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# First Class


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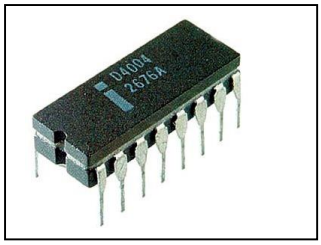
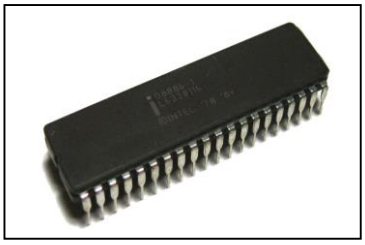
# Introduction to Microprocessor

The brain or engine of the PC is the *processor* (sometimes called *Microprocessor*), or *Central Processing Unit (CPU)*. The CPU performs the system's calculating and processing. The processor is often the most expensive single component in the system.

The CPU is a programmable, multipurpose, clock -driven, register-based electronic device that reads binary instructions from a storage device called memory, accepts binary data as input and processes data according to those instructions and provides results as output.

The microprocessor contains millions of tiny components like transistors, registers, and diodes that work together.

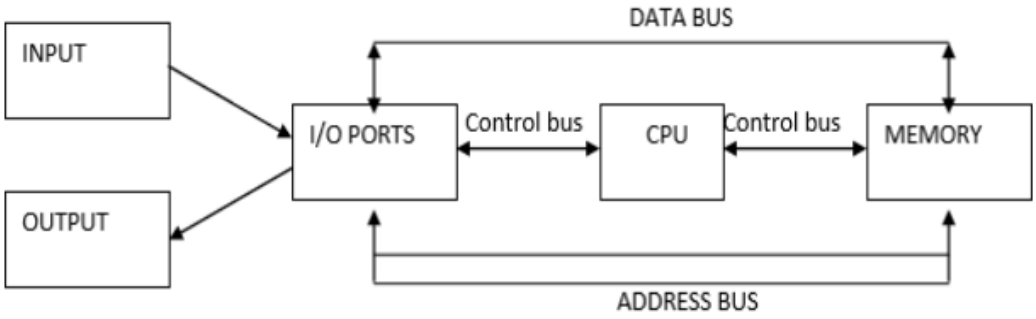



## Block Diagram of a Microcomputer

All microcomputers consist of (at least):

1. Central Processing Unit or CPU.
2. Memory.
3. Input / Output ports.
4. System Bus.




**Block diagram of simple computer or microcomputer.**

## 1.Central Processing Unit or CPU

The Central Processing Unit or CPU controls the operation of the computer. It fetches binary-coded instruction of the computer. It fetches binary-coded instructions from memory, decodes the instructions into a series of simple actions, and carries out these actions.

The CPU contains three main parts:

- **Arithmetic Logic Unit (ALU)**: Executes all arithmetic and logical operations. Arithmetic calculations like as addition, subtraction, multiplication and division. Logical operation like compare numbers, letters, or special characters.
- **Control Unit (CU):** controls and co-ordinates computer components. The function of CU are:
  1. Read the code for the next instruction to be executed.
  2. Increment the program counter so it points to the next instruction.
  3. Read whatever data the instruction requires from cells in memory.
  4. Provide the necessary data to an ALU or register.
  5. If the instruction requires an ALU or specialized hardware to complete, instruct the hardware to perform the requested operation.
- **Registers**: Stores the data that is to be executed next, "very fast storage area".

## 2. Memory

The memory section usually consists of a mixture of RAM and ROM. It may also have magnetic floppy disks, magnetic hard disks, or laser optical disks. Memory has two purposes. The first purpose is to store the binary codes for the sequence of instructions you want the computer to carry out. When you write a computer program, what you are really doing is just writing a sequential list of instructions for the computer. The second purpose of the memory is to store the binary-coded data with which the computer is going to be working.

## 3. Input/Output

The input/output or I/O section allows the computer to take in data from the outside world or send data to the outside world. These allow the user

and the computer to communicate with each other. The actual physical devices used to interface the computer buses to external systems are often called ports.

## 4. System Bus.

A bus is a number of wires organized to provide a means of communication among different elements in a microcomputer system. There are three main bus groups:

- **Address Bus**: The address bus consists of 16, 20, 24, or more parallel signal lines. On these lines the CPU sends out the address of the memory location that is to be written to or read from. The number of address lines determines the number of memory locations that the CPU can address. If the CPU has N address lines then it can directly address $2^N$ memory locations. The address bus is unidirectional.
- **Data Bus**: The data bus consists of 8, 16, 32 or more parallel signal lines. As indicated by the double-ended arrows on the data bus line, the data bus lines are bi-directional. This means that the CPU can read data in on these lines from memory or from a port as well as send data out on these lines to memory location or to a port. Many devices in a system will have their outputs connected to the data bus, but the outputs of only one device at a time will be enabled. The data bus lines are bidirectional.
- **Control Bus**: The control bus consists of 4-10 parallel signal lines. The CPU sends out signals on the control bus to enable the outputs of addressed memory devices or port devices. Typical control bus signals are memory read, memory write, I/O read, and I/O writer. To read a byte of data from a memory location, for example, the CPU sends out the address of the desired byte on the address bus and then sends out a memory read signal on the control bus.

## Evolution of Microprocessor

The microprocessor is identified with the word size of data (No. of bits). Also, this means the size of microprocessor. For e.g. The ALU can perform a 4- bit data operation at a time these microprocessor is called as 4-bit microprocessor.

| Processor | No. of bits | Clock speed (Hz) | Year of introduction |
|---|---|---|---|
| 4004 | 4 | 740K | 1971 |
| 8008 | 8 | 500K | 1972 |
| 8080 | 8 | 2M | 1974 |
| 8085 | 8 | 3M | 1976 |
| 8086 | 16 | 5, 8 or 10M | 1978 |
| 8088 | 16 | 5, 8 or 10M | 1979 |
| 80186 | 16 | 6M | 1982 |
| 80286 | 16 | 8M | 1982 |
| 80386 | 32 | 16 to 33M | 1986 |
| 80486 | 32 | 16 to 100M | 1989 |
| Pentium | 32 | 66M | 1993 |
| Pentium II | 32 | 233 to 500M | 1997 |
| Pentium III | 32 | 500M to 1.4G | 1999 |
| Pentium IV | 32 | 1.3 to 3.8G | 2000 |
| Dual core | 32 | 1.2 to 3 G | 2006 |
| Core 2 Duo | 64 | 1.2 to 3G | 2006 |
| i3, i5 and i7 | 64 | 2.4G to 3.6G | 2010 |

## Generations of Microprocessor

Microprocessors were categorized into five generations: first, second, third, fourth, and fifth generations. Their characteristics are described below:

1. **First generation :**

   From 1971 to 1972 the era of the first generation came which brought microprocessors like INTEL 4004 Rockwell international PPS-4 INTEL 8008 etc.

2. **Second generation :**

   The second generation marked the development of 8 bit microprocessors from 1973 to 1978. Processors like INTEL 8085 Motorola 6800 and 6801 etc came into existence.

3. **Third generation :**

   The third generation brought forward the 16 bit processors like INTEL 8086/80186/80286 Motorola 68000 68010 etc. From 1979 to 1980 this generation used the HMOS technology.

4. **Fourth generation :**

   The fourth generation came into existence from 1981 to 1995. The 32 bit processors using HMOS fabrication came into existence. INTEL 80386 and Mororola 68020 are some of the popular processors of this generation.

5. **Fifth generation ;**

   From 1996 till now we are in the fifth generation. 64 bit processors like PENTIUM, celeron, dual, quad and octa core processors came into existence.

## 8086 Microprocessor

The 8086 microprocessor is a 16-bit microprocessor chip designed by Intel Corporation in 1978. It is an enhanced version of 8085 Microprocessor that was designed by Intel in 1976. It is a 16-bit Microprocessor having 20 address lines and 16 data lines that provides up to 1MB storage. It consists of powerful instruction set, which provides operations like multiplication and division easily. It supports two modes of operation, i.e. Maximum mode and Minimum mode. Maximum mode is suitable for system having multiple processors and Minimum mode is suitable for system having a single processor.

## 8086 Microprocessor Features

1. Intel 8086 was launched in 1978.
2. It was the first 16-bit microprocessor. It's ALU, internal registers works with 16-bit binary word.
3. This microprocessor had major improvement over the execution speed of 8085.
4. It is available as 40-pin Dual-Inline-Package (DIP), with many of the pins having multiple functions.
5. It is available in three versions:
   a. 8086 (5 MHz)
   b. 8086 (8 MHz)
   c. 8086 (10 MHz)
6. It made of HMOS technology with an IC circuitry equivalent to ≈ 29000 transistors (HMOS: High Performance Metal Oxide Semiconductor).
7. 8086 has a 16 bit data bus. It can read or write data to a memory/port either 16 bits or 8 bit at a time.
8. 8086 has a 20-bit address bus which means, it can address up to $2^{20}$ = 1MB memory location.
9. It can support up to 64K I/O ports.
10. It provides 14 registers with 16-bit.
11. It has multiplexed address and data bus AD0-AD15 & A16-A19.
12. It requires single phase clock with 33% duty cycle to provide internal timing.
13. Prefetches up to 6 instruction bytes from memory and queues them in order to speed up the processing.
14. 8086 supports 2 modes of operation
    Minimum mode
    Maximum mode