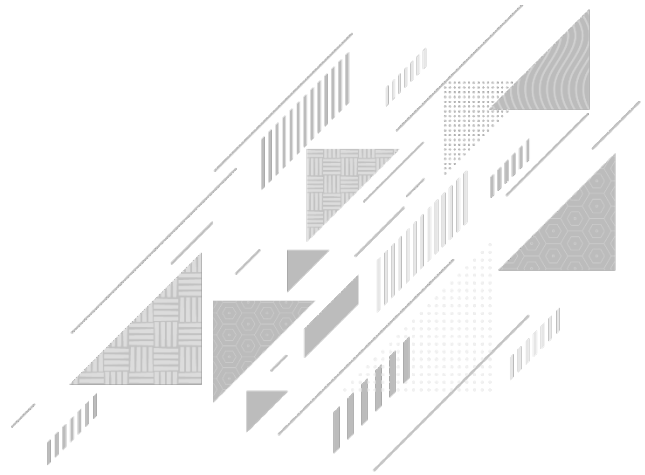
8085 Microprocessor



Topics to be covered

- Introduction
- 8085 Programming Model
- Bus Organization of 8085
- 8085 pin diagram
- 8085 Architecture/Block Diagram

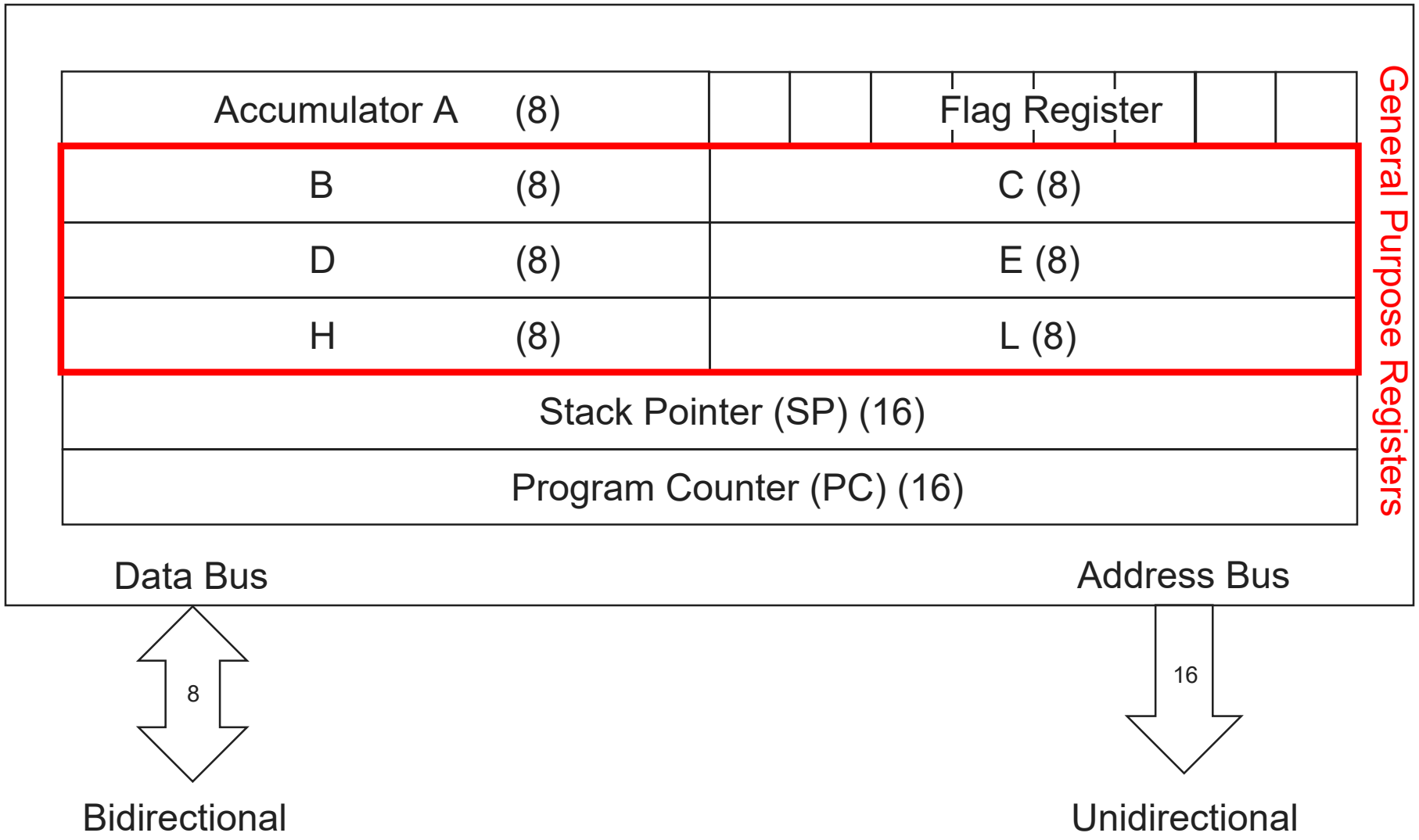
Introduction

Introduction

- 8085 is pronounced as "eighty-eighty-five" microprocessor.
- It is an 8-bit microprocessor designed by Intel in 1977 using NMOS technology.
- 8 bit General purpose microprocessor (i.e. 8 bit data bus).
- It is a single chip N MOS device with 40 pins.
- It has multiplexed address and data bus. (AD_0 - AD_7).
- It works on 5-Volt DC power supply.
- The maximum clock frequency is 3MHz while minimum frequency is 500kHz.
- It provides 16 address lines, therefore capable of addressing 2^{16} = 64K of memory
- It supports external interrupt request.
- It has two 16 bit registers named program counters (PC) and stack pointer (SP).
- It generates 8 bit I/O address so it can access 2^8 = 256 input ports.
- It provides 5 hardware interrupts

8085 Programming Model

8085 Programming Model

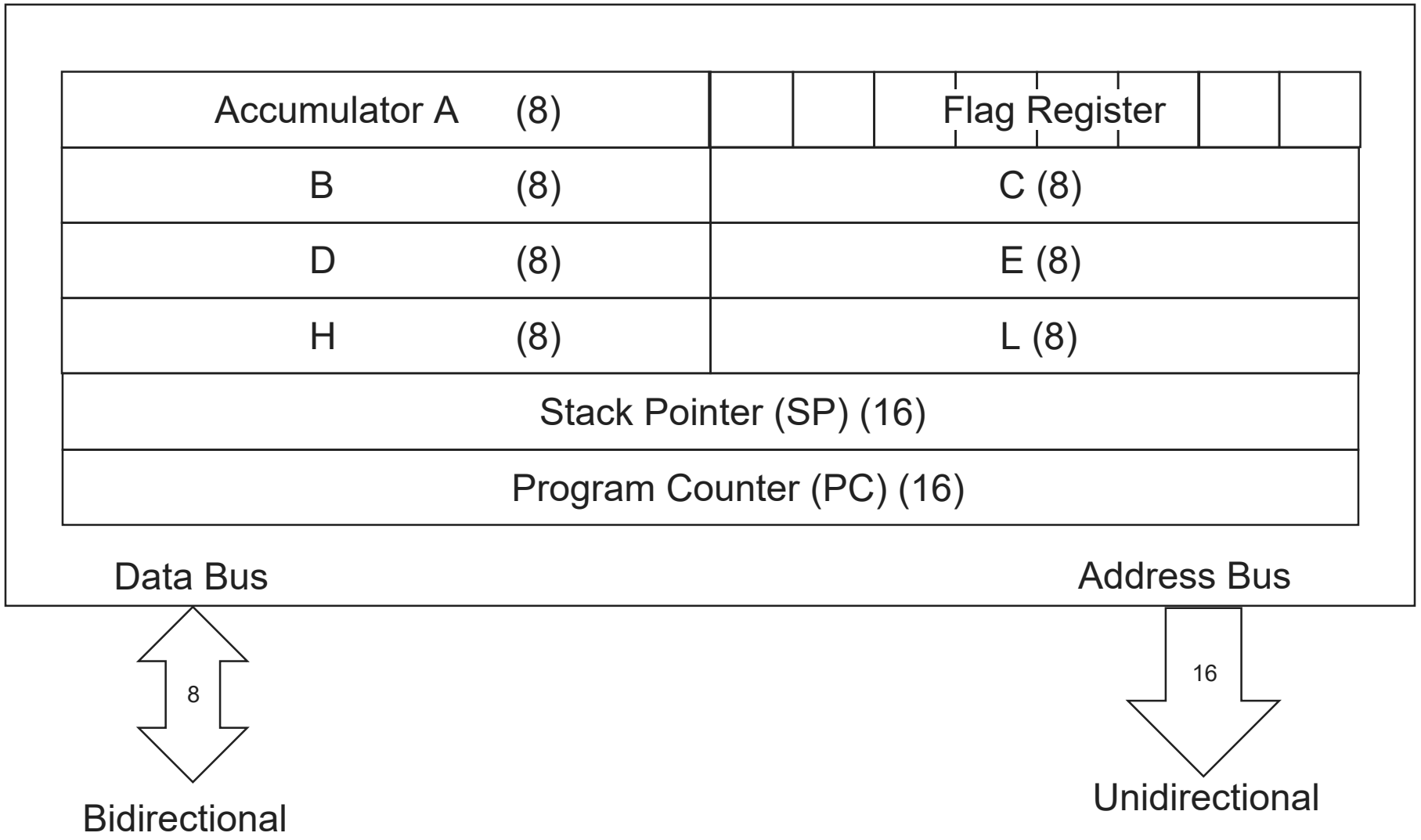


General Purpose Registers

- 6 general purpose registers to store 8-bit data B, C, D, E, H & L.
- Can be combined as fixed register pairs – BC, DE, HL to perform 16 bit operations.
- Used to store or copy data using data copy instructions.

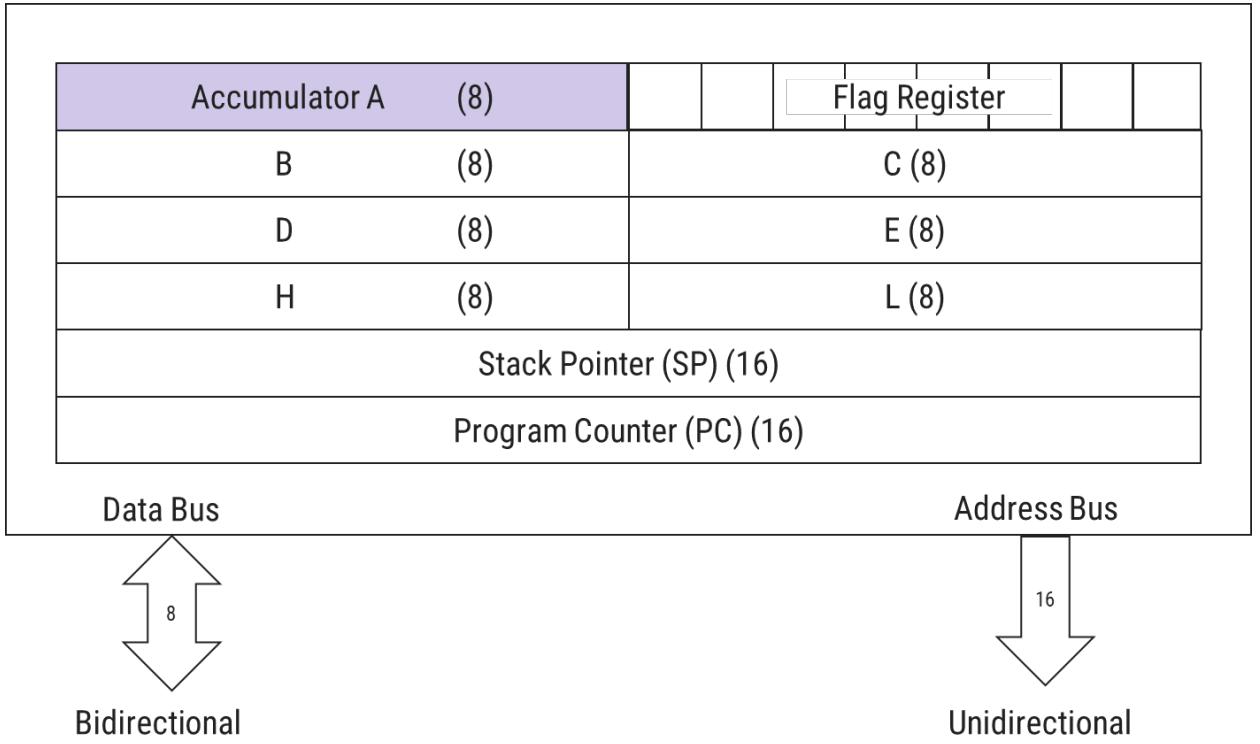
B (8)	C (8)
D (8)	E (8)
H (8)	L (8)

8085 Programming Model

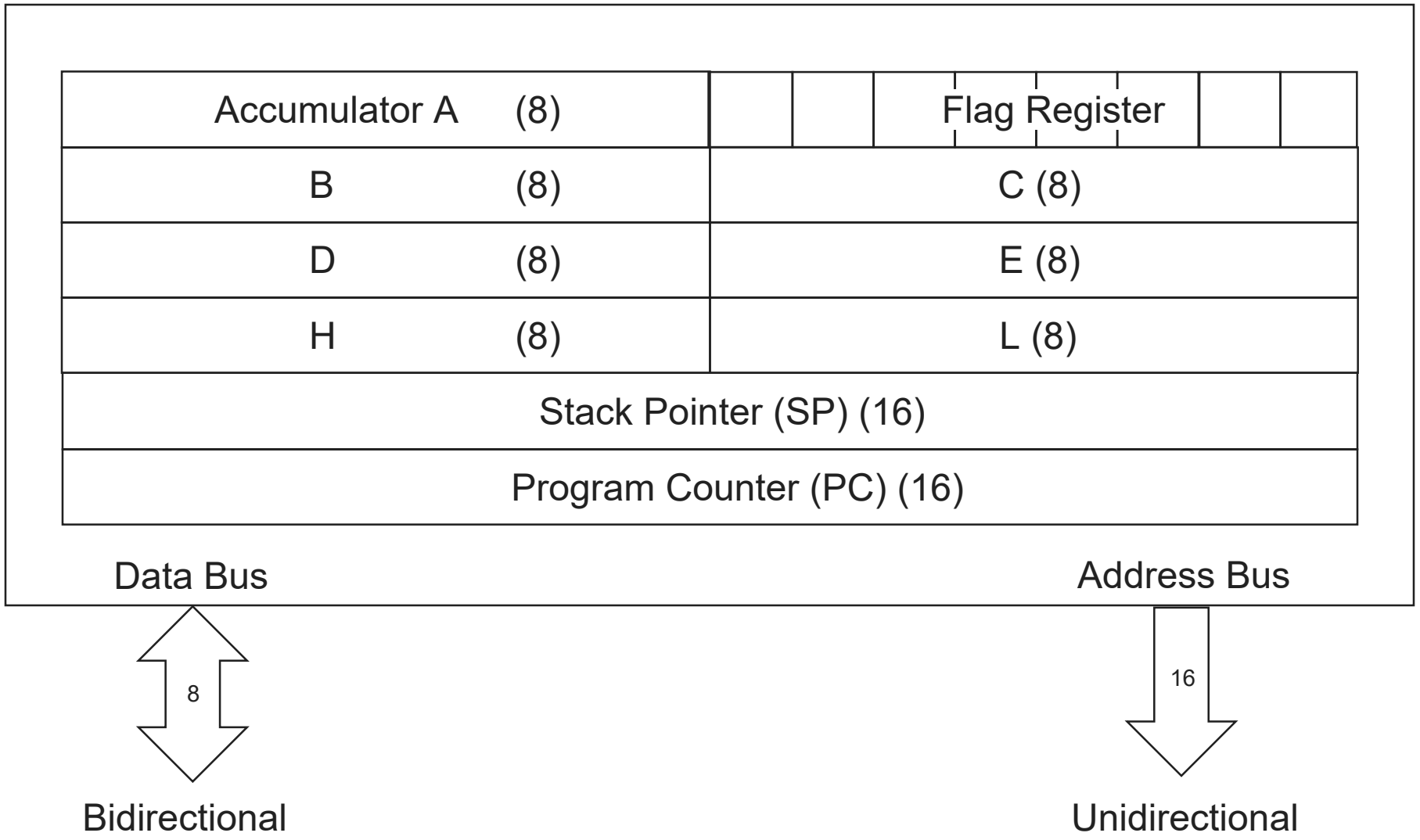


Accumulator

- 8 - bit register, identified as **A**
- Part of ALU
- Used to store 8-bit data to perform **arithmetic & logical** operations
- Result of operation is stored in Accumulator.



8085 Programming Model



Flag Register

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

X: Undefined

S - Sign Flag
Set (1) if 7th bit of result is 1; otherwise reset (0)

1 0 1 0 1 0 1 0
S = 1

Z - Zero Flag
Set (1) when result is zero; otherwise reset(0)

1 0 1 0
- 1 0 1 0
0 0 0 0
Z = 1

P - Parity Flag
Set (1) if result has even no. of 1's &
Reset (0) if result has odd no. of 1's

1 0 0 1 0 0 1 1
P = 1

AC - Auxiliary Carry Flag
Set (1) when carry bit is generated by 3rd bit & passed to bit 4th bit.

1 1 1
0 0 1 0 1 0 1 0
+ 0 1 1 0 1 0 0 1
1 0 0 1 0 0 1 1
AC = 1

CY - Carry Flag
Set (1) if arithmetic operation results in carry;
otherwise reset(0)

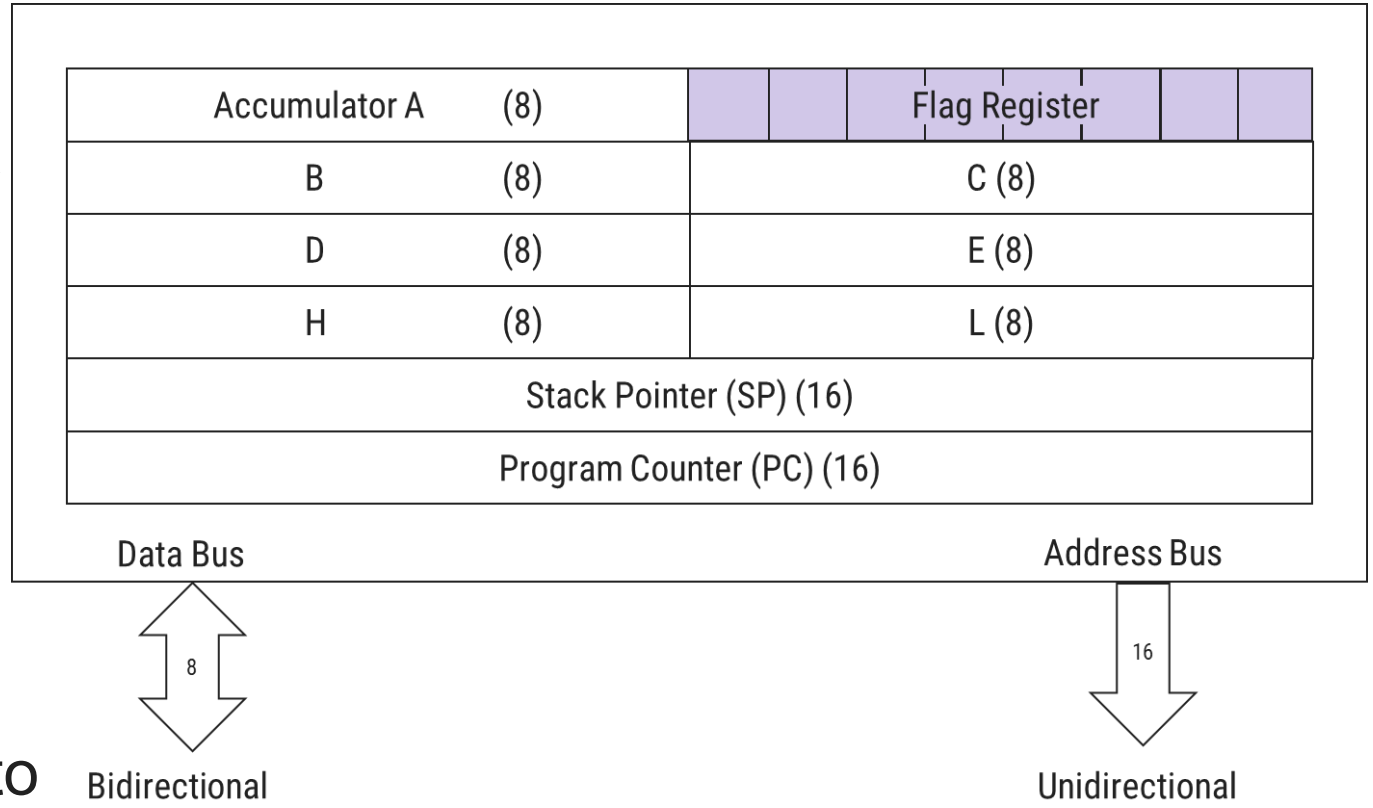
1 1 1
1 0 1 0 1 0 1 0
+ 0 1 1 0 1 0 0 1
1 0 0 0 1 0 0 1 1
CY = 1

Flag Register

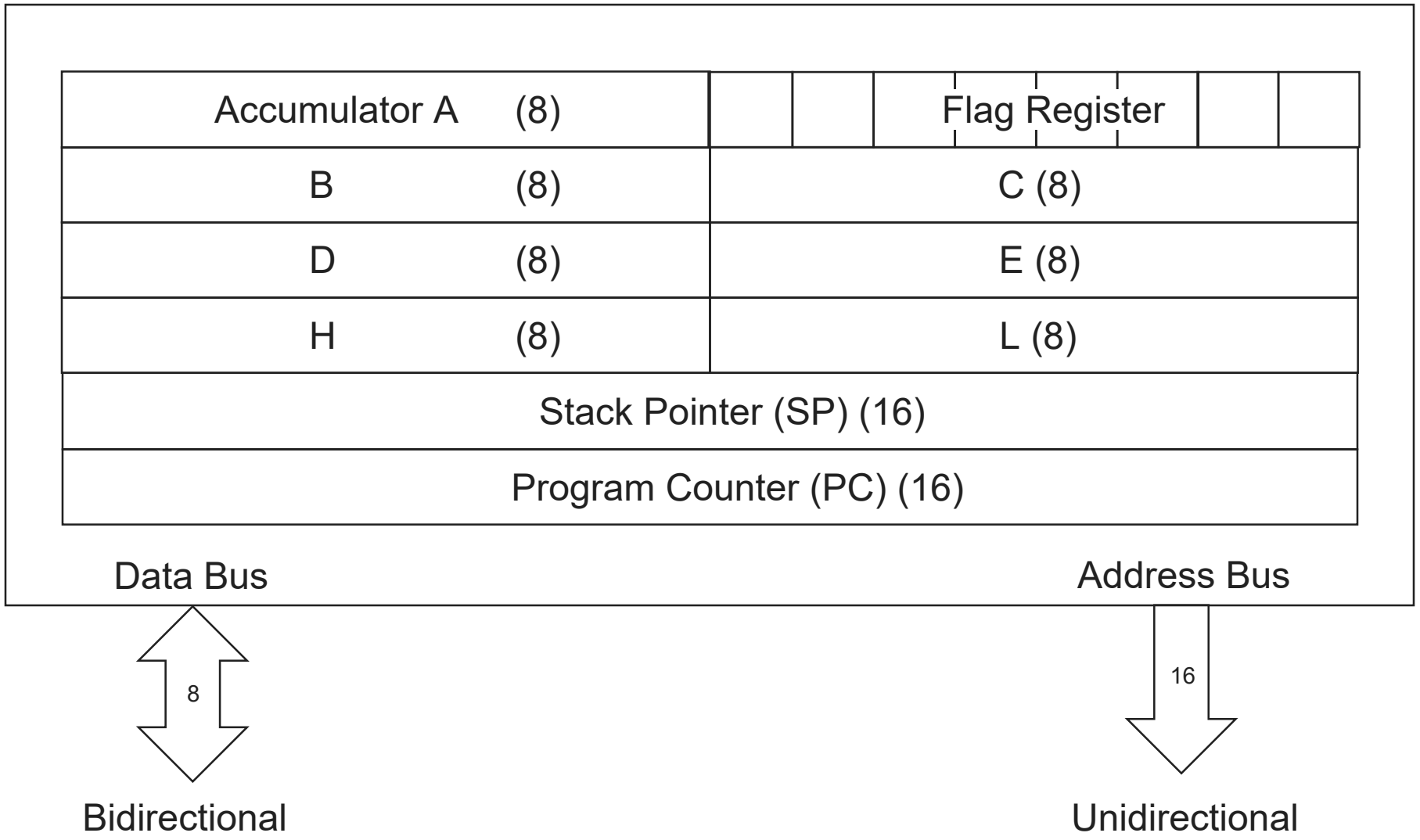
- ALU has 5 Flag Register that set/reset after an operation according to data conditions of the result in accumulator & other registers
- Helpful in decision making process of microprocessor
- Conditions are tested through software instructions

For e.g.

JC (Jump On Carry) is implemented to change the sequence of program when CY (Carry Flag) is set(1).



8085 Programming Model



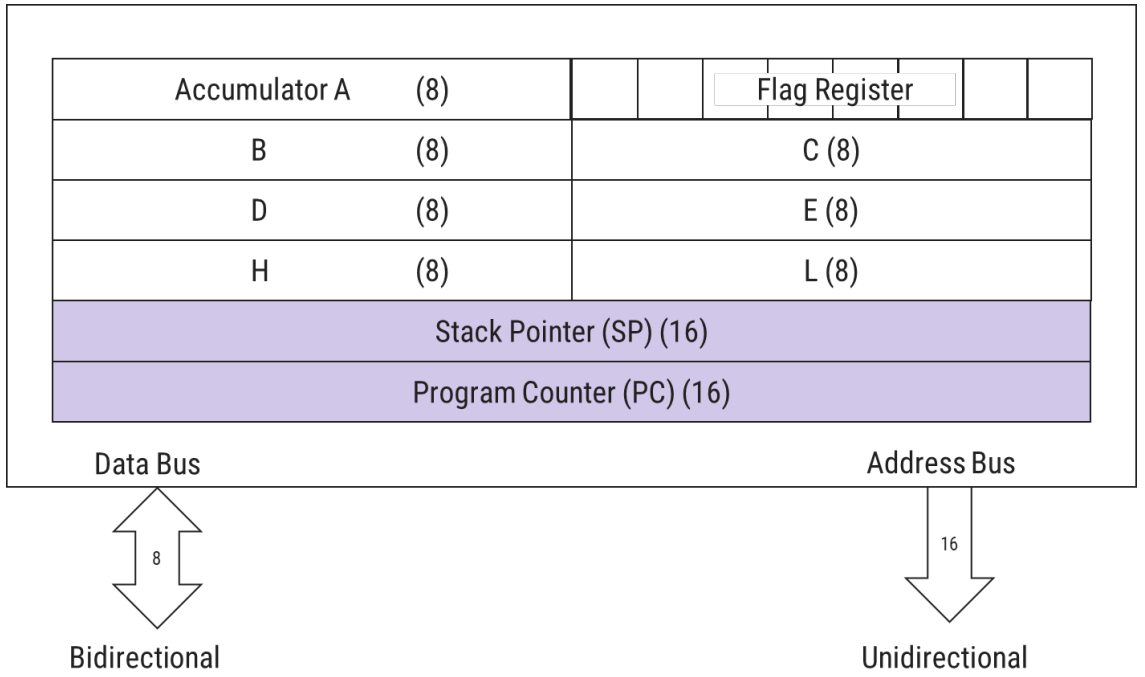
Stack Pointer & Program Counter

Stack Pointer (SP)

- Used as memory pointer.
- Points to the memory location in R/W memory, called Stack.
- Beginning of stack is defined by loading a 16-bit address in the stack pointer.

Program Counter (PC)

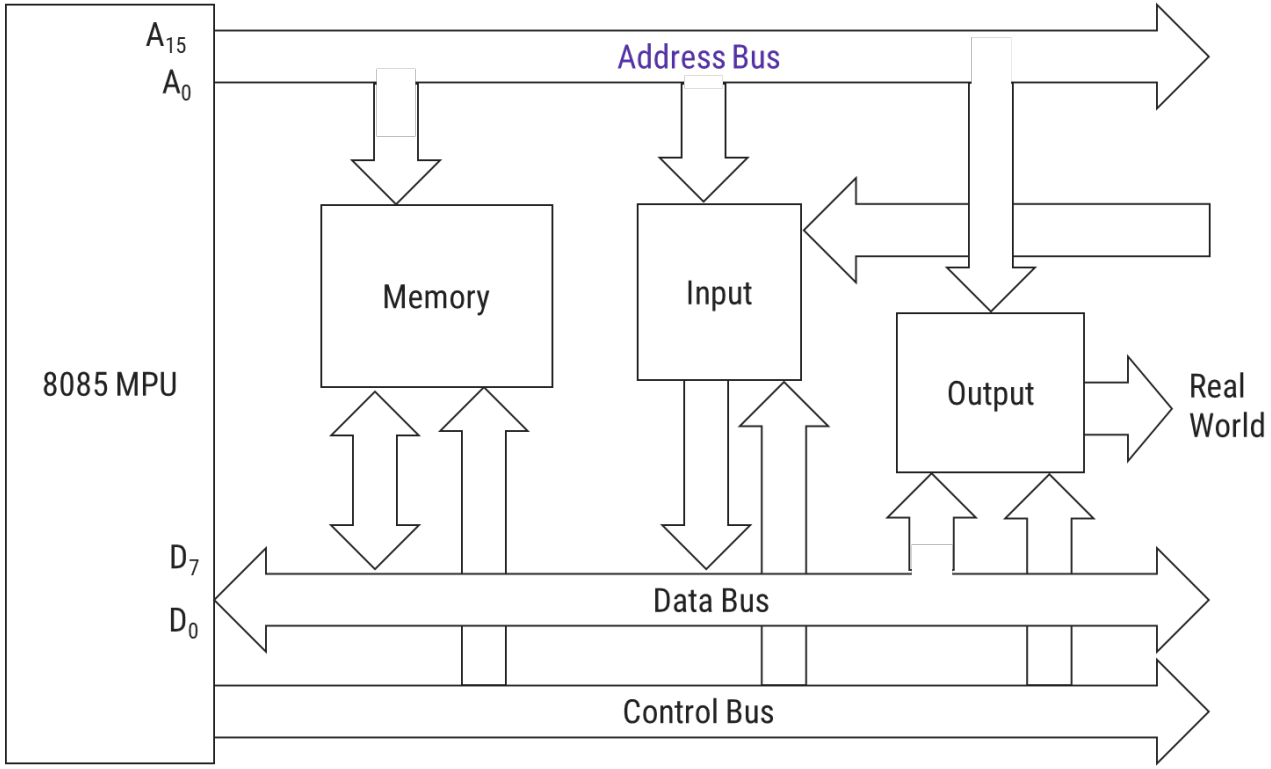
- Microprocessor uses PC register to sequence the execution of instructions.
- Its function is to point to memory address from which next byte is to be fetched.
- When a byte is being fetched, PC is incremented by 1 to point next memory location.



Bus Organization of 8085

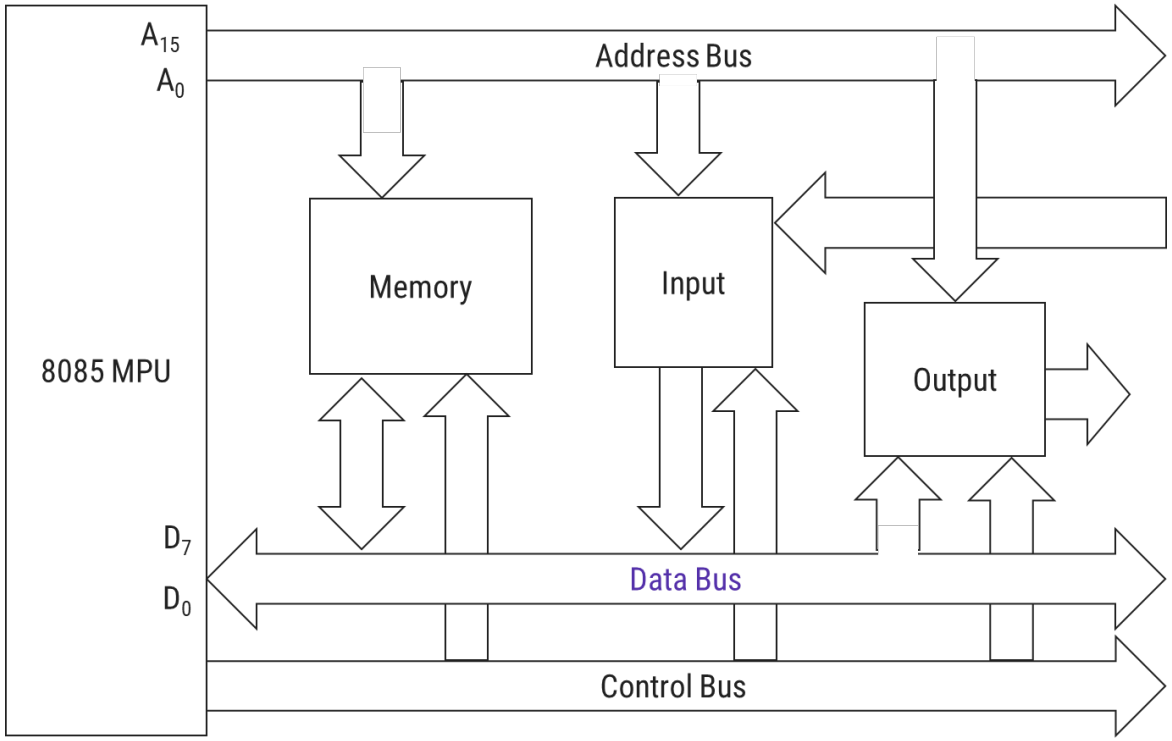
Address bus

- Group of 16 unidirectional lines generally identified as A_0 to A_{15}.
  i.e. bits flow from microprocessor to peripheral devices
- 16 address lines are capable of addressing 65536 memory locations So, 8085 has 64K memory locations



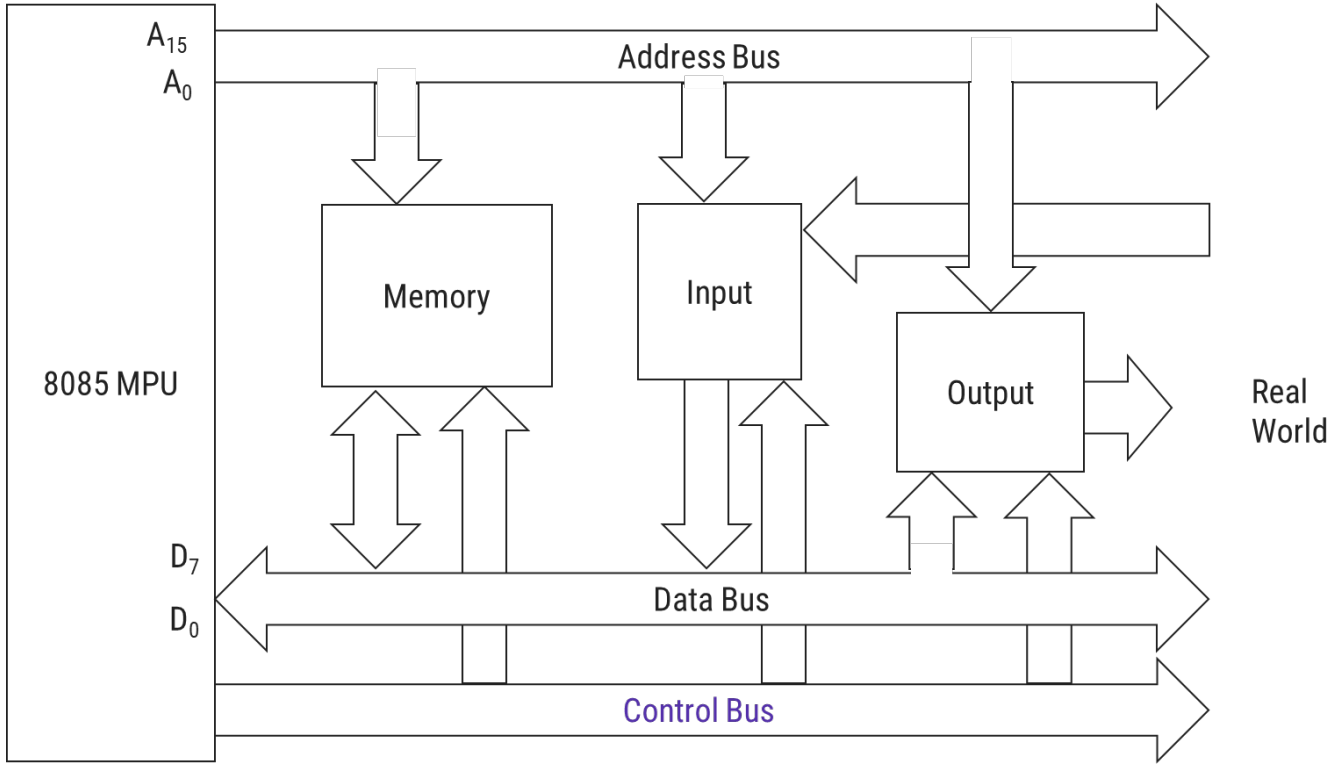
Data bus

- Group of 8 lines identified as D_0 to D_7.
- They are bidirectional i.e. data flow in both directions between microprocessor, memory & peripheral
- 8 data lines enable microprocessor to manipulate data ranging from 00 H to FF H (2^8=256 numbers.)
- Largest number appear on data bus is 1111 1111=>$(255)_{10}$.
- As Data bus is of 8-bit, 8085 is known as 8-bit Microprocessor

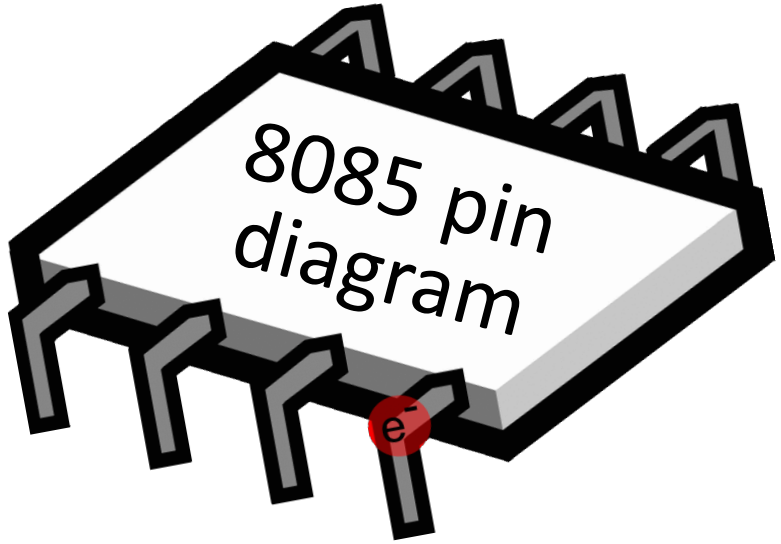


Control bus

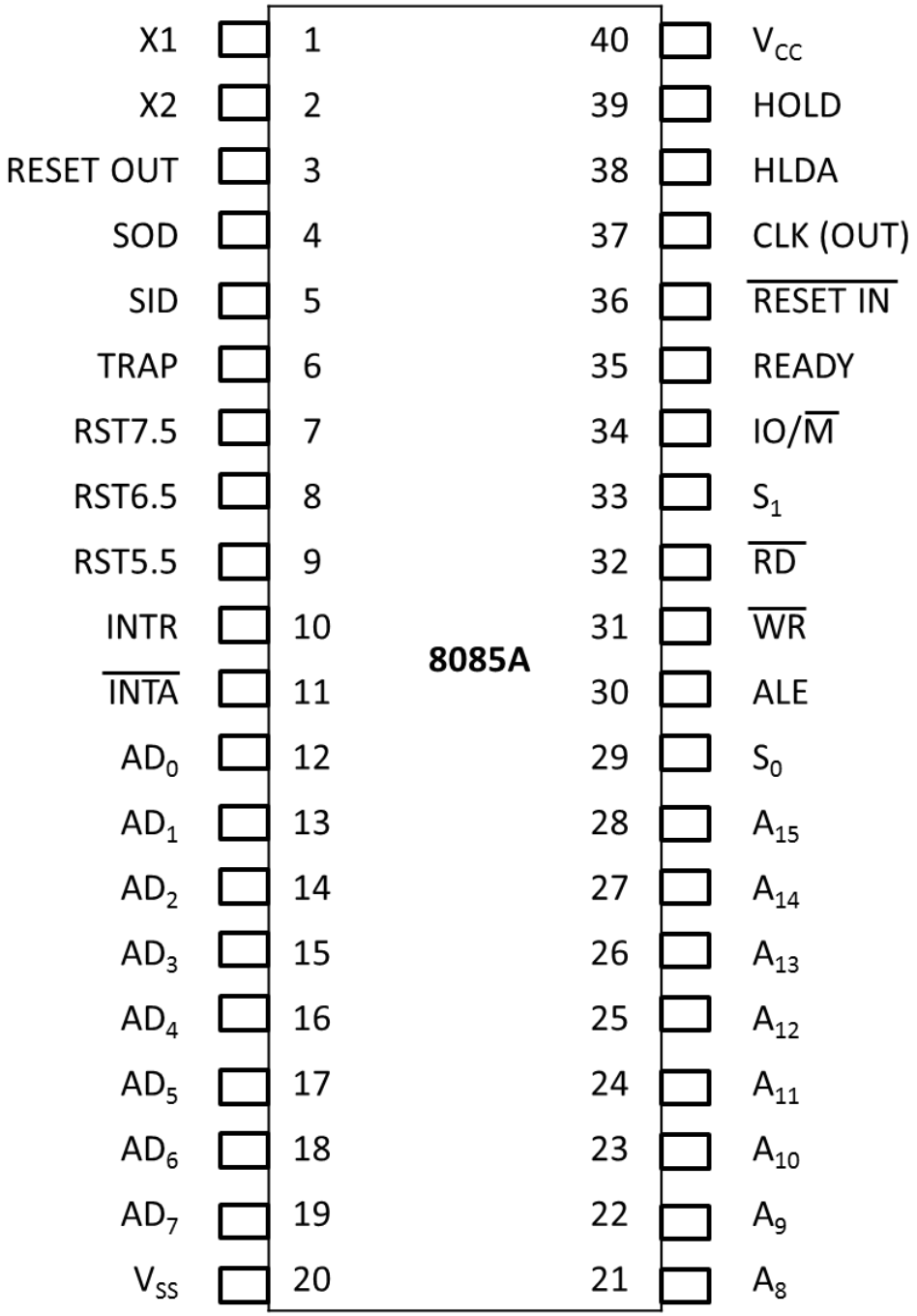
- It comprises of various single lines that carry synchronization, timing & control signals.
- These signals are used to identify a device type with which MPU intends to communicate.
- Some control signals are **Read**, **Write** and **Opcode fetch** etc.



8085 pin diagram



8085 pin diagram

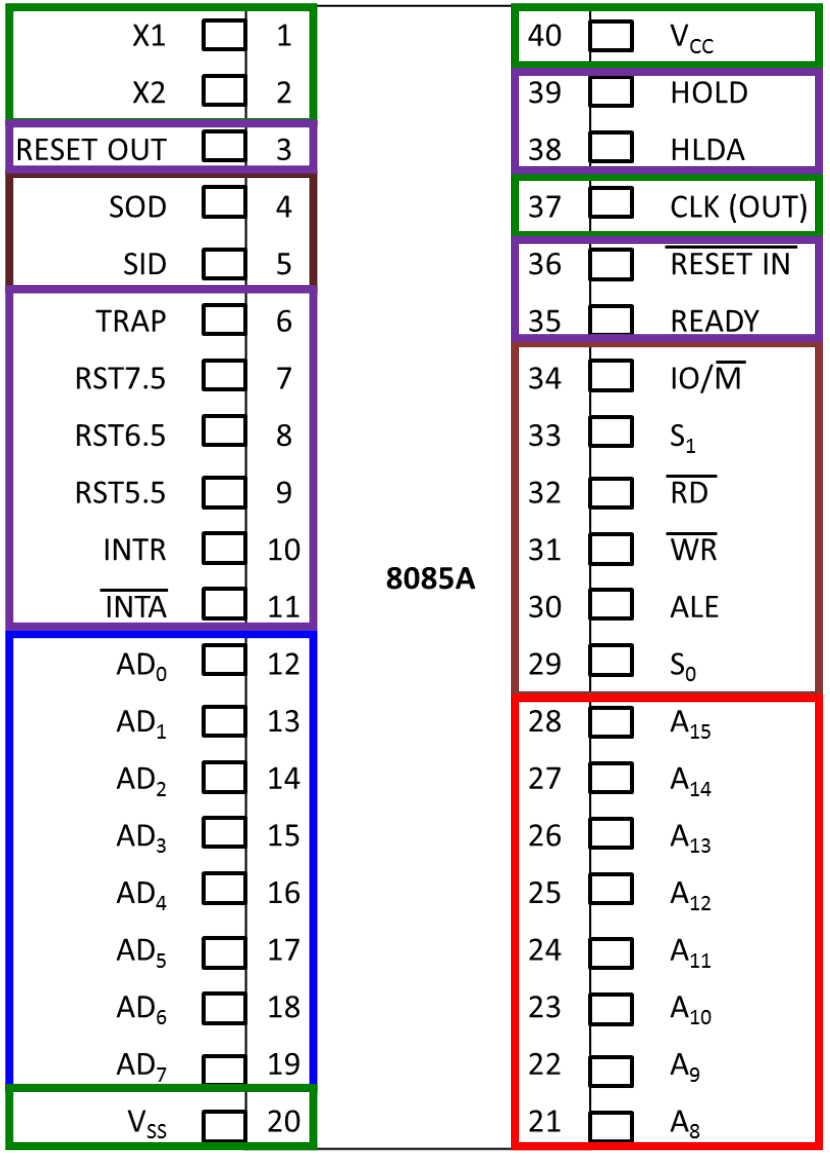


- 8-bit general purpose microprocessor.
- Capable of addressing 64K of memory.
- It has 40 pins.
- Requires +5V single power supply.

8085 pin diagram

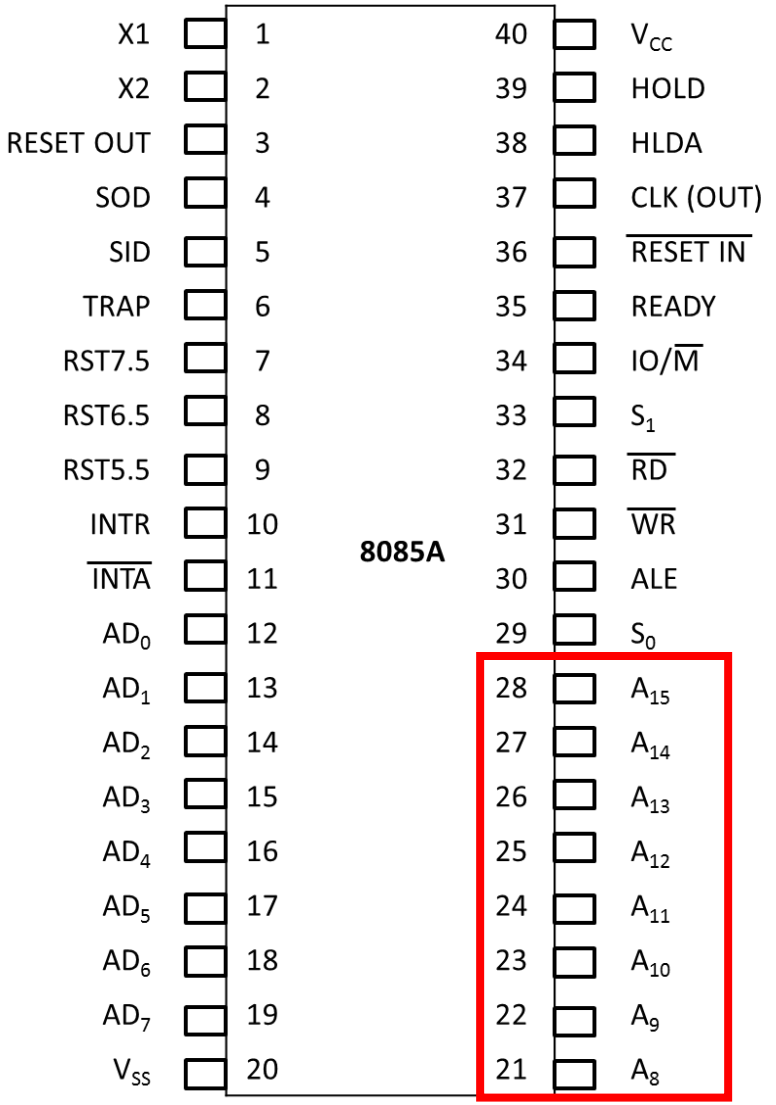
Signals are classified into 6 groups

1. Address bus
2. Multiplexed address/data bus
3. Control & status signals
4. Power supply & frequency signals
5. Externally initiated signals
6. Serial I/O ports



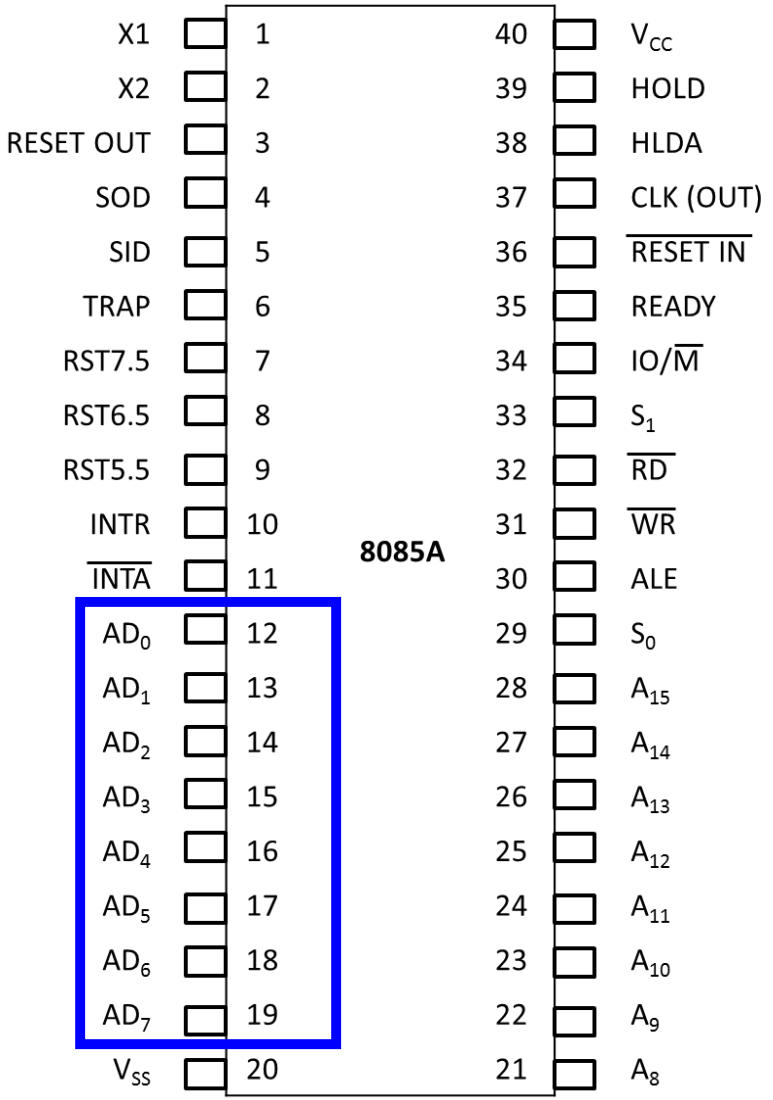
8085 pin diagram: Address Bus

- 16 signal lines are used as address bus.
- However these lines are split into two segments A_{15} - A_8 and AD_7 - AD_0
- A_{15} - A_8 are unidirectional and used to carry high-order address of 16-bit address.
- AD_7 - AD_0 are used for dual purpose.



8085 pin diagram: Multiplexed Address/Data Bus

- Signal lines AD_7-AD_0 are bidirectional and serve dual purpose.
- They are used as low-order address bus as well as data bus.
- The low-order address bus can be separate from these signals by using a latch (ALE).



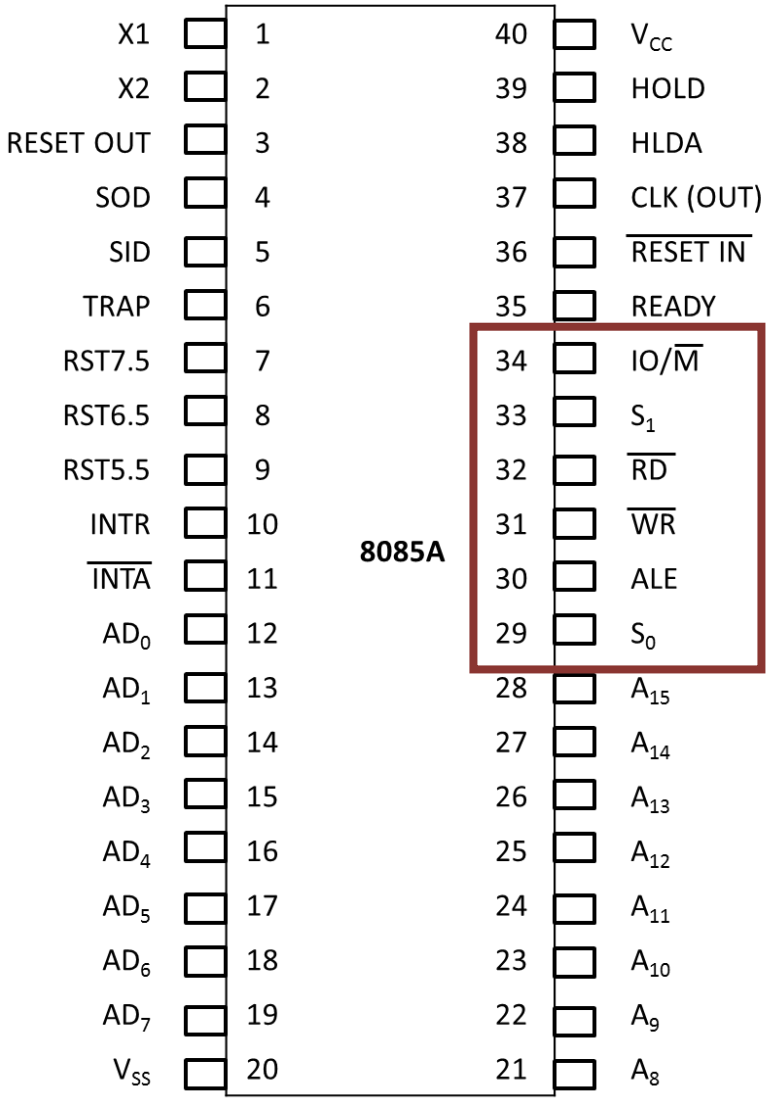
8085 pin diagram: Control & Status Signals

To identify nature of operation

- Two Control Signals
  1. $\overline{RD}$ (Read)
  2. $\overline{WR}$ (Write)
- Three Status Signals
  1. S_1
  2. S_0
  3. $IO/\overline{M}$
- To indicate beginning of operation
  1. ALE (Address Latch Enable)

     ALE ← 1, then Address bus

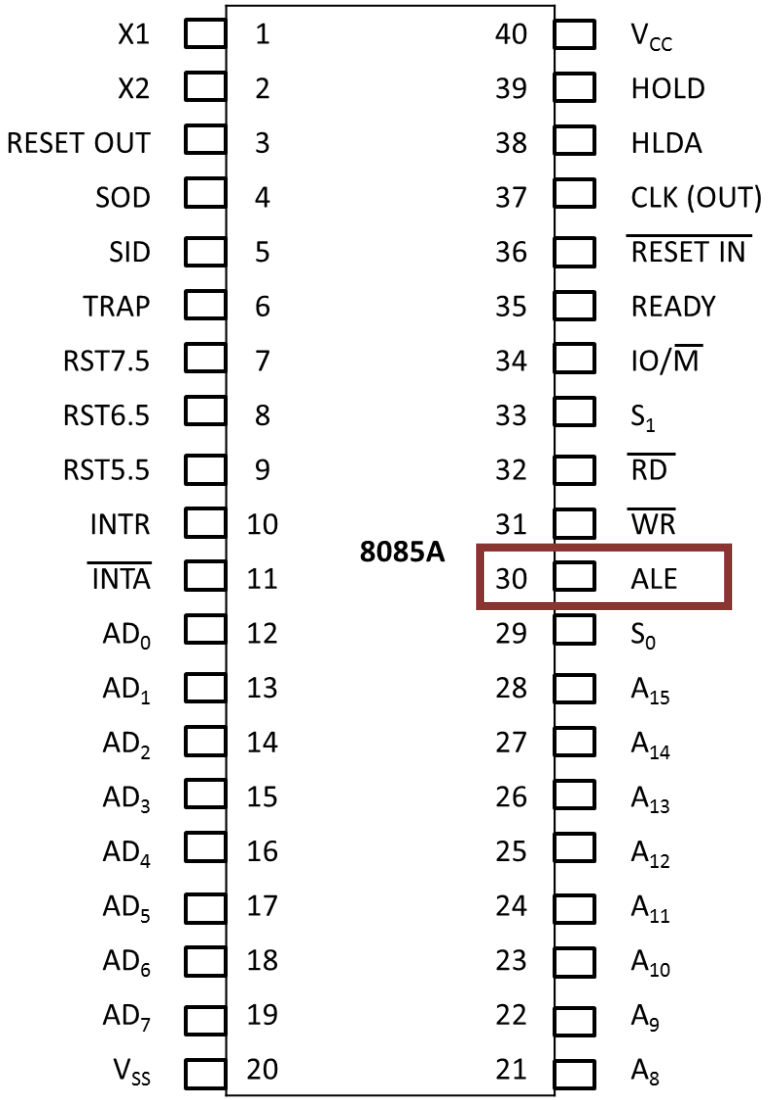
     ALE ← 0, then Data bus



8085 pin diagram: Control & Status Signals

ALE Pin 30

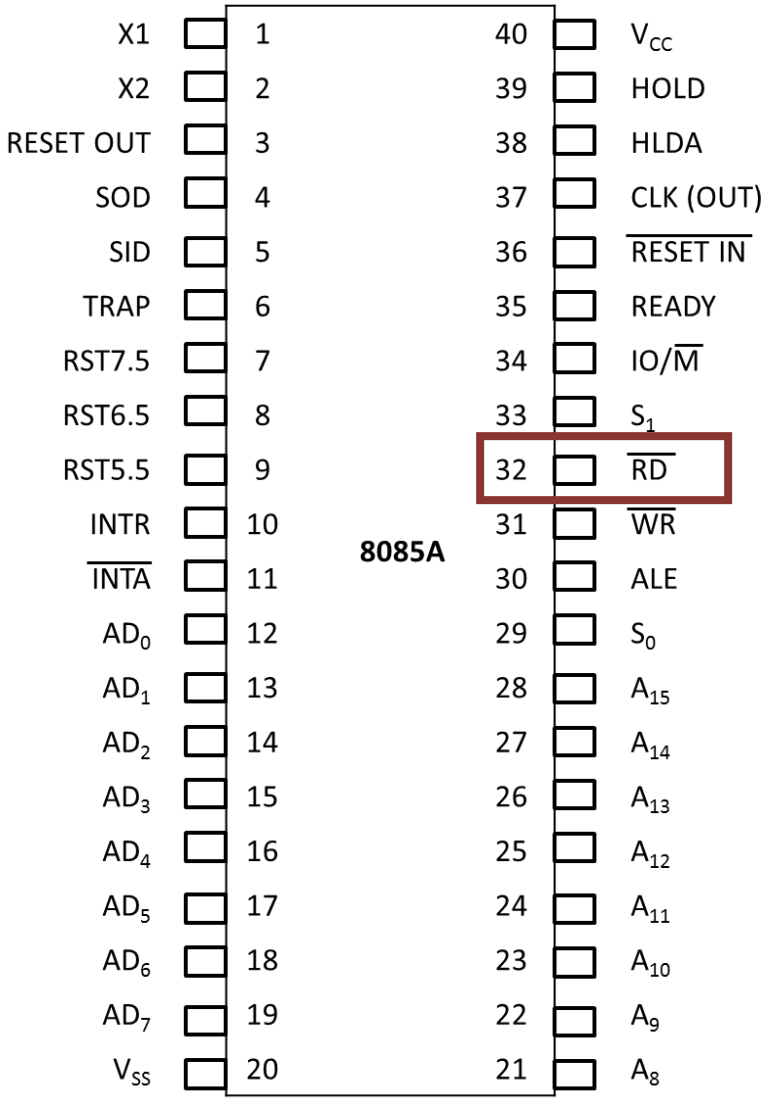
- This is positive going pulse generated everytime the 8085 begins an operation (machine cycle)
- It indicates that the bits on AD_7-AD_0 are address bits.
- This signal is used primarily to latch the low-address from multiplexed bus & generate a separate set of address lines A_7-A_0.



8085 pin diagram: Control & Status Signals

$\overline{RD}$ (Read) Pin 32

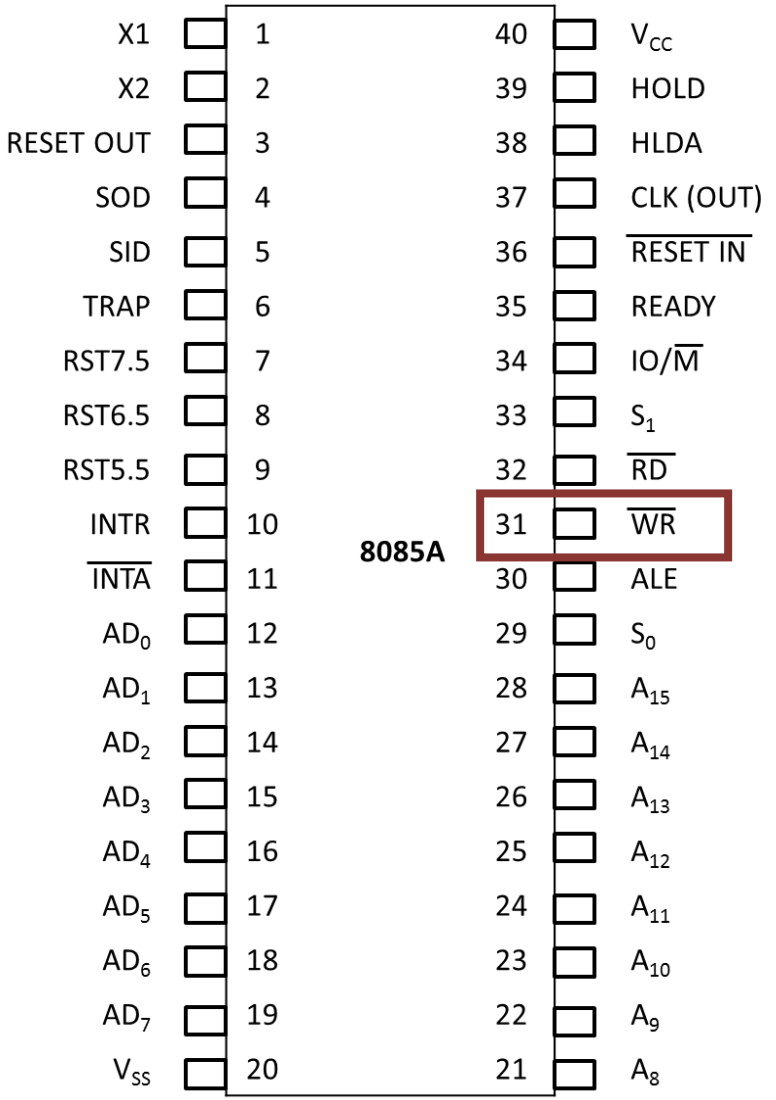
- This is a read control signal (active low)
- This signal indicates that the selected I/O or Memory device is to be read & data is available on data bus.



8085 pin diagram: Control & Status Signals

$\overline{WR}$ (Write) Pin 31

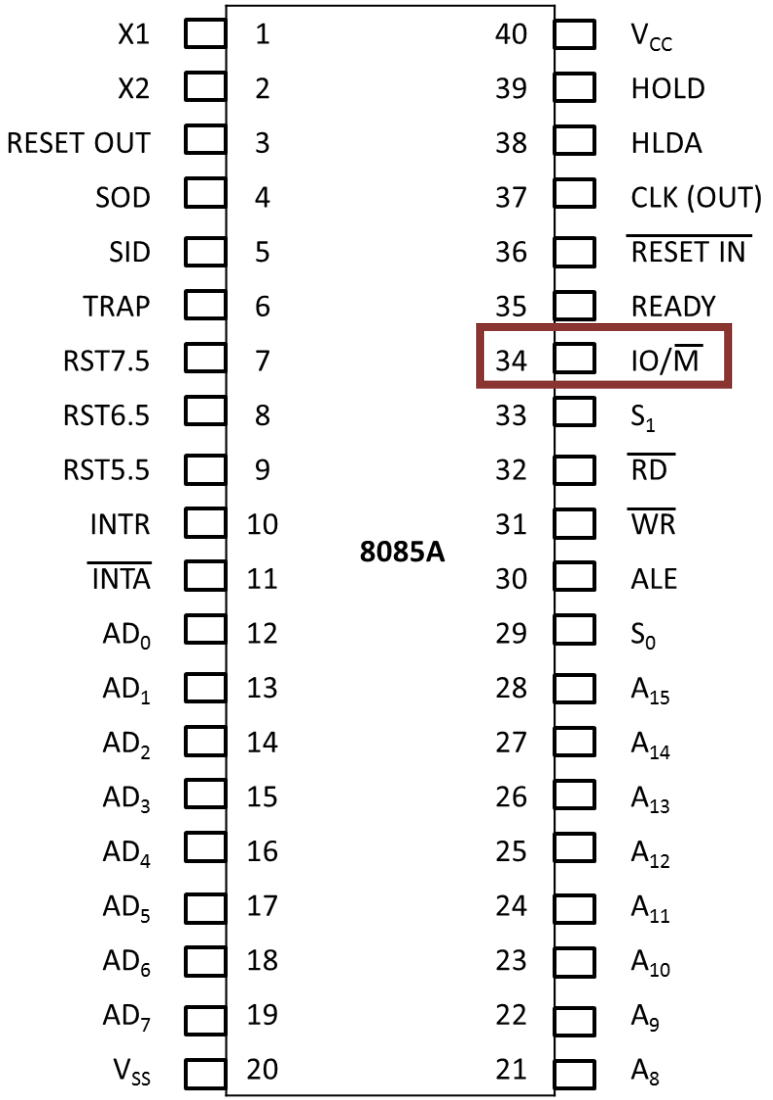
- This is a write control signal (active low)
- This signal indicates that the selected I/O or Memory device is to be write & data is available on data bus.



8085 pin diagram: Control & Status Signals

$IO/\overline{M}$: Pin 34

- This is a status signal used to differentiate I/O and memory operation.
- When signal is
  - high → I/O operation
  - low → Memory operation
- This signal is combined with $\overline{RD}$ and $\overline{WR}$ to generate I/O & memory control signals.

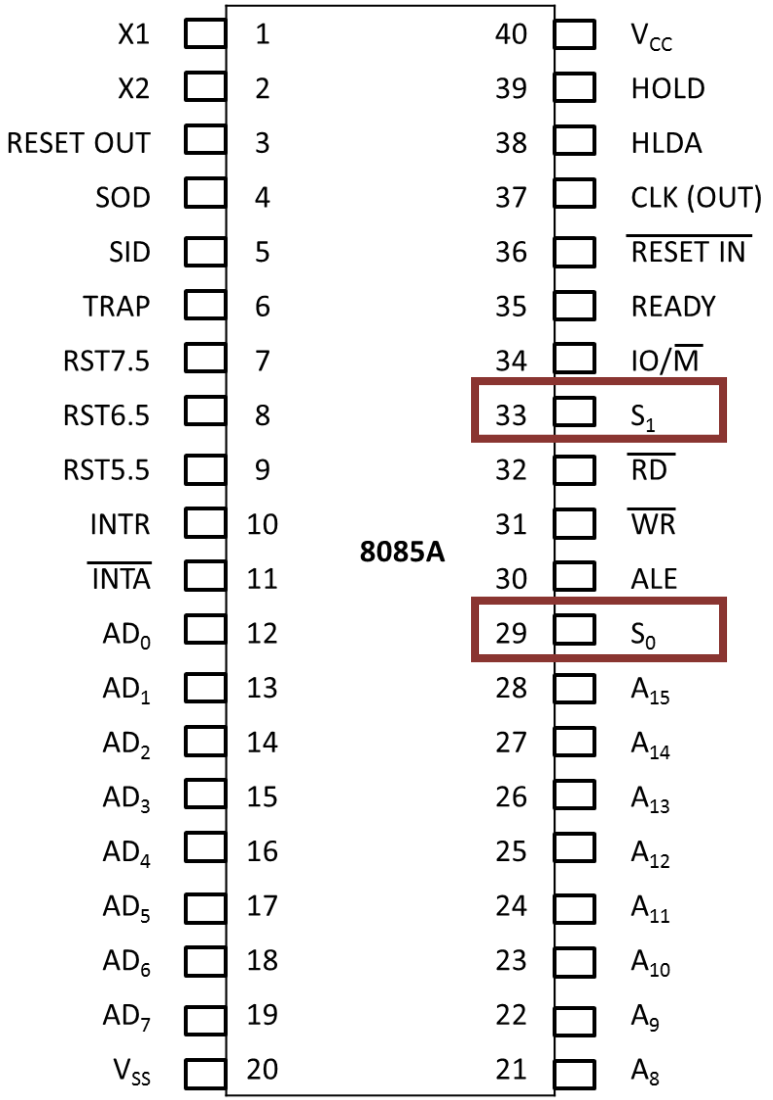


8085 pin diagram: Control & Status Signals

S_1 (Pin 33) & S_0 (Pin 29)

- These status signals can identify various operations

S_1	S_0	Mode
0	0	HLT
0	1	WRITE
1	0	READ
1	1	OPCODE FETCH

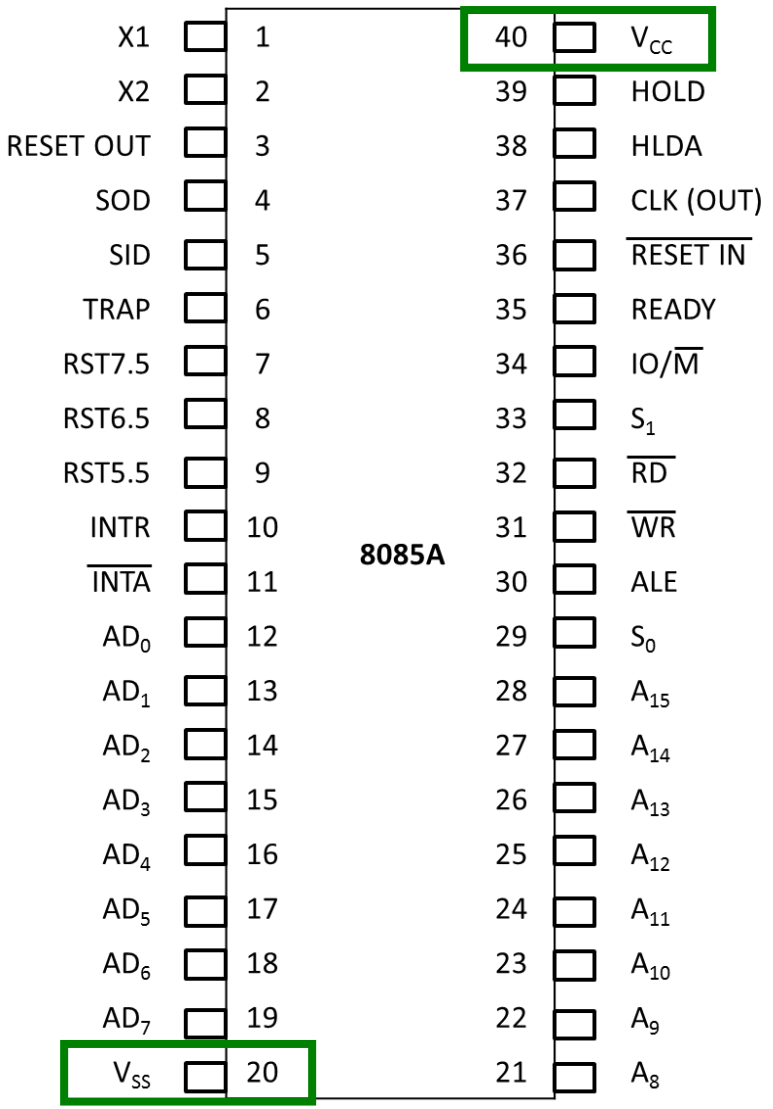


8085 pin diagram

IO/$\overline{M}$	$\overline{RD}$	$\overline{WR}$	Operation
0	0	0	HLT
0	0	1	$\overline{MEMR}$
0	1	0	$\overline{MEMW}$
0	1	1	Opcode Fetch
1	0	0	HLT
1	0	1	$\overline{IOR}$
1	1	0	$\overline{IOW}$
1	1	1	NOP

8085 Pin Diagram: Power Supply & Frequency Signal

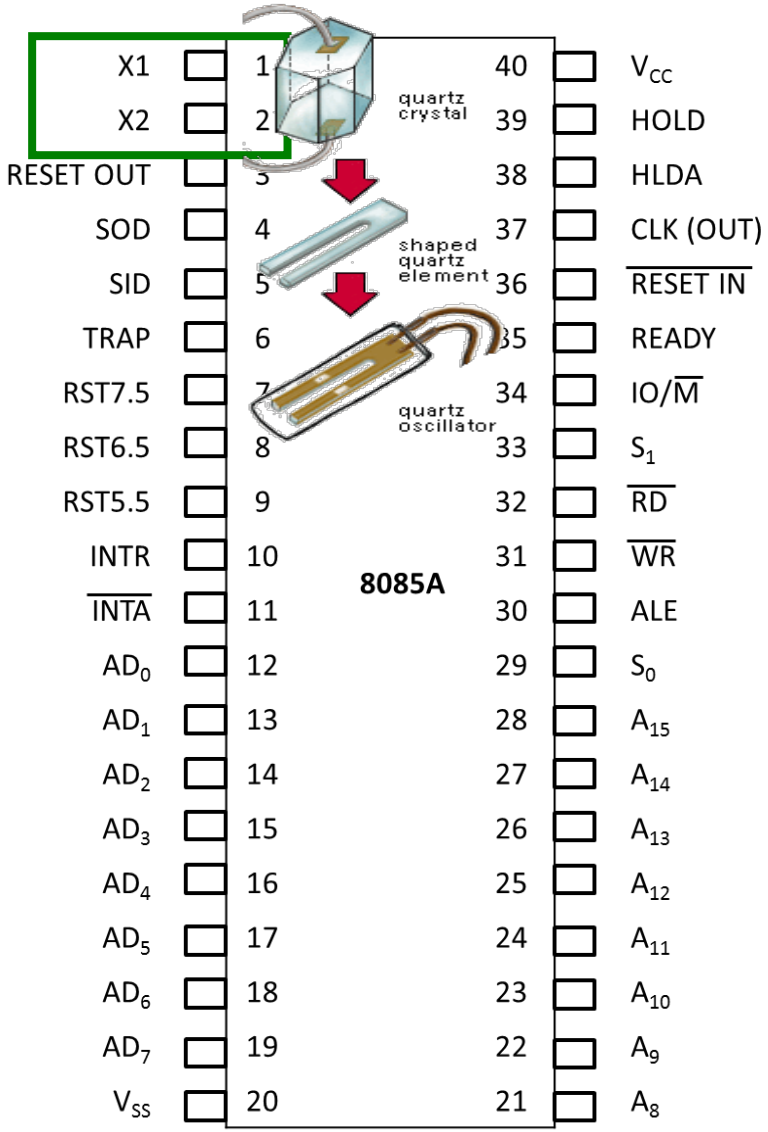
- $V_{cc} \rightarrow$ Pin40, +5V Supply
- $V_{ss} \rightarrow$ Pin20, Ground Reference



8085 Pin Diagram: Power Supply & Frequency Signal

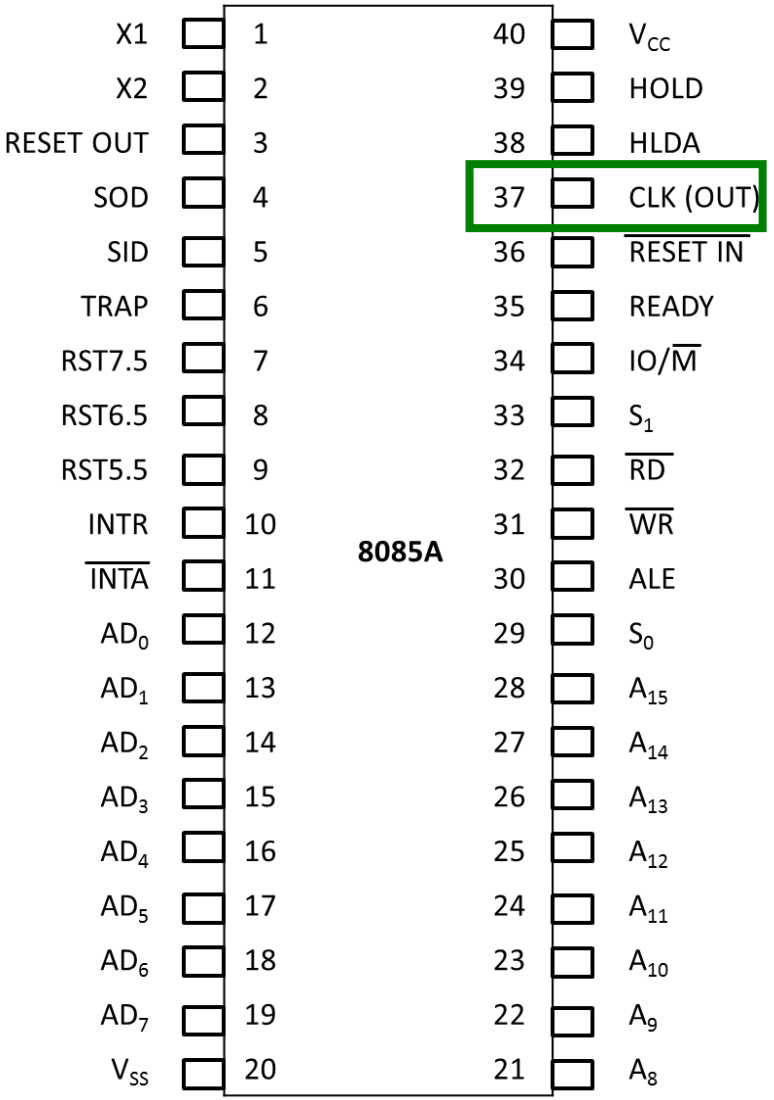
- **X1, X2** → Pin 1 & 2, Crystal Oscillator is connected at these two pins.
- The frequency is internally divided by two;

  therefore, to operate a system at 3MHz, the crystal should have a frequency of 6MHz.



8085 Pin Diagram: Power Supply & Frequency Signal

- **CLK(OUT)→** Clockoutput
- Pin 37: This signal is used as system clock for other I/O devices for synchronization with Microprocessor

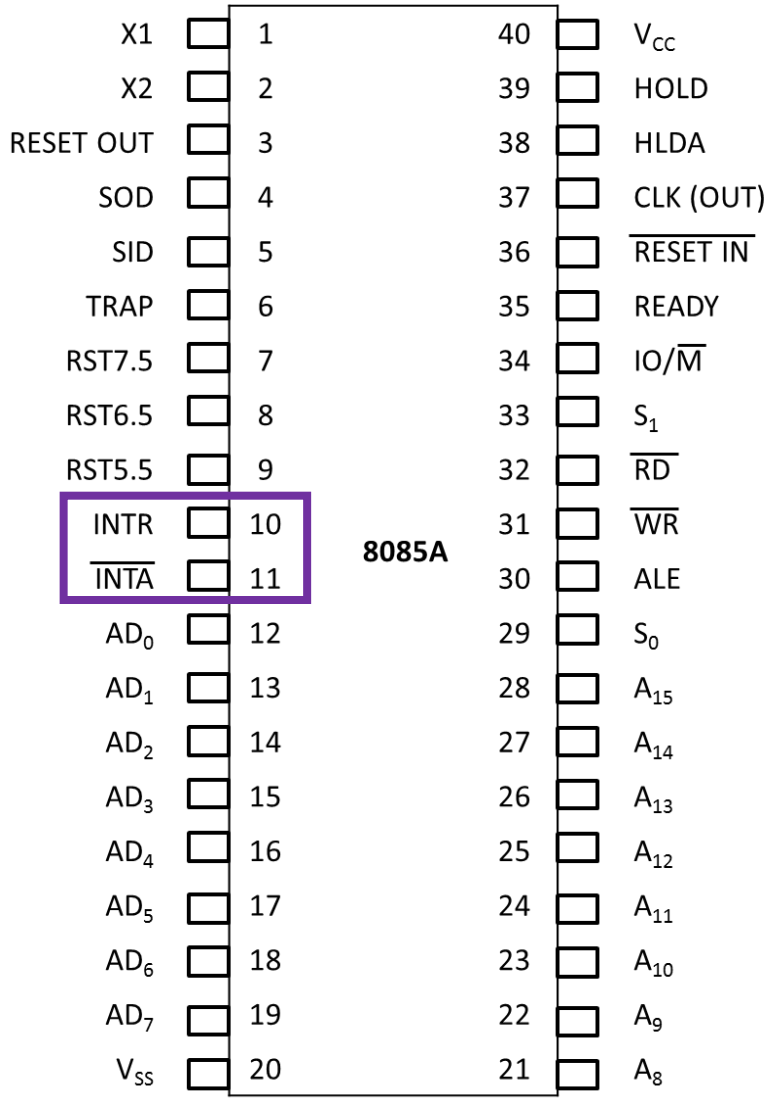


8085 Pin Diagram: Externally Initiated Signals

- **INTR** (Input) → Interrupt Request

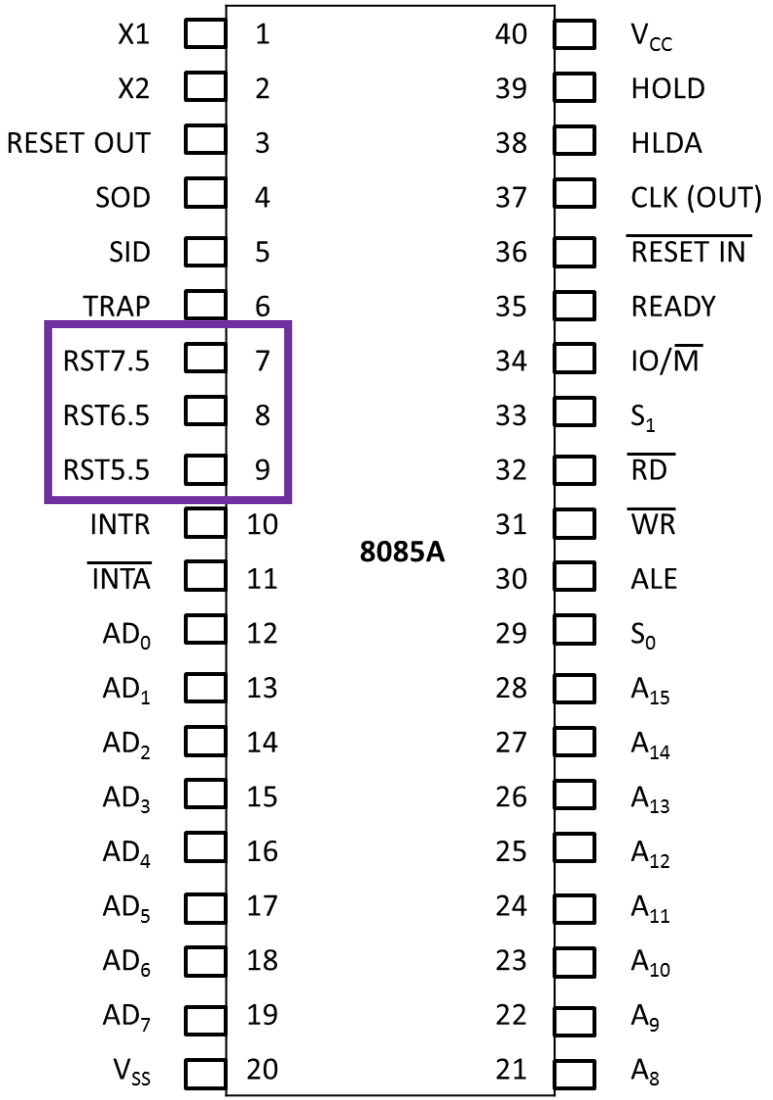
  It is used for general purpose interrupt.

- **$\overline{\text{INTA}}$** (Output) → Interrupt Acknowledge.



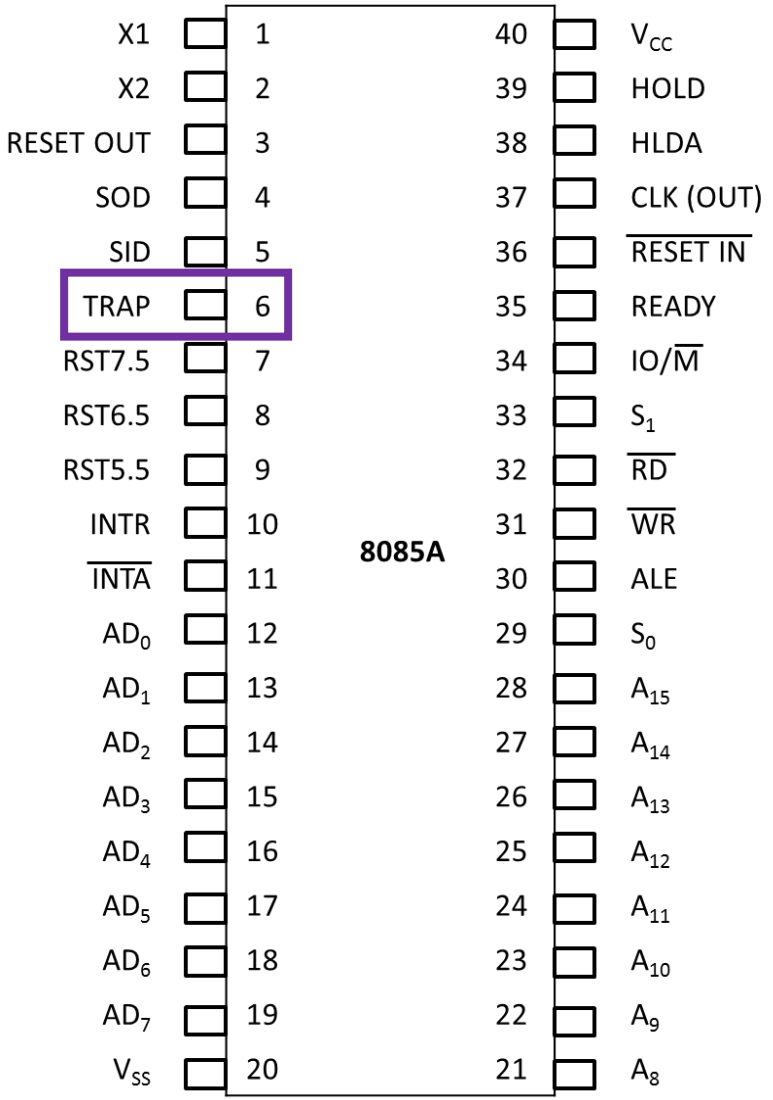
8085 Pin Diagram: Externally Initiated Signals

- **RST7.5, RST6.5, RST5.5** (Input) → Restart Interrupts.
- These are vector interrupts that transfer the program control to specific memory locations.
- RST7.5, RST6.5, RST5.5 have higher priorities than INTR interrupt.
- Among these 3 interrupts, the priority order (higher to lower) is RST7.5, RST6.5, RST5.5 respectively.



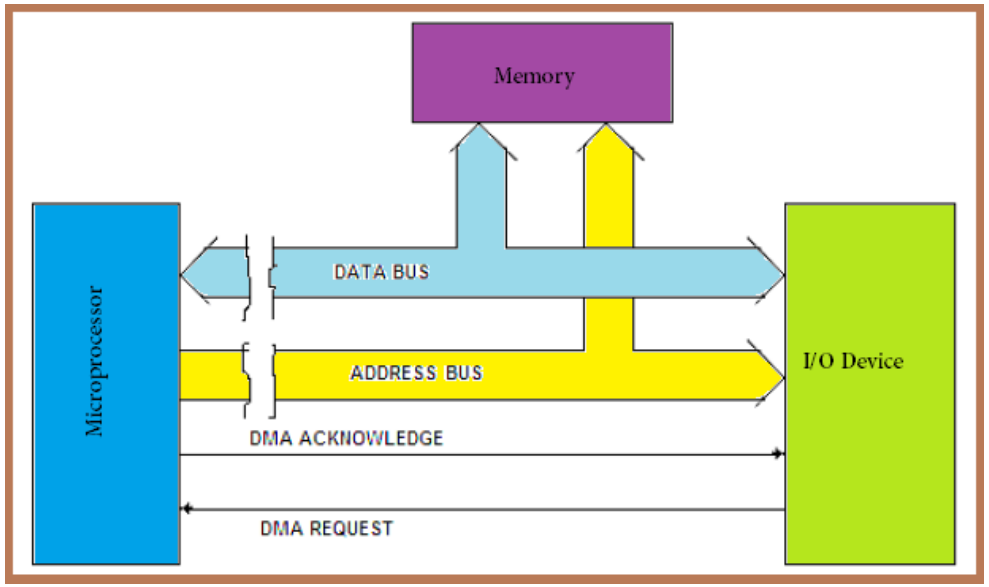
8085 Pin Diagram: Externally Initiated Signals

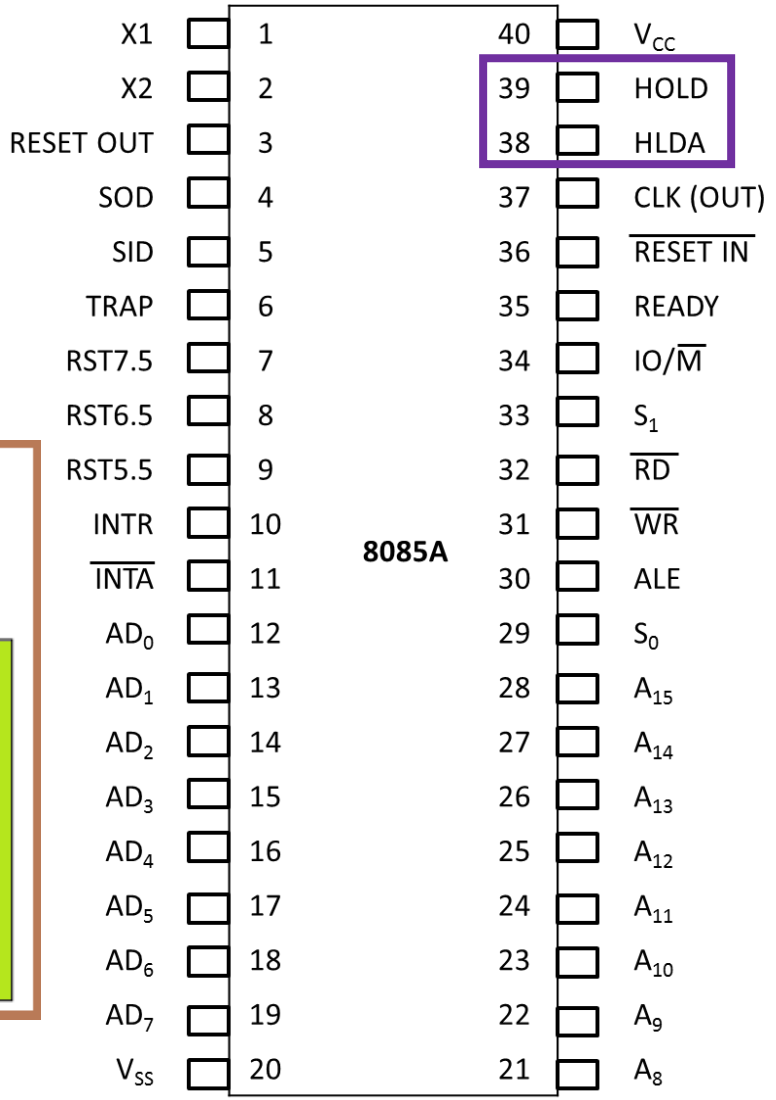
- **TRAP (Input)** → This is a non maskable interrupt & has the **highest priority**.



8085 Pin Diagram: Externally Initiated Signals

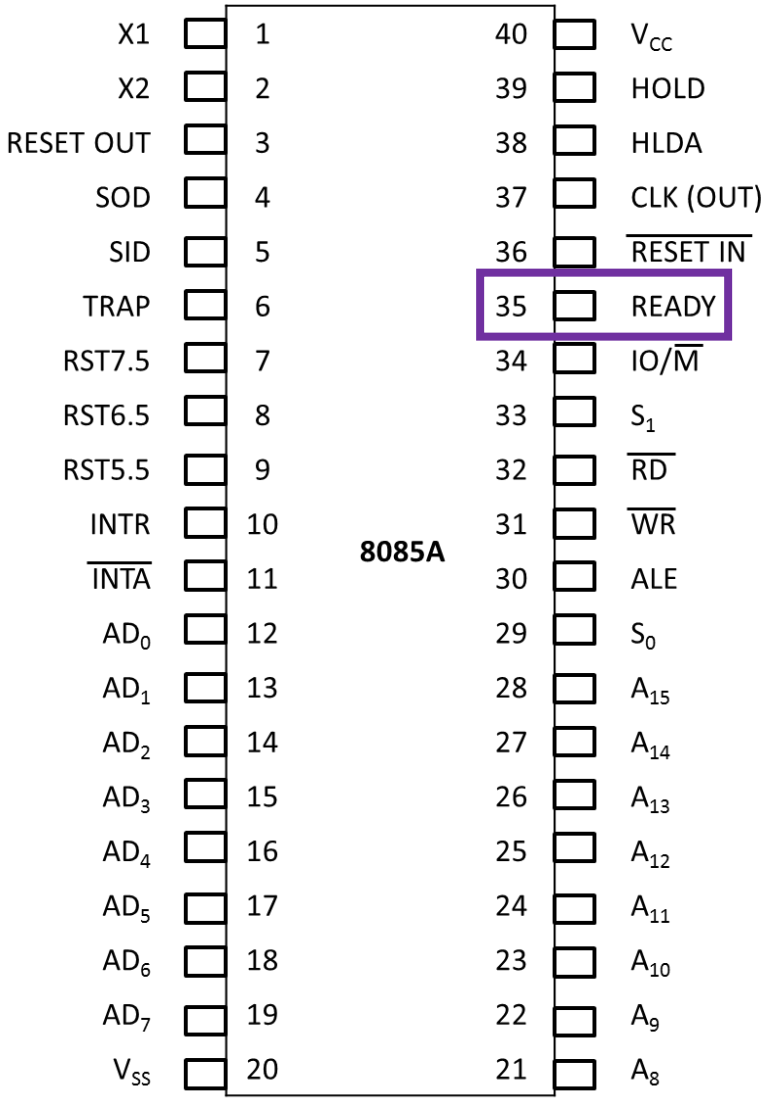
- **HOLD(Input)** → This signal indicates that a peripheral such as DMA Controller is requesting the use of address & data buses
- **HLDA(Output)** → Hold Acknowledge. This signal acknowledges the HOLD request





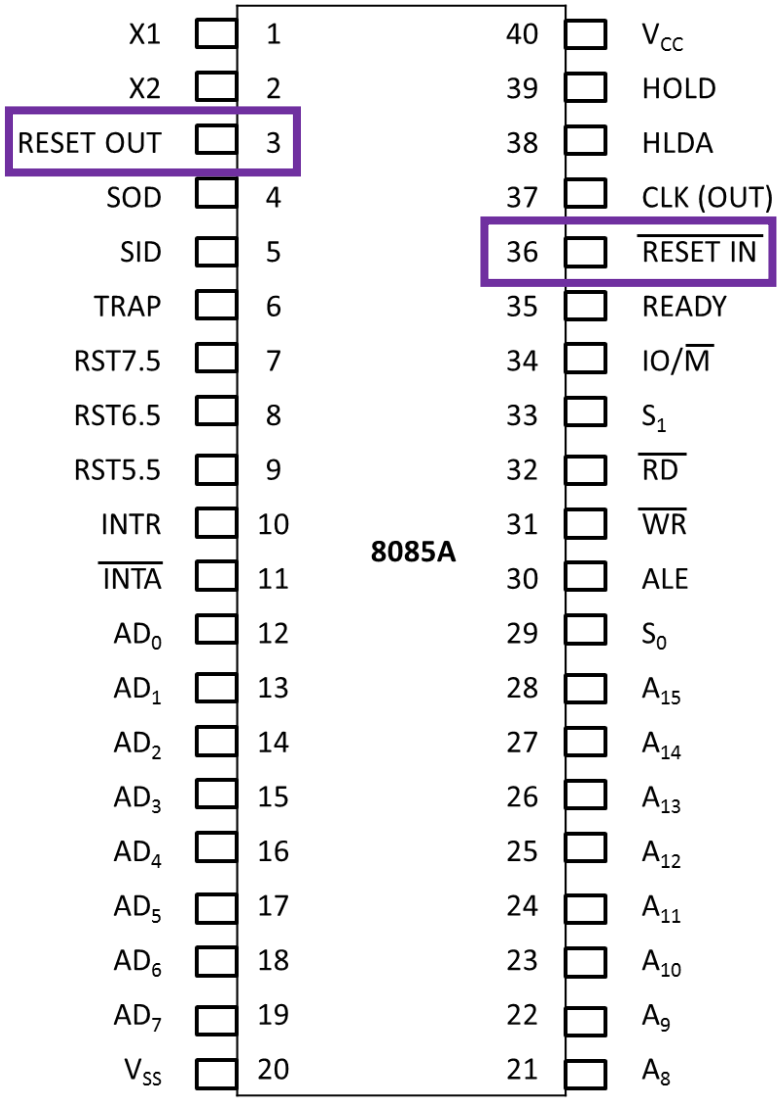
8085 Pin Diagram: Externally Initiated Signals

- **READY** (Input) → This signal is used to delay the microprocessor read or write cycles until low-responding peripheral is ready to send or accept data.
- When the signal goes low, the microprocessor waits for an integral no. of clock cycles until **READY** signal goes high.



8085 Pin Diagram: Externally Initiated Signals

- **$\overline{\text{RESET IN}}$** (Input) → When the signal on this pin goes low, the Program Counter is set to zero, the buses are tri-stated &microprocessor is reset.
- **RESET OUT** (Output) → This signal indicates that microprocessor is being reset. The signal is also used to reset other devices.

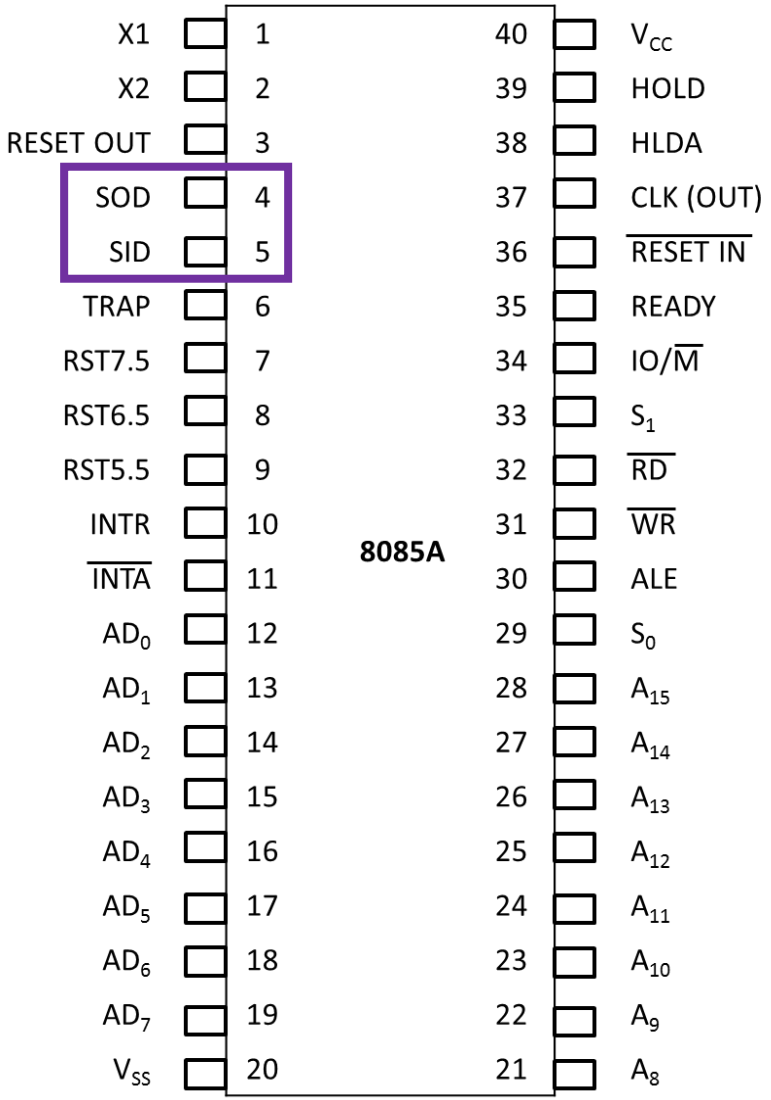


8085 Pin Diagram: Serial I/O Ports

Two pins for serial transmission

1. SID (Serial Input Data)
2. SOD (Serial Output Data)

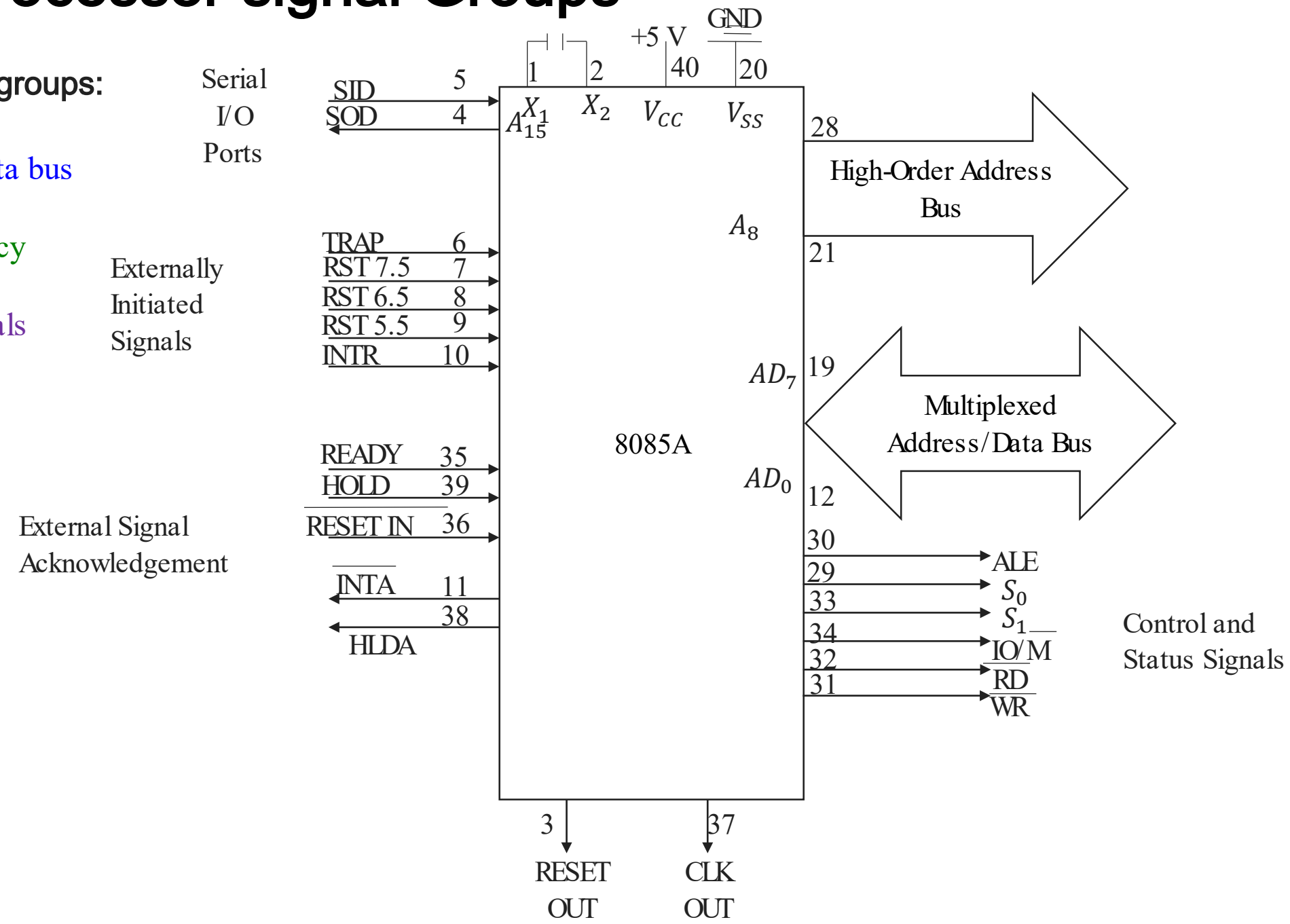
- In serial transmission, data bits are sent over a single line, one bit at a time.



8085 Microprocessor signal Groups

Signals are classified into 6 groups:

1. Address bus
2. Multiplexed address/data bus
3. Control &status signals
4. Power supply &frequency signals
5. Externally initiated signals
6. Serial I/O ports



Thank You