**8051 Microcontroller Arithmetic Operations**

**PSW(Program Status Word)**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **C** | **AC** | **F0** | **RS1** | **RS0** | **OV** | **-** | **P** |

**Carry Flag(C):**

* **When two 8-bit integers are added if there is a carry from bit-7 then carry flag is set.**

**Auxiliary Carry Flag (AC):**

* **When two 8-bit integers are added if there is a carry from bit 3 to bit 4 (or lower nibble to higher nibble) then auxiliary carry flag is set.**

**Over Flow (OV):**

1. **When two 8-bit integers are added if there is a carry from bit-6 to bit-7 and no carry from bit-7 then overflow flag is set.(OV = 1, C= 0)**
2. **If there is a carry from bit-6 to bit-7 and after bit-7 also there is a carry then(OV = 0, C=1)**
3. Bit-6 to bit-7 no carry, after bit-7 there is a carry, then (OV = 1, C = 1)

Ex:1 7 6 5 4 3 2 1 0 (bits)

FFH 1 1 1 1 1 1 1 (carry)

+ FFH 1 1 1 1 1 1 1 1

01 FEH 1 1 1 1 1 1 1 1

Carry 1 1 1 1 1 1 1 1 0 C=1,AC=1,OV=0,P=1

Ex:2 7 6 5 4 3 2 1 0 (bits)

7FH + 1 1 1 1 1 1 1 (carry)

7FH 0 1 1 1 1 1 1 1 +

FEH 0 1 1 1 1 1 1 1

1 1 1 1 1 1 1 0 C=0,AC=1,OV=1,P=1

Ex:3 7 6 5 4 3 2 1 0 (bits)

BFH + 0 1 1 1 1 1 1 (carry)

9FH 1 0 1 1 1 1 1 1 +

01 5EH 1 0 0 1 1 1 1 1

Carry 1 0 1 0 1 1 1 1 0 C=1,AC=1,OV=1,P=1

Multiplication and Division

* Multiplication and division are the largest instructions in 8051
* Which needs 4 machine cycles each to execute.

1)MUL AB :

* In mul 8-bit integer in A is multiplied with 8-bit integer in B and stores the result in A.
* If the result is more than 8-bit then lower byte is stored in A register and higher byte in B register.
* Carry, overflow, parity flags are effected.
* Carry is always clear (after executing mul instruction carry flag is zero).
* In mul instruction if the result is more than 8-bit then overflow flag is set.
* Parity depends on Accumulator.

2)DIV AB:

* The 8-bit integer in A is divided by 8-bit integer

in B.

* After division Reminder is stored in B register

Quotient is stored in A.

* (C, OV,P) flags are effected.
* Carry flag always clear
* Overflow is set to indicate divide-by-zero error
* Parity flag depends on accumulator

3)DA (Decimal Adjust):

* If the lower nibble of A is > 9 (or) (AC== 1) then it will add 06 to the Accumulator to get the BCD digit.
* If the higher nibble of A is >9 (or) (C == 1) then it will add 60H to the Accumulator.
* C and P flags are affected.