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Class/Branch: SE **Subject: MP**

8255 PPI (Programmable Peripheral Interface)

8255 provides an interface b/w the processor and I/O devices.

Why 8255 ?

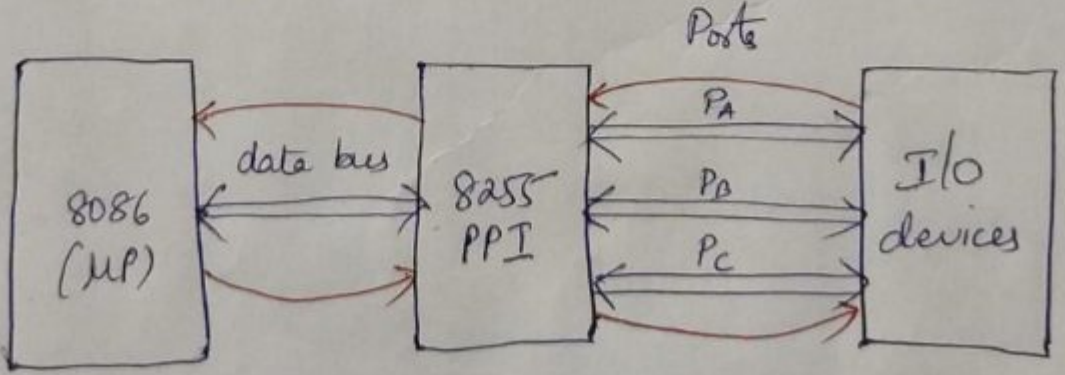
I/O devices are never connected directly to the data bus of the µP. They are connected to ports and these ports come from a chip like 8255.

What if we dont connect 8255 in b/w and connect I/O devices directly to the data bus of µP?

Transfer is unreliable.

I/O devices blindly sends data to µP hoping that µP is in a condition to accept data. Here no permission is taken by the I/O device and no acknowledgement is sent by µP. So the data transfer is unreliable.

This reliability is given by a chip like 8255.



8255 on one side is connected to µP by the data bus and on the other side is connected to i/p o/p devices by the ports.

8255 has 3 8 bit ports which are bidirectional.

Port A, Port B, Port C } can transfer 8 bits data
can be used as i/p port or o/p port.

Suppose an I/O device wants to send data to µP. It sends the data to 8255. How? – Blindly? – NO

The I/O device takes the permission of 8255 prior to sending the data. On receipt of data 8255 stores it and then informs the µP that it has data waiting to be read. Whenever free, the µP issues a read signal asking for data.

In case the µP is busy right now and has not yet read the data. In the meanwhile can the I/O device send new data? – NO

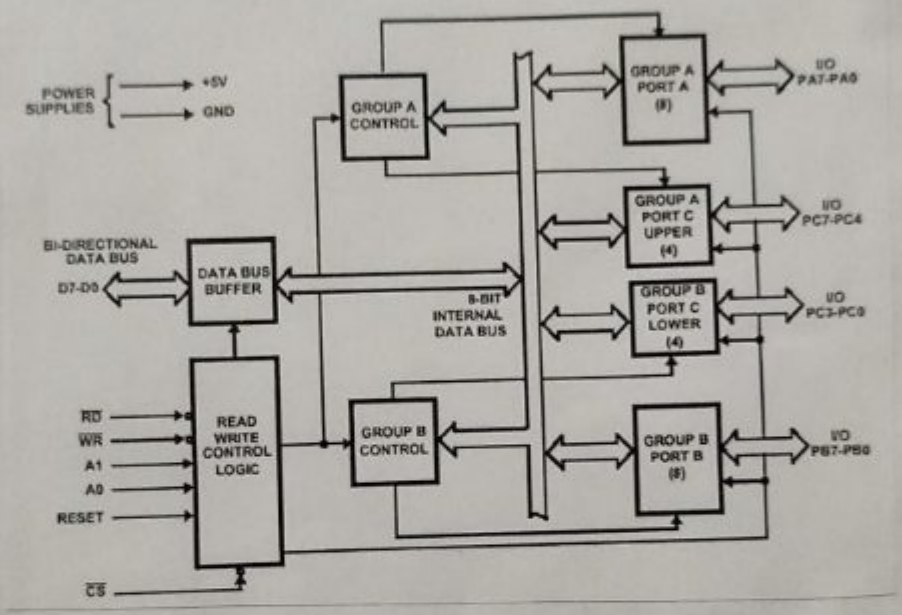
8255 does not grant permission to new data so that the previous data is not lost.

Only once the previous data is transferred to µP, 8255 grants permission for new data.

So will this take time? – YES
will this take long time? – MAY BE
How long? – 8255 does not know. There is no clock in 8255.

The signals which make the transfer reliable are called hand shaking signals and this is the reason why 8255 is used.

8255 Block Diagram / Architecture :



The data bus buffer is a 8-bit bidirectional buffer used to interface the internal data bus of 8255 with the system data bus.

8255 has 3 8 bit ports.
Port A lines are called $PA_0 - PA_7$
Port B lines are called $PB_0 - PB_7$
Port C lines are called $PC_0 - PC_7$. Even though it is an 8 bit port, it is divided into 2 parts:

$\underbrace{PC_0 - PC_3}_{\text{Port C lower}}$ $\underbrace{PC_4 - PC_7}_{\text{Port C higher}}$

Physically it is one port just like P_A and P_B. The division is shown logically.

Suppose on P_A we connected a Printer.
on P_B we connected a Monitor
on P_C we connected a Speaker.

The data that is sent by µP for Printer (ie Port A) should not go on other ports (ie Port B and Port C), which implies that all ports have their unique addresses.

∴ 8255 consumes 4 addresses.

One address for P_A
One address for P_B
One address for P_C
One address for Commands / Control word.

There are 2 commands which µP sends to 8255:

1) I/O command
2) Bit Set Reset (BSR) Command - to initialize 8255.

Any data on the databus has 4 places to go
P_A (Port A)
P_B (Port B)
P_C (Port C)
CW (Control word)

This is decided by 2 lines A_1 and A_0.

A_1	A_0	
0	0	Port A
0	1	Port B
1	0	Port C
1	1	control word.

8255 Interfacing with 8086

Note :- A_1 and A_0 of 8255 are connected with A_2 & A_1 of MP.

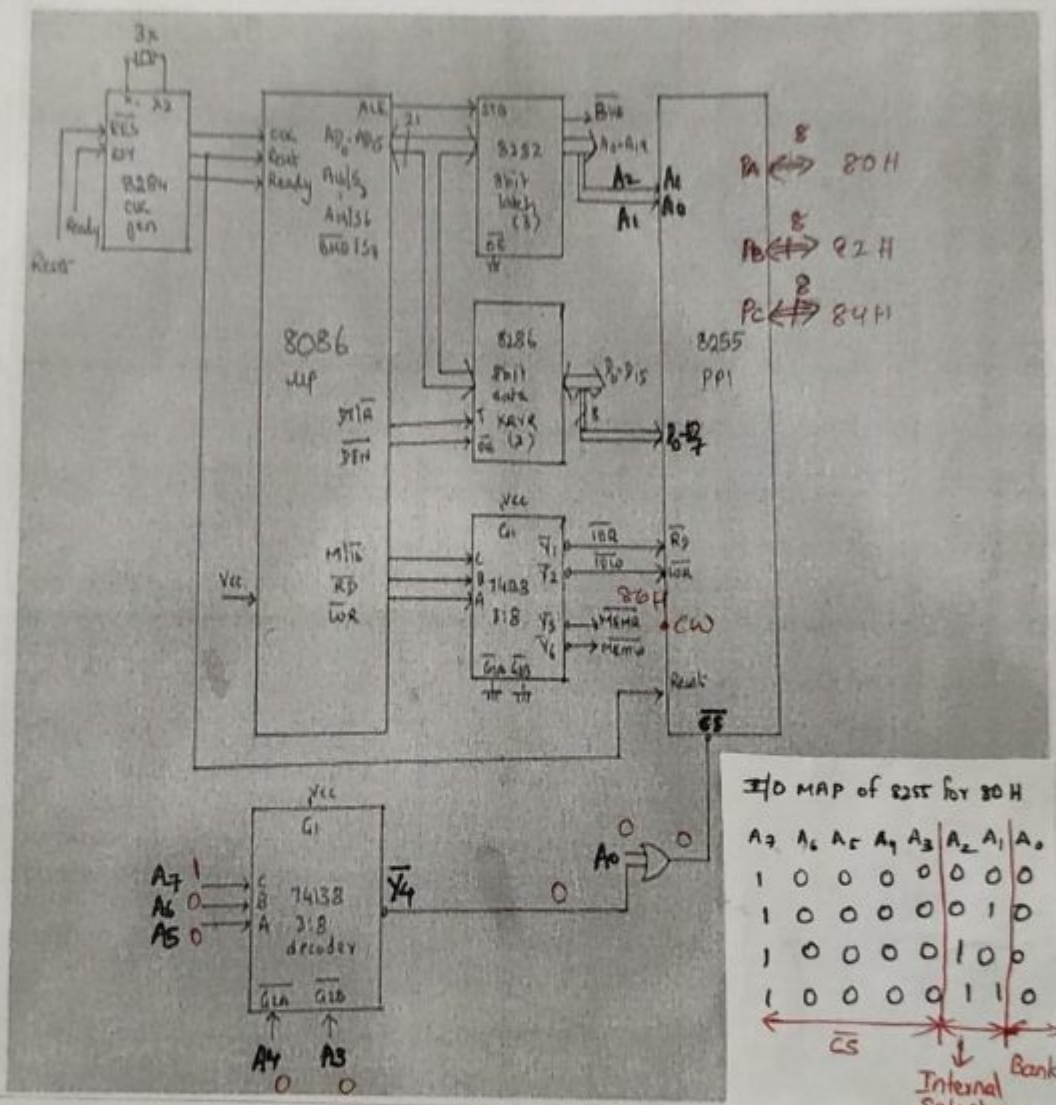


Figure:- Interfacing of 8255 with 8086 in minimum mode

IOR and IOW of μP are connected to $\overline{RD}$ & $\overline{WR}$ of 8255.
Reset of clock generator is connected to reset of 8255.

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8255 operates in three different modes:

	Mode 0 (Simple I/O)	Mode 1 (Handshake I/O)	Mode 2 (Bidirectional Handshake I/O)
Port A	✓	✓	✓
Port B	✓	✓	Mode 0 / Mode 1
Port C	✓	X	X

- In mode 0 all 3 ports are allowed to transfer data.
- In mode 1, only port A and B are allowed to transfer data. Port C lines are sacrificed to perform handshaking.

  If port A is in mode 1, it will take the upper lines of Port C to perform handshaking.
  If port B is in mode 1, it will take the lower lines of port C to perform handshaking.

  Port C upper works with Port A, so together they are called Group A.
  Port C lower works with Port B, so together they are called Group B.
  Group A is controlled by the Group A control logic.
  Group B is controlled by the Group B control logic.
- In mode 2, only port A can transfer data. Port B is functional but it will work in mode 1 or mode 0. Port C will be lost in doing handshaking.

So, port A can work in all the 3 modes.
port B can work in Mode 0 or Mode 1.
port C can work only in Mode 0

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8255 Commands → I/O command
→ BSR command

I/O Command

Control word for I/O command:

I/O/BSR	Mode	PA	PA	PC$_U$	MB	PB	PC$_L$
D_7	D_6 D_5		D_4	D_3	D_2	D_1	D_0
Eg:- 1	0	0	1	0	0	1	0

Port A - MO - i/p
Port B - MO - i/p
Port C - MO - o/p

Control word
1001 0010
92 H

MOV AL, 92H
OUT 86H, AL

- **Group B**
  - Port C (lower): 1 = I/P, 0 = O/P
  - Port B: 1 = I/P, 0 = O/P
  - Mode Selection: 0 = Mode 0, 1 = Mode 1
- **Group A**
  - Port C (Upper): 1 = I/P, 0 = O/P
  - Port A: 1 = I/P, 0 = O/P
  - Mode Selection: 00 = Mode 0, 01 = Mode 1, 1X = Mode 2
- **Mode Set Flag**: 1 = I/O command, 0 = BSR command

To do 8 bit transfer using Port A, B, C 8255 has to be in I/O mode. The bit pattern for the control word in I/O mode is shown above.

The MSB of the command identifies whether it is an I/O command or BSR command.

When 8255 is initialized, there are 2 things to be decided for every port.
- which mode it will work in
- which direction it will work in.

- 2 bits are used to tell the mode of Port A as it can work in 3 modes, but only 1 bit is used to tell the mode of port B as it can work in only 2 modes.
  The mode of port C is automatically decided by the mode of Port A and Port B ie, if port A is in mode 0 and port B is mode 0; obviously port C will also be in mode 0, otherwise port C lines are used for handshaking.
- If some data is sent on the data bus, it does not stay, it comes and goes. But if something is sent to a port, it will stay as each port internally has a latch.
  If the port is working as an i/p port, the latch has to be disabled so that the data which the I/O device is sending can be read. So the direction (I/P or O/P) has to be informed to the port.

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BSR Command

The BSR command is only for Port C.

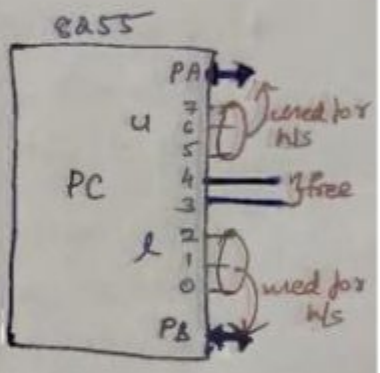
Control Word for BSR command:

D_7	D_6	D_5	D_4	D_3	D_2	D_1	D_0
0	X	X	X	PC	PC	PC	S/R

- D_7 = 0 → BSR mode.
- D_3 D_2 D_1 → Select a line of Port C
  - 000 - PC_0
  - 001 - PC_1
  - ...
  - 111 - PC_7
- D_0 → 1 = Set, 0 = Reset

Why is it only for port c ?

When port A is in mode 1, and port B is also in mode 1, they take away lines for port c for handshaking. Each port takes 3 lines of port C. 2 lines of port C are still free.



Suppose we want to connect a bulb to line 3 or 4 (as they are free). A 0 or 1 can be send on this line to turn it ON or OFF. To do this we will send data to 8255 and direct it to port C.

We want to send data to only line 3. But when we attempt to do this, some or the other data will also come on other lines. So to use this one line, we are disturbing the other lines which are busy doing handshaking.

So to use the free lines without disturbing others, the BSR command can be used to set or reset the individual bits of port C.