

DEC-12-UW5A-D  
June, 1970

## NMRSIM(E)

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## 1.0 ABSTRACT

NMRSIM(E)<sup>1</sup> is designed to calculate theoretical spectra of compounds containing nuclei of spin one-half, including hydrogen, fluorine, and carbon-13. Chemical shifts for each nucleus and coupling constants between nuclei are input from the Teletype. Calculated line spectra are displayed on the VR12 scope. Twenty-five calibration points are displayed across the X axis. Output is to LINCtape and high- or low-speed paper tape punch, as well as to the Teletype. NMRSIM has options that allow varying all the parameters as well as offsets for enhancement of resolution. Chemical shifts and coupling constants may be adjusted continuously until the displayed theoretical spectrum is acceptable. Spectra may be read back and displayed from LINCtape or paper tape; several spectra may be merged in this mode of operation, thereby allowing the simulation of large spin systems or mixtures of compounds.

## 2.0 EQUIPMENT

A PDP-12A equipped with KW12A real time clock and MC12 4K Memory Extension is required.

## 3.0 OPERATING PROCEDURES

NMRSIM(E) is loaded from a LAP6-DIAL<sup>2</sup> tape containing the program by the command

```
→ LO NMRSIM(E),Ø )
```

Refer to the LAP6-DIAL Programmer's Manual, DEC-12-SE2B-D for further details.

The restarting procedure is as follows:

- 1) Press the STOP key on the PDP-12A.
- 2) Press I/O PRESET.
- 3) Press START.

NMRSIM then returns to the display mode.

---

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NMRSIME utilizes the EAE option for the PDP-12.

<sup>2</sup>LAP6-DIAL is hereafter referred to as DIAL.

#### 4.0 SPECTRUM GENERATION

After the program is loaded, it prints a series of messages on the Teletype to specialize the parameters for the experiment. The user types a reply to each message and terminates the response by pressing the RETURN key. If an illegal response is typed, a ? is printed on the Teletype and the message is repeated. The RUBOUT key can be used to erase incorrectly typed characters before a terminator is typed. The messages are listed below with their acceptable responses. Refer to section 8.0 for a sample dialogue.

#### 4.1 COMMENTS:

Any amount of commentary can be typed at this time using any of the Teletype keys. After entering appropriate titles, type CTRL/A to advance to the next message.

#### 4.2 WANT PAPER TAPE I/O?

Only a response of Y or N is acceptable. A reply of N stores the position and intensity of all calculated transitions on LINtape only. A reply of Y outputs the position and intensity of all calculated transitions on paper tape in addition to LINtape. After a reply of Y, a second question is printed:

WANT HIGH SPEED READER-PUNCH?

Type Y to use the high-speed punch, type N to output to the Teletype punch.

#### 4.3 NO. OF SPINS =

Enter the number of spins; values from 1 through 6 are acceptable.

#### 4.4 OFFSET & WIDTH

These two parameters define the range of the X axis on the scope. OFFSET is the value in Hz of the first point displayed along the horizontal axis. WIDTH is the total range in Hz of the horizontal axis. It is important to keep in mind that the axis will be displayed from right to left corresponding to the standard display mode for NMR data.

#### 4.5 CHEMICAL SHIFTS:

Enter the value in Hz of the CHEMICAL SHIFTS in order. Type a comma to separate values:

1, 2, . . . , n

#### 4.6 COUPLING CONSTANTS

Enter the value in Hz of the coupling constants in order:

$J_{1\ 2}, J_{1\ 3}, J_{1\ 4}, \dots, J_{1n}, J_{2\ 3}, J_{2\ 4}, \dots, J_{2n}, \dots, J_{(n-1)n}$

Specify every coupling constant required, even if the value is zero. Type a comma after each value.

#### 4.7 BLOCK, U:

Type the starting block in octal notation, a comma, and the number of the LINCtape transport unit to be used to store the peak parameters of the calculated transitions. The number of blocks required is dependent upon the size of the spin system desired.

The computer now calculates the theoretical spectra and automatically stores the data on the LINCtape.

#### 5.0 COMMANDS

When displaying a line spectrum the Teletype is active and can be used to issue commands defining the next task for the computer. Six options are available to the user at this time. Each of these commands is issued by typing the appropriate letter followed by a colon. The command may be changed by using the RUBOUT key before the colon has been typed. The display can be scaled with Right Switches 9, 10 and 11.

#### 5.1 R (RESTART)

Restart prints the message COMMENTS (section 4.1) and restarts the program. It is used to calculate a complete set of new data. Note that paper tape status can not be changed after the initial responses to the messages.

## 5.2 C (COUPLING CONSTANTS)

Returns to section 4.6 and requests new parameters. Used for open loop iteration to find the best coupling constants.

## 5.3 O (OFFSET & WIDTH)

This command allows a new section of the X axis to be displayed on the scope so that any section of the calculated spectrum can be displayed on the scope. The OFFSET option is useful for resolution enhancement. To exercise this option, there must be NMR data on LINCtape or paper tape (prepared by the P: command). If paper tape was requested during initialization (section 4.2), the question

TAPE INPUT?

is asked. Type Y to read data from the high speed or Teletype reader and write it on LINCtape before display. Type N to read data from LINCtape.

## 5.4 D (DIAL)

Program returns control to the DIAL Operating System.

## 5.5 L (LIST)

The L command lists intensity and energy data on the Teletype in tabular format. After typing L, the message

MIN. INTENSITY:

is printed. Type an integer number between 0 and 1000. If the intensity of the transition is greater than the entered value, the transition will be in the output list. This question thus serves as a threshold on the intensities that are listed. A second question

DISPLAY LIST

is then printed. Type Y to output only the lines which are displayed on the scope. Type N to output all lines in the table. There are usually many more lines than are displayed on the scope because the scope cannot resolve closely adjacent lines.<sup>1</sup>

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If the Teletype punch is turned on during a List operation, a binary coded decimal paper tape is produced which may be used as input to CATAL (DEC-12-UW1A-D) to produce a spectrum consisting of peaks instead of lines.

## 5.6 P (PUNCH)

The accumulated spectrum can be punched on the high-speed reader/punch by issuing the punch command.

## 6.0 OPERATING SUGGESTIONS

A useful starting point for many 60 MHz NMR (hydrogen) spectra of organic molecules is a sweep offset of 0 Hz and a sweep width of 500 Hz. For best results, however, all peaks should eventually be examined at a considerably smaller sweep width, since rounding errors may give misleading scope displays with large sweep widths. It should be noted that increasing the sweep offset moves peaks to the right, and decreasing the sweep offset moves peaks to the left. Once the peaks are observed, the proper sweep offset and width can be determined from the 25 calibration marks placed across the X axis.

For purposes of estimating a logical minimum intensity, remember that the calibration on the scope on the Y axis is always 0 to 1000.

## 7.0 NMR BACKGROUND

The discussion below assumes that the nuclei being studied are hydrogen, fluorine, carbon-13 or other nuclei of spin 1/2.

Each nucleus in a molecule can be assigned a spin of either  $\alpha$  or  $\beta$ . For a system containing  $n$  nuclei, there are  $2^n$  spin states possible. Each of these states is called a basic product function. The energy of a basic product function can be calculated from equation 1 below where  $s_i = -1/2$  for  $\beta$  spin and  $+1/2$  for  $\alpha$  spin,  $\nu_i$  is the frequency of absorption in Hz,  $T_{ij} = +1/4$  if  $i$  and  $j$  have the same spin and  $-1/4$  if  $i$  and  $j$  have opposite spin, and  $J_{ij}$  is the coupling constant between  $i$  and  $j$  in cps.

$$1 \quad H_{uu} = \sum_{i=1}^n (s_i \nu_i + \sum_{j>i} T_{ij} J_{ij})$$

The energy of interaction between two basic product functions is 0 unless both have the same number of  $\alpha$  and  $\beta$  spins. When this condition is fulfilled, the interaction energy is calculated from equation 2 where  $U=1$  if the basic product functions differ only in the interchange of spins  $i$  and  $j$  ( $J_{ij}$  as defined above). Otherwise,  $U=0$ .

$$2 \quad H_{uv} = 1/2 U J_{ij}$$

Thus, to calculate an NMR spectrum, one constructs all of the possible basic product functions and sorts them into groups, each member of a group containing the same number of  $\alpha$  and  $\beta$  spins. The energy of each of them is determined and used as the diagonal element in a square matrix. The off-diagonal elements of this matrix (H matrix) are energies of interaction between the members of the group. This matrix is diagonalized and these elements then contain the energies of the final spin functions. These final spin eigenfunctions are the columns of the matrix (U matrix) required to diagonalize the H matrix. Each element in a spin function represents the contribution of a basic product function to that spin function.

Before continuing, it is necessary to define the  $F_z$  value of a spin function, as shown in equation 3, where  $s_i$  is as previously defined.

$$3 \quad F_z = \sum_{i=1}^n s_i$$

Now the peaks observed in NMR spectra are transitions from one spin function to another. These transition energies and their intensities can be calculated as outlined below. Transitions are allowed between spin functions whose  $F_z$  values differ only by 1. If this holds, the energy of the transition is the difference in energy of the final spin eigenfunctions, and the intensity of the transition is given by equation 4 where  $C_u$  is the  $u$ th element in one spin function,  $C'_v$  is the  $v$ th element in the other spin function, and  $A=1$  if the basic product functions represented by  $C_u$  and  $C'_v$  differ by one spin. Otherwise,  $A=0$ .

$$4 \quad I = \left( \sum_u \sum_v C_u C'_v A \right)^2$$

### 8.0 EXAMPLE

The following pages represent an actual printout. The spectra are representations of those displayed on the scope. The underlined data is that typed by the user.

LO NMRSIME, 2

NMRSIM

COMMENTS: DEMO 1

WANT PAPER TAPE I/O? Y

WANT HIGH SPEED READER-PUNCH? Y

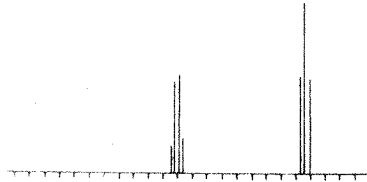
NO. OF SPINS= 5

OFFSET & WIDTH: 0, 500

CHEMICAL SHIFTS: 90, 90, 90, 260, 260

COUPLING CONSTANTS: 0, 0, 8, 8, 0, 8, 8, 8, 8, 0,

BLOCK, U: 400, 3



L:

MIN. INTENSITY: 0

DISPLAY LIST? Y

INTENSITY	ENERGY
27.00	272.00
90.00	264.00
99.00	256.00
36.00	248.00
104.00	97.00
189.00	90.00
86.00	81.00

P:  
Q:

OFFSET & WIDTH: 0,300

TAPE INPUT? Y

BLOCK, U: 420,3,

MORE? N

P:

NMRSIM

COMMENTS: DEMO 1 CONT

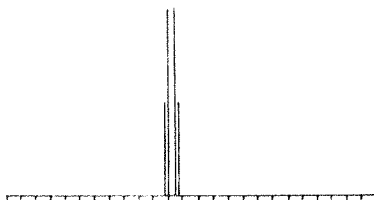
NO. OF SPINS= 2

OFFSET & WIDTH: 0,500

CHEMICAL SHIFTS: 265,280

COUPLING CONSTANTS: 5

BLOCK, U: 440,3



C:

COUPLING CONSTANTS: 10

BLOCK, U: 440,3

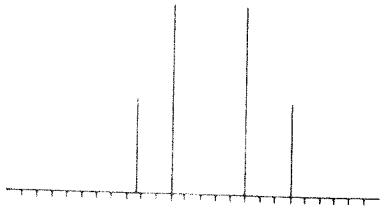
G:

OFFSET & WIDTH: 250,50

TAPE INPUT? N

BLOCK, U: 440,3

MORE?N



D:

## 9.0 ASSEMBLING NMRSIM

The NMRSIM program is supplied to the user in both source and binary on the tape. To generate a new binary file if the source program is modified, use the following procedure.

1. Load a DIAL-MS tape on unit 0. Load unit 1 with either a DIAL-V2 or DIAL-MS system tape. If another tape unit is available, mount the tape containing the CLEARSYM and NMRSIM source programs there. If only two tape units are available, place the source programs on unit 0 (with PIP if necessary), in order to reduce the assembly time.

2. Type →ZE↵ to clear the binary Working Area of unit 1.
3. Type →AS CLEARSYM↵. CLEARSYM is a two word program which produces a clean symbol table.

```
0000  
SAVSYM 1
```

4. Type →AS NMR2,0↵. Error messages generated at this time should be ignored. Press the RETURN key to terminate the assembly after the errors have all been printed to suppress printing of the symbol table.
5. Type →ZE↵. This clears the binary Working Area on unit 1.
6. Type →LI NMR3,0↵. If no listing is desired, use the AS command. Any errors generated now are real and must be corrected.
7. Type →LI NMR2,0↵. Because the symbol table produced is the same as the one generated in step 6, printing may be suppressed with the RETURN key after it has started to be printed.
8. Type →SB NMR23,0↵. This saves the binary output from the two previous assemblies
9. Type →ZE↵.
10. Two versions of the Floating Point Package are applied. If the machine has the FAE option, NMR1F should be used in the following steps and NMRSIME will be generated. If the machine does not have this option, NMR1 should be used to generate NMRSIM.

11. Type `+AB NMRL,Ø`.
12. Type `+AB NMR23,Ø`.
13. Type `+SB NMRSIM,ØP`. A binary file of NMRSIM(E) has now been generated and the command `+LO NMRSIM,Ø` will cause load and execute.

#### 10.0 INTERNAL DESCRIPTION

The complete program listings are contained at the back of the manual. The following is a brief outline of the program; capital letters below refer to variables.

1. Begins with text mode for input of commentary.
2. Enter the number of spins and store in N.
3. Set "switch" for punched output.
4. Set up basic produce functions (BPFs).
  - A. Calculate NARRY array which contains relative addresses of the BPFs of different  $F_z$  value.
  - B. Calculate NUSE array. This array actually contains the BPFs. They are stored in groups, each group having an  $F_z$  value one greater than the preceding group.
5. Get sweep offset and sweep width.
6. Get chemical shifts.
7. Get coupling constants.
8. Initialize SPEC array.
  - A. This array eventually contains the displayed spectrum.
  - B. It is initialized to Ø except for calibration points where it is set to 4ØØØØ.
9. Calculate first H and U matrices.
  - A. First H matrix is always a 1 X 1 which does not require diagonalization.
  - B. First U matrix is always a 1 X 1 with its only element equal to 1.
10. Set FLAG which is the negative of the number of times the loop from 11 to 17 must be executed.

11. Set N2, calculate EN and UOLD arrays.
  - A. Copy the trace of the H matrix into the EN array.
  - B. Copy the U matrix into the UOLD array.
  - C. Set N2 equal to the size of the H matrix just copied.
12. Calculate the size of the next H matrix and put in into N1.
13. Determine which transitions will be allowed between the BPFs represented by UOLD and those that will be represented by U. This is stored in the array called TABLE.
14. Initialize H and U matrixes.
  - A. Diagonal H elements are calculated by equation 1.
  - B. Off-diagonal H elements are calculated by equation 2.
  - C. The U matrix is initialized to all zeros except for ones on the diagonal.
15. Diagonalize the H matrix and calculate the U matrix by the Jacobi method.
16. Calculate transitions.
  - A. Calculate transition energies by forming the differences between the elements of the trace of the H matrix and the elements in the EN array.
  - B. Calculate transition intensities from equation 4.
  - C. Store appropriate values in SPEC array.
17. Test FLAG to see if the loop is done.
  - A. If loop is not done, go to 11.
  - B. If loop is done, display spectrum.
18. If ALT MODE is typed, interpret mnemonic and execute option.

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0373	0437	1324	TAD	SPECAD	
0374	0440	7510	SPA		/IN RIGHT RANG
0375	0441	5222	JMP	GET	/NO, LOOK AT NL, ONE
0376	0442	1326	TAD	M500	/MAYBE
0377	0443	7700	SMA CLA	GET	/IN RIGHT RANGE?
0400	0444	5222	JMP	SPECAD	/NO, LOOK NEXT CASE
0401	0445	1324	TAD	SPECB	/YES, ADDRESS IN SPEC ARRAY
0402	0446	1071	TAD	SPECAD	
0403	0447	3324	DCA	10	
0404	0450	6211	CDF	I	
0405	0451	1724	TAD	SPECAD	
0406	0452	7004	RAL		/SET BIT 0 TO 0
0407	0453	7110	CLL RAR	APROB	/OVERFLOW?
0410	0454	1325	TAD	SMA CLA	/NO
0411	0455	7700	JMP	6	/YES, SET TO MAX
0412	0456	5264	JMP	I	
0413	0457	1724	TAD	SPECAD	
0414	0460	7004	RAL		
0415	0461	7250	CLA CMA	RAR	
0416	0462	3724	DCA I	SPECAD	/STORE
0417	0463	5222	JMP	GET	/LOOK NEXT CASE
0420	0464	1724	TAD	I	
0421	0465	1325	TAD	APROB	/INCREMENT CURRENT VALUE
0422	0466	5262	JMP	4	
0423	0467	4474	JMS I	PRINT	/MORE?
0424	0470	3761	HD3		
0425	0471	4713	JMS I	ASKMX	
0426	0472	7640	SZA CLA		
0427	0473	5302	JMP	NMRE	
0430	0474	1102	TAD	INSWT	/YES
0431	0475	7650	SNA CLA		/PAPER?
0432	0476	5216	JMP	GET-4	/YES
0433	0477	4505	JMS I	TPGT	/NO, LINCTAPE; GET BLOCK, UNIT
0434	0500	4715	JMS I	TPSIR	/INIT. TAPE AND BUFFER
0435	0501	5222	JMP	GET	
0436	0502	4714	JMS I	CARLFD	
0437	0503	1102	TAD	INSWT	
0440	0504	7640	SZA CLA		
0441	0505	5475	JMP I	DISPLAY	
0442	0506	7133	STL IAC	RTR	/INSERT TAG WORD
0443	0507	6201	COF 0		
0444	0510	3411	DCA I	11	
0445	0511	4476	JMS I	TAPTRN	/WRITE OUT LAST BUFFER
0446	0512	5475	JMP I	DISPLAY	
0447	0513	4315	ASKMX,	ASKM	
0450	0514	2663	CARLFD,	CRLFD	
0451	0515	3317	TPSTR,	STRTP	
0452	0516	1121	INSPA,	INSPEC	
0453	0517	3554	AULIM,	ULIMP	
0454	0520	0000	HALFA,	0	
0455	0521	2000	0	2000	
0456	0522	0000	0	0	
0457	0523	3127	FIXA,	FIX	
0460	0524	0000	SPECAD,	0	
0461	0525	0000	APROB,	0	
0462			DECIMAL		
0463	0526	7014	M500,	-500	
0464			OCIAL		
0465	0527	0000	RWD,	0	
0466	0530	7200	CLA	CLA	
0467	0531	6201	COF 0		
0470	0532	1102	TAD	INSWT	

0472	JMP	STPE	/NORMAL RETURN
0473	JMS I	FACLOD	
0474	JMP	RDEX	
0475	JMP I	RWD	
0476	STA CLL	RTL	
0477	DCA	FLAG	/INITIALIZE TO READ THREE WORDS
0500	TAD	P44	
0501	DCA	ADD0	
0502	JMS I	CKEND	/CHECK FOR END OF BUFFER
0503	CLA CLL		
0504	JMS I	HRED	
0505	RTL		
0506	RTL		/SHIFT TO BITS 2-7
0507	RAL		
0510	SPA		/IS THIS A STARTING MARK?
0511	JMP	BACK0	/YES
0512	SZL		/NO, IS IT AN END MARK?
0513	JMP I	RWD	/YES, EXIT W/O INCRD RETURN
0514	RAL		/NO, SHIFT TO BITS 0-5
0515	JMS I	HRED	
0516	DCA I	ADD0	/STORE COMPLETE WORD
0517	TAD I	ADD0	
0520	DCA I	I1	/STICK IT IN CORE BUFFER
0521	ISZ	ADD0	
0522	ISZ	FLAG	/IS WHOLE F.P. READ?
0523	JMP	BACK0	/NO, READ NEXT WORD
0524	ISZ	RWD	/NORMALLY INCR, RETURN
0525	JMP I	RWD	/YES, RETURN
0526	P44		
0527	ENDCHK		
0530	FLAGR, 0		
0531	FACLOD, LODFAC		
0532	*600		
0533	WC,		
0534	CLA		/INPUT OF CPS AND CUP
0535	TAD		
0536	DCA	CPSB	
0537	TAD	ADDR	/START OF CPS ARRAY
0540	CIA	N	
0541	DCA	FLAG	/SET OF CHEMICAL SHIFTS
0542	JMP	RPTC	/GET CHEMICAL SHIFTS
0543	0		
0544	CLA		
0545	TAD	JC	
0546	DCA	WC	
0547	TAD	CUPB	
0550	DCA	ADDR	/START OF CUP ARRAY
0551	TAD	N	
0552	CIA		
0553	IAC		
0554	DCA	FLAG	/SET TO CALCULATE OF JS
0555	TAD	FLAG	
0556	ISZ	FLAG	
0557	JMP	,-2	
0560	DCA	FLAG	/FLAG CONTAINS - OF JS
0561	JMS I	INPUT	/GET A VALUE
0562	JMS I	INTERP	
0563	FDIV2		
0564	FPUT I	ADDR	/STORE
0565	FEXT		
0566	CLA IAC	STL RAL	
0567	TAD	ADDR	

ISZ	FLAG	/DONE?
0571	RPTC	/NO; GET NEXT
0572	WC	/YES; RETURN
0573	KLAEL	/CLEAR ADD0 (3 WORDS)
0574	CPSB	
0575	ADDRC	/ADDRC INITIALIZED TO CPS
0576	CUPB	
0577	ADDRC1	/ADDRC1 INITIALIZED TO CUP
0578	N	
0579	FLAG	/SET CPS DO LOOP
0580	TEMP	/GET BPF
0581	TEMC	/STORE IN TEMC
0582	TEMC	
0583	TEMC	
0584	TEMC1	
0585	TEMP	/GET RIGHTMOST BIT
0586	TEMP	/STORE REDUCED BPF
0587	TEMP	
0588	TEMP	
0589	TEMP	
0590	TEMP	
0591	TEMP	
0592	TEMP	
0593	TEMP	
0594	TEMP	
0595	TEMP	
0596	TEMP	
0597	TEMP	
0598	TEMP	
0599	TEMP	
0600	TEMP	
0601	TEMP	
0602	TEMP	
0603	TEMP	
0604	TEMP	
0605	TEMP	
0606	TEMP	
0607	TEMP	
0608	TEMP	
0609	TEMP	
0610	TEMP	
0611	TEMP	
0612	TEMP	
0613	TEMP	
0614	TEMP	
0615	TEMP	
0616	TEMP	
0617	TEMP	
0618	TEMP	
0619	TEMP	
0620	TEMP	
0621	TEMP	
0622	TEMP	
0623	TEMP	
0624	TEMP	
0625	TEMP	
0626	TEMP	
0627	TEMP	
0628	TEMP	
0629	TEMP	
0630	TEMP	
0631	TEMP	
0632	TEMP	
0633	TEMP	
0634	TEMP	
0635	TEMP	
0636	TEMP	
0637	TEMP	
0638	TEMP	
0639	TEMP	
0640	TEMP	
0641	TEMP	
0642	TEMP	
0643	TEMP	
0644	TEMP	
0645	TEMP	
0646	TEMP	
0647	TEMP	
0648	TEMP	
0649	TEMP	
0650	TEMP	
0651	TEMP	
0652	TEMP	
0653	TEMP	
0654	TEMP	
0655	TEMP	
0656	TEMP	
0657	TEMP	
0658	TEMP	
0659	TEMP	
0660	TEMP	
0661	TEMP	
0662	TEMP	
0663	TEMP	
0664	TEMP	
0665	TEMP	
0666	TEMP	

```

0670 06700 FEXT
0671 06736 CLA IAC STL RAL
0672 06737 TAD ADDRCL
0673 06740 DCA ADDRCL
0674 06741 ISZ FLAGCL
0675 06742 JMP RPTC2
0676 06743 JMP RPTC1
0677 06744 FADD I ADDRCL
0678 06745 FADD I ADDRCL
0679 06746 FSUB I ADDRCL
0680 06747 FSUB I ADDRCL
0681 06750 SNL
0682 06751 CLAEL
0683 06752 FLAGCL
0684 06753 FLAGCL
0685 06754 TEMCL
0686 06755 TEMCL
0687 06756 ADDRCL
0688 06757 ADDRCL
0689 06760 FPINP
0690 06761 CDF
0691 06762 JMS I FLIN
0692 06763 TAD
0693 06764 SNA CLA
0694 06765 JMP
0695 06766 JMP I FPINP
0696 06767 FLIN
0697 06768 *1000
0698 06769 XTERM
0699 06770
0700 10000 CLAEL /3 WORD CLEAR OF ADD0
0701 10001 JMS
0702 10002 STA
0703 10003 DCA
0704 10004 DCA
0705 10005 CLL STA
0706 10006 DCA
0707 10007 YAD
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0719 10023 JMP
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1066 1142 4744 JMS I INTAP /RETURN
1067 1143 5721 JMP I INSPEC
1070 1144 3317 STIRTP INTAP,
1071 1145 7754 M20,
1072 1146 7014 M5000,
1073 1147 0000 CLAEL,
1074 1150 6211
1075 1151 7240 CDF 10
1076 1152 1113 STA ADD0
1077 1153 3010 DCA 10
1100 1154 3410 DCA I 10
1101 1155 3410 DCA I 10
1102 1156 3410 DCA I 10
1103 1157 6201 CDF 0
1104 1160 5747 JMP I CLAEL
1105 1161 0000 ENDCHK,
1106 1162 7300 CLA CLL
1107 1163 1011 TAD 11
1110 1164 1103 TAD AREND
1111 1165 7710 SPA CLA /REACHED END OF TAPE BUFFER?
1112 1166 5761 JMP I ENDCHK /NO
1113 1167 4476 JMS I TAPTRN /YES, WRITE OUT THE BUFFER
1114 1170 1104 TAD CORBUF
1115 1171 3011 DCA 11
1116 1172 5761 JMP I ENDCHK
1117 *1200
1120 1200 0000 JAKE,
1121 1201 7200 RPTE,
1122 1202 1115
1123 1203 7041
1124 1204 3365 DCA FLAGE /SET DO LOOP
1125 1205 7040 CMA
1126 1206 1115 TAD N1
1127 1207 3267 DCA CTRE /CTRE=N1=1
1130 1210 3270 DCA IS /IS=0
1131 1211 7200 RPTE1,
1132 1212 2365 CLA FLAGE /LOOP DONE?
1133 1213 5220 JMP +5 /NO, CONTINUE
1134 1214 1270 TAD IS /YES
1135 1215 7450 SNA /MATRIX DIAGONALIZED?
1136 1216 5600 JMP I JAKE /YES, RETURN
1137 1217 5201 JMP RPTE /NO, GO THROUGH AGAIN
1140 1220 1267 TAD CTRE
1141 1221 7041 CIA FLAGE1 /SET INNER DO LOOP
1142 1222 3265 DCA R2
1143 1223 1367 TAD INSTE
1144 1224 3364 DCA FLAGE1 /DONE WITH INNER LOOP?
1145 1225 2265 ISZ +6 /NO, CONTINUE
1146 1226 5234 JMP CMA /YES, INCREMENT CTRE AND OUTER DO LOOP
1147 1227 7240 CLA CTRE
1150 1230 1267 TAD CTRE /CTRE=CTRE-1
1151 1231 3267 DCA R1
1152 1232 1366 TAD INSTE
1153 1233 3364 DCA N1
1154 1234 7200 CLA FLAGE
1155 1235 1115 TAD TEMP
1156 1236 1365 TAD N1
1157 1237 3107 DCA FLAGE1
1160 1240 1115 TAD TEMPI
1161 1241 1265 TAD HSUBE
1163 1242 4273 JMS /TEMP AND TEMPI HAS SUBSCRIPTS
1164 1243 1513 TAD /KEY ELEMENT OF SUBSCRIPTS

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1165 1245 1266 TAD TESTE /ADD 13 TO EXPONENT
1166 1246 7510 SPA /ELEMENT SMALL ENOUGH?
1167 1247 5764 JMP I INSTE /YES, LOOK FOR OTHER
1170 1250 2113 ISZ ADD0 /IS IT 0?
1171 1251 7300 CLA CLL
1172 1252 1513 TAD I ADD0
1173 1253 7004 RAL
1174 1254 7450 SNA
1175 1255 5764 JMP I INSTE /ITS 0
1176 1256 7240 STA /RESTORE ADD0
1177 1257 1113 TAD ADD0
1200 1260 3113 DCA ADD0
1201 1261 2270 ISZ IS /SHOW THAT A LARGE ELEMENT IS FOUND
1202 1262 4671 JMS I TRIGE /0 THE ELEMENT
1203 1263 4672 JMS I VALUE /CONTINUE
1204 1264 5764 JMP I INSTE
1205 1265 0000 FLAG1, 0
1206 1266 0015 TESTE, 15
1207 1267 0000 CTRE, 0
1210 1270 0000 IS,
1211 1271 1400 TRIGE, TRIG
1212 1272 1600 VALUE, VALUEG
1213 1273 0000 HSUBE, 0
1214 1274 7200 CLA
1215 1275 1107 TAD
1216 1276 7041 CIA
1217 1277 1114 TAD
1220 1300 7500 SMA
1221 1301 5310 JMP
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1252 1332 1113 TAD
1253 1333 1073 TAD
1254 1334 3113 DCA
1255 1335 5673 JMP I
1256 1336 0000 IND1,
1257 1337 0000 IND2,
1260 1340 0000 DIFF,
1261 1341 0000 USUB,
1262 1342 7240 STA

```

```

/ADD 13 TO EXPONENT
/ELEMENT SMALL ENOUGH?
/YES, LOOK FOR OTHER
/IS IT 0?
/ITS 0
/RESTORE ADD0
/SHOW THAT A LARGE ELEMENT IS FOUND
/0 THE ELEMENT
/CONTINUE
/FIND ADDRESS OF H ELEMENT
/TEMP1-TEMP
/WHICH IS BIGGEST?
/TEMP1
/TEMP
/ FROM DIAGONAL ELEMENT
/SET DO LOOP
/SET UP REGISTER
/ENOUGH ADDITIONS?
/NO, CONTINUE
/YES, GET OUT OF LOOP
/AC CONTAINS OF ELEMENTS IN SKIPPED ROWS
/ OF ELEMENTS TO SKIP
/ADD0 CONTAINS ADDRESS
/GETS ADDRESS IN U MATRIX

```

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1204 1344 /420 /IS THIS 0
1265 JMP +6 /YES
1266 CIA 7041 /NO
1267 DCA IND1 /SET DO LOOP
1270 TAD N1
1271 1351 IND1 /DONE WITH LOOP?
1272 1352 JMP -2 /NO CONTINUE
1273 1353 TAD TEMP /AC CONTAINS OF ELEMENTS TO BE SKIPPED
1274 1354 DCA ADD0
1275 1355 CLL STA RTL
1276 1356 TAD ADD0
1277 1357 TAD ADD0
1300 1360 TAD ADD0
1301 1361 TAD UB
1302 1362 DCA ADD0
1303 1363 JMP I USUB
1304 1364 0000
1305 1365 0000
1306 1366 1211
1307 1367 1225
1310 1310
1311 1400 0000
1312 1401 4407
1313 1402 5513
1314 1403 6337
1315 1404 0000
1316 1405 1107
1317 1406 3527
1320 1407 1114
1321 1410 3330
1322 1411 1527
1323 1412 3114
1324 1413 4742
1325 1414 4407
1326 1415 5513
1327 1416 6531
1330 1417 0000
1331 1420 1530
1332 1421 3107
1333 1422 1530
1334 1423 3114
1335 1424 4742
1336 1425 4407
1337 1426 5513
1340 1427 6334
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1342 1431 6321
1343 1432 3321
1344 1433 6324
1345 1434 5337
1346 1435 0003
1347 1436 0003
1350 1437 3337
1351 1440 1324
1352 1441 0002
1353 1442 6324
1354 1443 0000
1355 1444 1522
1356 1445 7500
1357 1446 5253
1360 1447 4407
1361 1448 0005
1362 1451 6324
0 JMS I INTERP /GET H(JF,K)
0 FGET I ADD0
0 FPUT HJK
0 FEXT
0 TAD TEMP
0 DCA JF
0 TAD TEMP1
0 DCA KF
0 TAD JF
0 DCA TEMP1
0 JMS I HSUBF /GET ADDRESS OF H(J,J)
0 JMS I INTERP
0 FGET I ADD0 /HJJ=H(J,J)
0 FEXT
0 TAD KF
0 DCA TEMP
0 TAD KF
0 DCA TEMP1
0 JMS I HSUBF /GET ADDRESS OF H(K,K)
0 JMS I INTERP
0 FGET I ADD0 /HKK=H(K,K)
0 FPUT HKK
0 FSUB HJJ /Y=HKK=HJJ
0 FPUT Y /R=Y**2
0 FMPY R
0 FGET HJK
0 FMPY2
0 FMPY HJK
0 FADD R
0 SUBR00T
0 FPUT R
0 FEXT
0 TAD Y1
0 SMA
0 JMS I INTERP /IS Y NEGATIVE?
0 NEGATE
0 FPUT R /THEN SET R=R

```

```

1363 1452 0000 FEXT INTERP
1364 4407 JMS I Y
1365 454 5321 FGET Y
1366 4324 FDIV R
1367 6321 FPUT Y
1370 5337 FGET HJK
1371 0003 FMPY2
1372 4524 FDIV R
1373 6524 FPUT R
1374 5316 FGET ONEF
1375 1521 FADD Y
1376 0004 FDIV2
1377 0002 SQR00T
1400 6127 FPUT
1401 5324 FGET
1402 4127 FDIV
1403 0004 FDIV2
1404 6124 FPUT
1405 5331 FGET HJJ
1406 1334 FADD HJK
1407 0004 FDIV2
1410 6116 FPUT A
1411 5337 FGET HJK
1412 3324 FMPY R
1413 6121 FPUT B
1414 5331 FGET HJJ
1415 2334 FSUB HJK
1416 0004 FDIV2
1417 5321 FMPY Y
1420 2121 FSUB B
1421 6121 FPUT B
1422 0000 FEXT
1423 1512 TAD
1424 3107 DCA
1425 6211 CDF 10
1426 5600 JMP I
1427 0001 ONEF,
1430 2000 0
1431 0000 0
1432 0000 Y,
1433 0000 Y1,
1434 0000 R,
1435 0000 R,
1436 0000 0
1437 0000 0
1440 0000 JF,
1441 0000 KF,
1442 0000 HJJ,
1443 0000 0
1444 0000 0
1445 0000 HKK,
1446 0000 0
1447 0000 0
1450 0000 HJK,
1451 0000 0
1452 0000 0
1453 1273 HSUBF, HSUBE
1454 0000 ONESET, 0
1455 7240 STA
1456 1113 TAD ADD0
1457 5010 DCA 10
1460 6211 CDF 10

```

/Y(FCOS2)=Y/R

/R(FSIN2)=2\*HJK/R

/FCOS=((1+FCOS2)/)\*\*.5

/FSIN=FSIN2/FCOS/2

/A=(HJJ+HKK)/2

/B=HJK\*FSIN2

/B=(HJJ-HKK)\*FCOS2/2-HJK\*FSIN2

/RESTORE TEMP AND TEMPI

/RETURN





1660	1734	IAU I	ADDZ	
1661	3340	DCA	BPF2	/GET BPF2
1662	2030	TAD I	ADD1	
1663	3337	OCA	BPF1	/GET BPF1
1664	2032	COF 0		
1665	2033	ISZ	ADD1	
1666	2034	JMS	TEST	/FIND OUT IF ALLOWED TRANSITION
1667	2035	ISZ	FLAGH1	/DONE WITH INNER LOOP?
1670	2036	JMP	RPTH1	/NO, CONTINUE
1671	2037	ISZ	FLAGH	/YES, DONE WITH OUTER LOOP?
1672	2040	JMP	INC	/NO, CONTINUE
1673	2041	TAD	CTRH3	/IS LAST TABLE ENTRY NORMALIZED?
1674	2042	CIA		
1675	2043	TAD	M12H	
1676	2044	SNA	CLA	
1677	2045	JMP	RETH	/YES, RETURN
1700	2046	TAD I	TABADH	/NO, NORMALIZE IT
1701	2047	CLL	RAR	
1702	2050	ISZ	CTRH3	/NORMALIZED?
1703	2051	JMP	:2	/NO, ROTATE AGAIN
1704	2052	OCA I	TABADH	/YES, STORE IT
1705	2053	COF 10		
1706	2054	JMP I	ALLOW	/RETURN
1707	2055	ISZ	ADD2	
1710	2056	JMP	RPTH	
1711	2057	0		
1712	2060	TAD	N	
1713	2061	CIA		
1714	2062	DCA	CTRH	/- OF ROTATIONS
1715	2063	IAC		
1716	2064	CMA		
1717	2065	DCA	CTRH1	/INITIALIZED TO -2
1720	2066	CLA	CLL	
1721	2067	TAD	BPF1	
1722	2070	RAR		
1723	2071	OCA	BPF1	/STORE ROTATED VALUE
1724	2072	SEL		/TEST LINK AND SET UP LATER TEST
1725	2073	JMP	:4	
1726	2074	TAD	NLINK	
1727	2075	OCA	INSTH	
1730	2076	JMP	:3	
1731	2077	TAD	ZLINK	
1732	2100	OCA	INSTH	
1733	2101	CLL		
1734	2102	TAD	BPF2	
1735	2103	RAR		
1736	2104	OCA	BPF2	/STORE ROTATED VALUE
1737	2105	0		
1740	2106	JMP	:5	/SPINS THE SAME
1741	2107	ISZ	CTRH1	/DIFFERENT
1742	2110	JMP	:3	
1743	2111	CLA	CLL	/TOO MANY DIFFERENCES
1744	2112	JMP	:5	
1745	2113	ISZ	CTRH	/DONE ROTATING?
1746	2114	JMP	OVER	/NO, ROTATE AGAIN
1747	2115	CLA		/YES, ALLOWED TRANSITION
1750	2116	STL		
1751	2117	TAD I	TABADH	/STORES ALLOWEDNESS
1752	2120	RAR		
1753	2121	OCA I	TABADH	
1754	2122	ISZ	CTRH3	/NEED TO INCREMENT ABAD?
1755	2123	JMP I	TEST	/NO
1756	2124	ICZ	TARION	

/REINIT CTRH3

1757	2125	1531	TAD M12H
1760	2126	3532	DCA CTRH3
1761	2127	5657	JMP I TEST
1762	2130	0000	TABADH, 0
1763	2131	7764	M12H, 7764
1764	2132	0000	CTRH3, 0
1765	2133	0000	ADD1, 0
1766	2134	0000	ADD2, 0
1767	2135	0000	FLAGH, 0
1770	2136	0000	FLAGH1, 2
1771	2137	0000	BPF1, 0
1772	2140	0000	BPF2, 0
1773	2141	0000	CTRH, 0
1774	2142	0000	CTRH1, 0
1775	2143	7420	NLINK, SNL
1776	2144	0000	0
1777	2145	0000	TABL, 0
2000			SAVSYM 2

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PMODE
LOOSYM
LISTAP =1
*2200
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HUGET,
0000
2201 7240 STA
2202 1133 JTEMP
2203 1064 NUSEB
2204 3247 DCA ADDR0
2205 1073 TAD HB
2206 5113 DCA ADDR0
2207 1115 TAD N1
2210 7041 CIA
2211 3245 DCA IAC
2212 7201 CLA IAC
2213 1247 TAD ADDR0
2214 5250 DCA ADDR2
2215 1647 TAD I ADDR0
2216 5107 DCA TEMP
2217 4651 JMS I DIAGEL
2220 2247 ISZ ADDR0
2221 2113 ISZ ADDR0
2222 2113 ISZ ADDR0
2223 2113 ISZ ADDR0
2224 7201 CLA IAC
2225 1245 TAD ADDR0
2226 7450 SNA
2227 5253 JMP
2230 3246 DCA CTRI
2231 7200 RPTI2,
2232 1650 TAD I ADDR2
2233 3114 DCA TEMP1
2234 4652 JMS I XTERMI
2235 2113 ISZ ADDR0
2236 2113 ISZ ADDR0
2237 2113 ISZ ADDR0
2240 2250 ISZ ADDR2
2241 2246 ISZ CTRI
2242 2231 JMP RPTI2
2243 2245 ISZ ICTRI
2244 2212 JMP RPTI
2245 0 ICTRI,
2246 0 CTRI,
2247 0 ADDR0,
2250 0 ADDR2,
2251 0 DIAGL,
2252 0 XTERMI,
2253 0 UGET,
2254 0 N1
2255 0 CIA
2256 0 DCA
2257 0 TAD
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2867 0 CTRI
2868 0 N1
2869 0 CTRI
2870 0 N1
2871 0 CTRI
2872 0 N1
2873 0 CTRI
2874 0 N1
2875 0 CTRI
2876 0 N1
2877 0 CTRI
2878 0 N1
2879 0 CTRI
2880 0 N1
2881 0 CTRI
2882 0 N1
2883 0 CTRI
2884 0 N1
2885 0 CTRI
2886 0 N1
2887 0 CTRI
2888 0 N1
2889 0 CTRI
2890 0 N1
2891 0 CTRI
2892 0 N1
2893 0 CTRI
2894 0 N1
2895 0 CTRI
2896 0 N1
2897 0 CTRI
2898 0 N1
2899 0 CTRI
2900 0 N1
2901 0 CTRI
2902 0 N1
2903 0 CTRI
2904 0 N1
2905 0 CTRI
2906 0 N1
2907 0 CTRI
2908 0 N1
2909 0 CTRI
2910 0 N1
2911 0 CTRI
2912 0 N1
2913 0 CTRI
2914 0 N1
2915 0 CTRI
2916 0 N1
2917 0 CTRI
2918 0 N1
2919 0 CTRI
2920 0 N1
2921 0 CTRI
2922 0 N1
2923 0 CTRI
2924 0 N1
2925 0 CTRI
2926 0 N1
2927 0 CTRI
2928 0 N1
2929 0 CTRI
2930 0 N1
2931 0 CTRI
2932 0 N1
2933 0 CTRI
2934 0 N1
2935 0 CTRI
2936 0 N1
2937 0 CTRI
2938 0 N1
2939 0 CTRI
2940 0 N1
2941 0 CTRI
2942 0 N1
2943 0 CTRI
2944 0 N1
2945 0 CTRI
2946 0 N1
2947 0 CTRI
2948 0 N1
2949 0 CTRI
2950 0 N1
2951 0 CTRI
2952 0 N1
2953 0 CTRI
2954 0 N1
2955 0 CTRI
2956 0 N1
2957 0 CTRI
2958 0 N1
2959 0 CTRI
2960 0 N1
2961 0 CTRI
2962 0 N1
2963 0 CTRI
2964 0 N1
2965 0 CTRI
2966 0 N1
2967 0 CTRI
2968 0 N1
2969 0 CTRI
2970 0 N1
2971 0 CTRI
2972 0 N1
2973 0 CTRI
2974 0 N1
2975 0 CTRI
2976 0 N1
2977 0 CTRI
2978 0 N1
2979 0 CTRI
2980 0 N1
2981 0 CTRI
2982 0 N1
2983 0 CTRI
2984 0 N1
2985 0 CTRI
2986 0 N1
2987 0 CTRI
2988 0 N1
2989 0 CTRI
2990 0 N1
2991 0 CTRI
2992 0 N1
2993 0 CTRI
2994 0 N1
2995 0 CTRI
2996 0 N1
2997 0 CTRI
2998 0 N1
2999 0 CTRI

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0076 2271 5113 DCA ADD0 /ADDRESS IN U MATRIX
0077 2272 5513 DCA I ADD0 /LOOP ZEROES A OF U MATRIX
0100 2273 2113 ISZ ADD0
0101 2274 2246 ISZ CTRI /LOOP DONE?
0102 2275 5272 JMP ,=3 /NO
0123 2276 1115 TAD N1 /YES, PUT 1S ON DIAGONAL
0124 2277 7041 CIA /SET LOOP
0109 2500 3246 DCA CTRI
0126 2501 6201 CDF 0
0127 2502 7201 CLA IAC
0110 2503 1246 TAD CTRI
0111 2504 1115 TAD N1
0112 2505 3107 DCA TEMP
0113 2506 1107 TAD TEMP
0114 2507 3114 DCA TEMP1
0115 2310 4717 JMS I USUBI /INDICES OF DIAGONAL U ELEMENT
0116 2311 4716 JMS I SETONE /GET ADDRESS OF DIAGONAL ELEMENT
0117 2312 2246 ISZ CTRI /LOOP DONE?
0120 2313 5302 JMP OVERI /NO
0121 2314 6211 CDF 10 /YES
0122 2315 5600 JMP I HUGET /RETURN
0123 2316 1543 SETONE, ONESET
0124 2317 1341 USUBI, USUB
0125 2320 0200 COPY, 0
0126 2321 7200 CLA
0127 2322 1072 TAD UB
0130 2323 3247 DCA ADDR0
0131 2324 1067 TAD BOLD
0132 2325 3072 DCA UB
0133 2326 1247 TAD ADDR0
0134 2327 3067 DCA BOLD
0135 2330 6201 CDF 0
0136 2331 1115 TAD N1
0137 2332 7041 CIA
0140 2333 5246 DCA CTRI /SET LOOP
0141 2334 1070 TAD ENB
0142 2335 5247 DCA ADDR0 /ADDRESS IN EN
0143 2336 7201 AGAINI, CLA IAC
0144 2337 1246 TAD CTRI
0145 2340 1115 TAD N1
0146 2341 3107 DCA TEMP
0147 2342 1107 TAD TEMP
0150 2343 3114 DCA TEMP1 /INDICES OF DIAGONAL H ELEMENT
0151 2344 4703 JMS I HSUBI /ADDRESS OF DIAGONAL H ELEMENT
0152 2345 4407 JMS I INTERP
0153 2346 5513 FGET I ADDR0 /GET H ELEMENT
0154 2347 6647 FPUT I ADDR0 /STORE IT
0155 2550 0000 FEXT
0156 2551 2247 ISZ ADDR0
0157 2552 2247 ISZ ADDR0
0160 2553 2247 ISZ ADDR0
0161 2554 2246 ISZ CTRI /DONE?
0162 2555 5336 JMP AGAINI /NO
0163 2556 7200 CLA
0164 2557 1115 TAD N1
0165 2560 3132 DCA N2 /SET N2=N1
0166 2561 5211 CDF 10
0167 2562 5720 JMP I COPY /RETURN
0170 2563 1273 HSUBI,
0171 2400 *2400 TRANS, 0
0172 0000
0173 6201 CDF 0

```

0175	2403	1067	TAD	BOLD	/ADDRESS OF 1ST ELEMENT IN CURRENT OLD
0176	2404	3336	DCA	IN2ADD	/EIGENVECTOR
0177	2405	1070	TAD	ENB	/ADDRESS OF OLD EIGENVALUE
0200	2406	3121	DCA	B	
0201	2407	1132	TAD	N2	
0202	2410	7041	CIA	FLAGJ1	/SET 1ST ORDER LOOP
0203	2411	3337	DCA	UP	
0204	2412	5224	JMP		
0205	2413	7200	CLA		/INCREMENT ADDRESS IN EN
0206	2414	2121	ISZ	B	
0207	2415	2121	ISZ	B	
0210	2416	2121	ISZ	B	
0211	2417	1132	TAD	N2	
0212	2420	1132	TAD	N2	
0213	2421	1132	TAD	N2	
0214	2422	1336	TAD	IN2ADD	/INCREMENT IN2 ADD
0215	2423	3336	DCA	IN2ADD	
0216	2424	1072	TAD	UB	
0217	2425	3340	DCA	IN1ADD	/ADDRESS OF 1ST ELEMENT IN CURRENT
0220	2426	1115	TAD	N1	/NEW EIGENVECTOR
0221	2427	7041	CIA	FLAGJ2	/SET 2ND ORDER LOOP
0222	2430	3341	DCA	,+7	
0223	2431	5240	JMP		
0224	2432	7200	CLA		
0225	2433	1115	TAD	N1	
0226	2434	1115	TAD	N1	
0227	2435	1115	TAD	N1	
0230	2436	1340	TAD	IN1ADD	
0231	2437	3340	DCA	IN1ADD	/INCREMENT IN1ADD
0232	2440	7001	IAC		
0233	2441	1341	TAD	FLAGJ2	
0234	2442	1115	TAD	N1	
0235	2443	5107	DCA	TEMP	
0236	2444	1107	TAD	TEMP	
0237	2445	5114	DCA	TEMP1	/SET SUBSCRIPTS FOR NEW EIGENVALUE
0240	2446	3116	DCA	A	
0241	2447	5117	DCA	A+1	
0242	2450	3120	DCA	A+2	/INITIALIZE TRANSITION PROBABILITY
0243	2451	1336	TAD	IN2ADD	
0244	2452	3342	DCA	N2ADD	/ADDRESS IN OLD EIGENVECTOR
0245	2453	7040	CMA		
0246	2454	3343	DCA	CTR	/INITIALIZE CTR
0247	2455	7040	CMA		
0250	2456	1024	TAD	TABLE	
0251	2457	3344	DCA	TABAD	/ADDRESS OF CHECK WORD
0252	2460	1132	TAD	N2	
0253	2461	7041	CIA	FLAGJ3	/SET 3RD ORDER LOOP
0254	2462	3345	DCA	CALC1	/CALCULATE TRANSITION ENERGY
0255	2463	4746	JMS	I	
0256	2464	7200	CLA		
0257	2465	1340	TAD	IN1ADD	
0258	2466	3347	DCA	IN1ADD	/ADDRESS IN NEW EIGENVECTOR
0261	2467	1115	TAD	N1	
0262	2470	7041	CIA	FLAGJ4	/SET 4TH ORDER LOOP
0263	2471	3350	DCA		
0264	2472	7200	CLA		
0265	2473	2343	ISZ	CTR	/NEED A NEW CHECK WORD?
0266	2474	5302	JMP	+6	/NO, GO ON
0267	2475	2344	ISZ	TABAD	/YES, INCREMENT ADDRESS
0270	2476	1351	TAD	M12	
0271	2477	3343	DCA	CTR	/REINITIALIZE CTR
0272	2480	1744	TAD	TABAD	
0273	2481	3344	DCA		

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0274 2502 1352 TAD /GET CHECK WORD
0275 2503 7210 RAR /PUT CURRENT BY INTO LINK
0276 2504 3352 DCA /STORE BALANCE
0277 2505 7420 SNL /ALLOWED TRANSITION?
0300 2506 5315 JMP .+7 /NO, SKIP CALCULATION
0301 2507 4407 JMS I INTER /YES, CALCULATE PROBABILITY
0302 2510 5742 FGET I N2ADD
0303 2511 5747 FMPY I N1ADD
0304 2512 1116 FPUT A
0305 2513 6116 FEXT A
0306 2514 0000
0307 2515 2347 ISZ N1ADD
0310 2516 2347 ISZ N1ADD
0311 2517 2347 ISZ N1ADD
0312 2520 2350 ISZ FLAGJ4
0313 2521 5272 JMP RPT4
0314 2522 2342 ISZ N2ADD
0315 2523 2342 ISZ N2ADD
0316 2524 2342 ISZ N2ADD
0317 2525 2345 ISZ N2ADD
0320 2526 5264 JMP FLAGJ3
0321 2527 4753 JMS I CALC2 /INCREMENT NEW EIGENFUNCTION
0322 2530 2341 ISZ FLAGJ2 /4TH ORDER LOOP DONE?
0323 2531 5232 JMP RPT2 /NO, CONTINUE
0325 2532 2337 ISZ FLAGJ1 /YES, COMPUTE TOTAL PROBABILITY
0326 2533 5213 JMP RPT1 /2ND ORDER LOOP DONE?
0327 2534 6211 CDF 10 /1ST ORDER LOOP DONE?
0328 2535 5600 JMP I TRANS /NO, CONTINUE
0329 2536 0000 /YES
0330 2537 0000 /RETURN
0331 2537 0000 IN2ADD, 0
0332 2540 0000 FLAGJ1, 0
0333 2541 0000 IN1ADD, 0
0334 2542 0000 FLAGJ2, 0
0335 2543 0000 N2ADD, 0
0336 2544 0000 CTR, 0
0337 2545 0000 TABAD, 0
0340 2546 3000 FLAGJ3, 0
0341 2547 0000 CALC1, CALCM1
0342 2550 0000 N1ADD, 0
0343 2551 7764 FLAGJ4, 0
0344 2552 0000 M12, =14
0345 2553 5042 CHECK, 0
0346 2554 0000 CALC2, CALCM2
0347 2555 4765 ARRLD, 0
0348 2556 1044 JMS I CHKEND /CHECK FOR END OF TAPE BUFFER
0349 2557 5411 EXP
0350 2560 1045 TAD OCA I 11
0351 2561 5411 DCA I 11 HORD
0352 2562 1046 DCA I 11 LORD
0353 2563 3411 TAD DCA I 11
0354 2564 5754 JMP I ARRLD
0355 2565 1161 CHKEND, ENDCBK
0356 2600 6036 #2600 /GET A CHARACTER
0357 2601 4032 INTRUP, KRB
0358 2602 7041 JMS TYPE
0359 2603 5127 DCA TEMP
0360 2604 5114 DCA TEMP1
0361 2605 1244 TAD CHTB
0362 2606 5010 DCA 10
0363 2607 4025 JMS READ
0364 2610 4032 JMS TYPE
0365 2611 4032 JMS TYPE

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0476	CALL	WRITE	/TYPE LEFT 6 BITS
0475	JMS	WRITE	
0474	CLA	JUMP	
0473	TAD I	JUMP	
0472	ISZ	JUMP	
0471	JMS	WRITE	/TYPE RIGHT 6 BITS
0470	JMP	AGAINL	
0469	0		
0468	AND	MASK1	/MASK OUT LEFT 6 BITS
0467	SNA	EXITT	/EITHER HALF =0?
0466	JMP	M36	/YES, EXIT
0465	TAD		/NO
0464	SPA SNA		/200 OR 300 SERIES?
0463	JMP	.*4	/300 SERIES
0462	TAD	P236	/200 SERIES
0461	JMS	TYPE	/TYPE IT
0460	JMP I	WRITE	
0459	SZA		/SPECIAL CODE 36?
0458	JMS	.*3	/NO
0457	JMP	CRLFD	
0456	JMP I	WRITE	
0455	TAD	P336	
0454	JMS	TYPE	/TYPE IT
0453	JMP I	WRITE	
0452	CDF 10		
0451	JMP I	PRINTL	
0450	0		
0449	=36		
0448	336		
0447	336		
0446	0077		
0445	TEXT3=.		/TEXT3 LOADS
0444	*3000		
0443	0		
0442	JMS I	HSUBM	/GET ADDRESS OF OLD EIGENVALUE
0441	JMS I	INTERP	
0440	FCGT I	B	
0439	FSUB I	ADD0	/EN=HII
0438	FEXT		
0437	JMS I	LOARR	/LOAD ARRAY W/ -CHEMICAL SHIFT
0436	JMS I	INTERP	
0435	FADD	LIMIT	/LIMIT -CHEMICAL SHIFT
0434	FMPY	FACTOR	
0433	FADD	HALFM	/SET TO FIX AND ROUND
0432	FEXT		
0431	JMS	FIX	/FIX IT
0430	SPA		/IN RIGHT RANGE?
0429	JMP	AHEAD	/NO, TOO SMALL
0428	TAD	M500M	/MAYBE
0427	SMA		/IN RIGHT RANGE?
0426	JMP	AHEAD	/NO, TOO BIG
0425	TAD	P500M	/YES
0424	TAD	SPECB	
0423	DCA	ADSPEC	/ADDRESS FOR STORING PROBABILITY
0422	JMP I	CALCM1	
0421	CLA CLL		
0420	TAD	M500M	
0419	DCA	ADSPEC	
0418	JMP I	CALCM1	
0417	ARRLD		
0416	HSUBM		
0415	0		
0414	HALFM		
0413	2000		
0412	2000		
0411	4633		
0410	4407		
0409	521		
0408	2513		
0407	0000		
0406	4632		
0405	4407		
0404	1110		
0403	5134		
0402	1234		
0401	0000		
0400	4327		
0399	7510		
0398	5226		
0397	1237		
0396	7500		
0395	5226		
0394	1240		
0393	1071		
0392	5241		
0391	5600		
0390	7300		
0389	1237		
0388	5241		
0387	5600		
0386	7300		
0385	1237		
0384	5241		
0383	5600		
0382	2554		
0381	1273		
0380	0000		
0379	2000		

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0571 3036 0000
0572 3037 7014 M500M,
0573 3040 0764 P5000M,
0574 3041 0000 ADSPEC, 0
0575 3042 0000 CALCM2, 0
0576 3043 6211 CDF 10
0577 3044 7200 CLA
0600 3045 1641 TAD I ADSPEC
0601 3046 0305 AND MASKM /ERASE CALIBRATION MARK
0602 3047 3024 DCA SIGN /STORE
0603 3050 4407 JMS I INTERP
0604 3051 5116 FGET A /SQUARE TO GET PROBABILITY
0605 3052 3116 FMPY A /SCREEN OUT LOW INTENSITIES
0606 3053 0000 FEXT
0607 3054 1306 TAD PL6
0610 3055 1044 TAD EXP
0611 3056 3044 DCA EXP
0612 3057 4632 JMS I LDARR
0613 3060 4327 JMS FIX /FIX
0614 3061 3303 DCA PROB /STORE CURRENT PROBABILITY
0615 3062 1241 TAD ADSPEC
0616 3063 7710 SPA CLA
0617 3064 5642 JMP I CALCM2
0620 3065 6211 CDF 10
0621 3066 1303 TAD PROB
0622 3067 1304 TAD SIGN
0623 3070 7700 SMA CLA
0624 3071 5276 JMP ,+5 /NOT TOO BIG
0625 3072 1641 TAD I ADSPEC /TOO BIG, SET TO MAX
0626 3073 7004 RAL
0627 3074 7250 STA RAR
0630 3075 5300 JMP ,+3
0631 3076 1641 TAD I ADSPEC /GET OLD SPEC ELEMENT
0632 3077 1303 TAD PROB /INCREMENT IT
0633 3100 3641 DCA I ADSPEC /STORE IT
0634 3101 6201 CDF 0
0635 3102 5642 JMP I CALCM2 /RETURN
0636 3103 0000 PROB,
0637 3124 0000 SIGN,
0640 3105 3777 MASKM,
0641 3106 0026 PL6,
0642 3107 0000 SETUP,
0643 3110 3325 DCA HOLD
0644 3111 1325 TAD HOLD
0645 3112 7012 RTR
0646 3113 7012 RTR
0647 3114 7012 RTR
0650 3115 0326 AND BLIND /MASK OUT BITS 0-5
0651 3116 4423 JMS I HPUN /PUNCH FIRST 6 BITS
0652 3117 7200 CLA
0653 3120 1325 TAD HOLD
0654 3121 0326 AND BLIND /PUNCH LST 6 BITS
0655 3122 4423 JMS I HPUN
0656 3123 7200 CLA
0657 3124 5707 JMP I SETUP /RETURN
0660 3125 0000 HOLD,
0661 3126 0377 BLIND,
0662 3127 0000 FIX,
0663 3150 7200 CLA
0664 3151 1044 TAD EXP
0665 3152 7540 SMA SZA
0666 3153 5336 JMP ,+3

```

/SUBROUTINE INCREMENTS PROPER ELEMENT  
/IN SPEC ARRAY

/ERASE CALIBRATION MARK  
/STORE

/SQUARE TO GET PROBABILITY

/SCREEN OUT LOW INTENSITIES

/FIX  
/STORE CURRENT PROBABILITY

/GET - AC IF SUM IS TOO BIG

/NOT TOO BIG  
/TOO BIG, SET TO MAX

/GET OLD SPEC ELEMENT  
/INCREMENT IT  
/STORE IT

/RETURN

HOLD  
HOLD

BLIND  
HPUN

HOLD  
BLIND  
HPUN

SETUP  
RETURN

ROUTINE FIXES A F, P.

EXP  
SZA  
JMP ,+3

IS <1  
NO GO ON

```

0671 0671 JMP I PIA /RETURN
0672 0672 TAD M11 /IS HORD ALREADY RIGHT?
0673 0673 SZA +3 /NO
0674 0674 TAD HORD /YES, GET HORD
0675 0675 JMP I FIX /RETURN
0676 0676 SMA /IS TOO BIG TO FIX?
0677 0677 JMP /YES, SET TO 3777
0678 0678 DCA HOLD /NO, SET FIXING LOOP
0679 0679 TAD HORD /ROTATE RIGHT FILLING WITH 1S IF NEG
0680 0680 CLL /FOR OS IF POS
0681 0681 SPA /LOOP DONE?
0682 0682 STL /NO
0683 0683 RAR /YES RETURN
0684 0684 ISZ *5
0685 0685 JMP /FIX
0686 0686 JMP I MASKM
0687 0687 TAD /FIX
0688 0688 TAD M11
0689 0689 *3200
0690 0690 JMS I PRINT /MIN INTENSITY=
0691 0691 HD10
0692 0692 JMS I INPUT
0693 0693 JMS I INTERP
0694 0694 FPUT A
0695 0695 FEXT
0696 0696 JMS I PRINT /DISPLAY LISTING?
0697 0697 HD9
0698 0698 JMS I ASKRX
0699 0699 SNA CLA
0700 0700 JMP I DSLST /YES
0701 0701 JMS I STRIP /INIT, TAPE READ
0702 0702 JMS I PRINT /INTENSITY ENERGY
0703 0703 HD11
0704 0704 CDF 0
0705 0705 JMS LODFAC
0706 0706 SKP /NORMAL RETURN
0707 0707 JMP I DISPLAY /FOUND TERMINATOR
0708 0708 JMS I INTERP
0709 0709 NEGATE
0710 0710 FPUT FSIN
0711 0711 FEXT
0712 0712 JMS LODFAC /GET CORRESPONDING INTENSITY
0713 0713 JMS SKP /GOT HERE ONLY BY BAD FILE!
0714 0714 HLT
0715 0715 JMP EIPRNT
0716 0716 JMS BACK
0717 0717 HD11
0718 0718 JMS I AREND
0719 0719 SPA CLA
0720 0720 JMP I LDCHK /NEED NEW BUFFER LOAD?
0721 0721 TAD /NO
0722 0722 DCA CORBUF /YES
0723 0723 JMS I
0724 0724 IAC
0725 0725 JMS I TAPTRN
0726 0726 TAD /LDCHK
0727 0727 JMS I LDCHK
0728 0728 *3250
0729 0729 LODFAC. 0

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0767 JMS LDCHK
0770 TAD I 11
0771 DCA EXP
0772 STL RTR
0773 TAD EXP
0774 SNA CLA /GET 6000, I.E., END WORD?
0775 ISZ LODFAC /YES, INCR, RETURN
0776 TAD I 11
0777 DCA HORD
1000 TAD I 11
1001 DCA LORD
1002 JMP I LODFAC
1003 EIPRNT,
1004 JMS I INTERP
1005 FPUT FCOS
1006 FSUB A
1007 FEXT
1010 TAD HORD
1011 SPA CLA /INTENSITY TOO SMALL?
1012 JMP I EIPRNT /YES, GET NEXT VALUES
1013 JMS I INTERP /NO, OUTPUT
1014 FGET FCOS
1015 FEXT
1019 CLL IAC RAL /OUTPUT INTENSITY
1020 JMS I OUTPUT
1021 TAD SPACE
1022 JMS TYPE
1023 JMS TYPE
1024 JMS I INTERP /OUTPUT CHEM SHIFT
1025 FGET FSIN
1026 FEXT
1028 IAC CLL RAL
1029 JMS I OUTPUT /OUTPUT CHEM SHIFT
1030 JMS I CARLF
1031 JMP I EIPRNT
1032 CARLF,
1033 ASKN,
1034 SPACE,
1035 STRTP,
1036 CLA
1037 TAD CORBUF
1040 OCA 11
1041 TAD STBLK
1042 DCA BLK1
1043 JMS I TAPTRN /READ FIRST BLOCK
1044 JMP I STRTP
1045 JMS STRTP
1047 CDF 0
1050 JMS LEDR
1051 TAD KK300
1052 JMS I HPUN
1053 JMS LDCHK
1054 TAD I 11
1055 OCA TTT
1056 STL RTR TTT
1057 TAD TTT
1060 SNA CLA /GET 6000 FOR END?
1061 JMP PEX /YES
1062 TAD TTT
1063 JMS I BPUN
1064 TAD I 11
1065 JMS I 11

```

1000	3520	1411	TAD I	11	
1067	3551	4757	JMS I	BPUN	
1070	3322	5335	JMP	PNOUT	
1071	3355	1361	TAD	KK200	
1072	3354	4423	JMS I	HPUN	
1073	3355	4564	JMS	LEDR	
1074	3356	5475	JMP I	DISPLAY	
1075	3357	3107	SETUP		
1076	3360	7700	LCT,	-100	
1077	3361	2400	KK200,	200	
1100	3362	0500	KK300,	300	
1101	3363	0000	TTT,	0	
1102	3364	0000	LEDR,	0	
1103	3365	7200	CLA		
1104	3366	1360	TAD	LCT	
1105	3367	3563	DCA	TTT	
1106	3370	4423	JMS I	HPUN	
1107	3371	2363	ISZ	TTT	
1110	3372	5370	JMP	*2	
1111	3373	5764	JMP I	LEDR	
1112			*3400		
1113	3400	0000	INITB,		
1114	3401	7200	CLA		
1115	3402	6211	COF 10		
1116	3403	1106	TAD	N	
1117	3404	7041	CIA		
1120	3405	3334	DCA	FLAGB	
1121	3406	7201	CLA	IAC	
1122	3407	7104	CLL	RAL	
1123	3410	2334	ISZ	FLAGB	
1124	3411	5207	JMP	*2	
1125	3412	5536	DCA	NTOT	
1126	3413	1063	TAD	IFZB	
1127	3414	3333	DCA	ADDRB	
1130	3415	7001	IAC		
1131	3416	3733	DCA I	ADDRB	
1132	3417	2333	ISZ	ADDRB	
1133	3420	7105	CLL	IAC	
1134	3421	3733	DCA I	ADDRB	
1135	3422	2333	ISZ	ADDRB	
1136	3423	7105	CLL	IAC	
1137	3424	1106	TAD	N	
1140	3425	3733	DCA I	ADDRB	
1141	3426	2333	ISZ	ADDRB	
1142	3427	7346	CLL	STA	
1143	3430	1106	TAD	RTL	
1144	3431	7510	SPA	N	
1145	3432	5267	JMP	CONT3	
1146	3433	7550	SPA	SNA	
1147	3434	5264	JMP	CONT4	
1148	3435	7041	CIA		
1151	3436	7001	IAC		
1152	3437	7001	IAC		
1153	3440	7540	SMA	SZA	
1154	3441	2256	JMP	CONT2	
1155	3442	7650	SNA	CLA	
1156	3443	2253	JMP	CONT1	
1157	3444	1340	TAD	P23	
1160	3445	3733	DCA I	ADDRB	
1161	3446	2333	ISZ	ADDRB	
1162	3447	1341	TAD	P43	
1163	3450	3733	DCA I	ADDRB	
1164	3451	2333	ISZ	ADDRB	

/GET OF BASIC PRODUCT FUNCTIONS

/INITIALIZE NARRAY

/FIRST 3 INITIALIZED

/N-3 IN AC

/DONE INITIALIZING

/JUST ONE TO CALCULATE

/3-N IN AC

/5-N IN AC

/JUST TWO TO CALCULATE

/3 TO CALCULATE

/4 TO GO

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1165 3452 JMP CONT2 /FOR N#6, 4 & 5 DONE
1166 3453 TAD P17
1167 3454 DCA I ADDR8
1170 3455 ISZ ADDR8 /FOR N#5, 4 DONE
1171 3456 CLA CONT2, N
1172 3457 TAD
1173 3460 CIA
1174 3461 TAD NTOT
1175 3462 DCA I ADDR8 /2ND LAST ELEMENT=NTOT-N
1176 3463 ISZ ADDR8
1177 3464 CLA CONT4, /CALCULATE FINAL ELEMENT
1200 3465 TAD NTOT
1201 3466 DCA I ADDR8 /INITIALIZE NUSE
1202 3467 CLA CONT3, /-NTOT IN FLAGB
1204 3471 CIA
1205 3472 DCA RPTB1, /-NTOT IN FLAGB
1206 3473 CLA
1207 3474 DCA CTRB
1210 3475 TAD N
1211 3476 CIA INDEX /-N IN INDEX
1212 3477 DCA
1213 3500 IAC FLAGB /BPF TO BE TESTED IN AC
1214 3501 TAD RAR /EXAMINE BIT BY BIT
1215 3502 CIA
1216 3503 GLL
1217 3504 RAR
1220 3505 SZL
1221 3506 ISZ
1222 3507 ISZ
1223 3510 JMP RPTB2 /INCREMENT CTRB ON NON-ZERO LINK
1224 3511 CLA /DONE WITH THIS BPF?
1225 3512 TAD /NO: ROTATE AGAIN
1226 3513 TAD CTRB /YES: PUT IN PROPER IN NUSE ARRAY
1227 3514 DCA IFZB
1230 3515 TAD ADDR8
1231 3516 DCA TEMP /TEMP CONTAINS REL. ADDRESS
1232 3517 ISZ I ADDR8 /INCREMENT NARRAY ELEMENT
1233 3520 STA
1234 3521 TAD TEMP
1235 3522 TAD NUSEB
1236 3523 DCA ADDR8 /ADDR8 CONTAINS LOCATION IN NUSE
1237 3524 IAC FLAGB
1240 3525 TAD
1241 3526 CIA /VALUE IN NUSE
1242 3527 DCA I ADDR8 /DONE?
1243 3530 ISZ FLAGB
1244 3531 JMP RPTB1 /NO: GET NEXT NUMBER
1245 3532 JMP I /YES: RETURN
1246 3533 ADDR8, 0
1247 3534 FLAGB, 0
1250 3535 INDEX, 0
1251 3536 NTOT, 0
1252 3537 P17, 21
1253 3540 P23, 27
1254 3541 P43, 53
1255 3542 CTRB, 0
1256 3543 MLPY2, 0
1257 3544 EXP
1260 3545 MLPY2
1261 3546 JMP I
1262 3547 DIVD2, 0
1263 3548

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1264 TAD EXP 1044
1265 DCA EXP 3044
1266 JMP I DIV02 5747
1267 0 ULIMP, 0000
1270 JMS I PRINT /SWEEP OFFSET AND WIDTH: 4474
1271 HD7 3554
1272 JMS I INPUT 3555
1273 JMS I INTERP 4405
1274 FPUT OFSET 4407
1275 FPUT LIMIT 6137
1276 FLOIN 3562
1277 FPUT 0006 6110
1278 FADD 3564
1279 FPUT LIMIT 1110 6134
1280 FPUT LIMIT 3565
1281 FGET P500 6110
1282 FDIV 3567
1283 FPUT FACTOR 4134
1284 FEFT 3571
1285 CDF 10 0000 6134
1286 JMP I ULIMP 3573
1287 0011 6211
1288 3720 5754
1289 0000 P500, 0011
1290 /NMR DISPLAY ROUTINE PART A 3720
1291 *3600
1292 STDIS, 0000
1293 JMS INITK 7200
1294 TAD I YK 6211
1295 AND K3777 4526
1296 SNA 3603
1297 DCA HOLDK 1741
1298 ISZ YK 0334
1299 ISZ XCTRK 7450
1300 JMP *+2 5237
1301 TAD I YK 3607
1302 AND K3777 5344
1303 SNA 3610
1304 JMP NINCR 2541
1305 TAD I YK 3611
1306 AND K4000 2342
1307 DCA HOLDK 5214
1308 ISZ XCTRK 2242
1309 JMP *+2 1741
1310 TAD I YK 3613
1311 AND K3777 0334
1312 SNA 3615
1313 JMP NINCR 7450
1314 TAD I YK 3616
1315 AND K4000 5237
1316 DCA HOLDK 1344
1317 ISZ XCTRK 0334
1318 JMP *+2 3544
1319 TAD I YK 3621
1320 AND K3777 1741
1321 DCA HOLDK 0335
1322 TAD I YK 3622
1323 AND K4000 1741
1324 DCA I YK 3624
1325 CMA 3625
1326 TAD I YK 3626
1327 DCA I YK 5741
1328 TAD I YK 3627
1329 DCA I YK 7040
1330 TAD I YK 3630
1331 DCA I YK 1541
1332 TAD I YK 3631
1333 AND K4000 5541
1334 DCA I YK 3632
1335 DCA I YK 1741
1336 ISZ YK 0335
1337 ISZ YK 3633
1338 JMP NEXTK 3634
1339 ISZ YK 5741
1340 ISZ YK 2541
1341 JMP NEXTK 3635
1342 ISZ YK 5203
1343 ISZ YK 2341
1344 JMP NEXTK 3637
1345 ISZ YK 2342
1346 JMP NEXTK 3641
1347 JMS INITK 4526
1348 TAD I YK 3643
1349 AND K3777 1741
1350 /ROUTINE TO FIND LARGEST ELEMENT 3644
1351 /IN ARRAY 0334
1352 /ROUTINE TO COMBINE ADJACENT
1353 /ELEMENTS IN THE SPECB ARRAY
1354 /CHECK FOR NON-ZERO ELEMENT
1355 /GET NEXT ELEMENT
1356 /COMBINE ELEMENTS
1357 /SAVE CALIBRATION MARK
1358 /ERASE PREVIOUS ELEMENT
1359 /GO ON TO NEXT ELEMENT
1360 /ROUTINE TO FIND LARGEST ELEMENT
1361 /IN ARRAY

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1360 3690 DCA
1364 3647 NEXTKV, ISZ
1365 3650 XCTRK
1366 3651 ,*2
1367 3652 JMP ROTATE
1370 3655 TAD, I
1371 3654 AND
1372 3655 TAD
1373 3656 SPA CLA
1374 3657 JMP
1375 3660 JMP
1376 3661 ROTATE, JMS
1377 3662 DCA
1400 3663 TAD
1401 3664 CIA
1402 3665 DCA
1403 3666 TAD
1404 3667 AND
1405 3670 SNA CLA
1406 3671 JMP
1407 3672 TAD
1410 3673 AND
1411 3674 RAR
1412 3675 DCA
1413 3676 ISZ
1414 3677 JMP
1415 3700 OK,
1416 3701 TAD
1417 3702 SNA
1420 3703 JMP I
1421 3704 CIA
1422 3705 DCA
1423 3706 TAD
1424 3707 DCA
1425 3710 TAD I
1426 3711 RAR
1427 3712 AND
1430 3713 ISZ
1431 3714 JMP
1432 3715 DCA
1433 3716 TAD I
1434 3717 AND
1435 3720 TAD
1436 3721 DCA I
1437 3722 ISZ
1440 3723 ISZ
1441 3724 JMP
1442 3725 JMP I
1443 3726 INITK,
1444 3727
1445 3730 DCA
1446 3731 TAD
1447 3732 DCA
1450 3733 JMP I
1451 3734 INITK
1452 3735 K3777,
1453 3736 K4000,
1454 3737 K3400,
1455 3737 ARRLIK, =764
1456 3741 HGT,
1457 3741 YK,
1460 3743 XCTRK,
1461 3744 FLAG,

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/ROUTINE TO CHECK FOR OVERSIZED
/ELEMENT AND COMPUTE NUMBER OF
/ROTATIONS REQUIRED TO PREVENT
/DISPLAY BUFFER OVERFLOW

```

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/ROTATE ALL ELEMENTS IN ARRAY
/ANY ROTATIONS NEEDED?
/NO, EXIT TO DISPLAY

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/SAVE CALIBRATION MARK

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/NUMBER OF ELEMENTS IN ARRAY

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```

1462 FLGR, 0000
1463 XSTART, 4001
1464 TEXT1=,
1465 *4000
1466 /NMR DISPLAY ROUTINE PART B
1467 X,
1470 START, CDF 10
1471 4001 6211 KSF
1472 4002 6031 SKP CLA
1473 4003 7610 JMP I
1474 4004 5702 DCA
1475 4005 3200 X
1476 4006 1071 TAD
1477 4007 3300 DCA
1478 4010 5220 JMP
1479 /THE FOLLOWING 7 WORD KLUDGE BOOTSTRAPS DIAL INTO CORE:
1500 DIAL, LINC
1501 6141
1502 LMODE
1503 1020
1504 0013 0020
1505 0014 0004
1506 0015 0643
1507 0016 0701
1508 0017 7300
1509 PMODE
1510 TAD
1511 ARR LIM
1512 4020 1273 DCA
1513 4021 3277 XCTR
1514 4022 1700 TAD I
1515 4023 7440 YP
1516 4024 5233 SZA
1517 4025 1274 JMP
1518 4026 6141 TAD
1519 LINC
1520 AFMRK=2
1521 M377
1522 DIS 0
1523 PDP
1524 PMODE
1525 CLA
1526 JMP
1527 4032 5252
1528 4033 7510 SPA
1529 4034 5257 JMP
1530 4035 7041 CIA
1531 4036 3301 AFMRK,
1532 4037 1274 DCA
1533 4038 1274 TAD
1534 4040 1276 RPY,
1535 4041 6141 TAD
1536 LINC
1537 0042 0140 LMODE
1538 0043 0002 PDP
1539 PMODE
1540 ISZ
1541 4044 2301
1542 4045 5240 JMP
1543 4046 7604 LAS
1544 4047 0275 AND
1545 4050 7001 IAC
1546 4051 3276 DCA
1547 4052 2200 INCR,
1548 4053 2300 ISZ
1549 4054 2277 ISZ
1550 4055 5222 JMP
1551 4056 5202 JMP
1552 4057 7346 MRKR,
1553 4060 1274 CLL STA
1554 4061 6141 TAD
1555 LINC
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1561	0002	0140	DIS 0	
1562	0063	0002	PDP	
1563			PMODE	
1564	4064	7200	CLA	
1565	4065	1700	TAD I	YP
1566	4066	0272	AND	K3777P
1567	4067	7450	SNA	
1570	4070	5252	JMP	INCR
1571	4071	0235	JMP	AFMRK
1572	4072	3777	K3777P,	
1573	4073	7014	ARRLIM,	
1574	4074	7404	M377,	
1575	4075	0007	KK7,	
1576	4076	0000	INKY,	
1577	4077	0000	XCTR,	
1600	4100	0000	YP,	
1601	4101	0000	HGTP,	
1602	4102	2600	INTRUP	
1603	4103	0000	LNCTAP,	
1604	4104	7640	SZA CLA	
1605	4105	1342	TAD	CRDC
1606	4106	1343	TAD	CWRC
1607	4107	5332	DCA	RWTI
1610	4110	1101	TAD	BLK1
1611	4111	5333	DCA	RWTI+1
1612	4112	2101	ISZ	BLK1
1613	4113	1077	TAD	UNIT
1614	4114	7110	CLL RAR	
1615	4115	1344	TAD	CXOB
1616	4116	5332	DCA	XOBL
1617	4117	7026	RTL	
1620	4120	7026	RTL	
1621	4121	1332	TAD	RWTI
1622	4122	5332	DCA	RWTI
1623	4123	7001	IAC	
1624	4124	1104	TAD	CORBUF
1625	4125	6141	LINC	
1626			LMODE	
1627	0126	0023	23	/TMA
1630	0127	1020	1020	/LDA I 0
1631	0130	0020	XOBL,	
1632	0131	0001	1	/AXO
1633	0132	0000	RWTI,	
1634	0133	0000	2	
1635	0134	0003	3	/TAC
1636	0135	0002	PDP	
1637			PMODE	
1640	4136	7001	IAC	
1641	4137	7440	SZA	
1642	4140	7402	HLT	
1643	4141	5703	JMP I	LNCTAP
1644	4142	7774	CRDC,	
1645	4143	0704	CWRC,	
1646	4144	0020	CXOB,	
1647			*4200	
1650	4200	0000	OCTIN,	
1651	4201	7200	CLA	VALU
1652	4202	3243	DCA	READ
1653	4203	4025	JMS	TYPE
1654	4204	4032	JMS	CHAR
1655	4205	3245	DCA	LSCHR
1656	4206	1245	TAD	LSCHR

/GENERAL LINC TAPE I/O SUBR,  
/IF AC=0, WRITE; IF NOT, READ

/TRANSFER OK?  
/NO!!

/OCTAL INPUT ROUTINE  
/ANY NON OCTAL CHAR TERMINATES  
/GET A CHARACTER

2052 4445 2005  
2052 4446 2240  
2052 4447 2401  
2052 4450 2005  
2052 4451 4011  
2052 4452 5717  
2052 4453 7700

IHD1, TEXT \^\*WANT PAPER TAPE I/0? \

2052 4454 2701  
2053 4455 1624  
2053 4456 4010  
2053 4457 1107  
2053 4460 1040  
2053 4461 2320  
2053 4462 0505  
2053 4463 0440  
2053 4464 2205  
2053 4465 0104  
2053 4466 0522  
2053 4467 5520  
2053 4470 2516  
2053 4471 0310  
2053 4472 7700

IHD2, TEXT /WANT HIGH SPEED READER=PUNCH?/  
\*TEXT1

2054  
2055 3747 3616  
2055 3750 1522  
2055 3751 2311  
2055 3752 1536  
2055 3753 3603  
2055 3754 1715  
2055 3755 1505  
2055 3756 1624  
2055 3757 2372  
2055 3760 4000

HD1, TEXT /+NMRSIM+COMMENTS: /

2056 3761 1517  
2056 3762 2205  
2056 3763 7700

HD3, TEXT /MORE?/

2056 3764 1617  
2057 3765 5640  
2057 3766 1706  
2057 3767 4023  
2057 3770 2011  
2057 3771 1623  
2057 3772 7540  
2057 3773 4000

HD2, TEXT /NO. OF SPINS= /  
\*TEXT2

2060 1736 0214  
2061 1737 1703  
2061 1740 1554  
2061 1741 4025  
2061 1742 7240  
2061 1743 4000

HD4, TEXT /BLOCK, U: /

2061 1744 0310  
2062 1745 0515  
2062 1746 1103  
2062 1747 0114  
2062 1750 4023

2002	1754	4000	HD5,	TEXT /CHEMICAL SHIFTS: /
2062	1753	2372		
2062	1754	4000		
2062	1755	0317		
2063	1756	2520		
2063	1757	1411		
2063	1760	1607		
2063	1761	4003		
2063	1762	1716		
2063	1763	2324		
2063	1764	0116		
2063	1765	2423		
2063	1766	7240		
2063	1767	4000		
2063	1770	2401	HD6,	TEXT /COUPLING CONSTANTS: /
2064	1771	2005		
2064	1772	4011		
2064	1773	1620		
2064	1774	2524		
2064	1775	7700		
2064	1775	7700		
2065			HD8,	TEXT /TAPE INPUT?/ *TEXT3
2066	2750	1706		
2066	2751	0623		
2066	2752	0524		
2066	2753	4046		
2066	2754	4027		
2066	2755	1104		
2066	2756	2410		
2066	2757	7200		
2066	2760	0411	HD7,	TEXT /OFFSET & WIDTH: /
2067	2761	2320		
2067	2762	1401		
2067	2763	3140		
2067	2764	1411		
2067	2765	2324		
2067	2766	7700		
2067	2767	1511	HD9,	TEXT /DISPLAY LIST? /
2070	2770	1656		
2070	2771	4011		
2070	2772	1624		
2070	2773	0516		
2070	2774	2311		
2070	2775	2431		
2070	2776	7200		
2070	2776	7200	HD10,	TEXT /MIN. INTENSITY: / *TEXT4
2071	1557	3640		
2072	1560	4011		
2072	1561	1624		
2072	1562	0516		
2072	1563	2311		
2072	1564	2431		
2072	1565	4040		
2072	1566	4040		
2072	1567	4005		
2072	1570	1605		
2072	1571	2207		
2072	1572	3140		

2072	2073	3800	HD11, TEXT /* INTENSITY ENERGY /*	ROUTINE SETS DF=1 FOR GETTING
2072	0142	0000	INDIR, 0	/ROUTINE SETS DF=1 FOR GETTING
2073	0143	3550	DCA I LOC	/DATA ON INDIRECT INSTRUCTIONS
2074	2144	6211	DF, CDF 10	/JMS TO THIS ROUTINE FROM 5626
2075	0145	1144	TAD DF	
2076	0146	3157	DCA CONTPR	
2077	0147	5542	JMP I INDIR	
2100	0150	5656	JMP I 5656	
2101	0151	0000	RESET, 0	/ROUTINE SETS DF=0 AFTER
2102	0152	7006	RTL	/LOADING FAC
2103	0153	6201	CDF 0	
2104	0154	5551	JMP I RESET	
2105	0155	0000	STORE, 0	/ROUTINE SETS DF FOR FPUT
2106	0156	1044	TAD EXP	
2107	0157	0000	CONTPR, 0	
2108	0160	5555	JMP I STORE	
2109	0161	0000	NEXT, 0	
2110	0162	7500	CLA CLL	
2111	0163	6201	CDF 0	/ROUTINE SETS DF=0 BEFORE
2112	0164	5561	JMP I NEXT	/GETTING NEXT INSTRUCTION
2113	0165	1163	TAD NEXT+2	/SETS DF=0 FOR STORAGE
2114	0166	3157	DCA CONTPR	
2115	0167	5570	JMP I ,+1	
2116	0170	5627	5627	
2127	5624	5165	JMP DIR	
2130	5626	4142	JMS INDIR	
2131	5644	4151	JMS RESET	
2132	5705	4155	JMS STORE	
2133	5601	4161	JMS NEXT	
2134	7255	3172	FMPY 172	
2135	0172	0004	0004	
2136	0173	2400	2400	
2137	0174	0000	0000	
2140	7463	3175	FMPY 175	
2141	0175	7775	7775	
2142	0176	3146	3146	
2143	0177	3147	3147	
2144	7327	0240	*7327	
2145	7330	0015	240	
2146	6547	3543	*547	
2147	6550	3547	MLPY2	
2150	6551	6000	DIVD2	
2151	6552	0760	6000	
2152			FPIP	
2153				
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2162				
2163				
2164				
2165				
2166				
2167				

/MODIFIED DECUS 8-44:  
/CHANGES TO FLOATING POINT OUTPUT ROUTINE  
/TO ALLOW OPTIONAL FIXED POINT OUTPUT





2366	5501	1364	TAD TEMPX	/NO,	
2367	5502	7001	IAC		
2370	5503	7710	SPA CLA	/ P > 1 ?	
2371	5504	1360	TAD SPACX	/YES, TAKE SPACE; OTHERWISE 0	
2372	5505	4323	JMS OUTX	/PRINT CHARACTER	
2373	5506	2364	ISZ TEMPX	/P CHARACTERS PRINTED?	
2374	5507	5275	JMP BACKX	/NO	
2375	5510	1362	TAD POINT	/YES,	
2376	5511	4757	JMS I OPUT	/PRINT DECIMAL POINT	
2377	5512	5275	JMP BACKX		
2400	5513	7040	CMA		
2401	5514	1366	TAD PLCE		
2402	5515	3366	DCA PLCE		
2403	5516	5236	JMP RETX		
2404	5517	7200	CLA		
2405	5520	1363	TAD CHX		
2406	5521	4323	JMS OUTX	/PRINT "X"	
2407	5522	5320	JMP ,=2	/AND REPEAT	
2410	5523	0000	0		
2411	5524	4757	JMS I OPUT	/PRINT CHARACTER	
2412	5525	2366	ISZ FCOUNT	/F CHARACTERS PRINTED?	
2413	5526	5723	JMP I OUTX	/NO, RETURN	
2414	5527	5600	JMP I FIXX	/YES, NUMBER FINISHED	
2415	5530	7040	CMA		
2416	5531	1044	TAD 44	/REDUCE E BY 1	
2417	5532	3044	DCA 44		
2420	5533	2365	ISZ SCOUNT	/6 SIG, FIGS, PRINTED?	
2421	5534	5340	JMP ,+4	/NO	
2422	5535	7040	CMA	/YES,	
2423	5536	3365	DCA SCOUNT	/RESET COUNT TO -1	
2424	5537	5305	JMP IN	/AND LEAVE C(IAC) = 0	
2425	5540	1415	TAD I 15	/TAKE NEXT DIGIT FROM BUFFER	
2426	5541	5305	JMP IN		
2427	5542	1354	TAD M6	/SET COUNT TO PRINT	
2430	5543	3366	DCA FCOUNT	/6 DIGITS AFTER DECIMAL POINT	
2431	5544	4757	JMS I OPUT	/PRINT "0"	
2432	5545	1362	TAD POINT		
2433	5546	4757	JMS I OPUT	/PRINT ", "	
2434	5547	2200	ISZ FIXX	/INCREMENT RETURN ADDRESS	
2435	5550	1415	TAD I 15	/TAKE NEXT DIGIT FROM BUFFER	
2436	5551	4323	JMS OUTX	/PRINT IT	
2437	5552	5350	JMP ,=2	/AND REPEAT	
2440	5553	0007	7		
2441	5554	7772	M6,	-6	
2442	5555	7766	M10,	=12	
2443	5556	5566	BUFST,	BUFFER=1	
2444	5557	7352	OPUT,	7352	
2445	5560	7760	SPACX,	240=260	
2446	5561	7771	M7X,	=7	
2447	5562	7776	POINT,	256=260	
2450	5563	0050	CHX,	330=260	
2451	5564	0000	TEMPX,	0	
2452	5565	0020	SCOUNT,	0	
2453	5566	0000	FCOUNT,	0	
2454	5567	0000	BUFFER,	2	
2455			FACE=FCOUNT		
2456			FACE=SCOUNT		
2457			SAVSYM =		



A 0116  
ADDRB 3533

ADDRC 0756  
ADDRC1 0757  
ADDRL 15  
ADDR0 0027  
ADDR2 2247  
ADDR2 2250  
AUD0 0113  
ADD1 2133  
ADD2 2134  
ADSPEC 3041  
AFMRK 4035  
AGAIN 1131  
AGAINI 2336  
AGAINK 3666  
AGAINL 2705  
AHEAD 3026  
ALLOW 2000  
ALLOWO 0322  
ALPHA 0744  
ALPH1 0745  
ALTR 2530  
APROB 0525  
AREND 0103  
ARRLD 2554  
ARYLIK 3737  
ARRLIM 4073  
ASCOUT 7344  
ASK 0313  
ASKI 4440  
ASKM 4315  
ASKMX 0513  
ASKN 3315  
ASKRX 3234  
AULIM 0517  
B 0121  
BACK 3217  
BACKO 0545  
BACKX 5475  
BEGIN 0202  
BEIA 0740  
BETA1 0747  
BEXP 7324  
BERST 7376  
BLIND 3126  
BLK1 0101  
BOLD 0067  
BPF1 2137  
BPF2 2140  
BPACH 3330  
BRUN 3357  
BUFFER 5567  
BUFST 5556  
CALCM1 3000  
CALCM2 3042  
CALC1 2546  
CALC2 2553  
CARLF 3314  
CARLFD 0514  
CARRTN 7341  
CARTN 0310  
CASE1 0750  
CASE2 0663  
CHF 7343

CHECK 2222  
CHKEND 2565  
CHRTB 2646  
CHTB 2644  
CHX 5563  
CKEND 0571  
CLAEL 1147  
CLAJAC 4433  
CONT 1052  
CONTPR 0157  
CONTR0 0732  
CONT1 3453  
CONT2 3456  
CONT3 3467  
CONT4 3464  
COPY 2320  
COPY0 0325  
CORBUF 0104  
CPSB 0065  
CRDC 4142  
CRLF 7223  
CRLFD 2663  
CRTL 4437  
CTR 2543  
CTRB 3542  
CTRDD 1112  
CTRE 1267  
CTRH 2141  
CTRH1 2142  
CTRH3 2152  
CTRI 2246  
CJPB 0266  
CARC 4145  
CX0B 4144  
DATBUF 4337  
DECR 5513  
DF 0144  
DIAGC 0642  
DIAGEL 2251  
DIALEX 4011  
DIFF 1340  
DIG 5550  
DIR 0165  
DIRC 0720  
DIRD 1035  
DISPLA 0075  
DIV02 3547  
DVOM 4313  
DWIN 0467  
DLSL 4246  
DLSLST 3233  
DSPL 2641  
DTEM 4244  
EIPRNT 3265  
EL 1673  
ENB 0070  
ENUCHK 1161  
ENDCOM 3642  
ERROR 3156  
ERRORO 0217  
EXITT 2741  
EXP 0044  
FXPT 7537

FACLU0 0270  
FACTOR 0134  
FADD 100  
FCOS 127  
FCOUNT 5566  
FOIV 4000  
FOIV2 0004  
FEXT 0000  
FGET 5000  
FIX 3127  
FIXA 0523  
FIXM 0312  
FIXX 5400  
FLAGB 3534  
FLAGC 0752  
FLAGC1 0753  
FLAGD 1120  
FLAGE 1365  
FLAGE1 1265  
FLAGG 1664  
FLAGH 2135  
FLAGH1 2136  
FLAGJ1 2537  
FLAGJ2 2541  
FLAGJ3 2545  
FLAGJ4 2550  
FLAGK 3743  
FLAGO 0326  
FLAGR 0572  
FLGR 3745  
FLIN 0767  
FLOIN 0006  
FLOP 542  
FLOTR 4303  
FMPY 3000  
FMPY2 0003  
FNISH 4224  
FNOR 7000  
FOUT 7200  
FRINP 0760  
FPUT 6000  
FSIN 0124  
FSUB 2000  
FXAD 7377  
GET 0422  
GICHR 4203  
GTSPN 0222  
GTTP 0334  
HALFA 0520  
HALFM 3034  
HB 0073  
HD1 3747  
HD10 2767  
HD11 1557  
HD2 3764  
HD3 3761  
HD4 1736  
HD5 1744  
HD6 1755  
HD7 2750  
HD8 1770  
HD9 2760  
HGT 3740

HGTP 4101  
HIPUN 0361  
HIRED 0354  
HJJ 1531  
HJK 1537  
HKK 1534  
HOLD 3125  
HOLDK 3744  
HORD 0045  
HORDER 0045  
HPUN 0023  
HRED 0022  
HSRP 4416  
HSUBE 1273  
HSUBF 1542  
HSUBG 1660  
HSUBI 2363  
HSUBM 3033  
HUGET 2200  
HUGETO 0321  
ICTRI 2245  
IEPRNT 4302  
IFZB 0063  
IHD1 4441  
IHD2 4454  
IN 5505  
INC 2055  
INCR 4052  
INDD1 1113  
INDD2 1114  
INDEX 3535  
INDIAL 4400  
INDIL 0320  
INDIR 0142  
IND1 1336  
IND2 1337  
INITB 3400  
INITK 3726  
INITO 0311  
INKY 4076  
INPEC 0317  
INPUT 0005  
INSPA 0516  
INSPEC 1121  
INSTD 1022  
INSTD1 1117  
INSTE 1364  
INSTH 2105  
INSTK 3711  
INSWT 0102  
INTAP 1144  
INTERP 0207  
INTRUP 2602  
INLADD 2540  
IN2ADD 2530  
IRREP 4102  
IS 1270  
JAKE 1200  
JAKEO 0324  
JC 0610  
JF 1520  
JG 1662

JTEMP 0135  
JUMP 3  
K 3  
XF 1530  
KK200 3361  
KK300 3362  
KK7 4075  
KLAEL 0751  
ALREL 1657  
K3400 3736  
K3777 3734  
K3777P 4072  
K4000 3735  
K7 5553  
LCT 3360  
LDARR 3032  
LDCHK 3235  
LEDR 3364  
LF 2675  
LIMIT 0110  
LISP 3200  
LJ 1670  
LK 1665  
LNCTAP 4103  
LNFEED 7342  
LOC 0150  
LODFAC 3250  
LOKUP 2621  
LORD 0046  
LONT 4423  
LRO 4434  
LSCHR 4245  
LTP 4435  
MASKM 3105  
MASK1 2747  
MLPY2 3543  
MV 4335  
MV500 4301  
MV7 4240  
MRBT 4242  
MRKR 4057  
MRSRC 4255  
MR377 2643  
MSK7 0352  
MY 4334  
Y1J 5555  
M11 3161  
M12 2551  
M12H 2131  
M2 1145  
M2010 0332  
M212 2642  
M35 2744  
MS77 4074  
MS00 0526  
MS000 1146  
MS00M 3037  
M6 5554  
M7 0331  
M7X 5561  
N 0106  
NEGATE 0005

NEXT 0161  
NEXTK 3603  
NEXTKV 3647  
NEXTY 3705  
NINCR 3637  
NLINK 2143  
NMRE 0502  
NOLN 4276  
NIUT 3536  
NODAT 0240  
NUSEB 0064  
N1 0115  
NIADD 2547  
N2 0132  
N2ADD 2542  
OCIN 0353  
OCTIN 4200  
OFFS 0402  
OFSC 4432  
OFSET 0137  
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ONEF 1516  
ONESET 1543  
OPUT 5557  
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OVER 2066  
OVERI 2302  
OVERO 0207  
PEX 3353  
PLJE 5566  
PLI3 4314  
PL6 3106  
PROUT 3335  
POINT 5562  
PRINT 0074  
PRINTL 2676  
PRNT 5451  
PROB 3103  
POND 0142  
P17 3537  
P215 2674  
P23 3540  
P236 2745  
P336 2746  
P43 3541  
P44 0570  
P50M 3575  
P50M 3040  
P7 0333  
P7M0 4241  
PWERK 4330  
PUEST 0330  
P 1524  
POEX 0566  
POMOR 2607  
POND 0527  
POND 0025  
RESET 0154  
REI 100  
RETH 2053

RETX 5436  
ROTATE 61  
RPTB1 73  
RPTB2 3504  
RPTC 0626  
RPTC1 0655  
RPTC2 0714  
RPTD 1016  
RPTD 1201  
RPTD 1211  
RPTD 1225  
RPTD 1612  
RPTH 2016  
RPTH1 2025  
RPTI 2212  
RPTI2 2231  
RPTI 0265  
RPTI 2413  
RPTI 2432  
RPTI 2464  
RPTI 2472  
RPTI 4022  
RPTI 4040  
RPTI 4132  
R1 1366  
R2 1367  
R6 5425  
SAC 5565  
SCAD 7375  
SCOUNT 5565  
SETONE 2316  
SETUP 3107  
SIGN 3104  
SKPP 4436  
SMINUS 7330  
SPACE 3316  
SPACX 5560  
SPECAD 0524  
SPECB 0071  
SPLUS 7327  
SQRDUT 0022  
SQUARE 0001  
START 4001  
STBLK 0100  
STDIS 3600  
STORE 0155  
STPE 0540  
STRIP 3317  
SUBS 1656  
SUTII 0055  
TABAD 2544  
TABADH 2132  
TABADL 2655  
TABL 2145  
TABLE 0024  
TAPIRN 0076  
TEM 1115  
TEMC 0754  
TEMC1 0755  
TEMP 0107  
TEMPX 5564  
TEMP1 0114

TEXT 2057  
TESTE 1266  
TEXT1 3747  
TEXT2 1736  
TEXT3 2554  
TEXT4 1557  
TEXT5 3125  
TEXT6 2515  
TEXT7 2420  
TEXT8 2322  
TEXT9 1402  
TEXT10 1271  
TEXT11 1453  
TEXT12 3363  
TEXT13 2032  
TEXT14 2272  
TEXT15 2253  
TEXT16 2315  
TEXT17 3554  
TEXT18 4077  
TEXT19 2424  
TEXT20 1341  
TEXT21 1661  
TEXT22 2317  
TEXT23 4243  
TEXT24 1272  
TEXT25 1602  
TEXT26 2314  
TEXT27 2622  
TEXT28 2722  
TEXT29 4222  
TEXT30 4277  
TEXT31 3742  
TEXT32 4132  
TEXT33 3742  
TEXT34 1202  
TEXT35 2252  
TEXT36 3517  
TEXT37 1522  
TEXT38 3741  
TEXT39 4132  
TEXT40 1522  
TEXT41 2172

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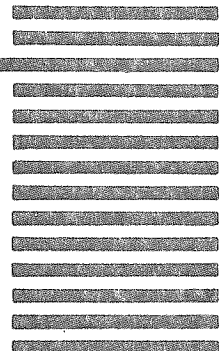
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