

### 3.6.1 REGISTER TO REGISTER

Mnemonic	Operand	Cycles	Instruction						Description	Status Change
MOVR	SSS,DDD	6/7*	X	XXX	XX0	010	SSS	DDD	MOVE contents of Register SSS to Register DDD.	S, Z
TSTR	SSS	6/7**			0	010	SSS	SSS	TeST contents of Register SSS.	S, Z
JR	SSS	7			0	010	SSS	111	Jump to address in Register SSS (move address to Register 7).	S, Z
ADDR	SSS,DDD	6/7*			0	011	SSS	DDD	ADD contents of Register SSS to contents of register DDD. Results to DDD.	S, Z, C, OV
SUBR	SSS,DDD	6/7*			0	100	SSS	DDD	SUBtract contents of Register SSS from contents of register DDD. Results to DDD.	S, Z, C, OV
CMPR	SSS,DDD	6/7*			0	101	SSS	DDD	CoMPare Register SSS with register DDD by subtraction. Results not stored.	S, Z, C, OV
ANDR	SSS,DDD	6/7*			0	110	SSS	DDD	logical AND contents of Register SSS with contents of register DDD. Results to DDD.	S, Z
XORR	SSS,DDD	6/7*			0	111	SSS	DDD	eXclusive OR contents of Register SSS with contents of register DDD. Results to DDD.	S, Z
CLRR	DDD	6/7*			0	111	DDD	DDD	CLear Register to zero.	S, Z

\*7 Cycles if DDD=6 or 7.

\*\*7 Cycles if SSS=6 or 7.

### 3.6.2 SINGLE REGISTER

Mnemonic	Operand	Cycles	Instruction						Description	Status Change
INCR	DDD	6/7*	X	XXX	XX0	000	001	DDD	INCrement contents of Register DDD. Results to DDD.	S, Z
DECR	DDD	6/7**			0	000	010	DDD	DECrement contents of Register DDD. Results to DDD.	S, Z
COMR	DDD	7			0	000	011	DDD	one's COMplement contents of Register DDD. Results to DDD.	S, Z
NEGR	DDD	6/7*			0	000	100	DDD	two's complement contents of Register DDD. Results to DDD.	S, Z, C, OV
ADCR	DDD	6/7*			0	000	101	DDD	ADd Carry bit to contents of Register DDD. Results to DDD.	S, Z, C, OV
GSWD	DDD	6			0	000	110	ODD	Get Status WorD in register DD. Bits 0-3, 8-11 set to 0. Bits 4, 12=C; 5, 13=OV; 6, 14=Z; 7, 15=S.	
NOP		6			0	000	110	10X	No Operation.	
SIN		6			0	000	110	11X	Software Interrupt; pulse to PCIT pin.	
RSWD	SSS	6			0	000	111	SSS	Restore Status WorD from register SSS; Bit 4 to C, Bit 5 to OV, Bit 6 to Z, Bit 7 to S.	S, Z, C, OV

### 3.6.3 REGISTER SHIFT

Executable only with Registers 0, 1, 2, 3.

Shifts are not interruptible.

Mnemonic	Operand	Cycles	Instruction					Description	Status Change	
SWAP	RR<,n>	6	X	XXX	XX0	001	001	NRR	N=0, SWAP bytes of register RR. S equals Bit 7 of results of SWAP.	S, Z
		8							N=1, not supported.	S, Z
SLL	RR<,n>	6			0	001	001	NRR	N=0, Shift Logical Left one bit. Zero to low bit.	S, Z
		8							N=1, Shift Logical Left two bits. Zero to low 2 bits.	S, Z
RLC	RR<,n>	6			0	001	010	NRR	N=0, Rotate Left one bit using C as bit 16.	S, Z, C
		8							N=1, Rotate Left two bits using C as bit 17 and OV as bit 16.	S, Z, C, OV
SLLC	RR<,n>	6			0	001	011	NRR	N=0, Shift Logical Left one bit using C as bit 16. Zero to low bit.	S, Z, C
		8							N=1, Shift Logical Left two bits using C as bit 17, OV as bit 16. Zero to low 2 bits.	S, Z, C, OV
SLR	RR<,n>	6			0	001	100	NRR	N=0, Shift Logical Right one bit. Zero to high bit.	S, Z
		8							N=1, Shift Logical Right two bits. Zero to high two bits.	S, Z
SAR	RR<,n>	6			0	001	101	NRR	N=0, Shift Arithmetic Right one bit. Sign bit copied to high bit.	S, Z
		8							N=1, Shift Arithmetic Right two bits. Sign bit copied to high 2 bits.	S, Z
RRC	RR<,n>	6			0	001	110	NRR	N=0, Rotate right one bit using C as bit 16.	S, Z, C
		8							N=1, Rotate right two bits using C as bit 16 and OV as bit 17.	S, Z, C, OV
SARC	RR<,n>	6			0	001	111	NRR	N=0, Shift Arithmetic Right one bit, thru C. Sign bit copied to high bit.	S, Z, C
		8							N=1, Shift Arithmetic Right two bits, thru OV and C. Sign bit copied to high 2 bits.	S, Z, C, OV

NOTE: n = 1 or 2 places

### 3.6.4 CONTROL

Mnemonic	Operand	Cycles	Instruction						Description	Status Change
HLT		4	X	XXX	XX0	000	000	000	HaLT after next interruptible instruction is executed. Resume on start	
SDBD		4			0	000	000	001	Set Double Byte Data for the next instruction which must be an external reference instruction.	
EIS		4			0	000	000	010	Enable Interrupt System. Not Interruptable.	
DIS		4			0	000	000	011	Disable Interrupt System. Not Interruptable.	
TCI		4			0	000	000	101	Terminate Current Interrupt. Not Interruptable.	
CLRC		4			0	000	000	110	CLeaR Carry to zero. Not Interruptable.	C
SETC		4			0	000	000	111	SET Carry to one. Not interruptable.	C

### 3.6.5 JUMP

Mnemonic	Operand	Cycles	Instruction						Description	Status Change
J	DA		X	XXX	XX0	000	000	100	Jump to address. Program counter is set to 16 bits of A's.	
			X	XXX	XX1	1AA	AAA	A00		
			X	XXX	XXA	AAA	AAA	AAA		
JE	DA				0	000	000	100	Jump to address. Enable interrupt system. Program counter is set to 16 bits of A's.	
					1	1AA	AAA	A01		
					A	AAA	AAA	AAA		
JD	DA				0	000	000	100	Jump to address. Disable interrupt system. Program counter is set to 16 bits of A's.	
					1	1AA	AAA	A10		
					A	AAA	AAA	AAA		
JSR	BB, DA				1	000	000	100	Jump and Save Return address (PC + 3) in register designated by 1BB. Program counter is set to 16 bits of A's. BB != 11.	
					B	BAA	AAA	A00		
					A	AAA	AAA	AAA		
JSRE	BB, DA				0	000	000	100	Jump and Save Return and Enable interrupt system. Return (PC + 3) is saved in register 1BB. Program counter is set to 16 bits of A's. BB != 11.	
					B	BAA	AAA	A01		
					A	AAA	AAA	AAA		
JSRD	BB, DA				0	000	000	100	Jump and Save Return and Disable interrupt system. Return (PC + 3) is saved in register 1BB. Program counter is set to 16 bits of A's. BB != 11.	
					B	BAA	AAA	A10		
					A	AAA	AAA	AAA		

NOTE: Bits 2-7 of the second word form bits 10-16 of the Destination Address.  
 Bits 0-9 of the third word form bits 0-9 of the Destination Address.

### 3.6.6 BRANCHES

The Branch instructions are Program Counter Relative, i.e. the Effective Address = PC +/- Displacement.

P-P is the Displacement and S is 0 for + and 1 for -.

For a forward branch an addition is performed.

For a backward branch a one's complement subtraction is performed.

Computation performed on PC + 2.

Mnemonic	Operand	Cycles	Instruction						Description	Status Change
<b>B</b>	DA	9	X	XXX	XX1	000	S00	000	Branch unconditional. Program counter relative (+ 1025 to - 1024)	
			P	PPP	PPP	PPP	PPP	PPP		
<b>NOPP</b>	DA	7			1	000	S01	000	No Operation, two words	
			P	PPP	PPP	PPP	PPP	PPP		
<b>BC (BLGE)</b>	DA	7 / 9			1	000	S00	001	Branch on Carry (Branch if Logical Greater Than or Equal). C = 1.	
			P	PPP	PPP	PPP	PPP	PPP		
<b>BNC (BLLT)</b>	DA	7 / 9			1	000	S01	001	Branch on No Carry (Branch if Logical Less Than). C = 0	
			P	PPP	PPP	PPP	PPP	PPP		
<b>BOV</b>	DA	7 / 9			1	000	S00	010	Branch on Overflow. OV = 1	
			P	PPP	PPP	PPP	PPP	PPP		
<b>BNOV</b>	DA	7 / 9			1	000	S01	010	Branch on No Overflow. OV = 0	
			P	PPP	PPP	PPP	PPP	PPP		
<b>BPL</b>	DA	7 / 9			1	000	S00	011	Branch on Plus. S = 0	
			P	PPP	PPP	PPP	PPP	PPP		
<b>BMI</b>	DA	7 / 9			1	000	S01	011	Branch on Minus. S = 1	
			P	PPP	PPP	PPP	PPP	PPP		
<b>BZE (BEQ)</b>	DA	7 / 9			1	000	S00	100	Branch on Zero (Branch if Equal). Z = 1	
			P	PPP	PPP	PPP	PPP	PPP		
<b>BNZE (BNEQ)</b>	DA	7 / 9			1	000	S01	100	Branch on No Zero (Branch if Not Equal). Z = 0	
			P	PPP	PPP	PPP	PPP	PPP		
<b>BLT</b>	DA	7 / 9			1	000	S00	101	Branch if Less Than. S ^ OV = 1	
			P	PPP	PPP	PPP	PPP	PPP		
<b>BGE</b>	DA	7 / 9			1	000	S01	101	Branch if Greater than or Equal. S ^ OV = 0	
			P	PPP	PPP	PPP	PPP	PPP		
<b>BLE</b>	DA	7 / 9			1	000	S00	110	Branch if Less than or Equal. Z   (S ^ OV) = 1	
			P	PPP	PPP	PPP	PPP	PPP		
<b>BGT</b>	DA	7 / 9			1	000	S01	110	Branch if Greater Than. Z   (S ^ OV) = 0	
			P	PPP	PPP	PPP	PPP	PPP		
<b>BUSC</b>	DA	7 / 9			1	000	S00	111	Branch if Unequal Sign and Carry. C ^ S = 1	
			P	PPP	PPP	PPP	PPP	PPP		
<b>BESC</b>	DA	7 / 9			1	000	S01	111	Branch on Equal Sign and Carry. C ^ S = 0	
			P	PPP	PPP	PPP	PPP	PPP		
<b>BEXT</b>	DA, EEEE	7 / 9			1	000	S1E	EEE	Branch if External condition is True. Field EEEE is externally decoded to select 1 of 16 conditions. Response is tested for true condition.	
			P	PPP	PPP	PPP	PPP	PPP		

NOTE: 7/9 7 Cycles if test condition is not true, 9 cycles if true.

### 3.6.7 DIRECT ADDRESSED DATA — MEMORY

Mnemonic	Operand	Cycles	Instruction						Description	Status Change
MVO	SSS, DA	11	X	XXX	XX1	001	000	SSS	MoVe Out data from register SSS to address A - A. Not interruptible.	
MVI	SA, DDD	10	A	AAA	AAA	AAA	AAA	AAA	MoVe In data from address A - A to register DDD.	
ADD	SA, DDD	10	A	AAA	AAA	AAA	AAA	AAA	ADD data from address A - A to register DDD. Results DDD.	S, Z, C, OV
SUB	SA, DDD	10	A	AAA	AAA	AAA	AAA	AAA	SUBtract data from address A - A from register DDD. Results to DDD.	S, Z, C, OV
CMP	SA, DDD	10	A	AAA	AAA	AAA	AAA	AAA	CoMPare data from address A-A with register SSS by subtraction. Results not stored.	S, Z, C, OV
AND	SA, DDD	10	A	AAA	AAA	AAA	AAA	AAA	logical AND data from address A - A with register DDD. Results to DDD.	S, Z
XOR	SA, DDD	10	A	AAA	AAA	AAA	AAA	AAA	eXclusive OR data from address A - A with register DDD. Results to DDD.	S, Z

### 3.6.8 IMMEDIATE DATA — REGISTER

Mnemonic	Operand	Cycles	Instruction						Description	Status Change
MVOI	SSS, DA	9	X	XXX	XX1	001	000	SSS	MoVe Out Immediate data from register SSS to PC + 1 (field). Not interruptible.	
MVII	SA, DDD	8	I	III	III	III	III	III	MoVe In Immediate data to register DDD from PC + 1 (field).	
ADDI	SA, DDD	8	I	III	III	III	III	III	Add Immediate data to contents of register DDD. Results to DDD.	S, Z, C, OV
SUBI	SA, DDD	8	I	III	III	III	III	III	SUBtract Immediate data from contents of register DDD. Results to DDD.	S, Z, C, OV
CMPI	SA, DDD	8	I	III	III	III	III	III	CoMPare Immediate data from contents of register SSS by subtraction. Results not stored.	S, Z, C, OV
ANDI	SA, DDD	8	I	III	III	III	III	III	logical AND Immediate data with contest of register DDD. Results to DDD.	S, Z
XORI	SA, DDD	8	I	III	III	III	III	III	eXclusive OR Immediate data with the contents of register DDD. Results to DDD.	S, Z

### 3.6.9 INDIRECT ADDRESSED DATA—REGISTER

MMM Source data is located at the address contained in Register R1 - R6.  
 MMM=4, 5: post-increment R4 or R5.

MMM=6: MVO instruction — post-increment R6. PUSH data from Register SSS to the Stack.

Other instructions — pre-decrement R. PULL data from the Stack to be used at the first operand.

Mnemonic	Operand	Cycles	Instruction						Description	Status Change	
MVO@	SSS, MMM	9	X	XXX	XX1	001	MMM	SSS	MoVe Out data from register SSS to the address in register MMM. Note: SSS=MMM=4,5,6 or 7 not supported. Not interruptible.		
PSHR	SSS	9				1	001	110	SSS	PuSH data from Register SSS to the stack. Not interruptible.	
MVI@	MMM, DDD	8 / 11				1	010	MMM	DDD	MoVe In data from the address in register MMM to register DDD.	
PULR	DDD	11				1	010	110	DDD	PULI data from the stack to Register DDD.	
ADD@	MMM, DDD	8 / 11				1	011	MMM	DDD	ADD data located at the address in register MMM to contents of register DDD. Results to DDD.	S, Z, C, OV
SUB@	MMM, DDD	8 / 11				1	100	MMM	DDD	SUBtract data located at the address in register MMM from contents of register DDD. Results to DDD.	S, Z, C, OV
CMPE	MMM, DDD	8 / 11				1	101	MMM	SSS	CoMPare data located at the address in register MMM with contents of register SSS by subtraction. Results not stored.	S, Z, C, OV
AND@	MMM, DDD	8 / 11				1	110	MMM	DDD	logical AND contents of register DDD with data located at the address in register MMM. Results to DDD.	S, Z
XOR@	MMM, DDD	8 / 11				1	111	MMM	DDD	eXclusive OR contents of regsister DDD with data located at the address in register MMM. Results to DDD.	S, Z

NOTE: 8 / 11 - 11 Cycles if MMM = 6, 8 Cycles otherwise

### 3.6.10 IMMEDIATE DOUBLE BYTE DATA — REGISTER

Mnemonic	Operand	Cycles	Instruction						Description	Status Change
SDBD MVII	I-I, DDD	14	X	XXX	XX0	000	000	001	MoVe In Immediate double byte data to register DDD.	
			X	XXX	XX1	010	111	DDD		
			X	XXX	XXX	XLL	LLL	LLL		
			X	XXX	XXX	XUU	UUU	UUU		
SDBD ADDI	I-I, DDD	14			0	000	000	001	ADD Immediate double byte data to contents of register DDD.	S, Z, C, OV
					1	011	111	DDD	Results to DDD.	
						LL	LLL	LLL		
						UU	UUU	UUU		
SDBD SUBI	I-I, DDD	14			0	000	000	001	SUBtract Immediate double byte data from contents of register	S, Z, C, OV
					1	100	111	DDD	DDD. Results to DDD.	
						LL	LLL	LLL		
						UU	UUU	UUU		
SDBD CMPI	I-I, DDD	14			0	000	000	001	CoMPare Immediate double byte data with contents of register	S, Z, C, OV
					1	101	111	DDD	SSS by subtraction. Results not stored.	
						LL	LLL	LLL		
						UU	UUU	UUU		
SDBD ANDI	I-I, DDD	14			0	000	000	001	logical AND Immediate double byte data with contents of register	S, Z
					1	100	111	DDD	DDD. Results to register DDD.	
						LL	LLL	LLL		
						UU	UUU	UUU		
SDBD XORI	I-I, DDD	14			0	000	000	001	eXclusive OR Immediate double byte data with contents of	S, Z
					1	101	111	DDD	register DDD. Results to register DDD.	
						LL	LLL	LLL		
						UU	UUU	UUU		

NOTE: I - I — UUUUUUUULLLLLLLL; L - L indicates low byte of literal; U - U indicates upper byte.

NOTE: The SDBD instruction is normally supplied by the assembler as required to properly generate machine code.

### 3.6.11 INDIRECT ADDRESSED DOUBLE BYTE DATA — REGISTER

Mnemonic	Operand	Cycles	Instruction						Description	Status Change
SDBD			X	XXX	XX0	000	000	001	MoVe In double byte data from the address in register MMM to register DDD.	
MVI@	MMM, DDD	14	X	XXX	XX1	010	MMM	DDD		
SDBD					0	000	000	001	ADD double byte data located at the address in register MMM to contents of register DDD. Results to DDD.	S, Z, C, OV
ADD@	MMM, DDD	14			1	011	MMM	DDD		
SDBD					0	000	000	001	SUBtract double byte data located at the address in register MMM from contents of register DDD. Results to DDD.	S, Z, C, OV
SUB@	MMM, DDD	14			1	100	111	DDD		
SDBD					0	000	000	001	CoMPare double byte data located at the address in register MMM with the contents of register SSS by subtraction. Results not stored.	S, Z, C, OV
CMP@	MMM, DDD	14			1	101	111	DDD		
SDBD					0	000	000	001	logical AND double byte data located at the address in register MMM with contents of register DDD. Results to DDD.	S, Z
AND@	MMM, DDD	14			1	100	111	DDD		
SDBD					0	000	000	001	eXclusive OR double byte data located at the address in register MMM with contents of register DDD. Results to DDD.	S, Z
XOR@	MMM, DDD	14			1	101	111	DDD		

### 3.6.12 SYMBOLIC NOTATION — The following symbolic notation is used in all CP1600 instruction documentation.

<b>Address</b>			<b>Functions +</b>		<b>MMM - Register Address Mode</b>
<b>Modes:</b>	R	- register	-	- addition	000 - direct address in location following instruction
	blank'	- direct address		- subtraction	001 - indirect address for Register 1
	I	- immediate data	^	- inclusive OR	010 - indirect address for Register 2
	@	indirect address	&	- exclusive OR	011 - indirect address for Register 3
			()	- AND	100 - indirect address for Register 4, post increment
<b>Operands:</b>	SSS	- Source Register	<-	- contents of	101 - indirect address for Register 5, post increment
	DDD	- Destination Register	< >	- is replaced by	110 - indirect address for Register 6, post increment
	MMM	- Register Address Mode	<b>Status:</b> S	- optional operand	for MVO only; indirect address for Register 6, pre decrement for all instructions except MVC
	RR	- Register (0 - 3)	Z	- Sign bit	111 - indirect address for Register 7, post increment.
	N	- Number of Shifts (0 = 1, 1 = 2)	C	- Zero bit	(Immediate data in location following instruction.)
	S	- Sign of Address Displacement	OV	- Carry bit	
	EEEE	- External Condition Code (0 - 15)		- Overflow bit	
	DA	- Destination Address			
	SA	- Source Address			
	I - I	- Immediate data word			
	P - P	- Address displacement for Branch			