Introduction

- Microprocessor is a Central Processing Unit (CPU) etched on a single chip. A single Integrated Circuit (IC) has all the functional components of a CPU namely Arithmetic Logic Unit (ALU), Control Unit and registers. The 8085 microprocessor is an 8-bit processor that includes on its chip most of the logic circuitry for performing computing tasks and for communicating with peripherals.

Features

- 8 bit microprocessor(8085 microprocessor can read or write or perform arithmetic and logical operations on 8-bit data at time)
- It has 8 data lines and 16 address lines hence capacity is 216 = 64 kB of memory
- Cock frequency is 3 MHz
- It requires +5V power supply.
- It is a single chip NMOS device implemented with 6200 transistors.
- It provides 74 instructions with five addressing modes.
- It provides 5 hardware interrupt and 8 software interrupts.

Pin Configuration

- 40 pins classified into

6 groups:

1. Data bus
2. Address bus
3. Control & status lines
4. Externally generated
5. Serial interface
6. Power supply & clock

Pin Configuration cont...

1) Address Bus (A15-A8 and AD7-AD0):

The microprocessor 8085 has 16 bit address lines from A15-A8 and AD7-AD0. These lines are used to transfer 16 bit address of memory as well as 8-bit address of I/O ports.

2) Data Bus:

The lower 8 lines (AD7-AD0) are often called as multiplexed data lines.

CONTROL LINES

- RD : Read: This is active low signal which indicates that the selected I/O or memory device is to be read and also is available on the data bus.
- WR : Write: This is active low signal which indicates that the data on data bus are to be written into a selected memory location.
- IO/ M : (Input / Output / Memory): This is used to select either Input / Output devices or memory operation. When it is high it indicates an I/O operation and when it is low, it indicates a memory operation.

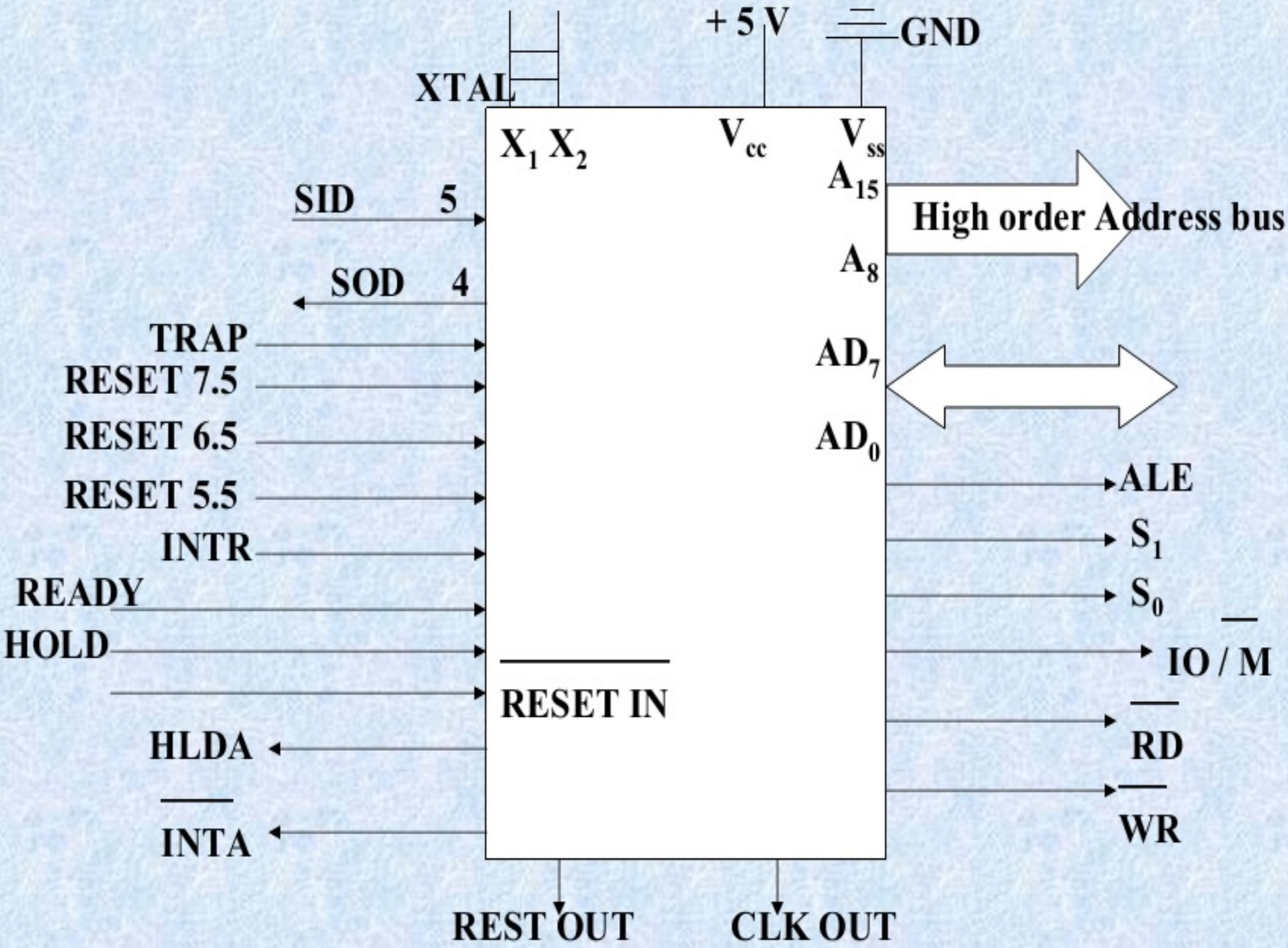
STATUS LINES

- Status Pins (S1, S0): The microprocessor 8085 has two status pins as S1, S0 which is used to indicate the status of microprocessor or operation which is performed by microprocessor.

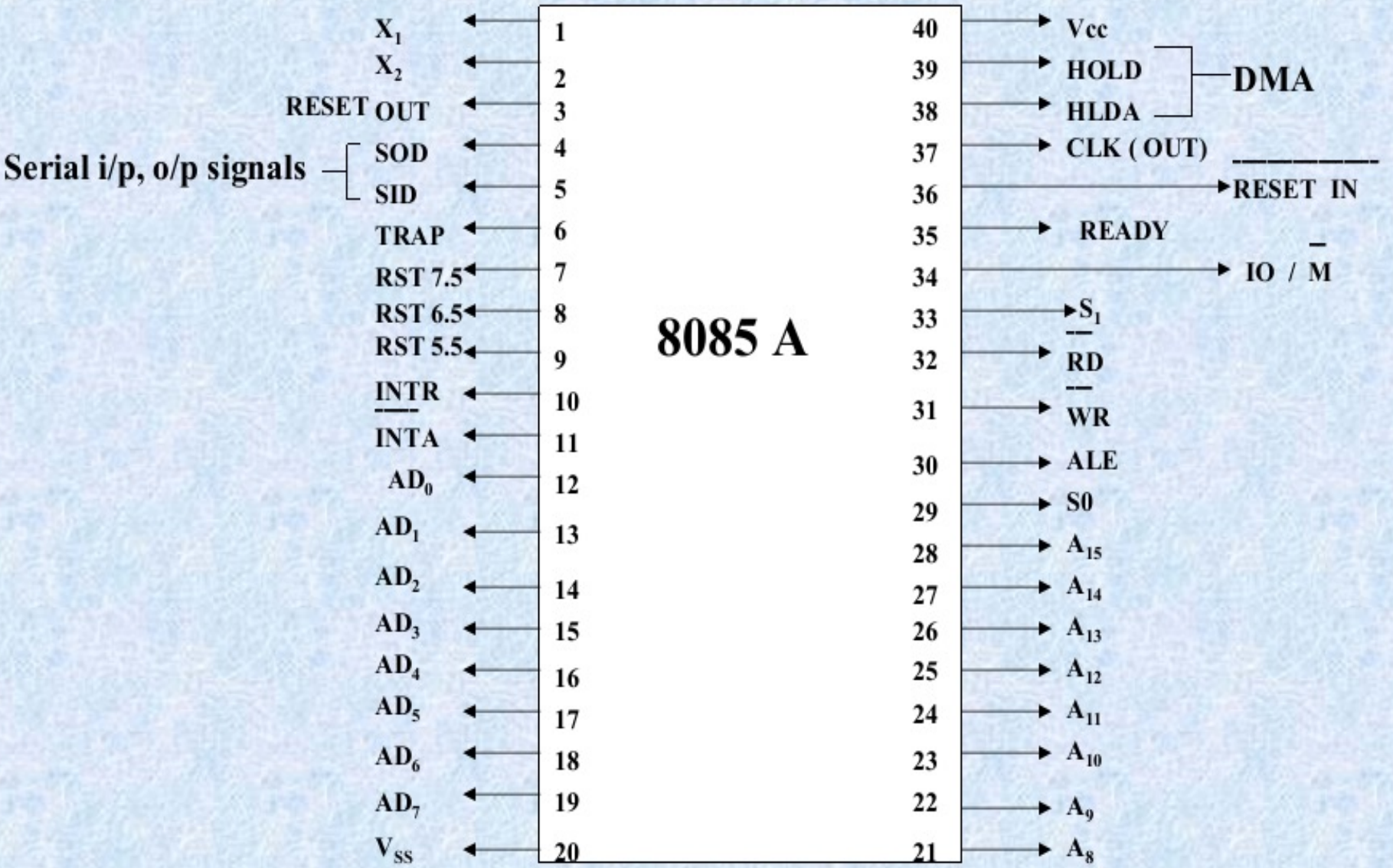
SPECIAL SIGNAL

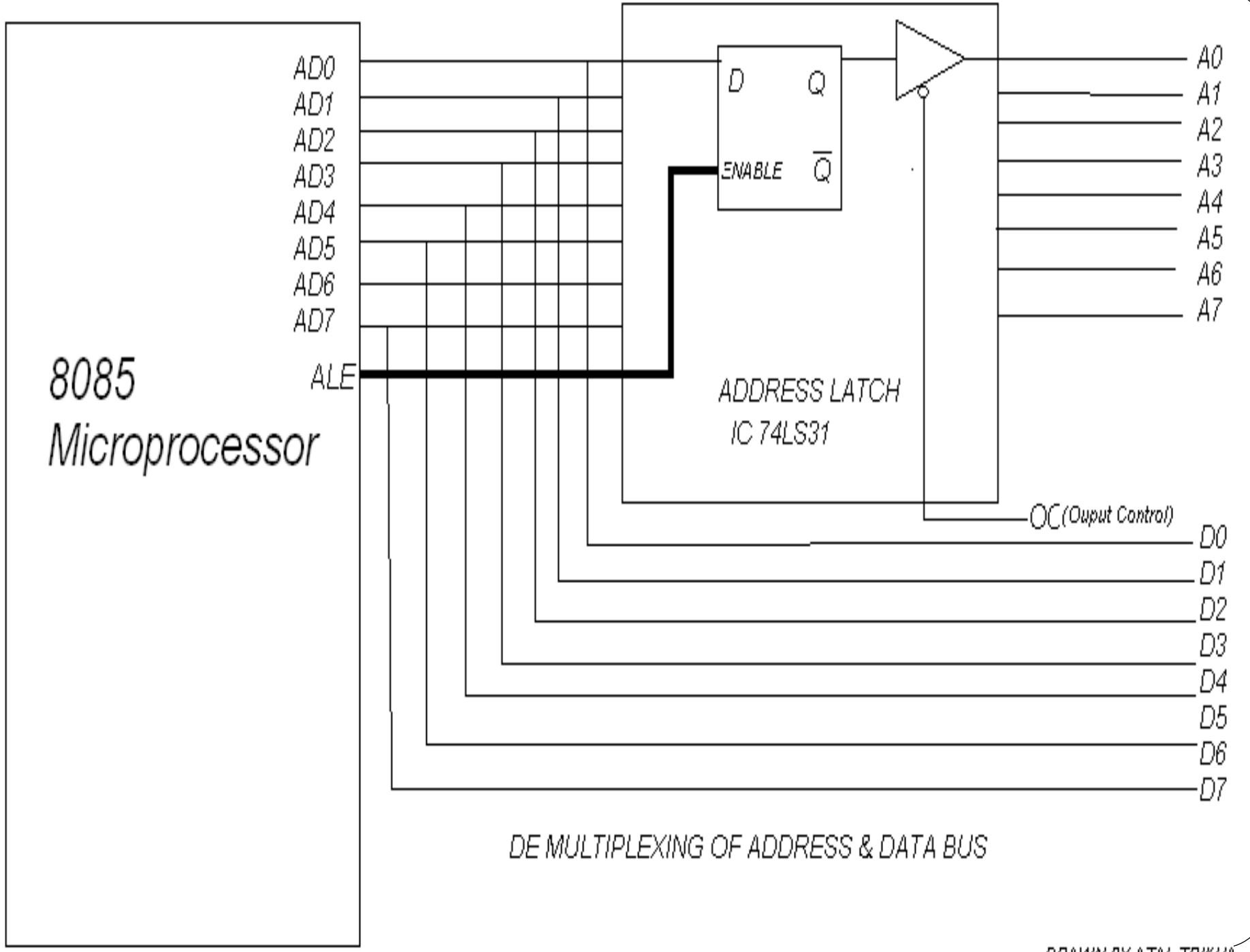
- ALE (Address Latch Enable): The ALE signal is used to enable or disable the external latch IC (74373/8212).
- The external latch IC is used for the de-multiplexing of AD7-AD0 lines, i.e., it is used to separate the address and data from AD7-AD0 lines.
- If ALE = 1/0 then external latch IC is enabled / disabled respectively.

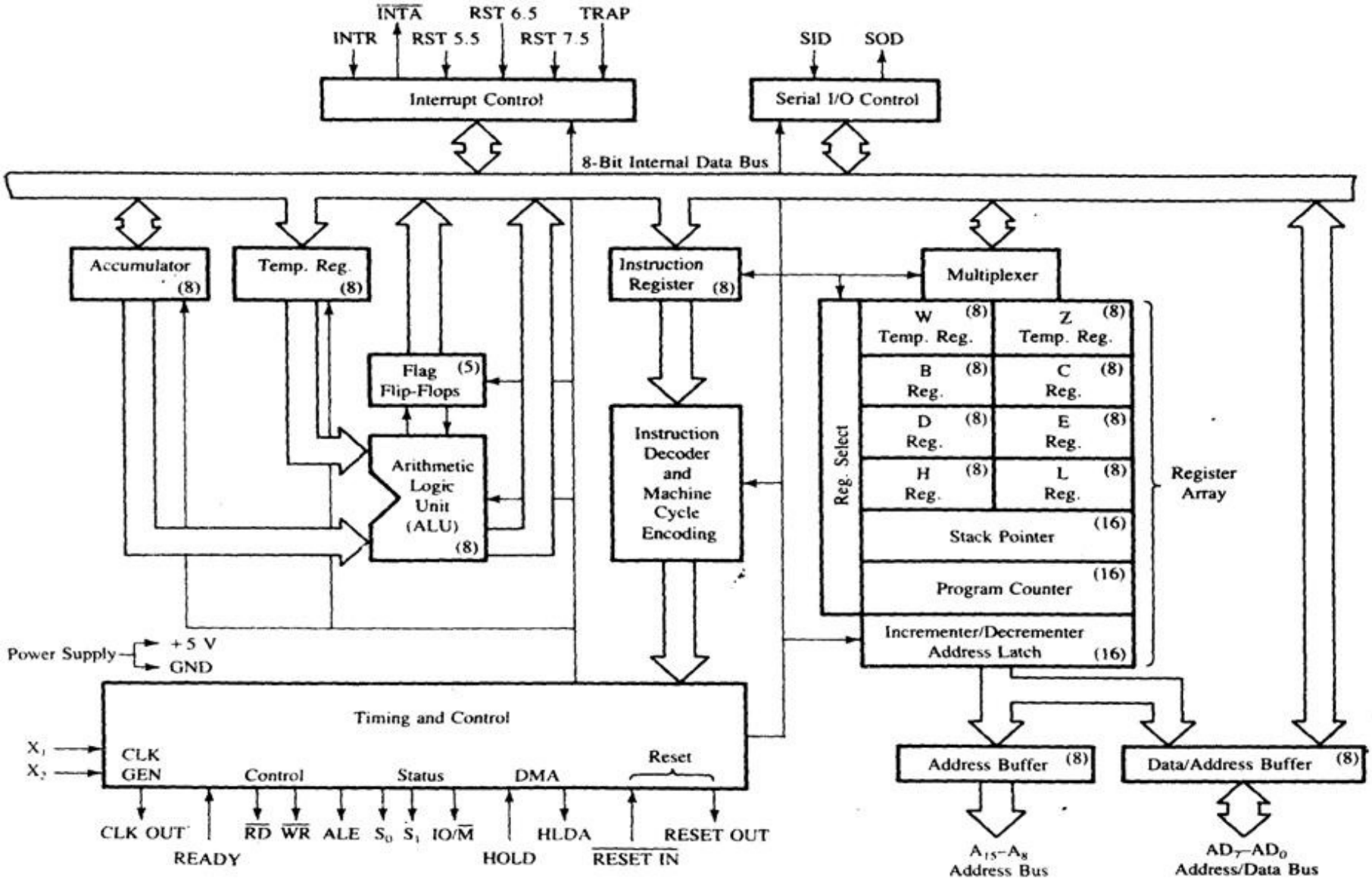
Signal Groups of 8085



Pin Diagram of 8085




8085
Microprocessor
AD0
AD1
AD2
AD3
AD4
AD5
AD6
AD7
ALE
D
Q
ENABLE
Q
ADDRESS LATCH
IC 74LS31
A0
A1
A2
A3
A4
A5
A6
A7
OC (Ouput Control)
D0
D1
D2
D3
D4
D5
D6
D7
DE MULTIPLEXING OF ADDRESS & DATA BUS
DRAWN BY ATAL TRIKHA

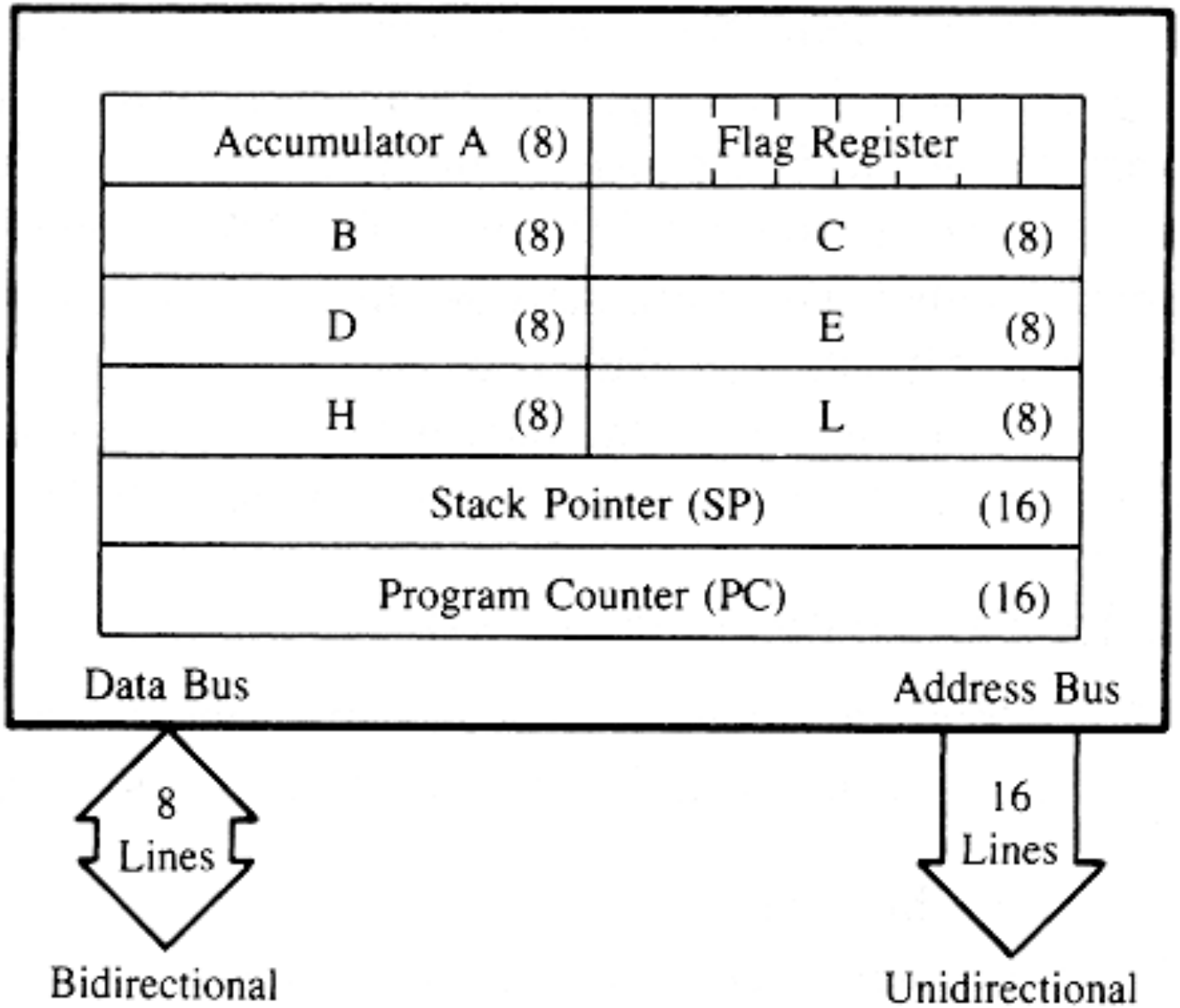

INTA
INTR
RST 5.5
RST 6.5
RST 7.5
TRAP
SID
SOD
Interrupt Control
Serial I/O Control
8-Bit Internal Data Bus
Accumulator (8)
Temp. Reg. (8)
Flag Flip-Flops (5)
Arithmetic Logic Unit (ALU) (8)
Instruction Register (8)
Instruction Decoder and Machine Cycle Encoding
Multiplexer
Reg. Select
W Temp. Reg. (8)
Z Temp. Reg. (8)
B Reg. (8)
C Reg. (8)
D Reg. (8)
E Reg. (8)
H Reg. (8)
L Reg. (8)
Register Array
Stack Pointer (16)
Program Counter (16)
Incrementer/Decrementer Address Latch (16)
Power Supply
+5 V
GND
Timing and Control
X1
X2
CLK GEN
Control
Status
DMA
Reset
CLK OUT
READY
RD WR ALE S0 S1 IO/M
HOLD
HLDA
RESET IN
RESET OUT
Address Buffer (8)
Data/Address Buffer (8)
A15–A8
Address Bus
AD7–AD0
Address/Data Bus

Architecture 0f 8085

1. ALU
2. Timing and Control Unit
3. General Purpose Registers
4. Program Status word
5. Program Counter
6. Stack Pointer
7. Instruction Register and Decoder

8. Interrupt Control
9. Serial I/O Control
10. Address Bus
11. Data Bus

PROGRAMMING MODEL OF 8085



REGISTERS

The Registers are of 8-bit & 16-bit size used for different purposes

A- Accumulator – This is an special purpose register. All the ALU operations are performed with reference to the contents of Accumulator.

B,C,D,E,H,L – General purpose registers. These registers can also used for 16-bit operations in pairs. The default pairs are BC, DE & HL.

F – Flag register – This register indicates the status of the ALU operation.

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

PC – Program Counter – This is a 16-bit register used to address the memory location from where an instruction is going to be executed.

SP – Stack pointer - This is a 16-bit register used to address the top of the stack memory location.

Temporary register, W & Z – These registers are only used by 8085 and are not available for the programmer.

ALU – Arithmetic & Logic Unit

ALU of 8085 performs 8-bit arithmetic & logical operations. The operations are generally performed with Accumulator as one of the operands. The result is saved in accumulator register.

Timing & Control Unit

This unit works as the brain of the CPU and generates all the timing and control signals to perform all the internal & external operations of the CPU.

Instruction Decoder & Machine Cycle Encoder Unit

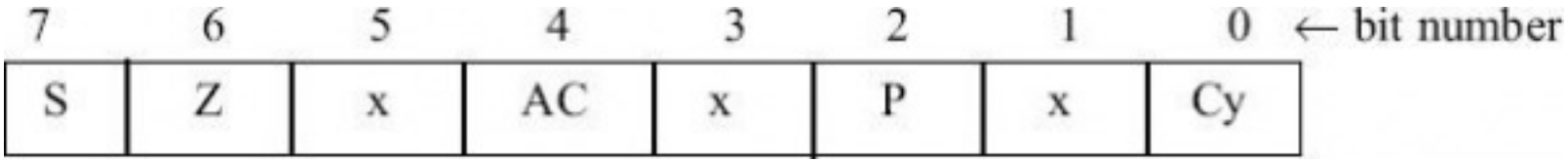
This unit decodes the op-code stored in the Instruction Register (IR) and encodes it for the timing & control unit to perform the execution of the instruction.

Flag Registers in 8085

- Carry flag (Cy),
- Auxiliary carry flag (AC),
- Sign flag (S),
- Parity flag (P), and
- Zero flag (Z).

In 8085 microprocessor, the flags register can have a total of eight flags. Thus a flag can be represented by 1 bit of information. But only five flags are implemented in 8085.

- The respective position of these flag bits in flag register has been show the below figure. The positions marked by “x” are to be considered as don't care bits in the flags register.

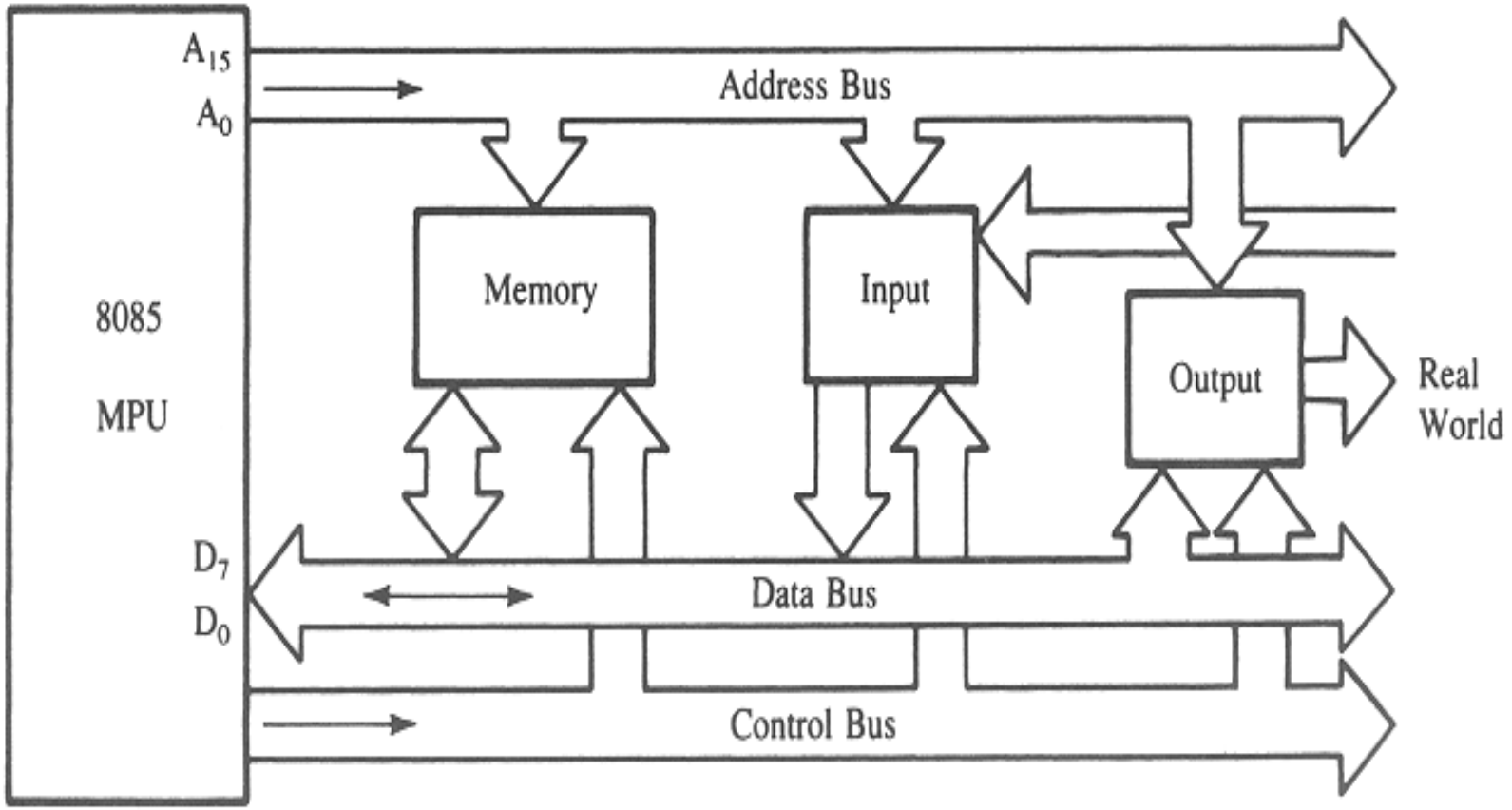


- **Carry flag (Cy):** after performing the addition of any two 8-bit numbers, the carry generated can be either 0 or 1. That is only 1-bit. Thus to store the carry information 1-bit storage is enough.
- **Auxiliary carry flag (Ac):** Now let us consider the addition of any two 8-bit (2-hex digit) numbers, a carry may be generated when we add the LS hex digits of the two numbers. Such a carry is called intermediate carry also known as half carry, or auxiliary carry (AC). Intel prefers to call it AC.

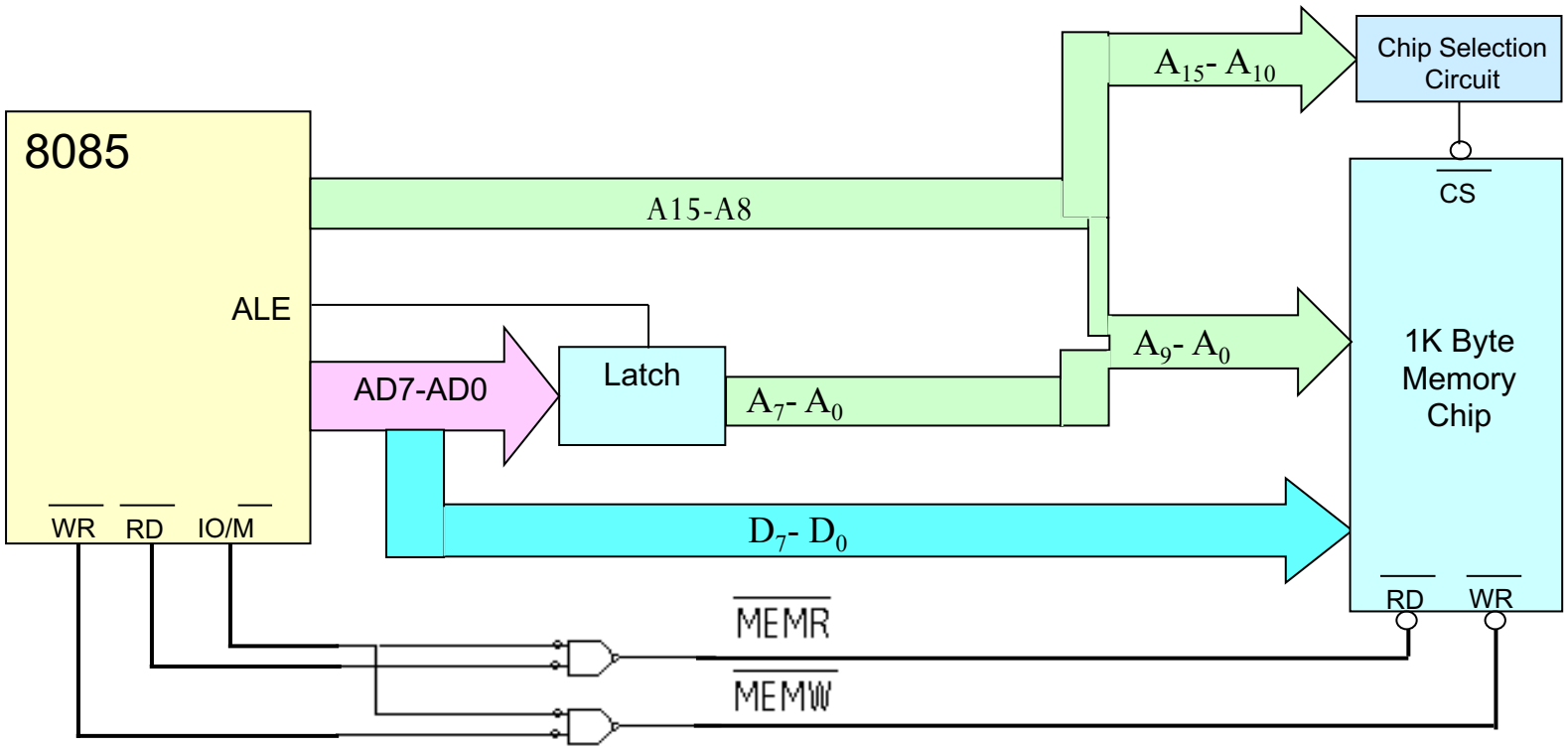
- **Sign flag (S):** The S flag is set to 1, when the result thus produced against any logical or arithmetic operations is negative, indicated by MS bit of 8-bit result being 1. It is reset to 0 otherwise if the result is positive, indicated by MS bit of 8-bit result being 0.
- **Parity flag (P):** The P flag is set to 1, if the 8-bit result thus produced against any logical and arithmetic operation has an even number of 1's in it. If there are odd number of 1's in the 8-bit result, the P flag is reset to 0.
- **Zero flag (Z):** The Z flag is set to 1, if after arithmetic and logical operations, the 8-bit result thus produced, is 00H. If the 8-bit result is not equal to 00H, the Z flag is reset to 0. Thus the Z flag is hoisted to indicate that the result is 0.

The 8085 Bus Structure

The 8-bit 8085 CPU (or MPU – Micro Processing Unit) communicates with the other units using a 16-bit address bus, an 8-bit data bus and a control bus.



Over all structure



Instruction Set

- Broadly classified into two types:
  - Based on word size:
    - One word- Opcode only (CMA, ADD B)
    - Two word- Opcode ,an operand (MVI A,32H)
    - Three word- Opcode, operand, operand (LDA 4200, STA 4500)
  - Based on function:
    - Data transfer group (MOV A,B; MVI A,32H;MOV C,4500)
    - Arithmetic operations (ADD B, SBI 32H,INC D, DEC B)
    - Logical operations (ANA B, ORI 05H, RLC, RAR)
    - Branching operations (JUMP, JMP, JNZ, JC, CALL, RETURN)
    - Machine control instructions (HLT, NOP,EI,DI,SIM,RIM)

Addressing Modes

- Immediate (MOV A,B ;ADD B; SUB E;ANA C)
- Register (MVI A,05H;LXI B, 20AEH; ADI 05H;ORI 07H)
- Direct (LDA 4500H;STA 7500H;IN 09H;OUT 70H)
- Indirect (MOV A, M;MOV M,A;ADD M;ORA M)
- Implied(implicit) (HLT; NOP;RST;RET)

Addressing modes

- These are the instructions used to transfer the data from one register to another register, from the memory to the register, and from the register to the memory without any alteration in the content. Addressing modes in 8085 is classified into 5 groups –

Immediate addressing mode

- In this mode, the 8/16-bit data is specified in the instruction itself as one of its operand. **For example:** MVI K, 20F: means 20F is copied into register K.

Register addressing mode

- In this mode, the data is copied from one register to another. **For example:** MOV K, B: means data in register B is copied to register K.

Direct addressing mode

- In this mode, the data is directly copied from the given address to the register. **For example:** LDB 5000K: means the data at address 5000K is copied to register B.

Indirect addressing mode

- In this mode, the data is transferred from one register to another by using the address pointed by the register. **For example:** MOV K, B: means data is transferred from the memory address pointed by the register to the register K.

Implied addressing mode

- This mode doesn't require any operand; the data is specified by the opcode itself. **For example:** CMP.