

Complete 8086 instruction set

Quick reference:

AAA	CMPSB	JAE	JNBE	JPO	MOV	RCR	SCASB
AAD	CMPSW	JB	JNC	JS	MOVSB	REP	SCASW
AAM	CWD	JBE	JNE	JZ	MOVSW	REPE	SHL
AAS	DAA	JC	JNG	LAHF	MUL	REPNE	SHR
ADC	DAS	JCXZ	JNGE	LDS	NEG	REPNZ	STC
ADD	DEC	JE	JNLE	LEA	NOP	REPZ	STD
AND	DIV	JG	JNLE	LEA	NOT	RET	STI
CALL	HLT	JGE	JNO	LODSB	OR	RETF	STOSB
CBW	IDIV	JL	JNP	LODSW	OUT	ROL	STOSW
CLC	IMUL	JLE	JNS	LOOP	POP	ROR	SUB
CLD	IN	JL	JNZ	LOOP	POPA	ROR	SUB
CLI	INC	JMP	JNZ	LOOPE	POPF	SAHF	TEST
CMC	INT	JNA	JO	LOOPNE	PUSH	SAL	XCHG
CMP	INTO	JNAE	JP	LOOPNZ	PUSHA	SAR	XLATB
	IRET	JNB	JPE	LOOPZ	PUSHF	SBB	XOR
	JA				RCL		

Operand types:

REG: AX, BX, CX, DX, AH, AL, BL, BH, CH, CL, DH, DL, DI, SI, BP, SP.

SREG: DS, ES, SS, and only as second operand: CS.

memory: [BX], [BX+SI+7], variable, etc...(see [Memory Access](#)).

immediate: 5, -24, 3Fh, 10001101b, etc...

Notes:

- When two operands are required for an instruction they are separated by comma. For example:

REG, memory

- When there are two operands, both operands must have the same size (except shift and rotate instructions). For example:

AL, DL

DX, AX

m1 DB ?

AL, m1

m2 DW ?

AX, m2

- Some instructions allow several operand combinations. For example:

memory, immediate

REG, immediate

memory, REG

REG, SREG

- Some examples contain macros, so it is advisable to use **Shift + F8** hot key to *Step Over* (to make macro code execute at maximum speed set **step delay** to zero), otherwise emulator will step through each instruction of a macro. Here is an example that uses PRINTN macro:

```
include 'emu8086.inc'
ORG 100h
MOV AL, 1
MOV BL, 2
PRINTN 'Hello World!' ; macro.
MOV CL, 3
PRINTN 'Welcome!' ; macro.
RET
```



These marks are used to show the state of the flags:



- 1** - instruction sets this flag to **1**.
- 0** - instruction sets this flag to **0**.
- r** - flag value depends on result of the instruction.
- ?** - flag value is undefined (maybe **1** or **0**).




Some instructions generate exactly the same machine code, so disassembler may have a problem decoding to your original code. This is especially important for Conditional Jump instructions (see "[Program Flow Control](#)" in Tutorials for more information).



Instructions in alphabetical order:









Instruction	Operands	Description
		<p>ASCII Adjust after Addition. Corrects result in AH and AL after addition when working with BCD values.</p> <p>It works according to the following Algorithm:</p> <p>if low nibble of AL > 9 or AF = 1 then:</p>



AAA	No operands	<ul style="list-style-type: none"> • $AL = AL + 6$ • $AH = AH + 1$ • $AF = 1$ • $CF = 1$ <p>else</p> <ul style="list-style-type: none"> • $AF = 0$ • $CF = 0$ <p>in both cases: clear the high nibble of AL.</p> <p>Example:</p> <pre>MOV AX, 15 ; AH = 00, AL = 0Fh AAA ; AH = 01, AL = 05 RET</pre> <table border="1" data-bbox="689 801 880 902"> <tr> <td>C</td><td>Z</td><td>S</td><td>O</td><td>P</td><td>A</td> </tr> <tr> <td>r</td><td>?</td><td>?</td><td>?</td><td>?</td><td>r</td> </tr> </table> 	C	Z	S	O	P	A	r	?	?	?	?	r
C	Z	S	O	P	A									
r	?	?	?	?	r									
AAD	No operands	<p>ASCII Adjust before Division. Prepares two BCD values for division.</p> <p>Algorithm:</p> <ul style="list-style-type: none"> • $AL = (AH * 10) + AL$ • $AH = 0$ <p>Example:</p> <pre>MOV AX, 0105h ; AH = 01, AL = 05 AAD ; AH = 00, AL = 0Fh (15) RET</pre> <table border="1" data-bbox="689 1570 880 1671"> <tr> <td>C</td><td>Z</td><td>S</td><td>O</td><td>P</td><td>A</td> </tr> <tr> <td>?</td><td>r</td><td>r</td><td>?</td><td>r</td><td>?</td> </tr> </table> 	C	Z	S	O	P	A	?	r	r	?	r	?
C	Z	S	O	P	A									
?	r	r	?	r	?									
		<p>ASCII Adjust after Multiplication. Corrects the result of multiplication of two BCD values.</p> <p>Algorithm:</p> <ul style="list-style-type: none"> • $AH = AL / 10$ • $AL = \text{remainder}$ 												

AAM	No operands	<p>Example:</p> <pre>MOV AL, 15 ; AL = 0Fh AAM ; AH = 01, AL = 05 RET</pre> <table border="1" data-bbox="689 338 880 439"> <tr> <td>C</td><td>Z</td><td>S</td><td>O</td><td>P</td><td>A</td> </tr> <tr> <td>?</td><td>r</td><td>r</td><td>?</td><td>r</td><td>?</td> </tr> </table> 	C	Z	S	O	P	A	?	r	r	?	r	?
C	Z	S	O	P	A									
?	r	r	?	r	?									
AAS	No operands	<p>ASCII Adjust after Subtraction. Corrects result in AH and AL after subtraction when working with BCD values.</p> <p>Algorithm:</p> <p>if low nibble of AL > 9 or AF = 1 then:</p> <ul style="list-style-type: none"> • AL = AL - 6 • AH = AH - 1 • AF = 1 • CF = 1 <p>else</p> <ul style="list-style-type: none"> • AF = 0 • CF = 0 <p>in both cases: clear the high nibble of AL.</p> <p>Example:</p> <pre>MOV AX, 02FFh ; AH = 02, AL = 0FFh AAS ; AH = 01, AL = 09 RET</pre> <table border="1" data-bbox="689 1563 880 1664"> <tr> <td>C</td><td>Z</td><td>S</td><td>O</td><td>P</td><td>A</td> </tr> <tr> <td>r</td><td>?</td><td>?</td><td>?</td><td>?</td><td>r</td> </tr> </table> 	C	Z	S	O	P	A	r	?	?	?	?	r
C	Z	S	O	P	A									
r	?	?	?	?	r									
ADC	REG, memory memory, REG REG, REG	<p>Add with Carry.</p> <p>Algorithm:</p> <p>operand1 = operand1 + operand2 + CF</p> <p>Example:</p>												

	<pre>memory, immediate REG, immediate</pre>	<pre>STC ; set CF = 1 MOV AL, 5 ; AL = 5 ADC AL, 1 ; AL = 7 RET</pre> <table border="1" data-bbox="691 255 880 356"> <tr><td>C</td><td>Z</td><td>S</td><td>O</td><td>P</td><td>A</td></tr> <tr><td>r</td><td>r</td><td>r</td><td>r</td><td>r</td><td>r</td></tr> </table> 	C	Z	S	O	P	A	r	r	r	r	r	r
C	Z	S	O	P	A									
r	r	r	r	r	r									
ADD	<pre>REG, memory memory, REG REG, REG memory, immediate REG, immediate</pre>	<p>Add.</p> <p>Algorithm:</p> <pre>operand1 = operand1 + operand2</pre> <p>Example:</p> <pre>MOV AL, 5 ; AL = 5 ADD AL, -3 ; AL = 2 RET</pre> <table border="1" data-bbox="691 943 880 1043"> <tr><td>C</td><td>Z</td><td>S</td><td>O</td><td>P</td><td>A</td></tr> <tr><td>r</td><td>r</td><td>r</td><td>r</td><td>r</td><td>r</td></tr> </table> 	C	Z	S	O	P	A	r	r	r	r	r	r
C	Z	S	O	P	A									
r	r	r	r	r	r									
AND	<pre>REG, memory memory, REG REG, REG memory, immediate REG, immediate</pre>	<p>Logical AND between all bits of two operands. Result is stored in operand1.</p> <p>These rules apply:</p> <pre>1 AND 1 = 1 1 AND 0 = 0 0 AND 1 = 0 0 AND 0 = 0</pre> <p>Example:</p> <pre>MOV AL, 'a' ; AL = 01100001b AND AL, 11011111b ; AL = 01000001b ('A') RET</pre> <table border="1" data-bbox="691 1771 850 1872"> <tr><td>C</td><td>Z</td><td>S</td><td>O</td><td>P</td></tr> <tr><td>0</td><td>r</td><td>r</td><td>0</td><td>r</td></tr> </table> 	C	Z	S	O	P	0	r	r	0	r		
C	Z	S	O	P										
0	r	r	0	r										
		<p>Transfers control to procedure, return address is (IP) is pushed to stack. <i>4-byte address</i> may be entered in this form: 1234h:5678h, first value is a</p>												

CALL	procedure name label 4-byte address	<p>segment second value is an offset (this is a far call, so CS is also pushed to stack).</p> <p>Example:</p> <pre> ORG 100h ; for COM file. CALL p1 ADD AX, 1 RET ; return to OS. p1 PROC ; procedure declaration. MOV AX, 1234h RET ; return to caller. p1 ENDP </pre> <div data-bbox="689 750 880 851" style="border: 1px solid black; padding: 2px; display: inline-block;"> <table border="1" style="border-collapse: collapse;"> <tr> <td style="padding: 2px;">C</td> <td style="padding: 2px;">Z</td> <td style="padding: 2px;">S</td> <td style="padding: 2px;">O</td> <td style="padding: 2px;">P</td> <td style="padding: 2px;">A</td> </tr> <tr> <td colspan="6" style="padding: 2px;">unchanged</td> </tr> </table> </div> <div data-bbox="1407 855 1484 922" style="text-align: right;">  </div>	C	Z	S	O	P	A	unchanged					
C	Z	S	O	P	A									
unchanged														
CBW	No operands	<p>Convert byte into word.</p> <p>Algorithm:</p> <p>if high bit of AL = 1 then:</p> <ul style="list-style-type: none"> • AH = 255 (0FFh) <p>else</p> <ul style="list-style-type: none"> • AH = 0 <p>Example:</p> <pre> MOV AX, 0 ; AH = 0, AL = 0 MOV AL, -5 ; AX = 000FBh (251) CBW ; AX = 0FFFBh (-5) RET </pre> <div data-bbox="689 1724 880 1825" style="border: 1px solid black; padding: 2px; display: inline-block;"> <table border="1" style="border-collapse: collapse;"> <tr> <td style="padding: 2px;">C</td> <td style="padding: 2px;">Z</td> <td style="padding: 2px;">S</td> <td style="padding: 2px;">O</td> <td style="padding: 2px;">P</td> <td style="padding: 2px;">A</td> </tr> <tr> <td colspan="6" style="padding: 2px;">unchanged</td> </tr> </table> </div> <div data-bbox="1407 1830 1484 1897" style="text-align: right;">  </div>	C	Z	S	O	P	A	unchanged					
C	Z	S	O	P	A									
unchanged														
		<p>Clear Carry flag.</p> <p>Algorithm:</p> <p>CF = 0</p>												

CLC	No operands	 
CLD	No operands	<p>Clear Direction flag. SI and DI will be incremented by chain instructions: CMPSB, CMPSW, LODSB, LODSW, MOVSB, MOVSW, STOSB, STOSW.</p> <p>Algorithm:</p> $DF = 0$  
CLI	No operands	<p>Clear Interrupt enable flag. This disables hardware interrupts.</p> <p>Algorithm:</p> $IF = 0$  
CMC	No operands	<p>Complement Carry flag. Inverts value of CF.</p> <p>Algorithm:</p> <pre>if CF = 1 then CF = 0 if CF = 0 then CF = 1</pre>  
		<p>Compare.</p> <p>Algorithm:</p> $\text{operand1} - \text{operand2}$

<p>CMP</p>	<p>REG, memory memory, REG REG, REG memory, immediate REG, immediate</p>	<p>result is not stored anywhere, flags are set (OF, SF, ZF, AF, PF, CF) according to result.</p> <p>Example:</p> <pre>MOV AL, 5 MOV BL, 5 CMP AL, BL ; AL = 5, ZF = 1 (so equal!) RET</pre> <table border="1" data-bbox="691 477 880 577"> <tr> <td>C</td><td>Z</td><td>S</td><td>O</td><td>P</td><td>A</td> </tr> <tr> <td>r</td><td>r</td><td>r</td><td>r</td><td>r</td><td>r</td> </tr> </table> 	C	Z	S	O	P	A	r	r	r	r	r	r
C	Z	S	O	P	A									
r	r	r	r	r	r									
<p>CMPSB</p>	<p>No operands</p>	<p>Compare bytes: ES:[DI] from DS:[SI].</p> <p>Algorithm:</p> <ul style="list-style-type: none"> • DS:[SI] - ES:[DI] • set flags according to result: OF, SF, ZF, AF, PF, CF • if DF = 0 then <ul style="list-style-type: none"> ◦ SI = SI + 1 ◦ DI = DI + 1 else <ul style="list-style-type: none"> ◦ SI = SI - 1 ◦ DI = DI - 1 <p>Example: open cmplib.asm from c:\emu8086\examples</p> <table border="1" data-bbox="691 1355 880 1456"> <tr> <td>C</td><td>Z</td><td>S</td><td>O</td><td>P</td><td>A</td> </tr> <tr> <td>r</td><td>r</td><td>r</td><td>r</td><td>r</td><td>r</td> </tr> </table> 	C	Z	S	O	P	A	r	r	r	r	r	r
C	Z	S	O	P	A									
r	r	r	r	r	r									
<p>CMPSW</p>	<p>No operands</p>	<p>Compare words: ES:[DI] from DS:[SI].</p> <p>Algorithm:</p> <ul style="list-style-type: none"> • DS:[SI] - ES:[DI] • set flags according to result: OF, SF, ZF, AF, PF, CF • if DF = 0 then <ul style="list-style-type: none"> ◦ SI = SI + 2 ◦ DI = DI + 2 else <ul style="list-style-type: none"> ◦ SI = SI - 2 ◦ DI = DI - 2 												

example:
open **cmpsw.asm** from c:\emu8086\examples

C	Z	S	O	P	A
r	r	r	r	r	r



Convert Word to Double word.

Algorithm:

if high bit of AX = 1 then:

- DX = 65535 (0FFFFh)

else

- DX = 0

Example:

```
MOV DX, 0 ; DX = 0
MOV AX, 0 ; AX = 0
MOV AX, -5 ; DX AX = 0000h:0FFFFh
CWD ; DX AX = 0FFFFh:0FFFFh
RET
```

C	Z	S	O	P	A
unchanged					



Decimal adjust After Addition.
Corrects the result of addition of two packed BCD values.

Algorithm:

if low nibble of AL > 9 or AF = 1 then:

- AL = AL + 6
- AF = 1

if AL > 9Fh or CF = 1 then:

- AL = AL + 60h
- CF = 1

Example:

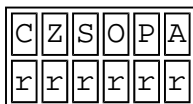
CWD

No operands

DAA

No operands

```
MOV AL, 0Fh ; AL = 0Fh (15)
DAA          ; AL = 15h
RET
```



DAS

No operands

Decimal adjust After Subtraction.
Corrects the result of subtraction of two packed BCD values.

Algorithm:

if low nibble of AL > 9 or AF = 1 then:

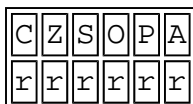
- AL = AL - 6
- AF = 1

if AL > 9Fh or CF = 1 then:

- AL = AL - 60h
- CF = 1

Example:

```
MOV AL, 0FFh ; AL = 0FFh (-1)
DAS          ; AL = 99h, CF = 1
RET
```



DEC

REG
memory

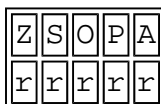
Decrement.

Algorithm:

operand = operand - 1



Example:




```
MOV AL, 255 ; AL = 0FFh (255 or -1)
DEC AL      ; AL = 0FEh (254 or -2)
RET
```








CF - unchanged!








DIV	REG memory	<p>Unsigned divide.</p> <p>Algorithm:</p> <p>when operand is a byte: $AL = AX / \text{operand}$ $AH = \text{remainder (modulus)}$</p> <p>when operand is a word: $AX = (DX\ AX) / \text{operand}$ $DX = \text{remainder (modulus)}$</p> <p>Example:</p> <pre>MOV AX, 203 ; AX = 00CBh MOV BL, 4 DIV BL ; AL = 50 (32h), AH = 3 RET</pre> <table border="1" data-bbox="691 779 882 880"> <tr><td>C</td><td>Z</td><td>S</td><td>O</td><td>P</td><td>A</td></tr> <tr><td>?</td><td>?</td><td>?</td><td>?</td><td>?</td><td>?</td></tr> </table> 	C	Z	S	O	P	A	?	?	?	?	?	?
C	Z	S	O	P	A									
?	?	?	?	?	?									
HLT	No operands	<p>Halt the System.</p> <p>Example:</p> <pre>MOV AX, 5 HLT</pre> <table border="1" data-bbox="691 1245 882 1346"> <tr><td>C</td><td>Z</td><td>S</td><td>O</td><td>P</td><td>A</td></tr> <tr><td colspan="6">unchanged</td></tr> </table> 	C	Z	S	O	P	A	unchanged					
C	Z	S	O	P	A									
unchanged														
IDIV	REG memory	<p>Signed divide.</p> <p>Algorithm:</p> <p>when operand is a byte: $AL = AX / \text{operand}$ $AH = \text{remainder (modulus)}$</p> <p>when operand is a word: $AX = (DX\ AX) / \text{operand}$ $DX = \text{remainder (modulus)}$</p> <p>Example:</p> <pre>MOV AX, -203 ; AX = 0FF35h MOV BL, 4 IDIV BL ; AL = -50 (0CEh), AH = -3 (0FDh) RET</pre>												



		<table border="1"> <tr> <td>C</td><td>Z</td><td>S</td><td>O</td><td>P</td><td>A</td> </tr> <tr> <td>?</td><td>?</td><td>?</td><td>?</td><td>?</td><td>?</td> </tr> </table> 	C	Z	S	O	P	A	?	?	?	?	?	?
C	Z	S	O	P	A									
?	?	?	?	?	?									
IMUL	REG memory	<p>Signed multiply.</p> <p>Algorithm:</p> <p>when operand is a byte: $AX = AL * \text{operand}$.</p> <p>when operand is a word: $(DX\ AX) = AX * \text{operand}$.</p> <p>Example:</p> <pre>MOV AL, -2 MOV BL, -4 IMUL BL ; AX = 8 RET</pre> <table border="1"> <tr> <td>C</td><td>Z</td><td>S</td><td>O</td><td>P</td><td>A</td> </tr> <tr> <td>r</td><td>?</td><td>?</td><td>r</td><td>?</td><td>?</td> </tr> </table> <p>CF=OF=0 when result fits into operand of IMUL.</p> 	C	Z	S	O	P	A	r	?	?	r	?	?
C	Z	S	O	P	A									
r	?	?	r	?	?									
IN	AL, im.byte AL, DX AX, im.byte AX, DX	<p>Input from port into AL or AX. Second operand is a port number. If required to access port number over 255 - DX register should be used.</p> <p>Example:</p> <pre>IN AX, 4 ; get status of traffic lights. IN AL, 7 ; get status of stepper-motor.</pre> <table border="1"> <tr> <td>C</td><td>Z</td><td>S</td><td>O</td><td>P</td><td>A</td> </tr> <tr> <td colspan="6">unchanged</td> </tr> </table> 	C	Z	S	O	P	A	unchanged					
C	Z	S	O	P	A									
unchanged														
INC	REG memory	<p>Increment.</p> <p>Algorithm:</p> $\text{operand} = \text{operand} + 1$ <p>Example:</p> <pre>MOV AL, 4 INC AL ; AL = 5</pre>												



		<p>RET</p> <table border="1" data-bbox="691 170 850 271"> <tr> <td>Z</td><td>S</td><td>O</td><td>P</td><td>A</td> </tr> <tr> <td>r</td><td>r</td><td>r</td><td>r</td><td>r</td> </tr> </table> <p>CF - unchanged!</p> 	Z	S	O	P	A	r	r	r	r	r				
Z	S	O	P	A												
r	r	r	r	r												
INT	immediate byte	<p>Interrupt numbered by immediate byte (0..255).</p> <p>Algorithm:</p> <p>Push to stack:</p> <ul style="list-style-type: none"> o flags register o CS o IP <ul style="list-style-type: none"> • IF = 0 • Transfer control to interrupt procedure <p>Example:</p> <pre>MOV AH, 0Eh ; teletype. MOV AL, 'A' INT 10h ; BIOS interrupt. RET</pre> <table border="1" data-bbox="691 1160 911 1261"> <tr> <td>C</td><td>Z</td><td>S</td><td>O</td><td>P</td><td>A</td><td>I</td> </tr> <tr> <td colspan="6">unchanged</td><td>0</td> </tr> </table> 	C	Z	S	O	P	A	I	unchanged						0
C	Z	S	O	P	A	I										
unchanged						0										
INTO	No operands	<p>Interrupt 4 if Overflow flag is 1.</p> <p>Algorithm:</p> <p>if OF = 1 then INT 4</p> <p>Example:</p> <pre>; -5 - 127 = -132 (not in -128..127) ; the result of SUB is wrong (124), ; so OF = 1 is set: MOV AL, -5 SUB AL, 127 ; AL = 7Ch (124) INTO ; process error. RET</pre> 														
		Interrupt Return.														



IRET	No operands	<p>Algorithm:</p> <p>Pop from stack:</p> <ul style="list-style-type: none"> o IP o CS o flags register <div style="border: 1px solid black; padding: 5px; width: fit-content; margin: 10px auto;"> <table border="1" style="border-collapse: collapse; text-align: center;"> <tr> <td style="padding: 2px 5px;">C</td> <td style="padding: 2px 5px;">Z</td> <td style="padding: 2px 5px;">S</td> <td style="padding: 2px 5px;">O</td> <td style="padding: 2px 5px;">P</td> <td style="padding: 2px 5px;">A</td> </tr> <tr> <td colspan="6" style="padding: 2px 5px;">popped</td> </tr> </table> </div> <div style="text-align: right; margin-top: 10px;">  </div>	C	Z	S	O	P	A	popped					
C	Z	S	O	P	A									
popped														
JA	label	<p>Short Jump if first operand is Above second operand (as set by CMP instruction). Unsigned.</p> <p>Algorithm:</p> <p style="padding-left: 40px;">if (CF = 0) and (ZF = 0) then jump</p> <p>Example:</p> <pre style="margin-left: 40px;">include 'emu8086.inc' ORG 100h MOV AL, 250 CMP AL, 5 JA labell PRINT 'AL is not above 5' JMP exit labell: PRINT 'AL is above 5' exit: RET</pre> <div style="border: 1px solid black; padding: 5px; width: fit-content; margin: 10px auto;"> <table border="1" style="border-collapse: collapse; text-align: center;"> <tr> <td style="padding: 2px 5px;">C</td> <td style="padding: 2px 5px;">Z</td> <td style="padding: 2px 5px;">S</td> <td style="padding: 2px 5px;">O</td> <td style="padding: 2px 5px;">P</td> <td style="padding: 2px 5px;">A</td> </tr> <tr> <td colspan="6" style="padding: 2px 5px;">unchanged</td> </tr> </table> </div> <div style="text-align: right; margin-top: 10px;">  </div>	C	Z	S	O	P	A	unchanged					
C	Z	S	O	P	A									
unchanged														
JAE	label	<p>Short Jump if first operand is Above or Equal to second operand (as set by CMP instruction). Unsigned.</p> <p>Algorithm:</p> <p style="padding-left: 40px;">if CF = 0 then jump</p> <p>Example:</p> <pre style="margin-left: 40px;">include 'emu8086.inc' ORG 100h MOV AL, 5 CMP AL, 5 JAE labell PRINT 'AL is not above or equal to 5' JMP exit labell:</pre>												



		<table border="1"> <tr> <td>C</td><td>Z</td><td>S</td><td>O</td><td>P</td><td>A</td> </tr> <tr> <td colspan="6">unchanged</td> </tr> </table> 	C	Z	S	O	P	A	unchanged					
C	Z	S	O	P	A									
unchanged														
JC	label	<p>Short Jump if Carry flag is set to 1.</p> <p>Algorithm:</p> <p style="padding-left: 40px;">if CF = 1 then jump</p> <p>Example:</p> <pre>include 'emu8086.inc' ORG 100h MOV AL, 255 ADD AL, 1 JC labell PRINT 'no carry.' JMP exit labell: PRINT 'has carry.' exit: RET</pre> <table border="1"> <tr> <td>C</td><td>Z</td><td>S</td><td>O</td><td>P</td><td>A</td> </tr> <tr> <td colspan="6">unchanged</td> </tr> </table> 	C	Z	S	O	P	A	unchanged					
C	Z	S	O	P	A									
unchanged														
JCXZ	label	<p>Short Jump if CX register is 0.</p> <p>Algorithm:</p> <p style="padding-left: 40px;">if CX = 0 then jump</p> <p>Example:</p> <pre>include 'emu8086.inc' ORG 100h MOV CX, 0 JCXZ labell PRINT 'CX is not zero.' JMP exit labell: PRINT 'CX is zero.' exit: RET</pre> <table border="1"> <tr> <td>C</td><td>Z</td><td>S</td><td>O</td><td>P</td><td>A</td> </tr> <tr> <td colspan="6">unchanged</td> </tr> </table> 	C	Z	S	O	P	A	unchanged					
C	Z	S	O	P	A									
unchanged														
		<p>Short Jump if first operand is Equal to second operand (as set by CMP instruction).</p>												



JE	label	<p>Signed/Unsigned.</p> <p>Algorithm:</p> <p style="padding-left: 40px;">if ZF = 1 then jump</p> <p>Example:</p> <pre>include 'emu8086.inc' ORG 100h MOV AL, 5 CMP AL, 5 JE labell PRINT 'AL is not equal to 5.' JMP exit labell: PRINT 'AL is equal to 5.' exit: RET</pre> <div style="border: 1px solid black; padding: 2px; display: inline-block;"> <table border="1" style="border-collapse: collapse;"> <tr> <td style="padding: 2px 5px;">C</td> <td style="padding: 2px 5px;">Z</td> <td style="padding: 2px 5px;">S</td> <td style="padding: 2px 5px;">O</td> <td style="padding: 2px 5px;">P</td> <td style="padding: 2px 5px;">A</td> </tr> <tr> <td colspan="6" style="padding: 2px 5px;">unchanged</td> </tr> </table> </div> <div style="text-align: right; margin-top: 10px;"></div>	C	Z	S	O	P	A	unchanged					
C	Z	S	O	P	A									
unchanged														
JG	label	<p>Short Jump if first operand is Greater then second operand (as set by CMP instruction). Signed.</p> <p>Algorithm:</p> <p style="padding-left: 40px;">if (ZF = 0) and (SF = OF) then jump</p> <p>Example:</p> <pre>include 'emu8086.inc' ORG 100h MOV AL, 5 CMP AL, -5 JG labell PRINT 'AL is not greater -5.' JMP exit labell: PRINT 'AL is greater -5.' exit: RET</pre> <div style="border: 1px solid black; padding: 2px; display: inline-block;"> <table border="1" style="border-collapse: collapse;"> <tr> <td style="padding: 2px 5px;">C</td> <td style="padding: 2px 5px;">Z</td> <td style="padding: 2px 5px;">S</td> <td style="padding: 2px 5px;">O</td> <td style="padding: 2px 5px;">P</td> <td style="padding: 2px 5px;">A</td> </tr> <tr> <td colspan="6" style="padding: 2px 5px;">unchanged</td> </tr> </table> </div> <div style="text-align: right; margin-top: 10px;"></div>	C	Z	S	O	P	A	unchanged					
C	Z	S	O	P	A									
unchanged														
		<p>Short Jump if first operand is Greater or Equal to second operand (as set by CMP instruction). Signed.</p> <p>Algorithm:</p>												



JGE	label	<p>if SF = OF then jump</p> <p>Example:</p> <pre>include 'emu8086.inc' ORG 100h MOV AL, 2 CMP AL, -5 JGE labell PRINT 'AL < -5' JMP exit labell: PRINT 'AL >= -5' exit: RET</pre> <table border="1" data-bbox="691 611 880 712"> <tr> <td>C</td><td>Z</td><td>S</td><td>O</td><td>P</td><td>A</td> </tr> <tr> <td colspan="6">unchanged</td> </tr> </table> 	C	Z	S	O	P	A	unchanged					
C	Z	S	O	P	A									
unchanged														
JL	label	<p>Short Jump if first operand is Less then second operand (as set by CMP instruction). Signed.</p> <p>Algorithm:</p> <p>if SF <> OF then jump</p> <p>Example:</p> <pre>include 'emu8086.inc' ORG 100h MOV AL, -2 CMP AL, 5 JL labell PRINT 'AL >= 5.' JMP exit labell: PRINT 'AL < 5.'</pre> <pre>exit: RET</pre> <table border="1" data-bbox="691 1529 880 1630"> <tr> <td>C</td><td>Z</td><td>S</td><td>O</td><td>P</td><td>A</td> </tr> <tr> <td colspan="6">unchanged</td> </tr> </table> 	C	Z	S	O	P	A	unchanged					
C	Z	S	O	P	A									
unchanged														
		<p>Short Jump if first operand is Less or Equal to second operand (as set by CMP instruction). Signed.</p> <p>Algorithm:</p> <p>if SF <> OF or ZF = 1 then jump</p> <p>Example:</p>												



JLE	label	<pre>include 'emu8086.inc' ORG 100h MOV AL, -2 CMP AL, 5 JLE label1 PRINT 'AL > 5.' JMP exit label1: PRINT 'AL <= 5.' exit: RET</pre> <div style="border: 1px solid black; padding: 2px; display: inline-block;"> <table border="1" style="border-collapse: collapse;"> <tr> <td style="padding: 2px;">C</td> <td style="padding: 2px;">Z</td> <td style="padding: 2px;">S</td> <td style="padding: 2px;">O</td> <td style="padding: 2px;">P</td> <td style="padding: 2px;">A</td> </tr> <tr> <td colspan="6" style="padding: 2px;">unchanged</td> </tr> </table> </div> <div style="text-align: right; margin-top: 10px;"></div>	C	Z	S	O	P	A	unchanged					
C	Z	S	O	P	A									
unchanged														
JMP	label 4-byte address	<p>Unconditional Jump. Transfers control to another part of the program. <i>4-byte address</i> may be entered in this form: 1234h:5678h, first value is a segment second value is an offset.</p> <p>Algorithm:</p> <p style="padding-left: 40px;">always jump</p> <p>Example:</p> <pre>include 'emu8086.inc' ORG 100h MOV AL, 5 JMP label1 ; jump over 2 lines! PRINT 'Not Jumped!' MOV AL, 0 label1: PRINT 'Got Here!' RET</pre> <div style="border: 1px solid black; padding: 2px; display: inline-block;"> <table border="1" style="border-collapse: collapse;"> <tr> <td style="padding: 2px;">C</td> <td style="padding: 2px;">Z</td> <td style="padding: 2px;">S</td> <td style="padding: 2px;">O</td> <td style="padding: 2px;">P</td> <td style="padding: 2px;">A</td> </tr> <tr> <td colspan="6" style="padding: 2px;">unchanged</td> </tr> </table> </div> <div style="text-align: right; margin-top: 10px;"></div>	C	Z	S	O	P	A	unchanged					
C	Z	S	O	P	A									
unchanged														
JNA	label	<p>Short Jump if first operand is Not Above second operand (as set by CMP instruction). Unsigned.</p> <p>Algorithm:</p> <p style="padding-left: 40px;">if CF = 1 or ZF = 1 then jump</p> <p>Example:</p> <pre>include 'emu8086.inc' ORG 100h MOV AL, 2</pre>												

		<pre> CMP AL, 5 JNA label1 PRINT 'AL is above 5.' JMP exit label1: PRINT 'AL is not above 5.' exit: RET </pre> <div style="border: 1px solid black; padding: 2px; display: inline-block;"> <table border="1" style="border-collapse: collapse;"> <tr> <td style="padding: 2px;">C</td> <td style="padding: 2px;">Z</td> <td style="padding: 2px;">S</td> <td style="padding: 2px;">O</td> <td style="padding: 2px;">P</td> <td style="padding: 2px;">A</td> </tr> <tr> <td colspan="6" style="padding: 2px;">unchanged</td> </tr> </table> </div> <div style="text-align: right; margin-top: 10px;"></div>	C	Z	S	O	P	A	unchanged					
C	Z	S	O	P	A									
unchanged														
JNAE	label	<p>Short Jump if first operand is Not Above and Not Equal to second operand (as set by CMP instruction). Unsigned.</p> <p>Algorithm:</p> <pre> if CF = 1 then jump </pre> <p>Example:</p> <pre> include 'emu8086.inc' ORG 100h MOV AL, 2 CMP AL, 5 JNAE label1 PRINT 'AL >= 5.' JMP exit label1: PRINT 'AL < 5.' exit: RET </pre> <div style="border: 1px solid black; padding: 2px; display: inline-block;"> <table border="1" style="border-collapse: collapse;"> <tr> <td style="padding: 2px;">C</td> <td style="padding: 2px;">Z</td> <td style="padding: 2px;">S</td> <td style="padding: 2px;">O</td> <td style="padding: 2px;">P</td> <td style="padding: 2px;">A</td> </tr> <tr> <td colspan="6" style="padding: 2px;">unchanged</td> </tr> </table> </div> <div style="text-align: right; margin-top: 10px;"></div>	C	Z	S	O	P	A	unchanged					
C	Z	S	O	P	A									
unchanged														
JNB	label	<p>Short Jump if first operand is Not Below second operand (as set by CMP instruction). Unsigned.</p> <p>Algorithm:</p> <pre> if CF = 0 then jump </pre> <p>Example:</p> <pre> include 'emu8086.inc' ORG 100h MOV AL, 7 CMP AL, 5 JNB label1 PRINT 'AL < 5.' </pre>												

		<pre> JMP exit label1: PRINT 'AL >= 5.' exit: RET </pre> <div style="border: 1px solid black; padding: 2px; display: inline-block;"> <table border="1" style="border-collapse: collapse;"> <tr> <td style="padding: 2px;">C</td> <td style="padding: 2px;">Z</td> <td style="padding: 2px;">S</td> <td style="padding: 2px;">O</td> <td style="padding: 2px;">P</td> <td style="padding: 2px;">A</td> </tr> <tr> <td colspan="6" style="padding: 2px;">unchanged</td> </tr> </table> </div> <div style="text-align: right; margin-top: 10px;"></div>	C	Z	S	O	P	A	unchanged					
C	Z	S	O	P	A									
unchanged														
JNBE	label	<p>Short Jump if first operand is Not Below and Not Equal to second operand (as set by CMP instruction). Unsigned.</p> <p>Algorithm:</p> <p style="padding-left: 40px;">if (CF = 0) and (ZF = 0) then jump</p> <p>Example:</p> <pre> include 'emu8086.inc' ORG 100h MOV AL, 7 CMP AL, 5 JNBE label1 PRINT 'AL <= 5.' JMP exit label1: PRINT 'AL > 5.' exit: RET </pre> <div style="border: 1px solid black; padding: 2px; display: inline-block;"> <table border="1" style="border-collapse: collapse;"> <tr> <td style="padding: 2px;">C</td> <td style="padding: 2px;">Z</td> <td style="padding: 2px;">S</td> <td style="padding: 2px;">O</td> <td style="padding: 2px;">P</td> <td style="padding: 2px;">A</td> </tr> <tr> <td colspan="6" style="padding: 2px;">unchanged</td> </tr> </table> </div> <div style="text-align: right; margin-top: 10px;"></div>	C	Z	S	O	P	A	unchanged					
C	Z	S	O	P	A									
unchanged														
JNC	label	<p>Short Jump if Carry flag is set to 0.</p> <p>Algorithm:</p> <p style="padding-left: 40px;">if CF = 0 then jump</p> <p>Example:</p> <pre> include 'emu8086.inc' ORG 100h MOV AL, 2 ADD AL, 3 JNC label1 PRINT 'has carry.' JMP exit label1: PRINT 'no carry.' exit: </pre>												

		<p>RET</p> <table border="1" data-bbox="691 168 880 264"> <tr> <td>C</td><td>Z</td><td>S</td><td>O</td><td>P</td><td>A</td> </tr> <tr> <td colspan="6">unchanged</td> </tr> </table> 	C	Z	S	O	P	A	unchanged					
C	Z	S	O	P	A									
unchanged														
JNE	label	<p>Short Jump if first operand is Not Equal to second operand (as set by CMP instruction). Signed/Unsigned.</p> <p>Algorithm:</p> <p style="padding-left: 40px;">if ZF = 0 then jump</p> <p>Example:</p> <pre>include 'emu8086.inc' ORG 100h MOV AL, 2 CMP AL, 3 JNE labell PRINT 'AL = 3.' JMP exit labell: PRINT 'Al <> 3.' exit: RET</pre> <table border="1" data-bbox="691 1153 880 1249"> <tr> <td>C</td><td>Z</td><td>S</td><td>O</td><td>P</td><td>A</td> </tr> <tr> <td colspan="6">unchanged</td> </tr> </table> 	C	Z	S	O	P	A	unchanged					
C	Z	S	O	P	A									
unchanged														
JNG	label	<p>Short Jump if first operand is Not Greater then second operand (as set by CMP instruction). Signed.</p> <p>Algorithm:</p> <p style="padding-left: 40px;">if (ZF = 1) and (SF <> OF) then jump</p> <p>Example:</p> <pre>include 'emu8086.inc' ORG 100h MOV AL, 2 CMP AL, 3 JNG labell PRINT 'AL > 3.' JMP exit labell: PRINT 'Al <= 3.' exit: RET</pre>												

		<div style="border: 1px solid black; display: inline-block; padding: 2px;">C Z S O P A</div> <div style="border: 1px solid black; display: inline-block; padding: 2px;">unchanged</div> <div style="text-align: right;"></div>
JNGE	label	<p>Short Jump if first operand is Not Greater and Not Equal to second operand (as set by CMP instruction). Signed.</p> <p>Algorithm:</p> <pre>if SF <> OF then jump</pre> <p>Example:</p> <pre>include 'emu8086.inc' ORG 100h MOV AL, 2 CMP AL, 3 JNGE label1 PRINT 'AL >= 3.' JMP exit label1: PRINT 'Al < 3.' exit: RET</pre> <div style="border: 1px solid black; display: inline-block; padding: 2px;">C Z S O P A</div> <div style="border: 1px solid black; display: inline-block; padding: 2px;">unchanged</div> <div style="text-align: right;"></div>
JNL	label	<p>Short Jump if first operand is Not Less then second operand (as set by CMP instruction). Signed.</p> <p>Algorithm:</p> <pre>if SF = OF then jump</pre> <p>Example:</p> <pre>include 'emu8086.inc' ORG 100h MOV AL, 2 CMP AL, -3 JNL label1 PRINT 'AL < -3.' JMP exit label1: PRINT 'Al >= -3.' exit: RET</pre> <div style="border: 1px solid black; display: inline-block; padding: 2px;">C Z S O P A</div>

		<div data-bbox="691 103 879 152" style="border: 1px solid black; padding: 2px; display: inline-block;">unchanged</div> <div data-bbox="1401 152 1481 226" style="text-align: right;"></div>												
JNLE	label	<p>Short Jump if first operand is Not Less and Not Equal to second operand (as set by CMP instruction). Signed.</p> <p>Algorithm:</p> <p style="padding-left: 40px;">if (SF = OF) and (ZF = 0) then jump</p> <p>Example:</p> <pre>include 'emu8086.inc' ORG 100h MOV AL, 2 CMP AL, -3 JNLE labell PRINT 'AL <= -3.' JMP exit labell: PRINT 'Al > -3.' exit: RET</pre> <div data-bbox="691 1039 879 1140" style="border: 1px solid black; padding: 2px; display: inline-block;"> <table border="1" style="border-collapse: collapse; text-align: center;"> <tr> <td>C</td><td>Z</td><td>S</td><td>O</td><td>P</td><td>A</td> </tr> <tr> <td colspan="6">unchanged</td> </tr> </table> </div> <div data-bbox="1401 1140 1481 1214" style="text-align: right;"></div>	C	Z	S	O	P	A	unchanged					
C	Z	S	O	P	A									
unchanged														
JNO	label	<p>Short Jump if Not Overflow.</p> <p>Algorithm:</p> <p style="padding-left: 40px;">if OF = 0 then jump</p> <p>Example:</p> <pre>; -5 - 2 = -7 (inside -128..127) ; the result of SUB is correct, ; so OF = 0: include 'emu8086.inc' ORG 100h MOV AL, -5 SUB AL, 2 ; AL = 0F9h (-7) JNO labell PRINT 'overflow!' JMP exit labell: PRINT 'no overflow.' exit: RET</pre> <div data-bbox="691 2069 879 2130" style="border: 1px solid black; padding: 2px; display: inline-block;"> <table border="1" style="border-collapse: collapse; text-align: center;"> <tr> <td>C</td><td>Z</td><td>S</td><td>O</td><td>P</td><td>A</td> </tr> </table> </div>	C	Z	S	O	P	A						
C	Z	S	O	P	A									

unchanged



Short Jump if No Parity (odd). Only 8 low bits of result are checked. Set by CMP, SUB, ADD, TEST, AND, OR, XOR instructions.

Algorithm:

```
if PF = 0 then jump
```

Example:

```
include 'emu8086.inc'

ORG 100h
MOV AL, 00000111b ; AL = 7
OR AL, 0 ; just set flags.
JNP labell
PRINT 'parity even.'
JMP exit
labell:
PRINT 'parity odd.'
exit:
RET
```

C	Z	S	O	P	A
unchanged					



JNP

label

Short Jump if Not Signed (if positive). Set by CMP, SUB, ADD, TEST, AND, OR, XOR instructions.

Algorithm:

```
if SF = 0 then jump
```

Example:

```
include 'emu8086.inc'

ORG 100h
MOV AL, 00000111b ; AL = 7
OR AL, 0 ; just set flags.
JNS labell
PRINT 'signed.'
JMP exit
labell:
PRINT 'not signed.'
exit:
RET
```

C	Z	S	O	P	A
unchanged					

JNS

label



Short Jump if Not Zero (not equal). Set by CMP, SUB, ADD, TEST, AND, OR, XOR instructions.

Algorithm:

if ZF = 0 then jump

Example:

```
include 'emu8086.inc'

ORG 100h
MOV AL, 00000111b    ; AL = 7
OR  AL, 0            ; just set flags.
JNZ labell
PRINT 'zero.'
JMP exit
labell:
PRINT 'not zero.'
exit:
RET
```

C	Z	S	O	P	A
unchanged					



JNZ

label

Short Jump if Overflow.

Algorithm:

if OF = 1 then jump

Example:

```
; -5 - 127 = -132 (not in -128..127)
; the result of SUB is wrong (124),
; so OF = 1 is set:
```

```
include 'emu8086.inc'



org 100h
MOV AL, -5
SUB AL, 127    ; AL = 7Ch (124)
JO  labell
PRINT 'no overflow.'
JMP exit
labell:
PRINT 'overflow!'
exit:
RET
```



C	Z	S	O	P	A
unchanged					







JO


label

JP	label	<p>Short Jump if Parity (even). Only 8 low bits of result are checked. Set by CMP, SUB, ADD, TEST, AND, OR, XOR instructions.</p> <p>Algorithm:</p> <pre>if PF = 1 then jump</pre> <p>Example:</p> <pre>include 'emu8086.inc' ORG 100h MOV AL, 00000101b ; AL = 5 OR AL, 0 ; just set flags. JP label1 PRINT 'parity odd.' JMP exit label1: PRINT 'parity even.' exit: RET</pre> <div data-bbox="691 869 880 969" style="border: 1px solid black; padding: 2px; display: inline-block;"> <table border="1" style="border-collapse: collapse;"> <tr> <td style="padding: 2px;">C</td> <td style="padding: 2px;">Z</td> <td style="padding: 2px;">S</td> <td style="padding: 2px;">O</td> <td style="padding: 2px;">P</td> <td style="padding: 2px;">A</td> </tr> <tr> <td colspan="6" style="padding: 2px;">unchanged</td> </tr> </table> </div> <div data-bbox="1401 969 1485 1041" style="text-align: right;">  </div>	C	Z	S	O	P	A	unchanged					
C	Z	S	O	P	A									
unchanged														
JPE	label	<p>Short Jump if Parity Even. Only 8 low bits of result are checked. Set by CMP, SUB, ADD, TEST, AND, OR, XOR instructions.</p> <p>Algorithm:</p> <pre>if PF = 1 then jump</pre> <p>Example:</p> <pre>include 'emu8086.inc' ORG 100h MOV AL, 00000101b ; AL = 5 OR AL, 0 ; just set flags. JPE label1 PRINT 'parity odd.' JMP exit label1: PRINT 'parity even.' exit: RET</pre> <div data-bbox="691 1854 880 1955" style="border: 1px solid black; padding: 2px; display: inline-block;"> <table border="1" style="border-collapse: collapse;"> <tr> <td style="padding: 2px;">C</td> <td style="padding: 2px;">Z</td> <td style="padding: 2px;">S</td> <td style="padding: 2px;">O</td> <td style="padding: 2px;">P</td> <td style="padding: 2px;">A</td> </tr> <tr> <td colspan="6" style="padding: 2px;">unchanged</td> </tr> </table> </div> <div data-bbox="1401 1955 1485 2027" style="text-align: right;">  </div>	C	Z	S	O	P	A	unchanged					
C	Z	S	O	P	A									
unchanged														
		Short Jump if Parity Odd. Only 8 low bits of result												

JPO	label	<p>are checked. Set by CMP, SUB, ADD, TEST, AND, OR, XOR instructions.</p> <p>Algorithm:</p> <pre>if PF = 0 then jump</pre> <p>Example:</p> <pre>include 'emu8086.inc' ORG 100h MOV AL, 00000111b ; AL = 7 OR AL, 0 ; just set flags. JPO labell PRINT 'parity even.' JMP exit labell: PRINT 'parity odd.' exit: RET</pre> <div data-bbox="691 831 879 931" style="border: 1px solid black; padding: 2px; display: inline-block;"> <table border="1" style="border-collapse: collapse;"> <tr> <td style="padding: 2px;">C</td> <td style="padding: 2px;">Z</td> <td style="padding: 2px;">S</td> <td style="padding: 2px;">O</td> <td style="padding: 2px;">P</td> <td style="padding: 2px;">A</td> </tr> <tr> <td colspan="6" style="padding: 2px;">unchanged</td> </tr> </table> </div> <div data-bbox="1401 936 1481 1003" style="text-align: right;">  </div>	C	Z	S	O	P	A	unchanged					
C	Z	S	O	P	A									
unchanged														
JS	label	<p>Short Jump if Signed (if negative). Set by CMP, SUB, ADD, TEST, AND, OR, XOR instructions.</p> <p>Algorithm:</p> <pre>if SF = 1 then jump</pre> <p>Example:</p> <pre>include 'emu8086.inc' ORG 100h MOV AL, 10000000b ; AL = -128 OR AL, 0 ; just set flags. JS labell PRINT 'not signed.' JMP exit labell: PRINT 'signed.' exit: RET</pre> <div data-bbox="691 1783 879 1883" style="border: 1px solid black; padding: 2px; display: inline-block;"> <table border="1" style="border-collapse: collapse;"> <tr> <td style="padding: 2px;">C</td> <td style="padding: 2px;">Z</td> <td style="padding: 2px;">S</td> <td style="padding: 2px;">O</td> <td style="padding: 2px;">P</td> <td style="padding: 2px;">A</td> </tr> <tr> <td colspan="6" style="padding: 2px;">unchanged</td> </tr> </table> </div> <div data-bbox="1401 1888 1481 1955" style="text-align: right;">  </div>	C	Z	S	O	P	A	unchanged					
C	Z	S	O	P	A									
unchanged														
		<p>Short Jump if Zero (equal). Set by CMP, SUB, ADD, TEST, AND, OR, XOR instructions.</p>												

JZ	label	<p>Algorithm:</p> <pre>if ZF = 1 then jump</pre> <p>Example:</p> <pre>include 'emu8086.inc' ORG 100h MOV AL, 5 CMP AL, 5 JZ label1 PRINT 'AL is not equal to 5.' JMP exit label1: PRINT 'AL is equal to 5.' exit: RET</pre> <div style="border: 1px solid black; padding: 2px; display: inline-block;"> <table style="border-collapse: collapse;"> <tr> <td style="border: 1px solid black; padding: 2px;">C</td> <td style="border: 1px solid black; padding: 2px;">Z</td> <td style="border: 1px solid black; padding: 2px;">S</td> <td style="border: 1px solid black; padding: 2px;">O</td> <td style="border: 1px solid black; padding: 2px;">P</td> <td style="border: 1px solid black; padding: 2px;">A</td> </tr> <tr> <td colspan="6" style="border: 1px solid black; padding: 2px; text-align: center;">unchanged</td> </tr> </table> </div> <div style="text-align: right; margin-top: 10px;"></div>	C	Z	S	O	P	A	unchanged					
C	Z	S	O	P	A									
unchanged														
LAHF	No operands	<p>Load AH from 8 low bits of Flags register.</p> <p>Algorithm:</p> <pre>AH = flags register</pre> <pre>AH bit: 7 6 5 4 3 2 1 0 [SF] [ZF] [0] [AF] [0] [PF] [1] [CF]</pre> <p>bits 1, 3, 5 are reserved.</p> <div style="border: 1px solid black; padding: 2px; display: inline-block;"> <table style="border-collapse: collapse;"> <tr> <td style="border: 1px solid black; padding: 2px;">C</td> <td style="border: 1px solid black; padding: 2px;">Z</td> <td style="border: 1px solid black; padding: 2px;">S</td> <td style="border: 1px solid black; padding: 2px;">O</td> <td style="border: 1px solid black; padding: 2px;">P</td> <td style="border: 1px solid black; padding: 2px;">A</td> </tr> <tr> <td colspan="6" style="border: 1px solid black; padding: 2px; text-align: center;">unchanged</td> </tr> </table> </div> <div style="text-align: right; margin-top: 10px;"></div>	C	Z	S	O	P	A	unchanged					
C	Z	S	O	P	A									
unchanged														
		<p>Load memory double word into word register and DS.</p> <p>Algorithm:</p> <ul style="list-style-type: none"> • REG = first word • DS = second word <p>Example:</p> <pre>ORG 100h</pre>												

LDS	REG, memory	<pre>LDS AX, m RET m DW 1234h DW 5678h END</pre> <p>AX is set to 1234h, DS is set to 5678h.</p> <table border="1" data-bbox="689 481 880 582"> <tr> <td>C</td><td>Z</td><td>S</td><td>O</td><td>P</td><td>A</td> </tr> <tr> <td colspan="6">unchanged</td> </tr> </table> 	C	Z	S	O	P	A	unchanged					
C	Z	S	O	P	A									
unchanged														
LEA	REG, memory	<p>Load Effective Address.</p> <p>Algorithm:</p> <ul style="list-style-type: none"> REG = address of memory (offset) <p>Example:</p> <pre>MOV BX, 35h MOV DI, 12h LEA SI, [BX+DI] ; SI = 35h + 12h = 47h</pre> <p>Note: The integrated 8086 assembler automatically replaces LEA with a more efficient MOV where possible. For example:</p> <pre>org 100h LEA AX, m ; AX = offset of m RET m dw 1234h END</pre> <table border="1" data-bbox="689 1736 880 1836"> <tr> <td>C</td><td>Z</td><td>S</td><td>O</td><td>P</td><td>A</td> </tr> <tr> <td colspan="6">unchanged</td> </tr> </table> 	C	Z	S	O	P	A	unchanged					
C	Z	S	O	P	A									
unchanged														
		<p>Load memory double word into word register and ES.</p> <p>Algorithm:</p>												

LES	REG, memory	<ul style="list-style-type: none"> • REG = first word • ES = second word <p>Example:</p> <pre> ORG 100h LES AX, m RET m DW 1234h DW 5678h END </pre> <p>AX is set to 1234h, ES is set to 5678h.</p> <table border="1" data-bbox="689 869 880 967"> <tr> <td>C</td><td>Z</td><td>S</td><td>O</td><td>P</td><td>A</td> </tr> <tr> <td colspan="6">unchanged</td> </tr> </table> 	C	Z	S	O	P	A	unchanged					
C	Z	S	O	P	A									
unchanged														
LODSB	No operands	<p>Load byte at DS: [SI] into AL. Update SI.</p> <p>Algorithm:</p> <ul style="list-style-type: none"> • AL = DS:[SI] • if DF = 0 then <ul style="list-style-type: none"> ◦ SI = SI + 1 else <ul style="list-style-type: none"> ◦ SI = SI - 1 <p>Example:</p> <pre> ORG 100h LEA SI, a1 MOV CX, 5 MOV AH, 0Eh m: LODSB INT 10h LOOP m RET a1 DB 'H', 'e', 'l', 'l', 'o' </pre> <table border="1" data-bbox="689 2002 880 2101"> <tr> <td>C</td><td>Z</td><td>S</td><td>O</td><td>P</td><td>A</td> </tr> <tr> <td colspan="6">unchanged</td> </tr> </table>	C	Z	S	O	P	A	unchanged					
C	Z	S	O	P	A									
unchanged														



Load word at DS:[SI] into AX. Update SI.

Algorithm:

- AX = DS:[SI]
- if DF = 0 then
 - SI = SI + 2
- else
 - SI = SI - 2

Example:

```
ORG 100h
```

```
LEA SI, a1
```

```
MOV CX, 5
```

```
REP LODSW ; finally there will be 555h in AX.
```

```
RET
```

```
a1 dw 111h, 222h, 333h, 444h, 555h
```

C	Z	S	O	P	A
unchanged					



LODSW

No operands

Decrease CX, jump to label if CX not zero.

Algorithm:

- CX = CX - 1
- if CX <> 0 then
 - jump
- else
 - no jump, continue

Example:

```
include 'emu8086.inc'
```

```
ORG 100h
```

```
MOV CX, 5
```

```
label1:
```

```
PRINTN 'loop!'
```

```
LOOP label1
```

```
RET
```

C	Z	S	O	P	A
unchanged					

LOOP

label



Decrease CX, jump to label if CX not zero and Equal (ZF = 1).

Algorithm:

- $CX = CX - 1$
- if $(CX \neq 0)$ and $(ZF = 1)$ then
 - jump
 - else
 - no jump, continue

Example:

```
; Loop until result fits into AL alone,
; or 5 times. The result will be over 255
; on third loop (100+100+100),
; so loop will exit.
```

```
include 'emu8086.inc'
```

```
ORG 100h
MOV AX, 0
MOV CX, 5
```

```
label1:
  PUTC '*'
  ADD AX, 100
  CMP AH, 0
  LOOPE label1
  RET
```



LOOPE

label

Decrease CX, jump to label if CX not zero and Not Equal (ZF = 0).

Algorithm:

- $CX = CX - 1$
- if $(CX \neq 0)$ and $(ZF = 0)$ then
 - jump
 - else
 - no jump, continue

Example:

```
; Loop until '7' is found,
; or 5 times.
```

```
include 'emu8086.inc'
```

```
ORG 100h
```

LOOPNE

label

```

MOV SI, 0
MOV CX, 5
label1:
  PUTC '*'
  MOV AL, v1[SI]
  INC SI      ; next byte (SI=SI+1).
  CMP AL, 7
  LOOPNE label1
  RET
v1 db 9, 8, 7, 6, 5

```

C	Z	S	O	P	A
unchanged					



Decrease CX, jump to label if CX not zero and ZF = 0.

Algorithm:

- CX = CX - 1
- if (CX <> 0) and (ZF = 0) then
 - jump
 - else
 - no jump, continue

Example:

```

; Loop until '7' is found,
; or 5 times.

```

```

include 'emu8086.inc'

```

```

ORG 100h
MOV SI, 0
MOV CX, 5
label1:
  PUTC '*'
  MOV AL, v1[SI]
  INC SI      ; next byte (SI=SI+1).
  CMP AL, 7
  LOOPNZ label1
  RET
v1 db 9, 8, 7, 6, 5

```

C	Z	S	O	P	A
unchanged					





LOOPNZ



label



Decrease CX, jump to label if CX not zero and ZF = 1.




Algorithm:




- CX = CX - 1



<p>LOOPZ</p>	<p>label</p>	<ul style="list-style-type: none"> • if (CX <> 0) and (ZF = 1) then <ul style="list-style-type: none"> ◦ jump else <ul style="list-style-type: none"> ◦ no jump, continue <p>Example:</p> <pre>; Loop until result fits into AL alone, ; or 5 times. The result will be over 255 ; on third loop (100+100+100), ; so loop will exit. include 'emu8086.inc' ORG 100h MOV AX, 0 MOV CX, 5 label1: PUTC '*' ADD AX, 100 CMP AH, 0 LOOPZ label1 RET</pre> <div style="border: 1px solid black; padding: 2px; display: inline-block;"> <table border="1" style="border-collapse: collapse;"> <tr> <td style="padding: 2px;">C</td> <td style="padding: 2px;">Z</td> <td style="padding: 2px;">S</td> <td style="padding: 2px;">O</td> <td style="padding: 2px;">P</td> <td style="padding: 2px;">A</td> </tr> <tr> <td colspan="6" style="padding: 2px;">unchanged</td> </tr> </table> </div> <div style="text-align: right; margin-top: 10px;">  </div>	C	Z	S	O	P	A	unchanged					
C	Z	S	O	P	A									
unchanged														
<p>MOV</p>	<p>REG, memory memory, REG REG, REG memory, immediate REG, immediate</p> <p>SREG, memory memory, SREG REG, SREG SREG, REG</p>	<p>Copy operand2 to operand1.</p> <p>The MOV instruction <u>cannot</u>:</p> <ul style="list-style-type: none"> • set the value of the CS and IP registers. • copy value of one segment register to another segment register (should copy to general register first). • copy immediate value to segment register (should copy to general register first). <p>Algorithm:</p> <p style="text-align: center;">operand1 = operand2</p> <p>Example:</p> <pre>ORG 100h MOV AX, 0B800h ; set AX = B800h (VGA memory). MOV DS, AX ; copy value of AX to DS. MOV CL, 'A' ; CL = 41h (ASCII code). MOV CH, 01011111b ; CL = color attribute. MOV BX, 15Eh ; BX = position on screen. MOV [BX], CX ; w.[0B800h:015Eh] = CX. RET ; returns to operating system.</pre> <div style="text-align: center; margin-top: 10px;">  </div>												




		<div style="border: 1px solid black; padding: 5px; display: inline-block;"> <table border="1" style="border-collapse: collapse;"> <tr> <td style="padding: 2px;">C</td> <td style="padding: 2px;">Z</td> <td style="padding: 2px;">S</td> <td style="padding: 2px;">O</td> <td style="padding: 2px;">P</td> <td style="padding: 2px;">A</td> </tr> <tr> <td colspan="6" style="text-align: center; padding: 2px;">unchanged</td> </tr> </table> </div> <div style="text-align: right; margin-top: 10px;">  </div>	C	Z	S	O	P	A	unchanged					
C	Z	S	O	P	A									
unchanged														
MOVSB	No operands	<p>Copy byte at DS:[SI] to ES:[DI]. Update SI and DI.</p> <p>Algorithm:</p> <ul style="list-style-type: none"> • ES:[DI] = DS:[SI] • if DF = 0 then <ul style="list-style-type: none"> ◦ SI = SI + 1 ◦ DI = DI + 1 else <ul style="list-style-type: none"> ◦ SI = SI - 1 ◦ DI = DI - 1 <p>Example:</p> <pre> ORG 100h CLD LEA SI, a1 LEA DI, a2 MOV CX, 5 REP MOVSB RET a1 DB 1,2,3,4,5 a2 DB 5 DUP(0) </pre> <div style="border: 1px solid black; padding: 5px; display: inline-block; margin-top: 10px;"> <table border="1" style="border-collapse: collapse;"> <tr> <td style="padding: 2px;">C</td> <td style="padding: 2px;">Z</td> <td style="padding: 2px;">S</td> <td style="padding: 2px;">O</td> <td style="padding: 2px;">P</td> <td style="padding: 2px;">A</td> </tr> <tr> <td colspan="6" style="text-align: center; padding: 2px;">unchanged</td> </tr> </table> </div> <div style="text-align: right; margin-top: 10px;">  </div>	C	Z	S	O	P	A	unchanged					
C	Z	S	O	P	A									
unchanged														
		<p>Copy word at DS:[SI] to ES:[DI]. Update SI and DI.</p> <p>Algorithm:</p> <ul style="list-style-type: none"> • ES:[DI] = DS:[SI] • if DF = 0 then <ul style="list-style-type: none"> ◦ SI = SI + 2 ◦ DI = DI + 2 else <ul style="list-style-type: none"> ◦ SI = SI - 2 ◦ DI = DI - 2 <p>Example:</p>												



MOVSW	No operands	<pre> ORG 100h CLD LEA SI, a1 LEA DI, a2 MOV CX, 5 REP MOVSW RET a1 DW 1,2,3,4,5 a2 DW 5 DUP(0) </pre> <div style="border: 1px solid black; padding: 2px; display: inline-block;"> <table border="1" style="border-collapse: collapse;"> <tr><td>C</td><td>Z</td><td>S</td><td>O</td><td>P</td><td>A</td></tr> <tr><td colspan="6">unchanged</td></tr> </table> </div> <div style="text-align: right;"></div>	C	Z	S	O	P	A	unchanged					
C	Z	S	O	P	A									
unchanged														
MUL	REG memory	<p>Unsigned multiply.</p> <p>Algorithm:</p> <p style="padding-left: 40px;">when operand is a byte: AX = AL * operand.</p> <p style="padding-left: 40px;">when operand is a word: (DX AX) = AX * operand.</p> <p>Example:</p> <pre> MOV AL, 200 ; AL = 0C8h MOV BL, 4 MUL BL ; AX = 0320h (800) RET </pre> <div style="border: 1px solid black; padding: 2px; display: inline-block;"> <table border="1" style="border-collapse: collapse;"> <tr><td>C</td><td>Z</td><td>S</td><td>O</td><td>P</td><td>A</td></tr> <tr><td>r</td><td>?</td><td>?</td><td>r</td><td>?</td><td>?</td></tr> </table> </div> <p>CF=OF=0 when high section of the result is zero.</p> <div style="text-align: right;"></div>	C	Z	S	O	P	A	r	?	?	r	?	?
C	Z	S	O	P	A									
r	?	?	r	?	?									
NEG	REG memory	<p>Negate. Makes operand negative (two's complement).</p> <p>Algorithm:</p> <ul style="list-style-type: none"> • Invert all bits of the operand • Add 1 to inverted operand <p>Example:</p> <pre> MOV AL, 5 ; AL = 05h NEG AL ; AL = 0FBh (-5) NEG AL ; AL = 05h (5) </pre>												



		<p>RET</p> <table border="1"> <tr> <td>C</td><td>Z</td><td>S</td><td>O</td><td>P</td><td>A</td> </tr> <tr> <td>r</td><td>r</td><td>r</td><td>r</td><td>r</td><td>r</td> </tr> </table> 	C	Z	S	O	P	A	r	r	r	r	r	r
C	Z	S	O	P	A									
r	r	r	r	r	r									
NOP	No operands	<p>No Operation.</p> <p>Algorithm:</p> <ul style="list-style-type: none"> • Do nothing <p>Example:</p> <pre>; do nothing, 3 times: NOP NOP NOP RET</pre> <table border="1"> <tr> <td>C</td><td>Z</td><td>S</td><td>O</td><td>P</td><td>A</td> </tr> <tr> <td colspan="6">unchanged</td> </tr> </table> 	C	Z	S	O	P	A	unchanged					
C	Z	S	O	P	A									
unchanged														
NOT	REG memory	<p>Invert each bit of the operand.</p> <p>Algorithm:</p> <ul style="list-style-type: none"> • if bit is 1 turn it to 0. • if bit is 0 turn it to 1. <p>Example:</p> <pre>MOV AL, 00011011b NOT AL ; AL = 11100100b RET</pre> <table border="1"> <tr> <td>C</td><td>Z</td><td>S</td><td>O</td><td>P</td><td>A</td> </tr> <tr> <td colspan="6">unchanged</td> </tr> </table> 	C	Z	S	O	P	A	unchanged					
C	Z	S	O	P	A									
unchanged														
	REG, memory	<p>Logical OR between all bits of two operands. Result is stored in first operand.</p> <p>These rules apply:</p> <pre>1 OR 1 = 1 1 OR 0 = 1 0 OR 1 = 1 0 OR 0 = 0</pre>												



OR	memory, REG REG, REG memory, immediate REG, immediate	<p>Example:</p> <pre>MOV AL, 'A' ; AL = 01000001b OR AL, 00100000b ; AL = 01100001b ('a') RET</pre> <div style="border: 1px solid black; display: inline-block; padding: 2px;"> <table style="border-collapse: collapse; text-align: center;"> <tr><td>C</td><td>Z</td><td>S</td><td>O</td><td>P</td><td>A</td></tr> <tr><td>0</td><td>r</td><td>r</td><td>0</td><td>r</td><td>?</td></tr> </table> </div> <div style="text-align: right;"></div>	C	Z	S	O	P	A	0	r	r	0	r	?
C	Z	S	O	P	A									
0	r	r	0	r	?									
OUT	im.byte, AL im.byte, AX DX, AL DX, AX	<p>Output from AL or AX to port. First operand is a port number. If required to access port number over 255 - DX register should be used.</p> <p>Example:</p> <pre>MOV AX, 0FFFh ; Turn on all OUT 4, AX ; traffic lights. MOV AL, 100b ; Turn on the third OUT 7, AL ; magnet of the stepper-motor.</pre> <div style="border: 1px solid black; display: inline-block; padding: 2px;"> <table style="border-collapse: collapse; text-align: center;"> <tr><td>C</td><td>Z</td><td>S</td><td>O</td><td>P</td><td>A</td></tr> <tr><td colspan="6">unchanged</td></tr> </table> </div> <div style="text-align: right;"></div>	C	Z	S	O	P	A	unchanged					
C	Z	S	O	P	A									
unchanged														
POP	REG SREG memory	<p>Get 16 bit value from the stack.</p> <p>Algorithm:</p> <ul style="list-style-type: none"> • operand = SS:[SP] (top of the stack) • SP = SP + 2 <p>Example:</p> <pre>MOV AX, 1234h PUSH AX POP DX ; DX = 1234h RET</pre> <div style="border: 1px solid black; display: inline-block; padding: 2px;"> <table style="border-collapse: collapse; text-align: center;"> <tr><td>C</td><td>Z</td><td>S</td><td>O</td><td>P</td><td>A</td></tr> <tr><td colspan="6">unchanged</td></tr> </table> </div> <div style="text-align: right;"></div>	C	Z	S	O	P	A	unchanged					
C	Z	S	O	P	A									
unchanged														
		<p>Pop all general purpose registers DI, SI, BP, SP, BX, DX, CX, AX from the stack.</p>												



POPA	No operands	<p>SP value is ignored, it is Popped but not set to SP register).</p> <p>Note: this instruction works only on 80186 CPU and later!</p> <p>Algorithm:</p> <ul style="list-style-type: none"> • POP DI • POP SI • POP BP • POP xx (SP value ignored) • POP BX • POP DX • POP CX • POP AX <div style="border: 1px solid black; padding: 2px; display: inline-block;"> <table border="1" style="border-collapse: collapse;"> <tr> <td style="padding: 2px;">C</td> <td style="padding: 2px;">Z</td> <td style="padding: 2px;">S</td> <td style="padding: 2px;">O</td> <td style="padding: 2px;">P</td> <td style="padding: 2px;">A</td> </tr> <tr> <td colspan="6" style="padding: 2px;">unchanged</td> </tr> </table> </div> <div style="text-align: right;"></div>	C	Z	S	O	P	A	unchanged					
C	Z	S	O	P	A									
unchanged														
POPF	No operands	<p>Get flags register from the stack.</p> <p>Algorithm:</p> <ul style="list-style-type: none"> • flags = SS:[SP] (top of the stack) • SP = SP + 2 <div style="border: 1px solid black; padding: 2px; display: inline-block;"> <table border="1" style="border-collapse: collapse;"> <tr> <td style="padding: 2px;">C</td> <td style="padding: 2px;">Z</td> <td style="padding: 2px;">S</td> <td style="padding: 2px;">O</td> <td style="padding: 2px;">P</td> <td style="padding: 2px;">A</td> </tr> <tr> <td colspan="6" style="padding: 2px;">popped</td> </tr> </table> </div> <div style="text-align: right;"></div>	C	Z	S	O	P	A	popped					
C	Z	S	O	P	A									
popped														
PUSH	REG SREG memory immediate	<p>Store 16 bit value in the stack.</p> <p>Note: PUSH immediate works only on 80186 CPU and later!</p> <p>Algorithm:</p> <ul style="list-style-type: none"> • SP = SP - 2 • SS:[SP] (top of the stack) = operand <p>Example:</p> <pre>MOV AX, 1234h PUSH AX POP DX ; DX = 1234h RET</pre>												

		<table border="1"> <tr> <td>C</td><td>Z</td><td>S</td><td>O</td><td>P</td><td>A</td> </tr> <tr> <td colspan="6">unchanged</td> </tr> </table> 	C	Z	S	O	P	A	unchanged					
C	Z	S	O	P	A									
unchanged														
PUSHA	No operands	<p>Push all general purpose registers AX, CX, DX, BX, SP, BP, SI, DI in the stack. Original value of SP register (before PUSHA) is used.</p> <p>Note: this instruction works only on 80186 CPU and later!</p> <p>Algorithm:</p> <ul style="list-style-type: none"> • PUSH AX • PUSH CX • PUSH DX • PUSH BX • PUSH SP • PUSH BP • PUSH SI • PUSH DI <table border="1"> <tr> <td>C</td><td>Z</td><td>S</td><td>O</td><td>P</td><td>A</td> </tr> <tr> <td colspan="6">unchanged</td> </tr> </table> 	C	Z	S	O	P	A	unchanged					
C	Z	S	O	P	A									
unchanged														
PUSHF	No operands	<p>Store flags register in the stack.</p> <p>Algorithm:</p> <ul style="list-style-type: none"> • $SP = SP - 2$ • $SS:[SP]$ (top of the stack) = flags <table border="1"> <tr> <td>C</td><td>Z</td><td>S</td><td>O</td><td>P</td><td>A</td> </tr> <tr> <td colspan="6">unchanged</td> </tr> </table> 	C	Z	S	O	P	A	unchanged					
C	Z	S	O	P	A									
unchanged														
		<p>Rotate operand1 left through Carry Flag. The number of rotates is set by operand2. When immediate is greater than 1, assembler generates several RCL xx, 1 instructions because 8086 has machine code only for this instruction (the same principle works for all other shift/rotate instructions).</p> <p>Algorithm:</p>												

RCL	<pre>memory, immediate REG, immediate memory, CL REG, CL</pre>	<p>shift all bits left, the bit that goes off is set to CF and previous value of CF is inserted to the right-most position.</p> <p>Example:</p> <pre>STC ; set carry (CF=1). MOV AL, 1Ch ; AL = 00011100b RCL AL, 1 ; AL = 00111001b, CF=0. RET</pre> <div style="display: flex; align-items: center;"> <table border="1" style="border-collapse: collapse; text-align: center; margin-right: 10px;"> <tr><td>C</td><td>O</td></tr> <tr><td>r</td><td>r</td></tr> </table> <p>OF=0 if first operand keeps original sign.</p> </div> 	C	O	r	r
C	O					
r	r					
RCR	<pre>memory, immediate REG, immediate memory, CL REG, CL</pre>	<p>Rotate operand1 right through Carry Flag. The number of rotates is set by operand2.</p> <p>Algorithm:</p> <p>shift all bits right, the bit that goes off is set to CF and previous value of CF is inserted to the left-most position.</p> <p>Example:</p> <pre>STC ; set carry (CF=1). MOV AL, 1Ch ; AL = 00011100b RCR AL, 1 ; AL = 10001110b, CF=0. RET</pre> <div style="display: flex; align-items: center;"> <table border="1" style="border-collapse: collapse; text-align: center; margin-right: 10px;"> <tr><td>C</td><td>O</td></tr> <tr><td>r</td><td>r</td></tr> </table> <p>OF=0 if first operand keeps original sign.</p> </div> 	C	O	r	r
C	O					
r	r					
		<p>Repeat following MOVSB, MOVSW, LODSB, LODSW, STOSB, STOSW instructions CX times.</p> <p>Algorithm:</p> <pre>check_cx: if CX <> 0 then</pre> <ul style="list-style-type: none"> • do following <u>chain instruction</u> 				

REP	chain instruction	<ul style="list-style-type: none"> • CX = CX - 1 • go back to check_cx <p>else</p> <ul style="list-style-type: none"> • exit from REP cycle <div style="border: 1px solid black; display: inline-block; padding: 2px;">Z</div> <div style="border: 1px solid black; display: inline-block; padding: 2px;">r</div> 
REPE	chain instruction	<p>Repeat following CMPSB, CMPSW, SCASB, SCASW instructions while ZF = 1 (result is Equal), maximum CX times.</p> <p>Algorithm:</p> <p>check_cx:</p> <p>if CX <> 0 then</p> <ul style="list-style-type: none"> • do following <u>chain instruction</u> • CX = CX - 1 • if ZF = 1 then: <ul style="list-style-type: none"> ◦ go back to check_cx else <ul style="list-style-type: none"> ◦ exit from REPE cycle <p>else</p> <ul style="list-style-type: none"> • exit from REPE cycle <p>example: open cmpsb.asm from c:\emu8086\examples</p> <div style="border: 1px solid black; display: inline-block; padding: 2px;">Z</div> <div style="border: 1px solid black; display: inline-block; padding: 2px;">r</div> 
		<p>Repeat following CMPSB, CMPSW, SCASB, SCASW instructions while ZF = 0 (result is Not Equal), maximum CX times.</p> <p>Algorithm:</p> <p>check_cx:</p> <p>if CX <> 0 then</p> <ul style="list-style-type: none"> • do following <u>chain instruction</u>

REPNE	chain instruction	<ul style="list-style-type: none"> • CX = CX - 1 • if ZF = 0 then: <ul style="list-style-type: none"> ◦ go back to check_cx else <ul style="list-style-type: none"> ◦ exit from REPNE cycle <p>else</p> <ul style="list-style-type: none"> • exit from REPNE cycle <div style="border: 1px solid black; display: inline-block; padding: 2px;">Z</div> <div style="border: 1px solid black; display: inline-block; padding: 2px;">r</div> 
REPZ	chain instruction	<p>Repeat following CMPSB, CMPSW, SCASB, SCASW instructions while ZF = 0 (result is Not Zero), maximum CX times.</p> <p>Algorithm:</p> <p>check_cx:</p> <p>if CX <> 0 then</p> <ul style="list-style-type: none"> • do following <u>chain instruction</u> • CX = CX - 1 • if ZF = 0 then: <ul style="list-style-type: none"> ◦ go back to check_cx else <ul style="list-style-type: none"> ◦ exit from REPZ cycle <p>else</p> <ul style="list-style-type: none"> • exit from REPZ cycle <div style="border: 1px solid black; display: inline-block; padding: 2px;">Z</div> <div style="border: 1px solid black; display: inline-block; padding: 2px;">r</div> 
		<p>Repeat following CMPSB, CMPSW, SCASB, SCASW instructions while ZF = 1 (result is Zero), maximum CX times.</p> <p>Algorithm:</p> <p>check_cx:</p> <p>if CX <> 0 then</p>

REPZ	chain instruction	<ul style="list-style-type: none"> do following <u>chain instruction</u> $CX = CX - 1$ if $ZF = 1$ then: <ul style="list-style-type: none"> go back to check_cx else <ul style="list-style-type: none"> exit from REPZ cycle <p>else</p> <ul style="list-style-type: none"> exit from REPZ cycle <div style="border: 1px solid black; padding: 2px; display: inline-block;"> <table style="border-collapse: collapse;"> <tr><td style="border: 1px solid black; padding: 2px;">Z</td></tr> <tr><td style="border: 1px solid black; padding: 2px;">r</td></tr> </table> </div> <div style="text-align: right;"></div>	Z	r										
Z														
r														
RET	No operands or even immediate	<p>Return from near procedure.</p> <p>Algorithm:</p> <ul style="list-style-type: none"> Pop from stack: <ul style="list-style-type: none"> IP if <u>immediate</u> operand is present: <ul style="list-style-type: none"> $SP = SP + \text{operand}$ <p>Example:</p> <pre>ORG 100h ; for COM file. CALL p1 ADD AX, 1 RET ; return to OS. p1 PROC ; procedure declaration. MOV AX, 1234h RET ; return to caller. p1 ENDP</pre> <div style="border: 1px solid black; padding: 2px; display: inline-block;"> <table style="border-collapse: collapse;"> <tr> <td style="border: 1px solid black; padding: 2px;">C</td> <td style="border: 1px solid black; padding: 2px;">Z</td> <td style="border: 1px solid black; padding: 2px;">S</td> <td style="border: 1px solid black; padding: 2px;">O</td> <td style="border: 1px solid black; padding: 2px;">P</td> <td style="border: 1px solid black; padding: 2px;">A</td> </tr> <tr> <td colspan="6" style="border: 1px solid black; padding: 2px;">unchanged</td> </tr> </table> </div> <div style="text-align: right;"></div>	C	Z	S	O	P	A	unchanged					
C	Z	S	O	P	A									
unchanged														
RETF	No operands or even immediate	<p>Return from Far procedure.</p> <p>Algorithm:</p> <ul style="list-style-type: none"> Pop from stack: <ul style="list-style-type: none"> IP CS if <u>immediate</u> operand is present: 												

$$SP = SP + \text{operand}$$


Rotate operand1 left. The number of rotates is set by operand2.

Algorithm:

shift all bits left, the bit that goes off is set to CF and the same bit is inserted to the right-most position.

Example:

```
MOV AL, 1Ch      ; AL = 00011100b
ROL AL, 1       ; AL = 00111000b, CF=0.
RET
```



OF=0 if first operand keeps original sign.



ROL

memory, immediate
REG, immediate

memory, CL
REG, CL

Rotate operand1 right. The number of rotates is set by operand2.

Algorithm:

shift all bits right, the bit that goes off is set to CF and the same bit is inserted to the left-most position.

Example:

```
MOV AL, 1Ch      ; AL = 00011100b
ROR AL, 1       ; AL = 00001110b, CF=0.
RET
```



OF=0 if first operand keeps original sign.





ROR

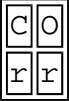

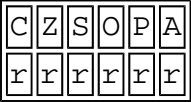

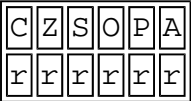

memory, immediate
REG, immediate

memory, CL
REG, CL

Store AH register into low 8 bits of Flags register.

Algorithm:

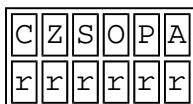
SAHF	No operands	<p>flags register = AH</p> <p>AH bit: 7 6 5 4 3 2 1 0 [SF] [ZF] [0] [AF] [0] [PF] [1] [CF]</p> <p>bits 1, 3, 5 are reserved.</p> <table border="1" data-bbox="691 376 882 477"> <tr><td>C</td><td>Z</td><td>S</td><td>O</td><td>P</td><td>A</td></tr> <tr><td>r</td><td>r</td><td>r</td><td>r</td><td>r</td><td>r</td></tr> </table> 	C	Z	S	O	P	A	r	r	r	r	r	r
C	Z	S	O	P	A									
r	r	r	r	r	r									
SAL	<p>memory, immediate REG, immediate</p> <p>memory, CL REG, CL</p>	<p>Shift Arithmetic operand1 Left. The number of shifts is set by operand2.</p> <p>Algorithm:</p> <ul style="list-style-type: none"> • Shift all bits left, the bit that goes off is set to CF. • Zero bit is inserted to the right-most position. <p>Example:</p> <pre>MOV AL, 0E0h ; AL = 11100000b SAL AL, 1 ; AL = 11000000b, CF=1. RET</pre> <table border="1" data-bbox="691 1173 759 1274"> <tr><td>C</td><td>O</td></tr> <tr><td>r</td><td>r</td></tr> </table> <p>OF=0 if first operand keeps original sign.</p> 	C	O	r	r								
C	O													
r	r													
SAR	<p>memory, immediate REG, immediate</p> <p>memory, CL REG, CL</p>	<p>Shift Arithmetic operand1 Right. The number of shifts is set by operand2.</p> <p>Algorithm:</p> <ul style="list-style-type: none"> • Shift all bits right, the bit that goes off is set to CF. • The sign bit that is inserted to the left-most position has the same value as before shift. <p>Example:</p> <pre>MOV AL, 0E0h ; AL = 11100000b SAR AL, 1 ; AL = 11110000b, CF=0. MOV BL, 4Ch ; BL = 01001100b SAR BL, 1 ; BL = 00100110b, CF=0. RET</pre>												

		 <p>OF=0 if first operand keeps original sign.</p> 
SBB	REG, memory memory, REG REG, REG memory, immediate REG, immediate	<p>Subtract with Borrow.</p> <p>Algorithm:</p> $\text{operand1} = \text{operand1} - \text{operand2} - \text{CF}$ <p>Example:</p> <pre> STC MOV AL, 5 SBB AL, 3 ; AL = 5 - 3 - 1 = 1 RET </pre>  
SCASB	No operands	<p>Compare bytes: AL from ES:[DI].</p> <p>Algorithm:</p> <ul style="list-style-type: none"> • AL - ES:[DI] • set flags according to result: OF, SF, ZF, AF, PF, CF • if DF = 0 then <ul style="list-style-type: none"> ◦ DI = DI + 1 else ◦ DI = DI - 1  
SCASW	No operands	<p>Compare words: AX from ES:[DI].</p> <p>Algorithm:</p> <ul style="list-style-type: none"> • AX - ES:[DI] • set flags according to result: OF, SF, ZF, AF, PF, CF • if DF = 0 then <ul style="list-style-type: none"> ◦ DI = DI + 2


```

else
  o DI = DI - 2

```



Shift operand1 Left. The number of shifts is set by operand2.

Algorithm:

- Shift all bits left, the bit that goes off is set to CF.
- Zero bit is inserted to the right-most position.

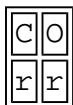
Example:

```

MOV AL, 11100000b
SHL AL, 1          ; AL = 11000000b, CF=1.

```

RET



OF=0 if first operand keeps original sign.



SHL

memory, immediate
REG, immediate

memory, CL
REG, CL

Shift operand1 Right. The number of shifts is set by operand2.

Algorithm:

- Shift all bits right, the bit that goes off is set to CF.
- Zero bit is inserted to the left-most position.

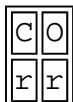
Example:

```

MOV AL, 00000111b
SHR AL, 1          ; AL = 00000011b, CF=1.

```

RET







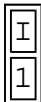

OF=0 if first operand keeps original sign.








SHR



memory, immediate
REG, immediate

memory, CL
REG, CL

STC	No operands	<p>Set Carry flag.</p> <p>Algorithm:</p> $CF = 1$  
STD	No operands	<p>Set Direction flag. SI and DI will be decremented by chain instructions: CMPSB, CMPSW, LODSB, LODSW, MOVSB, MOVSW, STOSB, STOSW.</p> <p>Algorithm:</p> $DF = 1$  
STI	No operands	<p>Set Interrupt enable flag. This enables hardware interrupts.</p> <p>Algorithm:</p> $IF = 1$  
STOSB	No operands	<p>Store byte in AL into ES:[DI]. Update DI.</p> <p>Algorithm:</p> <ul style="list-style-type: none"> • $ES:[DI] = AL$ • if $DF = 0$ then <ul style="list-style-type: none"> ◦ $DI = DI + 1$ else <ul style="list-style-type: none"> ◦ $DI = DI - 1$ <p>Example:</p> <pre>ORG 100h LEA DI, a1</pre>

		<pre>MOV AL, 12h MOV CX, 5 REP STOSB RET a1 DB 5 dup(0)</pre> <div style="border: 1px solid black; padding: 2px; display: inline-block;"> <table border="1" style="border-collapse: collapse;"> <tr> <td style="padding: 2px;">C</td> <td style="padding: 2px;">Z</td> <td style="padding: 2px;">S</td> <td style="padding: 2px;">O</td> <td style="padding: 2px;">P</td> <td style="padding: 2px;">A</td> </tr> <tr> <td colspan="6" style="padding: 2px; text-align: center;">unchanged</td> </tr> </table> </div> <div style="text-align: right; margin-top: 10px;"></div>	C	Z	S	O	P	A	unchanged					
C	Z	S	O	P	A									
unchanged														
STOSW	No operands	<p>Store word in AX into ES:[DI]. Update DI.</p> <p>Algorithm:</p> <ul style="list-style-type: none"> • ES:[DI] = AX • if DF = 0 then <ul style="list-style-type: none"> ◦ DI = DI + 2 else <ul style="list-style-type: none"> ◦ DI = DI - 2 <p>Example:</p> <pre>ORG 100h LEA DI, a1 MOV AX, 1234h MOV CX, 5 REP STOSW RET a1 DW 5 dup(0)</pre> <div style="border: 1px solid black; padding: 2px; display: inline-block;"> <table border="1" style="border-collapse: collapse;"> <tr> <td style="padding: 2px;">C</td> <td style="padding: 2px;">Z</td> <td style="padding: 2px;">S</td> <td style="padding: 2px;">O</td> <td style="padding: 2px;">P</td> <td style="padding: 2px;">A</td> </tr> <tr> <td colspan="6" style="padding: 2px; text-align: center;">unchanged</td> </tr> </table> </div> <div style="text-align: right; margin-top: 10px;"></div>	C	Z	S	O	P	A	unchanged					
C	Z	S	O	P	A									
unchanged														
SUB	<p>REG, memory memory, REG REG, REG memory, immediate REG, immediate</p>	<p>Subtract.</p> <p>Algorithm:</p> $\text{operand1} = \text{operand1} - \text{operand2}$ <p>Example:</p> <pre>MOV AL, 5 SUB AL, 1 ; AL = 4 RET</pre>												

		<table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td>C</td><td>Z</td><td>S</td><td>O</td><td>P</td><td>A</td> </tr> <tr> <td>r</td><td>r</td><td>r</td><td>r</td><td>r</td><td>r</td> </tr> </table> 	C	Z	S	O	P	A	r	r	r	r	r	r
C	Z	S	O	P	A									
r	r	r	r	r	r									
TEST	REG, memory memory, REG REG, REG memory, immediate REG, immediate	<p>Logical AND between all bits of two operands for flags only. These flags are effected: ZF, SF, PF. Result is not stored anywhere.</p> <p>These rules apply:</p> <pre> 1 AND 1 = 1 1 AND 0 = 0 0 AND 1 = 0 0 AND 0 = 0 </pre> <p>Example:</p> <pre> MOV AL, 00000101b TEST AL, 1 ; ZF = 0. TEST AL, 10b ; ZF = 1. RET </pre> <table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td>C</td><td>Z</td><td>S</td><td>O</td><td>P</td> </tr> <tr> <td>0</td><td>r</td><td>r</td><td>0</td><td>r</td> </tr> </table> 	C	Z	S	O	P	0	r	r	0	r		
C	Z	S	O	P										
0	r	r	0	r										
XCHG	REG, memory memory, REG REG, REG	<p>Exchange values of two operands.</p> <p>Algorithm:</p> <pre> operand1 < - > operand2 </pre> <p>Example:</p> <pre> MOV AL, 5 MOV AH, 2 XCHG AL, AH ; AL = 2, AH = 5 XCHG AL, AH ; AL = 5, AH = 2 RET </pre> <table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td>C</td><td>Z</td><td>S</td><td>O</td><td>P</td><td>A</td> </tr> <tr> <td colspan="6" style="text-align: center;">unchanged</td> </tr> </table> 	C	Z	S	O	P	A	unchanged					
C	Z	S	O	P	A									
unchanged														
		<p>Translate byte from table. Copy value of memory byte at DS:[BX + unsigned AL] to AL register.</p> <p>Algorithm:</p>												

XLATB	No operands	<p>AL = DS:[BX + unsigned AL]</p> <p>Example:</p> <pre> ORG 100h LEA BX, dat MOV AL, 2 XLATB ; AL = 33h RET dat DB 11h, 22h, 33h, 44h, 55h </pre> <table border="1" data-bbox="691 593 880 689"> <tr> <td>C</td><td>Z</td><td>S</td><td>O</td><td>P</td><td>A</td> </tr> <tr> <td colspan="6">unchanged</td> </tr> </table> 	C	Z	S	O	P	A	unchanged					
C	Z	S	O	P	A									
unchanged														
XOR	<p>REG, memory memory, REG REG, REG memory, immediate REG, immediate</p>	<p>Logical XOR (Exclusive OR) between all bits of two operands. Result is stored in first operand.</p> <p>These rules apply:</p> <pre> 1 XOR 1 = 0 1 XOR 0 = 1 0 XOR 1 = 1 0 XOR 0 = 0 </pre> <p>Example:</p> <pre> MOV AL, 00000111b XOR AL, 00000101b ; AL = 00000101b RET </pre> <table border="1" data-bbox="691 1422 880 1518"> <tr> <td>C</td><td>Z</td><td>S</td><td>O</td><td>P</td><td>A</td> </tr> <tr> <td>0</td><td>r</td><td>r</td><td>0</td><td>r</td><td>?</td> </tr> </table> 	C	Z	S	O	P	A	0	r	r	0	r	?
C	Z	S	O	P	A									
0	r	r	0	r	?									