LIST OF JOHNNIAC OPERATIONS - June 30, 1961

Operation Codes are Base Eight Numbers. Notes are Base Ten

000		Proceed to next order in sequence			
001	TNL	If A < 0, c$\longrightarrow$ left command in M	005	TNR	If A < 0, c$\longrightarrow$ right command in M
002	TPL	If A ≥ 0, c$\longrightarrow$ left command in M	006	TPR	If A ≥ 0, c$\longrightarrow$ right command in M
003	TFL	If overflow, c$\longrightarrow$ left command in M	007	TFR	If overflow, c$\longrightarrow$ right command in M
010	TRL	c$\longrightarrow$ left command in M	014	TRR	c$\longrightarrow$ right command in M
011	T1L	If T_1 on, c$\longrightarrow$ left command in M	015	T1R	If T_1 on, c$\longrightarrow$ right command in M
012	T2L	If T_2 on, c$\longrightarrow$ left command in M	016	T2R	If T_2 on, c$\longrightarrow$ right command in M
013	T3L	If T_3 on, c$\longrightarrow$ left command in M	017	T3R	If T_3 on, c$\longrightarrow$ right command in M
020	RA	Clear A, M $\longrightarrow$ A	024	A	M + A $\longrightarrow$ A
021	RS	Clear A, $-$M $\longrightarrow$ A	025	S	$-$M + A $\longrightarrow$ A
022	RAV	Clear A, $\lvert$ M $\rvert\longrightarrow$ A	026	AV	$\lvert$ M $\rvert$ + A $\longrightarrow$ A
023	RSV	Clear A, $-\lvert$ M $\rvert\longrightarrow$ A	027	SV	$-\lvert$ M $\rvert$ + A $\longrightarrow$ A
030	MR	Clear A, M · MQ rounded $\longrightarrow$ A	034	MB	M · MQ + 2^{-39} [A + $\frac{1}{2}(1-_1 A_1)$] $\longrightarrow$A and MQ
031	MNR	Clear A, $-$M · MQ rounded $\longrightarrow$ A	035	MNB	$-$M · MQ + 2^{-39} [A + $\frac{1}{2}(1-_1 A_1)$] $\longrightarrow$A and MQ
032	M	Clear A, M · MQ $\longrightarrow$ A and MQ	036	MA	M · MQ + 2^{-39} A $\longrightarrow$ A and MQ
033	MN	Clear A, $-$M · MQ $\longrightarrow$ A and MQ	037	MNA	$-$M · MQ + 2^{-39} A $\longrightarrow$ A and MQ
040	DS	A $\div$ M $\longrightarrow$ MQ, r $\longrightarrow$ A	044	D	(A + 2^{-39} MQ) $\div$ M $\longrightarrow$ MQ, r $\longrightarrow$ A
041	DNS	A $\div$ ($-$M) $\longrightarrow$ MQ, r $\longrightarrow$ A	045	DN	(A + 2^{-39} MQ) $\div$ ($-$ M) $\longrightarrow$ MQ, r $\longrightarrow$ A
050	ST	A $\longrightarrow$ M	054	SAB	$_7A_{19}$ and $_{28}A_{39}$ $\longrightarrow$ $_7M_{19}$ and $_{28}M_{39}$
051	SOL	$_0A_6 \longrightarrow {}_0M_6$	055	SOR	$_{20}A_{27} \longrightarrow {}_{20}M_{27}$
052	SAL	$_7A_{19} \longrightarrow {}_7M_{19}$	056	SAR	$_{28}A_{39} \longrightarrow {}_{28}M_{39}$
053	SHL	$_0A_{19} \longrightarrow {}_0M_{19}$	057	SHR	$_{20}A_{39} \longrightarrow {}_{20}M_{39}$
060	STQ	Clear A, MQ $\longrightarrow$ A and M	064	AQS	MQ + A $\longrightarrow$ A and M
061	SNQ	Clear A, $-$MQ $\longrightarrow$ A and M	065	SQS	$-$ MQ + A $\longrightarrow$ A and M
062	SVQ	Clear A, $\lvert$ MQ $\rvert\longrightarrow$ A and M	066	AVS	$\lvert$ MQ $\rvert$ + A $\longrightarrow$ A and M
063	SNV	Clear A, $-\lvert$ MQ $\rvert\longrightarrow$ A and M	067	SVS	$-\lvert$ MQ $\rvert$ + A $\longrightarrow$ A and M
070	SRC	Clear MQ, shift A right n places. Zeros into A_0.	074	SRH	Shift A right n places. Zeros into A_0.
071	CLC	Clear MQ, circular shift of A and MQ left n places. Couple MQ_0 to A_{39}, A_0 to MQ_{39}.	075	CLH	Circular shift of A and MQ left n places. Couple MQ_0 to A_{39}; A_0 to MQ_{39}.
072	LRC	Clear MQ, power shift A and MQ right n places. Couple A_{39} to MQ_1. $_0A_0$ to $\longrightarrow$ $_0MQ_0$.	076	LRH	Power shift A and MQ right n places. Couple A_{39} to MQ_1. $_0A_0 \longrightarrow {}_0MQ_0$.
073	LLC	Clear MQ, power shift A and MQ left n places. Couple zeros into MQ_{39}; MQ_1 to A_{39}.	077	LLH	Power shift A and MQ left n places. Couple zeros into MQ_{39}, MQ_1 to A_{39}.
100	SEL	Select I-O. Address Part of 100: XXX0 Pri. Feed Reader; XXX1 Sec. Feed Reader; XXX2 Feed Punch; XXX3 Feed Punch & Echo; XXX4 Sel. left 80 col. of Printer; XXX5 Sel. right 80 " " "; XXX6 Sel. Plotter	104	DIS	Display
101	C	M Copy Order M$\longrightarrow$ 40 Leftmost Selected Col.; A$\longrightarrow$ 40 Rightmost " "	105	HUT	Hoot
			106	EJ	Address part of 106: XXX0 Restore one page; XXX1 Advance 1 print line; XXX2 Advance 2 print lines
110	RD	Read drum words to M and memory addresses following numerically. Denoting MQ as xxx $f_1f_2f_3f_4$ dpb $l_1l_2l_3l_4$, the f's determine the first drum address and the l's the last drum address. d selects the drum; p, the position of the heads; and b, the bank to be read.			
111	WD	Read M and words in memory addresses following numerically to drum. MQ has the same significance as in 110.			
120	ZTA	Clear A to Zero	124	PI	M I A $\longrightarrow$ A
121		Clear A	125	NI	$-$ M I A $\longrightarrow$ A ($-$ denotes digit inversion of M).
122		Clear A	126	PMI	$\lvert$ M $\rvert$ I A$\longrightarrow$ A
123		Clear A	127	NMI	$-\lvert$ M $\rvert$ I A$\longrightarrow$ A
130	HTL	Halt c $\longrightarrow$ left command in M	134	HTR	Halt c $\longrightarrow$ right command in M
131	H1L	Halt if H_1 on; c $\longrightarrow$ left command in M	135	H1R	Halt if H_1 on; c $\longrightarrow$ right command in M
132	H2L	Halt if H_2 on; c $\longrightarrow$ left command in M	136	H2R	Halt if H_2 on; c $\longrightarrow$ right command in M
133	H3L	Halt if H_3 on; c $\longrightarrow$ left command in M	137	H3R	Halt if H_3 on; c $\longrightarrow$ right command in M
140					
150					
160					
170					

*A copy order (10.1) directed to the Plotter as selected by 10.0 XXX6 gates only the contents of the specified memory word to the Plotter register with the following meaning:

DEFINITIONS

A Accumulator

033	MN	Clear A, $-M \cdot MQ \longrightarrow$ A and MQ	037	MNA	$-M \cdot MQ + 2^{-39}$ A $\longrightarrow$ A and MQ
040	DS	A $\div$ M $\longrightarrow$ MQ, r $\longrightarrow$ A	044	D	(A $+ 2^{-39}$ MQ) $\div$ M $\longrightarrow$ MQ, r $\longrightarrow$ A
041	DNS	A $\div$ (−M) $\longrightarrow$ MQ, r $\longrightarrow$ A	045	DN	(A $+ 2^{-39}$ MQ) $\div$ (− M) $\longrightarrow$ MQ, r $\longrightarrow$ A
050	ST	A $\longrightarrow$ M	054	SAB	$_{7}A_{19}$ and $_{28}A_{39} \longrightarrow$ $_{7}M_{19}$ and $_{28}M_{39}$
051	SOL	$_{0}A_{6} \longrightarrow {}_{0}M_{6}$	055	SOR	$_{20}A_{27} \longrightarrow {}_{20}M_{27}$
052	SAL	$_{7}A_{19} \longrightarrow {}_{7}M_{19}$	056	SAR	$_{28}A_{39} \longrightarrow {}_{28}M_{39}$
053	SHL	$_{0}A_{19} \longrightarrow {}_{0}M_{19}$	057	SHR	$_{20}A_{39} \longrightarrow {}_{20}M_{39}$
060	STQ	Clear A, MQ $\longrightarrow$ A and M	064	AQS	MQ + A $\longrightarrow$ A and M
061	SNQ	Clear A, −MQ $\longrightarrow$ A and M	065	SQS	− MQ + A $\longrightarrow$ A and M
062	SVQ	Clear A, | MQ | $\longrightarrow$ A and M	066	AVS	| MQ | + A $\longrightarrow$ A and M
063	SNV	Clear A, −| MQ | $\longrightarrow$ A and M	067	SVS	−| MQ | + A $\longrightarrow$ A and M
070	SRC	Clear MQ, shift A right n places. Zeros into A_0.	074	SRH	Shift A right n places. Zeros into A_0.
071	CLC	Clear MQ, circular shift of A and MQ left n places. Couple MQ_0 to A_{39}, A_0 to MQ_{39}.	075	CLH	Circular shift of A and MQ left n places. Couple MQ_0 to A_{39}; A_0 to MQ_{39}.
072	LRC	Clear MQ, power shift A and MQ right n places. Couple A_{39} to MQ_1. $_{0}A_{0}$ to $\longrightarrow {}_{0}MQ_{0}$.	076	LRH	Power shift A and MQ right n places. Couple A_{39} to MQ_1. $_{0}A_{0} \longrightarrow {}_{0}MQ_{0}$.
073	LLC	Clear MQ, power shift A and MQ left n places. Couple zeros into MQ_{39}; MQ_1 to A_{39}.	077	LLH	Power shift A and MQ left n places. Couple zeros into MQ_{39}, MQ_1 to A_{39}.
100	SEL	Select I-O XXX0 Pri. Feed Reader; XXX1 Sec. Feed Reader; XXX2 Feed Punch; XXX3 Feed Punch & Echo; XXX4 Sel. left 80 col. of Printer; XXX5 Sel. right 80 " " "; XXX6 Sel. Plotter. Address Part of 100	104	DIS	Display
101	C	M Copy Order M $\longrightarrow$ 40 Leftmost Selected Col. A $\longrightarrow$ 40 Rightmost " "	105	HUT	Hoot
			106	EJ	Address part of 106: XXX0 Restore one page; XXX1 Advance 1 print line; XXX2 Advance 2 print lines
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140					
150					
160					
170					

A copy order (10.1) directed to the Plotter as selected by 10.0 XXX6 gates only the contents of the specified memory word to the Plotter register with the following meaning:

$_{0}M_{6}$-Circle Radius

$_{7}M_{18}$-X Magnitude

$_{21}M_{24}$-Character Selection

M_{25}-Circle Drawing

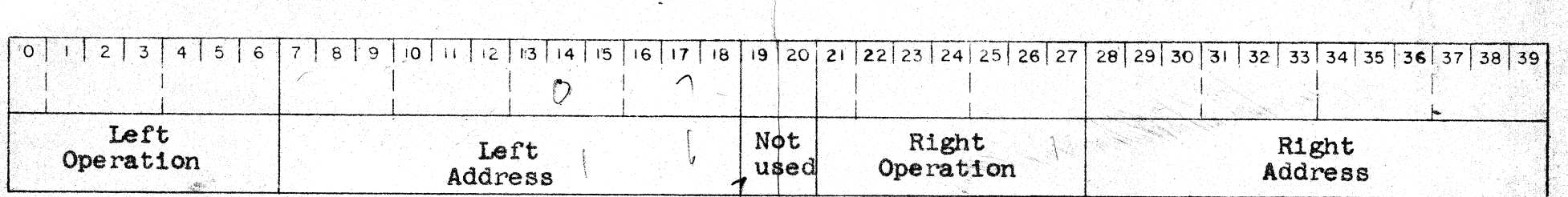
M_{26}-Line Drawing

M_{27}-Arm Selection

$_{28}M_{39}$-Y Magnitude

DEFINITIONS

A		Accumulator
MQ		Multiplier Quotient Register
M		Word in the M^{th} address in Internal Storage
$_{20}A_{39}$		Digits in position 2^{-20} through 2^{-39} of the word in A
c	$\longrightarrow$	Control goes to
I		Logical (digit by digit) product or intersection



JOHNNIAC Instruction Word Layout