



8086 Flag Register

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Lecture References:

? Book:

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

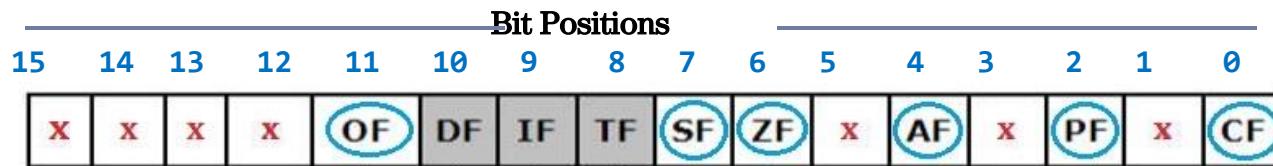
8086 Flag Register

? 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



Overflow Flag

1 = Overflow Occurred

0 = No Overflow Occurred

(OF is calculated as C7 Ex-Or C6)

Auxiliary Carry Flag

1 = Carry from Lower Nibble to Higher Nibble

0 = No such Carry
(Used in 8-bit operations)

Zero Flag

1 = Result = 0

0 = Result ≠ 0

Parity Flag

1 = Even Parity

0 = Odd Parity

Sign Flag

1 = MSB of result is 1 (∴ -ve)

0 = MSB of result is 0 (∴ +ve)
(Used for "Signed" numbers)

Carry Flag

1 = Carry out of MSB

0 = No such Carry

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 $0...255$). 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 7th bit to the 8th bit ONLY or
- from the 8th bit to the 9th bit ONLY

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

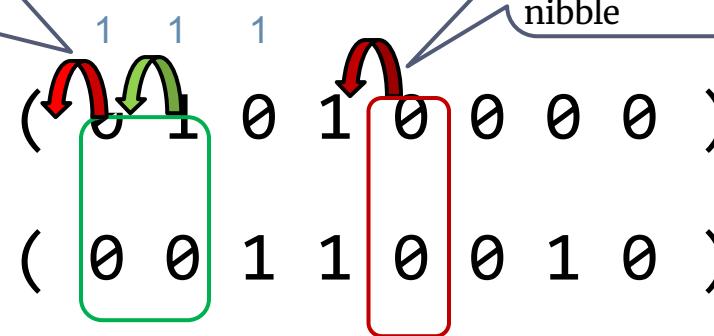
OF=1

Set because there is a carry from the 7th bit to the 8th bit ONLY

AF=0

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

MOV AL, 50h



MOV BL, 32h

ADD AL, BL



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:

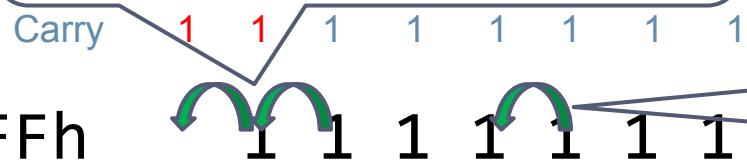
OF is reset to 0 if:

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

OF=0

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

□ MOV AL, FFh



AF=1

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

□ 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:

- ? **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?

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

Thank You !!

