8088 Instruction Set (Courtesy of Intel Corp.)

Table A-2. Key to Flag Codes

Code	Meaning
1	unconditionally set
0	unconditionally cleared
X	altered to reflect operation result
U	undefined (mask it out)
R	replaced from memory (e.g., SAHF)
b	(blank) unaffected

INSTRUCTION-SET TABLES

AAA	AAA (no operands) ASCII adjust for addition			Flags	OD I T S Z A P C U U U X U X
Operands	**Clocks**	**Transfers***	**Bytes**	**Coding Example**	
(no operands)	4	—	1	AAA	

AAD	AAD (no operands) ASCII adjust for division			Flags	OD I T S Z A P C U X X U X U
Operands	**Clocks**	**Transfers***	**Bytes**	**Coding Example**	
(no operands)	60	—	2	AAD	

AAM	AAM (no operands) ASCII adjust for multiply			Flags	OD I T S Z A P C U X X U X U
Operands	**Clocks**	**Transfers***	**Bytes**	**Coding Example**	
(no operands)	83	—	1	AAM	

AAS	AAS (no operands) ASCII adjust for subtraction			Flags	OD I T S Z A P C U U U X U X
Operands	**Clocks**	**Transfers***	**Bytes**	**Coding Example**	
(no operands)	4	—	1	AAS	

* For the 8086, add four clocks for each 16-bit word transfer with an odd address. For the 8088, add four clocks for each 16-bit word transfer.

ADC	ADC destination,source Add with carry			Flags O D I T S Z A P C X X X X X
Operands	**Clocks**	**Transfers***	**Bytes**	**Coding Example**
register, register	3	—	2	ADC AX, SI
register, memory	9+EA	1	2-4	ADC DX, BETA [SI]
memory, register	16+EA	2	2-4	ADC ALPHA [BX] [SI], DI
register, immediate	4	—	3-4	ADC BX, 256
memory, immediate	17+EA	2	3-6	ADC GAMMA, 30H
accumulator, immediate	4	—	2-3	ADC AL, 5

ADD	ADD destination,source Addition			Flags O D I T S Z A P C X X X X X
Operands	**Clocks**	**Transfers***	**Bytes**	**Coding Example**
register, register	3	—	2	ADD CX, DX
register, memory	9+EA	1	2-4	ADD DI, [BX], ALPHA
memory, register	16+EA	2	2-4	ADD TEMP, CL
register, immediate	4	—	3-4	ADD CL, 2
memory, immediate	17+EA	2	3-6	ADD ALPHA, 2
accumulator, immediate	4	—	2-3	ADD AX, 200

AND	AND destination,source Logical AND			Flags O D I T S Z A P C 0 X X U X 0
Operands	**Clocks**	**Transfers***	**Bytes**	**Coding Example**
register, register	3	—	2	AND AL, BL
register, memory	9+EA	1	2-4	AND CX, FLAG_WORD
memory, register	16+EA	2	2-4	AND ASCII [DI],AL
register, immediate	4	—	3-4	AND CX0, F0H
memory, immediate	17+EA	2	3-6	AND BETA, 01H
accumulator, immediate	4	—	2-3	AND AX, 01010000B

CALL	CALL target Call a procedure			Flags O D I T S Z A P C
Operands	**Clocks**	**Transfers***	**Bytes**	**Coding Examples**
near-proc	19	1	3	CALL NEAR_PROC
far-proc	28	2	5	CALL FAR_PROC
memptr 16	21+EA	2	2-4	CALL PROC_TABLE [SI]
regptr 16	16	1	2	CALL AX
memptr 32	37+EA	4	2-4	CALL [BX], TASK [SI]

* For the 8086, add four clocks for each 16-bit word transfer with an odd address. For the 8088, add four clocks for each 16-bit word transfer.

CBW	CBW (no operands) Convert byte to word			Flags ODITSZAPC
Operands	Clocks	Transfers*	Bytes	Coding Example
(no operands)	2	—	1	CBW

CLC	CLC (no operands) Clear carry flag			Flags ODITSZAPC 0
Operands	Clocks	Transfers*	Bytes	Coding Example
(no operands)	2	—	1	CLC

CLD	CLD (no operands) Clear direction flag			Flags ODITSZAPC 0
Operands	Clocks	Transfers*	Bytes	Coding Example
(no operands)	2	—	1	CLD

CLI	CLI (no operands) Clear interrupt flag			Flags ODITSZAPC 0
Operands	Clocks	Transfers*	Bytes	Coding Example
(no operands)	2	—	1	CLI

CMC	CMC (no operands) Complement carry flag			Flags ODITSZAPC X
Operands	Clocks	Transfers*	Bytes	Coding Example
(no operands)	2	—	1	CMC

CMP	CMP destination,source Compare destination to source			Flags ODITSZAPC X XXXXX
Operands	Clocks	Transfers*	Bytes	Coding Example
register, register	3	—	2	CMP BX, CX
register, memory	9+EA	1	2-4	CMP DH, ALPHA
memory, register	9+EA	1	2-4	CMP [BP+2],SI
register, immediate	4	—	3-4	CMP BL, 02H
memory, immediate	10+EA	1	3-6	CMP [BX].RADAR [DI], 3420H
accumulator, immediate	4	—	2-3	CMP AL, 00010000B

* For the 8086, add four clocks for each 16-bit word transfer with an odd address. For the 8088, add four clocks for each 16-bit word transfer.

CMPS	CMPS dest-string,source-string Compare string			Flags O D I T S Z A P C X X X X X
Operands	**Clocks**	**Transfers***	**Bytes**	**Coding Example**
dest-string, source-string	22	2	1	CMPS BUFF1, BUFF2
(repeat) dest-string, source-string	9+22/rep	2/rep	1	REPE CMPS ID, KEY

CWD	CWD (no operands) Convert word to doubleword			Flags O D I T S Z A P C
Operands	**Clocks**	**Transfers***	**Bytes**	**Coding Example**
(no operands)	5	—	1	CWD

DAA	DAA (no operands) Decimal adjust for addition			Flags O D I T S Z A P C X X X X X
Operands	**Clocks**	**Transfers***	**Bytes**	**Coding Example**
(no operands)	4	—	1	DAA

DAS	DAS (no operands) Decimal adjust for subtraction			Flags O D I T S Z A P C U X X X X X
Operands	**Clocks**	**Transfers***	**Bytes**	**Coding Example**
(no operands)	4	—	1	DAS

DEC	DEC destination Decrement by 1			Flags O D I T S Z A P C X X X X
Operands	**Clocks**	**Transfers***	**Bytes**	**Coding Example**
reg16	2	—	1	DEC AX
reg8	3	—	2	DEC AL
memory	15+EA	2	2-4	DEC ARRAY [SI]

DIV	DIV source Division,unsigned			Flags O D I T S Z A P C U U U U U
Operands	**Clocks**	**Transfers***	**Bytes**	**Coding Example**
reg8	80-90	—	2	DIV CL
reg16	144-162	—	2	DIV BX
mem8	(86-96)+EA	1	2-4	DIV ALPHA
mem16	(150-168)+EA	1	2-4	DIV TABLE [SI]

* For the 8086, add four clocks for each 16-bit word transfer with an odd address. For the 8088, add four clocks for each 16-bit word transfer.

ESC	ESC external-opcode,source Escape			Flags ODITSZAPC
Operands	**Clocks**	**Transfers***	**Bytes**	**Coding Example**
immediate, memory	8+EA	1	2-4	ESC 6,ARRAY [SI]
immediate, register	2	—	2	ESC 20,AL

HLT	HLT (no operands) Halt			Flags ODITSZAPC
Operands	**Clocks**	**Transfers***	**Bytes**	**Coding Example**
(no operands)	2	—	1	HLT

IDIV	IDIV source Integer division			Flags ODITSZAPC U UUUUU
Operands	**Clocks**	**Transfers***	**Bytes**	**Coding Example**
reg8	101-112	—	2	IDIV BL
reg16	165-184	—	2	IDIV CX
mem8	(107-118) +EA	1	2-4	IDIV DIVISOR BYTE [SI]
mem16	(171-190) +EA	1	2-4	IDIV [BX]. DIVI- SOR_WORD

IMUL	IMUL source Integer multiplication			Flags ODITSZAPC X UUUUX
Operands	**Clocks**	**Transfers***	**Bytes**	**Coding Example**
reg8	80-98	—	2	IMUL CL
reg16	128-154	—	2	IMUL BX
mem8	(86-104) +EA	1	2-4	IMUL RATE_BYTE
mem16	(134-160) +EA	1	2-4	IMUL RATE_WORD [BP]+ [DI]

IN	IN accumulator,port Input byte or word			Flags ODITSZAPC
Operands	**Clocks**	**Transfers***	**Bytes**	**Coding Example**
accumulator, immed8	10	1	2	IN AL, 0FFEAH
accumulator, DX	8	1	1	IN AX, DX

* For the 8086, add four clocks for each 16-bit word transfer with an odd address. For the 8088, add four clocks for each 16-bit word transfer.

INC	INC destination Increment by 1			Flags O D I T S Z A P C X X X X X
Operands	Clocks	Transfers*	Bytes	Coding Example
reg16	2	—	1	INC CX
reg8	3	—	2	INC BL
memory	15+EA	2	2-4	INC ALPHA [DI] [BX]

INT	INT interrupt-type interrupt			Flags O D I T S Z A P C 0 0
Operands	Clocks	Transfers*	Bytes	Coding Example
Immed8 (type=3)	52	5	1	INT 3
Immed8 (type≠3)	51	5	2	INT 67

INTR	INTR (external maskable interrupt) Interrupt if INTR and IF=1			Flags O D I T S Z A P C 0 0
Operands	Clocks	Transfers*	Bytes	Coding Example
(no operands)	61	7	N/A	N/A

INTO	INTO (no operands) Interrupt if overflow			Flags O D I T S Z A P C 0 0
Operands	Clocks	Transfers*	Bytes	Coding Example
(no operands)	53 or 4	5	1	INTO

IRET	IRET (no operands) Interrupt Return			Flags O D I T S Z A P C R R R R R R R R R
Operands	Clocks	Transfers*	Bytes	Coding Example
(no operands)	24	3	1	IRET

JA/JNBE	JA/JNBE short-label Jump if above/Jump if not below nor equal			Flags O D I T S Z A P C
Operands	Clocks	Transfers*	Bytes	Coding Example
short-label	16 or 4	—	2	JA ABOVE

* For the 8086, add four clocks for each 16-bit word transfer with an odd address. For the 8088, add four clocks for each 16-bit word transfer.

JAE/JNB	JAE/JNB short-label Jump if above or equal/Jump if not below			Flags ODITSZA
Operands	**Clocks**	**Transfers***	**Bytes**	**Coding Example**
short-label	16 or 4	—	2	JAE ABOVE_EQUAL

JB/JNAE	JB/JNAE short-label Jump if below/Jump if not above nor equal			Flags ODITSZAI
Operands	**Clocks**	**Transfers***	**Bytes**	**Coding Example**
short-label	16 or 4	—	2	JB BELOW

JBE/JNA	JBE/JNA short-label Jump if below or equal/Jump if not above			Flags ODITSZAP
Operands	**Clocks**	**Transfers***	**Bytes**	**Coding Example**
short-label	16 or 4	—	2	JNA NOT ABOVE

JC	JC short-label Jump if carry			Flags ODITSZAP
Operands	**Clocks**	**Transfers***	**Bytes**	**Coding Example**
short-label	16 or 4	—	2	JC CARRY SET

JCXZ	JCXZ short-label Jump if CX is zero			Flags ODITSZAP
Operands	**Clocks**	**Transfers***	**Bytes**	**Coding Example**
short-label	18 or 6	—	2	JCXZ COUNT DONE

JE/JZ	JE/JZ short-label Jump if equal/Jump if zero			Flags ODITSZAP
Operands	**Clocks**	**Transfers***	**Bytes**	**Coding Example**
short-label	16 or 4	—	2	JZ ZERO

* For the 8086, add four clocks for each 16-bit word transfer with an odd address. For the 8088, add four clocks for each 16-bit word transfer.

JG/JNLE	JG/JNLE short-label Jump if greater/Jump if not less nor equal			Flags ODITSZAPC
Operands	**Clocks**	**Transfers***	**Bytes**	**Coding Example**
short-label	16 or 4	—	2	JG GREATER

JGE/JNL	JGE/JNL short-label Jump if greater or equal/ Jump if not less			Flags ODITSZAPC
Operands	**Clocks**	**Transfers***	**Bytes**	**Coding Example**
short-label	16 or 4	—	2	JGE GREATER EQUAL

JL/JNGE	JL/JNGE short-label Jump if less/Jump if not greater nor equal			Flags ODITSZAPC
Operands	**Clocks**	**Transfers***	**Bytes**	**Coding Example**
short-label	16 or 4	—	2	JL LESS

JLE/JNG	JLE/JNG short-label Jump if less or equal/Jump if not greater			Flags ODITSZAPC
Operands	**Clocks**	**Transfers***	**Bytes**	**Coding Example**
short-label	16 or 4	—	2	JNG NOT GREATER

JMP	JMP target Jump			Flags ODITSZAPC
Operands	**Clocks**	**Transfers***	**Bytes**	**Coding Example**
short-label	15	—	2	JMP SHORT
near-label	15	—	3	JMP WITHIN SEGMENT
far-label	15	—	5	JMP FAR LABEL
memptr16	18+EA	1	2-4	JMP [BX].TARGET
regptr16	11	—	2	JMP CX
memptr32	24+EA	2	2-4	JMP OTHER.SEG [SI]

JNC	JNC short-label Jump if not carry			Flags ODITSZAPC
Operands	**Clocks**	**Transfers***	**Bytes**	**Coding Example**
short-label	16 or 4	—	2	JNC NOT CARRY

* For the 8086, add four clocks for each 16-bit word transfer with an odd address. For the 8088, add four clocks for each 16-bit word transfer.

JNE/JNZ	JNE/JNZ short-label Jump if not equal/Jump if not zero			Flags ODITSZAP(
Operands	**Clocks**	**Transfers***	**Bytes**	**Coding Example**
short-label	16 or 4	—	2	JNE NOT EQUAL

JNO	JNO short-label Jump if not overflow			Flags ODITSZAP(
Operands	**Clocks**	**Transfers***	**Bytes**	**Coding Example**
short-label	16 or 4	—	2	JNO NO OVERFLOW

JNP/JPO	JNP/JPO short-label Jump if not parity/Jump if parity odd			Flags ODITSZAPC
Operands	**Clocks**	**Transfers***	**Bytes**	**Coding Example**
short-label	16 or 4	—	2	JPO ODD PARITY

JNS	JNS short-label Jump if not sign			Flags ODITSZAPC
Operands	**Clocks**	**Transfers***	**Bytes**	**Coding Example**
short-label	16 or 4	—	2	JNS POSITIVE

JO	JO short-label Jump if overflow			Flags ODITSZAPC
Operands	**Clocks**	**Transfers***	**Bytes**	**Coding Example**
short-label	16 or 4	—	2	JO SIGNED_OVRFLW

JP/JPE	JP/JPE short-label Jump if parity/Jump if parity even			Flags ODITSZAPC
Operands	**Clocks**	**Transfers***	**Bytes**	**Coding Example**
short-label	16 or 4	—	2	JPE EVEN_PARITY

* For the 8086, add four clocks for each 16-bit word transfer with an odd address. For the 8088, add four clocks for each 16-bit word transfer.

JS	JS short-label Jump if sign			Flags ODITSZAPC
Operands	Clocks	Transfers*	Bytes	Coding Example
short-label	16 or 4	—	2	JS NEGATIVE

LAHF	LAHF (no operands) Load AH from flags			Flags ODITSZAPC
Operands	Clocks	Transfers*	Bytes	Coding Example
(no operands)	4	—	1	LAHF

LDS	LDS destination,source Load pointer using DS			Flags ODITSZAPC
Operands	Clocks	Transfers*	Bytes	Coding Example
reg16, mem32	16+EA	2	2-4	LDS SI,DATA,SEG [DI]

LOCK	LOCK (no operands) Lock bus			Flags ODITSZAPC
Operands	Clocks	Transfers*	Bytes	Coding Example
(no operands)	2	—	1	LOCK XCHG FLAG,AL

LODS	LODS source-string Load string			Flags ODITSZAPC
Operands	Clocks	Transfers*	Bytes	Coding Example
source-string (repeat) source-string	12 9+13/rep	1 1/rep	1 1	LODS CUSTOMER NAME REP LODS NAME

LOOP	LOOP short-label Loop			Flags ODITSZAPC
Operands	Clocks	Transfers*	Bytes	Coding Example
short-label	17/5	—	2	LOOP AGAIN

* For the 8086, add four clocks for each 16-bit word transfer with an odd address. For the 8088, add four clocks for each 16-bit word transfer.

It will exit the loop if the condition is not equal OR if CX = 0

LOOPE/ LOOPZ	LOOPE/LOOPZ short-label Loop if equal/Loop if zero			Flags ODITSZAPC
Operands	Clocks	Transfers*	Bytes	Coding Example
short-label	18 or 6	—	2	LOOPE AGAIN

will exit if cond. equal & CX = 0

LOOPNE/ LOOPNZ	LOOPNE/LOOPNZ short-label Loop if not equal/Loop if not zero			Flags ODITSZAPC
Operands	Clocks	Transfers*	Bytes	Coding Example
short-label	19 or 5	—	2	LOOPNE AGAIN

LEA	LEA destination,source Load effective address			Flags ODITSZAPC
Operands	Clocks	Transfers*	Bytes	Coding Example
reg16, mem16	2+EA	—	2-4	LEA BX, [BP] [DI]

LES	LES destination,source Load pointer using ES			Flags ODITSZAPC
Operands	Clocks	Transfers*	Bytes	Coding Example
reg16, mem32	16+EA	2	2-4	LES DI, [BX], TEXT_BUFF

NMI	NMI (external nonmaskable interrupt) Interrupt if NMI = 1			Flags ODITSZAPC 00
Operands	Clocks	Transfers*	Bytes	Coding Example
(no operands)	50	5	N/A	N/A

* For the 8086, add four clocks for each 16-bit word transfer with an odd address. For the 8088, add four clocks for each 16-bit word transfer.

MOV	MOV destination,source Move			Flags ODITSZAPC
Operands	Clocks	Transfers*	Bytes	Coding Example
memory, accumulator	10	1	3	MOV ARRAY [SI], AL
accumulator, memory	10	1	3	MOV AX, TEMP_RESULT
register, register	2	—	2	MOV AX,CX
register, memory	8+EA	1	2-4	MOV BP, STACK_TOP
memory, register	9+EA	1	2-4	MOV COUNT [DI], CX
register, immediate	4	—	2-3	MOV CL, 2
memory, immediate	10+EA	1	3-6	MOV MASK [BX] [SI], 2 CH
seg-reg, reg16	2	—	2	MOV ES, CX
seg-reg, mem16	8+EA	1	2-4	MOV DS, SEGMENT_BASE
reg16, seg-reg	2	—	2	MOV BP, SS
memory, seg-reg	9+EA	1	2-4	MOV [BX], SEG_SAVE, CS

MOVS	MOVS dest-string,source-string Move string			Flags ODITSZAPC
Operands	Clocks	Transfers*	Bytes	Coding Example
dest-string, source-string	18	2	1	MOVS LINE,EDIT_DATA
(repeat) dest-string, source-string	9+17/rep	2/rep	1	REP MOVS SCREEN, BUFFER

MOVSB/MOVSW	MOVSB/MOVSW (no operands) Move string (byte/word)			Flags ODITSZAPC
Operands	Clocks	Transfers*	Bytes	Coding Example
(no operands)	18	2	1	MOVSB
(repeat) (no operands)	9+17/rep	2/rep	1	REP MOVSW

MUL	MUL source Multiplication, unsigned			Flags ODITSZAPC X UUUUX
Operands	Clocks	Transfers*	Bytes	Coding Example
reg8	70-77	—	2	MUL BL
reg16	118-133	—	2	MUL CX
mem8	(76-83)+EA	1	2-4	MUL MONTH [SI]
mem16	(124-139)+EA	1	2-4	MUL BAUD_RATE

* For the 8086, add four clocks for each 16-bit word transfer with an odd address. For the 8088, add four clocks for each 16-bit word transfer.

NEG	NEG destination Negate			Flags ODITSZAPC X XXXX1*
Operands	Clocks	Transfers*	Bytes	Coding Example
register	3	—	2	NEG AL
memory	16+EA	2	2-4	NEG MULTIPLIER

*0 if destination = 0

NOP	NOP (no operands) No Operation			Flags ODITSZAPC
Operands	Clocks	Transfers*	Bytes	Coding Example
(no operands)	3	—	1	NOP

NOT	NOT destination Logical NOT			Flags ODITSZAPC
Operands	Clocks	Transfers*	Bytes	Coding Example
register	3	—	2	NOT AX
memory	16+EA	2	2-4	NOT CHARACTER

OR	OR destination,source Logical inclusive OR			Flags ODITSZAPC 0 XXUX0
Operands	Clocks	Transfers*	Bytes	Coding Example
register, register	3	—	2	OR AL, BL
register, memory	9+EA	1	2-4	OR DX, PORT ID [DI]
memory, register	16+EA	2	2-4	OR FLAG BYTE, CL
accumulator, immediate	4	—	2-3	OR AL,0110110B
register, immediate	4	—	3-4	OR CX,01FH
memory, immediate	17+EA	2	3-6	OR [BX] CMD WORD,0CFH

OUT	OUT port,accumulator Output byte or word			Flags ODITSZAPC
Operands	Clocks	Transfers*	Bytes	Coding Example
immed8, accumulator	10	1	2	OUT 44, AX
DX, accumulator	8	1	1	OUT DX, AL

* For the 8086, add four clocks for each 16-bit word transfer with an odd address. For the 8088, add four clocks for each 16-bit word transfer.

POP	POP destination Pop word off stack			Flags ODITSZAPC
Operands	**Clocks**	**Transfers***	**Bytes**	**Coding Example**
register	8	1	1	POP DX
seg-reg (CS illegal)	8	1	1	POP DS
memory	17+EA	2	2-4	POP PARAMETER

POPF	POPF (no operands) Pop flags off stack			Flags ODITSZAPC RRRRRRRRR
Operands	**Clocks**	**Transfers***	**Bytes**	**Coding Example**
(no operands)	8	1	1	POPF

PUSH	PUSH source Push word onto stack			Flags ODITSZAPC
Operands	**Clocks**	**Transfers***	**Bytes**	**Coding Example**
register	11	1	1	PUSH SI
seg-reg (CS legal)	10	1	1	PUSH ES
memory	16+EA	2	2-4	PUSH RETURN CODE [SI]

PUSHF	PUSHF (no operands) Push flags onto stack			Flags ODITSZAPC
Operands	**Clocks**	**Transfers***	**Bytes**	**Coding Example**
(no operands)	10	1	1	PUSHF

RCL	RCL destination,count Rotate left through carry			Flags ODITSZAPC X X
Operands	**Clocks**	**Transfers***	**Bytes**	**Coding Example**
register, 1	2	—	2	RCL CX,1
register, CL	8+4/bit	—	2	RCL AL, CL
memory, 1	15+EA	2	2-4	RCL ALPHA, 1
memory, CL	20+EA+4/bit	2	2-4	RCL [BP], PARM, CL

* For the 8086, add four clocks for each 16-bit word transfer with an odd address. For the 8088, add four clocks for each 16-bit word transfer.

RCR	RCR destination,count Rotate right through carry			Flags O D I T S Z A P C X X
Operands	**Clocks**	**Transfers***	**Bytes**	**Coding Example**
register, 1	2	—	2	RCR BX, 1
register, CL	8+4/bit	—	2	RCR BL, CL
memory, 1	15+EA	2	2-4	RCR [BX], STATUS, 1
memory, CL	20+EA+4/bit	2	2-4	RCR ARRAY [DI], CL

REP	REP (no operands) Repeat string operation			Flags O D I T S Z A P C
Operands	**Clocks**	**Transfers***	**Bytes**	**Coding Example**
(no operands)	2	—	1	REP MOVS DEST, SRCE

REPE/REPZ	REPE/REPZ (no operands) Repeat string operation while equal/while zero			Flags O D I T S Z A P C
Operands	**Clocks**	**Transfers***	**Bytes**	**Coding Example**
(no operands)	2	—	1	REPE CMPS DATA, KEY

REPNE/ REPNZ	REPNE/REPNZ (no operands) Repeat string operation while not equal/not zero			Flags O D I T S Z A P C
Operands	**Clocks**	**Transfers***	**Bytes**	**Coding Example**
(no operands)	2	—	1	REPNE SCAS INPUT LINE

RET	RET optional-pop-value Return from procedure			Flags O D I T S Z A P C
Operands	**Clocks**	**Transfers***	**Bytes**	**Coding Example**
(intra-segment, no pop)	8	1	1	RET
(intra-segment, pop)	12	1	3	RET 4
(inter-segment, no pop)	18	2	1	RET
(inter-segment, pop)	17	2	3	RET 2

* For the 8086, add four clocks for each 16-bit word transfer with an odd address. For the 8088, add four clocks for each 16-bit word transfer.

ROL	ROL destination,count Rotate left			Flags O D I T S Z A P C X X
Operands	**Clocks**	**Transfers***	**Bytes**	**Coding Example**
register, 1	2	—	2	ROL BX, 1
register, CL	8+4/bit	—	2	ROL DI, CL
memory, 1	15+EA	2	2-4	ROL FLAG BYTE [DI], 1
memory, CL	20+EA+4/bit	2	2-4	ROL ALPHA, CL

ROR	ROR destination,count Rotate right			Flags O D I T S Z A P C X X
Operands	**Clocks**	**Transfers***	**Bytes**	**Coding Example**
register, 1	2	—	2	ROR AL, 1
register, CL	8+4/bit	—	2	ROR BX, CL
memory, 1	15+EA	2	2-4	ROR PORT STATUS, 1
memory, CL	20+EA+4/bit	2	2-4	ROR CMD WORD, CL

SAHF	SAHF (no operands) Store AH into flags			Flags O D I T S Z A P C R R R R R
Operands	**Clocks**	**Transfers***	**Bytes**	**Coding Example**
(no operands)	4	—	1	SAHF

SAL/SHL	SAL/SHL destination,count Shift arithmetic left/Shift logical left			Flags O D I T S Z A P C X X
Operands	**Clocks**	**Transfers***	**Bytes**	**Coding Example**
register, 1	2	—	2	SAL AL, 1
register, CL	8+4/bit	—	2	SHL DI, CL
memory, 1	15+EA	2	2-4	SHL [BX], OVERDRAW, 1
memory, CL	20+EA+4/bit	2	2-4	SAL STORE_COUNT, CL

SAR	SAR destination,source Shift arithmetic right			Flags O D I T S Z A P C X X X U X X
Operands	**Clocks**	**Transfers***	**Bytes**	**Coding Example**
register, 1	2	—	2	SAR DX, 1
register, CL	8+4/bit	—	2	SAR DI, CL
memory, 1	15+EA	2	2-4	SAR N BLOCKS, 1
memory, CL	20+EA+4/bit	2	2-4	SAR N BLOCKS, CL

* For the 8086, add four clocks for each 16-bit word transfer with an odd address. For the 8088, add four clocks for each 16-bit word transfer.

SBB	SBB destination,source Subtract with borrow			Flags O D I T S Z A P C X X X X X
Operands	**Clocks**	**Transfers***	**Bytes**	**Coding Example**
register, register	3	—	2	SBB BX, CX
register, memory	9+EA	1	2-4	SBB DI, [BX], PAYMENT
memory, register	16+EA	2	2-4	SBB BALANCE, AX
accumulator, immediate	4	—	2-3	SBB AX, 2
register, immediate	4	—	3-4	SBB CL, 1
memory, immediate	17+EA	2	3-6	SBB COUNT [SI], 10

SCAS	SCAS dest-string Scan string			Flags O D I T S Z A P C X X X X X
Operands	**Clocks**	**Transfers***	**Bytes**	**Coding Example**
dest-string	15	1	1	SCAS INPUT LINE
(repeat) dest-string	9+15/rep	1/rep	1	REPNE SCAS BUFFER

SHR	SHR destination,count Shift logical right			Flags O D I T S Z A P C X X
Operands	**Clocks**	**Transfers***	**Bytes**	**Coding Example**
register, 1	2	—	2	SHR SI, 1
register, CL	8+4/bit	—	2	SHR SI, CL
memory, 1	15+EA	2	2-4	SHR ID BYTE [SI] [BX], 1
memory, CL	20+EA+4/bit	2	2-4	SHR INPUT WORD, CL

SINGLE STEP	SINGLE STEP (Trap flag interrupt) Interrupt if TF = 1			Flags O D I T S Z A P C 0 0
Operands	**Clocks**	**Transfers***	**Bytes**	**Coding Example**
(no operands)	50	5	N/A	N/A

STC	STC (no operands) Set carry flag			Flags O D I T S Z A P C 1
Operands	**Clocks**	**Transfers***	**Bytes**	**Coding Example**
(no operands)	2	—	1	STC

* For the 8086, add four clocks for each 16-bit word transfer with an odd address. For the 8088, add four clocks for each 16-bit word transfer.

STD	STD (no operands) Set direction flag			Flags ODITSZAPC 1
Operands	Clocks	Transfers*	Bytes	Coding Example
(no operands)	2	—	1	STD

STI	STI (no operands) Set interrupt enable flag			Flags ODITSZAPC 1
Operands	Clocks	Transfers*	Bytes	Coding Example
(no operands)	2	—	1	STI

STOS	STOS dest-string Store byte or word string			Flags ODITSZAPC
Operands	Clocks	Transfers*	Bytes	Coding Example
dest-string (repeat) dest-string	11 9+10/ rep	1 1/rep	1 1	STOS PRINT LINE REP STOS DISPLAY

SUB	SUB destination,source Subtraction			Flags ODITSZAPC X XXXXX
Operands	Clocks	Transfers*	Bytes	Coding Example
register, register	3	—	2	SUB CX, BX
register, memory	9+EA	1	2-4	SUB DX, MATH TOTAL [SI]
memory, register	16+EA	2	2-4	SUB [BP+2], CL
accumulator, immediate	4	—	2-3	SUB AL, 10
register, immediate	4	—	3-4	SUB SI, 5280
memory, immediate	17+EA	2	3-6	SUB [BP], BALANCE, 1000

TEST	TEST destination,source Test or nondestructive logical AND			Flags ODITSZAPC 0 XXUX0
Operands	Clocks	Transfers*	Bytes	Coding Example
register, register	3	—	2	TEST SI, DI
register, memory	9+EA	1	2-4	TEST SI, END COUNT
accumulator, immediate	4	—	2-3	TEST AL, 00100000B
register, immediate	5	—	3-4	TEST BX, 0CC4H
memory, immediate	11+EA	—	3-6	TEST RETURN CODE, 01H

* For the 8086, add four clocks for each 16-bit word transfer with an odd address. For the 8088, add four clocks for each 16-bit word transfer.

WAIT	WAIT (no operands) Wait while TEST pin not asserted			Flags ODITSZAPC
Operands	**Clocks**	**Transfers***	**Bytes**	**Coding Example**
(no operands)	3+5n	—	1	WAIT

XCHG	XCHG destination,source Exchange			Flags ODITSZAPC
Operands	**Clocks**	**Transfers***	**Bytes**	**Coding Example**
accumulator, reg16	3	—	1	XCHG AX, BX
memory, register	17+EA	2	2-4	XCHG SEMAPHORE, AX
register, register	4	—	2	XCHG AL, BL

XLAT	XLAT source-table Translate			Flags ODITSZAPC
operands	**Clocks**	**Transfers***	**Bytes**	**Coding Example**
source-table	11	1	1	XLAT ASCII_TAB

XOR	XOR destination,source Logical exclusive OR			Flags ODITSZAPC 0 XXUX0
Operands	**Clocks**	**Transfers***	**Bytes**	**Coding Example**
register, register	3	—	2	XOR CX, BX
register, memory	9+EA	1	2-4	XOR CL, MASK BYTE
memory, register	16+EA	2	2-4	XOR ALPHA [SI],DX
accumulator, immediate	4	—	2-3	XOR AL, 01000010B
register, immediate	4	—	3-4	XOR SI, 00C2H
memory, immediate	17+EA	2	3-6	XOR RETURN CODE, 0D2H

* For the 8086, add four clocks for each 16-bit word transfer with an odd address. For the 8088, add four clocks for each 16-bit word transfer.