

8086 Arithmetic Instructions

| Type | Instruction | Example | Meaning | Flags Affected | | | | | |
|-------------|-------------|------------|-------------------|----------------|--------|--------|--------|--------|--------|
| | | | | O F | S F | Z F | A F | P F | C F |
| Addition | ADD | ADD AX,7BH | AX ? AX + 7B | * | * | * | * | * | * |
| | ADC | ADC AX,7BH | AX ? AX + 7B +CF | * | * | * | * | * | * |
| | INC | INC [BX] | [BX]? [BX]+1 | * | * | * | * | * | - |
| | DAA | DAA | | ? | * | * | * | * | * |
| Subtraction | SUB | SUB CL,AH | CL ? CL - AH | * | * | * | * | * | * |
| | SBB | SBB CL,AH | CL ? CL - AH - CF | * | * | * | * | * | * |
| | DEC | DEC DAT | [DAT]? [DAT] - 1 | * | * | * | * | * | - |
| | DAS | DAS | | ? | * | * | * | * | * |
| | NEG | NEG CX | CX ? 0 - CX | * | * | * | * | * | * |

Note: * flag affected and may be predicted, ? flag affected but may not be predicted, - flag unaffected by instruction.

Table 9.1: Add and Subtract Instructions

Decimal Adjust: (DAA and DAS)

The DAA instruction allows addition of numbers represented in 8bit packed BCD code. It is used immediately after normal addition instruction operating on BCD codes. This instruction assumes the AL register as the source and the destination, and hence it requires no operand. The effect of DAS (Decimal Adjust after Subtraction) instruction is similar to that of DAA, except the fact that it is used after performing a subtraction.

| Type | Instruction | Example | Meaning | Flags Affected | | | | | |
|----------------|-------------|------------------------------------|--|----------------|--------|--------|--------|--------|--------|
| | | | | O F | S F | Z F | A F | P F | C F |
| Multiplication | MUL | MUL CL MUL CX | AX ? AL * CL (DX,AX) ? AX * CX | * | ? | ? | ? | ? | * |
| | IMUL | IMUL BYTE PTR X IMUL WORD PTR X | AX ? AL * [X] (DX,AX) ? AX * [X] | * | ? | ? | ? | ? | * |
| Division | DIV | DIV WORD PTR X | AX ? Q((DX,AX)/[X]) DX ? R((DX,AX)/[X]) | ? | ? | ? | ? | ? | ? |
| | IDIV | IDIV BH | AL ? Q(AX/BH) AH ? R(AX/BH) | ? | ? | ? | ? | ? | ? |

Table 9.2: Multiply and Divide Instructions

After MUL: CF/OF = 0 if upper half of result is zero and 1 otherwise

After IMUL: CF/OF = 0 if upper half of result is the sign extension of the lower half and 1 otherwise

After DIV/IDIV: A divide overflow occurs if the quotient is too big to fit in the specified destination. This happens when the divisor is much smaller than the dividend.

| Sign Extension | Instruction | Example | Meaning | O F | S F | Z F | A F | P F | C F |
|----------------|-------------|---------|--------------|--------|--------|--------|--------|--------|--------|
| | CBW | CBW | AH ? MSB(AL) | - | - | - | - | - | - |
| | CWD | CWD | DX ? MSB(AX) | - | - | - | - | - | - |

Table 9.3: Sign Extension Instructions

CBW and CWD are used to facilitate division of 8 and 16 bit signed numbers. Since division requires a double-width dividend, CBW converts an 8-bit signed number (in AL), to a word, where the MSB of AL register is copied to AH register. Similarly, CWD converts a 16-bit signed number to a 32-bit signed number. The MSB of AX is copied into DX and the resulting double word will be: (DX, AX).