Typewriter Control
Codes and Operating Times

Operation	Q_{11}	Time (in milliseconds)		
		Total	CPU Interlocked	Available Overlap
Space	1	56	56	None
Return carriage [1]	2	800	124	676
Back space	3	56	56	None
Index	4	124	124	None
Tabulate [2]	8	250	56	194

[1] Maximum return of 85 positions.   [2] Tabulate 20 positions.

Printer Control
Codes and Printing Speeds

Operation	Q_{10}-Q_{11} Codes	
	Before Printing	After Printing
One space	51	21
Two spaces	52	62
Three spaces	53	63
Skip to channel:		
1	71	41
2	72	42
3	73	43
4	74	44
5	75	45
6	76	46
7	77	47
8	78	48
9	79	49
10	70	40
11	33	03
12	34	04

Time required, spacing and skipping	First line: 45 ms Each additional line: 10 ms	First two lines included in print time. Each additional line: 10 ms

Printing Speed — Lines per Minute		
Character Set	1443-1	1443-2
13	430	600
39	190	300
52	150	240

Input/Output Device Codes

Q_8Q_9	Device	Operating Speed
01	Typewriter	15.5 char/sec
02	Tape Punch	15 char/sec
02	Plotter	Model 1: 18,000 steps/min Model 2: 12,000 steps/min
03	Paper Tape Reader	150 char/sec
04	Card Punch	Model 1: 125 cards/min Model 2: 250 cards/min
05	Card Reader	Model 1: 250 cards/min Model 2: 500 cards/min
07	Disk Storage Drive	Speed varies with function
09	Printer	Model 1: 150 - 430 lines/min Model 2: 240 - 600 lines/min

Typewriter Program Control Characters

Character	Symbol	Use
Record mark	‡	‡ key during input; record mark sensed during Dump Numerically operation.
Overscore (FLG) on keyboard)	$\bar{4}$	FLG key during input; flag bit sensed during output.
Strike-through	— or ¥	CORR key during output; prints through parity errors during output.
Pillow	▮	Invalid character sensed during output.
Release/Start	$\frac{R}{S}$	Release and Start ($\frac{R}{S}$) key.

Index Register Table

Register Number	P/Q Address	Core Storage Locations	
		Band 1	Band 2
(None Specified)	xxxxx	00300 - 00304*	00340 - 00344*
1	xxxx̄x	00305 - 00309	00345 - 00349
2	xxxx̄x	00310 - 00314	00350 - 00354
3	xxxx̄x	00315 - 00319	00355 - 00359
4	xx̄xxx	00320 - 00324	00360 - 00364
5	xxx̄x̄x	00325 - 00329	00365 - 00369
6	xx̄xx̄x	00330 - 00334	00370 - 00374
7	xx̄x̄x̄x	00335 - 00339	00375 - 00379

* Data from Q field stored; no address modification.

Multiply Table

High-Order Positions of Address	Units Position of Address									
	0	1	2	3	4	5	6	7	8	9
0010	0	0	0	0	0	0	0	0	0	0
0011	0	0	1	0	2	0	3	0	4	0
0012	0	0	2	0	4	0	6	0	8	0
0013	0	0	3	0	6	0	9	0	2	1
0014	0	0	4	0	8	0	2	1	6	1
0015	0	0	5	0	0	1	5	1	0	2
0016	0	0	6	0	2	1	8	1	4	2
0017	0	0	7	0	4	1	1	2	8	2
0018	0	0	8	0	6	1	4	2	2	3
0019	0	0	9	0	8	1	7	2	6	3
0020	0	0	0	0	0	0	0	0	0	0
0021	5	0	6	0	7	0	8	0	9	0
0022	0	1	2	1	4	1	6	1	8	1
0023	5	1	8	1	1	2	4	2	7	2
0024	0	2	4	2	8	2	2	3	6	3
0025	5	2	0	3	5	3	0	4	5	4
0026	0	3	6	3	2	4	8	4	4	5
0027	5	3	2	4	9	4	6	5	3	6
0028	0	4	8	4	6	5	4	6	2	7
0029	5	4	4	5	3	6	2	7	1	8

Switch and Indicator Codes

Code	Name	Light	Turned on by	Turned off by
1620				
01-04	1620 Program Switches 1-4	No	Operator (Program Switch On)	Operator (Program switch Off)
06	Read Check	Yes	I/O Input Error	BI, BNI, Reset key, or Check Reset key
07	Write Check	Yes	I/O Output Error	BI, BNI, Reset key, or Check Reset key
09	Last Card (1622 Card Read)	Yes	Last Card Data Transfer to Core Storage	BI, BNI, or Reset key
11	High-Positive (H/P)	Yes	Arithmetic Result positive and greater than zero	Reset key or next arithmetic instruction
12	Equal-Zero (E/Z)	Yes	Arithmetic Result of zero	Reset key, or next arithmetic instruction
13	H/P or E/Z	No	Indicator 11 or 12	Indicators 11 and 12 Off
14	Arithmetic Check	Yes	Arithmetic Overflow	BI, BNI, or Reset key
15	Exponent Check	Yes	Exponent Overflow/Underflow	BI, BNI, or Reset key
16	MBR-E Check	Yes	Parity Error in MBR-E, MIR-E	BI, BNI, Check Reset or reset key
17	MBR-O Check	Yes	Parity Error in MBR-O, MIR-O	BI, BNI, Check Reset or reset key
19	Any Check	No	Indicator 06, 07, 16, 17, 25, or 39 on	Indicators 06, 07, 16, 17, 25, and 39 off, or check Reset key
30	IX Band 0	No	Power on or Branch and Select instruction	Power off or Branch and Select instruction
31	IX Band 1	Yes	Branch and Select instruction	Power off or Branch and Select instruction
32	IX Band 2	Yes	Branch and Select instruction	Power off or Branch and Select instruction
1311				
36	Address Check	Yes	Unequal address, or no address found in disk storage, or multiple heads, or multiple drives are selected.	BI, BNI, Check Reset, or Reset keys disk operation
37	Wrong-Length Record/ Read-Back Check	Yes	Incorrect record length, or corresponding data in disk storage and core storage does not compare	BI, BNI, Check Reset, or Reset key, or disk operation
38	Cylinder Overflow	Yes	Disk operation completes last sector and sector count is not 000	BI, BNI, Check Reset or Reset keys, or disk operation
39	Any Disk Error	No	36, 37, or 38 on	Reset of 36, 37, and 38
1443				
25	Printer Check	Yes	Parity error or sync. check in 1443	If a parity error: BI, BNI, 1620 or 1443 Reset keys. If a sync. check error: 1443 Reset key only.
33	Channel 9	No	Punched hole in Channel 9 of carriage control tape	BI, BNI, 1620 Reset key, or a punched hole in Channel 1 of carriage control tape.
34	Channel 12	No	Punched hole in channel 12 of carriage control tape	BI, BNI, 1620 Reset key, or a punched hole in Channel 1 of carriage control tape.
35	Printer Busy	No	1443 printing (buffer is unavailable for loading)	1443 Completion of printing (buffer available for loading)

SPS Mnem.	Op Code	Instruction	Timing	Operation	① Ind. Add P	① Ind. Add Q	② IX Mod. P	② IX Mod. Q	Notes
A	21	Add	Basic: $10(6.5+.5Dq+Dp)$ Recomp: $10Dp$	Q field data added to P field data; result replaces P field data	Y	Y	Y	Y	3
AM	11	Add Immediate	Same as A-21	Q data added to P field data; result replaces P field data.	Y	N	Y	N	3
ANDF	93*	AND to Field	$10(6+2Dq)$	Q field 4, 2, and 1 bits ANDed to corresponding P field bits; result in P field.	Y	Y	Y	Y	
B	49	Branch	40	Instruction at P address executed.	Y	N	Y	N	4
BB	42	Branch Back	20	Instruction at address saved in previous operation is executed.	N	N	N	N	4,5
BLX	65*	Branch and Load Index Register	140	Q field data stored in IX specified by flags in Q_8-Q_{10}.	Y	N	Y	N	6
BLXM	66*	Branch and Load Index Register Immediate	140	Q data stored in IX specified by flags in Q_8-Q_{10}.	Y	N	Y	N	6
BX	61*	Branch and Modify Index Register	$10(6.5+.5Dq+Lx)$	Q field data added to IX specified by flags in Q_8-Q_{10}.	Y	N	Y	N	6
BXM	62*	Branch and Modify Index Register Immediate	140	Q data added to IX specified by flags in Q_8-Q_{10}.	Y	N	Y	N	6
BS	60	Branch and Select	60	IX band (0,1,2) or Ind. Add. (8,9) selected by Q_{11} digit.	Y	N	Y	N	6
BSX	67*	Branch and Store Index Register	140	Data from IX specified by flags in Q_8-Q_{10} stored in Q field.	Y	N	Y	N	6
BT	27	Branch and Transmit	$10(7.5+1.5Dq)$	Address of next sequential instruction saved; Q field data stored in Lp-1.	Y	Y	Y	Y	6
BTM	17	Branch and Transmit Immediate	$10(7.5+1.5Dq')$	Address of next sequential instruction saved; Q data stored at Lp-1.	Y	N	Y	N	6
BTA	20	Branch and Transmit Address	$10(7.5+1.5Dq)$	Same as BT-27, except that flags in the first four low-order positions of the Q field ignored as indication to terminate transmittal of data.	Y	Y	Y	Y	6
BTAM	10	Branch and Transmit Address Immediate	Same as BTM-17	Same as BTA-20, except Q data transmitted.	Y	N	Y	N	6
BTFL	07	Branch and Transmit Floating	$10(9.5+1.5L)$	Address of next sequential instruction saved; Q field data stored at Lp-1.	Y	Y	Y	Y	6
BCX	63*	Branch Conditionally and Modify Index Registers	$10(6.5+.5Dq+Lx)$	Data in Q field added to IX specified by flags in Q_8-Q_{10}. No IX sign change: next instruction at P address.	Y	N	Y	N	7
BCXM	64*	Branch Conditionally and Modify Index Registers Immediate	140	Same as BCX-63, except Q data added to IX.	Y	N	Y	N	7
BI	46	Branch Indicator	60	Indicator specified by Q_8-Q_9 tested. ON: next instruction at P address.	Y	N	Y	N	7
BNF	44	Branch No Flag	70	No flag bit at Q address: next instruction at P address.	Y	Y	Y	Y	7
BNG	55*	Branch No Group Mark	70	No Group Mark at Q address: next instruction at P address.	Y	Y	Y	Y	7
BNI	47	Branch No Indicator	60	Indicator specified by Q_8-Q_9 OFF: next instruction at P address	Y	N	Y	N	7
BNR	45	Branch No Record Mark	70	No Record Mark (or Group Mark) at Q address: next instruction at P address.	Y	Y	Y	Y	7
BBT	90*	Branch on Bit	70	Bits in digit at address specified by Q_8-Q_{11} compared with bits in digit in Q_7. If any bit is common to both, next instruction at P address.	Y	Y	Y	Y	7
BD	43	Branch on Digit	70	Digit other than zero at Q address: next instruction at P address.	Y	Y	Y	Y	7
BMK	91*	Branch on Mask	70	Same as BBT-90, except that any 1, 2, 4, or 8 bit(s) must be common to both digits.	Y	Y	Y	Y	7
CDGN	36*	Check Disk - WLRC Q: x07x1	$10(6+2200+200S)$ (Average time)	Data in specified number of disk sectors compared with data in core storage. Record length checked.	Y	N	Y	N	8
CDN	36*	Check Disk Q: x07x3	Same as CDGN	Same as CDGN without record length check.	Y	N	Y	N	8
CTGN	36*	Check Disk Track - WLRC Q: x07x5	Same as CDGN	Data and addresses from specified full track compared with data and addresses in core storage. Record length checked.	Y	N	Y	N	8
CTN	36*	Check Disk Track Q: x07x7	Same as CDGN	Same as CTGN, without record length check.	Y	N	Y	N	8
CF	33	Clear Flag	70	Flag bit at P address is removed; C-bit added if necessary.	Y	N	Y	N	4
C	24	Compare	Unlike signs: $10(8+1.5Dz)$ Like signs: $10(6.5+.5Dq+Dp)$	Data in P field compared with data in Q field.	Y	Y	Y	Y	
CM	14	Compare Immediate	Same as C-24	Data in P field compared with Q data.	Y	N	Y	N	
CPFL	94*	Complement Octal Field	$10(6+2Dq)$	Data in Q field complemented on an octal basis and stored in P field.	Y	Y	Y	Y	
K	34*	Control (Printer)	See Printer Control Code table.	Q_8-Q_9: printer code. $Q_{10}-Q_{11}$ printer function. See table.	N	N	N	N	5

SPS Mnem.	Op Code	Instruction	Timing	Operation	① Ind. Add P	① Ind. Add Q	② IX Mod. P	② IX Mod. Q	Notes
K	34	Control (Typewriter)	See Typewriter Control Code Table.	Q_8-Q_9: typewriter code. $Q_{10}-Q_{11}$: function performed. See table.	N	N	N	N	5
DTO	97*	Decimal to Octal Conversion	$10[31+Tq+ 4.125Tq(Tq+1)]$	Decimal field located at 00099 converted to octal and stored, with leftmost digit at P address. Q address specifies location of power-of-eight number in first subtraction.	Y	Y	Y	Y	9
D	29	Divide	$10(6+13.5Qt+ 9.75DvQt)$	Dividend at 00099; divisor in Q field; P is location of units position of divisor for first subtraction.	Y	Y	Y	Y	10
DM	19	Divide Immediate	Same as D-29	Same as D-29, except that divisor is in Q.	Y	N	Y	N	10
DN DNCD DNPT (None) PRD DNTY	35 35* 35* 35* 35* 35	Dump Numerically Card: x04xx Paper Tape: x02xx Plotter: x02xx Printer: x09xx Typewriter: x01xx	1.7 ms# 15 char/sec 200 μsec/char# 2.1 ms# 15.5 char/sec	Data from P address and succeedingly higher locations transmitted to I/O unit, through highest-numbered position of module. Q specifies I/O unit.	Y	N	Y	N	
EORF	95*	Exclusive OR to Field	$10(6+2Dq)$	Q field 4, 2, and 1 bits Exclusive ORed to corresponding bits of P field. Results in P field.	Y	Y	Y	Y	
FADD	01*	Floating Add	$10(15+2.2L)$ average Recomp: 10L	Mantissa of Q field added to mantissa of P field; result stored in P field; exponent modified as required.	Y	Y	Y	Y	3
FDIV	09*	Floating Divide	$10(34.5+27L +9.75L^2)$ average	P field mantissa divided by Q field mantissa; P exponent minus Q exponent; resulting mantissa and exponent in P field.	Y	Y	Y	Y	10
FMUL	03*	Floating Multiply	$10[28+3L+4Lz +4L(L-Lz)]$	P field mantissa multiplied by Q field mantissa; P exponent plus Q exponent; product and exponent in P field.	Y	Y	Y	Y	
FSL	05*	Floating Shift Left	$10(7+2L+2L')$	Q field mantissa shifted left until high-order position is in P address.	Y	Y	Y	Y	
FSR	08*	Floating Shift Right	$10(7+2L)$	Q field shifted right to location specified by P address.	Y	Y	Y	Y	
FSUB	02*	Floating Subtract	$10(15+2.2L)$ average 10L recomp.	P field mantissa minus Q field mantissa replaces P field; exponent modified as required.	Y	Y	Y	Y	3
H	48	Halt	60	Stop.	N	N	N	N	4,5
LD	28	Load Dividend	$10(17.5+1.5Dn)$	Dividend in Q field stored in product area specified by P address.	Y	Y	Y	Y	
LDM	18	Load Dividend Immediate	Same as LD-28	Same as LD-28, except dividend in Q.	Y	N	Y	N	
MA	70*	Move Address	140	Five digits in Q field moved to P field.	Y	Y	Y	Y	
MF	71	Move Flag	80	Flag at Q address moved to P address.	Y	Y	Y	Y	
M	23	Multiply	$10[16+Dq+4Zq +4Dp(Dq-Zq)]$	P field multiplied by Q field: product at 00099.	Y	Y	Y	Y	
MM	13	Multiply Immediate	Same as M-23	Same as M-23, except Q data is multiplier.	Y	N	Y	N	
NOP	41	No Operation	60	Next sequential instruction executed.	N	N	N	N	4,5
OTD	96*	Octal to Decimal Conversion	$10[28+Dq(2Dq-1)]$	Octal field at Q address converted to decimal; result at 00099; table of base-eight numbers at P address.	Y	Y	Y	Y	
ORF	92*	OR to Field	$10(6+2Dq)$	Q field 4, 2, and 1 bits ORed to corresponding P field bits; results in P field.	Y	Y	Y	Y	
RA RACD RAPT RATY	37 37* 37* 37	Read Alphamerically Card: x05xx Paper Tape: x03xx Typewriter: x01xx	1.7 ms# 150 char/sec Speed of operator	I/O unit data read to Lp-1 and succeedingly higher-numbered locations.	Y	N	Y	N	
RBPT	37*	Read Binary Paper Tape Q: x33xx	300 binary char/ sec	Binary data read from paper tape into location specified by P address and succeedingly higher-numbered locations.	Y	N	Y	N	
RDGN	36*	Read Disk - WLRC Q: x07x0	$10(6+2200+200S)$ (Average time)	Data from specified number of sectors read into core storage; record length checked.	Y	N	Y	N	8
RDN	36*	Read Disk Q: x07x2	Same as RDGN	Same as RDGN without record length check.	Y	N	Y	N	8
RTGN	36*	Read Disk Track - WLRC Q: x07x4	Same as RDGN	Addresses and data from specified full track transferred to core storage. Record length checked.	Y	N	Y	N	8
RTN	36*	Read Disk Track Q: x07x6	Same as RDGN	Same as RTGN without record length check.	Y	N	Y	N	8
RN RNCD RNPT RNTY	36 36* 36* 36	Read Numerically Card: x05xx Paper Tape: x03xx Typewriter: x01xx	1.7 ms# 150 char/sec Speed of operator	Data from I/O unit read into location specified by P address and succeedingly higher-numbered locations. Q: Input device.	Y	N	Y	N	
SK	34*	Seek Q: x07x1	160μsec#. Average access time: 250 ms.	Access mechanism returns to home position and then moves in to cylinder specified.	Y	N	Y	N	8
SF	32	Set Flag	70	Store flag at location specified by P address.	Y	N	Y	N	4
S	22	Subtract	Basic: $10(6.5+.5Dq+Dp)$ Recomp: 10 Dp	Q field data subtracted from P field data; result replaces P field data.	Y	Y	Y	Y	3
SM	12	Subtract Immediate	Same as S-22	Same as S-22, except Q data is subtrahend.	Y	N	Y	N	3

Instruction Summary

SPS Mnem.	Op Code	Instruction	Timing	Operation	Ind. Add ① P	Ind. Add ① Q	IX Mod ② P	IX Mod ② Q	Notes
TD	25	Transmit Digit	80	Digit at Q address transmitted to P address.	Y	Y	Y	Y	
TDM	15	Transmit Digit Immediate	80	Digit at Q_{11} transmitted to P address.	Y	N	Y	N	
TF	26	Transmit Field	10(6.5+1.5Dq) (Average time)	Data in Q field transmitted to P field.	Y	Y	Y	Y	
TFM	16	Transmit Field Immediate	Same as TF-26	Q data transmitted to P field.	Y	N	Y	N	
TFL	06	Transmit Floating	10(9.5 – 1.5L) (Average time)	Q field exponent and mantissa transmitted to P field.	Y	Y	Y	Y	
TR	31	Transmit Record	10(6.5+1.5Dq)	Record at Q address transmitted to P address. (P address and Q address are high-order positions.)	Y	Y	Y	Y	
TRNM	30	Transmit Record No Record Mark	Same as TR-31	Same as TR-31, except record mark in Q field not transmitted.	Y	Y	Y	Y	
TNF	73	Transfer Numeric Fill	10(6+Dp)	Q field numeric data transmitted to corresponding odd-numbered positions of the P field.	Y	Y	Y	Y	
TNS	72	Transfer Numeric Strip	Same as TNF-73	P field alphameric data from odd-numbered positions transmitted to corresponding numeric positions of Q field.	Y	Y	Y	Y	
WA	39	Write Alphamerically		Data from Lp-1 and succeeding higher-numbered locations transmitted to output device specified by Q_8-Q_9.	Y	N	Y	N	
WACD	39*	Card: x04xx	1.7 ms#						
WAPT	39*	Paper Tape: x02xx	15 char/sec						
(None)	39*	Plotter: x02xx	200 μsec/char#						
PRA	39*	Printer: x09xx	2.1 ms#						
WATY	39	Typewriter: x01xx	15.5 char/sec						
WBPT	39*	Write Binary Paper Tape Q: x32xx	30 binary char/sec	Data from adjacent even- and odd-numbered positions punched into the same tape columns, from the P address and succeeding higher-numbered locations.	Y	N	Y	N	
WDGN	38*	Write Disk – WLRC Q: x07x0	10(6+2200+200S) (Average time)	Data is transferred from core storage to specified number of disk sectors. Record length checked. Write Address key must be OFF.	Y	N	Y	N	8
WDN	38*	Write Disk Q: x07x2	Same as WDGN	Same as WDGN, except no WLRC.	Y	N	Y	N	8
WTGN	38*	Write Disk Track – WLRC Q: x07x4	Same as WDGN	Addresses and data transferred from core storage to specified full track. Record length checked. Write Address key must be ON.	Y	N	Y	N	8
WTN	38*	Write Disk Track Q: x07x6	Same as WDGN	Same as WTGN, except no WLRC.	Y	N	Y	N	8
WN	38	Write Numerically		Data from location specified by P address and succeeding higher-numbered locations transferred to output device specified by Q_8-Q_9.	Y	N	Y	N	
WNCD	38*	Card: x04xx	1.7 ms#						
WNPT	38*	Paper Tape: x02xx	15 char/sec						
(None)	38*	Plotter: x02xx	200 μsec/char#						
PRN	38*	Printer: x09xx	2.1 ms#						
WNTY	38	Typewriter: x01xx	15.5 char/sec						

DEFINITIONS

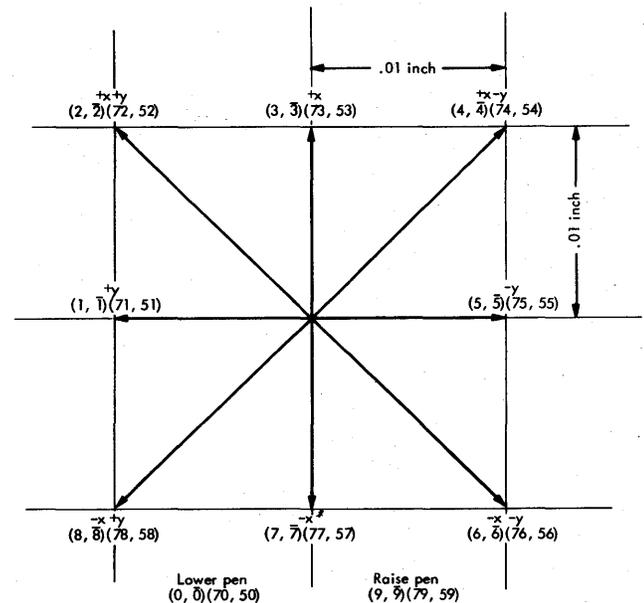|	
Dn	Number of digits, including high-order zeros, in dividend.
Dp	Number of digits, including high-order zeros, in the field at the P address.
Dq	Number of digits, including high-order zeros, in the field at the Q address.
Dq'	Number of digits, including high-order zeros, in the Q part of the instruction.
Dv	Number of digits, including high-order zeros, in the divisor.
Dz	Number of digits compared until a digit other than zero is detected in either field.
IX	Index Register.
L	Number of digits in mantissa.
L'	Number of digits mantissa is increased by shift left.
Lp	Core storage location defined by P address.
Lx	Length of index register field.
Lz	Number of zeros in mantissa.
ms	Milliseconds.
Qt	Number of digits, including high-order zeros, in quotient.
S	Number of disk sectors.
Tq	Position number of octal table entry addressed. Average octal number is 3.5.
μsec	Microseconds.
Zq	Number of zeros in field at Q (multiplier).
#	Time CPU is interlocked.
*	Special feature.

NOTES

1. Indirect Addressing. Indicates that the P and/or Q address can (Y) or cannot (N) be an indirect address.
2. Index Modification. Indicates that the P and/or the Q address can (Y) or cannot (N) be modified by an index register.
3. If there is no change of sign of the P data, the basic time formula is used. If the sign of the P data changes, recomplement time is added to basic time.
4. The Q address is not used.
5. The P address is not used.
6. The next instruction executed is at the P address.
7. If the branch does not occur, the next sequential instruction is executed.
8. The P address is the location of the disk control field.
9. For computation of instruction time, assume that the average octal digit equals 3.5.
10. For computation of instruction time, assume that the average quotient digit value equals 4.5.

Storage Register Functions

IR-1	Contains address of next instruction if machine is stopped with Stop key or Halt instruction. Saves return address when interrupt is serviced (1710 Control System)
IR-2	Saves return address when any branch and transmit instruction is executed in Mainline program.
IR-3	Contains interrupt address — used in place of IR-1 during interrupt program operation (1710 Control System only).
IR-4	Saves return address when any Branch and Transmit instruction is executed in the Interrupt Program (1710 Control System only).
OR-1	Contains Q address after I cycles of an instruction. In disk storage operations, used to store and control disk sector address.
OR-2	Contains P address after I cycles of an instruction. In disk storage operations contains core storage address where data from disk storage is written to or read from.
OR-3	Retains address of low-order multiplier digit during multiplication.
OR-4	Used to store and control the exponent address E_q during automatic floating-point operations.
OR-5	Used to store and control the exponent address E_p during automatic floating-point operations.
PR-1	Saves return address when a Save key operation occurs. Decremented for each new multiplier digit during multiply.
PR-2	Decremented for each new multiplicand digit during multiply. In disk storage operations, used to store and control number of sectors in operation.
MAR	Addresses core storage.
MBR	Receives digits leaving core storage.
MIR	Receives digits entering core storage.
OP	Contains Op code of instruction just executed if machine is stopped with Stop key or Halt instruction.
CR-1	Used to store the algebraic difference between E_p and E_q for determination of decimal alignment during automatic floating-point operations. CR-1 is also used during floating-point operations to count high-order zeros when normalizing — the contents of CR-1 are subtracted from E_p.
Multiplier/ Quotient	Contains multiplier and quotient digits during multiply and automatic divide operations.
Data Register	Decodes Q_8 and Q_9 digits of BI, BNI, and I/O instructions. Stores partial product digits during multiply instructions. Stores digits affecting MARS during all I cycles. Stores one of the digits used in any addition or subtraction.

Plotter Record Control Characters

+x+y (2, 2̄)(72, 52)   +x (3, 3̄)(73, 53)   +x-y (4, 4̄)(74, 54)

+y (1, 1̄)(71, 51)   -y (5, 5̄)(75, 55)

.01 inch

-x+y (8, 8̄)(78, 58)   -x (7, 7̄)(77, 57)   -x-y (6, 6̄)(76, 56)

Lower pen (0, 0̄)(70, 50)   Raise pen (9, 9̄)(79, 59)

NOTE: Figures in parenthesis are (left) positive and negative numeric characters and (right) positive and negative alphabetic characters that correspond to the associated plotting movement.
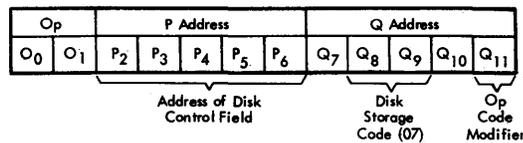
Compare Results

Condition (Algebraic)	Indicators		
	High/Positive	Equal/Zero	H/P or E/Z
P Greater than Q	ON	OFF	ON
P Less than Q	OFF	OFF	OFF
P Equal to Q	OFF	ON	ON

P = Data in Field at P Address
Q = Data in Field at Q Address

Specified Areas in Core Storage

Area	Address
Console Area	00000 - 00099
Product Area	00080 - 00099
Multiply Table	00100 - 00299
Index Registers	00300 - 00379

Disk Storage Instruction Format

Op		P Address						Q Address					
O_0	O_1	P_2	P_3	P_4	P_5	P_6	Q_7	Q_8	Q_9	Q_{10}	Q_{11}		

Address of Disk Control Field — Disk Storage Code (07) — Op Code Modifier

Sign Control Chart

	ADD				SUBTRACT			
Sign of P Field	+	+	–	–	+	+	–	–
Sign of Q Field	+	–	+	–	+	–	+	–
True or Complement Add Q Field	True	Comp	Comp	True	Comp	True	True	Comp
Recomplement only if value of Q Field is greater than value of P Field		↑	↑		↑			↑
Change P Field sign only if recomplement occurs (changed sign shown).		–	+		–			+

Disk Control Field Format

DRIVE CODE	SECTOR ADDRESS					SECTOR COUNT			CORE ADDRESS				
X	X	X	X	X	X	X	X	X	X	X	X	X	X

Drive Code (1, 3, 5, or 7)

Sector Address
00000–19999
20000–39999
40000–59999
60000–79999
80000–99999

Sector Count 001–200

Core Address
00000–19999
00000–39999
00000–59999
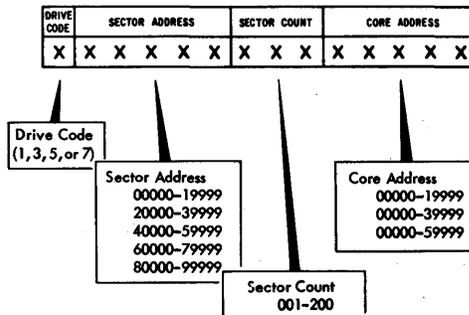
Character Coding Chart

ALPHABETIC MODE

Character	INPUT/OUTPUT ①					CORE STORAGE	
	Numeric Code	Type-writer	Paper Tape	Printer	Card	Zone	Numeric
(blank)	00	(space)	C	(blank)	(blank)	C	C
(period)	03	.	X0821	.	12-3-8	C	C21
)	04	)	CX084	)	12-4-8	C	4
+	10	+	CX0	+	12	1	C
$	13	$	CX821	$	11-3-8	1	C21
*	14	*	X84	*	11-4-8	1	4
- (hyphen)	20	–	X	–	11	2	C
/	21	/	C01	/	0-1	2	1
,	23	,	C0821	,	0-3-8	2	C21
(	24	(	084	(	0-4-8	2	4
(special)	26		0C842			2	C42
=	33	=	821	=	3-8	C21	C21
@	34	@	C84	@	4-8	C21	4
A	41	A	X01	A	12-1	4	1
B	42	B	X02	B	12-2	4	2
C	43	C	CX021	C	12-3	4	C21
D	44	D	X04	D	12-4	4	4
E	45	E	CX041	E	12-5	4	C41
F	46	F	CX042	F	12-6	4	C42
G	47	G	X0421	G	12-7	4	421
H	48	H	X08	H	12-8	4	8
I	49	I	CX081	I	12-9	4	C81
0 (-)	50	-②	X ②	–	11-0	C41	C
J/-1	51	J	CX1	J	11-1	C41	1
K/-2	52	K	CX2	K	11-2	C41	2
L/-3	53	L	X21	L	11-3	C41	C21
M/-4	54	M	CX4	M	11-4	C41	4
N/-5	55	N	X41	N	11-5	C41	C41
O/-6	56	O	X42	O	11-6	C41	C42
P/-7	57	P	CX421	P	11-7	C41	421
Q/-8	58	Q	CX8	Q	11-8	C41	8
R/-9	59	R	X81	R	11-9	C41	C81
S	62	S	C02	S	0-2	C42	2
T	63	T	021	T	0-3	C42	C21
U	64	U	C04	U	0-4	C42	4
V	65	V	041	V	0-5	C42	C41
W	66	W	042	W	0-6	C42	C42
X	67	X	C0421	X	0-7	C42	421
Y	68	Y	C08	Y	0-8	C42	8
Z	69	Z	081	Z	0-9	C42	C81
0	70	0	0	0	0 ③	421	C
1	71	1	1	1	1	421	1
2	72	2	2	2	2	421	2
3	73	3	C21	3	3	421	C21
4	74	4	4	4	4	421	4
5	75	5	C41	5	5	421	C41
6	76	6	C42	6	6	421	C42
7	77	7	421	7	7	421	421
8	78	8	8	8	8	421	8
9	79	9	C81	9	9	421	C81
‡		‡	082	(none)	0-2-8	C	C82
‡		(none)	X82	(none)	11-2-8	C	C82
‡		‡ ④	08421	(none)	0-7-8	C	C8421
‡		(none)	X8421	(none)	12-7-8	C41	C8421

NUMERIC MODE

Character	INPUT/OUTPUT				Disk Storage	Core Storage
	Type-writer	Paper Tape	Printer	Card		
(blank)	(space)/0	⑤ C/0	0	(blank)/0	C82	C
0 (+)	0	0	0	0 ③	C82	C
1	1	1	1	1	1	1
2	2	2	2	2	2	2
3	3	C21	3	3	C21	C21
4	4	4	4	4	4	4
5	5	C41	5	5	C41	C41
6	6	C42	6	6	C42	C42
7	7	421	7	7	421	421
8	8	8	8	8	8	8
9	9	C81	9	9	C81	C81
0 (-)	0̄	X ⑥	–	11-0	X82	F
-1	1̄	CX1	J	11-1	CX1	CF1
-2	2̄	CX2	K	11-2	CX2	CF2
-3	3̄	X21	L	11-3	X21	F21
-4	4̄	CX4	M	11-4	CX4	CF4
-5	5̄	X41	N	11-5	X41	F41
-6	6̄	X42	O	11-6	X42	F42
-7	7̄	CX421	P	11-7	CX421	CF421
-8	8̄	CX8	Q	11-8	CX8	CF8
-9	9̄	X81	R	11-9	X81	F81
‡	‡	082	‡	0-2-8	082	C82
‡	‡	X82	W	11-2-8	CX082	F82
‡	‡ ④	08421	G ④	0-7-8	08421	C8421
‡	‡	X8421	X	12-7-8	CX08421	F8421
numeric blank	@	C84	@	4-8/(blank)	C	C84

NOTES

1. Writing on disk storage is in numeric mode only.

2. Output only; no input is provided.

3. Can be 0 or 12-0 for input; punched 0 for output.

4. Input operations and Dump Numeric only. For Write Alphamerically and Write Numerically, EOL is punched in Paper Tape and no output is provided on the typewriter or printer.

5. Input/output characters are separated by slash.

6. Can be X or CX0 for input.