Introduction to 8086 Microprocessor

The 8086 Microprocessor is an enhanced version of the 8085 Microprocessor, it was developed to overcome the drawbacks of the 8085 Microprocessor in 1976. It is a 16-bit-based Microprocessor that has 20 address lines and 16 data lines.

The 8086 Microprocessor supports both operation modes. The maximum operation mode is useful for systems which have multiple processors and the minimum operation mode is useful for the systems which have a single processor.

Features of 8086 Microprocessor

The most important features of 8086 microprocessors are as follows -

- The 8086 microprocessor is a 16-bit microprocessor. What this means is that the ALU and the internal registers work with 16 bit of binary data at a time.
- It has 16 bits of the data bus. Because of this, the 8086 can read or write either 16 bit or 8 bit of data at a time.
- The 8086 microprocessor has 20 bits of address lines that can access 220 address locations.
- Each memory location is a byte-addressable memory location.

Therefore, the total amount of memory that the 8086 microprocessor contains = 220 bytes = 1 MB.Therefore, the 8086 can access up to 1 MB of memory.

- It works in the frequency range of about 5-10 MHz. (There are 3 versions of the 8086 microprocessor and each of them works in a different frequency range.)
- The 8086 microprocessor works in 2 modes:
- Maximum mode
- Minimum mode
- The instruction queue of the 8086 microprocessor is of 6 bytes of length. Therefore, the 8086 microprocessor can pre-fetch up to 6 instructions from the memory and queue them in order to speed up the instruction execution.
- The 8086 microprocessor can perform only fixed-point arithmetic instructions. It means that the floating-point operations cannot be performed by it. This is a drawback of the 8086 which was later eliminated in the further series of Intel processors.

Components of 8086 Microprocessor

The following are the components of an 8086 microprocessor:

The 8086 microprocessor consists of two main blocks:

Bus Interface Unit (BIU)

Execution Unit (EU)

The Bus Interface Unit (BIU) consists of the following components:

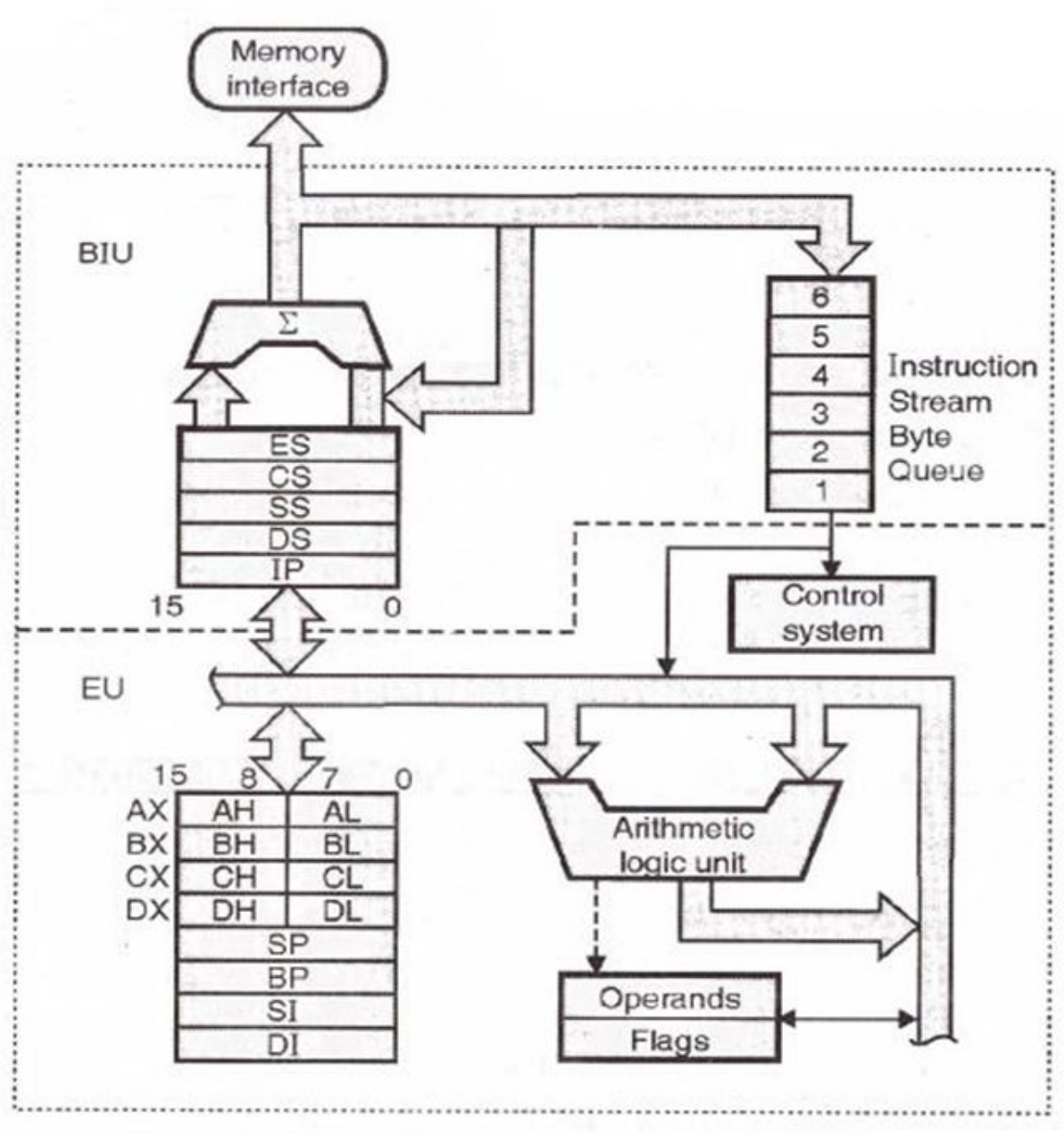
Instruction Queue

Segment Registers

Instruction Pointer (IP)

- The Execution Unit (EU) consists the following:
- Arithmetic Logic Unit (ALU)
- Control Unit
- General Purpose registers
- Index registers and pointers (except IP)
- Flags and Operands.

Architecture of 8086 Microprocessor Diagram



8086 internal architecture

- It is clear from the diagram that only the BIU has a direct link with the memory. This memory can be directly accessed either by the segment registers, the Instruction Pointer (IP) or the Instruction Queue for fetching up the instructions. These instructions are sent in the Control Unit for execution. The control unit takes the help of General Purpose registers, Index registers and Pointers, operands, flags and the most important, the Arithmetic Logic Unit (ALU). All these are part of the Execution Unit.

1. Bus Interface Unit (BIU)
1.1. Bus Interface Unit (BIU)

The Instruction Queue contains the set of instruction which is to be executed. To make the processing faster, the 8086 pre-fetches up to 6 instructions in advance and stores them in the Instruction queue. So, whenever one instruction completes its execution, the control unit need not wait for the next instruction to be fetched and then brought for execution because this job is already done and the next instruction that is to be executed is ready in the Instruction queue.

1.2. **Segment Registers**

Each Segment register can work with 16 bits of binary data. There are 4 types of segment registers:

CS: Code Segment Register
DS: Data Segment Register
SS: Stack Segment Register
ES: Extra Segment Register

1.3. **Instruction Pointer**

The Instruction pointer contains the address of the next instruction that is to be executed.

2**. Execution Unit (EU)**

2.1. **Control Unit (CU)**

All the Instructions are executed inside the Control Unit. It is the main component which is responsible for the processing of any processor.

2.2. **Arithmetic Logic Unit (ALU)**

All the Mathematical and Logical Operations are performed inside the ALU. So, if any instruction needs to perform such operation, the Control Unit handovers it to the ALU.

2.3. **Flag Register**

The flag Register is of 16-bit length which consists of 9 flags, and the rest 7 bits are of don't care cases.

2.4**. General Purpose Registers**

The General Purpose Registers are used as containers for storing the values which may be required for executing the instructions. Each General Purpose Register consists of 16 bits. There are 4 types of General Purpose Registers:

AX = [AH:AL]
BX = [BH:BL]
CX = [CH:CL]
DX = [DH:DL]

2.5. **Pointers and Index Registers**

The 8086 contains following Pointers and Index Registers. (Here, IP is not mentioned because it is a part of the BIU)

BP: Base Pointer
SP: Stack Pointer
SI: Source Index
DI: Destination Index
2.6. **Operands**
These may be used within the instructions.

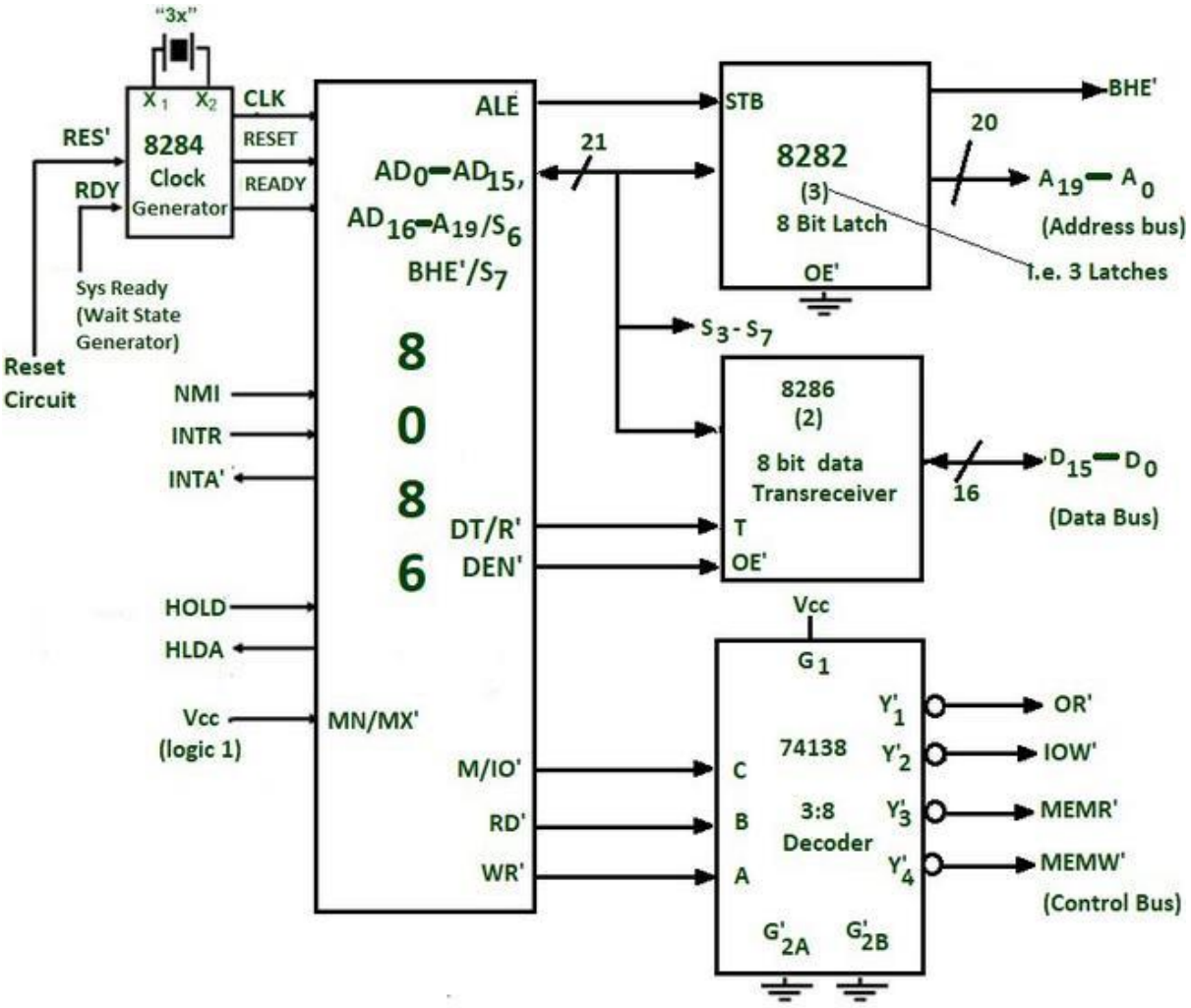
Difference Between Minimum Mode and Maximum Mode in 8086 Microprocessor

Introduction :
In the 8086 microprocessor, there are two modes of operation: minimum mode and maximum mode.

Minimum mode is used when the 8086 microprocessor is operating as a standalone processor without any external coprocessors or support chips. In this mode, the 8086 uses a single 8-bit bus for both data and instructions, and a single 20-bit address bus. The minimum mode requires a minimum set of support chips, such as clock generator, address latch, and bus controller.

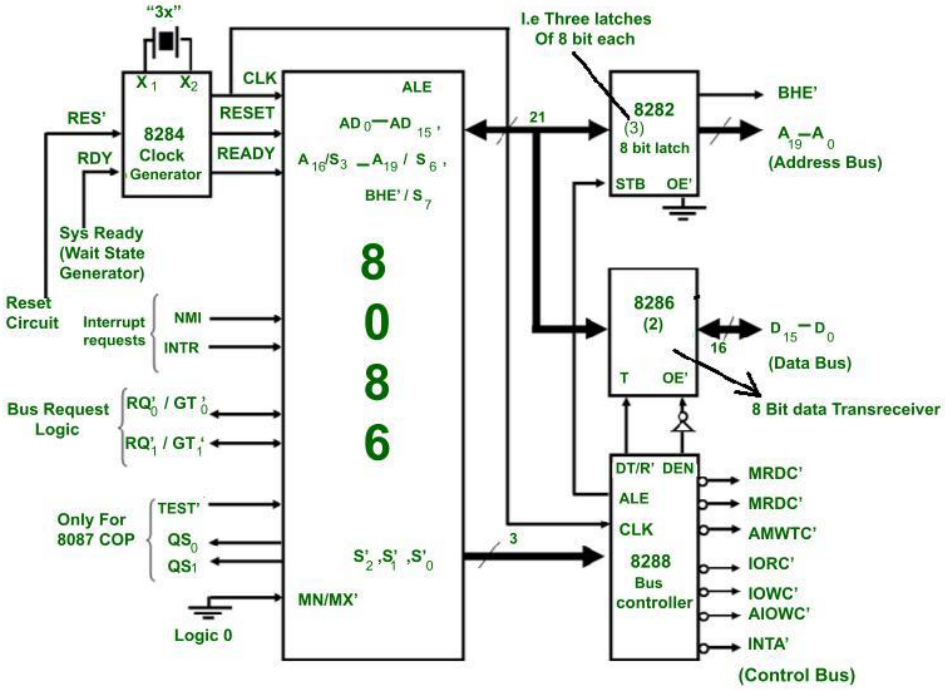
Maximum mode is used when the 8086 microprocessor is operating with one or more external coprocessors or support chips. In this mode, the 8086 uses a multiplexed bus for data and instructions, and a 20-bit address bus. The maximum mode requires additional support chips, such as a bus controller, a clock generator, and a data buffer.

Minimum Mode
When MN/MX' = 1, the 8086 microprocessor runs in the minimum mode. All the control signals required for memory operations and I/O interfaces are provided by the system's only processor running in minimum mode, the 8086, alone. The circuit in this case is simple, but it does not permit multiprocessing.
In this mode, the microprocessor chip itself transmits all control signals. The system's latches, transceiver, clock generator, memory, and I/O devices make up the remaining parts.



Maximum Mode

When 8086 is used as more than just a processor to perform calculations, that is when 8086 is operating in maximum mode. The MN/MX pin is connected to the ground to operate the 8086 in maximum mode. The system's components are identical to those in the minimum mode system.



Minimum mode	Maximum mode
There can be only one processor.	There can be multiple processors.
Performance is slower.	Performance is faster.
The circuit is simple.	The circuit is complex.
Multiprocessing cannot be performed.	Multiprocessing can be performed.
MN/MX is 1 to indicate the minimum mode.	MN/MX is 0 to indicate the maximum mode
The 8086 generates INTA for interrupt acknowledgment.	The 8288 Bus Controller generates the interrupt acknowledgment signal (INTA).
The 8086 itself provides an ALE for the latch.	Because there are several processors, the 8288 bus controller provides ALE for the latch.
The system is more affordable.	The system costs more money.
It is used for small systems.	It is used for large systems.
The multiprocessor setup is not supported.	The multiprocessor configuration is accepted.