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PROGRAM LIBRARY

DECUS NO.	FOCAL8-132
TITLE	CIG-8 MARK II
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DATE	May 1970
SOURCE LANGUAGE	PAL-D

3.2 Saving on MONITOR Disk/tape.

Use the following sequence, waiting for MONITOR's dot at the start of each line before proceeding:

```
*LIBRARY          (In Focal)
 3206
 3217
 3217
 4617
•SAVE DSTART!4600-7577;200 ↵
•SAVE CG8B!0-3217; ↵
•SAVE CG8A!0-11377,15600; ↵
•DSTART ↵ (Replaces the program)
```

Focal text and display files may also be saved once they have been created:

```
*TYPE %4,FDIS(0) ↵
=255*L ↵
3206
XXXX
YYYY
4617
•SAVE FNAME:0,3206-XXXX; ↵
•SAVE DNAME:15600-<15600+377>; ↵
•DSTART ↵
```

Note that the display file limit must be converted to OCTAL.

The FCOM buffer may be saved with

```
•SAVE FCOM:11400-14377; ↵
```

3.3 Loading from MONITOR Disk/tape.

Perform the following sequence:

```
•CG8A ↵
•CG8B ↵
•CALL DNAME ↵          Optional
•CALL FNAME ↵          "
•CALL FCOM ↵           "
•DSTART ↵              overtyped by ?00.00
*GO ↵
```

CIG-8 Mk II.

Computer interactive Graphics for PDP-8.

1. ABSTRACT.

CIG-8 is an overlay to FOCAL 1969 for interactive graphics on a non-storage scope. A reasonable refresh rate is obtained through a display file assembled by an integer storage function. Selective modification of the file by FOCAL programs gives interaction. The HSR routine is sacrificed but the rest of FOCAL plus a shortened FCOM, FIN and the F.F.T. function are added.

2. REQUIREMENTS.

2.1 Equipment.

8-K PDP8 with VC8/I or equivalent;
optional: DISK/Tape MONITOR and ADO8.

2.2 Storage.

All of both Fields. The top pages should be loaded with MONITOR/TC01 Library head and BIN/RIM. If there is no disk or tape set HLT in 7577 after loading.

3. USAGE.

3.1 Loading from scratch.

- i) Load FOCAL 1969 into FIELD 0 in the normal way. Answer the initial dialogue with 'YES' and wait for the *.
- ii) Stop the computer at the console. Ensure that BIN is in the top page of FIELD 1. Place the CIG-8 binary overlay in the TTY (or H.S.) reader.
- iii) Start the computer at 017777. When the tape has read in, look for a checksum error. If OK -
- iv) Restart FOCAL at 000200. It will type its 'console start' diagnostic; there should also be a display.

To change any of the "CALL"ed programmes

*L ↵

3206

etc

•CALL NEWP ↵

•DSTART ↵

4. RESTRICTIONS.

- (i) The H.S.R. must not be used.
- (ii) The FADC function addresses the ~~ADDO~~. ^{AD08}
- (iii) FDIS is used to address the display file only.
- (iv) The FCOM vector is limited to 512 variables.

Note that FCOM(0) in CIG-8 = FCOM(256) in FOCAL:
this may assist interchange between the two.

- (v) The TTY response is slowed if there is much picture to display. Before reading paper tapes disable the display with SET Z = FDIS(1,0) and use paper tapes which have been edited with blanks between lines. The WRITE function has been patched for 5 blanks, and output tapes can be read with the initial display on.

5. DESCRIPTION.

5.1 The display file.

5.1.1 The FDIS function has been converted to an "integer FCOM" to access the display file. The display file is thus a vector 1024 long from FDIS(0) to FDIS(1023). It should first be cleared:

```
*10.1 FOR I=0,1023;SET Z=FDIS(I,0) ↵  
*DO 10 ↵
```

5.1.2 The display file is divided into a name file starting in FDIS(1) and any number of picture files, starting anywhere. Each file is terminated by a zero entry. Successive entries in the name file point to the (start-1) of each picture file. It is convenient to assemble picture files contiguously, using FDIS(0) as a file pointer:

```
*8.1 SET Z=FDIS(FDIS(0),Z);SET Z=FDIS(0,FDIS(0)+1) ↵
```

"DO 8" then enters Z into the current picture file and returns Z as the next pointer.

5.1.3 As an example let us enter 2 pictures starting the first in
FDIS(100+1)

```
*DO 10 ǁ          takes some time
*SET Z=FDIS(0,101)ǁ      initialise pointer.
*SET Z=FDIS(1,100)ǁ     enter name 1
```

A string of picture codes can be read conversationally by the routine

```
*1.1 ASK Z;DO 8 ǁ
*1.2 GOTO 1.1 ǁ
*GO ǁ
:1 :400 :400 :2 :3 :3 :100 :100 :100 :100 :+C ǁ
*
```

The significance of the codes is explained later, but the picture, a cross centred on 400,400 appears on the display. The second picture, the same cross centred on 600,600 is entered as follows:

```
*SET Z=FDIS(2,FDIS(0))ǁ   New name
*SET Z=0;DO 8 ǁ          Terminates 1st picture file
*GO ǁ
:1 :600 :600 :2 :3 :3 :100 :100 :100 :100 :+C ǁ
*
```

5.1.4 The second picture start and finish are located by:

```
*TYPE %4,FDIS(2),!FDIS(0)ǁ
= 111
= 122*          both entries are zeros
```

5.1.5 A picture may be made 'passive', i.e. stored but off, by negating its name file entry. Thus

```
*FOR I=1,20;SET Z=FDIS(2,-FDIS(2));FOR J=1,100;C ǁ
```

will 'flash' the second set of axes ten times.

(The I counter controls the number, the J counter the rate.)

/5.1.6

5.1.6 To "switch off" the whole display (useful when loading paper tapes)
store FDIS(1) and clear it:

```
*SET Z=FCOM(0,FDIS(1))↓
```

```
*SET Z=FDIS(1,0)↓
```

```
*ERASE ALL ↓
```

Load the new tape (local variables lost)

```
*SET Z=FDIS(1,FCOM(0))↓
```

```
* .... the original picture reappears.
```

5.2 Display Language.

The display interpreter provides a software simulation of the hardware functions or 'MODES' of expensive graphics terminals. Like FOCAL it is table driven and therefore easy to extend as required. CIG-8 Mk I used command letters (like FOCAL) to distinguish MODES, and 4-letter NAMES (like MONITOR) to establish the name file, but the simple expedient of using a FOCAL storage function to provide both assembly and interaction prompts the use of number codes and actual pointers.

Each picture is formed by a string of MODE FUNCTIONS beginning and ending in a zero. The PICTURE NAME pointer indicates the address of the initial zero (which may also be the terminator of the previous picture).

Each MODE FUNCTION comprises a MODEWORD followed by one or more DATAWORDS. Table I gives a list of MODE FUNCTIONS and their DATAWORD requirements. The following notes refer to the table:

- (i) The scope displays points on a 1024 x 1024 matrix with origin in the bottom L.H. corner. The ORIGIN is not displayed, but relativises the other MODES to an $X_r Y_r$ position. X_r, Y_r are interpreted modulo 1024.
- (ii) N_x draws a positive X-axis from $X_r Y_r$ to $(X_r + N_x \cdot \text{SIZE}), Y_r$ using N_x points, etc. Enter zeros for axis directions not required. 'AXES' does not change $X_r Y_r$.
- (iii) Where the DATAWORD list is undefined, 1024 is subtracted from each dataword so that the next MODEWORD (a +ve integer) may be distinguished. GRAPH Y values should be $-1024 \leq Y \leq 1023$.

/(iv)

- (iv) GRAPHS are plotted as a series of points $X_0 Y_0 \dots X_n Y_n \dots$
 where $X_n = X_r + n, \text{SIZE}$
 $Y_n = Y_r + Y_r$
 X_r, Y_r is not changed by 'GRAPH'.
- (v) A is the decimal ASCII code obtained by using FIN(). Codes from 240_8 to 337_8 are handled by a routine similar to Decus 5/3-23b on a 7x5 dot matrix. SIZE gives size control (3 to 7 is the useful range). Text starts at $X_r Y_r$, which is changed to $X_r Y_r - 10 \cdot \text{SIZE}$ by a code $<240_8$ for example C.R.
- (vi) REL. POINT allows curves to be computed in FOCAL. The absolute coordinate plotted is $X_r + \Delta X, Y_r + \Delta Y$. $X_r Y_r$ remains unchanged.
- (vii) LINES are plotted from $X_r Y_r$ to $(X_r + R \cos \theta), (Y_r + R \sin \theta)$. $X_r Y_r$ remains unchanged.
- (viii) CONTINUE automatically sets the ORIGIN to the end of the last LINE or REL. POINT curve so that connected diagrams need only have one ORIGIN.
- (ix) NAME permits pictures to be subroutined up to five in depth. A picture may not call itself as there would be no exit mechanism.

EXAMPLE: Plot e^{-x^2} from 0 to 2 assuming FOCAL subroutines already entered are still present:

```
*DO 10;SET Z=FDIS(0,101);SET Z=FDIS(1,100)    initialise picture
*COTO 1.1
:1 :100 :100 :2 :4 :3 :100 :0 :100 :0 :4 : +C )
*FOR X=0,100;SET Z=500*FEXP(-(X/50)^2)-1024;DO 8
*COMMENT-WATCH THE GRAPH APPEAR
*COTO 1.1
:1 :200 :700 ;5 : +C )    set origin for Text
*5.1 SET Z=FIN();IF (Z-160)1.1;C:-160(10)=SPACE
*5.2 SET Z=Z-1024;DO 8;GOTO 5.1
*COTO 5.1
GAUSSIAN PLOT )
:
```


TABLE I

MODE FUNCTION	MODE WORD	No. of DATAWORDS	DATAWORD IDENTIFICATION	Notes, see text
ORIGIN	1	2	$\left\{ \begin{array}{l} X_r \\ Y_r \end{array} \right.$	(i)
INCREMENT	2	1	SIZE	
AXES	3	4	$\left\{ \begin{array}{l} N_x \\ N_{-x} \\ N_y \\ N_{-y} \end{array} \right.$	(ii)
GRAPH	4	} any number	Y-1024	(iii) (iv)
HORIZ. TEXT	5		A-1024	(iii) (v)
VERT. TEXT	6		A-1024	(iii) (v)
REL. POINT	7	an even number }	$\left\{ \begin{array}{l} \Delta X-1024 \\ \Delta Y-1024 \end{array} \right.$	(vi)
LINE	8	3	$\left\{ \begin{array}{l} 1024 \cos \theta \\ 1024 \sin \theta \\ R \end{array} \right.$	(vii)
CONTINUE	9	NONE	NONE	(viii)
NAME	10	1	POINTER	(ix)

5.3 Error Diagnostic.

Most of the FOCAL 1969 error diagnostics are unchanged. In addition there are storage function overflow errors and a general "Field 1" error. If this was returned by the display interpreter, the offending display file entry is first zeroed out.

New error diagnostics

?00.89 Picture file error

?25.;Ø FCOM length exceeded

?25.77 FDIS length exceeded.

5.4 Dynamics.

On-line dynamics can be handled by plotting as the calculation proceeds. This is slow but most people find it fascinating. Dynamic simulations can be handled by storing successive views as separate pictures in the file (each 'picture' need only be a new ORIGIN and a NAME call). The picture starts can be arranged at regular intervals so that a program like the following would give movement:

```
*11.1 FOR I=300,6,420;SET Z=FDIS(2,I);C-DELAY HERE  
*11.2 GOTO 11.1
```

6. PROGRAM.

For FOCAL 1969 see DEC 08-AJAE-LA. The CIC-3 Mk II overlay follows, together with a few FOCAL programs.

```

/
/CIG-8 MK II
/FOCAL LINKED
/SYMBOLS FOR DEC-08-AJAE-PB      FOCAL 1969
INTEGE=53
PRINTC=JMS I 151
PUSHA=JMS I 142
READC=JMS I 152
CHAR=66
FLAC=44
P13=5
POPA=TAD I 13
SORTCN=54
EFUN31=136
ERROR=JMS I 166
ERR2=2726
PUSHJ=JMS I 140
EVAL=1613
INDX=37
DXL=6053
DXS=6057
DYL=6063
DYS=6067
MULT10=5667
RTL6=4557
T1=32
CCR=77
C260=113
LASTV=31
CFRS=133
BUFR=60
GETC=4545
MCR=116
TELSW=16
P4000=124
LASTOP=55
XI33=2666
XOUTL=2676
BOTTOM=35
TMP=2
DISFIL=5600
PDTOP=677
PDCT=16
CMNUM=-1000
CMST=1400
DISN=-2000
/END OF SYMBOLS
/
/

```

/USED BY FCOM, (HIMBUF)

/NOT FOR PDP5

/PDL LENGTH
/=512(10) FCOM LENGTH
/=FCOM(256) IN FOCAL
/=DISFIL LENGTH

```

/
/
FIELD Ø
/
/LINKS TO FOCAL
/
/ON PAGE Ø
*167
Ø167 6164 DIS1A, DIS1
Ø17Ø 6167 DIS2A, DIS2
Ø171 6172 DIS3A, DIS3
/
/PATCHES
/
/IN XI33
*2671
2671 5567 JMP I DIS1A
/IN XOUTL
*27Ø3
27Ø3 557Ø JMP I DIS2A
/IN EVAL
*1613
1613 5571 JMP I DIS3A
/
/LINKS TO FIELD 1
/
/DISPLAY SUBROUTINE
*616Ø
616Ø ØØØØ DIS, Ø
6161 6213 CDF CIF 1Ø
6162 4Ø53 JMS DISPL
6163 576Ø JMP I DIS
/FROM XI33
6164 436Ø DIS1, JMS DIS
6165 5766 JMP I .+1
6166 2667 2667
/FROM XOUTL
6167 436Ø DIS2, JMS DIS
617Ø 5771 JMP I .+1
6171 27Ø1 27Ø1
/FROM EVAL
6172 436Ø DIS3, JMS DIS
6173 3Ø55 DCA LASTOP
6174 5775 JMP I .+1
6175 1614 1614
/
/PATCHES TO FNTABF
*377
Ø377 6311 XDIS /DISPLAY FILE FN

```

		*410		
0410	2564		XFIN	/INPUT FN
0411	6352		XCOM	/STORAGE FN
0412	5352		XFX	/F.F.T. FN (P TCHABLE)
		/		
		/PATCH TO COMLST		
		*1012		
1012	0000		0	/REMOVE * FROM LIST
		/		
		/PATCH TO COMGO		
		*1173		
1173	7552		LIBR	/MOVED
		*1201		
1201	0177		177	/REMOVED HSR
		/		
		/REVISED ADC FUNCTION FOR ADO8		
		/RETURNS -1<=V<+1		
		*1343		
1343	4453	XADC,	JMS I INTEGE	/?MULTIPLEXER
1344	7000		NOP	/INSERT MULTIPLEXER CODE
1345	7200		CLA	
1346	6002		IOF	
1347	6532		6532	/READ ADC
1350	6531		6531	
1351	5350		JMP .-1	
1352	6534		6534	
1353	6001		ION	
1354	1124		TAD P4000	/NORMALIZE
1355	3045		DCA FLAC+1	
1356	3046		DCA FLAC+2	
1357	3044		DCA FLAC	
1360	5536		JMP I EFUN31	
		/		
		/PATCH TO FNTABL		
		*2201		
2201	1140		1140	/=FIN FOR FNEW
		/		
		/TEXT INPUT FUNCTION FIN		
		*2564		
2564	1054	XFIN,	TAD SORTCN	
2565	4542		PUSHA	
2566	4552		READC	
2567	1066		TAD CHAR	
2570	3045		DCA FLAC+1	
2571	3046		DCA FLAC+2	
2572	1005		TAD P13	
2573	3044		DCA FLAC	
2574	1413		POPA	
2575	3054		DCA SORTCN	
2576	5536		JMP I EFUN31	

/

/TIDY UP INTERRUPT HANDLER

*2646

2646	5254	JMP .+6	
2647	7000	NOP	
2650	7000	NOP	
2651	7000	NOP	
2652	7000	NOP	
2653	7000	NOP	
2654	1201	1201	/REPLACE ACC, L, RMF
2655	7104	7104	
2656	1200	1200	
2657	6244	6244	

/

/

/FAST FOURIER FUNCTION

/STANDARD CALL FX(NU, U)

/COULD BE PATCHED

*5352

5352	4453	AFX,	JMS I INTEGE
5353	7041		CIA
5354	3037		DCA INDX
5355	4540		PUSHJ
5356	1612		EVAL-1
5357	4453		JMS I INTEGE
5360	7410		SKP
5361	1046	FX2,	TAD FLAC+2
5362	7110		CLL RAR
5363	3046		DCA FLAC+2
5364	1045		TAD FLAC+1
5365	7004		RAL
5366	3045		DCA FLAC+1
5367	2037		ISZ INDX
5370	5361		JMP FX2
5371	1005		TAD P13
5372	3044		DCA FLAC
5373	5536		JMP I EFUN31

/

/DISPLAY FILE INTEGER STORAGE FUNCTION

*6311

6311	4453	XDIS,	JMS I INTEGE	
6312	7100		CLL	
6313	1347		TAD MLMIT	/TEST OVERFLOW
6314	7630		SZL CLA	
6315	4566		ERROR	
6316	1046		TAD FLAC+2	
6317	1351		TAD NFILB	/FILESTART
6320	4542		PUSHA	
6321	1066		TAD CHAR	
6322	1350		TAD MCOMA	/2ND ARG?

7543	0000	PRNTD,	0	
7544	0351		AND LP7	
7545	1113		TAD C260	
7546	4551		PRINTC	
7547	1032		TAD T1	
7550	5743		JMP I PRNTD	
7551	0007°	LP7,	7	
7552	1077	LIBR,	TAD CCR	/THIS IMPROVES IT
7553	4551		PRINTC	
7554	1133		TAD CFRS	
7555	4322		JMS PRNT8	
7556	1060		TAD BUFR	
7557	4322		JMS PRNT8	
7560	1031		TAD LASTV	
7561	4322		JMS PRNT8	
7562	1035		TAD BOTTOM	
7563	4322		JMS PRNT8	
7564	5367		JMP .+3	
7565	4545		GETC	
7566	4551		PRINTC	
7567	1066		TAD CHAR	
7570	1116		TAD MCR	
7571	7640		SZA CLA	
7572	5365		JMP .-5	
7573	1016		TAD TELSW	
7574	7640		SZA CLA	
7575	5373		JMP .-2	
7576	6002		IOF	
7577	7000		NOP	

/

/

/

/WRITE PATCH

/OVERWRITES I33

/NOT NEEDED NOW

*643

0643	5572		JMP I 172	/IN WRITE
			*172	
0172	2414		WPTCH	
0173	0644		644	/RETURN
			*2414	
2414	1120	WPTCH,	TAD 120	/M5 IN FOCAL
2415	3037		DCA INDX	
2416	1224		TAD P400	/WON'T PRINT
2417	4463		JMS I 63	/OUTDEV IN FOCAL
2420	2037		ISZ INDX	
2421	5216		JMP .-3	
2422	4553		4553	/PRINTLN
2423	5573		JMP I 173	
2424	0400	P400,	400	

/

/

/FOCAL LINKED CIG-8

FIELD I

		*1Ø		
ØØ1Ø	ØØØØ	FILE,	Ø	
ØØ11	ØØØØ	XNM,	Ø	
ØØ12	ØØØØ	TXT,	Ø	
ØØ13	Ø677	PDL,	PDTOP	
		*2Ø		
ØØ2Ø	ØØØØ	X,	Ø	
ØØ21	ØØØØ	Y,	Ø	
ØØ22	ØØØØ	X1,	Ø	
ØØ23	ØØØØ	Y1,	Ø	
ØØ24	ØØØØ	XR,	Ø	
ØØ25	ØØØØ	YR,	Ø	
ØØ26	ØØØØ	COSA,	Ø	
ØØ27	ØØØØ	COSB,	Ø	
ØØ3Ø	ØØØØ	SINA,	Ø	
ØØ31	ØØØØ	SINB,	Ø	
ØØ32	ØØØØ	TA,	Ø	/TEMP. REG.
ØØ33	1777	MSK,	1777	/=1Ø23(1Ø)
ØØ34	ØØØ4	SIZE,	4	
ØØ35	7774	MSIZE,	-4	
ØØ36	ØØØØ	COUNT,	Ø	
ØØ37	ØØØØ	SAVE,	Ø	
ØØ4Ø	ØØØØ	ROT,	Ø	/TXT ROTN INDEX
ØØ41	ØØØØ	SWITCH,	Ø	/USED BY DISPL
ØØ42	2ØØØ	P2ØØØ, 2ØØØ		
ØØ43	7771	M7,	-7	
ØØ44	7773	M5,	-5	
ØØ45	7774	M4,	-4	
ØØ46	0677	OFFSET,	677	/TXT CODE START
ØØ47	154Ø	CORRN,	2ØØØ-24Ø	/TXT CONVERSION
ØØ5Ø	7117	PDMX,	PDCT-PDTOP	
ØØ51	Ø677	PDLST,	PDTOP	
ØØ52	56ØØ	FSTA,	DISFIL	
ØØ53	ØØØØ	DISPL,	Ø	/ACCESS FILE NAME
ØØ54	1Ø41		TAD SWITCH	/=Ø FIRST TIME
ØØ55	764Ø		SZA CLA	/ONE FILE AT A TIME
ØØ56	5Ø65		JMP NEXT	
ØØ57	7Ø4Ø		CMA	/SET SWITCH
ØØ6Ø	3Ø41		DCA SWITCH	
ØØ61	1Ø51		TAD PDLST	
ØØ62	3Ø13		DCA PDL	
ØØ63	1Ø52		TAD FSTA	/PTS TO FDIS(1)
ØØ64	3Ø11		DCA XNM	/NAME FILE INDEX
ØØ65	1411	NEXT,	TAD I XNM	/NEXT NAMED FILE
ØØ66	ØØ33		AND MSK	/OVERFLOW PROTECT
ØØ67	745Ø		SNA	/LIST ENDED BY ZERO
ØØ7Ø	51Ø1		JMP RESET	

0071	7500		SMA	
0072	5075		JMP .+3	
0073	7200		CLA	
0074	5065		JMP NEXT	/NOT DISPLAYED IF NEG
0075	1052		TAD FSTA	
0076	3010		DCA FILE	/PTS TO FDIS(I+1)
0077	4104		JMS DO	
0100	7410		SKP	
0101	3041	RESET,	DCA SWITCH	
0102	6203		CDF CIF 0	/JMP DISPL+1 DEBUG
0103	5453		JMP I DISPL	
0104	0000	DO,	0	/DISPLAY ONE FILE
0105	1410		TAD I FILE	
0106	7550		SPA SNA	/+ & NON ZERO
0107	5121		JMP NMODE	
0110	3037		DCA SAVE	
0111	1037		TAD SAVE	
0112	1134		TAD MMAX	/PROTECTION
0113	7700		SMA CLA	/AGAINST DATA
0114	5123		JMP ERR	
0115	1037		TAD SAVE	
0116	1133		TAD JUMPA	/FORM JUMP
0117	3120		DCA .+1	
0120	0000		0	/=JMP I MODE+?
0121	7700	NMODE,	SMA CLA	
0122	5504		JMP I DO	/ENDFILE FOUND
0123	7040	ERR,	CMA	/ZERO OUT ERROR
0124	1010		TAD FILE	
0125	3010		DCA FILE	
0126	3410		DCA I FILE	
0127	3041		DCA SWITCH	
0130	6203		CDF CIF 0	/NOP DEBUG
0131	4532		JMS I .+1	/JMP I .-1 TO ODTN
0132	2726		ERR2	/IN FOCAL
0133	5534	JUMPA,	JMP I MODE-1	
0134	7762	MMAX,	-16	
0135	0502	MODE,	ORIGIN	
0136	0507		STEP	
0137	0200		AXES	
0140	0515		GRAPH	
0141	0264		HTXT	
0142	0263		UPTXT	
0143	0600		DOT	
0144	0400		LINE	
0145	0531		CONTU	
0146	0637		NAME	
0147	0123		ERR	
0150	0123		ERR	
0151	0123		ERR	

		*152		
Ø152	ØØØØ	NEWLN,	Ø	/LOOK FOR CR
Ø153	1Ø37		TAD SAVE	
Ø154	77ØØ		SMA CLA	
Ø155	5552		JMP I NEWLN	
Ø156	1Ø34		TAD SIZE	
Ø157	71Ø6		RTL CLL	
Ø16Ø	1Ø34		TAD SIZE	
Ø161	7ØØ4		RAL	
Ø162	3Ø32		DCA TA	
Ø163	1Ø4Ø		TAD ROT	
Ø164	77ØØ		SMA CLA	
Ø165	5172		JMP .+5	
Ø166	1Ø2Ø		TAD X	
Ø167	1Ø32		TAD TA	
Ø17Ø	3Ø2Ø		DCA X	
Ø171	5577		JMP I NXT	
Ø172	1Ø32		TAD TA	
Ø173	7Ø41		CIA	
Ø174	1Ø21		TAD Y	
Ø175	3Ø21		DCA Y	
Ø176	5577		JMP I NXT	
Ø177	Ø265	NXT,	HTXT+1	
		PAGE		
		AXES,		
Ø2ØØ	1Ø21		TAD Y	/LOAD Y
Ø2Ø1	6Ø63		DYL	
Ø2Ø2	73ØØ		CLA CLL	
Ø2Ø3	141Ø		TAD I FILE	/+X
Ø2Ø4	745Ø		SNA	
Ø2Ø5	5215		JMP .+1Ø	/IF ZERO
Ø2Ø6	7Ø41		CIA	
Ø2Ø7	3Ø36		DCA COUNT	
Ø21Ø	1Ø2Ø		TAD X	
Ø211	1Ø34		TAD SIZE	
Ø212	6Ø57		DXS	
Ø213	2Ø36		ISZ COUNT	
Ø214	5211		JMP .-3	
Ø215	73ØØ		CLA CLL	
Ø216	141Ø		TAD I FILE	/-X
Ø217	745Ø		SNA	
Ø22Ø	523Ø		JMP .+1Ø	/IF ZERO
Ø221	7Ø41		CIA	
Ø222	3Ø36		DCA COUNT	
Ø223	1Ø2Ø		TAD X	
Ø224	1Ø35		TAD MSIZE	
Ø225	6Ø57		DXS	
Ø226	2Ø36		ISZ COUNT	
Ø227	5224		JMP .-3	
Ø23Ø	73ØØ		CLA CLL	

Ø231	1Ø2Ø	TAD X	/LOAD X
Ø232	6Ø53	DXL	
Ø233	73ØØ	CLA CLL	
Ø234	141Ø	TAD I FILE	/+Y
Ø235	745Ø	SNA	
Ø236	5246	JMP .+1Ø	/IF ZERO
Ø237	7Ø41	CIA	
Ø240	3Ø36	DCA COUNT	
Ø241	1Ø21	TAD Y	
Ø242	1Ø34	TAD SIZE	
Ø243	6Ø67	DYS	
Ø244	2Ø36	ISZ COUNT	
Ø245	5242	JMP .-3	
Ø246	73ØØ	CLA CLL	
Ø247	141Ø	TAD I FILE	/-Y
Ø25Ø	745Ø	SNA	
Ø251	51Ø5	JMP DO+1	/FAST EXIT
Ø252	7Ø41	CIA	
Ø253	3Ø36	DCA COUNT	
Ø254	1Ø21	TAD Y	
Ø255	1Ø35	TAD MSIZE	
Ø256	6Ø67	DYS	
Ø257	2Ø36	ISZ COUNT	
Ø26Ø	5255	JMP .-3	
Ø261	73ØØ	CLA CLL	
Ø262	51Ø5	JMP DO+1	/EXIT
Ø263	7Ø4Ø	UPTXT, HTXT, CMA	
Ø264	3Ø4Ø	DCA ROT	/SET ROTN INDEX FOR TEXT
Ø265	1Ø2Ø	TAD X	/SAVE X, Y
Ø266	3Ø22	DCA XI	
Ø267	1Ø21	TAD Y	
Ø27Ø	3Ø23	DCA Y1	
Ø271	1Ø44	TAD M5	/5 X 7 MATRIX
Ø272	3Ø36	DCA COUNT	
Ø273	141Ø	TAD I FILE	/GET LETTER
Ø274	75ØØ	SMA	/?DATA
Ø275	51Ø6	JMP DO+2	/ONLY EXIT
Ø276	1Ø47	TAD CORR N	/+1Ø24(1Ø)-24Ø(8)!!
Ø277	3Ø37	DCA SAVE	/CHAR OFFSET FROM SP.
Ø3ØØ	4152	JMS NEWLN	
Ø3Ø1	1Ø37	TAD SAVE	
Ø3Ø2	71Ø6	CLL RTL	
Ø3Ø3	1Ø37	TAD SAVE	/*5=BUFF OFFSET
Ø3Ø4	1Ø46	TAD OFFSET	/=677, TXT START
Ø3Ø5	3Ø12	DCA TXT	/POINTER
Ø3Ø6	1Ø4Ø	TAD ROT	
Ø3Ø7	77ØØ	SMA CLA	/WAY UP?
Ø31Ø	5344	JMP NORM	/NORMAL
Ø311	1Ø23	UP, TAD Y1	/UP
Ø312	6Ø63	DYL	

Ø313	1Ø34		TAD SIZE	
Ø314	3Ø23		DCA Y1	
Ø315	1Ø43		TAD M7	/5 X 7 MATRIX
Ø316	3Ø37		DCA SAVE	
Ø317	1412		TAD I TXT	/GET CODE
Ø32Ø	711Ø		CLL RAR	/L.S. TO LINK
Ø321	3Ø32		DCA TA	/SAVE
Ø322	1Ø22		TAD X1	
Ø323	743Ø		SZL	
Ø324	6Ø57		DXS	
Ø325	1Ø35		TAD MSIZE	
Ø326	3Ø22		DCA X1	
Ø327	1Ø32		TAD TA	
Ø33Ø	2Ø37		ISZ SAVE	/COUNT SPOTS
Ø331	532Ø		JMP .-11	
Ø332	72ØØ		CLA	
Ø333	1Ø2Ø		TAD X	
Ø334	3Ø22		DCA X1	
Ø335	2Ø36		ISZ COUNT	
Ø336	5311		JMP UP	
Ø337	1Ø34		TAD SIZE	
Ø34Ø	71Ø4		CLL RAL	/OR CLL RTL
Ø341	1Ø34		TAD SIZE	/OR NOP
Ø342	1Ø23		TAD Y1	
Ø343	527Ø		JMP HTXT+4	/NEXT CHAR?
Ø344	1Ø22	NORM,	TAD X1	
Ø345	6Ø53		DXL	
Ø346	1Ø34		TAD SIZE	
Ø347	3Ø22		DCA X1	
Ø35Ø	1Ø43		TAD M7	/5 X 7 MATRIX
Ø351	3Ø37		DCA SAVE	
Ø352	1412		TAD I TXT	
Ø353	711Ø		CLL RAR	
Ø354	3Ø32		DCA TA	
Ø355	1Ø23		TAD Y1	
Ø356	743Ø		SZL	
Ø357	6Ø67		DYS	
Ø36Ø	1Ø34		TAD SIZE	
Ø361	3Ø23		DCA Y1	
Ø362	1Ø32		TAD TA	
Ø363	2Ø37		ISZ SAVE	
Ø364	5353		JMP .-11	
Ø365	72ØØ		CLA	
Ø366	1Ø21		TAD Y	
Ø367	3Ø23		DCA Y1	
Ø37Ø	2Ø36		ISZ COUNT	
Ø371	5344		JMP NORM	
Ø372	1Ø34		TAD SIZE	
Ø373	71Ø4		CLL RAL	/AS ABOVE
Ø374	1Ø34		TAD SIZE	

Ø375	1Ø22		TAD XI	
Ø376	3Ø22		DCA XI	
Ø377	5271		JMP HTXT+5	
			/END OF TEXT INTERPRETER	
		PAGE		
Ø4ØØ	1Ø2Ø	LINE,	TAD X	/SAVE X,Y
Ø4Ø1	3Ø22		DCA XI	
Ø4Ø2	1Ø21		TAD Y	
Ø4Ø3	3Ø23		DCA YI	
Ø4Ø4	3Ø24		DCA XR	/CLEAR EXTN.
Ø4Ø5	3Ø25		DCA YR	
Ø4Ø6	141Ø		TAD I FILE	/READ COS
Ø4Ø7	3Ø26		DCA COSA	
Ø41Ø	1Ø45		TAD M4	/'SIZE'=4 FOR LINE
Ø411	3Ø36		DCA COUNT	
Ø412	1Ø26		TAD COSA	
Ø413	771Ø		SPA CLA	
Ø414	7Ø4Ø		CMA	
Ø415	3Ø27		DCA COSB	
Ø416	1Ø26	RX,	TAD COSA	
Ø417	71Ø4		CLL RAL	
Ø42Ø	3Ø26		DCA COSA	
Ø421	1Ø27		TAD COSB	
Ø422	7ØØ4		RAL	
Ø423	3Ø27		DCA COSB	
Ø424	2Ø36		ISZ COUNT	
Ø425	5216		JMP RX	
Ø426	141Ø		TAD I FILE	/READ SIN
Ø427	3Ø3Ø		DCA SINA	
Ø43Ø	1Ø45		TAD M4	
Ø431	3Ø36		DCA COUNT	
Ø432	1Ø3Ø		TAD SINA	
Ø433	771Ø		SPA CLA	
Ø434	7Ø4Ø		CMA	
Ø435	3Ø31		DCA SINB	
Ø436	1Ø3Ø	RY,	TAD SINA	
Ø437	71Ø4		CLL RAL	
Ø44Ø	3Ø3Ø		DCA SINA	
Ø441	1Ø31		TAD SINB	
Ø442	7ØØ4		RAL	
Ø443	3Ø31		DCA SINB	
Ø444	2Ø36		ISZ COUNT	
Ø445	5236		JMP RY	
Ø446	141Ø		TAD I FILE	/LENGTH
Ø447	755Ø		SNA SPA	
Ø45Ø	51Ø6		JMP DO+2	/FAST EXIT & ERROR
Ø451	7Ø41		CIA	
Ø452	713Ø		CLL CML RAR	
Ø453	713Ø		CLL CML RAR	/*1/4
Ø454	3Ø36		DCA COUNT	

0455	7100	LNDO,	CLL	/DRAWING ALGRTHM
0456	1024		TAD XR	
0457	1026		TAD COSA	
0460	3024		DCA XR	
0461	7004		RAL	
0462	1022		TAD X1	
0463	1027		TAD COSB	
0464	6053		DXL	
0465	3022		DCA X1	
0466	7100		CLL	
0467	1025		TAD YR	
0470	1030		TAD SINA	
0471	3025		DCA YR	
0472	7004		RAL	
0473	1023		TAD Y1	
0474	1031		TAD SINB	
0475	6067		DYS	
0476	3023		DCA Y1	
0477	2036		ISZ COUNT	
0500	5255		JMP LNDO	
0501	5105		JMP DO+1	
		/END OF LINE		
0502	1410	ORIGIN,	TAD I FILE	/SET X,Y FROM FILE
0503	3020		DCA X	
0504	1410		TAD I FILE	
0505	3021		DCA Y	
0506	5105		JMP DO+1	
0507	1410	STEP,	TAD I FILE	/RESET INCREMENT
0510	3034		DCA SIZE	
0511	1034		TAD SIZE	
0512	7041		CIA	
0513	3035		DCA MSIZE	
0514	5105		JMP DO+1	
0515	1020	GRAPH,	TAD X	/PLOTS Y
0516	6053		DXL	
0517	3037		DCA SAVE	
0520	1410		TAD I FILE	
0521	7500		SMA	/DATA ALL -VE
0522	5106		JMP DO+2	
0523	1021		TAD Y	
0524	6067		DYS	
0525	7300		CLA CLL	
0526	1037		TAD SAVE	/INCR. X
0527	1034		TAD SIZE	
0530	5316		JMP GRAPH+1	
0531	1022	CONTU,	TAD X1	/RESET ORIGIN
0532	3020		DCA X	
0533	1023		TAD Y1	
0534	3021		DCA Y	
0535	5105		JMP DO+1	

0600	1020	PAGE	TAD X	/SAVE ORIGIN
0601	3022	DOT,	DCA X1	
0602	1021		TAD Y	
0603	3023		DCA Y1	
0604	1410	REPEAT,	TAD I FILE	
0605	7500		SMA	/DATA -VE
0606	5106		JMP DO+2	
0607	1022		TAD X1	
0610	6053		DXL	
0611	3022		DCA X1	
0612	1410		TAD I FILE	
0613	1023		TAD Y1	
0614	6067		DYS	
0615	3023		DCA Y1	
0616	5204		JMP REPEAT	
		/PUSHA FOR NAME DISPLAY		
0617	0000	PUSH,	Ø	
0620	3032		DCA TA	/TO SAVE
0621	7040		CMA	
0622	1013		TAD PDL	
0623	3013		DCA PDL	/RESET PDL
0624	7100		CLL	
0625	1013		TAD PDL	
0626	1050		TAD PDMX	
0627	7620		SNL CLA	/OVERFLOW?
0630	5123		JMP ERR	
0631	1032		TAD TA	
0632	3413		DCA I PDL	/PUSH
0633	7040		CMA	
0634	1013		TAD PDL	
0635	3013		DCA PDL	
0636	5617		JMP I PUSH	
0637	1410	NAME,	TAD I FILE	/GETS OFFSET (I)
0640	0033		AND MSK	/PREVENTS OVERFLOW
0641	7450		SNA	/IS FILE THERE?
0642	5105		JMP DO+1	/THEN IGNORE
0643	3037		DCA SAVE	
0644	1010		TAD FILE	
0645	4217		JMS PUSH	
0646	1104		TAD DO	
0647	4217		JMS PUSH	
0650	1037		TAD SAVE	
0651	1052		TAD FSTA	
0652	3010		DCA FILE	
0653	4104		JMS DO	
0654	1413		POPA	
0655	3104		DCA DO	
0656	1413		POPA	
0657	3010		DCA FILE	
0660	5105		JMP DO+1	
		/END OF DISPLAY PROGRAM		

/5 X 7 MATRIX
 /TEXT CODE MODELS FOR
 /FOCAL LINKED CIG-8

*700

0700	0000	0000;	0757	0101	0101;	1036	0061	0061/2
0701	0000	0000;	0760	0076	0076;	1037	0042	0042;
0702	0000	0000;	0761	0000	0000/)	1040	0101	0101;
0703	0000	0000;	0762	0052	0052;	1041	0101	0101;
0704	0000	0000/SP.	0763	0024	0024;	1042	0111	0111;
0705	0000	0000;	0764	0412	0412;	1043	0066	0066/3
0706	0000	0000;	0765	0024	0024;	1044	0004	0004;
0707	0175	0175;	0766	0052	0052/*	1045	0014	0014;
0710	0000	0000;	0767	0000	0000;	1046	0024	0024;
0711	0000	0000/!	0770	0010	0010;	1047	0044	0044;
0712	0000	0000;	0771	0076	0076;	1050	0177	0177/4
0713	0400	0400;	0772	0010	0010;	1051	0162	0162;
0714	0000	0000;	0773	0000	0000/+	1052	0121	0121;
0715	0400	0400;	0774	0000	0000;	1053	0121	0121;
0716	0000	0000/"	0775	0001	0001;	1054	0121	0121;
0717	0024	0024;	0776	0002	0002;	1055	0116	0116/5
0720	0177	0177;	0777	0000	0000;	1056	0076	0076;
0721	0024	0024;	1000	0000	0000/,	1057	0111	0111;
0722	0177	0177;	1001	0000	0000;	1060	0111	0111;
0723	0024	0024/#	1002	0010	0010;	1061	0111	0111;
0724	0001	0001;	1003	0010	0010;	1062	0046	0046/6
0725	0025	0025;	1004	0010	0010;	1063	0101	0101;
0726	0177	0177;	1005	0000	0000/-	1064	0102	0102;
0727	0125	0125;	1006	0000	0000;	1065	0104	0104;
0730	0001	0001/\$	1007	0000	0000;	1066	0110	0110;
0731	0101	0101;	1010	0001	0001;	1067	0160	0160/7
0732	0046	0046;	1011	0000	0000;	1070	0066	0066;
0733	0010	0010;	1012	0000	0000/.	1071	0111	0111;
0734	0063	0063;	1013	0000	0000;	1072	0111	0111;
0735	0103	0103/%	1014	0001	0001;	1073	0111	0111;
0736	0066	0066;	1015	0010	0010;	1074	0066	0066/8
0737	0111	0111;	1016	0100	0100;	1075	0062	0062;
0740	0111	0111;	1017	0000	0000//	1076	0111	0111;
0741	0066	0066;	1020	0076	0076;	1077	0111	0111;
0742	0011	0011/&	1021	0101	0101;	1100	0111	0111;
0743	0000	0000;	1022	0101	0101;	1101	0076	0076/9
0744	0000	0000;	1023	0101	0101;	1102	0000	0000;
0745	0140	0140;	1024	0076	0076/0	1103	0000	0000;
0746	0000	0000;	1025	0000	0000;	1104	0022	0022;
0747	0000	0000/'	1026	0000	0000;	1105	0000	0000;
0750	0000	0000;	1027	0177	0177;	1106	0000	0000/;
0751	0000	0000;	1030	0000	0000;	1107	0000	0000;
0752	0076	0076;	1031	0000	0000/1	1110	0001	0001;
0753	0101	0101;	1032	0041	0041;	1111	0022	0022;
0754	0000	0000/(1033	0103	0103;	1112	0000	0000;
0755	0000	0000;	1034	0105	0105;	1113	0000	0000/;
0756	0000	0000;	1035	0111	0111;	1114	0000	0000;

1115	øø1ø	øø1ø;	12øø	ø11ø	ø11ø;	1263	ø11ø	ø11ø;
1116	øø24	øø24;	12ø1	ø1øø	ø1øø;	1264	øø6ø	øø6ø/P
1117	øø42	øø42;	12ø2	ø1øø	ø1øø/F	1265	øø76	øø76;
112ø	øøøø	øøøø/<	12ø3	øø76	øø76;	1266	ø1ø1	ø1ø1;
1121	øøøø	øøøø;	12ø4	ø1ø1	ø1ø1;	1267	ø1ø1	ø1ø1;
1122	øø24	øø24;	12ø5	ø1ø1	ø1ø1;	127ø	ø1ø5	ø1ø5;
1123	øø24	øø24;	12ø6	ø1ø5	ø1ø5;	1271	0076	0076/Q
1124	øø24	øø24;	12ø7	øø46	øø46/G	1272	ø177	ø177;
1125	øøøø	øøøø/=	121ø	ø177	ø177;	1273	ø11ø	ø11ø;
1126	øøøø	øøøø;	1211	øø1ø	øø1ø;	1274	ø11ø	ø11ø;
1127	øø42	øø42;	1212	øø1ø	øø1ø;	1275	ø114	ø114;
113ø	øø24	øø24;	1213	øø1ø	øø1ø;	1276	øø63	øø63/R
1131	øø1ø	øø1ø;	1214	ø177	ø177/H	1277	øø62	øø62;
1132	øøøø	øøøø/>	1215	øøøø	øøøø;	13øø	ø111	ø111;
1133	øø4ø	øø4ø;	1216	ø1ø1	ø1ø1;	13ø1	ø111	ø111;
1134	ø1øø	ø1øø;	1217	ø177	ø177;	13ø2	ø111	ø111;
1135	ø115	ø115;	122ø	ø1ø1	ø1ø1;	13ø3	øø46	øø46/S
1136	ø11ø	ø11ø;	1221	øøøø	øøøø/I	13ø4	ø1øø	ø1øø;
1137	øø6ø	øø6ø/?	1222	ø1ø2	ø1ø2;	13ø5	ø1øø	ø1øø;
114ø	øø1ø	øø1ø;	1223	ø1ø1	ø1ø1;	13ø6	ø177	ø177;
1141	øø1ø	øø1ø;	1224	ø177	ø177;	13ø7	ø1øø	ø1øø;
1142	øø1ø	øø1ø;	1225	ø1øø	ø1øø;	131ø	ø1øø	ø1øø/T
1143	øø34	øø34;	1226	ø1øø	ø1øø/J	1311	ø176	ø176;
1144	øø1ø	øø1ø/NOT	1227	ø177	ø177;	1312	øøø1	øøø1;
1145	øø37	øø37;	123ø	øø1ø	øø1ø;	1313	øøø1	øøø1;
1146	øø44	øø44;	1231	øø24	øø24;	1314	øøø1	øøø1;
1147	ø1ø4	ø1ø4;	1232	øø42	øø42;	1315	ø176	ø176/U
115ø	øø44	øø44;	1233	ø1ø1	ø1ø1/K	1316	ø174	ø174;
1151	øø37	øø37/A	1234	ø177	ø177;	1317	øøø2	øøø2;
1152	ø177	ø177;	1235	øøø1	øøø1;	132ø	øøø1	øøø1;
1153	ø111	ø111;	1236	øøø1	øøø1;	1321	øøø2	øøø2;
1154	ø111	ø111;	1237	øøø1	øøø1;	1322	ø174	ø174/V
1155	ø111	ø111;	124ø	øøø1	øøø1/L	1323	ø177	ø177;
1156	øø66	øø66/B	1241	ø177	ø177;	1324	øøø2	øøø2;
1157	øø76	øø76;	1242	øø4ø	øø4ø;	1325	øøø4	øøø4;
116ø	ø1ø1	ø1ø1;	1243	øø2ø	øø2ø;	1326	øøø2	øøø2;
1161	ø1ø1	ø1ø1;	1244	øø4ø	øø4ø;	1327	ø177	ø177/W
1162	ø1ø1	ø1ø1;	1245	ø177	ø177/M	133ø	ø143	ø143;
1163	øø42	øø42/C	1246	ø177	ø177;	1331	øø24	øø24;
1164	ø177	ø177;	1247	øø2ø	øø2ø;	1332	øø1ø	øø1ø;
1165	ø1ø1	ø1ø1;	125ø	øø1ø	øø1ø;	1333	øø24	øø24;
1166	ø1ø1	ø1ø1;	1251	øøø4	øøø4;	1334	ø143	ø143/X
1167	øø42	øø42;	1252	ø177	ø177/N	1335	ø1øø	ø1øø;
117ø	øø34	øø34/D	1253	øø76	øø76;	1336	øø4ø	øø4ø;
1171	ø177	ø177;	1254	ø1ø1	ø1ø1;	1337	øø37	øø37;
1172	ø111	ø111;	1255	ø1ø1	ø1ø1;	134ø	øø4ø	øø4ø;
1173	ø111	ø111;	1256	ø1ø1	ø1ø1;	1341	ø1øø	ø1øø/Y
1174	ø1ø1	ø1ø1;	1257	øø76	øø76/O	1342	ø1ø3	ø1ø3;
1175	ø1ø1	ø1ø1/E	126ø	ø177	ø177;	1343	ø1ø5	ø1ø5;
1176	ø177	ø177;	1261	ø11ø	ø11ø;	1344	ø111	ø111;
1177	ø11ø	ø11ø;	1262	ø11ø	ø11ø;	1345	ø121	ø121;

1346	Ø141	Ø141/Z
1347	Ø177	Ø177;
135Ø	Ø1Ø1	Ø1Ø1;
1351	Ø1Ø1	Ø1Ø1;
1352	ØØØØ	ØØØØ;
1353	ØØØØ	ØØØØ/ [
1354	ØØØØ	ØØØØ;
1355	Ø1ØØ	Ø1ØØ;
1356	Ø1ØØ	Ø1ØØ;
1357	ØØØ1	ØØØ1;
136Ø	ØØØØ	ØØØØ/R.O.
1361	ØØØØ	ØØØØ;
1362	ØØØØ	ØØØØ;
1363	Ø1Ø1	Ø1Ø1;
1364	Ø1Ø1	Ø1Ø1;
1365	0177	0177/]
1366	ØØ2Ø	ØØ2Ø;
1367	ØØ4Ø	ØØ4Ø;
137Ø	Ø177	Ø177;
1371	ØØ4Ø	ØØ4Ø;
1372	ØØ2Ø	ØØ2Ø/ ↑
1373	ØØ1Ø	ØØ1Ø;
1374	ØØ34	ØØ34;
1375	ØØ1Ø	ØØ1Ø;
1376	ØØ1Ø	ØØ1Ø;
1377	ØØ1Ø	ØØ1Ø/B.A.

/END OF SYMBOLS!!!
/UNIVERSAL END FILE
/TO END ALL FILES

AXES	0200	LIBR	7552	SINB	0031
BOTTOM	0035	LINE	0400	SIZE	0034
BUFR	0060	LNDO	0455	SORTCN	0054
CCR	0077	LP7	7551	STEP	0507
CFRS	0133	MCOMA	6350	SWITCH	0041
CHAR	0066	MCR	0116	TA	0032
CMNUM	7000	MLMIT	6347	TELSW	0016
CMST	1400	MMAX	0134	TMP	0002
CMSTA	6374	MODE	0135	TXT	0012
CONTU	0531	MSIZE	0035	TI	0032
CORPN	0047	MSK	0033	UP	0311
COSA	0026	MULTI0	5667	UPTXT	0263
COSB	0027	M4	0045	WPTCH	2414
COUNT	0036	M5	0044	X	0020
CTEST	6373	M7	0043	XADC	1343
C260	0113	NAME	0637	XCOM	6352
DIS	6160	NEWLN	0152	XDIS	6311
DISFIL	5600	NEXT	0065	XFIN	2564
DISN	6000	NFILB	6351	XFX	5352
DISPL	0053	NMODE	0121	XI33	2666
DIS1	6164	NORM	0344	XNM	0011
DIS1A	0167	NXT	0177	XOUTL	2676
DIS2	6167	OFFSET	0046	XR	0024
DIS2A	0170	ORIGIN	0502	XI	0022
DIS3	6172	OUT	6345	Y	0021
DIS3A	0171	PDCT	0016	YR	0025
DO	0104	PDL	0013	YI	0023
DOT	0600	PDLST	0051		
DXL	6053	PDMX	0050		
DXS	6057	PDTOP	0677		
DYL	6063	POPA	1413		
DYS	6067	PRINTC	4551		
EFUN31	0136	PRNTD	7543		
ERR	0123	PRNT8	7522		
ERROR	4566	PUSH	0617		
ERR2	2726	PUSHA	4542		
EVAL	1613	PUSHJ	4540		
FILE	0010	PUT	7503		
FIND	6335	PUTA	6372		
FLAC	0044	P13	0005		
FSTA	0052	P2000	0042		
FX2	5361	P400	2424		
GET	1142	P4000	0124		
GETA	6371	READC	4552		
GETC	4545	REPEAT	0604		
GRAPH	0515	RESET	0101		
HTXT	0264	ROT	0040		
INDX	0037	RTL6	4557		
INTEGE	0053	RX	0416		
JUMPA	0133	RY	0436		
LASTOP	0055	SAVE	0037		
LASTV	0031	SINA	0030		

/DUMMY DISPLAY FILE
 /'CIG-8 IS LOADED'
 FIELD 1
 *5600

5600	0072	72;	5657	6240	6240;
5601	0012	12;	5660	6311	6311;
5602	0000	0;	5661	6323	6323;
5603	0000	0;	5662	6215	6215;
5604	0000	0;	5663	6240	6240;
5605	0000	0;	5664	6314	6314;
5606	0000	0;	5665	6317	6317;
5607	0000	0;	5666	6301	6301;
5610	0000	0;	5667	6304	6304
5611	0000	0;	5670	6305	6305;
5612	0000	0;	5671	6304	6304;
5613	0001	1;	5672	0000	0000;
5614	0001	1;	5673	0000	0000;
5615	0001	1;	5674	0000	0000;
5616	0002	2;	5675	0000	0000
5617	0007	7;			
5620	0003	3;			
5621	0144	144;			
5622	0000	0;			
5623	0144	144;			
5624	0000	0			
5625	0001	1;			
5626	1776	1776;			
5627	1776	1776;			
5630	0003	3;			
5631	0000	0			
5632	0144	144;			
5633	0000	0			
5634	0144	144;			
5635	0001	1;			
5636	0310	310;			
5637	1130	1130;			
5640	0002	2;			
5641	0010	10;			
5642	0005	5;			
5643	6303	6303			
5644	6240	6240;			
5645	6311	6311;			
5646	6240	6240;			
5647	6307	6307;			
5650	6240	6240;			
5651	6255	6255;			
5652	6240	6240;			
5653	6270	6270;			
5654	6215	6215;			
5655	6240	6240			
5656	6240	6240			

C-THREE PART COMPILER FOR PICTURES:
 C-BASIC ROUTINES AND TEXT
 C-GRAPH PLOTTING
 C-VECTORS
 C-
 C-ASSEMBLE AND ERASE SELECTIVELY TO AVOID P.D.L. OVERFLOW
 C-
 C-BASIC ROUTINES:
 C-DO 10: ERASE FILES AND INITIALISE
 C-DO 11: START A NUMBERED FILE
 C-DO 12: ERASE ONE FILE
 C-DO 8: BASIC FILE ENTRY
 C-DO 9: REMOVE LAST FILE ENTRY
 C-DO 6.1: ENTER ORIGIN
 C-DO 6.2: FIX STEP SIZE
 C-DO 7.5: HORIZONTAL TEXT
 C-DO 7.6: VERTICAL TEXT
 C- TERMINATE BY ↑ D; <CR> GIVES NEW LINE
 C-DO 13.1: ENTER A PICTURE SUBROUTINE
 C-DO 13.2: TOGGLE A FILE ON/OFF

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C-FOCAL,1969

06.10 S Z=1;D 8;A ! "XQ"Z;D 8;A " Y0"Z;D 8
 06.20 S Z=2;D 8;A ! "SIZE"Z;D 8

 07.10 S Z=FIN();I (Z-141) 7.3,7.2;I (159-Z) 7.2;R
 07.20 S Z=Z-1024;D 8;G 7.1
 07.30 R
 07.40 D 6.2;D 6.1
 07.50 D 7.4;S Z=5;D 7.7
 07.60 D 7.4;S Z=6;D 7.7
 07.70 D 8;T !;D 7

 08.10 S Z=FDIS(FDIS(),Z);S Z=FDIS(0,FDIS()+1)

 09.10 S Z=FDIS(0,FDIS()-1);S Z=FDIS(Z,0)

 10.10 T ! "WAIT";F I=0,1023;S Z=FDIS(I,0)
 10.20 S Z=FDIS(0,64)

 11.10 S Z=FDIS(63,FDIS(63)+1);T ! "NAME "%2,Z
 11.20 S Z=FDIS(Z,FDIS());T " START "%4,Z
 11.30 S Z=0;D 8

12.1∅ S A=FDIS(63);I (-A)12.2;T !"??" ;R
 12.2∅ S B=FABS(FDIS(A));F I=B, FDIS();S Z=FDIS(1,∅)
 12.3∅ S Z=FDIS(∅, B);S Z=FDIS(63, A-1)

 13.1∅ S Z=1∅;D 8;A ! "NAME"Z;S Z=FABS(FDIS(Z));D 8
 13.2∅ A ! "NAME"Z;S Z=FDIS(Z, -FDIS(Z))
 13.3∅ A !, ?A?, " ", ?B?
 * @@@@@@@@@@@@@@@@@@ ←

C-NOW READ IN '5' TO INITIALISE GRAPH & AXES

C-ERASE 6.2 IF NO LONGER NEEDED

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05.10 A  ! "GRAPH: # PTS."Z;S Z=FCOM(506,Z)
05.20 A  ! "WINDOW, % SCREEN, X"A, " Y"B
05.30 A  ! "X-MIN"Z;S Z=FCOM(501,Z);A " X-MAX"Z;S Z=FCOM(503,Z)
05.40 A  ! "Y-MIN"Z;S Z=FCOM(504,Z);A " Y-MAX"Z;S Z=FCOM(505,Z)
05.50 S  Z=2;D 8;S Z=10.24*A/FCOM(506);D 8;S Z=3;D 8
05.60 S  Z=FCOM(502,(FCOM(503)-FCOM(501))/FCOM(506))
05.65 S  Z=FCOM(503)/Z;D 8;S Z=FCOM(506)-FDIS(Z-1);D 8
05.70 S  A=FCOM(505)/(FCOM(505)-FCOM(504))
05.80 S  Z=10.24*A*B/FDIS(Z-4);D 8
05.85 S  Z=10.24*(1-A)*B/FDIS(Z-5);D 8;S Z=FCOM(507,10.24*B)
05.90 S  Z=7;D 8;S Z=-FDIS(Z-7)*FDIS(Z-4)-1024;D 8
05.95 S  Z=-1024;D 8;S Z=9;D 8

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* @@@@@@@@@@@@@@@@@@ ←

C-DO 6.1;DO 5 TO INITIALISE GRAPH

C-NOW ERASE '5' OR '7' OR BOTH AND

C-ENTER A FORMULA IN '2'

C-READ IN '3' AND '4' THEN 'DO 3' TO PLOT

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C-FOCAL,1969

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02.10 S  Z=A*X ↑ 2

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03.10 S  Z=4;D 8;D 13.3;F X=FCOM(501),FCOM(502),FCOM(503);D 2;D 4

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04.10 I  (FCOM(505)-Z)4.2;I (Z-FCOM(504))4.2;G 4.3

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04.20 S  Z=0

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04.30 S  Z=Z*FCOM(507)=1024;D 8

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C-NOTE THE USE OF FCOM(501) ETC TO SAVE VARIABLES

C- FCOM(501)=X-MIN; FCOM(503)=X-MAX

C- FCOM(504)=Y-MIN; FCOM(505)=Y-MAX

C- FCOM(502)=X-INTERVAL

C- FCOM(506)=# OF PTS

C- FCOM(507)=RANGE OF Y

C-

C-FOR VECTORS E '2' '3' & '4' AND LOAD THE FOLLOWING

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C-FOCAL, 1969

Ø3.1Ø D 6.1;S Z=2;D 8;S Z=4;D 8;S Z=3;D 8
Ø3.2Ø A ! "AXIS LENGTHS:" "EAST"Z;S Z=Z/4;D 8;A " WEST"Z;S Z=Z/4;D 8
Ø3.3Ø A " NORTH"Z;S Z=Z/4;D 8;A " SOUTH"Z;S Z=Z/4;D 8

Ø4.1Ø S DE=3.14159/18Ø;S A=1Ø24;S Z=8;D 8
Ø4.2Ø A ! "ANGLE, DEGREES"B;S Z=A*FCOS(B*DE);D 8
Ø4.3Ø S Z=A*FSIN(B*DE);D 8;A " L"Z;D 8

Ø5.1Ø D 4.1;A ! "DX"X, " DY"Y;D 7;G 5.2
Ø5.2Ø S Z=1Ø24*A*FCOS(I);D 8;S Z=1Ø24*A*FSIN(I);D 8;S Z=B;D 8
Ø5.3Ø R
Ø5.4Ø S Z=9;D 8

Ø7.1Ø S A=1;S B=FSQT(X ↑ 2+Y ↑ 2);I (X)7.7,7.3,7.8
Ø7.3Ø I (Y)7.4,7.8;S I=9Ø*DE;R
Ø7.4Ø S I=27Ø*DE;R
Ø7.7Ø S A=-1
Ø7.8Ø S I=FATN(Y/X);R

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C-DO 3 PROVIDES VECTOR AXES
C-DO 4 GIVES POLAR VECTORS
C-DO 5 GIVES DX, DY VECTORS
C-DO 5.4 CONTINUES VECTOR FROM LAST PLOTTED POINT
C- OTHERWISE ALL VECTORS PLOTTED FROM LASRT ORIGIN
C-DO 6.1 TO RESET ORIGIN

C-WRITE CONTROL PROGRAMS IN 'I'
C-'QUIT' OR RECYCLE TO AVOID SUBROUTINES
C-CONFIGURE USEFUL COMBINATIONS TO CALL FROM DISC

C- BEST WISHES! !