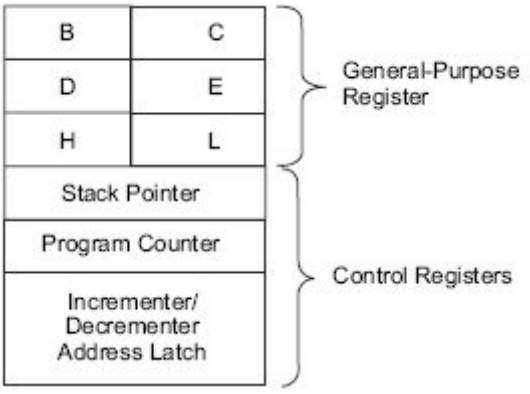
Register Set of 8085

The Intel 8085 has six general-purpose registers to store 8-bit data and these registers are identified as B, C, D, E, H and L. When two registers are combined, 16-bit data can be stored in a register pair. The only possible combinations of register pairs are BC, DE and HL. These register pairs are used to perform 16-bit operations. There is an accumulator register and one flag register. The accumulator is an 8-bit register. Arithmetic and logical operations are performed in the accumulator and after operation; the result will be stored in the accumulator. In addition with the above registers, there are two 16-bit registers, namely, the Stack Pointer (SP) and Program Counter (PC).



The registers are listed as follows:

- One 8-bit accumulator (ACC) known as register A
- Six 8-bit general-purpose registers: B, C, D, E, H and L
- One 16-bit Stack Pointer (SP)
- One 16-bit Program Counter (PC)
- Instruction register
- Temporary register
- Program Status Word (PSW) Register

Accumulator:

The accumulator is an 8-bit register, which is part of the Arithmetic Logic Unit (ALU). This is identified as register A or ACC. It is used to store 8-bit data and to perform arithmetic as well as logic operations. The final result of an operation performed in the ALU is also stored in the accumulator.

General-purpose registers:

The general-purpose registers of the 8085 microprocessor are B, C, D, E, H and L registers as shown in the figure. These registers are used to store 8-bit operands. To hold a 16-bit data or 16-bit memory address location, two 8-bit registers can be combined. The combination of two 8-bit registers is known as a register pair. The only possible combination register pairs of the 8085 microprocessor are B-C, D-E and H-L. The programmer cannot form a register pair by selecting any two registers of his choice. The H-L register pair can be used as the address of memory location whereas B-C and D-E register pairs are used to store 16-bit data. During the execution of the program, all general-purpose registers can be accessed by program instructions and also used for data manipulation.

Special-purpose registers:

In addition to the above general-purpose registers, the 8085 microprocessor has special-purpose registers, namely, Program Counter (PC), Stack Pointer (SP), Flags/Status Registers (SR), Instruction Register (IR), Memory Address Register (MAR), Temporary Register (TR), and Memory Buffer Register (MBR).

<u>Program Counter (PC)</u>

The program counter is a 16-bit special-purpose register. This is used to hold the memory address of the next instruction which will be executed. Actually, this register keeps track of memory locations of the instructions during execution of program. The microprocessor uses this register to execute instructions in sequence. For this, the microprocessor increments the content of the program counter.

Stack Pointer (SP)

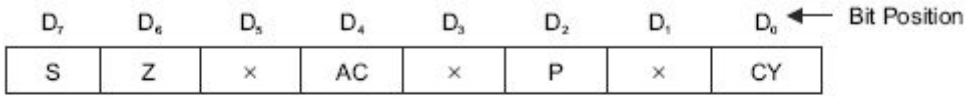
The stack pointer is a 16-bit register, which is used to point the memory location called the stack. The stack is a sequence of memory locations in the R/W memory. The starting of the stack is defined by loading a 16-bit address into the stack pointer. Generally, the programmers use this register to store and retrieve the contents of the accumulator, flags, program counter as well as general-purpose registers during the execution of a program.

Flags/Status Registers (SR)

The Arithmetic Logic Unit (ALU) includes five flip-flops, which are set or reset after an ALU operation according to data conditions of the result in the accumulator and other general-purpose registers. The status of each flip-flop is known as a flag. Therefore, there are five flags, namely, Carry flag (CY), Parity flag (P), Auxiliary Carry flag (AC), Zero flag (Z), and Sign (S) flags. The most commonly used flags are Carry(CY), Zero(Z) and Sign(S). Generally, the microprocessor uses these flags to test data conditions.

For example, after addition of two 8-bit numbers, if the sum in the accumulator is larger than eight bits, the flip-flop, which is used to indicate a carry, is set to one. So the Carry flag (CY) is set to1. If the result is zero after any arithmetic operation, the Zero (Z) flag is set to one.

Below figure shows an 8-bit register, which indicates bit positions of different flags. This register is known as flag register and it is adjacent to the accumulator. Though it is an eight-bit register, only five bit positions out of eight are used to store the outputs of the five flip-flops. The flags are stored in the 8-bit register so that the programmer can check these flags through an instruction. These flags are used in the decision-making process of the microprocessor.



S — Sign Flag

Z — Zero Flag

AC — Auxiliary Carry Flag

P — Parity Flag

CS — Carry Flag

Carry Flag (CY): The arithmetic operation generates a carry in case of addition or a borrow in case of subtraction after execution of an arithmetic instruction and the carry flag is set to 1. When the two 8-bit numbers are added and the sum is larger than 8 bits, a carry is produced and the carry flag is set to 1. During subtraction, if borrow is generated, the carry flag is also set to 1. The position of carry flag is D0 as depicted in above figure.

Parity Flag (P): After an arithmetic or logical operation, if the number of 1s in the result is even (even parity), this parity status flag (P) is set, and if the number of 1s is odd (odd parity), this flag is reset. For example, if the data byte is 1 1 1 1 1 1 1 1, the number of 1s in the data byte is eight (even parity) and the parity flag (P) is set to 1.

Auxiliary Carry Flag (AC): In arithmetic operations of numbers, if a carry is generated by bit D3 and passed on to D4, the auxiliary carry flag (AC) is set. Actually this flag is used for

internally Binary Coded Decimal (BCD) operations and this is not available for the programmer to change the sequence of operations through jump instructions.

Zeor Flag (Z): When an 8-bit ALU operation results in zero, the Zero (Z) flag is set; otherwise it is reset. This flag is affected by the results of the accumulator and general-purpose registers.

Sign Flag (S): The sign flag has its importance only when a signed arithmetic operation is performed. In arithmetic operations of signed numbers where the bit D7 is used to indicate a sign, this flag is set to indicate the sign of a number.

The most significant bit of an 8-bit data is the sign bit. When a number is negative, the sign bit is 1. If the number is positive, the sign bit is 0. For an 8-bit signed operation, the remaining 7 bits are used to represent the magnitude of a number. After execution of a signed arithmetic operation, the MSB of the result also represents its sign.

Program Status Word (PSW): In a flag register five bits (D7 D6 D4 D2 D0) indicate the five status flags and three bits D5 D3 and D1 are undefined. The combination of these 8 bits is known as Program Status Word (PSW). The PSW and the accumulator can be used as a 16-bit unit for stack operation.

Instruction Register (IR)

The instruction register holds the operation code (opcode) of the current instruction of a program during an arithmetic/logical operation. The instruction is fetched from the memory prior to execution. The decoder takes the instruction and decodes it. After that, the decoded instruction is passed to the next stage for execution.

Memory Address Register (MAR)

The Memory Address Register holds the address of the next program instruction. Then MAR feeds the address bus with addresses of the memory location of the program instruction which will be executed.

Temporary Register (TR)

This is an 8-bit register, which is associated with ALU. This register holds data during arithmetic and logical operation. This register can be used by the microprocessor but is not accessible to the programmer.