Basics Specific Microprocessor Architecture and its Specifications

Introduction

The 8085 microprocessor is an 8-bit microprocessor that was developed by **Intel in the mid-1970s**. It was widely used in the early days of personal computing and was a popular choice for hobbyists and enthusiasts due to its simplicity and ease of use. The architecture of the 8085 microprocessor consists of several key components, including the accumulator, registers, program counter, stack pointer, instruction register, flags register, data bus, address bus, and control bus.

The accumulator is an 8-bit register that is used to store arithmetic and logical results. It is the most commonly used register in the 8085 microprocessor and is used to perform arithmetic and logical operations such as addition, subtraction, and bitwise operations.

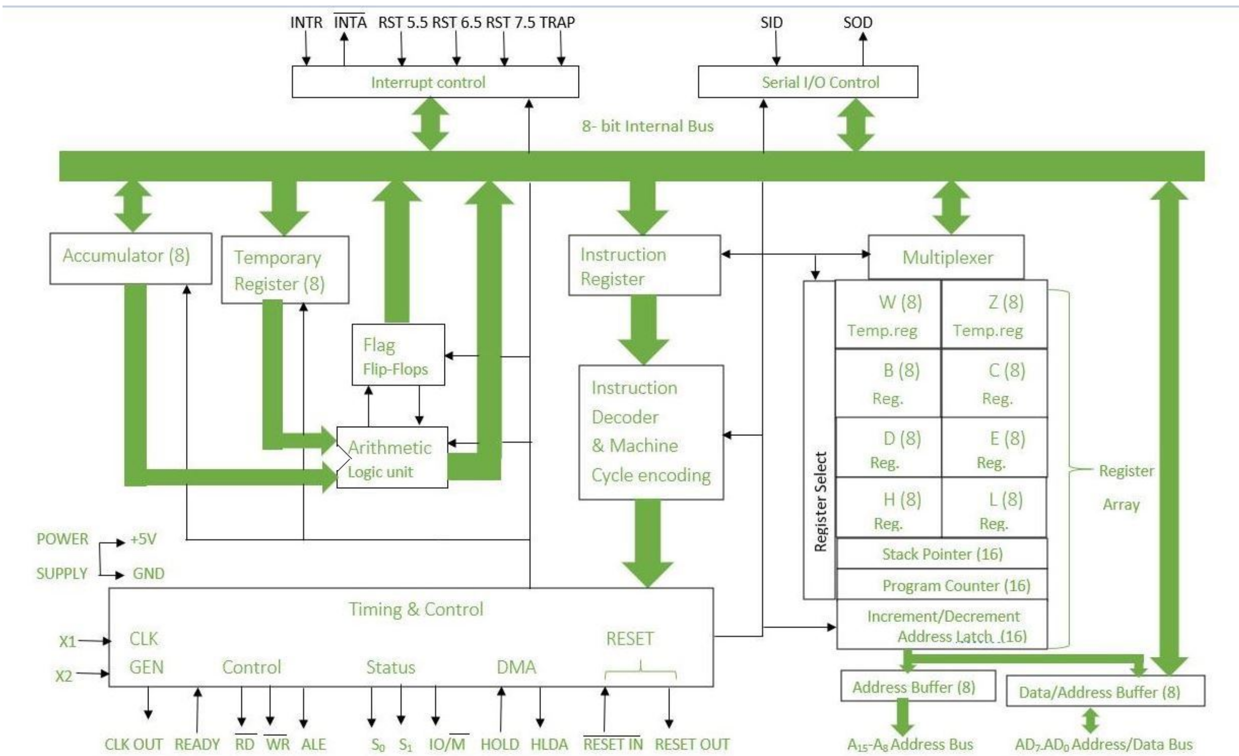
The 8085 microprocessor has six general-purpose registers, including B, C, D, E, H, and L, which can be combined to form 16-bit register pairs. The B and C registers can be combined to form the BC register pair, the D and E registers can be combined to form the DE register pair, and the H and L registers can be combined to form the HL register pair. These register pairs are commonly used to store memory addresses and other data. The program counter is a 16-bit register that contains the memory address of the next instruction to be executed. The program counter is incremented after each instruction is executed, which allows the microprocessor to execute instructions in sequence.

The stack pointer is a 16-bit register that is used to manage the stack. The stack is a section of memory that is used to store data temporarily, such as subroutine addresses and other data. The stack pointer is used to keep track of the top of the stack.

1. The instruction register is an 8-bit register that contains the current instruction being executed. The instruction register is used by the microprocessor to decode and execute instructions.
2. The flags register is an 8-bit register that contains status flags that indicate the result of an arithmetic or logical operation. These flags include the carry flag, zero flag, sign flag, and parity flag. The carry flag is set when an arithmetic operation generates a carry, the zero flag is set when the result of an arithmetic or logical operation is zero, the sign flag is set when the result of an arithmetic or logical operation is negative, and the parity flag is set when the result of an arithmetic or logical operation has an even number of 1 bits.
3. **The data bus** is an 8-bit bus that is used to transfer data between the microprocessor and memory or other devices. The data bus is bidirectional, which means that it can be used to read data from memory or write data to memory. **The address bus** is a 16-bit bus that is used to address memory and other devices. **The control bus** is a set of signals that controls the operations of the microprocessor, including the read and write operations. The control bus includes signals such as the read signal, write signal, interrupt signal, and reset signal. The read signal is used to read data from memory or other devices, the write signal is used to write data to memory or other devices, the interrupt signal is used to signal the microprocessor that an

interrupt has occurred, and the reset signal is used to reset the microprocessor to its initial state.

4. 8085 is an 8-bit, general-purpose microprocessor. It consists of the following functional units:



Arithmetic and Logic Unit (ALU) :

It is used to perform mathematical operations like addition, multiplication, subtraction, division, decrement, increment, etc. Different operations are carried out in ALU:

1- Logical operations
2- Bit-shifting operations.
3- Arthimatic operations.

Flag Register:

It is an 8-bit register that stores either 0 or 1 depending upon which value is stored in the accumulator. Flag Register contains 8-bit out of which 5-bits are important and the rest of 3-bits are "don't Care conditions". The flag register is a dynamic register because after each operation to check whether the result is zero, positive or negative, whether there is any overflow occurred or not, or for comparison of two 8-bit numbers carry flag is checked. So for numerous operations to check the contents of the accumulator and from that contents if we want to check the behavior of given result then we can use Flag register to verify and check. So we can say that the **flag register**

and it is a status register is used to check the status of the current operation which is being carried out by ALU.

Different Fields of Flag Register:

1. **Carry Flag**
2. **Parity Flag**
3. **Auxiliary Carry Flag**
4. **Zero Flag**
5. **Sign Flag**

Accumulator:

Accumulator is used to perform I/O, arithmetic, and logical operations. It is connected to ALU and the internal data bus. The accumulator is the heart of the microprocessor because for all arithmetic operations Accumulator's 8-bit pin will always there connected with ALU and in most-off times all the operations carried by different instructions will be stored in the accumulator after operation performance.

General Purpose Registers:

There are six general-purpose registers. These registers can hold 8-bit values. These 8-bit registers are B,C,D,E,H,L. These registers work as 16-bit registers when they work in pairs like B-C, D-E, and H-L. Here registers W and Z are reserved registers. We can't use these registers in arithmetic operations. It is reserved for microprocessors for internal operations like swapping two 16-bit numbers. We know that to swap two numbers we need a third variable hence here W-Z register pair works as temporary registers and we can swap two 16-bit numbers using this pair.

Program Counter:

Program Counter holds the address value of the memory to the next instruction that is to be executed. It is a 16-bit register.

For Example: Suppose current value of Program Counter: [PC] = 4000H

(It means that next executing instruction is at location 4000H.After fetching,program Counter(PC) always increments by +1 for fetching of next instruction.)

Stack Pointer:

It works like a stack. In stack, the content of the register is stored that is later used in the program. It is a 16-bit special register. The stack pointer is part of memory but it is part of Stack operations, unlike random memory access. Stack pointer works in a continuous and contiguous part of the memory. whereas Program Counter (PC) works in random memory locations. This pointer is very useful in stack-related operations like ***PUSH, POP, and nested CALL requests*** initiated by Microprocessor. *It reserves the address of the most recent stack entry.*

Temporary Register:

It is an 8-bit register that holds data values during arithmetic and logical operations.

Instruction registers and decoder:

It is an 8-bit register that holds the instruction code that is being decoded. The instruction is fetched from the memory.

Timing and control unit:

The timing and control unit comes under the CPU section, and it controls the flow of data from the CPU to other devices. It is also used to control the operations performed by the microprocessor and the devices connected to it. There are certain timing and control signals like Control signals, DMA Signals, RESET signals and Status signals.

Interrupt control:

Whenever a microprocessor is executing the main program and if suddenly an interrupt occurs, the microprocessor shifts the control from the main program to process the incoming request. After the request is completed, the control goes back to the main program. There are 5 interrupt signals in 8085 microprocessors: INTR, TRAP, RST 7.5, RST 6.5, and RST 5.5.

Priorities of Interrupts: TRAP > RST 7.5 > RST 6.5 > RST 5.5 > INTR

Address bus and data bus:

The data bus is bidirectional and carries the data which is to be stored. The address bus is unidirectional and carries the location where data is to be stored.

In the 8085 microprocessors, the address bus and data bus are two separate buses **that are used for** communication between the microprocessor and external devices.

The Address bus is used to transfer the memory address of the data that needs to be read or written. The address bus is a 16-bit bus, allowing the 8085 to access up to 65,536 memory locations.

The Data bus is used to transfer data between the microprocessor and external devices such as memory and I/O devices. The data bus is an 8-bit bus, allowing the 8085 to transfer 8-bit data at a time. The data bus can also be used for instruction fetch operations, where the microprocessor fetches the instruction code from memory and decodes it.

The combination of the address bus and data bus allows the 8085 to communicate with and control external devices, allowing it to execute its program and perform various operations.

Serial Input/output control:

It controls the serial data communication by using Serial input data and Serial output data.

Serial Input/Output control in the 8085 microprocessor refers to the communication of data between the microprocessor and external devices in a serial manner, i.e., one bit at a time. The 8085 has a serial I/O port (SID/SOD) for serial communication. The SID pin is used for serial input and the SOD pin is used for serial output. The timing and control of serial communication is managed by the 8085's internal circuitry. The 8085 also has two special purpose registers, the Serial Control Register (SC) and the Serial Shift Register (SS), which are used to control and monitor the serial communication.

The flow of an Instruction Cycle in 8085 Architecture:

1. Execution starts with Program Counter. It starts program execution with the next address field. it fetches an instruction from the memory location pointed by Program Counter.
2. For address fetching from the memory, multiplexed address/data bus acts as an address bus and after fetching instruction this address bus will now acts as a data bus and extract data from the specified memory location and send this data on an 8-bit internal bus. For multiplexed address/data bus Address Latch Enable (ALE) Pin is used. If ***ALE = 1 (Multiplexed bus is Address Bus otherwise it acts as Data Bus).***
3. After data fetching data will go into the Instruction Register it will store data fetched from memory and now data is ready for decoding so for this Instruction decoder register is used.
4. After that timing and control signal circuit comes into the picture. *It sends control signals all over the microprocessor to tell the microprocessor whether the given instruction is for READ/WRITE and whether it is for MEMORY/I-O Device activity.*
5. Hence according to timing and control signal pins, logical and arithmetic operations are performed and according to that data fetching from the different registers is done by a microprocessor, and mathematical operation is carried out by ALU. And according to operations Flag register changes dynamically.
6. With the help of Serial I/O data pin(SID or SOD Pins) we can send or receive input/output to external devices .in this way execution cycle is carried out.
7. ***While execution is going on if there is any interrupt detected then it will stop execution of the current process and Invoke Interrupt Service Routine (ISR)*** Function. Which will stop the current execution and do execution of the current occurred interrupt after that normal execution will be performed.

Uses of 8085 microprocessor:

The 8085 microprocessor is a versatile 8-bit microprocessor that has been used in a wide variety of applications, including:

1. Embedded Systems: The 8085 microprocessor is commonly used in embedded systems, such as industrial control systems, automotive electronics, and medical equipment.
2. Computer Peripherals: The 8085 microprocessor has been used in a variety of computer peripherals, such as printers, scanners, and disk drives.
3. Communication Systems: The 8085 microprocessor has been used in communication systems, such as modems and network interface cards.
4. Instrumentation and Control Systems: The 8085 microprocessor is commonly used in instrumentation and control systems, such as temperature and pressure controllers.
5. Home Appliances: The 8085 microprocessor is used in various home appliances, such as washing machines, refrigerators, and microwave ovens.

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6. Educational Purposes: The 8085 microprocessor is also used for educational purposes, as it is an inexpensive and easily accessible microprocessor that is widely used in universities and technical schools.

Issues in 8085 microprocessor :

Here are some common issues with the 8085 microprocessor:

1. Overheating: The 8085 microprocessor can overheat if it is used for extended periods or if it is not cooled properly. Overheating can cause the microprocessor to malfunction or fail.
2. Power Supply Issues: The 8085 microprocessor requires a stable power supply for proper operation. Power supply issues such as voltage fluctuations, spikes, or drops can cause the microprocessor to malfunction.
3. Timing Issues: The 8085 microprocessor relies on accurate timing signals for proper operation. Timing issues such as clock signal instability, noise, or interference can cause the microprocessor to malfunction.
4. Memory Interface Issues: The 8085 microprocessor communicates with memory through its address and data buses. Memory interface issues such as faulty memory chips, loose connections, or address decoding errors can cause the microprocessor to malfunction.
5. Hardware Interface Issues: The 8085 microprocessor communicates with other devices through its input/output ports. Hardware interface issues such as faulty devices, incorrect wiring, or improper device selection can cause the microprocessor to malfunction.
6. Programming Issues: The 8085 microprocessor is programmed with machine language or assembly language instructions. Programming issues such as syntax errors, logic errors, or incorrect instruction sequences can cause the microprocessor to malfunction or produce incorrect results.
7. Research and development: The 8085 microprocessor is often used in research and development projects, where it can be used to develop and test new digital electronics and computer systems. Researchers and developers can use the microprocessor to prototype new systems and test their performance.
8. Retro computing: The 8085 microprocessor is still used by enthusiasts today for retro computing projects. Retro computing involves using older computer systems and technologies to explore the history of computing and gain a deeper understanding of how modern computing systems have evolved.