



# 8086 Flag Register

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# Lecture References:

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## ? **Book:**

? *Microprocessors and Interfacing: Programming and Hardware,*  
*Chapter # 2, **Author:** Douglas V. Hall*

# 8086 Flag Register

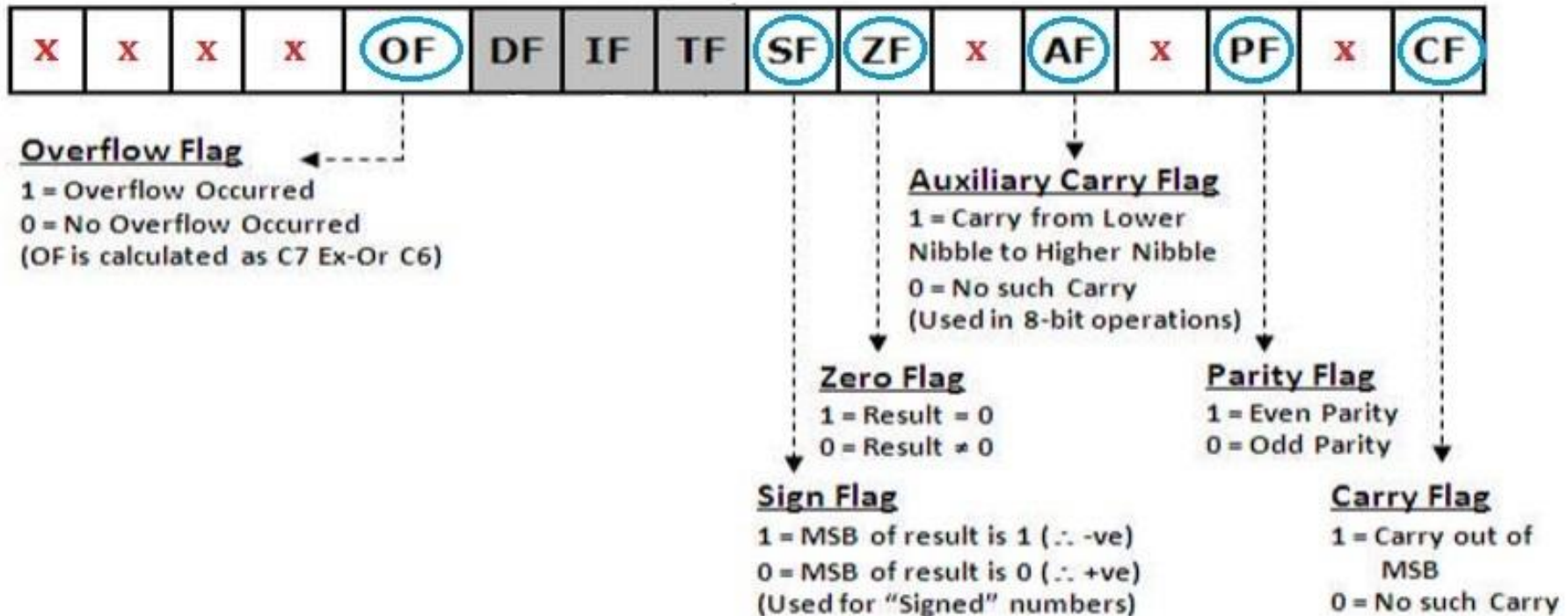
## ? 16-Bit register

- **7 bits are undefined/unused (marked by red x in the figure below)**
- **6 status/condition flags (marked by blue circles)**
- **3 control flags (those in grey boxes)**

- ? The condition flags are set (1) or reset (0) depending on the result of an arithmetic/logical operation.
- ? Control flags control the operations of the CPU



# Status Flags



Flags are useful in programming e.g. when writing conditions such as:

- If answer is zero, do ... else .... // zero flag comes in hand here
- If answer is less than zero, do ... else .... // sign flag can be used here

# Status Flags

- ? **Carry Flag (CF)** - is set to '1' when there is an unsigned overflow. E.g. when you add bytes  $255 + 1$  (result is not in range  $0 \dots 255$ ). When there is no overflow this flag is reset to 0.
- ? **Parity Flag (PF)** - set to '1' when there is even number of one bits in result, and reset to '0' when there is odd number of one bits.
- ? **Auxiliary Flag (AF)** - set to '1' when there is an unsigned overflow for low nibble (4 bits).

# Status Flags

- ? **Zero Flag (ZF)** - set to '1' when result is zero. For non-zero result this flag is reset to '0'.
- ? **Sign Flag (SF)** - set to '1' when result is negative. When result is positive it is reset to '0'. (This flag takes the value of the most significant bit).
- ? **Overflow Flag (OF)** - set to '1' when there is a signed overflow. For example, when you add bytes  $100 + 50$ .

# Status Flags

NB:

OF is set to 1 if there is a carry from:

- the 7<sup>th</sup> bit to the 8<sup>th</sup> bit ONLY or
- from the 8<sup>th</sup> bit to the 9<sup>th</sup> bit ONLY

If there is a carry from the 7<sup>th</sup> bit to the 8<sup>th</sup> bit and from the 8<sup>th</sup> bit to the 9<sup>th</sup> bit at THE SAME TIME then OF = 0

OF=1

Set because there is a carry from the 7<sup>th</sup> bit to the 8<sup>th</sup> bit ONLY

AF=0

Reset because there is NO carry from the lower nibble to the upper nibble

MOV AL, 50h ( 0 1 0 1 0 0 0 0 )

MOV BL, 32h ( 0 0 1 1 0 0 1 0 )

ADD AL, BL ( 1 0 0 0 0 0 1 0 )

CF=0

Reset because the answer has NO carry

SF=1

Set because the MSB is 1 indicating a negative answer

ZF=0

Reset because the answer is NOT zero

PF=1

Set because the answer has an EVEN number of 1s

# Status Flags

NB:

OF is reset to 0 if:

- there is a carry from the the 7<sup>th</sup> bit to the 8<sup>th</sup> bit and from the 8<sup>th</sup> bit to the 9<sup>th</sup> bit at THE SAME TIME or
- there is NO carry from the the 7<sup>th</sup> bit to the 8<sup>th</sup> bit and from the 8<sup>th</sup> bit to the 9<sup>th</sup> bit at THE SAME TIME

OF=0

Reset because there is a carry from the 7<sup>th</sup> bit to the 8<sup>th</sup> bit and from the 8<sup>th</sup> bit to the 9<sup>th</sup> bit at THE SAME TIME

Carry

1 1 1 1 1 1 1 1

AF=1

Set because there IS a carry from the lower nibble to the upper nibble

□ MOV AL, FFh

1 1 1 1 1 1 1 1

□ MOV BL, 01h

0 0 0 0 0 0 0 1

□ ADD AL, BL

1 0 0 0 0 0 0 0

CF=1

Set because the answer has a carry

SF=0

Reset because the MSB is 0 indicating a positive answer

ZF=1

Set because the answer IS zero

PF=1

Set because the answer has an EVEN number of 1s



# Control Flags:



**Direction Flag** ←  
1 = Auto Decrement  
0 = Auto Increment  
(Used in String Instructions)

**Interrupt Flag** ←  
1 = Enable Interrupt  
0 = Disable Interrupt  
(Affects Only INTR)

**Trap Flag**  
1 = Perform Single Stepping  
0 = Do Not Perform Single Stepping

# Control Flags:

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- ? **Trap Flag (TF)** - Used for on-chip single-step debugging.
- ? **Interrupt enable Flag (IF)** - when this flag is set to '1' CPU reacts to interrupts from external devices.
- ? **Direction Flag (DF)** - this flag is used by some instructions to process data chains, when this flag is set to '0' - the processing is done forward, when this flag is set to '1' the processing is done backward.

# Quiz: Status Flag Values?

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- MOV AX, ABCDh
- MOV BX, 9876h
- ADD AX, BX

# Thank You !!

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