Electronics Engineering

Microprocessors

Comprehensive Theory

with **Solved Examples** and **Practice Questions**

MADE EASY
Publications

MADE EASY Publications Pvt. Ltd.

Corporate Office: 44-A/4, Kalu Sarai (Near Hauz Khas Metro Station), New Delhi-110016
E-mail: infomep@madeeasy.in
Contact: 011-45124660, 8860378007
Visit us at: www.madeeasypublications.org

Microprocessors

First Edition: 2015
Second Edition: 2016
Third Edition: 2017
Fourth Edition: 2018
Fifth Edition: 2019
Sixth Edition : 2020
Seventh Edition : 2021

Contents

Microprocessors

■■■

Chapter 1

Introduction to 8085 and Its Functional Organization

1.1 Introduction

The most important technological invention of modern times is the "microprocessor". A microprocessor is a multiple purpose programmable clock driven, register based electronic device that reads binary instructions from memory, accepts binary data as input and processing this data according to the instructions written in the memory. The microprocessor is capable of performing computing functions and making decisions to change the sequence of program execution. The microprocessor can be embedded in a larger system, and can function as the CPU of a computer called a microcomputer.

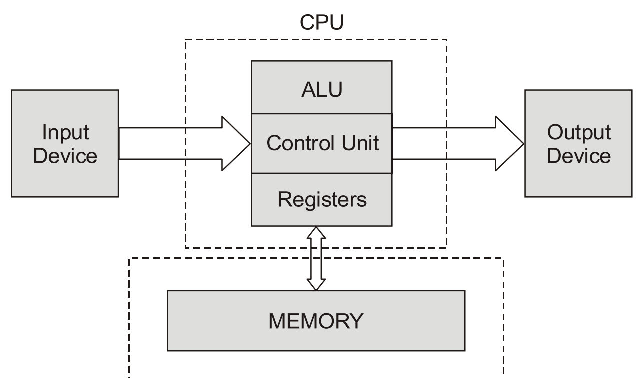


***Figure*-1.1 :** *Block diagram of microcomputer*

The Figure 1.1 shows the basic block diagram of a microcomputer which processes binary data and traditionally represented by four blocks i.e. CPU, memory, input device and output device.

Here, input device is a device that transfers information from outside world to the computer for example: Key board, mouse, webcam, microphone, scanner, electronic white boards, etc. The output device transfers information from computer to the outside world like monitor, printers (all types), speakers, headphones, projector, plotter, Braille embosser, LCD projection panel, computer output microfilm (COM) etc. Memory is an electronic medium that stores binary information.

Central Processing Unit (CPU) is the heart of computer systems. The microprocessors in any microcomputer act as a CPU. The CPU can be made up with ALU + CU + Registers, where ALU is the group of circuits that perform arithmetic and logical operations. Control Unit (CU) is a group of circuits that provide timings and signals to all the operations in the computer and controls the data flow.

Microcontroller is a programmable device that includes microprocessor, memory and I/O signal lines on a single chip, fabricated using VLSI technology. Microcontrollers are also known as single chip microcomputers. They are mostly used to perform dedicated functions such as automatic control of equipment, machines and process in industries and consumer appliances.

System Bus

A bus is a group of wires/lines used to transfer data (bits) between components inside a computer or between computers. In most simple form, they are communication path used to carry the signals between microprocessor and peripherals.

The system bus of a microprocessor is of three types:

1. **Address Bus**
   - It is a group of lines that are used to send a memory address or a device address from the Microprocessor Unit (MPU) to the memory or the peripheral.
   - The address bus is always uni-directional i.e. address always goes out of the microprocessor.
   - If the number of address lines is ‘n’ for a MPU then its addressing capacity is 2^n.
2. **Data Bus**
   - It is group of lines used to transfer data between the microprocessor and peripherals and/or memory.
   - Data bus is always bi-directional.
3. **Control Bus**
   - Control bus provides signals to control the flow of data.

Do You Know: The internal architecture of the microprocessor unit depends on the data bus width, which is equal to the bit-capacity of the microprocessor.

1.2 History of Microprocessors

A brief review of certain microprocessors were given in the Table 1.1. Intel introduced its first 4-bit PMOS microprocessor 4004 in the year 1971. It has 16 pins, 640-bytes of memory addressing capability and 10 address lines. After this enhanced version of 4004, a 4-bit, Intel 4040 was developed. In 1972, Intel introduced its first 8-bit processor Intel 8008, which also uses PMOS technology. The PMOS technology processors were slow and not compatible with TTL logic. These microprocessors could not survive as general purpose microprocessor due to design limitations. In 1974, Intel introduced its more powerful and faster 8 bit NMOS microprocessor Intel 8080. These processors were faster and compatible with TTL logic. Intel 8085 followed 8080 microprocessor. The main limitations of 8 bit microprocessors tempted the designers to go for more powerful processors in terms of advanced architecture, more processing capability, larger memory addressing capability and more powerful instruction set. The Intel 8086 was the result, launched in 1978 . The technology used was HMOS, high speed and high performance MOS technology.

Microprocessor	Word length	Memory capacity
Intel 4004 (PMOS)	4-bit	640 B
Intel 8008	8-bit	16 kB
Intel 8080 (NMOS)	8-bit	64 kB
Intel 8085 (NMOS)	8-bit	64 kB
Intel 8086 (HMOS)	16-bit	1 MB
Intel 8088	8/16-bit	1 MB
Intel 80186	16-bit	1 MB
Intel 80286	16-bit	16 MB real, 4 GB virtual
Intel 80386	32-bit	4 GB real, 4 GB virtual
Intel 80486	32-bit	4 GB real, 64 TB virtual
Pentium-II	64-bit	64 GB real
Z-80	8-bit	64 kB
Z-800	8-bit	500 kB

Table 1.1 : *A brief review of various microprocessors*

NOTE: Most of the general purpose microprocessors used in the modern world computers are the family of 8086.

1.3 Computer Language

- Scale of integration:
  - **SSI (Small Scale Integration):** The term refers to the technology used to fabricate discrete logic gates on a chip.
  - **MSI (Medium Scale Integration):** The process of designing few tens of gates on a single chip.
  - **LSI (Large Scale Integration):** The process of designing hundreds of gates on a single chip similarly terms VLSI (very large scale integration), ULSI (ultra large scale integration) are used to indicate the scale of integration.
- **Digital computer:** A programmable machine that processes binary data. It is traditionally represented by five components: CPU, ALU, CU, memory, input and output.
- **Instruction:** a command in binary that is recognized and executed by the computer in order to accomplish a task. Some instructions are designed with one word, and some require multiple words.
- **Mnemonic:** a combination of letters to suggest the operation of an instruction.
- **Program:** a set of instructions written in a specific sequence for the computer to accomplish a given task.
- **Machine Language:** the binary medium of communication with a computer through a designed set of instructions specific to each computer.
- **Assembly Language:** a medium of communication with a computer in which programs are written in mnemonics. An assembly language is specific to a given computer.
- **Low-Level Language:** a medium of communication that is machine-dependent or specific to a given computer. The machine and the assembly languages of a computer are considered low-level languages. Programs written in these languages are not transferrable to different types of machines.
- **High-Level Language:** a medium of communication that is independent of a given computer. Programs are written in English-like words, and they can be executed on a machine using a written translator (a compiler or an interpreter).
- **Compiler:** a program that translates English-like words of a high-level language into the machine language of a computer. A compiler reads a given program, called a source code, in its entirety, and then translates the program into the machine language which is called an object code. (Ex. *C*, *C*++)
- **Interpreter:** a program that translates the English-like statements of a high-level language into the machine language of a computer. An interpreter translates one statement at a time from a source code to an object code. (Ex. BASIC)
- **Assembler:** a computer program that translates an assembly language program from mnemonics to the binary machine code of a computer and these machine codes are called object programme .

  Difference between compiler and interpreter: Interpreter reads one line at a time, converts it into object code, executes and then reads next line. Whereas compiler reads whole program at a time and convert it into the object code and then execute.
- **Bit:** a binary digit, 0 or 1.
- **Byte:** a group of eight bits.
- **Nibble:** a group of four bits.
- **Word:** a group of byte the computer recognizes and processes at a time.

Example - 1.1 Machine instructions are written using which of the following?

(a) Bits 0 and 1 only
(b) Digits 0 and 9 only
(c) Digits 0 and 9 and the capital alphabets *A* to *Z* only
(d) Digits 0 to 9, the capital alphabets *A* to *Z* and certain special characters

Solution : (a)

Machine instructions are written using bits 0 and 1 only.

Example - 1.2 Output of the assembler in machine code is referred to as

(a) Object program
(b) Source program
(c) Macroinstruction
(d) Symbolic addressing

Solution : (a)

Output of the assembler in machine code is referred to as object program.

Example - 1.3 Which one of the following statements is correct?

A micro-controller differs from a microprocessor it has

(a) Both on-chip memory and on-chip ports
(b) Only on-chip memory but not on-chip ports
(c) Only on-chip ports but not on-chip memory
(d) Neither on-chip memory nor on-chip ports

Solution : (a)

A micro-controller differs from a microprocessor in that has both on-chip memory and on-chip ports.

Example - 1.4 Assertion (A): Many programmers prefer assembly level programming to machine language programming.

Reason (R): It is possible to efficiently utilize the hardware of the computer in machine language programming.

(a) Both A and R are true and R is the correct explanation of A.
(b) Both A and R are true but R is not a correct explanation of A.
(c) A is true but R is false.
(d) A is false but R is true.

Solution : (b)

Many programmers prefer assembly level programing to machine language programming because assembly language is simple and easily understandable. So assertion is true. Also it is possible to efficiently utilize the hardware of the computer in machine language programming because the machine language is directly understood by microprocessor.

Application of Microprocessors

A few more applications of microprocessors are mentioned below:

- A microprocessor based stepping motor controller used for controlling several stepping motors in a pulsed Laser system. The motors are used to precisely align a set of mirrors used in this system.
- There are several other motor control applications reported in the literature, Lin (1977) describes one approach to motor speed control using an SCR chopper.

- A microprocessor controlled Railways Signalling Inter lock was developed to exhibit the applications of microprocessors in signalling. The system mirrors train positions in different blocks on a section and sends speed codes to each block. The speed codes are displayed and used by train drivers to control the speed.
- A patient surveillance system was designed using distributed processing.
- Microprocessors have been used in a variety of automation applications. Control of tester for surveillance checking the electronic functioning capability of a target detecting device (Frantz, 1977) is one of these. A microprocessor based blood gas analyzer has been developed by Margalith et al. (1977).

1.4 Microprocessor Architecture

The process of data manipulation and communication is determined by the logic design of microprocessor, called the "Architecture". There are two types of architecture depending upon storage of program and data in memory:

- Von Neumann architecture of computers
- Harvard architecture of computers

Von Neumann Architecture

The idea of basic organization of a digital computer containing a CPU, a main memory, input and output device and secondary storage devices was given by John von Neumann in 1945. He introduced the "stored – program concept"-where the programs and data are stored in the same high speed memory unit. In Von Neumann architecture there is a program counter and instructions are executed in sequential manner. The MPU fetches one instruction of the program and executes it, then it goes to the next instruction. The speed of computer is limited by the speed at which the MPU can fetch the instructions and data from the memory and process them. Digital computers based on this principle are called control-flow or control driven computers.

Examples: Intel 8085 and Intel 8086

Harvard Architecture

The enhanced version of Von Neumann architecture is the Harvard architecture. It contains separate instruction memory and data memory. The instruction memory and data memory in Harvard architecture have separate data path , that eliminated the speed limitation of single bus architecture in a Von Neumann processor.

Examples: TMS 32010, Intel 8051, Intel's Pentium. etc.

1.5 The 8085 Microprocessor Pins and Signals

The 8085A (8085) is an 8-bit microprocessor. The device has 40 pins, requires a +5 V single power supply, and can operate with a 3 MHz single-phase clock frequency. The 8085 is an advance version of 8080A. Its instruction set is compatible with that of the 8080A, it means that 8085A instruction set includes all the instruction of 8080A with some additional instructions.

Figure 1.2 (a) and (b) shows the 8085 pinout and simplified pinout of 8085 respectively.

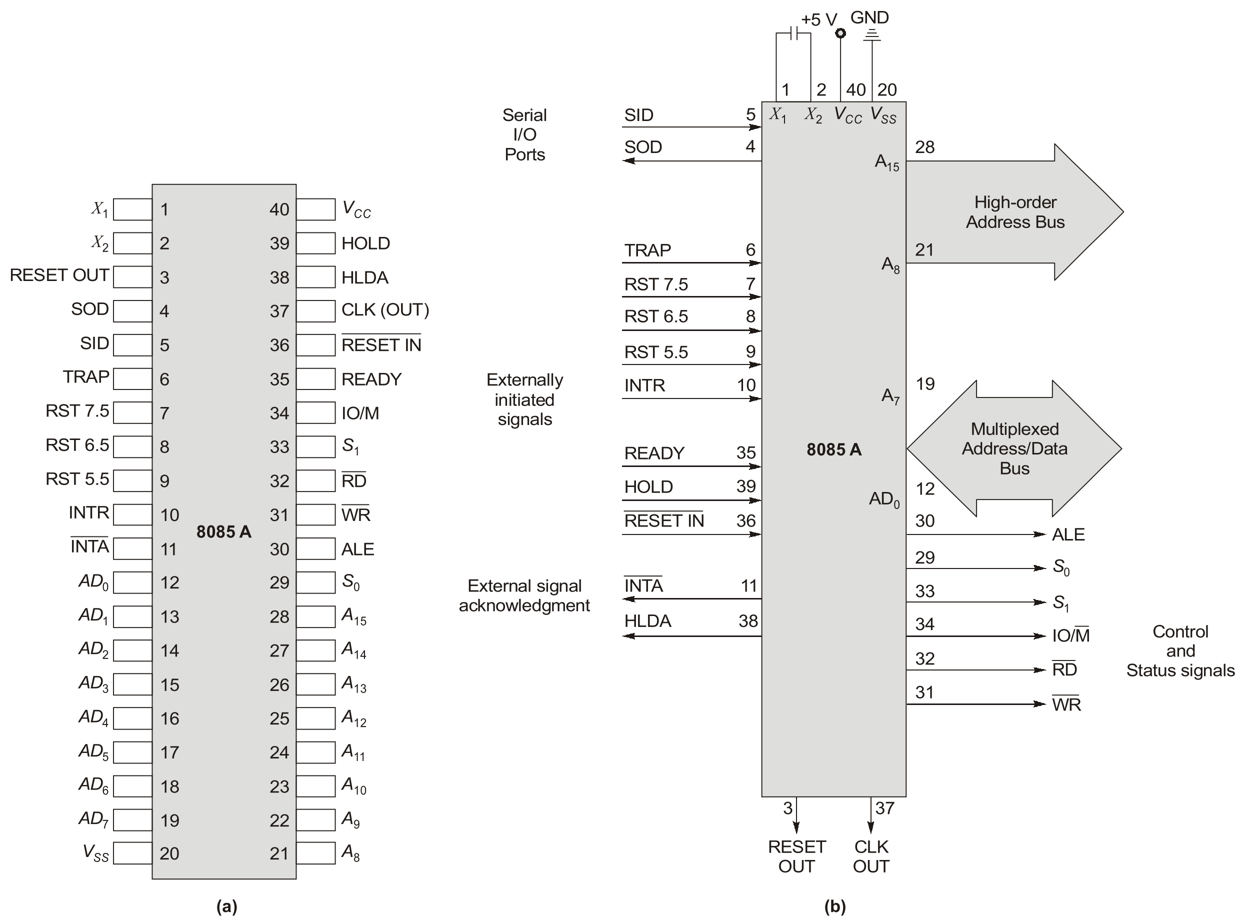


***Figure*-1.2 :** 8085 Pinout

Key Points of Microprocessors 8085

- It is manufactured using NMOS technology.
- It is upward compatible with 8080A.
- It is a 40 pin DIP (Dual in line Package) chip.
- It is a 8-bit processor.
- It has total 16 address lines with addressing capacity of 64 kB.
- It has 8 data bus lines which is the bit capacity of the microprocessor.
- Internal architecture of the 8085 depends on the bit capacity.
- Serial data transfer facility is provided by 8085 MPU.
- Low order address bus ($AD_0 - AD_7$) is multiplexed with data bus.
- High order address bus is not multiplexed with any other lines.
- Advantage of multiplexing lower order address with data lines is that the number of pins are reduced.
- To de-multiplex address from data ALE (Address Latch Enable) signal is used.
  ALE = 1, Address transfer to bus.
  ALE = 0, Data transfer to bus.
- Disadvantage of multiplexing is that speed will be reduced.
- It has on chip clock generation facility.

- It requires +5 V power supply for its operation.
- Only one ground pin is present.
- There are five hardware interrupts available for 8085.
- The crystal frequency of processor is 6 MHz and the clock frequency is 3.07 MHz (~3 MHz), which is approximately half the crystal frequency.
- The word length or bit capacity is 8.
- 8085 has 74 basic instructions with 246 opcodes.

Signals of 8085 Microprocessors

According to the above figure all the signals can be classified into six groups:

1. Address Bus signals
2. Data Bus signals
3. Control and Status signals
4. Power supply and frequency signals
5. Serial I/O ports
6. Externally initiated signals

Address Bus/Data Bus Signals

Address Bus Signals:

- Control pins: Pin 21 to 28.
- It is 16 bits in length.
- It is unidirectional bus.
- It is divided into two parts namely,
  Lower order address bus (AD_0 - AD_7) → also called "Line number".
  Higher order address bus (A_8 - A_{15}) → also called "Page Number".

Multiplexed Address/Data Bus Signals:

- Control pins: Pin 12 to 19.
- Its length is in 8-bit.
- It is a bidirectional bus.
- It is multiplexed with lower order address bus with lines (AD_0 - AD_7).
- To reducing the number of pins in microprocessor, databus is "Time Division Multiplexed" with address bus.

Control and Status Signals

Microprocessor 8085 has two control signals $\overline{\text{RD}}$ and $\overline{\text{WR}}$, three status signals $\text{IO}/\overline{\text{M}}$, S_1 and S_0 and one special purpose signal ALE.

- Control pins: pin31 and pin32
- Control signals: $\overline{\text{WR}}$ and $\overline{\text{RD}}$
- Status pins: pin34, pin33 and pin29
- Status signals: $\text{IO}/\overline{\text{M}}$, S_1 and S_0

$\overline{\text{RD}}$ (Read): It is an active low signal. When the signal is low on this pin, the microprocessor performs memory reading or I/O reading operation.

$\overline{WR}$ **(Write):** It is an active low signal. When the signal is low on this pin, the microprocessor performs memory writing or I/O writing operation.

$IO/\overline{M}$:

- This is the status signal used to differentiate between I/O and memory operations.
- When it is HIGH → an I/O operation performed.
- When it is LOW → a memory operation performed.

$IO/\overline{M}$	$\overline{RD}$	$\overline{WR}$	Description
0	0	1	Memory Read ($\overline{MEMR}$)
0	1	0	Memory Write ($\overline{MEMW}$)
1	0	1	IO Read ($\overline{IOR}$)
1	1	0	IO Write ($\overline{IOW}$)

***Table*-1.2 :** *Memory or IO operations based on Control Signals*

S_1 **and** S_0**:** These two status signals, similar to $IO/\overline{M}$, which can identify various operations based on the combinations of S_1 and S_0.

S_1	S_0	Microprocessor Operation
0	0	Halt (no operation)
0	1	Write operation
1	0	Read operation
1	1	Opcode fetch (Reading instruction)

***Table*-1.3 :** *Processor operation based on status pins S_1 and S_0*

Machine Cycle	Status			Control signals
	$IO/\overline{M}$	S_1	S_0	
Opcode Fetch	0	1	1	$\overline{RD}$ = 0
Memory Read	0	1	0	$\overline{RD}$ = 0
Memory Write	0	0	1	$\overline{WR}$ = 0
I/O Read	1	1	0	$\overline{RD}$ = 0
I/O Write	1	0	1	$\overline{WR}$ = 0
Interrupt Acknowledge	1	1	1	$\overline{INTA}$ = 0
Halt	X	0	0	

***Table*-1.4**

ALE (Address Latch Enable): It is a special signal used to demultiplex the address bus and data bus. This is a positive going pulse generated every time the processor begins an operation (machine cycle) to latch the low-order address from the multiplexed bus and generate a separate set of eight address lines A_7 to A_0.

Flags

Flags are flip flops that store bit 0 or 1 based on the arithmetic or logical operation performed by ALU. In most of the operations the result is stored in accumulator. Therefore, flags generally reflect the data conditions in the accumulator with some exceptions. There are five flags present in 8085 processor. All the flags are present in an 8 bit register called as status register or flags register. The flags generally reflect the status of arithmetic or logical operations. The description and conditions of flags are as follows:

Sign Flag (S): After the execution of an arithmetic or logic operation, if bit D_7 of the result (usually in the accumulator) is 1, the sign flag is set. This flag is used with signed numbers. In a given byte, if D_7 is 1, the number will be viewed as a negative number; if it is 0, the number will be considered positive. In arithmetic operations with signed numbers, bit D_7 is reserved for indicating the sign, and the remaining seven bits are used to represent the magnitude of a number. However flag is irrelevant for the operations of unsigned numbers. So, this flag is used for operation on signed numbers.

Zero Flag (Z): The zero flag is set when the ALU operation results in 0, and the flag is reset if the result is nonzero. This flag is affected by the results in accumulator as well as in the other registers.

Auxiliary Carry Flag (AC): In an arithmetic operation, when a carry is generated by digit D_3 and passed on to digit D_4, the AC flag is set. Among the five flags, AC flag is used internally for BCD arithmetic operations and is not available for the programmer to change the sequence of the program with a jump instruction.

Parity Flag (P): After the ALU operation, if the result contains even number of ones (even parity) the parity flag is set and if result has odd number of one (odd parity) the parity flag resets.

Carry Flag (CY): If an arithmetic operation results in a carry, the carry flag is set, otherwise it is reset. It works as a borrow flag during subtraction.

The Figure 1.5 shows the bit positions reserved for these flags in the flag register.

D_7	D_6	D_5	D_4	D_3	D_2	D_1	D_0
S	Z	×	AC	×	P	×	CY

***Figure*-1.5 :** *Flag registers*

Remember

- Among the five flags, the *AC* flag is used internally for *BCD* arithmetic; the instruction set does not include any conditional jump instruction based on the AC flag.
- 'X' in the flag register indicate the unused flip-flops.
- The values of D_1, D_3 and D_5 bits should be taken as '0' in programs while using PSW instruction.

***Example* - 1.10** Which of the following flag conditions are not available in 8085 processor?

(a) Zero flag
(b) Parity flag
(c) Overflow flag
(d) Auxiliary carry flag

***Answer* : (c)**

***Example* - 1.11** In 8085 microprocessor

(a) P flag is set when the result has odd parity
(b) P flag is reset when the result has odd parity
(c) P flag is reset when the result has even parity
(d) Any of above

***Solution* : (b)**

In 8085 P flag is set when the result has even parity and reset when result has odd parity.

***Example* - 1.12** The sign-flag of 8085 microprocessor is set to 1, if

(a) the result of an arithmetic operation is zero.
(b) the most significant bit of the result of an arithmetic or logic operation is 1.

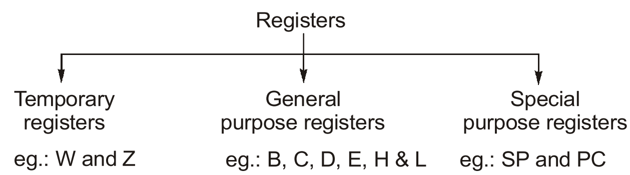
(c) there is a carry from addition or borrow from subtraction.
(d) the result of an operation carries four 1's in accumulator.

Solution : (b)

The sign-flag of 8085 microprocessor is set to 1, if the most significant bit of the result of an arithmetic or logic operation is 1.

Register Array

The register array can be categorized as:



Temporary Registers

The temporary registers *W* and *Z* are used to store data/address temporarily. It is only used by microprocessor to perform internal operations during the programme execution. This register is also called invisible register because they are not available for user during programme.

General Purpose Registers

The 8085 Microprocessor consists of six general purpose registers i.e. *B*, *C*, *D*, *E*, *H* and *L*. They all are 8-bit registers and can be accessed by the programmer. In addition to that general purpose register also forms three 16-bit register pair as *BC*, *DE* and *HL* pairs. Accumulator can also be used along with status register to form a 16-bit programmable register called program status word (PSW). Accumulator acts as one source of operand to the ALU and destination to the result. During I/O data transfer, data is transferred between accumulator and I/O device.

NOTE: The general purpose registers put together is called 'scratch pad memory'.

Special Purpose Registers

There are two 16-bits special purpose register called program counter (PC) and stack pointer (SP). They are user accessible.

Program Counter (PC): It is a 16-bit special purpose register used to sequence the execution of programme. During the programme it is required to keep track of the address of next instruction to be fetched from the memory for execution. In other words we can say that the PC provides the address of next instructions to memory which has to be executed. When a byte is fetched then PC automatically incremented by one (1), to point to next memory location.

NOTE: When the microprocessor is reset, the PC sets to zero [0000H].

Stack Pointer (SP): It is a 16-bit special purpose register, used as a memory pointer. Stack pointer provides the top address of stack. A memory location in R/W memory is called "STACK". It is a part of RAM, which is used during Subroutines, PUSH and POP operations.

NOTE: Stack grows from bottom to top following LIFO (Last In First Out) structure and the SP contents keep decreasing as the stack grows.

Increment and Decrement Latch

It is used for increment or decrement of 16-bit address, always increment and decrement by '1'.

Example - 1.13 In 8085 microprocessor, HL register pair is used for storing

(a) Address of memory (b) Data

(c) Address of next instruction (d) Current instruction

Solution : (a)

In 8085 microprocessor, HL register pair is used for storing address of memory.

Example - 1.14 The program counter (PC) in a microprocessor

(a) counts the number of programs being executed by the microprocessor

(b) counts the number of instruction being executed by the microprocessor

(c) counts the number of interrupts handled by the microprocessor

(d) keeps the address of the next instruction to be fetched

Solution : (d)

Program-counter is a 16-bit register used to store the address of next instruction to be fetched by the microprocessor.

Timing and Control Unit

- The control unit is the nerve centre of any MPU.
- It synchronizes all the microprocessor operations with the CLK and generates the control signals necessary for communication between the microprocessors and peripherals.
- In this unit X_1 and X_2 pins are used to connect external crystals or LC circuit to generate internal clock. Mathematically we have,

$$f_{\text{CLK}} = \frac{f_{\text{crystal}}}{2} \quad \text{and} \quad T = \frac{1}{f_{CLK}} = \text{T-state}$$

Instruction Register (IR) and Decoder

The instruction register and the decoder are the parts of the ALU.

Instruction Register: When an instruction is fetched into processor from memory, it is loaded in the instruction register. This register is only used for storing the opcode of instruction. It is invisible for user.

Instruction Decoder: The output of instruction register is connected to the decoder. The decoder decodes the instruction and establishes the sequence of events to follow.

Interrupt Control

As the name suggests this control interrupts a process. If a microprocessor is executing the main program, now whenever the interrupt signal is enabled or requested the microprocessor shifts the control from main program to process the incoming request and after the completion of request, the control goes back to the main program. For example an Input/output device may send an interrupt signal to notify that the data is ready for input. The microprocessor temporarily stops the execution of main program and transfers control to I/O device. After collecting the input data the control is transferred back to main program.

Interrupt signals present in 8085 are:

Hardware interrupts:

RSTn	Vectored address
RST 4.5 (TRAP)	0024 H
RST 5.5	002CH
RST 6.5	0034 H
RST 7.5	0036 H
INTR	Non-vectored

Apart from these hardware interrupts there are eight software interrupt present in 8085 microprocessor. All the software interrupts are vectored interrupt.

Software interrupts:

RSTn	Vectored address
RST 0	0000 H
RST 1	0008 H
RST 2	0010 H
RST 3	0018 H
RST 4	0020 H
RST 5	0028 H
RST 6	0030 H
RST 7	0038 H

***Example* - 1.15** Which interrupt is having the highest priority?

(a) RST 7.5 (b) RST 6.5
(c) RST 5.5 (d) TRAP

Solution : (d)

TRAP is having the highest priority among all the interrupts.

***Example* - 1.16** Which of these is software interrupt?

(a) RST 4.5 (b) RST 5
(c) RST 5.5 (d) RST 6.5

Solution : (b)

Except RST 5 all other options are the example of hardware interrupts.

NOTE

Trick for finding vectors address:
Firstly we get (n × 8), where n = 0,1,2, ...7. Then after convert it in hexadecimal.

e.g.: RST 2, $n = 2 \therefore n \times 8 = 16 \xrightarrow{\text{Hexa}} (0010)_H$

***Example* - 1.17** What is the vectored address of interrupt RST5?

(a) 0040 H (b) 0028 H
(c) 0005 H (d) 0008 H

Solution : (b)

Vectored address for RST $n = n \times 8$

Here, $n = 5$

$$5 \times 8 = (40)_{10} = (28)_{16} \Rightarrow 0028\text{ H}$$

Summary

- The 8085 microprocessor (μP) is an improved version of 8080 A.
- 8085 μP has 74 instruction sets.
- The programming of 8085 μP is done in Assembly language.
- There are 27 pins (16 + 1 + 1 + 9) for output in a 8085 μP.
- There are 21 pins for input in a 8085 μP.
- In 8085 μP, memory it contains 2^{16} address line or 64 K or 65536 memory locations and each location can stores 8 bit. So, we can say the memory capacity of 8085 μP equals to 64 k × 8 bit ≈ 64 k bytes.
- A "TRISTATE DEVICE" has 3 states, two logic states (1 or 0) and one high impedance state.
  When device is disabled, it remains in high impedance state and doesn't draw any current from the system.
- To interconnect peripherals with the microprocessor, additional logic circuitry (Buffers, Decoders, Encoders and Latches) are needed.
- Performance of "Cache Memory" are measured in "Hit ratio".
- An I/O processor controls the flow of information between main memory and I/O devices.
- "Cache Memory" is a small high-speed memory placed between the CPU and the main memory (RAM).
- When a CPU is interrupted, it acknowledges interrupt and branches to a subroutine.
- The reference bit is used for the purpose of implementing NRU (Not recently used) algorithm.
- The larger the RAM of a computer, the faster is its speed, since it eliminates frequent disk I/Os.
- An "Assembler" is used for translation of a program from assembly language to Machine language.

Student's Assignments 1

Q.1 The number of flip-flops in a flag register of INTEL 8085 are ___________.

Q.2 Maximum memory that can be connected to INTEL 8085 is __________ bytes.

Q.3 Explain the difference between a compiler an interpreter.

Q.4 Explain the functions of the ALE and $IO/\overline{M}$ signals of the 8085 μP.

Answers:

1. (8 or 5) 2. (65536)

Student's Assignments 2

Q.1 In 8085 microprocessor unit scratch pad memory comprises of
(a) *B*, *C*, *D*, *E*, *H* and *L* Registers
(b) *W*, *Z*, *B*, *C*, *D*, *E*, *H* and *L* Registers
(c) *W*, *Z*, *B*, *C*, *D* and *E* Registers
(d) *W*, *Z*, *B*, *C*, *D*, *E*, *H*, *L* and status Registers

Q.2 An interrupt in which the external device supplies its address as well as the interrupt request is known as
(a) vectored interrupt
(b) maskable interrupt
(c) polled interrupt
(d) non-maskable interrupt