UNIVERSITY OF ILLINOIS
DIGITAL COMPUTER LABORATORY
STATISTICAL LIBRARY

KSL 1.97 - 305

TITLE: Maxplane (An Oblique Factor Rotation Program)

TYPE: Entire program

SYMBOLS: Defined as used

CAPACITY: Number of factors $\leq$ 20

Number of variables $\leq$ 111

METHOD OF USE: Prepare input data as indicated on the Input Data and Format section.Just in passing, the time to output data and to print the output data increases with increasing d. The three hyperplane thicknesses allow increasingly finer determination of the simple structure as the fineness of the trial rotations is increased. The greatest hyperplane thickness is used only on the first set of trial rotations for each axis pair. The middle hyperplane thickness is used on the succeeding sets of trial rotations until 50 % of the points for the particular axis pair being used is within that thickness and thenceforth the least hyperplane thickness is used for trial rotations of that axis pair.

The program tape is read into Illiac with a clear start. After the scope heading at the leading end of the program tape has been read, Illiac will stop on a left hand 20 instruction. This should be bypassed by moving the Black Switch to its Start position. After reading in the rest of the program tape, Illiac will stop on a 24 instruction in the left hand side of location 1. Moving the Black Switch to Start or Ignore will cause the data tape to be read in.

If the user made an error on the data tape, the reader will stop after the terminating symbol (N, J, F, or L) of the offending block of data has been read, and the computer will stop on a left hand FF instruction whose address will indicate the type of error made. The Error Stops section lists the possible errors and their corresponding address numbers. After the error is corrected and/or if new data is to be used, the program tape must be read in again. After input data has been successfuly read, computation begins automatically. Once the computation has started, the user has a number of alternatives. Moving the Black Switch to Ignore initially will allow the program to run to its ultimate end. The computer will then try to read in data for a new computation. If, at any time, it is desired to interrupt the routine, the Black Switch should be returned to its center (Obey) position. After the rotation cycle being computed is finished, the computer will stop on a right hand 20 instruction. Moving the Black Switch to Start or Ignore will allow the computation to resume as if nothing had happened; however, if the White Switch is moved all the way up and then all the way down again, the first three elements of the output data (i.e. r, the hyperplane counts and percentages, and the correlation matrix) will be punched and the computer will stop on a right hand 24 instruction. In this manner the progress of the computation can be checked if it is desired. From this condition two alternatives are again available. Moving the Black Switch to Start or Ignore again allows the computation to continue as if nothing had happened; however, moving the White Switch all the way up and then all the way down again will cause a complete data output. The output data is the best attained before the interrupted program stops. In this way the program can be run in parts, and all that is required to resume the program once it has been interrupted is to use the output tape from the interrupted run, substituting the V_0 matrix for the V_n matrix on the output tape, as the input tape on resumption of the problem. Care must be taken to start reading after the correlation matrix on the output tape since the first three output data elements are not part of the required input data. Five carriage return-line feed and fifteen two hole delay characters are punched on the output tape after the correlation matrix in order to make the area to be placed in the reader for reentry of the tape as visually evident as possible.

If the Black Switch is moved to its center (Obey) position at any time during the complete data output--punching or scope plotting, the computer will stop on a right hand 24 instruction upon completion of the data output, and a final pair of alternatives is available to the user. If the Black Switch is moved to Start or Ignore, new data will be read in for a new computation and all the instructions given for the original data set apply. If the White Switch is moved all the way up and then all the way down again, however, the computation will commence from the condition that was left upon data output. This alternative allows a complete check of the progress of a problem while still allowing the computation to continue if it is desired.

If it is desired to run more than one problem, the data for the other problems can be put on the same data tape as the first problem's data, and as long as the Black Switch is in the Ignore position the new data will be run upon the completion of the immediately preceeding problem. The above described program interrupts can be made during the calculation of any or all of the sets of data, of course. An uninterrupted run can be accomplished by moving the Black Switch to the Ignore position after the data tape is in the reader; the run is completed when the data tape reads off the end of the reader.

INPUT DATA AND FORMAT: d: Number of digits after decimal point in output matrices

<u>Format</u>: +, one of the numbers: 1 - 9, N

t_1: Greatest hyperplane thickness

t_2: Middle hyperplane thickness

t_3: Least hyperplane thickness

__Format:__ +, 0, Decimal point, thickness value as an n place decimal fraction ($n \leq 10$) for each of the three thicknesses ---- no scaling is required. The third thickness is followed by an N

λ_0: A unit matrix if a Centroid V Matrix is used, or the λ output matrix from Oblimax or any similar Post-Centroid Routine (maximum size ---- 20 x 20).

__Format:__ Sign (+ or -), 0, decimal point, element value as an n place decimal fraction ($n \leq 11$) for each element in the matrix (0 elements are written as + only, unit elements as +1 or -1 only). (Note: decimal points are not required). Matrix elements are ordered by columns every column is suffixed by a J.
In addition, the last column is suffixed by an F after its J ---- no scaling is required.

V_0: V matrix output of the Centroid Routine always

__Format:__ Sign (+ or -), 0, decimal point, element value as an n place decimal fraction ($n \leq 11$) for each element in the matrix (0 elements are written as + only, unit elements as +1 or -1 only). (Note: decimal points are not required). Matrix elements are ordered by columns every column is suffixed by a J.
In addition, the last column is suffixed by an L after its J ---- no scaling is required.

Notes: Maximum size ---- 111 x 20
This matrix must have its vectors referenced to an orthogonal system and must be normalized such that the length of each vector is ≤ 1.0.

ERROR STOPS:

FF 1: Improper terminating symbol on input of d

FF 2: Improper terminating symbol on input of t_1, t_2, t_3

FF 3: Incorrect number of t's input

FF 4: Improper terminating symbol on input of λ_0

FF 5: Incorrect number of elements input in a column of λ_0

FF 6: Incorrect number of columns input for λ_0

FF 7: Improper terminating symbol on input of V_0

FF 8: Incorrect number of elements input in a column of V_0

FF 9: Incorrect number of columns input for V_0

FF 16: Drum error ---- sum check failed on the transfer of a block of information from the drum

NOTE: FF 16 is FF 010 sexadecimal

OUTPUT DATA AND FORMAT:

r: Number of rotation cycles carried out by the routine ---- as an integer

%: A three column block of information any row of which contains ---- reading from left to right ---- a V matrix column number as an integer, the number of elements in that V matrix column which are within the least hyperplane thickness as an integer, and the ratio of the number of elements in that V matrix column which are within the least hyperplane thickness to the total number of elements in a V matrix column as a decimal fraction.

The last row which is spaced off from the rest of the block has nothing in the column number column, the number of elements in the whole V matrix which are within the least hyperplane thickness as an integer, and the ratio of the number of elements in the whole V matrix which are within the least hyperplane thickness to the total number of elements in the whole V matrix as a decimal fraction.

C: Correlation matrix by columns

d: See Input Data and Format

t_1: See Input Data and Format

t_2: See Input Data and Format

t_3: See Input Data and Format

λ_n: New λ formed by Maxplane ------ has exactly the same format as the λ_0 matrix used on input except that each element is printed to d places after the decimal point.

V_n: $V_n = V_0 \lambda_n$ ---- has exactly the same format as the V_0 matrix used on input except that each element is printed to d places after the decimal point.

Scope Plots: One plot for every different axis pair in the hyperspace ---- each plot has the axis pair plotted as if the axis were orthogonal, each axis is labeled with its V_n matrix column number, the C matrix entry associated with the axis pair is in the upper right hand corner of the plot, and the projection of every V_n matrix point on the plane determined by the two axes is plotted. (Number of plots = n x $[n-1]$ where n = number of columns in a λ or V matrix).

NOTE: 5 carriage return-line feed characters and 15 two hole delay characters are punched between the last element of the C matrix and d on the output tape in order that the position where reading is to start if the output data is to be reentered to continue computation can be easily found. (See Method of use section).

DURATION:

1. Read master tape ----
   150 sec.
2. Read input data ----
   $0.07 + 0.004$ (No. of factors)^2 (No. digits in a factor matrix element) + 0.004 (No. of factors) (No. of variables) x (No. digits in a variable matrix element) sec.

3. Calculation time ----

   There is no way to estimate the calculation time since the data determines the number of operations within an iteration and the total number of iterations. Problems having 5 or less factors and 50 or less variables normally run in less than an hour. For longer problems, it is suggested that the problem be run for a fixed length of time. If the problem does not converge within that time it can be interrupted and continued at a subsequent time by the procedure described in "Method of Use" above.

4. Punch and Plot Output Data ----

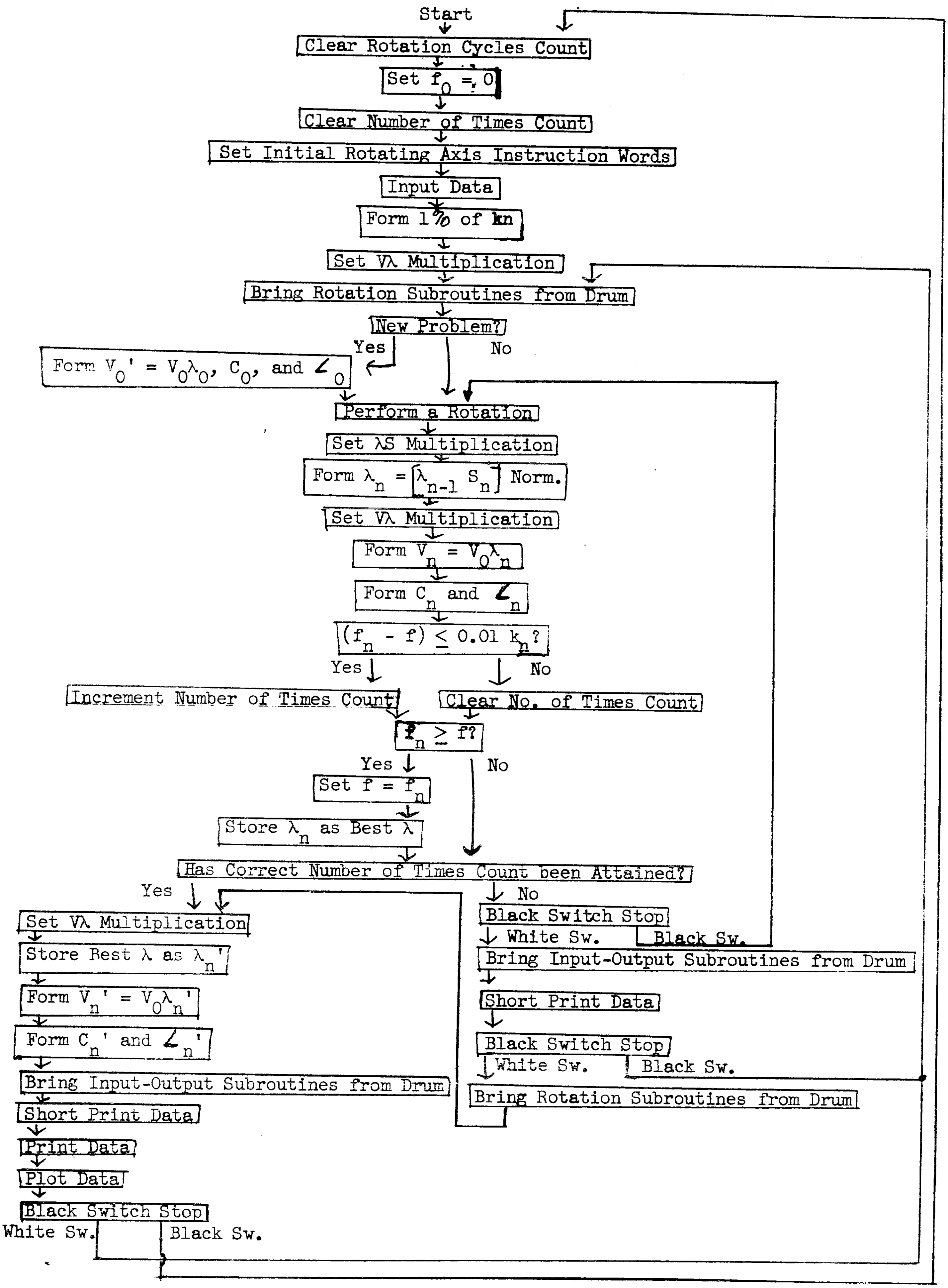
   $2 + 1/2$ (No. of factors) + $1/6$ (No. of factors)^2 + $\frac{(4 + d)}{60}$ (No. of factors) (No. of factors + No. of variables) + 3(No. of factors -1) (No. of factors) sec.

THE MAXPLANE PROCEDURE: See the article by R. B. Cattell and J. L. Muerle entitled "The 'Maxplane' Program for Factor Rotation to Oblique Simple Structure" published in the July 1960 issue of Educational and Psychological Measurement for the background, motivation, and description of the method for this program. Section 4 of the article gives a description of the program and the motivation for some of the programming techniques used.

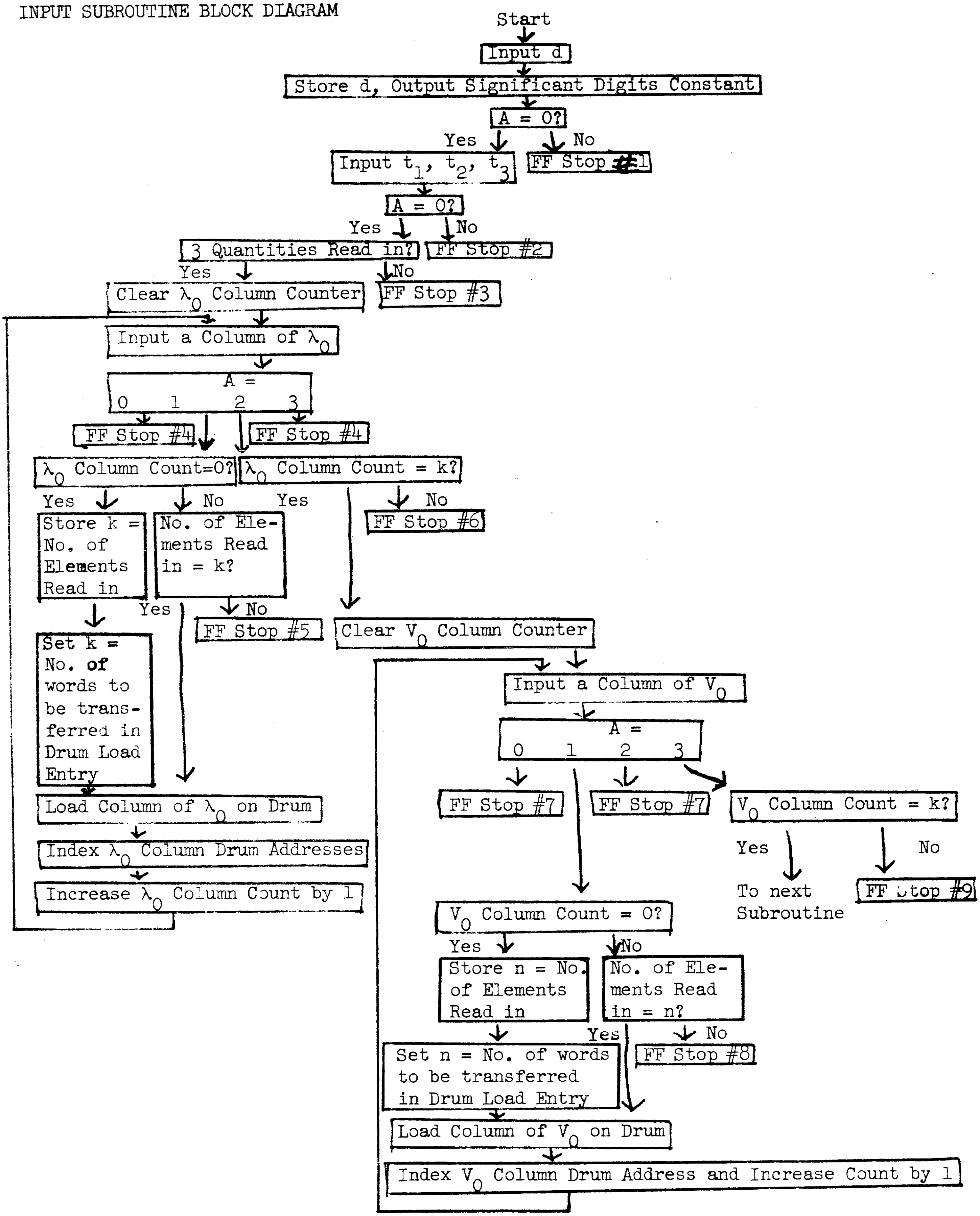
DATE September 9, 1960
PROGRAMMED BY J. L. Muerle
AND N. E. Wiseman
APPROVED BY [signature]

nj

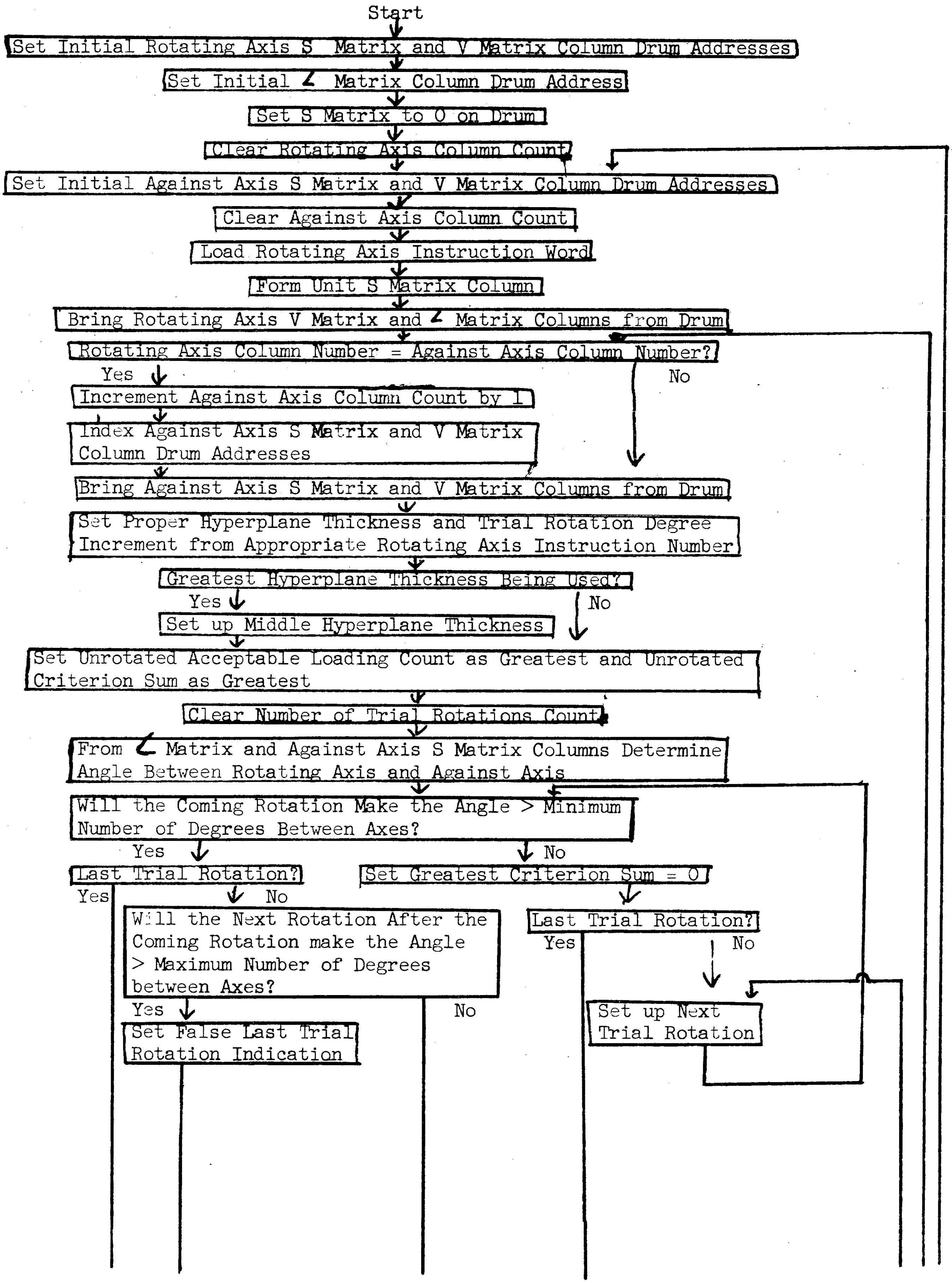
MAIN ROUTINE BLOCK DIAGRAM



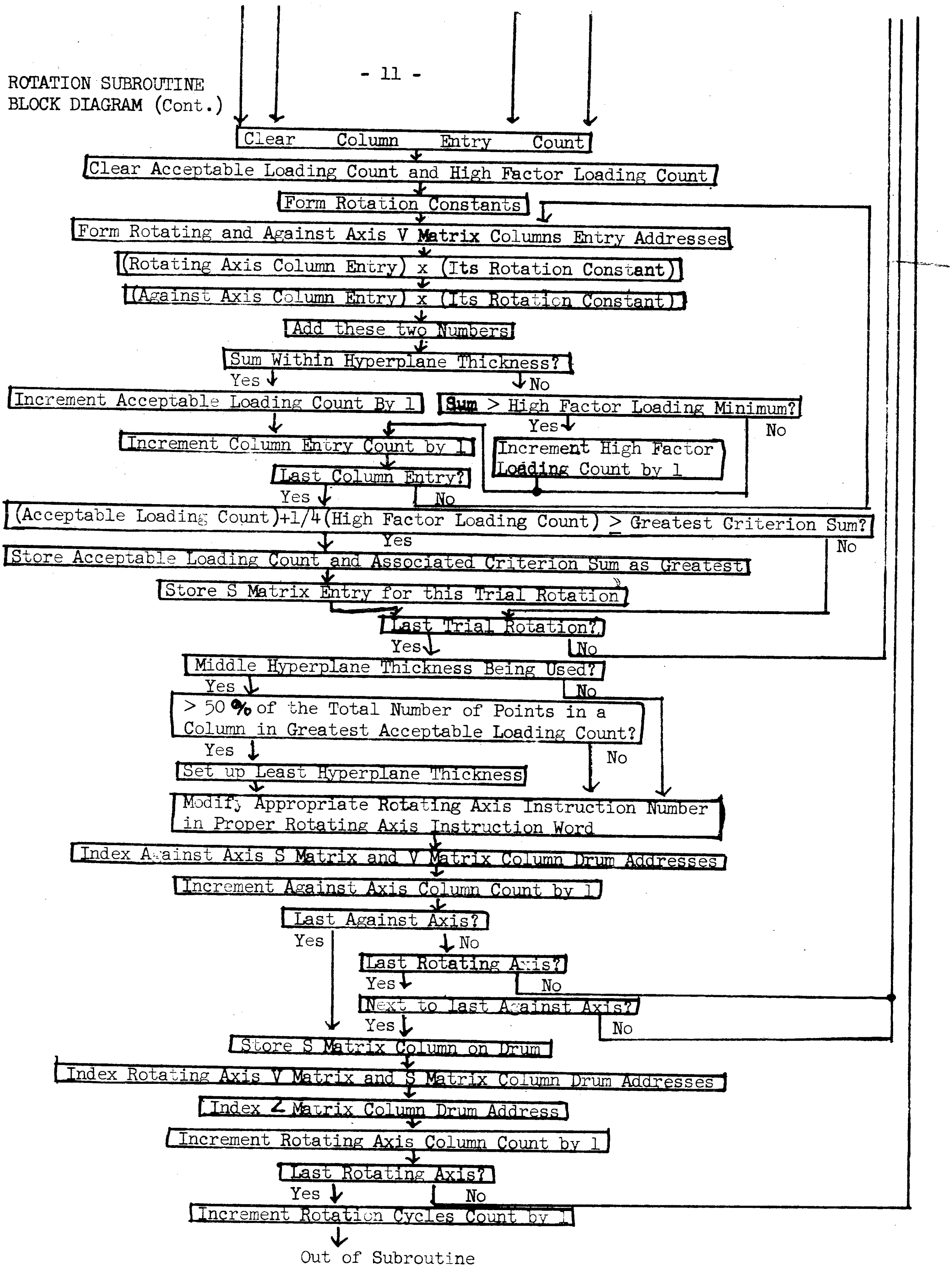
INPUT SUBROUTINE BLOCK DIAGRAM



ROTATION SUBROUTINE BLOCK DIAGRAM START



ROTATION SUBROUTINE
BLOCK DIAGRAM (Cont.)



LOCATION			ORDER	NOTES PAGE 1 KSL 1.97
Abs.	Rel.	Sym.		
			9	
			Maxplane Output Data	
			J	
			Maxplane Output Data	
			00K	
7	0	(Y1)	00 7K	Drum transfer library subroutine on drum
			00 K	
47	0	(0)	00 F	Type of matrix mult. switch (0=λS, + = Vλ)
			00 F	
	1		00 F	Drum add. of 1st element of λ
			00 3500F	
	2		00 F	k = number of rows in λ
			00 F	
50	3		00 F	Drum add. of 1st element of S
			00 3920F	
	4		00 F	Drum add. of 1st element of V_0
			00 4340F	
	5		00 F	n = number of rows of V
			00 F	
	6		00 F	Drum add. of 1st element of V_n
			00 6580F	
	7		00 F	λ column drum address increment
			00 21F	
	8		00 F	V column drum address increment
			00 112F	
	9		00 F	d = signif. digits on output data
			00 F	
	10		00 F	Greatest hyperplane thickness = t_1
			00 F	
	11		00 F	Middle hyperplane thickness = t_2
			00 F	
	12		00 F	Least hyperplane thickness = t_3
			00 F	

LOCATION			ORDER	NOTES PAGE 2 KSL 1.97
Abs.	Rel.	Sym.		
60	13		00 F	Rotation cycles count = r
			00 F	
	14		00 F	Best total no. points within least hyp. th.=f
			00 F	
	15		26 (Y1)	Drum address constant
			00 F	
	16		00 1F	Left hand address increment constant
			00 F	
	17		00 F	Scaling constant
			00 10F	
	18		00 F	0 constant
			00 F	
	19		00 F	Drum add. of 1st element of L
			00 8820F	
	20		00 F	Drum add. of 1st element of C
			00 9240F	
	21		00 F	Number of trial rotations/cycle
			00 10F	
	22		00 F	Degree increment for gr. hyp. th. trial rot.
			00 9F	
70	23		00 F	Degree increment for mid. hyp. th. trial rot.
			00 4F	
	24		00 F	Degree increment for least hyp. th. trial rot.
			00 2F	
	25		00 F	Minimum number of degrees between axes
			00 35F	
	26		00 F	Maximum number of degrees between axes
			00 145F	
	27		00 F	Maximum number of times constant
			00 10F	
	28		00 F	Number of times count = e
			00 F	
	2[illegible]		00 F	Scope plot parameter
			00 F	

LOCATION			ORDER	NOTES PAGE 3 KSL 1.97
Abs.	Rel.	Sym.		
77	30		00 F	Drum add. of 1st element of best λ
			00 9660F	
	31		00 F	Total no. points within least hyp. th.
			00 F	
	32		00 F	Number of points within least hyp. th.
			00 F	in each column of V_n by columns
			00 99K	
99	0	(')	00 F	Rotating axis instruction words
			00 F	
			00 20(')	
			02 K	
119	20	('1)	00 F	List of degrees for corresponding
			00 2F	
120	21		00 F	rotation constants below
			00 4F	
	22		00 F	
			00 6F	
	23		00 F	
			00 8F	
	24		00 F	
			00 9F	
	25		00 F	
			00 10F	
	26		00 F	
			00 12F	
	27		00 F	
			00 16F	
	28		00 F	
			00 18F	
	29		00 F	
			00 20F	
	30		00 F	
			00 27F	

LOCATION			ORDER	NOTES
Abs.	Rel.	Sym.		
130	31		00 F	
			00 36F	
	32		00 F	
			00 45F	
	33	('2)	00 F	
			00 9993 9082 7021 J	Rotating axis column rotation constant
	34		00 F	
			00 9975 6405 0262 J	
	35		00 F	
			00 9945 2189 5369 J	
	36		00 F	
			00 9902 6806 8743 J	
	37		00 F	
			00 9876 8834 0598 J	
	38		00 F	
			00 9848 0775 3013 J	
	39		00 F	
			00 9781 4760 0734 J	
	40		00 F	
			00 9612 6169 5938 J	
140	41		00 F	
			00 9510 5651 6293 J	
	42		00 F	
			00 9396 9262 0785 J	
	43		00 F	
			00 8910 0652 4189 J	
	44		00 F	
			00 8090 1699 4375 J	
	45		00 F	
			00 7071 0678 1188 J	
	46	('3)	00 F	Against axis column rotation constants
			00 0348 9949 6703 J	
	47		00 F	
			00 0697 5647 3744 J	

LOCATION			ORDER	NOTES PAGE 5 KSL 1.97
Abs.	Rel.	Sym.		
147	48		00 F	
			00 1045 2846 3267 J	
	49		00 F	
			00 1391 7310 0959 J	
	50		00 F	
			00 1564 3446 5040 J	
150	51		00 F	
			00 1736 4817 7672 J	
	52		00 F	
			00 2079 1169 0821 J	
	53		00 F	
			00 2756 3735 5820 J	
	54		00 F	
			00 3090 1699 4377 J	
	55		00 F	
			00 3420 2014 3327 J	
	56		00 F	
			00 4539 9049 9738 J	
	57		00 F	
			00 5877 8525 2295 J	
	58		00 F	
			00 7071 0678 1188 J	
	59	('4)	00 F	S matrix entry rotation constants
			00 0174 6038 4746 J	
	60		00 F	
			00 0349 6340 5973 J	
160	61		00 F	
			00 0525 5211 7633 J	
	62		00 F	
			00 0702 7041 7351 J	
	63		00 F	
			00 0791 9222 0162 J	
	64		00 F	
			00 0881 6349 0358 J	

LOCATION Abs.	Rel.	Sym.	ORDER	NOTES
164	65		00 F	
			00 1062 7828 0839 J	
	66		00 F	
			00 1433 7269 2883 J	
	67		00 F	
			00 1624 5984 8119 J	
	68		00 F	
			00 1819 8511 7133 J	
	69		00 F	
			00 2547 6272 4746 J	
	70		00 F	
			00 3632 7126 4005 J	
170	71		00 F	
			00 5000 0000 0000 J	
			00 264K	
264	0	(02)	40 F	Plot points and axes library subroutine (Modified)
			K5 F	
	1		36 13L	
			46 4L	
	2		42 9L	
			LJ F	
	3		LO 11L	
			40 F	
	4		LJ F	
			LO 12L	
	5		10 8F	
			32 6L	
270	6		LO 10L	
			50 F	
	7		JO 10L	
			S4 F	
	8		00 1F	
			82 16F	
	9		22 9L	
			22 F	

LOCATION			ORDER	NOTES
Abs.	Rel.	Sym.		
	10		LL 2048F	
			00 F	
275	11		00 F	
			00 F	
	12		00 F	
			00 F	
	13		42 26L	
			46 15L	
	14		L5 F	
			40 11L	
	15		L5 F	
			40 12L	
280	16		41 2F	
			26 18L	
	17		L5 28L	
			L4 27L	
	18		46 27L	
			42 27L	
	19		L0 27L	
			00 3F	
	20		40 1F	
			00 20F	
	21		J0 2F	
			50 21L	
	22		26 L	
			L5 2F	
	23		J0 1F	
			50 23L	
	24		26 L	
			19 6F	
	25		L4 2F	
			40 2F	
290	26		36 17L	
			22 F	

LOCATION Abs.	Rel.	Sym.	ORDER	NOTES
291	27		00 F	
			00 F	
	28		00 F	
			00 F	
			00 3K	S parameters for (04)
3	0		00 F	Scope display position parameter add.
			00 29(0)	
4	1		00 F	temporary storage address
			00 965F	
			00 293K	
293	0	(04)	40 S4	Fast fraction display library subroutine
			L5 S3	
	1		L4 36L	
			40 1S4	
	2		L0 37L	
			40 2S4	
	3		K5 F	
			46 38L	
	4		42 8L	
			50 1S4	
	5		J0 39L	
			32 31L	
	6		S5 F	
			40 3S4	
300	7		L5 38L	
			L0 40L	
	8		46 38L	
			32 F	
	9		L7 S4	
			10 2F	
	10		L6 S4	
			32 13L	
	11		L4 41L	
			40 S4	

LOCATION			ORDER	NOTES
Abs.	Rel.	Sym.		
305	12		F5 41L	
			50 S4	
	13		22 14L	
			40 S4	
	14		51 S4	
			00 3F	
	15		L4 31L	
			42 20L	
	16		L4 39L	
			42 19L	
310	17		S5 F	
			40 S4	
	18		L5 2S4	
			L4 37L	
	19		40 2S4	
			L5 F	
	20		40 1S4	
			50 F	
	21		S5 F	
			40 4S4	
	22		10 3F	
			J0 42L	
	23		S5 F	
			50 1S4	
	24		J0 43L	
			26 27L	
	25		F0 41L	
			36 29L	
	26		L4 2S4	
			82 16F	
320	27		36 25L	
			L4 3S4	
	28		82 8F	
			26 27L	

LOCATION			ORDER	NOTES PAGE 10 KSL 1.97
Abs.	Rel.	Sym.		
322	29		F1 4S4	
			36 7L	
	30		50 1S4	
			40 1S4	
	31		22 21L	
			S5 44L	
	32		40 3S4	
			50 S4	
	33		L5 S4	
			36 35L	
	34		F5 38L	
			22 15L	
	35		L3 8L	
			22 15L	
	36		7L F	
			00 1F	
330	37		00 80F	
			00 F	
	38		80 F	
			00 54L	
	39		LL F	
			00 12F	
	40		00 1F	
			00 F	
	41		80 F	
			00 F	
	42		87 2168F	
			78 1927F	
	43		43 3132F	
			3N 963F	
	44		12 89F	
			J6 2027F	
	45		4S 3325F	
			7J 4067F	

LOCATION			ORDER	NOTES
Abs.	Rel.	Sym.		
339	46		4K 90F	
			94 3019F	
340	47		52 3171F	
			20 2251F	
	48		19 13F	
			SN 4067F	
	49		52 98F	
			4F 4083F	
	50		12 1149F	
			LF 2027F	
	51		73 3135F	
			3N 3019F	
	52		52 97F	
			J6 3019F	
	53		21 1150F	
			SJ 3019F	
	54		5S 3133F	
			3N 4059F	
	55		5S 3133F	
			SN 3035F	
	56		08 2383F	
			31 24F	
350	57		42 3120F	
			00 F	
	58		49 1393F	
			N3 8F	
	59		4K 1394F	
			42 3120F	
	60		09 2517F	
			69 3104F	
	61		08 2382F	
			67 784F	
	62		4S 330F	
			0J 536F	

LOCATION Abs.	Rel.	Sym.	ORDER
356	63		29 1495F
			1N 579F
	64		08 3430F
			73 16F
	65		4S 473F
			55 3872F
	66		42 24F
			10 F
360	67		01 24F
			18F
			00K
361	0	(P1)	40 F
			L5 27L
	1		S4 F
			42 25L
	2		46 1L
			40 2F
	3		92 961F
			36 6L
	4		L5 F
			36 6L
	5		92 706F
			22 6L
	6		92 642F
			50 26L
	7		22 8L
			46 1L
	8		75 26L
			L5 1L
370	9		L0 19L
			32 7L
	10		S5 F
			40 1F
	11		L5 2F
			00 6F

NOTES

p	XY dF
	50 pF
p+1	26 xF

X=5 - is punched if A is negative
+ is punched if A is positive

x=J - is punched if A is negative
Space is punched if A is positive

Y=0 Integer A x 2^{-39} is punched

Y=2 Correctly rounded fraction A is punched

d=10q + s

s=digits before decimal point ($1 \leq s \leq 10$)

q=total number of digits punched ($1 \leq q \leq 11$)

LOCATION			ORDER	NOTES PAGE 13 KSL 1.97
Abs.	Rel.	Sym.		
373	12		50 L	
			32 14L	
	13		L7 F	
			66 1F	
	14		23 15L	
			67 1F	
	15		L7 F	
			S4 F	
	16		40 F	
			50 F	
	17		75 26L	
			00 36F	
	18		82 4F	
			10 40F	
380	19		S4 10F	
			40 F	
	20		L5 1L	
			LO 16L	
	21		46 1L	
			00 9F	
	22		36 23L	
			92 643F	
	23		L5 2F	
			LO 19L	
	24		46 2F	
			00 10F	
	25		32 16L	
			22 F	
	26		00 F	
			00 10F	
388	27		82 1013F	
			00 1F	
389	0	(N12)	00 K	Infraput library subroutine on drum

LOCATION			ORDER	NOTES
Abs.	Rel.	Sym.		
			OOK	
428	0	(-)	K5 F	Plant link
			42 (-18)	
	1	(-1)	52 9(0)	Store d in 9(0)
			50 (-1)	
430	2		26 (N12)	
			40 F	A = 0?
	3		L3 F	(N termination?)
			36 (-2)	
	4		FF 1F	No: FF stop # 1
			50 F	Waste order
	5	(-2)	50 10(0)	Yes: store t_1, t_2, t_3 in 10(0), 11(0), 12(0)
			50 (-2)	
	6		26 (N12)	respectively
			40 F	A = 0?
	7		L3 F	(N termination?)
			32 (-3)	
	8	(-3)	FF 2F	No: FF stop # 2
			L5 21(N12)	Yes: exactly 3 t's
	9		L0 (-24)	read in?
			40 F	
	10		L3 F	
			32 (-4)	
	11	(-4)	FF 3F	No: FF stop # 3
			41 ( )	Yes: clear λ_0 col. count
440	12	(-5)	50 10( )	Input column of λ_0
			50 (-5)	
	13		26 (N12)	
			L4 (-7)	Modify R.H. add. of
	14		42 (-6)	(-6) by contents of A
			L3 ( )	$- \lvert \lambda_0 \text{ col. count} \rvert$ to A
	15	(-6)	50 F	Waste order
			26 F	If, on input, A was --
	16	(-7)	FF 4F	0: FF stop # 4
			00 (-7)	Address constant

LOCATION Abs.	Rel.	Sym.	ORDER	NOTES
445	17		32 (-8)	1: λ_0 column count = 0?
			22 (-12)	
	18		L5 2(0)	2: λ_0 column count = k?
			22 (-13)	
	19	(-8)	FF 4F	3: FF stop # 4
			41 2(0)	Yes: clear 2(0)
	20		L5 21(N12)	Form k = number of rows in λ_0
			L0 (-5)	
	21		46 2(0)	in L.H. add. of 2(0)
			46 (-11)	k = number words to drum
450	22		L5 15(0)	Set drum address of 1st column of λ_0
			L4 1(0)	
	23		40 (-10)	
			50 F	Waste order
	24	(-9)	J0 10( )	Load column of λ_0 on drum
			50 (-9)	
	25	(-10)	26 (Y1)	
			00 F	
	26	(-11)	00 F	
			L5 (-10)	Increment drum starting add. for next λ_0 col.
	27		L4 7(0)	
			40 (-10)	
	28		F5 ( )	Increase λ_0 column count by 1
			40 ( )	
	29	(-12)	26 (-5)	Input next λ_0 col.
			41 F	No: clear 0
	30		L5 21(N12)	k elements read in?
			L0 (-5)	
	31		L0 2(0)	
			46 F	
460	32		L3 F	
			36 (-9)	Yes: load λ_0 col. on drum
	33	(-13)	FF 5F	No: FF stop # 5
			10 20F	

LOCATION			ORDER	NOTES
Abs.	Rel.	Sym.		
462	34		L0 ( )	
			40 F	
	35		L3 F	
			32 (-14)	
	36	(-14)	FF 6F	No: FF stop # 6
			41 1( )	Yes: clear V_0 col. count
	37	(-15)	50 10( )	Input column of V_0
			50 (-15)	
	38		26 (N12)	
			L4 (-17)	Modify R.H. add. of (-16) by contents of A
	39		42 (-16)	
			L3 1( )	- $\lvert V_0$ col. count$\rvert$ to A
	40	(-16)	50 F	Waste order
			26 F	If, on input, A was --
	41	(-17)	FF 7F	0: FF stop # 7
			00 (-17)	Address constant
470	42		32 (-19)	1: V_0 column count = 0?
			22 (-23)	
	43		FF 7F	2: FF stop # 7
			00 F	Waste order
	44		L5 2(0)	3: V_0 column count = k?
			10 20F	
	45		L0 1( )	
			40 F	
	46	(-18)	L3 F	
			32 F	Yes: out of subroutine
	47	(-19)	FF 9F	No: FF stop # 9
			41 5(0)	Yes: clear 5(0)
	48		L5 21(N12)	Form n = number of rows in V_0
			L0 (-15)	
	49		46 5(0)	
			46 (-22)	n = no. words to drum
	50		L5 15(0)	Set drum address of 1st column of V_0
			L4 4(0)	
	51		40 (-21)	
			50 F	**Waste order**

LOCATION			ORDER	NOTES
Abs.	Rel.	Sym.		
480	52	(-20)	J0 10( )	Load column of V_0 on drum
			50 (-20)	
	53	(-21)	26 (Y1)	
			00 F	
	54	(-22)	00 F	
			L5 (-21)	Increment drum starting add. for next V_0 col.
	55		L4 8(0)	
			40 (-21)	
	56		F5 1( )	Increase V_0 column count by 1
			40 1( )	
	57	(-23)	26 (-15)	Input next V_0 col.
			41 F	No: clear 0
	58		L5 21(N12)	n elements read in?
			L0 (-15)	
	59		L0 5(0)	
			46 F	
	60		L3 F	
			36 (-20)	Yes: load V_0 col. on drum
	61		FF 8F	No: FF stop # 8
			00 F	Waste order
490	62	(-24)	40 13(0)	t's input test constant
			L5 21(N12)	
			00 K	
491	0	(S:)	K5 F	Link
			42 (S:10)	
	1		96 1F	Set output to punch
			92 143F	Punch 4 crlf's
	2		92 515F	Punch 1 2-hole delay
			L5 13(0)	punch
	3		J0 22F	no. cycles
			50 3L	
	4		26 (P1)	
			92 135F	Punch 2 crlf
	5		92 515F	Punch 1 2-hole delay
			L5 2(0)	Make end

LOCATION			ORDER	NOTES PAGE 18 KSL 1.97
Abs.	Rel.	Sym.		
497	6		10 20F	constant
			40 ( )	
	7		41 1( )	Ctr. = 0
			92 131F	Punch 1 crlf
	8		92 515F	Punch 1 2-hole delay
			F5 1( )	Punch (ctr. + 1)
500	9	(S:1)	50 22F	
			50 (S:1)	
	10		26 (P1)	
			92 967F	2 spaces
	11	(S:2)	50 F	
			L5 32(0)	
	12	(S:3)	J0 44F	Punch no. pts.
			50 (S:3)	
	13		26 (P1)	
			92 967F	Punch 2 spaces
	14	(S:4)	50 18(0)	
			L5 32(0)	
	15		66 5(0)	
			S5 32(0)	
	16		00 19F	Punch % pts.
			40 F	
	17		50 F	
			7J (S:11)	
	18	(S:5)	J2 41F	
			50 (S:5)	
510	19		26 (P1)	
			F5 (S:2)	
	20		42 (S:2)	
			42 (S:4)	
	21		F5 1( )	
			40 1( )	
	22		L0 ( )	
			32 (S:6)	+ done

LOCATION			ORDER	NOTES
Abs.	Rel.	Sym.		
514	23	(S:6)	22 1022(S:1)	- loop
			L5 1(S:4)	Reset
	24		42 (S:2)	
			42 (S:4)	
	25		50 2(0)	k x 2^{-19}
			75 5(0)	nk x 2^{-38}
	26	(S:7)	40 ( )	Temp.
			92 135F	Punch 2 crlf
	27		92 515F	Punch 1 2-hole delay
			92 987F	Punch 6 spaces
	28		L5 31(0)	Punch # pts. in matrix
			50 F	
520	29	(S:8)	J0 44F	
			50 (S:8)	
	30		26 (P1)	
			92 967F	Punch 2 spaces
	31		50 18(0)	q = 0
			L5 31(0)	
	32		66 ( )	
			7J (S:11)	Punch % pts. in matrix
	33	(S:9)	J2 41F	
			50 (S:9)	
	34	(S:10)	26 (P1)	
			22 F	Exit
526	35	(S:11)	00 F	
			00 2000 0000 0000 J	
			00 K	
527	0	(:)	K5 11F	Link
			42 (:21)	
	1		L5 20(0)	
			L4 15(0)	Set C matrix add.
	2		40 (:2)	
			L5 2(0)	

LOCATION			ORDER	NOTES
Abs.	Rel.	Sym.		
530	3		46 (:3)	
			41 160( )	col. ctr. = 0
	4		92 131F	
			92 131F	
	5		L5 (:1)	Set col. add.
			46 (:4)	
	6	(:1)	50 ( )	
			50 (:1)	Get col. of C matrix
	7	(:2)	26 (Y1)	
			00 F	
	8	(:3)	00 F	
			92 131F	Punch 1 crlf
	9		92 515F	Punch 1 2-hole delay
			50 F	
	10	(:4)	L5 F	El. of C
			50 10(0)	
	11	(:5)	52 51F	Punch el.
			50 (:5)	
	12		26 (P1)	
			L5 (:4)	Adv. el. add. and test for col. end
540	13		L4 16(0)	
			46 (:4)	
	14		L0 (:23)	
			L0 2(0)	
	15		36 (:6)	+ end
			22 (:3)	- loop
	16	(:6)	L5 (:2)	Adv. col. add.
			L4 7(0)	
	17		40 (:2)	
			L5 160( )	Adv. col. ctr. and test for matrix end
	18		L4 16(0)	
			46 160( )	
	19		L0 2(0)	
			32 (:7)	+ end

LOCATION Abs.	Rel.	Sym.	ORDER	NOTES
547	20	(:7)	22 1022(:1)	- loop
			92 147F	Punch 5 crlf's
	21		92 571F	Punch 15 2-hole delays
			L5 9(0)	Punch sig. digits
	22	(:8)	50 11F	
			50 (:8)	
550	23		26 (P1)	
			92 131F	Punch crlf
	24		92 770F	N
			92 135F	Punch 2 crlf's
	25		L5 (:4)	Set add.
			42 (:9)	
	26	(:9)	50 ( )	
			L5 F	
	27	(:10)	52 111F	Punch hyperplane thickness
			50 (:10)	
	28		26 (P1)	
			92 131F	Punch crlf
	29		92 515F	Punch 1 2-hole delay
			F5 (:9)	Adv. add. and test for least hyp. add.
	30		42 (:9)	
			L0 1(:23)	
	31		32 (:9)	+ loop
			92 770F	N
	32		92 131F	Punch 1 crlf
			50 9(0)	
560	33		75 17(0)	Plant sig. digits in P1 entry
			00 59F	
	34		L4 L	
			46 (:18)	
	35		41 160( )	Switch = 0
			L5 1(0)	
	36		L4 15(0)	
			40 (:14)	λ plants

LOCATION			ORDER	NOTES
Abs.	Rel.	Sym.		
564	37		L5 2(0)	
			46 (:15)	
	38		40 161( )	
			L5 7(0)	
	39	(:12)	40 162( )	
			41 163( )	Ctr. = 0
	40	(:13)	50 ( )	
			50 (:13)	
	41	(:14)	26 (Y1)	Get col. of λ or V
			00 F	
	42	(:15)	00 F	
			L5 (:13)	
570	43	(:16)	46 (:17)	
			92 131F	
	44		92 515F	
			50 F	
	45	(:17)	L5 F	
			50 10(0)	
	46	(:18)	52 F	
			50 (:18)	
	47		26 (P1)	Punch all col. of λ or V
			L5 (:17)	
	48		L4 16(0)	
			46 (:17)	
	49		L0 (:23)	
			L0 161( )	
	50		36 (:19)	
			22 (:16)	
	51	(:19)	92 131F	
			92 834F	
	52		L5 (:14)	
			L4 162( )	
580	53		40 (:14)	
			L5 163 ( )	

LOCATION Abs.	Rel.	Sym.	ORDER	NOTES
581	54		L4 16(0)	
			40 163( )	
	55		L0 2(0)	
			32 (:20)	
	56	(:20)	22 (:13)	
			L1 160( )	- switch
	57		36 (:22)	+ done λ
			92 962F	L
	58	(:21)	92 139F	- done λ and V
			22 F	and exit
	59	(:22)	49 160( )	switch = 1/2
			92 898F	F
	60		92 135F	
			L5 6(0)	
	61		L4 15(0)	
			40 (:14)	
	62		L5 5(0)	
			46 (:15)	V plants
590	63		40 161( )	
			L5 8(0)	
	64		40 162( )	
			22 (:12)	Loop
	65	(:23)	L5 ( )	Test words
			50 10(0)	
593	66		J0 ( )	
			L5 13(0)	
			00 K	
594	0	(=)	K5 222( )	Link
			42 48L	
	1		50 2(0)	
			75 8(0)	
	2		00 19F	112k
			L4 6(0)	End const. for 2

LOCATION			ORDER	NOTES
Abs.	Rel.	Sym.		
597	3		40 3F	Store
			L0 8(0)	End const. for l
	4		40 4F	= 112(k-1)
			96 65F	C. R. O.
	5		L5 20(0)	
			L4 15(0)	C add.
600	6		40 12L	
			40 54L	
	7		L5 2(0)	
			46 13L	Rows in λ
	8		46 55L	
			19 18F	Ctr. = 1 x 2^{-19}
	9		40 5F	
			L5 5(0)	Rows in V
	10		46 18L	
			46 21L	
	11		50 222( )	Col. of C
			50 11L	
	12		26 (Y1)	in 222( )
			00 F	
	13		00 F	
			L5 6(0)	1st V col. add.
	14		L4 15(0)	
			40 17L	
	15		L4 8(0)	2nd V col. add.
			40 20L	
610	16		50 ( )	1st V col. in ( )
			50 16L	
	17		26 (Y1)	
			00 F	
	18		00 F	
			92 769F	Adv. film
	19		50 111( )	
			50 19L	

LOCATION Abs.	Rel.	Sym.	ORDER	NOTES
614	20		26 (Y1)	2nd V col. in 111( )
			00 F	
	21		00 F	
			26 66L	To 66L
	22		50 18(0)	Plot axes
			50 22L	
	23		26 (02)	
			50 111( )	El.
	24		75 59L	x 5
			00 39F	Q → A
	25		40 6F	Temp. st.
			50 59L	5
620	26		75 ( )	x el.
			00 39F	Q → A
	27		J0 6F	Plot point
			50 27L	
	28		26 (02)	
			F5 23L	
	29		42 23L	Inc. adds.
			L5 26L	
	30		L4 16(0)	
			46 26L	
	31		L0 5(0)	Test
			L0 57L	
	32		36 33L	+ done
			22 23L	- loop
	33		L5 L	Set λ look up 222 + i + ctr.
			L4 5F	
	34		46 35L	
			50 17(0)	10
	35		75 F	10 x FR
			00 39F	Q → A
630	36		50 4F	Plot cos α
			50 36L	

LOCATION			ORDER	NOTES
Abs.	Rel.	Sym.		
631	37		26 (04)	
			L5 60L	Reset
	38		42 23L	23L
			46 26L	26L
	39		L5 L	222 + i → 222 + i + 1
			L4 16(0)	
	40		46 L	
			L4 5F	Test for λ end of col.
	41		L0 2(0)	
			L0 58L	
	42		36 50L	+ yes
			L5 20L	Inc. V 2 col. add.
	43		L4 8(0)	
			40 20L	
	44		L0 3F	Test for V 2 col. end
			L0 15(0)	
	45		36 46L	+ yes
			22 18L	- loop
640	46		L5 17L	Inc. V 1 col. add.
			L4 8(0)	
	47		40 17L	
			L0 4F	Test for V 1 col. end
	48		L0 15(0)	
			32 F	+ out
	49		L5 17L	Set A
			26 15L	- loop
	50		L5 7(0)	Inc. λ add.
			L4 54L	
	51		40 54L	
			L5 5F	Inc. ctr.
	52		L4 16(0)	
			40 5F	
	53		50 222( )	Get new col. of C
			50 53L	

LOCATION Abs.	Rel.	Sym.	ORDER	NOTES
648	54		26(Y1)	
			00 F	
	55		00 F	
			L5 58L	Reset OL
650	56		46 L	
			22 42L	
	57		75 ( )	
			00 39F	
	58		K5 222( )	
			42 48L	
	59		00 F	
			00 5F	
	60		00 ( )	
			00 111( )	
	61		00 20F	Marker constant for (02)
			00 20F	
	62		00 F	0.01
			00 100 0000 0000 J	
	63		L6 2160F	Vertical axis label position
			00 F	
	64		87 3888F	Horizontal axis label position
			00 F	
	65		L6 3584F	Cosine label position
			00 F	
660	66		50 61L	Form marker constant for scale calibration
			00 42F	
	67		40 28(02)	
			49 242( )	1/2 in A and 242( )
	68		50 242( )	Form scale calibration on scope
			50 68L	
	69		26 (02)	
			L5 63L	Set vertical axis label position
	70		40 29(0)	
			51 5F	Form vertical axis label from counter

LOCATION			ORDER	NOTES PAGE 28 KSL 1.97
Abs.	Rel.	Sym.		
665	71		L0 20F	
			L5 17(0)	
	72		74 62L	
			S5 F	
	73		J0 2F	Plot vertical axis label on scope
			50 73L	
	74		26 (04)	
			L5 64L	Set horizontal axis label position
	75		40 29(0)	
			L5 L	Form horizontal axis label from counter
670	76		L0 58L	and C matrix col. element number
			L4 5F	
	77		L4 16(0)	
			10 59F	
	78		L5 17(0)	
			74 62L	
	79		S5 F	
			50 F	Waste order
	80		J0 2F	Plot horizontal axis label
			50 80L	
	81		26 (04)	
			L5 65L	Set cosine label position
	82		40 29(0)	
			41 28(02)	Set axes or. and mark. const.
677	83		26 22L	To 22L
			0F F	Waste order
			00 722K	Temporary storage (722-1023)
		( )	J0 264F	Store (02), (04), (P1), (N12), (-),
			50 ( )	
			26 (Y1)	(S:), (:) and (=) on drum and then
			00 2560F	resume input
			00 458F	
			22 1014F	
			26 ( )	
			26 1N	

LOCATION Abs.	Rel.	Sym.	ORDER	NOTES PAGE 29 KSL 1.97
			00 179K	
179	0	(+)	41 13(0)	Clear rot. cycles count
			41 14(0)	Set f = 0
	1		L5 (+8)	Set first initial rot. axis instr. word add.
			42 (+1)	
	2	(+1)	41 28(0)	Clear no. of times count
			41 F	Set initial rotating axis instr. words
	3		F5 (+1)	
			40 (+1)	
	4		L5 (+37)	Last rotating axis instruction word?
			L0 (+1)	
	5	(+2)	32 (+1)	No: close loop
			50 (+2)	Yes: input data
	6		26 (-)	
			50 2(0)	Form 1% of total no. of pts. in V matrix
	7		75 5(0)	
			10 40F	
	8		7J (+38)	
			40 (+39)	
	9		49 (0)	Set Vλ multiplication
			L5 2(0)	Set no. of elements in λ column
	10		46 (+15)	
			46 (+18)	
190	11		46 (+23)	
			46 (+26)	
	12		L5 (+5)	Set form V_0, C_0, $\mathcal{L}_0$ branch
			42 (+4)	
	13	(+3)	50 264F	Bring rotation subroutines from drum
			50 (+3)	
	14		26 (Y1)	
			00 3030F	
	15	(+4)	00 458F	
			22 F	New problem?----
	16	(+5)	0F F	If not to (+7)
			50 (+5)	Form $V_0' = V_0\lambda_0$

LOCATION			ORDER	NOTES PAGE 30 KSL 1.97
Abs.	Rel.	Sym.		
196	17	(+6)	26 (x)	
			50 (+6)	Form C_0 and $\angle_0$
	18		26 (.)	
			L5 (+7)	Set do not form V_0', C_0, $\angle_0$ branch
	19	(+7)	42 (+4)	
			50 (+7)	Perform a rotation
	20	(+8)	26 (/)	
			50 (')	Address constant
200	21	(+9)	41 (0)	Set λS multiplication
			50 (+9)	Form $\lambda_n = [\lambda_{n-1} S_n]$ norm.
	22		26 (x)	
			49 (0)	Set Vλ multiplication
	23	(+10)	50 F	Waste order
			50 (+10)	Form $V_n = V_0\lambda_n$
	24	(+11)	26 (x)	
			50 (+11)	Form C_n and $\angle_n$
	25		26 (.)	
			L5 14(0)	$(f_n - f) \leq 1$ % of total no. of pts.
	26		L4 (+39)	
			L0 31(0)	
	27		36 (+12)	
			23 (+12)	No: clear no. times count
	28	(+12)	F5 28(0)	Yes: increment no. of times count by 1
			40 28(0)	
	29		L5 14(0)	$f_n \geq f$?
			F0 31(0)	
	30		32 (+19)	No: to (+19)
			L5 31(0)	Yes: Set $f = f_n$
210	31		40 14(0)	
			41 ( )	Clear λ column count
	32		L5 15(0)	Set initial λ_n column drum address
			L4 1(0)	
	33		40 (+14)	
			L5 15(0)	Set initial best λ col. drum add.

LOCATION Abs.	Rel.	Sym.	ORDER	NOTES
213	34		L4 30(0)	
			40 (+17)	
	35	(+13)	50 10( )	Bring a column of λ_n from drum
			50 (+13)	
	36	(+14)	26 (Y1)	
			00 F	
	37	(+15)	00 F	
			50 F	Waste order
	38	(+16)	J0 10( )	Store a column of best λ on drum
			50 (+16)	
	39	(+17)	26 (Y1)	
			00 F	
	40	(+18)	00 F	
			L5 (+14)	Increment λ_n col. drum add.
220	41		L4 7(0)	
			40 (+14)	
	42		L5 (+17)	Increment best λ col. drum add.
			L4 7(0)	
	43		40 (+17)	
			L5 ( )	Increment λ col. count by 1
	44		L4 16(0)	
			40 ( )	
	45		L5 2(0)	Last λ column?
			F0 ( )	
	46	(+19)	36 (+13)	No: close loop
			L5 27(0)	Yes: correct no. times count attained?
	47		F0 28(0)	
			32 (+33)	No: to (+33)
	48	(+20)	49 (0)	Yes: set Vλ multiplication
			41 ( )	Clear λ column count
	49		L5 15(0)	Set initial best λ col. drum add.
			L4 30(0)	
	50		40 (+22)	
			L5 15(0)	Set initial λ_n column drum address

LOCATION			ORDER	NOTES PAGE 32 KSL 1.97
Abs.	Rel.	Sym.		
230	51		L4 1(0)	
			40 (+25)	
	52	(+21)	50 10( )	Bring a col. of best λ from drum
			50 (+21)	
	53	(+22)	26 (Y1)	
			00 F	
	54	(+23)	00 F	
			50 F	Waste order
	55	(+24)	J0 10( )	Store a col. of λ_n on drum
			50 (+24)	
	56	(+25)	26 (Y1)	
			00 F	
	57	(+26)	00 F	
			L5 (+22)	Increment best λ col. drum add.
	58		L4 7(0)	
			40 (+22)	
	59		L5 (+25)	Increment λ_n col. drum add.
			L4 7(0)	
	60		40 (+25)	
			L5 ( )	Increment λ col. count by 1
240	61		L4 16(0)	
			40 ( )	
	62		L5 2(0)	Last λ column?
			F0 ( )	
	63	(+27)	36 (+21)	No: close loop
			50 (+27)	Yes: form $V_n' = V_0\lambda_n'$
	64	(+28)	26 (x)	
			50 (+28)	Form C_n' and $\mathcal{L}_n'$
	65		26 (.)	
			50 F	Waste order
	66	(+29)	50 264F	Bring input-output subroutines from drum
			50 (+29)	
	67		26 (Y1)	
			00 2560F	

LOCATION Abs.	Rel.	Sym.	ORDER	NOTES
247	68	(+30)	00 458F	
			50 (+30)	Short print data
	69	(+31)	26 (S:)	
			50 (+31)	Print data
	70	(+32)	26 (:)	
			50 (+32)	Plot data
250	71		26 (=)	
			92 769F	Advance 2 frames to separate sets of plots
	72		92 769F	
			24 (+)	On black switch: to (+)
	73	(+33)	26 (+3)	On white switch: to (+3)
			20 (+7)	On black switch: to (+7)
	74	(+34)	50 264F	On white switch: bring input-output subroutines from drum
			50 (+34)	
	75		26 (Y1)	
			00 2560F	
	76	(+35)	00 458F	
			50 (+35)	Short print data
	77		26 (S:)	
			24 (+3)	On black switch: to (+3)
	78	(+36)	50 264F	On white switch: bring rotation subroutines from drum
			50 (+36)	
	79		26 (Y1)	
			00 3030F	
	80		00 458F	
			26 (+20)	Thence to (+20)
260	81	(+37)	41 28(0)	Last rot. axis instr. word test constant
			41 19(')	
	82	(+38)	00 F	0.01
			00 100 0000 0000 J	
262	83	(+39)	00 F	1 % of kn
			00 F	

LOCATION			ORDER	NOTES
Abs.	Rel.	Sym.		
264	0	(R1)	00 264K	Square root library subroutine on drum
			00 K	
273	0	(/)	K5 F	Plant link
			42 (/75)	
	1		L5 2(0)	Set no. of elements in S matrix and C
			46 (/4)	matrix col. drum transfers
	2		46 (/16)	
			46 (/21)	
	3		46 (/74)	
			10 20F	Store k as right hand address
	4		40 11( )	
			L5 5(0)	Set no. of elements in V matrix col.
	5		46 (/13)	drum transfers
			46 (/24)	
	6		10 20F	Store n as right hand add.
			40 12( )	
280	7		L5 15(0)	Set initial S matrix column
			L4 3(0)	drum address
	8		40 (/3)	
			40 (/73)	
	9		L5 15(0)	Set initial rot. axis V matrix col. drum add.
			L4 6(0)	
	10		40 (/12)	
			L5 15(0)	Set initial ∠ matrix col. drum add.
	11		L4 19(0)	
			40 (/15)	
	12		L5 (/8)	Set initial S matrix col. add.
			42 (/1)	
	13		L5 11( )	Form clear an S matrix col. end test const.
			L4 (/1)	
	14	(/1)	40 13( )	
			41 F	Clear an S matrix col.
	15		F5 (/1)	
			40 (/1)	

LOCATION			ORDER	NOTES PAGE 35 KSL 1.97
Abs.	Rel.	Sym.		
289	16		L5 13( )	Last S matrix column element?
			F0 (/1)	
290	17		32 (/1)	No: close loop
			41 13( )	Yes: clear col. count
	18	(/2)	J0 40( )	Clear S matrix col. on drum
			50 (/2)	
	19	(/3)	26 (Y1)	
			00 F	
	20	(/4)	00 F	
			L5 7(0)	Increment S matrix column drum add.
	21		L4 (/3)	
			40 (/3)	
	22		F5 13( )	Increment col. count by 1
			40 13( )	
	23		L5 11( )	Last S matrix column?
			F0 13( )	
	24		36 (/2)	No: close loop
			41 1( )	Yes: cl. rot. axis col. count
	25	(/5)	L5 15(0)	Set initial against axis S matrix col.
			L4 3(0)	drum add.
	26		40 (/20)	
			L5 15(0)	Set initial against axis V matrix col.
300	27		L4 6(0)	drum add.
			40 (/23)	
	28		L5 (/6)	Form rot. axis instr. word add.
			L4 1( )	
	29	(/6)	42 (/7)	
			50 (')	Address constant
	30	(/7)	41 2( )	Clear ag. axis col. count
			L5 F	Load rotating axis instr. word
	31	(/8)	40 ( )	
			50 40( )	Address constant
	32		L5 (/8)	Form initial S matrix col. element add.
			42 (/9)	

LOCATION Abs.	Rel.	Sym.	ORDER	NOTES
306	33		L5 11( )	Form clear rot. axis S matrix col.
			L4 (/9)	element test constant
	34	(/9)	40 13( )	
			41 F	Clear rot. axis S matrix column
	35		F5 (/9)	
			40 (/9)	
	36		L5 13( )	Last S. matrix column element?
			F0 (/9)	
310	37		32 (/9)	No: close loop
			L5 (/8)	Yes: store unit x 1/2 entry to form
	38		L4 1( )	unit S matrix column
			42 (/10)	
	39	(/10)	59 F	
			40 F	
	40	(/11)	50 80( )	Bring rot. axis V matrix col. from drum
			50 (/11)	
	41	(/12)	26 (Y1)	
			00 F	
	42	(/13)	00 F	
			50 10(0)	Address constant
	43	(/14)	50 20( )	Bring rot. axis ∠ matrix col. from drum
			50 (/14)	
	44	(/15)	26 (Y1)	
			00 F	
	45	(/16)	00 F	
			L5 1( )	Rotating axis col. no. = against axis
	46		L0 2( )	col. number?
			40 13( )	
320	47		L3 13( )	
			32 (/17)	
	48	(/17)	26 (/19)	No: to (/19)
			F5 2( )	Yes: increment against axis col. count by 1
	49		40 2( )	
			L5 7(0)	Increment against axis S mat. col. drum add.

LOCATION Abs.	Rel.	Sym.	ORDER	NOTES
323	50		L4 (/20)	
			40 (/20)	
	51		L5 8(0)	Increment against axis V matrix col.
			L4 (/23)	drum add.
	52	(/18)	40 (/23)	
			50 80( )	Add. constant
	53	(/19)	50 60( )	Bring against axis S matrix col. from drum
			50 (/19)	
	54	(/20)	26 (Y1)	
			00 F	
	55	(/21)	00 F	
			50 20( )	Address constant
	56	(/22)	50 191( )	Bring against axis V matrix col. from drum
			50 (/22)	
330	57	(/23)	26 (Y1)	
			00 F	
	58	(/24)	00 F	
			51 ( )	Form rotating axis instr. number
	59		00 2F	
			40 9( )	
	60		L4 (/13)	Form current hyp. thickness add.
			42 (/26)	
	61	(/25)	S5 F	Store rot. axis instr. word back
			40 ( )	
	62		F5 (/43)	Form current no. of degrees/trial rot. add.
			L4 9( )	
	63	(/26)	42 (/27)	
			L5 F	Store current hyp. thickness
	64	(/27)	40 6( )	
			L5 F	Store current no. degrees/trial rot.
	65		40 7( )	
			L3 9( )	Rot. axis instruction no. = 0?
	66		32 (/28)	No: set rot. axis instr. word mod. = 0 and
			41 18( )	to (/29)

LOCATION			ORDER	NOTES PAGE 38 KSL 1.97
Abs.	Rel.	Sym.		
340	67	(/28)	22 (/29)	
			F5 9( )	Yes: set rot. axis instr. word mod. = 1
	68	(/29)	40 18( )	
			41 5( )	Clear gr. acc. load. count
	69		41 19( )	Clear high fac. load. count
			L5 (/18)	Set initial rot. axis V matrix col. entry
	70		42 (/30)	
			L5 12( )	Form unrotated acceptable load. count end
	71		L4 (/30)	test
			40 13( )	
	72	(/30)	L5 6( )	Unrotated col. entry > hyp. th.?
			L2 F	
	73		32 (/99)	No: to (/99)
			L0 6( )	Yes: unrot. col. entry > hi. fac. load.
	74		L4 (/77)	min.?
			32 (/31)	No: to (/31)
	75		F5 19( )	Yes: increment hi. fac. load. count by 1
			40 19( )	
	76	(/99)	22 (/31)	Then to (/31)
			F5 5( )	Increment gr. acc. load. count by 1
350	77	(/31)	40 5( )	
			F5 (/30)	Set up next column entry
	78		40 (/30)	
			L5 13( )	Last col. entry?
	79		F0 (/30)	
			36 (/30)	No: close loop
	80		L5 19( )	Set unrotated criterion sum as greatest
			10 2F	
	81		L4 5( )	
			40 14( )	
	82		41 8( )	Clear no. trial rot. count
			L5 2( )	Set ∠ matrix column entry add. for prim.
	83		L4 (/21)	angle between axes
			42 (/32)	

LOCATION			ORDER	NOTES PAGE 39 KSL 1.97
Abs.	Rel.	Sym.		
357	84		L5 (/36)	Form init. S Mat. entry rot. const.
			42 (/34)	search add.
	85		L5 1( )	Form against axis S matrix col. entry add.
			L4 (/39)	
	86	(/32)	42 (/33)	
			L5 F	Store primary angle between axes
360	87	(/33)	40 10( )	
			L5 F	Store against axis S matrix col. entry
	88		40 13( )	
			L3 13( )	Column entry = 0?
	89	(/34)	36 (/40)	Yes: to (/40)
			L5 F	No: |against axis S mat. col. entry| = S
	90		L2 13( )	matrix entry rot. constant?
			40 F	
	91		L3 F	
			32 (/35)	Yes: to (/35)
	92		F5 (/34)	No: increment S mat. entry rot. const. add.
			40 (/34)	
	93	(/35)	22 (/34)	Close loop
			L5 (/34)	Form add. of word containing no. of
	94		L0 (/36)	degrees for S matrix entry rot. const.
			L4 (/41)	
	95	(/36)	42 (/37)	
			50 ('4)	Address constant
	96	(/37)	50 F	Waste order
			L5 F	Store degrees in rotated angle betw. axes
370	97		40 F	
			L5 13( )	S matrix entry rot. const. > 0?
	98		36 (/38)	
			L5 10( )	No: add. rot. angle betw. axes to pri. angle
	99		L4 F	
			26 (/39)	Then to (/39)
	100	(/38)	L5 10( )	Yes: subt. rot. angle betw. axes from
			L0 F	pri. angle

LOCATION			ORDER	NOTES PAGE 40 KSL 1.97
Abs.	Rel.	Sym.		
374	101	(/39)	40 10( )	Store angle betw. axes
			50 60( )	Address constant
	102	(/40)	51 21(0)	Form angle of initial trial rotation
			10 1F	
	103	(/41)	75 7( )	
			S1 ('1)	
	104	(/42)	40 15( )	
			L5 25(0)	Will this trial rotation bring axes
	105		L0 10( )	on or within min. angle?
			L0 15( )	
	106		36 (/44)	Yes: to (/44)
			F5 8( )	No: last trial rotation?
380	107		L0 21(0)	
			36 (/48)	Yes: to (/48)
	108		L5 26(0)	No: will next trial rot. bring angle
			L0 10( )	between axes outside of max. angle
	109		L0 15( )	
			L0 7( )	
	110	(/43)	36 (/48)	No: to (/48)
			L5 21(0)	Yes: set up false last trial rot.
	111		40 8( )	
			26 (/48)	Then to (/48)
	112	(/44)	41 14( )	Set gr. crit. sum = 0
			F5 8( )	Last trial rotation?
	113		L0 21(0)	
			36 (/48)	Yes: to (/48)
	114	(/45)	L5 7( )	No: increment angle of trial rotation
			L4 15( )	
	115		40 15( )	
			L3 15( )	Angle of trial rotation = 0?
	116		36 (/46)	
			22 (/47)	No: to (/47)
390	117	(/46)	L5 7( )	Yes: increment angle of trial rot. again
			L4 15( )	

LOCATION			ORDER	NOTES PAGE 41 KSL 1.97
Abs.	Rel.	Sym.		
391	118	(/47)	40 15( )	
			F5 8( )	Increment no. of trial rot. count by 1
	119		40 8( )	
			22 (/42)	Then to (/42)
	120	(/48)	41 3( )	Clear col. entry count
			L5 (/41)	Set initial degree search address
	121		42 (/49)	
			41 4( )	Clear acc. load. count
	122	(/49)	41 19( )	Clear high factor load. count.
			L5 F	|Angle of trial rot.| = degrees in table?
	123		L2 15( )	
			40 13( )	
	124		L3 13( )	
			32 (/50)	Yes: to (/50)
	125		F5 (/49)	No: increment degrees table add.
			40 (/49)	
	126	(/50)	22 (/49)	Close loop
			L5 (/49)	Form table add. increment for rot. const.
400	127		L0 (/41)	addresses
			42 13( )	
	128		L4 (/61)	Form add. of cur. rot. axis col. rot. const.
			42 (/51)	
	129		L5 13( )	Form add. of current against axis col.
			L4 (/55)	rotating constant
	130	(/51)	42 (/52)	
			L5 F	Load current rot. axis col. rot. const.
	131	(/52)	40 16( )	
			L5 F	Load current against axis col. rot. const.
	132		40 17( )	
			L1 15( )	Angle of current trial rotation > 0?
	133		32 (/53)	
			L1 17( )	Yes: Make cur. ag. axis col. rot. const.
	134	(/53)	40 17( )	negative
			L5 3( )	No: form rotating axis V mat. col. entry add.

LOCATION			ORDER	NOTES PAGE 42 KSL 1.97
Abs.	Rel.	Sym.		
408	135		L4 (/18)	
			42 (/54)	
	136		L5 3( )	Form against axis V mat. col. entry add.
			L4 (/59)	
410	137	(/54)	42 (/56)	
			50 F	(Rot. axis col. entry) x (its rot. const.)
	138	(/55)	7J 16( )	
			50 ('3)	Address constant
	139	(/56)	40 F	Store product
			50 F	(Ag. axis col. entry) x (its rot. const.)
	140		7J 17( )	
			L4 F	Add the two products and store
	141		40 F	
			L7 F	Result within cur. hyp. thickness?
	142		L0 6( )	
			32 (/57)	No: to (/57)
	143		F5 4( )	Yes: increment acc. load. count by 1
			40 4( )	
	144	(/57)	26 (/58)	Then to (/58)
			L5 (/77)	Result > high factor loading min.?
	145		L2 F	
			36 (/58)	
	146		F5 19( )	Yes: increment high factor load. count by 1
			40 19( )	
420	147	(/58)	F5 3( )	No: increment col. entry count by 1
			40 3( )	
	148		L5 12( )	Last col. entry?
			F0 3( )	
	149		32 (/53)	No: close loop
			L5 19( )	Yes: form (acceptable load count) + 1/4
	150		10 2F	(high factor load. count) ≡ crit. sum and
			L4 4( )	store
	151		40 F	
			L5 14( )	Criterion sum ≥ greatest criterion sum?

LOCATION Abs.	Rel.	Sym.	ORDER	NOTES
425	152		F0 F	
			36 (/63)	No: to (/63)
	153		L5 4( )	Yes: store acc. load. count as greatest
			40 5( )	
	154		L5 F	Store criterion sum as greatest
			40 14( )	
	155		L5 13( )	Form rot. axis S mat. col. entry rot.
			L4 (/36)	const. address
	156	(/59)	42 (/60)	
			50 191( )	Address constant
430	157		L5 2( )	Form rot. axis S mat. col. entry add.
			L4 (/8)	
	158	(/60)	42 (/62)	
			L5 F	Store S mat. col. entry rot. const.
	159		40 F	
			L1 15( )	Cur. tr. rot. angle > 0?
	160		36 (/62)	No: to (/62)
			L1 F	Yes: Make S mat. col. ent. rot. const. neg.
	161	(/61)	40 F	
			50 ('2)	Address constant
	162	(/62)	L5 F	Load rot. axis S mat. col. entry
			40 F	
	163	(/63)	F5 8( )	Last trial rotation?
			L0 21(0)	
	164		36 (/64)	
			26 (/45)	No: close loop
	165	(/64)	L5 9( )	Yes: is middle hyp. thickness being used?
			F0 18(0)	
	166		40 F	
			L3 F	
440	167		36 (/65)	
			26 (/67)	No: to (/67)
	168	(/65)	50 18(0)	Yes: are > 50 % of the total no. of pts.
			L1 5( )	within the greatest acceptable load. count

LOCATION			ORDER	NOTES PAGE 44 KSL 1.97
Abs.	Rel.	Sym.		
442	169		66 12( )	
			S5 F	
	170		L4 (/76)	
			36 (/67)	No: to (/67)
	171	(/66)	F5 18( )	Yes: set rot. axis instr. word mod. = 1
			40 18( )	
	172	(/67)	L5 (/6)	Form rot. axis instruction word add.
			L4 1( )	
	173		42 (/70)	
			42 (/71)	
	174		L5 1( )	Form rot. axis instr. word mod. shifter
			L0 2( )	using against axis col. count if rot.
	175		36 (/68)	axis col. count ≥ against axis col.
			F1 18(0)	count otherwise use (against axis col.
	176		L4 2( )	count -1)
			22 (/68)	
450	177	(/68)	L5 2( )	
			40 F	
	178		L4 F	
			40 F	
	179		F5 F	
			42 (/69)	
	180		50 18(0)	Modify proper no. in rot. axis inst. word
			L5 18( )	
	181	(/69)	00 38F	
			10 F	
	182	(/70)	50 F	
			L4 F	
	183	(/71)	50 F	Waste order
			40 F	Store rot. axis instr. word back
	184		L5 7(0)	Increment against axis S matrix col.
			L4 (/20)	drum address
	185		40 (/20)	
			L5 8(0)	Increment against axis V mat. col. drum add.

LOCATION Abs.	Rel.	Sym.	ORDER	NOTES
459	186		L4 (/23)	
			40 (/23)	
460	187		F5 2( )	Increment against axis col. count by 1
			40 2( )	
	188		L0 11( )	Last against axis?
			36 (/72)	Yes: to (/72)
	189		F1 18(0)	No: Last rotating axis?
			L4 11( )	
	190		F0 1( )	
			32 (/16)	No: close loop
	191		F1 18(0)	Yes: next to last against axis?
			L4 11( )	
	192		F0 2( )	
			32 (/16)	No: close loop
	193	(/72)	J0 40( )	Yes: store rotating axis S matrix col.
			50 (/72)	on drum
	194	(/73)	26 (Y1)	
			00 F	
	195	(/74)	00 F	
			L5 8(0)	Increment rotating axis V mat. col.
	196		L4 (/12)	drum address
			40 (/12)	
470	197		L5 7(0)	Increment rot. axis ∠ mat. col. drum add.
			L4 (/15)	
	198		40 (/15)	
			L5 7(0)	Increment rot. axis S mat. col. drum add.
	199		L4 (/73)	
			40 (/73)	
	200		F5 1( )	Increment rot. axis col. count by 1
			40 1( )	
	201		L5 11( )	Last rotating axis?
			F0 1( )	
	202		36 (/5)	No: close loop
			F5 13(0)	Yes: increment rot. cycles count by 1

LOCATION Abs.	Rel.	Sym.	ORDER	NOTES
476	203	(/75)	40 13(0)	
			22 F	Out of subroutine
	204	(/76)	00 F	0.50
			00 5000 0000 0000 J	
478	205	(/77)	00 F	0.50×10^{-1}
			00 500 0000 0000 J	
			00 K	
479	0	(x)	K5 131( )	Link
			42 (10x)	
480	1		L1 (0)	Mode word
			32 (1x)	$+ \lambda S, - V\lambda$
	2		L5 1023(15x)	Set store add.
			42 (14x)	
	3		41 31(0)	Sum box = 0
			50 F	Waste order
	4		L5 4(0)	Plant M 1 add.
			L4 15(0)	
	5		40 1(4x)	
			L5 1(0)	Plant M 2 add.
	6		L4 15(0)	
			40 1(3x)	
	7		L5 6(0)	Plant M π add.
			L4 15(0)	
	8		40 1(8x)	
			L5 5(0)	Plant # rows in M 1 and M π
	9		46 2(4x)	
			46 2(8x)	
	10		L5 8(0)	Drum inc.
			40 3F	
490	11	(1x)	26 (2x)	Skip
			L5 1(0)	
	12		L4 15(0)	Plant M 1 add.
			40 1(4x)	

LOCATION			ORDER	NOTES PAGE 47 KSL 1.97
Abs.	Rel.	Sym.		
492	13		L5 3(0)	Plant M 2 add.
			L4 15(0)	
	14		40 1(3x)	
			L5 1(10x)	Plant M π temp. add.
	15		40 1(8x)	
			L5 2(0)	Plant # rows in M 1 and M π
	16		46 2(4x)	
			46 2(8x)	
	17		L5 7(0)	Drum inc.
			40 3F	
	18	(2x)	L5 2(0)	Plant # rows in M 2
			46 2(3x)	
	19		41 4F	End ctr. = 0
			41 131( )	
	20		F5 1(2x)	Clear sum boxes
			40 1(2x)	
500	21		L0 2(10x)	
			32 1(2x)	
	22		L5 2(3x)	Reset
			42 1(2x)	
	23	(3x)	50 ( )	Col. of M 2 in ( )
			50 (3x)	
	24		26 (Y1)	
			00 F	
	25		00 F	
			50 131( )	
	26	(4x)	50 20 ( )	
			50 (4x)	Col. of M 1 in 20( )
	27		26 (Y1)	
			00 F	
	28		00 F	
			40 F	
	29	(5x)	50 ( )	b_{11}
			26 1(5x)	Waste order

LOCATION Abs.	Rel.	Sym.	ORDER	NOTES
509	30		7J 20( )	$a_{11}b_{11}$
			40 F	
510	31		50 F	11 in Q
			L1 (0)	Mode word
	32		36 (6x)	+ λS
			75 17(0)	x 10 . 2^{-39}
	33		00 39F	Q → A
			40 F	
	34	(6x)	L5 F	
			L4 131( )	+ sum box
	35		40 131( )	To sum box
			F5 (6x)	
	36		40 (6x)	Inc. M 1 element add. and test for col. end
			L5 16(0)	
	37		L4 1(6x)	
			40 1(6x)	
	38		L5 1(5x)	
			L4 16(0)	
	39		40 1(5x)	
			L0 2(4x)	
	40		L0 3(10x)	
			32 (7x)	+ end
520	41	(7x)	26 (5x)	- loop
			L5 (4x)	
	42		46 1(5x)	
			L5 (x)	
	43		46 1(6x)	Reset
			L5 2(3x)	
	44		42 (6x)	
			L5 (5x)	Inc. M 2 element add. and test for col. end
	45		L4 16(0)	
			46 (5x)	
	46		L0 2(0)	
			L0 4(10x)	

LOCATION			ORDER	NOTES
Abs.	Rel.	Sym.		
526	47		36 (11x)	+ end
			L5 1(4x)	Inc. M 1 col. add.
	48		L4 3F	
			40 1(4x)	
	49		26 (4x)	Loop
			50 F	Waste order
	50	(8x)	J0 131( )	
			50 (8x)	Store col. of M π
530	51		26 (Y1)	
			00 F	
	52		00 F	
			L5 1(8x)	Inc. M π col. add.
	53		L4 3F	
			40 1(8x)	
	54		L1 (0)	Mode word
			36 (9x)	+ λS
	55		L5 4(0)	
			22 (9x)	Reset M 1 col. add.
	56	(9x)	L5 1(0)	
			L4 15(0)	
	57		40 1(4x)	
			L5 (3x)	Reset M 2 element add.
	58		46 (5x)	
			L5 1(3x)	Inc. M 2 col. add.
	59		L4 7(0)	
			40 1(3x)	
	60		L5 4F	Inc. end ctr. and test
			L4 16(0)	
540	61		40 4F	
			L0 2(0)	
	62		36 7(9x)	+ done
			22 1(2x)	- loop
	63		L1 (0)	Mode word
			36 (R)	+ λS

LOCATION Abs.	Rel.	Sym.	ORDER	NOTES
543	64	(10x)	50 F	
			22 F	Out
	65		26 (Y1)	Temp. M π add.
			00 10080F	
	66		N1 4F	Test constants
			41 242( )	
	67		7J 20( )	
			00 F	
	68		50 ( )	
			26 1(5x)	
	69	(11x)	L1 (0)	Mode word
			32 (8x)	+ exit cos λS
	70		L5 1023(12x)	-Vλ
			46 (12x)	Set V add.
550	71		50 131( )	
			41 (15x)	Ctr. = 0
	72	(12x)	L7 F	V element
			L2 12(0)	
	73		32 (13x)	+ no good
			F5 (15x)	- inc. count
	74	(13x)	40 (15x)	
			L5 (12x)	
	75		L4 16(0)	Adv.
			46 (12x)	
	76		L0 (16x)	
			L0 5(0)	
	77		36 (14x)	+ done
			26 (12x)	- loop
	78	(14x)	L5 (15x)	Store #
			40 F	
	79		L4 31(0)	+ sum box
			40 31(0)	
	80		F5 (14x)	Adv. store add.
			40 (14x)	

LOCATION			ORDER	NOTES PAGE 51 KSL 1.97
Abs.	Rel.	Sym.		
560	81		22 (8x)	
			00 32(0)	Exit
	82	(15x)	00 F	Ctr.
			00 F	
562	83	(16x)	L7 131( )	Test constant
			L2 12(0)	
			00 K	
563	0	(R)	L5 1(10x)	Plant temp. M π add.
			40 1(1R)	
	1		L5 1(0)	Plant destination M π add.
			L4 15(0)	
	2		40 1(5R)	
			L5 2(0)	Plant # rows in M π
	3		46 2(1R)	
			46 2(5R)	
	4		41 3F	End ctr. = 0
			41 F	Sum box = 0
	5	(1R)	50 ( )	Col. of M π in ( )
			50 (1R)	
	6		26 (Y1)	
			00 F	
570	7		00 F	
			50 ( )	El.
	8		7J ( )	El^2
			L4 F	+ sum box
	9		40 F	To sum box
			F5 2(1R)	
	10		40 2(1R)	Inc. adds and test for col. end
			L5 3(1R)	
	11		L4 16(0)	
			46 3(1R)	
	12		L0 2(0)	
			L0 1(6R)	

LOCATION			ORDER	NOTES	PAGE 52	KSL 1.97
Abs.	Rel.	Sym.				
576	13		36 (2R)	+ done		
			22 2(1R)	- loop		
	14	(2R)	L5 (6R)			
			42 2(1R)			
	15		L5 (1R)	Reset		
			46 3(1R)			
	16		L5 F			
			50 2(2R)			
580	17		26 (R1)	$\sqrt{\Sigma^2}$		
			40 F			
	18	(3R)	50 ( )	El.		
			75 2(6R)	0.1 el.		
	19		66 F	Normed el.		
			S5 F	Q → A		
	20		40 ( )	St. el_n		
			L5 (3R)			
	21		L4 16(0)	Inc. adds. and test for col. end		
			46 (3R)			
	22		46 2(3R)			
			L0 2(0)			
	23		L0 3(6R)			
			32 (4R)	+ done		
	24	(4R)	26 (3R)	- loop		
			L5 (1R)			
	25		46 (3R)	Reset		
			46 2(3R)			
	26	(5R)	J0 ( )	Store col. of M π		
			50 (5R)			
590	27		26 (Y1)			
			00 F			
	28		00 F			
			L5 1(1R)			
	29		L4 7(0)	Inc. adds. ctr. and test		
			40 1(1R)			

LOCATION			ORDER	NOTES PAGE 53 KSL 1.97
Abs.	Rel.	Sym.		
593	30		L5 1(5R)	
			L4 7(0)	
	31		40 1(5R)	
			L5 3F	
	32		L4 16(0)	
			40 3F	
	33		L0 2(0)	
			36 (10x)	+ done
	34	(6R)	22 4(R)	- loop
			00 ( )	
	35		7J ( )	
			L4 F	Constants
	36		00 F	
			00 1000 0000 0000 J	
600	37		50 ( )	
			71 2(6R)	
			00 K	
601	0	(.)	K5 40( )	Link
			42 (.13)	
	1		41 3F	End ctr. = 0
			50 15(0)	
	2		L5 1(0)	Plant λ_1 add.
			S4 60( )	
	3		40 1(.2)	
			L5 19(0)	Plant $\angle$ add.
	4		S4 F	
			40 1(.11)	
	5		L5 20(0)	Plant C add.
			S4 ( )	
	6		40 1(.12)	
			L5 2(0)	
	7		46 2(.2)	Plant rows in λ_1, λ_2, $\angle$ and C
			46 2(.3)	

LOCATION			ORDER	NOTES
Abs.	Rel.	Sym.		
609	8		46 2(.11)	
			46 2(.12)	
610	9	(.1)	L5 1(0)	Plant λ_2 add.
			L4 15(0)	
	10		40 1(.3)	
			L5 L	Plant col. start for ∠
	11		46 1(.9)	
			L5 2(.)	Plant col. start for C
	12		42 (.6)	
			41 (.14)	θ box = 0
	13	(.2)	50 ( )	
			50 (.2)	Col. of λ_1
	14		26 (Y1)	
			00 F	
	15		00 F	
			41 F	Sum box = 0
	16	(.3)	50 20( )	
			50 (.3)	Col. of λ_2
	17		26 (Y1)	
			00 F	
	18		00 F	
			L5 5(.)	Plant add. for λ_2 el.
620	19		42 (.4)	
			L5 2(.14)	
	20	(.4)	40 1(.4)	Plant add. for λ_1 el.
			50 ( )	
	21		75 20( )	
			00 6F	
	22		L4 F	Form $\sum_i x_i y_i$
			40 F	
	23		F5 (.4)	
			42 (.4)	
	24		L5 1(.4)	
			L4 16(0)	

LOCATION			ORDER	NOTES
Abs.	Rel.	Sym.		
626	25		46 1(.4)	
			L0 2(0)	
	26		L0 2(.14)	
			36 2(.5)	+ done
	27	(.5)	22 (.4)	-loop
			F5 (.14)	$\theta \rightarrow \theta + 1$
	28		42 (.14)	
			26 2(.8)	Skip
630	29		50 F	
			75 17(0)	
	30	(.6)	00 33F	Σ
			40 60( )	El. of C matrix
	31		F5 (.6)	Inc. row add. for C
			42 (.6)	
	32		L5 3(.14)	Set table start add.
			42 (.7)	
	33		L7 F	
			40 1F	
	34		10 20F	Construct test word
			50 18(0)	
	35		00 1F	
			50 1F	
	36		00 19F	
			40 1F	
	37	(.7)	L5 1F	Test word
			L0 F	(Test-table) word
	38		50 18(0)	
			32 (.8)	+ this word
640	39		F5 (.7)	- inc. table add.
			42 (.7)	
	40	(.8)	26 (.7)	Loop
			00 20F	Try next 1/2 word
	41		36 2(.8)	+ this part
			22 (.5)	- inc. by 1

LOCATION Abs.	Rel.	Sym.	ORDER	NOTES
643	42		11 1F	$q_1 = 0$
			L5 (.7)	
	43		L0 3(.14)	
			00 1F	Form θ
	44		L4 (.14)	
			42 (.14)	
	45		L5 F	Virgin word
			32 (.9)	+ done
	46		L5 1(.14)	$\theta \rightarrow 180 - \theta$
			L0 (.14)	
	47	(.9)	40 (.14)	
			L5 (.14)	
	48		40 40( )	Store θ
			L5 1(.3)	Inc. λ_2
650	49		L4 7(0)	
			40 1(.3)	
	50		L5 1(.9)	Inc. add. of θ and test for col. end
			L4 16(0)	
	51		46 1(.9)	
			L0 2(0)	
	52		L0 4(.14)	
			32 (.10)	+ end of col.
	53	(.10)	22 3(.1)	- loop
			L5 1(.2)	
	54		L4 7(0)	Inc. λ_1
			40 1(.2)	
	55	(.11)	J0 40( )	Store col. of θ
			50 (.11)	
	56		26 (Y1)	
			00 F	
	57		00 F	
			41 (.14)	θ box = 0
	58	(.12)	J0 60( )	
			50 (.12)	Store col. of cos θ

LOCATION Abs.	Rel.	Sym.	ORDER	NOTES
660	59		26 (Y1)	
			00 F	
	60		00 F	
			L5 3F	
	61		L4 16(0)	End?
			40 3F	
	62	(.13)	L0 2(0)	
			32 F	Exit if +
	63		L5 1(.11)	
			L4 7(0)	
	64		40 1(.11)	Inc. adds. if -
			L5 1(.12)	
	65		L4 7(0)	
			40 1(.12)	
	66		26 (.1)	Loop
			0F F	Waste order
	67	(.14)	00 F	θ
			00 F	
	68		00 F	180
			00 180F	
670	69		75 20( )	
			00 6F	Constants
	70		L5 1F	
			L0 (.15)	
	71		40 40( )	
			L5 1(.3)	
	72	(.15)	51 3654F	Table of cosines scaled by 64/100
			51 3755F	
	73		51 3141F	
			51 3450F	
	74		51 2225F	
			51 2735F	
	75		51 896F	
			51 1611F	

LOCATION Abs.	Rel.	Sym.	ORDER	NOTES
677	76		50 3264F	
			51 84F	
	77		50 1127F	
			50 2244F	
	78		4L 2689F	
			4L 4008F	
680	79		4F 3853F	
			4L 1273F	
	80		4F 527F	
			4F 2239F	
	81		4J 905F	
			4J 2811F	
	82		4N 901F	
			4N 2998F	
	83		4S 514F	
			4S 2803F	
	84		49 3851F	
			4K 2228F	
	85		48 2719F	
			49 1281F	
	86		47 1228F	
			47 4067F	
	87		45 3475F	
			46 2395F	
	88		44 1279F	
			45 371F	
690	89		42 2837F	
			43 2100F	
	90		40 4060F	
			41 3491F	
	91		3L 865F	
			40 456F	
	92		3J 1453F	
			3F 1199F	

LOCATION			ORDER	NOTES
Abs.	Rel.	Sym.		
694	93		3S 1730F	
			3N 1630F	
	94		39 1714F	
			3K 1759F	
	95		37 1410F	
			38 1596F	
	96		35 831F	
			36 1154F	
	97		32 4080F	
			34 441F	
	98		30 2980F	
			31 3562F	
700	99		2F 1640F	
			2L 2339F	
	100		2N 64F	
			2J 880F	
	101		29 2366F	
			2K 3290F	
	102		27 364F	
			28 1389F	
	103		24 2264F	
			25 3386F	
	104		21 3979F	
			23 1095F	
	105		1L 1430F	
			20 2726F	
	106		1N 2323F	
			1F 97F	
	107		19 4068F	
			1S 1416F	
	108		17 1093F	
			18 2598F	
710	109		14 2094F	
			15 3655F	

Abs.	Rel.	Sym.	ORDER	NOTES PAGE 60 KSL 1.97
711	110		11 2993F	
			13 509F	
	111		0F 3806F	
			10 1361F	
	112		0N 445F	
			0J 2134F	
	113		09 1120F	
			0K 2839F	
	114		06 1751F	
			07 3490F	
	115		03 2348F	
			05 5F	
	116		00 2929F	
			02 593F	
718	117		00 F	
			00 F	
			00 722K	
	0	( )	J0 264F	Store (R1), (/), (x), (R), and (.) on drum
			50 ( )	
	1		26 (Y1)	
			00 3030F	
	2		00 458F	
			50 F	
	3		50 264F	Bring input-output subroutines from drum and resume input
			50 3( )	
	4		26 (Y1)	
			00 2560F	
	5		00 458F	
			22 1014F	
			26( )	
			261N	
			24(+) 261N	Start routine