Experiment No: 2

Interfacing with 8255A Programmable Peripheral Interface (PPI)

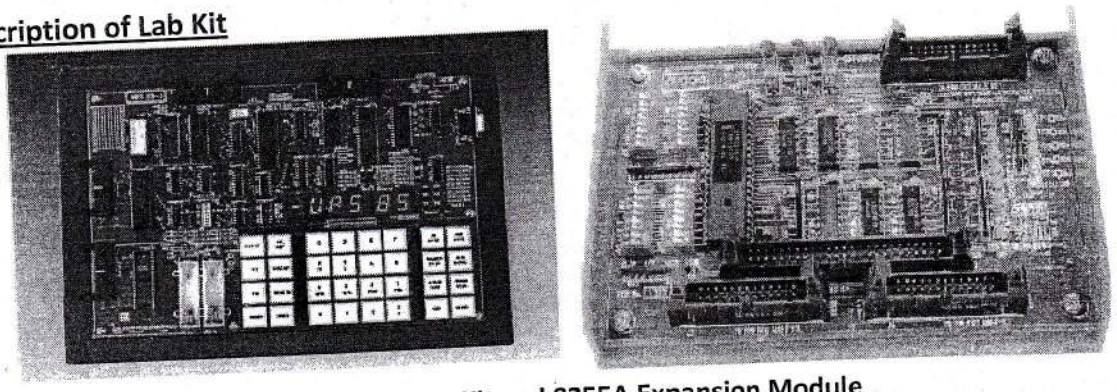
Background

8255A is a general purpose programmable I/O device designed for use with all Intel and most other microprocessors. The functional configuration of the 8255A is programmed by the system software so that no external logic is necessary to interface peripheral devices or structures.

The 8255A has 24 I/O pins grouped into 3 Ports of 8 pins each; Port A, Port B and Port C. Each of the ports can be configured either as an input port or an output port. Port C is further divided into two four bit ports (Port C_{UPPER} and Port C_{LOWER}). The functional configuration of each port is defined by sending a control word to the control register of 8255A. The control word contains information such as modes, I/O configurations, bit set/reset, etc. that initializes the functional configuration of 8255A.

Refer to 8255A datasheet and your class notes for detailed information on 8255A and its operation.

Description of Lab Kit



Microprocessor Kit and 8255A Expansion Module

The kit available in the lab is based on 8085 microprocessor. It is a versatile microprocessor trainer used as an instructional aide in colleges and universities. It is a complete single board microcomputer used for software and hardware development in research institutions and R&D labs. The board contains the following peripherals and connectors which will be used in the lab.

- **8255A**: Two 8255A are available to give 48 programmable I/O lines. One of them is mapped at base address of **40H** and another at base address of **00H** (nearer to battery socket). The I/O lines of each 8255A are connected to 26 pin ribbon cable connectors **J1** (for 8255A at 00H) and **J2** (for 8255A at 40H). Using these connectors, the external devices such as seven segment displays, ADC, DAC, stepper motor etc. can be interfaced.
- **Bus Expansion:** Fully de-multiplexed and buffered TTL compatible system bus signals (address, data and control lines) are brought out through two 26 pin ribbon cable connectors **J3** and **J4** for expansion. This bus expansion is used to monitor and control the external devices which are interfaced with the kit.
- **8255 Expansion Kit:** Expanded using **J3** and **J4** connectors of Microprocessor Kit and is mapped at base address of **80H**.

For lab work, we can use 48 I/0 lines. 24 I/O lines from onboard 8255A mapped at 40H are connected to 24 LEDs within the microprocessor kit. These set of I/O lines can be used as output lines only. Other 24 I/O lines are available in the expansion kit which is mapped at base address of 80H.These set of I/O lines can be used as input as well output lines.

Description of the 8255A Expansion Kit

- The interface has 4 DIP switches SW1, SW2, SW3 and SW4.
- The 8255A ports A and B can be configured as output by using appropriate control word in software and keeping the switches SW1 and SW3 in O/P position. Switches SW2 and SW4 will have no effect.
- 8255A port A can be configured as input by using control word and keeping SW1 in I/P position. After executing the program it reads the status of SW2 position. Similarly port B can be configured as input in software while keeping SW3 in I/P position. After executing the program it reads the status of SW4 position.
- 8 RED LEDs are provided to read the status of port A and 8 GREEN LEDs are provided to read the status of port B and YELLOW LEDs are provided to read the handshake signal status (Port C).
- Switches S1, S2 and S3 are provided to simulate STB* or ACK* signals in Mode1 and in Mode 2. Provision is made for connecting buffered external interrupt (RST 7.5 etc.,) to **J5** by keeping the jumper **JP2** at PC0 or PC3 depending on the type of Mode.
- The interface has 4 connectors named as **J2**, **J3**, **J4** and **P1**. **J3** and **J4** are reserved for connecting to MPS 85-3 trainer. All the 24 I/O lines are brought out to the **J2** connector. But port C lines are used as handshake signals so user cannot use those lines. (Only port A and port B lines are available to user). **P1** connector will not be used.

Installation

- Connect J3 connector on MPS 85-3 trainer kit to J3 connector on 8255A study card and J4 connector on MPS 85-3 trainer kit to J4 connector on 8255A study card using two 26 pin ribbon cables.

Switch off the power to the Trainer while connecting the Study Card. Press Reset after giving power to the Trainer.

Problems:

Initial 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 kit (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 PC0 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 1b and 1c.

2. Initialize the 8255A 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.

3. For the following cases write down the appropriate program and note down the results:
   a. Read data from Port A of expansion kit and display it to Port B of same kit and Port A of microprocessor board.
   b. Read data from Port A and Port B of expansion kit and display their sum to Port A and carry to Port C of microprocessor board.

4.
   a. The following program is used to read strobed input from Port A (Mode 1) of the expansion kit and display it to Port B (Mode 0) of same kit. The program runs in a continuous loop and if you change the input, the same thing will be repeated at Port B LEDs after **STB_A*** signal is sent to **PC_2**.

```
8000    MVI A, 0E   ; Initialize Interrupts
        SIM         ; Unmask RST 5.5
        EI          ; Enable Interrupts
LOOP:   JMP LOOP    ; Wait until interrupt

; On interrupt at RST 5.5, Program Counter is
  vectored to 8FB3 H

8FB3    JMP 9000
; Jump to RST 5.5 Service Routine

9000    IN   80 ; Read from Port A
        OUT  81 ; Output to Port B
        EI      ; Re-enable Interrupt
        RET     ; Return to main program
```

   Generate suitable control words and rewrite the program with proper initialization instructions for 8255A in the expansion kit. Run the program and comment on the result.
   Connect $INTR_A$ to external interrupt by placing jumper JP2 at PC_3 ($INTR_A$). Press S2 switch to simulate STB_A* signal.

   b. Write a continuous program to read through Port B of expansion kit and output it to Port A of same kit, each time the **STB_B*** signal is asserted (as in 4a.). Use RST 6.5 for interrupt request. On interrupt at RST 6.5, Program Counter is vectored to 8FB9 H.
   Connect $INTR_B$ to external interrupt by placing jumper JP2 at PC_0 ($INTR_B$). Press S1 switch to simulate STB_B* signal.

5. Generate the control words to initialize 8255A in Mode 2 and remaining pins as simple output and to enable $INTE_2$ for interrupt request. The following program uses Port A for both input and output. Complete it with proper initialization instructions for 8255A.

```
8000    MVI A, 0D   ; Initialize Interrupts
        SIM         ; Unmask RST 6.5
        EI          ; Enable Interrupts
LOOP:   JMP LOOP    ; Wait until interrupt

; On interrupt at RST 6.5, Program Counter is
  vectored to 8FB9 H

8FB9    JMP 9000
; Jump to RST 5.5 Service Routine

9000    IN   80 ; Read from Port A
        OUT  81 ; Output to Port B

        MVI  A, 0F
        OUT  80 ; Output 0F to Port A

        EI      ; Re-enable Interrupt
        RET     ; Return to main program
```

   Run the program and comment on the result.
   Connect $INTR_A$ to external interrupt by placing jumper JP2 at PC_3 ($INTR_A$).
   Press S2 switch to simulate STB_A* signal. Press and hold S3 switch to observe the output at Port A LEDs.