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**BROOKHAVEN NATIONAL LABORATORY
COMPUTER USER'S GUIDE**

**INTRODUCTION
TO
GRAPHICS AT THE CSCF**

THOMAS S. CLIFFORD

**CENTRAL SCIENTIFIC COMPUTING FACILITY
APPLIED MATHEMATICS DEPARTMENT**

**BROOKHAVEN NATIONAL LABORATORY
ASSOCIATED UNIVERSITIES, INC.**

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INTRODUCTION TO GRAPHICS OF THE CSCF

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CHAPTER 1

INTRODUCTION

In some future computer environment graphical output will be as much an integral part of the system as alphanumeric print output is for today's systems, and plots will be generated as easily as printer output is today. Until these future systems arrive and a plotting language becomes standard, those who choose to do graphics will deal explicitly with a variety of graphic output devices and different plotting languages. There are a several types of plotting devices available to the users of Brookhaven National Laboratory's Central Scientific Computing Facility and three plotting languages which interface to FORTRAN. The purpose of this Introduction is to briefly describe the available devices and languages as well as give some basic advice on their use.

1.1 ORGANIZATION OF THE DOCUMENT

The purpose of this document is to indicate what graphic options are available to the general user community. The details of how to run a particular job can be found in section 4000 of the USERQA file, which is a file containing examples of sample jobs which are intended to show a user how to run a particular job. An index to the sample jobs which deal with graphics is reproduced here in Appendix A along with directions on how to obtain a listing of the sample jobs.

As the reader of this Introduction will discover, an effort has been made to make the graphics software "device independent" so that the decision of which plotting device should be used for a particular plot need be made only at run time. The characteristics of the plotting devices are covered in Chapter 2 to give the user a basis for deciding which plotter is best for a specific plot.

The choice of which plotting language to use is much more fundamental than the choice of plotter. The plotting languages are very much different from each other and it is not all that easy to convert from one to another. Some investment of time is required to become familiar with a graphics language and some aspects of plotting are accomplished with more or less effort by a particular language. The features of the supported languages, CALCOMP, DISSPLA, and Advanced Graphing II, are summarized in Section 3 and some guidelines are offered as to which to use for particular applications.

Chapters 2 and 3 are meant to be read once to get a good summary of the CSCF graphics capabilities in order to make the proper decision on how to best make use of these facilities.

Chapter 4, on the driver libraries, is a reference manual for these libraries. The initialization routines for each device are described and other user callable routines on each library are documented in Chapter 4.

Finally, some programs of special interest to graphics users are covered in Chapter 5 of this Introduction.

1.2 OVERVIEW

The following diagrams show in a graphical fashion, the graphics hardware and software and the connection between the two. To find the details of how to run a job using a particular language linked to a device the USERQA file should be consulted.

Figure 1.1. DISSPLA language.

Figure 1.2. CALCOMP language.

Figure 1.3. Advanced graphing 2.

1.3 CSCF GRAPHICS BIBLIOGRAPHY

The following section lists the documents available in the CSCF Library which pertain to the graphics hardware and software in use at the CSCF. With the exception of the manuals indicated "Reference Only" the documents listed below can be purchased from the library.

1. COMP80/FR80 USER MANUAL, Information International Inc., Pub. No. 90367A, 1976, (Reference Only).
2. PLOT 10 TERMINAL CONTROL SYSTEM USERS MANUAL, Tektronix Inc., Pub. No. 062-1474-00, 1976.
3. PLOT 10 ADVANCED GRAPHING II USERS MANUAL, Tektronix Inc., Pub. No. 062-1530-00, 1975.
4. 4006-1 COMPUTER DISPLAY TERMINAL USERS INSTRUCTION MANUAL, Tektronix Inc., Pub. No. 070-1891-00, 1975. (Reference Only).
5. 4010 and 4014-1 USER MANUAL, Tektronix Inc., Pub. No. 070-1225-00, (Reference Only).
6. TERMINAL CONTROL SYSTEM USERS REFERENCE CARD, Tektronix Inc., Pub. No. 070-1869-00, 1976.
7. 835 PLOTTING SYSTEM, edited by M. Hind, Brookhaven National Laboratory, BNL-14680, 1968, (Obsolete, Reference Only).
8. BROOKHAVEN NATIONAL LABORATORY COMPUTER USER'S GUIDE CALCOMP LANGUAGE REFERENCE MANUAL, edited by R. G. Wittlock, Brookhaven National Laboratory, BNL 23 , 1977.
9. DISSPLA BEGINNERS/INTERMEDIATE MANUAL, Integrated Software Systems Corp., 1975.
10. DISSPLA ADVANCED MANUAL, Integrated Software Systems Corp., 1975.
11. DISSPOP USER MANUAL, Integrated Software Systems Corp., 1976.
12. DISSPLA POCKET MANUAL, Integrated Software System Corp., 1976.

CHAPTER 2

PLOTTING DEVICES

Each plotting device has its own set of characteristics which determine the type and quality of a plot which can be produced. The basic characteristics of a plotter are: number of raster points, resolution, plot size and output medium. Digital plotters have points on the plotter which can be addressed as the starting point or end point of a vector; these points are called raster points. A vector plotter draws a vector, light (DRAW) or dark (MOVE) directly from one point to another; on incremental (step) plotter approximates a vector by moving in steps to the raster points which lie among the vector to be drawn. To indicate the resolution of a plotter we indicate how close two parallel lines can be drawn to each other and still be seen as two distinct lines. Some plotters have more features than the basic DRAW and MOVE commands which every plotter must have. Two common features are variable intensity; able to draw vectors at different intensity and hardware character generation; able to generate alphanumeric characters without drawing them.

The choice as to which device to use to display a particular plot is influenced by the above characteristics as well as availability, turn around and cost. This section on plotting devices gives the details of each device available for use in connection with the CSCF and offers some advice on their use.

2.1 LINE PRINTERS

The ordinary line printer or interactive terminal tty like printer is often useful as a graphic output device. Resolution is 0.1 inch in the horizontal direction for 13.6 inches and .16 inches in the vertical direction for line printers. A printer does, of course, have a character generator, is as available as the nearest RJE station and involves no additional turnaround time for viewing results. The line printer as a plotting device is useful for debug and in some cases can produce plots of sufficient quality to serve as the final plots.

2.2 CALCOMP 835 PLOTTING SYSTEM

The CALCOMP 835 Plotting System, circa 1967, consists of a Calcomp Model 835 Electronic Plotter, a Model 565 Electromechanical (Drum) plotter and Model 780 Magnetic Tape Unit. The plotters are run only off line through the 780 tape unit which reads labeled or unlabeled 7 track magnetic tape supplied by the user written in binary mode at 556 bpi. The same magnetic tape can be used to drive either the film or paper plotter.

There is no charge for use of the 835. The 35 mm film from the electronic plotter is developed twice a day or upon request. Normal turn around for paper plots is about 6 hours.

2.2.1 PAPER PLOTTER

The 565 drum plotter plots in steps of 0.01 inches on paper 11.0 inches wide (y direction) and unbounded in the x direction. The pens in use are ball point pens which draw lines about 0.01 inches wide. Lines drawn at 0 , 45 , 90 do not show the 0.01" step size all other lines do, giving a rather shakey appearance to most lines. Parallel lines drawn 0.02" apart are not resolved, those drawn 0.03" apart are resolved.

The following chart paper is available for the 565 plotter:

- 00 blank
- 01 linear, 10 lines per inch
- 02 linear, 20 lines per inch
- 20 semi-log, 2 cycles
- 30 semi-log, 3 cycles
- 40 semi-log, 4 cycles

The paper plots do not copy very well because of the thin pen line which is not really dark. The copies are hardly suitable for distribution.

2.2.2 35MM FILM PLOTTER

The normal plotting area for the 35mm plotter is 0.733 inches (y direction) by 1.133 inches which gives a plotting area of 11" x 17" with a 15x enlargement. The 1100 x 1700 raster points of the Cathode Ray Tube (CRT) give a step size of 0.01" for the enlarged plot which is the same as the paper plots. In order for parallel lines to be resolved they must be at least 3 raster points apart at normal intensity - thus they should be at least 0.03" apart. The CRT in the plotter has 32 intensity levels. It is possible to plot a little outside of the .733" x 1.133" area by using special software. Such use of this plotter is not advised.

The 35mm film can be viewed on the viewer in the CSCF Ready Room. The Photography Department can mount the film into the standard 2" x 2" slide mount which leaves the full .733" x 1.133" appature exposed in the .8" x 1.3" slide appature.

Glossy prints can be made from the 35mm film which can be copied for most distribution but they are not quite of publication quality.

2.3 III FR-80 FILM RECORDER

The III (Information International Inc.) FR80 operates off line, with input on 9 track 3200 fci or 800 bpi 1/2 inch magnetic tape. Files can be queued to be dumped to the FR80 tape by using IDCARD which is described in Chapter

5. The FR80 control unit is an 18 bit 16K mini computer which is programmable. The display is a precision Cathode Ray Tube with 16K by 16K raster points and 256 levels of intensity with 8 different spot sizes (line width). Besides operating in vector (plotting) mode the FR80 has a character generator able to generate characters in any of 64 different sizes at eight different rotations. There are also hardware commands to draw arcs, dashed lines and to define and call up subpictures. There is currently no charge for FR80 use. Turnaround is about three hours from the time the plot is dumped to tape.

2.3.1 48X 105MM MICROFICHE CAMERA

The 105mm fiche camera is used in connection with alphanumeric Computer Output Microfilm (COM) and is also very useful for some plotting. Figure 2-1 shows the full plotting area for the fiche camera as well as the suggested plotting area. The suggested plotting area shown in Figure 2-1 is 13.5 inches in x direction, 10.6 inches in y direction using a scale factor of 1000 points per enlarged (48x) inch. Using the suggested area will provide space between each plot but if you try to use the full plotting area, plots will run into each other on the fiche.

There are 45470 raster points per inch on the 105mm microfiche film which gives 950 points per enlarged inch at 48x magnification. Parallel lines drawn as close together as 20 raster points are easily resolved on a 48x projection when drawn with the smallest spot size. The film used gives a wide range of intensity starting at intensity level 150. Intensity below 150 gives no image.

Because each fiche has space for 252 plots, fiche is useful for storage of plots as well as viewing individual plots. Fiche cannot be used as negatives for photographic enlargement. Microfiche reader/printers are available for making low quality hard copy from fiche. There is a reader/printer as in the User Service Consultants office in the Ready Room which is available for general use.

2.3.2 HIGH RESOLUTION UNSPROCKETED 35MM CAMERA

The 35mm unsprocketed camera is recommended for plots which will be mounted as slides or used as a negative for making photographic prints. Figure 2-2 shows the plotting area for this camera in both inches on the film itself and raster points. Using a scale factor of 1000 points per inch plots can be 15.0" x 12.4". The aperture for the normal 2" x 2" slides is 1.3" x 0.9" so a plot to be used for a 2" x 2" slide can not use the full plotting area on the film.

There are 11442 raster points per inch on the 35mm film. At 15 x enlargement this is 762 points per enlarged inch. Parallel lines must be more than 20 raster points apart in order to be resolved on a 15x blow up. The film used gives a wide range of intensity using the 256 intensity levels of the FR80. Plots of publication quality can be produced from the 35mm film either by

Figure 2.1. Plot size for 48x microfiche film.
Units are in raster points.

Figure 2.2. Plot size for 35mm unsprocketed film.
Units in inches and raster points.

having photographic enlargements made or by producing offset plates directly from the negative.

2.4 TEKTRONIX DISPLAY TERMINALS

The only interactive graphics capability is currently supplied by the Tektronix 4000 series display terminals running as INTERCOM terminals. Graphics is supported for terminals running in either asynchronous mode or synchronous 200 UT protocol. Speeds are 110, 300 and 1200 baud (asynchronous) or 4800 baud synchronous. The 4006, 4010, and 4012 have a screen size of 7.5" by 5.6" with 1024 x 780 raster points which gives about 135 points/inch, a point size of .007". Parallel lines must be drawn at least 3 points, 0.02", apart to be distinguished as two lines. (The 4006 which has no graphic input is the lowest priced of the display terminals and sells for about \$3000.00.)

The 4014 has a screen size of 15.0" x 11" and can have 4096 x 3120 raster points or about 270 points per inch (point size of .0035"). As expected two parallel lines can be distinguished to a distance of about .01" apart.

All the 4000-series displays have hardware characters, the 4015 has two sizes. Hard copy units are available for most of the 4000 series displays.

The 4014 has hardware dashed lines as well as crude intensity control.

A 4010 with a hard copy unit is available for general use in the Consulting Office off the ready room in Building 515.

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CHAPTER 3

PLOTTING LANGUAGES

The term "plotting language" refers to a collection of FORTRAN callable routines which can be used to help draw a plot. The routines may range from the basic MOVE, or DRAW type routines to routines to draw axes or grids, to scaling or even data smoothing routines. Many routines in a plotting language need not interface with a plotting device in any way while other routines, especially the basic ones need to interface with the plotting device.

The implementation of a language can be device independent, that is, it can produce plots on different devices. The best implementation of a language is a device independent one but at the same time a "device smart" one. This means that the language implementation is such that it is able to take advantage of different features of hardware plots. A device dumb implementation of a language treats all plot devices the same.

3.1 CALCOMP LANGUAGE

The CALCOMP language supported by the CSCF is much more than the basic CALCOMP routines provided by the Calcomp Corp. The basic CALCOMP routines are provided as well as the Scientific, General, Business and Drafting packages. This proprietary software is augmented by some very useful locally written routines to do such tasks as 3D plots, contour maps and shading.

Some of the features of the CALCOMP language are:

- Self scaling plots
- Month or user labeled axes
- Smoothing
- 3D hidden line surfaces
- 3D perspective
- Bar charts
- Shading

The language is useful for obtaining a variety of graphical output on any of the graphic devices mentioned in Chapter 2.

An extremely readable document, the BNL CALCOMP LANGUAGE REFERENCE MANUAL documents, with examples, all the CALCOMP languages routines supported by the CSCF. Because the implementation of CALCOMP is done locally, the package is

device smart and is able to take advantage of the features of different plotters.

Most computer centers with plotting devices support the basic CALCOMP routines. Source code for locally written routines can be obtained by contacting the Consultant.

The CALCOMP language is a collection of somewhat independent routines and a plot is built up by making calls to the individual routines. There is little or no communication between routines.

3.2 DISSPLA LANGUAGE

The DISSPLA Language is a plotting language developed by the Integrated Software Systems Corp., which is useful for creating plots and maps on all the devices mentioned in Section 2. The documentation for DISSPLA consists of BEGINNERS/INTERMEDIATE MANUAL and a ADVANCED MANUAL (ref. 9 & 10).

DISSPLA has many features which allow the user to produce very fancy plots. These features include:

- Self-Scaling Linear, Log-Log, Log-Linear, Polar plots

- Month or user labeled axis

- Pie and bar charts

- Curve interpolation and smoothing

- Shading, cross hatching, blocking

- 8 Alphabets in 7 styles

- Typesetting

- Map projections and Map data files

- 3D hidden line surfaces

- 3D perspective projections

While many of the DOE labs have the DISSPLA language it is not as universally used as the basic CALCOMP Language routines so some caution is recommended in its use in code which is to be used elsewhere. DISSPLA users find the package takes a great deal of core for most jobs.

The DISSPLA language is device dumb and knows nothing of the plotting device except the available plotting area.

The DISSPLA package is a true package with routines interacting with one another. Sometimes it is not easy to override some of the defaults of plot size or some other feature to get exactly the plot you want.

3.3 ADVANCED GRAPHING II LANGUAGE

The Advanced Graphing II Language, a proprietary software package of Tektronix Inc., is designed to provide the terminal user with a comprehensive capability to depict his data in the form of a graph. The software is supported only for Tektronix terminals. The language is comprehensive and provides a number of features among which are:

- Bar charts

- Scaling, Linear and Log

- Business type axes

- Shading

- Grid line generation

- Axis with optional tic mark placement

Documentation for Advanced Graphing can be found in Advanced Graphing II User Manual and TSC User Manual.

AG2, through the Terminal Control System, (TCS) provides for graphic input from the graphic terminals.

The main drawback to using AG2 is that it is tied to the Tektronix displays - it is not device independent.

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CHAPTER 4

DRIVER LIBRARIES

The routines which translate the basic plotting commands such as MOVE, DRAW, and NEW PAGE into instructions for a particular plotting device are referred to as driver routine and reside on driver libraries. There is a driver library for each plotting device supported by the CSCF. The choice of which plotting device to use is made by linking a Fortran program to a particular driver library.

4.1 PLOTDVC

The various plotting devices and the driver routines must be initialized before they are used for the first time. The subroutine PLOTDVC-PLOT De-vice- which is called to perform the initialization is described in this section. PLOTDVC should be the first plot routine called in any program which is to do plotting. As the reader will discover, PLOTDVC has one argument for each device which enables the user to set up one call to PLOTDVC which will cover all the plotting devices.

```
CALL PLOTDVC (INUNIT, OUTUNIT, C835, ITEK, FR80, PRINT)
```

Where

INUNIT is the integer tape number, or file name in nL format, of the graphic input file. The graphic input unit only applies to graphic devices which have graphic input capability which, on the current system on the Tektronix terminals. The INUNIT parameter is not used by the passive graphic devices. Default for Tektronix is TAPE98.

OUTUNIT is the integer tape number, or file name in nL format, of the plot file. The default unit is TAPE99.

C835 is an one dimensional integer array

- C835(1) user name in 10H format. Default is the job name.
- C835(2) plot identifier in 10H format. Default is NO NAME.

ITEK is a one dimensional integer array

- ITEK(1) is baud rate for terminal in characters per second.
- ITEK(2) is terminal type 1 for 4006, 4010, 4012
4 for 4014
- ITEK(3) is character size (4014 only)
- ITEK(4) is screen size 1024 for 4006, 4010, 4012
4096 for 4014.

The default values for ITEK depend on the TEKLIB used.

	<u>Asynchronous</u>	<u>Synchronous</u>
ITEK(1)	120	zero
ITEK(2)	1	1
ITEK(3)	1	1
ITEK(4)	1024	4096

FR80 is a one dimensional integer array

FR80(1) is camera number 0 for any camera
1 for 35mm camera
2 for 105mm 48x fiche camera

Default for camera is zero.

FR80(2) is CINE/COMIC mode- 1 cine
0 comic

Default for mode is zero, comic mode.

PRINT is not used.

The Hollerith strings in C835(1) and C835(2) are used to produce a title frame for plot identification.

Comic (from comic strip) mode means the x direction is along the length of the film for both 35mm and 105mm film. In the cine (cinema or movie) mode the coordinate system is rotated 90°. See Fig. 4-1.

PLOTDVC supplies the default values indicated above if it is called with the argument "DEFAULT" in place of an argument or if it is called with fewer arguments than would be needed to specify the argument for a particular device.

Call PLOTDVC ("DEFAULT")

will supply defaults for all arguments for all devices.

Call PLOTDVC ("DEFAULT", 20)

will make the plot file TAPE20, all other arguments default. If the user wishes to specify the values for one device and use the default values for other devices the Hollerith string "DEFAULT" can be used as an argument. The following example of a call to PLOTDVC uses defaults for all devices except the FR80 plotter because the arguments for the other devices are "DEFAULT."

I(1) = 0

I(2) = 1

CALL PLOTDVC(D,"DEFAULT","DEFAULT", "DEFAULT", I)

FORTRAN does not allow a "null" parameter so the string "DEFAULT" is a placeholder in the argument list. In the example D can have any value as it is not used by the FR80, a passive graphics device.

The labeled common /BNLPL2/ has one integer variable DEVICE which is set as follows:

PRINTLIB	DEVICE =	10
FR80LIB	DEVICE =	20 + camera number
LIB835	DEVICE =	30
TEKLIBS	DEVICE =	40 synchronous
TEKLIBA	DEVICE =	45 asynchronous
FILELIB	DEVICE =	50

A user program can test this variable to determine to which library the program has been linked.

Figure 4-1. COMIC and CINE.

4.2 LIB835

LIB835 is the driver library for the CALCOMP 835 plotting system.

There is one user callable routine, CALCMP on LIB835 which is described below. As most of the functions of the CALCMP calls can be done with other subroutines it is strongly recommended you do not call CALCMP directly but rather use the CALCOMP language routines. Once you start using CALCMP directly your code is no longer device independent.

4.2.1 CALCMP(X,Y, IZ, IP)

CALCMP is used to move the beam or pen to a new location, to write the plot file and to adjust or return the values of certain parameters which control intensity, origin, pen delays, point plotting, and limit switches.

CALCMP has four parameters; the last parameter, IP, is used to specify the type of entry. Currently it may take on values from -8 to +8. The primary function of each entry is listed below.

Entry Point (IP)	Function
1	Move to a point at a specified intensity.
-1	Return the value of the current beam position and intensity.
2	Generate a block number and advance film.
-2	Return the value of last block generated.
3	Set X,Y origin and Z (intensity) origin.
-3	Return the current values of X,Y and Z origins.
4	Set scaling values for X and Y coordinates.
-4	Return values of current scaling factors.
5	Plot a single point at a specified intensity
-5	Not used.
6	Plot outside the normal 17" x 11" area.
-6	Not used.
7	Set a "standard" intensity level.
-7	Return the current value of the "standard" intensity.
8	Set the number of codes outputted for pen up pen down delay
-8	Return the current value of the pen up and pen down delays.

IP = 1

This entry generates a movement to a point at a specified intensity. It corresponds to the routine PLOT.

CALL CALCMP(X,Y,IZ,1)

where

(X,Y) are the coordinates to which the beam or pen will be moved.

IZ is the intensity level indicator

IZ = 0	specifies beam off
IZ = 1,30	specifies the desired intensity
IZ = 99	specifies the standard intensity IZSET.

If a positive (non-zero) beam intensity is specified, the beam intensity is modified by a value IZORG: $IZTRUE = IPEN + IZORG$

where

IPEN is the intensity specified by IZ

IZORG is a positive or negative intensity level offset; initially = 0.

If IZTRUE is zero or negative the beam will be turned off. If IZTRUE=1,30 it is the intensity level used and the beam is turned on.

The movement is made in a straight line approximation from the current beam (or pen) position to (X,Y). The location of the point (X,Y) in deflection from the true origin is given by

$XABSC = X * XFACT + XORG$
 $YORD = Y * YFACT + YORG$

where

(XORG,YORG) is the translated origin; initially (.5, .5)

XFACT and YFACT are scaling factors for abscissa and ordinate values, respectively, initially = 1.0. XORG,YORG, and IZORG may be redefined by using IP=3. XFACT and YFACT may be redefined by using IP=4.

IP = -1

This entry is used to return the floating point values of the current pen location.

CALL CALCMP(XWHERE,YWHERE,IZWHAT,-1)

where

(XWHERE, YWHERE) are the coordinates of the current beam location.

IZWHAT is the current intensity level.

IP = 2

This entry is used to generate block numbers. A block number may be thought of as a plot record separator which may have a value from 0 to 999. By appropriate use of block numbers, any portion of the plot tape may be isolated for selective plotting. A block number with a value of 999 is generally used to indicate the physical end of plotting information on the tape.

CALL CALCMP(XNEW,YNEW,IBLOCK,2)

where

(XNEW,YNEW) is the coordinate to which the beam will be moved.

IBLOCK is a four digit decimal number with a value from 0 to 9999. The three least significant digits specify the block number to be written. If these least significant digits equal zero, the next sequential block number is written. If non-zero, a block number equal to those digits will be written. The most significant digit is used to control film advance and to close the output file. If the most significant digit is zero, the film will be advanced. If it is 1, the film will not be advanced. If it is 9, the output tape file will be closed.

A block number may be written with or without advancing the film. If the film is advanced, the new origin is in the lower left-hand corner of the plotting area. A move to (XNEW, YNEW) will always be made whether or not the film is advanced. The beam will always be turned off when the move is made. This entry corresponds to the routine PLOT with -3 as the last argument.

IP = -2

This routine is used to return the value of the last block number generated.

CALL CALCMP(XDUM,YDUM,IBLOCK, -2)

XDUM and YDUM are not used at this time.

IBLOCK is the location where the current block number is returned.

IP = 3

This entry sets the internal values of XORG, YORG, and IZORG. It is used to establish a translated origin for subsequent movements. IZORG functions as

a beam intensity origin. These values are initialized at .5, .5, and 0, respectively. If any of these values are changed, all subsequent movements will be made with the specified translation until the values are redefined by another entry.

CALL CALCMP(XORG,YORG,IZORG,3)

(XORG,YORG) are the coordinates of the logical origin relative to the physical origin of the plotter.

IZORG is the value desired for translation of beam intensity.

IP = -3

This entry is used to return the current origin translation values.

CALL CALCMP(XORG,YORG,IZORG,-3)

where

(XORG,YORG) are the coordinates of the logical origin in inches, relative to the physical origin of the plotter.

IZORG is the translation value for beam intensity currently in effect.

IP = 4

The purpose of this entry is to set scaling values for the X and Y coordinates. Scaling of abscissa and ordinate values may be completely independent. XFACT and YFACT are both initialized with a value of 1.0. If they are changed by this entry, the new values remain in effect until this entry is used again. For XFACT = YFACT, this entry corresponds to the subroutine FACTOR.

CALL CALCMP(XFACT,YFACT,IDUM,4)

where

XFACT is the scaling factor for the abscissa.

YFACT is the scaling factor for the ordinate.

IDUM has no current use.

IP = -4

This entry returns the values of the scaling factors currently in use.

CALL CALCMP(XFACT,YFACT,IDUM,-4)

IP = 5

This entry moves the beam to the coordinates (XPOINT,YPOINT) with the beam off; and when the beam arrives at those coordinates, turns the beam on. This produces a point of intensity level IZ at the coordinates (XPOINT,YPOINT). (These coordinates are translated and scaled as described on page 4-4.)

CALL CALCMP(XPOINT,YPOINT,IZ,5)

where

(XPOINT,YPOINT) are the coordinates where the point will be produced.

IZ is the intensity level of the point. IZ may take on the same values as described in paragraph 1.4, Beam Intensity.

IP = 6

This entry is used to defeat the 835 limit switches and to plot outside the normal 17" x 11" area. Because of distortion outside the normal plot area, it should be used only for labeling or plotting which does not require the inherent accuracy of the system.

CALL CALCMP(XCHEAT,YCHEAT,IZ,6)

where

XCHEAT,YCHEAT are the coordinates to which the beam will be moved. They are scaled and translated as described on page 4-4.

IZ is the intensity level of the beam during movement.

IP = 7

This entry sets IZSET to any desired value, and is its only real function at this time.

CALL CALCMP(D1,D2,IZSET,7)

where

D1,D2 are not used

IZSET is a value to be placed in IZSET. This is the value of the intensity level to be used when a movement is made, and IZ = 99. IZSET is initialized at 16. If it is changed by this entry, the new setting will remain in effect until changed again.

IP = -7

This entry returns the values stored IZSET.

CALL CALCMP(D1,D2,IZSET,-7)

IP = .8

This entry is used to change the values of pen delays. The 835 CRT does not need pen delays, but this allows the output of the delays necessary for the mechanical plotter. IPENUP, IPENDN are initialized at 2 and 12 for beam/pen compatibility. If the mechanical plotter is not to be used, this entry should be used to reset IPENUP and IPENDN to 1. This can result in a very substantial time savings during a plot, depending on how frequently the beam is turned on and off.

CALL CALCMP(IPENUP,IPENDN,IDUM,8)

where

IPENUP is the number of consecutive codes outputted for pen-up delay.

IPENDN is the number of consecutive codes outputted for pen-down delay.

IDUM has no current use.

IP = -8

This entry returns the current values stored in IPENUP and IPENDN.

CALL CALCMP(IPENUP,IPENDN,IDUM,-8)

4.3 FR80LIB

FR80LIB is the driver library for the FR80 COM recorder. There are two user callable routines on FR80LIB; CALCMP and SETBUFF.

4.3.1 SUBROUTINE CALCMP(X,Y,IZ,IP)

This CALCMP is the similar to the one described in Section 4.1.1 with the following exceptions:

IP = 1 IZ = 0 specifies beam off
IZ > greater than zero specifies intensity IZSET + IZORG

IP = 2 advances film regardless of value of IBLOCK

IP = 6 does not apply, not implemented

IP = ± 8 does not apply, not implemented

4.3.2 SETBUFF(IC,IMODE)

The subroutine SETBUFF on FR80LIB gives the user the full range of FR80 commands as described in reference one.

CALL SETBUFF (IC, MODE)

where

MODE is 1, 2 or 3

MODE = 1 the buffer is zeroed and the output unit is set to IC.

MODE = 3 the 18 lower bits of IC are placed in the buffer to be written to the FR80 file. The buffer is written if filled.

MODE = 2 IC is not used. The buffer is written to a file.

Using MODE = 2 in SETBUFF the user can take advantage of the full range of the many FR80 hardware capabilities.

The SETBUFF calls are, of course, not device independent.

4.4 TEKLIB

There are two driver libraries for the 4000 series Tektronix display terminals - one for asynchronous connected terminals and one for synchronous connected terminals running 200-UT protocol. TEKLIBS is for synchronous connected terminals while TEKLIBA is for the asynchronous terminals. The routine CALCMP as described in Section 4.1.1 is on TEKLIB with the following differences.

IP = 2 calls OPTION routine which pauses waiting for input from the terminal

IP = ± 6 action does not apply

IP = ± 7 action does not apply

IP = ± 8 action does not apply.

Besides the basic output routines on TEKLIB all the Tektronix TCS (Terminal Control System) routines as described in reference two are available. Because the graphic languages do not support graphic input the TCS routines must be used for graphic input. Alphanumeric input from the terminal is best done with formatted read statements to a unit other than the I/O units specified in the call to PLOTDVC.

4.4.1 OPTION

The routine OPTION allows the user to interact with the plotting program before the first plot and between successive plots. The routine, after prompting with a bell, accepts input from a terminal in the form of commands or input parameters. The commands are CONTINUE, SKIP, REWIND, WINDOW, OVERLAY, BATCH, QUIT, and ?

4.4.1.1 CONTINUE

Enter CONTINUE or C and the screen is erased and the program continues.

4.4.1.2 SKIP

Enter SKIP or S and the program asks how many plots to skip. After entering the number to "skip" the plots will be skipped, i.e., not drawn on the screen and the next plot, if any, will be drawn.

4.4.1.3 REWIND

Enter REWIND or R and the program asks which unit number to rewind. This command is useful for rewinding a data file. It does nothing to rewind the plot file.

4.4.1.4 ?

Enter " ? " and the list of commands will be displayed.

4.4.1.5 WINDOW

The WINDOW command is used to scale the plot so that it fits into the viewing area (WINDOW) of the screen. The "window" of the plotting device is a fixed size and the user must decide where to place the window in the plot and how much of the plot will be seen in the window. Enter WINDOW or W and OPTION asks "WHERE WOULD YOU LIKE THE ORIGIN (X,Y)?" The input should be the location of the lower left-hand corner (the origin) of your window expressed in inches in the absolute coordinate system of the plot. After this input is echoed, OPTION prompts ENTER SIZE(WIDTH,HEIGHT)." The input here should be width and height in inches of the plot which will be seen thru the window. The more of the plot in the window (on the screen) the smaller the scale of the plot will be. The default values for the origin are (-0.5,-0.5) and the plot size is (11.0,8.5).

Fig. 4-2 and 4-3 indicate how the WINDOW command works. The plot is shown in the top part of each figure, while the lower section shows the plot as viewed thru a screen 11 units by 8.5 units.

In Fig. 4-2 the WINDOW ORIGIN is specified as (-4, -1) in the plot which positions the lower left hand corner of the screen. The size (22, 4.25) requires that 22" of the plot be visible in the 11" horizontal unit window and that 4.25" of the plot fit into the 8.5" vertical units of the screen. The

result is a plot reduced in the horizontal by 1/2 and stretched in the vertical by a factor of 2.

In Fig. 4-3 the size (11, 8.5) is the same as the screen size so no scaling takes place. The origin location of (1,0) positions the lower left hand corner of the screen.

4.4.1.6 MULTIPLE PLOTS

The MULTIPLE PLOTS option allows two or more plots to be plotted without erasing the screen. Enter M and the overlay option will be toggled. The default is to start with MULTIPLE PLOTS off. MULTIPLE PLOTS is best used from BATCH option described below in section 4.4.1.7.

4.4.1.7 BATCH

The BATCH option switches the input and output for OPTION to different files. The default file names for I/O are INPUT and OUTPUT. A BATCH or B command will switch to the file name BIN for input and BOUT for output. The files are not connected or rewound. Graphic output to the screen continues without any pause between plots for viewing. When the BATCH command is encountered on the BIN input file, the I/O file names become INPUT and OUTPUT and the user is again in interactive control of plotting in the OPTION routine.

4.4.1.8 QUIT

Enter QUIT or Q and the job ends.

4.4.1.9 EXAMPLE

The following example of commands on the file BIN will first draw two plots at the current window on top of one another then erase this plot and draw the next four plots in four different areas of the screen. The final B command returns control to the user via file INPUT. This last plot will remain on the screen.

WINDOW ORIGIN $(-4, -1)$
SIZE $(22, 4.25)$

Figure 4.2.

WINDOW ORIGIN $(1, 0)$
SIZE $(11, 8.5)$

Figure 4.3.

```

M      set multiple plots on
C      continue, do a plot
C      continue, do a plot
M      set multiple plot off, erase plot
M      set multiple plot on
W      set window
0,0
25,17
C      do plot
W      redo window
0,-8
25,17
C      do plot
W      redo window
-11,-8
25,17
C      do plot
W      reset window
-11,0
25,17
C      do plot
B      switch back to INPUT

```

4.5 PRINTLIB

PRINTLIB is a driver library for the line printer used as a graphic device.

4.5.1 PRINTLIB has on it the CALCOMP routine as described in Section 4.1.1 with the following exceptions.

IP = +6 action does not apply

IP = +7 action does not apply

IP = +8 action does not apply.

4.6 FILELIB

FILELIB is the driver library which will write an intermediate file which can then be processed by VIEWER to produce a plot on any of devices mentioned in Section 2. Like the other driver libraries, FILELIB is initialized with a call to PLOTDC.

FILELIB does support calls to CALCOMP by passing them along on the intermediate file.

CHAPTER 5

5.1 FRCOPY/FRCOPY8

The program FRCOPY copies files formatted in DISSPLAYER format for the FR80. The routine is useful for copying printer output to plot files so the plots and alphanumeric output will be on the same film (35mm or microfiche). FRCOPY is also useful for copying alphanumeric output for plotting on 35mm film for making prints, offset plates or slides.

The format for the control statement is:

FRCOPY(lfn1,lfn2,n,CINE,NOBOX,CHSZ=a,CHSP=b,LNSP=c,CHPL=d,LNPP=e)

The first three parameters are positional. If they are not specified, their position must be marked with commas. The order of the other parameters is unimportant.

lfn1	file copied from, default to TAPE1
lfn2	file to copy to, default to TAPE2
n	the number of partitions to copy, default 9999
CINE	the page will be in CINE mode if this parameter is used. Default is COMIC mode.
NOBOX	nobox is drawn around the page if this parameter is used. Default is to draw a box around the page.
CHSZ=a	a is the character size value for the FR80. Legal value of a is 0 to 63. Default is character size 19.
CHSP=b	b is the character spacing given in FR80 raster points. If b is zero or CHSP is not specified the default is used. Default is $12.6 + (CHSZ*4.2)$.
LNSP=c	c is the line spacing given in FR80 raster points. If c is zero or LNSP is not specified the default is used. Default is $LNSP = 5/3 * CHSP$.
CHPL=d	d is the number of characters per line. If d is zero or CHPL is not specified the default is used. Default is $CHPL = 13000/CHSP$. If a line is longer than the value of CHPL, the line is truncated.
LNPP=e	e is the number of lines per page. If e is zero or LNPP is not specified the default is used. Default is $LNPP = 10600/LNSP$.

a, b, c, d and e must be intergers.

The following table shows default values for some character sizes.

CHSZ	19	30	40	50	60
CHSP	92	138	180	222	264
LNSP	153	230	300	370	440
CHPL	141	94	72	58	49
LNPP	69	46	35	28	24

The program is available on MFZ as a permanent file. Two typical jobs using FRCOPY are given below and in USERQA:

```
JOB,STMFZ,TPO.  
ACCOUNT(yourname,1234)  
ATTACH(PP, ID=yours)  
IDCARD(TAPE12,name,address,title,PLFI)  
PP.  
COMMENT. PP DOES PLOTS to TAPE 12  
REWIND(OUTPUT)  
ATTACH(FRCOPY)  
FRCOPY(OUTPUT,TAPE12, ,NOBOX)
```

6/7/8/9

```
JOB,STMFZ,TPO.  
ACCOUNT(yourname,1234)  
ATTACH(FRCOPY)  
ATTACH(EDTFILE,ID=mime,ST=MFA)  
FILE(EDTFILE,RT=Z,FL=50)  
IDCARD(TAPE2,name,address,title,PL35)  
FRCOPY(EDTFILE, ,2,CINE,CHSZ=35)
```

6/7/8/9

The program FRCOPY8 will copy 8 in 12 ASCII files to a FR80 DISSPLAYER formatted file for plotting (printing) on the FR80. The format of the FRCOPY8 is the same as the FRCOPY format. A typical job using FRCOPY8 is given below and in USERQA.

```
JOB,STMFZ,TPO.  
ACCOUNT(yourname,1234)  
ATTACH(TEXT,ID=your,ST=MFA)  
FILE(TEXT,RT=Z,FL=300)  
COMMENT, FL must be 300  
ATTACH(FRCOPY8)  
IDCARD(OUT,name,address,title,PLFI)  
FRCOPY8(TEXT,OUT,2,NOBOX,CHSZ=38)
```

6/7/8/9

5.2 VIEWER

The VIEWER program is used to read the intermediate plot file written by a graphic program through the FILELIB drivers and then write a plot file for the off-line devices or draw a plot on the on-line devices. The program reads two files, the intermediate plot file and a directive file and writes two files, the plot file and a message file. The default file names are TAPE1 for intermediate plot file, TAPE99 for plot file, INPUT for the directives and OUTPUT for its messages. As shown in the sample jobs in USERQA, VIEWER must be linked to a driver library to work correctly.

5.2.1 VIEWER DIRECTIVES

There are seven different directives for the VIEWER program, CONTINUE, SKIP, REWIND, WINDOW, and OVERLAY, ZOOM and END. Each directive consists of two records; the first record of a directive must have the first letter of the directive in column one, the second record has the parameter values for the directive in free format.

When using VIEWER to view a plot on a Tektronix terminal the user does not have access to the VIEWER commands described below. The controls to scale plots, skip plots, rewind the intermediate plot file, and so on are provided for through the OPTION routine described in Section 4.4.1.

5.2.1.1 CONTINUE

The CONTINUE directive has one parameter, an integer, which indicates how many plots should be produced before the next directive is read.

5.2.1.2 SKIP

The SKIP directive has one parameter, an integer, which indicates the number of plots to skip, i.e., not plot, before next directive is read.

5.2.1.3 REWIND

The REWIND directive has one parameter, an integer, which indicates which file to rewind before reading the next directive. Normally the file to be rewound would be the intermediate plot file, TAPE1.

5.2.1.4 OVERLAY

The OVERLAY option allows two or more plots to be plotted without erasing the screen. It has one parameter, a zero value turns overlaying off, and nonzero turns it on. The default is overlay off.

5.2.1.5 WINDOW

The WINDOW command is used to scale a plot to fit into window on the plotting area. This command is designed to be compatible with the WINDOW command in the OPTION so that once the proper windowing has been established via a ses-

sion with VIEWER on a TEKTRONIX the same windowing can be used to produce a slide on 35mm film drawn to what will fit in the .8" x 1.3" slide apparatus. The available plotting area is reduced by clipping the vectors to be drawn just as the TEKTRONIX hardware does. The WINDOW command has four parameters as described in section 4.4.1.5, which are all entered on the same card. If the WIDTH of the plot is input as zero, WINDOW will be turned off so the full plotting area will be available and the scale factors will be set to their defaults.

5.2.1.6 ZOOM

The ZOOM directive has four parameters, all real, which control the windowing for all the plots produced until the next window directive is processed.

The first two parameters $X1, Y1$ are the coordinates of the physical origin of the plotting device relative to the logical origin of the plot. The units of $X1, Y1$ are scaled inches. The next two parameters ($X2, Y2$) are the scale factors for X and Y values respectively. Please understand the negative values for the origin. Consider the CALCOMP paper plotter, the (0,0) point of the physical plotter, the paper edge, is below, i.e., at a negative Y value of the plot for most plots, thus the default is negative 1/2" in the Y direction.

$$\begin{aligned} XSCALED &= X * X2 - X1 \\ YSCALED &= Y * Y2 - Y1 \end{aligned}$$

5.2.1.7 END

The END directive ends plotting. It has no parameters.

5.3 IDCARD

The program IDCARD, on MFA, MFZ, and MFB, is used to route files to the queues for the FR80.

$$IDCARD (LFN, NAME, ADDR, TITLE, NC = n, TYPE, NR INDEX=XXYYZZ)$$

The first four parameters are positional.

LFN is the name of the file on which the header is written and which is put in the FR80 queue.

NAME is the users name and can be up to 20 characters long.

ADDR is the address to which the completed film is to be sent and can be up to 20 characters long.

TITLE is the eye readable title written on top of the fiche or in the first frame on 35mm film and can be up to 40 characters long.

TYPE one of the following keywords indicating the type of output for fiche. TYPE defaults to PRFI.

PRFI for alphanumeric print file fiche

PLFI for plot fiche (DISSPLA & CALCMP)

PL35 for plot 35mm film COM title.

PRPR for a banner like title page for line printers output. This title page, which has date and time on it as well as your title information can be useful in keeping track of your output.

NC=n is the multiple copy parameter where n is the number of copies of fiche required, default is 1.

NR is the keyword indicating no rewind before writing the title on the file. This should only be used to title the second fiche on a file. The default is rewind on.

INDEX=XXYYYYZZ indicates the field on each page used on the fiche index.

XX is the line number of the index field.

YYY is the starting character of the index field.

ZZ is the length of the index field max of 25.

All digits must be specified.

INDEX=0101512 specifies the index field on line 1 beginning in the 15 column and 12 characters long.

INDEX without the field defaults to the index value needed to properly index the output from the FTN compiler.

Appendix A

The following is a list of the sample jobs in USERQA which deal with graphics.

How do I use CALCOMP to make a FR80(FICHE) Plot

How do I use CALCOMP to make a FR80(35mm) Plot

How do I use CALCOMP to make a TEKTRONIX(ASYNC) Plot

How do I use CALCOMP to make a TEKTRONIX(SYNC) Plot

How do I use CALCOMP to make a PRINTER PLOT

How do I use CALCOMP to make a CALCOMP 835 Tape

How do I use CALCOMP to make an INTERMEDIATE PLOT FILE

How do I use DISSPLA to make a FR80(FICHE) Plot

How do I use DISSPLA to make a TEKTRONIX(ASYNC) Plot

How do I use DISSPLA to make a TEKTRONIX(SYNC) Plot

How do I use DISSPLA to make a FR80(35mm) Plot

How do I use DISSPLA to make a PRINTER PLOT

How do I use DISSPLA to make a CALCOMP 835 Tape

How do I use DISSPLA to make an INTERMEDIATE PLOT FILE

How do I use VIEWER to make a FR80(FICHE) Plot

How do I use VIEWER to make a FR80(35mm) Plot

How do I use VIEWER to make a TEKTRONIX(ASYNC) Plot

How do I use VIEWER to make a TEKTRONIX(SYNC) Plot

How do I use VIEWER to make a PRINTER PLOT

How do I use VIEWER to make a CALCOMP 835 Tape

The following job will list all the sample jobs in USERQA.

JOB,STMFA.

ACCOUNT(your name, your problem number)

ATTACH(OLDPL,USERQA)

UPDATE(F,8,D)

COPY(COMPIL,OUTPUT)

6/7/8/9