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DOCUMENTS

ONCAL: An On-line Calculator for the HP2100A

Program Listings

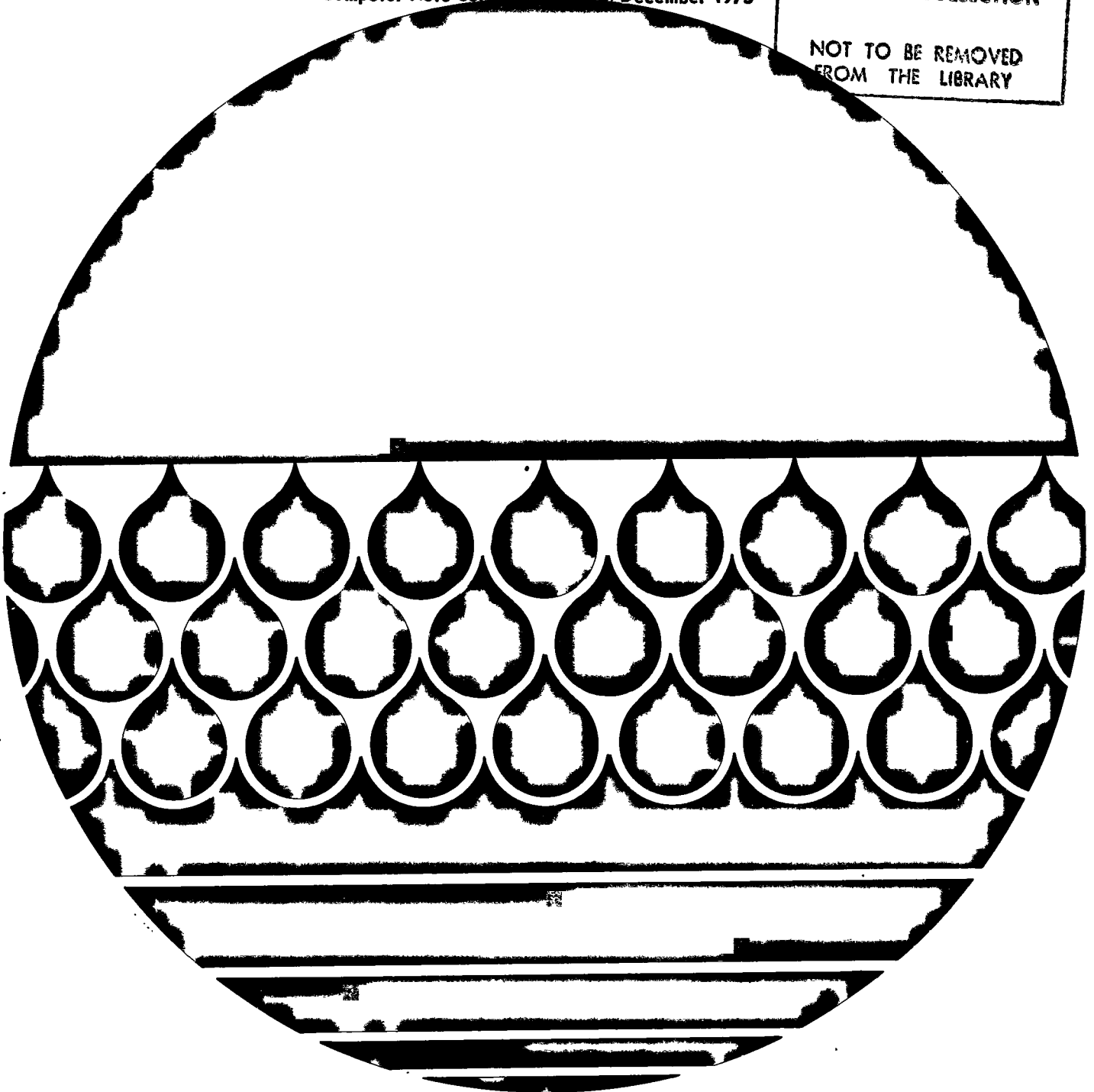
A. S. Bennett

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BEDFORD INSTITUTE OF OCEANOGRAPHY

Dartmouth, Nova Scotia
Canada

VOLUME II.

ONCAL: AN ON-LINE CALCULATOR FOR THE HP2100A

Program Listings

by

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Ocean and Aquatic Sciences
Department of the Environment

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ABSTRACT

Program listings are presented for the 'ONCAL' language. This interpretative language is designed for acquisition and processing of data on an HP2100A computer.

RESUME

On y présente les listes des programmes pour la langue 'ONCAL'. Cette langue interprétative est projetée pour l'acquisition et traitement des données par un ordinateur HP2100A.

Contents

All program listings produced by the Hewlett-Packard HP2100A Assembler start at 'PAGE 0002 #01'. To help diminish the confusion, listings are separated by coloured pages.

1. Standard F-version
2. Standard X-version (extended precision)
3. V148X overlay; FSW, FAP
4. V149F overlay; FSW, FAP
5. V150F overlay; FSW, FSAL, FSGT, FADC, FTAG, FCLK
(Guildline prototype digital CTD)
6. V151F overlay; XFORM command, FSGT, FSAL
7. V152F overlay; FSW, special FAP
8. V153X overlay; FSW, special FAP
9. V154F overlay; FSW, FSAL, FSGT, FADC, FTAG, FCLK
(Guildline production ditigal CTD)
10. V155F overlay; FSW, FSAL, FSGT, FADC, FTAG, FCLK
(Fluke DVM/Guildline analogue CTD)

PAGE 0002 #01 ON=LINE CALCULATOR

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0001          ASMB,A,L
0003*        STANDARD SINGLE PRECISION  VERSION
0004*        BASE PAGE/ I/O ETC
0005 00002          ORG 20
0006          SUP
0007 37677          CORE EQU 37677B  LAST WORD AVAILABLE
0008 00002 102002   DMAC1 HLT 2
0009 00003 102003   DMAC2 HLT 3
0010 00004 102004          HLT 4
0011 00005 102005          HLT 5
0012 00006 114026   DMA1 JSB 26B,I  DMA CH 1
0013 00007 114027   DMA2 JSB 27B,I  DMA CH 2
0014 00010 102010   DISCD HLT 10B  DISC/ DOES NOT USE IR
0015 00011 102011   DISCC HLT 11B
0016 00012 102012   MTD HLT 12B  MAG TAPE DATA
0017 00013 114030   MTC JSB 30B,I  MAG TAPE CONTROL
0018 00014 114041   LINEP JSB 41B,I  LINEPRINTER
0019 00015 114032   HSR JSB 32B,I  HS READER
0020 00016 114033   PNCH JSB 33B,I  HS PUNCH
0021 00017 114034   TTY JSB 34B,I  TELETYPE
0022 00020 114035   PLOT JSB 35B,I  PLOTTER
0023 00021 114036   DISPL JSB 36B,I  'SCOPE
0024 00022 102022          HLT 22B
0025 00023 102023          HLT 23B
0026 00024 102024          HLT 24B
0027 00025 102025          HLT 25B
0028 00026 007270   DEF DMAI1  DMA CH 1
0029 00027 007274   DEF DMAI2  DMA CH 2
0030 00030 007300   DEF MTCI  MAGTAPE
0031 00031 000000   NOP
0032 00032 007202   DEF HSRI  HS READER
0033 00033 007220   DEF HPNI  HS PUNCH
0034 00034 007106   ITTJ DEF ITTO  TELETYPE
0035 00035 004424   DEF PLIR  PLOTTER
0036 00036 007306   DEF DISI  'SCOPE
0037 00037 000000   NOP
0038 00040 000000   NOP
0039 00041 007224   DEF LPIR
0040*
0041*        FLOATING POINT HARDWARE DEFINITIONS
0042*        BECAUSE OF THE PECULIARITIES OF THE HP ASSEMBLER,
0043*        THESE MUST BE REFERENCED BY
0044*        ABS =FAD  ETC
0045*
0046 73000          FAD EQU 73000B
0047 72700          FSB EQU 72700B
0048 72740          FMP EQU 72740B
0049 72720          PDV EQU 72720B
0050 72660          FLT EQU 72660B

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0052* BASIC PROGRAM TO READ COMMANDS ('START'),
0053* STORE THEM ('INPTN') AND TO EXECUTE
0054* BOTH DIRECT COMMANDS AND STORED
0055* COMMANDS ACCESSED VIA 'GO' ('NEXTL'),
0056* THE "TIDY UP" SECTION AFTER ADDING A LINE
0057* TO THE STORED TEXT IS ALSO USED BY THE
0058* 'MODIFY' COMMAND, ENTERING AT 'MODX',
0059*
0060* INTERNAL RESTART ENTRY POINT
0061 00110          ORG 110B
0062 00110 060660  START LDA PROG0
0063 00111 070627          STA PC          POINT TO NULL
0064 00112 060663          LDA INBFE      SET END=STOP FOR INPUT
0065 00113 070617          STA PDL
0066 00114 061403          LDA B52        TYPE '*'
0067 00115 115123          JSB PRC,I      ON TELETYPE
0068 00116 060662          LDA INBF      SET INPUT TO 'COMIN'
0069 00117 001200          RAL
0070 00120 070616          STA TXIN
0071 00121 070633          STA PAKST
0072 00122 070626          STA TXOUT
0073 00123 115124          JSB RDC,I
0074 00124 051440          CPA B137      BACK ARROW?
0075 00125 024116          JMP *-7    LOSE TEXT
0076 00126 051364          CPA B12      LINE FEED?
0077 00127 024123          JMP *-4    IGNORE IT
0078 00130 115125          JSB PKC,I    PACK TO 'COMIN'
0079 00131 051366          CPA B15      CARRIAGE RETURN?
0080 00132 002001          RSS
0081 00133 024123          JMP *-8    GET NEXT
0082 00134 014401          JSB GETC    GET FIRST CH FROM 'COMIN'
0083 00135 060635          LDA BOTTM   SET UP PDL
0084 00136 070617          STA PDL
0085 00137 014316          JSB SPNOR   SKIP SPACES
0086 00140 014277          JSB SORT
0087 00141 002001          RSS
0088 00142 024156          JMP INPTN  OP/TERM
0089 00143 014542          NEXTL JSB PUSHJ  NUMBER; READ AND STORE
0090 00144 003473          DEF PROC    EXECUTE LINE
0091 00145 160627          LDA PC,I    TEST IF PC SET
0092 00146 002003          SZA,RSS
0093 00147 024110          JMP START  PC NOT SET OR END OF TEXT
0094 00150 070627          STA PC    SET PC TO NEXT LINE
0095 00151 041356          ADA B2
0096 00152 001200          RAL
0097 00153 070626          STA TXOUT
0098 00154 014401          JSB GETC
0099 00155 024143          JMP NEXTL  CONTINUE EXECUTING IN SEQUENCE
0100*
0101 00156 014413          INPTN JSB GETLN  NUMBER; STORE LINE
0102 00157 002021          SSA,RSS    ONE LINE?
0103 00160 014220          JSB ERROR  NO
0104 00161 064655          LDB BUFR  PACK TO TEXT BUFFER
0105 00162 006004          INB
0106 00163 060653          LDA LNNO
0107 00164 170001          STA 1,I

```

PAGE 0004 #01 ON-LINE CALCULATOR

0100	00165	006004		INB	
0109	00166	005200		RBL	
0110	00167	074616		STB TXIN	
0111	00170	014316		JSB SPNOR	
0112	00171	002001		RSS	
0113	00172	014401		JSB GETC	
0114	00173	115125		JSB PKC,I	
0115	00174	051366		CPA 015	UNTIL CR
0116	00175	002001		RSS	
0117	00176	024172		JMP *-4	
0118	00177	115162	MODX	JSB DEL,I	
0119	00200	160632		LDA LSTLN,I	MOVE PTR TO NEXT LINE
0120	00201	170655		STA BUFR,I	
0121	00202	060655		LDA BUFR	SET PTR TO THIS LINE
0122	00203	170632		STA LSTLN,I	
0123	00204	060616		LDA TXIN	SET PTR TO AVAILABLE SPACE
0124	00205	000010		SLA	ROUND UP ODD CHARACTER
0125	00206	002004		INA	
0126	00207	070616		STA TXIN	
0127	00210	001100		ARS	
0128	00211	070655		STA BUFR	
0129	00212	070654		STA LASTV	ERASE VARIABLES
0130	00213	024110		JMP START	


```

0132*      ERROR AND RECOVERY ROUTINES.
0133*      RESTART ENTRY IS AT LOCATION FOLLOWING 'RECOV'.
0134*      ENTRY THERE WITH A=0 GIVES A ZERO ERROR CODE.
0135 00214 000000 ERR2  NOP          ERROR ROUTINE; PRINTS A
0136 00215 070276      STA  ERRA      SAVE A TO PRINT LATER
0137 00216 060214      LDA  ERR2      AS WELL AS ERROR CODE
0138 00217 024222      JMP  **3
0139 00220 000000      ERROR  NOP          NORMAL ERROR ROUTINE;
0140 00221 060220      LDA  ERROR      PICK UP ERROR CODE
0141 00222 041335      ADA  BM1      CORRECT FOR JSB
0142 00223 102100      STF  0
0143 00224 065104      LOB  TTYSW      WAIT FOR O/P
0144 00225 006003      SZB, RSS
0145 00226 024224      JMP  **2
0146 00227 103100      CLF  0
0147 00230 002001      RSS
0148 00231 061453      RECOV LDA  B400
0149 00232 070653      STA  LNNO      SET ERROR CODE
0150 00233 015014      JSB  TTRON     SET TTY READER
0151 00234 061166      LDA  TTYPN
0152 00235 070647      STA  OUTCH     AND TTY OUTPUT
0153 00236 061073      LDA  TTBF0     RESET O/P BUFFER POINTERS
0154 00237 071074      STA  TTBF1
0155 00240 071075      STA  TTBF0
0156 00241 002400      CLA
0157 00242 071106      STA  TTYFL     CLEAR INPUT
0158 00243 102601      OTA  1        CLEAR SWITCH REGISTER
0159 00244 002404      CLA, INA
0160 00245 071104      STA  TTYSW     AND OUTPUT
0161 00246 061444      LDA  B200
0162 00247 114647      JSB  OUTCH, I  PRINT BLANK
0163 00250 061414      LDA  B77
0164 00251 114647      JSB  OUTCH, I
0165 00252 060653      LDA  LNNO      ERROR LOCATION
0166 00253 115126      JSB  PRO, I
0167 00254 034627      ISZ  PC
0168 00255 160627      LDA  PC, I
0169 00256 002003      SZA, RSS
0170 00257 024266      JMP  **7
0171 00260 070653      STA  LNNO
0172 00261 061415      LDA  B100      @
0173 00262 114647      JSB  OUTCH, I
0174 00263 061374      LDA  B40      SPACE
0175 00264 114647      JSB  OUTCH, I
0176 00265 115127      JSB  PRL, I    LINE NO
0177 00266 006400      CLB
0178 00267 060276      LDA  ERRA      GET 'A', IF ANY
0179 00270 074276      STB  ERRA      CLEAR 'A'
0180 00271 002002      SZA
0181 00272 115126      JSB  PRO, I    DON'T PRINT IF ZERO
0182 00273 061366      LDA  B15
0183 00274 114647      JSB  OUTCH, I
0184 00275 024110      JMP  START
0185 00276 000000      RRA  NOP

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PAGE 0006 #01 ON-LINE CALCULATOR

```

0187 00277 000000 SORT NOP
0190 00300 060652 LDA CHAR
0190 00301 000065 CLE,ERA ODD/EVEN TO E
0190 00302 040315 ADA SORTT MAKE TABLE ADDRESS
0191 00303 164000 LDB 0,I PICK UP ENTRY
0192 00304 002040 SEZ
0193 00305 005727 BLF,BLF POSITION IF ODD
0194 00306 101035 ASR 13 3-BIT SIGNED TYPE TO B
0195 00307 001722 ALF,RAL 5-BIT UNSIGNED = TO A
0196 00310 011373 AND B37
0197 00311 006020 SSB LEGAL?
0198 00312 014220 JSB ERROR NO
0199 00313 044277 ADB SORT MAKE EXIT
0200 00314 124001 JMP 1,I
0201* TABLE CODE IS 8-BITS PER ENTRY, MORE SIG 3 ARE 'TYPE'
0202* AND LESS SIG 5 ARE 'NUMBER'. E.G. 200 MEANS ILLEGAL, =0
0203* 43 MEANS NUMBER, =3; 12 MEANS TERMINATOR =10
0204*
0205 00315 006000 SORTT DEF SORTB
0206*
0207*
0208*
0209* RUN NON-SIGNIFICANT SPACES
0210 00316 000000 SPNOR NOP
0211 00317 060652 LDA CHAR GET CHARACTER
0212 00320 051374 CPA B40 IS IT SPACE ?
0213 00321 002001 RSS
0214 00322 124316 JMP SPNOR,I NO; ALL DONE
0215 00323 014401 JSB GETC YES; GET NEXT ONE
0216 00324 024317 JMP SPNOR+1
0217*
0218* 'RETURN' COMMAND AND RECURSIVE SUBROUTINE
0219* RETURN, 'POPJ'
0220 00325 060660 RETRN LDA PROG0 'RETURN'; SET END OF TEXT
0221 00326 070627 STA PC IN PROGRAM COUNTER
0222 00327 164617 POPJ LDB PDL,I RECURSIVE SR RETURN
0223 00330 034617 ISZ PDL GET RETURN FROM PDL
0224 00331 124001 JMP 1,I AND JUMP TO RETURN
0225*
0226* COMPARE GROUP NUMBER IN A WITH THAT IN LNNO
0227* 1ST EXIT IF DIFFERENT
0228* 2ND EXIT IF THE SAME
0229 00332 000000 TSTGP NOP
0230 00333 011345 AND B400 MASK OFF GROUP PART OF A
0231 00334 070001 STA 1 SAVE GROUP
0232 00335 060653 LDA LNNO GET LNNO
0233 00336 011345 AND B400 MASK OFF GROUP
0234 00337 050001 CPA 1 COMPARE GROUP NUMBE'IS
0235 00340 034332 ISZ TSTGP STEP EXIT IF THE SAME
0236 00341 124332 JMP TSTGP,I
0237*
0238* CHECK CLOSING PARENTHESIS
0239 00342 000000 PARTS NOP
0240 00343 060652 LDA CHAR PICK UP CHARACTER
0241 00344 051402 CPA B51 COMPARE )
0242 00345 002001 RSS OK

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0243	00346	014220	JSB ERROR	NO/ ERROR
0244	00347	014401	JSB GETC	PASS OVER)
0245	00350	124342	JMP PARTS,I	EXIT
0246*				
0247*				
0248*				
0249*		FIND A LINE IN TEXT		
0250*		STEP EXIT IF FOUND		
0251*		SET LSTLN TO LINE BEFORE		
0252*		SET THSLN TO REQUIRED LINE OR ONE AFTER IF NOT FOUND		
0253	00351	000000	FNDLN NOP	
0254	00352	060657	LDA TEXT0	START AT BEGINNING OF TEXT
0255	00353	070632	STA LSTLN	
0256	00354	070630	STA THSLN	
0257	00355	002004	INA	POINT TO LINE NUMBER
0258	00356	064653	LDB LNNO	
0259	00357	007104	CMB,CLE,INB	
0260	00360	144000	ADB 0,I	
0261	00361	006003	SZB,RSS	
0262	00362	024373	JMP **9	LINE FOUND
0263	00363	002040	SEZ	
0264	00364	024374	JMP **8	PASSED IT
0265	00365	060630	LDA THSLN	
0266	00366	070632	STA LSTLN	
0267	00367	160630	LDA THSLN,I	
0268	00370	002002	SZA	ZERO MARKS END
0269	00371	024354	JMP FNDLN+3	TRY NEXT
0270	00372	002001	RSS	
0271	00373	034351	ISZ FNDLN	
0272	00374	060630	LDA THSLN	
0273	00375	041356	ADA B2	
0274	00376	001200	RAL	POSITION POINTER
0275	00377	070626	STA TXOUT	
0276	00400	124351	JMP FNDLN,I	
0277*				
0278	00401	000000	GETC NUP	READ CH TO CHAR A
0279	00402	060626	LDA TXOUT	
0280	00403	000065	CLE,ERA	POSITION SET E
0281	00404	160000	LDA 0,I	READ WORD
0282	00405	002041	SEZ,RSS	
0283	00406	001727	ALF,ALF	SHIFT M,S, HALF
0284	00407	034626	ISZ TXOUT	STEP POINTER
0285	00410	011443	AND B177	
0286	00411	070652	STA CHAR	
0287	00412	124401	JMP GETC,I	
0288*				
0289*				
0290*				
0291	00413	000000	GETLN NOP	READ LINE NUMBER
0292	00414	014316	JSB SPNOR	
0293	00415	014277	JSB SORT	TEST 1ST CHARACTER
0294	00416	002001	RSS	OP/TERM; EXPN
0295	00417	024446	JMP GETN	NUMERIC
0296	00420	014542	JSB PUSHJ	GET LINE NO
0297	00421	004762	DEF EVAL	
0298	00422	061175	LDA FLAC	

0299	00423	065176		LDB	FLAC+1	
0300	00424	105040		ABS	=FMP	X100
0301	00425	001306		DEF	FL100	
0302	00426	115134		JSB	IFX,I	RESULT TO A
0303	00427	006400		CLB		
0304	00430	100400		DIV	D100	GROUP TO A
0305	00432	001727	GETL2	ALF,ALF		LINE IS IN B; POSITION A
0306	00433	040001		ADA	1B	TOTAL TO A
0307	00434	070653		STA	LNNO	STORE
0308	00435	002003		SZA,RSS		ZERO?
0309	00436	024444		JMP	GETAL	0='ALL'
0310	00437	061354		LDA	BMIN	ONE LINE
0311	00440	006003		SZB,RSS		
0312	00441	002400		CLA		OR GROUP
0313	00442	070651	GETLX	STA	LGAFI	
0314	00443	124413		JMP	GETLN,I	
0315*						
0316	00444	002404	GETAL	CLA,INA		'ALL'
0317	00445	024442		JMP	GETLX	
0318*						
0319	00446	006400	GETN	CLB		NUMERIC LINE NUMBER
0320	00447	074527		STB	GETL	CLEAR LINE NUMBER
0321	00450	074530		STB	GETG	AND GROUP NUMBER
0322	00451	051364		CPA	B12	"," IS LEGAL NUMERIC
0323	00452	024500		JMP	GETLL	GROUP ZERO
0324	00453	070530		STA	GETG	SAVE GROUP NO
0325	00454	100200		MPY	B12	X10
0326	00456	070531		STA	GET10	SAVE 10*GP NO
0327	00457	014401		JSB	GETC	GET NEXT CH
0328	00460	014277		JSB	SORT	TEST
0329	00461	024524		JMP	GETL1	OP/TERM; JUST A GROUP NO
0330	00462	002001		RSS		NUMERIC
0331	00463	014220	GETER	JSB	ERROR	LINE NO FORMAT ERROR
0332	00464	051364		CPA	B12	","?
0333	00465	024500		JMP	GETLL	GO GET LINE PART
0334	00466	040531		ADA	GET10	ADD IN MORE SIG PART
0335	00467	070530		STA	GETG	SET GROUP NO
0336*				2 DIGITS READ;	"," OR	TERMINATOR NEXT
0337	00470	014401		JSB	GETC	READ NEXT CH
0338	00471	014277		JSB	SORT	TEST IT
0339	00472	024524		JMP	GETL1	OP/TERM; JUST A GROUP NO
0340	00473	002001		RSS		NUMERIC
0341	00474	024463		JMP	GETER	ALPHABETIC; ERROR
0342	00475	051364		CPA	B12	NUMERIC MUST BE ","
0343	00476	002001		RSS		
0344	00477	024463		JMP	GETER	3RD DIGIT; ERROR
0345	00500	014401	GETLL	JSB	GETC	GET 1ST CH OF LINE PART
0346	00501	014277		JSB	SORT	TEST
0347	00502	024524		JMP	GETL1	OP/TERM; ALL DONE
0348	00503	051364		CPA	B12	NUMERIC; TEST ","
0349	00504	024463		JMP	GETER	ALPH OR ","; ERROR
0350	00505	100200		MPY	B12	X10
0351	00507	070527		STA	GETL	SAVE LINE PART
0352	00510	014401		JSB	GETC	GET NEXT
0353	00511	014277		JSB	SORT	TEST
0354	00512	024524		JMP	GETL1	OP/TERM; ALL DONE

0355	00513	051364	CPA 012	NUMERIC; ", " ILLEGAL
0356	00514	024463	JMP GETER	ALPH OR ".,"; ERROR
0357	00515	040527	ADA GETL	ADD UP LINE PART
0358	00516	070527	STA GETL	
0359	00517	014401	JSB GETC	MUST BE TERMINATOR
0360	00520	014277	JSB SORT	TEST
0361	00521	024524	JMP GETL1	OP/TERM; OK
0362	00522	024463	JMP GETER	
0363	00523	024463	JMP GETER	
0364	00524	064527	GETL1 LDB GETL	LINE PART TO B
0365	00525	060530	LDA GETG	GROUP PART TO A
0366	00526	024432	JMP GETL2	GO PUT TOGETHER
0367*				
0368	00527	000000	GETL NOP	STORE FOR LINE PART
0369	00530	000000	GETG NOP	STORE FOR GROUP PART
0370	00531	000000	GET10 NOP	STORE FOR GP MS PART
0371*				
0372*				
0373*				
0374*				
	PUSH DOWN	LIST ROUTINES		
0375	00532	000000	PUSHA NOP	BASIC 'PUSH' ROUTINE
0376	00533	007400	CCB	
0377	00534	044617	ADB PDL	
0378	00535	074617	STB PDL	SET NEW POINTER
0379	00536	054654	CPB LASTV	O'FLOW?
0380	00537	014220	JSB ERROR	PDL O'FLOW
0381	00540	170001	STA 1B,I	PUSH A TO PDL
0382	00541	124532	JMP PUSHA,I	
0383*				
0384	00542	000000	PUSHJ NOP	ENTER REENTRANT CODE
0385	00543	060542	LDA PUSHJ	
0386	00544	002004	INA	
0387	00545	014532	JSB PUSHA	PUSH RETURN
0388	00546	164542	LDB PUSHJ,I	
0389	00547	124001	JMP 1,I	
0390*				
0391	00550	160000	LDA 0,I	COPE WITH INDIRECT
0392	00551	024554	JMP **3	
0393	00552	000000	PUSHF NOP	PUSH FLOATING POINT NUMBER
0394*				
	PUSHES TWO OR THREE WORDS	DEPENDING ON FP PRECISION		
0395	00553	160552	LDA PUSHF,I	PICK UP ADDRESS
0396	00554	001275	RAL,CLE,SLA,ERA	
0397	00555	024550	JMP PUSHF=2	
0398	00556	034552	ISZ PUSHF	STEP EXIT
0399	00557	064617	LDB PDL	UPDATE POINTER
0400	00560	045336	ADB BM2	
0401	00561	074617	STB PDL	
0402	00562	007104	CMB,CLE,INB	ROOM?
0403	00563	044654	ADB LASTV	
0404	00564	002040	SEZ	
0405	00565	024537	JMP PUSHA+5	USE PUSHA O'FLOW CODE
0406	00566	104200	OLD 0,I	PICK UP DATA
0407	00570	104400	DST PDL,I	PUT IN PDL
0408	00572	124552	JMP PUSHF,I	
0409*				
0410	00573	160000	LDA 0,I	

0411	00574	024577		JMP **3	
0412	00575	000000	POPF	NOP	POP FLOATING POINT NUMBER
0413	00576	160575		LDA POPF,I	PICK UP ADDRESS
0414	00577	001275		RAL,CLE,SLA,ERA	
0415	00600	024573		JMP POPF=2	
0416	00601	034575		ISZ POPF	STEP EXIT
0417	00602	070623		STA T4	SAVE DATA POINTER
0418	00603	104200		DLD PDL,I	PICK UP FROM PDL
0419	00605	104400		DST T4,I	RESTORE DATA
0420	00607	034617		ISZ PDL	
0421	00610	034617		ISZ PDL	
0422	00611	124575		JMP POPF,I	
0423*					
0424	00612	000000	POPA	NOP	POP ONE WORD
0425	00613	160617		LDA PDL,I	
0426	00614	034617		ISZ PDL	
0427	00615	124612		JMP POPA,I	

```

0430*          POINTERS, WORKING REGISTERS ETC.
0431 00616 000000 TXIN  NOP
0432 00617 000000 PDL  NOP          PUSH DOWN LIST POINTER
0433 00620 000000 T1   NOP          GENERAL WORKING REGISTERS
0434 00621 000000 T2   NOP
0435 00622 000000 T3   NOP
0436 00623 000000 T4   NOP
0437 00624 000000 T5   NOP
0438 00625 000000 T6   NOP
0439 00626 000000 TXOUT NOP          TEXT POINTER FOR OUTPUT FROM BUFE
0440 00627 001222 PC   DEF FL0
0441 00630 000000 THSLN NOP
0442 00631 000000 THSQP NOP
0443 00632 000000 LSTLN NOP
0444 00633 000000 PAKST NOP
0445 00634 000000 PT1  NOP
0446 00635 037677 BOTTH ABS CORE
0447 00636 006655 READP DEF READ1
0448 00637 000401 GETCP DEF GETC
0449 00640 000000 INPUT NOP
0450 00641 000000 LSTOP NOP
0451 00642 000000 EVFNM NOP
0452 00643 000000 ATSW  NOP
0453 00644 000000 CNTR  NOP
0454 00645 000000 ADD   NOP
0455 00646 007140 INCH  DEF TTYR2  CHARACTER INPUT ROUTINE
0456 00647 005701 OUTCH  DEF PRNTC  CHARACTER OUTPUT ROUTINE
0457 00650 006140 FOUTP DEF FOUT1  NUMBER PRINT-OUT ROUTINE
0458 00651 000001 LGAFL OCT 1
0459 00652 000015 CHAR  OCT 15
0460 00653 000000 LNNO  NOP
0461 00654 011142 LASTV DEF BUFBG
0462 00655 011142 BUFR  DEF BUFBG
0463 00656 011142 ENDT  DEF BUFBG
0464 00657 011131 TEXT0 DEF TEXT
0465 00660 001222 PROG0 DEF FL0
0466 00661 000000 FORM  DEC 0
0467 00662 007426 INBF  DEF COMIN
0468 00663 007602 INBFE DEF COME=1

```

0470* FUNCTION NAMES
 0471 00664 002123 FABS OCT 2123
 0472 00665 046356 FSGN OCT 46356
 0473 00666 022724 FINT OCT 22724
 0474 00667 023222 FITR OCT 23222
 0475 00670 010463 FDIS OCT 10463
 0476 00671 003216 FATN OCT 3216
 0477 00672 013420 FEXP OCT 13420
 0478 00673 030747 FLOG OCT 30747
 0479 00674 046456 FSIN OCT 46456
 0480 00675 006763 FCOS OCT 6763
 0481 00676 047064 FSQT OCT 47064
 0482 00677 002704 FAND OCT 2704
 0483 00700 022762 FIOR OCT 22762
 0484 00701 060762 FXOR OCT 60762
 0485 00702 000456 FIN OCT 456
 0486 00703 037264 FOUT OCT 37264
 0487 00704 000000 BSS 9 SPACE FOR SPECIAL FUNCTIONS

0488*
 0489* FUNCTION ENTRIES
 0490 00715 005256 PABS DEF XABS
 0491 00716 005347 PSGN DEF XSGN
 0492 00717 005262 PINT DEF XINT
 0493 00720 005402 PDIS DEF XDIS
 0494 00721 005571 PATN DEF ARTN
 0495 00722 005266 PEXP DEF XEXP
 0496 00723 005273 PLOG DEF XLOG
 0497 00724 005300 PSIN DEF XSIN
 0498 00725 005304 PCOS DEF XCOS
 0499 00726 005310 PSQT DEF XSQRT
 0500 00727 005315 PAND DEF XAND
 0501 00730 005340 PIOR DEF XIOR
 0502 00731 005343 PXOR DEF XXOR
 0503 00732 005356 PIN DEF XIN
 0504 00733 005370 POUT DEF XOUT
 0505 00734 000000 BSS 9 SPACE FOR SPECIAL FUNCTIONS

0506*
 0507* MAGNETIC TAPE COMMANDS; CODES AND WORKING SPACE
 0508 00745 177774 BUNT OCT =4 SELECTED UNIT; DEFAULT 0
 0509* 7=TRACK CODES; 9=TRACK IN COMMENTS
 0510 00746 000203 BUFRI OCT 203 23 READ BINARY
 0511 00747 100203 BUFRB OCT 100203 23 READ BCD
 0512 00750 000301 BUFWI OCT 301 31 WRITE BINARY
 0513 00751 100301 BUFWB OCT 100301 31 WRITE BCD
 0514 00752 100141 BUFWE OCT 100141 211 WRITE END OF FILE
 0515 00753 000121 BUFWG OCT 121 15 WRITE GAP
 0516 00754 000011 BUFRW OCT 11 101 REWIND
 0517 00755 000005 BUFSB OCT 5 41 SPACE RECORD BACKWARD
 0518 00756 000003 BUFSF OCT 3 3 SPACE RECORD FORWARD
 0519 00757 100045 BUFFB OCT 100045 241 SPACE FILE BACKWARD
 0520 00760 100043 BUFFF OCT 100043 203 SPACE FILE FORWARD
 0521 00761 000020 BUFET OCT 20 40 END OF TAPE
 0522 00762 000040 BUFST OCT 40 100 START OF TAPE
 0523 00763 000060 BUFSE OCT 60 140 START OR END
 0524 00764 000006 BUFTP OCT 6 22 TIMING OR PARITY
 0525 00765 000026 BUFEP OCT 26 62 EOT OR TIMING/PARITY

0526	00766	002000	BUFRG	OCT	2000	2000	REWINDING	
0527	00767	000010	BUFRJ	OCT	10	10	REJECT	
0528	00770	000400	BUFLC	OCT	400	1	LOCAL	
0529	00771	000100	BUFEF	OCT	100	200	END OF FILE	
0530	00772	000120	BUFFT	OCT	120	240	END OF FILE OR TAPE	
0531*								
0532	00773	000000	BUPT	NOP				
0533	00774	000000	BUL	NOP				
0534	00775	000000	MTIN	NOP				
0535	00776	000000	MTINB	NOP				
0536	00777	000000	MTINL	NOP				
0537	01000	000000	MTINC	NOP				
0538	01001	000000	MTINT	NOP				
0539	01002	000000	MTERC	NOP				
0540	01003	002724	MTAB1	DEF	MTAB			
0541	01004	000000	MTOP	NOP				
0542	01005	000000	MTOPB	NOP				
0543	01006	000000	MTOPL	NOP				
0544	01007	000000	MTOPC	NOP				
0545	01010	000000	MTOCH	NOP				
0546	01011	003066	MTAB2	DEF	MTB2			
0547*								
0548*			PROCESSOR WORKING SPACE					
0549	01012	000000	PCTEM	DEC	0.			
0550*								
0551*			SET TTY READER INPUT					
0552	01014	000000	TTRON	NOP				
0553	01015	107715		CLC	HSR,C		ABORT POSSIBLE HSR	
0554	01016	061164		LDA	TTYRR		SET TTY READ ROUTINE	
0555	01017	070646		STA	INCH		FOR CHARACTER INPUT	
0556	01020	125014		JMP	TTRON,I			
0557*								
0558*			STORE, CONSTANTS ETC FOR PLOTTER ROUTINE					
0559*			BUFFER					
0560	01021	004436	PLI	DEF	PLBUF		INPUT POINTER	
0561	01022	004436	PLO	DEF	PLBUF		START	
0562	01023	004474	PL1	DEF	PLEND		END	
0563	01024	004436	PLO	DEF	PLBUF		OUTPUT POINTER	
0564*			SCALES: X 2*INCREMENTS/INCH, Y 8*INCREMENTS/INCH					
0565	01025	062000	PLXS	DEC	200.			
0566	01027	062000	PLYS	DEC	800.			
0567	01031	037777	PLMSY	OCT	37777		MASK FOR Y	
0568	01032	000001	PLSW	OCT	1		0=BUSY	
0569	01033	000000	PLFL1	NOP			1ST TIME FLAG	
0570	01034	000000	PLINY	NOP			Y INPUT DATA	
0571	01035	040000	PLX	OCT	40000		DESTINATION	
0572	01036	010000	PLY	OCT	10000			
0573	01037	000000	PLNX	NOP			START	
0574	01040	000000	PLNY	NOP				
0575	01041	000001	PLPEN	DEC	1		PEN POSITION) 1=UP	
0576	01042	000000	PLDX	NOP			LINE LENGTHS	
0577	01043	000000	PLDY	NOP				
0578	01044	000000	PLMV	NOP			DIRECTION/COUNT	
0579	01045	000000	PLMAJ	NOP			MAJOR MOTION COMMAND	
0580	01046	000000	PLCOM	NOP			COMBINED MOTION COMMAND	
0581	01047	004474	PLT1	DEF	PLTB1		MOTION TABLE PTRS	

```

0582 01050 004476 PLT2 DEF PLTB2
0583 01051 004500 PLT3 DEF PLTB3
0584 01052 000000 PLT  NOP
0585 01053 000000 PLE0 NOP
0586 01054 000000 PLAB DEC 0.0
0587*
0588*          OUTPUT PRINT ROUTINE
0589 01056 000000 FORMF NOP
0590 01057 000000 FOUFM NOP
0591 01060 000000 FOTEM DEC 0.
0592 01062 000000 FOUF  NOP
0593 01063 000000 FOUFC NOP
0594 01064 000000 FOUOP NOP
0595 01065 000000 FOUFG NOP
0596 01066 000000 FOUFC NOP
0597 01067 000000 FOURN NOP
0598*
0599*          ARGUMENT SEARCH ROUTINE
0600 01070 000000 GTL  NOP
0601 01071 000000 SUBS NOP
0602*
0603*          I/O ROUTINES
0604 01072 000000 ITTA  NOP
0605 01073 003704 TTBF0 DEF TTBUF
0606 01074 003704 TTBF1 DEF TTBUF
0607 01075 003704 TTBF0 DEF TTBUF
0608 01076 004014 TTBF1 DEF TTEND
0609 01077 007130 ITTIN DEF TTYRI
0610 01100 007106 ITTON DEF ITTO
0611 01101 130000 TTOP  OCT 130000
0612 01102 140000 TTIPS OCT 140000
0613 01103 170000 TTIP  OCT 170000
0614 01104 000000 TTYSW NOP
0615 01105 000000 TTYFL NOP
0616 01106 000000 HSRFL NOP
0617 01107 000001 PNCHF OCT 1
0618 01110 000001 LPBS  OCT 1
0619 01111 000001 DISFL OCT 1
0620 01112 000000 DFLAG NOP
0621 01113 000000 BUFLG NOP
0622*
0623*          CLOCK ROUTINE
0624 01114 000000 XCL  DEC 0.
0625 01116 000000      NOP
0626*
0627*          TAG ROUTINE
0628 01117 000000 TAG  NOP
0629 01120 000000      NOP
0630*
0631*
0632 01121 010731 CMCOR DEF CMBUF
0633 01122 177600      DEC =128

```

PLOT COUNT
STORE FORE E,0
A,B

"FIXED" FLAG
CURRENT FORMAT
WORKING SPACE

TTY OUTPUT BUSY FLAG
TTY INPUT BUSY FLAG

0 = 'BUSY'

DISPLAY ERASING FLAG

DONE FLAG

PTR TO COMMON BUFFER
LENGTH OF COMMON BUFFER

0635* ROUTINE ENTRIES

0636	01123	005701	PRC	DEF PRNTC	PRINT A CHARACTER
0637	01124	005721	RDC	DEF READC	READ A CHARACTER
0638	01125	006100	PKC	DEF PACKC	PACK CHARACTER TO TEXT
0639	01126	005660	PRO	DEF PRNTO	PRINT OCTAL
0640	01127	005607	PRL	DEF PRNTL	PRINT LINE NUMBER
0641	01130	006475	FNP	DEF FINPT	READ IN A NUMBER
0642	01131	005622	PRN	DEF PRNT	PRINT DECIMAL 2 DIGITS
0643	01132	005627	PRD	DEF PRNTN	PRINT DECIMAL, 4 DIGITS
0644	01133	006673	GT1	DEF GET1	READ 1ST LETTER, LOSE REST
0645	01134	007312	IFX	DEF IFIX	CONVERT TO INTEGER
0646	01135	007134	TT1	DEF TTYR1	READ TTY SILENTLY
0647	01136	002213	BSL	DEF BUSEL	SELECT MT UNIT
0648	01137	010511	RTI	DEF ,RTOI	EXPONENTIATE REAL TO INT. PWR
0649	01140	010446	RTR	DEF ,RTOR	EXPONENTIATE REAL TO REAL
0650	01141	007643	ABSP	DEF ABS	ABSOLUTE VALUE (MODULUS)
0651	01142	007650	ENTP	DEF ENTIE	ENTIER ROUTINE
0652	01143	010065	EXPP	DEF EXP	EXPONENTIAL
0653	01144	010174	LOGP	DEF ALOG	LOGARITHM
0654	01145	010260	SINP	DEF SIN	SINE
0655	01146	010330	COSP	DEF COS	COSINE
0656	01147	010351	SQTP	DEF SQRT	SQUARE ROOT
0657	01150	007057	TTO	DEF TTOUT	TELETYPE OUTPUT
0658	01151	010017	ATN2	DEF ATAN2	2-ARG ARC TANGENT
0659	01152	007711	ATN	DEF ATAN	ARC TANGENT (1 ARG)
0660	01153	007351	FCM	DEF ,FCM	FP COMPLEMENT
0661	01154	010720	FLN	DEF ,FLUN	UNPACK LS EXP
0662	01155	010610	CHB	DEF ,CHEB	CHEBY
0663	01156	002621	BUW	DEF BUWT	MAG TAPE WAIT TILL DONE
0664	01157	002554	BUD	DEF BUDMA	MAG TAPE SET UP DMA
0665	01160	002570	BUG	DEF BUGO	MAG TAPE GO
0666	01161	007603	PW2	DEF ,PWR2	FP X PWR OF 2
0667	01162	003244	DEL	DEF DELET	DELETE ROUTINE
0668	01163	007164	MSRDR	DEF HSRIN	HIGH SPEED READER
0669	01164	007140	TTYRR	DEF TTYR2	TTY READ WITH ECHO
0670	01165	007207	HSPCH	DEF HPNCH	HIGH SPEED PUNCH
0671	01166	005701	TTYPN	DEF PRNTC	TTY PUNCH
0672	01167	002633	MTINP	DEF MTINR	CHARACTER INPUT FROM MT
0673	01170	002764	MTOPP	DEF MTOPR	CHARACTER OUTPUT TO MT

0674*

0675*

LINKS

0676	01171	003472	PR1	DEF PRCSS
0677	01172	003473	PR	DEF PROC
0678	01173	003347	COX	DEF COEND
0679	01174	005141	EFX	DEF EVFNX

0681* FLOATING PT WORKING SPACE AND CONSTANTS

0682	01175	000000	FLAC	DEC	0.
0683	01177	000000	F1	DEC	0.
0684	01201	000000	F2	DEC	0.
0685	01203	000000	NOP	STORAGE FOR EXPONENT	
0686	01204	000000	F3	DEC	0.
0687	01206	000000	F4	DEC	0.
0688	01210	000000	F5	DEC	0.
0689	01212	000000	F6	DEC	0.
0690	01214	000000	F7	DEC	0.
0691	01216	000000	F8	DEC	0.
0692	01220	000000	F9	DEC	0.
0693	01222	000000	FL0	DEC	0.
0694	01224	040000	FL.5	DEC	.5
0695	01226	040000	FL2	DEC	2.
0696	01230	062207	FLPI2	DEC	1.57079633
0697	01232	115570	FLMP2	DEC	-1.57079633
0698	01234	062207	FLPI	DEC	3.14159265
0699	01236	050574	FL2/P	DEC	.636619772
0700	01240	056125	FLG2E	DEC	1.4426950409
0701	01242	054271	FLGE2	DEC	.6931471805
0702	01244	055202	FLRTH	DEC	.707106781

0703*

0704* TABLE OF POWERS OF TEN

0705	01246	055022		DEC	1.E-14,1.E-13,1.E-12,1.E-11,1.E-10
0706	01260	042270		DEC	1.E-9,1.E-8,1.E-7,1.E-6,1.E-5
0707	01272	064333		DEC	1.E-4,1.E-3,1.E-2
0708	01300	063146	FL.1	DEC	.1
0709	01302	040000	FL1	DEC	1.
0710	01304	050000	FL10	DEC	10.
0711	01306	062000	FL100	DEC	100.

0712*

0713	01310	000000	FT1	NOP	
0714	01311	000000	FT2	NOP	
0715	01312	000000	FT3	NOP	
0716	01313	000000	FT4	NUP	
0717	01314	000000	FT5	NOP	

0718*

0719* CONSTANTS

0720	01315	177775	BM3	OCT	=3
0721	01316	177772	BM6	OCT	=6
0722	01317	177771	BM7	OCT	=7
0723	01320	177766	DM10	DEC	=10
0724	01321	177762	BM16	OCT	=16
0725	01322	177742	BM36	OCT	=36
0726	01323	177702	BM76	OCT	=76
0727	01324	177670	DM72	DEC	=72
0728	01325	177660	DM80	DEC	=80
0729	01326	177657	DM81	DEC	=81
0730	01327	177645	BM133	OCT	=133
0731	01330	177604	DM124	DEC	=124
0732	01331	177602	BM176	OCT	=176
0733	01332	177601	BM177	OCT	=177
0734	01333	177402	BM376	OCT	=376
0735	01334	177002	BM776	OCT	=776

0736*

0737* FOLLOWING ARE USED AS MASK TABLE

0738	01335	177777	BM1	OCT	-1
0739	01336	177776	BM2	OCT	-2
0740	01337	177774	BM4	OCT	-4
0741	01340	177770	BM10	OCT	-10
0742	01341	177760	BM20	OCT	-20
0743	01342	177740	BM40	OCT	-40
0744	01343	177700	BM100	OCT	-100
0745	01344	177600	BM200	OCT	-200
0746	01345	177400	BM400	OCT	-400
0747	01346	177000	BMTH	OCT	-1000,-2000,-4000
0748	01351	170000		OCT	170000,160000
0749	01353	140000	BCRIT	OCT	140000
0750	01354	100000	BMIN	OCT	100000

0751* END OF MASK TABLE

0752*

0753	01355	000001	B1	OCT	1
0754	01356	000002	B2	OCT	2
0755	01357	000003	B3	OCT	3
0756	01360	000004	B4	OCT	4
0757	01361	000006	B6	OCT	6
0758	01362	000007	B7	OCT	7
0759	01363	000010	B10	OCT	10
0760	01364		D10	EQU	*
0761	01364	000012	B12	OCT	12
0762	01365	000014	B14	OCT	14
0763	01366	000015	B15	OCT	15
0764	01367	000017	B17	OCT	17
0765	01370	000020	B20	OCT	20
0766	01371	000027	B27	OCT	27
0767	01372	000032	B32	OCT	32
0768	01373	000037	B37	OCT	37
0769	01374	000040	B40	OCT	40
0770	01375	000041	B41	OCT	41
0771	01376	000042	B42	OCT	42
0772	01377	000044	B44	OCT	44
0773	01400	000045	B45	OCT	45
0774	01401	000050	B50	OCT	50
0775	01402	000051	B51	OCT	51
0776	01403	000052	B52	OCT	52
0777	01404	000053	B53	OCT	53
0778	01405	000054	B54	OCT	54
0779	01406	000055	B55	OCT	55
0780	01407	000056	B56	OCT	56
0781	01410	000060	B60	OCT	60
0782	01411	000072	B72	OCT	72
0783	01412	000073	B73	OCT	73
0784	01413	000075	B75	OCT	75
0785	01414	000077	B77	OCT	77
0786	01415	000100	B100	OCT	100
0787	01416	000102	B102	OCT	102
0788	01417	000105	B105	OCT	105
0789	01420	000106	B106	OCT	106
0790	01421	000107	B107	OCT	107
0791	01422	000111	B111	OCT	111
0792	01423	000112	B112	OCT	112

0793	01424	000113	B113	OCT	113	
0794	01425	000114	B114	OCT	114	
0795	01426	000115	B115	OCT	115	
0796	01427	000116	B116	OCT	116	
0797	01430	000117	B117	OCT	117	
0798	01431	000120	B120	OCT	120	
0799	01432	000122	B122	OCT	122	
0800	01433	000123	B123	OCT	123	
0801	01434	000124	B124	OCT	124	
0802	01435	000125	B125	OCT	125	
0803	01436	000127	B127	OCT	127	
0804	01437	000134	B134	OCT	134	
0805	01440	000137	B137	OCT	137	
0806	01441	000144	D100	DEC	100	
0807	01442	000176	B176	OCT	176	
0808	01443	000177	B177	OCT	177	
0809	01444	000200	B200	OCT	200	
0810	01445	000212	B212	OCT	212	
0811	01446	000215	B215	OCT	215	
0812	01447	000272	B272	OCT	272	
0813	01450	000364	D244	DEC	244	
0814	01451	000376	B376	OCT	376	
0815	01452	000377	B377	OCT	377	
0816	01453	000400	B400	OCT	400	
0817	01454	000402	B402	OCT	402	
0818	01455	000776	B776	OCT	776	
0819	01456	000777	B777	OCT	777	
0820	01457	001000	B1000	OCT	1000	
0821	01460	010020	BSPSP	OCT	10020	BCD SPACE-SPACE
0822	01461	040000	BPLUS	OCT	40000	
0823	01462	077777	BMAX	OCT	77777	
0824	01463	000000	FORDI	NOP		FFT TRANSFORM DIRECTION
0825	01464	000000	FORX	NOP		FFT REAL ARRAY
0826	01465	000000	FORY	NOP		FFT IMAGINARY ARRAY
0827	01466	000000	FORP1	NOP		FFT POWER SPECTRUM 1
0828	01467	000000	FORP2	NOP		FFT POWER SPECTRUM 2
0829	01470	000000	FORV1	NOP		FFT POWER VARIANCE 1
0830	01471	000000	FORV2	NOP		FFT POWER VARIANCE 2
0831	01472	000000	FORT1	NOP		FFT POWER TREND 1
0832	01473	000000	FORT2	NOP		FFT POWER TREND 2
0833	01474	000000	FORC	NOP		FFT CROSS SPECTRUM
0834	01475	000000	FORSN	NOP		FFT SERIAL NUMBER
0835	01476	000000	XFRM0	NOP		STORAGE FOR OPTION
0836	01477	000000	XFRMC	NOP		COUNT FOR ARRAYS
0837	01500	001464	XFRM1	DEF	FURX	START OF ARRAY TABLE
0838	01501	000000	XFRMP	NOP		POINTER TO ARRAY TABLE
0839	01502	000000	XFRML	NOP		POINTER TO LENGTH TABLE
0840	01503	001504	XFRM2	DEF	**1	LENGTH TABLE
0841	01504	000777		DEC	511,511,257,257,257,257,257,257,511,1	

```
0844*          START UP AND RECOVERY ENTRY POINT
0845  02000          ORG 2000B
0846  02000 000000  BEGIN NOP          SOME SYSTEMS ENTER WITH JSB
0847  02001 002400  CLA
0848  02002 024232  JMP RECOV+1
0849*
```

0851*	"ASK" AND		"TYPE" COMMANDS		
0852	02003	003400	ASK	CCA	
0853	02004	002001		RSS	
0854	02005	002400	TYPE	CLA	
0855	02006	070643		STA ATSW	SET FLAG A OR T
0856	02007	014316	TASK	JSB SPNDR	
0857	02010	051400		CPA B45	%
0858	02011	026062		JMP TFORM	
0859	02012	051376		CPA B42	"
0860	02013	026053		JMP TQUOT	
0861	02014	051375		CPA B41	!
0862	02015	026067		JMP TCRLF	
0863	02016	051377		CPA B44	\$
0864	02017	026073		JMP DUMP	
0865	02020	051405		CPA B54	,
0866	02021	026071		JMP TASK4	
0867	02022	051412		CPA B73	;
0868	02023	125171		JMP PR1,I	END OF ASK/TYPE; MORE ON SAME LINE
0869	02024	051366		CPA B15	
0870	02025	024327		JMP POPJ	
0871	02026	051402		CPA B51)
0872	02027	014220		JSB ERROR	
0873	02030	034643		ISZ ATSW	NO; A OR T?
0874	02031	026047		JMP TYPE2	
0875	02032	014542		JSB PUSHJ	ASK; GET VBL
0876	02033	006717		DEF GTARG	
0877	02034	060652		LDA CHAR	SAVE NEXT CH
0878	02035	014532		JSB PUSHA	
0879	02036	060636		LDA READP	SET READC
0880	02037	070640		STA INPUT	
0881	02040	002404		CLA,INA	READ FIRST DIGIT TOO
0882	02041	115130		JSB FNP,I	INPUT NUMBER
0883	02042	104400		DST PT1,I	
0884	02044	014612		JSB PUPA	
0885	02045	070652		STA CHAR	RESTORE CHAR
0886	02046	026003		JMP ASK	
0887*					
0888	02047	014542	TYPE2	JSB PUSHJ	EVALUATE EXPRESSION
0889	02050	004762		DEF EVAL	
0890	02051	114650		JSB FOUTP,I	AND TYPE IT
0891	02052	026005		JMP TYPE	
0892*					
0893	02053	014401	TQUOT	JSB GETC	OUTPUT TEXT BETWEEN QUOTES
0894	02054	051376		CPA B42	"
0895	02055	026071		JMP TASK4	END OF QUOTES
0896	02056	051366		CPA B15	
0897	02057	024327		JMP POPJ	CR = END OF COMMAND
0898	02060	114647		JSB OUTCH,I	OUTPUT TEXT CHARACTER
0899	02061	026053		JMP TQUOT	CONTINUE
0900*					
0901	02062	014401	TFORM	JSB GETC	READ FORMAT
0902	02063	014413		JSB GETLN	
0903	02064	060653		LDA LNNO	AND STORE IT
0904	02065	070661		STA FORM	
0905	02066	026007		JMP TASK	
0906*					

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0907 02067 061366 TCRLF LDA B15      TYPE CRLF
0908 02070 114647      JSB OUTCH,I
0909 02071 014401 TASK4 JSB GETC
0910 02072 026007      JMP TASK
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0912*          DUMP DIRECTORY TO VARIABLES VIA "TYPE S"
0913*          ALSO ACCESSED BY 'ASK S'...DON'T!!
0914  02073 060655  DUMP  LDA BUFR
0915  02074 070634          STA PT1          SET PTR TO VBL
0916  02075 050654          CPA LASTV         AT END?
0917  02076 026071          JMP TASK4        YES; DO REST OF COMMAND
0918  02077 160634          LDA PT1,I        GET VARIABLE NAME
0919  02100 001727          ALF,ALF          MORE SIG. CHARACTER
0920  02101 011443          AND B177        MASK OFF THE REST
0921  02102 114647          JSB OUTCH,I     OUTPUT M.S. CHARACTER
0922  02103 160634          LDA PT1,I        GET L.S. CHARACTER
0923  02104 011443          AND B177        MASK OFF THE REST
0924  02105 002003          SZA,RSS        CONVERT NULL
0925  02106 061374          LDA B40         TO SPACE
0926  02107 114647          JSB OUTCH,I     OUTPUT L.S. CHARACTER
0927  02110 061374          LDA B40         OUTPUT SPACE
0928  02111 114647          JSB OUTCH,I
0929  02112 034634          ISZ PT1        STEP PTR TO LENGTH
0930  02113 160634          LDA PT1,I        GET LENGTH
0931  02114 041315          ADA BM3        CONVERT TO MAX SUBSCRIPT
0932  02115 001100          ARS          SCALE
0933  02116 002002          SZA          DON'T OUTPUT ZERO
0934  02117 115132          JSB PRD,I       OUTPUT AS DECIMAL
0935  02120 061366          LDA B15        CRLF
0936  02121 114647          JSB OUTCH,I
0937  02122 060634          LDA PT1        STEP TO NEXT
0938  02123 140634          ADA PT1,I
0939  02124 026074          JMP DUMP+1     GO DO NEXT

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0941	02125	115133	BUF	JSB GT1,I	READ 1ST LETTER
0942	02126	051435		CPA B125	IS IT 'UNIT'
0943	02127	026163		JMP BUU	
0944	02130	072161		STA BUTEM	SAVE FUNCTION
0945	02131	060745		LDA BUNT	UNIT SELECTED?
0946	02132	002020		SSA	
0947	02133	016213		JSB BUSEL	DEFAULT TO UNIT 0
0948	02134	062161		LDA BUTEM	RESTORE FUNCTION
0949	02135	051433		CPA B123	S ?
0950	02136	026425		JMP BUST	
0951	02137	072162		STA BUFN	SET CURRENT FUNCTION
0952	02140	016621		JSB BUWT	WAIT TILL READY
0953	02141	066266		LDB BUCNT	SET NO OF ATTEMPTS
0954	02142	076267		STB BUECT	
0955	02143	062162		LDA BUFN	RESET CURRENT FUNCTION
0956	02144	051432		CPA B122	R
0957	02145	026270		JMP BURED	READ
0958	02146	051436		CPA B127	W
0959	02147	026340		JMP BUWR	WRITE
0960	02150	051417		CPA B105	E
0961	02151	026367		JMP BUWF	END FILE
0962	02152	051431		CPA B120	P
0963	02153	026444		JMP BUPOS	POSITION
0964	02154	051421		CPA B107	G
0965	02155	026401		JMP BUGP	GAP
0966	02156	051416		CPA B102	B
0967	02157	026413		JMP BUBK	BACKSPACE 1 RECORD
0968	02160	014214		JSB ERR2	ILLEGAL FUNCTION
0969*					
0970	02161	000000	BUTEM	NOP	
0971	02162	000000	BUFN	NOP	
0972*					
0973	02163	014542	BUU	JSB PUSHJ	GET UNIT NUMBER
0974	02164	006706		DEF ARG	
0975	02165	014220		JSB ERROR	NO UNIT NUMBER
0976	02166	061175		LDA FLAC	
0977	02167	065176		LDB FLAC+1	
0978	02170	115134		JSB IFX,I	
0979	02171	016213	BUU1	JSB BUSEL	SELECT UNIT
0980	02172	060652		LDA CHAR	SET OPTIONS, IF ANY
0981	02173	051405		CPA B54	, ?
0982	02174	002001		RSS	
0983	02175	027347		JMP COEND	ALL DONE
0984	02176	014401		JSB GETC	SKIP COMMA
0985	02177	115133		JSB GT1,I	READ OPTION
0986	02200	051427		CPA B116	N
0987	02201	026235		JMP BUOPN	NORMAL
0988	02202	051432		CPA B122	R
0989	02203	026234		JMP BUOPR	RETURN
0990	02204	051422		CPA B111	I
0991	02205	026241		JMP BUOPI	INTEGER I.E. BINARY
0992	02206	051416		CPA B102	B
0993	02207	026246		JMP BUOPB	BCD
0994	02210	051434		CPA B124	
0995	02211	026253		JMP BUOPT	SET NO OF TRIES
0996	02212	014214		JSB ERR2	ILLEGAL OPTION

0997*

0998	02213	000000	BUSEL	NOP	SELECT ROUTINE
0999	02214	011357		AND B3	MAKE IT LEGAL
1000	02215	070745		STA BUNT	SAVE UNIT NO
1001	02216	042227		ADA BUNTT	
1002	02217	160000		LDA 0,I	GET SELECT CODE
1003	02220	102613		OTA MTC	AND ISSUE IT
1004	02221	102513		LIA MTC	GET STATUS
1005	02222	010770		AND BUFLC	LOCAL?
1006	02223	002002		SZA	
1007	02224	026607		JMP BUABT	UNIT IN LOCAL.
1008	02225	035113		ISZ BUFLG	SET 'DONE'
1009	02226	126213		JMP BUSEL,I	

1010*

1011	02227	002230	BUNTT	DEF	++1	
1012	02230	001400		OCT	1400,2400,4400,10400	SELECT CODES

1014	02234	003401	BUOPR	CCA,RSS	'RETURN'; SET R
1015	02235	002400	BUOPN	CLA	'NORMAL'; CLEAR R
1016	02236	072240		STA BURFL	
1017	02237	026172		JMP BUU1+1	
1018	02240	000000	BURFL	NOP	
1019*					
1020*				SET UP READ/WRITE MODE	
1021	02241	060746	BUOPI	LDA BUFRI	READ BINARY
1022	02242	064750		LDB BUFWI	WRITE BINARY
1023	02243	072251		STA BURDC	SET UP COMMANDS
1024	02244	076252		STB BUWRC	
1025	02245	026172		JMP BUU1+1	
1026	02246	060747	BUOPB	LDA BUFRB	READ BCD
1027	02247	064751		LDB BUFWB	WRITE BCD
1028	02250	026243		JMP *-5	
1029	02251	100203	BURDC	OCT 100203	DEFAULT TO BCD
1030	02252	100301	BUWRC	OCT 100301	FOR BOTH READ WRITE
1031*					
1032	02253	014542	BUOPT	JSB PUSHJ	'TRY' OPTION
1033	02254	006706		DEF ARG	READ NO. OF TIMES
1034	02255	026263		JMP *+6	
1035	02256	061175		LDA FLAC	
1036	02257	065176		LDB FLAC+1	
1037	02260	115134		JSB IFX,I	CONVERT TO INTEGER
1038	02261	003004		CMA,INA	
1039	02262	002021		SSA,RSS	
1040	02263	003400		CCA	SET 1 IF 0 OR -VE
1041	02264	072266		STA BUCNT	
1042	02265	026172		JMP BUU1+1	
1043	02266	177775	BUCNT	DEC -3	
1044	02267	000000	BUECT	NOP	
1045*					
1046	02270	061354	BURED	LDA BMIN	INDICATE 'READ'
1047	02271	016525		JSB BUSTX	SET DATA POINTERS
1048	02272	016540		JSB BUSTN	SET COUNT OUTPUT VARIABLE
1049	02273	072551		STA BUN	
1050	02274	016554		JSB BUDMA	SET UP DMA
1051	02275	062251		LDA BURDC	GET READ COMMAND
1052	02276	016570		JSB BUGO	GO
1053	02277	016614		JSB BUTR	
1054	02300	016621		JSB BUWT	WAIT TILL DONE
1055	02301	010771		AND BUFEF	END OF FILE?
1056	02302	002002		SZA	
1057	02303	026327		JMP BUREF	YES
1058	02304	102513		LIA MTC	
1059	02305	010761		AND BUFET	END OF TAPE?
1060	02306	002002		SZA	
1061	02307	026330		JMP BUEND	YES
1062	02310	060774		LDA BUL	GET NUMBER READ
1063	02311	003004		CMA,INA	
1064	02312	106503		LIB DMAC2	
1065	02313	040001		ADA 1B	
1066	02314	016333		JSB BUSN	
1067	02315	102513		LIA MTC	GET MT STATUS
1068	02316	010764		AND BUFTP	CHECK TIMING AND PARITY
1069	02317	002002		SZA	

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1070	02320	026322		JMP BURER	ERROR
1071	02321	027347		JMP COEND	
1072	02322	036267	BURER	ISZ BUECT	
1073	02323	002001		RSS	
1074	02324	014214		JSB ERR2	TOO MANY ERRORS
1075	02325	016415		JSB BUBAK	
1076	02326	026274		JMP BURED+4	TRY AGAIN
1077*					
1078	02327	002401	BUREF	CLA,RSS	MAKE 0 FOR EOF
1079	02330	003400	BUEND	CCA	=1 FOR EOT
1080	02331	016333		JSB BUSN	SET COUNT TO N
1081	02332	027347		JMP COEND	
1082*					
1083	02333	000000	BUSN	NOP	SET COUNT TO N
1084	02334	105120		ABS -FLT	
1085	02335	104400		DST BUN,I	
1086	02337	126333		JMP BUSN,I	
1087*					
1088	02340	002400	BUWR	CLA	INDICATE 'WRITE'
1089	02341	016525		JSB BUSTX	SET DATA POINTERS
1090	02342	014542		JSB PUSHJ	IS LENGTH SPECIFIED?
1091	02343	006706		DEF ARG	
1092	02344	026352		JMP **6	NO; USE FULL ARRAY LENGTH
1093	02345	061175		LDA FLAC	YES; CONVERT TO INTEGER
1094	02346	065176		LDB FLAC+1	
1095	02347	115134		JSB IFX,I	
1096	02350	003004		CMA,INA	NEGATE
1097	02351	070774		STA BUL	SET AS -VE WORD COUNT
1098	02352	016554		JSB BUDMA	SET UP DMA
1099	02353	062252		LDA BUWRC	GET WRITE COMMAND
1100	02354	016570		JSB BUGO	GO
1101	02355	016614		JSB BUTR	
1102	02356	016621		JSB BUWT	WAIT TILL DONE
1103	02357	010761		AND BUFET	END OF TAPE?
1104	02360	002002		SZA	
1105	02361	026367		JMP BUEF	WRITE EOF THEN EOT ERROR
1106	02362	102513		LIA MTC	
1107	02363	010764		AND BUFTP	TIMING PARITY
1108	02364	002002		SZA	
1109	02365	014214		JSB ERR2	
1110	02366	027347		JMP COEND	
1111*					
1112	02367	016371	BUEF	JSB BUEOF	END FILE
1113	02370	027347		JMP COEND	
1114	02371	000000	BUEOF	NOP	
1115	02372	060752		LDA BUFWE	FILE MARK
1116	02373	016570		JSB BUGO	
1117	02374	016621		JSB BUWT	
1118	02375	010765		AND BUFEP	EOT, TIMING/PARITY
1119	02376	002002		SZA	
1120	02377	014214		JSB ERR2	
1121	02400	126371		JMP BUEOF,I	
1122*					
1123	02401	016403	BUGP	JSB BUGAP	GAP
1124	02402	027347		JMP COEND	
1125	02403	000000	BUGAP	NOP	

1126	02404	060753		LDA	BUFWG	GAP
1127	02405	016570		JSB	BUGO	
1128	02406	016621		JSB	BUWT	
1129	02407	010761		AND	BUFET	EOT?
1130	02410	002002		SZA		
1131	02411	014220		JSB	ERROR	
1132	02412	126403		JMP	BUGAP,I	
1133*						
1134	02413	016415	BUBK	JSB	BUBAK	BACKSPACE 1 RECORD
1135	02414	027347		JMP	COEND	
1136	02415	000000	BUBAK	NOP		
1137	02416	060755		LDA	BUFSB	
1138	02417	016570		JSB	BUGO	
1139	02420	016621		JSB	BUWT	
1140	02421	010762		AND	BUFST	START OF TAPE?
1141	02422	002002		SZA		
1142	02423	014220		JSB	ERROR	
1143	02424	126415		JMP	BUBAK,I	

1145	02425	016540	BUST	JSB BUSTN	GET OUTPUT VARIABLE
1146	02426	072552		STA BUS	
1147	02427	016621		JSB BUWT	WAIT TILL DONE
1148	02430	105120		ABS =FLT	FLOAT STATUS
1149	02431	104400		DST BUS,I	STORE AS STATUS VBL
1150	02433	062162		LDA BUFN	WAS I READING?
1151	02434	051432		CPA B122	
1152	02435	026437		JMP BUX	GET COUNT TOO
1153	02436	027347		JMP COEND	
1154	02437	060774	BUX	LDA BUL	INITIAL WORD COUNT
1155	02440	003004		CMA,INA	
1156	02441	106503		LIB DMAC2	FINAL WORD COUNT
1157	02442	040001		ADA 1	NO. READ
1158	02443	026331		JMP BUEND+1	GO WRITE TO 'N'
1159*					
1160	02444	014542	BUPOS	JSB PUSHJ	GET FILE COUNT
1161	02445	006706		DEF ARG	
1162	02446	026514		JMP BUP2	NO ARGUMENTS = REWIND
1163	02447	061175		LDA FLAC	
1164	02450	065176		LDB FLAC+1	
1165	02451	115134		JSB IFX,I	
1166	02452	002003		SZA,RSS	
1167	02453	026474		JMP BUP1	NO FILES; TRY RECORDS
1168	02454	070001		STA 1	
1169	02455	002021		SSA,RSS	MAKE FILE COUNT
1170	02456	003004		CMA,INA	
1171	02457	072524		STA BUCT	
1172	02460	060760		LDA BUFFF	FILES FORWARD
1173	02461	006020		SSB	
1174	02462	060757		LDA BUFFB	FILES BACKWARD
1175	02463	072553		STA BUCMD	
1176	02464	062553		LDA BUCMD	
1177	02465	016570		JSB BUGO	
1178	02466	016621		JSB BUWT	
1179	02467	010763		AND BUFSF	START OR END ?
1180	02470	002002		SZA	
1181	02471	027347		JMP COEND	QUIT AT ENDS OF TAPE
1182	02472	036524		ISZ BUCT	COUNT
1183	02473	026464		JMP **7	
1184*					
1185	02474	014542	BUP1	JSB PUSHJ	RECORD COUNT
1186	02475	006706		DEF ARG	
1187	02476	027347		JMP COEND	NONE
1188	02477	061175		LDA FLAC	
1189	02500	065176		LDB FLAC+1	
1190	02501	115134		JSB IFX,I	
1191	02502	002003		SZA,RSS	
1192	02503	027347		JMP COEND	ALL DONE
1193	02504	070001		STA 1	
1194	02505	002021		SSA,RSS	
1195	02506	003004		CMA,INA	
1196	02507	072524		STA BUCT	
1197	02510	060756		LDA BUFSF	RECORDS FORWARD
1198	02511	006020		SSB	
1199	02512	060755		LDA BUFSB	RECORDS BACKWARD
1200	02513	026463		JMP BUP1=9	


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1201*
1202 02514 102513 BUP2 LIA MTC REWIND; TEST BOT
1203 02515 010762 AND BUFST
1204 02516 002002 SZA
1205 02517 027347 JMP COEND ALREADY AT BOT
1206 02520 060754 LDA BUFRW REWIND
1207 02521 016570 JSB BUGO
1208 02522 016621 JSB BUWT
1209 02523 027347 JMP COEND
1210 02524 000000 BUCT NOP
1211*
1212 02525 000000 BUSTX NOP
1213 02526 072537 STA BUDIR SAVE READ/WRITE
1214 02527 014542 JSB PUSHJ GET X
1215 02530 006716 DEF GTARG=1
1216 02531 060634 LDA PT1 LOCATION
1217 02532 032537 IOR BUDIR COMBINE READ/WRITE
1218 02533 070773 STA BUPT
1219 02534 061070 LDA GTL LENGTH
1220 02535 070774 STA BUL
1221 02536 126525 JMP BUSTX,I
1222 02537 000000 BUDIR NOP
1223*
1224 02540 000000 BUSTN NOP SET UP COUNT OUTPUT VARIABLE
1225 02541 060652 LDA CHAR
1226 02542 051405 CPA B54 MUST BE COMMA
1227 02543 002001 RSS
1228 02544 014220 JSB ERROR NO OUTPUT VARIABLE
1229 02545 014542 JSB PUSHJ GET VARIABLE
1230 02546 006716 DEF GTARG=1
1231 02547 060634 LDA PT1
1232 02550 126540 JMP BUSTN,I
1233 02551 000000 BUN NOP
1234 02552 000000 BUS NOP
1235 02553 000000 BUCMD NOP

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1237	02554	000000	BUDMA	NOP	SET UP DMA
1238	02555	062567		LDA BUCW1	DMA CONTROL WORD
1239	02556	102607		OTA DMA2	
1240	02557	106703		CLC DMAC2	SET TO RECEIVE POINTER
1241	02560	060773		LDA BUPT	
1242	02561	102603		OTA DMAC2	
1243	02562	102703		STC DMAC2	AND LENGTH
1244	02563	060774		LDA BUL	
1245	02564	102603		OTA DMAC2	
1246	02565	103707		STC DMA2,C	START DMA
1247	02566	126554		JMP BUDMA,I	
1248	02567	020012	BUCW1	ABS MTD+20000B	CLC MTD WHEN DONE
1249*					
1250	02570	000000	BUGO	NOP	
1251	02571	006400		CLB	CLEAR DONE FLAG
1252	02572	075113		STB BUFLG	
1253	02573	070001		STA 1	SAVE COMMAND
1254	02574	102513		LIA MTC	GET MAG TAPE STATUS
1255	02575	010766		AND BUFRG	REWINDING?
1256	02576	002002		SZA	TEST
1257	02577	026574		JMP *-3	WAIT TILL DONE
1258	02600	106613		OTB MTC	ISSUE COMMAND
1259	02601	103713		STC MTC,C	START COMMAND
1260	02602	103712		STC MTD,C	START DATA
1261	02603	102513		LIA MTC	WAS IT REJECTED?
1262	02604	010767		AND BUFRJ	MASK REJECT BIT
1263	02605	002003		SZA,RSS	TEST
1264	02606	126570		JMP BUGO,I	OK! ALL DONE
1265*			ABORT MAG	TAPE TRANSFER	
1266	02607	035113	BUABT	ISZ BUFLG	SET "DONE"
1267	02610	107707		CLC DMA2,C	ABORT DMA
1268	02611	107712		CLC MTD,C	ABORT MAG TAPE DATA
1269	02612	107713		CLC MTC,C	ABORT MAG TAPE CONTROL
1270	02613	014220		JSB ERROR	QUIT
1271*					
1272	02614	000000	BUTR	NOP	TEST FOR 'RETURN' OPTION
1273	02615	062240		LDA BURFL	
1274	02616	002002		SZA	
1275	02617	027347		JMP COEND	
1276	02620	126614		JMP BUTR,I	
1277*					
1278	02621	000000	BUWT	NOP	
1279	02622	102513		LIA MTC	GET STATUS
1280	02623	010770		AND BUFLC	LOCAL?
1281	02624	002002		SZA	
1282	02625	026607		JMP BUABT	GO, ABORT
1283	02626	061113		LDA BUFLG	DONE?
1284	02627	002003		SZA,RSS	
1285	02630	026622		JMP *-6	WAIT TILL DONE
1286	02631	102513		LIA MTC	GET THE LATEST STATUS
1287	02632	126621		JMP BUWT,I	

1289	02633	000000	MTINR	NOP	MAG TAPE CHARACTER INPUT
1290	02634	035000		ISZ MTINC	ANY LEFT?
1291	02635	026674		JMP MTIN1	
1292	02636	035001		ISZ MTINT	TERMINATED?
1293	02637	026713		JMP MTIN3	NO! GO MAKE CR
1294	02640	061336		LDA BM2	RESET TERMINATE COUNT
1295	02641	071001		STA MTINT	
1296	02642	060776		LDA MTINB	GET BUFFER POINTER
1297	02643	070775		STA MTIN	
1298	02644	002300		CCE	
1299	02645	001500		ERA	
1300	02646	070773		STA BUPT	
1301	02647	060777		LDA MTINL	LENGTH
1302	02650	001100		ARS	CONVERT TO WORDS
1303	02651	070774		STA BUL	
1304	02652	061315		LDA BM3	SET ERROR COUNT
1305	02653	071002		STA MTERC	
1306	02654	016554	MTIN2	JSB BUDMA	SET UP DMA
1307	02655	060747		LDA BUFRB	READ
1308	02656	016570		JSB BUGO	
1309	02657	016621		JSB BUWT	WAIT TILL DONE
1310	02660	010772		AND BUFT	EOF, EOT
1311	02661	002002		SZA	
1312	02662	014214		JSB ERR2	
1313	02663	102503		LIA DMAC2	GET NUMBER READ
1314	02664	001000		ALS	CONVERT TO CHARACTER COUNT
1315	02665	003004		CMA, INA	
1316	02666	040777		ADA MTINL	
1317	02667	071000		STA MTINC	
1318	02670	102513		LIA MTC	GET MAGTAPE STATUS
1319	02671	010764		AND BUFTP	CHECK TIMING AND PARITY
1320	02672	002002		SZA	
1321	02673	026717		JMP MTINE	ERROR
1322*					
1323	02674	064775	MTIN1	LDB MTIN	READ BUFFER
1324	02675	004065		CLE, ERB	
1325	02676	160001		LDA I, I	
1326	02677	002041		SEZ, RSS	ODD/EVEN IS IN LINK
1327	02700	001727		ALF, ALF	
1328	02701	034775		ISZ MTIN	STEP POINTER
1329	02702	011414		AND B77	
1330	02703	000065		CLE, ERA	CONVERT BCD-ASCII
1331	02704	041003		ADA MTAB1	POINT TO TABLE
1332	02705	160000		LDA 0, I	PICK UP ASCII
1333	02706	002041		SEZ, RSS	
1334	02707	001727		ALF, ALF	POSITION EVEN CHARACTER
1335	02710	011443		AND B177	RUB OUT THE OTHER HALF
1336	02711	070652		STA CHAR	
1337	02712	126633		JMP MTINR, I	
1338*					
1339	02713	003400	MTIN3	CCA	TERMINATE;
1340	02714	071000		STA MTINC	RESET EXPIRING COUNT
1341	02715	061366		LDA B15	AND MAKE CR
1342	02716	026711		JMP *-5	
1343*					
1344	02717	035002	MTINE	ISZ MTERC	COUNT PARITY ERRORS

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1345	02720	002001	RSS		
1346	02721	014220	JSB ERROR	TOO MANY	
1347	02722	016415	JSB BUBAK	BACKSPACE	
1348	02723	026654	JMP MTIN2	AND TRY AGAIN	
1349*					
1350	02724	020061	MTAB ASC 16,	1234567890=0!>* /STUVWXYZ+,Z=!"	
1351	02744	026512	ASC 16,	=JKLMNOPQR!S*)]]+ABCDEFGHI?.[(<↑	

1353	02764	000000	MTOPR	NOP	MAG TAPE CHARACTER OUTPUT
1354	02765	011443		AND B177	
1355	02766	051366		CPA B15	CR?
1356	02767	027046		JMP MTOP3	
1357	02770	035007		ISZ MTOPC	FULL?
1358	02771	027023		JMP MTOP2	
1359	02772	071010		STA MTOCH	SAVE CHARACTER
1360	02773	061005	MTOP1	LDA MTOPB	WRITE OUT BUFFER
1361	02774	000065		CLE,ERA	
1362	02775	070773		STA BUPT	
1363	02776	061004		LDA MTOP	SET COUNT
1364	02777	003004		CMA,INA	
1365	03000	041005		ADA MTOPB	
1366	03001	002003		SZA,RSS	NOTHING?
1367	03002	027060		JMP MTOP0	ADD SOME NULL CHARACTERS
1368	03003	001100		ARS	LOSE L.S. / =ROUND UP
1369	03004	070774	MTOP4	STA BUL	
1370	03005	016554		JSB BUDMA	
1371	03006	060751		LDA BUFWB	WRITE
1372	03007	016570		JSB BUGO	
1373	03010	016621		JSB BUWT	
1374	03011	010765		AND BUFEP	EOT, TIMING, PARITY
1375	03012	002002		SZA	
1376	03013	014214		JSB ERR2	
1377	03014	061005		LDA MTOPB	RESET POINTERS COUNTS
1378	03015	071004		STA MTOP	
1379	03016	061006		LDA MTOPL	
1380	03017	071007		STA MTOPC	
1381	03020	061010		LDA MTOCH	CHECK SAVED CHARACTER
1382	03021	051366		CPA B15	CR?
1383	03022	126764		JMP MTOPR,I	ALL DONE IF CR
1384*					
1385	03023	041342	MTOP2	ADA BM40	CONVERT ASCII-BCD
1386	03024	002020		SSA	
1387	03025	126764		JMP MTOPR,I	LOSE LF, FF, ETC
1388	03026	011414		AND B77	
1389	03027	000065		CLE,ERA	
1390	03030	041011		ADA MTAB2	POINT TO ASCII-BCD TABLE
1391	03031	160000		LDA 0,I	PICK UP BCD
1392	03032	002041		SEZ,RSS	
1393	03033	001727		ALF,ALF	POSITION EVEN CHARACTER
1394	03034	011414		AND B77	
1395	03035	065004		LDB MTOP	WRITE TO BUFFER
1396	03036	004065		CLE,ERB	
1397	03037	002041		SEZ,RSS	
1398	03040	001727		ALF,ALF	
1399	03041	002040		SEZ	
1400	03042	140001		ADA 1,I	ADD IN M.S. HALF
1401	03043	170001		STA 1,I	
1402	03044	035004		ISZ MTOP	STEP POINTER
1403	03045	126764		JMP MTOPR,I	
1404*					
1405	03046	071010	MTOP3	STA MTOCH	SAVE CR
1406	03047	061004		LDA MTOP	CHECK BUFFER
1407	03050	002011		SLA,RSS	
1408	03051	026773		JMP MTOP1	EVEN IS OK

1409	03052	000065		CLE,ERA	POSITION POINTER
1410	03053	164000		LDB 0,I	PICK UP PART WORD
1411	03054	045370		ADB B20	FILL UP WITH SPACE
1412	03055	174000		STB 0,I	
1413	03056	035004		ISZ MTOP	COUNT THE EXTRA CHARACTER
1414	03057	026773		JMP MTOP1	
1415*					
1416	03060	061460	MTOP0	LDA BSPSP	NULL RECORD; MAKE SPACE-SPACE
1417	03061	065005		LDB MTOPB	
1418	03062	004065		CLE,ERB	POSITION BUFFER POINTER
1419	03063	170001		STA 1,I	
1420	03064	003400		CCA	SET ONE WORD
1421	03065	027004		JMP MTOP4	
1422*					
1423	03066	010052	MTB2	OCT 10052,17413,25434,30036	
1424	03072	036455		OCT 36455,26060,15440,35421	
1425	03076	005001		OCT 05001,01003,02005,03007	
1426	03102	004011		OCT 04011,06456,37035,07072	
1427	03106	006061		OCT 06061,31063,32065,33067	
1428	03112	034071		OCT 34071,20442,21444,22446	
1429	03116	023450		OCT 23450,24422,11424,12426	
1430	03122	013430		OCT 13430,14474,10057,37432	

1432*	'DO' COMMAND				
1433	03126	014413	DO	JSB GETLN	SET LNNO,LGAFI
1434	03127	014552		JSB PUSHF	
1435	03130	000626		DEF TXOUT	SAVE TXOUT, PC
1436	03131	014552	DOGRP	JSB PUSHF	
1437	03132	000652		DEF CHAR	SAVE CHAR, LNNO
1438	03133	060651		LDA LGAFI	TEST LINE=GROUP=ALL
1439	03134	014532		JSB PUSHA	SAVE LGAFI
1440	03135	002020		SSA	
1441	03136	027172		JMP DOONE	ONE LINE
1442	03137	014351		JSB FNDLN	SET LSTLN,THSLN, TXOUT
1443	03140	000000		NOP	
1444	03141	060630		LDA THSLN	
1445	03142	002004		INA	
1446	03143	160000		LDA 0,I	PICK UP LINE NO.
1447	03144	014332		JSB TSTGP	
1448	03145	014220		JSB ERROR	WRONG GROUP
1449	03146	014542		JSB PUSHJ	
1450	03147	003470		DEF PRCSS=2	UPDATE PC
1451	03150	014612		JSB POPA	RESTORE LINE=GROUP=ALL
1452	03151	070651		STA LGAFI	
1453	03152	014575		JSB POPF	
1454	03153	000652		DEF CHAR	RESTORE CHAR, LNNO
1455	03154	160627		LDA PC,I	NEXT LINE?
1456	03155	002003		SZA,RSS	
1457	03156	027202		JMP DONE	END OF TEXT
1458	03157	002004		INA	
1459	03160	070634		STA PT1	
1460	03161	060651		LDA LGAFI	
1461	03162	000010		SLA	ALL OR GROUP?
1462	03163	027167		JMP **4	
1463	03164	160634		LDA PT1,I	GROUP
1464	03165	014332		JSB TSTGP	
1465	03166	027202		JMP DONE	END OF GROUP
1466	03167	160634		LDA PT1,I	SAME GROUP OR ALL
1467	03170	070653		STA LNNO	
1468	03171	027131		JMP DOGRP	CONTINUE
1469*					
1470	03172	014351	DOONE	JSB FNDLN	FIND THE LINE
1471	03173	014220		JSB ERROR	NO SUCH LINE
1472	03174	014542		JSB PUSHJ	
1473	03175	003472		DEF PRCSS	DON'T UPDATE PC
1474	03176	014612		JSB POPA	RESTORE LINE=GROUP=ALL
1475	03177	070651		STA LGAFI	
1476	03200	014575		JSB POPF	
1477	03201	000652		DEF CHAR	RRSTORE CHAR, LNNO
1478	03202	014575	DONE	JSB POPF	RESTORE TXOUT, PC
1479	03203	000626		DEF TXOUT	
1480	03204	125172		JMP PR,I	

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1482*      'ERASE' COMMAND
1483 03205 014316 ERASE JSB SPNOR
1484 03206 014277      JSB SORT
1485 03207 027241      JMP ERVAR      OP/TERM; E
1486 03210 027222      JMP ERLIN      NUMBER; E X,Y
1487 03211 051355      CPA B1        LETTER; E A
1488 03212 002001      RSS
1489 03213 014220      JSB ERROR      NOT A
1490 03214 060656      LDA ENDT      ERASE ALL
1491 03215 070655      STA BUFR      TEXT
1492 03216 070654      STA LASTV     AND VARIABLES
1493 03217 002400      CLA
1494 03220 170657      STA TEXT0,I
1495 03221 024110      JMP START
1496*
1497 03222 014413      ERLIN JSB GETLN      ERASE LINE OR GROUP
1498 03223 060655      LDA BUFR
1499 03224 001200      RAL
1500 03225 070616      STA TXIN
1501 03226 017244      ERGRP JSB DELET
1502 03227 060651      LDA LGAFL
1503 03230 002020      SSA
1504 03231 027241      JMP ERVAR      ONE LINE
1505 03232 034630      ISZ THSLN     GROUP
1506 03233 160630      LDA THSLN,I
1507 03234 014332      JSB TSTGP
1508 03235 027241      JMP ERVAR      DONE; ERASE VBLs TOO
1509 03236 160630      LDA THSLN,I
1510 03237 070653      STA LNNO
1511 03240 027226      JMP ERGRP
1512 03241 060655      ERVAR LDA BUFR      JUST VARIABLES
1513 03242 070654      STA LASTV
1514 03243 024327      JMP POPJ
1515*
1516*      DELETE SUBROUTINE USED BY 'ERASE', 'MODIFY' AND
1517*      WHEN READING IN A NEW LINE.
1518 03244 000000      DELET NOP
1519 03245 103100      CLF 0
1520 03246 014351      JSB FNOLN
1521 03247 127244      JMP DELET,I
1522 03250 014401      JSB GETC      FIND END OF LINE
1523 03251 051366      CPA B15
1524 03252 002001      RSS
1525 03253 027250      JMP *-3
1526 03254 060626      LDA TXOUT     HOW MANY?
1527 03255 001100      ARS
1528 03256 003004      CMA,INA
1529 03257 040630      ADA THSLN
1530 03260 070644      STA CNTR
1531 03261 060657      LDA TEXT0     DON'T RUB FIRST LINE
1532 03262 050630      CPA THSLN
1533 03263 024110      JMP START
1534 03264 160630      LDA THSLN,I  PTR TO NEXT LINE
1535 03265 170632      STA LSTLN,I  SET INTO LAST LINE
1536 03266 060657      LDA TEXT0     START AT BEGINNING
1537 03267 070621      DEL1 STA T2    FIRST MODIFY CHAIN OF PTRS

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1538	03270	160621	LDA T2,I	LINE POINTER
1539	03271	002003	SZA,RSS	ZERO = DONE
1540	03272	027305	JMP DELX	
1541	03273	070620	STA T1	
1542	03274	060630	LDA THSLN	AFTER ERASED BIT?
1543	03275	003104	CMA,CLE,INA	
1544	03276	040620	ADA T1	
1545	03277	002440	CLA,SEZ	
1546	03300	060644	LDA CNTR	IF YES, MOD POINTER
1547	03301	040620	ADA T1	
1548	03302	170621	STA T2,I	
1549	03303	060620	LDA T1	NEXT
1550	03304	027267	JMP DEL1	
1551	03305	060630	DELX LDA THSLN	THEN MOVE DOWN TEXT
1552	03306	070623	STA T4	
1553	03307	064644	LDB CNTR	
1554	03310	007004	CMB,INB	
1555	03311	040001	ADA 1B	
1556	03312	070624	STA T5	
1557	03313	060644	LDA CNTR	UPDATE BUFR
1558	03314	040655	ADA BUFR	
1559	03315	070655	STA BUFR	
1560	03316	060616	LDA TXIN	
1561	03317	001100	ARS	
1562	03320	003000	CMA	
1563	03321	040624	ADA T5	
1564	03322	070620	STA T1	
1565	03323	060616	LDA TXIN	UPDATE TXIN
1566	03324	040644	ADA CNTR	
1567	03325	040644	ADA CNTR	
1568	03326	070616	STA TXIN	
1569	03327	160624	LDA T5,I	
1570	03330	034624	ISZ T5	
1571	03331	170623	STA T4,I	
1572	03332	034623	ISZ T4	
1573	03333	034620	ISZ T1	
1574	03334	027327	JMP *-5	
1575	03335	027245	JMP DELET+1	

1577*		'FOR' AND	'SET' COMMANDS;	ASSIGNMENT STATEMENTS
1578	03336 061012	PCSET	LDA PCTEM	NORMAL ASSIGNMENT STATEMENT
1579	03337 070626		STA TXOUT	
1580	03340 061013		LDA PCTEM+1	
1581	03341 070652		STA CHAR	
1582	03342 002001		RSS	
1583	03343 014401		JSB GETC	
1584	03344 017356	SET	JSB XSET	'SET' FOR 'FICAL' COMPATIBILITY
1585	03345 051405		CPA B54	, ?
1586	03346 027343		JMP SET-1	
1587	03347 060652	COEND	LDA CHAR	
1588	03350 051412		CPA B73	; CONTINUE WITH THIS LINE
1589	03351 125171		JMP PR1,I	
1590	03352 051366		CPA B15	CR
1591	03353 024327		JMP POPJ	
1592	03354 014401		JSB GETC	RUN GARBAGE
1593	03355 027347		JMP COEND	
1594*				
1595	03356 000000	XSET	NOP	
1596	03357 014542		JSB PUSHJ	FIND DESTINATION
1597	03360 006717		DEF GTARG	
1598	03361 014316		JSB SPNOR	
1599	03362 051413		CPA B75	NEXT MUST BE =
1600	03363 002001		RSS	
1601	03364 014220		JSB ERROR	NO IT ISN'T
1602	03365 060634		LDA PT1	SAVE DESTINATION
1603	03366 014532		JSB PUSHA	
1604	03367 014542		JSB PUSHJ	EVALUATE EXPRESSION
1605	03370 004761		DEF EVAL-1	
1606	03371 164617		LDB PDL,I	TRANSFER RESULT
1607	03372 074634		STB PT1	SAVE POINTER
1608	03373 034617		ISZ PDL	DONE WITH POINTER
1609	03374 061175		LDA FLAC	
1610	03375 065176		LDB FLAC+1	
1611	03376 104400		DST PT1,I	
1612	03400 014316		JSB SPNOR	RUN SPACES
1613	03401 127356		JMP XSET,I	
1614*				
1615	03402 017356	FOR	JSB XSET	'FOR' COMMAND
1616	03403 060634		LDA PT1	
1617	03404 014532		JSB PUSHA	SAVE PTR TO VAR
1618	03405 014542		JSB PUSHJ	
1619	03406 006706		DEF ARG	
1620	03407 014220		JSB ERROR	MISSING ARG
1621	03410 014316		JSB SPNOR	
1622	03411 051412		CPA B73	; TEST FOR 2-ARG FORM
1623	03412 027460		JMP FOR2	
1624	03413 014552		JSB PUSHF	SAVE STEP
1625	03414 001175		DEF FLAC	
1626	03415 014542		JSB PUSHJ	
1627	03416 006706		DEF ARG	
1628	03417 014220		JSB ERROR	WRONG FORMAT
1629	03420 014316		JSB SPNOR	
1630	03421 014552	FOR1	JSB PUSHF	SAVE END VALUE
1631	03422 001175		DEF FLAC	
1632	03423 014552		JSB PUSHF	SAVE TEXT POINTER

1633	03424	000626		DEF TXOUT	
1634	03425	014542	FORCO	JSB PUSHJ	PROCESS
1635	03426	003472		DEF PRCSS	
1636	03427	014575		JSB POPF	RESTORE TEXT POINTER
1637	03430	000626		DEF TXOUT	
1638	03431	014575		JSB POPF	RESTORE END VALUE
1639	03432	001175		DEF FLAC	
1640	03433	014575		JSB POPF	RESTORE STEP
1641	03434	003463		DEF FORTM	
1642	03435	014612		JSB POPA	GET PTR TO VAR
1643	03436	070634		STA PT1	
1644	03437	104200		OLD 0,I	GET VARIABLE
1645	03441	105000		ABS =FAD	INCREMENT IT
1646	03442	003463		DEF FORTM	
1647	03443	104400		DST PT1,I	SAVE INCREMENTED VARIABLE
1648	03445	105020		ABS =FSB	SUBTRACT END
1649	03446	001175		DEF FLAC	
1650	03447	067463		LDB FORTM	WHICH WAY WAS I GOING ?
1651	03450	006021		SSB,RSS	TEST SIGN OF INCREMENT
1652	03451	003000		CMA	REVERSE SIGN IF COUNTING UP
1653	03452	002026		SSA,INA,SZA	TEST IF DONE
1654	03453	024327		JMP POPJ	COUNT COMPLETE
1655	03454	060617		LDA PDL	STEP BACK PDL POINTER
1656	03455	041317		ADA BM7	
1657	03456	070617		STA PDL	
1658	03457	027425		JMP FORCO	
1659*					
1660	03460	014552	FOR2	JSB PUSMF	
1661	03461	001302		DEF FL1	
1662	03462	027421		JMP FOR1	
1663	03463	000000	FORTM	DEC 0,	

Address	Label	Command	Command Processing
1665*	'GO' OR 'GOTO'	COMMAND AND	COMMAND PROCESSING
1666	03465 014413	GOTO JSB GETLN	
1667	03466 014351	JSB FNDLN	
1668	03467 014220	JSB ERROR	
1669	03470 060030	LDA THSLN	
1670	03471 070627	STA PC	
1671	03472 014401	PRCSS JSB GETC	
1672	03473 102501	PROC LIA 1	READ SWITCHES
1673	03474 002020	SSA	TEST SIGN BIT
1674	03475 024231	JMP RECOV	EXIT ON SIGN BIT
1675	03476 014316	JSB SPNDR	
1676	03477 051366	CPA B15	
1677	03500 024327	JMP POPJ	
1678	03501 051412	CPA B73	?
1679	03502 027472	JMP PRCSS	
1680	03503 071013	STA PCTEM+1	SAVE CHAR
1681	03504 060626	LDA TXOUT	SAVE POINTER
1682	03505 071012	STA PCTEM	
1683	03506 115133	JSB GT1,I	GET NEXT CH
1684	03507 064652	LDB CHAR	EXAMINE TERMINATOR
1685	03510 055413	CPB B75	IS IT = ?
1686	03511 027336	JMP PCSET	YES
1687	03512 055401	CPB B50	(?
1688	03513 027336	JMP PCSET	
1689	03514 041327	ADA BM133	BEYOND Z?
1690	03515 002021	SSA,RSS	
1691	03516 027521	JMP **+3	
1692	03517 041372	ADA B32	BEFORE A?
1693	03520 002020	SSA	
1694	03521 014220	ILCOM JSB ERROR	ILLEGAL COMMAND
1695	03522 043524	ADA COMGO	
1696	03523 124000	JMP 0B,I	
1697*			
1698	03524 103525	COMGO DEF **+1,I	COMMAND ENTRIES
1699	03525 002003	DEF ASK	A
1700	03526 002125	DEF BUF	B
1701	03527 000327	DEF POPJ	C
1702	03530 003126	DEF DO	D
1703	03531 003205	DEF ERASE	E
1704	03532 003402	DEF FOR	F
1705	03533 003465	DEF GOTO	G
1706	03534 003521	DEF ILCOM	H
1707	03535 003557	DEF IF	I
1708	03536 003521	DEF ILCOM	J
1709	03537 003521	DEF ILCOM	K
1710	03540 003521	DEF ILCOM	L
1711	03541 003612	DEF MOD	M
1712	03542 004560	DEF NCODE	N
1713	03543 004015	DEF OPTN	O
1714	03544 004155	DEF XLOT	P
1715	03545 000110	DEF START	Q
1716	03546 000325	DEF RETRN	R
1717	03547 003344	DEF SET	S
1718	03550 002005	DEF TYPE	T
1719	03551 004504	DEF UNPK	U
1720	03552 004674	DEF VAR	V

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1721	03553	004702	DEF WRITE	W
1722	03554	003521	DEF ILCOM	X
1723	03555	003521	DEF ILCOM	Y
1724	03556	004745	DEF ZER	Z

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1726*      'IF' COMMAND
1727 03557 014316 IF      JSB SPNOR
1728 03560 051401        CPA B50      (
1729 03561 002001        RSS
1730 03562 014220        JSB ERRQR   NOT (
1731 03563 014542        JSB PUSHJ   EVALUATE EXPRESSION
1732 03564 004761        DEF EVAL-1
1733 03565 014342        JSB PARTS   TEST )
1734 03566 061175        LDA FLAC    TEST EXPRESSION
1735 03567 002020        SSA
1736 03570 027465        JMP GOTO   SKIP NONE IF +VE
1737 03571 007400        CCB        B=-1
1738 03572 002002        SZA
1739 03573 005000        BLS        OR B=-2 IF EXPN +VE
1740 03574 074620        STB T1
1741 03575 060652 IF3   LDA CHAR
1742 03576 051405        CPA B54
1743 03577 027606        JMP IF1
1744 03600 051412        CPA B73
1745 03601 027472        JMP PRCS
1746 03602 051366        CPA B15   CR END OF LINE
1747 03603 024327        JMP POPJ
1748 03604 014401        JSB GETC
1749 03605 027576        JMP *-7
1750 03606 014401 IF1   JSB GETC   SKIP OVER COMMA
1751 03607 034620        ISZ T1    COUNT COMMAS
1752 03610 027575        JMP IF3   GET ANOTHER COMMA
1753 03611 027465        JMP GOTO  ENOUGH? GOTO!

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Line	Address	Command	Description
1755*		'MODIFY' COMMAND	
1756	03612 014413	MOD JSB GETLN	
1757	03613 002021	SSA,RSS	TEST SOURCE LINE
1758	03614 014220	JSB ERROR	NOT 1 LINE
1759	03615 060626	LDA TXOUT	SAVE TEXT
1760	03616 073703	STA MODT	
1761	03617 014351	JSB FNDLN	SET LSTLN, THSLN TXOUT
1762	03620 014220	JSB ERROR	NO SUCH LINE
1763	03621 063703	LDA MODT	RESTORE TEXT
1764	03622 064626	LDB TXOUT	SAVE SOURCE
1765	03623 070626	STA TXOUT	
1766	03624 077703	STB MODT	
1767	03625 060652	LDA CHAR	TEST ,
1768	03626 051405	CPA B54	
1769	03627 027675	JMP MODNL	GO GET NEW LINE NO
1770	03630 063703	MOD1 LDA MODT	RESTORE SOURCE
1771	03631 070626	STA TXOUT	
1772	03632 064655	LDB BUFR	SET UP OUTPUT LINE
1773	03633 006004	INB	
1774	03634 060653	LDA LNNO	
1775	03635 170001	STA 1,I	
1776	03636 006004	INB	
1777	03637 005200	RBL	
1778	03640 074616	STB TXIN	
1779	03641 074633	STB PAKST	
1780	03642 115135	MODSK JSB TT1,I	READ TTY SILENTLY
1781	03643 011443	AND B177	
1782	03644 073702	STA MODCH	
1783	03645 014401	MODCP JSB GETC	COPY TILL SRCH CH OR END
1784	03646 115123	JSB PRC,I	OUTPUT ON TTY
1785	03647 060652	LDA CHAR	
1786	03650 115125	JSB PKC,I	
1787	03651 051366	CPA B15	CR
1788	03652 024177	JMP MODX	END OF LINE
1789	03653 053702	CPA MODCH	SEARCH CH
1790	03654 027660	JMP MODFD	"
1791	03655 027645	JMP MODCP	CONTINUE
1792*			
1793	03656 060633	MODBA LDA PAKST	BACK ARROW
1794	03657 070616	STA TXIN	LOSE COPIED TEXT
1795	03660 115124	MODFD JSB RDC,I	READ TEXT OR EDIT COMMANDS
1796	03661 051365	CPA B14	FORM=FEED
1797	03662 027645	JMP MODCP	SEARCH AGAIN
1798	03663 051362	CPA B7	BELL
1799	03664 027642	JMP MODSK	CHANGE SEARCH CH
1800	03665 051440	CPA B137	BACK ARROW
1801	03666 027656	JMP MODBA	LOSE TEXT
1802	03667 051364	CPA B12	LINE FEED
1803	03670 027644	JMP MODSK+2	COPY REST OF LINE
1804	03671 115125	JSB PKC,I	
1805	03672 051366	CPA B15	CR
1806	03673 024177	JMP MODX	TERMINATE LINE
1807	03674 027660	JMP MODFD	CONTINUE
1808*			
1809*		READ LINE NUMBER FOR MODIFIED LINE	
1810	03675 014401	MODNL JSB GETC	PASS COMMA

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1811 03676 014413      JSB GETLN   NEW NO
1812 03677 002020      SSA        TEST LGAFL
1813 03700 027630      JMP MOD1
1814 03701 014220      JSB ERROR  NOT SINGLE LINE
1815 03702 000000      MODCH NOP  SEARCH CH
1816 03703 000000      MODT NOP
1817*
1818*
1819*          TELETYPE OUTPUT BUFFER
1820 03704 000000      TTBUF BSS 72
1821 04014          TTEND EQU *
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1823*      'INCODE' COMMAND LISTED WITH 'UNPACK' BELOW
1824*
1825*      'OPTION' COMMAND
1826      04014 014401      JSB GETC      GET NEXT OPTION
1827      04015 115133      OPTN  JSB GT1,I
1828      04016 051432      CPA B122      R
1829      04017 026037      JMP OPTNR     HIGH SPEED READER
1830      04020 051424      CPA B113      K
1831      04021 026046      JMP OPTNK     KEYBOARD
1832      04022 051431      CPA B120      P
1833      04023 026050      JMP OPTNP     PUNCH
1834      04024 051434      CPA B124      T
1835      04025 026056      JMP OPTNT     TYPE
1836      04026 051425      CPA B114      L
1837      04027 026061      JMP OPTNL     LINE PRINTER
1838      04030 051420      CPA B106      F
1839      04031 026071      JMP OPTNF     FIXED OUTPUT FORMAT
1840      04032 051421      CPA B107      G
1841      04033 026070      JMP OPTNG     GENERAL OUTPUT FORMAT
1842      04034 051426      CPA B115      M
1843      04035 026074      JMP OPTNM     MAG TAPE I/O
1844      04036 014220      JSB ERROR     ILLEGAL OPTION
1845*
1846      04037 061163      OPTNR LDA HSRDR  SET H.S. READER
1847      04040 070646      STA INCH     FOR CHARACTER INPUT
1848      04041 103715      STC HSR,C   INITIATE
1849      04042 060652      OPTN1 LDA CHAR   ANY MORE OPTIONS?
1850      04043 051405      CPA B54     , ?
1851      04044 026014      JMP OPTN-1  GO GET NEXT
1852      04045 125173      JMP COX,I   ALL DONE
1853*
1854      04046 015014      OPTNK JSB TTRON  SET KEYBOARD INPUT
1855      04047 026042      JMP OPTN1
1856*
1857      04050 061165      OPTNP LDA HSPCH  SET H.S. PUNCH
1858      04051 070647      STA OUTCH   FOR CHARACTER OUTPUT
1859      04052 107716      CLC PNCH,C  INITIALISE
1860      04053 002404      CLA,INA
1861      04054 071107      STA PNCHF   CLEAR 'BUSY'
1862      04055 026042      JMP OPTN1
1863*
1864      04056 061166      OPTNT LDA TTYPN  SET TTY PUNCH
1865      04057 070647      STA OUTCH   FOR CHARACTER OUTPUT
1866      04060 026042      JMP OPTN1
1867*
1868      04061 062066      OPTNL LDA LPR    SET LINEPRINTER
1869      04062 070647      STA OUTCH   FOR CHARACTER OUTPUT
1870      04063 000000      NOP        SPACE TO KEEP IN STEP
1871      04064 000000      NOP
1872      04065 026042      JMP OPTN1
1873      04066 007230      LPR  DEF LPDUT
1874      04067 007224      LPI  DEF LPIR
1875*
1876      04070 002401      OPTNG CLA,RSS   CLEAR
1877      04071 002404      OPTNF CLA,INA   OR SET
1878      04072 071056      STA FORMF    "FIXED" FORMAT FLAG

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1879	04073	026042		JMP OPTN1	
1880*					
1881	04074	014316	OPTNM	JSB SPNOR	CHECK ,
1882	04075	051405		CPA B54	
1883	04076	002001		RSS	
1884	04077	014220		JSB ERROR	NOT ,
1885	04100	014401		JSB GETC	PASS ,
1886	04101	115133		JSB GT1,I	READ I OR O
1887	04102	051422		CPA B111	I
1888	04103	026113		JMP OPTMI	INPUT
1889	04104	051430		CPA B117	O
1890	04105	026137		JMP OPTMO	OUTPUT
1891	04106	051423		CPA B112	J
1892	04107	026127		JMP OPTMS=2	CONTINUE MAG TAPE INPUT
1893	04110	051431		CPA B120	P
1894	04111	026152		JMP OPTM2	CONTINUE OUTPUT
1895	04112	014220		JSB ERROR	ILLEGAL MAG TAPE OPTION
1896*					
1897	04113	014542	OPTMI	JSB PUSHJ	SET UP INPUT BUFFER
1898	04114	006716		DEF GTARG=1	
1899	04115	060634		LDA PT1	
1900	04116	000066		CLE,ELA	
1901	04117	070775		STA MTIN	
1902	04120	070776		STA MTINB	
1903	04121	061070		LDA GTL	= LENGTH
1904	04122	001000		ALS	CONVERT TO CHARACTER COUNT
1905	04123	070777		STA MTINL	
1906	04124	003400		CCA	SET BUFFER EMPTY
1907	04125	071000		STA MTINC	
1908	04126	071001		STA MTINT	SET 'TERMINATED'
1909	04127	061167		LDA MTINP	SET MT INPUT ROUTINE
1910	04130	070646		STA INCH	
1911	04131	060745	OPTMS	LDA BUNT	UNIT SELECTED?
1912	04132	002021		SSA,RSS	
1913	04133	026042		JMP OPTN1	
1914	04134	002400		CLA	DEFAULT TO UNIT 0
1915	04135	115136		JSB BSL,I	
1916	04136	026042		JMP OPTN1	
1917*					
1918	04137	014542	OPTMO	JSB PUSHJ	SET UP OUTPUT BUFFER
1919	04140	006716		DEF GTARG=1	
1920	04141	060634		LDA PT1	
1921	04142	000066		CLE,ELA	
1922	04143	071004		STA MTOP	
1923	04144	071005		STA MTOPB	
1924	04145	061070		LDA GTL	
1925	04146	001000		ALS	
1926	04147	041335		ADA BM1	PLUS ONE
1927	04150	071007		STA MTOPC	
1928	04151	071006		STA MTOPL	
1929	04152	061170	OPTM2	LDA MTOPP	SET MT OUTPUT ROUTINE
1930	04153	070647		STA QUTCH	
1931	04154	026131		JMP OPTMS	GO CHECK IF UNIT SELECTED

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1933*      PLOT COMMAND (BUFFERED)
1934*      CALLS) P X,Y,OPTION OR P X,Y
1935*      OPTION =VE; INITIALISE, CURRENT POINT (X,Y); RAISE PEN
1936*      +VE, EVEN OR OMITTED; PLOT TO (X,Y), PEN DOWN
1937*      +VE, ODD; PLOT TO (X,Y) WITH PEN UP
1938 04155 014542 XLOT JSB PUSHJ GET X
1939 04156 004762 DEF EVAL
1940 04157 061175 LDA FLAC PICK UP X
1941 04160 065176 LDB FLAC+1
1942 04161 105040 ABS =FMP SCALE X
1943 04162 001025 DEF PLXS
1944 04163 115134 JSB IFX,I CONVERT TO INTEGER
1945 04164 041354 ADA BMIN CONVERT TO ONES COMP
1946 04165 000065 CLE,ERA TRUNCATE TO 15 BITS
1947 04166 171021 STA PLI,I X TO BUFFER; NOT RECURSIVE
1948 04167 014542 JSB PUSHJ GET Y
1949 04170 006706 DEF ARG
1950 04171 014220 JSB ERROR NO Y
1951 04172 061175 LDA FLAC
1952 04173 065176 LDB FLAC+1
1953 04174 105040 ABS =FMP SCALE Y
1954 04175 001027 DEF PLYS
1955 04176 115134 JSB IFX,I CONVERT TO INTEGER
1956 04177 041354 ADA BMIN CONVERT TO ONES COMP
1957 04200 000065 CLE,ERA CLEAR SIGN AND
1958 04201 001121 ARS,ARS TRUNCATE TO 13 BITS
1959 04202 071034 STA PLYN SAVE Y
1960 04203 014542 JSB PUSHJ GET OPTION
1961 04204 006706 DEF ARG
1962 04205 026215 JMP **8 NO OPTION=OPTION 0
1963 04206 061175 LDA FLAC GET OPTION
1964 04207 065176 LDB FLAC+1
1965 04210 115134 JSB IFX,I OPTION TO A AS INTEGER
1966 04211 001300 RAR POSITION LS AND SIGN
1967 04212 011353 AND BCRT MASK OFF
1968 04213 031034 IOR PLYN INCLUDE IN Y
1969 04214 002001 RSS
1970 04215 061034 LDA PLYN OPTION 0
1971 04216 065021 LDB PL: GET BUFFER POINTER
1972 04217 006004 INB STEP PTR FROM X TO Y
1973 04220 170001 STA 1,I STORE Y AND OPTION
1974 04221 006004 INB STEP BUFFER POINTER
1975 04222 055023 CPB PL1 END OF BUFFER?
1976 04223 065022 LDB PL0 RESET TO START
1977 04224 055024 PLTST CPB PLO IS BUFFER NOW FULL?
1978 04225 026376 JMP PLFUL YES; WAIT TILL IT ISN'T
1979 04226 075021 STB PLI SET UPDATED POINTER
1980*
1981 04227 061032 LDA PLSW BUSY?
1982 04230 002003 SZA,RSS 0=BUSY
1983 04231 125173 JMP COX,I YES; ALL DONE
1984*
1985 04232 002400 CLA SET BUSY
1986 04233 071032 STA PLSW
1987 04234 071033 STA PLFL1 SET '1ST TIME'
1988*

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1989	04235	061035	PLSTT	LDA PLX	INITIATE LINE PLOT
1990	04236	071037		STA PLNX	SET UP 'NOW' PTRS
1991	04237	061036		LDA PLY	
1992	04240	071040		STA PLNY	
1993	04241	161024		LDA PLO,I	PICK UP X
1994	04242	071036		STA PLX	SET DESTINATION
1995	04243	035024		ISZ PLO	
1996	04244	161024		LDA PLO,I	PICK UP Y
1997	04245	011031		AND PLMSY	MASK Y
1998	04246	071036		STA PLY	
1999	04247	161024		LDA PLO,I	GET OPTION
2000	04250	011353		AND BCRIT	MASK OPTION BITS
2001	04251	001200		RAL	POSITION OPTION
2002	04252	065024		LDB PLO	STEP BUFFER POINTER
2003	04253	006004		INB	
2004	04254	055023		CPB PL1	END OF BUFFER?
2005	04255	065022		LDB PLO	RESET TO START
2006	04256	075024		STB PLO	SET UPDATED POINTER
2007	04257	002020		SSA	TEST OPTION
2008	04260	026363		JMP PLRST	VE; RESET ORIGIN
2009	04261	070001		STA 1	SAVE PEN POSN IN B
2010	04262	021041		XOR PLPEN	TEST PEN POSITION
2011	04263	002003		SZA,RSS	
2012	04264	026272		JMP PLXX	UNCHANGED
2013	04265	075041		STB PLPEN	SWAP PEN POSITION
2014	04266	061374		LDA B40	PEN DOWN
2015	04267	006002		SZB	
2016	04270	061370		LDA B20	PEN UP
2017	04271	016402		JSB PLWT	GO, MOVE PEN
2018*					
2019	04272	061035	PLXX	LDA PLX	FORM DX
2020	04273	003104		CMA,CLE,INA	
2021	04274	041037		ADA PLNX	
2022	04275	006441		CLB,SEZ,RSS	TAKE MODULUS
2023	04276	003004		CMA,INA	
2024	04277	071042		STA PLDX	
2025	04300	005600		ELB	MOTION TO B
2026	04301	061036		LDA PLY	FORM DY
2027	04302	003104		CMA,CLE,INA	
2028	04303	041040		ADA PLNY	
2029	04304	002020		SSA	TAKE MODULUS
2030	04305	003004		CMA,INA	
2031	04306	071043		STA PLDY	
2032	04307	005600		ELB	Y MOTION TO B
2033	04310	075044		STB PLMV	SAVE MOTION BITS
2034	04311	003104		CMA,CLE,INA	WHICH IS GREATER?
2035	04312	041042		ADA PLDX	
2036	04313	002040		SEZ	
2037	04314	026325		JMP PLOT2	DX GREATER
2038	04315	061042		LDA PLDX	DY GREATER; SWAP
2039	04316	065043		LDB PLDY	
2040	04317	071043		STA PLDY	
2041	04320	075042		STB PLDX	
2042	04321	002404		CLA,INA	SET UP MAJOR MOTION
2043	04322	011044		AND PLMV	MASK Y MOTION
2044	04323	041047		ADA PLT1	Y MOTION TABLE

2045	04324	026330		JMP **+4	
2046	04325	061044	PLOT2	LDA PLMV	GET MOTION BITS
2047	04326	001100		ARS	POSITION X MOTION
2048	04327	041050		ADA PLT2	X MOTION TABLE
2049	04330	164000		LDB 0,I	
2050	04331	075045		STB PLMAJ	MAJOR MOTION
2051	04332	061043		LDA PLDY	GET MINOR MOTION
2052	04333	003004		CMA,INA	NEGATE IT FOR PLOT COUNT
2053	04334	071043		STA PLDY	
2054	04335	002003		SZA,RSS	TEST FOR ZERO
2055	04336	026342		JMP **+4	IF 0, COMBINED=MAJOR
2056	04337	061044		LDA PLMV	MOTION BITS
2057	04340	041051		ADA PLT3	COMBINED MOTION TABLE
2058	04341	164000		LDB 0,I	
2059	04342	075046		STB PLCOM	COMBINED MOTION
2060	04343	065042		LDB PLDX	SET STEP COUNT
2061	04344	007000		CMB	+1; COUNT BEFORE STEP
2062	04345	075044		STB PLMV	
2063	04346	065042		LDB PLOX	START PLOT COUNT
2064	04347	005100		BR5	WITH MAJOR DELTA/2
2065	04350	035044	PLOT3	ISZ PLMV	DONE?
2066	04351	002101		CLE,RSS	
2067	04352	026367		JMP PLEX	END OF THIS SEGMENT
2068	04353	045043		ADB PLDY	STEP PLOT COUNT BY MINOR
2069	04354	061045		LDA PLMAJ	SET EITHER MAJOR MOTION
2070	04355	002040		SEZ	OR, IF O'FLOW
2071	04356	026361		JMP **+3	
2072	04357	031046		IOR PLCOM	SET COMBINED MOTION
2073	04360	045042		ADB PLDX	AND ADD MAJOR TO COUNT
2074	04361	016402		JSB PLWT	GO PLOT
2075	04362	026350		JMP PLOT3	
2076*					
2077	04363	002404	PLRST	CLA,INA	INITIALISE
2078	04364	071041		STA PLPEN	PEN UP
2079	04365	061370		LDA B20	
2080	04366	016402		JSB PLWT	
2081	04367	061024	PLEX	LDA PLO	ANY MORE IN BUFFER?
2082	04370	051021		CPA PLI	
2083	04371	002401		CLA,RSS	NO
2084	04372	026235		JMP PLSTT	CONTINUE PLOTTING
2085	04373	035032		ISZ PLSW	CLEAR 'BUSY'
2086	04374	016402		JSB PLWT	SHOULD NOT RETURN
2087	04375	014220		JSB ERROR	UNEXPECTED PLOTTER INTERRUPT
2088*					
2089*					
					BUFFER FULL; TEST SWITCHES
2090	04376	102501	PLFUL	LIA 1	READ SWITCHES
2091	04377	002020		SSA	TEST SIGN BIT
2092	04400	024231		JMP RECOV	QUIT IF -VE
2093	04401	026224		JMP PLTST	
2094*					
2095	04402	004401	PLWT	DEF *-1	PLOT I/O
2096	04403	075052		STB PLT	PRESERVE 0
2097	04404	002003		SZA,RSS	NULL INSTRUCTION?
2098	04405	026410		JMP **+3	
2099	04406	102620		OTA PLOT	OUTPUT INSTRUCTION
2100	04407	103720		STC PLOT,C	

2101	04410	061033	LDA PLFL1	1ST TIME?
2102	04411	002002	SZA	
2103	04412	026415	JMP *+3	
2104	04413	035033	ISZ PLFL1	SET 'NOT 1ST TIME'
2105	04414	125173	JMP COX,I	1ST TIME EXIT
2106	04415	061053	LDA PLEO	NORMAL EXIT
2107	04416	103101	CLO	
2108	04417	000036	SLA,ELA	
2109	04420	102101	STF I	
2110	04421	061054	LDA PLAB	RESTORE A
2111	04422	065055	LDB PLAB+1	AND B
2112	04423	126424	JMP PLIR,I	
2113*				
2114	04424	000000	PLIR NOP	PLOTTER IR ROUTINE
2115	04425	103120	CLF PLOT	CLEAR FLAG
2116	04426	071054	STA PLAB	SAVE REGISTERS
2117	04427	075055	STB PLAB+1	
2118	04430	001520	ERA,ALS	
2119	04431	102201	SOC	
2120	04432	002004	INA	
2121	04433	071053	STA PLEO	
2122	04434	065052	LDB PLT	
2123	04435	126402	JMP PLWT,I	
2124*				
2125*	BUFFER			
2126			PLBUF REP 30	
2127	04436	000000	NOP	
2127	04437	000000	NOP	
2127	04440	000000	NOP	
2127	04441	000000	NOP	
2127	04442	000000	NOP	
2127	04443	000000	NOP	
2127	04444	000000	NOP	
2127	04445	000000	NOP	
2127	04446	000000	NOP	
2127	04447	000000	NOP	
2127	04450	000000	NOP	
2127	04451	000000	NOP	
2127	04452	000000	NOP	
2127	04453	000000	NOP	
2127	04454	000000	NOP	
2127	04455	000000	NOP	
2127	04456	000000	NOP	
2127	04457	000000	NOP	
2127	04460	000000	NOP	
2127	04461	000000	NOP	
2127	04462	000000	NOP	
2127	04463	000000	NOP	
2127	04464	000000	NOP	
2127	04465	000000	NOP	
2127	04466	000000	NOP	
2127	04467	000000	NOP	
2127	04470	000000	NOP	
2127	04471	000000	NOP	
2127	04472	000000	NOP	
2127	04473	000000	NOP	

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2128	04474		PLEND EQU *
2129	04474	000004	PLTB1 DEC 4,8
2130	04476	000001	PLTB2 DEC 1,2
2131	04500	000005	PLTB3 DEC 5,9,6,10

2133* 'QUIT' COMMAND TRANSFERS CONTROL TO 'START'.
 2134*
 2135* 'RETURN' COMMAND LISTED WITH 'POPJ' SUBROUTINE.
 2136*
 2137* 'SET' COMMAND LISTED WITH 'FOR', ABOVE.
 2138*
 2139* 'TYPE' COMMAND LISTED WITH 'ASK', ABOVE.
 2140*
 2141* 'UNPACK' COMMAND;
 2142* CONVERTS BCD OR BINARY ('INTEGER'
 2143* TO AVOID CONFUSION OF INITIAL LETTERS) TO INTERNAL
 2144* FLOATING POINT FORMAT
 2145 04504 016644 UNPK JSB UNPK0 SET UP ARRAYS AND COUNTS
 2146 04505 100200 MPY UNPKN
 2147 04507 072555 STA UNPKN =LENGTH REQUIRED FOR OUTPUT
 2148 04510 003104 CMA,CLE,INA
 2149 04511 041070 ADA GTL COMPARE LENGTH AVAILABLE
 2150 04512 065070 LDB GTL
 2151 04513 002042 SEZ,SZA SKIP IF SUFFICIENT
 2152 04514 076555 STB UNPKN OTHERWISE SET SHORTER
 2153*
 2154 04515 162553 UNPK2 LDA UNPKS,I GET DATA
 2155 04516 036553 ISZ UNPKS
 2156 04517 066552 LDB UNPK0 FIND OPTION
 2157 04520 055416 CPB B102
 2158 04521 026524 JMP UNPKB
 2159 04522 016540 JSB UNPKR
 2160 04523 026515 JMP UNPK2
 2161*
 2162 04524 072556 UNPKB STA UNPKT SAVE L.S.
 2163 04525 001727 ALF,ALF GET M.S.
 2164 04526 011452 AND B377
 2165 04527 051364 CPA B12
 2166 04530 002400 CLA COPE WITH CODED ZERO
 2167 04531 016540 JSB UNPKR
 2168 04532 062556 LDA UNPKT GET L.S.
 2169 04533 011452 AND B377
 2170 04534 051364 CPA B12
 2171 04535 002400 CLA
 2172 04536 016540 JSB UNPKR
 2173 04537 026515 JMP UNPK2
 2174*
 2175 04540 000000 UNPKR NOP STORE AND COUNT
 2176 04541 105120 ABS =FLT DATA TO FLOATING POINT
 2177 04542 170634 STA PT1,I STORE DATA
 2178 04543 034634 ISZ PT1
 2179 04544 174634 STB PT1,I
 2180 04545 034634 ISZ PT1
 2181 04546 036555 ISZ UNPKN DOESN'T SKIP
 2182 04547 036555 ISZ UNPKN .COUNT
 2183 04550 126540 JMP UNPKR,I MORE TO COME
 2184 04551 125173 JMP COX,I ALL DONE
 2185*
 2186 04552 000000 UNPK0 NOP OPTION
 2187 04553 000000 UNPKS NOP SOURCE
 2188 04554 000000 UNPKL NOP SOURCE LENGTH

PAGE 0053 #01 ONCAL COMMANDS

2189	04555	000000	UNPKN NOP	WORD COUNT
2190	04556	000000	UNPKT NOP	TEMP STORAGE, BCD UNPACK
2191	04557	000000	UNPKF NOP	FRACTION FLAG, BCD PACK

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2193*      NCODE COMMAND; INVERSE OF UNPACK
2194  04560 016644  NCODE JSB UNPK0   SET UP ARRAYS AND COUNTS
2195  04561 007400          CCB
2196  04562 100400          DIV UNPKN   *O/P REQUIRED
2197  04564 072555          STA UNPKN
2198  04565 076557          STB UNPKF   FRACTION (0 FOR INTEGER)
2199  04566 003104          CMA,CLE,INA
2200  04567 041070          ADA GTL     COMPARE LENGTH AVAILABLE
2201  04570 006441          CLB,SEZ,RSS
2202  04571 026575          JMP **4
2203  04572 076557          STB UNPKF   SET SHORTER
2204  04573 065070          LDB GTL
2205  04574 076555          STB UNPKN
2206*
2207  04575 162553  PACK2 LDA UNPKS,I  GET DATA
2208  04576 036553          ISZ UNPKS  AND STEP POINTER
2209  04577 166553          LDB UNPKS,I
2210  04600 036553          ISZ UNPKS
2211  04601 115134          JSB IFX,I   CONVERT TO INTEGER
2212  04602 066552          LDB UNPKD  OPTION?
2213  04603 055416          CPB B102
2214  04604 026625          JMP PACKB  BCD
2215  04605 170634  PACK3 STA PT1,I   INTEGER
2216  04606 034634          ISZ PT1
2217  04607 036555          ISZ UNPKN  DONE?
2218  04610 026575          JMP PACK2
2219  04611 062557          LDA UNPKF  BCD HALF WORD?
2220  04612 002021          SSA,RSS
2221  04613 125173          JMP COX,I
2222  04614 104200          DLD UNPKS,I
2223  04616 115134          JSB IFX,I
2224  04617 011414          AND B77
2225  04620 002003          SZA,RSS
2226  04621 061364          LDA B12
2227  04622 001727          ALF,ALF
2228  04623 170634          STA PT1,I
2229  04624 125173          JMP COX,I
2230*
2231  04625 011414  PACKB AND B77   PACK BCD
2232  04626 002003          SZA,RSS   TEST FOR ZERO
2233  04627 061364          LDA B12
2234  04630 001727          ALF,ALF
2235  04631 170634          STA PT1,I
2236  04632 162553          LDA UNPKS,I  GET 2ND CHARACTER
2237  04633 036553          ISZ UNPKS  STEP POINTER
2238  04634 166553          LDB UNPKS,I
2239  04635 036553          ISZ UNPKS
2240  04636 115134          JSB IFX,I   CONVERT TO INTEGER
2241  04637 011414          AND B77
2242  04640 002003          SZA,RSS
2243  04641 061364          LDA B12
2244  04642 140634          ADA PT1,I
2245  04643 026605          JMP PACK3

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2247	04644	000000	UNPK0	NOP	SET UP 'UNPACK' AND 'PACK'
2248	04645	115133		JSB GT1,I	GET OPTION
2249	04646	072552		STA UNPK0	
2250	04647	051416		CPA B102	IS IT 'BCD'
2251	04650	026654		JMP JNPK1	
2252	04651	051422		CPA B111	IS IT 'INTEGER'
2253	04652	026654		JMP UNPK1	
2254	04653	014220		JSB ERROR	
2255*					
2256	04654	014542	UNPK1	JSB PUSHJ	GET SOURCE ARRAY
2257	04655	006716		DEF GTARG=1	SKIPPING TERMINATOR
2258	04656	060634		LDA PT1	POSITION
2259	04657	072553		STA UNPKS	
2260	04660	061070		LDA GTL	AND LENGTH
2261	04661	072554		STA UNPKL	
2262	04662	014542		JSB PUSHJ	GET DESTINATION
2263	04663	006716		DEF GTARG=1	SKIPPING TERMINATOR
2264	04664	066552		LOB UNPK0	GET OPTION
2265	04665	061356		LDA B2	RATIO 2
2266	04666	055416		CPB B102	
2267	04667	061360		LDA B4	OR 4 IF BCD
2268	04670	072555		STA UNPKN	
2269	04671	062554		LDA UNPKL	=LENGTH
2270	04672	128644		JMP UNPK0,I	

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2272*      'VARIABLE', 'WRITE', 'ZERO'
2273*
2274*      'VARIABLE' COMMAND TO SET UP VARIABLES
2275*      LIKE THE FORTRAN 'DIMENSION' STATEMENT
2276 04673 014401      JSB GETC      COMMA; DO ANOTHER
2277 04674 014542      VAR      JSB PUSHJ      SET UP VARIABLES
2278 04675 006717      DEF GTARG
2279 04676 014316      JSB SPNOR
2280 04677 051405      CPA B54      ,
2281 04700 026673      JMP VAR=1      MORE
2282 04701 125173      JMP COX,I
2283*
2284*      'WRITE' COMMAND
2285 04702 014413      WRITE JSB GETLN      WRITE LINE, GROUP OR ALL TEXT
2286 04703 014351      JSB FNDLN      FIND LINE
2287 04704 026734      JMP WRIT1      NOT FOUND; GROUP OR ALL?
2288 04705 060653      LDA LNNO
2289 04706 002002      SZA
2290 04707 115127      JSB PRL,I      PRINT NON-ZERO LINE NO
2291 04710 014401      JSB GETC      PRINT LINE
2292 04711 114647      JSB OUTCH,I
2293 04712 060652      LDA CHAR
2294 04713 051366      CPA B15      UNTIL CR
2295 04714 002001      RSS
2296 04715 026710      JMP *-5
2297 04716 160630      LDA THSLN,I      TRY NEXT LINE
2298 04717 002003      WRIT2 SZA,RSS
2299 04720 024327      JMP POPJ      END OF TEXT
2300 04721 002004      INA
2301 04722 070634      STA PT1
2302 04723 060651      LDA LGAFL
2303 04724 002020      SSA
2304 04725 024327      JMP POPJ      EXIT IF SINGLE LINE
2305 04726 160634      LDA PT1,I      CONTINUE IF GROUP OR ALL
2306 04727 014332      JSB TSTGP
2307 04730 026736      JMP WRIT3      DIFFERENT GROUP
2308 04731 160634      WRIT4 LDA PT1,I
2309 04732 070653      STA LNNO      CONTINUE SOMEWHAT INELEGANTLY
2310 04733 026703      JMP WRITE+1    ...BUT IT WORKS
2311*
2312 04734 060630      WRIT1 LDA THSLN
2313 04735 026717      JMP WRIT2
2314*
2315 04736 060651      WRIT3 LDA LGAFL      IF NOT ALL, THEN DONE
2316 04737 002011      SLA,RSS
2317 04740 024327      JMP POPJ
2318 04741 061366      LDA B15      ALL; CONTINUE
2319 04742 114647      JSB OUTCH,I
2320 04743 026731      JMP WRIT4
2321*
2322*      'ZERO' COMMAND TO ZERO OUT AN ARRAY
2323 04744 014401      JSB GETC      COMMA; DO ANOTHER
2324 04745 014542      ZER      JSB PUSHJ
2325 04746 006717      DEF GTARG      SET PT1 AND GTL
2326 04747 061070      LDA GTL      PICK UP LENGTH
2327 04750 006400      CLB

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2328	04751	174634	STB	PT1,I	
2329	04752	034634	ISZ	PT1	
2330	04753	002006	INA	SZA	
2331	04754	026751	JMP	*=3	
2332	04755	014316	JSB	SPNQR	
2333	04756	051405	CPA	B54	,
2334	04757	026744	JMP	ZER=1	MORE
2335	04760	125173	JMP	COX,I	

2338	04761	014401		JSB GETC	RECURSIVE EVALUATE ROUTINE
2339	04762	002400	EVAL	CLA	
2340	04763	070641		STA LSTOP	
2341	04764	071175		STA FLAC	SET 0 IN FLAC
2342	04765	071176		STA FLAC+1	
2343	04766	014277		JSB SORT	
2344	04767	027011		JMP EVOP1	OP/TERM AS FIRST CH
2345	04770	027144		JMP EVNUM	NUMBER
2346	04771	051361	EVVAR	CPA B6	LETTER? IS IT F?
2347	04772	027151		JMP EVFUN	IF SO, IT IS A FUNCTION
2348	04773	060641		LDA LSTOP	SAVE LSTOP
2349	04774	014532		JSB PUSHA	
2350	04775	014542		JSB PUSHJ	
2351	04776	006725		DEF GTVAR	
2352	04777	014612		JSB POPA	RESTORE LSTOP
2353	05000	070641		STA LSTOP	
2354	05001	104200		DLD PT1,I	TRANSFER VARIABLE
2355	05003	071175		STA FLAC	TO FLAC
2356	05004	075176		STB FLAC+1	
2357	05005	014277	EVOPR	JSB SORT	
2358	05006	027025		JMP EVOP2	OP/TERM IS EXPECTED
2359	05007	000000		NOP	NUMBER
2360	05010	014220		JSB ERROR	OR LETTER ARE ILLEGAL
2361*					
2362	05011	002003	EVOP1	SZA,RSS	RUN SPACES
2363	05012	026761		JMP EVAL=1	
2364	05013	051361		CPA B6	(
2365	05014	027131		JMP EVOP3+3	
2366	05015	051356		CPA B2	IS IT UNARY =?
2367	05016	027033		JMP EVOP4=1	
2368	05017	051355		CPA B1	IS IT UNARY PLUS?
2369	05020	027067		JMP EVARG	JUST IGNORE IT
2370	05021	041362		ADA B7	TERMINATOR?
2371	05022	002020		SSA	
2372	05023	014220		JSB ERROR	
2373	05024	024327		JMP POPJ	TERMINATOR = NULL = 0
2374*					
2375	05025	051361	EVOP2	CPA B6	(
2376	05026	014220		JSB ERROR	
2377	05027	041317		ADA BM7	TERMINATOR?
2378	05030	002021		SSA,RSS	
2379	05031	002401		CLA,RSS	SET OPERATION 0
2380	05032	041362		ADA B7	
2381	05033	070631		STA THSOP	
2382	05034	064631	EVOP4	LDB THSOP	COMPAKE PRIORITIES
2383	05035	007004		CMB,INB	
2384	05036	044641		ADB LSTOP	
2385	05037	060641		LDA LSTOP	
2386	05040	006020		SSB	
2387	05041	027062		JMP EVPAR	
2388	05042	002003		SZA,RSS	ALL DONE?
2389	05043	024327		JMP POPJ	
2390	05044	043074		ADA EVOPT	SET UP OPERATION
2391	05045	160000		LDA 0B,I	
2392	05046	073051		STA EVOP	
2393	05047	104200		OLD PUL,I	GET ARGUMENT FROM PDL

2394	05051	000000	EVOP	NOP	CARRY OUT OPERATION	LSTOP
2395	05052	001175		DEF	FLAC	
2396	05053	071175		STA	FLAC	RESULT TO FLAC
2397	05054	075176		STB	FLAC+1	
2398	05055	034617		ISZ	PDL	DUMP USED ARGUMENT
2399	05056	034617		ISZ	PDL	
2400	05057	014612		JSB	PUPA	RESTORE OP FROM STACK
2401	05060	070641		STA	LSTOP	
2402	05061	027034		JMP	EVOP4	
2403*						
2404	05062	014532	EVPAR	JSB	PUSHA	SAVE OP
2405	05063	014552		JSB	PUSHF	AND FLAC ON STACK
2406	05064	001175		DEF	FLAC	
2407	05065	060631		LDA	THSOP	
2408	05066	070641		STA	LSTOP	
2409	05067	014401	EVARG	JSB	GETC	EXPECT AN ARGUMENT
2410	05070	014277		JSB	SORT	
2411	05071	027126		JMP	EVOP3	OP/TERM MUST BE (
2412	05072	027144		JMP	EVNUM	NUMBER
2413	05073	026771		JMP	EVVAR	LETTER
2414*						
2415	05074	005074	EVOPT	DEF	*	OPERATION TABLE
2416	05075	105000		ABS	=FAD	
2417	05076	105020		ABS	=FSB	
2418	05077	105060		ABS	=FDV	
2419	05100	105040		ABS	=FMP	
2420	05101	027102		JMP	EVPOW	
2421*						
2422	05102	061175	EVPOW	LDA	FLAC	EXPONENTIATE ROUTINE
2423	05103	065176		LDB	FLAC+1	GET POWER
2424	05104	115134		JSB	IFX,I	INTEGER PART
2425	05105	073125		STA	EVPWI	SAVE IT
2426	05106	105120		ABS	=FLT	FLOAT IT
2427	05107	105020		ABS	=FSB	SAME AS FLAC ?
2428	05110	001175		DEF	FLAC	
2429	05111	002002		SZA		
2430	05112	027120		JMP	EVPWF	NO; FRACTIONAL POWER
2431	05113	115137		JSB	RTI,I	YES; INTEGER POWER
2432	05114	100617		DEF	PDL,I	
2433	05115	005125		DEF	EVPWI	
2434	05116	014220		JSB	ERROR	NO GOOD
2435	05117	027053		JMP	EVOP+2	
2436*						
2437	05120	115140	EVPWF	JSB	RTR,I	EVALUATE FRACTIONAL POWER
2438	05121	100617		DEF	PDL,I	AS EXP(POWER*LOG(BASE))
2439	05122	001175		DEF	FLAC	
2440	05123	014220		JSB	ERROR	NO GOOD
2441	05124	027053		JMP	EVOP+2	
2442*						
2443	05125	000000	EVPWI	NOP		

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2445	05126	051361	EVOP3	CPA B6	(
2446	05127	002001		RSS	
2447	05130	014220		JSB ERROR	
2448	05131	060641		LDA LSTOP	SAVE LAST OP
2449	05132	014532		JSB PUSHA	
2450	05133	014542		JSB PUSHJ	EVALUATE WITHIN PARENTHESES
2451	05134	004761		DEF EVAL=1	SKIPPING (
2452	05135	014612		JSB POPA	RESTORE LAST OP
2453	05136	070641		STA LSTOP	
2454	05137	014342		JSB PARTS	CHECK PARENTHESES
2455	05140	027005		JMP EVOPR	LOOK FOR NEXT OP
2456	05141	071175	EVFNX	STA FLAC	STORE FUNCTION RESULT
2457	05142	075176		STB FLAC+1	
2458	05143	027135		JMP **6	
2459*					
2460	05144	060637	EVNUM	LDA GETCP	SET TO READ TEXT
2461	05145	070640		STA INPUT	
2462	05146	002400		CLA USE CHAR AS 1ST DIGIT	
2463	05147	115130		JSB FNP,I	READ NUMBER
2464	05150	027003		JMP EVOPR=2	
2465*					
2466*	FUNCTION; READ	NAME			
2467	05151	002400	EVFUN	CLA	CLEAR FUNCTION
2468	05152	070642		STA EVFNM	
2469	05153	014401		JSB GETC	READ NEXT CH
2470	05154	014277		JSB SORT	
2471	05155	027165		JMP **8	OP/TERM
2472	05156	000000		NOP	NUMBER
2473	05157	064642		LDB EVFNM	LETTER; ADD IN TO NAME
2474	05160	005720		BLF,BLS	SHIFT 5 PLACES
2475	05161	060652		LDA CHAR	PLUS 5 NEW BITS
2476	05162	011373		AND B37	
2477	05163	040001		ADA 18	
2478	05164	027152		JMP EVFUN+1	
2479	05165	051361		CPA B6	(
2480	05166	002001		RSS	
2481	05167	014220		JSB ERROR	
2482	05170	060641		LDA LSTOP	SAVE LSTOP
2483	05171	014532		JSB PUSHA	
2484	05172	060642		LDA EVFNM	SAVE FUNCTION
2485	05173	014532		JSB PUSHA	
2486	05174	014542		JSB PUSHJ	
2487	05175	004761		DEF EVAL=1	
2488	05176	014612		JSB POPA	RESTORE FUNCTION
2489	05177	050664		CPA FABS	ABS
2490	05200	124715		JMP PABS,I	
2491	05201	050665		CPA FSGN	SGN
2492	05202	124716		JMP PSGN,I	
2493	05203	050666		CPA FINT	INT
2494	05204	124717		JMP PINT,I	
2495	05205	050667		CPA FITR	ITR
2496	05206	124717		JMP PINT,I	
2497	05207	050670		CPA FDIS	DIS
2498	05210	124720		JMP PDIS,I	
2499	05211	050671		CPA FATN	ATN
2500	05212	124721		JMP PATN,I	

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2501	05213	050672	CPA	FEXP	EXP		
2502	05214	124722	JMP	PEXP,I			
2503	05215	050673	CPA	FLOG	LOG		
2504	05216	124723	JMP	PLOG,I			
2505	05217	050674	CPA	FSIN	SIN		
2506	05220	124724	JMP	PSIN,I			
2507	05221	050675	CPA	FCOS	COS		
2508	05222	124725	JMP	PCOS,I			
2509	05223	050676	CPA	FSQT	SQT		
2510	05224	124726	JMP	PSQT,I			
2511	05225	050677	CPA	FAND	AND		
2512	05226	124727	JMP	PAND,I			
2513	05227	050700	CPA	FIOR	IOR		
2514	05230	124730	JMP	PIOR,I			
2515	05231	050701	CPA	FXOR	XOR		
2516	05232	124731	JMP	PXOR,I			
2517	05233	050702	CPA	FIN	IN		
2518	05234	124732	JMP	PIN,I			
2519	05235	050703	CPA	FOUT	OUT		
2520	05236	124733	JMP	POUT,I			
2521			REP	14			
2522	05237	000000	NOP		SPACE FOR SPECIAL FUNTIONS		
2522	05240	000000	NOP		SPACE FOR SPECIAL FUNTIONS		
2522	05241	000000	NOP		SPACE FOR SPECIAL FUNTIONS		
2522	05242	000000	NOP		SPACE FOR SPECIAL FUNTIONS		
2522	05243	000000	NOP		SPACE FOR SPECIAL FUNTIONS		
2522	05244	000000	NOP		SPACE FOR SPECIAL FUNTIONS		
2522	05245	000000	NOP		SPACE FOR SPECIAL FUNTIONS		
2522	05246	000000	NOP		SPACE FOR SPECIAL FUNTIONS		
2522	05247	000000	NOP		SPACE FOR SPECIAL FUNTIONS		
2522	05250	000000	NOP		SPACE FOR SPECIAL FUNTIONS		
2522	05251	000000	NOP		SPACE FOR SPECIAL FUNTIONS		
2522	05252	000000	NOP		SPACE FOR SPECIAL FUNTIONS		
2522	05253	000000	NOP		SPACE FOR SPECIAL FUNTIONS		
2522	05254	000000	NOP		SPACE FOR SPECIAL FUNTIONS		
2523	05255	014220	JSB	ERROR			

PAGE 0062 #01 STANDARD FUNCTIONS

2526*		MISCELLANEOUS FUNCTIONS			
2527	05256	061175	XABS	LDA FLAC	ABS FUNCTION
2528	05257	065176		LDB FLAC+1	
2529	05260	115141		JSB ABSP,I	
2530	05261	027141		JMP EVFNX	
2531*					
2532	05262	061175	XINT	LDA FLAC	INTEGER PART
2533	05263	065176		LDB FLAC+1	
2534	05264	115142		JSB ENTP,I	
2535	05265	027141		JMP EVFNX	
2536*					
2537	05266	061175	XEXP	LDA FLAC	EXPONENTIAL
2538	05267	065176		LDB FLAC+1	
2539	05270	115143		JSB EXPP,I	
2540	05271	014220		JSB ERROR	
2541	05272	027141		JMP EVFNX	
2542*					
2543	05273	061175	XLOG	LDA FLAC	NATURAL LOGARITHM
2544	05274	065176		LDB FLAC+1	
2545	05275	115144		JSB LOGP,I	
2546	05276	014220		JSB ERROR	
2547	05277	027141		JMP EVFNX	
2548*					
2549	05300	061175	XSIN	LDA FLAC	SINE
2550	05301	065176		LDB FLAC+1	
2551	05302	115145		JSB SINP,I	
2552	05303	027141		JMP EVFNX	
2553*					
2554	05304	061175	XCOS	LDA FLAC	COSINE
2555	05305	065176		LDB FLAC+1	
2556	05306	115146		JSB CUSP,I	
2557	05307	027141		JMP EVFNX	
2558*					
2559	05310	061175	XSQRT	LDA FLAC	SQUARE ROOT
2560	05311	065176		LDB FLAC+1	
2561	05312	115147		JSB SQTP,I	
2562	05313	014220		JSB ERROR	
2563	05314	027141		JMP EVFNX	
2564*					
2565	05315	063346	XAND	LDA IAND	INTEGER AND(N1,N2)
2566	05316	073333		STA IXOPR	
2567	05317	061175		LDA FLAC	
2568	05320	065176		LDB FLAC+1	
2569	05321	115134		JSB IFX,I	FIX 1ST ARGUMENT
2570	05322	014532		JSB PUSHA	SAVE IT
2571	05323	014542		JSB PUSHJ	2ND ARG
2572	05324	006706		DEF ARG	
2573	05325	014220		JSB ERROR	NO 2ND ARG
2574	05326	061175		LDA FLAC	
2575	05327	065176		LDB FLAC+1	
2576	05330	115134		JSB IFX,I	FIX 2ND ARGUMENT
2577	05331	070001		STA I SAVE	2ND ARG
2578	05332	014612		JSB POPA	RESTORE 1ST ARG
2579	05333	000000	IXOPR	NOP	OPERATE
2580	05334	105120		ABS =FLT	BACK TO FLOATING POINT
2581	05335	071175		STA FLAC	

PAGE 0063 #01 STANDARD FUNCTIONS

2582	05336	075176		STB	FLAC+1	
2583	05337	027141		JMP	EVFNX	
2584*						
2585	05340	063342	XIOR	LDA	*+2	INTEGER INCLUSIVE OR
2586	05341	027316		JMP	XAND+1	
2587	05342	030001		IOR	1	
2588*						
2589	05343	063345	XXOR	LDA	*+2	INTEGER EXCLUSIVE OR
2590	05344	027316		JMP	XAND+1	
2591	05345	020001		XOR	1	
2592	05346	010001	IAND	AND	1	
2593*						
2594	05347	061175	XSGN	LDA	FLAC	SIGN FUNCTION; =1,0,+1
2595	05350	011353		AND	BCRIT	MAKE HI
2596	05351	065356		LDB	B2	SET EXP FOR +
2597	05352	002002		SZA		CLEAR EXP IF 0
2598	05353	002020		SSA		,,OR =VE
2599	05354	006400		CLB		
2600	05355	027141		JMP	EVFNX	
2601*						
2602	05356	060652	XIN	LDA	CHAR	
2603	05357	073367		STA	XINTM	SAVE CHAR
2604	05360	114646		JSB	INCH,I	
2605	05361	105120		ABS	=FLT	
2606	05362	071310		STA	FT1	SAVE HI OF RESULT
2607	05363	063367		LDA	XINTM	RESTORE CHAR
2608	05364	070652		STA	CHAR	
2609	05365	061310		LDA	FT1	RESTORE HI OF RESULT
2610	05366	027141		JMP	EVFNX	
2611	05367	000000	XINTM	NOP		
2612*						
2613	05370	061175	XOUT	LDA	FLAC	CHARACTER OUTPUT; FOUT
2614	05371	065176		LDB	FLAC+1	
2615	05372	115134		JSB	IFX,I	
2616	05373	064647		LDB	OUTCH	TEST OUTPUT DEVICE
2617	05374	055166		CPB	TTYPN	TELETYPE?
2618	05375	027400		JMP	*+3	
2619	05376	114647		JSB	OUTCH,I	
2620	05377	027141		JMP	EVFNX	
2621	05400	115150		JSB	TTO,I	OUTPUT TO TELETYPE
2622	05401	027141		JMP	EVFNX	

2624* MORE MISCELLANEOUS FUNCTIONS

2625*

2626* 'FDIS' DISPLAY ON STORAGE 'SCOPE

2627* NOTE; NOT RECURSIVE!!

2628*

2629*

CALLS:

2630*

FDIS() OR FDIS(ARG) FOR ERASE

2631*

FDIS(X,Y) DISPLAY POINT X,Y

2632*

FDIS(X,Y,EVEN) DRAW LINE TO X,Y

2633*

FDIS(X,Y,ODD) NO DISPLAY; SET CURRENT POINT
POSITION TO X,Y

2634*

2635*

2636	05402	061175	XDIS	LDA FLAC	GET X
2637	05403	065176		LDB FLAC+1	
2638	05404	115134		JSB IFX,I	CONVERT TO INTEGER
2639	05405	073505		STA DINX	STORE NEW X VALUE
2640	05406	014542		JSB PUSHJ	GO GET NEW Y
2641	05407	006706		DEF ARG	
2642	05410	027564		JMP DISER	NO ARG; ERASE SCREEN
2643	05411	061175		LDA FLAC	
2644	05412	065176		LDB FLAC+1	
2645	05413	115134		JSB IFX,I	CONVERT Y TO INTEGER
2646	05414	073504		STA DINY	STORE NEW Y VALUE
2647	05415	061111		LDA DISFL	WAIT TILL DONE
2648	05416	002003		SZA,RSS	ERASING
2649	05417	027415		JMP *-2	
2650	05420	014542		JSB PUSHJ	GET OPTION
2651	05421	006706		DEF ARG	
2652	05422	027516		JMP DIEND	NO OPTION
2653	05423	061175		LDA FLAC	
2654	05424	065176		LDB FLAC+1	
2655	05425	115134		JSB IFX,I	OPTION TO INTEGER
2656	05426	000010		SLA	ODD OPTION?
2657	05427	027516		JMP DIEND	ODD; DISPLAY POINT
2658	05430	063506		LDA DIOX	EVEN; DRAW LINE
2659	05431	003004		CMA,INA	X LINE LENGTH
2660	05432	043505		ADA DINX	NEW = OLD
2661	05433	002121		CLE,SSA,RSS	TEST SIGN
2662	05434	003204		CMA,CME,INA	MAKE =MODULUS OF LX
2663	05435	006445		CLB,SEZ,INB,RSS	MAKE +1 IF LX +VE
2664	05436	007400		CCB	MAKE =1 IF LX =VE
2665	05437	077512		STB DIMX	SET X INCREMENT
2666	05440	073510		STA DIDX	SET =MOD LX
2667	05441	063507		LDA DIOY	Y LINE LENGTH
2668	05442	003004		CMA,INA	
2669	05443	043504		ADA DINY	NEW = OLD
2670	05444	002121		CLE,SSA,RSS	TEST SIGN
2671	05445	003204		CMA,CME,INA	MAKE =MOD LY
2672	05446	006445		CLB,SEZ,INB,RSS	MAKE +1 IF LY +VE
2673	05447	007400		CCB	MAKE =1 IF LY =VE
2674	05450	077513		STB DIMY	SET Y INCREMENT
2675	05451	073511		STA DIDY	SET =MOD LY
2676	05452	003004		CMA,INA	
2677	05453	043510		ADA DIDX	MOD LY = MOD LX
2678	05454	073515		STA DIMG	SET 'SWAPPED' FLAG
2679	05455	002020		SSA	WHICH IS GREATER?

PAGE 0065 #01 STANDARD FUNCTIONS

2680	05456	027463		JMP DIS2	MOD LX GREATER
2681	05457	063510		LDA DIDX	SWAP LENGTHS IF
2682	05460	067511		LDB DIDY	MOD LY WAS LARGER
2683	05461	073511		STA DIDY	
2684	05462	077510		STB DIDX	
2685	05463	067510	DIS2	LDB DIDX	MAKE LONGER ONE +VE
2686	05464	007004		CMB,INB	
2687	05465	077510		STB DIDX	SET INCREMENT
2688	05466	007000		CMB	=(LONGER+1)
2689	05467	077514		STB DIMV	FOR COUNT
2690	05470	007000		CMB	+LONGER/2
2691	05471	005100		BRS	AS STARTER
2692	05472	037514	DIS3	ISZ DIMV	COUNT
2693	05473	002401		CLA,RSS	NOT DONE; CLEAR FLAG
2694	05474	027141		JMP EVFNX	DONE
2695	05475	047511		ADB DIDY	SUBTRACT SHORTER
2696	05476	006021		SSB,RSS	O'FLOW?
2697	05477	027502		JMP *+3	NO
2698	05500	061355		LDA B1	YES; SET FLAG
2699	05501	047510		ADB DIDX	AND ADD LONGER
2700	05502	017527		JSB DISPX	DISPLAY POINT
2701	05503	027472		JMP DIS3	TRY AGAIN
2702	05504	000000	DINY	NOP	
2703	05505	000000	DINX	NOP	
2704	05506	000000	DIOX	NOP	
2705	05507	000000	DIOY	NOP	
2706	05510	000000	DIOX	NOP	
2707	05511	000000	DIDY	NOP	
2708	05512	000000	DIMX	NOP	
2709	05513	000000	DIMY	NOP	
2710	05514	000000	DIMV	NOP	
2711	05515	000000	DIMG	NOP	
2712	05516	067505	DIEND	LDB DINX	MOVE CURRENT POINT
2713	05517	077506		STB DIOX	
2714	05520	067504		LDB DINY	
2715	05521	077507		STB DIOY	
2716	05522	006400		CLB	LIGHT POINT
2717	05523	077512		STB DIMX	
2718	05524	077513		STB DIMY	
2719	05525	017527		JSB DISPX	
2720	05526	027141		JMP EVFNX	
2721*					
2722*					
2723*					
2724	05527	000000	DISPX	NOP	DISPLAY ROUTINE
2725	05530	002003		SZA,RSS	COMBINED MOTION?
2726	05531	027540		JMP DIS4	NO
2727	05532	063506		LDA DIOX	YES; STEP BOTH
2728	05533	043512		ADA DIMX	X
2729	05534	073506		STA DIOX	
2730	05535	063507		LDA DIOY	AND Y
2731	05536	043513		ADA DIMY	
2732	05537	027552		JMP DIS6	
2733	05540	063515	DIS4	LDA DIMG	SINGLE MOTION;
2734	05541	002021		SSA,RSS	SWAPPED?
2735	05542	027550		JMP DIS5	YES; GO STEP Y

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2736	05543	063506		LDA DIOX	NO; STEP X
2737	05544	043512		ADA DIMX	
2738	05545	073506		STA DIOX	
2739	05546	063507		LDA DIOY	
2740	05547	027553		JMP DIS6+1	
2741	05550	063507	DIS5	LDA DIOY	SWAPPED; STEP Y
2742	05551	043513		ADA DIMY	
2743	05552	073507	DIS6	STA DIOY	
2744	05553	011452		AND B377	MASK Y
2745	05554	001727		ALF,ALF	POSITION Y
2746	05555	073563		STA DIDS	SAVE Y
2747	05556	063506		LDA DIOX	GET X
2748	05557	011452		AND B377	MASK X
2749	05560	033563		IOR DIDS	INCLUDE Y
2750	05561	102621		OTA DISPL	LIGHT UP POINT
2751	05562	127527		JMP DISPX,I	
2752	05563	000000	DIDS	NOP	
2753*					
2754*					
2755	05564	002400	DISER	CLA	CLEAR DONE FLAG
2756	05565	071111		STA DISFL	
2757	05566	103121		CLF DISPL	ERASE SCOPE
2758	05567	103721		STC DISPL,C	CLEAR FLAG AGAIN
2759	05570	027141		JMP EVFNX	

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2761*      ARC TANGENT ROUTINE
2762 05571 014552 ARTN JSB PUSHF   SAVE FLAC
2763 05572 001175      DEF FLAC
2764 05573 014542      JSB PUSHJ   ANY MORE ARGS?
2765 05574 006706      DEF ARG
2766 05575 027603      JMP ARTAN   GO DO 1 ARG
2767 05576 014575      JSB POPF   2 ARGS; RESTORE FLAC
2768 05577 000000      OCT 0       POP TO A   B
2769 05600 115151      JSB ATN2,I 2 ARG ARC TAN
2770 05601 001175      DEF FLAC
2771 05602 027141      JMP EVFNX
2772*
2773 05603 014575 ARTAN JSB POPF
2774 05604 000000      OCT 0       POP TO A   B
2775 05605 115152      JSB ATN,I  1 ARG ARC TAN
2776 05606 027141      JMP EVFNX

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			MISCELLANEOUS PRINT ROUTINES		
2779*					
2780	05607	000000	PRNTL	NOP	PRINT LNNO AS NN,NN
2781	05610	060653		LDA LNNO	
2782	05611	001727		ALF,ALF	
2783	05612	017622		JSB PRNT	NN
2784	05613	061407		LDA B56	*
2785	05614	114647		JSB OUTCH,I	
2786	05615	060653		LDA LNNO	
2787	05616	017622		JSB PRNT	NN
2788	05617	061374		LDA B40	ONE SPACE FOLLOWING
2789	05620	114647		JSB OUTCH,I	
2790	05621	127607		JMP PRNTL,I	
2791*					
2792	05622	000000	PRNT	NOP	PRINT 8-BIT AS NN
2793	05623	011452		AND B377	
2794	05624	067633		LDB PRNT2	2 DECIMAL DIGITS
2795	05625	017642		JSB PRNTD	GO PRINT
2796	05626	127622		JMP PRNT,I	
2797	05627	000000	PRNTN	NOP	PRINT AS NNNN
2798	05630	067634		LDB PRNT4	4 DECIMAL DIGITS
2799	05631	017642		JSB PRNTD	GO PRINT
2800	05632	127627		JMP PRNTN,I	
2801	05633	005637	PRNT2	DEF **4	
2802	05634	005635	PRNT4	DEF **1	
2803	05635	001750		DEC 1000	
2804	05636	000144		DEC 100	
2805	05637	000012		DEC 10	
2806	05640	000001		DEC 1	
2807	05641	000000		NOP	
2808*					TERMINATE DIVISOR LIST
2809	05642	000000	PRNTD	NOP	GENERAL INTEGER PRINT ROUTINE
2810	05643	074621		STB T2	SET DIVISOR POINTER
2811	05644	006400		CLB	SET UP FOR DIVISION
2812	05645	100400		DIV T2,I	DIVIDE
2813	05647	074620		STB T1	SAVE REMAINDER
2814	05650	034621		ISZ T2	STEP TO NEXT DIVISOR
2815	05651	041410		ADA B60	CONVERT TO ASCII
2816	05652	114647		JSB OUTCH,I	PRINT CHARACTER
2817	05653	060620		LDA T1	PICK UP REMAINDER
2818	05654	164621		LDB T2,I	TEST NEXT DIVISOR
2819	05655	006002		SZB	0=END
2820	05656	027644		JMP PRNTD+2	DO NEXT
2821	05657	127642		JMP PRNTD,I	DONE
2822*					
2823	05660	000000	PRNT0	NOP	PRINT A AS OCTAL
2824	05661	065316		LDB B06	6 DIGITS
2825	05662	074644		STB CNTR	
2826	05663	001200		RAL	
2827	05664	070620		STA T1	
2828	05665	011355		AND B1	FIRST DIGIT IS 1 BIT
2829	05666	011362		AND B7	REST ARE 3 BIT
2830	05667	041410		ADA B60	CONVERT TO ASCII
2831	05670	114647		JSB OUTCH,I	
2832	05671	060620		LDA T1	
2833	05672	001723		ALF,RAR	
2834	05673	070620		STA T1	

2835	05674	034644		ISZ CNTR	COUNT DIGITS
2836	05675	027666		JMP *-7	
2837	05676	061374		LDA B40	ONE SPACE
2838	05677	114647		JSB OUTCH,I	
2839	05700	127660		JMP PRNTO,I	
2840*					
2841	05701	000000	PRNTC	NOP	TELETYPE OUTPUT ROUTINE
2842	05702	031444		IOR B200	
2843	05703	051446		CPA B215	
2844	05704	027713		JMP PRNCR	OUTPUT CRLF
2845	05705	115150	PRN1	JSB TTO,I	
2846	05706	037720		ISZ PRNCT	COUNT CHARACTERS ON THE LINE
2847	05707	127701		JMP PRNTC,I	
2848	05710	061447		LDA B272	: AS CONTINUATION MARK
2849	05711	115150		JSB TTO,I	
2850	05712	061446		LDA B215	CR
2851	05713	115150	PRNCR	JSB TTO,I	OUTPUT CR
2852	05714	061324		LDA DM72	RESET CH COUNT
2853	05715	073720		STA PRNCT	
2854	05716	061445		LDA B212	LF
2855	05717	027705		JMP PRN1	
2856	05720	177670	PRNCT	DEC *-72	COUNT TTY LINE LENGTH
2857*					
2858*					
2859*					
	CHARACTER		READ-IN ROUTINE,	'READC'	
2860	05721	000000	READC	NOP	NORMAL PROGRAM READ ROUTINE
2861	05722	114646		JSB INCH,I	GET NEXT
2862	05723	011443		AND B177	TRUNCATE
2863	05724	002003		SZA,RSS	RUN BLANKS, LEADER
2864	05725	027722		JMP *-3	
2865	05726	070652		STA CHAR	
2866	05727	051357		CPA B3	TEST 'END OF MEDIUM'
2867	05730	024231		JMP RECOV	
2868	05731	051411		CPA B72	: = CONTINUATION
2869	05732	027756		JMP RDCON	
2870	05733	064646		LDB INCH	WHICH INPUT DEVICE?
2871	05734	055164		CPB TTYRR	TTY?
2872	05735	027737		JMP RDTTY	GO, CHECK NO/LINE
2873	05736	127721		JMP READC,I	
2874*					
2875	05737	051366	RDTTY	CPA B15	CR?
2876	05740	027750		JMP RECR	
2877	05741	037720		ISZ PRNCT	COUNT CHARACTERS
2878	05742	127721		JMP READC,I	NORMAL EXIT
2879	05743	061411		LDA B72	PRINT :
2880	05744	017701		JSB PRNTC	
2881	05745	061366		LDA B15	AND CRLF
2882	05746	017701		JSB PRNTC	
2883	05747	027754		JMP RECR+4	
2884	05750	061324	RECR	LDA DM72	RESET CH COUNT
2885	05751	073720		STA PRNCT	
2886	05752	061445		LDA B212	MAKE LF TOO
2887	05753	017701		JSB PRNTC	
2888	05754	060652		LDA CHAR	
2889	05755	127721		JMP READC,I	
2890	05756	114646	RDCON	JSB INCH,I	IGNORE TILL CR

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2891	05757	011443	AND	B177	
2892	05760	002003	SZA,	RSS	
2893	05761	027756	JMP	*=3	
2894	05762	051357	CPA	B3	
2895	05763	024231	JMP	RECOV	
2896	05764	051366	CPA	B15	
2897	05765	002001	RSS		
2898	05766	027756	JMP	*=8	
2899	05767	064646	LDB	INCH	
2900	05770	055164	CPB	TTYRR	TTY?
2901	05771	002001	RSS		
2902	05772	027722	JMP	READC+1	
2903	05773	061324	LDA	DM72	RESET CH COUNT
2904	05774	073720	STA	PRNCT	
2905	05775	061445	LDA	B212	MAKE LF TOO
2906	05776	017701	JSB	PRNTC	
2907	05777	027722	JMP	READC+1	

2909*		TABLE FOR SORT ROUTINE	
2910	06000 100200	SORTB	OCT 100200,100200,100200,100200
2911	06004 100200		OCT 100200,100200,100012,100200
2912	06010 100200		OCT 100200,100200,100200,100200
2913	06014 100200		OCT 100200,100200,100200,100200
2914	06020 000014		OCT 14,6416,7420,100200
2915	06024 003007		OCT 3007,2001,4002,25003
2916	06030 020041		OCT 20041,21043,22045,23047
2917	06034 024051		OCT 24051,100011,100013,100200
2918	06040 100101		OCT 100101,41103,42105,43107
2919	06044 044111		OCT 44111,45113,46115,47117
2920	06050 050121		OCT 50121,51123,52125,53127
2921	06054 054131		OCT 54131,55200,100200,2600
2922			REP 4
2923	06060 100200		OCT 100200,100200,100200,100200
2923	06064 100200		OCT 100200,100200,100200,100200
2923	06070 100200		OCT 100200,100200,100200,100200
2923	06074 100200		OCT 100200,100200,100200,100200
2924	06100 000000	PACKC	NOP PACK TEXT VIA TXIN
2925	06101 070624		STA T5
2926	06102 011443		AND B177 INSURANCE
2927	06103 064616		LDB TXIN
2928	06104 051443		CPA B177 RUBOUT?
2929	06105 026121		JMP PACKR
2930	06106 004065		CLE,ERB
2931	06107 054617		CPB PDL FULL?
2932	06110 014220		JSB ERROR
2933	06111 002041		SEZ,RSS EVEN?
2934	06112 001727		ALF,ALF POSITION WORD
2935	06113 002040		SEZ ODD?
2936	06114 140001		ADA 1,I ADD IN M.S. HALF
2937	06115 170001		STA 1,I OUTPUT TO BUFFER
2938	06116 034616		ISZ TXIN
2939	06117 060624	PACKX	LDA T5
2940	06120 126100		JMP PACKC,I
2941*			
2942	06121 054633	PACKR	CPB PAKST ANYTHING TO RUB?
2943	06122 126100		JMP PACKC,I NO
2944	06123 045335		ADB BM1 STEP POINTER BACK
2945	06124 074616		STB TXIN
2946	06125 005100		BRS
2947	06126 160001		LDA 1,I RUB OUT CH., IF ANY
2948	06127 011345		AND BM400
2949	06130 170001		STA 1,I
2950	06131 064646		LDB INCH WHICH INPUT DEVICE?
2951	06132 055164		CPB TTYRR TTY?
2952	06133 002001		RSS
2953	06134 026117		JMP PACKX
2954	06135 061437		LDA B134 OUTPUT \
2955	06136 115123		JSB PRC,I ON TELETYPE
2956	06137 026117		JMP PACKX

2958*			OUTPUT ROUTINES	
2959	06140	000000	FOUT1	NOP
2960	06141	002400		CLA
2961	06142	071064		STA FOUOP
2962	06143	061175		LDA FLAC
2963	06144	071065		STA FOUSG
2964	06145	002021		SSA,RSS
2965	06146	026153		JMP **5
2966	06147	065176		LDB FLAC+1
2967	06150	115153		JSB FCM,I
2968	06151	071175		STA FLAC
2969	06152	075176		STB FLAC+1
2970	06153	060661		LDA FORM
2971	06154	071057	FOU1	STA FOUFM
2972	06155	011367		AND B17
2973	06156	070001		STA 1
2974	06157	061057		LDA FOUFM
2975	06160	001727		ALF,ALF
2976	06161	011367		AND B17
2977	06162	003007		CMA,INA,SZA,RSS
2978	06163	026247		JMP FOUEX
2979	06164	071063		STA FOUFC
2980	06165	040001		ADA 1
2981	06166	006002		SZB
2982	06167	002004		INA
2983	06170	002021		SSA,RSS
2984	06171	003400		CCA
2985	06172	007000		CMB
2986	06173	005000		BLS
2987	06174	046472		ADB FOUTB
2988	06175	075067		STB FOURN
2989	06176	065065		LDB FOUSG
2990	06177	006020		SSB
2991	06200	034000		ISZ 0
2992	06201	006401		CLB,RSS
2993	06202	007400		CCB
2994	06203	076474		STB FOUDF
2995	06204	071062		STA FOUTD
2996	06205	001000		ALS
2997	06206	042472		ADA FOUTB
2998	06207	071066		STA FOUFC
2999*	ALL SET UP; NOW			START LOOKING AT DATA
3000	06210	104200		DLD FOURN,I
3001	06212	115161		JSB PW2,I
3002	06213	177777		DEC =1
3003	06214	105000		ABS =FAD
3004	06215	001175		DEF FLAC
3005	06216	105040		ABS =FMP
3006	06217	101066		DEF FOUFC,I
3007	06220	071060		STA FOTEM
3008	06221	075061		STB FOTEM+1
3009	06222	115142		JSB ENTP,1
3010	06223	115134		JSB IFX,I
3011	06224	041320		ADA DM10
3012	06225	002021		SSA,RSS
3013	06226	026231		JMP FOUOF

CLEAR
 OP FLAG
 GET SIGN
 SAVE IT
 TEST SIGN
 + OK
 =VE; TAKE MODULUS
 AND STORE BACK
 IN FLAC
 GET REQUESTED FORMAT
 SET CURRENT FORMAT
 NO OF DEC PLACES
 SAVE IN B
 GET FORMAT AGAIN
 POSITION NO OF FIGS
 MASK NO OF FIGS
 NEGATE AND TEST
 =E FORMAT
 SET CHARACTER COUNT
 =NO BEFORE DEC PT
 TEST FOR NO DEC PT
 COUNT DECIMAL POINT
 TEST IF LEGAL
 MAKE IT LEGAL
 MAKE POINTER
 TO TABLE OF
 POWERS OF TEN
 FOR ROUNDING
 TEST SIGN
 =; INCREMENT, TEST ZERO
 CLEAR
 OR SET
 0 FLAG
 SAVE COUNT FOR DEC PT
 MAKE POINTER TO TABLE
 OF POWERS OF TEN
 FOR SCALING
 MAKE ROUNDING
 X,5
 ADD DATA
 SCALE
 SAVE
 GET DIGIT
 AS INTEGER
 TEST SIZE
 GO COPE WITH O'FLOW

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3014 06227 016366 FOU2 JSB FOPRT PRINT
3015 06230 126140 JMP FOUT1,I ALL DONE
3016*
3017* OVERFLOW WITH CURRENT FORMAT
3018 06231 061057 FOUOF LDA FOUFM GET CURRENT FORMAT
3019 06232 011367 AND B17 MASK NO OF DECIMAL PLACES
3020 06233 002003 SZA,RSS ZERO IS THE LIMIT
3021 06234 026240 JMP FOU3 END OF THE ROAD
3022 06235 003400 CCA NOT THERE YET;
3023 06236 041057 ADA FOUFM TRY ONE LESS
3024 06237 026154 JMP FOU1 TRY AGAIN
3025*
3026 06240 061056 FOU3 LDA FORMF "FIXED" FORMAT?
3027 06241 002002 SZA 0="GENERAL"
3028 06242 026227 JMP FOU2 "FIXED"; OUTPUT 9'S
3029 06243 060661 LDA FORM "GENERAL"; SET E FORMAT
3030 06244 001727 ALF,ALF WITH SAME NO OF FIGS
3031 06245 011367 AND B17 I,E, 6 MORE CHARACTERS
3032 06246 026154 JMP FOU1 TRY AGAIN
3033*
3034* E FORMAT; =N,NNNE+XX
3035 06247 007007 FOUEX CMB,INB,SZB,RSS SET NO OF SIG FIGS
3036 06250 065317 LDB BM7 DEFAULT TO 7
3037 06251 075063 STB FOUFC SET FIGURE COUNT
3038 06252 006007 INB,SZB,RSS STEP IF GREATER THAN ONE
3039 06253 007400 CCB TO COUNT DECIMAL POINT
3040 06254 005000 BLS MAKE POINTER TO TABLE
3041 06255 046472 ADB FOUTB OF POWERS OF TEN
3042 06256 075067 STB FOURN FOR ROUNDING
3043 06257 002400 CLA CLEAR
3044 06260 072473 STA FOUX EXPONENT
3045 06261 072474 STA FOUDF AND "D" FLAG
3046 06262 065065 LDB FOU5G GET SIGN
3047 06263 071065 STA FOU5G CLEAR SIGN
3048 06264 061374 LDA B40 MAKE SPACE
3049 06265 006020 SSB OR
3050 06266 061406 LDA B55 =SIGN
3051 06267 114647 JSB OUTCH,I OUTPUT SPACE OR SIGN
3052 06270 061175 LDA FLAC GET DATA
3053 06271 065176 LDB FLAC+1
3054 06272 071060 FOUX1 STA FOTEM SAVE DATA
3055 06273 075061 STB FOTEM+1
3056 06274 002003 SZA,RSS TEST ZERO
3057 06275 026347 JMP FOUX0 GO TYPE ZERO
3058 06276 115154 JSB FLN,I UNPACK EXPONENT
3059 06277 002002 SZA TEST 0
3060 06300 002020 SSA OR =VE
3061 06301 026310 JMP FOUX2 SMALL ENOUGH
3062 06302 036473 ISZ FOUX STEP EXPONENT
3063 06303 061060 LDA FOTEM SCALE
3064 06304 065061 LDB FOTEM+1
3065 06305 105040 ABS =FMP BY
3066 06306 001300 DEF FL,1 0.1
3067 06307 026272 JMP FOUX1 AND TRY AGAIN
3068*
3069 06310 003400 FOUX2 CCA STEP EXPONENT

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3070	06311	042473	ADA FOUX	BY -1
3071	06312	072473	STA FOUX	
3072	06313	061060	LDA FOTEM	GET DATA
3073	06314	065061	LDB FOTEM+1	
3074	06315	105040	ABS =FMP	SCALE
3075	06316	001304	DEF FL10	BY 10
3076	06317	071060	STA FOTEM	SAVE DATA
3077	06320	075061	STB FOTEM+1	
3078	06321	115154	JSB FLN,I	GET EXPONENT
3079	06322	002002	SZA	TEST 0
3080	06323	002020	SSA	OR =VE
3081	06324	026310	JMP FOUX2	STILL SMALL
3082	06325	104200	DLD FOURN,I	ROUND
3083	06327	115161	JSB PW2,I	BY ADDING
3084	06330	177777	DEC -1	
3085	06331	105000	ABS =FAD	
3086	06332	001060	DEF FOTEM	
3087	06333	071060	STA FOTEM	SAVE
3088	06334	075061	STB FOTEM+1	
3089	06335	105020	ABS =FSB	TEST FOR OVERFLOW
3090	06336	001304	DEF FL10	
3091	06337	002020	SSA	GREATER THAN 10?
3092	06340	026347	JMP **7	OK
3093	06341	036473	ISZ FOUX	TOO BIG; ADJUST EXPONENT
3094	06342	000000	NOP	CAN SKIP
3095	06343	061302	LDA FL1	SET MANTISSA
3096	06344	065303	LDB FL1+1	EQUAL TO ONE
3097	06345	071060	STA FOTEM	
3098	06346	075061	STB FOTEM+1	
3099*	DATA IS NOW IN THE RANGE 1 TO 9,XXX (OR ZERO)			
3100	06347	003400	FOUX0 CCA	SET EXPIRING COUNT
3101	06350	071062	STA FOU0	FOR DECIMAL POINT
3102	06351	016366	JSB FOPRT	PRINT MANTISSA
3103	06352	061417	LDA B105	"E"
3104	06353	114647	JSB OUTCH,I	PRINT "E"
3105	06354	066473	LDB FOUX	TEST EXP
3106	06355	061404	LDA B53	"+"
3107	06356	006020	SSB	
3108	06357	061406	LDA B55	OR "-"
3109	06360	114647	JSB OUTCH,I	PRINT "+" OR "-"
3110	06361	062473	LDA FOUX	GET EXPONENT
3111	06362	002020	SSA	TAKE MODULUS
3112	06363	003004	CMA,INA	
3113	06364	115131	JSB PRN,I	PRINT EXPONENT
3114	06365	126140	JMP FOUT1,I	ALL DONE
3115*				
3116*	PRINT ROUTINE			
3117	06366	000000	FOPRT NOP	
3118	06367	061060	LDA FOTEM	GET DATA
3119	06370	065061	LDB FOTEM+1	
3120	06371	115142	FOU4 JSB ENTP,I	GET DIGIT
3121	06372	115134	JSB IFX,I	AS INTEGER
3122	06373	041320	ADA DM10	TEST SIZE
3123	06374	002021	SSA,RSS	IF BIG
3124	06375	003400	CCA	MAKE 9
3125	06376	041364	ADA D10	

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3126	06377	070625		STA T6	SAVE DIGIT
3127	06400	036474		ISZ FOUDF	TEST AND CLEAR "D" FLAG
3128	06401	026420		JMP FOU8	"D" WAS CLEAR
3129	06402	035063		ISZ FOUFC	"D" SET; WAS THAT THE LAST FIG
3130	06403	026407		JMP **4	NO
3131	06404	061410		LDA B60	YES; ZERO IS THE MOST
3132	06405	114647		JSB OUTCH,I	NEGATIVE SINGLE DIGIT
3133	06406	126366		JMP FOPRT,I	DONE
3134	06407	061406		LDA B55	=SIGN
3135	06410	114647		JSB OUTCH,I	OUTPUT =SIGN
3136	06411	002400		CLA	CLEAR
3137	06412	071065		STA FOU5G	SIGN
3138	06413	061407		LDA B56	","
3139	06414	114647		JSB OUTCH,I	OUTPUT ","
3140	06415	035063		ISZ FOUFC	COUNT CHARACTERS
3141	06416	016452	FOU7	JSB FOUTS	OUTPUT DIGIT
3142	06417	026440		JMP FOU6	
3143	06420	035062	FOU8	ISZ FOU0	COUNT FOR DEC PT
3144	06421	026430		JMP FOU5	
3145	06422	016452		JSB FOUTS	END SUPPRESSION
3146	06423	061407		LDA B56	","
3147	06424	114647		JSB OUTCH,I	OUTPUT ","
3148	06425	035063		ISZ FOUFC	COUNT FIGURES
3149	06426	026440		JMP FOU6	
3150	06427	126366		JMP FOPRT,I	
3151	06430	041064	FOU5	ADA FOUOP	NO "OP" AND ZERO DIGIT?
3152	06431	002002		SZA	
3153	06432	026416		JMP FOU7	END SUPPRESSION
3154	06433	061374		LDA B40	STILL SUPPRESSING
3155	06434	114647		JSB OUTCH,I	OUTPUT SPACE
3156	06435	035063		ISZ FOUFC	COUNT FIGURES
3157	06436	002001		RSS	
3158	06437	126366		JMP FOPRT,I	
3159	06440	060625	FOU6	LDA T6	GET DIGIT
3160	06441	003004		CMA,INA	SUBTRACT
3161	06442	105120		ABS =FLT	DIGIT
3162	06443	105000		ABS =FAD	FROM DATA
3163	06444	001060		DEF FOTEM	
3164	06445	105040		ABS =FMP	SCALE REMAINDER
3165	06446	001304		DEF FL10	X10
3166	06447	071060		STA FOTEM	SAVE
3167	06450	075061		STB FOTEM+1	
3168	06451	026371		JMP FOU4	DO NEXT DIGIT
3169*					
3170*					DIGIT OUTPUT; TEST SIGN; TURN OFF SUPPRESSION
3171	06452	000000		FOUTS NOP	
3172	06453	035064		ISZ FOUOP	TURN OFF SUPPRESSION
3173	06454	061065		LDA FOU5G	TEST SIGN
3174	06455	002021		SSA,RSS	
3175	06456	026464		JMP **6	+VE
3176	06457	061406		LDA B55	=SIGN
3177	06460	114647		JSB OUTCH,I	OUTPUT =SIGN
3178	06461	035063		ISZ FOUFC	COUNT CHARACTERS
3179	06462	002400		CLA	CLEAR
3180	06463	071065		STA FOU5G	SIGN
3181	06464	060625		LDA T6	GET DIGIT

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3182	06465	041410	ADA	B60	CONVERT TO ASCII
3183	06466	114647	JSB	OUTCH,I	OUTPUT DIGIT
3184	06467	035063	ISZ	FOUFC	COUNT FIGURES
3185	06470	126452	JMP	FOUTS,I	MORE
3186	06471	126366	JMP	FOPRT,I	DONE
3187*					
3188	06472	001304	FOUTB	DEF	FL10
3189	06473	000000	FOUX	NOP	STORAGE FOR EXPONENT
3190	06474	000000	FOUDF	NOP	"D" FLAG


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3192*      INPUT ROUTINES
3193 06475 000000  FINPT NOP
3194 06476 002002      SZA      USE CHAR IF A=0
3195 06477 114640      JSB INPUT,I
3196 06500 060652      LDA CHAR
3197 06501 051374      CPA B40      IGNORE SPACES
3198 06502 026477      JMP *-3
3199 06503 016601      JSB FINGP    GET 1ST DIGIT GROUP  SIGN
3200 06504 060652      LDA CHAR
3201 06505 051407      CPA B56      IS IT .?
3202 06506 002001      RSS
3203 06507 026516      JMP FIN1
3204 06510 114640      JSB INPUT,I
3205 06511 002400      CLA      CLEAR DIGIT COUNT
3206 06512 072577      STA FINCT
3207 06513 016622      JSB FING2    GET 2ND DIGIT GROUP
3208 06514 062577      LDA FINCT    COUNT DECIMAL PLACES
3209 06515 003005      CMA,INA,RSS
3210 06516 002400  FIN1  CLA
3211 06517 070622      STA T3
3212 06520 036600      ISZ FINSN    TEST SIGN
3213 06521 026527      JMP **6
3214 06522 061175      LDA FLAC
3215 06523 065176      LDB FLAC+1
3216 06524 115153      JSB FCM,I    COMPLEMENT IF NEGATIVE
3217 06525 071175      STA FLAC
3218 06526 075176      STB FLAC+1
3219 06527 064652      LDB CHAR
3220 06530 055417      CPB B105    IS IT E?
3221 06531 002001      RSS
3222 06532 026551      JMP FIN2    NO EXPONENT
3223 06533 014552      JSB PUSHF    SAVE FLAC
3224 06534 001175      DEF FLAC
3225 06535 114640      JSB INPUT,I  SKIP OVER E
3226 06536 016601      JSB FINGP    READ EXPONENT
3227 06537 061175      LDA FLAC    CONVERT
3228 06540 065176      LDB FLAC+1  TO
3229 06541 115134      JSB IFX,I    INTEGER
3230 06542 066600      LDB FINSN    TEST SIGN OF EXP
3231 06543 006020      SSB
3232 06544 003004      CMA,INA
3233 06545 040622      ADA T3
3234 06546 070622      STA T3
3235 06547 014575      JSB POPF    RESTORE FLAC
3236 06550 001175      DEF FLAC
3237*
3238 06551 060622  FIN2  LDA T3      GET EXPONENT
3239 06552 065176  FIN2  LDB FLAC+1  GET LO
3240 06553 002021  FIN2  SSA,RSS    TEST SIGN OF EXP
3241 06554 026563  FIN2  JMP FIN4    + OR 0
3242 06555 061175  FIN2  LDA FLAC    -VE POWER
3243 06556 105040  FIN3  ABS =FMP    SCALE BY 10↑(-E)
3244 06557 001300  FIN3  DEF FL,1
3245 06560 034622  FIN3  ISZ T3
3246 06561 026556  FIN3  JMP FIN3
3247 06562 126475  FIN3  JMP FINPT,I

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3248	06563	003004	FIN4	CMA,INA	NEGATE EXPONENT
3249	06564	002003		SZA,RSS	OR WAS IT ZERO ?
3250	06565	026575		JMP FIN6	ZERO EXPONENT
3251	06566	070622		STA T3	
3252	06567	061175		LDA FLAC	
3253	06570	105040	FIN5	ABS =FMP	SCALE BY 10↑E
3254	06571	001304		DEF FL10	
3255	06572	034622		ISZ T3	
3256	06573	026570		JMP FIN5	
3257	06574	126475		JMP FINPT,I	
3258	06575	061175	FIN6	LDA FLAC	NO SCALING NEEDED
3259	06576	126475		JMP FINPT,I	
3260*					
3261	06577	000000	FINCT	NOP	
3262	06600	000000	FINSN	NOP	
3263*					
3264	06601	000000	FINGP	NOP	READ GROUP OF DIGITS
3265	06602	006400		CLB	OPTIONAL SIGN LEADING SPACES
3266	06603	075175		STB FLAC	INITIALISE
3267	06604	075176		STB FLAC+1	
3268	06605	076577		STB FINCT	
3269	06606	060652		LDA CHAR	TEST SIGN
3270	06607	051406		CPA B55	"
3271	06610	007000		CMB	
3272	06611	076600		STB FINSN	SET SIGN IN FINSN
3273	06612	051406		CPA B55	
3274	06613	002001		RSS	
3275	06614	051404		CPA B53	+
3276	06615	114640		JSB INPUT,I	SKIP UNARY +
3277	06616	051374		CPA B40	SPACE?
3278	06617	026615		JMP *=2	
3279	06620	016622		JSB FING2	READ REMAINING STRING
3280	06621	126601		JMP FINGP,I	
3281*					
3282	06622	000000	FING2	NOP	READ UNSIGNED DIGIT STRING
3283	06623	051417		CPA B105	E?
3284	06624	126622		JMP FING2,I	
3285	06625	014277		JSB SORT	
3286	06626	126622		JMP FING2,I	OP/TERM
3287	06627	002001		RSS	NUMBER
3288	06630	026633		JMP FIN7	OR LETTER
3289	06631	051364		CPA U10	" ?
3290	06632	126622		JMP FING2,I	
3291	06633	105120	FIN7	ABS =FLT	DIGIT TO FLOATING POINT
3292	06634	072653		STA X10T	SAVE DIGIT
3293	06635	076654		STB X10T+1	
3294	06636	061175		LDA FLAC	
3295	06637	065176		LOB FLAC+1	
3296	06640	105040		ABS =FMP	PREVIOUS *10
3297	06641	001304		DEF FL10	
3298	06642	105000		ABS =FAD	*DIGIT
3299	06643	006653		DEF X10T	
3300	06644	071175		STA FLAC	
3301	06645	075176		STB FLAC+1	
3302	06646	036577		ISZ FINCT	
3303	06647	114640		JSB INPUT,I	

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3304	06650	051374	CPA B40
3305	06651	126622	JMP FING2,I
3306	06652	026623	JMP FING2+1 GET NEXT DIGIT

```
3308 06653 000000 X10T DEC 0.  
3309*  
3310* READ ROUTINE FOR 'ASK' INPUT  
3311* ACCESSED BY 'JSB INPUT,I' VIA 'READP'  
3312 06655 000000 READ1 NOP  
3313 06656 115124 JSB RDC,I  
3314 06657 051440 CPA B137 BACK ARROW/START AGAIN  
3315 06660 026477 JMP FINPT+2  
3316 06661 051443 CPA B177 RUBOUT/ IGNORE  
3317 06662 026656 JMP READ1+1  
3318 06663 051364 CPA B12 LINEFEED DITTO  
3319 06664 026656 JMP READ1+1  
3320 06665 051442 CPA B176 ESCAPE/ LEAVE UNCHANGED  
3321 06666 002001 RSS  
3322 06667 126655 JMP READ1,I  
3323 06670 104200 OLD PT1,I GET OLD VALUE  
3324 06672 126475 JMP FINPT,I
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3326*      READ NEXT NON=SPACE TO A; RUN THROUGH TO TERMINATOR
3327 06673 000000 GET1  NOP
3328 06674 014316      JSB SPNOR
3329 06675 072705      STA GETEM      SAVE CHARACTER
3330 06676 014401      JSB GETC
3331 06677 014277      JSB SORT
3332 06700 026703      JMP *+3      OP/TERM
3333 06701 026676      JMP *-3      NUMBER; IGNORE
3334 06702 026676      JMP *-4      LETTER; IGNORE
3335 06703 062705      LDA GETEM
3336 06704 126673      JMP GET1,I
3337 06705 000000      GETEM NOP
3338*
3339*      ARG ROUTINE; CALL IS
3340*      JSB PUSHJ
3341*      DEF ARG
3342*      NO ARGUMENT RETURN
3343*      ARGUMENT READ O,K, RETURN
3344 06706 060652      ARG  LDA CHAR
3345 06707 051405      CPA B54      IS CHAR A COMMA?
3346 06710 002001      RSS
3347 06711 024327      JMP POPJ      NO ARGUMENT
3348 06712 134617      ISZ PDL,I    STEP RETURN
3349 06713 014542      JSB PUSHJ
3350 06714 004761      DEF EVAL-1
3351 06715 024327      JMP POPJ

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3353*      RECURSIVE SUBROUTINE TO FIND A VARIABLE OR
3354*      TO SET UP A NEW VARIABLE,
3355*      ENTRY AT 'GTARG' CHECKS NATURE OF 1ST CHARACTER
3356*      OF NAME/ ENTRY AT 'GTARG=1' SKIPS A CHARACTER FIRST.
3357*      ENTRY AT GTVAR ASSUMES THAT CURRENT 'CHAR' IS
3358*      VALID 1ST CHARACTER OF NAME.
3359 06716 014401      JSB GETC      SKIP A CHARACTER
3360 06717 014316      GTARG JSB SPNOR
3361 06720 014277      JSB SORT
3362 06721 000000      NOP
3363 06722 014220      JSB ERROR      OP/TERM
3364 06723 051361      CPA B6          OR NUMBER
3365 06724 027046      JMP GTF          F
3366 06725 060652      GTVAR LDA CHAR      SET UP F OPTION
3367 06726 001727      ALF,ALF      ALPHABETIC; O.K.
3368 06727 070645      STA ADD
3369 06730 014401      JSB GETC
3370 06731 014277      JSB SORT
3371 06732 026744      JMP GTSCH      OP/TERM; TRY SUBSCRIPT
3372 06733 000000      NOP          NUMBER
3373 06734 060652      LDA CHAR      ADD IN 2ND CH
3374 06735 040645      ADA ADD
3375 06736 070645      STA ADD
3376 06737 014401      JSB GETC      IGNORE REST
3377 06740 014277      JSB SORT
3378 06741 026744      JMP GTSCH
3379 06742 026737      JMP **3      IGNORE MORE NUMBERS
3380 06743 026737      JMP **4      OR LETTERS
3381 06744 051361      GTSCH CPA B6      (
3382 06745 026761      JMP GTSUB
3383 06746 002400      CLA
3384 06747 071071      STA SUBS
3385 06750 060655      LOA BUFR
3386 06751 064645      LDB ADD
3387 06752 050654      CPA LASTV      ALL DONE?
3388 06753 026777      JMP GTNEW      GO ADD TO LIST
3389 06754 154000      CPB 0B,I      COMPARE NAME
3390 06755 027027      JMP GTFND      SAME
3391 06756 002004      INA
3392 06757 140000      ADA 0B,I      TRY NEXT
3393 06760 026752      JMP **6
3394*
3395 06761 060645      GTSUB LDA ADD      PRESERVE NAME
3396 06762 014532      JSB PUSHA
3397 06763 014542      JSB PUSHJ      GET SUBSCRIPT
3398 06764 004761      DEF EVAL=1
3399 06765 014612      JSB POPA      RESTORE NAME
3400 06766 070645      STA ADD
3401 06767 014342      JSB PARTS      )
3402 06770 061175      LDA FLAC
3403 06771 065176      LDB FLAC+1
3404 06772 115134      JSB IFX,I      CONVERT SUBS TO INTEGER
3405 06773 001000      ALS          2 WORDS/NUMBER
3406 06774 002020      SSA          TEST -VE SUBSCRIPT
3407 06775 014220      JSB ERROR
3408 06776 026747      JMP GTSCH+3

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3409*
3410 06777 041071 GTNEW ADA SUBS      TEST SPACE
3411 07000 041356      ADA B2
3412 07001 003104      CMA,CLE,INA
3413 07002 040617      ADA PDL
3414 07003 002041      SEZ,RSS
3415 07004 014220      JSB ERROR
3416 07005 060654      LDA LASTV
3417 07006 174000      STB 00,I      SET UP NAME
3418 07007 070001      STA 10
3419 07010 041071      ADA SUBS
3420 07011 041356      ADA B2
3421 07012 070634      STA PT1      SET UP PT1
3422 07013 041356      ADA B2
3423 07014 070654      STA LASTV    UPDATE LASTV
3424 07015 061071      LDA SUBS     SET UP LENGTH
3425 07016 041357      ADA B3
3426 07017 006004      INB
3427 07020 170001      STA 10,I
3428 07021 002400      CLA        ZERO NEW VARIABLES
3429 07022 006004      INB
3430 07023 054654      CPB LASTV
3431 07024 027042      JMP GTEX     ALL DONE
3432 07025 170001      STA 10,I
3433 07026 027022      JMP *-4
3434*
3435 07027 002004 GTFND INA
3436 07030 070001      STA 1 SAVE PTR TO LENGTH
3437 07031 041071      ADA SUBS
3438 07032 002004      INA
3439 07033 070634      STA PT1      SET PT1
3440 07034 061071      LDA SUBS     TEST LENGTH
3441 07035 041357      ADA B3
3442 07036 003004      CMA,INA
3443 07037 140001      ADA 1,I
3444 07040 002020      SSA
3445 07041 014220      JSB ERROR    OFF END OF ARRAY
3446 07042 041356 GTEX ADA B2      SET UP LENGTH
3447 07043 003004      CMA,INA
3448 07044 071070      STA GTL
3449 07045 024327      JMP POPJ
3450*
3451 07046 061121 GTF  LDA CMCOR    SET POINTER TO FCOM BUFFER
3452 07047 070634      STA PT1
3453 07050 061122      LDA CMCOR+1
3454 07051 071070      STA GTL
3455 07052 014401      JSB GETC     SKIP REST OF NAME
3456 07053 014277      JSB SORT
3457 07054 024327      JMP POPJ     OP/TERM
3458 07055 027052      JMP *-3
3459 07056 027052      JMP *-4
3460*

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TELETYPE			INPUT/OUTPUT ROUTINES		
3463*					
3464	07057	000000	TTOUT	NOP	TTY O/P
3465	07060	102100		STF 0	INSURANCE
3466	07061	065104		LDB TTYSW	0=BUSY
3467	07062	006003		SZB,RSS	
3468	07063	027075		JMP TTO1	
3469	07064	065101		LDB TTOP	MAKE TTY AN OUTPUT DEVICE
3470	07065	106617		OTB TTY	
3471	07066	065100		LDB ITTON	SET O/P IR ROUTINE
3472	07067	074034		STB ITTJ	
3473	07070	102617		OTA TTY	OUTPUT THE CHARACTER
3474	07071	103717		STC TTY,C	AND START THE TTY
3475	07072	002400		CLA	SET BUSY
3476	07073	071104		STA TTYSW	
3477	07074	127057		JMP TTOUT,I	
3478*					
3479	07075	065074	TTO1	LDB TTBF1	STEP BUFFER POINTER
3480	07076	006004		INB	
3481	07077	055076		CPB TTBF1	CIRCULARLY
3482	07100	065073		LDB TTBF0	
3483	07101	055075		CPB TTBF0	WAIT TILL ROOM
3484	07102	027101		JMP *-1	FOR ONE MORE
3485	07103	171074		STA TTBF1,I	STORE CHARACTER IN BUFFER
3486	07104	075074		STB TTBF1	UPDATE BUFFER POINTER
3487	07105	127057		JMP TTOUT,I	
3488*					
3489*					
3490	07106	000000	ITTO	NOP	TTY O/P IR ROUTINE
3491	07107	071072		STA ITTA	SAVE A
3492	07110	061075		LDA TTBF0	ANY OUTPUT?
3493	07111	051074		CPA TTBF1	
3494	07112	027125		JMP ITTX	NO MORE
3495	07113	161075		LDA TTBF0,I	OUTPUT THE CHARACTER
3496	07114	102617		OTA TTY	
3497	07115	103717		STC TTY,C	START THE TTY
3498	07116	061075		LDA TTBF0	STEP BUFFER POINTER
3499	07117	034000		ISZ 0	
3500	07120	051076		CPA TTBF1	CIRCULARLY
3501	07121	061073		LDA TTBF0	
3502	07122	071075		STA TTBF0	
3503	07123	061072		LDA ITTA	RESTORE A
3504	07124	127106		JMP ITTO,I	
3505*					
3506	07125	035104	ITTX	ISZ TTYSW	SET NOT BUSY
3507	07126	107717		CLC TTY,C	TURN OFF HARDWARE
3508	07127	027123		JMP *-4	
3509*					
3510*					
3511*					
3512	07130	000000	TTYRI	NOP	IR INPUT
3513	07131	107717		CLC TTY,C	CLEAR HARDWARE
3514	07132	035105		ISZ TTYFL	SET SOFTWARE FLAG
3515	07133	127130		JMP TTYRI,I	
3516*					
3517	07134	000000	TTYR1	NOP	SILENT TTY READ
3518	07135	061102		LDA TTIPS	

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3519	07136	017144		JSB TTYRD	
3520	07137	127134		JMP TTYR1,I	
3521*					
3522	07140	000000	TTYR2	NOP	TTY READ WITH ECHO
3523	07141	061103		LDA TTIP	
3524	07142	017144		JSB TTYRD	
3525	07143	127140		JMP TTYR2,I	
3526*					
3527	07144	000000	TTYRD	NOP	TELETYPE INPUT
3528	07145	102100		STF 0	ENABLE INTERRUPT
3529	07146	065104		LOB TTYSW	WAIT FOR OUTPUT
3530	07147	006003		SZB,RSS	
3531	07150	027146		JMP *-2	
3532	07151	102617		OTA TTY	SET UP OPTIONS
3533	07152	061077		LDA ITTIN	SET UP IR JUMP
3534	07153	070034		STA ITTJ	
3535	07154	103717		STC TTY,C	ENABLE TTY
3536	07155	061105		LDA TTYFL	WAIT FOR INPUT
3537	07156	002003		SZA,RSS	
3538	07157	027155		JMP *-2	
3539	07160	002400		CLA	
3540	07161	071105		STA TTYFL	CLEAR INPUT BUFFER
3541	07162	102517		LIA TTY	GET CHARACTER
3542	07163	127144		JMP TTYRD,I	

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3544	07164	000000	HSRIN	NOP	HIGH SPEED READER
3545	07165	002400		CLA	SET TIMER
3546	07166	073206		STA HSRCT	
3547	07167	061106	HSRD2	LDA HSRFL	WAIT FOR INPUT
3548	07170	002002		SZA	
3549	07171	027175		JMP HSGO	FOUND SOME
3550	07172	037206		ISZ HSRCT	
3551	07173	027167		JMP HSRD2	TRY AGAIN
3552	07174	014220		JSB ERROR	WAITED TOO LONG
3553*					
3554	07175	006400	HSGO	CLB	CLEAR FLAG
3555	07176	075106		STB HSRFL	
3556	07177	102515		LIA HSR	READ INPUT
3557	07200	103715		STC HSR,C	ASK FOR ANOTHER
3558	07201	127164		JMP HSRIN,I	
3559*					
3560	07202	000000	HSRI	NOP	HSR IR ROUTINE
3561	07203	107715		CLC HSR,C	CLEAR HSR
3562	07204	035106		ISZ HSRFL	SET PROGRAM FLAG
3563	07205	127202		JMP HSRI,I	
3564	07206	000000	HSRCT	NOP	TIMER COUNT

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3566	07207	000000	HPNCH	NOP	HIGH SPEED PUNCH ROUTINE
3567	07210	065107		LDB PNCHF	
3568	07211	006003		SZB,RSS	WAIT FOR 'NOT BUSY'
3569	07212	027210		JMP *-2	
3570	07213	006400		CLB	SET 'BUSY'
3571	07214	075107		STB PNCHF	
3572	07215	102616		OTA PNCH	OUTPUT CHARACTER
3573	07216	103716		STC PNCH,C	
3574	07217	127207		JMP HPNCH,I	
3575*					
3576	07220	000000	HPNI	NOP	H.S. PUNCH INTERRUPT ROUTINE
3577	07221	035107		ISZ PNCHF	CLEAR 'BUSY'
3578	07222	107716		CLC PNCH,C	CLEAR HARDWARE
3579	07223	127220		JMP HPNI,I	

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3581	07224	000000	LPIR	NOP	LINEPRINTER IR ROUTINE
3582	07225	035110		ISZ LPBS	
3583	07226	107714		CLC LINEP,C	
3584	07227	127224		JMP LPIR,I	
3585*					
3586	07230	000000	LPOUT	NOP	LINEPRINTER OUTPUT
3587	07231	011443		AND B177	
3588	07232	051364		CPA B12	LF
3589	07233	127230		JMP LPOUT,I	IGNORE LF
3590	07234	051365		CPA B14	FORM=FEED
3591	07235	027251		JMP LPCR+1	
3592	07236	051366		CPA B15	CR
3593	07237	027250		JMP LPCR	
3594	07240	037266		ISZ LPCT	TOO MANY FOR ONE LINE?
3595	07241	027253		JMP LP1	OK
3596	07242	073267		STA LPTM	TOO MANY; SAVE CHARACTER
3597	07243	061364		LDA B12	
3598	07244	017255		JSB LPOU2	OUTPUT CARRIAGE RETURN
3599	07245	063267		LDA LPTM	RESTORE CHARACTER
3600	07246	065325		LDB DM80	SET COUNT INCLUDING CH
3601	07247	027252		JMP LP1=1	
3602	07250	061364	LPCR	LDA B12	SET LINEFEED
3603	07251	065326		LDB DM81	RESET CHARACTER COUNT
3604	07252	077266		STB LPCT	
3605	07253	017255	LP1	JSB LPOU2	OUTPUT TO LINEPRINTER
3606	07254	127230		JMP LPOUT,I	
3607*					
3608	07255	000000	LPOU2	NOP	ACTUAL CHARACTER OUTPUT
3609	07256	065110		LDB LPBS	WAIT FOR NOT BUSY
3610	07257	006003		SZB,RSS	
3611	07260	027256		JMP *=2	
3612	07261	102614		OTA LINEP	OUTPUT CHARACTER
3613	07262	002400		CLA	
3614	07263	071110		STA LPBS	SET BUSY
3615	07264	103714		STC LINEP,C	START HARDWARE
3616	07265	127255		JMP LPOU2,I	
3617*					
3618	07266	177657	LPCT	DEC =81	
3619	07267	000000	LPTM	NOP	

```

3621*      INTERRUPT ROUTINES
3622*
3623  07270 000000 DMAI1 NOP          DMA1 INTERRUPT ROUTINE
3624  07271 035112      ISZ DFLAG    SET DONE FLAG
3625  07272 103106      CLF DMA1     CLEAR DMA1 HARDWARE
3626  07273 127270      JMP DMAI1,I
3627*
3628  07274 000000 DMAI2 NOP          DMA2 INTERRUPT ROUTINE
3629  07275 107712      CLC MTD,C    CLEAR MT DATA
3630  07276 107707      CLC DMA2,C   CLEAR DMA
3631  07277 127274      JMP DMAI2,I
3632*
3633  07300 000000 MTCI  NOP          MT CONTROL INTERRUPT
3634  07301 107713      CLC MTC,C    CLEAR CONTROL
3635  07302 107712      CLC MTD,C    ABORT FURTHER DATA
3636  07303 107707      CLC DMA2,C   MAKE SURE DMA DEAD TOO
3637  07304 035113      ISZ BUFLG   SET DONE FLAG
3638  07305 127300      JMP MTCI,I
3639*
3640  07306 000000 DISI  NOP          DISPLAY; ERASE DONE
3641  07307 106721      CLC DISPL   CLEAR INTERRUPT
3642  07310 035111      ISZ DISFL   SET DONE FLAG
3643  07311 127306      JMP DISI,I   RETURN FROM INTERRUPT

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PAGE 0090 #01 FLOATING POINT ROUTINES

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3646*   FLOATING POINT TO FIXED POINT CONVERSION
3647*   CALLING SEQUENCE,,
3648*   DLD X OR EQUIVALENT
3649*   JSB IFIX
3650*   RESULT AS INTEGER IN A
3651*   TRUNCATES TO LARGEST INTEGER OF CORRECT SIGN
3652*   IN CASE OF OVERFLOW; NOTE CHANGE FROM HP
3653*   BENNETT 74 JULY 24
3654   07312 000000  IFIX  NOP
3655   07313 071310      STA FT1
3656   07314 119154      JSB FLN,I   UNPACK LO AND EXP
3657   07315 002020      SSA           TEST SIZE
3658   07316 027345      JMP FIX1    SMALL
3659   07317 003004      CMA,INA     COMPUTE NO OF SHIFTS
3660   07320 041367      ADA B17
3661   07321 002020      SSA           TEST SIZE
3662   07322 027337      JMP FIX2    LARGE
3663   07323 002002      SZA
3664   07324 043350      ADA FIXI    MAKE ASR INSTRUCTION
3665   07325 073330      STA *+3
3666   07326 060001      LDA 1      LO (IN CASE EXP=17)
3667   07327 065310      LDB FT1    HI
3668   07330 000000      NOP        BECOMES ASR
3669   07331 103101      CLO        IN CASE EXP=17
3670   07332 002020      SSA        TEST NEXT BIT
3671   07333 006004      INB        ROUND; CAN SET O'FLOW
3672   07334 060001      LDA 1      TRANSFER RESULT TO A
3673   07335 102301      SOS        TEST O'FLOW ON ROUNDING
3674   07336 127312      JMP IFIX,I OK
3675   07337 061462      FIX2 LDA BMAX O'FLOW; SET LARGEST +VE
3676   07340 065310      LDB FT1    GET SIGN
3677   07341 006020      SSB        TEST SIGN
3678   07342 003000      CMA        SET MOST -VE IF -VE
3679   07343 102101      STO        SET O'FLOW FLAG
3680   07344 127312      JMP IFIX,I
3681*
3682   07345 002400      FIX1 CLA      SMALL; SET ZERO
3683   07346 103101      CLO
3684   07347 127312      JMP IFIX,I
3685*
3686   07350 101020      FIXI ASR 16

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```

3688*   FLOATING POINT NEGATE
3689*   CALLING SEQUENCE,,
3690*   OLD X OR EQUIVALENT
3691*   JSB  ,,FCM
3692*   BENNETT VERSION, 74 JULY 24
3693   07351 000000  ,,FCM NOP
3694   07352 071310          STA FT1          SAVE HI
3695   07353 115154          JSB FLN,I        SPLIT
3696   07354 006003          SZB,RSS         LO=0 ?
3697   07355 027365          JMP FCM1        GO TEST SPECIAL CASES
3698   07356 007004          CMB,INB        NEGATE LO/ NO CARRY
3699   07357 001200          RAL           REPOSITION EXPONENT
3700   07360 011452          AND B377
3701   07361 044000          ADB 0          = INCLUSIVE OR TO LO
3702   07362 061310          LDA FT1        DEAL WITH HI
3703   07363 003000          CMA
3704   07364 127351          JMP  ,,FCM,I
3705*
3706*   SPECIAL CASES WITH LO=0 ARE
3707*HI=100000; RES=040000, E INCREMENTED; O'FLOW IF E=177
3708*HI=040000; RES=100000, E DECREMENTED; U'FLOW IF E=-200
3709   07365 065310  FCM1  LDB FT1          GET HI
3710   07366 055354          CPB BMIN       IS IT 100000 ?
3711   07367 027400          JMP FCM2       1ST SPECIAL CASE
3712   07370 055461          CPB BPLUS      IS IT 040000 ?
3713   07371 027410          JMP FCM3       2ND SPECIAL CASE
3714   07372 001200          RAL           REPOSITION EXPONENT
3715   07373 011452          AND B377
3716   07374 070001          STA 1         B IS NOW CORRECT
3717   07375 061310          LDA FT1        DEAL WITH HI
3718   07376 003004          CMA,INA       NEGATE/ NO O'FLOW
3719   07377 127351          JMP  ,,FCM,I  ALL DONE
3720*
3721   07400 051443  FCM2  CPA B177          EXP O'FLOW ?
3722   07401 027420          JMP FCM5       SET LARGEST POSSIBLE
3723   07402 002004          INA           INCREMENT EXP
3724   07403 001200          RAL           POSITION
3725   07404 011452          AND B377
3726   07405 070001          STA 1
3727   07406 061461          LDA BPLUS      MAKE HI
3728   07407 127351          JMP  ,,FCM,I
3729*
3730   07410 051344  FCM3  CPA BM200         UNDERFLOW ?
3731   07411 027423          JMP FCM6       SET ZERO
3732   07412 041335          ADA BM1        DECREMENT EXP
3733   07413 001200          RAL
3734   07414 011452          AND B377
3735   07415 070001          STA 1
3736   07416 061354          LDA BMIN       MAKE HI
3737   07417 127351          JMP  ,,FCM,I
3738*
3739   07420 061462  FCM5  LDA BMAX          O'FLOW
3740   07421 061336          LDA BM2        SET LARGEST
3741   07422 127351          JMP  ,,FCM,I
3742*
3743   07423 002400  FCM6  CLA           U'FLOW

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```
3744 07424 006400      CLB      SET ZERO
3745 07425 127351      JMP    ..FCM,I
3746*
3747*
3748*      COMMAND INPUT BUFFER
3749 07426 000000      COMIN BSS 109
3750 07603      COME EQU *
```


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```

3752*      SCALE BY POWER OF 2: .PWR2
3753*      CALLING SEQUENCE,,
3754*      OLD X OR EQUIVALENT
3755*      JSB .PWR2
3756*      DEC N NOT DEF N!!
3757*      SCALES X BY 2↑N
3758*      BENNETT VERSION, 74 JULY 24 CHECKS
3759*      FOR OVER AND UNDERFLOW
3760 07603 000000      .PWR2 NOP
3761 07604 002003      SZA,RSS      X=0 ?
3762 07605 027625      JMP PWRX      YES; ANS=0
3763 07606 071310      STA FT1      SAVE HI
3764 07607 115154      JSB FLN,I    UNPACK LO      EXP
3765 07610 143603      ADA .PWR2,I  ADD POWER OF 2 TO EXP
3766 07611 041444      ADA B200    TEST UNDERFLOW
3767 07612 002020      SSA
3768 07613 027627      JMP PWRUF   UNDERFLOW
3769 07614 041345      ADA B0400  TEST OVERFLOW
3770 07615 002021      SSA,RSS
3771 07616 027632      JMP PWR0F   OVERFLOW
3772 07617 041444      ADA B200    RESTORE EXPONENT
3773 07620 001200      RAL        POSITION EXPONENT
3774 07621 011452      AND B377    TRUNCATE
3775 07622 030001      IOR 1      ADD IN LO
3776 07623 070001      STA 1
3777 07624 061310      LDA FT1    RESTORE HI
3778 07625 037603      PWRX ISZ .PWR2  STEP TO EXIT
3779 07626 127603      JMP .PWR2,I
3780*
3781 07627 002400      PWRUF CLA      UNDERFLOW; SET ZERO
3782 07630 006400      CLB
3783 07631 027625      JMP PWRX
3784*
3785 07632 061310      PWR0F LDA FT1    OVERFLOW; GET SIGN
3786 07633 002020      SSA      =VE ?
3787 07634 027640      JMP PWR0M  YES
3788 07635 061462      LDA BMAX  NO; SET LARGEST POSITIVE
3789 07636 065336      LDB B02
3790 07637 027625      JMP PWRX
3791 07640 061354      PWR0M LDA BMIN  SET LARGEST NEGATIVE
3792 07641 065451      LDB B376
3793 07642 027625      JMP PWRX

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3795*			ABSOLUTE VALUE		
3796*			CALLING SEQUENCE..		
3797*			OLD X OR EQUIVALENT		
3798*			JSB ABS		
3799	07643	000000	ABS	NOP	
3800	07644	002021		SSA,RSS	X<0 ?
3801	07645	127643		JMP ABS,I	NO? ANS=X
3802	07646	115153		JSB FCM,I	NEGATE
3803	07647	127643		JMP ABS,I	ANS=X

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3805 07650 000000 ENTIE NOP   ENTIER ROUTINE
3806*   CALL IS      (DLD ARG)   PUT ARG IN A   B
3807*   JSB ENTIE
3808*   RESULT IS    NORMALISED FP IN A   B
3809 07651 071177   STA F1      SAVE HI
3810 07652 060001   LDA 1      LO AND EXP TO A
3811 07653 011452   AND B377   MASK OFF EXP
3812 07654 001300   RAR       POSITION; WRONG IF EXP -VE
3813 07655 003004   CMA,INA   NEGATE
3814 07656 002021   SSA,RSS   SMALL?
3815 07657 027703   JMP ENT1   EXP -VE OR ZERO; SMALL
3816 07660 041371   ADA B27   LARGE?
3817 07661 002020   SSA      EXP>27; LARGE
3818 07662 027701   JMP ENT2   EXIT WITHOUT CHANGING ARG
3819 07663 041340   ADA BM10  EXP>17?
3820 07664 002020   SSA
3821 07665 027674   JMP ENT3   LOSE 0-7 BITS
3822*   LOSE 10-27 BITS
3823 07666 043707   ADA ENTM1 MAKE POINTER TO MASK
3824 07667 160000   LDA 0,I   GET MASK
3825 07670 011177   AND F1    MASK HI
3826 07671 071177   STA F1    SAVE HI
3827 07672 061452   LDA B377  MASK FOR LO
3828 07673 027677   JMP ENT3+3
3829*
3830 07674 043710   ENT3 ADA ENTM2 MAKE POINTER TO MASK
3831 07675 160000   LDA 0,I   GET MASK
3832 07676 031452   IOR B377  DON'T LOSE EXP
3833 07677 010001   AND 1     MASK LO
3834 07700 070001   STA 1     MOVE RESULT TO LO
3835 07701 061177   ENT2 LDA F1   PICK UP HI
3836 07702 127650   JMP ENTIE,I
3837*
3838 07703 061177   ENT1 LDA F1   GET SIGN BIT
3839 07704 011354   AND BMIN  =1 IF -VE
3840 07705 006400   CLB      CLEAR LO   EXP
3841 07706 127650   JMP ENTIE,I
3842*
3843 07707 001335   ENTM1 DEF BM1
3844 07710 001355   ENTM2 DEF BM1+16

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3846*   SINGLE ARGUMENT ARC TANGENT
3847*   CALLING SEQUENCE.
3848*   DLD X OR EQUIVALENT
3849*   JSB ATAN
3850*   CALCULATES ARCTAN(X)
3851*   RESULT IN RANGE =PI/2 TO PI/2
3852   07711 000000   ATAN   NOP
3853   07712 071214           STA F7       SAVE ARGUMENT, X
3854   07713 075215           STB F7+1
3855   07714 060001           LDA 1       EXPONENT TO A
3856   07715 011452           AND B377
3857   07716 071311           STA FT2    SAVE EXPONENT
3858   07717 002002           SZA
3859   07720 000010           SLA       ABS(X)>1 ?
3860   07721 027760           JMP ATN1   NO
3861   07722 061302           LDA FL1   GET 1
3862   07723 065303           LDB FL1+1
3863   07724 105060           ABS =FDV  U=1/X
3864   07725 001214           DEF F7
3865   07726 071216   ATN4   STA F8       SAVE U
3866   07727 075217           STB F8+1
3867   07730 105040           ABS =FMP  U+2
3868   07731 001216           DEF F8
3869   07732 115161           JSB PW2,I DOUBLE IT
3870   07733 000001           DEC 1
3871   07734 105020           ABS =FSB  2*U+2=1
3872   07735 001302           DEF FL1
3873   07736 115155           JSB CHB,I EVALUATE CHEBY
3874   07737 007772           DEF ATNC
3875   07740 105040           ABS =FMP  Y=U*CHEBY(2*U+2=1)
3876   07741 001216           DEF F8
3877   07742 071220           STA F9    SAVE Y
3878   07743 075221           STB F9+1
3879   07744 061311           LDA FT2   PICK UP EXPONENT
3880   07745 002002           SZA
3881   07746 000010           SLA       ABS(X)>1 ?
3882   07747 027763           JMP ATN5   NO
3883   07750 061214           LDA F7    GET SIGN
3884   07751 002020           SSA       X<0 ?
3885   07752 027766           JMP ATN3
3886   07753 061230           LDA FLPI2 GET PI/2
3887   07754 065231           LDB FLPI2+1
3888   07755 105020           ABS =FSB  ANS=PI/2=Y
3889   07756 001220           DEF F9
3890   07757 127711           JMP ATAN,I
3891*
3892   07760 061214   ATN1   LDA F7       U=X
3893   07761 065215           LDB F7+1
3894   07762 027726           JMP ATN4
3895*
3896   07763 061220   ATN5   LDA F9       ANS=Y
3897   07764 065221           LDB F9+1
3898   07765 127711           JMP ATAN,I
3899*
3900   07766 061232   ATN3   LDA FLMP2    GET =PI/2
3901   07767 065233           LDB FLMP2+1

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3902	07770	027755		JMP	ATN1=3	ANS=-PI/2=Y
3903	07771	127711		JMP	ATAN,I	
3904*						
3905	07772	106671	ATNC	DEC	=1,33034E-8,8,64888E-8,-56,99186E-8	
3906	10000	040033		DEC	3,821037E-6,-2,6215196E-5,1,8574297E-4	
3907	10006	122573		DEC	=1,381195004E-3,.01113584206,-,105892924	
3908	10014	070320		DEC	1.762747174,0	

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3910*      2 ARGUMENT ARC TANGENT
3911*      CALLING SEQUENCE,,
3912*      DLD X OR EQUIVALENT
3913*      JSB ATAN2
3914*      DEF Y
3915*      CALCULATES ARCTAN(X/Y)
3916*      RESULT IN RANGE =PI TO PI
3917*      BENNETT, 74 JULY 22
3918  10017 000000  ATAN2 NOP
3919  10020 071312      STA FT3      SAVE SIGN OF X
3920  10021 162017      LDA ATAN2,I  GET POINTER TO Y
3921  10022 036017      ISZ ATAN2    STEP RETURN
3922  10023 071313      STA FT4      SET POINTER TO Y
3923  10024 161313      LDA FT4,I    GET SIGN OF Y
3924  10025 002003      SZA,RSS
3925  10026 026054      JMP ATN20    Y IS ZERO
3926  10027 061312      LDA FT3      RESTORE HI X
3927  10030 105060      ABS =FDV     X/Y
3928  10031 101313      DEF FT4,I
3929  10032 115152      JSB ATN,I    TAKE 1 ARG ARCTAN
3930  10033 071314      STA FT5      SAVE HI OF RESULT
3931  10034 161313      LDA FT4,I    GET SIGN OF Y AGAIN
3932  10035 002021      SSA,RSS     TEST SIGN OF Y
3933  10036 026046      JMP ATN2X    Y +VE; ALL DONE
3934  10037 061312      LDA FT3      Y -VE; GET SIGN OF X
3935  10040 002020      SSA
3936  10041 026050      JMP ATN21    X -VE
3937  10042 061314      LDA FT5      X +VE; ANS=RES+PI
3938  10043 105000      ABS =FAD
3939  10044 001234      DEF FLPI
3940  10045 126017      JMP ATAN2,I
3941*
3942  10046 061314  ATN2X LDA FT5      RESTORE HI; ANS=RES
3943  10047 126017      JMP ATAN2,I
3944*
3945  10050 061314  ATN21 LDA FT5      X -VE; ANS=RES-PI
3946  10051 105020      ABS =FSB
3947  10052 001234      DEF FLPI
3948  10053 126017      JMP ATAN2,I
3949*
3950  10054 061312  ATN20 LDA FT3      Y=0; GET SIGN OF X
3951  10055 002020      SSA
3952  10056 026062      JMP *+4     X -VE
3953  10057 061230      LDA FLPI2   X+VE; RES=PI/2
3954  10060 065231      LDB FLPI2+1
3955  10061 126017      JMP ATAN2,I
3956  10062 061232      LDA FLMP2   X-VE; RES=-PI/2
3957  10063 065233      LDB FLMP2+1
3958  10064 126017      JMP ATAN2,I

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3960*      EXPONENTIAL
3961*      CALLING SEQUENCE,,
3962*      OLD X OR EQUIVALENT
3963*      JSB EXP
3964*      JMP ERROR    OVERFLOW EXIT
3965*      CALCULATES EXP(X); RESULT FLOATING POINT
3966*      MODIFIED FROM HP VERSION BY BENNETT, 74 JULY 22
3967      10065 000000    EXP    NOP
3968      10066 105040    ABS    =FMP      SCALE BY LOG E (BASE 2)
3969      10067 001240    DEF    FLG2E
3970      10070 071204    STA    F3
3971      10071 075205    STB    F3+1
3972      10072 115142    JSB    ENTP,I    MUST USE BENNETT VERSION
3973      10073 071206    STA    F4          F4=ENTIER(F3)
3974      10074 075207    STB    F4+1
3975      10075 115134    JSB    IFX,I    MUST USE BENNETT VERSION
3976      10076 072156    STA    EXPI
3977      10077 041330    ADA    DM124    TEST MAGNITUDE
3978      10100 002021    SSA,RSS      >124 ?
3979      10101 126065    JMP    EXP,I    TOO BIG; ERROR EXIT
3980      10102 041450    ADA    D244    <=-120 ?
3981      10103 002020    SSA
3982      10104 026161    JMP    EXP0    SMALL; ANS =0
3983      10105 061204    LDA    F3      PICK UP SCALED ARGUMENT
3984      10106 065205    LDB    F3+1
3985      10107 105020    ABS    =FSB    FRACTIONAL PART
3986      10110 001206    DEF    F4
3987      10111 071204    STA    F3      SAVE IT
3988      10112 075205    STB    F3+1
3989      10113 105040    ABS    =FMP    SQUARE IT
3990      10114 001204    DEF    F3
3991      10115 071210    STA    F5      SAVE SQUARE
3992      10116 075211    STB    F5+1
3993      10117 105000    ABS    =FAD
3994      10120 010164    DEF    EXPA
3995      10121 071206    STA    F4
3996      10122 075207    STB    F4+1    F4=F3↑2+A
3997      10123 062166    LDA    EXPB
3998      10124 066167    LDB    EXPB+1
3999      10125 105060    ABS    =FDV
4000      10126 001206    DEF    F4
4001      10127 071206    STA    F4
4002      10130 075207    STB    F4+1    F4=B/F4
4003      10131 062170    LDA    EXPC
4004      10132 066171    LDB    EXPC+1
4005      10133 105040    ABS    =FMP
4006      10134 001210    DEF    F5
4007      10135 105000    ABS    =FAD
4008      10136 010172    DEF    EXPD
4009      10137 105020    ABS    =FSB
4010      10140 001204    DEF    F3
4011      10141 105020    ABS    =FSB
4012      10142 001206    DEF    F4
4013      10143 071206    STA    F4
4014      10144 075207    STB    F4+1    F4=F3+D+C*F3↑2=F4
4015      10145 061204    LDA    F3

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4016	10146	065205		LDB	F3+1	
4017	10147	105060		ABS	=FDV	
4018	10150	001206		DEF	F4	
4019	10151	105000		ABS	=FAD	
4020	10152	001224		DEF	FL,5	
4021	10153	036156		ISZ	EXPI	
4022	10154	000000		NOP		
4023	10155	115161		JSB	PW2,I	
4024	10156	000000	EXPI	NOP		
4025	10157	036065		ISZ	EXP	STEP PAST ERROR EXIT
4026	10160	126065		JMP	EXP,I	ANS=(0,5+F3/F4)*2↑I
4027*						
4028	10161	002400	EXP0	CLA		ANS=0
4029	10162	006400		CLB		
4030	10163	026157		JMP	EXPI+1	
4031*						
4032	10164	053552	EXPA	DEC	87,417497202	
4033	10166	046477	EXPB	DEC	617,9722695	
4034	10170	043372	EXPC	DEC	,03465735903	
4035	10172	047643	EXPD	DEC	9,9545957821	

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4037* LOGARITHM
4038* CALLING SEQUENCE..
4039* DLD X OR EQUIVALENT
4040* JSB ALOG
4041* JMP ERROR -VE OR 0 ARG
4042* CALCULATES NATURAL LOG OF X
4043 10174 000000 ALOG NOP
4044 10175 071204 STA F3
4045 10176 016720 JSB ,FLUN
4046 10177 075205 STB F3+1 F3=MANT(X)
4047 10200 105120 ABS =FLT F4=EXP(X)
4048 10201 071206 STA F4
4049 10202 075207 STB F4+1
4050 10203 061204 LDA F3 GET HI OF X
4051 10204 002002 SZA
4052 10205 002020 SSA TEST SIGN
4053 10206 126174 JMP ALOG,I ERROR; -VE OR ZERO
4054 10207 065205 LDB F3+1 PICK UP REST OF MANT
4055 10210 105000 ABS =FAD ADD SQRT(.5)
4056 10211 001244 DEF FLRTH
4057 10212 071210 STA F5
4058 10213 075211 STB F5+1 F5=MANT(X)+SQRT(.5)
4059 10214 061204 LDA F3
4060 10215 065205 LDB F3+1
4061 10216 105020 ABS =FSB MANT(X)-SQRT(.5)
4062 10217 001244 DEF FLRTH
4063 10220 105060 ABS =FDV
4064 10221 001210 DEF F5
4065 10222 071210 STA F5
4066 10223 075211 STB F5+1 (MANT-SQRT)/(MANT+SQRT)
4067 10224 105040 ABS =FMP SQUARED
4068 10225 001210 DEF F5
4069 10226 105020 ABS =FSB
4070 10227 010256 DEF LOGC
4071 10230 071204 STA F3
4072 10231 075205 STB F3+1 F3=F5+2=C
4073 10232 062254 LDA LOGB
4074 10233 066255 LDB LOGB+1
4075 10234 105060 ABS =FDV
4076 10235 001204 DEF F3
4077 10236 105000 ABS =FAD
4078 10237 010252 DEF LOGA
4079 10240 105040 ABS =FMP
4080 10241 001210 DEF F5
4081 10242 105020 ABS =FSB
4082 10243 001224 DEF FL.5
4083 10244 105000 ABS =FAD
4084 10245 001206 DEF F4
4085 10246 105040 ABS =FMP ANS=LOG(2)*(EXP(X)-.5+F5*A-B/F3)
4086 10247 001242 DEF FLGE2
4087 10250 036174 ISZ ALOG STEP PAST ERROR EXIT
4088 10251 126174 JMP ALOG,I
4089*
4090 10252 051260 LOGA DEC 1,2920070987
4091 10254 125606 LOGB DEC -2,6398577035
4092 10256 065010 LOGC DEC 1,6567626301

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4094*      SINE AND COSINE
4095*      CALLING SEQUENCE..
4096*      DLD X OR EQUIVALENT
4097*      JSB SIN      OR      JSB COS
4098*      MODIFIED FROM HP VERSION, BENNETT, 74 JULY 3
4099  10260 000000   SIN  NOP
4100  10261 105040   ABS  =FMP      X=X*2/PI
4101  10262 001236   DEF  FL2/P
4102  10263 071214   STA  F7
4103  10264 075215   STB  F7+1
4104  10265 105000   ABS  =FAD
4105  10266 001302   DEF  FL1
4106  10267 115161   JSB  PW2,I
4107  10270 177776   DEC  =2
4108  10271 115142   JSB  ENTP,I   BENNETT VERSION ONLY
4109  10272 115161   JSB  PW2,I   X4
4110  10273 000002   DEC  2
4111  10274 115153   JSB  FCM,I   X=4
4112  10275 105000   ABS  =FAD
4113  10276 001214   DEF  F7
4114  10277 071214   STA  F7
4115  10300 075215   STB  F7+1   X=X-4*ENTIER((X+1)/4)
4116  10301 105020   ABS  =FSB
4117  10302 001302   DEF  FL1
4118  10303 002020   SSA                      X<1 ?
4119  10304 026313   JMP  SIN1      YES
4120  10305 061226   LDA  FL2
4121  10306 065227   LDB  FL2+1
4122  10307 105020   ABS  =FSB
4123  10310 001214   DEF  F7
4124  10311 071214   STA  F7
4125  10312 075215   STB  F7+1   X=2-X
4126  10313 061214   SIN1 LDA  F7
4127  10314 065215   LOB  F7+1
4128  10315 105040   ABS  =FMP
4129  10316 001214   DEF  F7
4130  10317 115161   JSB  PW2,I
4131  10320 000001   DEC  1
4132  10321 105020   ABS  =FSB
4133  10322 001302   DEF  FL1
4134  10323 016610   JSB  ,CHEB
4135  10324 010336   DEF  SINC
4136  10325 105040   ABS  =FMP
4137  10326 001214   DEF  F7
4138  10327 126260   JMP  SIN,I   ANS=X*CHEBY(2*X+2-1)
4139*
4140*      COSINE
4141*      CALCULATES COS(X)=-SINE(X-PI/2)
4142  10330 000000   COS  NOP
4143  10331 105000   ABS  =FAD      ADD  =PI/2
4144  10332 001232   DEF  FLMP2
4145  10333 016260   JSB  SIN
4146  10334 115153   JSB  FCM,I
4147  10335 126330   JMP  COS,I
4148*
4149  10336 047605   SINC DEC  1.18496E-6,=1,365875E-4,9,118016E-3

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4150 10344 133371

DEC -.2852615692,2.5525579248,0

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4152*   SQUARE ROOT
4153*   CALLING SEQUENCE,,
4154*   DLD X OR EQUIVALENT
4155*   JSB SQRT
4156*   JMP ERROR   =VE ARGUMENT
4157*   RESULT FLOATING POINT
4158   10351 000000   SQRT   NOP
4159   10352 002003           SZA,RSS      X=0 ?
4160   10353 026421           JMP SQRTE+1  YES; ANS=0
4161   10354 002020           SSA          X<0 ?
4162   10355 126351           JMP SQRT,I  ERROR EXIT
4163   10356 071204           STA F3      SAVE X
4164   10357 075205           STB F3+1
4165   10360 016720           JSB ,FLUN   UNPACK EXP
4166   10361 000031           SLA,ARS     ODD ?
4167   10362 026423           JMP SQRT1   YES
4168   10363 041335           ADA B#1
4169   10364 072420           STA SQRTE   E=EXPONENT/2-1
4170   10365 075205           STB F3+1   F3=MANT(X)
4171   10366 061204           LDA F3
4172   10367 105040           ABS =FMP
4173   10370 010440           DEF SQRTB
4174   10371 105000           ABS =FAD    F4=D+B*F3
4175   10372 010444           DEF SQRTD
4176   10373 071206   SQRT2  STA F4
4177   10374 075207           STB F4+1
4178   10375 061204           LDA F3
4179   10376 065205           LDB F3+1
4180   10377 105060           ABS =FDV
4181   10400 001206           DEF F4
4182   10401 105000           ABS =FAD
4183   10402 001206           DEF F4
4184   10403 115161           JSB PW2,I
4185   10404 177777           DEC =1
4186   10405 071206           STA F4
4187   10406 075207           STB F4+1   F4=(F4+F3/F4)/2
4188   10407 061204           LDA F3     2ND ITERATION
4189   10410 065205           LDB F3+1
4190   10411 105060           ABS =FDV
4191   10412 001206           DEF F4
4192   10413 105000           ABS =FAD
4193   10414 001206           DEF F4
4194   10415 071206           STA F4
4195   10416 075207           STB F4+1
4196   10417 115161           JSB PW2,I
4197   10420 000000   SQRTE  NOP
4198   10421 036351           ISZ SQRT   STEP PAST ERROR EXIT
4199   10422 126351           JMP SQRT,I ANS=(F4+F3/F4)*2↑E
4200*
4201   10423 072420   SQRT1  STA SQRTE   E=EXPONENT/2
4202   10424 061205           LDA F3+1
4203   10425 031452           IOR B377   FORCE EXPONENT =1
4204   10426 071205           STA F3+1
4205   10427 070001           STA 1
4206   10430 061204           LDA F3
4207   10431 105040           ABS =FMP

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4208	10432	010436	DEF	SQRTA	
4209	10433	105000	ABS	=FAD	
4210	10434	010442	DEF	SQRTC	
4211	10435	026373	JMP	SQRT2	F4=C+A*F3
4212*					
4213	10436	070000	SQRTA	DEC	.875
4214	10440	045000	SQRTB	DEC	.578125
4215	10442	043524	SQRTC	DEC	.27863
4216	10444	066000	SQRTD	DEC	.421875

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4218*      EXPONENTIATE; REAL TO REAL POWER
4219*      CALLING SEQUENCE,,
4220*      JSB ,RTOR
4221*      DEF BASE
4222*      DEF POWER
4223*      JMP ERROR      NOTE CHANGE FROM HP
4224*      CALCULATES BASE↑POWER
4225*      RESULT FLOATING POINT IN A  B
4226 10446 000000 ,RTOR NOP
4227 10447 162446 LDA ,RTOR,I GET POINTER TO BASE
4228 10450 104200 DLD 0,I PICK UP BASE
4229 10452 071212 STA F6 AND SAVE IT
4230 10453 075213 STB F6+1
4231 10454 036446 ISZ ,RTOR STEP TO POWER POINTER
4232 10455 162446 LDA ,RTOR,I GET POINTER TO POWER
4233 10456 036446 ISZ ,RTOR STEP TO ERROR EXIT
4234 10457 104200 DLD 0,I PICK UP POWER
4235 10461 071214 STA F7 AND SAVE IT
4236 10462 075215 STB F7+1
4237 10463 065212 LDB F6 GET SIGN OF BASE
4238 10464 002003 SZB,RSS POWER=0 ?
4239 10465 026506 JMP RTOR0 YES
4240 10466 006003 SZB,RSS BASE=0 ?
4241 10467 026502 JMP RTOR1 YES
4242 10470 061212 LDA F6 PICK UP BASE
4243 10471 065213 LDB F6+1
4244 10472 016174 JSB ALOG TAKE LOGARITHM
4245 10473 126446 JMP ,RTOR,I ERROR; BASE =VE OR 0
4246 10474 105040 ABS =FMP MULTIPLY BY POWER
4247 10475 001214 DEF F7
4248 10476 016065 JSB EXP TAKE EXPONENTIAL
4249 10477 126446 JMP ,RTOR,I ERROR; EXPONENTIAL OVERFLOW
4250 10500 036446 RTORX ISZ ,RTOR STEP TO COMPLETION RETURN
4251 10501 126446 JMP ,RTOR,I ANS=EXP(POWER*ALOG(BASE))
4252*
4253 10502 002020 RTOR1 SSA POWER =VE ?
4254 10503 126446 JMP ,RTOR,I ERROR; ZERO TO =VE POWER
4255 10504 002400 CLA ANS=0
4256 10505 026500 JMP RTORX
4257*
4258 10506 061302 RTOR0 LDA FL1 ANS=1
4259 10507 065303 LDB FL1+1
4260 10510 026500 JMP RTORX

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4262*   EXPONENTIATE; REAL TO INTEGER POWER
4263*   CALLING SEQUENCE..
4264*   JSB ,RTOI
4265*   DEF BASE      (FLOATING)
4266*   DEF POWER     (INTEGER)
4267*   JMP ERROR    ERROR EXIT
4268   10511 000000 ,RTOI NOP
4269   10512 162511 LDA ,RTOI,I GET PTR TO BASE
4270   10513 104200 DLD 0,I PICK UP BASE
4271   10515 071204 STA F3 SAVE IT
4272   10516 075205 STB F3+1
4273   10517 036511 ISZ ,RTOI STEP PTR TO POWER
4274   10520 166511 LDB ,RTOI,I GET PTR
4275   10521 164001 LDB 1,I GET POWER
4276   10522 036511 ISZ ,RTOI STEP TO EXIT
4277   10523 006003 SZB,RSS POWER=0 ?
4278   10524 026565 JMP RTOI0 YES
4279   10525 002003 SZA,RSS BASE=0 ?
4280   10526 026561 JMP RTOI1 YES
4281   10527 061302 LDA FL1 GET 1.0
4282   10530 071206 STA F4 AND SET IN F4
4283   10531 061303 LDA FL1+1
4284   10532 071207 STA F4+1
4285   10533 075310 STB FT1 SAVE SIGN OF POWER
4286   10534 006020 SSB TAKE MODULUS
4287   10535 007004 CMB,INB
4288   10536 075311 STB FT2 SAVE MOD(POWER)
4289   10537 065311 RTOI2 LDB FT2
4290   10540 004031 SLB,BRS TEST LSB AND HALVE
4291   10541 026570 JMP RTOI3 LSB WAS 1; GO MULTIPLY
4292   10542 075311 STB FT2
4293   10543 006002 RTOI6 SZB TEST POWER=0 (=DONE)
4294   10544 026601 JMP RTOI4 NO
4295   10545 061310 LDA FT1 TEST SIGN OF POWER
4296   10546 002020 SSA
4297   10547 026554 JMP RTOI5 -VE; ANS=1/F4
4298   10550 061206 LDA F4 +VE; ANS=F4
4299   10551 065207 LDB F4+1
4300   10552 036511 RTOIX ISZ ,RTOI STEP PAST ERROR EXIT
4301   10553 126511 JMP ,RTOI,I
4302*
4303   10554 061302 RTOI5 LDA FL1 PICK UP 1.0
4304   10555 065303 LDB FL1+1
4305   10556 105060 ABS -FDV ANS=1/F4
4306   10557 001206 DEF F4
4307   10560 026552 JMP RTOIX
4308*
4309   10561 006020 RTOI1 SSB POWER<0 ?
4310   10562 126511 JMP ,RTOI,I ERROR; 0 TO -VE POWER
4311   10563 006400 CLB
4312   10564 026552 JMP RTOIX ANS=0
4313*
4314   10565 061302 RTOI0 LDA FL1
4315   10566 065303 LDB FL1+1
4316   10567 026552 JMP RTOIX ANS=1
4317*

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4318	10570	075311	RTOI3	STB FT2	SAVE POWER
4319	10571	061204		LDA F3	
4320	10572	065205		LDB F3+1	
4321	10573	105040		ABS =FMP	
4322	10574	001206		DEF F4	
4323	10575	071206		STA F4	
4324	10576	075207		STB F4+1	F4=F4*BASE
4325	10577	065311		LDB FT2	RESTORE POWER
4326	10600	026543		JMP RTOI6	
4327*					
4328	10601	061204	RTOI4	LDA F3	
4329	10602	065205		LDB F3+1	
4330	10603	105040		ABS =FMP	
4331	10604	001204		DEF F3	
4332	10605	071204		STA F3	
4333	10606	075205		STB F3+1	BASE=BASE+2
4334	10607	026537		JMP RTOI2	


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4336*   EVALUATE CHEBYCHEV POLYNOMIAL
4337*   CALLING SEQUENCE,,
4338*   DLD X OR EQUIVALENT
4339*   JSB ,CHEB
4340*   DEF C TABLE OF COEFFS
4341*   INTEGER ZERO TERMINATES TABLE
4342   10610 000000   ,CHEB NOP
4343   10611 115161   JSB PW2,I
4344   10612 000001   DEC 1
4345   10613 071204   STA F3
4346   10614 075205   STB F3+1   F3=2*X
4347   10615 162610   LDA ,CHEB,I GET POINTER TO COEFFS
4348   10616 071310   STA FT1
4349   10617 104200   DLD FT1,I   GET 1ST COEFF
4350   10621 071206   STA F4
4351   10622 075207   STB F4+1   F4=C(N)
4352   10623 002400   CLA
4353   10624 071210   STA F5
4354   10625 071211   STA F5+1   F5=0
4355   10626 035310   CHEB1 ISZ FT1
4356   10627 035310   ISZ FT1   N=N-1
4357   10630 161310   LDA FT1,I GET SIGN OF NEXT COEFF
4358   10631 002003   SZA,RSS   C(N)=0 ?
4359   10632 026654   JMP CHEB2 0 FLAGS END
4360   10633 061210   LDA F5
4361   10634 065211   LDB F5+1
4362   10635 071212   STA F6
4363   10636 075213   STB F6+1   F6=F5
4364   10637 061206   LDA F4
4365   10640 065207   LDB F4+1
4366   10641 071210   STA F5
4367   10642 075211   STB F5+1   F5=F4
4368   10643 105040   ABS =FMP
4369   10644 001204   DEF F3
4370   10645 105020   ABS =FSB
4371   10646 001212   DEF F6
4372   10647 105000   ABS =FAD
4373   10650 101310   DEF FT1,I
4374   10651 071206   STA F4
4375   10652 075207   STB F4+1   F4=C(N)-F6+F5*2*X
4376   10653 026626   JMP CHEB1
4377*
4378   10654 061206   CHEB2 LDA F4
4379   10655 065207   LDB F4+1
4380   10656 105020   ABS =FSB
4381   10657 001212   DEF F6
4382   10660 115161   JSB PW2,I
4383   10661 177777   DEC =1
4384   10662 036610   ISZ ,CHEB STEP TO EXIT
4385   10663 126610   JMP ,CHEB,I ANS=(F4-F6)/2

```

```

4387*      EVALUATE POLYNOMIAL
4388*      CALLING SEQUENCE..
4389*          DLD X OR EQUIVALENT
4390*          JSB ,POLY
4391*          DEC N NO OF COEFFS
4392*          DEF C TABLE OF COEFFS
4393*      COEFFICIENTS STORED WITH HIGHEST POWER FIRST
4394*      RESULT IS C1*X↑(N=1)+.....+CN
4395*      BENNETT, 74 JULY 24
4396 10664 000000      ,POLY NOP
4397 10665 071204      STA F3          SAVE X
4398 10666 075205      STB F3+1
4399 10667 162664      LDA ,POLY,I  GET N
4400 10670 003004      CMA,INA      NEGATE
4401 10671 071310      STA FT1      SET COUNT
4402 10672 036664      ISZ ,POLY   STEP PTR TO TABLE
4403 10673 162664      LDA ,POLY,I  GET PTR
4404 10674 036664      ISZ ,POLY   STEP PTR TO EXIT
4405 10675 071311      STA FT2      SET PTR TO TABLE
4406 10676 061310      LDA FT1      CHECK N
4407 10677 002021      SSA,RSS      =VE OR 0 ?
4408 10700 026715      JMP POLY0     SILLY!
4409 10701 104200      DLD FT2,I    GET 1ST COEFF
4410 10703 035310      POLY1 ISZ FT1  COUNT COEFFICIENTS
4411 10704 002001      RSS
4412 10705 126664      JMP ,POLY,I  DONE
4413 10706 035311      ISZ FT2      STEP TO NEXT COEFF
4414 10707 035311      ISZ FT2
4415 10710 105040      ABS =FMP     MULTIPLY BY X
4416 10711 001204      DEF F3
4417 10712 105000      ABS =FAD     ADD NEXT COEFFICIENT
4418 10713 101311      DEF FT2,I
4419 10714 026703      JMP POLY1
4420*
4421 10715 002400      POLY0 CLA     NO COEFFICIENTS...
4422 10716 006400      CLB         OR EVEN FEWER;
4423 10717 126664      JMP ,POLY,I  ANS=0

```

PAGE 0111 #01 FLOATING POINT ROUTINES

```

4425* UNPACK 2ND WORD OF FLOATING POINT NUMBER
4426* CALLING SEQUENCE,,
4427* LDB LO OR EQUIVALENT E.G. DLD X
4428* JSB .FLUN
4429* RETURNS WITH A=EXPONENT, B=LOW MANTISSA
4430 10720 000000 .FLUN NOP
4431 10721 060001 LDA 1 TRANSFER LO TO A
4432 10722 011452 AND 8377 MASK OFF EXPONENT BITS
4433 10723 007000 CMB
4434 10724 044000 ADB 0 SUBTRACT EXP BITS FROM B
4435 10725 007000 CMB
4436 10726 000033 SLA,RAR POSITION TEST SIGN OF EXP
4437 10727 031344 IOR 8M200 PUT IN EXTRA BITS IF -VE
4438 10730 126720 JMP .FLUN,I

```

PAGE 0112 #01 FLOATING POINT ROUTINES

```
4440 10731 000000 CMBUF BSS 128 COMMON USE BUFFER
4441*
4442 11131 000000 TEXT OCT 0
4443 11132 000000 OCT 0
4444 11133 041455 ASC 6,C=ONCAL, LEAD IN MESSAGE
4445 11141 043015 OCT 43015
4446 11142 BUFBG EQU *
4447 END
** NO ERRORS*
```

```

0001          ASMB,A,L
0003*        STANDARD EXTENDED PRECISION VERSION
0004*
0005*        BASE PAGE; I/O ETC
0006 00002          ORG 2B
0007          SUP
0008 37677          CORE EQU 37677B LAST WORD AVAILABLE
0009 00002 102002   DMAC1 HLT 2
0010 00003 102003   DMAC2 HLT 3
0011 00004 102004          HLT 4
0012 00005 102005          HLT 5
0013 00006 114026   DMA1 JSB 26B,I DMA CH 1
0014 00007 114027   DMA2 JSB 27B,I DMA CH 2
0015 00010 102010   DISCD HLT 10B DISC; DOES NOT USE IR
0016 00011 102011   DISCC HLT 11B
0017 00012 102012   MTD HLT 12B MAG TAPE DATA
0018 00013 114030   MTC JSB 30B,I MAG TAPE CONTROL
0019 00014 114031   LINEP JSB 31B,I LINEPRINTER
0020 00015 114032   HSR JSB 32B,I HS READER
0021 00016 114033   PNCH JSB 33B,I HS PUNCH
0022 00017 114034   TTY JSB 34B,I TELETYPE
0023 00020 114035   PLOT JSB 35B,I PLOTTER
0024 00021 114036   DISPL JSB 36B,I 'SCOPE
0025 00022 102022          HLT 22B
0026 00023 102023          HLT 23B
0027 00024 102024          HLT 24B
0028 00025 102025          HLT 25B
0029 00026 007257   DEF DMAI1 DMA CH 1
0030 00027 007263   DEF DMAI2 DMA CH 2
0031 00030 007267   DEF MTCI MAGTAPE
0032 00031 007213   DEF LPIR LINEPRINTER
0033 00032 007171   DEF HSRI HS READER
0034 00033 007207   DEF HPNI HS PUNCH
0035 00034 007075   ITTJ DEF ITTO TELETYPE
0036 00035 004411   DEF PLIR PLOTTER
0037 00036 007275   DEF DISI 'SCOPE
0038 00037 000000   NOP
0039 00040 000000   NOP
0040*

```

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0042*   BASIC PROGRAM TO READ COMMANDS ('START'),
0043*   STORE THEM ('INPTN') AND TO EXECUTE
0044*   BOTH DIRECT COMMANDS AND STORED
0045*   COMMANDS ACCESSED VIA 'GO' ('NEXTL').
0046*   THE "TIDY UP" SECTION AFTER ADDING A LINE
0047*   TO THE STORED TEXT IS ALSO USED BY THE
0048*   'MODIFY' COMMAND, ENTERING AT 'MODX'.
0049*
0050*   INTERNAL RESTART ENTRY POINT
0051   00110           ORG 1100
0052   00110 060675   START LDA PROG0
0053   00111 070644           STA PC           POINT TO NULL
0054   00112 060701           LDA INBFE       SET END=STOP FOR INPU
0055   00113 070634           STA PDL
0056   00114 061516           LDA B52        TYPE '!'
0057   00115 115142           JSB PRC,I      ON TELETYPE
0058   00116 060700           LDA INBF       SET INPUT TO 'COMIN'
0059   00117 001200           RAL
0060   00120 070633           STA TXIN
0061   00121 070650           STA PAKST
0062   00122 070643           STA TXOUT
0063   00123 115143           JSB RDC,I
0064   00124 051553           CPA B137     BACK ARROW?
0065   00125 024116           JMP *-7   LOSE TEXT
0066   00126 051467           CPA B12     LINE FEED?
0067   00127 024123           JMP *-4   IGNORE IT
0068   00130 115144           JSB PKC,I  PACK TO 'COMIN'
0069   00131 051501           CPA B15   CARRIAGE RETURN?
0070   00132 002001           RSS
0071   00133 024123           JMP *-8   GET NEXT
0072   00134 014401           JSB GETC  GET FIRST CH FROM 'COMIN'
0073   00135 060652           LDA BOTTM SET UP PDL
0074   00136 070634           STA PDL
0075   00137 014316           JSB SPNOR SKIP SPACES
0076   00140 014277           JSB SORT
0077   00141 002001           RSS
0078   00142 024156           JMP INPTN OP/TERM
0079   00143 014544   NEXTL JSB PUSHJ  NUMBER; READ AND STORE
0080   00144 003462           DEF PROC EXECUTE LINE
0081   00145 160644           LDA PC,I  TEST IF PC SET
0082   00146 002003           SZA,RSS
0083   00147 024110           JMP START PC NOT SET OR END OF TEXT
0084   00150 070644           STA PC   SET PC TO NEXT LINE
0085   00151 041472           ADA B2
0086   00152 001200           RAL
0087   00153 070643           STA TXOUT
0088   00154 014401           JSB GETC
0089   00155 024143           JMP NEXTL CONTINUE EXECUTING IN SEQUENCE
0090*
0091   00156 014413   INPTN JSB GETLN  NUMBER; STORE LINE
0092   00157 002021           SSA,RSS  ONE LINE?
0093   00160 014220           JSB ERROR NO
0094   00161 064672           LDB BUFR  PACK TO TEXT BUFFER
0095   00162 006004           INB
0096   00163 060670           LDA LNNO
0097   00164 170001           STA I,I

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0098	00165	006004		INB	
0099	00166	005200		RBL	
0100	00167	074633		STB	TXIN
0101	00170	014316		JSB	SPNOR
0102	00171	002001		RSS	
0103	00172	014401		JSB	GETC
0104	00173	115144		JSB	PKC,I
0105	00174	051501		CPA	B15 UNTIL CR
0106	00175	002001		RSS	
0107	00176	024172		JMP	*-4
0108	00177	115204	MODX	JSB	DEL,I
0109	00200	160647		LDA	LSTLN,I MOVE PTR TO NEXT LINE
0110	00201	170672		STA	BUFR,I
0111	00202	060672		LDA	BUFR SET PTR TO THIS LINE
0112	00203	170647		STA	LSTLN,I
0113	00204	060633		LDA	TXIN SET PTR TO AVAILABLE SPACE
0114	00205	000010		SLA	ROUND UP ODD CHARACTER
0115	00206	002004		INA	
0116	00207	070633		STA	TXIN
0117	00210	001100		ARS	
0118	00211	070672		STA	BUFR
0119	00212	070671		STA	LASTV ERASE VARIABLES
0120	00213	024110		JMP	START

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0122*      ERROR AND RECOVERY ROUTINES.
0123*      RESTART ENTRY IS AT LOCATION FOLLOWING 'RECOV'.
0124*      ENTRY THERE WITH A=0 GIVES A ZERO ERROR CODE,
0125 00214 000000 ERR2 NOP          ERROR ROUTINE; PRINTS A
0126 00215 070276      STA ERRA      SAVE A TO PRINT LATER
0127 00216 060214      LDA ERR2      AS WELL AS ERROR CODE
0128 00217 024222      JMP **3
0129 00220 000000 ERROR NOP          NORMAL ERROR ROUTINE;
0130 00221 060220      LDA ERROR      PICK UP ERROR CODE
0131 00222 041437      ADA B#1       CORRECT FOR JSB
0132 00223 102100      STF 0
0133 00224 065124      LDB TTYSW      WAIT FOR O/P
0134 00225 006003      SZB,RSS
0135 00226 024224      JMP **2
0136 00227 103100      CLF 0
0137 00230 002001      RSS
0138 00231 061564 RECOV LDA B400
0139 00232 070670      STA LNNO      SET ERROR CODE
0140 00233 015032      JSB TTRON     SET TTY READER
0141 00234 061210      LDA TTYPN
0142 00235 070664      STA OUTCH     AND TTY OUTPUT
0143 00236 061113      LDA TTBF0     RESET O/P BUFFER POINTERS
0144 00237 071114      STA TTBF1
0145 00240 071115      STA TTBF0
0146 00241 002400      CLA
0147 00242 071125      STA TTYFL     CLEAR INPUT
0148 00243 102601      OTA 1       CLEAR SWITCH REGISTER
0149 00244 002404      CLA,INA
0150 00245 071124      STA TTYSW     AND OUTPUT
0151 00246 061557      LDA B200
0152 00247 114664      JSB OUTCH,I  PRINT BLANK
0153 00250 061530      LDA B77
0154 00251 114664      JSB OUTCH,I
0155 00252 060670      LDA LNNO     ERROR LOCATION
0156 00253 115145      JSB PRO,I
0157 00254 034644      ISZ PC
0158 00255 160644      LDA PC,I
0159 00256 002003      SZA,RSS
0160 00257 024266      JMP **7
0161 00260 070670      STA LNNO
0162 00261 061461      LDA B100    0
0163 00262 114664      JSB OUTCH,I
0164 00263 061507      LDA B40     SPACE
0165 00264 114664      JSB OUTCH,I
0166 00265 115146      JSB PRL,I    LINE NO
0167 00266 006400      CLB
0168 00267 060276      LDA ERRA     GET 'A', IF ANY
0169 00270 074276      STB ERRA     CLEAR 'A'
0170 00271 002002      SZA
0171 00272 115145      JSB PRO,I    DON'T PRINT IF ZERO
0172 00273 061501      LDA B15
0173 00274 114564      JSB OUTCH,I
0174 00275 024110      JMP START
0175 00276 000000 ERR2 NOP

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0177 00277 000000 SORT NOP
0178 00300 060667 LDA CHAR
0179 00301 000065 CLE,ERA ODD/EVEN TO E
0180 00302 040315 ADA SORTT MAKE TABLE ADDRESS
0181 00303 164000 LDB 0,I PICK UP ENTRY
0182 00304 002040 SEZ
0183 00305 005727 BLF,BLF POSITION IF ODD
0184 00306 101035 ASR 13 3-BIT SIGNED TYPE TO B
0185 00307 001722 ALF,RAL 5-BIT UNSIGNED = TO A
0186 00310 011506 AND B37
0187 00311 006020 SSB LEGAL?
0188 00312 014220 JSB ERROR NO
0189 00313 044277 ADB SORT MAKE EXIT
0190 00314 124001 JMP 1,I
0191* TABLE CODE IS 8-BITS PER ENTRY, MORE SIG 3 ARE 'TYPE'
0192* AND LESS SIG 5 ARE 'NUMBER', E.G. 200 MEANS ILLEGAL, #0
0193* 43 MEANS NUMBER, #3; 12 MEANS TERMINATOR #10
0194*
0195 00315 005720 SORTT DEF SORTB
0196*
0197*
0198*
0199* RUN NON-SIGNIFICANT SPACES
0200 00316 000000 SPNOR NOP
0201 00317 060667 LDA CHAR GET CHARACTER
0202 00320 051507 CPA B40 IS IT SPACE ?
0203 00321 002001 RSS
0204 00322 124316 JMP SPNOR,I NO! ALL DONE
0205 00323 014401 JSB GETC YES; GET NEXT ONE
0206 00324 024317 JMP SPNOR+1
0207*
0208* 'RETURN' COMMAND AND RECURSIVE SUBROUTINE
0209* RETURN, 'POPJ'
0210 00325 060675 RETRN LDA PROG0 'RETURN'; SET END OF TEXT
0211 00326 070644 STA PC IN PROGRAM COUNTER
0212 00327 164634 POPJ LDB PDL,I RECURSIVE SR RETURN
0213 00330 034634 ISZ PDL GET RETURN FROM PDL
0214 00331 124001 JMP 1,I AND JUMP TO RETURN
0215*
0216* COMPARE GROUP NUMBER IN A WITH THAT IN LNNO
0217* 1ST EXIT IF DIFFERENT
0218* 2ND EXIT IF THE SAME
0219 00332 000000 TSTGP NOP
0220 00333 011447 AND BM400 MASK OFF GROUP PART OF A
0221 00334 070001 STA 1 SAVE GROUP
0222 00335 060670 LDA LNNO GET LNNO
0223 00336 011447 AND BM400 MASK OFF GROUP
0224 00337 050001 CPA 1 COMPARE GROUP NUMBERS
0225 00340 034332 ISZ TSTGP STEP EXIT IF THE SAME
0226 00341 124332 JMP TSTGP,I
0227*
0228* CHECK CLOSING PARENTHESIS
0229 00342 000000 PARTS NOP
0230 00343 060667 LDA CHAR PICK UP CHARACTER
0231 00344 051515 CPA B51 COMPARE )
0232 00345 002001 RSS OK

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0233	00346	014220	JSB ERROR	NO) ERROR
0234	00347	014401	JSB GETC	PASS OVER)
0235	00350	124342	JMP PARTS,I	EXIT
0236*				
0237*				
0238*				
0239*		FIND A LINE IN TEXT		
0240*		STEP EXIT IF FOUND		
0241*		SET LSTLN TO LINE BEFORE		
0242*		SET THSLN TO REQUIRED LINE OR ONE AFTER IF NOT FOUND		
0243	00351	000000	FNDLN NOP	
0244	00352	060674	LDA TEXT0	START AT BEGINNING OF TEXT
0245	00353	070647	STA LSTLN	
0246	00354	070645	STA THSLN	
0247	00355	002004	INA	POINT TO LINE NUMBER
0248	00356	064670	LDB LNNO	
0249	00357	007104	CMB,CLE,INB	
0250	00360	144000	ADB 0,I	
0251	00361	006003	SZB,RSS	
0252	00362	024373	JMP **9	LINE FOUND
0253	00363	002040	SEZ	
0254	00364	024374	JMP **8	PASSED IT
0255	00365	060645	LDA THSLN	
0256	00366	070647	STA LSTLN	
0257	00367	160645	LDA THSLN,I	
0258	00370	002002	SZA	ZERO MARKS END
0259	00371	024354	JMP FNDLN+3	TRY NEXT
0260	00372	002001	RSS	
0261	00373	034351	ISZ FNDLN	
0262	00374	060645	LDA THSLN	
0263	00375	041472	ADA B2	
0264	00376	001200	RAL	POSITION POINTER
0265	00377	070643	STA TXOUT	
0266	00400	124351	JMP FNDLN,I	
0267*				
0268	00401	000000	GETC NOP	READ CH TO CHAR A
0269	00402	060643	LDA TXOUT	
0270	00403	000065	CLE,ERA	POSITION SET E
0271	00404	160000	LDA 0,I	READ WORD
0272	00405	002041	SEZ,RSS	
0273	00406	001727	ALF,ALF	SHIFT M.S. HALF
0274	00407	034643	ISZ TXOUT	STEP POINTER
0275	00410	011556	AND B177	
0276	00411	070667	STA CHAR	
0277	00412	124401	JMP GETC,I	
0278*				
0279*				
0280*				
0281	00413	000000	GETLN NOP	READ LINE NUMBER
0282	00414	014316	JSB SPNOR	
0283	00415	014277	JSB SORT	TEST 1ST CHARACTER
0284	00416	002001	RSS	OP/TERM; EXPN
0285	00417	024447	JMP GETN	NUMERIC
0286	00420	014544	JSB PUSHJ	GET LINE NO
0287	00421	004731	DEF EVAL	
0288	00422	115140	JSB FMP,I	X100

0289	00423	001217		DEF FLAC	
0290	00424	001217		DEF FLAC	
0291	00425	001353		DEF FL100	
0292	00426	115153		JSB INT,I	CONVERT TO INTEGER
0293	00427	001217		DEF FLAC	IN A
0294	00430	006400		CLB	
0295	00431	100400		DIV D100	GROUP TO A
0296	00433	001727	GETL2	ALF,ALF	LINE IS IN B; POSITION A
0297	00434	040001		ADA B	TOTAL TO A
0298	00435	070670		STA LNNO	STORE
0299	00436	002003		SZA,RSS	ZERO?
0300	00437	024445		JMP GETAL	0='ALL'
0301	00440	061456		LDA BMIN	ONE LINE
0302	00441	006003		SZB,RSS	
0303	00442	002400		CLA	OR GROUP
0304	00443	070666	GETLX	STA LGAFL	
0305	00444	124413		JMP GETLN,I	
0306*					
0307	00445	002404	GETAL	CLA,INA	'ALL'
0308	00446	024443		JMP GETLX	
0309*					
0310	00447	006400	GETN	CLB	NUMERIC LINE NUMBER
0311	00450	074530		STB GETL	CLEAR LINE NUMBER
0312	00451	074531		STB GETG	AND GROUP NUMBER
0313	00452	051467		CPA B12	"," IS LEGAL NUMERIC
0314	00453	024501		JMP GETLL	GROUP ZERO
0315	00454	070531		STA GETG	SAVE GROUP NO
0316	00455	100200		MPY B12	X10
0317	00457	070532		STA GET10	SAVE 10*GP NO
0318	00460	014401		JSB GETC	GET NEXT CH
0319	00461	014277		JSB SORT	TEST
0320	00462	024525		JMP GETL1	OP/TERM; JUST A GROUP NO
0321	00463	002001		RSS	NUMERIC
0322	00464	014220	GETER	JSB ERROR	LINE NO FORMAT ERROR
0323	00465	051467		CPA B12	","?
0324	00466	024501		JMP GETLL	GO GET LINE PART
0325	00467	040532		ADA GET10	ADD IN MORE SIG PART
0326	00470	070531		STA GETG	SET GROUP NO
0327*				2 DIGITS READ; "," OR	TERMINATOR NEXT
0328	00471	014401		JSB GETC	READ NEXT CH
0329	00472	014277		JSB SORT	TEST IT
0330	00473	024525		JMP GETL1	OP/TERM; JUST A GROUP NO
0331	00474	002001		RSS	NUMERIC
0332	00475	024464		JMP GETER	ALPHABETIC; ERROR
0333	00476	051467		CPA B12	NUMERIC MUST BE ","
0334	00477	002001		RSS	
0335	00500	024464		JMP GETER	3RD DIGIT; ERROR
0336	00501	014401	GETLL	JSB GETC	GET 1ST CH OF LINE PART
0337	00502	014277		JSB SORT	TEST
0338	00503	024525		JMP GETL1	OP/TERM; ALL DONE
0339	00504	051467		CPA B12	NUMERIC; TEST ","
0340	00505	024464		JMP GETER	ALPH OR ","; ERROR
0341	00506	100200		MPY B12	X10
0342	00510	070530		STA GETL	SAVE LINE PART
0343	00511	014401		JSB GETC	GET NEXT
0344	00512	014277		JSB SORT	TEST

0345	00513	024525	JMP	GETL1	OP/TERM; ALL DONE	
0346	00514	051467	CPA	012	NUMERIC; "." ILLEGAL	
0347	00515	024464	JMP	GETER	ALPH OR " "; ERROR	
0348	00516	040530	ADA	GETL	ADD UP LINE PART	
0349	00517	070530	STA	GETL		
0350	00520	014401	JSB	GETC	MUST BE TERMINATOR	
0351	00521	014277	JSB	SORT	TEST	
0352	00522	024525	JMP	GETL1	OP/TERM; OK	
0353	00523	024464	JMP	GETER		
0354	00524	024464	JMP	GETER		
0355	00525	064530	GETL1	LDB	GETL	LINE PART TO B
0356	00526	060531	LDA	GETG	GROUP PART TO A	
0357	00527	024433	JMP	GETL2	GO PUT TOGETHER	
0358*						
0359	00530	000000	GETL	NOP	STORE FOR LINE PART	
0360	00531	000000	GETG	NOP	STORE FOR GROUP PART	
0361	00532	000000	GET10	NOP	STORE FOR GP MS PART	
0362*		PUSH DOWN		LIST ROUTINES		
0363	00533	000000	PUSHA	NOP	BASIC 'PUSH' ROUTINE	
0364	00534	007400		CCB		
0365	00535	044634		ADB	PDL	
0366	00536	074634		STB	PDL	SET NEW POINTER
0367	00537	054671		CPB	LASTV	O'FLOW?
0368	00540	014220		JSB	ERROR	PDL O'FLOW
0369	00541	170001		STA	10,I	PUSH A TO PDL
0370	00542	002400		CLA		
0371	00543	124533		JMP	PUSHA,I	
0372*						
0373	00544	000000	PUSHJ	NOP	ENTER REENTRANT CCDE	
0374	00545	060544		LDA	PUSHJ	
0375	00546	002004		INA		
0376	00547	014533		JSB	PUSHA	PUSH RETURN
0377	00550	164544		LDB	PUSHJ,I	
0378	00551	124001		JMP	1,I	
0379*						
0380	00552	160000		LDA	0,I	COPE WITH INDIRECT
0381	00553	024556		JMP	*+3	
0382	00554	000000	PUSHF	NOP	PUSH FLOATING POINT NUMBER	
0383*		PUSHES TWO OR THREE WORDS DEPENDING ON FP PRECISION				
0384	00555	160554		LDA	PUSHF,I	PICK UP ADDRESS
0385	00556	001275		RAL,CLE,SLA,ERA		
0386	00557	024552		JMP	PUSHF-2	
0387	00560	034554		ISZ	PUSHF	STEP EXIT
0388	00561	064634		LDB	PDL	UPDATE POINTER
0389	00562	045425		ADB	BM3	
0390	00563	074640		STB	T4	
0391	00564	074634		STB	PDL	
0392	00565	007104		CMB,CLE,INB	ROOM?	
0393	00566	044671		ADB	LASTV	
0394	00567	002040		SEZ		
0395	00570	024540		JMP	PUSHA+5	USE PUSHA O'FLOW CODE
0396	00571	164000		LDB	0,I	
0397	00572	174640		STB	T4,I	
0398	00573	002004		INA		
0399	00574	034640		ISZ	T4	
0400	00575	164000		LDB	0,I	

0401	00576	174640		STB T4,I	
0402	00577	002004		INA	
0403	00600	034640		ISZ T4	
0404	00601	164000		LDB 0,I	
0405	00602	174640		STB T4,I	
0406	00603	124554		JMP PUSHF,I	
0407*					
0408	00604	160000		LDA 0,I	
0409	00605	024610		JMP *+3	
0410	00606	000000	POPF	NOP	POP FLOATING POINT NUMBER
0411	00607	160606		LDA POPF,I	PICK UP ADDRESS
0412	00610	001275		RAL,CLE,SLA,ERA	
0413	00611	024604		JMP POPF=2	
0414	00612	034606		ISZ POPF	STEP EXIT
0415	00613	164634		LDB PDL,I	
0416	00614	174000		STB 0,I	
0417	00615	034634		ISZ PDL	
0418	00616	002004		INA	
0419	00617	164634		LDB PDL,I	
0420	00620	174000		STB 0,I	
0421	00621	034634		ISZ PDL	
0422	00622	002004		INA	
0423	00623	164634		LDB PDL,I	
0424	00624	174000		STB 0,I	
0425	00625	034634		ISZ PDL	
0426	00626	124606		JMP POPF,I	
0427*					
0428	00627	000000	POPA	NOP	POP ONE WORD
0429	00630	160634		LDA PDL,I	
0430	00631	034634		ISZ PDL	
0431	00632	124627		JMP POPA,I	

0434*			POINTERS, WORKING REGISTERS ETC.	
0435	00633	000000	TXIN	NOP
0436	00634	000000	PDL	NOP
0437	00635	000000	T1	NOP
0438	00636	000000	T2	NOP
0439	00637	000000	T3	NOP
0440	00640	000000	T4	NOP
0441	00641	000000	T5	NOP
0442	00642	000000	T6	NOP
0443	00643	000000	TXOUT	NOP
0444	00644	001356	PC	DEF FL0
0445	00645	000000	THSLN	NOP
0446	00646	000000	THSOP	NOP
0447	00647	000000	LSTLN	NOP
0448	00650	000000	PAKST	NOP
0449	00651	000000	PT1	NOP
0450	00652	037677	BOTTM	ABS CORE
0451	00653	006643	READP	DEF READ1
0452	00654	000401	GETCP	DEF GETC
0453	00655	000000	INPUT	NOP
0454	00656	000000	LSTOP	NOP
0455	00657	000000	EVFNM	NOP
0456	00660	000000	ATSW	NOP
0457	00661	000000	CNTR	NOP
0458	00662	000000	ADD	NOP
0459	00663	007127	INCH	DEF TTYR2
0460	00664	005621	OUTCH	DEF PRNTC
0461	00665	006060	FOUTP	DEF FOUT1
0462	00666	000001	LGAFI	OCT 1
0463	00667	000015	CHAR	OCT 15
0464	00670	000000	LNNO	NOP
0465	00671	012471	LASTV	DEF BUFBG
0466	00672	012471	BUFR	DEF BUFBG
0467	00673	012471	ENDT	DEF BUFBG
0468	00674	012460	TEXT0	DEF TEXT
0469	00675	001356	PROG0	DEF FL0
0470	00676	000000	FORM	DEC 0
0471	00677	000000	FORMF	NOP
0472	00700	007714	INBF	DEF CUMIN
0473	00701	010070	INBFE	DEF COME-1

PUSH DOWN LIST POINTER
GENERAL WORKING REGISTERS

TEXT POINTER FOR OUTPUT FROM BUF

CHARACTER INPUT ROUTINE
CHARACTER OUTPUT ROUTINE
NUMBER PRINT-OUT ROUTINE
=VE=ONE LINE; 0=GROUP; +1=ALL

"FIXED" FORMAT FLAG

0475* FUNCTION NAMES

0476 00702 002123 FABS OCT 2123
 0477 00703 046356 FSGN OCT 46356
 0478 00704 022724 FINT OCT 22724
 0479 00705 023222 FITR OCT 23222
 0480 00706 010463 FDIS OCT 10463
 0481 00707 003216 FATN OCT 3216
 0482 00710 013420 FEXP OCT 13420
 0483 00711 030747 FLOG OCT 30747
 0484 00712 046456 FSIN OCT 46456
 0485 00713 006763 FCOS OCT 6763
 0486 00714 047064 FSQT OCT 47064
 0487 00715 002704 FAND OCT 2704
 0488 00716 022762 FIOR OCT 22762
 0489 00717 060762 FXOR OCT 60762
 0490 00720 000456 FIN OCT 456
 0491 00721 037264 FOUT OCT 37264

0492* SPACE FOR 9 SPECIAL FUNCTIONS
 0493 00722 000000 BSS 9
 0494*

0495* FUNCTION ENTRIES

0496 00733 005230 PABS DEF XABS
 0497 00734 005302 PSGN DEF XSGN
 0498 00735 005232 PINT DEF XINT
 0499 00736 005337 PDIS DEF XDIS
 0500 00737 005523 PATN DEF ARTN
 0501 00740 005236 PEXP DEF XEXP
 0502 00741 005241 PLOG DEF XLOG
 0503 00742 005244 PSIN DEF XSIN
 0504 00743 005246 PCOS DEF XCOS
 0505 00744 005250 PSQT DEF XSQRT
 0506 00745 005253 PAND DEF XAND
 0507 00746 005273 PIOR DEF XIOR
 0508 00747 005276 PXOR DEF XXOR
 0509 00750 005315 PIN DEF XIN
 0510 00751 005326 POUT DEF XOUT

0511* SPACE FOR 9 MORE
 0512 00752 000000 BSS 9
 0513*

0514* MAGNETIC TAPE COMMANDS; CODES AND WORKING SPACE
 0515 00763 177774 BUNT OCT 74 SELECTED UNIT; DEFAULT 0
 0516* 7-TRACK CODES; 9-TRACK IN COMMENTS

0517 00764 000203 BUFRI OCT 203 23 READ BINARY
 0518 00765 100203 BUFRB OCT 100203 23 READ BCD
 0519 00766 000301 BUFWI OCT 301 31 WRITE BINARY
 0520 00767 100301 BUFWB OCT 100301 31 WRITE BCD
 0521 00770 100141 BUFWE OCT 100141 211 WRITE END OF FILE
 0522 00771 000121 BUFWG OCT 121 15 WRITE GAP
 0523 00772 000011 BUFRW OCT 11 101 REWIND
 0524 00773 000005 BUFSB OCT 5 41 SPACE RECORD BACKWARD
 0525 00774 000003 BUFSF OCT 3 3 SPACE RECORD FORWARD
 0526 00775 100045 BUFRB OCT 100045 241 SPACE FILE BACKWARD
 0527 00776 100043 BUFFF OCT 100043 203 SPACE FILE FORWARD
 0528 00777 000020 BUFET OCT 20 40 END OF TAPE
 0529 01000 000040 BUFST OCT 40 100 START OF TAPE
 0530 01001 000060 BUFSE OCT 60 140 START OR END

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0531	01002	000006	BUFTP	OCT 6	22	TIMING OR PARITY
0532	01003	000026	BUFEP	OCT 26	62	EOT OR TIMING/PARITY
0533	01004	002000	BUFRG	OCT 2000	2000	REWINDING
0534	01005	000010	BUFRJ	OCT 10	10	REJECT
0535	01006	000400	BUFLC	OCT 400	1	LOCAL
0536	01007	000100	BUFEF	OCT 100	200	END OF FILE
0537	01010	000120	BUFFT	OCT 120	240	END OF FILE OR TAPE
0538*						
0539	01011	000000	BUPT	NOP		
0540	01012	000000	BUL	NOP		
0541	01013	000000	MTIN	NOP		
0542	01014	000000	MTINB	NOP		
0543	01015	000000	MTINL	NOP		
0544	01016	000000	MTINC	NOP		
0545	01017	000000	MTINT	NOP		
0546	01020	000000	MTERC	NOP		
0547	01021	002720	MTAB1	DEF MTAB		
0548	01022	000000	MTOP	NOP		
0549	01023	000000	MTOPB	NOP		
0550	01024	000000	MTOPL	NOP		
0551	01025	000000	MTOPC	NOP		
0552	01026	000000	MTOCH	NOP		
0553	01027	003062	MTAB2	DEF MTAB2		
0554*						
0555*			PROCESSOR WORKING SPACE			
0556	01030	000000	PCTEM	DEC 0.		
0557*						
0558*			SET TTY READER INPUT			
0559	01032	000000	TTRON	NOP		
0560	01033	107715	CLC	HSR,C		ABORT POSSIBLE HSR
0561	01034	061206	LDA	TTYRR		SET TTY READ ROUTINE
0562	01035	070663	STA	INCH		FOR CHARACTER INPUT
0563	01036	125032	JMP	TTRON,I		
0564*						
0565*			STORE, CONSTANTS ETC FOR PLOTTER ROUTINE			
0566*			BUFFER			
0567	01037	004423	PLI	DEF PLBUF		INPUT POINTER
0568	01040	004423	PLO	DEF PLBUF		START
0569	01041	004461	PL1	DEF PLEND		END
0570	01042	004423	PLO	DEF PLBUF		OUTPUT POINTER
0571*			SCALES: X 2*INCREMENTS/INCH, Y 8*INCREMENTS/INCH			
0572	01043	062000	PLXS	DEX 200.		
0573	01046	062000	PLYS	DEX 800.		
0574	01051	037777	PLMSY	OCT 37777		MASK FOR Y
0575	01052	000001	PLSW	OCT 1		0=BUSY
0576	01053	000000	PLFL1	NOP		1ST TIME FLAG
0577	01054	000000	PLINY	NOP		Y INPUT DATA
0578	01055	040000	PLX	OCT 40000		DESTINATION
0579	01056	010000	PLY	OCT 10000		
0580	01057	000000	PLNX	NOP		START
0581	01060	000000	PLNY	NOP		
0582	01061	000001	PLPEN	DEC 1		PEN POSITION; 1=UP
0583	01062	000000	PLDX	NOP		LINE LENGTHS
0584	01063	000000	PLDY	NOP		
0585	01064	000000	PLMV	NOP		DIRECTION/COUNT
0586	01065	000000	PLMAJ	NOP		MAJOR MOTION COMMAND

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0587	01066	000000	PLCOM	NOP		COMBINED MOTION COMMAND
0588	01067	004461	PLT1	DEF	PLTB1	MOTION TABLE PTRS
0589	01070	004463	PLT2	DEF	PLTB2	
0590	01071	004465	PLT3	DEF	PLTB3	
0591	01072	000000	PLT	NOP		PLOT COUNT
0592	01073	000000	PLEO	NOP		STORE FORE E,0
0593	01074	000000	PLAB	DEC	0.0	A,B
0594*						
0595*			OUTPUT PRINT ROUTINE			
0596	01076	000000	FOUFM	NOP		CURRENT FORMAT
0597	01077	000000	FOTEM	DEX	0	WORKING SPACE
0598	01102	000000	FOUD	NOP		
0599	01103	000000	FOUFC	NOP		
0600	01104	000000	FOUOP	NOP		
0601	01105	000000	FOUSG	NOP		
0602	01106	000000	FOUSC	NOP		
0603	01107	000000	FOURN	NOP		
0604*						
0605*			ARGUMENT SEARCH ROUTINE			
0606	01110	000000	GTL	NOP		SPARE LENGTH
0607	01111	000000	SUBS	NOP		
0608*						
0609*			I/O ROUTINES			
0610	01112	000000	ITTA	NOP		
0611	01113	003673	TTBF0	DEF	TTBUF	
0612	01114	003673	TTBFI	DEF	TTBUF	
0613	01115	003673	TTBFO	DEF	TTBUF	
0614	01116	004003	TTBF1	DEF	TTEND	
0615	01117	007117	IT TIN	DEF	TTYRI	
0616	01120	007075	ITTON	DEF	ITTO	
0617	01121	130000	TTOP	OCT	130000	
0618	01122	140000	TTIPS	OCT	140000	
0619	01123	170000	TTIP	OCT	170000	
0620	01124	000000	TTYSW	NOP		TTY OUTPUT BUSY FLAG
0621	01125	000000	TTYFL	NOP		TTY INPUT BUSY FLAG
0622	01126	000000	MSRFL	NOP		
0623	01127	000001	PNCHF	OCT	1	0 = 'BUSY'
0624	01130	000001	LPBS	OCT	1	
0625	01131	000001	DISFL	OCT	1	DISPLAY ERASING FLAG
0626	01132	000000	DFLAG	NOP		
0627	01133	000000	BUFLG	NOP		DONE FLAG
0628*						
0629*						
0630	01134	011644	CMCOR	DEF	CMBUF	PTR TO COMMON BUFFER
0631	01135	177600		DEC	=128	LENGTH OF COMMON BUFFER

0633* ROUTINE ENTRIES

0634	01136	010076	FAD	DEF	,XADD	FLOATING POINT ADD
0635	01137	010071	FSB	DEF	,XSUB	FLOATING POINT SUBTRACT
0636	01140	010326	FMP	DEF	,XMPY	FLOATING POINT MULTIPLY
0637	01141	010620	FDV	DEF	,XDIV	FLOATING POINT DIVIDE
0638	01142	005621	PRC	DEF	PRNTC	PRINT A CHARACTER
0639	01143	005641	RDC	DEF	READC	READ A CHARACTER
0640	01144	006020	PKC	DEF	PACKC	PACK CHARACTER TO TEXT
0641	01145	005604	PRO	DEF	PRNTO	PRINT OCTAL
0642	01146	005540	PRL	DEF	PRNTL	PRINT LINE NUMBER
0643	01147	006433	FNP	DEF	FINPT	READ IN A NUMBER
0644	01150	005553	PRN	DEF	PRNT	PRINT DECIMAL 2 DIGITS
0645	01151	005560	PRD	DEF	PRNTN	PRINT DECIMAL, 4 DIGITS
0646	01152	006662	GT1	DEF	GET1	READ 1ST LETTER, LOSE REST
0647	01153	011001	INT	DEF	,DINT	CONVERT TO INTEGER
0648	01154	007123	TT1	DEF	TTYR1	READ TTY SILENTLY
0649	01155	002215	BSL	DEF	BUSEL	SELECT MT UNIT
0650	01156	012366	DTI	DEF	,DIOI	EXPONENTIATE FP TO INT PWR
0651	01157	012327	DTD	DEF	,DIOD	FP TO FP POWER
0652	01160	011326	ABS	DEF	,DABS	ABSOLUTE VALUE (MODULUS)
0653	01161	007335	ENT	DEF	ENTIX	ENTIER ROUTINE
0654	01162	011335	EXP	DEF	DEXP	EXPONENTIAL
0655	01163	011473	LOG	DEF	DLOG	LOGARITHM
0656	01164	012044	SIN	DEF	DSIN	SINE
0657	01165	012202	COS	DEF	DCOS	COSINE
0658	01166	012211	SQT	DEF	DSQRT	SQUARE ROOT
0659	01167	007046	TTO	DEF	TTOUT	TELETYPE OUTPUT
0660	01170	007661	ATN2	DEF	DATN2	2-ARG ARC TANGENT
0661	01171	007423	ATN	DEF	DATAN	ARC TANGENT
0662	01172	011107	DCM	DEF	,,DCM	FP COMPLEMENT
0663	01173	012447	FLN	DEF	,FLUN	UNPACK EXP
0664	01174	007301	DFR	DEF	,DFER	TRANSFER
0665	01175	007310	XFR	DEF	,XFER	
0666	01176	011043	DBL	DEF	,IDBL	INTEGER TO FP
0667	01177	012440	PAD	DEF	,PCAD	SINGLE PARAMETER XFER
0668	01200	011170	PAK	DEF	,XPAK	PACK (NORMALISE)
0669	01201	002615	BUN	DEF	BUWT	MAG TAPE WAIT TILL DONE
0670	01202	002550	BUD	DEF	BUDMA	MAG TAPE SET UP DMA
0671	01203	002564	BUG	DEF	BUGO	MAG TAPE GO
0672	01204	003233	DEL	DEF	DELET	DELETE ROUTINE
0673	01205	007153	HSRDR	DEF	HSRIN	HIGH SPEED READER
0674	01206	007127	TTYRR	DEF	TTYR2	TTY READ WITH ECHO
0675	01207	007176	HSPCH	DEF	HPNCH	HIGH SPEED PUNCH
0676	01210	005621	TTYPN	DEF	PRNTC	TTY PUNCH
0677	01211	002627	MTINP	DEF	MTINR	CHARACTER INPUT FROM MT
0678	01212	002760	MTOPP	DEF	MTOPR	CHARACTER OUTPUT TO MT

0679*

LINKS

0681	01213	003461	PR1	DEF	PRCSS
0682	01214	003462	PR	DEF	PROC
0683	01215	003336	COX	DEF	COEND
0684	01216	005106	EFX	DEF	EVFNX

0686* FLOATING POINT WORKING SPACE AND CONSTANTS

0687	01217	000000	FLAC	DEX	0
0688	01222	001217	FLACP	DEF	FLAC
0689	01223	000000	FLARG	DEX	0
0690	01226	000000	F1	DEX	0
0691	01231	000000		NOP	
0692	01232	000000	F2	DEX	0
0693	01235	000000		NOP	
0694	01236	000000	F3	DEX	0
0695	01241	000000	F4	DEX	0
0696	01244	000000	F5	DEX	0
0697	01247	000000	F6	DEX	0
0698	01252	000000	F7	DEX	0
0699	01255	000000	F8	DEX	0
0700	01260	000000	F9	DEX	0
0701	01263	000000	F10	DEX	0
0702	01266	001226	F1P	DEF	F1
0703	01267	001232	F2P	DEF	F2
0704	01270	001244	F5P	DEF	F5
0705	01271	001247	F6P	DEF	F6
0706	01272	001345	FL1P	DEF	FL1

FOR UNPACKED EXPONENT

0707*

0708* FLOATING POINT CONSTANTS

0709* TABLE OF POWERS OF 10

0710	01273	055022		DEX	1E=14,1E=13,1E=12,1E=11,1E=10
0711	01312	042270		DEX	1E=9,1E=8,1E=7,1E=6,1E=5
0712	01331	064333		DEX	1E=4,1E=3,1E=2
0713	01342	063146	FL.1	DEX	.1
0714	01345	040000	FL1	DEX	1
0715	01350	050000	FL10	DEX	10
0716	01353	062000	FL100	DEX	100

0717*

0718* MISCELLANEOUS

0719	01356	000000	FL0	DEX	0
0720	01361	040000	FL.5	DEX	.5
0721	01364	062207	FLPI2	DEX	1,5707963268
0722	01367	062207	FLPI	DEX	3,1415926536
0723	01372	062207	FL2PI	DEX	6,2831853072
0724	01375	056125	FLG2E	OCT	56125,16624,127002
0725	01400	054271	FLGE2	OCT	54271,8773,164400
0726	01403	001404	FMAXP	DEF	**1
0727	01404	007777		OCT	7777,-1,-2
0728	01407	001410	FMINP	DEF	**1
0729	01410	100000		OCT	100000,0,376

0730*

0731	01413	000000	FT1	NOP	
0732	01414	000000	FT2	NOP	
0733	01415	000000	FT3	NOP	
0734	01416	000000	FT4	NOP	
0735	01417	000000	FT5	NOP	
0736	01420	000000	FT6	NOP	
0737	01421	177773	BM5	OCT	-5
0738	01422	177721	BM57	OCT	-57
0739	01423	177720	BM60	OCT	-60
0740	01424	000047	B47	OCT	47

0741*

0742* CONSTANTS
 0743 01425 177775 BM3 OCT -3
 0744 01426 177772 BM6 OCT -6
 0745 01427 177771 BM7 OCT -7
 0746 01430 177766 DM10 DEC -10
 0747 01431 177764 DM12 DEC -12
 0748 01432 177763 DM13 DEC -13
 0749 01433 177670 DM72 DEC -72
 0750 01434 177660 DM80 DEC -80
 0751 01435 177657 DM81 DEC -81
 0752 01436 177645 BM133 OCT -133

0753*
 0754* FOLLOWING ARE USED AS MASK TABLE
 0755 01437 177777 BM1 OCT =1
 0756 01440 177776 BM2 OCT =2
 0757 01441 177774 BM4 OCT =4
 0758 01442 177770 BM10 OCT =10
 0759 01443 177760 BM20 OCT =20
 0760 01444 177740 BM40 OCT =40
 0761 01445 177700 BM100 OCT =100
 0762 01446 177600 BM200 OCT =200
 0763 01447 177400 BM400 OCT =400
 0764 01450 177000 BMTH OCT =1000, =2000, =4000
 0765 01453 170000 OCT 170000, 160000
 0766 01455 140000 BCRIT OCT 140000
 0767 01456 100000 BMIN OCT 100000

0768* END OF MASK TABLE

0769*
 0770* OCTAL TABLE OF DIVISORS
 0771 01457 010000 OCTAL OCT 10000, 1000
 0772 01461 000100 B100 OCT 100
 0773 01462 000010 B10 OCT 10
 0774 01463 000001 B1 OCT 1
 0775 01464 000000 NOP TERMINATOR

0776* DECIMAL TABLE OF DIVISORS
 0777 01465 001750 DECML DEC 1000, 100
 0778 01467 B12 EQU *
 0779 01467 000012 D10 DEC 10
 0780 01470 000001 DEC 1
 0781 01471 000000 NOP TERMINATOR

0782*
 0783 01472 000002 B2 OCT 2
 0784 01473 000003 B3 OCT 3
 0785 01474 000004 B4 OCT 4
 0786 01475 000006 B6 OCT 6
 0787 01476 000007 B7 OCT 7
 0788 01477 000011 B11 OCT 11
 0789 01500 D12 EQU *
 0790 01500 000014 B14 OCT 14
 0791 01501 000015 B15 OCT 15
 0792 01502 000017 B17 OCT 17
 0793 01503 000020 B20 OCT 20
 0794 01504 000030 B30 OCT 30
 0795 01505 000032 B32 OCT 32
 0796 01506 000037 B37 OCT 37
 0797 01507 000040 B40 OCT 40

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0798	01510	000041	B41	OCT	41
0799	01511	000042	B42	OCT	42
0800	01512	000044	B44	OCT	44
0801	01513	000045	B45	OCT	45
0802	01514	000050	B50	OCT	50
0803	01515	000051	B51	OCT	51
0804	01516	000052	B52	OCT	52
0805	01517	000053	B53	OCT	53
0806	01520	000054	B54	OCT	54
0807	01521	000055	B55	OCT	55
0808	01522	000056	B56	OCT	56
0809	01523	000057	B57	OCT	57
0810	01524	000060	B60	OCT	60
0811	01525	000072	B72	OCT	72
0812	01526	000073	B73	OCT	73
0813	01527	000075	B75	OCT	75
0814	01530	000077	B77	OCT	77
0815	01531	000102	B102	OCT	102
0816	01532	000105	B105	OCT	105
0817	01533	000106	B106	OCT	106
0818	01534	000107	B107	OCT	107
0819	01535	000111	B111	OCT	111
0820	01536	000112	B112	OCT	112
0821	01537	000113	B113	OCT	113
0822	01540	000114	B114	OCT	114
0823	01541	000115	B115	OCT	115
0824	01542	000116	B116	OCT	116
0825	01543	000117	B117	OCT	117
0826	01544	000120	B120	OCT	120
0827	01545	000122	B122	OCT	122
0828	01546	000123	B123	OCT	123
0829	01547	000124	B124	OCT	124
0830	01550	000125	B125	OCT	125
0831	01551	000127	B127	OCT	127
0832	01552	000134	B134	OCT	134
0833	01553	000137	B137	OCT	137
0834	01554	000144	D100	DEC	100
0835	01555	000176	B176	OCT	176
0836	01556	000177	B177	OCT	177
0837	01557	000200	B200	OCT	200
0838	01560	000212	B212	OCT	212
0839	01561	000215	B215	OCT	215
0840	01562	000272	B272	OCT	272
0841	01563	000377	B377	OCT	377
0842	01564	000400	B400	OCT	400
0843	01565	010020	BSPSP	OCT	10020
0844	01566	040000	BPLUS	OCT	40000
0845	01567	077777	BMAX	OCT	77777

BCD SPACE-SPACE

```

0848*          START UP AND RECOVERY ENTRY POINT
0849  02000          ORG 2000B
0850  02000 000000  BEGIN NOP          SOME SYSTEMS ENTER WITH JSB
0851  02001 002400          CLA
0852  02002 024232          JMP RECOV+1
0853*
0854*
0855*          "ASK" AND "TYPE" COMMANDS
0856  02003 003400  ASK   CCA
0857  02004 002001          RSS
0858  02005 002400  TYPE  CLA
0859  02006 070660          STA ATSW      SET FLAG A OR T
0860  02007 014316  TASK  JSB SPNOR
0861  02010 051513          CPA B45      %
0862  02011 026063          JMP TFORM
0863  02012 051511          CPA B42      "
0864  02013 026054          JMP TQUOT
0865  02014 051510          CPA B41      |
0866  02015 026070          JMP TCRLF
0867  02016 051512          CPA B44      $
0868  02017 026074          JMP DUMP
0869  02020 051520          CPA B54      ,
0870  02021 026072          JMP TASK4
0871  02022 051526          CPA B73      )
0872  02023 125213          JMP PR1,I
0873  02024 051501          CPA B15
0874  02025 024327          JMP POPJ
0875  02026 051515          CPA B51      )
0876  02027 014220          JSB ERROR
0877  02030 034660          ISZ ATSW      NO; A OR T?
0878  02031 026050          JMP TYPE2
0879  02032 014544          JSB PUSHJ     ASK; GET VBL
0880  02033 006706          DEF GTARG
0881  02034 060667          LDA CHAR     SAVE NEXT CH
0882  02035 014533          JSB PUSHA
0883  02036 060653          LDA READP   SET READC
0884  02037 070655          STA INPUT
0885  02040 002404          CLA,INA     READ FIRST DIGIT TOO
0886  02041 115147          JSB FNP,I   INPUT NUMBER
0887  02042 115174          JSB DFR,I
0888  02043 100651          DEF PT1,I
0889  02044 001217          DEF FLAC
0890  02045 014627          JSB POPA
0891  02046 070667          STA CHAR     RESTORE CHAR
0892  02047 026003          JMP ASK
0893*
0894  02050 014544  TYPE2 JSB PUSHJ     EVALUATE EXPRESSION
0895  02051 004731          DEF EVAL
0896  02052 114665          JSB FOUTP,I AND TYPE IT
0897  02053 026005          JMP TYPE
0898*
0899  02054 014401  TQUOT JSB GETC     OUTPUT TEXT BETWEEN QUOTES
0900  02055 051511          CPA B42     "
0901  02056 026072          JMP TASK4   END OF QUOTES
0902  02057 051501          CPA B15
0903  02060 024327          JMP POPJ    CR = END OF COMMAND

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0904	02061	114664		JSB	OUTCH,I	OUTPUT TEXT CHARACTER
0905	02062	026054		JMP	TQUOT	CONTINUE
0906*						
0907	02063	014401	TFORM	JSB	GETC	READ FORMAT
0908	02064	014413		JSB	GETLN	
0909	02065	060670		LDA	LNNO	AND STORE IT
0910	02066	070676		STA	FORM	
0911	02067	026007		JMP	TASK	
0912*						
0913	02070	061501	TCRLF	LDA	B15	TYPE CRLF
0914	02071	114664		JSB	OUTCH,I	
0915	02072	014401	TASK4	JSB	GETC	
0916	02073	026007		JMP	TASK	

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0918*          DUMP DIRECTORY TO VARIABLES VIA "TYPE $"
0919*          ALSO ACCESSED BY 'ASK $'...DON'T!!
0920 02074 060072 DUMP LDA BUFR
0921 02075 070651 STA PT1 SET PTR TO VBL
0922 02076 050671 CPA LASTV AT END?
0923 02077 026072 JMP TASK4 YES; DO REST OF COMMAND
0924 02100 160651 LDA PT1,I GET VARIABLE NAME
0925 02101 001727 ALF,ALF MORE SIG. CHARACTER
0926 02102 011556 AND B177 MASK OFF THE REST
0927 02103 114664 JSB OUTCH,I OUTPUT M,S. CHARACTER
0928 02104 160651 LDA PT1,I GET L,S. CHARACTER
0929 02105 011556 AND B177 MASK OFF THE REST
0930 02106 002003 SZA,RSS CONVERT NULL
0931 02107 061507 LDA B40 TO SPACE
0932 02110 114664 JSB OUTCH,I OUTPUT L,S. CHARACTER
0933 02111 061507 LDA B40 OUTPUT SPACE
0934 02112 114664 JSB OUTCH,I
0935 02113 034651 ISZ PT1 STEP PTR TO LENGTH.
0936 02114 160651 LDA PT1,I GET LENGTH
0937 02115 041425 ADA BM3 CONVERT TO MAX SUBSCRIPT
0938 02116 006400 CLB
0939 02117 100400 DIV B3 SCALE
0940 02121 002002 SZA DON'T OUTPUT ZERO
0941 02122 115151 JSB PRD,I OUTPUT AS DECIMAL
0942 02123 061501 LDA B15 CRLF
0943 02124 114664 JSB OUTCH,I
0944 02125 060651 LDA PT1 STEP TO NEXT
0945 02126 140651 ADA PT1,I
0946 02127 026075 JMP DUMP+1 GO DO NEXT

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0948	02130	115152	BUF	JSB GT1,I	READ 1ST LETTER
0949	02131	051550		CPA B125	IS IT 'UNIT'
0950	02132	026166		JMP BUU	
0951	02133	072164		STA BUTEM	SAVE FUNCTION
0952	02134	060763		LDA BUNT	UNIT SELECTED?
0953	02135	002020		SSA	
0954	02136	016215		JSB BUSEL	DEFAULT TO UNIT 0
0955	02137	062164		LDA BUTEM	RESTORE FUNCTION
0956	02140	051546		CPA B123	S ?
0957	02141	026424		JMP BUST	
0958	02142	072165		STA BUFN	SET CURRENT FUNCTION
0959	02143	016615		JSB BUWT	WAIT TILL READY
0960	02144	066267		LDB BUCNT	SET NO OF ATTEMPTS
0961	02145	076270		STB BUECT	
0962	02146	062165		LDA BUFN	RESET CURRENT FUNCTION
0963	02147	051545		CPA 0122	R
0964	02150	026271		JMP BURED	READ
0965	02151	051551		CPA B127	W
0966	02152	026340		JMP BUWR	WRITE
0967	02153	051532		CPA B105	E
0968	02154	026366		JMP BUWF	END FILE
0969	02155	051544		CPA B120	P
0970	02156	026442		JMP BUPOS	POSITION
0971	02157	051534		CPA B107	G
0972	02160	026400		JMP BUGP	GAP
0973	02161	051531		CPA B102	B
0974	02162	026412		JMP BUBK	BACKSPACE 1 RECORD
0975	02163	014214		JSB ERR2	ILLEGAL FUNCTION
0976*					
0977	02164	000000	BUTEM	NOP	
0978	02165	000000	BUFN	NOP	
0979*					
0980	02166	014544	BUU	JSB PUSHJ	GET UNIT NUMBER
0981	02167	006675		DEF ARG	
0982	02170	014220		JSB ERROR	NO UNIT NUMBER
0983	02171	115153		JSB INT,I	CONVERT TO INTEGER
0984	02172	001217		DEF FLAC	
0985	02173	016215	BUU1	JSB BUSEL	SELECT UNIT
0986	02174	060667		LDA CHAR	SET OPTIONS,IF ANY
0987	02175	051520		CPA B54	, ?
0988	02176	002001		RSS	
0989	02177	125215		JMP COX,I	ALL DONE
0990	02200	014401		JSB GETC	SKIP COMMA
0991	02201	115152		JSB GT1,I	READ OPTION
0992	02202	051542		CPA B116	N
0993	02203	026237		JMP BUOPN	NORMAL
0994	02204	051545		CPA B122	R
0995	02205	026236		JMP BUOPR	RETURN
0996	02206	051535		CPA B111	I
0997	02207	026243		JMP BUOPI	INTEGER I.E, BINARY
0998	02210	051531		CPA B102	B
0999	02211	026250		JMP BUOPB	BCD
1000	02212	051547		CPA B124	
1001	02213	026255		JMP BUOPT	SET NO OF TRIES
1002	02214	014214		JSB ERR2	ILLEGAL OPTION
1003*					

1004	02215	000000	BUSEL	NOP	SELECT ROUTINE
1005	02216	011473		AND BS	MAKE IT LEGAL
1006	02217	070763		STA BUNT	SAVE UNIT NO
1007	02220	042231		ADA BUNTT	
1008	02221	160000		LDA 0,I	GET SELECT CODE
1009	02222	102613		OTA MTC	AND ISSUE IT
1010	02223	102513		LIA MTC	GET STATUS
1011	02224	011006		AND BUFLC	LOCAL?
1012	02225	002002		SZA	
1013	02226	026603		JMP BUABT	UNIT IN LOCAL
1014	02227	035133		ISZ BUFLG	SET 'DONE'
1015	02230	126215		JMP BUSEL,I	
1016*					
1017	02231	002232	BUNTT	DEF **1	
1018	02232	001400		OCT 1400,2400,4400,10400	SELECT CODES

1020	02236	003401	BUOPR	CCA, RSS	'RETURN'; SET R
1021	02237	002400	BUOPN	CLA	'NORMAL'; CLEAR R
1022	02240	072242		STA BURFL	
1023	02241	026174		JMP BUU1+1	
1024	02242	000000	BURFL	NOP	
1025*					
1026*				SET UP READ/WRITE MODE	
1027	02243	060764	BUOPI	LDA BUFRI	READ BINARY
1028	02244	064766		LDB BUFWI	WRITE BINARY
1029	02245	072253		STA BURDC	SET UP COMMANDS
1030	02246	076254		STB BUWRC	
1031	02247	026174		JMP BUU1+1	
1032	02250	060765	BUOPB	LDA BUFRB	READ BCD
1033	02251	064767		LDB BUFWB	WRITE BCD
1034	02252	026245		JMP *-5	
1035	02253	100203	BURDC	OCT 100203	DEFAULT TO BCD
1036	02254	100301	BUWRC	OCT 100301	FOR BOTH READ WRITE
1037*					
1038	02255	014544	BUOPT	JSB PUSHJ	'TRY' OPTION
1039	02256	006675		DEF ARG	READ NO. OF TIMES
1040	02257	026264		JMP *-5	
1041	02260	115153		JSB INT, I	CONVERT TO INTEGER
1042	02261	001217		DEF FLAC	
1043	02262	003004		CMA, INA	
1044	02263	002021		SSA, RSS	
1045	02264	003400		CCA	SET 1 IF 0 OR -VE
1046	02265	072267		STA BUCNT	
1047	02266	026174		JMP BUU1+1	
1048	02267	177775	BUCNT	DEC -3	
1049	02270	000000	BUECT	NOP	
1050*					
1051	02271	061456	BURED	LDA BMIN	INDICATE 'READ'
1052	02272	016521		JSB BUSTX	SET DATA POINTERS
1053	02273	016534		JSB BUSTN	SET COUNT OUTPUT VARIABLE
1054	02274	072545		STA BUN	
1055	02275	016550		JSB BUDMA	SET UP DMA
1056	02276	062253		LDA BURDC	GET READ COMMAND
1057	02277	016564		JSB BUGO	GO
1058	02300	016610		JSB BUTR	
1059	02301	016615		JSB BUNT	WAIT TILL DONE
1060	02302	011007		AND BUFEF	END OF FILE?
1061	02303	002002		SZA	
1062	02304	026330		JMP BUREF	YES
1063	02305	102513		LIA MTC	
1064	02306	010777		AND BUFEF	END OF TAPE?
1065	02307	002002		SZA	
1066	02310	026331		JMP BUEND	YES
1067	02311	061012		LDA BUL	GET NUMBER READ
1068	02312	003004		CMA, INA	
1069	02313	106503		LIB DMAC2	
1070	02314	040001		ADA 1B	
1071	02315	016334		JSB BUSN	
1072	02316	102513		LIA MTC	GET MT STATUS
1073	02317	011002		AND BUFTP	CHECK TIMING AND PARITY
1074	02320	002002		SZA	
1075	02321	026323		JMP BURER	ERROR

1076	02322	027336		JMP	COEND	
1077	02323	036270	BURER	ISZ	BUECT	
1078	02324	002001		RSS		
1079	02325	014214		JSB	ERR2	TOO MANY ERRORS
1080	02326	016414		JSB	BUBAK	
1081	02327	026275		JMP	BURED+4	TRY AGAIN
1082*						
1083	02330	002401	BUREF	CLA	RSS	MAKE 0 FOR EOF
1084	02331	003400	BUEND	CCA		=1 FOR EOT
1085	02332	016334		JSB	BUSN	SET COUNT TO N
1086	02333	027336		JMP	COEND	
1087*						
1088	02334	000000	BUSN	NOP		SET COUNT TO N
1089	02335	115176		JSB	DBL,I	AS FLOATING POINT
1090	02336	102545		DEF	BUN,I	
1091	02337	126334		JMP	BUSN,I	
1092*						
1093	02340	002400	BUWR	CLA		INDICATE 'WRITE'
1094	02341	016521		JSB	BUSTX	SET DATA POINTERS
1095	02342	014544		JSB	PUSHJ	IS LENGTH SPECIFIED?
1096	02343	006675		DEF	ARG	
1097	02344	026352		JMP	*+6	NO; USE FULL ARRAY LENGTH
1098	02345	115153		JSB	INT,I	YES; CONVERT TO INTEGER
1099	02346	001217		DEF	FLAC	
1100	02347	003004		CMA	INA	NEGATE
1101	02350	071012		STA	BUL	SET AS -VE WORD COUNT
1102	02351	016550		JSB	BUDMA	SET UP DMA
1103	02352	062254		LDA	BUWRC	GET WRITE COMMAND
1104	02353	016564		JSB	BUGO	GO
1105	02354	016610		JSB	BUTR	
1106	02355	016615		JSB	BUWT	WAIT TILL DONE
1107	02356	010777		AND	BUFET	END OF TAPE?
1108	02357	002002		SZA		
1109	02360	026366		JMP	BUEF	WRITE EOF THEN EOT ERROR
1110	02361	102513		LIA	MTC	
1111	02362	011002		AND	BUFTP	TIMING PARITY
1112	02363	002002		SZA		
1113	02364	014214		JSB	ERR2	
1114	02365	027336		JMP	COEND	
1115*						
1116	02366	016370	BUEF	JSB	BUEOF	END FILE
1117	02367	027336		JMP	COEND	
1118	02370	000000	BUEOF	NOP		
1119	02371	060770		LDA	BUFWE	FILE MARK
1120	02372	016564		JSB	BUGO	
1121	02373	016615		JSB	BUWT	
1122	02374	011003		AND	BUFEP	EOT, TIMING/PARITY
1123	02375	002002		SZA		
1124	02376	014214		JSB	ERR2	
1125	02377	126370		JMP	BUEOF,I	
1126*						
1127	02400	016402	BUGP	JSB	BUGAP	GAP
1128	02401	027336		JMP	COEND	
1129	02402	000000	BUGAP	NOP		
1130	02403	060771		LDA	BUFWG	GAP
1131	02404	016564		JSB	BUGO	

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1132	02405	016615		JSB	BUWT	
1133	02406	010777		AND	BUFET	EOT?
1134	02407	002002		SZA		
1135	02410	014220		JSB	ERROR	
1136	02411	126402		JMP	BUGAP,I	
1137*						
1138	02412	016414	BUBK	JSB	BUBAK	BACKSPACE 1 RECORD
1139	02413	027336		JMP	COEND	
1140	02414	000000	BUBAK	NOP		
1141	02415	060773		LDA	BUFSB	
1142	02416	016564		JSB	BUGO	
1143	02417	016615		JSB	BUWT	
1144	02420	011000		AND	BUFST	START OF TAPE?
1145	02421	002002		SZA		
1146	02422	014220		JSB	ERROR	
1147	02423	126414		JMP	BUBAK,I	

1149	02424	016534	BUST	JSB BUSTN	GET OUTPUT VARIABLE
1150	02425	072546		STA BUS	
1151	02426	016615		JSB BUWT	WAIT TILL DONE
1152	02427	115176		JSB DBL,I	FLOAT STATUS AND
1153	02430	102546		DEF BUS,I	STORE AS STATUS VBL
1154	02431	062165		LDA BUFN	WAS I READING?
1155	02432	051545		CPA B122	
1156	02433	026435		JMP BUX	GET COUNT TOO
1157	02434	027336		JMP COEND	
1158	02435	061012	BUX	LDA BUL	INITIAL WORD COUNT
1159	02436	003004		CMA,INA	
1160	02437	106503		LIB DMAC2	FINAL WORD COUNT
1161	02440	040001		ADA 1	NO. READ
1162	02441	026332		JMP BUEND+1	GO WRITE TO 'N'
1163*					
1164	02442	014544	BUPOS	JSB PUSHJ	GET FILE COUNT
1165	02443	006675		DEF ARG	
1166	02444	026510		JMP BUP2	NO ARGUMENTS = REWIND
1167	02445	115153		JSB INT,I	FILE COUNT AS INTEGER
1168	02446	001217		DEF FLAC	
1169	02447	002003		SZA,RSS	
1170	02450	026471		JMP BUP1	NO FILES; TRY RECORDS
1171	02451	070001		STA 1	
1172	02452	002021		SSA,RSS	MAKE FILE COUNT
1173	02453	003004		CMA,INA	
1174	02454	072520		STA BUCT	
1175	02455	060776		LDA BUFFF	FILES FORWARD
1176	02456	006020		SSB	
1177	02457	060775		LDA BUFFB	FILES BACKWARD
1178	02460	072547		STA BUCMD	
1179	02461	062547		LDA BUCMD	
1180	02462	016564		JSB BUGO	
1181	02463	016615		JSB BUWT	
1182	02464	011001		AND BUFSE	START OR END ?
1183	02465	002002		SZA	
1184	02466	027336		JMP COEND	QUIT AT ENDS OF TAPE
1185	02467	036520		ISZ BUCT	COUNT
1186	02470	026461		JMP *-7	
1187*					
1188	02471	014544	BUP1	JSB PUSHJ	RECORD COUNT
1189	02472	006675		DEF ARG	
1190	02473	027336		JMP COEND	NONE
1191	02474	115153		JSB INT,I	RECORD CT AS INTEGER
1192	02475	001217		DEF FLAC	
1193	02476	002003		SZA,RSS	
1194	02477	027336		JMP COEND	ALL DONE
1195	02500	070001		STA 1	
1196	02501	002021		SSA,RSS	
1197	02502	003004		CMA,INA	
1198	02503	072520		STA BUCT	
1199	02504	060774		LDA BUFSF	RECORDS FORWARD
1200	02505	006020		SSB	
1201	02506	060773		LDA BUFSB	RECORDS BACKWARD
1202	02507	026460		JMP BUP1-9	
1203*					
1204	02510	102513	BUP2	LIA M1C	REWIND; TEST BOT

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1205	02511	011000		AND	BUFST	
1206	02512	002002		SZA		
1207	02513	027336		JMP	COEND	ALREADY AT BOT
1208	02514	060772		LDA	BUFRW	REWIND
1209	02515	016564		JSB	BUGO	
1210	02516	016615		JSB	BUWT	
1211	02517	027336		JMP	COEND	
1212	02520	000000	BUCT	NOP		
1213*						
1214	02521	000000	BUSTX	NOP		
1215	02522	072533		STA	BUDIR	SAVE READ/WRITE
1216	02523	014544		JSB	PUSHJ	GET X
1217	02524	006705		DEF	GTARG=1	
1218	02525	060651		LDA	PT1	LOCATION
1219	02526	032533		IOR	BUDIR	COMBINE READ/WRITE
1220	02527	071011		STA	BUPT	
1221	02530	061110		LDA	GTL	LENGTH
1222	02531	071012		STA	BUL	
1223	02532	126521		JMP	BUSTX,I	
1224	02533	000000	BUDIR	NOP		
1225*						
1226	02534	000000	BUSTN	NOP	SET UP	COUNT OUTPUT VARIABLE
1227	02535	060667		LDA	CHAR	
1228	02536	051520		CPA	B54	MUST BE COMMA
1229	02537	002001		RSS		
1230	02540	014220		JSB	ERROR	NO OUTPUT VARIABLE
1231	02541	014544		JSB	PUSHJ	GET VARIABLE
1232	02542	006705		DEF	GTARG=1	
1233	02543	060651		LDA	PT1	
1234	02544	126534		JMP	BUSTN,I	
1235	02545	000000	BUN	NOP		
1236	02546	000000	BUS	NOP		
1237	02547	000000	BUCMD	NOP		

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1239 02550 000000 BUDMA NOP SET UP DMA,
1240 02551 062563 LDA BUCW1 DMA CONTROL WORD
1241 02552 102607 OTA DMA2
1242 02553 106703 CLC DMAC2 SET TO RECEIVE POINTER
1243 02554 061011 LDA BUPT
1244 02555 102603 OTA DMAC2
1245 02556 102703 STC DMAC2 AND LENGTH
1246 02557 061012 LDA BUL
1247 02560 102603 OTA DMAC2
1248 02561 103707 STC DMA2,C START DMA
1249 02562 126550 JMP BUDMA,I
1250 02563 020012 BUCW1 ABS MTD+20000B CLC MTD WHEN DONE
1251*
1252 02564 000000 BUGO NOP
1253 02565 006400 CLB CLEAR DONE FLAG
1254 02566 075133 STB BUFLG
1255 02567 070001 STA 1 SAVE COMMAND
1256 02570 102513 LIA MTC GET MAG TAPE STATUS
1257 02571 011004 AND BUFRG REWINDING?
1258 02572 002002 SZA TEST
1259 02573 026570 JMP *+3 WAIT TILL DONE
1260 02574 106613 OTB MTC ISSUE COMMAND
1261 02575 103713 STC MTC,C START COMMAND
1262 02576 103712 STC MTD,C START DATA
1263 02577 102513 LIA MTC WAS IT REJECTED?
1264 02600 011005 AND BUFRJ MASK REJECT BIT
1265 02601 002003 SZA,RSS TEST
1266 02602 126564 JMP BUGO,I OK/ALL DONE
1267*
1268 02603 035133 ABORT MAG TAPE TRANSFER
1269 02604 107707 BUABT ISZ BUFLG SET "DONE"
1270 02605 107712 CLC DMA2,C ABORT DMA
1271 02606 107713 CLC MTD,C ABORT MAG TAPE DATA
1272 02607 014220 CLC MTC,C ABORT MAG TAPE CONTROL
1273*
1274 02610 000000 BUTR NOP TEST FOR 'RETURN' OPTION
1275 02611 062242 LDA BURFL
1276 02612 002002 SZA
1277 02613 027336 JMP COEND
1278 02614 126610 JMP BUTR,I
1279*
1280 02615 000000 BUWT NOP
1281 02616 102513 LIA MTC GET STATUS
1282 02617 011006 AND BUFLC LOCAL?
1283 02620 002002 SZA
1284 02621 026603 JMP BUABT GO, ABORT
1285 02622 061133 LDA BUFLG DONE?
1286 02623 002003 SZA,RSS
1287 02624 026610 JMP *+6 WAIT TILL DONE
1288 02625 102513 LIA MTC GET THE LATEST STATUS
1289 02626 126615 JMP BUWT,I

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1291	02627	000000	MTINR	NOP	MAG TAPE CHARACTER INPUT
1292	02630	035016		ISZ MTINC	ANY LEFT?
1293	02631	026670		JMP MTIN1	
1294	02632	035017		ISZ MTINT	TERMINATED?
1295	02633	026707		JMP MTIN3	NO? GO MAKE CR
1296	02634	061440		LDA BM2	RESET TERMINATE COUNT
1297	02635	071017		STA MTINT	
1298	02636	061014		LDA MTINB	GET BUFFER POINTER
1299	02637	071013		STA MTIN	
1300	02640	002300		CCE	
1301	02641	001500		ERA	
1302	02642	071011		STA BUPT	
1303	02643	061015		LDA MTINL	LENGTH
1304	02644	001100		ARS	CONVERT TO WORDS
1305	02645	071012		STA BUL	
1306	02646	061425		LDA BM3	SET ERROR COUNT
1307	02647	071020		STA MTERC	
1308	02650	016550	MTIN2	JSB BUDMA	SET UP DMA
1309	02651	060765		LDA BUFRB	READ
1310	02652	016564		JSB BUGO	
1311	02653	016615		JSB BUWT	WAIT TILL DONE
1312	02654	011010		AND BUFFT	EOF, EOT
1313	02655	002002		SZA	
1314	02656	014214		JSB ERR2	
1315	02657	102503		LIA DMAC2	GET NUMBER READ
1316	02660	001000		ALS	CONVERT TO CHARACTER COUNT
1317	02661	003004		CMA, INA	
1318	02662	041015		ADA MTINL	
1319	02663	071016		STA MTINC	
1320	02664	102513		LIA MTC	GET MAGTAPE STATUS
1321	02665	011002		AND BUFTP	CHECK TIMING AND PARITY
1322	02666	002002		SZA	
1323	02667	026713		JMP MTINE	ERROR
1324*					
1325	02670	065013	MTIN1	LDB MTIN	READ BUFFER
1326	02671	004065		CLE, ERB	
1327	02672	160001		LDA 1, I	
1328	02673	002041		SEZ, RSS	ODD/EVEN IS IN LINK
1329	02674	001727		ALF, ALF	
1330	02675	035013		ISZ MTIN	STEP POINTER
1331	02676	011530		AND B77	
1332	02677	000065		CLE, ERA	CONVERT BCD-ASCII
1333	02700	041021		ADA MTAB1	POINT TO TABLE
1334	02701	160000		LDA 0, I	PICK UP ASCII
1335	02702	002041		SEZ, RSS	
1336	02703	001727		ALF, ALF	POSITION EVEN CHARACTER
1337	02704	011556		AND B177	RUB OUT THE OTHER HALF
1338	02705	070667		STA CHAR	
1339	02706	126627		JMP MTINR, I	
1340*					
1341	02707	003400	MTIN3	CCA	TERMINATE;
1342	02710	071016		STA MTINC	RESET EXPIRING COUNT
1343	02711	061501		LDA B15	AND MAKE CR
1344	02712	026705		JMP *+5	
1345*					
1346	02713	035020	MTINE	ISZ MTERC	COUNT PARITY ERRORS

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1347	02714	002001		RSS	
1348	02715	014220		JSB ERROR	TOO MANY
1349	02716	016414		JSB BUBAK	BACKSPACE
1350	02717	026650		JMP MTIN2	AND TRY AGAIN
1351*					
1352	02720	020061	MTAB	ASC 16,	1234567890=@;>* /STUVWXYZ+,X=!"
1353	02740	026512		ASC 16,	=JKLMNOPQR[!\$*);]+ABCDEFGHI?.[(<†

1355	02760	000000	MTOPR	NOP	MAG TAPE CHARACTER OUTPUT
1356	02761	011556		AND B177	
1357	02762	051501		CPA B15	CR?
1358	02763	027042		JMP MTOP3	
1359	02764	035025		ISZ MTOPC	FULL?
1360	02765	027017		JMP MTOP2	
1361	02766	071026		STA MTOCH	SAVE CHARACTER
1362	02767	061023	MTOP1	LDA MTOPB	WRITE OUT BUFFER
1363	02770	000065		CLE,ERA	
1364	02771	071011		STA BUPT	
1365	02772	061022		LDA MTOP	SET COUNT
1366	02773	003004		CMA,INA	
1367	02774	041023		ADA MTOPB	
1368	02775	002003		SZA,RSS	NOTHING?
1369	02776	027054		JMP MTOP0	ADD SOME NULL CHARACTERS
1370	02777	001100		ARS	LOSE L.S.,? ROUND UP
1371	03000	071012	MTOP4	STA BUL	
1372	03001	016550		JSB BUDMA	
1373	03002	060707		LDA BUFWB	WRITE
1374	03003	016564		JSB BUGO	
1375	03004	016615		JSB BUWT	
1376	03005	011003		AND BUFEF	EOT, TIMING, PARITY
1377	03006	002002		SZA	
1378	03007	014214		JSB ERR2	
1379	03010	061023		LDA MTOPB	RESET POINTERS
1380	03011	071022		STA MTOP	COUNTS
1381	03012	061024		LDA MTOPL	
1382	03013	071025		STA MTOPC	
1383	03014	061026		LDA MTOCH	CHECK SAVED CHARACTER
1384	03015	051501		CPA B15	CR?
1385	03016	126760		JMP MTOPR,I	ALL DONE IF CR
1386*					
1387	03017	041444	MTOP2	ADA BM40	CONVERT ASCII=BCD
1388	03020	002020		SSA	
1389	03021	126760		JMP MTOPR,I	LOSE LF, FF, ETC
1390	03022	011530		AND B77	
1391	03023	000065		CLE,ERA	
1392	03024	041027		ADA MTAB2	POINT TO ASCII=BCD TABLE
1393	03025	160000		LDA 0,I	PICK UP BCD
1394	03026	002041		SEZ,RSS	
1395	03027	001727		ALF,ALF	POSITION EVEN CHARACTER
1396	03030	011530		AND B77	
1397	03031	065022		LOB MTOP	WRITE TO BUFFER
1398	03032	004065		CLE,ERB	
1399	03033	002041		SEZ,RSS	
1400	03034	001727		ALF,ALF	
1401	03035	002040		SEZ	
1402	03036	140001		ADA 1,I	ADD IN M.S. HALF
1403	03037	170001		STA 1,I	
1404	03040	035022		ISZ MTOP	STEP POINTER
1405	03041	126760		JMP MTOPR,I	
1406*					
1407	03042	071026	MTOP3	STA MTOCH	SAVE CR
1408	03043	061022		LDA MTOP	CHECK BUFFER
1409	03044	002011		SLA,RSS	
1410	03045	026767		JMP MTOP1	EVEN IS OK

1411	03046	000065		CLE,ERA	POSITION POINTER
1412	03047	164000		LDB 0,I	PICK UP PART WORD
1413	03050	045503		ADB B20	FILL UP WITH SPACE
1414	03051	174000		STB 0,I	
1415	03052	035022		ISZ MTOP	COUNT THE EXTRA CHARACTER
1416	03053	026767		JMP MTOP1	
1417*					
1418	03054	061565	MTOP0	LDA BSPSP	SPACE=SPACE
1419	03055	065023		LDB MTOPB	
1420	03056	004065		CLE,ERB	POSITION BUFFER POINTER
1421	03057	170001		STA 1,I	
1422	03060	003400		CCA	SET ONE WORD
1423	03061	027000		JMP MTOP4	
1424*					
1425	03062	010052	MTB2	OCT 10052,17413,25434,30036	
1426	03066	036455		OCT 36455,26060,15440,35421	
1427	03072	005001		OCT 05001,01003,02005,03007	
1428	03076	004011		OCT 04011,06456,37035,07072	
1429	03102	006061		OCT 06061,31063,32065,33067	
1430	03106	034071		OCT 34071,20442,21444,22446	
1431	03112	023450		OCT 23450,24422,11424,12426	
1432	03116	013430		OCT 13430,14474,10057,37432	

1434*	'DO' COMMAND			
1435	03122 014413	DO	JSB GETLN	SET LNNO,LGAFL
1436	03123 014554		JSB PUSHF	
1437	03124 000643		DEF TXOUT	SAVE TXOUT, PC
1438	03125 014554	DOGRP	JSB PUSHF	
1439	03126 000666		DEF LGAFL	SAVE LGAFL,CHAR,LNNO
1440	03127 060666		LDA LGAFL	TEST LINE=GROUP=ALL
1441	03130 002020		SSA	
1442	03131 027163		JMP DOONE	ONE LINE
1443	03132 014351		JSB FNDLN	SET LSTLN,THSLN, TXOUT
1444	03133 000000		NOP	
1445	03134 060645		LDA THSLN	
1446	03135 002004		INA	
1447	03136 160000		LDA 0,I	PICK UP LINE NO,
1448	03137 014332		JSB TSTGP	
1449	03140 014220		JSB ERROR	WRONG GROUP
1450	03141 014544		JSB PUSHJ	
1451	03142 003457		DEF PRCSS=2	UPDATE PC
1452	03143 014606		JSB POPF	
1453	03144 000666		DEF LGAFL	RESTORE LGAFL,CHAR,LNNO
1454	03145 160644		LDA PC,I	NEXT LINE?
1455	03146 002003		SZA,RSS	
1456	03147 027171		JMP DONE	END OF TEXT
1457	03150 002004		INA	
1458	03151 070651		STA PT1	
1459	03152 060666		LDA LGAFL	
1460	03153 000010		SLA	ALL OR GROUP?
1461	03154 027160		JMP *+4	
1462	03155 160651		LDA PT1,I	GROUP
1463	03156 014332		JSB TSTGP	
1464	03157 027171		JMP DONE	END OF GROUP
1465	03160 160651		LDA PT1,I	SAME GROUP OR ALL
1466	03161 070670		STA LNNO	
1467	03162 027125		JMP DOGRP	CONTINUE
1468*				
1469	03163 014351	DOONE	JSB FNDLN	FIND THE LINE
1470	03164 014220		JSB ERROR	NO SUCH LINE
1471	03165 014544		JSB PUSHJ	
1472	03166 003461		DEF PRCSS	DON'T UPDATE PC
1473	03167 014606		JSB POPF	
1474	03170 000666		DEF LGAFL	RESTORE LGAFL, CHAR, LNNO
1475	03171 014606	DONE	JSB POPF	RESTORE TXOUT, PC
1476	03172 000643		DEF TXOUT	
1477	03173 027462		JMP PROC	

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1479*      'ERASE' COMMAND
1480 03174 014316 ERASE JSB SPNOR
1481 03175 014277      JSB SORT
1482 03176 027230      JMP ERVAR      OP/TERM; E
1483 03177 027211      JMP ERLIN      NUMBER; E X,Y
1484 03200 051463      CPA B1        LETTER; E A
1485 03201 002001      RSS
1486 03202 014220      JSB ERROR      NOT A
1487 03203 060673      LDA ENDT      ERASE ALL
1488 03204 070672      STA BUFR      TEXT
1489 03205 070671      STA LASTV    AND VARIABLES
1490 03206 002400      CLA
1491 03207 170674      STA TEXT0,I
1492 03210 024110      JMP START
1493*
1494 03211 014413      ERLIN JSB GETLN  ERASE LINE OR GROUP
1495 03212 060672      LDA BUFR
1496 03213 001200      RAL
1497 03214 070633      STA TXIN
1498 03215 017233      ERGRP JSB DELET
1499 03216 060666      LDA LGAFL
1500 03217 002020      SSA
1501 03220 027230      JMP ERVAR      ONE LINE
1502 03221 034645      ISZ THSLN     GROUP
1503 03222 160645      LDA THSLN,I
1504 03223 014332      JSB TSTGP
1505 03224 027230      JMP ERVAR      DONE; ERASE VBLS TOO
1506 03225 160645      LDA THSLN,I
1507 03226 070670      STA LNNO
1508 03227 027215      JMP ERGRP
1509 03230 060672      ERVAR LDA BUFR  JUST VARIABLES
1510 03231 070671      STA LASTV
1511 03232 024327      JMP POPJ
1512*
1513*      DELETE SUBROUTINE USED BY 'ERASE', 'MODIFY' AND
1514*      WHEN READING IN A NEW LINE,
1515 03233 000000      DELET NOP
1516 03234 103100      CLF 0
1517 03235 014351      JSB FNDLN
1518 03236 127233      JMP DELET,I
1519 03237 014401      JSB GETC      FIND END OF LINE
1520 03240 051501      CPA B15
1521 03241 002001      RSS
1522 03242 027237      JMP *-3
1523 03243 060643      LDA TXOUT     HOW MANY?
1524 03244 001100      ARS
1525 03245 003004      CMA,INA
1526 03246 040645      ADA THSLN
1527 03247 070661      STA CNTR
1528 03250 060674      LDA TEXT0     DON'T RUB FIRST LINE
1529 03251 050645      CPA THSLN
1530 03252 024110      JMP START
1531 03253 160645      LDA THSLN,I  PTR TO NEXT LINE
1532 03254 170647      STA LSTLN,I  SET INTO LAST LINE
1533 03255 060674      LDA TEXT0     START AT BEGINNING
1534 03256 070636      DEL1 STA T2    FIRST MODIFY CHAIN OF PTRS

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1535	03257	160636	LDA T2,I	LINE POINTER
1536	03260	002003	SZA,RSS	ZERO = DONE
1537	03261	027274	JMP DELX	
1538	03262	070635	STA T1	
1539	03263	060645	LDA THSLN	AFTER ERASED BIT?
1540	03264	003104	CMA,CLE,INA	
1541	03265	040635	ADA T1	
1542	03266	002440	CLA,SEZ	
1543	03267	060661	LDA CNTR	IF YES, MOD POINTER
1544	03270	040635	ADA T1	
1545	03271	170636	STA T2,I	
1546	03272	060635	LDA T1	NEXT
1547	03273	027256	JMP DEL1	
1548	03274	060645	DELX LDA THSLN	THEN MOVE DOWN TEXT
1549	03275	070640	STA T4	
1550	03276	064661	LDB CNTR	
1551	03277	007004	CMB,INB	
1552	03300	040001	ADA 10	
1553	03301	070641	STA T5	
1554	03302	060661	LDA CNTR	UPDATE BUFR
1555	03303	040672	ADA BUFR	
1556	03304	070672	STA BUFR	
1557	03305	060633	LDA TXIN	
1558	03306	001100	ARS	
1559	03307	003000	CMA	
1560	03310	040641	ADA T5	
1561	03311	070635	STA T1	
1562	03312	060633	LDA TXIN	UPDATE TXIN
1563	03313	040661	ADA CNTR	
1564	03314	040661	ADA CNTR	
1565	03315	070633	STA TXIN	
1566	03316	160641	LDA T5,I	
1567	03317	034641	ISZ T5	
1568	03320	170640	STA T4,I	
1569	03321	034640	ISZ T4	
1570	03322	034635	ISZ T1	
1571	03323	027316	JMP *-5	
1572	03324	027234	JMP DELET+1	

1574*		'FOR' AND	'SET' COMMANDS;	ASSIGNMENT STATEMENTS
1575	03325	061030	PCSET	LDA PCTEM NORMAL ASSIGNMENT STATEMENT
1576	03326	070643		STA TXOUT
1577	03327	061031		LDA PCTEM+1
1578	03330	070667		STA CHAR
1579	03331	002001		RSS
1580	03332	014401		JSB GETC
1581	03333	017345	SET	JSB XSET 'SET' FOR 'FOCAL' COMPATIBILITY
1582	03334	051520		CPA B54 , ?
1583	03335	027332		JMP SET=1
1584	03336	060667	COEND	LDA CHAR
1585	03337	051526		CPA B73 ; CONTINUE WITH THIS LINE
1586	03340	027461		JMP PRCSS
1587	03341	051501		CPA B15 CR
1588	03342	024327		JMP POPJ
1589	03343	014401		JSB GETC RUN GARBAGE
1590	03344	027336		JMP COEND
1591*				
1592	03345	000000	XSET	NOP
1593	03346	014544		JSB PUSHJ FIND DESTINATION
1594	03347	006706		DEF GTARG
1595	03350	014316		JSB SPNOR
1596	03351	051527		CPA B75 NEXT MUST BE =
1597	03352	002001		RSS
1598	03353	014220		JSB ERROR NO IT ISN'T
1599	03354	060651		LDA PT1 SAVE DESTINATION
1600	03355	014533		JSB PUSHA
1601	03356	014544		JSB PUSHJ EVALUATE EXPRESSION
1602	03357	004730		DEF EVAL=1
1603	03360	164634		LDB PDL,I TRANSFER RESULT
1604	03361	074651		STB PT1 SAVE POINTER
1605	03362	034634		ISZ PDL DONE WITH POINTER
1606	03363	061222		LDA FLACP
1607	03364	115175		JSB XFR,I
1608	03365	014316		JSB SPNOR RUN SPACES
1609	03366	127345		JMP XSET,I
1610*				
1611	03367	017345	FOR	JSB XSET 'FOR' COMMAND
1612	03370	060651		LDA PT1
1613	03371	014533		JSB PUSHA SAVE PTR TO VAR
1614	03372	014544		JSB PUSHJ
1615	03373	006675		DEF ARG
1616	03374	014220		JSB ERROR MISSING ARG
1617	03375	014316		JSB SPNOR
1618	03376	051526		CPA B73 ; TEST FOR 2-ARG FORM
1619	03377	027446		JMP FOR2
1620	03400	014554		JSB PUSHF SAVE STEP
1621	03401	001217		DEF FLAC
1622	03402	014544		JSB PUSHJ
1623	03403	006675		DEF ARG
1624	03404	014220		JSB ERROR WRONG FORMAT
1625	03405	014316		JSB SPNOR
1626	03406	014554	FOR1	JSB PUSHF SAVE END VALUE
1627	03407	001217		DEF FLAC
1628	03410	014554		JSB PUSHF SAVE TEXT POINTER
1629	03411	000643		DEF TXOUT


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1630 03412 014544 FORCO JSB PUSHJ PROCESS
1631 03413 003461 DEF PRCSS
1632 03414 014606 JSB POPF RESTORE TEXT POINTER
1633 03415 000643 DEF TXOUT
1634 03416 014606 JSB POPF RESTORE END VALUE
1635 03417 001217 DEF FLAC
1636 03420 014606 JSB POPF RESTORE STEP
1637 03421 003451 DEF FORTM
1638 03422 014627 JSB POPA GET PTR TO VAR
1639 03423 070651 STA PT1
1640 03424 115136 JSB FAD,I INCREMENT VARIABLE
1641 03425 100651 DEF PT1,I
1642 03426 003451 DEF FORTM
1643 03427 100651 DEF PT1,I
1644 03430 115137 JSB FSB,I TEST END
1645 03431 001217 DEF FLAC
1646 03432 001217 DEF FLAC
1647 03433 100651 DEF PT1,I
1648 03434 061217 LDA FLAC DONE?
1649 03435 067451 LDB FORTM
1650 03436 006020 SSB
1651 03437 003000 CMA
1652 03440 002026 SSA,INA,SZA TEST IF DONE
1653 03441 024327 JMP POPJ
1654 03442 060634 LDA PDL STEP BACK PDL POINTER
1655 03443 041430 ADA DM10
1656 03444 070634 STA PDL
1657 03445 027412 JMP FORCO
1658*
1659 03446 014554 FOR2 JSB PUSHF
1660 03447 001345 DEF FL1
1661 03450 027406 JMP FOR1
1662 03451 000000 FORTM DEX 0

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1664*	'GO' OR 'GOTO'	COMMAND AND	COMMAND PROCESSING
1665	03454 014413	GOTO JSB	GETLN
1666	03455 014351	JSB	FNDLN
1667	03456 014220	JSB	ERROR
1668	03457 060645	LDA	THSLN
1669	03460 070644	STA	PC
1670	03461 014401	PRCSS JSB	GETC
1671	03462 102501	PROC LIA	1
1672	03463 002020	SSA	READ SWITCHES
1673	03464 024231	JMP	RECOV
1674	03465 014316	JSB	SPNOR
1675	03466 051501	CPA	B15
1676	03467 024327	JMP	POPJ
1677	03470 051526	CPA	B73
1678	03471 027461	JMP	PRCSS
1679	03472 071031	STA	PCTEM+1
1680	03473 060643	LDA	TXOUT
1681	03474 071030	STA	PCTEM
1682	03475 115152	JSB	GT1,I
1683	03476 064667	LDB	CHAR
1684	03477 055527	CPB	B75
1685	03500 027325	JMP	PCSET
1686	03501 055514	CPB	B50
1687	03502 027325	JMP	PCSET
1688	03503 041436	ADA	BM133
1689	03504 002021	SSA,	RSS
1690	03505 027510	JMP	*+3
1691	03506 041505	ADA	B32
1692	03507 002020	SSA	BEFORE A?
1693	03510 014220	ILCOM JSB	ERROR
1694	03511 043513	ADA	COMGO
1695	03512 124000	JMP	0B,I
1696*			
1697*			
1698	03513 103514	COMGO DEF	*+1,I
1699	03514 002003	DEF	ASK
1700	03515 002130	DEF	BUF
1701	03516 000327	DEF	POPJ
1702	03517 003122	DEF	DO
1703	03520 003174	DEF	ERASE
1704	03521 003367	DEF	FOR
1705	03522 003454	DEF	GOTO
1706	03523 003510	DEF	ILCOM
1707	03524 003546	DEF	IF
1708	03525 003510	DEF	ILCOM
1709	03526 003510	DEF	ILCOM
1710	03527 003510	DEF	ILCOM
1711	03530 003601	DEF	MOD
1712	03531 004547	DEF	NCODE
1713	03532 004004	DEF	OPTN
1714	03533 004141	DEF	XLOT
1715	03534 000110	DEF	START
1716	03535 000325	DEF	RETRN
1717	03536 003333	DEF	SET
1718	03537 002005	DEF	TYPE
1719	03540 004471	DEF	UNPK

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1720	03541	004643	DEF VAR	V
1721	03542	004651	DEF WRITE	W
1722	03543	003510	DEF ILCOM	X
1723	03544	003510	DEF ILCOM	Y
1724	03545	004714	DEF ZER	Z

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1726*      'IF' COMMAND
1727 03546 014316 IF      JSB SPNOR
1728 03547 051514      CPA B50      (
1729 03550 002001      RSS
1730 03551 014220      JSB ERROR      NOT (
1731 03552 014544      JSB PUSHJ      EVALUATE EXPRESSION
1732 03553 004730      DEF EVAL=1
1733 03554 014342      JSB PARTS      TEST )
1734 03555 061217      LDA FLAC      TEST EXPRESSION
1735 03556 002020      SSA
1736 03557 027454      JMP GOTO      SKIP NONE IF =VE
1737 03560 007400      CCB          B=-1
1738 03561 002002      SZA
1739 03562 005000      BLS          OR B=-2 IF EXPN +VE
1740 03563 074635      STB T1
1741 03564 060667      LDA CHAR      IF3
1742 03565 051520      CPA B54      ,
1743 03566 027575      JMP IF1      ,
1744 03567 051526      CPA B73      ;
1745 03570 027461      JMP PRCSS
1746 03571 051501      CPA B15      CR END OF LINE
1747 03572 024327      JMP POPJ
1748 03573 014401      JSB GETC
1749 03574 027565      JMP *-7
1750 03575 014401      JSB GETC      IF1
1751 03576 034635      ISZ T1      SKIP OVER COMMA
1752 03577 027564      JMP IF3      COUNT COMMAS
1753 03600 027454      JMP GOTO      GET ANOTHER COMMA
                        ENOUGH; GOTO!

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1755*	'MODIFY'	COMMAND		
1756	03601 014413	MOD	JSB GETLN	
1757	03602 002021		SSA,RSS	TEST SOURCE LINE
1758	03603 014220		JSB ERROR	NOT 1 LINE
1759	03604 060643		LDA TXOUT	SAVE TEXT
1760	03605 073672		STA MODT	
1761	03606 014351		JSB FNDLN	SET LSTLN, THSLN TXOUT
1762	03607 014220		JSB ERROR	NO SUCH LINE
1763	03610 063672		LDA MODT	RESTORE TEXT
1764	03611 064643		LDB TXOUT	SAVE SOURCE
1765	03612 070643		STA TXOUT	
1766	03613 077672		STB MODT	
1767	03614 060667		LDA CHAR	TEST ,
1768	03615 051520		CPA B54	
1769	03616 027664		JMP MODNL	GO GET NEW LINE NO
1770	03617 063672	MOD1	LDA MODT	RESTORE SOURCE
1771	03620 070643		STA TXOUT	
1772	03621 064672		LDB BUFR	SET UP OUTPUT LINE
1773	03622 006004		INB	
1774	03623 060670		LDA LNNO	
1775	03624 170001		STA 1,I	
1776	03625 006004		INB	
1777	03626 005200		RBL	
1778	03627 074633		STB TXIN	
1779	03630 074650		STB PAKST	
1780	03631 115154	MODSK	JSB TT1,I	READ TTY SILENTLY
1781	03632 011556		AND B177	
1782	03633 073671		STA MODCH	
1783	03634 014401	MODCP	JSB GETC	COPY TILL SRCH CH OR END
1784	03635 115142		JSB PRC,I	OUTPUT ON TTY
1785	03636 060667		LDA CHAR	
1786	03637 115144		JSB PKC,I	
1787	03640 051501		CPA B15	CR
1788	03641 024177		JMP MODX	END OF LINE
1789	03642 053671		CPA MODCH	SEARCH CH
1790	03643 027647		JMP MODFD	
1791	03644 027634		JMP MODCP	CONTINUE
1792*				
1793	03645 060650	MODBA	LDA PAKST	BACK ARROW
1794	03646 070633		STA TXIN	LOSE COPIED TEXT
1795	03647 115143	MODFD	JSB RDC,I	READ TEXT OR EDIT COMMANDS
1796	03650 051500		CPA B14	FORM=FEED
1797	03651 027634		JMP MODCP	SEARCH AGAIN
1798	03652 051476		CPA B7	BELL
1799	03653 027631		JMP MODSK	CHANGE SEARCH CH
1800	03654 051553		CPA B137	BACK ARROW
1801	03655 027645		JMP MODBA	LOSE TEXT
1802	03656 051467		CPA B12	LINE FEED
1803	03657 027633		JMP MODSK+2	COPY REST OF LINE
1804	03660 115144		JSB PKC,I	
1805	03661 051501		CPA B15	CR
1806	03662 024177		JMP MODX	TERMINATE LINE
1807	03663 027647		JMP MODFD	CONTINUE
1808*				
1809*	READ LINE NUMBER FOR MODIFIED LINE			
1810	03664 014401	MODNL	JSB GETC	PASS COMMA

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```
1811 03665 014413      JSB GETLN   NEW NO
1812 03666 002020      SSA        TEST LGAFL
1813 03667 027617      JMP MOD1
1814 03670 014220      JSB ERROR  NOT SINGLE LINE
1815 03671 000000      MODCH NOP   SEARCH CH
1816 03672 000000      MODT NOP
1817*
1818*          TELETYPE OUTPUT BUFFER
1819 03673 000000      TTBUF BSS 72
1820 04003          TTEND EQU *
```

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1822*      'INCODE' COMMAND LISTED WITH 'UNPACK' BELOW
1823*
1824*      'OPTION' COMMAND
1825  04003 014401      JSB GETC      GET NEXT OPTION
1826  04004 115152      OPTN  JSB GT1,I
1827  04005 051545      CPA B122      R
1828  04006 026026      JMP OPTNR     HIGH SPEED READER
1829  04007 051537      CPA B113      K
1830  04010 026035      JMP OPTNK     KEYBOARD
1831  04011 051544      CPA B120      P
1832  04012 026037      JMP OPTNP     PUNCH
1833  04013 051547      CPA B124      T
1834  04014 026045      JMP OPTNT     TYPE
1835  04015 051540      CPA B114      L
1836  04016 026050      JMP OPTNL     LINE PRINTER
1837  04017 051533      CPA B106      F
1838  04020 026055      JMP OPTNF     FIXED OUTPUT FORMAT
1839  04021 051534      CPA B107      G
1840  04022 026054      JMP OPTNG     GENERAL OUTPUT FORMAT
1841  04023 051541      CPA B115      M
1842  04024 026060      JMP OPTNM     MAG TAPE I/O
1843  04025 014220      JSB ERROR     ILLEGAL OPTION
1844*
1845  04026 061205      OPTNR LDA HSRDR  SET H.S. READER
1846  04027 070663      STA INCH     FOR CHARACTER INPUT
1847  04030 103715      STC HSR,C    INITIATE
1848  04031 060667      OPTN1 LDA CHAR   ANY MORE OPTIONS?
1849  04032 051520      CPA B54      , ?
1850  04033 026003      JMP OPTN-1   GO GET NEXT
1851  04034 125215      JMP COX,I    ALL DONE
1852*
1853  04035 015032      OPTNK JSB TTRON SET KEYBOARD INPUT
1854  04036 026031      JMP OPTN1
1855*
1856*
1857  04037 061207      OPTNP LDA HSPCH  SET H.S. PUNCH
1858  04040 070664      STA OUTCH   FOR CHARACTER OUTPUT
1859  04041 107716      CLC PNCH,C  INITIALISE
1860  04042 002404      CLA,INA
1861  04043 071127      STA PNCHF   CLEAR 'BUSY'
1862  04044 026031      JMP OPTN1
1863*
1864  04045 061210      OPTNT LDA TTYPN  SET TTY PUNCH
1865  04046 070664      STA OUTCH   FOR CHARACTER OUTPUT
1866  04047 026031      JMP OPTN1
1867*
1868  04050 062053      OPTNL LDA LPR     SET LINEPRINTER
1869  04051 070664      STA OUTCH   FOR CHARACTER OUTPUT
1870  04052 026031      JMP OPTN1
1871  04053 007217      LPR  DEF LPOUT
1872*
1873  04054 002401      OPTNG CLA,RSS   CLEAR
1874  04055 003400      OPTNF CCA      OR SET
1875  04056 070677      STA FORMF   "FIXED" FORMAT FLAG
1876  04057 026031      JMP OPTN1
1877*

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1878	04060	014316	OPTNM	JSB SPNOR	CHECK ,
1879	04061	051520		CPA B54	
1880	04062	002001		RSS	
1881	04063	014220		JSB ERROR	NOT ,
1882	04064	014401		JSB GETC	PASS ,
1883	04065	115152		JSB GT1,I	READ I OR O
1884	04066	051535		CPA B111	I
1885	04067	026077		JMP OPTMI	INPUT
1886	04070	051543		CPA B117	O
1887	04071	026123		JMP OPTMO	OUTPUT
1888	04072	051536		CPA B112	J
1889	04073	026113		JMP OPTMS=2	CONTINUE MAG TAPE INPUT
1890	04074	051544		CPA B120	P
1891	04075	026136		JMP OPTM2	CONTINUE OUTPUT
1892	04076	014220		JSB ERROR	ILLEGAL MAG TAPE OPTION
1893*					
1894	04077	014544	OPTMI	JSB PUSHJ	SET UP INPUT BUFFER
1895	04100	006705		DEF GTARG=1	
1896	04101	060651		LDA PT1	
1897	04102	000066		CLE,ELA	
1898	04103	071013		STA MTIN	
1899	04104	071014		STA MTINB	
1900	04105	061110		LDA GTL	* LENGTH
1901	04106	001000		ALS	CONVERT TO CHARACTER COUNT
1902	04107	071015		STA MTINL	
1903	04110	003400		CCA	SET BUFFER EMPTY
1904	04111	071016		STA MTINC	
1905	04112	071017		STA MTINT	SET 'TERMINATED'
1906	04113	061211		LDA MTINP	SET MT INPUT ROUTINE
1907	04114	070663		STA INCH	
1908	04115	060763	OPTMS	LDA BUNT	UNIT SELECTED?
1909	04116	002021		SSA,RSS	
1910	04117	026031		JMP OPTN1	
1911	04120	002400		CLA	DEFAULT TO UNIT 0
1912	04121	115155		JSB BSI,I	
1913	04122	026031		JMP OPTN1	
1914*					
1915	04123	014544	OPTMO	JSB PUSHJ	SET UP OUTPUT BUFFER
1916	04124	006705		DEF GTARG=1	
1917	04125	060651		LDA PT1	GET BUFFER PTR
1918	04126	000066		CLE,ELA	AS CHARACTER POINTER
1919	04127	071022		STA MTOP	SET CURRENT
1920	04130	071023		STA MTOPB	AND INITIAL PTRS
1921	04131	061110		LDA GTL	GET LENGTH
1922	04132	001000		ALS	IN CHARACTERS
1923	04133	041437		ADA BM1	PLUS ONE
1924	04134	071025		STA MTOPC	SET CURRENT
1925	04135	071024		STA MTOPL	AND INITIAL COUNTS
1926	04136	061212	OPTM2	LDA MTOPP	SET MT OUTPUT ROUTINE
1927	04137	070664		STA OUTCH	
1928	04140	026115		JMP OPTMS	GO CHECK IF UNIT SELECTED


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1930*      PLOT COMMAND (BUFFERED)
1931*      CALLS: P X,Y,OPTION  OR  P X,Y
1932*      OPTION =VE; INITIALISE, CURRENT POINT (X,Y); RAISE PEN
1933*      +VE, EVEN OR OMITTED; PLOT TO (X,Y), PEN DOWN
1934*      +VE, ODD; PLOT TO (X,Y) WITH PEN UP
1935  04141 014544  XLOT  JSB PUSHJ  GET X
1936  04142 004731          DEF EVAL
1937  04143 115140          JSB FMP,I   SCALE X
1938  04144 001217          DEF FLAC
1939  04145 001217          DEF FLAC
1940  04146 001043          DEF PLXS
1941  04147 115153          JSB INT,I   CONVERT TO INTEGER
1942  04150 001217          DEF FLAC
1943  04151 041456          ADA BMIN  CONVERT TO ONES COMP
1944  04152 000065          CLE,ERA  TRUNCATE TO 15 BITS
1945  04153 171037          STA PLI,I  X TO BUFFER
1946  04154 014544          JSB PUSHJ  GET Y
1947  04155 006675          DEF ARG
1948  04156 014220          JSB ERROR  NO Y
1949  04157 115140          JSB FMP,I  SCALE Y
1950  04160 001217          DEF FLAC
1951  04161 001217          DEF FLAC
1952  04162 001046          DEF PLYS
1953  04163 115153          JSB INT,I  CONVERT TO INTEGER
1954  04164 001217          DEF FLAC
1955  04165 041456          ADA BMIN  CONVERT TO ONES COMP
1956  04166 000065          CLE,ERA  CLEAR SIGN
1957  04167 001121          ARS,ARS  TRUNCATE TO 13 BITS
1958  04170 071054          STA PLINY SAVE Y
1959  04171 014544          JSB PUSHJ  GET OPTION
1960  04172 006675          DEF ARG
1961  04173 026202          JMP **7   NO OPTION=OPTION 0
1962  04174 115153          JSB INT,I  OPTION TO A AS INTEGER
1963  04175 001217          DEF FLAC
1964  04176 001300          RAR      POSITION LS AND SIGN
1965  04177 011455          AND BCRT MASK OFF
1966  04200 031054          IOR PLINY INCLUDE IN Y
1967  04201 002001          RSS
1968  04202 061054          LDA PLINY OPTION 0
1969  04203 065037          LDB PLI  GET BUFFER POINTER
1970  04204 006004          INB     STEP PTR FROM X TO Y
1971  04205 170001          STA 1,I  STORE Y AND OPTION
1972  04206 006004          INB     STEP BUFFER POINTER
1973  04207 055041          CPB PL1  END OF BUFFER?
1974  04210 065040          LDB PL0  RESET TO START
1975  04211 055042  PLTST CPB PLO  IS BUFFER NOW FULL?
1976  04212 026363          JMP PLFUL YES; WAIT TILL IT ISN'T
1977  04213 075037          STB PLI  SET UPDATED POINTER
1978*
1979  04214 061052          LDA PLSW  BUSY?
1980  04215 002003          SZA,RSS  0=BUSY
1981  04216 125215          JMP COX,I YES; ALL DONE
1982*
1983  04217 002400          CLA      SET BUSY
1984  04220 071052          STA PLSW
1985  04221 071053          STA PLFL1 SET '1ST TIME'

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1986*				
1987	04222	061055	PLSTT LDA PLX	INITIATE LINE PLOT
1988	04223	071057	STA PLNX	SET UP 'NOW' PTRS
1989	04224	061056	LDA PLY	
1990	04225	071060	STA PLNY	
1991	04226	061042	LDA PLO,I	PICK UP X
1992	04227	071055	STA PLX	SET DESTINATION
1993	04230	035042	ISZ PLO	
1994	04231	161042	LDA PLO,I	PICK UP Y
1995	04232	011051	AND PLMSY	MASK Y
1996	04233	071056	STA PLY	
1997	04234	161042	LDA PLO,I	GET OPTION
1998	04235	011455	AND BCRT	MASK OPTION BITS
1999	04236	001200	RAL	POSITION OPTION
2000	04237	065042	LDB PLO	STEP BUFFER POINTER
2001	04240	006004	INB	
2002	04241	055041	CPB PL1	END OF BUFFER?
2003	04242	065040	LDB PLO	RESET TO START
2004	04243	075042	STB PLO	SET UPDATED POINTER
2005	04244	002020	SSA	TEST OPTION
2006	04245	026360	JMP PLRST	NEVE; RESET ORIGIN
2007	04246	070001	STA I	SAVE PEN POSN IN B
2008	04247	021061	XOR PLPEN	TEST PEN POSITION
2009	04250	002003	SZA,RSS	
2010	04251	026257	JMP PLXX	UNCHANGED
2011	04252	075061	STB PLPEN	SWAP PEN POSITION
2012	04253	061507	LDA B40	PEN DOWN
2013	04254	006002	SZB	
2014	04255	061503	LDA B20	PEN UP
2015	04256	016367	JSB PLWT	GO, MOVE PEN
2016*				
2017	04257	061055	PLXX LDA PLX	FORM DX
2018	04260	003104	CMA,CLE,INA	
2019	04261	041057	ADA PLNX	
2020	04262	006441	CLB,SEZ,RSS	TAKE MODULUS
2021	04263	003004	CMA,INA	
2022	04264	071062	STA PLDX	
2023	04265	005600	ELB	MOTION TO B
2024	04266	061056	LDA PLY	FORM DY
2025	04267	003104	CMA,CLE,INA	
2026	04270	041060	ADA PLNY	
2027	04271	002020	SSA	TAKE MODULUS
2028	04272	003004	CMA,INA	
2029	04273	071063	STA PLDY	
2030	04274	005600	ELB	Y MOTION TO B
2031	04275	075064	STB PLMV	SAVE MOTION BITS
2032	04276	003104	CMA,CLE,INA	WHICH IS GREATER?
2033	04277	041062	ADA PLDX	
2034	04300	002040	SEZ	
2035	04301	026312	JMP PLOT2	DX GREATER
2036	04302	061062	LDA PLDX	DY GREATER; SWAP
2037	04303	065063	LDB PLDY	
2038	04304	071063	STA PLDY	
2039	04305	075062	STB PLDX	
2040	04306	002404	CLA,INA	SET UP MAJOR MOTION
2041	04307	011064	AND PLMV	MASK Y MOTION

2042	04310	041067		ADA PLT1	Y MOTION TABLE
2043	04311	026315		JMP **4	
2044	04312	061064	PLOT2	LDA PLMV	GET MOTION BITS
2045	04313	001100		ARS	POSITION X MOTION
2046	04314	041070		ADA PLT2	X MOTION TABLE
2047	04315	164000		LDB 0,I	
2048	04316	075065		STB PLMAJ	MAJOR MOTION
2049	04317	061063		LDA PLOY	GET MINOR MOTION
2050	04320	003004		CMA,INA	NEGATE IT FOR PLOT COUNT
2051	04321	071063		STA PLDY	
2052	04322	002003		SZA,RSS	TEST FOR ZERO
2053	04323	026327		JMP **4	IF 0, COMBINED=MAJOR
2054	04324	061064		LDA PLMV	MOTION BITS
2055	04325	041071		ADA PLT3	COMBINED MOTION TABLE
2056	04326	164000		LDB 0,I	
2057	04327	075066		STB PLCOM	COMBINED MOTION
2058	04330	065062		LDB PLDX	SET STEP COUNT
2059	04331	007000		CMB	+1; COUNT BEFORE STEP
2060	04332	075064		STB PLMV	
2061	04333	065062		LDB PLDX	START PLOT COUNT
2062	04334	005100		BRS	WITH MAJOR DELTA/2
2063	04335	035064	PLOT3	ISZ PLMV	DONE?
2064	04336	002101		CLE,RSS	
2065	04337	026354		JMP PLEX	END OF THIS SEGMENT
2066	04340	045063		ADB PLDY	STEP PLOT COUNT BY MINOR
2067	04341	061065		LDA PLMAJ	SET EITHER MAJOR MOTION
2068	04342	002040		SEZ	OR, IF 0'FLOW
2069	04343	026346		JMP **3	
2070	04344	031066		IOR PLCOM	SET COMBINED MOTION
2071	04345	045062		ADB PLDX	AND ADD MAJOR TO COUNT
2072	04346	016367		JSB PLWT	GO PLOT
2073	04347	026335		JMP PLOT3	
2074*					
2075	04350	002404	PLRST	CLA,INA	INITIALISE
2076	04351	071061		STA PLPEN	PEN UP
2077	04352	061503		LDA B20	
2078	04353	016367		JSB PLWT	
2079	04354	061042	PLEX	LDA PLO	ANY MORE IN BUFFER?
2080	04355	051037		CPA PLI	
2081	04356	002401		CLA,RSS	NO
2082	04357	026222		JMP PLSTT	CONTINUE PLOTTING
2083	04360	035052		ISZ PLSW	CLEAR 'BUSY'
2084	04361	016367		JSB PLWT	SHOULD NOT RETURN
2085	04362	014220		JSB ERROR	UNEXPECTED PLOTTER INTERRUPT
2086*					
2087*					
				BUFFER FULL; TEST SWITCHES	
2088	04363	102501	PLFUL	LIA 1	READ SWITCHES
2089	04364	002020		SSA	TEST SIGN BIT
2090	04365	024231		JMP RECOV	QUIT IF -VE
2091	04366	026211		JMP PLTST	
2092*					
2093	04367	004366	PLWT	DEF **1	PLOT I/O
2094	04370	075072		STB PLT	PRESERVE 0
2095	04371	002003		SZA,RSS	NULL INSTRUCTION?
2096	04372	026375		JMP **3	
2097	04373	102620		OTA PLOT	OUTPUT INSTRUCTION

2098	04374	103720		STC PLOT,C	
2099	04375	061053		LDA PLFL1	1ST TIME?
2100	04376	002002		SZA	
2101	04377	026402		JMP *+3	
2102	04400	035053		ISZ PLFL1	SET 'NOT 1ST TIME'
2103	04401	125215		JMP CUX,I	1ST TIME EXIT
2104	04402	061073		LDA PLEO	NORMAL EXIT
2105	04403	103101		CLO	
2106	04404	000036		SLA,ELA	
2107	04405	102101		STF 1	
2108	04406	061074		LDA PLAB	RESTORE A
2109	04407	065075		LDB PLAB+1	AND B
2110	04410	126411		JMP PLIR,I	
2111*					
2112	04411	000000	PLIR	NOP	PLOTTER IR ROUTINE
2113	04412	103120		CLF PLOT	CLEAR FLAG
2114	04413	071074		STA PLAB	SAVE REGISTERS
2115	04414	075075		STB PLAB+1	
2116	04415	001520		ERA,ALS	
2117	04416	102201		SOC	
2118	04417	002004		INA	
2119	04420	071073		STA PLEO	
2120	04421	065072		LDB PLT	
2121	04422	126367		JMP PLWT,I	
2122*					
2123*					
2124			PLBUF	REP 30	
2125	04423	000000		NOP	
2125	04424	000000		NOP	
2125	04425	000000		NOP	
2125	04426	000000		NOP	
2125	04427	000000		NOP	
2125	04430	000000		NOP	
2125	04431	000000		NOP	
2125	04432	000000		NOP	
2125	04433	000000		NOP	
2125	04434	000000		NOP	
2125	04435	000000		NOP	
2125	04436	000000		NOP	
2125	04437	000000		NOP	
2125	04440	000000		NOP	
2125	04441	000000		NOP	
2125	04442	000000		NOP	
2125	04443	000000		NOP	
2125	04444	000000		NOP	
2125	04445	000000		NOP	
2125	04446	000000		NOP	
2125	04447	000000		NOP	
2125	04450	000000		NOP	
2125	04451	000000		NOP	
2125	04452	000000		NOP	
2125	04453	000000		NOP	
2125	04454	000000		NOP	
2125	04455	000000		NOP	
2125	04456	000000		NOP	
2125	04457	000000		NOP	

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2125	04460	000000	NOP
2126	04461		PLEND EQU *
2127	04461	000004	PLTB1 DEC 4,8
2128	04463	000001	PLTB2 DEC 1,2
2129	04465	000005	PLTB3 DEC 5,9,6,10

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2131*      'QUIT' COMMAND TRANSFERS CONTROL TO 'START',
2132*
2133*      'RETURN' COMMAND LISTED WITH 'POPJ' SUBROUTINE.
2134*
2135*      'SET' COMMAND LISTED WITH 'FOR', ABOVE.
2136*
2137*      'TYPE' COMMAND LISTED WITH 'ASK', ABOVE.
2138*
2139*      'UNPACK' COMMAND;
2140*      CONVERTS BCD OR BINARY ('INTEGER'
2141*      TO AVOID CONFUSION OF INITIAL LETTERS) TO INTERNAL
2142*      FLOATING POINT FORMAT
2143      04471 016632  UNPK  JSB UNPK0  SET UP ARRAYS AND COUNTS
2144      04472 100200          MPY UNPKN
2145      04474 072544          STA UNPKN  =LENGTH REQUIRED FOR OUTPUT
2146      04475 003104          CMA,CLE,INA
2147      04476 041110          ADA GTL    COMPARE LENGTH AVAILABLE
2148      04477 065110          LDB GTL
2149      04500 002042          SEZ,SZA  SKIP IF SUFFICIENT
2150      04501 076544          STB UNPKN  OTHERWISE SET SHORTER
2151*
2152      04502 162542  UNPK2 LDA UNPKS,I GET DATA
2153      04503 036542          ISZ UNPKS
2154      04504 066541          LDB UNPK0  FIND OPTION
2155      04505 055531          CPB B102
2156      04506 026511          JMP UNPKB
2157      04507 016525          JSB UNPKR
2158      04510 026502          JMP UNPK2
2159*
2160      04511 072545  UNPKB STA UNPKT  SAVE L.S.
2161      04512 001727          ALF,ALF  GET M.S.
2162      04513 011563          AND B377
2163      04514 051467          CPA B12
2164      04515 002400          CLA          COPE WITH CODED ZERO
2165      04516 016525          JSB UNPKR
2166      04517 062545          LDA UNPKT  GET L.S.
2167      04520 011563          AND B377
2168      04521 051467          CPA B12
2169      04522 002400          CLA
2170      04523 016525          JSB UNPKR
2171      04524 026502          JMP UNPK2
2172*
2173      04525 000000  UNPKR NOP          STORE AND COUNT
2174      04526 115176          JSB DBL,I  CONVERT TO FLOATING POINT
2175      04527 100651          DEF PT1,I
2176      04530 060651          LDA PT1  STEP POINTER
2177      04531 041473          ADA B3
2178      04532 070651          STA PT1
2179      04533 062544          LDA UNPKN  COUNT
2180      04534 041473          ADA B3
2181      04535 072544          STA UNPKN
2182      04536 002020          SSA
2183      04537 126525          JMP UNPKR,I MORE TO COME
2184      04540 125215          JMP COX,I  ALL DONE
2185*
2186      04541 000000  UNPK0 NOP  OPTION

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PAGE 0052 #01 ONCAL COMMAND INTERPRETER

2187	04542	000000	UNPKS	NOP	SOURCE
2188	04543	000000	UNPKL	NOP	SOURCE LENGTH
2189	04544	000000	UNPKN	NOP	WORD COUNT
2190	04545	000000	UNPKT	NOP	TEMP STORAGE, BCD UNPACK
2191	04546	000000	UNPKF	NOP	FRACTION FLAG, BCD PACK

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2193*          'NCODE' COMMAND; INVERSE OF 'UNPACK'
2194 04547 016632 NCODE JSB UNPK0 SET UP ARRAYS AND COUNTS
2195 04550 007400          CCB
2196 04551 100400          DIV UNPKN =O/P REQUIRED
2197 04553 072544          STA UNPKN
2198 04554 076546          STB UNPKF FRACTION (0 FOR INTEGER)
2199 04555 003104          CMA,CLE,INA
2200 04556 041110          ADA GTL COMPARE LENGTH AVAILABLE
2201 04557 006441          CLB,SEZ,RSS
2202 04560 026564          JMP **4
2203 04561 076546          STB UNPKF SET SHORTER
2204 04562 065110          LDB GTL
2205 04563 076544          STB UNPKN
2206*
2207 04564 115153 PACK2 JSB INT,I GET DATA
2208 04565 104542          DEF UNPKS,I
2209 04566 066542          LDB UNPKS STEP POINTER
2210 04567 045473          ADB B3
2211 04570 076542          STB UNPKS
2212 04571 066541          LDB UNPK0 OPTION?
2213 04572 055531          CPB B102
2214 04573 026613          JMP PACKB BCD
2215 04574 170651 PACK3 STA PT1,I INTEGER
2216 04575 034651          ISZ PT1
2217 04576 036544          ISZ UNPKN DONE?
2218 04577 026564          JMP PACK2
2219 04600 062546          LDA UNPKF BCD HALF WORD?
2220 04601 002021          SSA,RSS
2221 04602 125215          JMP COX,I
2222 04603 115153          JSB INT,I
2223 04604 104542          DEF UNPKS,I
2224 04605 011530          AND B77
2225 04606 002003          SZA,RSS
2226 04607 061467          LDA B12
2227 04610 001727          ALF,ALF
2228 04611 170651          STA PT1,I
2229 04612 125215          JMP COX,I
2230*
2231 04613 011530 PACKB AND B77 PACK BCD
2232 04614 002003          SZA,RSS TEST FOR ZERO
2233 04615 061467          LDA B12
2234 04616 001727          ALF,ALF
2235 04617 170651          STA PT1,I
2236 04620 115153          JSB INT,I GET SECOND CHARACTER
2237 04621 104542          DEF UNPKS,I
2238 04622 066542          LDB UNPKS
2239 04623 045473          ADB B3
2240 04624 076542          STB UNPKS
2241 04625 011530          AND B77
2242 04626 002003          SZA,RSS
2243 04627 061467          LDA B12
2244 04630 140651          ADA PT1,I
2245 04631 026574          JMP PACK3

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2247	04632	000000	UNPK0	NOP	SET UP 'UNPACK' AND 'PACK'
2248	04633	115152		JSB GT1,I	GET OPTION
2249	04634	072541		STA UNPK0	
2250	04635	051531		CPA B102	IS IT 'BCD'
2251	04636	026642		JMP UNPK1	
2252	04637	051535		CPA B111	IS IT 'INTEGER'
2253	04640	026642		JMP UNPK1	
2254	04641	014220		JSB ERROR	
2255*					
2256	04642	014544	UNPK1	JSB PUSHJ	GET SOURCE ARRAY
2257	04643	014544	VAR	JSB PUSHJ	SET UP VARIABLES
2258	04644	006706		DEF GTARG	
2259	04645	014316		JSB SPNOR	
2260	04646	051520		CPA B54	,
2261	04647	026642		JMP VAR-1	MORE
2262	04650	125215		JMP COX,I	
2263*					
2264*					'WRITE' COMMAND
2265	04651	014413	WRITE	JSB GETLN	WRITE LINE, GROUP OR ALL TEXT
2266	04652	014351		JSB FNDLN	FIND LINE
2267	04653	026703		JMP WRIT1	NOT FOUND; GROUP OR ALL?
2268	04654	060670		LDA LNNO	
2269	04655	002002		SZA	
2270	04656	115146		JSB PRL,I	PRINT NON-ZERO LINE NO
2271	04657	014401		JSB GETC	PRINT LINE
2272	04660	114664		JSB OUTCH,I	
2273	04661	060667		LDA CHAR	
2274	04662	051501		CPA B15	UNTIL CR
2275	04663	002001		RSS	
2276	04664	026657		JMP *-5	
2277	04665	160645		LDA THSLN,I	TRY NEXT LINE
2278	04666	002003	WRIT2	SZA,RSS	
2279	04667	024327		JMP POPJ	END OF TEXT
2280	04670	002004		INA	
2281	04671	070651		STA PT1	
2282	04672	060666		LDA LGAFL	
2283	04673	002020		SSA	
2284	04674	024327		JMP POPJ	EXIT IF SINGLE LINE
2285	04675	160651		LDA PT1,I	CONTINUE IF GROUP OR ALL
2286	04676	014332		JSB TSTGP	
2287	04677	026705		JMP WRIT3	DIFFERENT GROUP
2288	04700	160651	WRIT4	LDA PT1,I	
2289	04701	070670		STA LNNO	CONTINUE SOMEWHAT INELEGANTLY
2290	04702	026652		JMP WRITE+1	...BUT IT WORKS
2291*					
2292	04703	060645	WRIT1	LDA THSLN	
2293	04704	026666		JMP WRIT2	
2294*					
2295	04705	060666	WRIT3	LDA LGAFL	IF NOT ALL, THEN DONE
2296	04706	002011		SLA,RSS	
2297	04707	024327		JMP POPJ	
2298	04710	061501		LDA B15	ALL; CONTINUE
2299	04711	114664		JSB OUTCH,I	
2300	04712	026700		JMP WRIT4	
2301*					
2302*					'ZERO' COMMAND TO ZERO OUT AN ARRAY

2303	04713	014401		JSB GETC	COMMA; DO ANOTHER
2304	04714	014544	ZER	JSB PUSHJ	
2305	04715	006706		DEF GTARG	SET PT1 AND GTL
2306	04716	061110		LDA GTL	PICK UP LENGTH
2307	04717	006400		CLB	
2308	04720	174651		STB PT1,I	
2309	04721	034651		ISZ PT1	
2310	04722	002006		INA,SZA	
2311	04723	026720		JMP *-3	
2312	04724	014316		JSB SPNOR	
2313	04725	051520		CPA B54	,
2314	04726	026713		JMP ZER-1	MORE
2315	04727	125215		JMP COX,I	

2318	04730	014401		JSB GETC	RECURSIVE EVALUATE ROUTINE
2319	04731	002400	EVAL	CLA	
2320	04732	070656		STA LSTOP	
2321	04733	071217		STA FLAC	SET 0 IN FLAC
2322	04734	071220		STA FLAC+1	
2323	04735	071221		STA FLAC+2	
2324	04736	014277		JSB SORT	
2325	04737	026760		JMP EVOP1	OP/TERM AS FIRST CH
2326	04740	027112		JMP EVNUM	NUMBER
2327	04741	051475	EVVAR	CPA B6	LETTER; IS IT F?
2328	04742	027117		JMP EVFUN	IF SO, IT IS A FUNCTION
2329	04743	060656		LDA LSTOP	SAVE LSTOP
2330	04744	014533		JSB PUSHA	
2331	04745	014544		JSB PUSHJ	
2332	04746	006714		DEF GTVAR	
2333	04747	014627		JSB POPA	RESTORE LSTOP
2334	04750	070656		STA LSTOP	
2335	04751	060651		LDA PT1	TRANSFER VARIABLE
2336	04752	065222		LOB FLACP	TO FLAC
2337	04753	115175		JSB XFR,I	
2338	04754	014277	EVOPR	JSB SORT	
2339	04755	026774		JMP EVOP2	OP/TERM IS EXPECTED
2340	04756	000000		NOP	NUMBER
2341	04757	014220		JSB ERROR	OR LETTER ARE ILLEGAL
2342*					
2343	04760	002003	EVOP1	SZA,RSS	RUN SPACES
2344	04761	026730		JMP EVAL-1	
2345	04762	051475		CPA B6	(
2346	04763	027102		JMP EVOP3+3	
2347	04764	051472		CPA B2	IS IT UNARY =?
2348	04765	027002		JMP EVOP4-1	
2349	04766	051463		CPA B1	IS IT UNARY PLUS?
2350	04767	027035		JMP EVARG	JUST IGNORE IT
2351	04770	041476		ADA B7	TERMINATOR?
2352	04771	002020		SSA	
2353	04772	014220		JSB ERROR	
2354	04773	024327		JMP POPJ	TERMINATOR = NULL = 0
2355*					
2356	04774	051475	EVOP2	CPA B6	(
2357	04775	014220		JSB ERROR	
2358	04776	041427		ADA B7	TERMINATOR?
2359	04777	002021		SSA,RSS	
2360	05000	002401		CLA,RSS	SET OPERATION 0
2361	05001	041476		ADA B7	
2362	05002	070646		STA THSOP	
2363	05003	064646	EVOP4	LOB THSOP	COMPARE PRIORITIES
2364	05004	007004		CM8,INB	
2365	05005	044656		ADB LSTOP	
2366	05006	060656		LDA LSTOP	
2367	05007	006020		SSB	
2368	05010	027030		JMP EVPAR	
2369	05011	002003		SZA,RSS	ALL DONE?
2370	05012	024327		JMP POPJ	
2371	05013	043042		ADA EVOPT	SET UP OPERATION
2372	05014	160000		LDA 0B,I	
2373	05015	073016		STA EVOP	

2374	05016	000000	EVOP	NOP	CARRY OUT OPERATION LSTOP
2375	05017	001217		DEF	FLAC
2376	05020	100634		DEF	PDL, I
2377	05021	001217		DEF	FLAC
2378	05022	060634		LDA	PDL
2379	05023	041473		ADA	B3
2380	05024	070634		STA	PDL
2381	05025	014627		JSB	POPA
2382	05026	070656		STA	LSTOP
2383	05027	027003		JMP	EVOP4
2384*					
2385	05030	014533	EVPAR	JSB	PUSHA
2386	05031	014554		JSB	PUSHF
2387	05032	001217		DEF	FLAC
2388	05033	060646		LDA	THSOP
2389	05034	070656		STA	LSTOP
2390	05035	014401	EVARG	JSB	GETC
2391	05036	014277		JSB	SORT
2392	05037	027077		JMP	EVOP3
2393	05040	027112		JMP	EVNUM
2394	05041	026741		JMP	EVVAR
2395*					
2396	05042	005042	EVOPT	DEF	* OPERATION TABLE
2397	05043	115136		JSB	FAD, I
2398	05044	115137		JSB	FSB, I
2399	05045	115141		JSB	FDV, I
2400	05046	115140		JSB	FMP, I
2401	05047	027050		JMP	EVPOW
2402*					
2403	05050	115153	EVPOW	JSB	INT, I
2404	05051	001217		DEF	FLAC
2405	05052	073073		STA	EVPWI
2406	05053	115176		JSB	DBL, I
2407	05054	005074		DEF	EVPWT
2408	05055	115137		JSB	FSB, I
2409	05056	005074		DEF	EVPWT
2410	05057	001217		DEF	FLAC
2411	05060	005074		DEF	EVPWT
2412	05061	063074		LDA	EVPWT
2413	05062	002002		SZA	
2414	05063	027070		JMP	EVPWF
2415	05064	063073		LDA	EVPWI
2416	05065	115156		JSB	DTI, I
2417	05066	014220		JSB	ERROR
2418	05067	027022		JMP	EVOP+4
2419*					
2420	05070	115157	EVPWF	JSB	QTD, I
2421	05071	014220		JSB	ERROR
2422	05072	027022		JMP	EVOP+4
2423*					
2424	05073	000000	EVPWI	NOP	
2425	05074	000000	EVPWT	DEX	0.

PAGE 0058 #01 RECURSIVE EVALUATE ROUTINE

2427	05077	051475	EVOP3	CPA B6	(
2428	05100	002001		RSS	
2429	05101	014220		JSB ERROR	
2430	05102	060656		LDA LSTOP	SAVE LAST OP
2431	05103	014533		JSB PUSHA	
2432	05104	014544		JSB PUSHJ	EVALUATE WITHIN PARENTHESES
2433	05105	004730		DEF EVAL=1	SKIPPING (
2434	05106	014627	EVFNX	JSB POPA	RESTORE LAST OP
2435	05107	070656		STA LSTOP	
2436	05110	014342		JSB PARTS	CHECK PARENTHESES
2437	05111	026754		JMP EVOPR	LOOK FOR NEXT OP
2438*					
2439	05112	060654	EVNUM	LDA GETCP	SET TO READ TEXT
2440	05113	070655		STA INPUT	
2441	05114	002400		CLA USE	CHAR AS 1ST DIGIT
2442	05115	115147		JSB FNP,I	READ NUMBER
2443	05116	026754		JMP EVOPR	
2444*					
2445*	FUNCTION)	READ	NAME		
2446	05117	002400	EVFUN	CLA	CLEAR FUNCTION
2447	05120	070657		STA EVFNM	
2448	05121	014401		JSB GETC	READ NEXT CH
2449	05122	014277		JSB SORT	
2450	05123	027133		JMP *+8	OP/TERM
2451	05124	000000		NOP	NUMBER
2452	05125	064657		LDB EVFNM	LETTER; ADD IN TO NAME
2453	05126	005720		BLF,BLS	SHIFT 5 PLACES
2454	05127	060667		LDA CHAR	PLUS 5 NEW BITS
2455	05130	011506		AND B37	
2456	05131	040001		ADA 1B	
2457	05132	027120		JMP EVFUN+1	
2458	05133	051475		CPA B6	(
2459	05134	002001		RSS	
2460	05135	014220		JSB ERROR	
2461	05136	060656		LDA LSTOP	SAVE LSTOP
2462	05137	014533		JSB PUSHA	
2463	05140	060657		LDA EVFNM	SAVE FUNCTION
2464	05141	014533		JSB PUSHA	
2465	05142	014544		JSB PUSHJ	
2466	05143	004730		DEF EVAL=1	
2467	05144	014627		JSB POPA	RESTORE FUNCTION
2468	05145	050702		CPA FABS	ABS
2469	05146	027230		JMP XABS	
2470	05147	050703		CPA FSGN	SGN
2471	05150	027302		JMP XSGN	
2472	05151	050704		CPA FINT	INT
2473	05152	027232		JMP XINT	
2474	05153	050705		CPA FITR	ITR
2475	05154	027232		JMP XINT	
2476	05155	050706		CPA FDIS	DIS
2477	05156	027337		JMP XDIS	
2478	05157	050707		CPA FATN	ATN
2479	05160	027523		JMP ARTN	
2480	05161	050710		CPA FEXP	EXP
2481	05162	027236		JMP XEXP	
2482	05163	050711		CPA FLOG	LOG

2483	05164	027241	JMP	XLOG		
2484	05165	050712	CPA	FSIN	SIN	
2485	05166	027244	JMP	XSIN		
2486	05167	050713	CPA	FCOS	COS	
2487	05170	027246	JMP	XCOS		
2488	05171	050714	CPA	FSQT	SQT	
2489	05172	027250	JMP	XSQRT		
2490	05173	050715	CPA	FAND	AND	
2491	05174	027253	JMP	XAND		
2492	05175	050716	CPA	FIOR	IOR	
2493	05176	027273	JMP	XIOR		
2494	05177	050717	CPA	FXOR	XOR	
2495	05200	027276	JMP	XXOR		
2496	05201	050720	CPA	FIN	IN	
2497	05202	027315	JMP	XIN		
2498	05203	050721	CPA	FOUT	OUT	
2499	05204	027326	JMP	XOUT		
2500			REP	18		
2501	05205	000000	NOP		SPARE	SPACE
2501	05206	000000	NOP		SPARE	SPACE
2501	05207	000000	NOP		SPARE	SPACE
2501	05210	000000	NOP		SPARE	SPACE
2501	05211	000000	NOP		SPARE	SPACE
2501	05212	000000	NOP		SPARE	SPACE
2501	05213	000000	NOP		SPARE	SPACE
2501	05214	000000	NOP		SPARE	SPACE
2501	05215	000000	NOP		SPARE	SPACE
2501	05216	000000	NOP		SPARE	SPACE
2501	05217	000000	NOP		SPARE	SPACE
2501	05220	000000	NOP		SPARE	SPACE
2501	05221	000000	NOP		SPARE	SPACE
2501	05222	000000	NOP		SPARE	SPACE
2501	05223	000000	NOP		SPARE	SPACE
2501	05224	000000	NOP		SPARE	SPACE
2501	05225	000000	NOP		SPARE	SPACE
2501	05226	000000	NOP		SPARE	SPACE
2502	05227	014220	JSB	ERROR	ILLEGAL	FUNCTION

MISCELLANEOUS FUNCTIONS					
2505*					
2506	05230	115160	XABS	JSB ABS,I	ABS FUNCTION
2507	05231	027106		JMP EVFNX	
2508*					
2509	05232	115161	XINT	JSB ENT,I	INTEGER PART
2510	05233	001217		DEF FLAC	
2511	05234	001217		DEF FLAC	
2512	05235	027106		JMP EVFNX	
2513*					
2514	05236	115162	XEXP	JSB EXP,I	EXPONENTIAL
2515	05237	014220		JSB ERROR	
2516	05240	027106		JMP EVFNX	
2517*					
2518	05241	115163	XLOG	JSB LOG,I	NATURAL LOGARITHM
2519	05242	014220		JSB ERROR	
2520	05243	027106		JMP EVFNX	
2521*					
2522	05244	115164	XSIN	JSB SIN,I	SINE
2523	05245	027106		JMP EVFNX	
2524*					
2525	05246	115165	XCOS	JSB COS,I	COSINE
2526	05247	027106		JMP EVFNX	
2527*					
2528	05250	115166	XSQRT	JSB SQT,I	SQUARE ROOT
2529	05251	014220		JSB ERROR	
2530	05252	027106		JMP EVFNX	
2531*					
2532	05253	063301	XAND	LDA IAND	INTEGER AND(N1,N2)
2533	05254	073267		STA IXOPR	
2534	05255	115153		JSB INT,I	1ST ARG
2535	05256	001217		DEF FLAC	
2536	05257	014533		JSB PUSHA	SAVE IT
2537	05260	014544		JSB PUSHJ	2ND ARG
2538	05261	006675		DEF ARG	
2539	05262	014220		JSB ERROR	NO 2ND ARG
2540	05263	115153		JSB INT,I	
2541	05264	001217		DEF FLAC	
2542	05265	070001		STA 1 SAVE	2ND ARG
2543	05266	014627		JSB POPA	RESTORE 1ST ARG
2544	05267	000000	IXOPR	NOP	OPERATE
2545	05270	115176		JSB DBL,I	BACK TO FLOATING POINT
2546	05271	001217		DEF FLAC	
2547	05272	027106		JMP EVFNX	
2548*					
2549	05273	063275	XIOR	LDA *+2	INTEGER INCLUSIVE OR
2550	05274	027254		JMP XAND+1	
2551	05275	030001		IOR 1	
2552*					
2553	05276	063300	XXOR	LDA *+2	INTEGER EXCLUSIVE OR
2554	05277	027254		JMP XAND+1	
2555	05300	020001		XOR 1	
2556	05301	010001	IAND	AND 1	
2557*					
2558	05302	061217	XSGN	LDA FLAC	SIGN FUNCTION) -1,0,+1
2559	05303	011455		AND BCRT	MAKE HI
2560	05304	065472		LOB B2	SET EXP FOR +

PAGE 0061: #01 STANDARD FUNCTIONS

2561	05305	002002		SZA	CLEAR EXP IF 0
2562	05306	002020		SSA	*,OR -VE
2563	05307	006400		CLB	
2564	05310	071217		STA FLAC	STORE RESULT
2565	05311	075221		STB FLAC+2	
2566	05312	002400		CLA	
2567	05313	071220		STA FLAC+1	
2568	05314	027106		JMP EVFNX	
2569*					
2570	05315	060667	XIN	LDA CHAR	
2571	05316	073325		STA XINTM	SAVE CHAR
2572	05317	114663		JSB INCH,I	
2573	05320	115176		JSB DBL,I	
2574	05321	001217		DEF FLAC	
2575	05322	063325		LDA XINTM	RESTORE CHAR
2576	05323	070667		STA CHAR	
2577	05324	027106		JMP EVFNX	
2578	05325	000000	XINTM	NOP	
2579*					
2580	05326	115153	XOUT	JSB INT,I	CHARACTER OUTPUT; FOUT
2581	05327	001217		DEF FLAC	
2582	05330	064664		LDB OUTCH	TEST OUTPUT DEVICE
2583	05331	055210		CPB TYPN	TELETYPE?
2584	05332	027335		JMP **3	
2585	05333	114664		JSB OUTCH,I	
2586	05334	027106		JMP EVFNX	
2587	05335	115167		JSB TTO,I	OUTPUT TO TELETYPE
2588	05336	027106		JMP EVFNX	

2590* MORE MISCELLANEOUS FUNCTIONS

2591*

2592* 'FDIS' DISPLAY ON STORAGE 'SCOPE

2593* NOTE; NOT RECURSIVE!!

2594*

2595* CALLS:

2596* FDIS() OR FDIS(ARG) FOR ERASE

2597* FDIS(X,Y) DISPLAY POINT X,Y

2598* FDIS(X,Y,EVEN) DRAW LINE TO X,Y

2599* FDIS(X,Y,ODD) DISPLAY POINT X,Y

2600*

2601	05337	115153	XDIS	JSB INT,I	GET X
2602	05340	001217		DEF FLAC	AS INTEGER
2603	05341	073437		STA DINX	STORE NEW X VALUE
2604	05342	014544		JSB PUSHJ	GO GET NEW Y
2605	05343	006675		DEF ARG	
2606	05344	027516		JMP DISER	NO ARG; ERASE SCRIEN
2607	05345	115153		JSB INT,I	CONVERT Y TO INTEGER
2608	05346	001217		DEF FLAC	
2609	05347	073436		STA DINY	STORE NEW Y VALUE
2610	05350	061131		LDA DISFL	WAIT TILL DONE
2611	05351	002003		SZA,RSS	ERASING
2612	05352	027350		JMP *-2	
2613	05353	014544		JSB PUSHJ	GET OPTION
2614	05354	006675		DEF ARG	
2615	05355	027450		JMP DIEND	NO OPTION
2616	05356	115153		JSB INT,I	OPTION TO INTEGER
2617	05357	001217		DEF FLAC	
2618	05360	000010		SLA	ODD OPTION?
2619	05361	027450		JMP DIEND	ODD; DISPLAY POINT
2620	05362	063440		LDA DIOX	EVEN; DRAW LINE
2621	05363	003004		CMA,INA	X LINE LENGTH
2622	05364	043437		ADA DINX	NEW = OLD
2623	05365	002121		CLE,SSA,RSS	TEST SIGN
2624	05366	003204		CMA,CME,INA	MAKE =MODULUS OF LX
2625	05367	006445		CLB,SEZ,INB,RSS	MAKE +1 IF LX +VE
2626	05370	007400		CCB	MAKE -1 IF LX -VE
2627	05371	077444		STB DIMX	SET X INCREMENT
2628	05372	073442		STA DIDX	SET =MOD LX
2629	05373	063441		LDA DIOY	Y LINE LENGTH
2630	05374	003004		CMA,INA	
2631	05375	043436		ADA DINY	NEW = OLD
2632	05376	002121		CLE,SSA,RSS	TEST SIGN
2633	05377	003204		CMA,CME,INA	MAKE =MOD LY
2634	05400	006445		CLB,SEZ,INB,RSS	MAKE +1 IF LY +VE
2635	05401	007400		CCB	MAKE -1 IF LY -VE
2636	05402	077445		STB DIMY	SET Y INCREMENT
2637	05403	073443		STA DIDY	SET =MOD LY
2638	05404	003004		CMA,INA	
2639	05405	043442		ADA DIDX	MOD LY = MOD LX
2640	05406	073447		STA DIMG	SET 'SWAPPED' FLAG
2641	05407	002020		SSA	WHICH IS GREATER?
2642	05410	027415		JMP DIS2	MOD LX GREATER
2643	05411	063442		LDA DIDX	SWAP LENGTHS IF
2644	05412	067443		LDB DIDY	MOD LY WAS LARGER
2645	05413	073443		STA DIDY	

2646	05414	077442		STB DIDX	
2647	05415	067442	DIS2	LDB DIOX	MAKE LONGER ONE +VE
2648	05416	007004		CMB, INB	
2649	05417	077442		STB DIOX	SET INCREMENT
2650	05420	007000		CMB	=(LONGER+1)
2651	05421	077446		STB DIMV	FOR COUNT
2652	05422	007000		CMB	+LONGER/2
2653	05423	005100		BRS	AS STARTER
2654	05424	037446	DIS3	ISZ DIMV	COUNT
2655	05425	002401		CLA, RSS	NOT DONE; CLEAR FLAG
2656	05426	027106		JMP EVFNX	DONE
2657	05427	047443		ADB DIDY	SUBTRACT SHORTER
2658	05430	006021		SSB, RSS	O'FLOW?
2659	05431	027434		JMP **3	NO
2660	05432	061463		LDA B1	YES; SET FLAG
2661	05433	047442		ADB DIDX	AND ADD LONGER
2662	05434	017461		JSB DISPX	DISPLAY POINT
2663	05435	027424		JMP DIS3	TRY AGAIN
2664	05436	000000	DINY	NOP	
2665	05437	000000	DINX	NOP	
2666	05440	000000	DIOX	NOP	
2667	05441	000000	DIOY	NOP	
2668	05442	000000	DIDX	NOP	
2669	05443	000000	DIDY	NOP	
2670	05444	000000	DIMX	NOP	
2671	05445	000000	DIMY	NOP	
2672	05446	000000	DIMV	NOP	
2673	05447	000000	DIMG	NOP	
2674	05450	067437	DIEND	LDB DINX	MOVE CURRENT POINT
2675	05451	077440		STB DIOX	
2676	05452	067436		LDB DINY	
2677	05453	077441		STB DIOY	
2678	05454	006400		CLB	LIGHT POINT
2679	05455	077444		STB DIMX	
2680	05456	077445		STB DIMY	
2681	05457	017461		JSB DISPX	
2682	05460	027106		JMP EVFNX	
2683*					
2684*					
2685*					
2686	05461	000000	DISPX	NOP	DISPLAY ROUTINE
2687	05462	002003		SZA, RSS	COMBINED MOTION?
2688	05463	027472		JMP DIS4	NO
2689	05464	063440		LDA DIOX	YES; STEP BOTH
2690	05465	043444		ADA DIMX	X
2691	05466	073440		STA DIOX	
2692	05467	063441		LDA DIOY	AND Y
2693	05470	043445		ADA DIMY	
2694	05471	027504		JMP DIS6	
2695	05472	063447	DIS4	LDA DIMG	SINGLE MOTION;
2696	05473	002021		SSA, RSS	SWAPPED?
2697	05474	027502		JMP DIS5	YES; GO STEP Y
2698	05475	063440		LDA DIOX	NO; STEP X
2699	05476	043444		ADA DIMX	
2700	05477	073440		STA DIOX	
2701	05500	063441		LDA DIOY	

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2702 05501 027505      JMP DIS6+1
2703 05502 063441  DIS5  LDA DIOY      SWAPPED; STEP Y
2704 05503 043445      ADA DIMY
2705 05504 073441  DIS6  STA DIOY
2706 05505 011563      AND B377      MASK Y
2707 05506 001727      ALF,ALF      POSITION Y
2708 05507 073515      STA DIDS      SAVE Y
2709 05510 063440      LDA DIOX      GET X
2710 05511 011563      AND B377      MASK X
2711 05512 033515      IOR DIDS      INCLUDE Y
2712 05513 102621      OTA DISPL     LIGHT UP POINT
2713 05514 127461      JMP DISPX,I
2714 05515 000000  DIDS  NOP
2715*
2716*
2717 05516 002400  DISER  CLA          CLEAR DONE FLAG
2718 05517 071131      STA DISFL
2719 05520 103121      CLF DISPL     ERASE SCOPE
2720 05521 103721      STC DISPL,C  CLEAR FLAG AGAIN
2721 05522 027106      JMP EVFNX
2722*
2723*
2724*      ARC TANGENT ROUTINE
2725 05523 014554  ARTN  JSB PUSHF     SAVE FLAC
2726 05524 001217      DEF FLAC
2727 05525 014544      JSB PUSHJ     ANY MORE ARGS?
2728 05526 006675      DEF ARG
2729 05527 027534      JMP ARTAN     GO DO 1 ARG
2730 05530 014606      JSB POPF      2 ARGS; RESTORE FLAC
2731 05531 001223      DEF FLARG
2732 05532 115170      JSB ATN2,I    2BLE PREC
2733 05533 027106      JMP EVFNX
2734*
2735 05534 014606  ARTAN  JSB POPF
2736 05535 001217      DEF FLAC
2737 05536 115171      JSB ATN,I     1 ARG ARC TAN
2738 05537 027106      JMP EVFNX

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2741*           MISCELLANEOUS PRINT ROUTINES
2742 05540 000000 PRNTL NOP          PRINT LNNO AS NN,NN
2743 05541 060670          LDA LNNO
2744 05542 001727          ALF,ALF
2745 05543 017553          JSB PRNT          NN
2746 05544 061522          LDA B56
2747 05545 114664          JSB OUTCH,I
2748 05546 060670          LDA LNNO
2749 05547 017553          JSB PRNT          NN
2750 05550 061507          LDA B40          ONE SPACE FOLLOWING
2751 05551 114664          JSB OUTCH,I
2752 05552 127540          JMP PRNTL,I
2753*
2754 05553 000000 PRNT  NOP          PRINT 8-BIT AS NN
2755 05554 011563          AND B377
2756 05555 067564          LDB PRNT2          2 DECIMAL DIGITS
2757 05556 017566          JSB PRNTD          GO PRINT
2758 05557 127553          JMP PRNT,I
2759 05560 000000 PRNTN NOP          PRINT AS NNNN
2760 05561 067565          LDB PRNT4          4 DECIMAL DIGITS
2761 05562 017566          JSB PRNTD          GO PRINT
2762 05563 127560          JMP PRNTN,I
2763 05564 001467 PRNT2 DEF D10
2764 05565 001465 PRNT4 DEF DECML
2765*
2766 05566 000000 PRNTD NOP          GENERAL INTEGER PRINT ROUTINE
2767 05567 074636          STB T2          SET DIVISOR POINTER
2768 05570 006400          CLB          SET UP FOR DIVISION
2769 05571 100400          DIV T2,I          DIVIDE
2770 05573 074635          STB T1          SAVE REMAINDER
2771 05574 034636          ISZ T2          STEP TO NEXT DIVISOR
2772 05575 041524          ADA B60          CONVERT TO ASCII
2773 05576 114664          JSB OUTCH,I          PRINT CHARACTER
2774 05577 060635          LDA T1          PICK UP REMAINDER
2775 05600 164636          LDB T2,I          TEST NEXT DIVISOR
2776 05601 006002          SZB          C=END
2777 05602 027570          JMP PRNTD+2          DO NEXT
2778 05603 127566          JMP PRNTD,I          DONE
2779*
2780 05604 000000 PRNTD NOP          PRINT A AS OCTAL
2781 05605 001265          RAL,CLE,ERA          SIGN TO E
2782 05606 070635          STA T1          SAVE A
2783 05607 061504          LDA B30          MAKE 0
2784 05610 001500          ELA          OR 1
2785 05611 114664          JSB OUTCH,I          OUTPUT MS DIGIT
2786 05612 060635          LDA T1          RESTORE A
2787 05613 067620          LDB PRNT6          SET UP
2788 05614 017566          JSB PRNTD          AND PRINT REMAINDER
2789 05615 061507          LDA B40          ONE SPACE
2790 05616 114664          JSB OUTCH,I
2791 05617 127604          JMP PRNTD,I
2792 05620 001457 PRNT6 DEF OCTAL          TABLE OF OCTAL DIVISORS
2793*
2794 05621 000000 PRNTC NOP
2795 05622 031557          IOR B200
2796 05623 051561          CPA B215

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2797	05624	027633		JMP PRNCR	OUTPUT CRLF
2798	05625	115167	PRN1	JSB TTO,I	
2799	05626	037640		ISZ PRNCT	COUNT CHARACTERS ON THE LINE
2800	05627	127621		JMP PRNTC,I	
2801	05630	061562		LDA B272	: AS CONTINUATION MARK
2802	05631	115167		JSB TTO,I	
2803	05632	061561		LDA B215	CR
2804	05633	115167	PRNCR	JSB TTO,I	OUTPUT CR
2805	05634	061433		LDA DM72	RESET CH COUNT
2806	05635	073640		STA PRNCT	
2807	05636	061560		LDA B212	LF
2808	05637	027625		JMP PRN1	
2809	05640	177670	PRNCT	DEC =72	
2810*		CHARACTER	READ-IN ROUTINE,	'READC'	
2811	05641	000000	READC	NOP	NORMAL PROGRAM READ ROUTINE
2812	05642	114663		JSB INCH,I	GET NEXT
2813	05643	011556		AND B177	TRUNCATE
2814	05644	002003		SZA,RSS	RUN BLANKS, LEADER:
2815	05645	027642		JMP *=3	
2816	05646	070667		STA CHAR	
2817	05647	051473		CPA B3	TEST 'END OF MEDIUM'
2818	05650	024231		JMP RECOV	
2819	05651	051525		CPA B72	: = CONTINUATION
2820	05652	027676		JMP RDCON	
2821	05653	064663		LDB INCH	WHICH INPUT DEVICE?
2822	05654	055206		CPB TTYRR	TTY?
2823	05655	027657		JMP RDTTY	GO, CHECK NO/LINE
2824	05656	127641		JMP READC,I	
2825*					
2826	05657	051501	RDTTY	CPA B15	CR?
2827	05660	027670		JMP RECR	
2828	05661	037640		ISZ PRNCT	COUNT CHARACTERS
2829	05662	127641		JMP READC,I	NORMAL EXIT
2830	05663	061525		LDA B72	PRINT :
2831	05664	017621		JSB PRNTC	
2832	05665	061501		LDA B15	AND CRLF
2833	05666	017621		JSB PRNTC	
2834	05667	027674		JMP RECR+4	
2835	05670	061433	RECR	LDA DM72	RESET CH COUNT
2836	05671	073640		STA PRNCT	
2837	05672	061560		LDA B212	MAKE LF TOO
2838	05673	017621		JSB PRNTC	
2839	05674	060667		LDA CHAR	
2840	05675	127641		JMP READC,I	
2841	05676	114663	RDCON	JSB INCH,I	IGNORE TILL CR
2842	05677	011556		AND B177	
2843	05700	002003		SZA,RSS	
2844	05701	027676		JMP *=3	
2845	05702	051473		CPA B3	
2846	05703	024231		JMP RECOV	
2847	05704	051501		CPA B15	
2848	05705	002001		RSS	
2849	05706	027676		JMP *=8	
2850	05707	064663		LDB INCH	
2851	05710	055206		CPB TTYRR	TTY?
2852	05711	002001		RSS	

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2853	05712	027642	JMP	READC+1	
2854	05713	061433	LDA	DM72	RESET CH COUNT
2855	05714	073640	STA	PRNCT	
2856	05715	061560	LDA	B212	MAKE LF TOO
2857	05716	017621	JSB	PRNTC	
2858	05717	027642	JMP	READC+1	

2860*		TABLE FOR SORT ROUTINE	
2861	05720 100200	SORTB	OCT 100200,100200,100200,100200
2862	05724 100200		OCT 100200,100200,100012,100200
2863	05730 100200		OCT 100200,100200,100200,100200
2864	05734 100200		OCT 100200,100200,100200,100200
2865	05740 000014		OCT 14,6416,7420,100200
2866	05744 003007		OCT 3007,2001,4002,25003
2867	05750 020041		OCT 20041,21043,22045,23047
2868	05754 024051		OCT 24051,100011,100013,100200
2869	05760 100101		OCT 100101,41103,42105,43107
2870	05764 044111		OCT 44111,45113,46115,47117
2871	05770 050121		OCT 50121,51123,52125,53127
2872	05774 054131		OCT 54131,55200,100200,2600
2873			REP 4
2874	06000 100200		OCT 100200,100200,100200,100200
2874	06004 100200		OCT 100200,100200,100200,100200
2874	06010 100200		OCT 100200,100200,100200,100200
2874	06014 100200		OCT 100200,100200,100200,100200
2875*		CHARACTER PACKING ROUTINE	
2876	06020 000000	PACKC	NOP PACK TEXT VIA TXIN
2877	06021 070641		STA T5
2878	06022 011556		AND B177 INSURANCE
2879	06023 064633		LDB TXIN
2880	06024 051556		CPA B177 RUBOUT?
2881	06025 026041		JMP PACKR
2882	06026 004065		CLE,ERB
2883	06027 054634		CPB PDL FULL?
2884	06030 014220		JSB ERROR
2885	06031 002041		SEZ,RSS EVEN?
2886	06032 001727		ALF,ALF POSITION WORD
2887	06033 002040		SEZ ODD?
2888	06034 140001		ADA 1,I ADD IN M.S. HALF
2889	06035 170001		STA 1,I OUTPUT TO BUFFER
2890	06036 034633		ISZ TXIN
2891	06037 060641	PACKX	LDA T5
2892	06040 126020		JMP PACKC,I
2893*		PACKR	
2894	06041 054650	CPB PAKST	ANYTHING TO RUB?
2895	06042 126020	JMP PACKC,I	NO
2896	06043 045437	ADB BM1	STEP POINTER BACK
2897	06044 074633	STB TXIN	
2898	06045 005100	BRS	
2899	06046 160001	LDA 1,I	RUB OUT CH., IF ANY
2900	06047 011447	AND BM400	
2901	06050 170001	STA 1,I	
2902	06051 064663	LDB INCH	WHICH INPUT DEVICE?
2903	06052 055206	CPB TTYRR	TTY?
2904	06053 002001	RSS	
2905	06054 026037	JMP PACKX	
2906	06055 061052	LDA B134	OUTPUT \
2907	06056 115142	JSB PRC,I	ON TELETYPE
2908	06057 026037	JMP PACKX	

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2910*          OUTPUT ROUTINE
2911 06060 000000 FOUT1 NOP
2912 06061 002400 CLA CLEAR
2913 06062 071104 STA FOUOP OP FLAG
2914 06063 061217 LDA FLAC GET SIGN
2915 06064 071105 STA FOUSG SAVE IT
2916 06065 002021 SSA,RSS TEST SIGN
2917 06066 026071 JMP *+3 + OK
2918 06067 115172 JSB DCM,I =VE; TAKE MODULUS
2919 06070 001217 DEF FLAC
2920 06071 060676 LDA FORM GET REQUESTED FORMAT
2921 06072 071076 FOU1 STA FOUFM SET CURRENT FORMAT
2922 06073 011502 AND B17 NO OF DEC PLACES
2923 06074 070001 STA 1 SAVE IN B
2924 06075 075107 STB FOURN AND IN FOURN
2925 06076 061076 LDA FOUFM GET FORMAT AGAIN
2926 06077 001727 ALF,ALF POSITION NO OF FIGS
2927 06100 011502 AND B17 MASK NO OF FIGS
2928 06101 003007 CMA,INA,SZA,RSS NEGATE AND TEST
2929 06102 020176 JMP FOUEX 0=E FORMAT
2930 06103 071103 STA FOUFC SET CHARACTER COUNT
2931 06104 040001 ADA 1 =NO BEFORE DEC PT
2932 06105 000002 SZB TEST FOR NO DEC PT
2933 06106 002004 INA COUNT DECIMAL POINT
2934 06107 002021 SSA,RSS TEST IF LEGAL
2935 06110 003400 CCA MAKE IT LEGAL
2936 06111 005105 LDB FOUSG TEST SIGN
2937 06112 006020 SSB
2938 06113 034000 ISZ 0 =I INCREMENT, TEST ZERO
2939 06114 006401 CLH,RSS CLEAR
2940 06115 007400 CCB OR SET
2941 06116 070432 STB FOUDF D FLAG
2942 06117 071102 STA FOUTD SAVE COUNT FOR DEC PT
2943 06120 100200 MPY B3 MAKE POINTER TO TABLE
2944 06122 042430 ADA FOUTB OF POWERS OF TEN
2945 06123 071106 STA FOUFC FOR SCALING
2946 06124 061107 LDA FOURN MAKE POINTER
2947 06125 003000 CMA =N=1
2948 06126 100200 MPY B3 FOR ROUNDING
2949 06130 042430 ADA FOUTB
2950 06131 071107 STA FOURN
2951* ALL SET UP; NOW START LOOKING AT DATA
2952 06132 110140 JSB FMP,I MAKE ROUNDING
2953 06133 001223 DEF FLARG
2954 06134 101107 DEF FOURN,I
2955 06135 001361 DEF FL.5
2956 06136 115136 JSB FAD,I ROUND DATA
2957 06137 001077 DEF FOTEM
2958 06140 001217 DEF FLAC
2959 06141 001223 DEF FLARG
2960 06142 115140 JSB FMP,I SCALE
2961 06143 001077 DEF FOTEM
2962 06144 001077 DEF FOTEM
2963 06145 101106 DEF FOUFC,I
2964 06146 115161 JSB ENT,I GET DIGIT
2965 06147 001223 DEF FLARG

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2966 06150 001077      DEF FOTEM
2967 06151 115153      JSB INT,I      AS INTEGER
2968 06152 001223      DEF FLARG
2969 06153 041430      ADA DM10      TEST SIZE
2970 06154 002021      SSA,RSS
2971 06155 026160      JMP FOUOF      GO COPE WITH O'FLOW
2972 06156 016321      FOU2 JSB FOPRT      PRINT
2973 06157 126060      JMP FOUT1,I    ALL DONE
2974*
2975*                OVERFLOW WITH CURRENT FORMAT
2976 06160 061076      FOUOF LDA FOUFM      GET CURRENT FORMAT
2977 06161 011502      AND B17      MASK NO OF DECIMAL PLACES
2978 06162 002003      SZA,RSS      ZERO IS THE LIMIT
2979 06163 026167      JMP FOU3      END OF THE ROAD
2980 06164 003400      CCA          NOT THERE YET;
2981 06165 041076      ADA FOUFM      TRY ONE LESS
2982 06166 026072      JMP FOU1      TRY AGAIN
2983*
2984 06167 060677      FOU3 LDA FORMF      "FIXED" FORMAT?
2985 06170 002002      SZA          0="GENERAL"
2986 06171 026156      JMP FOU2      "FIXED"; OUTPUT 9'S
2987 06172 060676      LDA FORM      "GENERAL"; SET E FORMAT
2988 06173 001727      ALF,ALF      WITH SAME NO OF FIGS
2989 06174 011502      AND B17      I.E. 6 MORE CHARACTERS
2990 06175 026072      JMP FOU1      TRY AGAIN
2991*
2992*                E FORMAT; =N,NNNE+XX
2993 06176 007007      FOUEX CMB,INB,SZB,RSS SET NO OF SIG FIGS
2994 06177 065431      LDB DM12      DEFAULT TO 12
2995 06200 075103      STB FOUFC      SET FIGURE COUNT
2996 06201 006007      INB,SZB,RSS STEP IF GREATER THAN ONE
2997 06202 007400      CCB          TO COUNT DECIMAL POINT
2998 06203 060001      LDA 1        MAKE POINTER TO TABLE
2999 06204 100200      MPY B3
3000 06206 042430      ADA FOUTB      OF POWERS OF TEN
3001 06207 071107      STA FOURN      FJR ROUNDING
3002 06210 002400      CLA          CLEAR
3003 06211 072431      STA FOUX      EXPONENT
3004 06212 072432      STA FOUDF      AND "D" FLAG
3005 06213 065105      LDB FOUFG      GET SIGN
3006 06214 071105      STA FOUFG      CLEAR SIGN
3007 06215 061507      LDA B40      MAKE SPACE
3008 06216 006020      SSB          OR
3009 06217 061521      LDA B55      =SIGN
3010 06220 114664      JSB OUTCH,I   OUTPUT SPACE OR SIGN
3011 06221 115174      JSB DFR,I     TRANSFER DATA
3012 06222 001077      DEF FOTEM     TO FOTEM
3013 06223 001217      DEF FLAC
3014 06224 061217      LDA FLAC     GET DATA
3015 06225 002003      SZA,RSS      TEST ZERO
3016 06226 026302      JMP FOUX0     GO TYPE ZERO
3017 06227 065101      FOUX1 LDB FOTEM+2 GET LO AND EXP
3018 06230 115173      JSB FLN,I     UNPACK EXPONENT
3019 06231 002002      SZA          TEST 0
3020 06232 002020      SSA          OR =VE
3021 06233 026242      JMP FOUX2     SMALL ENOUGH

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3022	06234	036431	ISZ	FOUX	STEP EXPONENT
3023	06235	115140	JSB	FMP,I	SCALE
3024	06236	001077	DEF	FOTEM	
3025	06237	001077	DEF	FOTEM	DATA BY
3026	06240	001342	DEF	FL.1	0.1
3027	06241	026227	JMP	FOUX1	AND TRY AGAIN
3028*					
3029	06242	003400	FOUX2	CCA	STEP EXPONENT
3030	06243	042431	ADA	FOUX	BY =1
3031	06244	072431	STA	FOUX	
3032	06245	115140	JSB	FMP,I	SCALE
3033	06246	001077	DEF	FOTEM	
3034	06247	001077	DEF	FOTEM	DATA BY
3035	06250	001350	DEF	FL10	10
3036	06251	065101	LDD	FOTEM+2	GET LO AND EXP
3037	06252	115173	JSB	FLN,I	GET EXPONENT
3038	06253	002002	SZA		TEST 0
3039	06254	002020	SSA		OR =VE
3040	06255	026242	JMP	FOUX2	STILL SMALL
3041	06256	115140	JSB	FMP,I	MAKE ROUNDING
3042	06257	001223	DEF	FLARG	
3043	06260	101107	DEF	FOURN,I	
3044	06261	001361	DEF	FL.5	
3045	06262	115136	JSB	FAD,I	ROUND DATA
3046	06263	001077	DEF	FOTEM	
3047	06264	001077	DEF	FOTEM	
3048	06265	001223	DEF	FLARG	
3049	06266	115137	JSB	FSE,I	TEST FOR OVERFLOW
3050	06267	001223	DEF	FLARG	
3051	06270	001077	DEF	FOTEM	
3052	06271	001350	DEF	FL10	
3053	06272	061223	LDA	FLARG	
3054	06273	002020	SSA		GREATER THAN 10?
3055	06274	026302	JMP	*+6	OK
3056	06275	036431	ISZ	FOUX	TOO BIG; ADJUST EXPONENT
3057	06276	000000	NOP		CAN SKIP
3058	06277	115174	JSB	DFR,I	SET MANTISSA
3059	06300	001077	DEF	FOTEM	
3060	06301	001345	DEF	FL1	EQUAL TO ONE
3061*	DATA IS NOW IN THE RANGE 1 TO 9,XXX (OR ZERO)				
3062	06302	003400	FOUX0	CCA	SET EXPIRING COUNT
3063	06303	071102	STA	FOUD	FOR DECIMAL POINT
3064	06304	016321	JSB	FOPRT	PRINT MANTISSA
3065	06305	061532	LDA	B105	"E"
3066	06306	114004	JSB	OUTCH,I	PRINT "E"
3067	06307	066431	LDB	FOUX	TEST EXP
3068	06310	061517	LDA	B53	"+"
3069	06311	000020	SSB		
3070	06312	061521	LDA	B55	OR "-"
3071	06313	114664	JSB	OUTCH,I	PRINT "+" OR "-"
3072	06314	062431	LDA	FOUX	GET EXPONENT
3073	06315	002020	SSA		TAKE MODULUS
3074	06316	003004	CMA,INA		
3075	06317	115150	JSB	PRN,I	PRINT EXPONENT
3076	06320	126060	JMP	FOUT1,I	ALL DONE
3077*					

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3078*          PRINT ROUTINE
3079 06321 000000 FOPRT NOP
3080 06322 115161 FOU4 JSB ENT,I   GET DIGIT
3081 06323 001223      DEF FLARG
3082 06324 001077      DEF FOTEM
3083 06325 115153 JSB INT,I   AS INTEGER
3084 06326 001223      DEF FLARG
3085 06327 041430 ADA DM10   TEST SIZE
3086 06330 002021 SSA,RSS   IF BIG
3087 06331 003400 CCA       MAKE 9
3088 06332 041407 ADA D10
3089 06333 070642 STA T6     SAVE DIGIT
3090 06334 036432 ISZ FOUDF  TEST AND CLEAR "D" FLAG
3091 06335 026354 JMP FOU8   "D" WAS CLEAR
3092 06336 035103 ISZ FOUFC  "D" SET; WAS THAT THE LAST FIG?
3093 06337 026343 JMP **4    NO
3094 06340 061524 LDA B60   YES; ZERO IS THE MOST
3095 06341 114664 JSB OUTCH,I NEGATIVE SINGLE DIGIT
3096 06342 126321 JMP FOPRT,I DONE
3097 06343 061521 LDA B55   -SIGN
3098 06344 114664 JSB OUTCH,I OUTPUT -SIGN
3099 06345 002400 CLA      CLEAR
3100 06346 071105 STA FOU5G SIGN
3101 06347 061522 LDA B56   "."
3102 06350 114664 JSB OUTCH,I OUTPUT "."
3103 06351 035103 ISZ FOUFC COUNT CHARACTERS
3104 06352 016410 FOU7 JSB FOUTS OUTPUT DIGIT
3105 06353 026374 JMP FOU6
3106 06354 035102 FOU8 ISZ FOU4 COUNT FOR DEC PT
3107 06355 026364 JMP FOU5
3108 06356 016410 JSB FOUTS END SUPPRESSION
3109 06357 061522 LDA B56   "."
3110 06360 114664 JSB OUTCH,I OUTPUT "."
3111 06361 035103 ISZ FOUFC COUNT FIGURES
3112 06362 026374 JMP FOU6
3113 06363 126321 JMP FOPRT,I
3114 06364 041104 FOU5 ADA FOUOP NO "OP" AND ZERO DIGIT?
3115 06365 002002 SZA
3116 06366 026352 JMP FOU7   END SUPPRESSION
3117 06367 061507 LDA B40   STILL SUPPRESSING
3118 06370 114664 JSB OUTCH,I OUTPUT SPACE
3119 06371 035103 ISZ FOUFC COUNT FIGURES
3120 06372 002001 RSS
3121 06373 126321 JMP FOPRT,I
3122 06374 060642 FOU6 LDA T6   GET DIGIT
3123 06375 115176 JSB OBL,I  AS FLOATING POINT
3124 06376 001223 DEF FLARG
3125 06377 115137 JSB FSB,I  SUBTRACT
3126 06400 001077 DEF FOTEM  DIGIT
3127 06401 001077 DEF FOTEM  FROM DATA
3128 06402 001223 DEF FLARG
3129 06403 115140 JSB FMP,I  SCALE
3130 06404 001077 DEF FOTEM  REMAINDER
3131 06405 001350 DEF FL10   BY 10
3132 06406 001077 DEF FOTEM
3133 06407 026322 JMP FOU4   DO NEXT DIGIT

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3134*
3135*          DIGIT OUTPUT; TEST SIGN; TURN OFF SUPPRESSION
3136 06410 000000 FOUTS NOP
3137 06411 035104 ISZ FOUOP  TURN OFF SUPPRESSION
3138 06412 061105 LDA FOUFG  TEST SIGN
3139 06413 002021 SSA,RSS
3140 06414 026422 JMP **6    +VE
3141 06415 061521 LDA 055   =SIGN
3142 06416 114664 JSB OUTCH,I OUTPUT =SIGN
3143 06417 035103 ISZ FOUFC  COUNT CHARACTERS
3144 06420 002400 CLA      CLEAR
3145 06421 071105 STA FOUFG  SIGN
3146 06422 060642 LDA T6    GET DIGIT
3147 06423 041524 ADA 060   CONVERT TO ASCII
3148 06424 114664 JSB OUTCH,I OUTPUT DIGIT
3149 06425 035103 ISZ FOUFC  COUNT FIGURES
3150 06426 126410 JMP FOUTS,I MORE
3151 06427 126321 JMP FOPRT,I DONE
3152*
3153 06430 001350 FOUTB DEF FL10
3154 06431 000000 FOUX  NOP          STORAGE FOR EXPONENT
3155 06432 000000 FOUDF NOP          "D" FLAG

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3157*      INPUT ROUTINES
3158 06433 000000 FINPT NOP
3159 06434 002002      SZA      USE CHAR IF A=0
3160 06435 114655      JSB INPUT,I
3161 06436 060667      LDA CHAR
3162 06437 051507      CPA B40      IGNORE SPACES
3163 06440 026435      JMP *-3
3164 06441 016533      JSB FINGP  GET 1ST DIGIT GROUP  SIGN
3165 06442 060667      LDA CHAR
3166 06443 051522      CPA B56      IS IT ,?
3167 06444 002401      CLA,RSS
3168 06445 026455      JMP FIN1   NO ","; CONTINUE
3169 06446 072531      STA FINCT  ","; CLEAR DIGIT COUNT
3170 06447 114655      JSB INPUT,I
3171 06450 002400      CLA      CLEAR DIGIT COUNT
3172 06451 072531      STA FINCT
3173 06452 016555      JSB FING2  GET 2ND DIGIT GROUP
3174 06453 062531      LDA FINCT  COUNT DECIMAL PLACES
3175 06454 003005      CMA,INA,RSS
3176 06455 002400 FIN1  CLA      INITIALISE EXPONENT TO 0
3177 06456 070637      STA T3
3178 06457 061523      LDA B57      MAKE EXPONENT NORMALIZED
3179 06460 115200      JSB PAK,I
3180 06461 001217      DEF FLAC
3181 06462 036532      ISZ FINSN   TEST SIGN
3182 06463 026466      JMP *-3
3183 06464 115172      JSB DCM,I   COMPLEMENT IF NEG
3184 06465 001217      DEF FLAC
3185 06466 064667      LDB CHAR
3186 06467 055532      CPB B105   IS IT E?
3187 06470 002001      RSS
3188 06471 026506      JMP FIN2   NO EXPONENT
3189 06472 014554      JSB PUSHF  SAVE FLAC
3190 06473 001217      DEF FLAC
3191 06474 114655      JSB INPUT,I SKIP OVER E
3192 06475 016533      JSB FINGP  READ EXPONENT
3193 06476 061221      LDA FLAC+2 DON'T CHECK O'FLOW
3194 06477 066532      LDB FINSN  TEST SIGN OF EXP
3195 06500 006020      SSB
3196 06501 003004      CMA,INA
3197 06502 040637      ADA T3
3198 06503 070637      STA T3
3199 06504 014606      JSB POPF   RESTORE FLAC
3200 06505 001217      DEF FLAC
3201*
3202 06506 060637 FIN2  LDA T3      SCALE BY POWERS OF TEN
3203 06507 002003 FIN3  SZA,RSS
3204 06510 126433      JMP FINPT,I FINISHED
3205 06511 002021      SSA,RSS
3206 06512 026521      JMP FIN4
3207 06513 115140      JSB FMP,I
3208 06514 001217      DEF FLAC
3209 06515 001217      DEF FLAC
3210 06516 001342      DEF FL.1
3211 06517 002404      CLA,INA
3212 06520 026526      JMP *-6

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J213	06521	115140	FIN4	JSB FMP,I	
J214	06522	001217		DEF FLAC	
J215	06523	001217		DEF FLAC	
J216	06524	001350		DEF FL10	
J217	06525	003400		CCA	
J218	06526	040637		ADA T3	
J219	06527	070637		STA T3	
J220	06530	026507		JMP FIN3	
J221*					
J222	06531	000000	FINCT	NOP	
J223	06532	000000	FINSN	NOP	
J224*					
J225	06533	000000	FINGP	NOP	READ GROUP OF DIGITS
J226	06534	006400		CLB	OPTIONAL SIGN LEADING SPACES
J227	06535	075217		STB FLAC	INITIALISE
J228	06536	075220		STB FLAC+1	
J229	06537	075221		STB FLAC+2	
J230	06540	078531		STB FINCT	
J231	06541	060667		LDA CHAR	TEST SIGN
J232	06542	051521		CPA B55	"
J233	06543	007000		CMB	
J234	06544	076532		STB FINSN	SET SIGN IN FINSN
J235	06545	051521		CPA B55	
J236	06546	002001		RSS	
J237	06547	051517		CPA B53	+
J238	06550	114655		JSB INPUT,I	SKIP UNARY +
J239	06551	051507		CPA B40	SPACE?
J240	06552	026550		JMP *-2	
J241	06553	016555		JSB FING2	READ REMAINING STRING
J242	06554	126533		JMP FINGP,I	
J243*					
J244	06555	000000	FING2	NOP	READ UNSIGNED DIGIT STRING
J245	06556	051532		CPA B105	E?
J246	06557	126555		JMP FING2,I	
J247	06560	014277		JSB SORT	
J248	06561	126555		JMP FING2,I	OP/TERM
J249	06562	002001		RSS	NUMBER
J250	06563	026566		JMP FIN7	OR LETTER
J251	06564	051467		CPA D10	?
J252	06565	126555		JMP FING2,I	
J253	06566	016574	FIN7	JSB X10	
J254	06567	036531		ISZ FINCT	
J255	06570	114655		JSB INPUT,I	
J256	06571	051507		CPA B40	
J257	06572	126555		JMP FING2,I	
J258	06573	026556		JMP FING2+1	GET NEXT DIGIT

3260	06574	000000	X10	NOP	ADD DIGIT IN A TO FLAC*10
3261	06575	072642		STA X10T	SAVE DIGIT
3262	06576	061221		LDA FLAC+2	GET LO
3263	06577	002120		CLE,SSA	SAVE SIGN
3264	06600	002200		CME	
3265	06601	100200		MPY D10	
3266	06603	002040		SEZ	CORRECT FOR 'SIGN
3267	06604	045467		ADB D10	
3268	06605	000040		CLE	
3269	06606	042642		ADA X10T	SETS E IF CARRY
3270	06607	071221		STA FLAC+2	
3271	06610	002140		SEZ,CLE	CARRY
3272	06611	006004		INB	DOES NOT PROPAGATE
3273	06612	061220		LDA FLAC+1	GET MID
3274	06613	075220		STB FLAC+1	SAVE PARTIAL SUM
3275	06614	002120		CLE,SSA	SAVE 'SIGN' OF MID
3276	06615	002200		CME	
3277	06616	100200		MPY D10	MULTIPLY
3278	06620	002040		SEZ	CORRECT FOR 'SIGN'
3279	06621	045467		ADB D10	
3280	06622	000040		CLE	
3281	06623	041220		ADA FLAC+1	ADD IN PARTIAL SUM
3282	06624	071220		STA FLAC+1	
3283	06625	002140		SEZ,CLE	CARRY
3284	06626	006004		INB	DOES NOT PROPAGATE
3285	06627	061217		LDA FLAC	GET HI; MUST BE +
3286	06630	075217		STB FLAC	SAVE PARTIAL SUM
3287	06631	100200		MPY D10	MULTIPLY
3288	06633	041217		ADA FLAC	ADD IN PARTIAL SUM
3289	06634	071217		STA FLAC	
3290	06635	006002		SZB	TEST O'FLOW
3291	06636	026641		JMP *+3	
3292	06637	002061		SEZ,SSA,RSS	
3293	06640	126574		JMP X10,I	
3294	06641	014220		JSB ERROR	O'FLOW
3295	06642	000000	X10T	NOP	
3296*					
3297*	READ ROUTINE FOR 'ASK' INPUT				
3298*	ACCESSED BY 'JSB INPUT,I' VIA 'READP'				
3299	06643	000000	READ1	NOP	
3300	06644	115143		JSB RDC,I	
3301	06645	051553		CPA B137	BACK ARROW; START AGAIN
3302	06646	026435		JMP FINPT+2	
3303	06647	051556		CPA B177	RUBOUT; IGNORE
3304	06650	026644		JMP READ1+1	
3305	06651	051467		CPA B12	LINEFEED DITTO
3306	06652	026644		JMP READ1+1	
3307	06653	051555		CPA B176	ESCAPE; LEAVE UNCHANGED
3308	06654	002001		RSS	
3309	06655	126643		JMP READ1,I	
3310	06656	115175		JSB XFR,I	GET OLD VALUE
3311	06657	100651		DEF PT,I	
3312	06660	001217		DEF FLAC	
3313	06661	126433		JMP FINPT,I	

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3315*      READ NEXT NON-SPACE TO A; RUN THROUGH TO TERMINATOR
3316  06662 000000  GET1  NOP
3317  06663 014316          JSB  SPNOR
3318  06664 072674          STA  GETEM      SAVE CHARACTER
3319  06665 014401          JSB  GETC
3320  06666 014277          JSB  SORT
3321  06667 026672          JMP  *+3      OP/TERM
3322  06670 026665          JMP  *-3      NUMBER; IGNORE
3323  06671 026665          JMP  *-4      LETTER; IGNORE
3324  06672 062674          LDA  GETEM
3325  06673 126662          JMP  GET1,I
3326  06674 000000  GETEM  NOP
3327*
3328*      ARG ROUTINE; CALL IS
3329*      JSB  PUSHJ
3330*      DEF  ARG
3331*      NO ARGUMENT RETURN
3332*      ARGUMENT READ O.K. RETURN
3333  06675 060667  ARG    LDA  CHAR
3334  06676 051520          CPA  854      IS CHAR A COMMA?
3335  06677 002001          RSS
3336  06700 024327          JMP  POPJ      NO ARGUMENT
3337  06701 134634          ISZ  PDL,I    STEP RETURN
3338  06702 014544          JSB  PUSHJ
3339  06703 004730          DEF  EVAL=1
3340  06704 024327          JMP  POPJ

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3342* RECURSIVE SUBROUTINE TO FIND A VARIABLE OR
3343* TO SET UP A NEW VARIABLE.
3344* ENTRY AT 'GTARG' CHECKS NATURE OF 1ST CHARACTER
3345* OF NAME; ENTRY AT 'GTARG=1' SKIPS A CHARACTER FIRST.
3346* ENTRY AT GTVAR ASSUMES THAT CURRENT 'CHAR' IS
3347* VALID 1ST CHARACTER OF NAME.
3348 06705 014401 JSB GETC SKIP A CHARACTER
3349 06706 014316 GTARG JSB SPNOR
3350 06707 014277 JSB SORT
3351 06710 000000 NOP OP/TERM
3352 06711 014220 JSB ERROR OR NUMBER
3353 06712 051475 CPA B6 F
3354 06713 027035 JMP GTF SET UP F OPTION
3355 06714 060667 GTVAR LDA CHAR ALPHABETIC; O.K.
3356 06715 001727 ALF,ALF
3357 06716 070662 STA ADD
3358 06717 014401 JSB GETC
3359 06720 014277 JSB SORT
3360 06721 026733 JMP GTSCH OP/TERM; TRY SUBSCRIPT
3361 06722 000000 NOP NUMBER
3362 06723 060667 LDA CHAR ADD IN 2ND CH
3363 06724 040662 ADA ADD
3364 06725 070662 STA ADD
3365 06726 014401 JSB GETC IGNORE REST
3366 06727 014277 JSB SORT
3367 06730 026733 JMP GTSCH
3368 06731 026726 JMP *-3 IGNORE MORE NUMBERS
3369 06732 026726 JMP *-4 OR LETTERS
3370 06733 051475 GTSCH CPA B6 (
3371 06734 026750 JMP GTSUB
3372 06735 002400 CLA
3373 06736 071111 STA SUBS
3374 06737 060672 LDA BUFR
3375 06740 064662 LDB ADD
3376 06741 050671 CPA LASTV ALL DONE?
3377 06742 026766 JMP GTNEW GO ADD TO LIST
3378 06743 154000 CPB 0B,I COMPARE NAME
3379 06744 027016 JMP GTFND SAME
3380 06745 002004 INA
3381 06746 140000 ADA 0B,I TRY NEXT
3382 06747 026741 JMP *-6
3383*
3384 06750 060662 GTSUB LDA ADD PRESERVE NAME
3385 06751 014533 JSB PUSHA
3386 06752 014544 JSB PUSHJ GET SUBSCRIPT
3387 06753 004730 DEF EVAL=1
3388 06754 014627 JSB POPA RESTORE NAME
3389 06755 070662 STA ADD
3390 06756 014342 JSB PARTS )
3391 06757 115153 JSB INT,I CONVERT SUBS TO INT
3392 06760 001217 DEF FLAC
3393 06761 100200 MPY B3
3394 06763 002020 SSA TEST -VE SUBSCRIPT
3395 06764 014220 JSB ERROR
3396 06765 026736 JMP GTSCH+3
3397*

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3398	06766	041111	GTNEW	ADA SUBS	TEST SPACE
3399	06767	041473		ADA B3	
3400	06770	003104		CMA,CLE,INA	
3401	06771	040634		ADA PDL	
3402	06772	002041		SEZ,RSS	
3403	06773	014220		JSB ERROR	
3404	06774	060671		LDA LASTV	
3405	06775	174000		STB 0B,I	SET UP NAME
3406	06776	070001		STA 1B	
3407	06777	041111		ADA SUBS	
3408	07000	041472		ADA B2	
3409	07001	070651		STA PT1	SET UP PT1
3410	07002	041473		ADA B3	
3411	07003	070671		STA LASTV	UPDATE LASTV
3412	07004	061111		LDA SUBS	SET UP LENGTH
3413	07005	041474		ADA B4	
3414	07006	006004		INB	
3415	07007	170001		STA 1B,I	
3416	07010	002400		CLA	ZERO NEW VARIABLES
3417	07011	006004		INB	
3418	07012	054671		CPB LASTV	
3419	07013	027031		JMP GTEX	ALL DONE
3420	07014	170001		STA 1B,I	
3421	07015	027011		JMP *-4	
3422*					
3423	07016	002004	GTFND	INA	
3424	07017	070001		STA 1	SAVE PTR TO LENGTH
3425	07020	041111		ADA SUBS	
3426	07021	002004		INA	
3427	07022	070651		STA PT1	SET PT1
3428	07023	061111		LDA SUBS	TEST LENGTH
3429	07024	041474		ADA B4	
3430	07025	003004		CMA,INA	
3431	07026	140001		ADA 1,I	
3432	07027	002020		SSA	
3433	07030	014220		JSB ERROR	OFF END OF ARRAY
3434	07031	041473	GTEX	ADA B3	SET UP LENGTH
3435	07032	003004		CMA,INA	
3436	07033	071110		STA GTL	
3437	07034	024327		JMP POPJ	
3438*					
3439	07035	061134	GTF	LDA CMCOR	SET POINTER TO FCOM BUFFER
3440	07036	070651		STA PT1	
3441	07037	061135		LDA CMCOR+1	
3442	07040	071110		STA GTL	
3443	07041	014401		JSB GETC	SKIP REST OF NAME
3444	07042	014277		JSB SORT	
3445	07043	024327		JMP POPJ	OP/TERM
3446	07044	027041		JMP *-3	
3447	07045	027041		JMP *-4	
3448*					

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3451*      TELETYPE INPUT/OUTPUT ROUTINES
3452 07046 000000 TTOUT NOP          TTY O/P
3453 07047 102100      STF 0          INSURANCE
3454 07050 065124      LDB TTYSW     0=BUSY
3455 07051 006003      SZB,RSS
3456 07052 027064      JMP TTO1
3457 07053 065121      LDB TTOP     MAKE TTY AN OUTPUT DEVICE
3458 07054 106617      OTB TTY
3459 07055 065120      LDB ITTON    SET O/P IR ROUTINE
3460 07056 074034      STB ITTJ
3461 07057 102617      OTA TTY     OUTPUT THE CHARACTER
3462 07060 103717      STC TTY,C   AND START THE TTY
3463 07061 002400      CLA        SET BUSY
3464 07062 071124      STA TTYSW
3465 07063 127046      JMP TTOUT,I
3466*
3467 07064 065114 TTO1 LDB TTBF1  STEP BUFFER POINTER
3468 07065 006004      INB
3469 07066 055116      CPB TTBF1   CIRCULARLY
3470 07067 065113      LDB TTBF0
3471 07070 055115      CPB TTBF0   WAIT TILL ROOM
3472 07071 027070      JMP *-1     FOR ONE MORE
3473 07072 171114      STA TTBF1,I STORE CHARACTER IN BUFFER
3474 07073 075114      STB TTBF1  UPDATE BUFFER POINTER
3475 07074 127046      JMP TTOUT,I
3476*
3477*
3478 07075 000000 ITTO NOP          TTY O/P IR ROUTINE
3479 07076 071112      STA ITTA    SAVE A
3480 07077 061115      LDA TTBF0   ANY OUTPUT?
3481 07100 051114      CPA TTBF1
3482 07101 027114      JMP ITTX    NO MORE
3483 07102 161115      LDA TTBF0,I OUTPUT THE CHARACTER
3484 07103 102617      OTA TTY
3485 07104 103717      STC TTY,C   START THE TTY
3486 07105 061115      LDA TTBF0   STEP BUFFER POINTER
3487 07106 034000      ISZ 0
3488 07107 051116      CPA TTBF1   CIRCULARLY
3489 07110 061113      LDA TTBF0
3490 07111 071115      STA TTBF0
3491 07112 061112      LDA ITTA    RESTORE A
3492 07113 127075      JMP ITTO,I
3493*
3494 07114 035124 ITTX ISZ TTYSW  SET NOT BUSY
3495 07115 107717      CLC TTY,C   TURN OFF HARDWARE
3496 07116 027112      JMP *-4
3497*
3498*
3499*
3500 07117 000000 TTYRI NOP        IR INPUT
3501 07120 107717      CLC TTY,C   CLEAR HARDWARE
3502 07121 035125      ISZ TTYFL   SET SOFTWARE FLAG
3503 07122 127117      JMP TTYRI,I
3504*
3505 07123 000000 TTYR1 NOP        SILENT TTY READ
3506 07124 061122      LDA TTIPS

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3507	07125	017133		JSB TTYRD	
3508	07126	127123		JMP TTYR1,I	
3509*					
3510	07127	000000	TTYR2	NOP	TTY READ WITH ECHO
3511	07130	061123		LDA TTIP	
3512	07131	017133		JSB TTYRD	
3513	07132	127127		JMP TTYR2,I	
3514*					
3515	07133	000000	TTYRD	NOP	TELETYPE INPUT
3516	07134	102100		STF 0	ENABLE INTERRUPT
3517	07135	065124		LDB TTYSW	WAIT FOR OUTPUT
3518	07136	006003		SZB,RSS	
3519	07137	027135		JMP *-2	
3520	07140	102617		OTA TTY	SET UP OPTIONS
3521	07141	061117		LDA ITTIN	SET UP IR JUMP
3522	07142	070034		STA ITTJ	
3523	07143	103717		STC TTY,C	ENABLE TTY
3524	07144	061125		LDA TTYFL	WAIT FOR INPUT
3525	07145	002003		SZA,RSS	
3526	07146	027144		JMP *-2	
3527	07147	002400		CLA	
3528	07150	071125		STA TTYFL	CLEAR INPUT BUFFER
3529	07151	102517		LIA TTY	GET CHARACTER
3530	07152	127133		JMP TTYRD,I	

3532	07153	000000	HSRIN	NOP	HIGH SPEED READER
3533	07154	002400		CLA	SET TIMER
3534	07155	073175		STA HSRCT	
3535	07156	061126	HSRD2	LDA HSRFL	WAIT FOR INPUT
3536	07157	002002		SZA	
3537	07160	027164		JMP HSGO	FOUND SOME
3538	07161	037175		ISZ HSRCT	
3539	07162	027156		JMP HSRD2	TRY AGAIN
3540	07163	014220		JSB ERROR	WAITED TOO LONG
3541*					
3542	07164	006400	HSGO	CLB	CLEAR FLAG
3543	07165	075126		STB HSRFL	
3544	07166	102515		LIA HSR	READ INPUT
3545	07167	103715		STC HSR,C	ASK FOR ANOTHER
3546	07170	127153		JMP HSRIN,I	
3547*					
3548	07171	000000	HSRI	NOP	HSR IR ROUTINE
3549	07172	107715		CLC HSR,C	CLEAR HSR
3550	07173	035126		ISZ HSRFL	SET PROGRAM FLAG
3551	07174	127171		JMP HSRI,I	
3552	07175	000000	HSRCT	NOP	TIMER COUNT

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3554	07176	000000	HPNCH	NOP	HIGH SPEED PUNCH ROUTINE
3555	07177	065127		LDB PNCHF	
3556	07200	008003		SZB,RSS	WAIT FOR 'NOT BUSY'
3557	07201	027177		JMP *-2	
3558	07202	006400		CLB	SET 'BUSY'
3559	07203	075127		STB PNCHF	
3560	07204	102616		OTA PNCH	OUTPUT CHARACTER
3561	07205	103716		STC PNCH,C	
3562	07206	127176		JMP HPNCH,I	
3563*					
3564	07207	000000	HPNI	NOP	H,S. PUNCH INTERRUPT ROUTINE
3565	07210	035127		ISZ PNCHF	CLEAR 'BUSY'
3566	07211	107716		CLC PNCH,C	CLEAR HARDWARE
3567	07212	127207		JMP HPNI,I	

3569	07213	000000	LPIR	NOP	LINEPRINTER IR ROUTINE
3570	07214	035130		ISZ LPBS	
3571	07215	107714		CLC LINEP,C	
3572	07216	127213		JMP LPIR,I	
3573*					
3574	07217	000000	LPOUT	NOP	LINEPRINTER OUTPUT
3575	07220	011556		AND B177	
3576	07221	051467		CPA B12	LF
3577	07222	127217		JMP LPOUT,I	IGNORE LF
3578	07223	051500		CPA B14	FORM=FEED
3579	07224	027240		JMP LPCR+1	
3580	07225	051501		CPA B15	CR
3581	07226	027237		JMP LPCR	
3582	07227	037255		ISZ LPCT	TOO MANY FOR ONE LINE?
3583	07230	027242		JMP LP1	OK
3584	07231	073256		STA LPTEM	TOO MANY; SAVE CHARACTER
3585	07232	061467		LDA B12	
3586	07233	017244		JSB LPOU2	OUTPUT CARRIAGE RETURN
3587	07234	063256		LDA LPTEM	RESTORE CHARACTER
3588	07235	065434		LDB DM80	SET COUNT INCLUDING CH
3589	07236	027241		JMP LP1=1	
3590	07237	061467	LPCR	LDA B12	SET LINEFEED
3591	07240	065435		LDB DM81	RESET CHARACTER COUNT
3592	07241	077255		STB LPCT	
3593	07242	017244	LP1	JSB LPOU2	OUTPUT TO LINEPRINTER
3594	07243	127217		JMP LPOUT,I	
3595*					
3596	07244	000000	LPOU2	NOP	ACTUAL CHARACTER OUTPUT
3597	07245	065130		LDB LPBS	WAIT FOR NOT BUSY
3598	07246	006003		SZB,RSS	
3599	07247	027245		JMP *-2	
3600	07250	102614		OTA LINEP	OUTPUT CHARACTER
3601	07251	002400		CLA	
3602	07252	071130		STA LPBS	SET BUSY
3603	07253	103714		STC LINEP,C	START HARDWARE
3604	07254	127244		JMP LPOU2,I	
3605*					
3606	07255	177657	LPCT	DEC =81	
3607	07256	000000	LPTEM	NOP	

J609* INTERRUPT ROUTINES

J610*

J611	07257	000000	DMAI1	NOP	DMA1 INTERRUPT ROUTINE
J612	07260	035132		ISZ DFLAG	SET DONE FLAG
J613	07261	103106		CLF DMA1	CLEAR DMA1 HARDWARE
J614	07262	127257		JMP DMAI1,I	

J615*

J616	07263	000000	DMAI2	NOP	DMA2 INTERRUPT ROUTINE
J617	07264	107712		CLC MTD,C	CLEAR MT DATA
J618	07265	107707		CLC DMA2,C	CLEAR DMA
J619	07266	127263		JMP DMAI2,I	

J620*

J621	07267	000000	MTCI	NOP	MT CONTROL INTERRUPT
J622	07270	107713		CLC MTC,C	CLEAR CONTROL
J623	07271	107712		CLC MTD,C	ABORT FURTHER DATA
J624	07272	107707		CLC DMA2,C	MAKE SURE DMA DEAD TOO
J625	07273	035133		ISZ BUFLG	SET DONE FLAG
J626	07274	127267		JMP MTCI,I	

J627*

J628	07275	000000	DISI	NOP	DISPLAY; ERASE DONE
J629	07276	106721		CLC DISPL	CLEAR INTERRUPT
J630	07277	035131		ISZ DISFL	SET DONE FLAG
J631	07300	127275		JMP DISI,I	RETURN FROM INTERRUPT


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3634*      TRANSFER ROUTINES
3635*      CALLS ARE
3636*          JSB DFR,I
3637*          DEF DESTINATION
3638*          DEF SOURCE
3639*      AND
3640*          LDA SOURCEPT
3641*          LDB DESTINPT
3642*          JSB XFR,I
3643 07301 000000 .DFER NOP
3644 07302 167301 LDB .DFER,I GET DESTINATION
3645 07303 037301 ISZ .DFER
3646 07304 163301 LDA .DFER,I GET SOURCE
3647 07305 037301 ISZ .DFER STEP TO RETURN
3648 07306 017310 JSB .XFER USE .XFER TO DO THE JOB
3649 07307 127301 JMP .DFER,I
3650*
3651 07310 000000 .XFER NOP
3652 07311 001275 RAL,CLE,SLA,ERA COPE WITH INDIRECT
3653 07312 027331 JMP DF1
3654 07313 071413 STA FT1 SAVE SOURCE POINTER
3655 07314 005275 RBL,CLE,SLB,ERB COPE WITH INDIRECT
3656 07315 027333 JMP DF1+2
3657 07316 161413 LDA FT1,I TRANSFER HI
3658 07317 035413 ISZ FT1
3659 07320 170001 STA 1,I
3660 07321 006004 INB
3661 07322 161413 LDA FT1,I TRANSFER MID
3662 07323 035413 ISZ FT1
3663 07324 170001 STA 1,I
3664 07325 006004 INB
3665 07326 161413 LDA FT1,I TRANSFER LO
3666 07327 170001 STA 1,I
3667 07330 127310 JMP .XFER,I ALL DONE
3668*
3669 07331 160000 DF1 LDA 0,I DO ONE LEVEL OF INDIRECT
3670 07332 027311 JMP .XFER+1
3671 07333 164001 LDB 1,I DO ONE LEVEL OF INDIRECT
3672 07334 027314 JMP .XFER+4

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3674*   'ENTIER' ROUTINE; INTEGER PART
3675*   CALL IS
3676*           JSB ENTIX
3677*           DEF DESTINATION
3678*           DEF SOURCE
3679   07335 000000 ENTIX NOP
3680   07336 163335 LDA ENTIX,I GET DESTINATION
3681   07337 071414 STA FT2 POINTER
3682   07340 037335 ISZ ENTIX STEP TO
3683   07341 163335 LDA ENTIX,I SOURCE POINTER
3684   07342 037335 ISZ ENTIX STEP TO EXIT
3685   07343 065266 LDB F1P SOURCE TO F1
3686   07344 115175 JSB XFR,I
3687   07345 065230 LDB F1+2 GET EXPONENT
3688   07346 115173 JSB FLN,I UNPACK IT
3689   07347 003004 CMA,INA NEGATE IT
3690   07350 002021 SSA,RSS SMALL ?
3691   07351 027411 JMP ENT1 SMALL
3692   07352 041424 ADA B47 NOT SMALL; TRY LARGE
3693   07353 002020 SSA
3694   07354 027405 JMP ENT2 LARGE; DON'T CHANGE
3695   07355 041442 ADA BM10 FIND NO OF BITS TO LOSE
3696   07356 002020 SSA
3697   07357 027400 JMP ENT3 LOSE 0-7
3698   07360 041443 ADA BM20
3699   07361 002020 SSA
3700   07362 027372 JMP ENT4 LOSE 10-27
3701   07363 043421 ADA ENTM1 LOSE 30-46; FIND MASK
3702   07364 160000 LDA 0,I PICK UP MASK WORD
3703   07365 011226 AND F1 MASK HI
3704   07366 071226 STA F1 ANSWER TO HI
3705   07367 002400 CLA
3706   07370 071227 STA F1+1 CLEAR MID
3707   07371 027402 JMP ENT5 GO FIX LO
3708*
3709   07372 043422 ENT4 ADA ENTM2 LOSE 10-27; FIND MASK
3710   07373 160000 LDA 0,I PICK UP MASK WORD
3711   07374 011227 AND F1+1 MASK MID
3712   07375 071227 STA F1+1 ANSWER TO MID
3713   07376 002400 CLA
3714   07377 027402 JMP ENT5 HI IS OK; GO FIX LO
3715*
3716   07400 043422 ENT3 ADA ENTM2 LOSE 0-7; FIND MASK
3717   07401 160000 LDA 0,I PICK UP MASK WORD
3718   07402 031563 ENT5 IOR B377 DON'T TOUCH EXP
3719   07403 011230 AND F1+2 MASK LO
3720   07404 071230 STA F1+2 RESULT TO LO
3721   07405 061266 ENT2 LDA F1P TRANSFER RESULT
3722   07406 065414 LDB FT2 TO DESTINATION
3723   07407 115175 JSB XFR,I
3724   07410 127335 JMP ENTIX,I
3725*
3726   07411 061226 ENT1 LDA F1 SMALL; GET SIGN
3727   07412 006700 CLB,CCE CLEAR B, SET E=1
3728   07413 075230 STB F1+2 CLEAR LO EXP
3729   07414 075227 STB F1+1 CLEAR MID

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3730	07415	002020	SSA	TEST SIGN
3731	07416	005500	ERB	MAKE FLOATING PT -1 IF -VE
3732	07417	075226	STB F1	STORE HI; 0 IF +VE
3733	07420	027405	JMP ENT2	
3734	07421	001437	ENTM1 DEF BM1	MASK TABLE POINTER
3735	07422	001457	ENTM2 DEF BM1+16	

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3737*      SINGLE ARGUMENT ARC TANGENT
3738*      OPERATES ON FLAC
3739 07423 000000  DATAN NOP
3740 07424 061217  LDA FLAC      TEST 0
3741 07425 002003  SZA,RSS
3742 07426 127423  JMP DATAN,I  ALREADY ZERO
3743*
3744 07427 006404  CLB,INB      SET SIGN FLAG
3745 07430 002020  SSA
3746 07431 007400  CCB
3747 07432 075417  STB FT5
3748 07433 006021  SSB,RSS
3749 07434 027437  JMP *+3
3750 07435 115172  JSB DCM,I    MAKE SOURCE +VE
3751 07436 001217  DEF FLAC
3752 07437 065221  LDB FLAC+2  GET EXPONENT
3753 07440 115173  JSB FLN,I
3754 07441 003004  CMA,INA
3755 07442 006404  CLB,INB      SET >1 FLAG
3756 07443 002020  SSA
3757 07444 007400  CCB
3758 07445 075420  STB FT6
3759 07446 006021  SSB,RSS
3760 07447 027454  JMP *+5
3761 07450 115141  JSB FDV,I    >1; SET X=1/X
3762 07451 001217  DEF FLAC
3763 07452 001345  DEF FL1
3764 07453 001217  DEF FLAC
3765 07454 115137  DATNM JSB FSB,I
3766 07455 001241  DEF F4
3767 07456 007613  DEF DATC1
3768 07457 001217  DEF FLAC
3769 07460 065241  LDB F4      TEST MAGNITUDE
3770 07461 063660  LDA DAT2    AND SET OPTIONS
3771 07462 006020  SSB
3772 07463 063657  LDA DAT1
3773 07464 073473  STA *+7
3774 07465 073503  STA DATP1
3775 07466 041473  ADA B3
3776 07467 073577  STA DATP2
3777 07470 115140  JSB FMP,I
3778 07471 001241  DEF F4
3779 07472 001217  DEF FLAC
3780 07473 000000  NOP
3781 07474 115136  DATNP JSB FAD,I
3782 07475 001241  DEF F4
3783 07476 001241  DEF F4
3784 07477 001345  DEF FL1
3785 07500 115137  JSB FSB,I
3786 07501 001217  DEF FLAC
3787 07502 001217  DEF FLAC
3788 07503 000000  DATP1 NOP
3789 07504 115141  JSB FDV,I
3790 07505 001217  DEF FLAC
3791 07506 001217  DEF FLAC
3792 07507 001241  DEF F4

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3793	07510	115140	JSB FMP,I
3794	07511	001241	DEF F4
3795	07512	001217	DEF FLAC
3796	07513	001217	DEF FLAC
3797	07514	115136	JSB FAD,I
3798	07515	001247	DEF F6
3799	07516	001241	DEF F4
3800	07517	007654	DEF DAT13
3801	07520	115140	JSB FMP,I
3802	07521	001252	DEF F7
3803	07522	007640	DEF DATC9
3804	07523	001247	DEF F6
3805	07524	115136	JSB FAD,I
3806	07525	001255	DEF F8
3807	07526	001241	DEF F4
3808	07527	007651	DEF DAT12
3809	07530	115140	JSB FMP,I
3810	07531	001255	DEF F8
3811	07532	001255	DEF F8
3812	07533	001247	DEF F6
3813	07534	115136	JSB FAD,I
3814	07535	001255	DEF F8
3815	07536	001255	DEF F8
3816	07537	007643	DEF DAT10
3817	07540	115140	JSB FMP,I
3818	07541	001247	DEF F6
3819	07542	007635	DEF DATC8
3820	07543	001255	DEF F8
3821	07544	115136	JSB FAD,I
3822	07545	001241	DEF F4
3823	07546	001241	DEF F4
3824	07547	007646	DEF DAT11
3825	07550	115140	JSB FMP,I
3826	07551	001241	DEF F4
3827	07552	001241	DEF F4
3828	07553	001255	DEF F8
3829	07554	115136	JSB FAD,I
3830	07555	001241	DEF F4
3831	07556	001241	DEF F4
3832	07557	001252	DEF F7
3833	07560	115141	JSB FDV,I
3834	07561	001241	DEF F4
3835	07562	001247	DEF F6
3836	07563	001241	DEF F4
3837	07564	115136	JSB FAD,I
3838	07565	001241	DEF F4
3839	07566	001241	DEF F4
3840	07567	007632	DEF DATC7
3841	07570	115140	JSB FMP,I
3842	07571	001241	DEF F4
3843	07572	001241	DEF F4
3844	07573	001217	DEF FLAC
3845	07574	115136	JSB FAD,I
3846	07575	001217	DEF FLAC
3847	07576	001241	DEF F4
3848	07577	000000	DATP2 NOP

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3849	07600	035420		ISZ FT6	TEST MAGNITUDE
3850	07601	027606		JMP **5	
3851	07602	115137		JSB FSB,I	
3852	07603	001217		DEF FLAC	
3853	07604	001364		DEF FLPI2	
3854	07605	001217		DEF FLAC	
3855	07606	035417		ISZ FT5	TEST SIGN
3856	07607	127423		JMP DATAN,I	
3857	07610	115172		JSB DCM,I	
3858	07611	001217		DEF FLAC	
3859	07612	127423		JMP DATAN,I	
3860*					
3861	07613	065011	DATC1	OCT	65011,163147,172377
3862	07616	052006	DATC3	OCT	52006,160252,160000
3863	07621	045545		OCT	45545,170774,146400
3864	07624	062727	DATC5	OCT	62727,153601,52775
3865	07627	062207		OCT	62207,166521,10775
3866	07632	065377	DATC7	OCT	65377,57600,170775
3867	07635	057417	DATC8	OCT	57417,40551,17004
3868	07640	112312	DATC9	OCT	112312,135516,167004
3869	07643	137030	DAT10	OCT	137030,44035,144775
3870	07646	050645	DAT11	OCT	50645,157155,170406
3871	07651	051261	DAT12	OCT	51261,113644,177004
3872	07654	052005	DAT13	OCT	52005,53376,37402
3873	07657	007616	DAT1	DEF	DATC3
3874	07660	007624	DAT2	DEF	DATC5

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3876*      TWO ARGUMENT ARC TANGENT
3877*      SOURCE1 (SIN) IN FLARG
3878*      SOURCE2 (COS) AND DESTINATION FLAG
3879 07661 000000 DATN2 NOP
3880 07662 061223 LDA FLARG SIGN OF X1
3881 07663 067474 LDB DATNP JSB FAD,I
3882 07664 002020 SSA
3883 07665 067454 LDB DATNM JSB FSB,I
3884 07666 061217 LDA FLAC SIGN OF X2
3885 07667 002002 SZA X2=0 ?
3886 07670 027677 JMP **7
3887 07671 077672 STB **1 SET + OR -
3888 07672 000000 NOP
3889 07673 001217 DEF FLAC
3890 07674 001356 DEF FL0
3891 07675 001364 DEF FLPI2
3892 07676 127661 JMP DATN2,I
3893*
3894 07677 002021 SSA,RSS
3895 07700 067676 LDB **2 'RETURN' IF X2 +VE
3896 07701 077707 STB DATNI SET INSTRUCTION
3897 07702 115141 JSB FDV,I X=X1/X2
3898 07703 001217 DEF FLAC
3899 07704 001223 DEF FLARG
3900 07705 001217 DEF FLAC
3901 07706 115171 JSB ATN,I GET A; -PI/2<A<PI/2
3902 07707 000000 DATNI NOP INST SET UP ABOVE
3903 07710 001217 DEF FLAC
3904 07711 001217 DEF FLAC
3905 07712 001367 DEF FLPI
3906 07713 127661 JMP DATN2,I
3907*
3908*
3909*      COMMAND INPUT BUFFER
3910 07714 000000 COMIN BSS 109
3911 10071 COME EQU *

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3913*      ADD/SUBTRACT ROUTINES
3914*      CALLS ARE
3915*          JSB ,XADD/,XSUB
3916*          DEF DESTINATION
3917*          DEF SOURCE 1
3918*          DEF SOURCE 2
3919 10071 000000 ,XSUB NOP
3920 10072 062071 LDA ,XSUB      TRANSFER RETURN
3921 10073 072076 STA ,XADD      TO ADD ROUTINE
3922 10074 003400 CCA          SET SUBTRACT FLAG
3923 10075 026100 JMP ,XADD+2
3924*
3925 10076 000000 ,XADD NOP
3926 10077 002400 CLA          SET 'ADD' FLAG
3927 10100 071415 STA FT3
3928 10101 115177 JSB PAD,I    GET DESTINATION
3929 10102 110076 DEF ,XADD,I
3930 10103 036076 ISZ ,XADD
3931 10104 072071 STA ,XSUB    SAVE DESTINATION
3932 10105 115177 JSB PAD,I    GET SOURCE 1
3933 10106 110076 DEF ,XADD,I
3934 10107 036076 ISZ ,XADD
3935 10110 065266 LDB F1P     TRANSFER TO F1
3936 10111 115175 JSB XFR,I
3937 10112 115177 JSB PAD,I    GET SOURCE 2
3938 10113 110076 DEF ,XADD,I
3939 10114 036076 ISZ ,XADD
3940 10115 065267 LDB F2P     TRANSFER TO F2
3941 10116 115175 JSB XFR,I
3942 10117 061226 LDA F1       GET SIGN OF SOURCE 1
3943 10120 065230 LDB F1+2    AND EXPONENT
3944 10121 002003 SZA,RSS     TEST FOR ZERO
3945 10122 006404 CLB,INB     =0? SET MOST -VE EXP
3946 10123 115173 JSB FLN,I    UNPACK
3947 10124 071231 STA F1+3     EXP
3948 10125 075230 STB F1+2     LD
3949 10126 061232 LDA F2       REPEAT FOR SOURCE 2
3950 10127 065234 LDB F2+2
3951 10130 002003 SZA,RSS
3952 10131 006404 CLB,INB
3953 10132 115173 JSB FLN,I
3954 10133 071235 STA F2+3
3955 10134 075234 STB F2+2
3956*
3957 10135 035415 ISZ FT3     WAS IT 'SUBTRACT' ?
3958 10136 026143 JMP *+5
3959 10137 017131 JSB ,XCOM   COMPLEMENT FOR SUBTRACTION
3960 10140 001232 DEF F2
3961 10141 041235 ADA F2+3    UPDATE EXPONENT
3962 10142 071235 STA F2+3
3963*
3964 10143 061235 LDA F2+3    START ADD ROUTINE
3965 10144 003004 XADS1 CMA,INA
3966 10145 041231 ADA F1+3    DIFF BETWEEN EXPS
3967 10146 002021 SSA,RSS
3968 10147 026171 JMP XADS2    OK

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3969	10150	061226		LDA F1	SWAP; F2 WAS BIGGER
3970	10151	065232		LDB F2	
3971	10152	071232		STA F2	
3972	10153	075226		STB F1	
3973	10154	061227		LDA F1+1	
3974	10155	065233		LDB F2+1	
3975	10156	071233		STA F2+1	
3976	10157	075227		STB F1+1	
3977	10160	061230		LDA F1+2	
3978	10161	065234		LDB F2+2	
3979	10162	071234		STA F2+2	
3980	10163	075230		STB F1+2	
3981	10164	061231		LDA F1+3	
3982	10165	065235		LDB F2+3	
3983	10166	075231		STB F1+3	SET REQUIRED EXPONENT
3984	10167	003004		CMA,INA	
3985	10170	040001		ADA 1	DIFF BETWEEN EXPS
3986	10171	016242	XADS2	JSB SHFTR	SHIFT F2 RIGHT
3987	10172	061234		LDA F2+2	ACTUAL ADD ROUTINE
3988	10173	065233		LDB F2+1	START WITH LO MID
3989	10174	000040		CLE	CLEAR 'CARRY' BIT
3990	10175	041230		ADA F1+2	ADD LO
3991	10176	002040		SEZ	
3992	10177	006104		CLE,INB	CARRY TO MID
3993	10200	071230		STA F1+2	STORE LO
3994	10201	061232		LDA F2	PROCEED WITH MID HI
3995	10202	045227		AUB F1+1	ADD MID
3996	10203	103101		CLO	
3997	10204	002040		SEZ	
3998	10205	002104		CLE,INA	CARRY TO HI
3999	10206	102201		SOC	O'FLOW ON CARRY ?
4000	10207	026235		JMP XADS3	GO COPE WITH O'FLOW
4001	10210	041226		ADA F1	ADD HI
4002	10211	102301		SOS	O'FLOW ON ADD ?
4003	10212	026224		JMP XADS4	NO O'FLOWS
4004	10213	001500	XADS5	ERA	O'FLOW; SHIFT 1 RIGHT
4005	10214	005500		ERB	3-WORD
4006	10215	071226		STA F1	HI DONE
4007	10216	061230		LDA F1+2	NOW DO LO
4008	10217	001500		ERA	MID IS STILL IN B
4009	10220	071230		STA F1+2	
4010	10221	035231		ISZ F1+3	COMPENSATE EXPONENT
4011	10222	000000		NOP	CAN SKIP
4012	10223	002001		RSS	
4013	10224	071226	XADS4	STA F1	STORE HI
4014	10225	075227		STB F1+1	STORE MID
4015	10226	061231		LDA F1+3	GET EXPONENT
4016	10227	017170		JSB ,XPAK	NORMALISE
4017	10230	001226		DEF F1	
4018	10231	061266		LDA F1P	TRANSFER TO DESTINATION
4019	10232	066071		LDB ,XSUB	
4020	10233	115175		JSB XFR,I	
4021	10234	126076		JMP ,XADD,I	
4022*					
4023	10235	103101	XADS3	CLO	CARRY O'FLOW
4024	10236	041226		ADA F1	ADD HI

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4025	10237	102301	SOS	SECOND O'FLOW ?
4026	10240	026213	JMP XADS5	NO; GO FIX 1ST O'FLOW
4027	10241	026224	JMP XADS4	YES; CANCELS 1ST O'FLOW

4029	10242	000000	SHFTR	NOP	SHIFT UNPACKED 3=WD MANTISSA
4030	10243	002003		SZA,RSS	IN F2 RIGHT N PLACES
4031	10244	126242		JMP SHFTR,I	
4032	10245	041423		ADA B20	TOO MANY ?
4033	10246	002021		SSA,RSS	
4034	10247	026322		JMP SHFT0	FILL WITH ZEROS
4035	10250	041503		ADA B20	1-57
4036	10251	002020		SSA	
4037	10252	026266		JMP SHFT2	1-37
4038	10253	002003		SZA,RSS	
4039	10254	026273		JMP SHFT1	40 IS SPECIAL CASE
4040	10255	042325		ADA SHFIN	41-57; MAKE ASR
4041	10256	072260		STA **2	
4042	10257	065232		LDB F2	HI
4043	10260	000000		NOP	SHIFT
4044	10261	075234		STB F2+2	TO LO
4045	10262	101020		ASR 16	PROPAGATE SIGN
4046	10263	075233		STB F2+1	
4047	10264	075232		STB F2	
4048	10265	126242		JMP SHFTR,I	
4049*					
4050	10266	041503	SHFT2	ADA B20	1-37
4051	10267	002020		SSA	
4052	10270	026304		JMP SHFT3	1-17
4053	10271	002003		SZA,RSS	
4054	10272	026305		JMP SHFT3+1	20 IS SPECIAL CASE
4055	10273	042325	SHFT1	ADA SHFIN	21-40;MAKE ASR
4056	10274	072277		STA **3	
4057	10275	065232		LDB F2	HI
4058	10276	061233		LDA F2+1	MID
4059	10277	000000		NOP	SHIFT
4060	10300	075233		STB F2+1	TO MID
4061	10301	071234		STA F2+2	AND LO
4062	10302	101020		ASR 16	PROPAGATE SIGN
4063	10303	026264		JMP SHFT2=2	
4064*					
4065	10304	041503	SHFT3	ADA B20	1-17
4066	10305	042325		ADA SHFIN	AND 20
4067	10306	072312		STA **4	
4068	10307	072316		STA **7	
4069	10310	065233		LDB F2+1	MID
4070	10311	061234		LDA F2+2	LO
4071	10312	000000		NOP	SHIFT
4072	10313	071234		STA F2+2	TO LO
4073	10314	065232		LDB F2	HI
4074	10315	061233		LDA F2+1	MID
4075	10316	000000		NOP	SHIFT
4076	10317	075232		STB F2	TO HI
4077	10320	071233		STA F2+1	AND MID
4078	10321	126242		JMP SHFTR,I	
4079*					
4080	10322	006400	SHFT0	CLB	
4081	10323	075234		STB F2+2	
4082	10324	026263		JMP SHFT2=3	
4083*					
4084	10325	101020	SHFIN	ASR 16	

4086*	MULTIPLY	ROUTINE		
4087	10326	000000	.XMPY	NOP
4088	10327	115177	JSB	PAD,I GET DESTINATION
4089	10330	110326	DEF	.XMPY,I
4090	10331	036326	ISZ	.XMPY
4091	10332	072071	STA	.XSUB SAVE DESTINATION
4092	10333	115177	JSB	PAD,I GET SOURCE 1
4093	10334	110326	DEF	.XMPY,I
4094	10335	036326	ISZ	.XMPY
4095	10336	065266	LDB	F1P TO F1
4096	10337	115175	JSB	XFR,I
4097	10340	115177	JSB	PAD,I GET SOURCE 2
4098	10341	110326	DEF	.XMPY,I
4099	10342	036326	ISZ	.XMPY
4100	10343	065267	LDB	F2P TO F2
4101	10344	115175	JSB	XFR,I
4102	10345	065230	LDB	F1+2 SPLIT EXPONENTS
4103	10346	115173	JSB	FLN,I
4104	10347	071231	STA	F1+3
4105	10350	075230	STB	F1+2
4106	10351	065234	LDB	F2+2
4107	10352	115173	JSB	FLN,I
4108	10353	071235	STA	F2+3
4109	10354	075234	STB	F2+2
4110	10355	002400	CLA	INITIALISE SIGN
4111	10356	071415	STA	FT3
4112	10357	061226	LDA	F1 TEST SIGN 1
4113	10360	002003	SZA	RSS ZERO ?
4114	10361	026506	JMP	XMPY0 YES; RESULT IS ZERO
4115	10362	002021	SSA	RSS =VE ?
4116	10363	026371	JMP	*+6 NO
4117	10364	017131	JSB	.XCOM YES; TAKE MODULUS
4118	10365	001226	DEF	F1
4119	10366	041231	ADA	F1+3 UPDATE EXPONENT
4120	10367	071231	STA	F1+3
4121	10370	035415	ISZ	FT3 REVERSE SIGN INDICATOR
4122	10371	061232	LDA	F2 TEST SIGN 2
4123	10372	002003	SZA	RSS ZERO ?
4124	10373	026510	JMP	XMPY0+2 YES; RESULT IS ZERO
4125	10374	002021	SSA	RSS =VE ?
4126	10375	026403	JMP	*+6 NO
4127	10376	017131	JSB	.XCOM YES; TAKE MODULUS
4128	10377	001232	DEF	F2
4129	10400	041235	ADA	F2+3 COMPENSATE EXPONENT
4130	10401	071235	STA	F2+3
4131	10402	035415	ISZ	FT3 REVERSE SIGN INDICATOR
4132*	MULTIPLY	ROUTINE	PROPER	
4133	10403	061230	LDA	F1+2 L01*HI2
4134	10404	065232	LDB	F2
4135	10405	016512	JSB	UMUL
4136	10406	075240	STB	F3+2 LOSE LESS SIG END
4137	10407	061227	LDA	F1+1 MID1*MID2
4138	10410	065233	LDB	F2+1
4139	10411	016512	JSB	UMUL
4140	10412	006104	CLE	INB BIAS TO COMPENSATE TRUNCATION
4141	10413	045240	ADB	F3+2 ADD TERMS

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4142	10414	075240	STB F3+2	
4143	10415	002400	CLA	
4144	10416	001600	ELA CARRY	
4145	10417	071237	STA F3+1	
4146	10420	061226	LDA F1	HI1*LO2
4147	10421	065234	LDB F2+2	
4148	10422	016512	JSB UMUL	
4149	10423	045240	ADB F3+2	ADD TERMS
4150	10424	075240	STB F3+2	
4151	10425	002140	SEZ,CLE	
4152	10426	035237	ISZ F3+1	CARRY
4153*				
4154	10427	061227	LDA F1+1	MID1*HI2
4155	10430	065232	LDB F2	
4156	10431	016512	JSB UMUL	
4157	10432	041240	ADA F3+2	ADD LS TO LO
4158	10433	071240	STA F3+2	
4159	10434	002140	SEZ,CLE	
4160	10435	006004	INB	CARRY TO MS
4161	10436	045237	ADB F3+1	ADD MS TO MID
4162	10437	075237	STB F3+1	
4163	10440	002400	CLA	LAST ADD COULD O'FLOW ONCE
4164	10441	001600	ELA	CARRY TO HI
4165	10442	071236	STA F3	
4166	10443	061226	LDA F1	HI1*MID2
4167	10444	065233	LDB F2+1	
4168	10445	016512	JSB UMUL	
4169	10446	041240	ADA F3+2	ADD LS TO LO
4170	10447	071240	STA F3+2	
4171	10450	002140	SEZ,CLE	CARRY TO MID
4172	10451	006004	INB	
4173	10452	045237	ADB F3+1	
4174	10453	075237	STB F3+1	
4175	10454	002140	SEZ,CLE	CARRY TO HI
4176	10455	035236	ISZ F3	DOESN'T SKIP
4177*				
4178	10456	061226	LDA F1	HI1*HI2
4179	10457	100200	MPY F2	BOTH ARE +VE
4180	10461	041237	ADA F3+1	ADD LS TO MID
4181	10462	071237	STA F3+1	
4182	10463	002140	SEZ,CLE	CARRY TO HI
4183	10464	006004	INB	
4184	10465	045236	ADB F3	
4185	10466	075236	STB F3	DOESN'T O'FLOW
4186*				
4187	10467	061415	LDA FT3	GET SIGN INDICATOR
4188	10470	001500	ERA	IN E
4189	10471	002541	CLA,SEZ,CLE,RSS	
4190	10472	026475	JMP *+3	+VE
4191	10473	017131	JSB ,XCOM	-VE
4192	10474	001236	DEF F3	
4193	10475	002004	INA	MAKE EXP
4194	10476	041231	ADA F1+3	
4195	10477	041235	ADA F2+3	
4196	10500	017170	JSB ,XPAK	
4197	10501	001236	DEF F3	

F3P

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4198	10502	062501		LDA F3P	
4199	10503	066071		LDB ,XSUB	
4200	10504	115175		JSB XFR,I	TRANSFER TO DEETINATION
4201	10505	126326		JMP ,XMPY,I	
4202*					
4203	10506	061266	XMPY0	LDA F1P	ANS = 0
4204	10507	026503		JMP *-4	
4205	10510	061267		LDA F2P	
4206	10511	026503		JMP *-6	
4207*					
4208*					
4209*					
					UNSIGNED MULTIPLY LIKE WHAT WOULD HAVE BEEN
					MORE USEFULLY PROVIDED AS HARDWARE
4210	10512	000000	UMUL	NOP	
4211	10513	072532		STA MULA	SAVE SARG1
4212	10514	076533		STB MULB	SAVE ARG2
4213	10515	100200		MPY MULB	SIGNED MULTIPLY
4214	10517	072534		STA MULAA	SAVE LS
4215	10520	062532		LDA MULA	TEST SIGN OF ARG1
4216	10521	002020		SSA	
4217	10522	046533		ADB MULB	ADJUST FOR ARG1 -VE
4218	10523	062533		LDA MULB	TEST SIGN OF ARG2
4219	10524	002020		SSA	
4220	10525	046532		ADB MULA	ADJUST FOR ARG2 -VE
4221	10526	062534		LDA MULAA	RESTORE LS
4222	10527	103101		CLO	
4223	10530	000040		CLE	
4224	10531	126512		JMP UMUL,I	
4225*					
4226	10532	000000	MULA	NOP	
4227	10533	000000	MULB	NOP	
4228	10534	000000	MULAA	NOP	

4230	10535	000000	SHFTL	NOP	SHIFT UNPACKED 3=WD MANTISSA
4231	10536	002003		SZA,RSS	IN F1 LEFT N PLACES
4232	10537	126535		JMP SHFTL,I	N=0
4233	10540	041423		ADA BM60	TOO MANY ?
4234	10541	002021		SSA,RSS	
4235	10542	026613		JMP SHF10	ALL BITS GONE; SET 0
4236	10543	041503		ADA B20	1=57
4237	10544	002020		SSA	
4238	10545	026560		JMP SHF11	1=37
4239	10546	002002		SZA	40 IS SPECIAL CASE
4240	10547	042616		ADA SHFI1	41=57; MAKE ASL
4241	10550	072553		STA **3	
4242	10551	065230		LDB F1+2	LO
4243	10552	002400		CLA	
4244	10553	000000		NOP	SHIFT
4245	10554	075226		STB F1	TO HI
4246	10555	071227		STA F1+1	
4247	10556	071230		STA F1+2	
4248	10557	126535		JMP SHFTL,I	
4249*					
4250	10560	041503	SHF11	ADA B20	1=37
4251	10561	002020		SSA	
4252	10562	026575		JMP SHF12	1=17
4253	10563	002002		SZA	20 IS SPECIAL CASE
4254	10564	042616		ADA SHFI1	21=37; MAKE ASL
4255	10565	072570		STA **3	
4256	10566	065227		LDB F1+1	MID
4257	10567	061230		LDA F1+2	LO
4258	10570	000000		NOP	SHIFT
4259	10571	075226		STB F1	TO HI
4260	10572	071227		STA F1+1	AND MID
4261	10573	002400		CLA	
4262	10574	026556		JMP SHF11=2	
4263*					
4264	10575	042617	SHF12	ADA SHFI2	1=17; MAKE ASL
4265	10576	072610		STA **10	
4266	10577	041503		ADA B20	AND LSL
4267	10600	072603		STA **3	
4268	10601	065227		LDB F1+1	MID
4269	10602	061230		LDA F1+2	AND LO
4270	10603	000000		NOP	LOGICAL SHIFT
4271	10604	071230		STA F1+2	TO LO
4272	10605	061227		LDA F1+1	
4273	10606	075227		STB F1+1	AND MID
4274	10607	065226		LDB F1	HI
4275	10610	000000		NOP	ARITHMETIC SHIFT
4276	10611	075226		STB F1	TO HI
4277	10612	126535		JMP SHFTL,I	
4278*					
4279	10613	002400	SHF10	CLA	
4280	10614	071226		STA F1	
4281	10615	026555		JMP SHF11=3	
4282*					
4283	10616	100020	SHFI1	ASL 16	
4284	10617	100040	SHFI2	OCT 100040	=ASL+20

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4286*      DIVIDE ROUTINE
4287 10620 000000      ,XDIV NOP
4288 10621 115177      JSB PAD,I      GET DESTINATION
4289 10622 110620      DEF ,XDIV,I
4290 10623 036620      ISZ ,XDIV
4291 10624 072071      STA ,XSUB      SAVE DESTINATION
4292 10625 115177      JSB PAD,I      GET NUMERATOR
4293 10626 110620      DEF ,XDIV,I
4294 10627 036620      ISZ ,XDIV
4295 10630 065266      LDB F1P      TO F1
4296 10631 115175      JSB XFR,I
4297 10632 115177      JSB PAD,I      GET DENOMINATOR
4298 10633 110620      DEF ,XDIV,I
4299 10634 036620      ISZ ,XDIV
4300 10635 065267      LDB F2P      TO F2
4301 10636 115175      JSB XFR,I
4302 10637 061232      LDA F2      ZERO?
4303 10640 002003      SZA,RSS
4304 10641 026764      JMP XDIV0      YES
4305 10642 065230      LDB F1+2      SPLIT EXPONENTS
4306 10643 115173      JSB FLN,I
4307 10644 071231      STA F1+3
4308 10645 075230      STB F1+2
4309 10646 065234      LDB F2+2
4310 10647 115173      JSB FLN,I
4311 10650 071235      STA F2+3
4312 10651 075234      STB F2+2
4313 10652 002400      CLA      INITIALISE SIGN INDICATOR
4314 10653 071415      STA FT3
4315 10654 071240      STA F3+2      AND ANSWER
4316 10655 061226      LDA F1      MAKE NUMERATOR +VE
4317 10656 002021      SSA,RSS
4318 10657 026665      JMP **6
4319 10660 017131      JSB ,XCOM
4320 10661 001226      DEF F1
4321 10662 041231      ADA F1+3
4322 10663 071231      STA F1+3
4323 10664 035415      ISZ FT3
4324 10665 061232      LDA F2      MAKE DENOMINATOR -VE
4325 10666 002020      SSA
4326 10667 026675      JMP **6
4327 10670 017131      JSB ,XCOM
4328 10671 001232      DEF F2
4329 10672 041235      ADA F2+3
4330 10673 071235      STA F2+3
4331 10674 035415      ISZ FT3
4332*
4333 10675 061422      LDA BM57      SET UP COUNT OF SHIFTS
4334 10676 071416      STA FT4
4335 10677 000040      XDIV1 CLE      DIVIDE LOOP
4336 10700 061230      LDA F1+2      SUBTRACT DENOM FROM NUM
4337 10701 065227      LDB F1+1      RESULT TO F4
4338 10702 041234      ADA F2+2
4339 10703 071243      STA F4+2
4340 10704 061226      LDA F1
4341 10705 002140      SEZ,CLE

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4342	10706	006004	INB	
4343	10707	045233	ADB F2+1	
4344	10710	075242	STB F4+1	
4345	10711	002140	SEZ,CLE	
4346	10712	002004	INA	
4347	10713	041232	ADA F2	
4348	10714	071241	STA F4	SIGN IN E
4349	10715	061240	LDA F3+2	SHIFT E INTO ANSWER
4350	10716	065237	LDB F3+1	
4351	10717	001600	ELA	
4352	10720	005600	ELB	
4353	10721	071240	STA F3+2	
4354	10722	075237	STB F3+1	
4355	10723	061236	LDA F3	
4356	10724	001600	ELA	
4357	10725	071236	STA F3	
4358	10726	061240	LDA F3+2	SIGN IS NOW LS BIT
4359	10727	000050	CLE,SLA	
4360	10730	026772	JMP XDIVT	TRANSFER F4 TO NUM
4361	10731	061230	XDIV2 LDA F1+2	SHIFT NUMERATOR LEFT
4362	10732	065227	LDB F1+1	
4363	10733	001600	ELA	
4364	10734	005600	ELB	
4365	10735	071230	STA F1+2	
4366	10736	075227	STB F1+1	
4367	10737	061226	LDA F1	
4368	10740	001600	ELA	
4369	10741	071226	STA F1	
4370	10742	035416	ISZ FT4	COUNT
4371	10743	026677	JMP XDIV1	
4372*				
4373	10744	061415	LDA FT3	CORRECT SIGN
4374	10745	001800	ERA	
4375	10746	002440	CLA,SEZ	
4376	10747	026752	JMP *+3	
4377	10750	017131	JSB ,XCOM	
4378	10751	001236	DEF F3	
4379	10752	003000	CMA	MAKE EXPONENT
4380	10753	041236	ADA F2+3	
4381	10754	003004	CMA,INA	
4382	10755	041231	ADA F1+3	
4383	10756	017170	JSB ,XPAK	
4384	10757	001236	DEF F3	
4385	10760	062501	LDA F3P	
4386	10761	066071	XDIVX LDB ,XSUB	
4387	10762	115175	JSB XFR,I	TRANSFER TO DESTINATION
4388	10763	126620	JMP ,XDIV,I	
4389*				
4390	10764	065226	XDIV0 LDB F1	DIV BY 0; SET LARGEST
4391	10765	061407	LDA FMINP	
4392	10766	006021	SSB,RSS	+ OR = FP NO
4393	10767	061403	LDA FMAXP	
4394	10770	102101	STO	
4395	10771	026761	JMP XDIVX	
4396*				
4397	10772	061243	XDIVT LDA F4+2	

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4398	10773	071230	STA F1+2
4399	10774	061242	LDA F4+1
4400	10775	071227	STA F1+1
4401	10776	061241	LDA F4
4402	10777	071226	STA F1
4403	11000	026731	JMP XDIV2

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4405	11001	000000	.DINT	NOP	CONVERT FP TO INTEGER IN A
4406	11002	163001		LDA .DINT,I	GET SOURCE
4407	11003	065266		LDB F1P	TO F1
4408	11004	115175		JSB XFR,I	
4409	11005	065230		LDB F1+2	GET EXPONENT
4410	11006	115173		JSB FLN,I	UNPACK IT
4411	11007	037001		ISZ .DINT	STEP TO RETURN
4412	11010	002020		SSA	TEST SIZE
4413	11011	027031		JMP DINT1	SMALL
4414	11012	003004		CMA,INA	
4415	11013	041502		ADA 017	
4416	11014	002020		SSA	
4417	11015	027034		JMP DINT2	LARGE
4418	11016	002002		SZA	
4419	11017	043042		ADA DINTI	MAKE ASR INSTRUCTION
4420	11020	073023		STA *+3	
4421	11021	061227		LDA F1+1	MID (IN CASE EXP=17)
4422	11022	065226		LDB F1	HI
4423	11023	000000		NOP	BECOMES ASR SHIFT
4424	11024	103101		CLO	(IN CASE EXP=17)
4425	11025	002020		SSA	
4426	11026	006004		INB	ROUND; CAN SET O'FLOW
4427	11027	060001		LDA 1	FIX FOR INCOMPETENCE
4428	11030	127001		JMP .DINT,I	
4429*					
4430	11031	002400	DINT1	CLA	SMALL; SET ZERO
4431	11032	103101		CLO	
4432	11033	127001		JMP .DINT,I	
4433*					
4434	11034	061567	DINT2	LDA BMAX	LARGE; SET FULL SCALE
4435	11035	065226		LDB F1	GET SIGN
4436	11036	006020		SSB	
4437	11037	003000		CMA	=VE; SET FULL SCALE =VE
4438	11040	102101		STO	SET O'FLOW FLAG
4439	11041	127001		JMP .DINT,I	
4440*					
4441	11042	101020	DINTI	ASR 16	

4443	11043	000000	.IDBL	NOP	CONVERT INTEGER IN A TO FP
4444	11044	067043		LDB ,IDBL	
4445	11045	164001		LDB 1,I	
4446	11046	005275		RBL,CLE,SLB,ERB	COPE WITH INDIRECTS
4447	11047	027045		JMP *-2	
4448	11050	075413		STB FT1	PTR TO HI OF DESTINATION
4449	11051	045472		ADB B2	
4450	11052	075414		STB FT2	PTR TO EXP
4451	11053	002003		SZA,RSS	ZERO ?
4452	11054	027103		JMP IDB0	
4453	11055	067105		LDB IDBIN	SET SEZ,INB
4454	11056	002021		SSA,RSS	
4455	11057	006004		INB	OR SEZ,INB,RSS IF A +VE
4456	11060	077063		STB *-3	
4457	11061	067106		LDB BM22	INITIALISE EXPONENT
4458	11062	000066		CLE,ELA	
4459	11063	006045	IDBI	SEZ,INB,RSS	
4460	11064	027062		JMP *-2	
4461	11065	001500		ERA	UNDO XS SHIFT
4462	11066	007000		CMB	MAKE EXPONENT
4463	11067	005040		BLS,CLE	
4464	11070	175414		STB FT2,I	STORE EXPONENT
4465	11071	067063		LDB IDBI	GET SIGN
4466	11072	006011		SLB,RSS	
4467	11073	002200		CME	
4468	11074	001500		ERA	UNDO 2ND XS SHIFT
4469	11075	171413	IDBI	STA FT1,I	STORE HI
4470	11076	035413		ISZ FT1	
4471	11077	002400		CLA	MID=0
4472	11100	171413		STA FT1,I	
4473	11101	037043		ISZ ,IDBL	
4474	11102	127043		JMP ,IDBL,I	
4475*					
4476	11103	171414	IDB0	STA FT2,I	
4477	11104	027075		JMP IDB1	
4478*					
4479	11105	006044	IDBIN	SEZ,INB	
4480	11106	177756	BM22	OCT =22	

4482	11107	000000	.,DCM	NOP	DOUBLE PRECISION NEGATE
4483	11110	163107		LDA	.,DCM,I
4484	11111	065266		LDB	F1P
4485	11112	115175		JSB	XFR,I
4486	11113	065230		LDB	F1+2
4487	11114	115173		JSB	FLN,I
4488	11115	071231		STA	F1+3
4489	11116	075230		STB	F1+2
4490	11117	017131		JSB	,XCOM
4491	11120	001226		DEF	F1
4492	11121	041231		ADA	F1+3
4493	11122	017170		JSB	,XPAK
4494	11123	001226		DEF	F1
4495	11124	061266		LDA	F1P
4496	11125	167107		LDB	.,DCM,I
4497	11126	115175		JSB	XFR,I
4498	11127	037107		ISZ	.,DCM
4499	11130	127107		JMP	.,DCM,I

4501	11131	000000	,XCOM NOP	NEGATE UNPACKED 3-WORD NUMBER
4502	11132	063131	LDA ,XCOM	
4503	11133	037131	ISZ ,XCOM	
4504	11134	160000	LDA 0,I	
4505	11135	001275	RAL,CLE,SLA,ERA	FIX INDIRECTS
4506	11136	027134	JMP *-2	
4507	11137	041472	ADA B2	POINT TO LO
4508	11140	164000	LDB 0,I	GET LO
4509	11141	007104	CMB,CLE,INB	NEGATE
4510	11142	174000	STB 0,I	
4511	11143	003004	CMA,INA	STEP PTR BACK
4512	11144	003000	CMA	WITHOUT SETTING E
4513	11145	164000	LDB 0,I	GET MID
4514	11146	007140	CMB,SEZ,CLE	
4515	11147	006004	INB	
4516	11150	174000	STB 0,I	STORE MID
4517	11151	003004	CMA,INA	
4518	11152	003000	CMA	
4519	11153	164000	LDB 0,I	GET HI
4520	11154	075413	STB FT1	SAVE IT
4521	11155	007140	CMB,SEZ,CLE	
4522	11156	006004	INB	
4523	11157	055413	CPB FT1	UNCHANGED ?
4524	11160	027165	JMP **5	YES
4525	11161	174000	STB 0,I	NO? OK
4526	11162	002400	CLA	
4527	11163	001600	ELA	MAKE EXPONENT CORRECTION
4528	11164	127131	JMP ,XCOM,I	
4529*				
4530	11165	005300	RBR	FIX SPECIAL CASES
4531	11166	002200	CME	
4532	11167	027161	JMP **6	

4534	11170	000000	.XPAK	NOP	NORMALISE
4535	11171	071414		STA FT2	SAVE EXPONENT
4536	11172	103170		LDA .XPAK,I	
4537	11173	065266		LDB F1P	
4538	11174	115175		JSB XFR,I	SOURCE TO F1
4539	11175	065226		LDB F1	TEST SIGN
4540	11176	002400		CLA	0 FOR +VE
4541	11177	006020		SSB	OR
4542	11200	003400		CCA	=1 FOR -VE
4543	11201	071413		STA FT1	SET 'NULL'
4544	11202	043325		ADA XPAKI	SEZ,INA,RSS FOR +VE
4545	11203	073210		STA XPAK2+1	OR SEZ,INA FOR -VE
4546	11204	061440		LDA BM2	INITIALISE SHIFT COUNT
4547	11205	055413		CPB FT1	HI NULL ?
4548	11206	027275		JMP XPAKM	TRY MID INSTEAD
4549	11207	004066	XPAK2	CLE,ELB	COUNT NO OF SHIFTS REQUIRED
4550	11210	000000		NOP	INST SET ABOVE
4551	11211	027207		JMP XPAK2	
4552	11212	071415		STA FT3	SAVE N
4553	11213	016535		JSB SHFTL	DO SHIFT
4554	11214	061230		LDA F1+2	ROUND
4555	11215	065226		LDB F1	
4556	11216	000040		CLE	
4557	11217	041556		ADA B177	BY 177
4558	11220	006021		SSB,RSS	
4559	11221	002004		INA	OR BY 200 IF +VE
4560	11222	011447		AND BM400	LOSE TAIL
4561	11223	071230		STA F1+2	STORE LO
4562	11224	002141		SEZ,CLE,RSS	CARRY ?
4563	11225	027241		JMP XPAK1	NO
4564	11226	061227		LDA F1+1	YES; CARRY TO MID
4565	11227	002004		INA	
4566	11230	071227		STA F1+1	
4567	11231	002141		SEZ,CLE,RSS	CARRY ?
4568	11232	027241		JMP XPAK1	NO
4569	11233	006004		INB	YES; CARRY TO HI
4570	11234	055455		CPB BCRIT	140000 ?
4571	11235	027265		JMP XPAK3	YES; GO COPE
4572	11236	055456		CPB BMIN	100000 ?
4573	11237	027270		JMP XPAK3+3	YES; GO COPE
4574	11240	075226		STB F1	
4575	11241	061415	XPAK1	LDA FT3	MAKE EXPONENT
4576	11242	003004		CMA,INA	
4577	11243	041414		ADA FT2	
4578	11244	041557		ADA B200	TEST SIZE
4579	11245	002020		SSA	
4580	11246	027317		JMP XPAKU	UNDERFLOW
4581	11247	041447		ADA BM400	
4582	11250	002021		SSA,RSS	
4583	11251	027311		JMP XPAKO	OVERFLOW
4584	11252	041557		ADA B200	
4585	11253	001200		RAL	POSITION
4586	11254	011563		AND B377	
4587	11255	041230		ADA F1+2	
4588	11256	071230		STA F1+2	
4589	11257	103101		CLO	

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4590	11260	061266	XPAKX	LDA F1P	TRANSFER BACK
4591	11261	167170		LDB ,XPAK,I	
4592	11262	115175		JSB XFR,I	
4593	11263	037170		ISZ ,XPAK	
4594	11264	127170		JMP ,XPAK,I	
4595*					
4596	11265	005000	XPAK3	BLS	=VE, NON-NORMAL
4597	11266	003400		CCA	
4598	11267	027272		JMP **3	
4599	11270	005300		RBR	+VE O'FLOW
4600	11271	002404		CLA,INA	
4601	11272	041414		ADA FT2	ADJUST EXP
4602	11273	071414		STA FT2	
4603	11274	027240		JMP XPAK1=1	
4604*					
4605	11275	041503	XPAKM	ADA B20	HI NULL; TRY MID
4606	11276	065227		LDB F1+1	
4607	11277	055413		CPB FT1	COMPARE WITH 'NULL'
4608	11300	002001		RSS	
4609	11301	027207		JMP XPAK2	
4610	11302	041503		ADA B20	MID NULL TOO; TRY LO
4611	11303	065230		LDB F1+2	
4612	11304	055413		CPB FT1	NULL?
4613	11305	006002		SZB	ALL 0 ?
4614	11306	027207		JMP XPAK2	
4615	11307	103101		CLO	ALL 0; DONE
4616	11310	027263		JMP XPAKX+3	
4617*					
4618	11311	061403	XPAKO	LDA FMAXP	OVERFLOW
4619	11312	065226		LDB F1	
4620	11313	006020		SSB	
4621	11314	061407		LDA FMINP	
4622	11315	102101		STO	
4623	11316	027261		JMP XPAKX+1	
4624*					
4625	11317	006400	XPAKU	CLB	UNDERFLOW
4626	11320	102101		STO	
4627	11321	075226		STB F1	SET ANS=0
4628	11322	075227		STB F1+1	
4629	11323	075230		STB F1+2	
4630	11324	027260		JMP XPAKX	
4631*					
4632	11325	002045	XPAKI	SEZ,INA,RSS	


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4634*          IN SITU MODULUS OF FLAC
4635 11326 000000 ,DABS NOP
4636 11327 061217 LDA FLAC    PICK UP SIGN
4637 11330 002021 SSA,RSS    TEST SIGN
4638 11331 127326 JMP ,DABS,I RETURN IF PLUS
4639 11332 115172 JSB DCM,I  COMPLEMENT IF -VE
4640 11333 001217 DEF FLAC
4641 11334 127326 JMP ,DABS,I
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4643*      EXPONENTIAL FUNCTION; OPERATES ON FLAC
4644  11335 000000 DEXP NOP
4645  11336 115140 JSB FMP,I   SCALE BY LOG E(2)
4646  11337 001244 DEF F5
4647  11340 001217 DEF FLAC
4648  11341 001375 DEF FLG2E
4649  11342 115153 JSB INT,I
4650  11343 001244 DEF F5
4651  11344 071417 STA FT5
4652  11345 115176 JSB OBL,I
4653  11346 001217 DEF FLAC
4654  11347 115137 JSB FSB,I   GET FRACTION
4655  11350 001244 DEF F5
4656  11351 001244 DEF F5
4657  11352 001217 DEF FLAC
4658  11353 115140 JSB FMP,I
4659  11354 001244 DEF F5
4660  11355 001244 DEF F5
4661  11356 001400 DEF FLGE2
4662  11357 115140 JSB FMP,I
4663  11360 001247 DEF F6
4664  11361 001244 DEF F5
4665  11362 011462 DEF DEXC2
4666  11363 115140 JSB FMP,I
4667  11364 001252 DEF F7
4668  11365 001244 DEF F5
4669  11366 001244 DEF F5
4670  11367 115136 JSB FAD,I
4671  11370 001252 DEF F7
4672  11371 001252 DEF F7
4673  11372 011465 DEF DEXC3
4674  11373 115140 JSB FMP,I
4675  11374 001255 DEF F8
4676  11375 001252 DEF F7
4677  11376 011457 DEF DEXC1
4678  11377 115140 JSB FMP,I
4679  11400 001252 DEF F7
4680  11401 001252 DEF F7
4681  11402 001244 DEF F5
4682  11403 115136 JSB FAD,I
4683  11404 001252 DEF F7
4684  11405 001252 DEF F7
4685  11406 001247 DEF F6
4686  11407 115140 JSB FMP,I
4687  11410 001247 DEF F6
4688  11411 001252 DEF F7
4689  11412 011454 DEF FL40
4690  11413 115136 JSB FAD,I
4691  11414 001244 DEF F5
4692  11415 001244 DEF F5
4693  11416 011470 DEF DEXC4
4694  11417 115140 JSB FMP,I
4695  11420 001244 DEF F5
4696  11421 001244 DEF F5
4697  11422 001252 DEF F7
4698  11423 115136 JSB FAD,I

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4699	11424	001244	DEF	F5	
4700	11425	001244	DEF	F5	
4701	11426	001255	DEF	F8	
4702	11427	115141	JSB	FDV,I	
4703	11430	001244	DEF	F5	
4704	11431	001247	DEF	F6	
4705	11432	001244	DEF	F5	
4706	11433	115136	JSB	FAD,I	
4707	11434	001217	DEF	FLAC	
4708	11435	001244	DEF	F5	
4709	11436	001345	DEF	FL1	
4710	11437	065221	LDB	FLAC+2	MAKE EXPONENT
4711	11440	115173	JSB	FLN,I	
4712	11441	075221	STB	FLAC+2	
4713	11442	041417	ADA	FT5	
4714	11443	102201	SOC		
4715	11444	127335	JMP	DEXP,I	O'FLOW ERROR
4716	11445	115200	JSB	PAK,I	
4717	11446	001217	DEF	FLAC	
4718	11447	061217	LDA	FLAC	UNDER OR OVER-FLOW?
4719	11450	102201	SOC		
4720	11451	002003	SZA,RSS		IGNORE UNDERFLOW
4721	11452	037335	ISZ	DEXP	STEP OVER ERROR EXIT
4722	11453	127335	JMP	DEXP,I	OVERFLOW ERROR
4723*					
4724	11454	050000	FL40	DEX	40
4725	11457	042400	DEXC1	DEX	138
4726	11462	073515	DEXC2	OCT	73515,164675,33412
4727	11465	060544	DEXC3	OCT	60544,26205,110410
4728	11470	130000	DEXC4	OCT	130000,0,12

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4730*		LOGARITHM; OPERATES ON FLAC		
4731	11473	000000	DLOG	NDP
4732	11474	061217	LDA	FLAC
4733	11475	002021	SSA,RSS	SIGN?
4734	11476	002003	SZA,RSS	=VE ?
4735	11477	127473	JMP	DLOG,I
4736	11500	065221	LDB	FLAC+2
4737	11501	115173	JSB	FLN,I
4738	11502	075221	STB	FLAC+2
4739	11503	115176	JSB	DBL,I
4740	11504	001247	DEF	F6
4741	11505	115137	JSB	FSB,I
4742	11506	001247	DEF	F6
4743	11507	001247	DEF	F6
4744	11510	001361	DEF	FL,5
4745	11511	115140	JSB	FMP,I
4746	11512	001247	DEF	F6
4747	11513	001247	DEF	F6
4748	11514	001400	DEF	FLGE2
4749*				
4750	11515	115137	JSB	FSB,I
4751	11516	001252	DEF	F7
4752	11517	001217	DEF	FLAC
4753	11520	011617	DEF	DLC3
4754	11521	115136	JSB	FAD,I
4755	11522	001244	DEF	F5
4756	11523	001217	DEF	FLAC
4757	11524	011617	DEF	DLC3
4758	11525	115141	JSB	FDV,I
4759	11526	001241	DEF	F4
4760	11527	001252	DEF	F7
4761	11530	001244	DEF	F5
4762	11531	115140	JSB	FMP,I
4763	11532	001244	DEF	F5
4764	11533	001241	DEF	F4
4765	11534	001241	DEF	F4
4766	11535	115136	JSB	FAD,I
4767	11536	001252	DEF	F7
4768	11537	001244	DEF	F5
4769	11540	011641	DEF	DLC9
4770	11541	115140	JSB	FMP,I
4771	11542	001255	DEF	F8
4772	11543	011625	DEF	DLC5
4773	11544	001252	DEF	F7
4774	11545	115136	JSB	FAD,I
4775	11546	001260	DEF	F9
4776	11547	001244	DEF	F5
4777	11550	011636	DEF	DLC8
4778	11551	115140	JSB	FMP,I
4779	11552	001260	DEF	F9
4780	11553	001260	DEF	F9
4781	11554	001252	DEF	F7
4782	11555	115136	JSB	FAD,I
4783	11556	001260	DEF	F9
4784	11557	001260	DEF	F9
4785	11560	011630	DEF	DLC6

4786	11561	115140		JSB FMP,I
4787	11562	001252		DEF F7
4788	11563	011622		DEF DLC4
4789	11564	001260		DEF F9
4790	11565	115136		JSB FAD,I
4791	11566	001244		DEF F5
4792	11567	001244		DEF F5
4793	11570	011633		DEF DLC7
4794	11571	115140		JSB FMP,I
4795	11572	001244		DEF F5
4796	11573	001244		DEF F5
4797	11574	001260		DEF F9
4798	11575	115136		JSB FAD,I
4799	11576	001244		DEF F5
4800	11577	001244		DEF F5
4801	11600	001255		DEF F8
4802	11601	115140		JSB FMP,I
4803	11602	001252		DEF F7
4804	11603	001252		DEF F7
4805	11604	001241		DEF F4
4806	11605	115141		JSB FDV,I
4807	11606	001244		DEF F5
4808	11607	001252		DEF F7
4809	11610	001244		DEF F5
4810	11611	115136		JSB FAD,I
4811	11612	001217		DEF FLAC
4812	11613	001244		DEF F5
4813	11614	001247		DEF F6
4814	11615	037473		ISZ DLOG
4815	11616	127473		JMP DLOG,I
4816*				
4817	11617	055202	DLC3	OCT 55202,74631,176400
4818	11622	133024	DLC4	OCT 133024,75341,44012
4819	11625	120554	DLC5	OCT 120554,153524,156412
4820	11630	100750	DLC6	OCT 100750,162307,156775
4821	11633	100466	DLC7	OCT 100466,46623,62410
4822	11636	103737	DLC8	OCT 103737,34700,147004
4823	11641	123217	DLC9	OCT 123217,17743,36402
4824*				COMMON USE BUFFER
4825	11644	000000	CMBUF	BSS 128

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4827*          SINE; OPERATES ON FLAC
4828 12044 000000 DSIN NOP
4829 12045 002400          CLA          INITIALISE SIGN FLAG
4830 12046 071417          STA FT5
4831 12047 061217          LDA FLAC          SIGN ?
4832 12050 002021          SSA,RSS
4833 12051 026055          JMP *+4
4834 12052 115172          JSB DCM,I          NEGATE
4835 12053 001217          DEF FLAC
4836 12054 035417          ISZ FT5          REVERSE SIGN FLAG
4837 12055 115137          JSB FSB,I          TEST SIZE
4838 12056 001247          DEF F6
4839 12057 001217          DEF FLAC
4840 12060 001372          DEF FL2PI
4841 12061 061247          LDA F6
4842 12062 002020          SSA
4843 12063 026103          JMP DSIN1          < 2PI
4844 12064 115141          JSB FDV,I          > 2PI
4845 12065 001247          DEF F6
4846 12066 001217          DEF FLAC
4847 12067 001372          DEF FL2PI
4848 12070 115161          JSB ENT,I          REDUCE TO 0 TO 2PI
4849 12071 001247          DEF F6
4850 12072 001247          DEF F6
4851 12073 115140          JSB FMP,I
4852 12074 001247          DEF F6
4853 12075 001247          DEF F6
4854 12076 001372          DEF FL2PI
4855 12077 115137          JSB FSB,I
4856 12100 001217          DEF FLAC
4857 12101 001217          DEF FLAC
4858 12102 001247          DEF F6
4859 12103 115137 DSIN1 JSB FSB,I          > PI ?
4860 12104 001247          DEF F6
4861 12105 001217          DEF FLAC
4862 12106 001367          DEF FLPI
4863 12107 061247          LDA F6
4864 12110 002020          SSA
4865 12111 026116          JMP *+5
4866 12112 115174          JSB DFR,I          SET X=X-PI
4867 12113 001217          DEF FLAC
4868 12114 001247          DEF F6
4869 12115 035417          ISZ FT5          REVERSE SIGN FLAG
4870 12116 115137          JSB FSB,I          > PI/2 ?
4871 12117 001247          DEF F6
4872 12120 001217          DEF FLAC
4873 12121 001364          DEF FLPI2
4874 12122 061247          LDA F6
4875 12123 002020          SSA
4876 12124 026132          JMP *+6
4877 12125 115137          JSB FSB,I          X=X+PI
4878 12126 001217          DEF FLAC
4879 12127 001217          DEF FLAC
4880 12130 001367          DEF FLPI
4881 12131 035417          ISZ FT5          REVERSE SIGN
4882 12132 115140          JSB FMP,I

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4883	12133	001247		DEF F6
4884	12134	001217		DEF FLAC
4885	12135	001217		DEF FLAC
4886	12136	016261		JSB XPOLY
4887	12137	001247		DEF F6
4888	12140	000007		DEC 7
4889	12141	001247		DEF F6
4890	12142	012155		DEF DSINC
4891	12143	115140		JSB FMP,I
4892	12144	001217		DEF FLAC
4893	12145	001247		DEF F6
4894	12146	001217		DEF FLAC
4895	12147	061417		LDA FT5 SIGN ?
4896	12150	002011		SLA,RSS
4897	12151	026154		JMP **3
4898	12152	115172		JSB DCM,I
4899	12153	001217		DEF FLAC
4900	12154	126044		JMP DSIN,I
4901*				
4902	12155	052251	DSINC	OCT 52251,144311,26301
4903	12160	112177		OCT 112177,152274,154317
4904	12163	056167		OCT 56167,34402,77735
4905	12166	113771		OCT 113771,100307,114351
4906	12171	042104		OCT 42104,42102,41365
4907	12174	125252		OCT 125252,125252,125775
4908	12177	040000		DEX 1,

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4910*          COSINE; USES SINE AND OPERATES ON FLAC
4911 12202 000000 DCOS  NOP
4912 12203 115136          JSB FAD,I
4913 12204 001217          DEF FLAC
4914 12205 001217          DEF FLAC
4915 12206 001364          DEF FLPI2
4916 12207 016044          JSB DSIN
4917 12210 126202          JMP DCOS,I
```



```

4919*      SQUARE ROOT; OPERATES ON FLAC
4920 12211 000000 DSGRT NOP
4921 12212 061217 LDA FLAC SIGN ?
4922 12213 002020 SSA
4923 12214 126211 JMP DSGRT,I ERROR
4924 12215 036211 ISZ DSGRT STEP PAST ERROR EXIT
4925 12216 002003 SZA,RSS ZERO ?
4926 12217 126211 JMP DSGRT,I ALREADY ZERC
4927 12220 065221 LDB FLAC+2 GET EXP
4928 12221 115173 JSB FLN,I
4929 12222 066257 LDB DSGC1 MAKE 1ST APPROX
4930 12223 002014 SLA,INA TEST LS OF EXP
4931 12224 066260 LDB DSGC2
4932 12225 001122 ARS,RAL MAKE EXP
4933 12226 071246 STA F5+2
4934 12227 075244 STB F5
4935 12230 061421 LDA BM5 SET 5 ITERATIONS
4936 12231 071417 STA FT5
4937*
4938 12232 115141 DSG1 JSB FDV,I Y/XN
4939 12233 001247 DEF F6
4940 12234 001217 DEF FLAC
4941 12235 001244 DEF F5
4942 12236 115136 JSB FAD,I XN+Y/XN
4943 12237 001244 DEF F5
4944 12240 001247 DEF F6
4945 12241 001244 DEF F5
4946 12242 065246 LDB F5+2 XN+1=(XN+Y/XN)/2
4947 12243 115173 JSB FLN,I
4948 12244 041437 ADA BM1 NO NEED TO CHECK O'FLOW
4949 12245 001200 RAL POSITION EXP
4950 12246 011563 AND B377
4951 12247 044000 ADB 0
4952 12250 075246 STB F5+2
4953 12251 035417 ISZ FT5
4954 12252 026232 JMP DSG1 ITERATE
4955*
4956 12253 061270 LDA F5P
4957 12254 065222 DSGX LDB FLACP
4958 12255 115175 JSB XFR,I
4959 12256 126211 JMP DSGRT,I
4960*
4961 12257 046034 DSGC1 DEC 19484 1ST APPROXIMATIONS
4962 12260 065642 DSGC2 DEC 27554

```

```

4964*      POLYNOMIAL EVALUATION ROUTINE
4965 12261 000000  XPOLY NOP
4966 12262 162261      LDA XPOLY,I  GET DESTINATION
4967 12263 072324      STA POLY1   SET DESTINATION
4968 12264 036261      ISZ XPOLY   STEP TO N
4969 12265 162261      LDA XPOLY,I  GET NO OF COEFFS
4970 12266 003004      CMA,INA     NEGATE FOR COUNT
4971 12267 071420      STA FT6    SET COUNT
4972 12270 036261      ISZ XPOLY   STEP TO SOURCE
4973 12271 162261      LDA XPOLY,I  GET SOURCE
4974 12272 072316      STA POLY2   SET SOURCE
4975 12273 036261      ISZ XPOLY   STEP TO TABLE PTR
4976 12274 016440      JSB ,PCAD   GET PTR
4977 12275 112261      DEF XPOLY,I  TO TABLE
4978 12276 072307      STA POLY3   WITHOUT INDIRECTS
4979 12277 036261      ISZ XPOLY   STEP TO EXIT
4980 12300 002400      CLA       CLEAR WORKING SPACE
4981 12301 071260      STA F9
4982 12302 071261      STA F9+1
4983 12303 071262      STA F9+2
4984 12304 115136      JSB FAD,I
4985 12305 001260  F9P  DEF F9
4986 12306 001260      DEF F9
4987 12307 000000  POLY3 NOP          PTR TO TABLE
4988 12310 035420      ISZ FT6
4989 12311 002001      RSS
4990 12312 026323      JMP XPEX
4991 12313 115140      JSB FMP,I
4992 12314 001260      DEF F9
4993 12315 001260      DEF F9
4994 12316 000000  POLY2 NOP          PTR TO SOURCE
4995 12317 062307      LDA POLY3   STEP TABLE PTR
4996 12320 041473      ADA B3      BY ONE FP NO
4997 12321 072307      STA POLY3
4998 12322 026304      JMP *-14
4999*
5000 12323 115174  XPEX JSB DFR,I  TRANSFER RESULT
5001 12324 000000  POLY1 NOP          PTR TO DESTINATION
5002 12325 001260      DEF F9
5003 12326 126261      JMP XPOLY,I

```

```

5005*      EXPONENTIATION; EXTENDED PRECISION BASE IN PDL TO
5006*      EXTENDED PRECISION POWER IN FLAC
5007  12327 000000      ,DTOD NOP
5008  12330 160634      LDA PDL,I      GET SIGN OF BASE
5009  12331 065217      LDB FLAC      AND OF POWER
5010  12332 006003      SZB,RSS      POWER 0 ?
5011  12333 026342      JMP DTODX      X↑0=1
5012  12334 002002      SZA      BASE=0 ?
5013  12335 026346      JMP DTOD1      NO; OK
5014  12336 006020      SSB      YES; INDEX =VE ?
5015  12337 126327      JMP ,DTOD,I    ERROR
5016  12340 060634      LDA PDL      INDEX +VE; SET ANS=0
5017  12341 002001      RSS
5018  12342 061272      DTODX LDA FL1P
5019  12343 065222      LDB FLACP
5020  12344 115175      JSB XFR,I
5021  12345 026364      JMP DTOD2
5022*
5023  12346 061222      DTOD1 LDA FLACP      SAVE FLAC
5024  12347 066361      LDB FLRGP      IN FLARG
5025  12350 115175      JSB XFR,I
5026  12351 060634      LDA PDL      BRING DOWN BASE
5027  12352 065222      LDB FLACP      TO FLAC
5028  12353 115175      JSB XFR,I
5029  12354 115163      JSB LOG,I      TAKE LOGS
5030  12355 126327      JMP ,DTOD,I    BASE =VE; ERROR
5031  12356 115140      JSB FMP,I
5032  12357 001217      DEF FLAC
5033  12360 001217      DEF FLAC
5034  12361 001223      FLRGP DEF FLARG
5035  12362 115162      JSB EXP,I
5036  12363 126327      JMP ,DTOD,I    OVERFLOW ERROR
5037  12364 036327      DTOD2 ISZ ,DTOD    STEP PAST ERROR EXIT
5038  12365 126327      JMP ,DTOD,I

```

```

5040*      EXPONENTIATION; DOUBLE PRECISION BASE IN PDL
5041*      TO INTEGER POWER IN A
5042 12366 000000      ,DIOI NOP
5043 12367 164634      LDB PDL,I      HI OF BASE
5044 12370 002003      SZA,RSS      POWER 0?
5045 12371 026377      JMP DIOI3      ANS=1
5046 12372 006002      SZB      BASE 0?
5047 12373 026377      JMP DIOI3      NO; OK
5048 12374 002020      SSA      YES; IS POWER -VE?
5049 12375 126366      JMP ,DIOI,I      YES; ERROR
5050 12376 002404      CLA,INA      SET PWR=1; ANS=0
5051 12377 071416      DIOI3 STA FT4      SET POWER
5052 12400 002020      SSA      AND
5053 12401 003004      CMA,INA      MODULUS
5054 12402 071417      STA FT5
5055 12403 036366      ISZ ,DIOI      STEP PAST ERROR EXIT
5056 12404 061272      LDA FL1P      INITIALISE TO 1
5057 12405 065222      LDB FLACP
5058 12406 115175      JSB XFR,I
5059 12407 061417      DIOI1 LDA FT5
5060 12410 002011      SLA,RSS
5061 12411 026416      JMP *+5
5062 12412 115140      JSB FMP,I
5063 12413 001217      DEF FLAC
5064 12414 001217      DEF FLAC
5065 12415 100634      DEF PDL,I
5066 12416 061417      LDA FT5
5067 12417 001100      ARS
5068 12420 002003      SZA,RSS
5069 12421 026430      JMP DIOI2
5070 12422 071417      STA FT5
5071 12423 115140      JSB FMP,I      SQUARE BASE
5072 12424 100634      DEF PDL,I
5073 12425 100634      DEF PDL,I
5074 12426 100634      DEF PDL,I
5075 12427 026407      JMP DIOI1
5076*
5077 12430 061416      DIOI2 LDA FT4      TEST SIGN OF POWER
5078 12431 002021      SSA,RSS
5079 12432 126366      JMP ,DIOI,I
5080 12433 115141      JSB FQV,I
5081 12434 001217      DEF FLAC
5082 12435 001345      DEF FL1
5083 12436 001217      DEF FLAC
5084 12437 126366      JMP ,DIOI,I

```

PAGE 0122 #01 FLOATING POINT ROUTINES

5086	12440	000000	,PCAD	NOP
5087	12441	162440		LDA ,PCAD,I
5088	12442	160000		LDA 0,I
5089	12443	001275		RAL,CLE,SLA,ERA
5090	12444	026442		JMP **2
5091	12445	036440		ISZ ,PCAD
5092	12446	126440		JMP ,PCAD,I

```

5095*      UNPACK 2ND WORD OF FLOATING POINT NUMBER
5096*      CALLING SEQUENCE,,
5097*      LDB LO          OR EQUIVALENT E.G. DLD X
5098*      JSB FLN,I
5099*      RETURNS WITH A=EXPONENT, B=LOW MANTISSA
5100 12447 000000      .FLUN NOP
5101 12450 060001      LDA 1          TRANSFER LO TO A
5102 12451 011563      AND B377      MASK OFF EXPONENT BITS
5103 12452 007000      CMB
5104 12453 044000      ADB 0          SUBTRACT EXP BITS FROM B
5105 12454 007000      CMB
5106 12455 000033      SLA,RAR      POSITION TEST SIGN OF EXP
5107 12456 031446      IOR BM200     PUT IN EXTRA BITS IF -VE
5108 12457 126447      JMP .FLUN,I

```

5111* TEXT BUFFER

5112 12460 000000 TEXT OCT 0
5113 12461 000000 OCT 0
5114 12462 041455 ASC 6,C=ONCAL,
5115 12470 054015 OCT 54015
5116 12471 BUFBG EQU *
5117 END

LEAD IN MESSAGE

** NO ERRORS*

```

0001                ASMB,A,L
0003*              FUNCTION OVERLAY FOR STANDARD X VERSION OF ONCAL
0004*              V148X FSW,FAP
0005*              SELECT CODE ASSIGNMENTS
0006  00022                ORG 22B
0007  00022 114037  AP      JSB 37B,I      ACOUSTIC POSITIONING
0008*
0009*              MISC DEFINITIONS
0010  01217                FLAC EQU 1217B
0011  01153                INT  EQU 1153B
0012  01216                EFX  EQU 1216B
0013  00231                RECOV EQU 231B
0014  01176                DBL  EQU 1176B
0015*
0016*              INTERRUPT ROUTINE LINK
0017  00037                ORG 37B
0018  00037 012535                DEF APIR      ACOUSTIC POSITIONING
0019*
0020*              UPDATE TEXT POINTERS
0021  00671                ORG 671B
0022  00671 013567                DEF BUFBG
0023  00672 013567                DEF BUFBG
0024  00673 013567                DEF BUFBG
0025  00674 013556                DEF TEXT      START OF TEXT BUFFER
0026*
0027*              NEW FUNCTION NAMES
0028  00722                ORG 722B
0029  00722 001167  FSW          OCT 1167
0030  00723 000060  FAP          OCT 60
0031*
0032*              NEW FUNCTION ROUTINE POINTERS
0033  00752                ORG 752B
0034  00752 012504  PSW          DEF XSW
0035  00753 012514  PAP          DEF XAP
0036*
0037*              TEST FOR NEW FUNCTIONS
0038  05225                ORG 5225B
0039  05225 050722                CPA FSW      SW
0040  05226 124752                JMP PSW,I
0041  05227 050723                CPA FAP      AP
0042  05230 124753                JMP PAP,I

```


0044* NEW FUNCTIONS

0045* FSW, READ/WRITE SWITCH REGISTER

0046*

0047	12504		ORG	12504B	
0048	12504	115153	XSW	JSB INT, I	SWITCH REGISTER FUNCTION
0049	12505	001217		DEF	FLAC
0050	12506	070001		STA	I
0051	12507	102501		LIA	I
0052	12510	106601		OTB	I
0053	12511	115176		JSB	DBL, I
0054	12512	001217		DEF	FLAC
0055	12513	125216		JMP	EFX, I

0056*

0057* FAP, READ DATA FROM ACOUSTIC POSITIONING

0058	12514	102722	XAP	STC	AP	TURN ON INTERFACE
0059	12515	066555		LDB	AP0	ANY DATA YET?
0060	12516	056554		CPB	API	
0061	12517	026530		JMP	APWT	NO; GO WAIT
0062	12520	160001		LDA	I, I	YES; GET DATA
0063	12521	006004		INB		STEP POINTER
0064	12522	056553		CPB	APE	END OF BUFFER?
0065	12523	066552		LDB	AP0	YES; RESET TO START
0066	12524	076552		STB	AP0	SET NEW BUFFER POINTER
0067	12525	115176		JSB	DBL, I	FLOAT DATA
0068	12526	001217		DEF	FLAC	
0069	12527	125216		JMP	EFX, I	EXIT

0070*

0071	12530	106501	APWT	LIB	I	READ SWITCHES
0072	12531	006021		SSB, RSS		TIRED OF WAITING?
0073	12532	026515		JMP	XAP+1	NO; TRY AGAIN
0074	12533	107722		CLC	AP, C	YES; TURN OF INTERFACE
0075	12534	024231		JMP	RECOV	AND QUIT

0076*

0077* INTERRUPT ROUTINE; PUT DATA IN BUFFER

0078	12535	000000	APIR	NOP		INTERRUPT COMES HERE
0079	12536	072551		STA	APA	SAVE A ONLY
0080	12537	102522		LIA	AP	READ DATA
0081	12540	172554		STA	API, I	STORE IN BUFFER
0082	12541	062554		LDA	API	GET BUFFER POINTER
0083	12542	034000		ISZ	0	STEP WITHOUT USE OF E OR O
0084	12543	052553		CPA	APE	END OF BUFFER?
0085	12544	062552		LDA	AP0	YES; RESET TO START
0086	12545	072554		STA	API	SET NEW BUFFER POINTER
0087	12546	062551		LDA	APA	RESTORE A
0088	12547	103122		CLF	AP	CLEAR INTERFACE FLAG
0089	12550	126535		JMP	APIR, I	RETURN FROM INTERRUPT

0090*

0091	12551	000000	APA	NOP		STORE FOR A
0092	12552	012556	AP0	DEF	APBUF	START PTR FOR BUFFER
0093	12553	013556	APE	DEF	APEND	END PTR FOR BUFFER
0094	12554	012556	API	DEF	APBUF	INPUT PTR TO BUFFER
0095	12555	012556	AP0	DEF	APBUF	OUTPUT PTR FROM BUFFER
0096	12556	000000	APBUF	BSS	512	BUFFER
0097	13556		APEND	EQU	*	END OF BUFFER

0098*

0099*

```
0100*      NEW START OF TEXT + VERSION ID
0101  13556 000000 TEXT OCT 0
0102  13557 000000      OCT 0
0103  13560 041455      ASC 6,C-ONCAL,V148      LEAD IN MESSAGE
        13561 047516
        13562 041501
        13563 046054
        13564 053061
        13565 032070
0104  13566 054015      OCT 54015      X + LF
0105  13567      BUFBG EQU *
0106*
0107*
0108      END
** NO ERRORS*
```

```

0001          ASMB,A,L
0003*        FUNCTIONS V149F      FSW,FAP
0004*        SELECT CODE ASSIGNMENTS
0005*
0006 00022          ORG 22B
0007 00022 114031  AP      JSB 31B,I      ACOUSTIC POSITIONING
0008*
0009*        INTERRUPT ROUTINE LINK
0010 00031          ORG 31B
0011 00031 011161          DEF APIR
0012*
0013*        UPDATE TEXT POINTERS
0014 00654          ORG 654B
0015 00654 012213          DEF BUFBG
0016 00655 012213          DEF BUFBG
0017 00656 012213          DEF BUFBG
0018 00657 012202          DEF TEXT
0019*
0020*        NEW FUNCTION NAMES
0021 00704          ORG 704B
0022 00704 001167  FSW      OCT 1167
0023 00705 000060  FAP      OCT 60
0024*
0025*        NEW FUNCTION ROUTINE POINTERS
0026 00734          ORG 734B
0027 00734 C11131  PSW      DEF XSW
0028 00735 011141  FAP      DEF XAP
0029*
0030*        TEST FOR NEW FUNCTIONS
0031 05237          ORG 6237B
0032 05237 050705          CPA FAP      AP
0033 05240 124735          JMP PAP,I
0034 05241 050704          CPA FSW      SW
0035 05242 124734          JMP PSW,I
0036*

```

```

0038*      NEW FUNCTIONS
0039*      FSW-READ/WRITE SWITCH REGISTER
0040  11131          ORG 11131B
0041  11131 061175  XSW  LDA  FLAC
0042  11132 065176          LDB  FLAC+1
0043  11133 115134          JSB  IFX,I
0044  11134 070001          STA  I
0045  11135 102501          LIA  I
0046  11136 106601          OTB  I
0047  11137 105120          OCT 105120  FLOAT RESULT
0048  11140 125174          JMP  EFX,I
0049*
0050*      FAP,READ DATA FROM ACOUSTIC POSITIONING
0051  11141 102722  XAP  STC  AP      TURN ON INTERFACE
0052  11142 067201          LDB  APO      ANY DATA YET?
0053  11143 057200          CPB  API
0054  11144 027154          JMP  APWT      NO; GO WAIT
0055  11145 160001          LDA  I,I      GET DATA
0056  11146 006004          INB          STEP POINTER
0057  11147 057177          CPB  APE      END OF BUFFER?
0058  11150 067176          LDB  APO      YES; RESET TO START
0059  11151 077201          STB  APO      SET NEW BUFFER PTR
0060  11152 105120          OCT 105120  FLOAT DATA
0061  11153 125174          JMP  EFX,I
0062*
0063  11154 106501  APWT  LIB  I      READ SWITCHES
0064  11155 006021          SSB,RSS     TIRED OF WAITING?
0065  11156 027142          JMP  XAP+1   NO; TRY AGAIN
0066  11157 107722          CLC  AP,C   YES; TURN OFF INTERFACE
0067  11160 024231          JMP  RECOV   AND QUIT
0068*
0069*      INTERRUPT ROUTINE; PUT DATA IN BUFFER
0070  11161 000000  APIR  NOP      INTERRUPT COMES HERE
0071  11162 073175          STA  APA      SAVE A ONLY
0072  11163 102522          LIA  AP      READ DATA
0073  11164 173200          STA  API,I   STORE IN BUFFER
0074  11165 063200          LDA  API      GET BUFFER POINTER
0075  11166 034000          ISZ  0      STEP WITHOUT USE OF E OR O
0076  11167 053177          CPA  APE      END OF BUFFER?
0077  11170 063176          LDA  APO      YES; RESET TO START
0078  11171 073200          STA  API      SET NEW BUFFER POINTER
0079  11172 063175          LDA  APA      RESTORE A
0080  11173 103122          CLF  AP      CLEAR INTERFACE FLAG
0081  11174 127161          JMP  APIR,I   RETURN FROM INTERRUPT
0082*
0083  11175 000000  APA  NOP      STORE FOR A
0084  11176 011202  APO  DEF  APBUF  START PTR FOR BUFFER
0085  11177 012202  APE  DEF  APEND  END PTR FOR BUFFER
0086  11200 011202  API  DEF  APBUF  INPUT PTR FOR BUFFER
0087  11201 011202  APO  DEF  APBUF  OUTPUT PTR FROM BUFFER
0088  11202 000000  APBUF BSS 512  BUFFER
0089  12202          APEND EQU *      END OF BUFFER
0090*
0091*      NEW START OF TEXT+VERSION ID
0092  12202 000000  TEXT  OCT 0
0093  12203 000000          OCT 0

```

0094	12204	041455	ASC 6,C-ONCAL,V149	LEAD IN MESSAGE
	12205	047516		
	12206	041501		
	12207	046054		
	12210	053061		
	12211	032071		
0095	12212	043015	OCT 43015	F+CR
0096	12213	BUFBG	EQU *	
0097	01174	EPX	EQU 1174B	
0098	01175	FLAC	EQU 1175B	
0099	01134	IFX	EQU 1134B	
0100	00231	RECOV	EQU 23 IB	
0101*				
0102			END	
**	NO ERRORS*			

```

0001          ASMB,A,L
0003*
0004*    ONCAL FUNCTIONS V150F
0005*    FADC,FCLK,FTAG,FSAL,FSGT,FSW
0006*    FADC IS FOR GUILDLINE PROTOTYPE DIGITAL CTD
0007*
0008*    SELECT CODE ASSIGNMENTS
0009  00023          ORG 23B
0010          SUP
0011  00023 114040  CLOCK JSB 40B,I    CLOCK
0012  00024 114031  ADC   JSB 31B,I    DIGITIZER
0013*    INTERRUPT ROUTINE LINKS
0014  00031          ORG 31B
0015  00031 011430  ADCIJ DEF ADCIR
0016  00040          ORG 40B
0017  00040 011131  DEF  CLKI    CLOCK
0018*    UPDATE TEXT POINTERS
0019*
0020  00654          ORG 654B
0021  00654 016510  DEF  BUFBG
0022  00655 016510  DEF  BUFBG
0023  00656 016510  DEF  BUFBG
0024  00657 016477  DEF  TEXT
0025*
0026*    NEW FUNCTION NAMES
0027  00704          ORG 704B
0028  00704 002203  FADC  OCT 2203
0029  00705 046054  FSAL  OCT 46054
0030  00706 046364  FSGT  OCT 46364
0031  00707 006613  FCLK  OCT 6613
0032  00710 050047  FTAG  OCT 50047
0033  00711 001167  FSW   OCT 1267
0034*
0035*    NEW FUNCTION ROUTINE POINTERS
0036  00734          ORG 734B
0037  00734 011211  PADC  DEF XADC
0038  00735 016163  PSAL  DEF XSAL
0039  00736 016403  PSGT  DEF XSGT
0040  00737 016060  PCLK  DEF XCLK
0041  00740 016147  PTAG  DEF XTAG
0042  00741 016137  PSW   DEF XSW
0043*
0044*    TEST FOR NEW FUNCTIONS
0045  05237          ORG 5237B
0046  05237 050705  CPA  FSAL    SAL
0047  05240 124735  JMP  PSAL,I
0048  05241 050706  CPA  FSGT    SGT
0049  05242 124736  JMP  PSGT,I
0050  05243 050707  CPA  FCLK    CLK
0051  05244 124737  JMP  PCLK,I
0052  05245 050704  CPA  FADC    ADC
0053  05246 124734  JMP  PADC,I
0054  05247 050711  CPA  FSW     SW
0055  05250 124741  JMP  PSW,I
0056  05251 050710  CPA  FTAG    TAG
0057  05252 124740  JMP  PTAG,I

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0059*

0060* NEW FUNCTIONS

0061*FCLK, REAL TIME CLOCK (INTERRUPT PART)

0062*ALSO CONTROLS DIGITISATION

0063 11131 ORG 11131B

0064*

```

0065 11131 000000 CLKI NOP          CLOCK INTERRUPT
0066 11132 073206          STA CLKA      SAVE A ONLY
0067 11133 063214          LDA ADCC2     FADC(0) ENABLED?
0068 11134 053422          CPA ADCIN
0069 11135 002001          RSS              YES
0070 11136 027173          JMP CLKI2     NO; JUST UPDATE TIME
0071 11137 037720          ISZ ADCTC     COUNT "TIM"
0072 11140 027173          JMP CLKI2     "TIM" NOT EXPIRED
0073*                TIME TO START DIGITISING; CHECK PREVIOUS TRANSFER
0074 11141 107724          CLC ADC,C    TURN OFF INTERFACE
0075 11142 063717          LDA ADCTM     RESET "TIM"
0076 11143 073720          STA ADCTC
0077 11144 063707 CLK2 LDA ADCCT     TRANSFER COMPLETE?
0078 11145 002021          SSA,RSS      0=COMPLETE
0079 11146 027157          JMP CLKI      YES; OK
0080*                PREVIOUS TRANSFER INCOMPLETE
0081 11147 063761          LDA ADCST     SET
0082 11150 033763          IOR ADCET     "TIMING ERROR"
0083 11151 073761          STA ADCST     IN ADC STATUS
0084 11152 063156          LDA CLKPT     SET UP RETURN
0085 11153 073430          STA ADCIR     FOR ADC IR ROUTINE
0086 11154 003400          CCA          FILL BUFFER WITH -1
0087 11155 027601          JMP ADCYY     USING ADC IR ROUTINE
0088 11156 011144 CLKPT DEF CLK2     RETURN TO CHECK COMPLETION
0089*
0090*                START DIGITISER
0091 11157 002400 CLKI CLA
0092 11160 073716          STA ADCCH     SET CHANNEL ZERO
0093 11161 063715          LDA ADCCHC    RESET CH COUNT
0094 11162 073707          STA ADCCT
0095 11163 063744          LDA ADCIP     SET CH 0 IR
0096 11164 073424          STA ADCRT
0097 11165 037722          ISZ ADCD      COUNT DECIMATION
0098 11166 027172          JMP **4       NO TRANSFER THIS TIME
0099 11167 063721          LDA ADCDC     RESET DECIMATION COUNT
0100 11170 073722          STA ADCD
0101 11171 037743          ISZ ADCTF     SET TRANSFER FLAG
0102 11172 103724          STC ADC,C    START DIGITISER
0103 11173 037207 CLKI2 ISZ CLKCT  COUNT TO 1 SEC
0104 11174 027203          JMP CLKIX
0105 11175 063210          LDA CLKC      RESET 1 SEC COUNT
0106 11176 073207          STA CLKCT
0107 11177 035115          ISZ XCL+1     STEP COUNT OF SECONDS
0108 11200 027203          JMP CLKIX
0109 11201 035114          ISZ XCL       OF 65536'S OF SECONDS
0110 11202 000000          NOP          SKIPS EVERY 140 YRS
0111 11203 063206 CLKIX LDA CLKA
0112 11204 103723          STC CLOCK,C REENABLE CLOCK
0113 11205 127131          JMP CLKI,I
0114*

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0115	11206	000000	CLKA	DEC	0
0116	11207	177634	CLKCT	DEC	-100
0117	11210	177634	CLKC	DEC	-100


```

0119*FADC,DIGITISATION ROUTINE FOR GUILDLINE PROTOTYPE CTD
0120 11211 061175 XADC LDA FLAC TEST OPTION
0121 11212 002002 SZA
0122 11213 027261 JMP ADCC1
0123 11214 014220 ADCC2 JSB ERROR ERROR IF NOT INITIALISED
0124 11215 006716 DEF GTARG-1 GET DESTINATION
0125 11216 061070 LDA GTL TEST LENGTH
0126 11217 043714 ADA ADCCL
0127 11220 002021 SSA,RSS
0128 11221 027225 JMP *+4 SHORT ENOUGH
0129 11222 063714 LDA ADCCL SET SHORTER
0130 11223 003004 CMA,INA
0131 11224 071070 STA GTL
0132*
0133 11225 063737 LDA ADCTO SAVE O/P POINTER
0134 11226 073742 STA ADCPT
0135 11227 063737 ADCC3 LDA ADCTO WAIT FOR DATA
0136 11230 053736 CPA ADCTJ
0137 11231 027230 JMP *-1
0138 11232 163737 LDA ADCTO,I GET DATA
0139 11233 037737 ISZ ADCTO STEP INPUT PTR
0140 11234 105120 ABS -FLT CONVERT TO FLOATING
0141 11235 104400 DST PT1,I OUTPUT TO ARRAY
0142 11237 034634 ISZ PT1 STEP OUTPUT PTR
0143 11240 034634 ISZ PT1
0144 11241 035070 ISZ GTL DOESN'T SKIP
0145 11242 035070 ISZ GTL COUNT
0146 11243 027227 JMP ADCC3
0147*
0148 11244 063742 LDA ADCPT MAKE CORRECT BUFFER POINTER
0149 11245 043713 ADA ADCCN
0150 11246 053741 CPA ADCTE END OF BUFFER?
0151 11247 063740 LDA ADCT0 RESET TO START
0152 11250 073737 STA ADCTO
0153 11251 006400 CLB TURN IR OFF
0154 11252 103100 CLF 0
0155 11253 063761 LDA ADCST GET STATUS
0156 11254 077761 STB ADCST CLEAR STATUS
0157 11255 102100 STF 0 TURN IR ON AGAIN
0158 11256 003004 CMA,INA NEGATE STATUS
0159 11257 105120 ABS -FLT
0160 11260 125174 JMP EFX,I
0161*
0162 11261 006400 ADCC1 CLB CLEAR MT FLAG
0163 11262 077723 STB ADCMF
0164 11263 002020 SSA TEST; - = TERMINATE
0165 11264 027416 JMP ADCCX -VE; JUST TERMINATE
0166 11265 065176 LDB FLAC+1 GET OPTION
0167 11266 115134 JSB IFX,I CONVERT TO INTEGER NCH
0168 11267 073713 STA ADCCN SAVE NCH
0169 11270 003004 CMA,INA NEGATE
0170 11271 073715 STA ADCHC SAVE -NCH
0171 11272 041356 ADA B2 TEST SIZE
0172 11273 002021 SSA,RSS OK IF 3 OR MORE
0173 11274 014220 JSB ERROR TOO FEW CHANNELS
0174 11275 063713 LDA ADCCN GET NCH

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0175	11276	001000	ALS	X2 FOR FP
0176	11277	073714	STA ADCCL	SET FP ARRAY LENGTH
0177*			COMPUTE ACTUAL BUFFER SIZES	
0178	11300	063724	LDA ADCBL	MAX BUFFER LENGTH
0179	11301	006400	CLB	SET UP FIXED PT DIV
0180	11302	100400	DIV ADCCN	RESULT = NO OF SETS
0181	11304	100200	MPY ADCCN	NO OF WORDS TO A
0182	11306	041360	ADA B4	PLUS SPACE FOR ID AND TIME
0183	11307	073725	STA ADCL	SAVE BUFFER LENGTH
0184	11310	063734	LDA ADCTL	MAX T BUFFER LENGTH
0185	11311	006400	CLB	
0186	11312	100400	DIV ADCCN	NO OF SETS IN T BUFFER
0187	11314	100200	MPY ADCCN	NO OF WORDS IN T BUFFER
0188	11316	043740	ADA ADCT0	PLUS START
0189	11317	073741	STA ADCTE	=END OF T BUFFER
0190*				
0191*			READ "TIM", THE TIME COUNT BETWEEN SAMPLES	
0192	11320	014542	JSB PUSHJ	GET "TIM"
0193	11321	006706	DEF ARG	
0194	11322	014220	JSB ERROR	NO "TIM"
0195	11323	061175	LDA FLAC	"TIM" TO A AND B
0196	11324	065176	LDB FLAC+1	
0197	11325	115134	JSB IFX,I	CONVERT TO INTEGER
0198	11326	003004	CMA,INA	NEGATE
0199	11327	073717	STA ADCTM	SAVE "-TIM"
0200*			READ "DEC", THE DECIMATION FACTOR	
0201	11330	014542	JSB PUSHJ	GET DEC
0202	11331	006706	DEF ARG	
0203	11332	027337	JMP *+5	IF NONE, SET 1
0204	11333	061175	LDA FLAC	"DEC" TO A AND B
0205	11334	065176	LDB FLAC+1	
0206	11335	115134	JSB IFX,I	CONVERT TO INTEGER
0207	11336	003007	CMA,INA,SZA,RSS	NEGATE, TEST ZERO
0208	11337	003400	CCA	IF NONE, SET 1
0209	11340	073721	STA ADCDC	SET DECIMATION COUNT
0210*			TEST FOR ",M" MAG TAPE OPTION	
0211	11341	014316	JSB SPNOR	GET NEXT CHARACTER
0212	11342	051405	CPA B54	IS IT COMMA
0213	11343	027402	JMP ADCC5	YES; GO TRY "M"
0214*			SET UP BUFFERS, START ACQUISITION	
0215	11344	063730	ADCC4 LDA ADCB1	SET 1ST BUFFER
0216	11345	073726	STA ADCB1	AS INPUT BUFFER
0217	11346	073732	STA ADCMC	AND FOR MT O/P
0218	11347	043725	ADA ADCL	MAKE END POINTER
0219	11350	073727	STA ADCBE	SET UP END
0220	11351	104200	DLD TAG	TRANSFER TAG
0221	11353	104400	DST ADCB1,I	TO BUFFER
0222	11355	037726	ISZ ADCB1	STEP POINTER
0223	11356	037726	ISZ ADCB1	
0224	11357	104200	DLD XCL	TRANSFER TIME
0225	11361	104400	DST ADCB1,I	TO BUFFER
0226	11363	037726	ISZ ADCB1	STEP POINTER
0227	11364	037726	ISZ ADCB1	
0228	11365	063740	LDA ADCT0	CLEAR T BUFFER
0229	11366	073735	STA ADCTI	WORD INPUT
0230	11367	073736	STA ADCTJ	SET INPUT

0231	11370	073737		STA ADCTO	AND OUTPUT
0232	11371	003400		CGA	SET EXPIRING COUNT
0233	11372	073720		STA ADCTC	FOR TIME
0234	11373	073722		STA ADCD	AND DECIMATION
0235	11374	002400		CLA	CLEAR CHANNEL COUNT
0236	11375	073707		STA ADCCT	= "TRANSFER COMPLETE"
0237	11376	073743		STA ADCTF	CLEAR TRANSFER FLAG
0238	11377	063422		LDA ADCIN	ENABLE FADC(0)
0239	11400	073214		STA ADCC2	= TURN ON DIGITISATION
0240	11401	125174		JMP EFX,I	
0241*					
0242	11402	014401	ADCC5	JSB GETC	PASS ,
0243	11403	115133		JSB GT1,I	GET OPTION
0244	11404	051426		CPA B115	M?
0245	11405	027407		JMP ADCCM	
0246	11406	014220		JSB ERROR	ILLEGAL OPTION
0247	11407	037723	ADCCM	ISZ ADCMF	SET MT FLAG
0248	11410	060745		LDA BUNT	ANY UNIT SELECTED?
0249	11411	002021		SSA,RSS	+ = YES
0250	11412	027344		JMP ADCC4	
0251	11413	002400		CLA	DEFAULT TO ZERO
0252	11414	115136		JSB BSL,I	SELECT UNIT ZERO
0253	11415	027344		JMP ADCC4	
0254*					
0255	11416	063423	ADCCX	LDA ADCI3	DISABLE FADC(0)
0256	11417	073214		STA ADCC2	
0257	11420	107724		CLC ADC,C	
0258	11421	125174		JMP EFX,I	
0259*					
0260	11422	014542	ADCIN	JSB PUSHJ	
0261	11423	014220	ADC13	JSB ERROR	

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0263*   ADC INTERRUPT ROUTINES FOR GUILDLINE DIGITAL
0264*   CTD PROTOTYPE;
0265*   THE DATA FORMAT IS
0266*   CH 0   CHECK; NOT EXAMINED
0267*   CH 1   C SUPPRESSION IN BITS 5-9
0268*   CH 2   C DATA. 12-BITS
0269*   CH 3   T DATA. 12-BITS
0270*   CH 4   T SUPPRESSION IN BITS 6-9
0271*   CH 5   P SUPPRESSION IN BITS 8-10
0272*   CH 6   P DATA. 12-BITS
0273*   CH 7   CHECK; NOT EXAMINED
0274*   CH 8 AND UP; 12-BIT DATA
0275*
0276*   FOLLOWING ROUTINE ACTS AS A SWITCH TO APPROPRIATE
0277*   INTERRUPT ROUTINE
0278  11424 011466  ADCRT DEF ADCI0  POINTER TO CURRENT IR ROUTINE
0279  11425 063710          LDA ADCA  RESTORE A
0280  11426 103124          CLF ADC  CLEAR ADC FLAG
0281  11427 127430          JMP ADCIR,I RETURN FROM INTERRUPT
0282*
0283*   INTERRUPT ENTRY POINT
0284  11430 000000  ADCIR NOP          INTERRUPT COMES HERE
0285  11431 073710          STA ADCA  SAVE A
0286  11432 102524          LIA ADC  GET DATA
0287  11433 013711          AND ADCM4 MASK CHANNEL NO
0288  11434 053716          CPA ADCCH COMPARE EXPECTED
0289  11435 027441          JMP *+4  OK
0290  11436 063761          LDA ADCST NOT EXPECTED CH
0291  11437 033762          IOR ADCCE SET "CHANNEL ERROR"
0292  11440 073761          STA ADCST IN ADC STATUS
0293  11441 043712          ADA ADCH1 STEP CHANNEL
0294  11442 073716          STA ADCCH SET NEW EXPECTED CH.
0295  11443 102524          LIA ADC  GET DATA AGAIN
0296  11444 127424          JMP ADCRT,I GO TO CURRENT IR ROUTINE
0297*
0298  11445 000000  ADCSV NOP          SAVE B,E,0
0299  11446 077464          STB ADCB  SAVE B
0300  11447 005520          ERB,BLS  E TO SIGN, CLEAR L.S.
0301  11450 102201          SOC          0..
0302  11451 006004          INB          ..TO L.S.
0303  11452 077465          STB ADCE0 SAVE E AND 0
0304  11453 127445          JMP ADCSV,I
0305*
0306*   RETURN AFTER USING B,E,0
0307  11454 000000  ADCR2 NOP
0308  11455 067465          LDB ADCE0 GET E,0
0309  11456 103101          CLO
0310  11457 004036          SLB,ELB  RESTORE E
0311  11460 102101          STO          RESET 0 IF NECESSARY
0312  11461 067464          LDB ADCB  RESTORE B
0313  11462 017424          JSB ADCRT NORMAL RETURN FROM IR
0314  11463 127454          JMP ADCR2,I GO TO CURRENT IR ROUTINE
0315*
0316  11464 000000  ADCB  NOP          STORE FOR B
0317  11465 000000  ADCE0 NOP         STORE FOR E AND 0
0318*

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0319* SPECIFIC INTERRUPT SERVICE ROUTINES

0320* CHANNEL ZERO; -VREF

0321 11466 017424 ADCI0 JSB ADCRT IGNORE -VREF

0322*

0323* CHANNEL 1; C SUPPRESSION

0324 11467 013745 AND ADCM1 BITS 5-9

0325 11470 001700 ALF SHIFT

0326 11471 001222 RAL,RAL 6 LEFT; BITS 11-15

0327 11472 023760 XOR ADCSG FIX SIGN

0328 11473 073754 STA ADCC SAVE

0329 11474 017424 JSB ADCRT RETURN

0330*

0331* CHANNEL 2; C DATA

0332 11475 013750 AND ADCM2 MASK FLAG BIT (M.S.)

0333 11476 017445 JSB ADCSV SAVE B,E,0

0334 11477 070001 STA I SAVE FLAG IN B

0335 11500 102524 LIA ADC GET DATA

0336 11501 013751 AND ADCM5 MASK DATA BITS

0337 11502 033754 IOR ADCC INCLUDE SUPPRESSION

0338 11503 006003 SZB,RSS TEST FLAG BIT

0339 11504 043753 ADA ADCOR CORRECT SUPPRESSION

0340 11505 073754 STA ADCC SAVE C

0341 11506 017454 JSB ADCR2 RESTORE B,E,0 AND RETURN

0342*

0343* CHANNEL 3; T DATA

0344 11507 073755 STA ADCT1 SAVE T DATA

0345 11510 017424 JSB ADCRT RETURN

0346*

0347* CHANNEL 4; T SUPPRESSION

0348 11511 013746 AND ADCMT BITS 6-9

0349 11512 001722 ALF,RAL POSITION; BITS 11-14

0350 11513 073756 STA ADCT2 SAVE SUPPRESSION BITS

0351 11514 063755 LDA ADCT1 GET REST OF DATA

0352 11515 013750 AND ADCM2 MASK FLAG BIT

0353 11516 017445 JSB ADCSV SAVE B,E,0

0354 11517 070001 STA I SAVE FLAG IN B

0355 11520 063755 LDA ADCT1 GET DATA AGAIN

0356 11521 013751 AND ADCM5 MASK DATA BITS

0357 11522 033756 IOR ADCT2 INCLUDE SUPPRESSION

0358 11523 006003 SZB,RSS TEST FLAG BIT

0359 11524 043753 ADA ADCOR CORRECT SUPPRESSION

0360 11525 073755 STA ADCT1 SAVE T

0361 11526 017454 JSB ADCR2 RESTORE B,E,0 AND RETURN

0362*

0363* CHANNEL 5; P SUPPRESSION

0364 11527 013747 AND ADCMP BITS 8-10

0365 11530 001723 ALF,RAR POSITION; BITS 11-13

0366 11531 073757 STA ADCP SAVE

0367 11532 017424 JSB ADCRT RETURN

0368*

0369* CHANNEL 6; P DATA

0370 11533 013750 AND ADCM2 MASK FLAG BIT

0371 11534 017445 JSB ADCSV SAVE B,E,0

0372 11535 070001 STA I SAVE FLAG IN B

0373 11536 102524 LIA ADC GET DATA

0374 11537 013751 AND ADCM5 MASK DATA BITS

0375	11540	033757	IOR ADCP	INCLUDE SUPPRESSION
0376	11541	006003	SZB,RSS	TEST FLAG
0377	11542	043753	ADA ADCOR	CORRECT SUPPRESSION
0378	11543	173726	STA ADCBI,I	PUT P IN BUFFER
0379	11544	037707	ISZ ADCCT	COUNT; DOESN'T SKIP
0380	11545	067743	LDB ADCTF	TRANSFER FLAG TO B
0381	11546	173735	STA ADCTI,I	P TO T BUFFER TOO
0382	11547	037726	ISZ ADCBI	STEP BUFFER PTR
0383	11550	006002	SZB	AND, IF WANTED,
0384	11551	037735	ISZ ADCTI	T BUFFER PTR TOO
0385	11552	063755	LDA ADCTI	GET T
0386	11553	173726	STA ADCBI,I	PUT T IN BUFFER
0387	11554	037707	ISZ ADCCT	COUNT; DOESN'T SKIP
0388	11555	173735	STA ADCTI,I	T TO T BUFFER TOO
0389	11556	037726	ISZ ADCBI	STEP BUFFER PTR
0390	11557	006002	SZB	AND, IF WANTED,
0391	11560	037735	ISZ ADCTI	T BUFFER PTR TOO
0392	11561	063754	LDA ADCC	AND C
0393	11562	173726	STA ADCBI,I	C TO BUFFER
0394	11563	173735	STA ADCTI,I	C TO T BUFFER TOO
0395	11564	037726	ISZ ADCBI	STEP BUFFER PTR
0396	11565	006002	SZB	AND, IF WANTED,
0397	11566	037735	ISZ ADCTI	T BUFFER PTR TOO
0398	11567	037707	ISZ ADCCT	COUNT CHANNELS
0399	11570	002001	RSS	
0400	11571	027612	JMP ADCXX	DONE
0401	11572	017454	JSB ADCR2	RESTORE B,E,0 AND RETURN
0402*				
0403*			CHANNEL 7; +VREF	
0404	11573	017424	JSB ADCRT	IGNORE +VREF
0405*				
0406*			CHANNELS 8 AND UP; 12-BIT DATA	
0407	11574	013752	AND ADCM3	MASK 12 DATA BITS
0408	11575	001700	ALF	LEFT 4; BITS 0-11
0409	11576	023760	XOR ADCSG	FIX SIGN
0410	11577	001121	ARS,ARS	POSITION
0411	11600	001121	ARS,ARS	BITS 0-15
0412	11601	173726	ADCYY STA ADCBI,I	STORE IN BUFFER
0413	11602	037726	ISZ ADCBI	STEP BUFFER POINTER
0414	11603	173735	STA ADCTI,I	OUTPUT TO TBUF TOO
0415	11604	063743	LDA ADCTF	THEN LOOK TO SEE
0416	11605	002002	SZA	IF WANTED
0417	11606	037735	ISZ ADCTI	YES; STEP POINTER
0418	11607	037707	ISZ ADCCT	COUNT CHANNELS
0419	11610	027425	JMP ADCRT+1	GO GET ANY MORE
0420	11611	017445	JSB ADCSV	SAVE A,B,E,0
0421*			END OF SET	
0422	11612	107724	ADCXX CLC ADC,C	TURN OFF INTERFACE
0423	11613	002400	CLA	CLEAR
0424	11614	073743	STA ADCTF	TRANSFER FLAG
0425	11615	063735	LDA ADCTI	CHECK T BUF PTR
0426	11616	053741	CPA ADCTE	AT END?
0427	11617	063740	LDA ADCT0	SET TO START
0428	11620	073735	STA ADCTI	SET NEW T BUF PTR
0429	11621	073736	STA ADCTJ	AND LET FADC(0) READ
0430	11622	063726	LDA ADCBI	CHECK BUFFER PTR

0431	11623	053727	CPA ADCBE	FULL?
0432	11624	027627	JMP ADCFU	YES; GO DEAL WITH IT
0433	11625	017454	JSB ADCR2	RESTORE B,E,0 AND RETURN
0434	11626	027466	JMP ADCI0	NEXT IR IS CH 0
0435*				
0436*				BUFFER FULL; SWAP TO OTHER, WRITE TO MT IF REQUIRED
0437	11627	063732	ADCFU LDA ADCMC	WHICH BUFFER?
0438	11630	053730	CPA ADCBI	1ST?
0439	11631	027701	JMP ADCF1	YES
0440	11632	063730	LDA ADCBI	WAS 2ND; SET 1ST
0441	11633	073726	ADCF2 STA ADCBI	SET START OF BUFFER
0442	11634	073733	STA ADCMD	FOR MT ALSO
0443	11635	043725	ADA ADCL	MAKE PTR TO END
0444	11636	073727	STA ADCBE	SET END OF BUFFER
0445	11637	104200	DLD TAG	GET TAG
0446	11641	104400	DST ADCBI,I	FOR NEW RECORD
0447	11643	037726	ISZ ADCBI	STEP PTR TO TIME
0448	11644	037726	ISZ ADCBI	
0449	11645	104200	DLD XCL	GET CURRENT TIME
0450	11647	104400	DST ADCBI,I	WRITE TO RECORD
0451	11651	037726	ISZ ADCBI	STEP PTR TO DATA
0452	11652	037726	ISZ ADCBI	
0453	11653	063723	LDA ADCMF	MT O/P ENABLED?
0454	11654	002003	SZA,RSS	
0455	11655	027675	JMP ADCIX	NO; EXIT
0456	11656	115156	JSB BUW,I	CHECK PREVIOUS MT XFER
0457*				THERE ARE CIRCUMSTANCES IN WHICH THE PROGRAM
0458*				CAN HANG UP HERE ... BUT IF IT DOES, YOU WERE
0459*				LOSING DATA ANYWAY.
0460	11657	010765	AND BUFEP	7-TRACK EOT, TIMING, PARITY
0461	11660	073761	STA ADCST	SET IN 'STATUS'
0462	11661	102513	LIA MTC	GET MT STATUS AGAIN
0463	11662	010761	AND BUFET	TEST END OF TAPE
0464	11663	002002	SZA	
0465	11664	027703	JMP ADCF3	GO SWAP TAPE UNITS
0466*				INITIATE MAG TAPE TRANSFER ON SELECTED UNIT
0467	11665	063732	ADCF4 LDA ADCMC	GET CORE PTR FOR MT O/P
0468	11666	070773	STA BUPT	SET IT IN MT ROUTINE
0469	11667	063725	LDA ADCL	GET BUFFER LENGTH
0470	11670	003004	CMA,INA	NEGATE
0471	11671	070774	STA SUL	SET IT IN MT ROUTINE
0472	11672	115157	JSB BUD,I	SET UP DMA FOR WRITE
0473	11673	060750	LDA BUFWI	BINARY WRITE
0474	11674	115160	JSB BUG,I	START TAPE MOVING
0475	11675	063733	ADCIX LDA ADCMD	SET MT CORE PTR
0476	11676	073732	STA ADCMC	FOR NEXT TIME
0477	11677	017454	JSB ADCR2	RETURN FROM INTERRUPT
0478	11700	027466	JMP ADCI0	NEXT IR IS CH 0
0479*				
0480	11701	063731	ADCF1 LDA ADCB2	WAS BUFFER 1; SET 2
0481	11702	027633	JMP ADCF2	
0482*				
0483	11703	060745	ADCF3 LDA BUNT	ONE TAPE FULL; SWAP TO
0484	11704	021355	XOR B1	THE OTHER UNIT, SWAPPING
0485	11705	115136	JSB BSL,I	0 AND 1 OR 2 AND 3.
0486	11706	027665	JMP ADCF4	

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0487*
0488*          POINTERS, COUNTS ETC.
0489  11707  000000  ADCCT  NOP          COUNT CHANNELS
0490  11710  000000  ADCA   NOP          STORE FOR A
0491  11711  170000  ADCM4  OCT 170000    MASK FOR CHANNEL NUMBER
0492  11712  010000  ADCH1  OCT 10000    ONE CHANNEL
0493  11713  000000  ADCCN  NOP          NO OF OUTPUT CHANNELS
0494  11714  000000  ADCCL  NOP          LENGTH OF FP ARRAY
0495  11715  000000  ADCHC  NOP          -NO OF OUTPUT CHS.
0496  11716  000000  ADCCH  NOP          EXPECTED CHANNEL NO
0497  11717  000000  ADCTM  NOP          -NO OF TIME INTS/CH
0498  11720  000000  ADCTC  NOP          COUNT TIME INTERVALS
0499  11721  000000  ADCDC  NOP          -DECIMATION COUNT
0500  11722  000000  ADCD   NOP          COUNT DECIMATION
0501  11723  000000  ADCMF  NOP          "M" FLAG; +=MT O/P
0502  11724  001604  ADCBL  DEC 900      MAXIMUM BUFFER
0503  11725  000000  ADCL  NOP          ACTUAL BUFFER LENGTH
0504  11726  000000  ADCBI  NOP          BUFFER INPUT POINTER
0505  11727  000000  ADCBE  NOP          BUFFER END POINTER
0506  11730  011764  ADCBI  DEF ADCBF    BUFFER 1
0507  11731  013574  ADCB2  DEF ADCBF+904  BUFFER 2
0508  11732  000000  ADCMC  NOP          CORE FOR MT XFER
0509  11733  000000  ADCMD  NOP          CORE FOR NEXT MT XFER
0510  11734  000454  ADCTL  DEC 300     MAX LENGTH T BUFFER
0511  11735  015404  ADCTI  DEF ADCT
0512  11736  015404  ADCTJ  DEF ADCT     T BUFFER SET PTR
0513  11737  015404  ADCTO  DEF ADCT     T BUFFER OUTPUT PTR
0514  11740  015404  ADCT0  DEF ADCT     START OF T BUFFER
0515  11741  000000  ADCTE  NOP          END T BUFFER
0516  11742  000000  ADCPT  NOP          CURRENT SET PTR
0517  11743  000000  ADCTF  NOP          TRANSFER FLAG
0518  11744  011466  ADCIP  DEF ADCI0    FIRST IR ROUTINE
0519  11745  001740  ADCM1  OCT 1740    MASK BITS 5-9
0520  11746  001700  ADCMT  OCT 1700    MASK BITS 6-9
0521  11747  003400  ADCMP  OCT 3400    MASK BITS 8-10
0522  11750  004000  ADCM2  OCT 4000    MASK FLAG BIT
0523  11751  003777  ADCM5  OCT 3777    MASK 11 DATA BITS
0524  11752  007777  ADCM3  OCT 7777    MASK 12 DATA BITS
0525  11753  174000  ADCOR  OCT -4000   CORRECTION TO M.S.
0526  11754  000000  ADCC   NOP          STORE FOR C
0527  11755  000000  ADCT1  NOP          STORE FOR T
0528  11756  000000  ADCT2  NOP          STORE FOR T SUPP
0529  11757  000000  ADCP   NOP          STORE FOR P SUPP
0530  11760  100000  ADCSG  OCT 100000  TO COMPLEMENT SIGN BIT
0531  11761  000000  ADCST  NOP          STATUS
0532  11762  000010  ADCCE  OCT 10     "CHANNEL ERROR" BIT 3
0533  11763  000001  ADCET  OCT 1     "ADC TIMING ERROR" BIT 0
0534  11764  000000  ADCBF  BSS 1808   BUFFER
0535  15404  000000  ADCT   BSS 300   TRANSFER BUFFER

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0537*FCLK,REAL TIME CLOCK(PROGRAM CALLED PART)
0538 16060 061175 XCLK LDA FLAG TEST ARGUMENT
0539 16061 002002 SZA 0=READ TIME
0540 16062 026104 JMP XCLKS
0541 16063 061114 LDA XCL GET M.S
0542 16064 105120 ABS -FLT FLOAT IT
0543 16065 115161 JSB PW2,I SCALE 2*16
0544 16066 000020 DEC 16
0545 16067 071204 STA F3 SAVE M.S
0546 16070 075205 STB F3+1
0547 16071 061115 LDA XCL+1 GET L.S.
0548 16072 105120 ABS -FLT FLOAT IT
0549 16073 002021 SSA,RSS TEST SIGN
0550 16074 026077 JMP *+3 +VE OK
0551 16075 105000 ABS -FAD CONVERT TO UNSIGNED
0552 16076 016102 DEF CLKFN BY ADDING 65536
0553 16077 105000 ABS -FAD ADD IN M.S.
0554 16100 001204 DEF F3
0555 16101 125174 JMP EFX,I
0556 16102 040000 CLKFN DEC 65536.
0557*
0558 16104 107723 XCLKS CLC CLOCK,C STOP CLOCK
0559 16105 002020 SSA +=SET TIME START CLOCK
0560 16106 125174 JMP EFX,I -=STOP CLOCK
0561 16107 065176 LDB FLAG+1 GET ARGUMENT
0562 16110 115161 JSB PW2,I SCALE BY 2*-15
0563 16111 177761 OCT -17
0564 16112 071114 STA XCL SAVE SCALED TIME
0565 16113 075115 STB XCL+1
0566 16114 115142 JSB ENTP,I TRUNCATE TO INTEGER
0567 16115 115134 JSB IFX,I GET MORE SIG
0568 16116 071116 STA XCL+2 AND SAVE IT
0569 16117 003004 CMA,INA -INTPT(X)
0570 16120 105120 ABS -FLT BACK TO FLOATING POINT
0571 16121 105000 ABS -FAD X-INTPT(X)
0572 16122 001114 DEF XCL
0573 16123 115161 JSB PW2,I SCALE IT BACK
0574 16124 000017 OCT 17
0575 16125 115134 JSB IFX,I INTEGER PART, ROUNDED
0576 16126 065116 LDB XCL+2 GET MORE SIG
0577 16127 004065 CLE,ERB POSITION
0578 16130 001225 RAL,ERA TRANSFER ODD BIT TO A
0579 16131 075114 STB XCL
0580 16132 071115 STA XCL+1
0581*
0582 16133 061356 LDA B2 SET CLOCK RATE
0583 16134 102623 OTA CLOCK
0584 16135 103723 STC CLOCK,C START CLOCK
0585 16136 125174 JMP EFX,I

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0587*FSW, READ WRITE SWITCH REGISTER

0588	16137	061175	XSW	LDA	FLAC
0589	16140	065176		LDB	FLAC+1
0590	16141	115134		JSB	IFX, I
0591	16142	070001		STA	I
0592	16143	102501		LIA	I
0593	16144	106601		OTB	I
0594	16145	105120		ABS	-FLT
0595	16146	125174		JMP	EFX, I

0596*

0597*FTAG, SET 32-BIT TAG FOR "FADC" MAGTAPE OUTPUT

0598	16147	061175	XTAG	LDA	FLAC
0599	16150	065176		LDB	FLAC+1
0600	16151	115134		JSB	IFX, I
0601	16152	071117		STA	TAG
					STORE TAG
0602	16153	014542		JSB	PUSHJ
					GET 2ND ARGUMENT
0603	16154	006706		DEF	ARG
					IF ANY
0604	16155	125174		JMP	EFX, I
					NO 2ND ARGUMENT
0605	16156	061175		LDA	FLAC
					PICK UP 2ND ARGUMENT
0606	16157	065176		LDB	FLAC+1
0607	16160	115134		JSB	IFX, I
					CONVERT TO INTEGER
0608	16161	071120		STA	TAG+1
					AND STORE
0609	16162	125174		JMP	EFX, I
					THAT'S ALL THERE IS TO IT

0610*

0612*	SAL	SALINITY	FUNCTION	
0613	16163	061175	XSAL LDA	FLAC SAVE P
0614	16164	065176	LDB	FLAC+1
0615	16165	072311	STA	SALP
0616	16166	076312	STB	SALP+1
0617	16167	014542	JSB	PUSHJ GET T
0618	16170	006706	DEF	ARG
0619	16171	014220	JSB	ERROR NO T
0620	16172	061175	LDA	FLAC SAVE T
0621	16173	065176	LDB	FLAC+1
0622	16174	072313	STA	SALT
0623	16175	076314	STB	SALT+1
0624	16176	014542	JSB	PUSHJ GET C
0625	16177	006706	DEF	ARG
0626	16200	014220	JSB	ERROR NO C
0627	16201	062313	LDA	SALT PRESSURE CORRECTION
0628	16202	066314	LDB	SALT+1 T POLY
0629	16203	115463	JSB	POLY,I
0630	16204	000003	DEC	3
0631	16205	016317	DEF	SAL1
0632	16206	072315	STA	SALT1
0633	16207	076316	STB	SALT1+1
0634	16210	062311	LDA	SALP P POLY
0635	16211	066312	LDB	SALP+1
0636	16212	115463	JSB	POLY,I
0637	16213	000004	DEC	4
0638	16214	016325	DEF	SAL2
0639	16215	105060	ABS	-FDV P POLY/T POLY
0640	16216	016315	DEF	SALT1
0641	16217	105000	ABS	-FAD
0642	16220	001302	DEF	FL1
0643	16221	072315	STA	SALT1
0644	16222	076316	STB	SALT1+1 1+P POLY/T POLY
0645*				
0646	16223	062313	LDA	SALT MAIN TEMPERATURE COMP.
0647	16224	066314	LDB	SALT+1
0648	16225	115463	JSB	POLY,I
0649	16226	000006	DEC	6
0650	16227	016335	DEF	SAL3
0651	16230	105040	ABS	-FMP APPLY P T CORRECTION
0652	16231	016315	DEF	SALT1
0653	16232	072315	STA	SALT1
0654	16233	076316	STB	SALT1+1
0655	16234	061175	LDA	FLAC TO CONDUCTIVITY
0656	16235	065176	LDB	FLAC+1
0657	16236	105060	ABS	-FDV
0658	16237	016315	DEF	SALT1
0659	16240	071175	STA	FLAC RETURN MODIFIED CONDUCTIVITY
0660	16241	075176	STB	FLAC+1 TO FLAC
0661*				
0662	16242	105020	ABS	-FSB MAKE SMALL CORRECTIONS
0663	16243	001302	DEF	FL1
0664	16244	105040	ABS	-FMP C*(C-1)
0665	16245	001175	DEF	FLAC
0666	16246	072315	STA	SALT1
0667	16247	076316	STB	SALT1+1

0668	16250	062313	LDA	SALT	PRESSURE TERM
0669	16251	066314	LDB	SALT+1	
0670	16252	115463	JSB	POLY,I	
0671	16253	000002	DEC	2	
0672	16254	016357	DEF	SAL5	
0673	16255	105040	ABS	-FMP	
0674	16256	016311	DEF	SALP	
0675	16257	072355	STA	SAL4+4	
0676	16260	076356	STB	SAL4+5	
0677*					
0678	16261	061175	LDA	FLAC	C-T TERMS
0679	16262	065176	LDB	FLAC+1	
0680	16263	115463	JSB	POLY,I	
0681	16264	000002	DEC	2	
0682	16265	016363	DEF	SAL6	
0683	16266	072353	STA	SAL4+2	
0684	16267	076354	STB	SAL4+3	
0685	16270	062313	LDA	SALT	COMBINE
0686	16271	066314	LDB	SALT+1	
0687	16272	115463	JSB	POLY,I	
0688	16273	000003	DEC	3	
0689	16274	016351	DEF	SAL4	
0690	16275	105040	ABS	-FMP	*C*(C-1)
0691	16276	016315	DEF	SALT1	
0692	16277	072315	STA	SALT1	
0693	16300	076316	STB	SALT1+1	
0694*					
0695	16301	061175	LDA	FLAC	MAIN C TO S
0696	16302	065176	LDB	FLAC+1	
0697	16303	115463	JSB	POLY,I	
0698	16304	000006	DEC	6	
0699	16305	016367	DEF	SAL7	
0700	16306	105000	ABS	-FAD	ADD CORRECTIONS
0701	16307	016315	DEF	SALT1	
0702	16310	125174	JMP	EPX,I	RESULT IN A AND B
0703*					
0704	16311	000000	SALP	DEC	0.
0705	16313	000000	SALT	DEC	0.
0706	16315	000000	SALT1	DEC	0.
0707	16317	051422	SAL1	DEC	3.169E-4,3.0786E-2,1.
0708	16325	067423	SAL2	DEC	6.166E-15,-5.4945E-10,1.60836E-5,0.
0709	16335	137105	SAL3	DEC	-.95646E-9,.663405E-7,-.218091E-5,1.227E-3
0710	16345	051025	DEC	DEC	.200402E-1,.676518
0711	16351	103551	SAL4	DEC	-.46E-3,0.,0.
0712	16357	117261	SAL5	DEC	-2.9E-6,1.25E-4
0713	16363	137166	SAL6	DEC	-4.E-3,.442E-1
0714	16367	125522	SAL7	DEC	-1.32311,5.98624,-10.61869,12.13882
0715	16377	071555	DEC	DEC	28.8567,-.08996

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0717*      SINGLE PRECISION SIGMA T FUNCTION
0718*      USES FORMULA DERIVED BY BENNETT AS A FIT
0719*      TO DATA OF COX ET AL AND TO CLASSIC
0720*      DISTILLED WATER DATA
0721 16403 061175 XSGT LDA FLAC GET T
0722 16404 065176 LDB FLAC+1
0723 16405 115463 JSB POLY,I
0724 16406 000004 DEC 4
0725 16407 016453 DEF SGT2
0726 16410 072451 STA SGT1+8
0727 16411 076452 STB SGT1+9 MOST SIG SALINITY COEFF.
0728 16412 061175 LDA FLAC GET T AGAIN
0729 16413 065176 LDB FLAC+1
0730 16414 115463 JSB POLY,I
0731 16415 000004 DEC 4
0732 16416 016463 DEF SGT3
0733 16417 072447 STA SGT1+6
0734 16420 076450 STB SGT1+7 NEXT SAL COEFF.
0735 16421 061175 LDA FLAC T FOR THE LAST TIME
0736 16422 065176 LDB FLAC+1
0737 16423 115463 JSB POLY,I
0738 16424 000002 DEC 2
0739 16425 016473 DEF SGT4
0740 16426 072445 STA SGT1+4
0741 16427 076446 STB SGT1+5 3RD SAL COEFF
0742*
0743 16430 014542 JSB PUSHJ GET SALINITY
0744 16431 006706 DEF ARG
0745 16432 014220 JSB ERROR NO SALINITY
0746 16433 061175 LDA FLAC S TO A B
0747 16434 065176 LDB FLAC+1
0748 16435 115463 JSB POLY,I
0749 16436 000005 DEC 5
0750 16437 016441 DEF SGT1
0751 16440 125174 JMP EFX,I EXIT; RESULT IN A B
0752*
0753 16441 120264 SGT1 DEC -3.55E-7,3.685E-5,0.,0.,0.
0754 16453 044174 SGT2 DEC 6.913E-5,-8.9871E-3,6.96899E-2,-6.016E-2
0755 16463 104256 SGT3 DEC -8.89E-7,7.469E-5,-3.7666E-3,.81993
0756 16473 056265 SGT4 DEC 5.526E-6,-1.259E-3

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0758* NEW START OF TEXT + VERSION ID

0759*

0760	16477	000000	TEXT	CCT	0	
0761	16500	000000		OCT	0	
0762	16501	041455		ASC	6,C-ONCAL,V150	LEAD IN MESSAGE
0763	16507	043015		OCT	43015	
0764	16510		BUFEG	EQU	*	

0765*

0766* ONCAL CONSTANTS AND ROUTINE ENTRIES

0767	01175		FLAC	EQU	1175B	
0768	00542		PUSHJ	EQU	542B	
0769	06706		ARG	EQU	6706B	
0770	00220		ERROR	EQU	220B	
0771	72660		FLT	EQU	72660B	
0772	72720		FDV	EQU	72720B	
0773	73000		FAD	EQU	73000B	
0774	72760		FSB	EQU	72760B	
0775	72740		FMP	EQU	72740B	
0776	01134		IFX	EQU	1134B	
0777	01302		FL1	EQU	1302B	
0778	01174		EFX	EQU	1174B	
0779	01161		PW2	EQU	1161B	
0780	01114		XCL	EQU	1114B	
0781	06717		GTARG	EQU	6717B	
0782	01070		GTL	EQU	1070B	
0783	00634		PT1	EQU	634B	
0784	01356		B2	EQU	1356B	
0785	01360		B4	EQU	1360B	
0786	00316		SPNOR	EQU	316B	
0787	01117		TAG	EQU	1117B	
0788	01426		B115	EQU	1426B	
0789	01156		BUW	EQU	1156B	
0790	00013		MTC	EQU	13B	
0791	01142		ENTP	EQU	1142B	
0792	00401		GETC	EQU	401B	
0793	01133		GT1	EQU	1133B	
0794	01204		F3	EQU	1204B	
0795	10664		.POLY	EQU	10664B	
0796	01405		B54	EQU	1405B	
0797	00761		BUFET	EQU	761B	
0798	00773		BUPT	EQU	773B	
0799	00774		BUL	EQU	774B	
0800	01157		BUD	EQU	1157B	
0801	00750		BUFWI	EQU	750B	
0802	01160		BUG	EQU	1160B	
0803	01355		B1	EQU	1355B	
0804	01136		BSL	EQU	1136B	
0805	00745		BUNT	EQU	745B	
0806	00765		BUFEP	EQU	765B	
0807*						
0808	01463			ORG	1463B	BASE PAGE LINKS
0809	01463	010664	POLY	DEF	.POLY	

0810*

0811 END

** NO ERRORS*

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0001                ASME,A,L
0003*             FSAL,FSGT,FSW,XFORM
0004*             FFT ROUTINES
0005*             UPDATE TEXT POINTERS
0006 00654                ORG 654B
0007                SUP
0008 00654 013735        DEF BUFBG
0009 00655 013735        DEF BUFBG
0010 00656 013735        DEF BUFBG
0011 00657 013724        DEF TEXT
0012*
0013*             NEW FUNCTION NAMES
0014 00704                ORG 704B
0015 00704 046054        FSAL  OCT 46054
0016 00705 046364        FSGT  OCT 46364
0017*
0018*             NEW FUNCTION ROUTINE POINTERS
0019 00734                ORG 734B
0020 00734 011131        PSAL  DEF XSAL
0021 00735 011351        PSGT  DEF XSGT
0022*
0023*             TEST FOR NEW FUNCTIONS
0024 05237                ORG 5237B
0025 05237 050704        CPA  FSAL  SAL
0026 05240 124734        JMP  PSAL,I
0027 05241 050705        CPA  FSGT  SGT
0028 05242 124735        JMP  PSGT,I
0029*
0030*             POINTER TO NEW COMMAND
0031 03554                ORG 3554B
0032 03554 012000        DEF XFRM  X

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0034*

0035* NEW FUNCTIONS

0036*FSAL, SALINITY FUNCTION

0037 11131

ORG 11131B

0038*

0039*

0040	11131	061175	XSAL	LDA	FLAC	SAVE P
0041	11132	065176		LDB	FLAC+1	
0042	11133	073257		STA	SALP	
0043	11134	077260		STB	SALP+1	
0044	11135	014542		JSB	PUSHJ	GET T
0045	11136	006706		DEF	ARG	
0046	11137	014220		JSB	ERROR	NO T
0047	11140	061175		LDA	FLAC	SAVE T
0048	11141	065176		LDB	FLAC+1	
0049	11142	073261		STA	SALT	
0050	11143	077262		STB	SALT+1	
0051	11144	014542		JSB	PUSHJ	GET C
0052	11145	006706		DEF	ARG	
0053	11146	014220		JSB	ERROR	NO C
0054	11147	063261		LDA	SALT	PRESSURE CORRECTION
0055	11150	067262		LDB	SALT+1	T POLY
0056	11151	016664		JSB	.POLY	
0057	11152	000003		DEC	3	
0058	11153	011265		DEF	SAL1	
0059	11154	073263		STA	SALT1	
0060	11155	077264		STB	SALT1+1	
0061	11156	063257		LDA	SALP	P POLY
0062	11157	067260		LDB	SALP+1	
0063	11160	016664		JSB	.POLY	
0064	11161	000004		DEC	4	
0065	11162	011273		DEF	SAL2	
0066	11163	105060		ABS	-FDV	P POLY/T POLY
0067	11164	011263		DEF	SALT1	
0068	11165	105000		ABS	-FAD	
0069	11166	001302		DEF	FL1	
0070	11167	073263		STA	SALT1	
0071	11170	077264		STB	SALT1+1	1+P POLY/T POLY
0072*						
0073	11171	063261		LDA	SALT	MAIN TEMPERATURE COMP.
0074	11172	067262		LDB	SALT+1	
0075	11173	016664		JSB	.POLY	
0076	11174	000006		DEC	6	
0077	11175	011303		DEF	SAL3	
0078	11176	105040		ABS	-FMP	APPLY P T CORRECTION
0079	11177	011263		DEF	SALT1	
0080	11200	073263		STA	SALT1	
0081	11201	077264		STB	SALT1+1	
0082	11202	061175		LDA	FLAC	TO CONDUCTIVITY
0083	11203	065176		LDB	FLAC+1	
0084	11204	105060		ABS	-FDV	
0085	11205	011263		DEF	SALT1	
0086	11206	071175		STA	FLAC	RETURN MODIFIED CONDUCTIVITY
0087	11207	075176		STB	FLAC+1	TO FLAC
0088*						
0089	11210	105020		ABS	-FSB	MAKE SMALL CORRECTIONS

0090	11211	001302	DEF	FL1	
0091	11212	105040	ABS	-FMP	C*(C-1)
0092	11213	001175	DEF	FLAC	
0093	11214	073263	STA	SALT1	
0094	11215	077264	STB	SALT1+1	
0095	11216	063261	LDA	SALT	PRESSURE TERM
0096	11217	067262	LDB	SALT+1	
0097	11220	016664	JSB	.POLY	
0098	11221	000002	DEC	2	
0099	11222	011325	DEF	SAL5	
0100	11223	105040	ABS	-FMP	
0101	11224	011257	DEF	SALP	
0102	11225	073323	STA	SAL4+4	
0103	11226	077324	STB	SAL4+5	
0104*					
0105	11227	061175	LDA	FLAC	C-T TERMS
0106	11230	065176	LDB	FLAC+1	
0107	11231	016664	JSB	.POLY	
0108	11232	000002	DEC	2	
0109	11233	011331	DEF	SAL6	
0110	11234	073321	STA	SAL4+2	
0111	11235	077322	STB	SAL4+3	
0112	11236	063261	LDA	SALT	COMBINE
0113	11237	067262	LDB	SALT+1	
0114	11240	016664	JSB	.POLY	
0115	11241	000003	DEC	3	
0116	11242	011317	DEF	SAL4	
0117	11243	105040	ABS	-FMP	*C*(C-1)
0118	11244	011263	DEF	SALT1	
0119	11245	073263	STA	SALT1	
0120	11246	077264	STB	SALT1+1	
0121*					
0122	11247	061175	LDA	FLAC	MAIN C TO S
0123	11250	065176	LDB	FLAC+1	
0124	11251	016664	JSB	.POLY	
0125	11252	000006	DEC	6	
0126	11253	011335	DEF	SAL7	
0127	11254	105000	ABS	-FAD	ADD CORRECTIONS
0128	11255	011263	DEF	SALT1	
0129	11256	125174	JMP	EFX,1	RESULT IN A AND B
0130*					
0131	11257	000000	SALP	DEC	0.
0132	11261	000000	SALT	DEC	0.
0133	11263	000000	SALT1	DEC	0.
0134	11265	051422	SAL1	DEC	3.169E-4,3.0786E-2,1.
0135	11273	067423	SAL2	DEC	6.166E-15,-5.4945E-10,1.60836E-5,1.
0136	11303	137105	SAL3	DEC	-.95646E-9,.663405E-7,-.218091E-5,.2227E-3
0137	11313	051025	DEC		.200402E-1,.676518
0138	11317	103551	SAL4	DEC	-.46E-3,0.,0.
0139	11325	117261	SAL5	DEC	-2.9E-6,2.25E-4
0140	11331	137166	SAL6	DEC	-4.E-3,.442E-1
0141	11335	125522	SAL7	DEC	-1.32311,5.98624,-10.61869,12.18882
0142	11345	071555	DEC		28.8567,-.08996

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0144*   SINGLE PRECISION SIGMA T FUNCTION
0145*   USES FORMULA DERIVED BY BENNETT AS A FIT
0146*   TO DATA OF COX ET AL AND TO CLASSIC
0147*   DISTILLED WATER DATA
0148   11351 061175  XSGT  LDA FLAC      GET T
0149   11352 065176      LDB FLAC+1
0150   11353 016664      JSB .POLY
0151   11354 000004      DEC 4
0152   11355 011421      DEF SGT2
0153   11356 073417      STA SGT1+8
0154   11357 077420      STB SGT1+9  MOST SIG SALINITY COEFF.
0155   11360 061175      LDA FLAC      GET T AGAIN
0156   11361 065176      LDB FLAC+1
0157   11362 015664      JSB .POLY
0158   11363 000004      DEC 4
0159   11364 011431      DEF SGT3
0160   11365 073415      STA SGT1+6
0161   11366 077416      STB SGT1+7  NEXT SAL COEFF.
0162   11367 061175      LDA FLAC      T FOR THE LAST TIME
0163   11370 065176      LDB FLAC+1
0164   11371 016664      JSB .POLY
0165   11372 000002      DEC 2
0166   11373 011441      DEF SGT4
0167   11374 073413      STA SGT1+4
0168   11375 077414      STB SGT1+5  3RD SAL COEFF
0169*
0170   11376 014542      JSB PUSHJ   GET SALINITY
0171   11377 006706      DEF ARG
0172   11400 014220      JSB ERROR   NO SALINITY
0173   11401 061175      LDA FLAC    S TO A & B
0174   11402 065176      LDB FLAC+1
0175   11403 016664      JSB .POLY
0176   11404 000005      DEC 5
0177   11405 011407      DEF SGT1
0178   11406 125174      JMP EFX,I   EXIT; RESULT IN A & B
0179*
0180   11407 120264  SGT1  DEC  -3.55E-7,3.685E-5,0.,0.,0.
0181   11421 044174  SGT2  DEC  6.913E-5,-8.9871E-3,6.96899E-2,-6.016E-2
0182   11431 104256  SGT3  DEC  -8.89E-7,7.469E-5,-3.7666E-3,.81993
0183   11441 056265  SGT4  DEC  5.526E-6,-1.259E-3

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0185*
0186*      XFORM COMMAND
0187*      CALLS;
0188*      X F,RE,IM    FOURIER ANALYSIS
0189*      X S,RE,IM    FOURIER SERIES
0190*      X R,R1,R2    DOUBLE REAL
0191*      X R1,R2,P1,P2,V1,V2,T1,T2,C,SN ACCUMULATE SPECTRA ETC.
0192 12000          ORG 12000B      START A NEW PAGE
0193 12000 115133   XFRM  JSB GT1,I  GET OPTION
0194 12001 071476          STA XFRM0  SAVE OPTION
0195 12002 061320          LDA DM10  INITIALISE COUNT
0196 12003 071477          STA XFRMC
0197 12004 061500          LDA XFRM1  SET POINTER
0198 12005 071501          STA XFRMP  TO ARRAY TABLE
0199 12006 061503          LDA XFRM2
0200 12007 071502          STA XFRML  AND TO MINIMUM LENGTHS
0201 12010 060652   XFRM4 LDA CHAR  TEST FOR COMMA
0202 12011 051405          CPA B54
0203 12012 026051          JMP XFRM3  GET NEXT ARRAY
0204 12013 061477   XFRM5 LDA XFRMC  CHECK COUNT
0205 12014 065476          LDB XFRMO  AGAINST OPTION
0206 12015 055420          CPB B106  F ?
0207 12016 041363          ADA B10  MINIMUM 2
0208 12017 055433          CPB B123  S ?
0209 12020 041363          ADA B10  MINIMUM 2
0210 12021 055432          CPB B122  R ?
0211 12022 041363          ADA B10  MINIMUM 2
0212 12023 002020          SSA  OTHERWISE MINIMUM 10
0213 12024 014220          JSB ERROR  TOO FEW ARRAYS FOR FFT
0214 12025 061464          LDA FORX  SET UP PTR
0215 12026 003004          CMA,INA  FOR DIFFERENCE
0216 12027 041465          ADA FORY  BETWEEN X AND Y
0217 12030 073006          STA FORXY
0218 12031 003400          CCA  SET UP DIRECTION
0219 12032 055433          CPB B123  S ?
0220 12033 002400          CLA  0 IF S, -1 OTHERWISE
0221 12034 071463          STA FORDI
0222 12035 016066          JSB XFORM  DO TRANSFORM ON X,Y
0223 12036 061476          LDA XFRMO  CHECK OPTION
0224 12037 051420          CPA B106  F ?
0225 12040 125173          JMP COX,I  DONE
0226 12041 051433          CPA B123  S ?
0227 12042 125173          JMP COX,I  DONE
0228 12043 017234          JSB FOR2R  SPLIT TWO REAL TRANSFORMS
0229 12044 061476          LDA XFRMO  CHECK OPTION
0230 12045 051432          CPA B122  R ?
0231 12046 125173          JMP COX,I  DONE
0232 12047 017356          JSB FORAC  ACCUMULATE
0233 12050 125173          JMP COX,I
0234*
0235 12051 014542   XFRM3 JSB PUSHJ  GET NEXT ARRAY
0236 12052 006716          DEF GTARG-1
0237 12053 060634          LDA PT1  SET POINTER
0238 12054 171501          STA XFRMP,I  IN TABLE
0239 12055 061070          LDA GTL  TEST LENGTH
0240 12056 141502          ADA XFRML,I  AGAINST LENGTH TABLE

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0241	12057	002021	SSA,RSS	
0242	12060	014220	JSB ERROR	ARRAY TOO SHORT
0243	12061	035501	ISZ XFRMF	STEP TO NEXT
0244	12062	035502	ISZ XFRML	
0245	12063	035477	ISZ XFRMC	COUNT
0246	12064	026010	JMP XFRM4	GET MORE, IF ANY
0247	12065	026013	JMP XFRM5	DONE

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0249*          FAST FOURIER ROUTINE
0250*          BASED ON FORTRAN SUBROUTINE 'FORT'; MANY OF THE COMMENTS
0251*          REFER TO NOMENCLATURE USED THERE.
0252*          SIMPLIFIED BY USING FIXED SIZE AND MODIFIED TO USE
0253*          SEPARATE REAL AND IMAGINARY ARRAYS. CALL IS 'JSB XFORM' WITH
0254*          PARAMETERS SET UP EXTERNALLY.
0255*          TRANSFORMS: 256 REAL, POINTER IN 'FORX'
0256*                   256 IMAGINARY ... 'FORY'
0257*          DIRECTION IN 'FORDI'; IF -VE, DIVIDE BY N AND CONJUGATE
0258*          AT START, CONJUGATE AT END
0259 12066 000000 XFORM NOP
0260 12067 061464 LDA FORX SET UP SPACING
0261 12070 003004 CMA,INA BETWEEN REAL
0262 12071 041465 ADA FORY AND IMAGINARY
0263 12072 073006 STA FORXY
0264 12073 061463 LDA FORDI TEST DIRECTION
0265 12074 002021 SSA,RSS IF (IFS)32,2,36
0266 12075 026127 JMP FORS0 +VE; GO SHUFFLE ALREADY
0267*          DIVIDE BY N AND CONJUGATE
0268 12076 061345 LDA BM400 SET COUNT
0269 12077 072771 STA FORI DO 34 I=1,N
0270 12100 061464 LDA FORX SET REAL PTR
0271 12101 073007 STA FORX1
0272 12102 061465 LDA FORY SET IM PTR
0273 12103 073013 STA FORY1
0274 12104 104200 FORL0 DLD FORX1,I GET REAL
0275 12106 115161 JSB PW2,I A(2*I-1)=A(2*I-1)/FN
0276 12107 177770 DEC -8
0277 12110 104400 DST FORX1,I
0278 12112 037007 ISZ FORX1 STEP REAL PTR
0279 12113 037007 ISZ FORX1
0280 12114 104200 DLD FORY1,I GET IMAGINARY
0281 12116 115161 JSB PW2,I 34 A(2*I)=-A(2*I)/FN
0282 12117 177770 DEC -8
0283 12120 115153 JSB FCM,I CONJUGATE
0284 12121 104400 DST FORY1,I
0285 12123 037013 ISZ FORY1 STEP IM PTR
0286 12124 037013 ISZ FORY1
0287 12125 036771 ISZ FORI COUNT
0288 12126 026104 JMP FORL0 CONTINUE
0289*          SHUFFLE ROUTINE
0290 12127 061464 FORS0 LDA FORX SET RUNNING POINTER
0291 12130 072774 STA FORIJ TO SOURCE
0292 12131 002400 CLA SET J1 COUNT
0293 12132 072776 STA FORJ1 DO 30 J1=2,K1,2
0294 12133 062776 FORS1 LDA FORJ1 SET J2 COUNT
0295 12134 072777 STA FORJ2 DO 30 J2=J1,K2,K1
0296 12135 062777 FORS2 LDA FORJ2 SET J3 COUNT
0297 12136 073000 STA FORJ3 DO 30 J3=J2,K3,K2
0298 12137 063000 FORS3 LDA FORJ3 SET J4 COUNT
0299 12140 073001 STA FORJ4 DO 30 J4=J3,K4,K3
0300 12141 063001 FORS4 LDA FORJ4 SET J5 COUNT
0301 12142 073002 STA FORJ5 DO 30 J5=J4,K5,K4
0302 12143 063002 FORS5 LDA FORJ5 SET J6 COUNT
0303 12144 073003 STA FORJ6 DO 30 J6=J5,K6,K5
0304 12145 063003 FORS6 LDA FORJ6 SET J7 COUNT

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0305	12146	073004	STA FORJ7	DO 30 J7=J6,K7,K6
0306	12147	063004	FORS7 LDA FORJ7	SET JI COUNT
0307	12150	072775	STA FORJI	DO 30 JI=J12,K13,K12
0308	12151	062775	FORS8 LDA FORJI	IJ-JI
0309	12152	041464	ADA FORX	PTR TO DATA(JI)
0310	12153	073010	STA FORX2	
0311	12154	003004	CMA,INA	NEGATE FOR SUBTRACTION
0312	12155	042774	ADA FORIJ	
0313	12156	002021	SSA,RSS	IF (IJ-JI)28,30,30
0314	12157	026216	JMP FORS9	
0315	12160	104200	DLD FORIJ,I	SWAP REALS
0316	12162	104400	DST FORT	T=A(IJ-1)
0317	12164	104200	DLD FORX2,I	A(IJ-1)=A(JI-1)
0318	12166	104400	DST FORIJ,I	
0319	12170	104200	DLD FORT	A(JI-1)=T
0320	12172	104400	DST FORX2,I	
0321	12174	062774	LDA FORIJ	SET PTRS TO IMS
0322	12175	043006	ADA FORXY	
0323	12176	073013	STA FORY1	SOURCE
0324	12177	063010	LDA FORX2	AND DESTINATION
0325	12200	043006	ADA FORXY	
0326	12201	073014	STA FORY2	
0327	12202	104200	DLD FORY1,I	SWAP IMS
0328	12204	104400	DST FORT	T=A(IJ)
0329	12206	104200	DLD FORY2,I	A(IJ)=A(JI)
0330	12210	104400	DST FORY1,I	
0331	12212	104200	DLD FORT	A(JI)=T
0332	12214	104400	DST FORY2,I	
0333*			END OF SWAP; NOW START COUNTING FOR SHUFFLE	
0334	12216	062774	FORS9 LDA FORIJ	IJ=IJ+2
0335	12217	041356	ADA B2	
0336	12220	072774	STA FORIJ	
0337	12221	062775	LDA FORJI	STEP JI
0338	12222	041453	ADA B400	
0339	12223	072775	STA FORJI	
0340	12224	041346	ADA BMTN	DONE JI?
0341	12225	002020	SSA	
0342	12226	026151	JMP FORS8	CONTINUE JI
0343	12227	063004	LDA FORJ7	STEP J7
0344	12230	041444	ADA B200	
0345	12231	073004	STA FORJ7	
0346	12232	041345	ADA BM400	DONE J7?
0347	12233	002020	SSA	
0348	12234	026147	JMP FORS7	CONTINUE J7
0349	12235	063003	LDA FORJ6	STEP J6
0350	12236	041415	ADA B100	
0351	12237	073003	STA FORJ6	
0352	12240	041344	ADA BM200	DONE J6?
0353	12241	002020	SSA	
0354	12242	026145	JMP FORS6	CONTINUE J6
0355	12243	063002	LDA FORJ5	STEP J5
0356	12244	041374	ADA B400	
0357	12245	073002	STA FORJ5	
0358	12246	041343	ADA BM100	DONE J5?
0359	12247	002020	SSA	
0360	12250	026143	JMP FORS5	CONTINUE J5

0361	12251	063001	LDA FORJ4	STEP J4
0362	12252	041370	ADA B20	
0363	12253	073001	STA FORJ4	
0364	12254	041342	ADA BM40	DONE J4?
0365	12255	002020	SSA	
0366	12256	026141	JMP FORS4	CONTINUE J4
0367	12257	063000	LDA FORJ3	STEP J3
0368	12260	041363	ADA B10	
0369	12261	073000	STA FORJ3	
0370	12262	041341	ADA BM20	DONE J3?
0371	12263	002020	SSA	
0372	12264	026137	JMP FORS3	CONTINUE J3
0373	12265	062777	LDA FORJ2	STEP J2
0374	12266	041360	ADA B4	
0375	12267	072777	STA FORJ2	
0376	12270	041340	ADA BM10	DONE J2?
0377	12271	002020	SSA	
0378	12272	026135	JMP FORS2	CONTINUE J2
0379	12273	062776	LDA FORJ1	STEP J1
0380	12274	041356	ADA B2	
0381	12275	072776	STA FORJ1	
0382	12276	041337	ADA BM4	DONE J1?
0383	12277	002020	SSA	
0384	12300	026133	JMP FORS1	
0385*			ALL SHUFFLED	
0386*				
0387*			ACTUAL TRANSFORM	
0388*				
0389*			START L=1 TRANSFORM STAGE	
0390	12301	061344	LDA BM200	USE I AS COUNT
0391	12302	072771	STA FORI	
0392	12303	061464	LDA FORX	AND X1 AS CORRESPONDING
0393	12304	073007	FORL2 STA FORX1	POINTER
0394	12305	041356	ADA B2	SET UP POINTERS
0395	12306	073010	STA FORX2	TO OTHER REAL
0396	12307	043006	ADA FORXY	AND TO IMS
0397	12310	073014	STA FORY2	
0398	12311	041336	ADA BM2	
0399	12312	073013	STA FORY1	
0400	12313	104200	DLD FORX1,I	PROCESS REALS
0401	12315	104400	DST FORT	
0402	12317	105000	ABS -FAD	
0403	12320	113010	DEF FORX2,I	
0404	12321	104400	DST FORX1,I	
0405	12323	104200	DLD FORT	
0406	12325	105020	ABS -FSB	
0407	12326	113010	DEF FORX2,I	
0408	12327	104400	DST FORX2,I	
0409	12331	104200	DLD FORY1,I	AND IMS
0410	12333	104400	DST FORT	
0411	12335	105000	ABS -FAD	
0412	12336	113014	DEF FORY2,I	
0413	12337	104400	DST FORY1,I	
0414	12341	104200	DLD FORT	
0415	12343	105020	ABS -FSB	
0416	12344	113014	DEF FORY2,I	

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0417 12345 104400      DST FORY2,I
0418 12347 063007      LDA FORX1   STEP POINTER
0419 12350 041360      ADA B4
0420 12351 036771      ISZ FORI   COUNT
0421 12352 026304      JMP FORL2  CONTINUE
0422*           L=1 TRANSFORM COMPLETE
0423*
0424*           START L=2,8 STAGES OF TRANSFORM
0425 12353 061317      LDA BM7   SET L COUNT
0426 12354 072773      STA FORL
0427 12355 002404      CLA,INA   SET UP OTHER CTS AND PTRS
0428 12356 065444      LDB B200  SINE TABLE STEP
0429 12357 072776  FORL3 STA FORJ1   J COUNT
0430 12360 001000      ALS
0431 12361 073022      STA FORL1  LI MINOR SPAN
0432 12362 001020      ALS,ALS
0433 12363 073023      STA FORLP  LP MAJOR SPAN
0434 12364 077024      STB FORNL  SET SINE TABLE STEP
0435 12365 005100      BRS       MAKE I COUNT
0436 12366 007004      CMB,INB
0437 12367 076771      STB FORI   SET I COUNT
0438 12370 076775      STB FORJ1  SAVE FOR REUSE
0439 12371 061464      LDA FORX   USING XI AS
0440 12372 073007  FORL4 STA FORX1   CORRESPONDING PTR
0441 12373 043022      ADA FORL1  SET UP POINTERS
0442 12374 073010      STA FORX2  FOR REALS
0443 12375 043022      ADA FORL1
0444 12376 073011      STA FORX3
0445 12377 043022      ADA FORL1
0446 12400 073012      STA FORX4
0447 12401 063007      LDA FORX1  AND IMS
0448 12402 043006      ADA FORXY
0449 12403 073013      STA FORY1
0450 12404 043022      ADA FORL1
0451 12405 073014      STA FORY2
0452 12406 043022      ADA FORL1
0453 12407 073015      STA FORY3
0454 12410 043022      ADA FORL1
0455 12411 073016      STA FORPY4
0456*           ALL SET; DO THE EASY BIT FIRST
0457*           JUST ADDITIONS AND SUBTRACTIONS
0458 12412 104200      DLD FORX1,I T=A(I-1)
0459 12414 104400      DST FORT
0460 12416 105000      ABS -FAD   A(I-1)=T+A(I2-1)
0461 12417 113011      DEF FORX3,I
0462 12420 104400      DST FORX1,I
0463 12422 104200      DLD FORT   A(I2-1)=T-A(I2-1)
0464 12424 105000      ABS -FSB
0465 12425 113011      DEF FORX3,I
0466 12426 104400      DST FORX3,I
0467 12430 104200      DLD FORY1,I T=A(I)
0468 12432 104400      DST FORT
0469 12434 105000      ABS -FAD   A(I)=T+A(I2)
0470 12435 113015      DEF FORY3,I
0471 12436 104400      DST FORY1,I
0472 12440 104200      DLD FORT   A(I2)=T-A(I2)

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0473	12442	105020	ABS -FSB
0474	12443	113015	DEF FORY3,I
0475	12444	104400	DST FORY3,I
0476	12446	104200	DLD FOFY4,I NOTE SIGN REVERSAL
0477	12450	104400	DST FORT T=+A(I3)
0478	12452	104200	DLD FORX4,I TI=A(I3-1)
0479	12454	104400	DST FORTI
0480	12456	104200	DLD FORX2,I A(I3-1)=A(I1-1)+T
0481	12460	105000	ABS -FAD NOTE SIGN COMPENSATION
0482	12461	013030	DEF FORT
0483	12462	104400	DST FORX4,I
0484	12464	104200	DLD FORY2,I A(I3)=A(I1)-TI
0485	12466	105020	ABS -FSB
0486	12467	013032	DEF FORTI
0487	12470	104400	DST FORY4,I
0488	12472	104200	DLD FORX2,I A(I1-1)=A(I1-1)-T
0489	12474	105020	ABS -FSB NOTE SIGN COMPENSATION
0490	12475	013030	DEF FORT
0491	12476	104400	DST FORX2,I
0492	12500	104200	DLD FORY2,I A(I1)=A(I1)+TI
0493	12502	105000	ABS -FAD
0494	12503	013032	DEF FORTI
0495	12504	104400	DST FORY2,I
0496	12506	063007	LDA FORX1 STEP POINTER
0497	12507	043023	ADA FORLP
0498	12510	036771	ISZ FORI COUNT
0499	12511	026372	JMP FORL4 CONTINUE
0500*			END OF THE EASY BIT
0501*			NOW FOR THE HARD STUFF
0502	12512	062776	LDA FORJ1 MAKE J COUNT
0503	12513	003004	CMA,INA
0504	12514	002007	INA,SZA,RSS TEST IF DONE
0505	12515	026742	JMP FORL5 YES; NO HARD STUFF
0506	12516	072772	STA FORJ SET J COUNT
0507	12517	063024	LDA FORNL JJ=NPL
0508	12520	073025	STA FORJJ
0509	12521	061464	LDA FORX SET UP PTR
0510	12522	041356	ADA B2 CORRESPONDING TO J
0511	12523	072774	FORL6 STA FORIJ
0512	12524	063025	LDA FORJJ SET PTR FOR UR
0513	12525	003004	CMA,INA =S(NT-JJ)
0514	12526	043027	ADA FORNT
0515	12527	043005	ADA FORS
0516	12530	073017	STA FORUR
0517	12531	063025	LDA FORJJ AND FOR UI
0518	12532	043005	ADA FORS =S(JJ)
0519	12533	073020	STA FORUI
0520	12534	063025	LDA FORJJ JJ=JJ+NPL
0521	12535	043024	ADA FORNL
0522	12536	073025	STA FORJJ
0523	12537	062775	LDA FORJI
0524	12540	072771	STA FORI SET UP I COUNT
0525	12541	062774	LDA FORIJ AND CORRESPONDING PTR
0526	12542	073007	FORL7 STA FORX1 FOR REALS
0527	12543	043022	ADA FORL1
0528	12544	073010	STA FORX2

0529	12545	043022	ADA FORL1	
0530	12546	073011	STA FORX3	
0531	12547	043022	ADA FORL1	
0532	12550	073012	STA FORX4	
0533	12551	063007	LDA FORX1	AND IMS
0534	12552	043006	ADA FORXY	
0535	12553	073013	STA FORY1	
0536	12554	043022	ADA FORL1	
0537	12555	073014	STA FORY2	
0538	12556	043022	ADA FORL1	
0539	12557	073015	STA FORY3	
0540	12560	043022	ADA FORL1	
0541	12561	073016	STA FORY4	
0542*			MAIN ARITHMETIC SECTION	
0543	12562	104200	DLD FORY3,I	$T=A(I2-1)*UR+A(I2)*UI$
0544	12564	105040	ABS -FMP	
0545	12565	113020	DEF FORUI,I	
0546	12566	104400	DST FORT	
0547	12570	104200	DLD FORX3,I	
0548	12572	105040	ABS -FMP	
0549	12573	113017	DEF FORUR,I	
0550	12574	105020	ABS -FSB	
0551	12575	013030	DEF FORT	
0552	12576	104400	DST FORT	
0553	12600	104200	DLD FORX3,I	$TI=A(I2-1)*UI+A(I2)*UR$
0554	12602	105040	ABS -FMP	
0555	12603	113020	DEF FORUI,I	
0556	12604	104400	DST FORTI	
0557	12606	104200	DLD FORY3,I	
0558	12610	105040	ABS -FMP	
0559	12611	113017	DEF FORUR,I	
0560	12612	105000	ABS -FAD	
0561	12613	013032	DEF FORTI	
0562	12614	104400	DST FORTI	
0563	12616	104200	DLD FORX1,I	$A(I2-1)=A(I-1)-T$
0564	12620	105020	ABS -FSB	
0565	12621	013030	DEF FORT	
0566	12622	104400	DST FORX3,I	
0567	12624	104200	DLD FORY1,I	$A(I2)=A(I)-TI$
0568	12626	105020	ABS -FSB	
0569	12627	013032	DEF FORTI	
0570	12630	104400	DST FORY3,I	
0571	12632	104200	DLD FORX1,I	$A(I-1)=A(A-1)+T$
0572	12634	105000	ABS -FAD	
0573	12635	013030	DEF FORT	
0574	12636	104400	DST FORX1,I	
0575	12640	104200	DLD FORY1,I	$A(I)=A(I)+TI$
0576	12642	105000	ABS -FAD	
0577	12643	013032	DEF FORTI	
0578	12644	104400	DST FORY1,I	
0579	12646	104200	DLD FORX4,I	$T=+A(I3-1)*UI+A(I3)*UR$
0580	12650	105040	ABS -FMP	NOTE CHANGE OF SIGN
0581	12651	113020	DEF FORUI,I	
0582	12652	104400	DST FORT	
0583	12654	104200	DLD FORY4,I	
0584	12656	105040	ABS -FMP	

0585	12657	113017	DEF FORUR,I	
0586	12660	105000	ABS -FAD	
0587	12661	013030	DEF FORT	
0588	12662	104400	DST FORT	
0589	12664	104200	DLD FORY4,I	TI=A(I3-1)*UR-A(I3)*UI
0590	12666	105040	ABS -FMP	
0591	12667	113020	DEF FORUI,I	
0592	12670	104400	DST FORTI	
0593	12672	104200	DLD FORK4,I	
0594	12674	105040	ABS -FMP	
0595	12675	113017	DEF FORUR,I	
0596	12676	105020	ABS -FSB	
0597	12677	013032	DEF FORTI	
0598	12700	104400	DST FORTI	
0599	12702	104200	DLD FORK2,I	A(I3-1)=A(I1-1)+T
0600	12704	105000	ABS -FAD	NOTE SIGN CHANGE
0601	12705	013030	DEF FORT	
0602	12706	104400	DST FORK4,I	
0603	12710	104200	DLD FORY2,I	A(I3)=A(I1)-TI
0604	12712	105020	ABS -FSB	
0605	12713	013032	DEF FORTI	
0606	12714	104400	DST FORY4,I	
0607	12716	104200	DLD FORK2,I	A(I1-1)=A(I1-1)-T
0608	12720	105020	ABS -FSB	NOTE SIGN CHANGE
0609	12721	013030	DEF FORT	
0610	12722	104400	DST FORK2,I	
0611	12724	104200	DLD FORY2,I	A(I1)=A(I1)+TI
0612	12726	105000	ABS -FAD	
0613	12727	013032	DEF FORTI	
0614	12730	104400	DST FORY2,I	
0615*			END OF MAIN ARITHMETIC SECTION	
0616	12732	063007	LDA FORK1	STEP I PTR
0617	12733	043023	ADA FORLP	
0618	12734	036771	ISZ FORI	COUNT I
0619	12735	026542	JMP FORL7	CONTINUE I
0620*				
0621	12736	062774	LDA FORIJ	STEP J PTR
0622	12737	041356	ADA B2	
0623	12740	036772	ISZ FORJ	COUNT J
0624	12741	026523	JMP FORL6	CONTINUE J
0625*				
0626	12742	062776	FORL5 LDA FORJ1	UPDATE J COUNT
0627	12743	001000	ALS	AND POINTERS
0628	12744	067024	LDB FORNL	NPL=NPL/2
0629	12745	005100	BRS	
0630	12746	036773	ISZ FORL	COUNT L
0631	12747	026357	JMP FORL3	CONTINUE L
0632*				
0633	12750	061463	LDA FORDI	WHICH WAY?
0634	12751	002021	SSA,RSS	
0635	12752	126066	JMP XFORM,I	ALL DONE
0636*				
0637*			CONJUGATE	
0638	12753	061345	LDA BM400	SET COUNT
0639	12754	072771	STA FORI	
0640	12755	061465	LDA FORY	SET PTR TO IM

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0641 12756 073013          STA FORY1
0642 12757 104200  FORL8 DLD FORY1,I GET DATA
0643 12761 115153          JSB FCM,I   NEGATE IT
0644 12762 104400          DST FORY1,I
0645 12764 037013          ISZ FORY1  STEP PTR
0646 12765 037013          ISZ FORY1
0647 12766 036771          ISZ FORI   COUNT
0648 12767 026757          JMP FORL8
0649 12770 126066          JMP XFORM,I ALL DONE
0650*
0651*          COUNTS, POINTERS AND WORKING SPACE
0652 12771 000000  FORI  NOP          I COUNT
0653 12772 000000  FORJ  NOP          J COUNT
0654 12773 000000  FORL  NOP          L COUNT
0655 12774 000000  FORIJ NOP          SHUFFLE COUNTS
0656 12775 000000  FORJI NOP
0657 12776 000000  FORJ1 NOP
0658 12777 000000  FORJ2 NOP
0659 13000 000000  FORJ3 NOP
0660 13001 000000  FORJ4 NOP
0661 13002 000000  FORJ5 NOP
0662 13003 000000  FORJ6 NOP
0663 13004 000000  FORJ7 NOP
0664*
0665 13005 013032  FORS  DEF FORST-2 SINE TABLE POINTER
0666 13006 000000  FORXY NOP          Y-X
0667 13007 000000  FORX1 NOP          POINTERS
0668 13010 000000  FORX2 NOP
0669 13011 000000  FORX3 NOP
0670 13012 000000  FORX4 NOP
0671 13013 000000  FORY1 NOP
0672 13014 000000  FORY2 NOP
0673 13015 000000  FORY3 NOP
0674 13016 000000  FORY4 NOP
0675 13017 000000  FORUR NOP          SINE POINTER
0676 13020 000000  FORUI NOP          COSINE POINTER
0677 13021 000000  FORIX NOP          I COUNT END
0678 13022 000000  FORL1 NOP          'LEXP1'
0679 13023 000000  FORLP NOP          'LEXP'
0680 13024 000000  FORNL NOP          'NPL'
0681 13025 000000  FORJJ NOP          'JJ'
0682 13026 000000  FORKL NOP          'KLAST'
0683 13027 000200  FORNT DEC 128          'NT'
0684*
0685 13030 000000  FORT  DEC 0.          FLOATING PT WORK SPACE
0686 13032 000000  FORTI DEC 0.
0687*          SINE TABLE
0688 13034 062205  FORST DEC 0.02454123,0.04906767,0.07356456,0.0980171
0689 13044 076531  DEC 0.12241068,0.14673047,0.17096189,0.1950903
0690 13054 070056  DEC 0.21910124,0.24293018,0.26671276,0.2902846
0691 13064 050115  DEC 0.31368174,0.33688985,0.35969504,0.3326034
0692 13074 063675  DEC 0.40724131,0.42755509,0.44961133,0.4713067
0693 13104 077056  DEC 0.49289819,0.51410274,0.53499762,0.5555702
0694 13114 044664  DEC 0.57580819,0.59569930,0.61523159,0.6343932
0695 13124 051633  DEC 0.65317284,0.67155895,0.68954054,0.7071067
0696 13134 056264  DEC 0.72424708,0.74095113,0.75720885,0.7730104

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0697 13144 062350
0698 13154 066044
0699 13164 071125
0700 13174 073554
0701 13204 075535
0702 13214 077035
0703 13224 077647

DEC 0.76834643,0.80320753,0.81758481,0.8314696
DEC 0.84485357,0.85772861,0.87008699,0.8800212
DEC 0.89322430,0.90398929,0.91420976,0.9238795
DEC 0.93299280,0.94154407,0.94952818,0.9569403
DEC 0.96377607,0.97003125,0.97570213,0.9807852
DEC 0.98527764,0.98917651,0.99247953,0.9951847
DEC 0.99729046,0.99879546,0.99969882,1.0000000

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0705*      SUBROUTINE TO SORT COMPLEX TRANSFORM INTO TWO TRANSFORMS OF
0706* REAL DATA
0707* INPUT COMPLEX TRANSFORM, REAL X (PTR IN 'FORX'), IMAGINARY Y
0708* (PTR IN 'FORY')
0709* OUTPUT X(0) TO X(128) REAL 1, X(129) TO X(255) IMAGINARY 1
0710*      Y(0) TO Y(128) REAL 2, Y(129) TO Y(255) IMAGINARY 2
0711*
0712* X(0), X(128), Y(0), Y(128) ARE ALREADY CORRECTLY POSITIONED
0713*
0714 13234 000000 FOR2R NOP
0715* FIRST SPLIT SYMMETRICAL AND ANTISYMMETRICAL PARTS IN SITU; THIS
0716* LEAVES THE IMAGINARY PARTS TRANSPOSED.
0717 13235 061332          LDA BM177      SET I COUNT
0718 13236 072771          STA FORI
0719 13237 061464          LDA FORX      GET CORRESPONDING PTR
0720 13240 041356          ADA B2        STARTING AT X(1)
0721 13241 065464          LDB FORX     AND SYMMETRICAL PTR
0722 13242 045455          ADB B776     STARTING AT X(255)
0723 13243 073007 FOR2I STA FORX1     SET UP POINTERS
0724 13244 043006          ADA FORXY
0725 13245 073013          STA FORY1
0726 13246 077010          STB FORX2
0727 13247 047006          ADB FORXY
0728 13250 077014          STB FORY2
0729 13251 104200          DLD FORX1,I T=X(1)
0730 13253 104400          DST FORT
0731 13255 105000          ABS -FAD     X(1)=(T+X(256-1))/2
0732 13256 113010          DEF FORX2,I
0733 13257 115161          JSB PW2,I
0734 13260 177777          DEC -1
0735 13261 104400          DST FORX1,I
0736 13263 104200          DLD FORX2,I X(256-1)=(X(256-1)-T)/2
0737 13265 105020          ABS -FSB
0738 13266 013030          DEF FORT
0739 13267 115161          JSB PW2,I
0740 13270 177777          DEC -1
0741 13271 104400          DST FORX2,I
0742 13273 104200          DLD FORY1,I T=Y(1)
0743 13275 104400          DST FORT
0744 13277 105000          ABS -FAD     Y(1)=(T+Y(256-1))/2
0745 13300 113014          DEF FORY2,I
0746 13301 115161          JSB PW2,I
0747 13302 177777          DEC -1
0748 13303 104400          DST FORY1,I
0749 13305 104200          DLD FORT     Y(256-1)=(T-Y(256-1))/2
0750 13307 105020          ABS -FSB
0751 13310 113014          DEF FORY2,I
0752 13311 115161          JSB PW2,I
0753 13312 177777          DEC -1
0754 13313 104400          DST FORY2,I
0755 13315 063007          LDA FORX1     UPDATE POINTERS
0756 13316 041356          ADA B2
0757 13317 067010          LDB FORX2
0758 13320 045336          ADB BM2
0759 13321 036771          ISZ FORI     COUNT I
0760 13322 027243          JMP FOR2I     CONTINUE I COUNT

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0761*           NOW SHUFFLE THE IMAGINARY PARTS
0762 13323 061332      LDA BM177   SET I COUNT
0763 13324 072771      STA FORI
0764 13325 061464      LDA FORX   GET CORRESPONDING POINTER
0765 13326 041454      ADA B402    STARTING AT X(129)
0766 13327 065465      LDB FORY   AND SYMMETRICAL POINTER
0767 13330 045455      ADB B776    STARTING AT Y(255)
0768 13331 073007 FOR22 STA FORX1   SET UP POINTERS
0769 13332 077013      STB FORY1
0770 13333 104200      DLD FORX1,I T=X(128+I)
0771 13335 104400      DST FORT
0772 13337 104200      DLD FORY1,I X(128+I)=Y(256-I)
0773 13341 104400      DST FORX1,I
0774 13343 104200      DLD FORT   Y(256-I)=T
0775 13345 104400      DST FORY1,I
0776 13347 063007      LDA FORX1  UPDATE POINTERS
0777 13350 041356      ADA B2
0778 13351 067013      LDB FORY1
0779 13352 045336      ADB B2
0780 13353 036771      ISZ FORI   COUNT I
0781 13354 027331      JMP FOR22  CONTINUE I COUNT
0782 13355 127234      JMP FOR2R,I DONE

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0784*      SUBROUTINE TO ACCUMULATE POWER AND CROSS SPECTRA TOGETHER
0785* WITH STATISTICS FOR FLUCTUATION AND TREND TESTS.
0786 13356 000000 FORAC NCP
0787*      SECTION FOR I=0 AND 128
0788 13357 061344      LDA DM200      SET I COUNT
0789 13360 072771      STA FORI
0790 13361 061466      LDA FORP1      SET UP POINTERS
0791 13362 072776      STA FORJ1      P1
0792 13363 061467      LDA FORP2
0793 13364 072777      STA FORJ2      P2
0794 13365 061470      LDA FORV1
0795 13366 073000      STA FORJ3      V1
0796 13367 061471      LDA FORV2
0797 13370 073001      STA FORJ4      V2
0798 13371 061472      LDA FORT1
0799 13372 073002      STA FORJ5
0800 13373 061473      LDA FORT2
0801 13374 073003      STA FORJ6      T2
0802 13375 065474      LDB FORC
0803 13376 061464      LDA FORX
0804 13377 073007 FORA2 STA FORX1      X REAL
0805 13400 043006      ADA FORMY
0806 13401 073013      STA FORY1      Y REAL
0807 13402 076774      STB FORI0      C REAL
0808 13403 104200      DLD FORX1,1 T=X(I)*2
0809 13405 105040      ABS -FMP
0810 13406 113007      DEF FORX1,1
0811 13407 104400      DST FORT
0812 13411 105000      ABS -FAD      P1(I)=P1(I)+T
0813 13412 112776      DEF FORJ1,1
0814 13413 104400      DST FORJ1,1
0815 13415 104200      DLD FORT      V1(I)=V1(I)+T*2
0816 13417 105040      ABS -FMP
0817 13420 013030      DEF FORT
0818 13421 105000      ABS -FAD
0819 13422 113000      DEF FORJ3,1
0820 13423 104400      DST FORJ3,1
0821 13425 104200      DLD FORT      T1(I)=T1(I)+T*SN
0822 13427 105040      ABS -FMP
0823 13430 101475      DEF FORSN,1
0824 13431 105000      ABS -FAD
0825 13432 113002      DEF FORJ5,1
0826 13433 104400      DST FORJ5,1
0827 13435 104200      DLD FORY1,1 T=Y(I)*2
0828 13437 105040      ABS -FMP
0829 13440 113010      DEF FORY1,1
0830 13441 104400      DST FORT
0831 13443 105000      ABS -FAD      P2(I)=P2(I)+T
0832 13444 112777      DEF FORJ2,1
0833 13445 104400      DST FORJ2,1
0834 13447 104200      DLD FORT      V2(I)=V2(I)+T*2
0835 13451 105040      ABS -FMP
0836 13452 013030      DEF FORT
0837 13453 105000      ABS -FAD
0838 13454 113001      DEF FORJ4,1
0839 13455 104400      DST FORJ4,1

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0840 13457 104200      DLD FORT      T2(I)=T2(I)+T*SN
0841 13461 105040      ABS -FMP
0842 13462 101475      DEF FORSN,I
0843 13463 105000      ABS -FAD
0844 13464 113003      DEF FORJ6,I
0845 13465 104400      DST FORJ6,I
0846 13467 104200      DLD FORX1,I  C(I)=C(I)+X(I)*Y(I)
0847 13471 105040      ABS -FMP
0848 13472 113013      DEF FORY1,I
0849 13473 105000      ABS -FAD
0850 13474 112774      DEF FORIJ,I
0851 13475 104400      DST FORIJ,I
0852 13477 062771      LDA FORI      I=128?
0853 13500 002020      SSA
0854 13501 027701      JMP FORA3     NO; GO DO I=1,127
0855 13502 104200      DLD FORSN,I  SN=SN+1
0856 13504 105000      ABS -FAD
0857 13505 001302      DEF FLI
0858 13506 104400      DST FORSN,I
0859 13510 127356      JMP FORAC,I  YES; DONE
0860*                MAIN SECTION; I=1,127
0861 13511 041356      FURA1 ADA B2      SET NEW POINTERS
0862 13512 073007      STA FORX1     X REAL
0863 13513 041453      ADA B400
0864 13514 073010      STA FORX2     X IN
0865 13515 043006      ADA FORKY
0866 13516 073014      STA FORY2     Y IN
0867 13517 041345      ADA B400
0868 13520 073013      STA FORY1     Y REAL
0869 13521 045356      ADB B2
0870 13522 076774      STB FORIJ     C REAL
0871 13523 045453      ADB B400
0872 13524 076775      STB FORJI     C IN
0873*                MAIN SECTION; ARITHMETIC PART
0874 13525 104200      DLD FORX1,I  T=2*(X(I)+2+X(J)+2)
0875 13527 105040      ABS -FMP
0876 13530 113007      DEF FORX1,I
0877 13531 104400      DST FORT
0878 13533 104200      DLD FORX2,I
0879 13535 105040      ABS -FMP
0880 13536 113010      DEF FORX2,I
0881 13537 105000      ABS -FAD
0882 13540 013030      DEF FORT
0883 13541 115161      JSB FW2,I
0884 13542 000001      DEC I
0885 13543 104400      DST FORT
0886 13545 105000      ABS -FAD     P1(I)=P1(I)+T
0887 13546 112776      DEF FORJ1,I
0888 13547 104400      DST FORJ1,I
0889 13551 104200      DLD FORT     V1(I)=V1(I)+T+2
0890 13553 105040      ABS -FMP
0891 13554 013030      DEF FORT
0892 13555 105000      ABS -FAD
0893 13556 113000      DEF FORJ3,I
0894 13557 104400      DST FORJ3,I
0895 13561 104200      DLD FORT     T1(I)=T1(I)+T*SN

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0896	13563	105040	ABS -FMP	
0897	13564	101475	DEF FORSN,I	
0898	13565	105000	ABS -FAD	
0899	13566	113002	DEF FORJ5,I	
0900	13567	104400	DST FORJ5,I	
0901	13571	104200	DLD FORY1,I	$T=2*(Y(I)+2+Y(J)+2)$
0902	13573	105040	ABS -FMP	
0903	13574	113013	DEF FORY1,I	
0904	13575	104400	DST FORT	
0905	13577	104200	DLD FORY2,I	
0906	13601	105040	ABS -FMP	
0907	13602	113014	DEF FORY2,I	
0908	13603	105000	ABS -FAD	
0909	13604	013030	DEF FORT	
0910	13605	115161	JSB PW2,I	
0911	13606	000001	DEC 1	
0912	13607	104400	DST FORT	
0913	13611	105000	ABS -FAD	$P2(I)=P2(I)+T$
0914	13612	112777	DEF FORJ2,I	
0915	13613	104400	DST FORJ2,I	
0916	13615	104200	DLD FORT	$V2(I)=V2(I)+T+2$
0917	13617	105040	ABS -FMP	
0918	13620	013030	DEF FORT	
0919	13621	105000	ABS -FAD	
0920	13622	113001	DEF FORJ4,I	
0921	13623	104400	DST FORJ4,I	
0922	13625	104200	DLD FORT	$T2(I)=T2(I)+T*SN$
0923	13627	105040	ABS -FMP	
0924	13630	101475	DEF FORSN,I	
0925	13631	105000	ABS -FAD	
0926	13632	113003	DEF FORJ6,I	
0927	13633	104400	DST FORJ6,I	
0928	13635	104200	DLD FORM1,I	$C(I)=C(I)+2*(X(I)*Y(I)+Y(J)*Y(J))$
0929	13637	105040	ABS -FMP	
0930	13640	113013	DEF FORY1,I	
0931	13641	104400	DST FORT	
0932	13643	104200	DLD FORM2,I	
0933	13645	105040	ABS -FMP	
0934	13646	113014	DEF FORY2,I	
0935	13647	105000	ABS -FAD	
0936	13650	013030	DEF FORT	
0937	13651	115161	JSB PW2,I	
0938	13652	000001	DEC 1	
0939	13653	105000	ABS -FAD	
0940	13654	112774	DEF FORIJ,I	
0941	13655	104400	DST FORIJ,I	
0942	13657	104200	DLD FORM1,I	$C(J)=C(J)+2*(X(J)*Y(I)-X(I)*Y(J))$
0943	13661	105040	ABS -FMP	
0944	13662	113014	DEF FORY2,I	
0945	13663	104400	DST FORT	
0946	13665	104200	DLD FORM2,I	
0947	13667	105040	ABS -FMP	
0948	13670	113013	DEF FORY1,I	
0949	13671	105000	ABS -FSB	
0950	13672	013030	DEF FORT	
0951	13673	115161	JSB PW2,I	

0952	13674	000001	DEC I	
0953	13675	105000	ABS -FAD	
0954	13676	112775	DEF FORJ1,I	
0955	13677	104400	DST FORJ1,I	
0956*			END OF MAIN ARITHMETIC SECTION; STEP POINTERS	
0957	13701	036776	FORA3 ISZ FORJ1	P1
0958	13702	036776	ISZ FORJ1	
0959	13703	036777	ISZ FORJ2	P2
0960	13704	036777	ISZ FORJ2	
0961	13705	037000	ISZ FORJ3	V1
0962	13706	037000	ISZ FORJ3	
0963	13707	037001	ISZ FORJ4	V2
0964	13710	037001	ISZ FORJ4	
0965	13711	037002	ISZ FORJ5	T1
0966	13712	037002	ISZ FORJ5	
0967	13713	037003	ISZ FORJ6	T2
0968	13714	037003	ISZ FORJ6	
0969	13715	063007	LDA FORX1	X,Y
0970	13716	066774	LDB FORIJ	C
0971	13717	036771	ISZ FORI	COUNT I
0972	13720	027511	JMP FORA1	CONTINUE
0973*			SET UP FOR I=128	
0974	13721	041356	ADA B2	
0975	13722	045356	ADB B2	
0976	13723	027377	JMP FORA2	

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0978*      NEW START OF TEXT + VERSION ID
0979  13724 000000 TEXT   OCT 0
0980  13725 000000          OCT 0
0981  13726 041455          ASC 6,C-ONCAL,V151      LEAD IN MESSAGE
0982  13734 043015          OCT 43015
0983  13735          BUFEG EQU *
0984*
0985*      XFORM BASE PAGE WORK SPACE
0986  01463          ORG 1463B
0987  01463 000000 FORDI NOP FFT TRANSFORM DIRECTION
0988  01464 000000 FORX  NOP          FFT REAL ARRAY
0989  01465 000000 FORY  NOP          FFT IMAGINARY ARRAY
0990  01466 000000 FORP1 NOP          FFT POWER SPECTRUM 1
0991  01467 000000 FORP2 NOP          FFT POWERSPECTRUM 2
0992  01470 000000 FORV1 NOP          FFT POWER VARIANCE 1
0993  01471 000000 FORV2 NOP          FFT POWER VARIANCE 2
0994  01472 000000 FORT1 NOP          FFT POWER TREND 1
0995  01473 000000 FORT2 NOP          FFT POWER TREND 2
0996  01474 000000 FORC  NOP          FFT CROSS SPECTRA
0997  01475 000000 FORSN NOP          FFT SERIAL NUMBER
0998  01476 000000 XFRMO NOP          STORAGE FOR OPTION
0999  01477 000000 XFRMC NOP          COUNT FOR ARRAYS
1000  01500 001464 XFRM1 DEF FORK
1001  01501 000000 XFRMP NOP          POINTER TO ARRAY TABLE
1002  01502 000000 XFRML NOP          POINTER TO LENGTH TABLE
1003  01503 001504 XFRM2 DEF *+1          LENGTH TABLE
1004  01504 000777          DEC 511,511,257,257,257,257,257,511,1
1006*
1006*
1007*      ONCAL PROGRAM CONSTANTS ETC
1008  01175          FLAC EQU 1175B
1009  00542          PUSHJ EQU 542B
1010  06706          ARG EQU 6706B
1011  00220          ERRCR EQU 220B
1012  10664          .POLY EQU 10664B
1013  72660          FLT EQU 72660B
1014  72720          FDV EQU 72720B
1015  73000          FAD EQU 73000B
1016  72760          FSB EQU 72760B
1017  72740          FMP EQU 72740B
1018  01134          IFX EQU 1134B
1019  01302          FL1 EQU 1302B
1020  01174          EFX EQU 1174B
1021  01133          GT1 EQU 1133B
1022  01405          B54 EQU 1405B
1023  01356          B2 EQU 1356B
1024  01453          B400 EQU 1453B
1025  01346          B1TH EQU 1346B
1026  01444          B000 EQU 1444B
1027  01415          B100 EQU 1415B
1028  01370          B20 EQU 1370B
1029  01337          B14 EQU 1337B
1030  01344          B1200 EQU 1344B
1031  01336          B12 EQU 1336B
1032  01317          B17 EQU 1317B
1033  01455          B776 EQU 1455B

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1034	01454	B402	EQU	1454B
1035	01332	BM177	EQU	1332B
1036	01341	BM200	EQU	1341B
1037	01342	BM400	EQU	1342B
1038	01374	B400	EQU	1374B
1039	01343	BM100	EQU	1343B
1040	01360	B4	EQU	1360B
1041	01340	BM10	EQU	1340B
1042	01433	B123	EQU	1433B
1043	01420	B106	EQU	1420B
1044	01173	COX	EQU	1173B
1045	01432	B122	EQU	1432B
1046	01153	FCM	EQU	1153B
1047	01363	B10	EQU	1363B
1048	01320	DM10	EQU	1320B
1049	01345	BM400	EQU	1345B
1050	00652	CHAR	EQU	652B
1051	06717	GTARG	EQU	6717B
1052	01161	PW2	EQU	1161B
1053	01070	GTL	EQU	1070B
1054	00634	PT1	EQU	634B

1055*

1056

END

** NO ERRORS*

```

0001          ASMB,A,L
0003*        FUNCTIONS V152F
0004*FSW,MODIFIED FAP
0005*
0006*        SELECT CODE ASSIGNMENTS
0007 00022          ORG 22B
0008 00022 114031  AP      JSB 31B,I      ACOUSTIC POSITIONING
0009*
0010*        INTERRUPT LINK
0011 00031          ORG 31B
0012 00031 011171        DEF APIB
0013*
0014*        UPDATE TEXT POINTERS
0015 00654          ORG 654B
0016 00654 012223        DEF BUFBG
0017 00655 012223        DEF BUFBG
0018 00656 012223        DEF BUFBG
0019 00657 012212        DEF TEXT
0020*
0021*        NEW FUNCTION NAMES
0022 00704          ORG 704B
0023 00704 001167  FSW    OCT 1167
0024 00705 000060  FAP    OCT 60
0025*
0026*        NEW FUNCTION ROUTINE POINTERS
0027 00734          ORG 734B
0028 00734 011131  PSW    DEF XSW
0029 00735 011141  FAP    DEF XAP
0030*
0031*        TEST FOR NEW FUNCTIONS
0032 05237          ORG 5237B
0033 05237 050705        CPA FAP      AP
0034 05240 124735        JMP FAP,I
0035 05241 050704        CPA FSW      SW
0036 05242 124734        JMP PSW,I
0037*

```



```

0095 11207 012212 APE DEF APEND END PTR FOR BUFFER
0096 11210 011212 API DEF APBUF INPUT PTR FOR BUFFER
0097 11211 011212 APO DEF APBUF OUTPUT PTR FROM BUFFER
0098 11212 000000 APBUF ESS 512 BUFFER
0099 12212 APEND EQU * END OF BUFFER
0100*
0101* NEW START OF TEXT + VERSION ID
0102 12212 000000 TEXT OCT 0
0103 12213 000000 OCT 0
0104 12214 041455 ASC 6,C-ONCAL,V152 LEAD IN MESSAGE
      12215 047516
      12216 041501
      12217 046054
      12220 053061
      12221 032462
0105 12222 043015 OCT 43015 F+CR
0106 12223 BUFBG EQU *
0107 01174 EFX EQU 1174B
0108 01175 FLAC EQU 1175B
0109 01134 IFX EQU 1134B
0110 00231 RECOV EQU 231B
0111*
0112 END
** NO ERRORS*

```



```

0001          ANNCAL
0003*          FUNCTION OVERLAY FOR STANDARD X VERSION OF ONCAL
0004*          V153X FSW,FAP(MODIFIED)
0005*
0006*          SELECT CODE ASSIGNMENTS
0007 00022          ORG 22D
0008 00022 114037  AP      JSB 37B,I      ACOUSTIC POSITIONING
0009*
0010*          NISC DEFINITIONS
0011 01217          FLAC  EQU 1217B
0012 01153          INT   EQU 1153B
0013 01216          EFX   EQU 1216B
0014 02231          RECOV EQU 231B
0015 01176          DEL   EQU 1176B
0016*
0017*          INTERRUPT ROUTINE LINK
0018 00037          ORG 37B
0019 00037 012545      DEF APIR      ACOUSTIC POSITIONING
0020*
0021*          UPDATE TEXT POINTERS
0022 00671          ORG 671B
0023 00671 013577      DEF BUFEG
0024 00672 013577      DEF BUFEG
0025 00673 013577      DEF BUFEG
0026 00674 013566      DEF TEXT      START OF TEXT BUFFER
0027*
0028*          NEW FUNCTION NAMES
0029 00722          ORG 722B
0030 00722 001167  FSW   OCT 1167
0031 00723 000060  FAP   OCT 60
0032*
0033*          NEW FUNCTION ROUTINE POINTERS
0034 00752          ORG 752B
0035 00752 012504  PSW   DEF XSW
0036 00753 012514  PAP   DEF XAP
0037*
0038*          TEST FOR NEW FUNCTIONS
0039 05225          ORG 5225B
0040 05225 050722      CPA FSW      SW
0041 05226 124752      JMP FSW,I
0042 05227 050723      CPA FAP      AP
0043 05230 124753      JMP FAP,I

```

```

0045*
0046*      DEF FUNCTIONS
0047*F3W, LEAD WRITE SWITCH REGISTER
0048  12504          CRG 10004B
0049  12504 115153  KSW  JSB INT, I      SWITCH REGISTER FUNCTION
0050  12505 001217          DEF FLAC
0051  12506 070001          STA 1
0052  12507 102501          LIA 1
0053  12510 106601          OTB 1
0054  12511 115176          JSB DBL, I
0055  12512 001217          DEF FLAC
0056  12513 125216          JMP EFX, I
0057*
0058*FAP, READ ACOUSTIC POSITIONING , RESET ON -VE ARG
0059  12514 102722  KAP  STC AP      TURN ON INTERFACE
0060  12515 061217          LDA FLAC      GET OPTION
0061  12516 002003          SZA, RSS      ZEP0?
0062  12517 026525          JMP *+6      YES
0063  12520 107722          CLC AP, C      TURN OFF INTERFACE
0064  12521 062562          LDA AP0      START OF BUFFER
0065  12522 072564          STA API      RESET POINTERS
0066  12523 072565          STA AP0
0067  12524 125216          JMP EFX, I
0068  12525 066565  KAPI  LDB APC      ANY DATA YET?
0069  12526 056564          CFB API
0070  12527 026540          JMP APWT      NO; GO WAIT
0071  12530 160001          LDA 1, I      YES; GET DATA
0072  12531 006004          INB          STEP POINTER
0073  12532 056563          CFB AFE      END OF BUFFER?
0074  12533 066562          LDB AP0      YES; RESET TO START
0075  12534 076565          STB AP0      SET NEW BUFFER POINTER
0076  12535 115176          JSB DBL, I      FLOAT DATA
0077  12536 001217          DEF FLAC
0078  12537 125216          JMP EFX, I      EXIT
0079*
0080  12540 106501  APWT  LIB 1      READ SWITCHES
0081  12541 006021          SSB, RSS      TIRED OF WAITING?
0082  12542 026524          JMP KAP+3     NO; TRY AGAIN
0083  12543 107722          CLC AP, C      YES; TURN OFF INTERFACE
0084  12544 024231          JMP RECCV      AND QUIT
0085*
0086*      INTERRUPT ROUTINE; PUT DATA IN BUFFER
0087  12545 000000  APIR  NOP          INTERRUPT COMES HERE
0088  12546 072561          STA APA      SAVE A ONLY
0089  12547 102502          LIA AP      READ DATA
0090  12550 172564          STA API, I   STORE IN BUFFER
0091  12551 062564          LDA API      GET BUFFER POINTER
0092  12552 034000          ISZ 0        STEP WITHOUT USE OF L OR C
0093  12553 052563          CFA APE      END OF BUFFER?
0094  12554 062562          LDA AP0      YES; RESET TO START
0095  12555 072564          STA API      SET NEW BUFFER POINTER
0096  12556 062561          LDA APA      RESTORE A
0097  12557 103122          CLF AP      CLEAR INTERFACE FLAG
0098  12560 126545          JMP APIR, I   RETURN FROM INTERRUPT
0099*
0100  12561 002000  APA  NOP          STORE FOR A

```

```

0101 12562 012566 APC DEF APBUF START PTP FOR BUFFER
0102 12563 013566 APE DEF APEND END PTP FOR BUFFER
0103 12564 012566 API DEF APBUF INPUT PTP TO BUFFER
0104 12565 012566 APO DEF APSUF OUTPUT PTP FROM BUFFER
0105 12566 000000 APBUF DSS 512 BUFFER
0106 13566 APEND EQU * END OF BUFFER
0107*
0108*
0109* NEW START OF TEXT + VERSION ID
0110 13566 000000 TEXT OCT 0
0111 13567 000000 OCT 0
0112 13570 041455 ASC 6,C-ONCAL,V153 LEAD IN MESSAGE
13571 047516
13572 041501
13573 046054
13574 053061
13575 032463
0113 13576 054015 OCT 54015 H + LF
0114 13577 BUFBG EQU *
0115*
0116*
0117 END
** NO ERRORS*

```

```

0001          ASME,A,L
0003*   ONCAL FUNCTIONS V154F
0004*   FADC,FCLK,FTAG,FSAL,FSGT,FSW
0005*   ALSO FKIL
0006*   FADC FOR GUIDELINE PRODUCTION MODEL DIGITAL CTD
0007*
0008*   SELECT CODE ASSIGNMENTS
0009   00014          ORG 14E
0010          SUF
0011   00014 114035   PLOT   JSB 35B,I
0012   00021          ORG 21E
0013   00021 114040   CLOCK  JSB 40B,I
0014   00022 114037   KIEL   JSB 37B,I       KIEL MULTISONDE
0015   00023 114031   ADC    JSB 31B,I       DIGITIZER
0016*
0017*   INTERRUPT ROUTINE LINKS
0018   00031          ORG 31E
0019   00031 011444   ADCIJ  DEF ADCIR
0020   00037          ORG 37E
0021   00037 011156   DEF   KIELI       KIEL MULTISONDE
0022   00040 031503   DEF   CLKI       CLOCK
0023*
0024*   UPDATE TEXT POINTERS
0025   00654          ORG 654E
0026   00654 031602   DEF   BUFEG
0027   00655 031602   DEF   BUFEG
0028   00656 031602   DEF   BUFEG
0029   00657 031571   DEF   TEXT
0030*
0031*   NEW FUNCTION NAMES
0032   00704          ORG 704E
0033   00704 002203   FADC  CCT 2203
0034   00705 046054   FSAL  CCT 46054
0035   00706 046364   FSGT  CCT 46364
0036   00707 006613   FCLK  CCT 6613
0037   00710 050047   FTAG  OCT 50047
0038   00711 001167   FSW   OCT 1167
0039   00712 026454   FKIEL OCT 26454
0040*
0041*   NEW FUNCTION ROUTINE LINKS
0042   00734          ORG 734E
0043   00734 011206   PADC  DEF XADC
0044   00735 031167   PSAL  DEF XSAL
0045   00736 031407   PSGT  DEF XSGT
0046   00737 031512   PCLK  DEF XCLK
0047   00740 031153   PTAG  DEF XTAG
0048   00741 031143   PSW   DEF XSW
0049   00742 011131   PKIEL DEF XKIEL
0050*
0051*   RECONFIGURE PLOTTER INSTRUCTIONS
0052   04425          ORG 4425E
0053   04425 103114   CLF   PLOT
0054*
0055   04406          ORG 4406E
0056   04406 102614   OTA   PLOT
0057   04407 103714   STC   PLOT,C

```

0058*

0059* TEST FOR NEW FUNCTIONS

0060	05237		ORG 5237B	
0061	05237	050705	CPA FSAL	SAL
0062	05240	124735	JMP PSAL,I	
0063	05241	050706	CPA FSGT	SGT
0064	05242	124736	JMP PSGT,I	
0065	05243	050707	CPA FCLK	CLK
0066	05244	124737	JMP PCLK,I	
0067	05245	050704	CPA FADC	ADC
0068	05246	124734	JMP PADC,I	
0069	05247	050711	CPA FSW	SW
0070	05250	124741	JMP PSW,I	
0071	05251	050710	CPA FTAG	TAG
0072	05252	124740	JMP PTAG,I	
0073	05253	050712	CPA FKIEL	KIL
0074	05254	124742	JMP PKIEL,I	

0076*

0077* NEW FUNCTIONS

0078*FKIEL, READ DATA FROM KIEL UNIVERSITY MULTISONDE

0079	11131		CRG 11131B	
0080	11131	014542	XKIEL JSB PUSHJ	GET STATUS AND COUNT OF MULTISONDE
0081	11132	006716	DEF GTARG-1	
0082	11133	006400	CLB	SET UP TO CLEAR STATUS AND COUNT
0083	11134	103100	CLF 00	TURN OFF INTERRUPT
0084	11135	063155	LDA KIELN	GET COUNT
0085	11136	073153	STA KIELO	SAVE COUNT
0086	11137	077155	STB KIELN	RESET COUNT
0087	11140	063154	LDA KIELS	GET STATUS
0088	11141	077154	STB KIELS	RESET STATUS
0089	11142	102100	STF 00	TURN ON INTERRUPT
0090	11143	013677	AND ADCM4	MASK STATUS BITS 14-12
0091	11144	001700	ALF	ROTATE TO BITS 0-4
0092	11145	105120	ABS -FLT	MAKE FLOATING POINT
0093	11146	104400	DST PT1,I	STORE IN STATUS VARIABLE IN CALL
0094	11150	063153	LDA KIELO	GET COUNT
0095	11151	105120	ABS -FLT	MAKE FLOATING POINT
0096	11152	125174	JMP EFX,I	RETURN FROM FUNCTION
0097*				
0098	11153	000000	KIELO NOP	COUNT
0099	11154	000000	KIELS NOP	STATUS
0100	11155	000000	KIELN NOP	COUNTER
0101*				
0102	11156	000000	KIELI NOP	INTERRUPT COMES HERE
0103	11157	073201	STA KIELA	SAVE A REGISTER
0104	11160	103100	CLF 0	TURN OFF INTERRUPT
0105	11161	063202	LDA KIELP	GET POINTER
0106	11162	053203	CPA KIELE	AT END?
0107	11163	027167	JMP **4	
0108	11164	037202	ISZ KIELP	NO STEP POINTER
0109	11165	102522	LIA KIEL	GET DATA
0110	11166	173202	STA KIELP,I	STORE IT
0111	11167	137204	ISZ KIELC,I	INCREMENT COUNT
0112	11170	000000	NOP	SHOULD NOT SKIP ,BUT
0113	11171	102100	STF 0	TURN ON INTERRUPT
0114	11172	033154	IOR KIELS	SAVE IN STATUS WORD
0115	11173	073154	STA KIELS	SAVE STATUS
0116	11174	037155	ISZ KIELN	INCREMENT COUNT
0117	11175	000000	NOP	SHOULD NOT SKIP IF FUNCTION IS CA
0118	11176	063201	LDA KIELA	RESTORE A REGISTER
0119	11177	103722	STC KIEL,C	READY FOR MORE DATA
0120	11200	127156	JMP KIELI,I	RETURN
0121*				
0122	11201	000000	KIELA NOP	A REGISTER
0123	11202	000000	KIELP NOP	BUFFER POINTER
0124	11203	000000	KIELE NOP	END BUFFER
0125	11204	000000	KIELC NOP	DATA COUNT
0126	11205	003411	KIELL ABS KIELF	LENGTH OF KIEL BUFFER
0127	03411		KIELF EQU 1801	
0128*				

```

0130*FADC,READ GUILDLINE DIGITAL CTD
0131* PROGRAM CALLED PART
0132 11206 061175 XADC LDA FLAC TEST OPTION
0133 11207 002002 SZA
0134 11210 027257 JMP ADCC1
0135 11211 014220 ADCC2 JSB ERROR ERROR IF NOT INITIALISED
0136 11212 006716 DEF GTARG-1 GET DESTINATION
0137 11213 061070 LDA GTL TEST LENGTH
0138 11214 043703 ADA ADCCL
0139 11215 002021 SSA,RSS
0140 11216 027222 JMP *+4 SHORT ENOUGH
0141 11217 063703 LDA ADCCL SET SHORTER
0142 11220 003004 CMA,INA
0143 11221 071070 STA GTL
0144*
0145 11222 063724 LDA ADCTO SAVE O/P POINTER
0146 11223 073727 STA ADCPT
0147 11224 063724 ADCC3 LDA ADCTO WAIT FOR DATA
0148 11225 053723 CPA ADCTJ
0149 11226 027225 JMP *-1
0150 11227 104200 DLD ADCTO,1 GET DATA
0151 11231 037724 ISZ ADCTO STEP INPUT PTR
0152 11232 037724 ISZ ADCTO
0153 11233 104400 DST PT1,1 OUTPUT TO ARRAY
0154 11235 034634 ISZ PT1 STEP OUTPUT PTR
0155 11236 034634 ISZ PT1
0156 11237 035070 ISZ GTL DOESN'T SKIP
0157 11240 035070 ISZ GTL COUNT
0158 11241 027224 JMP ADCC3
0159*
0160 11242 063727 LDA ADCPT MAKE CORRECT BUFFER POINTER
0161 11243 043703 ADA ADCCL
0162 11244 053726 CPA ADCTE END OF BUFFER?
0163 11245 063725 LDA ADCT0 RESET TO START
0164 11246 073724 STA ADCTO
0165 11247 006400 CLB TURN IR OFF
0166 11250 103100 CLF 0
0167 11251 063733 LDA ADCST GET STATUS
0168 11252 077733 STB ADCST CLEAR STATUS
0169 11253 102100 STF 0 TURN IR ON AGAIN
0170 11254 003004 CMA,INA NEGATE STATUS
0171 11255 105120 ABS -FLT
0172 11256 125174 JMP EFX,1
0173*
0174 11257 006400 ADCC1 CLB CLEAR MT FLAG
0175 11260 077710 STB ADCMF
0176 11261 002020 SSA TEST; - = TERMINATE
0177 11262 027421 JMP ADCCX -VE; JUST TERMINATE
0178 11263 065176 LDB FLAG+1 GET OPTION
0179 11264 115134 JSB IFX,1 CONVERT TO INTEGER NCH
0180 11265 073702 STA ADCCN SAVE NCH
0181 11266 003004 CMA,INA NEGATE
0182 11267 073704 STA ADCHC SAVE -NCH
0183 11270 041356 ADA B2 TEST SIZE
0184 11271 002021 SSA,RSS OK IF 3 OR MORE
0185 11272 014220 JSB ERROR TOO FEW CHANNELS

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0186 11273 063702 LDA ADCCN GET NCH
0187 11274 001000 ALS X2 FOR FF
0188 11275 073703 STA ADCCL SET FP ARRAY LENGTH
0189* COMPUTE ACTUAL BUFFER SIZES
0190 11276 063711 LDA ADCBL MAX BUFFER LENGTH
0191 11277 006400 CLB SET UP FIXED PT DIV
0192 11300 100400 DIV ADCCL RESULT = NO OF SETS
0193 11302 100200 MPY ADCCL NO OF WORDS TO A
0194 11304 041360 ADA B4 PLUS SPACE FOR ID AND TIME
0195 11305 073712 STA ADCL SAVE BUFFER LENGTH
0196 11306 063721 LDA ADCTL MAX T BUFFER LENGTH
0197 11307 006400 CLB
0198 11310 100400 DIV ADCCL NO OF SETS IN T BUFFER
0199 11312 100200 MPY ADCCL NO OF WORDS IN T BUFFER
0200 11314 043725 ADA ADCT0 PLUS START
0201 11315 073726 STA ADCTE =END OF T BUFFER
0202*
0203* READ "DEC", THE DECIMATION FACTOR
0204 11316 014542 JSB PUSHJ GET DEC
0205 11317 006706 DEF ARG
0206 11320 027325 JMP *+5 IF NONE, SET 1
0207 11321 061175 LDA FLAC "DEC" TO A AND B
0208 11322 065176 LDB FLAC+1
0209 11323 115134 JSB IFX,1 CONVERT TO INTEGER
0210 11324 003007 CMA,INA,SZA,RSS NEGATE, TEST ZERO
0211 11325 003400 CCA IF NONE, SET 1
0212 11326 073706 STA ADCDC SET DECIMATION COUNT
0213* TEST FOR ",M" MAG TAPE OPTION
0214 11327 014316 JSB SPNOR GET NEXT CHARACTER
0215 11330 051405 CPA B54 IS IT COMMA
0216 11331 027405 JMP ADCC5 YES; GO TRY "M"
0217* SET UP BUFFERS, START ACQUISITION
0218 11332 063715 ADCC4 LDA ADCB1 SET 1ST BUFFER
0219 11333 073713 STA ADCB1 AS INPUT BUFFER
0220 11334 073717 STA ADCMC AND FOR NT O/P
0221 11335 043712 ADA ADCL MAKE END POINTER
0222 11336 073714 STA ADCBE SET UP END
0223 11337 006400 CLB SET UP KIEL BUFFER
0224 11340 073204 STA KIELC DATA COUNTER
0225 11341 177204 STB KIELC,1 RESET TO ZERO
0226 11342 073202 STA KIELP KIEL BUFFER POINTER
0227 11343 043205 ADA KIELL LENGTH OF BUFFER
0228 11344 073203 STA KIELE SAVE END POINT
0229 11345 104200 DLD TAG TRANSFER TAG
0230 11347 104400 DST ADCBI,1 TO BUFFER
0231 11351 037713 ISZ ADCBI STEP POINTER
0232 11352 037713 ISZ ADCBI
0233 11353 104200 DLD KCL TRANSFER TIME
0234 11355 104400 DST ADCBI,1 TC BUFFER
0235 11357 037713 ISZ ADCBI STEP POINTER
0236 11360 037713 ISZ ADCBI
0237 11361 063725 LDA ADCT0 CLEAR T BUFFER
0238 11362 073722 STA ADCTI WORD INPUT
0239 11363 073723 STA ADCTJ SET INPUT
0240 11364 073724 STA ADCTC AND OUTPUT
0241 11365 003400 CCA SET EXPIRING COUNT

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0242	11366	073707		STA ADCD	FOR DECIMATION
0243	11367	002400		CLA	CLEAR CHANNEL COUNT
0244	11370	073705		STA ADCCH	SET CHANNEL COUNT
0245	11371	073730		STA ADCTF	CLEAR TRANSFER FLAG
0246	11372	073154		STA KIELS	CLEAR KIEL STATUS
0247	11373	073155		STA KIELN	CLEAR KIEL COUNT
0248	11374	063704		LDA ADCHC	CHANNEL COUNT
0249	11375	073676		STA ADCCT	RESET IT
0250	11376	063426		LDA ADCIN	ENABLE FADC(0)
0251	11377	073211		STA ADCC2	=TURN ON DIGITISATION
0252	11400	063731		LDA ADCIP	ADCIO ADDRESS
0253	11401	073430		STA ADCRT	SET UP FOR FIRST IR
0254	11402	103722		STC KIEL,C	START ACQUIRING KIEL DATA
0255	11403	103723		STC ADC,C	START ACQUIRING CTD DATA
0256	11404	125174		JMP EFX,I	
0257*					
0258	11405	014401	ADCC5	JSB GETC	PASS ,
0259	11406	115133		JSB GT1,I	GET OPTION
0260	11407	051426		CPA B15	M?
0261	11410	027412		JMP ADCCM	
0262	11411	014220		JSB ERROR	ILLEGAL OPTION
0263	11412	037710	ADCCM	ISZ ADCMF	SET NT FLAG
0264	11413	060745		LDA BUNT	ANY UNIT SELECTED?
0265	11414	002021		SSA,RSS	+ = YES
0266	11415	027332		JMP ADCC4	
0267	11416	002400		CLA	DEFAULT TO ZERO
0268	11417	115136		JSB BSL,I	SELECT UNIT ZERO
0269	11420	027332		JMP ADCC4	
0270*					
0271	11421	063427	ADCCX	LDA ADCI3	DISABLE FADC(0)
0272	11422	073211		STA ADCC2	
0273	11423	107723		CLC ADC,C	
0274	11424	107722		CLC KIEL,C	TURN OFF KIEL INTERFACE TOO
0275	11425	125174		JMP EFX,I	
0276*					
0277	11426	014542	ADCIN	JSB PUSHJ	
0278	11427	014220	ADCI3	JSB ERROR	

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0280*      ADC INTERRUPT ROUTINES FOR GUILDLINE DIGITAL
0281*      ALL DATA IS OFFSET BINARY THE CHANNEL
0282*      NUMBER IS IN BITS 15-12,THE DATA IS IN
0283*      BITS 0-11
0284*
0285*      FOLLOWING ROUTINE ACTS AS A SWITCH TO APPROPRIATE
0286*      INTERRUPT ROUTINE
0287              LST
0288  11430 011570  ADCRT DEF ADCI0  POINTER TO CURRENT IR ROUTINE
0289  11431 063441      LDA ADCA      RESTORE A
0290  11432 067443      LDB ADCE0      GET E AND 0
0291  11433 103101      CLO              CLEAR 0
0292  11434 004036      SLB,ELB      SIGN TO E,SET 0 IF NESSARY
0293  11435 102101      STO
0294  11436 067442      LDB ADCB      RESTORE B REGISTER
0295  11437 103723      STC ADC,C      REENABLE INTERFACE SENT PULSE TO
0296  11440 127444      JMP ADCIR,I  RETURN FROM INTERRUPT
0297  11441 000000  ADCA  NOP      STORE FOR A
0298  11442 000000  ADCB  NOP      STORE FOR B
0299  11443 000000  ADCE0 NOP      STO E FOR E AND 0
0300*
0301*
0302*      INTERRUPT ENTRY POINT
0303  11444 000000  ADCIR NOP      INTERRUPT COMES HERE
0304  11445 106723      CLC ADC      ONLY HERE SO I CAN SIMULATE CTD
0305  11446 073441      STA ADCA      SAVE A
0306  11447 077442      STB ADCB      SAVE B REGISTER
0307  11450 005520      ERB,BLS      E TO SIGN CLEAR LSB
0308  11451 102201      SOC          OVERFLOW SET
0309  11452 006004      INB          SET LSB
0310  11453 077443      STB ADCE0      SAVE E AND 0
0311  11454 102523      LIA ADC      GET DATA
0312  11455 013677      AND ADCM4     MASK CHANNEL NO
0313  11456 053705      CPA ADCCH     COMPARE EXPECTED
0314  11457 027466      JMP ADCI
0315  11460 002003      SZA,RSS      CHANNEL ZERO
0316  11461 027472      JMP ADC2      YES ,RESYNC
0317  11462 063733      LDA ADCST     NOT EXPECTED CH
0318  11463 033734      IOR ADCCE     SET "CHANNEL ERROR"
0319  11464 073733      STA ADCST     IN ADC STATUS
0320  11465 063705      LDA ADCCH     GET CHANNEL
0321  11466 043700  ADC1  ADA ADCH1     SET NEXT EXPECTED
0322  11467 073705      STA ADCCH     SET NEW EXPECTED CH.
0323  11470 102523      LIA ADC      GET DATA AGAIN
0324  11471 127430      JMP ADCRT,I  GO TO CURRENT IR ROUTINE
0325*
0326*
0327  11472 063700  ADC2  LDA ADCH1     SET CH. 1 NEXT EXPECTED
0328  11473 073705      STA ADCCH
0329  11474 063733      LDA ADCST     SET CHANNEL ERROR
0330  11475 033734      IOR ADCCE     IN STATUS
0331  11476 073733      STA ADCST
0332  11477 063676      LDA ADCCT     GET CHANNEL COUNT
0333  11500 053704      CPA ADCCH     IS IT AT START?
0334  11501 027570      JMP ADCI0     YES,THEN DON'T BOTHER RESYNC
0335  11502 002400  ADC3  CLA          PUT ZERO IN UNUSED CHANNELS

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0336	11503	006400		CLB	
0337	11504	104400		DST ADCBI,I	PUT IN BUFFER
0338	11506	104400		DST ADCTI,I	T BUFFER TOO
0339	11510	037713		ISZ ADCBI	STEP POINTER
0340	11511	037713		ISZ ADCBI	
0341	11512	063730		LDA ADCTF	KFER FLAG
0342	11513	002003		SZA,RSS	AND IF WANTED
0343	11514	027517		JMP **3	
0344	11515	037722		ISZ ADCTI	
0345	11516	037722		ISZ ADCTI	IN T BUFFER TOO
0346	11517	037676		ISZ ADCCT	STEP CHANNEL COUNT,DONE?
0347	11520	027502		JMP ADC3	NO
0348	11521	063704		LDA ADCHC	RESET CHANNEL COUNT
0349	11522	073676		STA ADCCT	
0350	11523	027570		JMP ADCI0	YES ,SET UP FOR NEXT DATA FRAME
0351*					
0352	11524	013732	ADCI1	AND ADCM3	MASK DATA BITS 0-11
0353	11525	102601		OTA 1	OUTPUT TO SWITCHES
0354	11526	037707		ISZ ADCD	COUNT DECIMATION
0355	11527	027533		JMP **4	
0356	11530	063706		LDA ADCDC	RESET DECIMATION
0357	11531	073707		STA ADCD	
0358	11532	037730		ISZ ADCTF	SET TRANSFER FLAG
0359	11533	063704		LDA ADCHC	RESET CHANNEL COUNT
0360	11534	073676		STA ADCCT	
0361*					
0362	11535	017430	ADCI2	JSB ADCRT	
0363*					
0364	11536	013732		AND ADCH3	MASK SUPPRESSION BITS 0-11
0365	11537	043735		ADA ADCM6	CONVERT TO 2'S COMPLEMENT
0366	11540	073736		STA ADCSP	SAVE SUPPRESSION
0367	11541	017430		JSB ADCRT	RETURN
0368*					
0369	11542	013732	ADCI4	AND ADCM3	DATA BITS 0-11
0370	11543	043735		ADA ADCM6	CONVERT TO 2'S COMPLEMENT
0371	11544	070001		STA 1	
0372	11545	063736		LDA ADCSP	SET SUPPRESSION
0373	11546	104400		DST ADCBI,I	PUT IN BUFFER
0374	11550	104400		DST ADCTI,I	PUT IN T BUFFER
0375	11552	037713		ISZ ADCBI	STEP BUFFER POINTER
0376	11553	037713		ISZ ADCBI	
0377	11554	067730		LDB ADCTF	TRANSFER FLAG
0378	11555	006003		SZB,RSS	AND IF WANTED T
0379	11556	027561		JMP **3	
0380	11557	037722		ISZ ADCTI	BUFFER PTR TOO
0381	11560	037722		ISZ ADCTI	
0382	11561	037676		ISZ ADCCT	ALL CHANNELS DONE
0383	11562	027535		JMP ADCI2	NO DO SOME MORE
0384	11563	063704		LDA ADCHC	RESET CHANNEL COUNT
0385	11564	073676		STA ADCCT	
0386	11565	002400		CLA	CLEAR
0387	11566	073705		STA ADCCH	
0388	11567	017430		JSB ADCRT	READ CHANNEL ZERO
0389	11570	002400	ADCI0	CLA	
0390	11571	073730		STA ADCTF	
0391	11572	063722		LDA ADCTI	CHECK T BUF PTR

0392	11573	053726	CPA ADCTE	AT END?
0393	11574	063725	LDA ADCT0	SET TO START
0394	11575	073722	STA ADCTI	SET NEW T BUF PTR
0395	11576	073723	STA ADCTJ	AND LET FADC(0) READ
0396	11577	063713	LDA ADCBI	CHECK BUFFER PTR
0397	11600	053714	CPA ADCBE	FULL?
0398	11601	027604	JMP ADCFU	YES; GO DEAL WITH IT
0399	11602	017430	JSB ADCRT	RESTORE B,E,0 AND RETURN
0400	11603	027524	JMP ADCII	NEXT IR IS CH 1
0401*				
0402*			BUFFER FULL; SWAP TO	OTHER, WRITE TO MT IF REQUIRED
0403	11604	063717	ADCFU LDA ADCMC	WHICH BUFFER?
0404	11605	053715	CPA ADCBI	1ST?
0405	11606	027670	JMP ADCF1	YES
0406	11607	063715	LDA ADCBI	WAS 2ND; SET 1ST
0407	11610	073713	ADCF2 STA ADCBI	SET START OF BUFFER
0408	11611	073720	STA ADCMD	FOR MT ALSO
0409	11612	043712	ADA ADCL	MAKE PTR TO END
0410	11613	073714	STA ADCBE	SET END OF BUFFER
0411	11614	006400	CLB	SET UP TO SWAP
0412	11615	103100	CLF 0	TURN OFF INTERRUPT
0413	11616	073204	STA KIELC	COUNTER
0414	11617	177204	STB KIELC,I	RESET TO ZERO
0415	11620	073202	STA KIELP	BUFFER POINTER
0416	11621	043205	ADA KIELL	BUFFER LENGTH
0417	11622	073203	STA KIELE	END POINT
0418	11623	102100	STF 0	TURN ON INTERRUPT
0419	11624	104200	DLD TAG	GET TAG
0420	11626	104400	DST ADCBI,I	FOR NEW RECORD
0421	11630	037713	ISZ ADCBI	STEP PTR TO TIME
0422	11631	037713	ISZ ADCBI	
0423	11632	104200	DLD XCL	GET CURRENT TIME
0424	11634	104400	DST ADCBI,I	WRITE TO RECORD
0425	11636	037713	ISZ ADCBI	STEP PTR TO DATA
0426	11637	037713	ISZ ADCBI	
0427	11640	063710	LDA ADCMF	MT O/P ENABLED?
0428	11641	002003	SZA,RSS	
0429	11642	027664	JMP ADCIX	NO; EXIT
0430	11643	115156	JSB BUW,I	CHECK PREVIOUS MT XFER
0431*			THERE ARE CIRCUMSTANCES IN WHICH THE PROGRAM	
0432*			CAN HANG UP HERE ... BUT IF IT DOES, YOU WERE	
0433*			LOSING DATA ANYWAY.	
0434	11644	010765	AND BUWEP	7-TRACK EOT, TIMING, PARITY
0435	11645	033733	ICR ADCST	ADD IN OTHER STATUS BITS
0436	11646	073733	STA ADCST	SET IN 'STATUS'
0437	11647	102513	LIA MTC	GET MT STATUS AGAIN
0438	11650	010761	AND BUWET	TEST END OF TAPE
0439	11651	002002	SZA	
0440	11652	027672	JMP ADCF3	GO SWAP TAPE UNITS
0441*			INITIATE MAG TAPE TRANSFER	ON SELECTED UNIT
0442	11653	063717	ADCF4 LDA ADCMC	GET CORE PTR FOR MT O/P
0443	11654	070773	STA BUPT	SET IT IN MT ROUTINE
0444	11655	063712	LDA ADCL	GET BUFFER LENGTH
0445	11656	043205	ADA KIELL	LONGER FOR KIEL DATA
0446	11657	003000	CMA	NEGATE
0447	11660	070774	STA BUL	SET IT IN MT ROUTINE

0448	11661	115157		JSB BUD,I	SET UP DMA FOR WRITE
0449	11662	060750		LDA BUFVI	BINARY WRITE
0450	11663	115160		JSB BUG,I	START TAPE MOVING
0451	11664	063720	ADCIX	LDA ADCMD	SET MT CORE PTR
0452	11665	073717		STA ADCMC	FOR NEXT TIME
0453	11666	017430		JSB ADCRT	RETURN FROM INTERRUPT
0454	11667	027524		JMP ADCI1	NEXT IR IS CH 1
0455*					
0456	11670	063716	ADCF1	LDA ADCB2	WAS BUFFER 1; SET 2
0457	11671	027610		JMP ADCF2	
0458*					
0459	11672	060745	ADCF3	LDA BUNT	ONE TAPE FULL; SWAP TO
0460	11673	021355		XOR B1	THE OTHER UNIT, SWAPPING
0461	11674	115136		JSB BSL,I	0 AND 1 OR 2 AND 3.
0462	11675	027653		JMP ADCF4	
0463*					
0464*					
					POINTERS, COUNTS ETC.
0465	11676	000000	ADCCT	NOP	COUNT CHANNELS
0466	11677	070000	ADCM4	OCT 70000	MASK FOR CHANNEL NUMBER
0467	11700	010000	ADCH1	OCT 10000	ONE CHANNEL
0468	11701	000024	ADCI1	OCT 24	EXPONENT INCREMENT FOR SUPPRESSION
0469	11702	000000	ADCCN	NOP	NO OF OUTPUT CHANNELS
0470	11703	000000	ADCCL	NOP	LENGTH OF FP ARRAY
0471	11704	000000	ADCHC	NOP	-NO OF OUTPUT CHS.
0472	11705	000000	ADCCH	NOP	EXPECTED CHANNEL NO
0473	11706	000000	ADCDC	NOP	-DECIMATION COUNT
0474	11707	000000	ADCD	NOP	COUNT DECIMATION
0475	11710	000000	ADCMF	NOP	"M" FLAG; +=MT O/P
0476	11711	003410	ADCBL	DEC 1300	MAXIMUM BUFFER
0477	11712	000000	ADCL	NOP	ACTUAL BUFFER LENGTH
0478	11713	000000	ADCB1	NOP	BUFFER INPUT POINTER
0479	11714	000000	ADCBE	NOP	BUFFER GND POINTER
0480	11715	011737	ADCB1	DEF ADCBF	BUFFER 1
0481	11716	020765	ADCB2	DEF ADCBF+KIELF+1805	BUFFER 2
0482	11717	000000	ADCMC	NOP	CORE FOR MT XFER
0483	11720	000000	ADCMD	NOP	CORE FOR NEXT MT XFER
0484	11721	001130	ADCTL	DEC 600	MAX LENGTH T BUFFER
0485	11722	030013	ADCTI	DEF ADCT	
0486	11723	030013	ADCTJ	DEF ADCT	T BUFFER SET PTR
0487	11724	030013	ADCTO	DEF ADCT	T BUFFER OUTPUT PTR
0488	11725	030013	ADCT0	DEF ADCT	START OF T BUFFER
0489	11726	000000	ADCTE	NOP	END T BUFFER
0490	11727	000000	ADCPT	NOP	CURRENT SET PTR
0491	11730	000000	ADCTF	NOP	TRANSFER FLAG
0492	11731	011570	ADCIP	DEF ADCI0	FIRST IR ROUTINE
0493	11732	007777	ADCM3	OCT 7777	MASK 12 DATA BITS
0494	11733	000000	ADCST	NOP	STATUS
0495	11734	000010	ADCCO	OCT 10	"CHANNEL ERROR" BIT 3
0496	11735	174000	ADCM6	OCT 174000	CONVERT TO 2'S COMP.
0497	11736	000000	ADCSP	NOP	STORE FOR SUPPRESSION
0498	11737	000000	ADCBF	BSS KIELF+KIELF+3610	BUFFER
0499	30013	000000	ADCT	BSS 600	TRANSFER BUFFER

0501*FSW, READ/WRITE SWITCH REGISTER

0502	31143	061175	XSW	LDA	FLAC
0503	31144	065176		LDB	FLAC+1
0504	31145	115134		JSB	IFX, I
0505	31146	070001		STA	1
0506	31147	102501		LIA	1
0507	31150	106601		CTB	1
0508	31151	105120		ABS	-FLT
0509	31152	125174		JMP	EFX, I

0510*

0511*FTAG, SET UP 32-BIT HEADER FOR 'FADC' MAGTAPE OUTPUT

0512*

0513	31153	061175	XTAG	LDA	FLAC	
0514	31154	065176		LDB	FLAC+1	
0515	31155	115134		JSB	IFX, I	
0516	31156	071117		STA	TAG	STORE TAG
0517	31157	014542		JSB	PUSHJ	GET 2ND ARGUMENT
0518	31160	006706		DEF	ARG	IF 3NY
0519	31161	125174		JMP	EFX, I	NO 2ND ARGUMENT
0520	31162	061175		LDA	FLAC	PICK UP 2ND ARGUMENT
0521	31163	065176		LDB	FLAC+1	
0522	31164	115134		JSB	IFX, I	CONVERT TO INTEGER
0523	31165	071120		STA	TAG+1	AND STORE
0524	31166	125174		JMP	EFX, I	THAT'S ALL THERE IS TO IT

0525*

C527*FSAL, SALINITY

0528	31167	061175	XSAL	LDA	FLAC	SAVE	P
0529	31170	065176		LDB	FLAC+1		
0530	31171	073315		STA	SALP		
0531	31172	077316		STB	SALF+1		
0532	31173	014542		JSB	PUSHJ	GET	T
0533	31174	006706		DEF	ARG		
0534	31175	014220		JSB	ERROR	NO	T
0535	31176	061175		LDA	FLAC	SAVE	T
0536	31177	065176		LDB	FLAC+1		
0537	31200	073317		STA	SALT		
0538	31201	077320		STB	SALT+1		
0539	31202	014542		JSB	PUSHJ	GET	C
0540	31203	006706		DEF	ARG		
0541	31204	014220		JSB	ERROR	NO	C
0542	31205	063317		LDA	SALT	PRESSURE	CORRECTION
0543	31206	067320		LDB	SALT+1	T	POLY
0544	31207	115463		JSB	POLY,I		
0545	31210	000003		DEC	3		
0546	31211	031323		DEF	SAL1		
0547	31212	073321		STA	SALT1		
0548	31213	077322		STB	SALT1+1		
0549	31214	063315		LDA	SALP	P	POLY
0550	31215	067316		LDB	SALF+1		
0551	31216	115463		JSE	POLY,I		
0552	31217	000004		DEC	4		
0553	31220	031331		DEF	SAL2		
0554	31221	105060		ABS	-FDV	P	POLY/T POLY
0555	31222	031321		DEF	SALT1		
0556	31223	105000		ABS	-FAD		
0557	31224	001302		DEF	FL1		
0558	31225	073321		STA	SALT1		
0559	31226	077322		STB	SALT1+1	1+P	POLY/T POLY
0560*							
0561	31227	063317		LDA	SALT	MAIN	TEMPERATURE COMP.
0562	31230	067320		LDB	SALT+1		
0563	31231	115463		JSB	POLY,I		
0564	31232	000006		DEC	6		
0565	31233	031341		DEF	SAL3		
0566	31234	105041		ABS	-FMP	APPLY	P T CORRECTION
0567	31235	031321		DEF	SALT1		
0568	31236	073321		STA	SALT1		
0569	31237	077322		STB	SALT1+1		
0570	31240	061175		LDA	FLAC	TO	CONDUCTIVITY
0571	31241	065176		LDB	FLAC+1		
0572	31242	105060		ABS	-FDV		
0573	31243	031321		DEF	SALT1		
0574	31244	071175		STA	FLAC	RETURN	MODIFIED CONDUCTIVITY
0575	31245	075176		STB	FLAC+1	TO	FLAC
0576*							
0577	31246	105020		ABS	-FSB	MAKE	SMALL CORRECTIONS
0578	31247	001302		DEF	FL1		
0579	31250	105041		ABS	-FMP	C*(C-1)	
0580	31251	001175		DEF	FLAC		
0581	31252	073321		STA	SALT1		
0582	31253	077322		STB	SALT1+1		

0583	31254	063317	LDA	SALT	PRESSURE TERM
0584	31255	067320	LDB	SALT+1	
0585	31256	115463	JSB	POLY,I	
0586	31257	000002	DEC	2	
0587	31260	031363	DEF	SALS	
0588	31261	105041	ABS	-FMP	
0589	31262	031315	DEF	SALP	
0590	31263	073361	STA	SAL4+4	
0591	31264	077362	STB	SAL4+5	
0592*					
0593	31265	061175	LDA	FLAC	C-T TERMS
0594	31266	065176	LDB	FLAC+1	
0595	31267	115463	JSB	POLY,I	
0596	31270	000002	DEC	2	
0597	31271	031367	DEF	SAL6	
0598	31272	073357	STA	SAL4+2	
0599	31273	077360	STB	SAL4+3	
0600	31274	063317	LDA	SALT	COMBINE
0601	31275	067320	LDB	SALT+1	
0602	31276	115463	JSB	POLY,I	
0603	31277	000003	DEC	3	
0604	31300	031355	DEF	SAL4	
0605	31301	105041	ABS	-FMP	*C*(C-1)
0606	31302	031321	DEF	SALT1	
0607	31303	073321	STA	SALT1	
0608	31304	077322	STB	SALT1+1	
0609*					
0610	31305	061175	LDA	FLAC	MAIN C TO S
0611	31306	065176	LDB	FLAC+1	
0612	31307	115463	JSB	POLY,I	
0613	31310	000006	DEC	6	
0614	31311	031373	DEF	SAL7	
0615	31312	105000	ABS	-FAD	ADD CORRECTIONS
0616	31313	031321	DEF	SALT1	
0617	31314	125174	JMP	EFX,I	RESULT IN A AND B
0618*					
0619	31315	000000	SALP	DEC 0.	
0620	31317	000000	SALT	DEC 0.	
0621	31321	000000	SALT1	DEC 0.	
0622	31323	051422	SAL1	DEC 3.169E-4,3.0786E-2,1.	
0623	31331	067423	SAL2	DEC 6.166E-15,-5.4945E-10,1.60336E-5,0.	
0624	31341	137105	SAL3	DEC -.95646E-9,.663375E-7,-.218091E-5,.1227E-3	
0625	31351	051022		DEC .200372E-1,.676513	
0626	31355	103551	SAL4	DEC -.46E-3,0.,0.	
0627	31363	117261	SAL5	DEC -2.9E-6,1.25E-4	
0628	31367	137166	SAL6	DEC -4.E-3,.442E-1	
0629	31373	125506	SAL7	DEC -1.3238,5.98624,-10.61069,12.13382	
0630	31403	071555		DEC 28.3567,-.08996	


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0632*   SINGLE PRECISION SIGMA T FUNCTION
0633*   USES FORMULA DERIVED BY BENNETT AS A FIT
0634*   TO DATA OF COX ET AL AND TO CLASSIC
0635*   DISTILLED WATER DATA
0636   31407 061175 XSGT LDA FLAC GET T
0637   31410 065176 LDB FLAC+1
0638   31411 115463 JSB POLY,I
0639   31412 000004 DEC 4
0640   31413 031457 DEF SGT2
0641   31414 073460 STA SGT1+11
0642   31415 077456 STB SGT1+9 MOST SIG SALINITY COEFF.
0643   31416 061175 LDA FLAC GET T AGAIN
0644   31417 065176 LDB FLAC+1
0645   31420 115463 JSB POLY,I
0646   31421 000004 DEC 4
0647   31422 031467 DEF SGT3
0648   31423 073453 STA SGT1+6
0649   31424 077454 STB SGT1+7 NEXT SAL COEFF.
0650   31425 061175 LDA FLAC T FOR THE LAST TIME
0651   31426 065176 LDB FLAC+1
0652   31427 115463 JSB POLY,I
0653   31430 000002 DEC 2
0654   31431 031477 DEF SGT4
0655   31432 073451 STA SGT1+4
0656   31433 077452 STB SGT1+5 3RD SAL COEFF
0657*
0658   31434 014542 JSB PUSHJ GET SALINITY
0659   31435 006706 DEF ARG
0660   31436 014220 JSB ERROR NO SALINITY
0661   31437 061175 LDA FLAC S TO A B
0662   31440 065176 LDB FLAC+1
0663   31441 115463 JSB POLY,I
0664   31442 000005 DEC 5
0665   31443 031445 DEF SGT1
0666   31444 125174 JMP EFX,I EXIT; RESULT IN A B
0667*
0668   31445 131216 SGT1 DEC -.577E-6,.5994E-4,0.,0.,0.
0669   31457 045172 SGT2 DEC .7103E-4,-.90399E-2,.70E23E-1,-.13230
0670   31467 137623 SGT3 DEC -.96E-6,.7674E-4,-.37845E-2,.3333093
0671   31477 057164 SGT4 DEC .563E-5,-.21192E-2

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0673*

0674*FCLK, REAL TIME CLOCK (INTERRUPT ROUTINE)

```

0675 31503 000000 CLKI  NOP          CLOCK INTERRUPT
0676 31504 035115      ISZ XCL+1    STEP COUNT OF SECONDS
0677 31505 027510      JMP CLKIX
0678 31506 035114      ISZ XCL      OF 65536'S OF SECONDS
0679 31507 000000      NOP          SKIPS EVERY 137 YRS
0680 31510 103721 CLKIX STC CLOCK,C REENABLE CLOCK
0681 31511 127503      JMP CLKI,I

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0682*

0683*FCLK, REAL TIME CLOCK

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0684 31512 061175 XCLK LDA FLAC      ARG
0685 31513 002002      SZA          0=READ TIME
0686 31514 027536      JMP XCLKS
0687 31515 061114      LDA XCL     GET M.S
0688 31516 105120      ABS -FLT   FLOAT IT
0689 31517 115161      JSB PW2,I  SCALE 2*16
0690 31520 000020      DEC 16
0691 31521 071204      STA F3     SAVE M.S
0692 31522 075205      STB F3+1
0693 31523 061115      LDA XCL+1  GET L.S.
0694 31524 105120      ABS -FLT   FLOAT IT
0695 31525 002021      SSA,RSS   TEST SIGN
0696 31526 027531      JMP *+3    +VE OK
0697 31527 105000      ABS -FAD   CONVERT TO UNSIGNED
0698 31530 031534      DEF CLKFN  BY ADDING 65536
0699 31531 105000      ABS -FAD   ADD IN M.S.
0700 31532 001204      DEF F3
0701 31533 125174      JMP EFX,I
0702 31534 040000 CLKFN DEC 65536.
0703*
0704 31536 107721 XCLKS CLC CLOCK,C STOP CLOCK
0705 31537 002020      SSA          +=SET TIME  START CLOCK
0706 31540 125174      JMP EFX,I    -=STOP CLOCK
0707 31541 065176      LDB FLAC+1  GET ARGUMENT
0708 31542 115161      JSB PW2,I  SCALE BY 2*-15
0709 31543 177761      OCT -17
0710 31544 071114      STA XCL     SAVE SCALED TIME
0711 31545 075115      STB XCL+1
0712 31546 115142      JSB ENTP,I  TRUNCATE TO INTEGER
0713 31547 115134      JSB IFX,I  GET MORE SIG
0714 31550 071116      STA XCL+2  AND SAVE IT
0715 31551 003004      CMA,INA    -INTPT(X)
0716 31552 105120      ABS -FLT   BACK TO FLOATING POINT
0717 31553 105000      ABS -FAD   X-INTPT(X)
0718 31554 001114      DEF XCL
0719 31555 115161      JSB PW2,I  SCALE IT BACK
0720 31556 000017      OCT 17
0721 31557 115134      JSB IFX,I  INTEGER PART, ROUNDED
0722 31560 065116      LDB XCL+2  GET MORE SIG
0723 31561 004065      CLE,ERB   POSITION
0724 31562 001225      RAL,ERA   TRANSFER ODD BIT TO A
0725 31563 075114      STB XCL
0726 31564 071115      STA XCL+1
0727*
0728 31565 061356      LDA B2     SET CLOCK RATE

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0729	31566	102621	OTA	CLOCK	
0730	31567	103721	STC	CLOCK,C	START CLOCK
0731	31570	125174	JMP	EFX,I	
0732*					
0733*	START	NEW TEXT + VERSION ID			
0734	31571	000000	TEXT	OCT	0
0735	31572	000000		OCT	0
0736	31573	041455	ASC	6,C-ONCAL,V154	LEAD IN MESSAGE
0737	31601	043015		OCT	43015
0738	31602		BUFBG	EQU	*
0739*					
0740*			ONCAL CONSTANTS AND ROUTINE ENTRIES		
0741	01175		FLAC	EQU	1175B
0742	00542		PUSHJ	EQU	542B
0743	06706		ARG	EQU	6706B
0744	00220		ERROR	EQU	220B
0745	72660		FLT	EQU	72660B
0746	72720		FDV	EQU	72720B
0747	73000		FAD	EQU	73000B
0748	72760		FSB	EQU	72760B
0749	72737		FMP	EQU	72737B
0750	01134		IFX	EQU	1134B
0751	01302		FL1	EQU	1302B
0752	01174		EFX	EQU	1174B
0753	01161		PW2	EQU	1161B
0754	01114		XCL	EQU	1114B
0755	06717		GTARG	EQU	6717B
0756	01070		GTL	EQU	1070B
0757	00634		PT1	EQU	634B
0758	01373		B37	EQU	1373B
0759	01443		B177	EQU	1443B
0760	00646		INCH	EQU	646B
0761	04042		OPTN1	EQU	4042B
0762	00231		RECOV	EQU	231B
0763	01356		B2	EQU	1356B
0764	01360		B4	EQU	1360B
0765	00316		SPNOR	EQU	316B
0766	01117		TAG	EQU	1117B
0767	01367		B17	EQU	1367B
0768	01426		B115	EQU	1426B
0769	01156		BUW	EQU	1156B
0770	00013		MTC	EQU	13B
0771	01142		ENTP	EQU	1142B
0772	00401		GETC	EQU	401B
0773	01133		GT1	EQU	1133B
0774	01204		F3	EQU	1204B
0775	10664		.POLY	EQU	10664B
0776	01405		B54	EQU	1407B
0777	00761		BUFET	EQU	761B
0778	00773		BUPT	EQU	773B
0779	00774		BUL	EQU	774B
0780	01157		BUD	EQU	1157B
0781	00750		BUFWI	EQU	750B
0782	01160		BUG	EQU	1160B
0783	01355		B1	EQU	1355B
0784	01136		BSL	EQU	1136B

0785 00745 BUNT EQU 745B

0786 00765 BUFEP EQU 765B

0787*

0788 01463 ORG 1463B

BASE PAGE LINKS

0789 01463 010664 POLY DEF .POLY

0790*

0791 END

** NO ERRORS*

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0001          ASSEMBL
0003*        FLUKE/BENNETT MULTIFLEXOR FADC
0004*        FLUKE CONNECTED VIA 16-BIT INTERFACE
0005*        MULTIFLEXOR VIA "+3 BIT" WITH INVERTED LOGIC
0006*
0007*        SELECT CODE ASSIGNMENTS
0008 00014          ORG 14B
0009          SUP
0010 00014 114035  FLOT  JSB 35B.I  PLOTTER
0011*
0012 00020          ORG 20B
0013 00020 114031  ADC3  JSB 31B.I  REED DELAY MULTIFLEXOR
0014*
0015*        INTERRUPT ROUTINE LINKS
0016 00021 114040  CLOCK JSB 40B.I  CLOCK
0017 00022 114037  ADC1  JSB 37B.I  FLUKE DVL.
0018*
0019 00031          ORG 31B
0020 00031 016704  DEF ADC13
0021*
0022 00037          ORG 37B
0023 00037 012771  DEF ADC11  ADC1
0024 00040 012057  DEF CLK1   CLOCK
0025*
0026*
0027*
0028*        FLOATING POINT HARDWARE DEFINITIONS
0029*        BECAUSE OF THE PECULIARITIES OF THE HP ASSEMBLER,
0030*        THESE MUST BE REFERENCED BY
0031*          ABS -FAD  ETC
0032*
0033 73000          FAD  EQU 73000B
0034 72760          FSB  EQU 72760B
0035 72740          FMP  EQU 72740B
0036 72720          FDV  EQU 72720B
0037 72660          FLT  EQU 72660B
0038*
0039*        UPDATE TEXT POINTERS
0040 00654          ORG 654B
0041 00654 016734  DEF BUFBG
0042 00655 016734  DEF BUFBG
0043 00656 016734  DEF BUFBG
0044 00657 016723  DEF TEXT
0045*
0046*        NEW FUNCTION NAMES
0047*
0048 00704          ORG 704B
0049 00704 046054  FSAL  OCT 46054
0050 00705 046364  FSQT  OCT 46364
0051 00706 005613  FCLK  OCT 6613
0052 00707 002203  FADC  OCT 2203
0053 00710 050047  FTAG  OCT 50047
0054*
0055*        NEW FUNCTION ROUTINE POINTERS
0056 00734          ORG 734B
0057 00734 011131  PSAL  DEF XSAL

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0052	00735	011351	PSGT	DEF	XSGT
0059	00736	012000	PCLK	DEF	XCLK
0060	00737	012133	PADC	DEF	XADC
0061	00740	016707	FTAG	DEF	XTAG
0062*					
0063*			RECONFIGURE PLOTTER I/O		
0064	04425			ORG	4425B
0065	04425	103114		CLF	PLOT
0066*					
0067	04406			ORG	4406B
0068	04406	102614		OTA	PLOT
0069	04407	103714		STC	PLOT,C
0070*					
0071*			TEST FOR NEW FUNCTIONS		
0072	05237			ORG	5237B
0073	05237	050704		CPA	FSAL
0074	05240	124734		JMP	PSAL,I
0075	05241	050705		CPA	FSGT
0076	05242	124735		JMP	PSGT,I
0077	05243	050706		CPA	FCLK
0078	05244	124736		JMP	PCLK,I
0079	05245	050707		CPA	FADC
0080	05246	124737		JMP	PADC,I
0081	05247	050710		CPA	FTAG
0082	05250	124740		JMP	FTAG,I
0083*					

0085* NEW FUNCTIONS

0086*FSAL, SALINITY

0087	11131		ORG 11131B	
0088	11131	061175	XSAL LDA FLAC	SAVE P
0089	11132	065176	LDB FLAC+1	
0090	11133	073257	STA SALT	
0091	11134	077260	STB SALT+1	
0092	11135	014542	JSB PUSHJ	GET T
0093	11136	006706	DEF ARG	
0094	11137	014220	JSB ERROR	NO T
0095	11140	061175	LDA FLAC	SAVE T
0096	11141	065176	LDB FLAC+1	
0097	11142	073261	STA SALT	
0098	11143	077262	STB SALT+1	
0099	11144	014542	JSB PUSHJ	GET C
0100	11145	006706	DEF ARG	
0101	11146	014220	JSB ERROR	NO C
0102	11147	063261	LDA SALT	PRESSURE CORRECTION
0103	11150	067262	LDB SALT+1	T POLY
0104	11151	016664	JSB .POLY	
0105	11152	000003	DEC 3	
0106	11153	011265	DEF SALT1	
0107	11154	073263	STA SALT1	
0108	11155	077264	STB SALT1+1	
0109	11156	063257	LDA SALT	P POLY
0110	11157	067260	LDB SALT+1	
0111	11160	016664	JSB .POLY	
0112	11161	000024	DEC 4	
0113	11162	011273	DEF SALT2	
0114	11163	105060	ABS -FDV	P POLY/T POLY
0115	11164	011263	DEF SALT1	
0116	11165	105000	ABS -FAD	
0117	11166	001302	DEF FL1	
0118	11167	073263	STA SALT1	
0119	11170	077264	STB SALT1+1	1+P POLY/T POLY
0120*				
0121	11171	063261	LDA SALT	MAIN TEMPERATURE COMP.
0122	11172	067262	LDB SALT+1	
0123	11173	016664	JSB .POLY	
0124	11174	000006	DEC 6	
0125	11175	011303	DEF SALT3	
0126	11176	105040	ABS -FHF	APPLY P & T CORRECTION
0127	11177	011263	DEF SALT1	
0128	11200	073263	STA SALT1	
0129	11201	077264	STB SALT1+1	
0130	11202	061175	LDA FLAC	TO CONDUCTIVITY
0131	11203	065176	LDB FLAC+1	
0132	11204	105060	ABS -FDV	
0133	11205	011263	DEF SALT1	
0134	11206	071175	STA FLAC	RETURN MODIFIED CONDUCTIVITY
0135	11207	075176	STB FLAC+1	TO FLAC
0136*				
0137	11210	105020	ABS -FSE	MAKE SMALL CORRECTIONS
0138	11211	001302	DEF FL1	
0139	11212	105040	ABS -FMP	C*(C-1)
0140	11213	001175	DEF FLAC	

0141	11214	073263	STA	SALT1	
0142	11215	077264	STB	SALT1+1	
0143	11216	063261	LDA	SALT	PRESSURE TERM.
0144	11217	067262	LDB	SALT+1	
0145	11220	016664	JSB	.POLY	
0146	11221	000002	DEC	2	
0147	11222	011325	DEF	SAL5	
0148	11223	105040	ABS	-FMP	
0149	11224	011257	DEF	SALP	
0150	11225	073323	STA	SAL4+4	
0151	11226	077324	STB	SAL4+5	
0152*					
0153	11227	061175	LDA	FLAC	C-T TERMS
0154	11230	065176	LDB	FLAC+1	
0155	11231	016664	JSB	.POLY	
0156	11232	000002	DEC	2	
0157	11233	011331	DEF	SAL6	
0158	11234	073321	STA	SAL4+2	
0159	11235	077322	STB	SAL4+3	
0160	11236	063261	LDA	SALT	COMBINE
0161	11237	067262	LDB	SALT+1	
0162	11240	016664	JSB	.POLY	
0163	11241	000003	DEC	3	
0164	11242	011317	DEF	SAL4	
0165	11243	105040	ABS	-FMP	*C*(C-1)
0166	11244	011263	DEF	SALT1	
0167	11245	073263	STA	SALT1	
0168	11246	077264	STB	SALT1+1	
0169*					
0170	11247	061175	LDA	FLAC	MAIN C TO S
0171	11250	065176	LDB	FLAC+1	
0172	11251	016664	JSB	.POLY	
0173	11252	000006	DEC	6	
0174	11253	011335	DEF	SAL7	
0175	11254	105000	ABS	-FAD	ADD CORRECTIONS
0176	11255	011263	DEF	SALT1	
0177	11256	125174	JMP	EFX,1	RESULT IN A AND E
0178*					
0179	11257	000000	SALP	DEC 0.	
0180	11261	000000	SALT	DEC 0.	
0181	11263	000000	SALT1	DEC 0.	
0182	11265	051422	SAL1	DEC 3.169E-4,3.0786E-2,1.	
0183	11273	067423	SAL2	DEC 6.166E-15,-5.4845E-12,1.60336E-8,0.	
0184	11303	137105	SAL3	DEC -.95646E-9,.063402E-7,-.013091E-5,.1227E-7	
0185	11313	051025		DEC .200402E-1,.676513	
0186	11317	103551	SAL4	DEC -.46E-3,0.,0.	
0187	11325	117261	SAL5	DEC -2.9E-6,1.25E-4	
0188	11331	107166	SAL6	DEC -4.E-3,.442E-1	
0189	11335	125522	SAL7	DEC -1.32311,5.93624,-10.61302,22.17102	
0190	11345	071555		DEC 28.0567,-.003996	


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0192*   SINGLE PRECISION SIGMA T FUNCTION
0193*   USES FORMULA DERIVED BY BENNETT AS A FIT
0194*   TO DATA OF COX ET AL END TO CLASSIC
0195*   DISTILLED WATER DATA
0196*
0197*   SMALL ERROR IN DERIVATION AFFECTS RESULTS AWAY
0198*   FROM S=35PPT
0199*
0200  11351 061175 XSGT  LDA FLAC      GET T
0201  11352 065176      LDB FLAC+1
0202  11353 016664      JSB .POLY
0203  11354 000004      DEC 4
0204  11355 011421      DEF SGT2
0205  11356 073417      STA SGT1+8
0206  11357 077420      STB SGT1+9  MOST SIG SALINITY COEFF.
0207  11360 061175      LDA FLAC      GET T AGAIN
0208  11361 065176      LDB FLAC+1
0209  11362 016664      JSB .POLY
0210  11363 000004      DEC 4
0211  11364 011431      DEF SGT3
0212  11365 073415      STA SGT1+6
0213  11366 077416      STB SGT1+7  NEXT SAL COEFF.
0214  11367 061175      LDA FLAC      T FOR THE LAST TIME
0215  11370 065176      LDB FLAC+1
0216  11371 016664      JSB .POLY
0217  11372 000002      DEC 2
0218  11373 011441      DEF SGT4
0219  11374 073413      STA SGT1+4
0220  11375 077414      STB SGT1+5  3RD SAL COEFF
0221*
0222  11376 014542      JSB PUSHJ   GET SALINITY
0223  11377 006706      DEF ARG
0224  11400 014220      JSB ENPOP   NO SALINITY
0225  11401 061175      LDA FLAC    S TO A & B
0226  11402 065176      LDB FLAC+1
0227  11403 016664      JSB .POLY
0228  11404 000005      DEC 5
0229  11405 011407      DEF SGT1
0230  11406 125174      JMP DFX,1   EXIT; RESULT IN A & B
0231*
0232  11407 120264  SGT1  DEC -3.55E-7,3.685E-5,0.0,0.0.
0233  11421 044174  SGT2  DEC 6.913E-5,-3.9871E-3,6.96899E-2,-3.716E-2
0234  11431 104256  SGT3  DEC -3.89E-7,7.469E-5,-3.7666E-3,-3.2199E-2
0235  11441 056265  SGT4  DEC 5.526E-6,-1.259E-2

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0237*      CLOCK AND ADC ROUTINES FOR FLUKE DVM AND BENNETT CYCLE
0238*
0239*      CLOCK ROUTINES
0240*
0241      12000                ORG 12000B
0242      12000 061175  XCLK LDA FLAC      TEST ARGUMENT
0243      12001 002002          SZA          0=READ TIME
0244      12002 026024          JMP XCLKS
0245      12003 061114          LDA XCL      GET M.S.
0246      12004 105120          ABS -FLT     FLOAT IT
0247      12005 115161          JSB PW2,I    SCALE 2*16
0248      12006 000020          DEC 16
0249      12007 071204          STA F3      SAVE M.S.
0250      12010 075205          STB F3+1
0251      12011 061115          LDA XCL+1   GET L.S.
0252      12012 105120          ABS -FLT     FLOAT IT
0253      12013 002021          SSA,RSS     TEST SIGN
0254      12014 026017          JMP *+3     +VE CK
0255      12015 105000          ABS -FAD     CONVERT TO UNSIGNED
0256      12016 012022          DEF CLKFN   BY ADDING 65536
0257      12017 105000          ABS -FAD     ADD IN H.S.
0258      12020 001204          DEF F3
0259      12021 125174          JMP EFX,I
0260      12022 040000  CLKFN DEC 65536.
0261*
0262      12024 107721  XCLKS CLC CLOCK,C  STOP CLOCK
0263      12025 002020          SSA          +=SET TIME  START CLOCK
0264      12026 125174          JMP EFX,I    -=STOP CLOCK
0265      12027 065176          LDB FLAC+1  GET ARGUMENT
0266      12030 115161          JSB PW2,I    SCALE BY 2*-15
0267      12031 177761          OCT -17
0268      12032 071114          STA XCL      SAVE SCALED TIME
0269      12033 075115          STB XCL+1
0270      12034 115142          JSB ENTP,I  TRUNCATE TO INTEGER
0271      12035 115134          JSB IFX,I   GET MORE SIG
0272      12036 071116          STA XCL+2   AND SAVE IT
0273      12037 003004          CMA,INA     -INTPT(X)
0274      12040 105120          ABS -FLT     BACK TO FLOATING POINT
0275      12041 105000          ABS -FAD     X-INTPT(X)
0276      12042 061114          DEF XCL
0277      12043 115161          JSB PW2,I    SCALE IT BACK
0278      12044 000017          OCT 17
0279      12045 115134          JSB IFX,I   INTEGER PART, ROUNDED
0280      12046 065116          LDB XCL+2   GET MORE SIG
0281      12047 004065          CLE,ERB     POSITION
0282      12050 001225          RAL,ERA     TRANSFER ODD BIT TO A
0283      12051 075114          STB XCL
0284      12052 071115          STA XCL+1
0285*
0286      12053 061356          LDA B2      SET CLOCK RATE
0287      12054 102621          OTA CLOCK
0288      12055 103721          STC CLOCK,C START CLOCK
0289      12056 125174          JMP EFX,I
0290*
0291      12057 000000  CLKI  R0F      CLOCK INTERRUPT
0292      12060 036127          ISZ CLKC1   COUNT NUMBERTIME

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0293	12061	026124		JMP CLKIX+1	
0294	12062	072126		STA CLKA	SAVE A
0295	12063	061463		LDA DN20	
0296	12064	072127		STA CLKC1	
0297	12065	062136		LDA ADCC2	A/D ENABLED?
0298	12066	052300		CPA ADCNO	
0299	12067	026113		JMP CLKI2	
0300	12070	062307		LDA ADCBS	STILL BUSY?
0301	12071	002002		SZA	
0302	12072	026113		JMP CLKI2	JUST LOSE A SAMPLE
0303	12073	036307		ISZ ADCBS	SET BUSY
0304	12074	063250		LDA ADCRE	CHECK RELAYS
0305	12075	051336		CPA BM2	SHOULD BE RESET TO =1
0306	12076	026103		JMP *+5	
0307	12077	062300		LDA ADCNO	DISABLE A/D
0308	12100	072136		STA ADCC2	
0309	12101	107722		CLC ADC1,C	AND TURN OFF HARDWARE
0310	12102	014220		JSB ERROR	DIGITISEE HARDWARE ERROR?
0311	12103	063247		LDA ADCW2	CONTROL WORD 2
0312	12104	102622		OTA ADC1	READ WORD TWO FIRST
0313	12105	103722		STC ADC1,C	START DIGITISEE
0314	12106	036131		ISZ CLKC3	COUNT DECIMATION
0315	12107	026113		JMP CLKI2	NOT EXPIRED
0316	12110	062132		LDA CLKC4	RESET DECIMATION COUNT
0317	12111	072131		STA CLKC3	
0318	12112	073254		STA ADCDF	SET TRANSFER FLAG
0319	12113	036130	CLKI2	ISZ CLKC2	COUNT SAMPLES
0320	12114	026123		JMP CLKIX	
0321	12115	061464		LDA BM5	RESET SAMPLE COUNT
0322	12116	072130		STA CLKC2	
0323	12117	035115		ISZ XCL+1	STEP COUNT OF SECONDS
0324	12120	026123		JMP CLKIX	
0325	12121	035114		ISZ XCL	OF 65536'S OF SECONDS
0326	12122	000000		NOP	SKIPS EVERY 142 YRS
0327	12123	062126	CLKIX	LDA CLKA	
0328	12124	103721		STC CLOCK,C	REENABLE CLOCK
0329	12125	126057		JMP CLKI,I	
0330*					
0331	12126	000000	CLKA	DEC 0	
0332	12127	177754	CLKC1	DEC -20	
0333	12130	177773	CLKC2	DEC -5	
0334	12131	177777	CLKC3	DEC -1	
0335	12132	177777	CLKC4	DEC -1	DECIMATION COUNT

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0337*      ADC ROUTINES; PROGRAM ENTRY
0338 12133 061175  XADC LDA FLAC      TEST OPTION
0339 12134 002002           SZA
0340 12135 026203           JMP ADCC1
0341 12136 014220  ADCC2 JSB ERROR    ERROR IF NOT INITIALISED
0342 12137 006716           DEF STARG-1 GET DESTINATION
0343 12140 061070           LDA GTL      TEST LENGTH
0344 12141 042305           ADA ADCCL
0345 12142 002021           SSA,RSS
0346 12143 026147           JNP **4     SHORT ENOUGH
0347 12144 062305           LDA ADCCL   SET SHORTER
0348 12145 003004           CMA,INA
0349 12146 071070           STA GTL
0350*
0351 12147 062303           LDA ADCB0   SAVE O/P POINTER
0352 12150 072313           STA ADCBP
0353 12151 062303  ADCC3 LDA ADCB0   WAIT FOR DATA
0354 12152 052302           CPA ADCBI
0355 12153 026152           JMP *-1
0356 12154 162303           LDA ADCB0,I GET DATA
0357 12155 036303           ISZ ADCB0  STEP INPUT PTR
0358 12156 105120           ABS -FLT   CONVERT TO FLOATING
0359 12157 170634           STA PT1,I  OUTPUT TO ARRAY
0360 12160 034634           ISZ PT1   STEP OUTPUT PTR
0361 12161 174634           STB PT1,I
0362 12162 034634           ISZ PT1
0363 12163 035070           ISZ GTL   DOESN'T SKIP
0364 12164 035070           ISZ GTL   COUNT
0365 12165 026151           JMP ADCC3
0366*
0367 12166 062313           LDA ADCBP  MAKE CORRECT BUFFER POINTER
0368 12167 042306           ADA ADCCN
0369 12170 052304           CPA ADCBF  END OF BUFFER?
0370 12171 062301           LDA ADCB0  RESET TO START
0371 12172 072303           STA ADCB0
0372 12173 006400           CLB      TURN IR OFF
0373 12174 103100           CLF 0
0374 12175 063252           LDA ADCST  GET M.T.STATUS
0375 12176 077252           STB ADCST  CLEAR M.T. STATUS
0376 12177 102100           STF 0 TURN IR ON AGAIN
0377 12200 003004           CMA,INA   NEGATE M.T. STATUS
0378 12201 105120           ABS -FLT
0379 12202 125174           JMP EFX,I
0380*
0381 12203 006400  ADCC1 CLB      CLEAR MT FLAG
0382 12204 077251           STB ADCMF
0383 12205 002020           SSA      TEST; - = TERMINATE
0384 12206 026273           JNP ADCCX -VE; JUST TERMINATE
0385 12207 065176           LDB FLAC+1 GET DECIMATION COUNT
0386 12210 115134           JSB IFX,I  AS INTEGER
0387 12211 003007           CMA,INA,SZA,RSS NEGATE
0388 12212 003400           CCA      MAKE SURE IT IS SENSIBLE
0389 12213 072132           STA CLKC4 SET DECIMATION COUNT
0390 12214 072131           STA CLKC3
0391 12215 014316           JSB SPNOR +VE; GET NEXT CHARACTER
0392 12216 051405           CPA B54   , ?

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0393	12217	026257		JMP ADCC5	GO SET MT OPTION
0394	12220	002400	ADCC4	CLA	
0395	12221	072307		STA ADCB5	CLEAR BUSY
0396	12222	107720		CLC ADC3,C	PREPARE HARDWARE
0397	12223	062277		LDA ADCIN	ENABLE FADC(0)
0398	12224	072136		STA ADCC2	
0399	12225	063247		LDA ADCW2	GET CONTROL WORD
0400	12226	102622		OTA ADC1	OUTPUT TO FLUKE
0401	12227	061336		LDA BM2	SET 1ST RELAY
0402	12230	073250		STA ADCBE	
0403	12231	103720		STC ADC3,C	
0404	12232	102620		OTA ADC3	
0405	12233	062301		LDA ADCES	RESET FADC BUFFER
0406	12234	072303		STA ADCEO	
0407	12235	072302		STA ADCBI	
0408	12236	104200		DLD ADCBB	SET MT C/P BUFFER =1
0409	12240	104400		DST ADCBM	
0410	12242	104200		DLD TAG	SET TAG
0411	12244	104400		DST ADCBM,I	INTO RECORD
0412	12246	037255		ISZ ADCBM	STEP PTR TO TIME
0413	12247	037255		ISZ ADCBM	
0414	12250	104200		DLD XCL	GET CURRENT TIME
0415	12252	104400		DST ADCBM,I	WRITE TIME TO RECORD
0416	12254	037255		ISZ ADCBM	STEP PTR TO DATA
0417	12255	037255		ISZ ADCBM	
0418	12256	125174		JMP EFX,I	
0419*					
0420	12257	014401	ADCC5	JSB GETC	PASS ,
0421	12260	115133		JSB ST1,I	GET OPTION
0422	12261	051426		CPA B115	M?
0423	12262	026264		JMP ADCCM	
0424	12263	014220		JSB ERROR	ILLEGAL OPTION
0425	12264	037251	ADCCM	ISZ ADCMF	SET MT FLAG
0426	12265	060745		LDA BUNT	ANY UNIT SELECTED?
0427	12266	002021		SSA,RES	; = YES
0428	12267	026220		JMP ADCC4	
0429	12270	002400		CLA	DEFAULT TO ZERO
0430	12271	115136		JSB ESL,I	SELECT UNIT ZERO
0431	12272	026220		JMP ADCC4	
0432*					
0433	12273	062300	ADCCX	LDA ADCNO	DISABLE FADC(0)
0434	12274	072136		STA ADCC2	
0435	12275	107722		CLC ADC1,C	
0436	12276	125174		JMP EFX,I	
0437*					
0438	12277	014542	ADCIN	JSB PUSHU	
0439	12300	014220	ADCNO	JSB ERROR	
0440	12301	012315	ADCBE	DEF ADCB	
0441	12302	012315	ADCBI	DEF ADCB	
0442	12303	012315	ADCBO	DEF ADCB	
0443	12304	012771	ADCBF	DEF ADCBE	
0444	12305	000006	ADCCCL	DEC 6	
0445	12306	000003	ADCCCN	DEC 3	
0446	12307	000000	ADCBS	NOP	
0447	12310	000000	ADCSG	NOP	
0448	12311	000000	ADCIG	NOP	

0449	12312	000000	ADCMD	NOP	
0450	12313	000000	ADCLF	LOT	
0451	12314	000000	ADCIR	NOP	
0452	12315	000000	ADCD	ESS	300
0453	12771		ADCBE	EQU	* 100 SAMPLE BUFFER

0455*

0456* ADC ROUTINES , INTERRUPT PART

0457	12771	000000	ADC11 NOP	DIGITAL DATA READY
0458	12772	104400	DST ADCA1	SAVE A, B
0459	12774	001520	STA, ALS	E
0460	12775	102201	SOC	0
0461	12776	002004	INA	
0462	12777	073242	STA ADCA1+2	
0463	13000	107722	CLC ADC1, C	CLEAR CONTROL FLAG
0464	13001	102522	LIA ADC1	GET SIGN ETC
0465	13002	072310	STA ADCSG	SAVE SIGN
0466	13003	013243	AND ADCOV	TEST OVERFLOW
0467	13004	002002	SZA	
0468	13005	027203	JMP ADCCF	0'FLOW
0469	13006	062310	LDA ADCSG	RANGE AND FUNCTION
0470	13007	013244	AND ADCRM	
0471	13010	053245	CPA ADCRF	CHECK SETTING
0472	13011	002001	RSS	
0473	13012	014220	JSE ERROR	WRONG SETTING
0474	13013	062310	LDA ADCSG	START ON DATA
0475	13014	011452	AND B377	
0476	13015	001727	ALF, ALF	POSITION
0477	13016	001700	ALF	
0478	13017	072311	STA ADCIG	
0479	13020	011355	AND B1	DIGIT =1
0480	13021	100200	MPY D10	MAX 10
0481	13023	072310	STA ADCWD	START FORMING WORD
0482	13024	062311	LDA ADCIG	
0483	13025	001700	ALF	
0484	13026	011367	AND B17	=2
0485	13027	042310	ADA ADCWD	
0486	13030	100200	MPY D10	MAX 100
0487	13032	072310	STA ADCWD	
0488	13033	063046	LDA ADCV1	GET CONTROL WORD 1
0489	13034	102522	OTA ADC1	OUTPUT TO FLAME
0490	13035	102522	LIA ADC1	GET L.S.
0491	13036	001700	ALF	
0492	13037	072311	STA ADCIG	
0493	13040	011367	AND B17	=3
0494	13041	042310	ADA ADCWD	
0495	13042	100200	MPY D10	MAX 1000
0496	13044	072310	STA ADCWD	
0497	13045	062311	LDA ADCIG	
0498	13046	001700	ALF	
0499	13047	072311	STA ADCIG	
0500	13050	011367	AND B17	=4
0501	13051	042310	ADA ADCWD	
0502	13052	100000	MPY D10	MAX 10000
0503	13054	072310	STA ADCWD	
0504	13055	062311	LDA ADCIG	
0505	13056	001700	ALF	
0506	13057	072311	STA ADCIG	
0507	13059	011367	AND B17	=5
0508	13061	042310	ADA ADCWD	
0509	13062	100200	MPY D10	MAX 100000
0510	13064	072310	STA ADCWD	B MAX 1

0511	13065	006000	SZB	WHICH IS TOO BIG
0512	13066	027233	JMP ADCOF	TREAT AS 0'FLOW
0513	13067	062311	LDA ADCIG	
0514	13070	001740	ALF,CLE	
0515	13071	011367	AND B17	=6
0516	13072	042312	ADA ADCWD	E SET IF CARRY
0517	13073	002041	SEZ,RSS	TEST CARRY
0518	13074	002020	SSA	TEST SIGN BIT
0519	13075	027233	JMP ADCOF	0'FLOW
0520	13076	066310	LDB ADCSG	TEST SIGN OF DATA
0521	13077	006020	SSB	O.K. IF +
0522	13100	003004	CMA,INA	NEGATE IF -
0523	13101	173255	ADCC6 STA ADCEN,I	STORE DATA IN MT C/D BUFFER
0524	13102	037255	ISZ ADCEN	STEP PTR
0525	13103	067254	LDB ADCDF	TEST 1 SEC DATA FLAG
0526	13104	006000	SZB,RSS	
0527	13105	027114	JMP *+7	
0528	13106	172302	STA ADCBI,I	PUT DATA IN FADC BUFFER TOO
0529	13107	062302	LDA ADCBI	STEP PTR
0530	13110	002004	INA	
0531	13111	052304	CPA ADCBF	CIRCULARLY
0532	13112	062301	LDA ADCBC	
0533	13113	072302	STA ADCBI	
0534	13114	107720	CLC ADC3,C	PREFARE HARDWARE
0535	13115	063250	LDA ADCUE	GET CURRENT RELAY
0536	13116	001200	RAL	SET TO NEXT
0537	13117	051465	CPA BM1	PASSED END?
0538	13120	061336	LDA BM2	YES, RESET TO START
0539	13121	103720	STC ADC3,C	OPEN RELAYS
0540	13122	102620	GTA ADC3	SET NEW RELAY
0541	13123	073250	STA ADCRE	SAVE CURRENT RELAY
0542	13124	051336	CPA BM2	SET DONE?
0543	13125	027143	JMP ADCIC	YES
0544	13126	061350	LDA DMTH+2	GET DELAY COUNT
0545	13127	002006	INA,SZA	WAIT TILL
0546	13130	027127	JMP *-1	FLUKE DVM READY
0547	13131	063247	LDA ADCW2	CONTROL WORD 2
0548	13132	102622	GTA ADC1	OUTPUT TO FLUKE
0549	13133	103722	STC ADC1,C	GET NEXT
0550	13134	063242	ADCIK LDA ADCA1+2	RESTORE REGISTERS
0551	13135	103101	CLO	
0552	13136	000036	SLA,ELA	
0553	13137	102101	STO	
0554	13140	104200	DLB ADCA1	
0555	13142	126771	JMP ADCI1,I	EXIT FROM INTERRUPT
0556*	SCAN COMPLETE			
0557	13143	002400	ADCIK CLA	CLEAR 1 SEC DATA FLAG
0558	13144	073254	STA ADCDF	
0559	13145	063255	LDA ADCEN	TEST MT BUFFER FULL
0560	13146	053256	CPA ADCEN	BY COMPARING WITH END
0561	13147	027151	JMP ADCFU	BUFFER FULL
0562	13150	027216	JMP ADCIY	EXIT
0563*				
0564*	BUFFER FULL			
0565	13151	053260	ADCFU CPA ADCBB+1	WAS IT BUFFER =1
0566	13152	027221	JMP ADCF1	YES

0567	13153	104200		DLD ADCBB	WAS >0; SET =1
0568	13155	104400		DST ADCBM	
0569	13157	063261		LDA ADCB2	SET CORE PTR FOR MT C/P
0570	13160	073253	ADCF2	STA ADCBF	IN MT O/P PTR
0571	13161	104200		DLD TAG	GET TAG
0572	13163	104400		DST ADCBM,I	FOR NEW RECORD
0573	13165	037255		ISZ ADCBM	STEP PTR TO TIME
0574	13166	037255		ISZ ADCBM	
0575	13167	104200		DLD XCL	GET CURRENT TIME
0576	13171	104400		DST ADCBM,I	WRITE TO RECORD
0577	13173	037255		ISZ ADCBM	STEP PTR TO DATA
0578	13174	037255		ISZ ADCBM	
0579	13175	063251		LDA ADCMF	MT C/P ENABLED?
0580	13176	002003		SZA,RSS	
0581	13177	027216		JMP ADCIY	NO; EXIT
0582	13200	113156		JSB BUW,I	CHECK PREVIOUS MT XFER
0583*					THERE ARE CIRCUMSTANCES IN WHICH THE PROGRAM
0584*					CAN HANG UP HERE ... BUT IF IT DOES, YOU WERE
0585*					LOSING DATA ANYWAY.
0586	13201	010761		AND BUFET	TEST END OF TAPE
0587	13202	002002		SZA	
0588	13203	027227		JMP ADCF3	GO SWAP TAPE UNITS
0589	13204	102514	ADCF4	LIA MTC	GET MT STATUS AGAIN
0590	13205	010765		AND BUFEF	7-TRACK EOT, TIMING, FACILITY
0591	13206	073252		STA ADCST	SET IN 'STATUS'
0592*					INITIATE MAG TAPE TRANSFER ON SELECTED UNIT
0593	13207	063253		LDA ADCMF	GET BUFFER LOCATION
0594	13210	070773		STA BUFT	SET IT IN MT ROUTINE
0595	13211	063253		LDA ADCL	GET BUFFER LENGTH
0596	13212	070774		STA BUL	SET IT IN MT ROUTINE
0597	13213	115157		JSB BUD,I	SET UP DMA FOR WRITE
0598	13214	060750		LDA BUFWI	BINARY WRITE
0599	13215	115160		JSB BUG,I	START TAPE MOVING
0600	13216	002400	ADCIY	CLA	CLEAR BUSY
0601	13217	072307		STA ADCBS	
0602	13220	027134		JMP ADCIX	
0603*					
0604	13201	104200	ADCF1	DLD ADCB2	WAS BUFFER =1; SET =0
0605	13223	104400		DST ADCBM	
0606	13225	063257		LDA ADCBB	SET CORE FOR MT C/P
0607	13226	027162		JMP ADCF2	
0608*					
0609	13227	060745	ADCF3	LDA BUNT	ONE TAPE FULL; STATE TO
0610	13230	021355		KOR B1	THE OTHER UNIT, SWAPPING
0611	13231	115136		JSB BSL,I	0 AND 1 OR 2 AND 3.
0612	13232	027224		JMP ADCF4	
0613*					
0614	13233	061462	ADCOF	LDA BMAX	LARGEST +
0615	13234	066310		LDB ADCSG	TEST SIGN
0616	13235	006020		SSE	
0617	13236	003000		CMA	MOST -VE INSTEAD
0618	13237	027101		JMP ADCC6	
0619	13240	000000	ADCA1	DEX 0	STORAGE FOR A,B,C,0
0620	13243	040000	ADCOV	CCT 40000	0'FLOW BIT
0621	13244	037740	ADCRM	CCT 37740	RANGE FUNCTION BITS
0622	13245	001440	ADCRF	OCT 1440	10VDC BUT NOT REMOTE

0623	13246	017767	ADC71	CCT	17767	10VDC FOR FLUXE	HEAD NOTE 1
0624	13247	037767	ADCW2	CCT	37767	" " " "	" " 2
0625	13250	177776	ADCRE	DEC	-2	CURRENT RELAY	
0626	13251	000000	ADCMF	NCP		MT ENABLED FLAG	
0627	13252	000000	ADCST	NCP		MT STATUS	
0628	13253	000000	ADCMP	NCP		MT O/P PTR	
0629	13254	000000	ADCDF	NOP		1 SEC DATA FLAG	
0630	13255	013264	ADCBM	DEF	ADCB1	CURRENT MT BUFFER POINTER	
0631	13256	015074	ADCBX	DEF	ADCB3	CURRENT END OF MT BUFFER	
0632	13257	013264	ADCBB	DEF	ADCB1	BUFFER =1 POINTER	
0633	13260	015074		DEF	ADCB3	AND END	
0634	13261	015074	ADCB2	DEF	ADCB3	BUFFER =2 POINTER	
0635	13262	016704		DEF	ADCKX	AND END	
0636	13263	176170	ADCL	DEC	-904		
0637	13264	000000	ADCB1	BSS	904		
0638	15074	000000	ADCB3	BSS	904		
0639	16704		ADCKX	EQU	*		
0640*							
0641	16704	000000	ADC13	NOF		MULTIPLEXOR INTERRUPT	
0642	16705	107720	CLC	ADC3,C		CLEAR CONTROL AND FLAG	
0643	16706	126704	JMP	ADC13.1		AND RETURN	

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0645*FTAG,SET UP 32-BIT TAG FOR FADC MAGTAPE OUTPUT
0646 16707 061175  NTAG  LDA  FLAC
0647 16710 065176      LDB  FLAG+1
0648 16711 115134      JSB  IFX,I
0649 16712 071117      STA  TAG      STORE TAG
0650 16713 014542      JSB  PUSHJ    GET 2ND ARGUMENT
0651 16714 006706      DEF  ARG      IF ANY
0652 16715 125174      JMP  EFX,I    LEAVE 2ND WORD ALONE IF NO ARG
0653 16716 061175      LDA  FLAC    PICK UP 2ND ARG
0654 16717 065176      LDB  FLAG+1
0655 16720 115134      JSB  IFX,I    CONVERT TO INTEGER
0656 16721 071120      STA  TAG+1   END STORE
0657 16722 125174      JMP  EFX,I   THAT'S ALL THERE IS TO IT
0658*

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0660* NEW START OF TEXT + VERSION ID

0661	16723	000000	TEXT	OCT	0	
0662	16724	000000		OCT	0	
0663	16725	041455		ASC	6,C-ONCAL,V155	LEAD IN MESSAGE
0664	16733	043015		OCT	43015	
0665	16734		BUFEQ	EQU	*	

0666*

0667* MISCELLANEOUS DEFINITIONS

0668	01175		FLAC	EQU	1175B	
0669	00542		PUSHJ	EQU	542B	
0670	06706		ARG	EQU	6706B	
0671	00220		ERROR	EQU	220B	
0672	01134		IFX	EQU	1134B	
0673	01302		FL1	EQU	1302B	
0674	01174		EFX	EQU	1174B	
0675	01161		PW2	EQU	1161B	
0676	01114		XCL	EQU	1114B	
0677	06717		GTARG	EQU	6717B	
0678	07270		DMAI1	EQU	7270B	
0679	07274		DMAI2	EQU	7274B	
0680	07300		MTCI	EQU	7300B	
0681	07202		HSRI	EQU	7202B	
0682	07220		HPNI	EQU	7220B	
0683	07106		ITTO	EQU	7106B	
0684	04424		PLIR	EQU	4424B	
0685	07224		LPIR	EQU	7224B	
0686	01070		GTL	EQU	1070B	
0687	00634		PT1	EQU	634B	
0688	01373		B37	EQU	1373B	
0689	01443		B177	EQU	1443B	
0690	00646		INCH	EQU	646B	
0691	04042		OPTNI	EQU	4042B	
0692	00231		RECOV	EQU	231B	
0693	01356		B2	EQU	1356B	
0694	01360		B4	EQU	1360B	
0695	00316		SPNCR	EQU	316B	
0696	01117		TAG	EQU	1117B	
0697	01426		B115	EQU	1426B	
0698	01156		BUW	EQU	1156B	
0699	01336		BM2	EQU	1336B	
0700	01452		B377	EQU	1452B	
0701	01364		D10	EQU	1364B	
0702	01367		B17	EQU	1367B	
0703	01346		BMTH	EQU	1346B	
0704	01462		BMAX	EQU	1462B	
0705	01142		ENTP	EQU	1142B	
0706	00401		GETC	EQU	401B	
0707	01133		GT1	EQU	1133B	
0708	01204		F3	EQU	1204B	
0709	10664		.POLY	EQU	10664B	
0710	01405		B54	EQU	1405B	
0711	00761		BUFEI	EQU	761B	
0712	00773		BUFT	EQU	773B	
0713	00774		BUL	EQU	774B	
0714	01157		BUD	EQU	1157B	
0715	00750		BUFWI	EQU	750B	

0716	01160	BUG	EQU	1160B
0717	01355	B1	EQU	1355B
0718	01136	BSL	EQU	1136B
0719	00745	BUNT	EQU	745B
0720	00765	BUFEP	EQU	765L
0721	00014	MTC	EQU	14B

0722*

0723	01463		ORG	1463B
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BASE PAGE LINKS

0724	01463	177754	DM20	DEC	-20
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0725	01464	177773	DM5	OCT	-5
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0726	01465	177767	DM11	OCT	-11
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0727	01466	010664	POLY	DEF	.POLY
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0728*

0729				END
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** NO ERRORS*



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