# TERMS USED IN COMPARISON

## 4.2 Terms used in comparison

Above and Below used for comparing Unsigned numbers. Greater than and less than used when comparing signed numbers. All Intel microprocessors use this convention.

Accordingly, all the following statements are true.

| | |
|---|---|
| 95H is above 65H | Unsigned comparison - True |
| 95H is less than 65H | Signed comparison – True (as 95H is negative, 65H is positive) |
| 65H is below 95H | Unsigned comparison - True |
| 65H is greater than 95H | Signed comparison - True |

### 4.2.1 Jump based on multiple flags

Conditional Jumps based on multiple flags are used after a CMP (compare) instruction.

JBE / JNA instruction

'Jump if Below or Equal' or 'Jump if Not Above'

| *Jump if* | *No Jump if* | *Ex.* |
|---|---|---|
| Cy = 1 OR Z= 1 | Cy = 0 AND Z = 0 | CMP BX, CX |
| Below OR Equal | Surely Above | JBE BX_BE |

### 4.2.2 BX_BE (BX is Below or Equal) is a symbolic location

### 4.2.3 JNBE / JA instruction

'Jump if Not (Below or Equal)' or 'Jump if Above'

| *Jump if* | *No Jump if* | *Ex.* |
|---|---|---|
| Cy = 0 AND Z= 0 | Cy = 1 OR Z = 1 | CMP BX, CX |
| Surely Above | Below OR Equal | JBE BX_BE |

### 4.2.4 JLE / JNG instruction

'Jump if Less than OR Equal' or 'Jump if Not Greater than'

| *Jump if* | *No Jump if* |
|---|---|
| [(S=1 AND V=0) OR (S=0 AND V=0)] OR Z=1 | [(S=0 AND V=0) OR (S=1 AND V=1)] AND Z=0 |
| [(surely negative) or (wrong answer positive!)] or Equal | [(surely positive) or (wrong answer negative!)] and not equal |
| i.e. [S XOR V=1] OR Z=1 | i.e.[S XOR V=0] AND Z=0 |

| JNLE / JG instruction | |
|---|---|
| 'Jump if Not (Less than OR Equal)' or 'Jump if Greater than' | |
| Jump if | *No Jump if* |
| [(S=0 AND V=0) OR (S=1 AND V=1)] AND Z=0 | [(S=1 AND V=0) OR (S=0 AND V=1)] OR Z=1 |
| [(surely positive) or (wrong answer negative!)] and not equal | [(surely negative) or (wrong answer positive!)] or equal |
| | |
| i.e. S XOR V=0 AND Z=0 | i.e.S XOR V=1 OR Z=1 |

### 4.2.4 JL / JNGE instruction

'Jump if Less than' or 'Jump if NOT (Greater than or Equal)'

| *Jump if* | *No Jump if* |
|---|---|
| [S=1 AND V=0] OR [S=0 AND V=1] | [S=0 AND V=0] OR [S=1 AND V=1] |
| (surely negative)or (wrong answer positive!) | (surely positive) or (wrong answer negative!) |
| i.e. S XOR V=1 | i.e.S XOR V=0 |

Note: When S=1, result cannot be 0

## **4.2.5** JNL / JGE instruction

'Jump if Not Less than' or 'Jump if Greater than OR Equal'

| *Jump if* | *No Jump if* |
|---|---|
| [S=0 AND V=0] OR (S=1 AND V=1) | [S=1 AND V=0] OR (S=1 AND V=1) |
| (surely positive) or (wrong answer negative!) | (surely negative) or (wrong answer positive!) |
| i.e. S XOR V=0 | i.e. S XOR V=1 |

Note: When S=0, result can be >= 0

Unconditional Jump instruction

Unconditional Jump Instruction

↓ ↓

Near Jump or Intra segment Jump (Jump within the segment)

Far Jump or Inter segment Jump (Jump to a different segment)

Near Unconditional Jump instruction

Near Jump

↙ ↘

Direct Jump (common)

Indirect Jump (uncommon)

2-bytes Short Jump (EB r8) 3-bytes Long Jump (E9 r16) 2 or more bytes

Range: $\pm 2^7$ Range: $\pm 2^{15}$ Starting with FFH

Range: complete segment

Three Near Jump and two Far Jump instructions have the same mnemonic JMP, but they have different opcodes

### 4.2.5 Short Jump Instruction

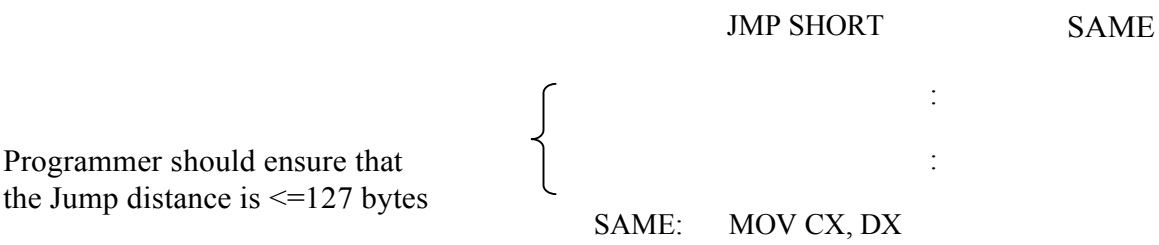
2 byte (EB r8) instruction with Range: -128 to +127 bytes

*For Backward jump:* Assembler knows the quantum of jump. Generates Short Jump code if <=128 bytes is the required jump. Generates code for Long Jump if >128 bytes is the required jump.

*For Forward jump:* Assembler doesn't know jump quantum in pass 1. Assembler reserves 3 bytes for the forward jump instruction. If jump distance turns out to be >128 bytes, the instruction is coded as E9 r16 (E9H = Long jump code). If jump distance becomes <=128 bytes, the instruction is coded as EB r8 followed by code for NOP (E8H = Short jump code).

## 4.2.5 SHORT Assembler Directive

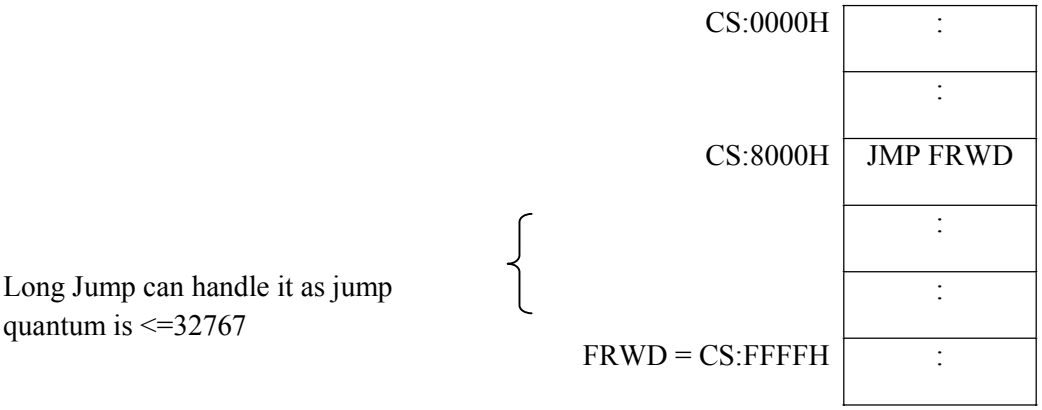
Assembler generates only 2 byte Short Jump code for forward jump, if the SHORT assembler directive is used.



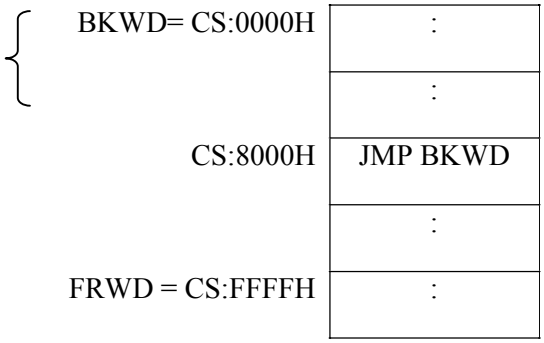

Long Jump instruction

3-byte (E9 r16) instruction with Range: -32768 to +32767 bytes

Long Jump can cover entire 64K bytes of Code segment



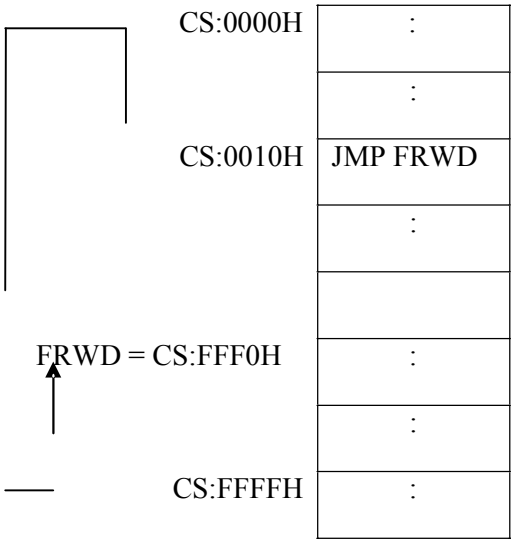
Long Jump can handle it as jump quantum is <=32767




## 4.2.6 Long Jump or Short Jump?

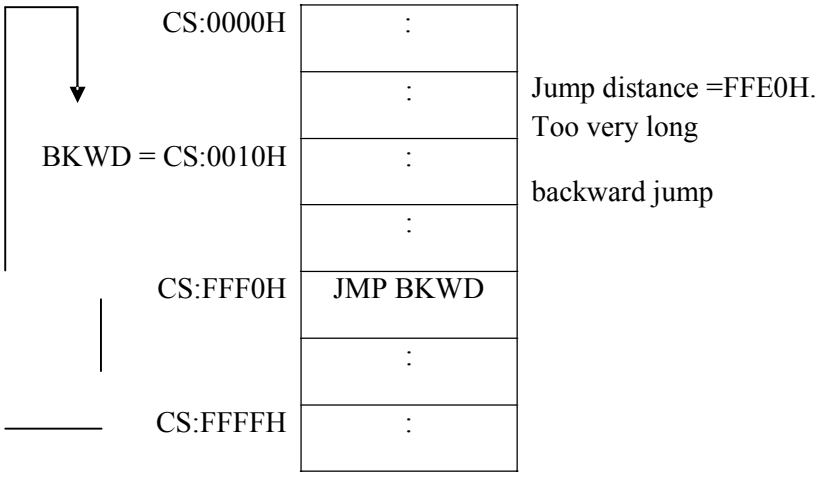
Can be treated as a small (20H) Backward

Branch!




Can be treated as a small (20H)

Forward Branch!



## 4.2.7 Intra segment indirect Jump

It is also called Near Indirect Jump. It is not commonly used.

Instruction length: 2 or more bytes  Range: complete segment

Ex.1:  JMP DX

If DX = 1234H, branches to CS:1234H. 1234H is not signed relative displacement.

Ex. 2: JMP wordptr 2000H[BX]


Far Jump instruction

### 4.2.8 Far Jump

| Direct Jump (common) | Indirect Jump (uncommon) |
|---|---|
| 5 bytes, opcode EA, 2 byte offset, 2 byte segment value | 2 or more bytes, starting with opcode FFH |
| Range: anywhere in memory | Range: anywhere in memory |

As stated earlier, three Near Jump and two Far Jump instructions have the same mnemonic JMP but different opcodes.

### 4.2.9 Inter segment Direct Jump instruction

Also called Far Direct Jump. It is the common inter segment jump scheme

It is a 5 byte instruction. 1 byte opcode (EAH), 2 byte offset value, 2 byte segment value

Ex. JMP Far ptr LOC

### 4.2.10 Inter segment Indirect Jump instruction

Also called Far Indirect Jump. It is not commonly used. Instruction length depends on the way jump location is specified. It can be a minimum of 2 bytes.

Ex. JMP DWORD PTR 2000H[BX]

If BX contents is 1234H branch takes place to location ABCDH:5678H. It is a 4-byte instruction.

| | |
|---|---|
| DS:3234H | 5678H |
| DS:3236H | ABCDH |

Iteration Instructions

Iteration instructions provide a convenient way to implement loops in a program