than the parallel cables, the serial port transmit '1' as -3 to -25 volts and '0' as +3 to +25 volts whereas parallel port transmits a '0' as 0v and '1' as 5v. Therefore the serial port can have the maximum swing of 50 volts. Therefore cable loss is not going to be as much of a problem for serial cables as they are for parallel.
2. You don't need many wires for communication as of parallel transmission.
3. Microcontrollers have also proven to be quiet popular these days; many of which have built in SCI (Serial communication Interface), which can also be used to talk to outside world. Serial communication reduces the pin counts on these MPU's to only TX and RX, compare to at least 8 pins if you use 8 bit parallel method.

The standard port addresses of Serial port are: Table1: COM port Address in the BIOS Data Areas

Name	Address
COM 1	3F8
COM 2	2F8
COM 3	3E8
COM 4	2E8

Start Address	Function
0000:0400	COM1's base Address
0000:0402	COM2's base Address
0000:0404	COM3's base Address
0000:0406	COM4's base Address

Hardware properties:

Devices which use serial cables for their communication are split into two categories. These are DCE (Data Communication Equipment) and DTE (Data terminal Equipment). DCE are devices as your modem, plotter etc. while DTE is your computer or terminal. The electrical specifications of the serial port are contained in the EIA (Electronic Industry Association) RS232 standard. It states many parameters such as-

1. A "space" (logic 0) will be between +3 and +25 Volts.
2. A "Mark" (logic 1) will be between -3 and -25 Volts.
3. The region between +3 and -3 volts is undefined.

Serial ports come in two "sizes", there are D-Type 25 pin connector and the D-Type 9 pin connectors both of which are male type in the back of your PC. Thus you need female connector to connect on your device. In this lab we will only concern only about DB-9 connector. Figure below is the pin configuration of DB-9 male connector:

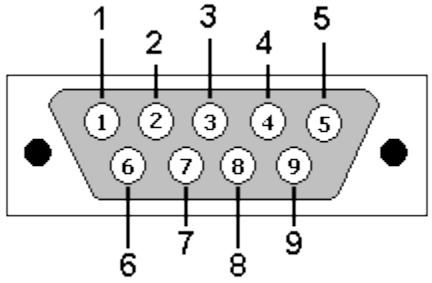


Fig 1: D-sub 9 Connector Pin-out

Table 2: Pin-out and diagram of DB9 connector, commonly used for serial ports (RS-232).

Pin	SIG.	Signal Name	DTE (PC)
1	DCD	Data Carrier Detect	In
2	RXD	Receive Data	In
3	TXD	Transmit Data	Out
4	DTR	Data Terminal Ready	Out
5	GND	Signal Ground	-
6	DSR	Data Set Ready	In

7	RTS	Request to Send	out
8	CTS	Clear to Send	in
9	RI	Ring Indicator	in

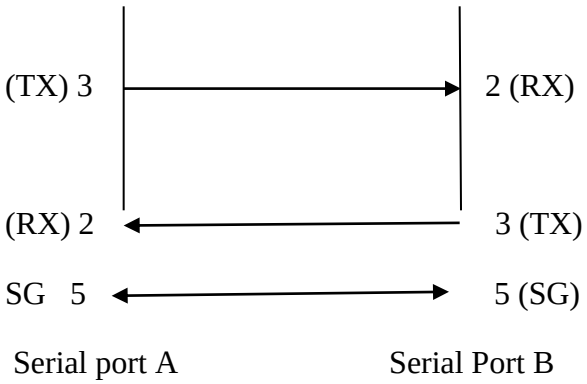


Fig 2: Wiring diagram of Serial communication (Null Modem)

Procedure:

i. Carry the pair of DB-9 (Female), CAT cable, Soldering iron with solder & flux.

ii. Set-up the Null Modem; Connect the wires according to figure 2.

iii. Connect the prepared cable between two PCs. (The assigned address for COM ports(1&2) can be seen by programming in turbo C.)

```
#include  <stdio.h>
#include  <dos.h>
void main(void)
{
 unsigned int far *ptraddr;  //pointer to location of port address
unsigned int address;                    //Address of the port
int a;
ptraddr=(unsigned int  far *)0x00000400;
for(a=0;a<4;a++)
{
 address=*ptraddr;
If(address==0)
printf("No port found for COM%d\n",a+1);
else
printf("Address assigned to COM%d is %Xh\n",a+1,address);
*ptraddr++;
}
}
```

iv. Open the "**Terminal"** desktop application in both PCs and set the following parameters:

- COM port: 1
- Baud rate: 9600
- Data bit: 8 with none parity & handshake

v. Send & Receive the data by typing the data like: Type "Hello" in transmitter (PC1), Receive same in Receiver (PC2).

Lab2: Parallel Interfacing with Microprocessor Based System- 82C55 PPI (Programmable Peripheral Interface) with 8085 Microprocessor.

Objectives:

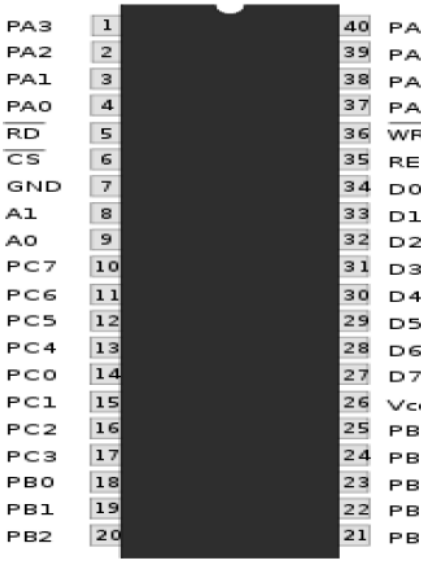
- To become familiar with Intel 8255A PPI
- To interface 8255 PPI with 8085 Microprocessor in both I/O mode (Lab 2.1) and BSR mode (Lab 2.2)

Apparatus:

- 8085 Microprocessor kit
- 8255 PPI kit

Theory:

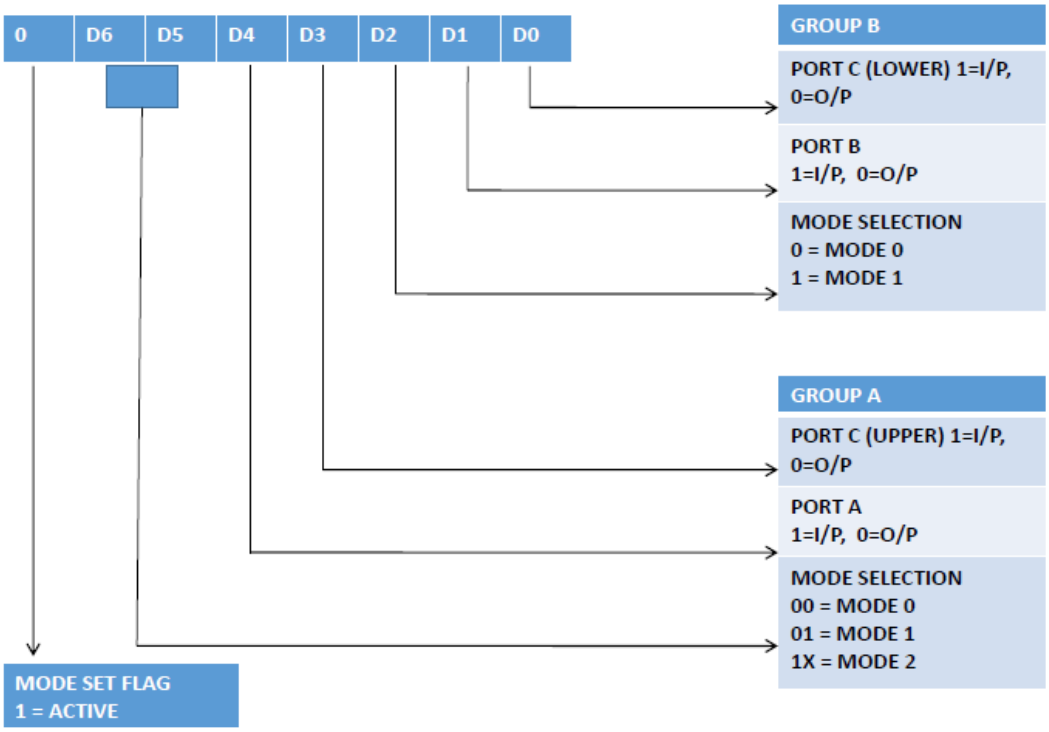
The Intel 8255 A is a general purpose programmable I/O device designed for use with Intel microprocessors. It has 24 I/O pins that can be grouped primarily in two 8-bit parallel ports: A and B, with the remaining bits as port C. The 8-bits of port C can be used as individual bits or be grouped in two 4-bits ports: C upper (Cu) and C lower (Cl). The functions of these ports are defined by writing a control word in the control register. 8255 functions in two modes:



- Bit Set/Reset mode: The BSR mode is used to set or reset the bits in port C.
- I/O mode: The I/O mode is further divided into three modes: mode 0, mode 1 and mode 2. In mode 0, all ports function as simple I/O ports. Mode 1 is a handshake mode whereby ports A and/or B use bits from port C as handshake signals. In the handshake mode, two types of I/O data transfer can be implemented: status check and interrupt. In mode 2, port A can be set up for bidirectional data transfer using handshake signals from port C and port B can be set up either in mode 0 or mode 1.

Description about Kit: This study card is interfaced through a 50 pin FRC cable to the Dyna-85 kit. It consists of one 82c55, with tags for all I/O ports, buffer, to drive LEDs, VCC and GND tags. The PPI chip 82c55 has three 8-bit I/O ports.

Control words in I/O Mode:



a. Port A output, mode of port A mode 1, port B output, mode of port B mode 0, port C lower pins as output and remaining pins of port C upper as output.

D_7	D_6	D_5	D_4	D_3	D_2	D_1	D_0
1	0	1	0	0	0	0	0

= A0H

Control words in BSR Mode:

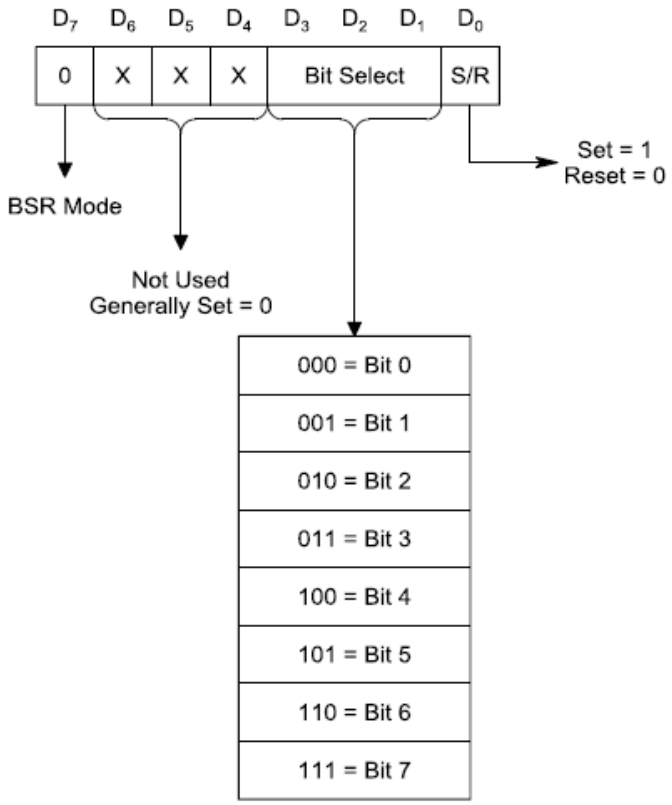


Fig: 8255A Control Word Format for BSR Mode

a. Set PC_7

To set PC_7

D_7	D_6	D_5	D_4	D_3	D_2	D_1	D_0
0	X	X	X	1	1	1	1

= 0FH [Normally don't care (X) = 0]

Procedure:

1. Keep Dyna card to the left side of the Dyna-85 kit.

2. Connect Dyna to Dyna-85 kit using the 50 pin FRC cable.

3. Do not connect/remove Dyna to/from Dyna-85 while power is ON.

4. The address of the interrupt service routine should be given at

FFC8H (RST6.5), FFC2H (RST5.5) and FFCE (7.5).

5. Default I/O address ranges of all experiment is 30H-37H.

Selection	Address
PORT A	30H
PORT B	31H
PORT C	32H
COMMAND	33H

Experiment 2.1: Programming 8255A in I/O mode

Case 1: Output mode: Mode 0

8255 is configured in mode 0, i.e. simple input/output mode. Port A, B, C are in mode 0. All the ports are in output mode and data is transmitted to the respective ports. Display AAH in Port A , 55H in Port B and 0FH in Port C.

- Derive control words for this configuration:

- Derive programs (mnemonics with opcodes):

Algorithm

- LOAD CONTROL WORD FOR OUTPUT MODE, MODE 0 IN ACCUMULATOR
- WRITE CONTROL WORD IN CONTROL REGISTER
- LOAD DATA FOR PORT A IN ACCUMULATOR
- DISPLAY THE READING AT PORTA, SIMILARLY FOR PORT B, C

- Compare your program with following program and apply it on kit

Address	Op code	Label	OBJ Operand code	Comments
C000	3E 80		MVI A, 80H	CONTROL WORD FOR OUTPUT MODE, MODE 0
C002	D3 33		OUT CMD_PORT	
C004	3E 55		MVI A,55H	DATA FOR PORT A
C006	D3 30		OUT PORT_A	
C008	3E AA		MVI A,AAH	DATA FOR PORT B
C00A	D3 31		OUT PORT_B	
C00C	3E 0F		MVI A,0FH	DATA FOR PORT C
C00E	D3 32		OUT PORT_C	
C010	CF		RST1	

Case 2: Input mode: Mode 0

8255 configuration in mode 0, i.e. simple Input/Output mode. Port A,B,C are in input mode. Data from all 3 ports are read and then stored in different registers.

- Derive control words for this configuration:

- Derive programs (mnemonics with opcodes):

Algorithm

- LOAD CONTROL WORD FOR OUTPUT MODE, MODE 0 IN ACCUMULATOR
- WRITE CONTROL WORD IN CONTROL REGISTER
- READ SWITCHES AT PORT A
- DISPLAY THE READING AT REGISTER D, SIMILARLY FOR PORT B, C

- Compare your program with following program and apply it on kit

Address	Op code	Label	OBJ Operand code	Comments
C000	3E 9B		MVI A, 9BH	;IN I/O MODE,PORTS ;A,B,C IN INPUT MODE ;MODE 0
C002	D3 33		OUT CMD_PORT	
C004	DB 30		IN PORT_A	
C006	57		MOV D,A	
C007	DB 31		IN PORT_B	
C009	47		MOV B,A	
C00A	DB 0F		IN PORT_C	
C00C	4F		MOV C,A	
C00D	CF		RST1	

Problems:

Note: Report should include the derivation for required control words and programs (mnemonics with opcodes) for all given problems

1. For the 8255A within the 8085 microprocessor (mapped at base address of 40H), initialize Port A in output mode 0, Port B in output mode 0 Port C-Upper in output and Port C-Lower in input mode.

    a. Display AAH in Port A and 55H in Port B
    b. Using BSR mode try to set PC6, PC4, PC2 and PCO and observe the result.
    c. Also configure all bits of Port C in output mode and observe the result by repeating 1b.
    d. Comment upon the results of l b and 1c.

2. Initialize the 8255 expansion kit (mapped at base address of 80H) as: - Port A in mode 0 input Port B in mode 0 output and Port C in output mode,
    a. Output AAH in all ports .Note down the result and identify MSB and LSB for each port output.
    b. There are only five LEDs connected to five pins of Port C. Use an appropriate program to find out the pins of Port C that are not used for display.

Experiment 2.2: Programming 8255A in BSR mode

Case1: First set the bit 7 then after some delay reset the bit 7 of PORT C.

- Derive control words for this configuration:

Control word for setting the bit 7: Control word for resetting the bit 7:

- Derive programs (mnemonics with opcodes):

- Compare your program with following program and apply it on kit

Address	Op code	Label	OBJ Operand code	Comments
C000	3E 80		MVI A, 80H	;PPORT C IN ; OUTPUT MODE
C002	D3 33		OUT CMD_PORT	
C004	3E 0F	LOOP1:	MVI A,0FH	;BSR MODE,BIT 7OF PORT C IS SET
C006	D3 33		OUT CMD_PORT	
C008	11 FF FF		LXI D,FFFFH	
C00B	CD F1 0F		CALL DELAY	
C00E	3E 0E		MVI A,0EH	;BIT 7 OF PORT C IS RESET
C010	D3 33		OUT CMD_PORT	
C012	11 FF FF		LXI D,FFFFH	
C015	CD F1 05		CALL DELAY	
C018	C3 44 C0		JMP LOOP1	