8085 MicroProcessor

8085 is pronounced as "eighty-eighty-five" microprocessor. It is an 8-bit microprocessor designed by Intel in 1977 using NMOS technology.

It has the following configuration −

- 8-bit data bus
- 16-bit address bus, which can address upto 64KB
- A 16-bit program counter
- A 16-bit stack pointer
- Six 8-bit registers arranged in pairs: BC, DE, HL
- Requires +5V supply to operate at 3.2 MHZ single phase clock

It is used in washing machines, microwave ovens, mobile phones, etc.

8085 Microprocessor – Functional Units

8085 consists of the following functional units −

Accumulator

It is an 8-bit register used to perform arithmetic, logical, I/O & LOAD/STORE operations. It is connected to internal data bus & ALU.

Arithmetic and logic unit

As the name suggests, it performs arithmetic and logical operations like Addition, Subtraction, AND, OR, etc. on 8-bit data.

General purpose register

There are 6 general purpose registers in 8085 processor, i.e. B, C, D, E, H & L. Each register can hold 8-bit data.

These registers can work in pair to hold 16-bit data and their pairing combination is like B-C, D-E & H-L.

Program counter

It is a 16-bit register used to store the memory address location of the next instruction to be executed. Microprocessor increments the program whenever an instruction is being executed, so that the program counter points to the memory address of the next instruction that is going to be executed.

Stack pointer

It is also a 16-bit register works like stack, which is always incremented/decremented by 2 during push & pop operations.

Temporary register

It is an 8-bit register, which holds the temporary data of arithmetic and logical operations.

Flag register

It is an 8-bit register having five 1-bit flip-flops, which holds either 0 or 1 depending upon the result stored in the accumulator.

These are the set of 5 flip-flops −

- Sign (S)
- Zero (Z)
- Auxiliary Carry (AC)
- Parity (P)
- Carry (C)

Its bit position is shown in the following table −

D7	D6	D5	D4	D3	D2	D1	D0
S	Z		AC		P		CY

Instruction register and decoder

It is an 8-bit register. When an instruction is fetched from memory then it is stored in the Instruction register. Instruction decoder decodes the information present in the Instruction register.

Timing and control unit

It provides timing and control signal to the microprocessor to perform operations. Following are the timing and control signals, which control external and internal circuits −

- Control Signals: READY, RD', WR', ALE
- Status Signals: S0, S1, IO/M'

- DMA Signals: HOLD, HLDA
- RESET Signals: RESET IN, RESET OUT

Interrupt control

As the name suggests it controls the interrupts during a process. When a microprocessor is executing a main program and whenever an interrupt occurs, the microprocessor shifts the control from the main program to process the incoming request. After the request is completed, the control goes back to the main program.

There are 5 interrupt signals in 8085 microprocessor: INTR, RST 7.5, RST 6.5, RST 5.5, TRAP.

Serial Input/output control

It controls the serial data communication by using these two instructions: SID (Serial input data) and SOD (Serial output data).

Address buffer and address-data buffer

The content stored in the stack pointer and program counter is loaded into the address buffer and address-data buffer to communicate with the CPU. The memory and I/O chips are connected to these buses; the CPU can exchange the desired data with the memory and I/O chips.

Address bus and data bus

Data bus carries the data to be stored. It is bidirectional, whereas address bus carries the location to where it should be stored and it is unidirectional. It is used to transfer the data & Address I/O devices.

8085 is an 8-bit microprocessor as it operates on 8 bits. The size of the address bus in 8085 is 16 bits. Thus, can address 64 KB memory. An 8085 microprocessor is an IC with 40 pins and operates with +5V power supply.

The pin configuration plays a very important role in understanding the architecture of 8085 microprocessor. So, now let's move further and understand how the processor operates inside any system with these 40 pins.

Pin Diagram of 8085 MP

Pin diagram of 8085 Microprocessor

Electronics Desk

The signals of this 40 pin IC is grouped into 7 categories, which are given below:

1. Power supply and clock signals
2. Data bus
3. Address bus
4. Serial I/O ports
5. Control and status signals

6. Interrupts and externally generated signals
7. Direct memory access

These are the categories among which the 40 pin configuration of 8085 is divided. So, let us proceed to understand the role of each pin inside the 8085 microprocessor.

1. **Address Bus and Data Bus:**
   The address bus is a group of sixteen lines i.e A0-A15. The address bus is unidirectional, i.e., bits flow in one direction from the microprocessor unit to the peripheral devices and uses the high order address bus.
2. **Control and Status Signals:**

   - **ALE –** It is an Address Latch Enable signal. It goes high during first T state of a machine cycle and enables the lower 8-bits of the address, if its value is 1 otherwise data bus is activated.

   - **IO/M' –** It is a status signal which determines whether the address is for input-output or memory. When it is high(1) the address on the address bus is for input-output devices. When it is low(0) the address on the address bus is for the memory.

   - **SO, S1 –** These are status signals. They distinguish the various types of operations such as halt, reading, instruction fetching or writing.

IO/M’	S1	S0	Data Bus Status
0	1	1	Opcode fetch
0	1	0	Memory read
0	0	1	Memory write
1	1	0	I/O read
1	0	1	I/O write
1	1	1	Interrupt acknowledge
0	0	0	Halt

- **RD’ –** It is a signal to control READ operation. When it is low the selected memory or input-output device is read.

- **WR’ –** It is a signal to control WRITE operation. When it goes low the data on the data bus is written into the selected memory or I/O location.

- **READY –** It senses whether a peripheral is ready to transfer data or not. If READY is high(1) the peripheral is ready. If it is low(0) the microprocessor waits till it goes high. It is useful for interfacing low speed devices.

3. Power Supply and Clock Frequency:

- **Vcc –** +5v power supply

- **Vss –** Ground Reference

- **XI, X2 –** A crystal is connected at these two pins. The frequency is internally divided by two, therefore, to operate a system at 3MHZ the crystal should have frequency of 6MHZ.

- **CLK (OUT) –** This signal can be used as the system clock for other devices.

4. Interrupts and Peripheral Initiated Signals:
The 8085 has five interrupt signals that can be used to interrupt a program execution.
(i) INTR
(ii) RST 7.5
(iii) RST 6.5
(iv) RST 5.5
(v) TRAP

The microprocessor acknowledges Interrupt Request by INTA' signal. In addition to Interrupts, there are three externally initiated signals namely RESET, HOLD and READY. To respond to HOLD request, it has one signal called HLDA.

- **INTR –** It is an interrupt request signal.

- **INTA' –** It is an interrupt acknowledgement sent by the microprocessor after INTR is received.

5. Reset Signals:

- **RESET IN' –** When the signal on this pin is low(0), the program-counter is set to zero, the buses are tristated and the microprocessor unit is reset.

- **RESET OUT –** This signal indicates that the MPU is being reset. The signal can be used to reset other devices.

6. DMA Signals:

- **HOLD –** It indicates that another device is requesting the use of the address and data bus. Having received HOLD request the microprocessor relinquishes the use of the buses as soon as the current machine cycle is completed. Internal processing may continue. After the removal of the HOLD signal the processor regains the bus.

- **HLDA –** It is a signal which indicates that the hold request has been received after the removal of a HOLD request, the HLDA goes low.

7. Serial I/O Ports:
Serial transmission in 8085 is implemented by the two signals,

- **SID and SOD –** SID is a data line for serial input where as SOD is a data line for serial output.