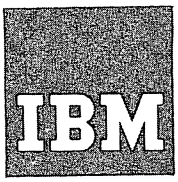
File No. 1130/1800-30
GC26-3755-2



Systems Reference Library

IBM 1130/1800 Plotter Subroutines

This publication describes relocatable plotter subroutines for the IBM 1130 and 1800 systems. These subroutines can be used to draw and scale grid lines, to draw special point characters, to draw alphameric characters at various angles, and to plot curves, graphs, charts, and maps. The subroutines can be used in both assembler and FORTRAN language programs.

PREFACE

This manual describes a group of relocatable plotter subroutines that aids the programmer in converting computed data into graphic form. These subroutines can be used with any IBM 1130 Computing System or 1800 Data Acquisition and Control System that includes an IBM 1627 Plotter, Model 1 or 2. These subroutines supplement the basic plotter subroutine included as a part of the 1130 and 1800 subroutine libraries and can be used with any of the following IBM programming systems:

- 1130 Card/Paper Tape Programming System
- 1130 Disk Monitor System, Version 1
- 1130 Disk Monitor System, Version 2
- 1800 Card/Paper Tape Programming System
- 1800 Time-Sharing Executive System
- 1800 Multiprogramming Executive Operating System

Core storage requirements are given in Appendix A, subroutine usage is listed in Appendix B, and three sample programs are shown in Appendix C.

Descriptions of related publications can be found in the following:

- IBM 1130 Computing System Bibliography (Form A26-5916)
- IBM 1800 Data Acquisition and Control System Bibliography (Form A26-5921)

Third Edition (June 1969)

This is a major revision of, and obsoletes, C26-3755-1 and Technical Newsletter N33-8010. Some parts of the manual have been revised, information has been added and other changes made, to increase the manuals accuracy and usefulness. Changes to the text, and small changes to illustrations are indicated by a vertical line to the left of the change; changed or added illustrations are denoted by the symbol • to the left of the caption.

Changes are periodically made to the specifications herein; before using this publication in connection with the operation of IBM systems, consult the latest SRL Newsletter, Form N20-1800 for the editions that are applicable and current.

A form is provided at the back of this publication for reader's comments. If the form has been removed, comments may be addressed to IBM Nordic Laboratory, Technical Communications, Box 962, 181 44 Lidingoe, Sweden.

CONTENTS

ILLUSTRATIONS

Figures

Tables

GENERAL

When connected to an IBM 1130 Computing System or an IBM 1800 Data Acquisition and Control System, the IBM 1627 Plotter can be programmed to produce bar charts, organization charts, engineering drawings, maps, or special curves. This manual describes a set of subroutines, written in assembler language, used to control the plotter. The subroutines can also be called from a FORTRAN-language program.

PLOTTER CHARACTERISTICS

The basic characteristics of the plotter are listed in Table 1.

X-axis movement is produced by rotating the chart paper on the drum under the pen. Rotating the drum down causes the pen to draw a line, effectively, in the up direction; this movement is the positive X-axis motion. Rotating the chart paper up produces the negative X-axis motion.

Y-axis movement is caused by moving the pen parallel to the drum axis. When looked at from the front of the plotter, the positive Y-axis motion is to the left; the negative, to the right.

Thus, the length of the X-axis is limited by the length of the roll of chart paper, and the length of the Y-axis is determined by the paper's width. Various combinations of paper and pen movement with the pen up or down are utilized to produce the desired drawings.

Table 1. IBM 1627 Plotter Characteristics

Characteristic	Model 1	Model 2
Chart Paper Width	12 inches	31 inches
Plotting Width	11 inches	29-1/2 inches
Chart Paper Length	120 feet	120 feet
Plotting Length	120 feet	120 feet
Incremental Step Size	1/100 inch	1/100 inch
Step Speed	Up to 18,000 steps/min.	Up to 12,000 steps/min.
Pen Status Change	600 Operations/min.	600 Operations/min.

PLOTTER CAPABILITIES

The plotter generates all lines by using a series of incremental straight line segments. The increment length is 0.01 inch, drawn in either a positive or a negative direction, parallel to either the X-axis or the Y-axis. Also, the paper and pen can be moved simultaneously to produce line increments at a 45^{o} angle to either axis in either direction. This results in a diagonal line connecting opposite corners of an X-Y square. Combinations of increments at various angles can closely approximate any desired curve.

Preciseness of lines and characters depends on the size of the pen point and the scale selected by the programmer. Figure 1 illustrates the smallest line increments capable of being generated and a sample curve made by using these increments.

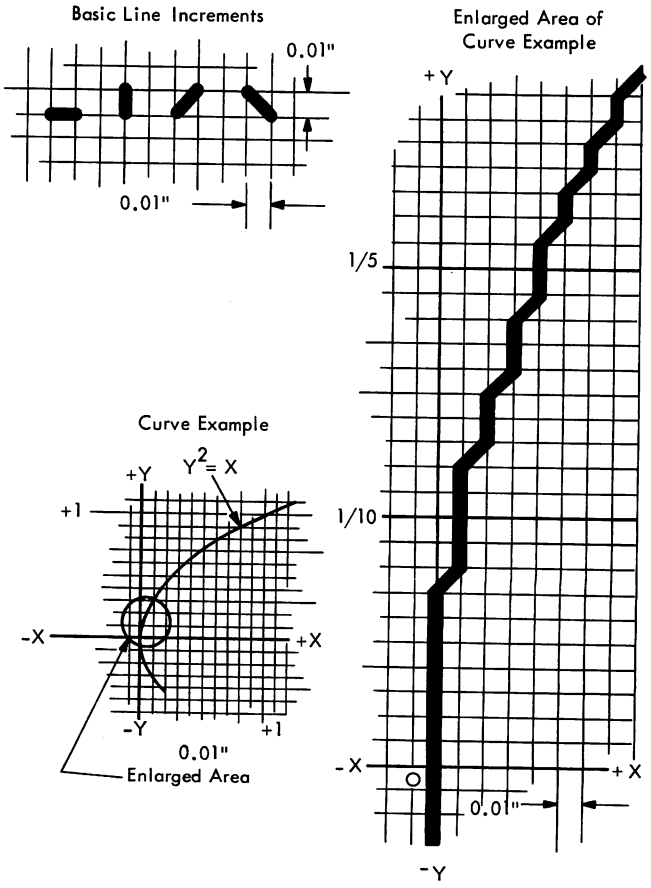


Figure 1. Plotter Line Generation

Graphs, curves, charts, etc., can be developed by programming the appropriate instructions to the plotter.

Because of the relative slowness of the plotter, compared with the computer, the plotter system has a buffering scheme which holds plotter instructions until they are executed. This leaves the computer free to do other jobs while the actual plotting is being completed.

SUBROUTINE FUNCTIONS

There are six primary functions of the plotter subroutines described in this manual.

- Scale: Accepts and stores scaling information required by the grid, plot and character functions.
- Grid: Draws a line with scaled grid marks.
- Plot: Moves the pen from its present position to a new position. It can also raise or lower the pen either before or after the traverse movement.
- Point: Draws a special point character at the present location of the pen, if the pen is down. The point characters available are +, ×, Δ, ▷, ▽, and ◁. All point characters are fixed in size.
- Character: Positions the pen for annotation and provides character size and angle information.
- Annotation: Forms the characters to be plotted from computer output data. Characters available are 0-9, A-Z, and ♭ - + . , * / = ( ) $ '. (The symbol ♭ represents a blank character.)

INPUT FORMAT

The input data to the subroutines can be either in extended or standard precision format, but different subroutines are required for each precision, with the exception of the point subroutine. For example, to perform the plot function in standard precision, the FPLOT subroutine is used; for extended precision, the EPLOT subroutine is used. Standard precision uses two 16-bit words to form a constant or variable, while extended precision uses three 16-bit words for the same constant or variable.

Subroutine	Up and down status of pen on execution		Co-ordinates of pen on execution	
	Required Before	After	Before	After
SCALE	not applicable (n. a)	(n. a)	present position (p. p) (origin is established)	original position
GRID	(n. a)	up	(n. a)	user specification
PLOT	(n. a)	user specification	(p. p)	user specification
POINT	down	down	(p. p)	original position
CHARACTER	(n. a)	up	(p. p)	user specification
ANNOTATION (WRITE)	(n. a)	up	those given to CHARACTER subroutine, otherwise (p. p)	end of List

• Figure 2. Pen status changes effected by the subroutines.

SCALE

The scale subroutine accepts and stores scaling information required by the grid, plot and character functions.

If the scale subroutine is not called, the plot subroutine assumes initial scale values of one inch per unit along both axes and establishes the origin (intersection of the X axis and the Y axis) at the present pen position. However, the scale subroutine must be called to define other scale factors and to establish the origin at other points. The scale subroutine can be called as often as required to redefine the scaling values and the origin position (see Figure 2).

Desired Scale: X Direction: 0.25 Inch Per User's Unit
Y Direction: 0.05 Inch Per User's Unit

Call Example (FORTRAN):

```
CALL SCALE (0.25, 0.05, -5., 30.)
```

X,Y Scale Factor (Inches Per User's Unit) — Present Pen Location (User's Units)

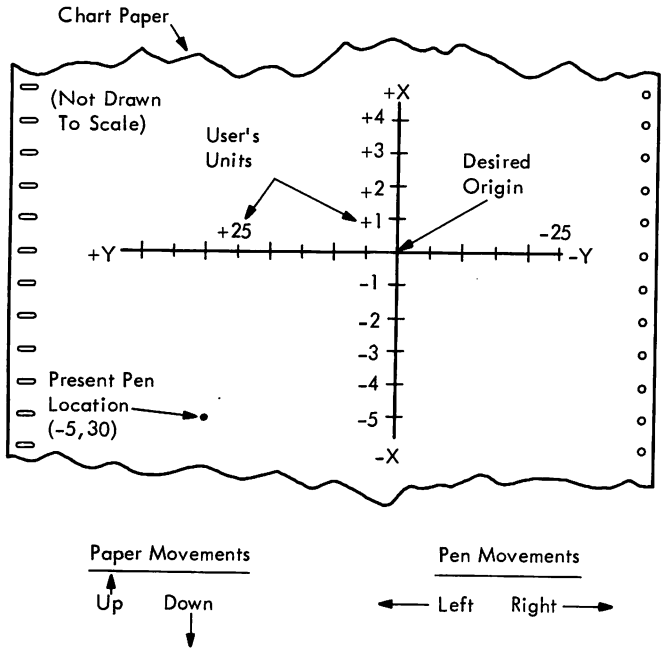


Figure 2. Scaling and Origin Location (Example)

NOTE: Each time the scale subroutine is called, the origin established is based on the physical location of the pen. Therefore, the pen must be moved to the position assumed by the subroutine before the subroutine is called. Also, the pen position cannot be moved more than 327.67 inches in either X direction from its physical location at the time the origin was last established.

Scale values are given in inches per unit of the using program. For example, to indicate a scale of 1/4 inch equal to 1 foot, the scale value would be 0.25. To indicate a scale of 1 inch equal to 10 years, the scale would be 0.1. Different scale values can be assigned to the X axis and the Y axis.

The pen is usually aligned by reticle adjustment to some point on the chart paper. The scale subroutine establishes the origin at any desired point relative to the physical location of the pen when the subroutine is called. Thereafter, or until the origin is moved, all measurements are calculated from this origin to prevent an accumulation of errors which would result from measuring from point to point with calculated values that have been rounded off or truncated.

The values inserted by this subroutine are positive or negative as measured perpendicularly from each desired axis to the present location of the pen.

FORTRAN

Standard precision:

```
CALL    SCALF (Xs, Ys, Xo, Yo)
```

Extended precision:

```
CALL    SCALE (Xs, Ys, Xo, Yo)
```

X_S is a real constant or variable that defines the number of inches per user's unit to be used along the X axis.

Y_S is a real constant or variable that defines the number of inches per user's unit to be used along the Y axis.

X_O is a signed real constant or variable that specifies the X value of the present position of the pen relative to the desired origin, measured in the user's units.

Y_O is a signed real constant or variable that specifies the Y value of the present position of the pen relative to the desired origin, measured in the user's units.

ASSEMBLER

Standard precision:

```
CALL    SCALF
DC      A
DC      B
DC      C
DC      D
```

Extended precision:

```
CALL    SCALE
DC      A
DC      B
DC      C
DC      D
```

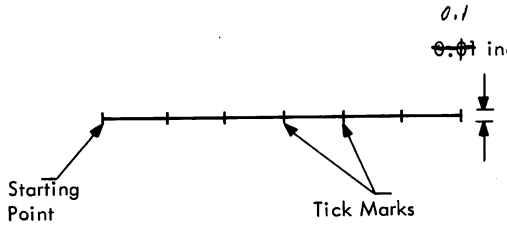
A, B, C, and D are the addresses of constants or variables whose values correspond to X_S, Y_S, X_O, and Y_O, respectively, as described in the FORTRAN calls.

For the standard precision calling sequence, each constant or variable designated by A, B, C, and D must be two words. This is accomplished best by using the DEC statement. For extended precision, each constant or variable must be three words. This is accomplished best by using the XFLC statement.

GRID

The grid subroutine plots a straight line parallel to either the X or the Y axis in a positive or a negative direction with tick marks at regularly spaced intervals. The tick marks are 0.10 inch long, with one half of the mark on each side of, and perpendicular to, the grid line. The programmer must specify the starting point, the direction to be plotted, how far to go, and the distance between tick marks.

It is not required to know either the location of the pen or whether it is up or down when this subroutine is called. At the end of the subroutine, the pen is left in the up position.



FORTRAN

Standard precision:

```
CALL    FGRID (I, X, Y, U, N)
```

Extended precision:

```
CALL    EGRID (I, X, Y, U, N)
```

I is an integer constant or variable that specifies the direction the grid line is to be generated, as follows:

I = 0 specifies the +X direction
I = 1 specifies the +Y direction
I = 2 specifies the -X direction
I = 3 specifies the -Y direction

Only the last two bits of I are used to determine the direction; therefore, use of larger numbers would repeat the instructions. For example, 24 or 4 plot the same as 0 (+X direction).

X is a signed real constant or variable that specifies the X value of the grid line starting point, measured in the user's units.

Y is a signed real constant or variable that specifies the Y value of the grid line starting point, measured in the user's units.

U is a real constant or variable that specifies the distance between tick marks, measured in the user's units.

N is an integer constant or variable that defines the length of the grid line. N is equal to the number of tick marks minus one, and must be less than 32768.

ASSEMBLER

Standard precision:

```
CALL    FGRID
DC      A
DC      B
DC      C
DC      D
DC      E
```

Extended precision:

```
CALL    EGRID
DC      A
DC      B
DC      C
DC      D
DC      E
```

A, B, C, D, and E are the addresses of constants or variables corresponding to I, X, Y, U, and N. respectively, of the FORTRAN language calls.

The constants or variables represented by A and E should be one word each in both standard and extended precision calls. Each constant or variable represented by B, C, and D must be two words for standard precision and three words for extended precision.

PLOT

This subroutine is called to move the pen from its present position to a new position. It is the user's responsibility to check that the coordinates of the new position are within limits. The pen can also be raised or lowered before or after the traverse movement, as a part of this subroutine.

NOTE: If the pen is up (or down), and a command is given to go up (or down), 100 milliseconds of plot time are wasted in performing the redundancy.

FORTRAN

Standard precision:

CALL FPLOT (I, X_n, Y_n)

Extended precision:

CALL EPLOT (I, X_n, Y_n)

I is an integer expression controlling the pen as follows:

I = Zero	No change
I = Positive	Control pen before movement
I = Negative	Control pen after movement
I = Odd	Raise pen
I = Even	Lower pen

X_n is a signed real constant or variable defining the X value of the new position, measured in the user's units.

Y_n is a signed real constant or variable defining the Y value of the new position, measured in the user's units.

ASSEMBLER

Standard precision:

```
CALL    FPLOT
DC      A
DC      B
DC      C
```

Extended precision:

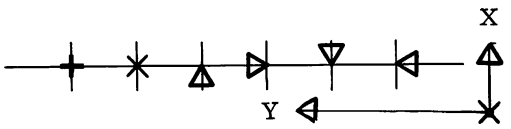
```
CALL    EPLOT
DC      A
DC      B
DC      C
```

A, B, and C are the addresses of constants or variables corresponding to I, X_n and Y_n, respectively, of the FORTRAN calls.

The constant or variable represented by A should be only one word in both standard and extended precision. Each constant or variable represented by B and C must be two words for standard precision and three words for extended precision.

POINT

The point subroutine draws special point characters at the present position of the pen. The pen must be down when this subroutine is called. The point characters, and the points about which they are drawn, are illustrated below. All points are at the intersection of the horizontal and vertical line.



This subroutine assumes the pen is down and leaves the pen down when finished. Each point character is inscribed within a 0.10 inch square.

FORTRAN

The pen remains in the down position:

CALL POINT (I)

I is an integer expression that defines the character to be drawn as follows:

I < 0 blank
I = 0 +
I = 1 ×
I = 2 △ (+X)
I = 3 ▷ (-Y)
I = 4 ▽ (-X)
I = 5 ◁ (+Y)
I ≥ 6 blank

ASSEMBLER

The pen remains in the down position:

CALL	POINT
DC	A

A is the address of a one-word constant or variable whose contents correspond to the I of the FORTRAN call. The constant or variable represented by A must be only one word in length.

CHARACTER

This subroutine is used to initialize the annotation subroutine by establishing the height and width of characters, the angle (relative to the X axis) they are drawn, and the starting location. Calling this subroutine also raises the pen (if down) and moves the pen to the specified starting location. The height and width parameters determine a rectangle inside of which each character is drawn (see Figure 3). The annotation subroutine remains initialized by the call to this subroutine until a new call supersedes the old one.

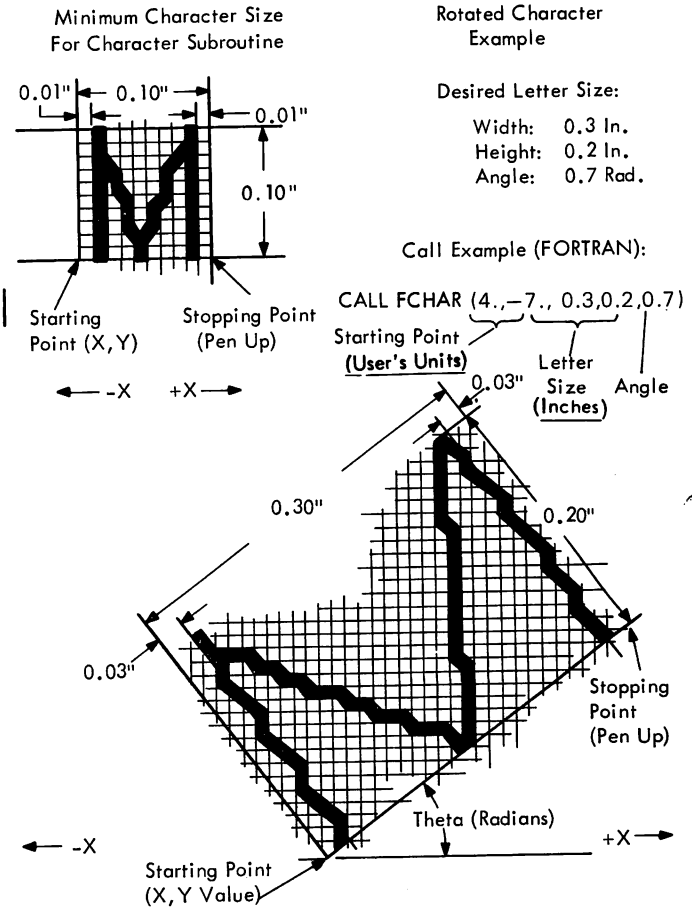
FORTRAN

Standard precision:

CALL FCHAR (X_n, Y_n, X_s, Y_s, Theta)

Extended precision:

CALL ECHAR (X_n, Y_n, X_s, Y_s, Theta)



● Figure 3. Character Plotting (Example)

X_n is a signed real variable or constant defining the X value (user's units) of the starting location.

Y_n is a signed real variable or constant defining the Y value (user's units) of the starting location.

X_S is an unsigned real variable or constant defining the width of the character, expressed in inches. A value exceeding two decimal places will be rounded off to the nearest 0.01.

Y_S is an unsigned real variable or constant defining the height of the character, expressed in inches. A value exceeding two decimal places will

be rounded off to the nearest 0.01.

Theta is a signed real variable or constant defining the angle at which the character (or line of characters) is to be drawn, expressed in radians. Theta is measured by rotating a line parallel to the X axis about the starting location. Positive values produce counterclockwise rotation; negative values, the opposite.

NOTE: Due to the physical resolution limitation of the plotter, it is impossible to rotate a character through all angles. The possible angles are discrete and are a function of the particular character being rotated and the angle of rotation. Thus there may be a discrepancy between Theta and the actual plotted angle of rotation, which will be most significant for small character sizes. The same phenomenon will also cause distortion of the character shape in many cases.

When using the annotation routine to plot a string of rotated characters, the rotational inaccuracies in each character will accumulate and may produce distorted lines. This accumulative affect may be overcome by drawing the line one character at a time and using ECHAR or FCHAR to position each character in its proper location.

NOTE: A rotation through a full circle (360^{o}) is 2π radians. A rotation through an nth part of a circle, $360^{o}/n$, is $2\pi/n$ radians.

ASSEMBLER

Standard precision:

```
CALL    FCHAR
DC      A
DC      B
DC      C
DC      D
DC      E
```

Extended precision:

```
CALL    ECHAR
DC      A
DC      B
DC      C
DC      D
DC      E
```

A, B, C, D, and E are the addresses of real constants or variables corresponding to the X_n, Y_n, X_s, Y_s, and Theta, respectively, of the FORTRAN calling sequence. The constants or variables represented by A, B, C, D, and E must be two words in standard precision and three words in extended precision.

NOTE: When the plotter subroutines are first loaded, X_n and Y_n are set to 0.10 inch and Theta is set to zero. If the annotation subroutine is called without calling the character subroutine, the characters are plotted at this size and angle, starting at the present position of the pen. These values are replaced by those of the character subroutine when first called and, if needed, must be reinserted by using the character subroutine.

ANNOTATION

This subroutine forms the characters specified by computer output data to the parameters established by the character subroutine. These parameters determine a rectangle inside of which each character is drawn. The starting location is the lower left corner of the rectangle. In a continuous row of characters, the starting location is the lower left corner of the first character. When the last character is completed, this subroutine stops the pen in the up position over the lower left corner of the next character position in sequence. Repetitive lines are plotted end to end. The character set available is 0-9, A-Z, and ₿ - + . , * / = ( ) $ '.

FORTRAN

Standard or extended precision:

```
WRITE (I, FORMAT) List
```

I is the unsigned integer constant or variable that specifies the logical unit number of the I/O unit (plotter) to be used for output data. This number can be changed in the 1800 system when establishing the FORTRAN I/O unit (IOU) table.

FORMAT is a statement number of the FORMAT statement describing the type of data conversion to be performed between the internal and external representation of each quantity in the list.

List is a list of variable names, separated by commas, which represent the output data.

Standard precision (except MPX):

```
   LIBF     FCHRI
   DC       (Non-Zero)
   DC       A
   DC       0 (Not Used)
   .        .
   .        .
   .        .
A  DC       U
   DC       0 (Not Used)
   EBC      V
   EBC      W
   .        .
   .        .
   .        .
```

Extended precision (except MPX):

```
   LIBF     ECHRI
   DC       (Non-Zero)
   DC       A
   DC       0 (Not Used)
   .        .
   .        .
   .        .
A  DC       U
   DC       0 (Not Used)
   EBC      V
   EBC      W
   .        .
   .        .
   .        .
```

Standard precision (MPX only):

```
   CALL     FCHRI
   DC       A
   .        .
   .        .
   .        .
A  DC       U
   DC       0 (Not Used)
   EBC      V
   EBC      W
   .        .
   .        .
   .        .
```

Extended precision (MPX only):

```
   CALL     ECHRI
   DC       A
   .        .
   .        .
   .        .
A  DC       U
   DC       0 (Not Used)
   EBC      V
   EBC      W
   .        .
   .        .
   .        .
```

A is an arbitrarily assigned label.

U is an unsigned integer expressing the total number of words contained under the label A, including one for the unused DC statement (0).

V, W, etc., are the output data in EBCDIC. There are two 8-bit characters per word with a maximum of 18 words for any one EBC statement.

NOTE: If 18 words are used, the last character of the 18th word will be blank because of the restrictions of the EBC statement.

APPENDIX A. CORE STORAGE REQUIREMENTS

Subroutine Function	Subroutine Name	Core Size (Words)	Remarks
Annotation	FCHRI*	580 586 (mpx)	Standard precision
	ECHRI*	588 576 (mpx)	Extended precision
Character	FCHAR	52 54 (mpx)	Standard precision
	ECHAR	58 60 (mpx)	Extended precision
Grid	FGRID EGRID	102 110	Standard precision Extended precision
Plot	FPLOT EPLOT	48 56	Standard precision Extended precision
Point	POINT	110	Standard and ext. precision
Scale	SCALF SCALE	4 4	Standard precision Extended precision
Plot Scaler	FRULE ERULE	114 130	Standard precision Extended precision
Pen Mover	XYPLT	104	Standard and ext. precision
Interface	PLOTI	18 66 (mpx)	

* In FORTRAN this function is performed using the WRITE statement.

APPENDIX B. SUBROUTINE USAGE

Subroutine		Other Subroutines Required	
Function	Name	Called by CALL	Called by LIBF
Annotation	FCHRX, FCHRI,* WCHRI*		FLOAT, FMPY, IFIX, FADD, FLDX, FINC, XYPLT, PLOTI, FSTOY, FLD
	ECHRX, ECHRI,* VCHRI*		FLOAT, EMPY, IFIX, EADD, ELDX, EINC, XYPLT, PLOTI, ESTOY, ELD
Character	FCHAR	FSIN, FCOS, FPLOT	FCHRX**, FLD, FSTOX, FSTO
	ECHAR	ESIN, ECOS, EPLOT	ECHRX**, ELD, ESTOX, ESTO
Grid	FGRID	FPLOT, POINT	FADD, FLD, FSTO, SNR
	EGRID	EPLOT, POINT	EADD, ELD, ESTO, SNR
Plot	FPLOT		FMOVE, XYPLT, PLOTI
	EPLOT		EMOVE, XYPLT, PLOTI, ELD, ESTO
Point	POINT		PLOTI
Scale	SCALF		FRULE
	SCALE		ERULE
Plot Scaler	FRULE, FMOVE, FINC		FLDX, FSUBX, FMPYX, FLD, FSTOX, FMPY, IFIX, FADD
	ERULE, EMOVE, EINC		ELDX, ESUBX, EMPYX, ELD, ESTOX, EMPY, IFIX, ESTO, EADD
Pen Mover	XYPLT		PLOTI
Interface	PLOTI, PLOTS		PLOTX**

*Separate entry points to the Annotation Routine. WCHRI and VCHRI are not entry points in the MPX System.

**Called by CALL in the MPX System.

This appendix contains three sample plotter programs utilizing the IBM 1130 Monitor System.

Test Program 4 demonstrates the character-drawing capabilities of the plotter. Figure 4 shows a listing of this program, and Figure 5 shows the resultant plotter drawing.

Test Program 5 demonstrates the curve-plotting capabilities of the plotter. Figure 6 shows a listing of this program, and Figure 7 shows the resultant plotter drawing.

Figure 8 is a listing demonstrating the capability of the plotter to draw special point characters, and Figure 9 shows the resultant plotter drawing. The sample programs were assembled on the 1130 Disk Monitor System, Version 2.

```
// JOB
// FOR
**PLOTTER TEST 4
*IOCS ( 1132 PRINTER, PLOTTER, CARD )
*LIST ALL
*ONE WORD INTEGERS
```

Cartridge status information will appear following // JOB Card on Monitor 2.

```
                    PLOTTER TEST 4
C     TEST CHARACTER ROUTINE
      DIMENSION IA(47),IB(36),IC(10),ID(26)
      EQUIVALENCE (IA(1),IB(1),IC(1)),(IA(11),ID(1))
1     FORMAT(' PL004')
2     FORMAT(' THIS IS A TEST OF THE CHARACTER ROUTINE'/' TEST IS IN 5'
     1' PARTS'//' PART 1 - PLOT THE FOLLOWING CHARACTERS .2 IN SIZE')
3     FORMAT(1H 47A1)
4     FORMAT(//' PART 2 - PLOT CHARACTERS A-Z .27W BY .37H HORIZONTAL')
5     FORMAT(47A1)
6     FORMAT(//' PART 3 - PLOT CHARACTERS A-Z .25W BY .15H ON A 45')
7     FORMAT(//' PART 4 - PLOT CHARACTERS 0-9 .15W BY .25H VERTICAL')
8     FORMAT(//' PART 5 - PLOT CHARACTERS 0-9,A-Z .15 BY .15 ON A'
     1' 3 INCH CIRCLE')
      K=2
      L=3
      M=7
      READ (K,5)IA
      WRITE(L,1)
      WRITE(L,2)
      PI = 3.14159
      WRITE(L,3)IA
      CALL FCHAR(0.,0.,.2,.2,0.)
      WRITE(M,5)IA
      WRITE(L,4)
      CALL FCHAR(0.,.3,.27,.37,0.)
      WRITE(M,5)ID
      WRITE(L,6)
      CALL FCHAR(.27,.75,.25,.15,PI/4.)
      WRITE(M,5)ID
      WRITE(L,7)
      CALL FCHAR(.25,1.2,.15,.25,PI/2.)
      WRITE(M,5)IC
      WRITE(L,8)
      T = 0.
      DEL = PI/18.
      DO 40 I = 1,36
      CALL FCHAR(2.+1.5*COS(T),5.75 +1.5*SIN(T),.15,.15,T)
      WRITE(M,5)IB(I)
40    T = T + DEL
      CALL FCHAR(1.,7.9,.1,.1,0.)
      WRITE(M,1)
      WRITE(L,1234)
      CALL EXIT
1234  FORMAT(//' END OF TEST'//)
C
C     PLACE PLOTTER IN LOWER RIGHT CORNER OF IMAGINARY
C     8 X 9 INCH RECTANGLE  (8 = Y)
C
      END
```

Set the values of K, L, and M to the Logical Unit Numbers of the I/O devices on your system:
K = Reader
L = Printer
M = Plotter

Figure 4. Plotter Test 4 Listing (Part 1 of 2)

```
VARIABLE ALLOCATIONS
    IA(I )=002E-0000     IB(I )=002E-000B     IC(I )=002E-0025     ID(I )=0024-000B     PI(R )=002E          T(R )=0030
   DEL(R )=0032           K(I )=0038           L(I )=0039           M(I )=003A           I(I )=003B

STATEMENT ALLOCATIONS
 1     =0067  2     =006C  3     =00AB  4     =00B0  5     =00CF  6     =00D2  7     =00EF  8     =010D  1234 =0132  40    =0900

FEATURES SUPPORTED
 ONE WORD INTEGERS
 IOCS
CALLED SUBPROGRAMS
 FCHAR    FCOS     FSIN     FMPY     FDIV     FLD      FSTO     CARDZ    PRNTZ    WCHRI    SRED     SWRT     SCOMP    SFIO     SIOSI
 SIOIX    SUBSC

REAL CONSTANTS
   .314159E 01=003E     .000000E 00=0040     .200000E 00=0042     .300000E 00=0044     .270000E 00=0046     .370000E 00=00=8
   .750000E 00=004A     .250000E 00=004C     .150000E 00=004E     .400000E 01=0050     .120000E 01=0052     .200000E 01=00$4
   .180000E 02=0056     .150000E 01=0058     .575000E 01=005A     .100000E 01=005C     .790000E 01=005E     .100000E 00=00.0

INTEGER CONSTANTS
      2=0062       3=0063       7=0064       1=0065      36=0066

CORE REQUIREMENTS FOR
 COMMON       0  VARIABLES     62  PROGRAM    482

 END OF COMPILATION



// XEQ

PL004
THIS IS A TEST OF THE CHARACTER ROUTINE
TEST IS IN 5 PARTS

PART 1 - PLOT THE FOLLOWING CHARACTERS .2 IN SIZE
 123456789ABCDEFGHIJKLMNOPQRSTUVWXYZ'=+.*/()$=,


PART 2 - PLOT CHARACTERS A-Z .27W BY .37H HORIZONTAL


PART 3 - PLOT CHARACTERS A-Z .25W BY .15H ON A 45


PART 4 - PLOT CHARACTERS 0-9 .15W BY .25H VERTICAL


PART 5 - PLOT CHARACTERS 0-9,A-Z .15 BY .15 ON A 3 INCH CIRCLE


END OF TEST
```

Insert data card following the object deck in the Card/Paper Tape system; following the // XEQ Card in Monitor system. The data card is shown under Part 1 (12345...) with the entries starting in column 1 (no embedded blanks). This data card will cause Figure 5 to be produced by the plotter.

Figure 4. Plotter Test 4 Listing (Part 2 of 2)

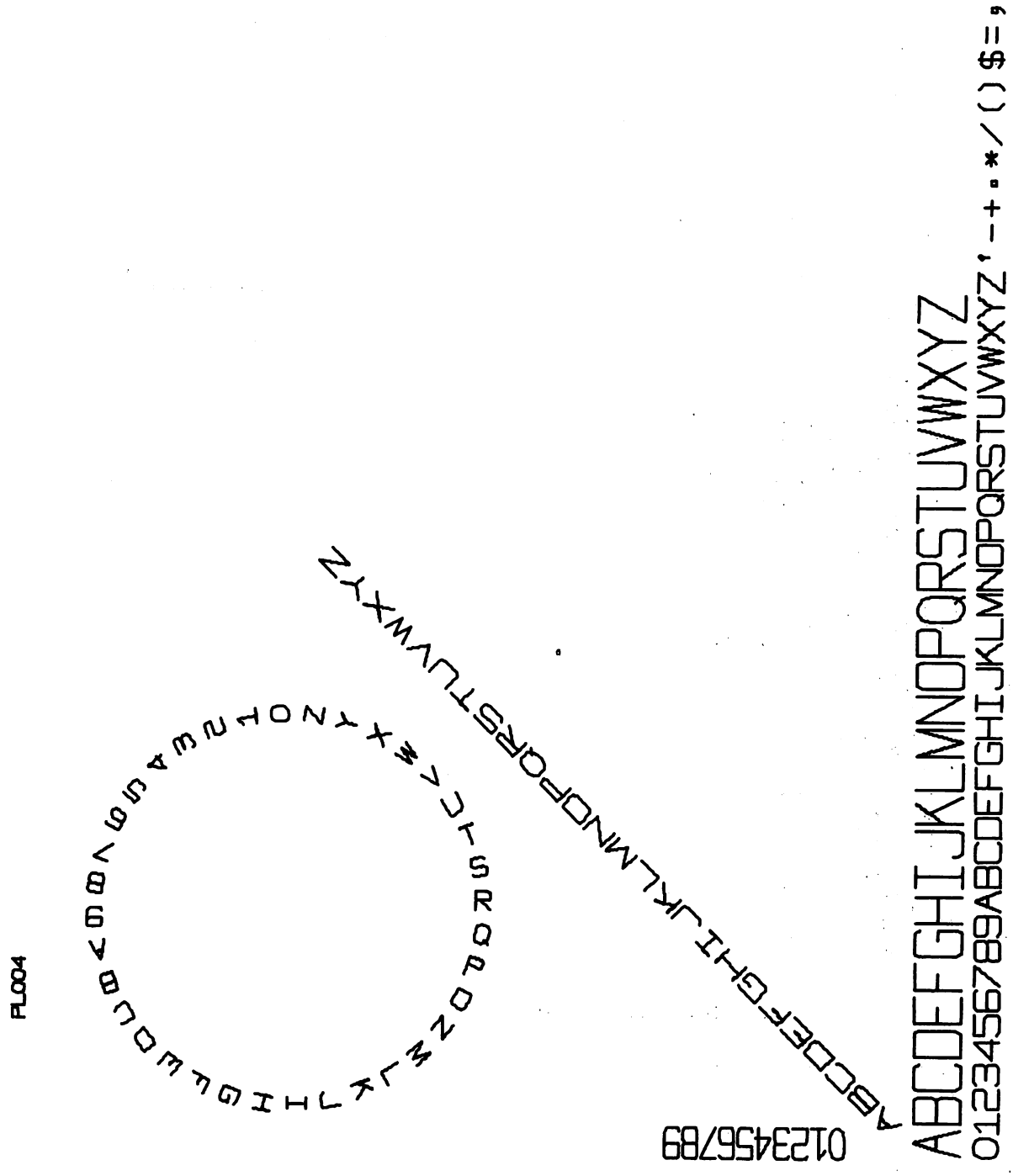


Figure 5. Plotter Test 4 Drawing (reduced approximately 23 percent)

```
// JOB
// FOR
**PLOTTER TEST 5
*NAME PL005
*LIST ALL
*ONE WORD INTEGERS
*IOCS ( 1132 PRINTER, PLOTTER )



1     FORMAT(' PL005')
3     FORMAT(' Y = SIN(2.*X) + COS(3.*X), X = -2.*PI, 2.*PI')
4     FORMAT(F7.4)
5     FORMAT(F7.3)
      L=3
      M=7
      WRITE(L,1)
      WRITE(L,3)
      PI = 3.14159
      SX = 14./(4.*PI)
      SY = 7./4.
      DY = .25
      PX = -2.1*PI
      PY = -2.1
      CALL FPLOT(2,0.,0.)
      CALL SCALF(SX,SY,PX,PY)
      CALL FGRID(0,0.,0.,PI/4.,8)
      CALL FGRID(2,0.,0.,PI/4.,8)
      CALL FGRID(1,0.,0.,DY,8)
      CALL FGRID(3,0.,0.,DY,8)
      T = 3.*PI/2.
      XD = .050/SX
      X  = -2.*PI
      Y  = -.05
      DEL = PI/4.
      EP  = .001
      DO 10 I = 1,17
      IF(ABS(X) - EP)9,9,7
7     CALL FCHAR(X-XD,Y,.10,.10,T)
      WRITE(M,4)X
9     X = X + DEL
10    CONTINUE
      T = 0.
      Y = -2.
      X = -0.770/SX
      DEL = DY
      XD = .05/SY
      DO 20 I = 1,17
      IF(ABS(Y) - EP)19,11,11
11    CALL FCHAR(X,Y-XD,.10,.10,T)
      WRITE(M,5)Y
19    Y = Y + DEL
20    CONTINUE
      X = -2.*PI
      CALL FPLOT(-2,X,SIN(2.*X)+COS(3.*X))
      DEL = PI/225.
      TEST = 2.*PI
30    Y = SIN(2.*X)+COS(3.*X)
      CALL FPLOT(0,X,Y)
      IF(TEST-X)50,50,40
40    X= X + DEL
      GO TO 30
50    CALL FCHAR(-22.*.11/SX,-2.-.40/SY,.11,.16,0.)
      WRITE(M,3)
      CALL FPLOT(-2,PX,PY)
      CALL FCHAR(-1.9*PI,-2.15,.1,.1,0.)
      WRITE(M,1)
      WRITE(L,1234)
      CALL EXIT

                    PLOTTER TEST 5

1234  FORMAT(//' END OF TEST'//)
C
C     PLACE PLOTTER IN LOWER RIGHT CORNER OF IMAGINARY
C     7 X 14 INCH RECTANGLE  (7 = Y)
C
      END
VARIABLE ALLOCATIONS
    PI(R )=0000        SX(R )=0002        SY(R )=0004        DY(R )=0006        PX(R )=0008        PY(R )=000A
     T(R )=000C        XD(R )=000E         X(R )=0010         Y(R )=0012       DEL(R )=0014        EP(R )=0016
  TEST(R )=0018         L(I )=0024         M(I )=0025         I(I )=0026

STATEMENT ALLOCATIONS
 1    =0057  3    =005C  4    =0075  5    =0077  1234 =0079  7    =0131  9    =0144  10   =014A  11   =0179  19   =088C
 20   =0192  30   =01D0  40   =01F4  50   =01FC
```

Cartridge status information will appear following // JOB Card on Monitor 2.

Set the values of L and M to the Logical Unit Numbers of the I/O devices on your system:
L = Printer
M = Plotter

Figure 6. Plotter Test 5 Listing (Part 1 of 2)

```
FEATURES SUPPORTED
 ONE WORD INTEGERS
 IOCS

CALLED SUBPROGRAMS
 FPLOT   SCALF   FGRID   FABS    FCHAR   FSIN    FCOS    FSUB    FMPY    FDIV    FLD     FSTO    FSBR    FDVR    PRN5Z
 WCHRI   SWRT    SCOMP   SFIO    SIOF    SNR

REAL CONSTANTS
  .314159E 01=0028    .140000E 02=002A    .400000E 01=002C    .700000E 01=002E    .250000E 00=0030    .210000E 01=0002
  .000000E 00=0034    .300000E 01=0036    .200000E 01=0038    .500000E-01=003A    .100000E-02=003C    .100000E 00=000E
  .770000E 00=0040    .225000E 03=0042    .220000E 02=0044    .110000E 00=0046    .400000E 00=0048    .160000E 00=00=A
  .190000E 01=004C    .215000E 01=004E

INTEGER CONSTANTS
     3=0050      7=0051      2=0052      0=0053      8=0054      1=0055     17=0056

CORE REQUIREMENTS FOR PL005
 COMMON       0  VARIABLES     40  PROGRAM     540

 END OF COMPILATION

// XEQ

PL005
Y = SIN(2.*X) + COS(3.*X), X = -2.*PI, 2.*PI


END OF TEST
```

Figure 6. Plotter Test 5 Listing (Part 2 of 2)

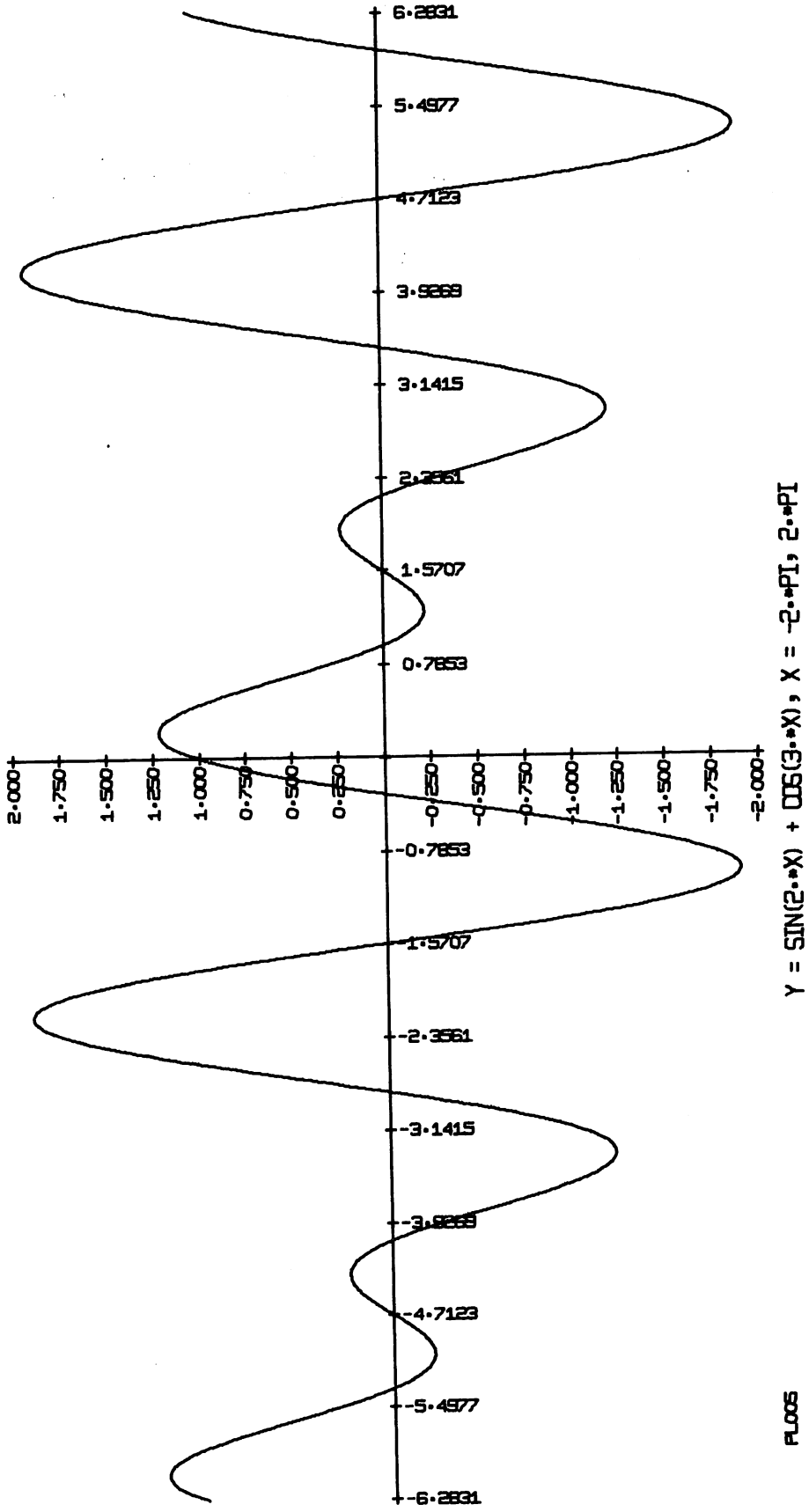


Figure 7. Plotter Test 5 Drawing (reduced approximately 37 percent)

```
// JOB
// FOR
*IOCS(PLOTTER)
*LIST ALL
      CALL FGRID (1,0,0,.5,6)
      X = 0.0
      Y = 0.0
      DO 2 I = 1,6
C
C     THIS PROGRAM DRAWS THE POINT CHARACTERS
C     PLACE PLOTTER ON RIGHT SIDE OF PAPER
C     THE PEN IS NOT RAISED AT THE END OF THE TEST
C
C     SPACE FIGURES ONE HALF INCH APART
C
      Y = Y + 0.5
C
C     LIFT PEN AND GO TO NEW LOCATION
C
      CALL FPLOT (1,X,Y)
C
C     DROP PEN
C
      CALL FPLOT (2,X,Y)
C
C     DRAW FIGURE
C
      CALL POINT (I-1)
C
C     LOOP
C
2     CONTINUE
      STOP
      END
VARIABLE ALLOCATIONS
     X(R )=0000          Y(R )=0002          I(I )=0006

STATEMENT ALLOCATIONS
 2    =0059

FEATURES SUPPORTED
 IOCS

CALLED SUBPROGRAMS
 FGRID   FPLOT   POINT   FLD     FSTO    WCHRI   SFIO    STOP

REAL CONSTANTS
  .500000E 00=0008    .000000E 00=000A

INTEGER CONSTANTS
     1=000C      0=000D      6=000E      2=000F      0=0010

CORE REQUIREMENTS FOR
 COMMON      0  VARIABLES      8  PROGRAM      92
END OF COMPILATION

// XEQ
```

Cartridge status information will appear following // JOB Card on Monitor 2.

Figure 8. Special Point Character Listing

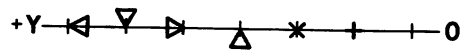


Figure 9. Special Point Character Drawing
(Actual Size 0.10 inch per character)

INDEX

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