

เอกสารอ้างอิง



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พระนคร: สำนักพิมพ์องค์การคำของคุรุสภา, 2520.
- บุญถึง แน่นหนา. ตำราโทรทัศน์ภาคทฤษฎีและปฏิบัติ. เล่ม 1. พิมพ์ครั้งที่ 1. พระนคร:
สำนักพิมพ์โอเคียนส์ไทร์, 2513.
- ว. 313. "เล็ก ๆ น้อย ๆ เกี่ยวกับ Storage." คอมพิวเตอร์สาร 5 (กรกฎาคม 2521):
13-20.
- Cromemco. "D+7AI/OTM REV E." Mountain View, CA: Cromemco,
[n.d.]. (Typewritten.)
- Gantt Jr., C.W. "Build a Television Display." Byte No. 10
(June 1976): 16-21.
- Tucker, John D. "Television Principles." The Focal Encyclo-
pedia of Film & Television Techniques (1969): 860-865.
- Zilog. "Z80-CPU Technical Manual." Los Altos, California:
Zilog, 1976.

ภาคผนวก

(Appendix)

ภาคผนวก ก.

ลักษณะของคำสั่งต่าง ๆ ที่ใช้ในภาษาแอสเซมบลีของ Z-80 microsystem

Mnemonic	Symbolic Operation	Flags						OP-Code			No. of Bytes	No. of M Cycles	No. of T Cycles	Comments	
		C	Z	P/V	S	N	H	76	543	210					
LD r, r'	r ← r'	•	•	•	•	•	•	01	r	r'	1	1	4	r, r'	Reg.
LD r, n	r ← n	•	•	•	•	•	•	00	r	110	2	2	7	000	B
									n	→				001	C
LD r, (HL)	r ← (HL)	•	•	•	•	•	•	01	r	110	1	2	7	010	D
LD r, (IX+d)	r ← (IX+d)	•	•	•	•	•	•	11	011	101	3	5	19	011	E
									r	110				100	H
									d	→				101	L
LD r, (IY+d)	r ← (IY+d)	•	•	•	•	•	•	11	111	101	3	5	19	111	A
									r	110					
									d	→					
LD (HL), r	(HL) ← r	•	•	•	•	•	•	01	110	r	1	2	7		
LD (IX+d), r	(IX+d) ← r	•	•	•	•	•	•	11	011	101	3	5	19		
									110	r					
									d	→					
LD (IY+d), r	(IY+d) ← r	•	•	•	•	•	•	11	111	101	3	5	19		
									110	r					
									d	→					
LD (HL), n	(HL) ← n	•	•	•	•	•	•	00	110	110	2	3	10		
									n	→					
LD (IX+d), n	(IX+d) ← n	•	•	•	•	•	•	11	011	101	4	5	19		
									110	110					
									d	→					
									n	→					
LD (IY+d), n	(IY+d) ← n	•	•	•	•	•	•	11	111	101	4	5	19		
									110	110					
									d	→					
									n	→					
LD A, (BC)	A ← (BC)	•	•	•	•	•	•	00	001	010	1	2	7		
LD A, (DE)	A ← (DE)	•	•	•	•	•	•	00	011	010	1	2	7		
LD A, (nn)	A ← (nn)	•	•	•	•	•	•	00	111	010	3	4	13		
									n	→					
									n	→					
LD (BC), A	(BC) ← A	•	•	•	•	•	•	00	000	010	1	2	7		
LD (DE), A	(DE) ← A	•	•	•	•	•	•	00	010	010	1	2	7		
LD (nn), A	(nn) ← A	•	•	•	•	•	•	00	110	010	3	4	13		
									n	→					
									n	→					
LD A, I	A ← I	•	‡	IFF	‡	0	0	11	101	101	2	2	9		
									010	111					
LD A, R	A ← R	•	‡	IFF	‡	0	0	11	101	101	2	2	9		
									011	111					
LD I, A	I ← A	•	•	•	•	•	•	11	101	101	2	2	9		
									000	111					
LD R, A	R ← A	•	•	•	•	•	•	11	101	101	2	2	9		
									001	111					

Notes: r, r' means any of the registers A, B, C, D, E, H, L

IFF the content of the interrupt enable flip-flop (IFF) is copied into the P/V flag

Flag Notation: • = flag not affected, 0 = flag reset, 1 = flag set, X = flag is unknown,

‡ = flag is affected according to the result of the operation.

8-BIT LOAD GROUP

Mnemonic	Symbolic Operation	Flags					Op-Code			No. of Bytes	No. of M Cycles	No. of T States	Comments
		C	Z	V	S	N	76	543	210				
LD dd, nn	dd ← nn	•	•	•	•	•	00	dd0	001	3	3	10	dd Pair 00 BC 01 DE 10 HL 11 SP
LD IX, nn	IX ← nn	•	•	•	•	•	11	011	101	4	4	14	
LD IY, nn	IY ← nn	•	•	•	•	•	11	111	101	4	4	14	
LD HL, (nn)	H ← (nn+1) L ← (nn)	•	•	•	•	•	00	101	010	3	5	16	
LD dd, (nn)	dd _H ← (nn+1) dd _L ← (nn)	•	•	•	•	•	11	101	101	4	6	20	
LD IX, (nn)	IX _H ← (nn+1) IX _L ← (nn)	•	•	•	•	•	11	011	101	4	6	20	
LD IY, (nn)	IY _H ← (nn+1) IY _L ← (nn)	•	•	•	•	•	00	101	010	4	6	20	
LD (nn), HL	(nn+1) ← H (nn) ← L	•	•	•	•	•	00	100	010	3	5	16	
LD (nn), dd	(nn+1) ← dd _H (nn) ← dd _L	•	•	•	•	•	11	101	101	4	6	20	
LD (nn), IX	(nn+1) ← IX _H (nn) ← IX _L	•	•	•	•	•	11	011	101	4	6	20	
LD (nn), IY	(nn+1) ← IY _H (nn) ← IY _L	•	•	•	•	•	11	111	101	4	6	20	
LD SP, HL	SP ← HL	•	•	•	•	•	11	111	001	1	1	6	
LD SP, IX	SP ← IX	•	•	•	•	•	11	011	101	2	2	10	
LD SP, IY	SP ← IY	•	•	•	•	•	11	111	101	2	2	10	
PUSH qq	(SP-2) ← qq _L (SP-1) ← qq _H	•	•	•	•	•	11	qq0	101	1	3	11	qq Pair 00 BC 01 DE 10 HL 11 AF
PUSH IX	(SP-2) ← IX _L (SP-1) ← IX _H	•	•	•	•	•	11	011	101	2	4	15	
PUSH IY	(SP-2) ← IY _L (SP-1) ← IY _H	•	•	•	•	•	11	111	101	2	4	15	
POP qq	qq _H ← (SP+1) qq _L ← (SP)	•	•	•	•	•	11	qq0	001	1	3	10	
POP IX	IX _H ← (SP+1) IX _L ← (SP)	•	•	•	•	•	11	011	101	2	4	14	
POP IY	IY _H ← (SP+1) IY _L ← (SP)	•	•	•	•	•	11	111	101	2	4	14	

Notes: dd is any of the register pairs BC, DE, HL, SP
 qq is any of the register pairs AF, BC, DE, HL
 (PAIR)_H, (PAIR)_L refer to high order and low order eight bits of the register pair respectively.
 E.g. BC_L = C, AF_H = A

Flag Notation: • = flag not affected, 0 = flag reset, 1 = flag set, X = flag is unknown,
 ‡ flag is affected according to the result of the operation.

16-BIT LOAD GROUP

Mnemonic	Symbolic Operation	Flags						Op-Code			No. of Bytes	No. of M Cycles	No. of T States	Comments
		C	Z	P	S	N	H	76	543	210				
EX DE, HL	DF ← HL	•	•	•	•	•	•	11	101	011	1	1	4	
EX AF, AF'	AF ← AF'	•	•	•	•	•	•	00	001	000	1	1	4	
EXX	(BC) ↔ (DE) (DE) ↔ (HL)	•	•	•	•	•	•	11	011	001	1	1	4	Register bank and auxiliary register bank exchange
EX (SP), HL	H ← (SP+1) L ← (SP)	•	•	•	•	•	•	11	100	011	1	5	19	
EX (SP), IX	IX _H ← (SP+1) IX _L ← (SP)	•	•	•	•	•	•	11	011	101	2	6	23	
FX (SP), IY	IY _H ← (SP+1) IY _L ← (SP)	•	•	•	•	•	•	11	111	101	2	6	23	
LDI	(DE) ← (HL) DE ← DE+1 HL ← HL+1 BC ← BC-1	•	•	1	•	0	0	11	101	101	2	4	16	Load (HL) into (DE), increment the pointers and decrement the byte counter (BC)
LDIR	(DE) ← (HL) DE ← DE+1 HL ← HL+1 BC ← BC-1 Repeat until BC = 0	•	•	0	•	0	0	11	101	101	2	5	21	If BC ≠ 0
								10	110	000	2	4	16	If BC = 0
LDD	(DF) ← (HL) DF ← DF-1 HL ← HL-1 BC ← BC-1	•	•	1	•	0	0	11	101	101	2	4	16	
LDDR	(DF) ← (HL) DF ← DF-1 HL ← HL-1 BC ← BC-1 Repeat until BC = 0	•	•	0	•	0	0	11	101	101	2	5	21	If BC ≠ 0
								10	111	000	2	4	16	If BC = 0
CPI	A ← (HL) HL ← HL+1 BC ← BC-1	•	‡	‡	‡	1	‡	11	101	101	2	4	16	
CPIR	A ← (HL) HL ← HL+1 BC ← BC-1 Repeat until A = (HL) or BC = 0	•	‡	‡	‡	1	‡	11	101	101	2	5	21	If BC ≠ 0 and A ≠ (HL)
								10	110	001	2	4	16	If BC = 0 or A = (HL)
CPD	A ← (HL) HL ← HL-1 BC ← BC-1	•	‡	‡	‡	1	‡	11	101	101	2	4	16	
CPDR	A ← (HL) HL ← HL-1 BC ← BC-1 Repeat until A = (HL) or BC = 0	•	‡	‡	‡	1	‡	11	101	101	2	5	21	If BC ≠ 0 and A ≠ (HL)
								10	111	001	2	4	16	If BC = 0 or A = (HL)

Notes: ① P V flag is 0 if the result of BC-1 = 0, otherwise P V = 1
 ② Z flag is 1 if A = (HL), otherwise Z = 0.

Flag Notation: • = flag not affected, 0 = flag reset, 1 = flag set, X = flag is unknown.
 ‡ = flag is affected according to the result of the operation.

EXCHANGE GROUP AND BLOCK TRANSFER AND SEARCH GROUP

Mnemonic	Symbolic Operation	Flags						Op-Code				No. of Bytes	No. of M Cycles	No. of T States	Comments
		C	Z	P/V	S	N	H	76	543	210					
ADD r	A ← A + r	†	†	V †	0 †	†	†	10	000	r	1	1	4	r	Reg.
ADD n	A ← A + n	†	†	V †	0 †	†	†	11	000	110	2	2	7	000	B
										n				001	C
														010	D
ADD (HL)	A ← A + (HL)	†	†	V †	0 †	†	†	10	000	110	1	2	7	011	E
ADD (IX+d)	A ← A + (IX+d)	†	†	V †	0 †	†	†	11	011	101	3	5	19	100	H
														101	L
										d				111	A
ADD (IY+d)	A ← A + (IY+d)	†	†	V †	0 †	†	†	11	111	101	3	5	19		
										d					
ADC s	A ← A + s + CY	†	†	V †	0 †	†	†		001						
SUB s	A ← A - s	†	†	V †	1 †	†	†		010						
SBC s	A ← A - s - CY	†	†	V †	1 †	†	†		011						
AND s	A ← A ∧ s	0 †	†	P †	1 †	†	†		100						
OR s	A ← A ∨ s	0 †	†	P †	0 †	†	†		110						
XOR s	A ← A ⊗ s	0 †	†	P †	0 †	†	†		101						
CP s	A - s	†	†	V †	1 †	†	†		111						
INC r	r ← r + 1	•	†	V †	0 †	†	†	00	r	100	1	1	4		
INC (HL)	(HL) ← (HL) + 1	•	†	V †	0 †	†	†	00	110	100	1	3	11		
INC (IX+d)	(IX+d) ← (IX+d) + 1	•	†	V †	0 †	†	†	11	011	101	3	6	23		
										d					
INC (IY+d)	(IY+d) ← (IY+d) + 1	•	†	V †	0 †	†	†	11	111	101	3	6	23		
										d					
DEC d	d ← d - 1	•	†	V †	1 †	†	†			101					

Notes: The V symbol in the P/V flag column indicates that the P/V flag contains the overflow of the result of the operation. Similarly the P symbol indicates parity. V = 1 means overflow, V = 0 means not overflow. P = 1 means parity of the result is even, P = 0 means parity of the result is odd.

Flag Notation: • = flag not affected, 0 = flag reset, 1 = flag set, X = flag is unknown, † = flag is affected according to the result of the operation.

8-BIT ARITHMETIC AND LOGICAL GROUP

Mnemonic	Symbolic Operation	Flags						Op-Code			No. of Bytes	No. of M Cycles	No. of T States	Comments
		C	Z	P/V	S	N	ii	76	543	210				
DAA	Converts acc. content into packed BCD following add or subtract with packed BCD operands	‡	‡	P	‡	•	‡	00	100	111	1	1	4	Decimal adjust accumulator
CPL	$A \leftarrow \bar{A}$	•	•	•	•	1	1	00	101	111	1	1	4	Complement accumulator (one's complement)
NEG	$A \leftarrow \bar{A} + 1$	‡	‡	V	‡	1	‡	11	101	101	2	2	8	Negate acc. (two's complement)
CCF	$CY \leftarrow \bar{CY}$	‡	•	•	•	0	X	00	111	111	1	1	4	Complement carry flag
SCF	$CY \leftarrow 1$	1	•	•	•	0	0	00	110	111	1	1	4	Set carry flag
NOP	No operation	•	•	•	•	•	•	00	000	000	1	1	4	
HALT	CPU halted	•	•	•	•	•	•	01	110	110	1	1	4	
DI	$IFF \leftarrow 0$	•	•	•	•	•	•	11	110	011	1	1	4	
EI	$IFF \leftarrow 1$	•	•	•	•	•	•	11	111	011	1	1	4	
IM 0	Set interrupt mode 0	•	•	•	•	•	•	11	101	101	2	2	8	
IM 1	Set interrupt mode 1	•	•	•	•	•	•	11	101	101	2	2	8	
IM 2	Set interrupt mode 2	•	•	•	•	•	•	11	101	101	2	2	8	
		•	•	•	•	•	•	01	011	110				

Notes: IFF indicates the interrupt enable flip-flop
CY indicates the carry flip-flop.

Flag Notation: • = flag not affected, 0 = flag reset, 1 = flag set, X = flag is unknown,
‡ = flag is affected according to the result of the operation.

Mnemonic	Symbolic Operation	Flags						Op-Code			No. of Bytes	No. of M Cycles	No. of T States	Comments
		C	Z	P/V	S	N	H	76	543	210				
ADD HL, ss	HL ← HL + ss	‡	•	•	•	0	X	00	ss1	001	1	3	11	ss Reg. 00 BC 01 DE 10 HL 11 SP
ADC HL, ss	HL ← HL + ss + CY	‡	‡	V	‡	0	X	11	101	101	2	4	15	
SBC HL, ss	HL ← HL - ss - CY	‡	‡	V	‡	1	X	11	101	101	2	4	15	
ADD IX, pp	IX ← IX + pp	‡	•	•	•	0	X	11	011	101	2	4	15	pp Reg. 00 BC 01 DE 10 IX 11 SP
ADD IY, rr	IY ← IY + rr	‡	•	•	•	0	X	11	111	101	2	4	15	rr Reg. 00 BC 01 DE 10 IY 11 SP
INC ss	ss ← ss + 1	•	•	•	•	•	•	00	ss0	011	1	1	6	
INC IX	IX ← IX + 1	•	•	•	•	•	•	11	011	101	2	2	10	
INC IY	IY ← IY + 1	•	•	•	•	•	•	11	111	101	2	2	10	
DEC ss	ss ← ss - 1	•	•	•	•	•	•	00	ss1	011	1	1	6	
DEC IX	IX ← IX - 1	•	•	•	•	•	•	11	011	101	2	2	10	
DEC IY	IY ← IY - 1	•	•	•	•	•	•	11	111	101	2	2	10	

Notes: ss is any of the register pairs BC, DE, HL, SP
pp is any of the register pairs BC, DE, IX, SP
rr is any of the register pairs BC, DE, IY, SP.

Flag Notation: • = flag not affected, 0 = flag reset, 1 = flag set, X = flag is unknown.
‡ = flag is affected according to the result of the operation.

Mnemonic	Symbolic Operation	Flags						Op-Code			No. of Bytes	No. of M Cycles	No. of T States	Comments		
		C	Z	P	V	S	N	H	76	543					210	
RLCA		‡	•	•	•	•	0	0	00	000	111	1	1	4	Rotate left circular accumulator	
RLA		‡	•	•	•	•	0	0	00	010	111	1	1	4	Rotate left accumulator	
RRCA		‡	•	•	•	•	0	0	00	001	111	1	1	4	Rotate right circular accumulator	
RRA		‡	•	•	•	•	0	0	00	011	111	1	1	4	Rotate right accumulator	
RLC r		‡	‡	P	‡	‡	0	0	11	001	011	2	2	8	Rotate left circular register r	
RLC (HL)		‡	‡	P	‡	‡	0	0	11	001	011	2	4	15	r Reg.	
RLC (IX+d)		‡	‡	P	‡	‡	0	0	00	000	r	4	6	23	000 B	
RLC (IY+d)		‡	‡	P	‡	‡	0	0	00	000	110	4	6	23	001 C	
		‡	‡	P	‡	‡	0	0	11	011	101	4	6	23	010 D	
RLC (IX+d)		‡	‡	P	‡	‡	0	0	11	001	011	4	6	23	011 E	
		‡	‡	P	‡	‡	0	0	00	000	110	4	6	23	100 H	
		‡	‡	P	‡	‡	0	0	11	111	101	4	6	23	101 L	
		‡	‡	P	‡	‡	0	0	00	000	110	4	6	23	111 A	
RL s		‡	‡	P	‡	‡	0	0	00	010					Instruction format and states are as shown for RLC.s. To form new OP-code replace 000 of RLC,s with shown code	
RRC s		‡	‡	P	‡	‡	0	0	00	001						
RR s		‡	‡	P	‡	‡	0	0	00	011						
SLA s		‡	‡	P	‡	‡	0	0	00	100						
SRA s		‡	‡	P	‡	‡	0	0	00	101						
SRL s		‡	‡	P	‡	‡	0	0	00	111						
RLD		•	‡	P	‡	‡	0	0	11	101	101	2	5	18		Rotate digit left and right between the accumulator and location (HL). The content of the upper half of the accumulator is unaffected
RRD		•	‡	P	‡	‡	0	0	11	101	101	2	5	18		

Flag Notation: • = flag not affected, 0 = flag reset, 1 = flag set, X = flag is unknown, ‡ = flag is affected according to the result of the operation.

ROTATE AND SHIFT GROUP

Mnemonic	Symbolic Operation	Flags						Op-Code			No. of Bytes	No. of M Cycles	No. of T States	Comments	
		C	Z	V	S	N	H	76	543	210					
BIT b, r	$Z \leftarrow \overline{T}_b$	•	‡	X	X	0	1	11	001	011	2	2	8	r	Reg.
								01	b	r					
BIT b, (HL)	$Z \leftarrow \overline{(HL)}_b$	•	‡	X	X	0	1	11	001	011	2	3	12	000	B
								01	b	110				001	C
BIT b, (IX+d)	$Z \leftarrow \overline{(IX+d)}_b$	•	‡	X	X	0	1	11	011	101	4	5	20	010	D
								11	001	011				011	E
								←	d	→				100	H
								01	b	110				101	L
								11	111	101				111	A
BIT b, (IY+d)	$Z \leftarrow \overline{(IY+d)}_b$	•	‡	X	X	0	1	11	111	101	4	5	20	b	Bit Tested
								11	001	011				000	0
								←	d	→				001	1
								01	b	110				010	2
								11	001	011				011	3
								←	d	→				100	4
								01	b	110				101	5
								11	111	101				110	6
								11	001	011				111	7
SET b, r	$r_b \leftarrow 1$	•	•	•	•	•	•	11	001	011	2	2	8		
								11	b	r					
SET b, (HL)	$(HL)_b \leftarrow 1$	•	•	•	•	•	•	11	001	011	2	4	15		
								11	b	110					
SET b, (IX+d)	$(IX+d)_b \leftarrow 1$	•	•	•	•	•	•	11	011	101	4	6	23		
								11	001	011					
								←	d	→					
								11	b	110					
SET b, (IY+d)	$(IY+d)_b \leftarrow 1$	•	•	•	•	•	•	11	111	101	4	6	23		
								11	001	011					
								←	d	→					
								11	b	110					
RES b, s	$s_b \leftarrow 0$ $s \equiv r, (HL), (IX+d), (IY+d)$							10							

To form new OR-
code replace 11
of SET b,s with
10. Flags and time
states for SET
instruction

Notes: The notation s_b indicates bit b (0 to 7) or location s.
Flag Notation: • = flag not affected, 0 = flag reset, 1 = flag set, X = flag is unknown,
‡ = flag is affected according to the result of the operation.

BIT SET, RESET AND TEST GROUP

Mnemonic	Symbolic Operation	Flags						Op-Code			No. of Bytes	No. of M Cycles	No. of T States	Comments	
		C	Z	P/V	S	N	H	76	543	210					
JP nn	PC ← nn	•	•	•	•	•	•	11	000	011	3	3	10		
JP cc, nn	If condition cc is true PC ← nn, otherwise continue	•	•	•	•	•	•	← n →	← n →	← n →	3	3	10	cc	Condition
								← n →	← n →	← n →				000	NZ non zero
								← n →	← n →	← n →				001	Z zero
								← n →	← n →	← n →				010	NC non carry
JR e	PC ← PC + e	•	•	•	•	•	•	00	011	000	2	3	12		
								← e-2 →	← e-2 →	← e-2 →					
JR C, e	If C = 0, continue	•	•	•	•	•	•	00	111	000	2	2	7		If condition not met
								← e-2 →	← e-2 →	← e-2 →					
JR C, e	If C = 1, PC ← PC + e	•	•	•	•	•	•	00	111	000	2	3	12		If condition is met
								← e-2 →	← e-2 →	← e-2 →					
JR NC, e	If C = 1, continue	•	•	•	•	•	•	00	110	000	2	2	7		If condition not met
								← e-2 →	← e-2 →	← e-2 →					
JR NC, e	If C = 0, PC ← PC + e	•	•	•	•	•	•	00	110	000	2	3	12		If condition is met
								← e-2 →	← e-2 →	← e-2 →					
JR Z, e	If Z = 0 continue	•	•	•	•	•	•	00	101	000	2	2	7		If condition not met
								← e-2 →	← e-2 →	← e-2 →					
JR Z, e	If Z = 1, PC ← PC + e	•	•	•	•	•	•	00	101	000	2	3	12		If condition is met
								← e-2 →	← e-2 →	← e-2 →					
JR NZ, e	If Z = 1, continue	•	•	•	•	•	•	00	100	000	2	2	7		If condition not met
								← e-2 →	← e-2 →	← e-2 →					
JR NZ, e	If Z = 0, PC ← PC + e	•	•	•	•	•	•	00	100	000	2	3	12		If condition met
								← e-2 →	← e-2 →	← e-2 →					
JP (HL)	PC ← HL	•	•	•	•	•	•	11	101	001	1	1	4		
JP (IX)	PC ← IX	•	•	•	•	•	•	11	011	101	2	2	8		
								11	101	001					
JP (IX)	PC ← IX	•	•	•	•	•	•	11	111	101	2	2	8		
								11	101	001					
JP (IY)	PC ← IY	•	•	•	•	•	•	11	111	101	2	2	8		
								11	101	001					
DJNZ, e	B ← B-1 If B = 0, continue	•	•	•	•	•	•	00	010	000	2	2	8		If B = 0
								← e-2 →	← e-2 →	← e-2 →					
DJNZ, e	If B ≠ 0, PC ← PC + e	•	•	•	•	•	•	00	010	000	2	3	13		If B ≠ 0
								← e-2 →	← e-2 →	← e-2 →					

Notes: e represents the extension in the relative addressing mode.
e is a signed two's complement number in the range <-126, 129>
e-2 in the op-code provides an effective address of pc + e as PC is incremented by 2 prior to the addition of e.

Flag Notation: • = flag not affected, 0 = flag reset, 1 = flag set, X = flag is unknown.
‡ = flag is affected according to the result of the operation.

JUMP GROUP

Mnemonic	Symbolic Operation	Flags						Op-Code			No. of Bytes	No. of M Cycles	No. of T States	Comments																			
		C	Z	V	S	N	H	76	543	210																							
CALL nn	(SP-1) \leftarrow PC _H (SP-2) \leftarrow PC _L PC \leftarrow nn	•	•	•	•	•	•	11 001 101				3	5	17																			
CALL cc, nn	If condition cc is false continue, otherwise same as CALL nn	•	•	•	•	•	•	11 cc 100				3	3	10	If cc is false																		
		•	•	•	•	•	•	\leftarrow n \rightarrow				3	5	17	If cc is true																		
RET	PC _L \leftarrow (SP) PC _H \leftarrow (SP+1)	•	•	•	•	•	•	11 001 001				1	3	10																			
RET cc	If condition cc is false continue, otherwise same as RET	•	•	•	•	•	•	11 cc 000				1	1	5	If cc is false																		
		•	•	•	•	•	•					1	3	11	If cc is true																		
RETI	Return from interrupt	•	•	•	•	•	•	11 101 101				2	4	14	<table border="1"> <thead> <tr> <th>cc</th> <th>Condition</th> </tr> </thead> <tbody> <tr><td>000</td><td>NZ non zero</td></tr> <tr><td>001</td><td>Z zero</td></tr> <tr><td>010</td><td>NC non carry</td></tr> <tr><td>011</td><td>C carry</td></tr> <tr><td>100</td><td>PO parity odd</td></tr> <tr><td>101</td><td>PE parity even</td></tr> <tr><td>110</td><td>P sign positive</td></tr> <tr><td>111</td><td>M sign negative</td></tr> </tbody> </table>	cc	Condition	000	NZ non zero	001	Z zero	010	NC non carry	011	C carry	100	PO parity odd	101	PE parity even	110	P sign positive	111	M sign negative
		cc	Condition																														
		000	NZ non zero																														
		001	Z zero																														
		010	NC non carry																														
		011	C carry																														
		100	PO parity odd																														
101	PE parity even																																
110	P sign positive																																
111	M sign negative																																
•	•	•	•	•	•	01 001 101																											
•	•	•	•	•	•	11 101 101					2	4	14																				
•	•	•	•	•	•	01 000 101																											
•	•	•	•	•	•	11 t 111					1	3	11																				
•	•	•	•	•	•																												
•	•	•	•	•	•																												
RST p	(SP-1) \leftarrow PC _H (SP-2) \leftarrow PC _L PC _H \leftarrow 0 PC _L \leftarrow P	•	•	•	•	•	•																										

Flag Notation: • = flag not affected, 0 = flag reset, 1 = flag set, X = flag is unknown
‡ = flag is affected according to the result of the operation.

CALL AND RETURN GROUP

Mnemonic	Symbolic Operation	Flags						Op-Code			No. of Bytes	No. of M Cycles	No. of T States	Comments
		C	Z	P/V	S	N	H	76	543	210				
IN A, n	A ← (n)	•	•	•	•	•	•	11	011	011	2	3	10	n to A ₀ ~ A ₇ Acc to A ₈ ~ A ₁₅
IN r, (C)	r ← (C) if r = 110 only the flags will be affected	•	‡	P	‡	0	‡	11	101	101	2	3	11	C to A ₀ ~ A ₇ B to A ₈ ~ A ₁₅
INI	(HL) ← (C) B ← B - 1 HL ← HL + 1	•	‡	X	X	1	X	11	101	101	2	4	15	C to A ₀ ~ A ₇ B to A ₈ ~ A ₁₅
INIR	(HL) ← (C) B ← B - 1 HL ← HL + 1 Repeat until B = 0	•	1	X	X	1	X	11	101	101	2	5 (If B ≠ 0)	20	C to A ₀ ~ A ₇ B to A ₈ ~ A ₁₅
											2	4 (If B = 0)	15	
IND	(HL) ← (C) B ← B - 1 HL ← HL - 1	•	‡	X	X	1	X	11	101	101	2	4	15	C to A ₀ ~ A ₇ B to A ₈ ~ A ₁₅
INDR	(HL) ← (C) B ← B - 1 HL ← HL - 1 Repeat until B = 0	•	1	X	X	1	X	11	101	101	2	5 (If B ≠ 0)	20	C to A ₀ ~ A ₇ B to A ₈ ~ A ₁₅
											2	4 (If B = 0)	15	
OUT n, A	(n) → A	•	•	•	•	•	•	11	010	011	2	3	11	n to A ₀ ~ A ₇ Acc to A ₈ ~ A ₁₅
OUT (C), r	(C) → r	•	•	•	•	•	•	11	101	101	2	3	12	C to A ₀ ~ A ₇ B to A ₈ ~ A ₁₅
OUTI	(C) ← (HL) B ← B - 1 HL ← HL + 1	•	‡	X	X	1	X	11	101	101	2	4	15	C to A ₀ ~ A ₇ B to A ₈ ~ A ₁₅
OTIR	(C) ← (HL) B ← B - 1 HL ← HL + 1 Repeat until B = 0	•	1	X	X	1	X	11	101	101	2	5 (If B ≠ 0)	20	C to A ₀ ~ A ₇ B to A ₈ ~ A ₁₅
											2	4 (If B = 0)	15	
OUTD	(C) ← (HL) B ← B - 1 HL ← HL - 1	•	‡	X	X	1	X	11	101	101	2	4	15	C to A ₀ ~ A ₇ B to A ₈ ~ A ₁₅
OTDR	(C) ← (HL) B ← B - 1 HL ← HL - 1 Repeat until B = 0	•	1	X	X	1	X	11	101	101	2	5 (If B ≠ 0)	20	C to A ₀ ~ A ₇ B to A ₈ ~ A ₁₅
											2	4 (If B = 0)	15	

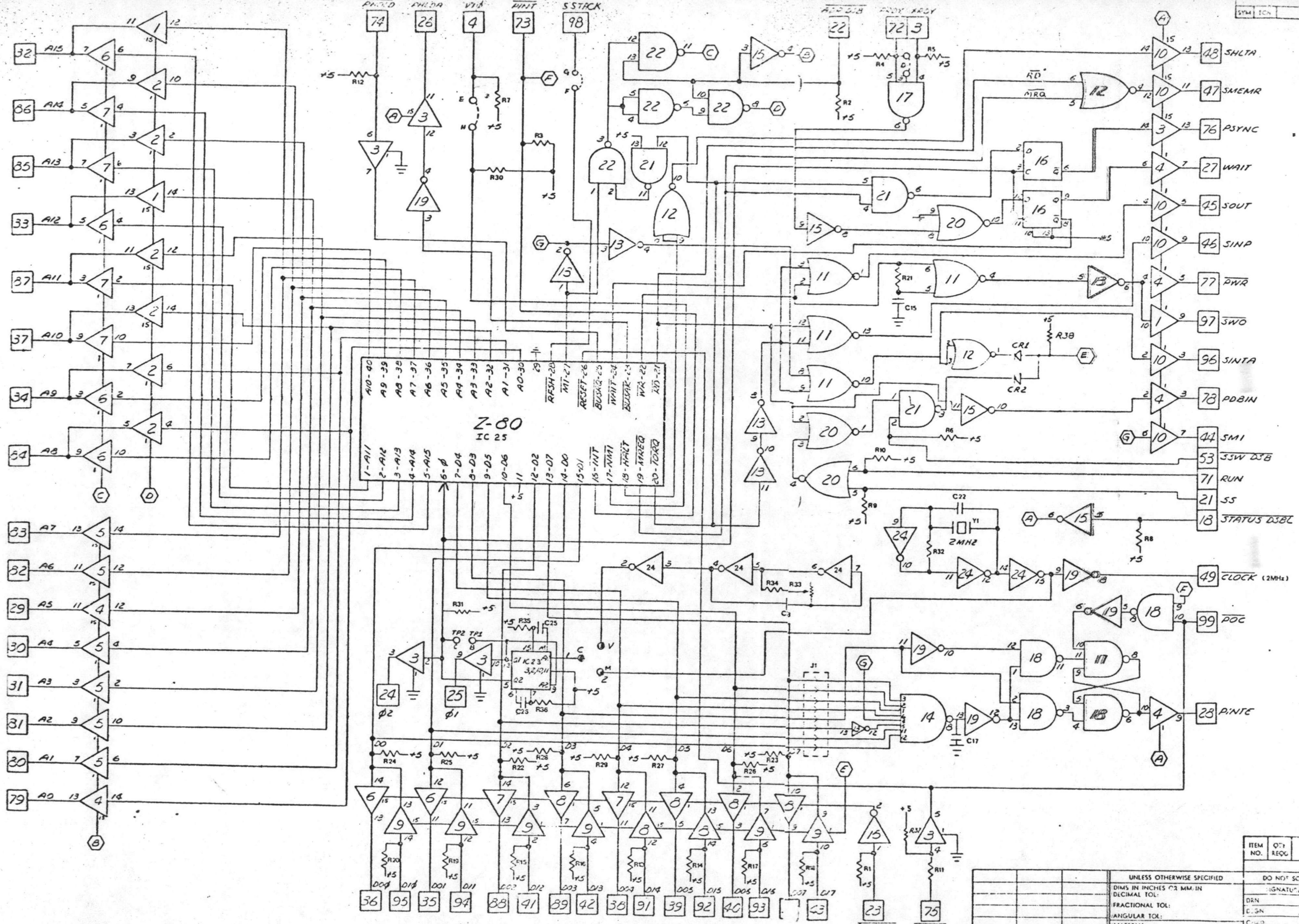
Notes: ① If the result of B - 1 is zero the Z flag is set, otherwise it is reset.

Flag Notations: • = flag not affected, 0 = flag reset, 1 = flag set, X = flag is unknown, ‡ = flag is affected according to the result of the operation.

INPUT AND OUTPUT GROUP

ภาพแนว ก.

วงจรของ Z-80 CPU Board



ITEM NO.	QTY REQD	PART OR IDENT. NO.	LIST
UNLESS OTHERWISE SPECIFIED			
DO NOT SCALE D-WG			
DIM'S IN INCHES OR MM. IN DECIMAL TOL.			
SIGNATURES DATE			
DRN			
E.D.S.N			
ANGULAR TOL.			
MATERIAL			
C.D.W.D			
APP'D <i>Reddy</i>			

ภาคผนวก ค.

ตัวอย่างข้อมูลหรือค่าความเข้มของภาพที่เก็บไว้ในหน่วยความจำ

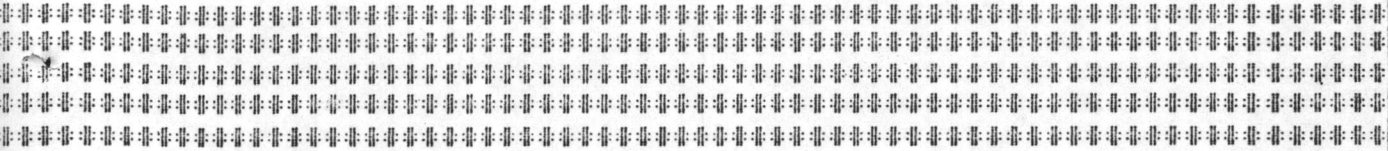
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0410	11	16	14	14	13	16	13	12	11	16	16	18	17	1A	18	18
0420	15	18	17	16	15	1A	18	18	17	1A	16	16	15	16	12	10
0430	0D	18	15	14	13	16	15	14	13	16	14	16	13	18	15	16
0440	13	16	14	14	13	16	13	14	11	16	17	1A	19	1A	19	1A
0450	17	1A	17	16	15	1A	17	18	17	1A	16	18	15	16	12	10
0460	10	18	13	14	11	16	14	14	11	16	13	14	13	16	15	16
0470	13	18	15	16	13	16	14	14	11	16	17	1C	19	1C	19	18
0480	17	1A	17	18	15	1A	17	18	17	1A	16	16	15	16	12	10
0490	0D	16	13	12	11	16	14	14	11	16	13	14	13	16	15	16
04A0	13	18	16	16	15	16	15	14	13	18	19	1C	19	1C	19	18
04B0	17	1A	17	18	15	18	17	18	17	18	16	16	13	16	0F	0F
04C0	0D	16	12	12	11	16	15	14	11	16	13	14	11	16	15	16
04D0	13	18	16	18	15	18	16	16	13	18	19	1C	1B	1C	19	18
04E0	17	1A	17	1A	15	18	17	18	17	18	15	16	13	16	11	10
04F0	0D	16	12	12	13	16	16	16	11	16	12	12	11	16	15	16
0500	13	18	17	16	15	18	16	16	13	18	1A	1C	19	1C	19	18
0510	17	18	17	1A	15	16	16	1A	17	16	15	16	13	14	0F	0F
0520	0D	16	12	12	13	1A	17	16	13	16	12	12	11	16	15	16
0530	15	1A	17	17	15	1A	16	14	13	1A	1A	1C	19	1C	19	18
0540	15	18	17	1A	15	16	17	1A	17	16	15	16	13	0F	0F	0F
0550	0D	16	12	14	15	1C	18	16	15	16	13	14	11	16	15	16
0560	15	1A	18	18	17	1A	16	14	11	18	1A	20	19	1C	19	18
0570	15	18	18	1A	17	16	17	1C	17	18	15	18	13	14	10	10
0580	0D	16	12	14	15	1C	1A	17	15	16	13	12	11	16	15	16
0590	15	1A	17	18	17	1A	16	14	11	18	1A	1E	1B	1C	19	18
05A0	15	16	17	1A	15	16	17	1C	17	16	16	16	13	0F	0F	0E
05B0	0D	16	12	16	19	1E	1B	1A	17	18	13	14	11	16	15	16
05C0	15	1A	18	18	17	1A	17	14	11	18	1C	20	20	1C	19	18
05D0	15	18	16	18	15	16	17	1C	17	18	16	18	13	14	10	10
05E0	10	16	12	16	19	20	1B	1A	19	18	13	14	11	16	15	16
05F0	15	1A	18	18	17	1A	17	14	11	18	1C	22	20	1E	19	18
0600	15	18	16	16	13	16	17	1B	17	18	16	16	13	12	10	10
0610	10	16	12	16	19	1E	1B	1C	19	1A	13	12	11	16	14	14
0620	15	1A	18	18	17	1A	17	14	11	16	1C	20	20	1E	1A	18
0630	15	18	15	16	13	16	17	1A	17	16	16	16	13	12	10	0E
0640	0D	16	13	16	19	1E	1B	1C	19	1A	13	14	11	16	14	14
0650	13	1A	18	18	17	1A	17	14	11	18	1C	22	20	1E	1A	18
0660	15	18	14	14	13	16	17	1A	15	18	16	16	11	12	10	10
0670	10	16	13	16	19	1C	1B	1C	19	18	13	14	11	16	14	14
0680	13	1A	18	17	15	1A	17	14	11	1A	1C	22	1D	1E	1A	18
0690	15	16	13	14	13	16	18	1A	15	16	16	16	11	12	0F	0F
06A0	0D	16	13	16	17	1C	1B	1C	19	18	13	14	11	16	13	14
06B0	13	18	17	16	15	1A	17	16	13	1A	1C	20	1D	1E	19	18
06C0	15	16	13	14	13	16	17	18	15	16	16	14	11	12	0F	0F
06D0	0D	16	12	16	15	1A	1A	1C	19	18	13	14	11	16	13	14
06E0	13	18	15	16	15	1A	17	16	13	1A	1D	22	1D	1E	19	18
06F0	13	16	12	14	13	16	17	18	13	16	15	14	11	12	10	10
0700	10	16	12	14	15	16	18	1A	15	16	13	14	11	14	13	14
0710	11	16	14	14	13	1A	18	16	13	1A	1E	22	1D	1C	19	17
0720	13	16	13	14	13	16	17	17	13	16	15	14	11	12	0F	0F
0730	10	16	12	14	13	16	15	18	13	16	12	14	11	14	12	14
0740	11	16	14	14	13	1A	19	16	13	1C	1E	22	1D	1C	17	16
0750	13	16	13	14	13	16	17	18	13	16	15	14	11	12	10	10
0760	10	14	12	12	11	16	13	14	11	14	12	14	13	14	11	12
0770	11	14	13	12	13	1A	19	16	13	1C	20	22	1B	1C	17	16
0780	13	16	13	14	13	16	17	18	13	16	14	14	10	12	10	10
0790	10	16	12	12	13	14	13	14	11	1A	12	14	13	14	0F	0F

07B0	13	16	14	13	16	17	17	13	16	14	14	OF	OF	OF	OF	
07C0	10	1A	16	14	15	16	15	16	11	16	16	16	15	14	11	12
07D0	11	14	12	12	13	18	17	14	13	1C	20	22	1B	1A	16	16
07E0	13	16	14	16	13	16	17	16	13	18	14	12	10	12	10	10
07F0	10	1C	18	16	17	1A	17	17	17	18	18	18	15	18	13	14
0800	13	14	12	OF	13	16	16	14	13	1E	1F	1F	1B	1A	16	16
0810	13	16	14	14	13	16	16	16	13	16	14	12	OF	OF	OF	OF
0820	OF	1E	1B	1C	19	1C	1C	1A	19	1A	1A	1C	17	1A	19	16
0830	15	16	13	12	11	16	14	14	15	1E	1F	1F	1B	1A	15	14
0840	11	16	14	14	13	16	15	14	13	16	13	OF	OF	OF	OF	OF
0850	OF	24	20	20	20	20	20	20	20	1E	20	20	1B	1E	1D	1A
0860	19	1A	16	14	11	16	14	14	15	1E	20	22	1B	1A	15	14
0870	11	16	14	14	13	16	14	14	13	16	13	12	10	12	10	10
0880	11	26	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1C
0890	1E	1E	17	14	11	16	13	14	15	1E	1F	1F	19	18	15	14
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0920	17	1E	18	16	11	14	12	12	13	1A	1B	1E	19	1A	16	14
0930	11	14	12	14	13	16	15	16	17	16	12	10	OF	OF	10	14
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0950	15	1A	16	14	11	14	11	12	11	1A	1A	1C	19	1A	15	14
0960	11	14	12	12	11	16	16	18	17	18	12	10	10	12	10	1C
0970	39	2A	22	22	20	24	24	24	20	1E	1B	14	11	16	13	14
0980	13	16	14	12	10	14	11	12	11	1C	1B	1C	1B	1A	16	13
0990	11	12	12	12	11	16	17	1A	17	18	12	10	OF	12	11	2C
09A0	40	2C	23	22	20	24	25	24	20	1E	1C	14	11	14	12	12
09B0	11	14	13	12	10	12	10	10	11	1C	1A	1E	1F	1C	15	12
09C0	11	12	12	12	11	16	17	1A	19	18	12	10	OF	12	13	30
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09E0	11	14	11	12	10	12	10	10	11	1C	22	20	21	1E	16	14
09F0	11	12	11	12	11	16	17	1A	19	18	11	10	10	12	19	36
0A00	43	2A	26	2A	21	26	28	20	19	1A	14	10	10	12	10	10
0A10	10	14	10	OF	10	OF	10	10	11	1C	24	22	20	1E	19	14
0A20	11	12	11	12	11	16	17	1A	17	18	12	10	10	14	2C	3C
0A30	45	2C	28	2C	25	26	27	1E	15	18	12	10	10	12	10	10
0A40	10	12	10	10	10	12	10	10	11	1A	23	20	1B	1C	1B	18
0A50	13	12	11	12	11	14	15	1A	17	18	12	12	10	1C	31	40
0A60	45	2C	28	2E	27	26	1E	1A	13	14	11	10	10	12	10	10
0A70	10	12	10	10	OD	12	10	10	11	16	23	1C	19	1C	1D	1C
0A80	17	14	11	12	11	14	15	1A	17	16	12	12	1B	24	35	40
0A90	43	2C	27	2E	25	1F	1A	14	11	OF	OF	OF	OF	OF	OF	OF
0AA0	OD	OF	OF	OE	OD	OF	OF	OF	OF	16	1E	1A	19	1E	1D	1E
0AB0	17	16	OF	12	11	14	15	18	15	16	12	14	1D	26	34	40
0AC0	43	2E	28	2E	23	1E	16	12	11	12	10	12	10	12	10	10
0AD0	10	12	10	OE	OD	12	OF	10	10	16	1D	18	1B	1E	1C	1C
0AE0	1B	1E	12	12	11	16	15	18	15	16	13	1A	1D	24	2A	30
0AF0	40	2E	27	2C	1F	16	14	OF	OF	OF	OF	OF	OF	OF	OF	OF
0B00	OD	OF	OF	OE	OD	OF	OF	OF	OF	14	16	16	19	1E	1B	1E
0B10	1F	1F	14	12	11	16	15	16	15	16	16	1C	1B	1C	24	2A
0B20	2B	2C	27	26	1B	16	OF	OF	OF	OF	OF	OF	OF	OF	OF	OF
0B30	OF	OF	OF	OE	OD	OF	OF	OF	OF	OF	15	16	17	1E	1F	1E
0B40	21	26	16	14	11	16	14	16	13	16	1B	1E	19	1C	1E	24
0B50	25	2C	26	22	15	14	11	10	10	12	11	12	11	14	12	12
0B60	10	14	10	10	10	12	10	10	10	14	14	16	17	1E	20	20
0B70	21	28	17	14	13	16	14	16	13	18	20	1C	17	1C	20	23
0B80	23	2C	24	1E	13	14	OF	OF	OF	OF	OF	OF	11	OF	13	12
0B90	11	16	OF	OF	OF	OF	OF	OF	OD	OF	13	14	15	1C	1D	1E
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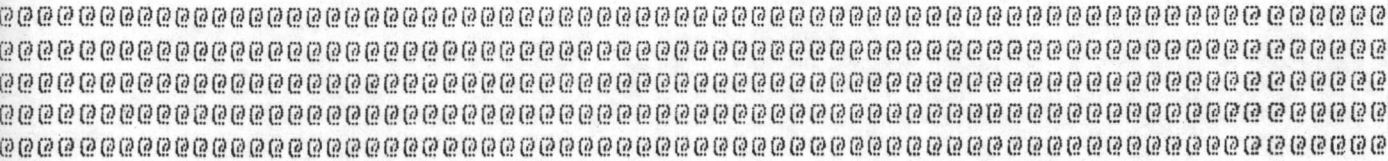
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OC00	21	26	20	20	20	20	20	22	20	26	22	22	25	2A	2B
OC10	2B	2A	1C	14	11	12	10	10	10	14	12	12	11	14	13
OC20	11	16	12	12	11	12	11	14	13	1E	2B	26	29	24	22
OC30	21	26	22	20	21	22	23	26	21	2A	2B	26	27	2E	2C
OC40	2D	28	17	14	10	12	10	10	10	14	11	12	11	14	13
OC50	11	16	12	12	11	14	15	16	20	24	2C	32	2B	2E	29
OC60	25	28	24	26	23	26	25	28	27	2E	2C	2C	29	30	30
OC70	30	22	16	12	10	12	10	10	10	14	11	12	10	14	13
OC80	11	16	12	12	11	16	18	20	21	2E	34	32	31	2E	2B
OC90	27	2A	28	26	27	26	26	28	29	2E	2E	2E	2D	32	31
OCA0	31	22	14	12	10	12	10	10	10	14	10	12	10	14	13
OCB0	11	16	12	12	13	1C	1C	24	2D	34	37	36	33	34	2D
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OCD0	31	1E	13	12	10	12	10	10	10	12	10	10	10	14	12
OCE0	11	14	12	16	1B	1E	27	28	31	3A	3B	3A	35	36	31
OCE0	11	14	12	16	1B	1E	27	28	31	3A	3B	3A	35	36	31
OCE0	11	14	12	16	1B	1E	27	28	31	3A	3B	3A	35	36	31
OCF0	2D	2E	2C	2C	2B	2E	2B	2A	29	2E	30	30	30	34	33
OD00	33	1B	12	12	10	12	11	10	10	12	10	10	10	14	12
OD10	11	14	17	18	20	2A	2A	30	35	3A	3B	3A	37	38	33
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OD30	33	1A	12	12	10	12	11	10	10	12	10	10	10	12	11
OD40	11	16	1A	24	23	2C	30	32	35	3C	3B	3E	39	3A	35
OD50	31	34	30	32	2D	32	30	2C	29	2E	2E	30	30	32	31
OD60	31	16	11	12	10	12	10	10	10	12	10	10	10	12	11
OD70	13	1E	24	26	29	2E	31	34	35	3C	3A	3E	3B	3C	36
OD80	31	34	33	32	31	32	30	2E	29	2C	2C	30	30	32	31
OD90	31	16	0F	0F	0F	0F	0F	0F	0F	0F	0F	0F	0F	0F	16
ODA0	1D	1F	27	2C	2B	2F	31	32	31	3C	3A	3C	3B	3C	36
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OE60	29	30	2C	28	2B	2C	29	26	29	32	33	36	35	36	31
OE70	31	34	34	36	33	34	31	30	30	2E	2B	2C	30	32	30
OE80	30	0F	0F	0F	0D	0E	0E	0E	0D	0E	0E	0E	11	1E	22
OE90	29	2E	2C	26	29	28	29	24	25	2E	2F	34	33	34	2F
OEA0	2D	2F	33	34	33	34	2F	2F	2D	2E	2B	2A	2D	2F	2F
OEB0	2F	12	10	10	10	10	10	10	10	12	10	10	17	20	26
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OED0	30	32	34	34	31	34	31	30	30	2E	2B	2A	2B	32	30
OEE0	31	12	10	10	10	10	10	10	10	12	10	12	17	24	27
OEF0	29	2E	26	1C	23	26	26	20	23	2C	2C	30	30	2E	2B
OF00	30	32	32	32	31	34	31	30	30	2E	2B	2A	29	2E	2B
OF10	30	12	0F	0E	0D	0E	0F	0E	0D	0E	0F	14	19	24	27
OF20	29	2C	25	1A	21	26	21	1E	23	24	2A	2C	2B	2C	28
OF30	2B	2E	31	30	31	32	30	2F	2B	2E	2B	2A	27	2C	29
OF40	2D	12	10	10	10	10	10	10	10	12	10	16	20	26	27
OF50	29	2C	20	1A	20	26	20	1C	21	22	26	2A	27	2A	28
OF60	2B	30	30	30	30	32	30	30	2B	2E	2B	2A	27	28	28
OF70	2B	0F	0F	0E	0D	0F	0F	0E	0D	0F	12	1A	20	26	27
OF80	27	2A	1F	16	1B	1F	17	18	1B	1E	25	26	25	28	27
OF90	29	2E	2E	2E	2D	2E	2E	2C	29	2C	2B	2A	27	26	23
OFA0	25	12	0F	0E	0D	0F	0F	0E	0D	0F	13	1A	20	26	25
OFB0	27	2A	1F	16	17	1E	15	14	15	1C	23	24	23	28	26
OF00	27	2C	2C	2C	2D	2E	2D	2C	27	2C	2B	2A	27	26	20

ภาคผนวก ง.

ลักษณะการจัดแบ่งระดับความเข้มของตัวอักษรโดยใ้การ เปรียบเทียบ
ความเข้มของตัวอักษร เป็นกลุ่ม ๆ (เมื่อใช้ตัวอักษรหนึ่งตัวแทนค่าความ
เข้มหนึ่งระดับ)



ระกำที่ 10



ระกำที่ 9



ระกำที่ 8



ระกำที่ 7



ระกำที่ 6



ระกำที่ 5



ระกำที่ 4



ระกำที่ 3



ระกำที่ 2



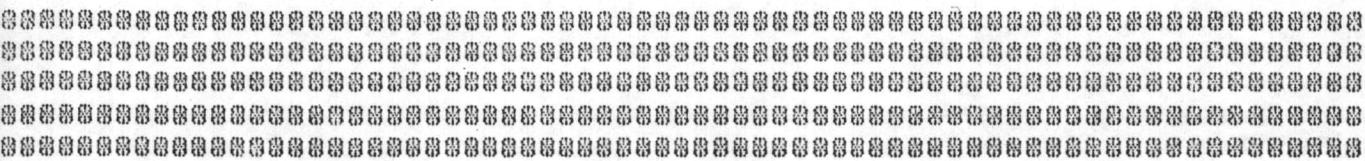
ระกำที่ 1

ภาคผนวก จ.

เปรียบเทียบค่าความเข้มของตัวอักษรแต่ละกลุ่มเมื่อใช้ตัวอักษรสองตัว
แทนค่าความเข้มหนึ่งระดับ



ระดับที่ 10



ระดับที่ 9



ระดับที่ 8



ระดับที่ 7



ระดับที่ 6



ระดับที่ 5



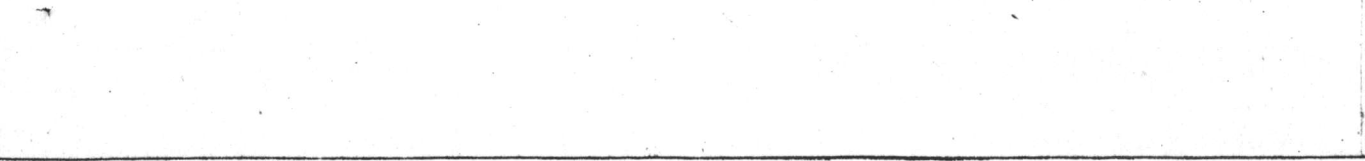
ระดับที่ 4



ระดับที่ 3



ระดับที่ 2



ระดับที่ 1

ภาคผนวก ฉ.

ตัวอย่างภาพที่วาคสนโคยไซตัวอักษรหนึ่งตัวแทนความเข้มหนึ่งระดับ

ภาคผนวก ข.

ตัวอย่างภาพที่วาคันโคโยใช้ตัวอักษรผสมสองตัวแทนความเข้มหนึ่งระดับ

ภาคผนวก ข.

ภาพที่วาดหลังจากปรับปรุงเครื่องพิมพ์แล้ว

ประวัติผู้เขียน

นางสาวอุไรลักษณ์ สัตยนาวิน เกิดวันที่ 22 กรกฎาคม พ.ศ. 2497 ที่กรุงเทพมหานคร สำเร็จการศึกษาปริญญาวิทยาศาสตรบัณฑิต (สาขาฟิสิกส์) จากมหาวิทยาลัยเกษตรศาสตร์ เมื่อปี พ.ศ. 2519 ปัจจุบันทำงานที่ บริษัท โรงงานส่งเสริมไทยอุตสาหกรรม จำกัด ตำแหน่ง System Analyst

