

Registers in CPU

Overview

A CPU register is a very small and very fast storage location inside the processor. It temporarily holds data, instructions, and addresses while a program is running. Registers are faster than RAM and help the CPU execute instructions efficiently.

Types of Registers (Input → Process → Output)

We can understand registers by their role in the data flow.

Category	Purpose
Input Registers	Receive data or instructions
Processing Registers	Perform operations and calculations
Output Registers	Store results before sending to memory

1. Input Registers

✓ Overview

Input registers bring data or instructions into the CPU for execution.

✓ Examples

Memory Address Register (MAR)

Instruction Register (IR)

✓ Technical Example

Statement

Fetch an instruction from memory and load it into CPU.

Code Example (Assembly)

```
MOV MAR, 2000H ; address of instruction  
LOAD IR, [MAR] ; instruction loaded
```

2. Processing Registers

✓ Overview

Processing registers perform calculations and logical operations.

✓ Examples

Accumulator (ACC)

General Purpose Registers (AX, BX, CX, DX)

Flag Register

✓ Technical Example

Statement

Add two numbers using CPU registers.

Code Example

```
MOV AX, 5  
MOV BX, 3  
ADD AX, BX ; AX = AX + BX
```

Result stored in AX = 8

3. Output Registers

✓ Overview

Output registers hold the final result before sending it to memory or output devices.

✓ Examples

Memory Data Register (MDR)

Output Buffer Register

✓ Technical Example

Statement

Store calculation result into memory.

Code Example

```
MOV MDR, AX  
STORE [3000H], MDR
```

Result written to memory location 3000H

Detailed List of Common CPU Registers

Register	Full Name	Category	Function
MAR	Memory Address Register	Input	Holds memory address
IR	Instruction Register	Input	Stores current instruction
ACC	Accumulator	Processing	Arithmetic operations
GPR	General Purpose Register	Processing	Temporary storage
FLAGS	Status Register	Processing	Condition flags
MDR	Memory Data Register	Output	Holds data to/from memory
PC	Program Counter	Control	Next instruction address

SP Stack Pointer Control Top of stack address

How Registers Work Together (Simple Flow)

PC gives address → MAR

Memory sends instruction → IR

CPU processes using ACC/GPR

Result stored → MDR

Written to memory/output