NASA Technical Memorandum 81908 (REVISED)

NASA-TM-81908 19830025286

GUIDELINES IN PREPARING COMPUTER-GENERATED PLOTS FOR NASA TECHNICAL REPORTS WITH THE LaRC GRAPHICS OUTPUT SYSTEM

NANCY L. TAYLOR

AUGUST 1983

National Aeronautics and
Space Administration

Langley Research Center
Hampton, Virginia 23665

```
 43        1        1 RN/NASA-TM-81908
             DISPLAY 43/2/1
       83N33557*#    ISSUE 21    PAGE 3532    CATEGORY 61    RPT#: NASA-TM-81908 NAS
       1.15:81908    83/08/00   112 PAGES    UNCLASSIFIED DOCUMENT
       Revised
UTTL:  Guidelines in preparing computer-generated plots for NASA technical
       reports with the LaRC graphics output system
AUTH:  A/TAYLOR, N. L.
CORP:  National Aeronautics and Space Administration. Langley Research Center,
       Hampton, Va.     AVAIL.NTIS    SAP: HC A06/MF A01
MAJS:  /*COMPUTER GRAPHICS/*COMPUTER PROGRAMS/*DOCUMENTS/*PLOTTING/*PRINTERS
```

GUIDELINES IN PREPARING COMPUTER-GENERATED PLOTS FOR NASA TECHNICAL REPORTS WITH THE LaRC GRAPHICS OUTPUT SYSTEM (FORTRAN V)

NANCY L. TAYLOR

CONTENTS

CONTENTS

GUIDELINES IN PREPARING COMPUTER-GENERATED PLOTS FOR NASA TECHNICAL REPORTS WITH THE LaRC GRAPHICS OUTPUT SYSTEM (FORTRAN V)

Nancy L. Taylor

Langley Research Center

SUMMARY

This guideline illustrates methods of obtaining computer-generated plots that are acceptable to the Langley publication process. These guidelines deal only with the publication requirements of the computer-generated plots; for any other requirements, it is suggested that you first have a planning session with a technical editor.

An outline of the rules applied in developing these guidelines and a listing of the program used to generate the examples for this report are included.

INTRODUCTION

Because of the time and the manpower required to generate hand-drawn plots for publication, the Langley Research Center has developed a computer program library and established rules for preparing computer-generated plots that are acceptable for publication. The LaRC Graphics Output System has been modified to encompass the publication requirements. This report explains the capability that you can use to help generate publication-quality computer-generated plots for NASA reports.

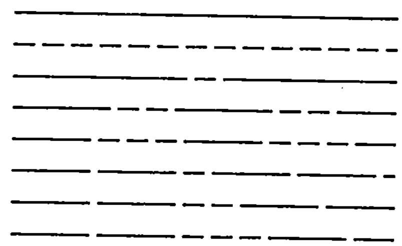
The following people have contributed to developing these guidelines: J. Frances Bray, Jeanne P. Huffman, Mary M. Johnson, Thomas E. Pinelli, Charles R. Pruitt, C. Wayne Williams, and Lynn K. Wright.

An outline of the rules applied in developing these guidelines is included in Appendix A. A listing of the program used to generate the examples for this report is included in Appendix B.

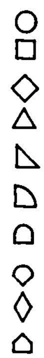
GLOSSARY

Alphanumeric	A combination of letters and/or digits.
CalComp 1055 drum plotter	A digital incremental drum pen plotter. The plot quality is recommended for publication.
Character height	Character height in inches for a full-size character.
Correction paper	A self-adhesive white paper used for blanking out areas of preprinted grid paper. This is also used for corrections or additions.
Elite type style	An elite type style of print measuring 12 characters per inch and 6 lines per inch which is used for text and legends.
Final figure	Original figures ready for publication.
Flag	A differentiation made to a symbol.
Frame	A complete unit of plotting. A final figure. A page.
Graphic device	A device for generating graphical output on paper.
Grid	A network of lines used for locating points by means of coordinates. Two types: preprinted grid paper plotter-generated grid pattern
Horizontal figure	The horizontal (X) measurement of the image area is greater than the vertical (Y) measurement.
Image area	The usable area of a standard report figure page including the legend: For vertical figure: the X = 7 1/8 inches (181.0 mm) the Y = 9 3/16 inches (233.4 mm) For horizontal figure: the X = 9 3/16 inches (233.4 mm) the Y = 7 1/8 inches (181.0 mm)
Key	A block of information placed in the plot area explaining any codes or symbols used on the figure.
Label	The identification of parts of the figure. The labels can be connected by leaders.
Leader	A line connecting a label to a specific part of the figure.
Left justified	The information is aligned on the left margin.
Legend	The figure number and title.
Legend area	The area including the legend and the 0.25 inch (6.4 mm) space separating the legend and the plot area.

NASA line pattern — A line pattern connecting two points. The following is the NASA recommended line pattern sequence:



NASA symbols — Identifiers. The following is the NASA recommended symbol sequence:



circle
square
diamond
triangle
right triangle
quadrant
dog house
fan
long diamond
house

Plot area — The image area minus the legend area.

Plot Vector File — A file of plotting commands generated by an application program using the preprocessor, for input to the postprocessor. This file contains plotter-independent commands.

Preprocessor (LARCGOS) — A library of graphics subroutines. An application program is written to call these graphics subroutines to produce plotter-independent commands on the Plot Vector File for later postprocessing for the specified graphics device.

Postprocessor (PLOT) — A program that reads the Plot Vector File of plotting commands and generates output for a particular graphics device.

Reduction — A change in size of the figure photographically. For example, a 25 percent reduction means the original figure must be reduced to a fourth of the original size to produce a report size figure.

Right justified	The information is aligned on the right margin.
Scale factor	The change in value per scale increment.
Scale origin	The beginning lower scale value. This is usually the minimum value or an adjusted minimum value.
Scaled value	The data have been converted to plot values.
SI units	The International System of Units.
Sublegend	A subtitle used when a figure has several parts. This sublegend is placed between the plot and the legend.
Tektronix terminal	A direct-view storage tube terminal. The plot quality generated from the hardcopy unit is not recommended for publication.
Tick mark	Short lines at specified intervals denoting grid.
Varian plotter	An electrostatic graphics output device. The plot quality is not recommended for publication.
Versatec plotter	An electrostatic graphics output device. The plot quality is recommended for publication. (See restrictions in section entitled "PLOTTERS AT THE LANGLEY RESEARCH CENTER SCIENTIFIC COMPUTER COMPLEX.")
Vertical figure	The vertical (Y) measurement of the image area is greater than the horizontal (X) measurement.

LaRC GRAPHICS OUTPUT SYSTEM

The LaRC Graphics Output System is a graphics software system designed in two parts, the preprocessor and the postprocessor, on the CDC Cyber 170 and CDC Cyber 700 Series Computer Systems at the Langley Research Center Scientific Computer Complex.

The preprocessor, part 1, is a graphics library of FORTRAN callable subroutines. The preprocessor is graphics-device-independent software, which means that your application program is written identically for all graphics devices. Your application program, using the preprocessor, generates a Plot Vector File of plotting commands that are device independent. The preprocessor library contains subroutines that enable you to build a plot by calling routines that will provide alphabetic or numeric labels, draw and annotate axes, generate grid or tick marks, scale data, and plot an array of data points using solid lines, NASA standard symbols, NASA recommended line patterns, or a combination of symbols and line patterns. A capability has been added to the library to help you generate the correct plot size and corresponding label sizes and symbol sizes that are recommended for a NASA publication.

The postprocessor, part 2, is a program that reads the Plot Vector File of plotting commands and generates output for a particular graphics device specified by you. Some plotter output is recommended for publication (such as the CalComp 1055 and Versatec); some plotter output is not recommended for publication (such as the Varian and Tektronix hardcopy) because the quality is not controllable to the level to make it acceptable photographically at all times.

There are two methods to control the size of the plotting. One method is for you to write your application program using the actual size needed. A second method is for you to change the size created in your application program by using options available in the postprocessor.

For specific information on the LaRC Graphics Output System, refer to the Langley Programing Manual, Volume IV, Section 1.

Several steps that you should consider in order to obtain computer-generated publication-quality plots:

PLANNING YOUR REPORT REQUIREMENTS

You should plan what your figure requirements are before writing your application program. Since the standard size NASA report and the Langley publication process equipment define an image size of 7 1/8 X 9 3/16 inches (181.0 X 233.4 mm), you should plan the size of your plots keeping in mind the ratio factor of 7.125/9.1875 (0.78). Planning the plot size is discussed in detail in the section entitled "PLANNING FIGURES."

GENERATING YOUR APPLICATION PROGRAM

Unless you can use some general-purpose graphics program available, you need to generate an application program that includes generating your data and/or plotting your data. Since data generation is unique to you, only the basics for generating the plots are included.

The graphics part of your application program should include:

A Graphics Initialization Call - A routine is available to set up the graphics, which must be the first graphics executable statement. This sets up the parameters and linkage necessary to record the generated plot data in the form of a device-independent Plot Vector File. This Plot Vector File is postprocessed at the end of program execution.

Setting Up Publication Size Requirements - Routines are available to set up the recommended sizes and distances for publication-quality plots.

Labeling - Routines are available to provide alphabetic or numeric labels.

Axis Labeling - Routines are available to provide an axis label which includes a title for the variable and its units of measurement, plus the magnitude of quantities evenly spaced along the axis.

Grids - Routines are available to create tick marks or grids, or to use preprinted grid paper.

Scaling - Routines are available to scale the data.

Data Plotting - Routines are available to plot data using NASA symbols only, NASA recommended line patterns, or a combination of NASA symbols and line patterns.

Frame Advancement - A routine is available to terminate a frame and initialize for the next frame. A frame is considered a separate unit of plotting. The definition of a frame is discussed in greater detail in the section entitled "Preprocessor."

Terminate Plotting - A routine is available to terminate the plotting when all frames are completed.

POSTPROCESSING YOUR ORIGINAL PLOTS

You generate your plots by directing your Plot Vector File to a specific graphics output device.

GENERATING YOUR REPORT FIGURES

You submit your original plots to publication, and they are reduced photographically by the Langley publication process to report figures.

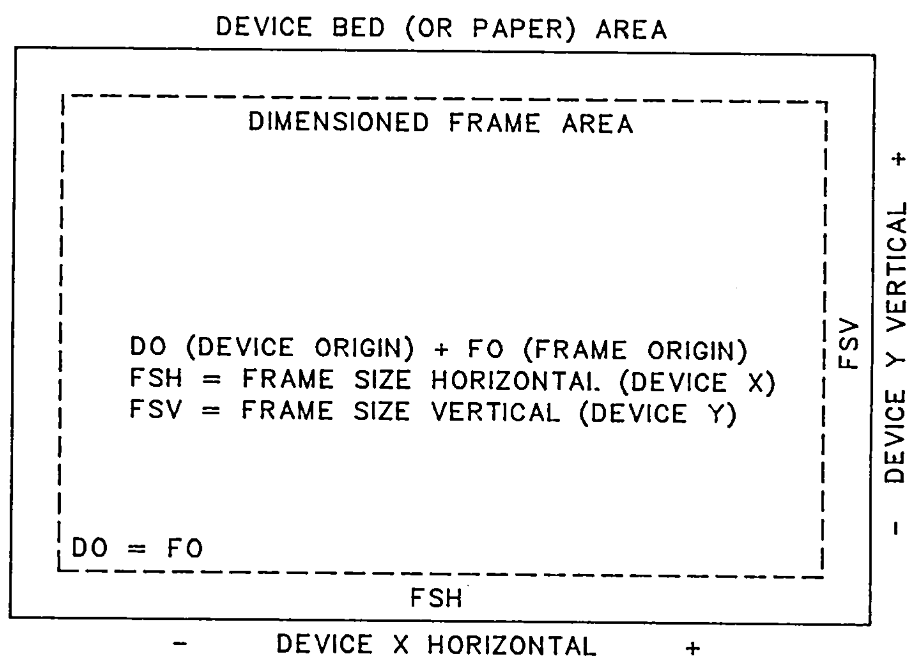
Preprocessor

The preprocessor is a graphics library of FORTRAN callable subroutines. These subroutines are graphic-output-device-independent, which means that a program that generates a plot for a 20 X 20 inch (508 X 502 mm) plotter could also be used for a 10 X 10 inch (254 X 254 mm) plotter without reprograming.

The sign convention for the preprocessor is designed for standard graphs, with the horizontal dimension designated as the X axis and the vertical dimension as the Y axis. The origin is set to plotting device origin (DO), as shown in Example 1, before beginning and can then be moved through preprocessor routine calls. The position of the origin has a direct bearing on the direction of plotting and the sign of the variable.

The area available for plotting depends upon the choice of graphics output device. The graphics output devices are discussed later.

One complete unit of plotting is called a frame. An example of a frame would be a plot on a sheet of paper. The usable plotting area for any frame is finitely bounded, and the frame (or device) origin is always in the lower left corner of the plotting area. This lower left corner setup will be assumed, and will be referred to here as the device origin (DO) or first frame origin (FO). A dimensioned frame area will then be measured in positive X and Y directions from this point. A conceptual view of a frame area imposed on a device bed (or paper) area is shown in Example 1.



Example 1

Since the pen, at any given time, could be anywhere within the plotting area, the following convention is defined: the pen is originally located at the lower left corner of the plotting device. This is device origin or frame origin as shown in Example 1. For preprinted grid paper, the frame origin is located on heavy grid lines for both X and Y. The use of preprinted grid paper is discussed later. You then know the pen location and are responsible for establishing succeeding origins.

Capabilities

The preprocessor is a library of subroutines and is called LARCGOS. Some of the capabilities of the preprocessor are:

INITIALIZATION OF THE GRAPHICS

PSEUDO initializes the graphics in your application program.

BASIC PLOTTING ROUTINE

CALPLT produces the basic pen motion (move or draw).

FRAME ADVANCE

NFRAME provides a frame advance command.

LOCATING PEN POSITION

WHERE determines the current pen position on the plot.

RESCALING

FACTOR provides automatic rescaling of plots in your application program.

ONE-CALL PLOTTING ROUTINE

INFOPLT provides a one-call method of automatically preparing a plot.

PLOTTER CONTROL FUNCTIONS FOR PEN PLOTTERS

LEROY changes the speed for the Leroy pens.

PLTSTOP transmits a message to the plotter operator.

GRIDCK provides a means to transmit a message to the plotter operator to check the grid alignment for preprinted grid paper.

NEWPEN selects different pens on the drum plotter.

ORGCK checks the origin at the beginning and the end of the frame.

DEBUGGING CAPABILITY

CKI activates a check for any infinite or indefinite parameter that is passed in any graphics routine and provides a traceback to the routine.

NOCKI deactivates the check for any infinite or indefinite parameter that was initiated by call to CKI.

CKARG activates a check for an incorrect number of parameters passed in any graphics routine and provides a traceback to the routine.

NOCKARG deactivates the check for an incorrect number of parameters that was initiated by call to CKARG.

SET UP PUBLICATION SIZE REQUIREMENTS

PUBSET sets and activates the publication parameters according to the reduction factor.

PIMAGE sets and activates the publication parameters according to the image size and returns the estimated axis lengths.

PAXLEN sets and activates the publication parameters according to the axis length and returns the estimated image size.

Sppppp changes (sets) the current value of the publication parameter ppppp.

Gppppp reads (gets) the current value of the publication parameter ppppp.

PUBRST deactivates the publication capability.

BASIC LABELING

ENUMBER draws a number in scientific notation (X 10 to a power).

NUMBER draws a number in FORTRAN F or I format with numbers left justified.

COLUM draws a number in FORTRAN F or I suitable for tabular usage (right justified).

CHARACT draws a character string using a variety of character fonts and allowing control of upper and lower case, superscripts, and three levels of subscripts if the character font capability has been activated. A character string is drawn in upper case only if the character font capability has not been activated.

CHARWH calculates the width and height of a character string.

CHARACTER FONT CAPABILITY - CHARACTER SETS

CHARSTn loads and activates a basic character set n, where n is a character set number from 1 to 9.

CHARSnn loads character set nn, where nn is a character set number greater than 9.

CHARACTER FONT CAPABILITY - UTILITIES

CHNGSET changes the active character set.

CHNGKCC changes the control characters used in the character string decoding.

REPCHAR replaces an existing character set.

CHARRET returns the active character set number.

CHAROFF deactivates the character font capability and uses only character set 1 upper case capability.

AXES

AXES draws and annotates the axis with numerics at specified intervals with or without tick marks.

AXISB draws and annotates the axis with alphabetic labels at specified intervals or between specified intervals with or without tick marks.

AXESLOG draws and annotates the axis with numerics at specified intervals in each log cycle for logarithmetic plots and labels the beginning of the cycle with 10 to a power.

AXES OFFSET CALCULATIONS

AXESOF calculates the axis offset for the routine AXES.

AXISBOF calculates the axis offset for the routine AXISB.

AXLOGOF calculates the axis offset for the routine AXESLOG.

AXES IDENTIFICATION LABELS

HALABEL draws a horizontal axis identification label consisting of one or more lines of character strings.

VALABEL draws a vertical axis identification label consisting of one or more lines of character strings.

GRIDS

DGRID draws a rectangular grid of either tick marks or points at grid intersections.

GRID draws a rectangular grid.

GRIDB draws a rectangular grid with rectangular areas remaining blank for the key.

LOGRID draws log-log, semi-log, or linear grid or draws tick marks along the axis.

LOGRIDB draws log-log, semi-log, or rectangular grid with rectangular areas remaining blank for the key.

POLRGRD draws a polar grid.

SCALING

ASCALE scans a data array to determine scaling parameters for rectangular plotting.

BSCALE scans a data array to determine scaling parameters for rectangular plotting and allows control of origin.

SCALOG scans a data array to determine scaling parameters for logarithmic plotting.

RSCALE scans a data array to determine scaling parameters for polar plotting.

DATA PLOTTING

PNTPLT draws a single NASA standard symbol centered about an X,Y point.

POINT draws a point at X,Y.

PARROW draws an arrowhead at the end of a line between two points.

LINPLT draws a solid or dashed line between data points and/or draws NASA standard symbols at each data point or draws a solid or dashed line with or without a specified symbol at end.

DRAW draws a solid line between scaled data points.

ARROW draws a solid line with a variety of arrowheads at the end of the line.

DASHPLT draws a dashed line. (Dash pattern specified in calling sequence.)

LGLIN draws a solid or dashed line between data points and/or draws NASA standard symbols using log-log, semi-log, or rectangular scale.

RLINE draws a solid or dashed line between data points and/or draws NASA standard symbols using polar coordinates.

KEYS

KEY draws a key consisting of a column of NASA symbols, NASA line patterns, or a combination of the NASA symbols and the NASA line patterns and one or more columns of identification with a centered title over each column.

KEYWH calculates the width and height of a key to enable the user to determine the placement of the key.

GEOMETRIC SHAPES

ARC draws an arc.

CIRCLE draws a circle or an arc segment.

ELIPS draws an ellipse or elliptical segment.

RECT draws a rectangle.

SHADING

HAFTONE shades between two lines using dots.

SHADE shades between two lines using lines.

SPECIAL TYPES OF PLOTS

BARPLT draws a horizontal or a vertical bar plot.

Parameter Vocabulary

Some of the commonly used preprocessor parameters are:

CHARS	A character string.
HEIGHT	The height of a full-size character in floating point inches.
HSIZ	The horizontal measurement of an image.
IS	A code specifying the size of NASA standard symbols: 1 small 0.100 inch (2.5 mm) 2 medium 0.132 inch (3.4 mm) 3 large 0.168 inch (4.3 mm)
ISYM	A code specifying the NASA standard symbol: 0 no symbol 1 circle 2 square etc. For a complete list of the symbols, see GLOSSARY.
S	The length in floating point inches over which the data are to be plotted (usually an axis length).
SX	The length of the X axis.
SY	The length of the Y axis.
THETA	The angle in floating point degrees at which information is to be drawn.
TMAJ	The distance in floating point inches between major tick marks.
TMIN	The number of divisions per inch for minor tick marks.
X	The X coordinate of a point in floating point inches.
XARRAY	X data array containing X coordinates in floating point.
XOFF	The X offset for vertical axis.
XUL	The X coordinate in floating point inches of the upper left corner of the key.
Y	The Y coordinate of a point in floating point inches.
YARRAY	Y data array containing Y coordinates in floating point.
YOFF	The Y offset for horizontal axis.
YUL	The Y coordinate in floating point inches of the upper left corner of the key.
VSIZ	The vertical measurement of an image.

Postprocessor

The postprocessor is a separate program that reads a Plot Vector File, performs various operations on the file, and formats the data to a file that can be used to drive the specified graphics plotting device.

The postprocessor is loaded and executed with the PLOT control statement after the execution of your application program. You must employ an appropriate form of the PLOT control statement to call into execution the required graphics device postprocessor.

The following graphics device postprocessor output is recommended for publication quality:

PLOT.CALPOST,33 — The postprocessor for CalComp Model 1055 Electromechanical Plotter. This is a drum plotter that uses a continuous roll paper with a usable plotting surface of 33 inches (838.2 mm) in Y and 110 feet (33.5 m) in X.

PLOT.CALPOST,11 — The postprocessor for CalComp Model 1055 Electromechanical Plotter. This is a drum plotter that uses a continuous roll paper with a usable plotting surface of 11 inches (279.4 mm) in Y and 110 feet (33.5 m) in X.

PLOT.VERPOST — The postprocessor for the Versatec Model 8136A Electrostatic Plotter. This is a plotter that uses continuous roll paper with a usable plotting surface of 35 inches (889 mm) in Y and 110 feet (33.5 m) in X.

Some of the capabilities of the postprocessor are:

XM	Change X magnification factor.
YM	Change Y magnification factor.
XO	Change X origin offset.
YO	Change Y origin offset.
EDIT	Process selected frames only.

The size of the plots can be changed by using the XM and YM parameters in the specified postprocessor. The default values for XM and YM are set to 1 (no change in size). For example, the size of the original plots can be reduced by half on the CalComp Drum Plotter by:

```
PLOT.CALPOST,11(XM=.5,YM=.5)
```

The size of the original plots can be doubled on the Versatec Plotter by:

```
PLOT.VERPOST(XM=2.,YM=2.)
```

The plots can be offset on the plotter paper by using the XO and YO parameters in the specified postprocessor. The default values for XO and YO are set to 0 (no offsets). For example, the plots can be offset up 1 inch in Y and over 2 inches in X on the CalComp Drum Plotter by:

```
PLOT.CALPOST,33(XO=2.,YO=1.)
```

Certain frames can be selected for postprocessing by using the EDIT parameter in the specified postprocessor. For example, every other frame can be plotted starting with frame 2 and ending with frame 10 on the Versatec Plotter by:

```
PLOT.VERPOST(EDIT(2,10,2))
```

Plotting instructions must be specified for the CalComp plotters. The postprocessor routes your plotting instructions to the plotting operators. These instructions must include the type of paper, the type and size of pen, and the color of ink. When the plots are to be used for publication, a notation should be made in the plotting instructions. You supply the plotting instructions on CONT statement(s) immediately following the PLOT statement. For example, blank paper and a Leroy 3 pen with black ink can be specified on the 33 inch (838.2 mm) CalComp Drum Plotter by:

```
PLOT.CALPOST,33
CONT.//BLANK PAPER LEROY 3,BLACK INK
CONT.PUBLICATION FIGURES//
```

PLOTTERS AT THE LANGLEY RESEARCH CENTER SCIENTIFIC COMPUTER COMPLEX

The following plotter outputs are recommended for publication:

CalComp 1055 Drum

The CalComp 1055 is a high-speed, two-axis recorder designed for plotting one variable against another in response to digital incremental signals. This drum plotter uses ballpoint pens (not recommended for publication) and Leroy pens (recommended for publication). This drum plotter is the only plotter that has the capability of using preprinted grid paper. When using the preprinted grid paper, no final labeling can be generated in the gridded area since labeling is not readable in the gridded area. Hand labeling can be eliminated if the data can be generated using tick marks or a coarse grid on blank paper.

Versatec

The Versatec plotter is an electrostatic graphics output device that places electrostatic charges on dielectric-coated plotter paper. This charged paper is developed by a liquid black toner to produce a permanent black-on-white image. The resolution is 0.01 inch (0.3 mm) in both directions. The quality could be acceptable for publication if the plots are generated larger than page size and then reduced photographically by the Langley publication process. Since plotted output has only a 0.01 inch resolution, some lines and symbols look ragged with no reduction. You can make the plots larger in either your application program or the postprocessor.

The following plotter outputs are not recommended for publication:

Varian

The Varian plotter is an electrostatic graphics output device that places electrostatic charges on dielectric-coated plotter paper. This charged paper is developed by a liquid black toner to produce a permanent black-on-white image. The resolution is 0.01 inch (0.3 mm) in both directions. The Varian plotters are on-line to the CDC NOS Computers. Since these are on-line plotters, the quality of the plot output cannot be maintained for publication quality. The Varian should be used to debug and generate working plots before submitting these plots for plotting on the publication-quality plotters.

Tektronix hardcopy

The Tektronix 4010 Series Graphic Terminals are direct-view storage tube terminals. The Tektronix is usually accompanied by a hardcopy unit. The quality is not controllable to a level to make the Tektronix hardcopy acceptable photographically at all times. The Tektronix should be used to preview plots on the Tektronix screen before submitting these plots for plotting on the publication-quality plotters.

Plotter Paper

The plotting paper available depends on the choice of the graphics output device.

The Versatec plotter uses only dielectric-coated plotter paper. The charged paper is developed by a liquid black toner to produce a permanent black-on-white image.

The CalComp drum plotter has the following types of paper available:

Blank paper

Preprinted grid paper

Retain grid
Red 20 divisions per inch
Red 10 divisions per inch

Drop grid
Blue 20 divisions per inch
Blue 10 divisions per inch

When the grid is retained, labeling cannot be done directly on the preprinted grid because it is not readable.

Special Considerations for Pen-Type Plotters

There are special considerations for the CalComp drum pen-type plotter. These special considerations are:

- Require plotting instructions
- Support multiple pen capability
- Support different pen sizes
- Support different ink colors
- Require loss-of-origin check
- Require grid-alignment check for preprinted grid paper

Each of these considerations is discussed separately.

Plotting Instructions

You must specify plotting instructions for the CalComp plotter. These instructions must include the type of paper, the type and size of pen, and the color of ink. You should note in the plotting instructions that the plots are to be used for publication. You supply the plotting instructions on CONT statement(s) immediately following the PLOT statement. For example, blank paper and a Leroy 5 pen with black ink can be specified for the 33 inch (838.2 mm) CalComp drum plotter by:

```
PLOT.CALPOST,33
CONT.//BLANK PAPER,LEROY 5,BLACK INK
CONT.PUBLICATION FIGURES//
```

Multiple Pen Capability

The multiple pen capability is available on the CalComp drum plotter. This plotter has the capability to select up to four different pens. Because of pen problems, the multiple pen capability should not be used unless it is necessary to enhance the readability of the plot. If a pen is not used continuously, the pen may clog after a delay. If the multiple pen capability is used, you should plot something with the pen outside the plot area and stop to allow the plotting operator to check the pen as shown in the following code:

```
MSG='TRY PEN'
CALL CALPLT(2.,1.,-3)
CALL NEWPEN(1)
CALL CHARACT(-.2,0.,.2,'TRY PEN',90.,7)
CALL PLTSTOP(MSG)
CALL GRID(0.,0, ...
CALL NEWPEN(2)
CALL CHARACT(-.2,1.0,.2,'TRY PEN',90.,7)
CALL PLTSTOP(MSG)
CALL AXES(0.,0.,0., ...
CALL AXES(0.,0.,90., ...
CALL LINPLT(XARRAY,YARRAY, ...
CALL NFRAME
```

Pen Size
(Line Widths)

The CalComp drum plotter uses two types of pens: ballpoint and Leroy. The ballpoint line width is not heavy enough for publication. The Leroy pens are liquid ink pens heavy enough for publication and are available in 3 sizes.

The following is an example of the width of the three Leroy pen sizes:

Leroy pen size 3 ————————
Leroy pen size 4 ————————
Leroy pen size 5 ————————

The Leroy pen size 3 should be used when the original figure size range is from 9.2 X 7.1 to 16.5 X 13 inch (233.4 X 181.0 to 419.1 X 330.2 mm).

The Leroy pen size 4 should be used when the original figure size range is from 16.5 X 13 to 23 X 17.5 inch (419.1 X 330.2 to 584.2 X 444.5 mm).

The Leroy pen size 5 should be used when the original figure size range is from 23 X 17.5 to maximum size of 40 X 29 inch (584.2 X 444.5 to 1016 X 736.6 mm). The maximum size of 40 X 29 is the maximum size of the camera easel used in the Langley publication process. This maximum size should not be exceeded.

Because of the pen problems previously discussed in the section entitled "Multiple Pen Capability," all line widths for a figure should be the same.

Pen Ink Color

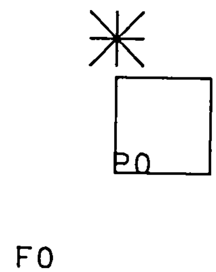
The Leroy liquid ink is available in four different colors for the CalComp plotter, but the color recommended for publication is black.

Loss-of-Origin Check

Loss of origin, which occassionaly occurs on pen-type plotters due to plotter malfunction, is difficult for the plotting operators to detect. A routine is available for you to initiate a check on loss of origin. A call to this routine will set up a command to the CalComp postprocessor to plot a "+" when the routine ORGCK is called and to plot a "x" at the same location when the routine NFRAME is called. The "+" and the "x" should form an "*". If these symbols are not at the same location, some malfunction occurred while the plots were being plotted. If preprinted grid paper is used and the plotting operator has made grid alignments, the "+" and the "x" could be different. A call to ORGCK should be made at the beginning of each frame for any plotting on the CalComp drum, except when using preprinted grid paper.

The origin check should not be made at the plot origin; but at a point outside the plotting area and within the frame area. You should request an origin check at the beginning of each frame as shown in Example 2 and generated by the following FORTRAN code:

```
CALL ORGCK(.5,1.5)
CALL CHARACT(0.,0.,.1,'FO',0.,2)
CALL CALPLT(.5,.5,-3)
CALL CHARACT(0.,0.,.1,'PO',0.,2)
CALL RECT(0.,0.,.5,.5,0.,3)
CALL NFRAME
```



Example 2

Grid-Alignment Check

The atmospheric conditions can cause the paper to shrink or to expand thus affecting the accuracy of plotting on the preprinted grid paper. The routine GRIDCK is available for you to request the plotting operator to stop the plotter and check for grid alignment at specified places.

A grid alignment check should be used before drawing a set of axes as shown in the following FORTRAN code:

```
CALL CALPLT(1.,1.,-3)
CALL GRIDCK
CALL AXES(0.,0.,0.,...
CALL AXES(0.,0.,90.,...
CALL LINPLT(XARRAY,YARRAY,...
CALL CALPLT(0.,4.,-3)
CALL GRIDCK
CALL AXES(0.,0.,0.,...
CALL AXES(0.,0.,90.,...
CALL LINPLT(XARRAY,YARRAY,...
CALL NFRAME
```

If preprinted grid paper is used and the plotting operator does realign the pen to correspond to heavy grid intersections at specified points, then the origin check test will be distorted.

PLANNING FIGURES

Most of the figures in NASA reports are grouped together at the end of the report instead of inserted in the text; therefore, all figures should be as uniform as possible. The basic rules to follow in planning uniform figures are:

1. The plot perspective should be read from one point; the person reading the plots should not have to rotate the paper to read the plots. The one exception to this rule is a long vertical label.

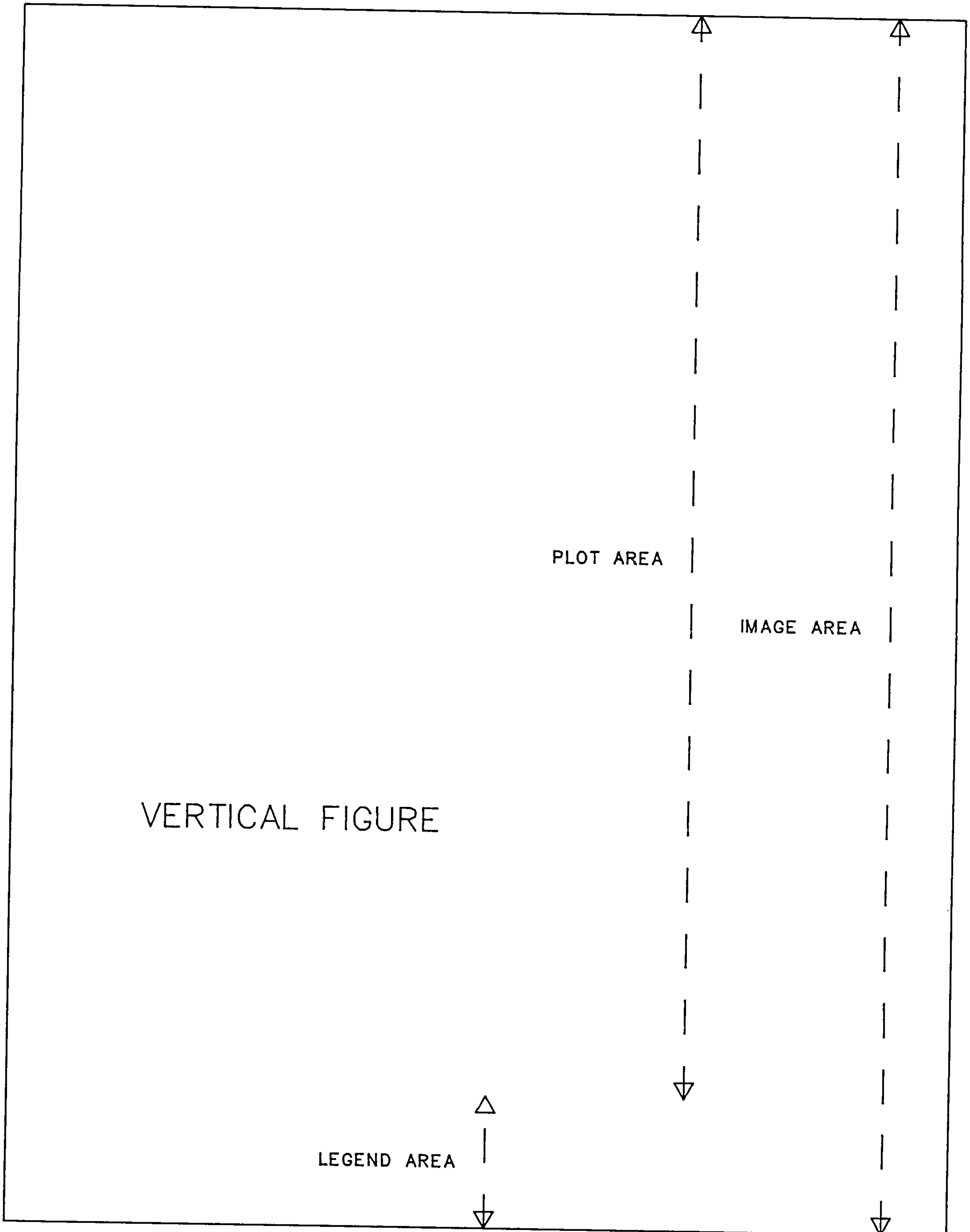
2. The plot areas should be kept the same size and the plots should be oriented the same throughout the report.

3. The same scale per unit value should be used on similar data, even if the data are in different ranges. For example, a scale increment for an angle should remain the same even if the range is 0 to 90 for one plot and 90 to 180 for another plot.

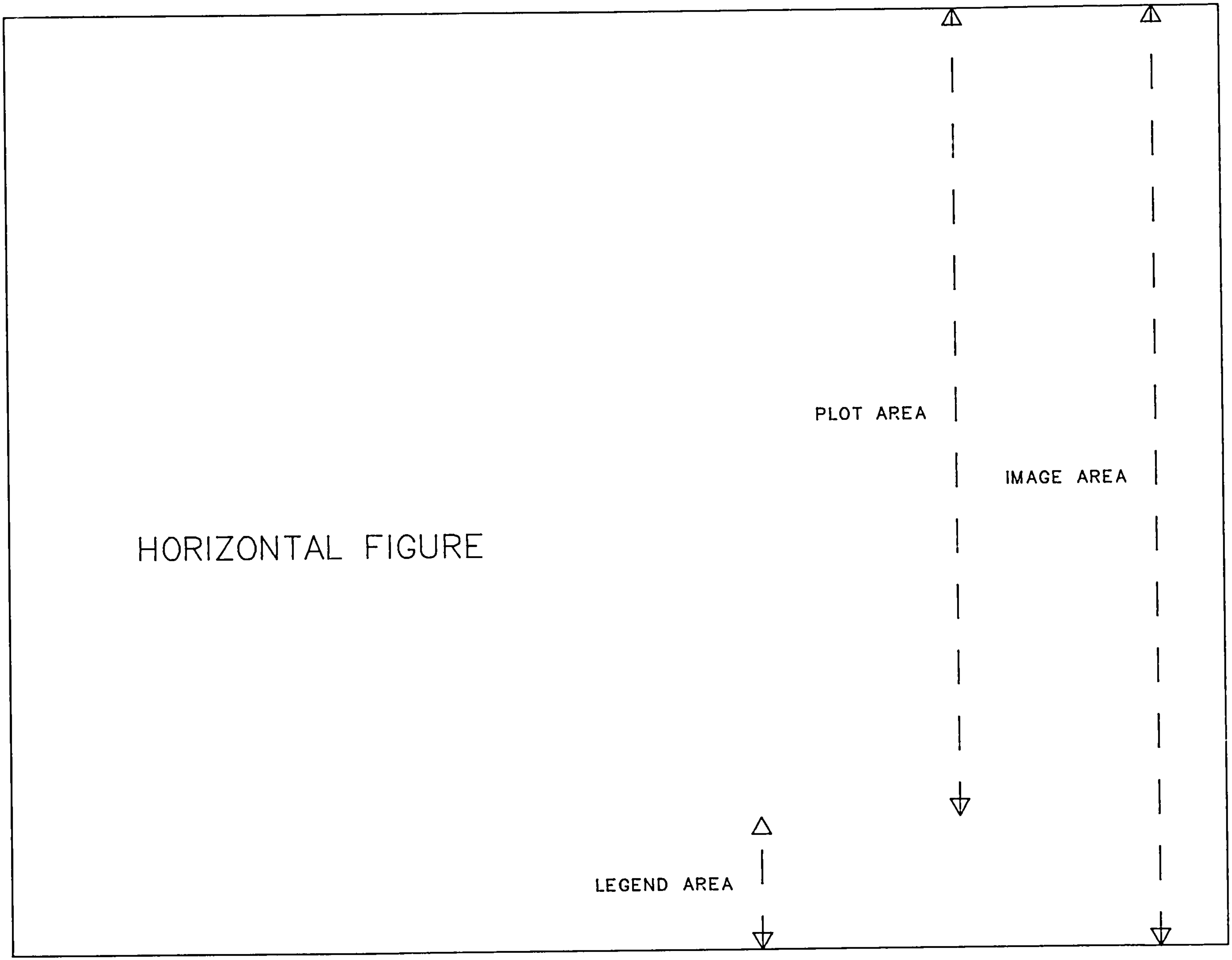
4. The vertical figure orientation (see Example 3) is preferred. The vertical measurement is 9 3/16 inches (233.4 mm) and the horizonal measurement is 7 1/8 inches (181.0 mm).

5. The horizontal figure orientation (see Example 4) is not preferred because the report must be physically rotated to view the figure, but there are times when the data necessitate using the horizontal figure. The horizontal measurement is 9 3/16 inches (233.4 mm) and the vertical measurement is 7 1/8 inches (181.0 mm).

6. All labeling within the plot area should be the same size even if the figure is divided into multiple parts. If a figure is divided into multiple parts, the height of the full-size character for labeling is based on the size of the whole figure, not each separate part.



Example 3



Example 4

Image Area

The standard size NASA report allows the image area to be a maximum size of 7 1/8 X 9 3/16 inches (181.0 X 233.4 mm). No figure can exceed this image size for publication. The horizontal image length is the distance measured from the lower left corner of the leftmost character to the lower right corner of the rightmost character. The vertical image length is calculated from the top of the figure to the bottom of the legend as shown in Example 3.

Legend Area

The legend is a figure number and title that identifies each plot or figure. The legend area includes the legend and a 0.25 inch (6.4 mm) space separating the legend and the plot area.

The legend is always typed by the Langley publication process with an elite style type after the plot area has been reduced to report size. The legend is always centered and the length may be the entire width of the image area. If a legend requires more than one line, the last line is centered as shown below.

Figure 1.- This is a multiple-line legend example.
Each line is centered.

If a figure has several parts, the parts are identified by sublegends. The sublegends are placed between the figure and legend as shown below.

(a). The sublegend appears between plot and legend.

Figure 2.- This is a legend example that requires a sublegend.

If a figure contains several parts on the same page, each part could be identified by a sublegend.

The legend area must be calculated first in order to determine the amount of space available for the plot area. It might be helpful to generate legends for identification and sizing purposes. If possible, try to decide what type of legends will be used in the report, since the reduction factor could change depending on the size and type of legends used. If the legend requirements are not known, then a two-line legend should be assumed.

To estimate the legend area, the following measurements are used:

1. The legend is separated from the plot area by 0.25 inch (6.4 mm).

2. Each line of legend takes 0.086 inch (2.2 mm).

3. The distance between two lines of a legend is 0.081 inch (2.1 mm).

Since the legend area is a factor in the vertical image, a table of approximate sizes is included here:

Types of legends	Approximate legend size, in. (mm)	Approximate plot size, in. (mm)
One-line legend	3/8 (10)	7 1/8 X 8 13/16 (181 X 224)
Two-line legend	1/2 (13)	7 1/8 X 8 11/16 (181 X 221)
One-line legend with one-line sublegend	5/8 (16)	7 1/8 X 8 9/16 (181 X 217)
Two-line legend with one-line sublegend	3/4 (19)	7 1/8 X 8 7/16 (181 X 214)

Plot Area

The plot area is the image area minus the legend area as shown in Example 3. The data requirements dictate how the plots are generated, but the plots generated for a NASA report must be produced so that they can be reduced photographically by the Langley publication process to fit into this plot area.

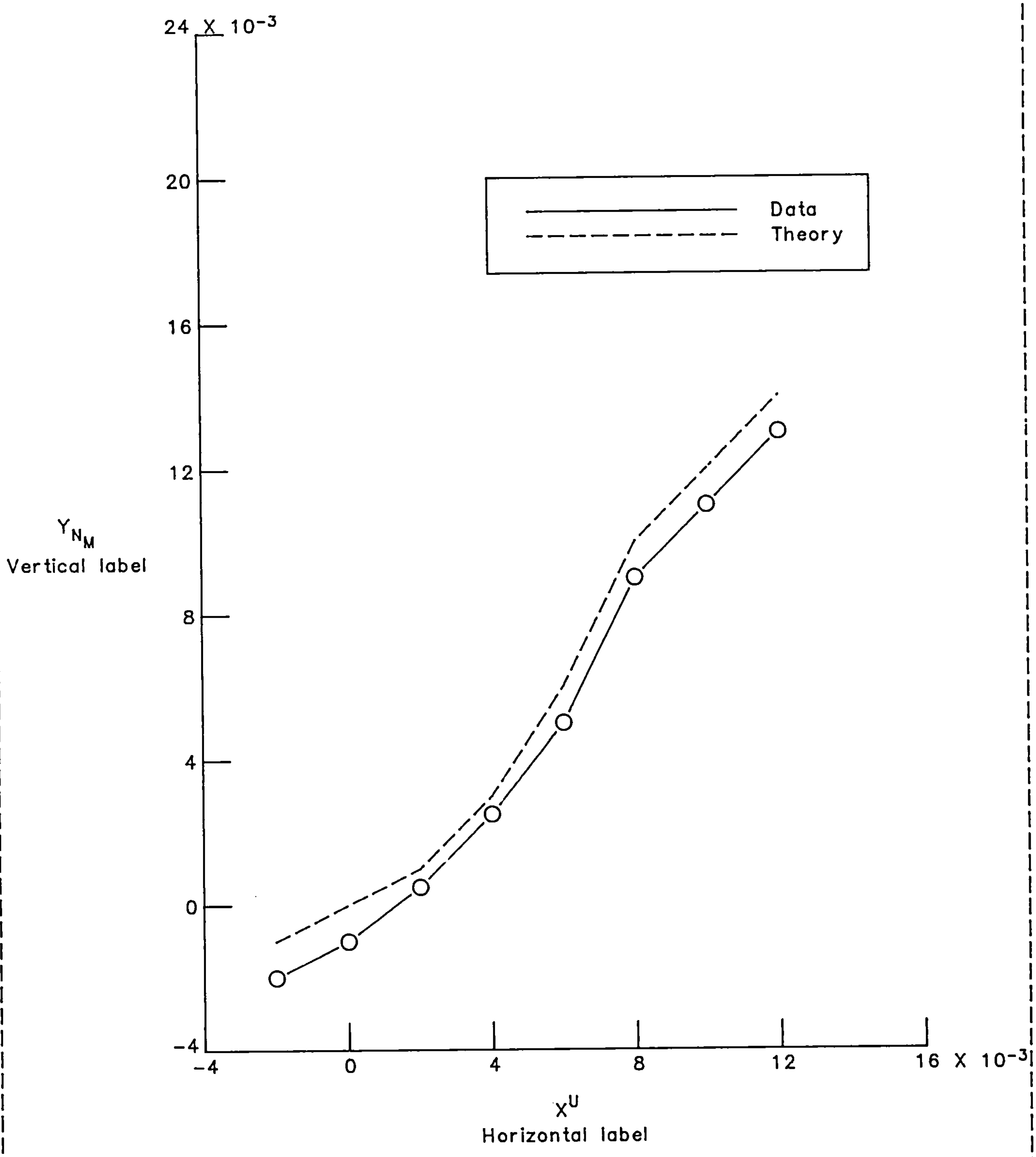
Although the camera easel used by the Langley publication process has a maximum size of 40 X 29 inches (1016 X 736.6 mm), the original plot size should be kept below this maximum size if possible. The image size ratio (7.125/9.1875 (0.78)) should be used in determining the original plot size. If the original figure is larger than the plot area, it is always reduced to fit within the plot area. If the original figure is less than the plot area, it is not expanded to fill the plot area.

PUBLICATION CAPABILITY

The publication capability is a feature in the preprocessor to help you generate publication acceptable plots. A set of publication parameters are defined that control the size of the characters used for labeling, the distances to the labels, the distances between lines and columns, the length of tick marks, and the symbol size. The publication parameters depend on the amount of reduction necessary to reduce an original size plot to the report size plot. Many NASA reports need multiple plots per figure due to the data requirements and the method of presentation; however, the examples in this report illustrate only the single plot per figure. When multiple plots per figure are required, the publication capability should be set up based on the size of the whole figure. An acceptable single plot per figure example using the recommended publication parameters is shown in Example 5.

The reduction factor is calculated by using the largest dimension of the original plot. If the largest dimension of the original plot is Y, then the reduction factor is calculated by dividing the original Y dimension by the needed Y dimension (Y plot area value). The postprocessor options XM and YM should be used to reduce this to the report plot size in order to see how the final report figure will look. For example, a 13 x 10 inch plot (330 X 254 mm) can be reduced to a 9 X 7 inch plot (229 X 178 mm) by setting the postprocessor options XM and YM to the reduction factor; in this case the reduction factor is 0.69.

To produce a better quality plot for publication, the original plots should be generated larger than page size and be reduced photographically by the Langley publication process.



(a) Sublegend.

Figure 1. - Line 1 of legend should be typed here.
Line 2

Example 5

Initializing Publication Capability

The publication capability is initialized and activated by using one of three different subroutines in the preprocessor:

1. PUBSET - sets the publication parameters according to the reduction factor given.

2. PIMAGE - sets the publication parameters according to the total image size. This subroutine is used for a figure with one or more plots.

3. PAXLEN - sets the publication parameters according to the axis lengths for a figure with one plot.

All three subroutines basically calculate the approximate reduction factor that the Langley publication process uses to reduce the original figure to fit within the report image area. The reduction factor (REDUC) for a vertical figure is the report image vertical size (Y) divided by the original image vertical size (Y). The reduction factor for a horizontal figure is the report image horizontal size (X) divided by the original image horizontal size (X). The image vertical measurement includes the vertical axis length (Y) plus the horizontal scale labels (X) plus the horizontal axis labels plus the legend area. The image horizontal measurement includes the horizontal axis length (X) plus the vertical scale labels (Y) plus the vertical axis labels. If the original image is 9 3/16 X 7 1/8 inches (233.4 X 181.0 mm), REDUC is 1. If the original image is the maximum size of 40 X 29 inches (1016 X 736.6 mm), REDUC is 0.25.

This reduction factor is then used to calculate the correct labeling sizes, symbol sizes, and distances to be used so that when the Langley publication process does reduce the original figure, the sizes will be correct for the report figure.

For example, the HEIGHT of the labeling for a NASA report figure should be 0.086 inches (2.2 mm). If the original vertical image is 18 3/8 inches (466.7 mm), then REDUC is calculated to be 0.5 (9 3/16 divided by 18 3/8. This means that the Langley publication process would reduce the original figure to one-half of the original size to produce a report figure. Since the report figure HEIGHT should be 0.086 inch (2.2 mm), it follows that the HEIGHT of the original figure would have to be 2 times 0.086 inch (4.4 mm).

Routine PUBSET

The routine PUBSET sets the publication parameters according to the reduction factor and is used after the user has determined the axis lengths, labels, and legends as shown in the following FORTRAN code:

```
CALL PSEUDO
CALL PUBSET(1.)
CALL AXESOF(XOFF,YOFF,0.,...
CALL AXESOF(XOFF,YOFF,90.,...
CALL CALPLT(XOFF,YOFF,-3)
CALL AXES(0.,0.,0.,...
CALL AXES(0.,0.,90.,...
CALL LINPLT(XARRAY,YARRAY,...
CALL KEY(XUL,YUL,...
CALL NFRAME
```

For more details on the FORTRAN code, see Example 5a in Appendix B.

Routine PIMAGE

The routine PIMAGE sets the publication parameters according to the total image size and is used if you have one or more plots on each page. PIMAGE is called with at least two parameters, HSIZ and VSIZ, where HSIZ and VSIZ are the image horizontal and vertical sizes, respectively. There are other parameters available if you want to estimate axis lengths. PIMAGE determines a reduction factor and sets up the publication parameters based on either the image horizontal or vertical size, whichever is larger, as shown in the following FORTRAN code:

```
CALL PSEUDO
HSIZ=7.125
VSIZ=9.1875
CALL PIMAGE(HSIZ,VSIZ,3,2,'V(ERTICAL LABEL)',16,SX,SY)
SX=IFIX(SX)
SY=IFIX(SY)
CALL AXESOF(XOFF,YOFF,0.,SX,...
CALL AXESOF(XOFF,YOFF,90.,SY,...
CALL CALPLT(XOFF,YOFF,-3)
CALL AXES(0.,0.,0.,...
CALL AXES(0.,0.,90.,...
CALL LINPLT(XARRAY,YARRAY,...
CALL KEY(XUL,YUL,...
CALL NFRAME
```

For more details on the FORTRAN code, see Example 5b in Appendix B.

Routine PAXLEN

The routine PAXLEN sets the publication parameters according to the axis lengths and is used if you have only one plot per page. PAXLEN is called with at least two parameters, SX and SY, where SX and SY are the axis lengths of the X axis and Y axis, respectively. There are other parameters available if you want to be more accurate about the size of the axis labels. PAXLEN determines a reduction factor and sets up the publication parameters necessary for a vertical or horizontal figure, depending upon the axis lengths and label sizes, as shown in the following FORTRAN code:

```
CALL PSEUDO
SX=5.
SY=7.
CALL PAXLEN(SX,SY,3,2,'V(ERTICAL LABEL)',16,HSIZ,VSIZ)
CALL AXESOF(XOFF,YOFF,0.,...
CALL AXESOF(XOFF,YOFF,90.,...
CALL CALPLT(XOFF,YOFF,-3)
CALL AXES(0.,0.,0.,...
CALL AXES(0.,0.,90.,...
CALL LINPLT(XARRAY,YARRAY,...
CALL KEY(XUL,YUL,...
CALL NFRAME
```

For more details on the FORTRAN code, see Example 5c in Appendix B.

For more information on these routines, refer to the Langley Programing Manual, Volume IV, Section 1.

Publication Parameter Definitions

The publication parameters are defined as follows:

The height (HEIGHT) of the characters used for labeling is determined by the full-size character height in inches. The distances to the labels, the distances between lines and columns, the lengths of tick marks, and the symbol sizes are also measured in inches.

REDUCTION

REDUC is the reduction factor, which is a ratio of the report plot size to the original plot size.

HEIGHT

PHNUM is the HEIGHT of the numeric or alphabetic scale label.

PHLAB is the HEIGHT of the axis label.

PHLEG is the HEIGHT of the legend.

PHKEY is the HEIGHT of the key label.

PHSUB is the HEIGHT of subscripts and superscripts.

PHX10 is the HEIGHT of X for X 10 to a power in numeric labels.

PHEXP is the HEIGHT of the exponent for X 10 to a power in numeric labels.

PHNUM, PHLAB, PHLEG, PHKEY, PHSUB, PHX10, and PHEXP are shown in Example 6.

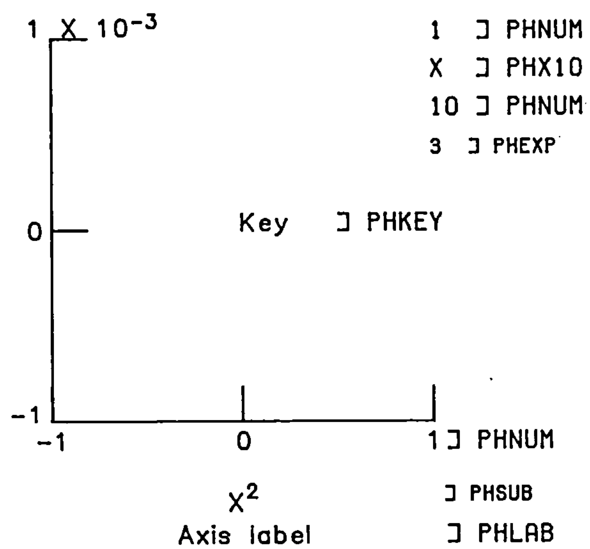


Figure 1. - Legend.] PHLEG

Example 6

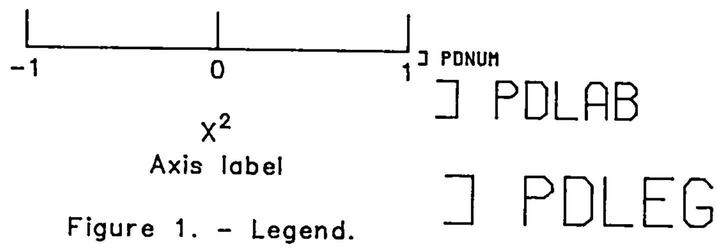
DISTANCES TO THE LABELS

PDNUM is the distance measured from the axis to the top of the numeric scale label.

PDLAB is the distance measured from the bottom of the numeric scale label to the top of the axis label.

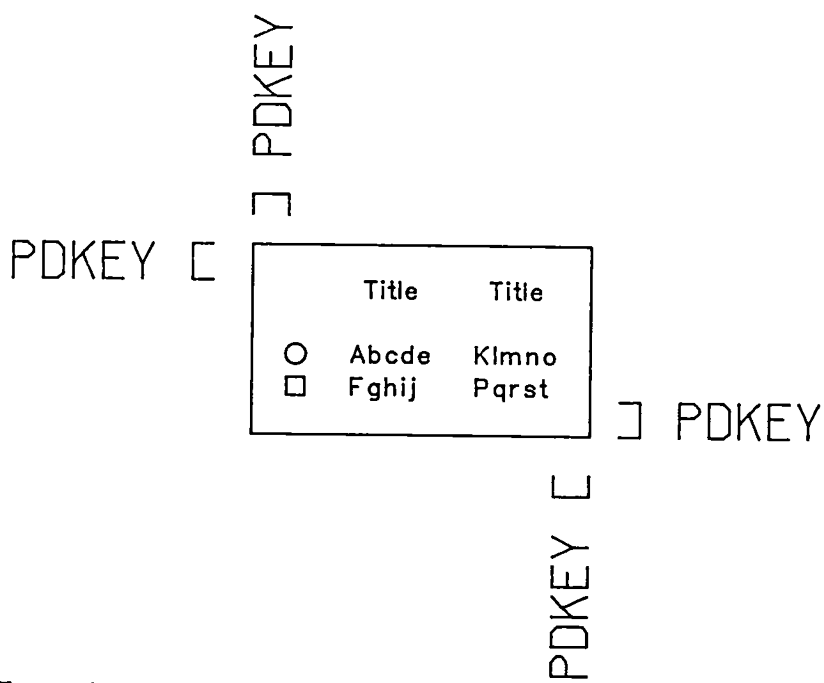
PDLEG is the distance measured from the bottom of the axis label to the top of the legend.

PDNUM, PDLAB, and PDLEG are shown in Example 7.



Example 7

PDKEY is the distance measured from a box enclosing the key to the key labels (margin). PDKEY is shown in Example 8.



Example 8

DISTANCES BETWEEN LINES AND COLUMNS

PBLIN is the distance measured from the bottom of one line to the top of the next line. PBLIN is shown in Example 9. It should be noted that the size of this example is twice the normal page size in order to illustrate PBLIN.

Line 1

] PBLIN

X^2_L

] PBLIN

Line 3

Example 9

PBLEG is the distance measured from the bottom of the sublegend to the top of the legend. PBLEG is shown in Example 10.

(a) Sublegend.

] PBLEG

Figure 1. - Line 1 of legend should be typed here.
Line 2.

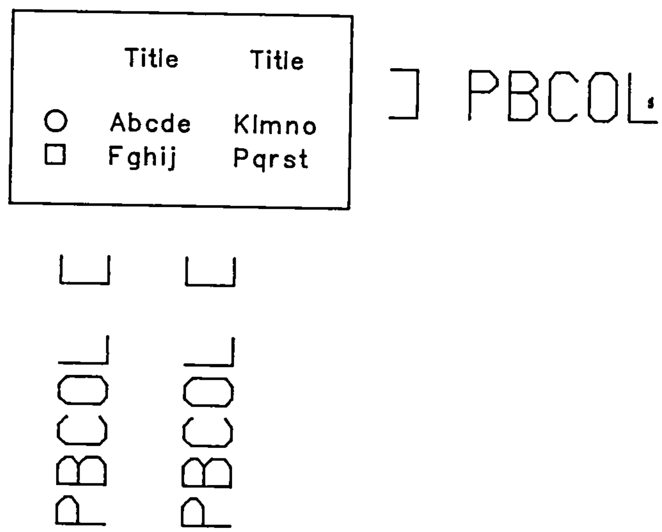
] PBLIN

Example 10

To calculate the above legend area:

Legend area = PDLEG + PHLEG + PBLEG + PHLEG + PBLIN + PHLEG

PBCOL is the distance measured between columns in the key and also between the title and the identification column. PBCOL is shown in Example 11.



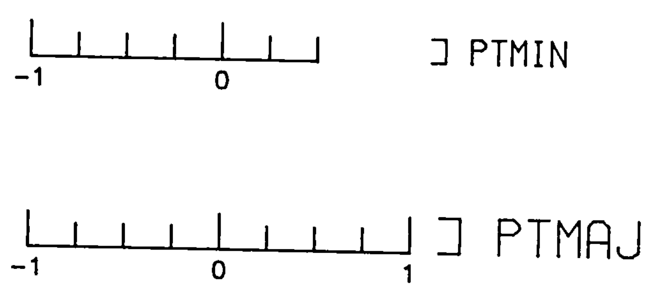
Example 11

LENGTH OF TICK MARKS

PTMAJ is the length of a major tick mark.

PTMIN is the length of a minor tick mark.

PTMAJ and PTMIN are shown in Example 12.



Example 12

SYMBOL SIZE

PSYMS is the height of a NASA standard symbol measured in inches. PSYMS is shown in Example 13.

○] PSYMS

□] PSYMS

Example 13

PEN SIZE

IPENS is the Leroy pen size and is shown in Example 14. The pen size is determined by REDUC as follows:

REDUC	PEN SIZE
1.-.55	3
.55-.40	4
.40-.20	5

3 for Leroy .3 mm pen size.

4 for Leroy .4 mm pen size.

5 for Leroy .5 mm pen size.

Example 14

Publication Capability Activated

If the publication capability is activated, the labeling size (HEIGHT), symbol size, and lengths are determined and used as follows:

HEIGHT

The two levels of labeling are:

1. Labeling using the basic text subroutines (CHARACT, COLUM, ENUMBER, and NUMBER).

2. Labeling using routines that call the basic text subroutines.

HEIGHT in level 1

The HEIGHT specified in level 1 subroutines (CHARACT, COLUM, ENUMBER, and NUMBER) is used. You can change the HEIGHT in these basic text subroutines by using the Gppppp subroutines to get the value for any publication parameter ppppp. For example, to use the publication parameter PHLAB in subroutine CHARACT:

```
CALL GPHLAB(HEIGHT)
CALL CHARACT(X,Y,HEIGHT,...
```

HEIGHT in level 2

The HEIGHT specified in level 2 subroutines (AXES, AXESLOG, AXISB, HALABEL, KEY, POLRGRD, and VALABEL) is ignored and the publication parameters are used. Also, although HEIGHT is not specified in INFOPLT, the publication parameters are used.

SYMBOL SIZE

The symbol size, IS, specified in subroutines (LGLIN, LINPLT, PNTPLT, and RLINE) is ignored and the publication parameter PSYMS is used. Also, although IS is not specified in subroutines INFOPLT and KEY, the publication parameter PSYMS is used for the symbol size.

TICK MARK LENGTH

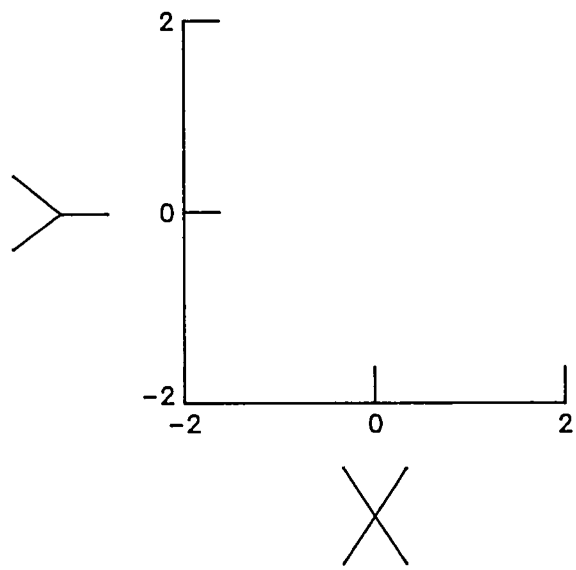
The tick mark length, DTICK, specified in subroutine DGRID is ignored and the publication parameter PTMAJ is used for the tick mark length.

Changing and/or Using a Publication Parameter

The capability is available to get the values of the publication parameters (Gppppp where ppppp is the parameter name) and to set these values (Sppppp). For example, CALL GPSYMS(SYMS) would return in parameter SYMS the symbol size in inches and CALL SPSYMS(.5) would change the symbol size to 0.5 inch (12.7 mm).

The publication parameters all begin with a P and are five characters. The subroutine names to set or get these parameters have a prefix of S or G and are six characters.

An example of changing a publication value is generated to illustrate exactly how this capability works. PHLAB is the height of the axis label and has been set to a value of 0.5 by CALL SPHLAB(.5) as shown in Example 15. It should be noted that PHLAB is changed but PHNUM is not changed.



Example 15

Publication Parameter Values for Page Size

The default publication values for a page size plot are defined as follows:

REDUCTION		
REDUC	1.000	
PEN SIZE		
IPENS	3	
HEIGHT	inches	(mm)
PHNUM	.086	(2.2)
PHLAB	.086	(2.2)
PHLEG	.086	(2.2)
PHKEY	.086	(2.2)
PHSUB	.069	(1.8)
PHX10	.086	(2.2)
PHEXP	.069	(1.8)
DISTANCES TO THE LABELS		
PDNUM	.063	(1.6)
PDLAB	.188	(4.8)
PDLEG	.250	(6.4)
PDKEY	.188	(4.8)
DISTANCES BETWEEN LINES AND COLUMNS		
PBLIN	.081	(2.1)
PBLEG	.188	(4.8)
PBCOL	.250	(6.4)
TICK MARK SIZE		
PTMAJ	.188	(4.8)
PTMIN	.125	(3.2)
SYMBOL SIZE		
PSYMS	.086	(2.2)

Table of Range of Publication Values

A table illustrating the range of values for X and Y image sizes (in inches (mm)) and the corresponding REDUC (reduction factor), HEIGHT (height of labeling), PSYMS (symbol size), IPENS (pen size), and a SAMPLE (character size drawn with corresponding pen size) is:

X IMAGE SIZE	Y IMAGE SIZE	REDUC	HEIGHT	PSYMS	IPENS	SAMPLE
7.125 (181.0)	9.1875 (233.4)	1.000	.086 (2.2)	.086 (2.2)	3	Sample
7.917 (201.1)	10.208 (259.3)	.900	.096 (2.4)	.096 (2.4)	3	Sample
8.906 (226.2)	11.484 (291.7)	.800	.107 (2.7)	.107 (2.7)	3	Sample
10.179 (258.6)	13.125 (333.4)	.700	.123 (3.1)	.123 (3.1)	3	Sample
11.875 (301.6)	15.313 (389.0)	.600	.143 (3.6)	.143 (3.6)	3	Sample
14.250 (362.0)	18.375 (466.7)	.500	.172 (4.4)	.172 (4.4)	4	Sample
17.813 (452.5)	22.969 (583.4)	.400	.215 (5.5)	.215 (5.5)	5	Sample
23.750 (603.3)	30.625 (777.9)	.300	.287 (7.3)	.287 (7.3)	5	Sample
28.500 (723.9)	36.750 (933.4)	.250	.399 (10.1)	.399 (10.1)	5	Sample

LABELING

The routine (CHARACT) generates labels consisting of alphanumeric information and some special characters. The size of the label is determined by the height of the full-size character. The width of each character may vary, but the width of the digits is constant. There is a routine (CHARWH) that will determine the width of a character string.

The height of a full-size character for a page size plot should be 0.086 inch (2.2 mm). All labeling on a plot should be the same size. This includes all scale labels, axis labels, keys, and any other special labeling.

Character Sets Recommended

There are several character font sets available in the LaRC Graphics Output System. The following characters sets are recommended for publication:

Character set 3
Character set 4 for Greek

The recommended character sets, drawn at the correct size for a page size figure with no publication reduction requirement, are shown in Example 16.

This is an example using character set 3
Τθιτ ιτ αξ εωανπμε φτιξη γθασαγνεσ τευ 4

Example 16

In addition, the expanded character font capability provides the capability to control upper and lower case as shown in Example 17, the ability to generate one level of superscript and three levels of subscripts as shown in Example 18, and the ability to mix the character fonts as shown in Example 19.

The size of the superscripts and subscripts is 0.8 the size of the base character.

NASA Report	$X^2_{n_{A_C}}$	C_{l_β}
Example 17	Example 18	Example 19

Numbers

The routines (NUMBER and ENUMBER) generate numbers in the format of an integer number (no decimal point), a number with a specified number of decimal places, or a number written X 10 to a power. These routines round the number at the required decimal place and write the numbers left justified. The different formats available to write the number, 1234.5, is shown in Example 20.

1235	1235.	.1235 X 10^4
	1234.5	.12345 X 10^4
		1235 X 10^0
		12345 X 10^{-1}

Example 20

The routine (COLUM) generates numbers right justified. If numbers are written in a table, the numbers are written right justified with decimal places aligned as shown in Example 21.

```
1234.5
   0.0
-778.2
```

Example 21

SCALING

The routines (BSCALE, ASCALE) scale the data and generate an acceptable scale for publication. The scales should be determined so that the data can be easily read. The data are scaled by the following equation:

SV=(AE-AMV)/SF

where

SV = scaled value
AE = present value of data
AMV = computed adjusted minimum value (origin)
SF = computed scale factor

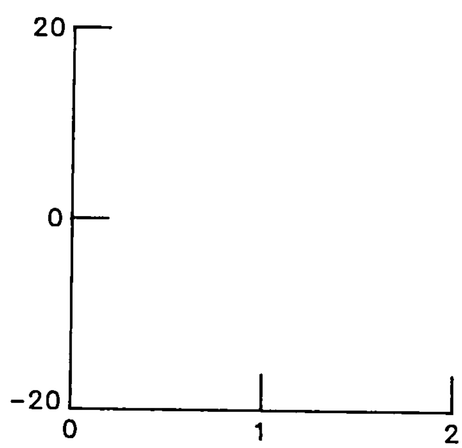
The scale factor is the change in scale per scale increment. The scale factor is calculated by the following:

SF=A*10**J

where

A is 1,2,4, or 5
J is an integer power.

The origin and scale factor are shown in Example 22. The origin value is 0 and the scale factor is 1 for the X. The origin value is -20 and the scale factor is 20 for the Y.



Example 22

SCALE INCREMENT IDENTIFIERS

Three methods of identifying the scale increments on the plots are:

- Tick marks
- Coarse grids
- Preprinted grid paper

Tick Marks

Tick marks are short lines at indicated intervals denoting scale values. The routines that generate tick marks are AXES or GRID for rectangular coordinates, AXESLOG or LOGRID for logarithmic coordinates, and POLRGRD for polar coordinates. For rectangular or logarithmic plots, the tick marks extend in from the axis. For polar plots, the tick marks extend out from the circumference.

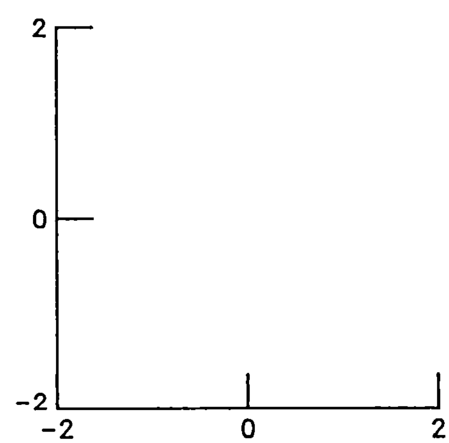
There are two types of tick marks:

- Major tick marks
- Minor tick marks

Major tick marks are longer than minor tick marks and are labeled.

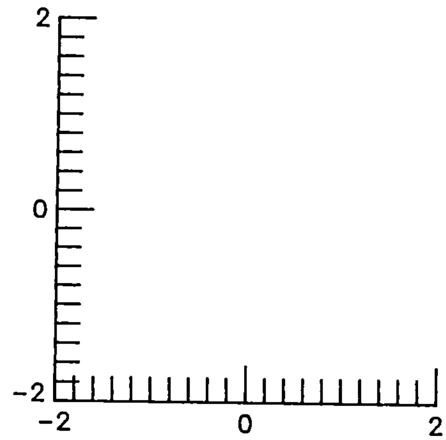
Minor tick marks are placed between major tick marks to help identify scale increments.

Normally for rectangular plots tick marks are generated for the left vertical axis and the lower horizontal axis. The routine (AXES or GRID) is used to generate tick marks for rectangular scales. The use of major tick marks only is shown in Example 23. An axis should always end with a major tick mark.



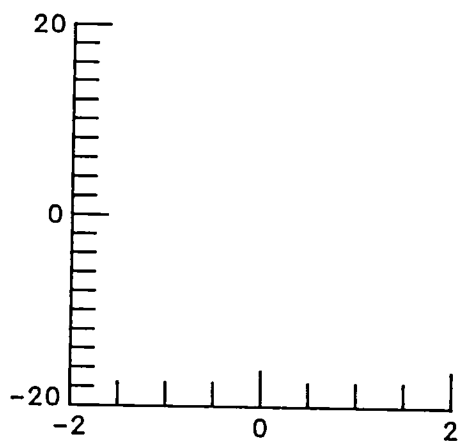
Example 23

The use of major tick marks and accompanying minor tick marks is shown in Example 24. In this example, the minor tick marks are used to indicate 10 divisions per major tick mark increment. When choosing the number of minor tick marks to use, it is important to consider how the tick mark pattern will appear after the plot has been reduced to page size. If a large number of minor tick marks are used on a large plot, the tick marks may not be legible after the plot is reduced.



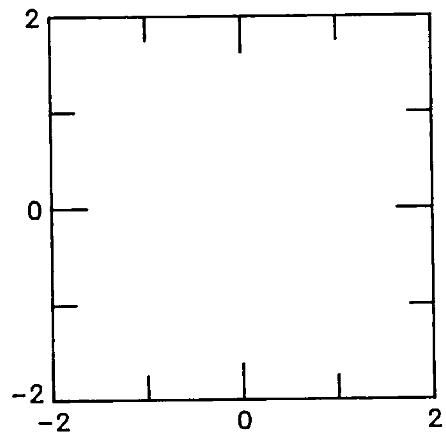
Example 24

The number of minor tick marks can be different for both axes as shown in Example 25.



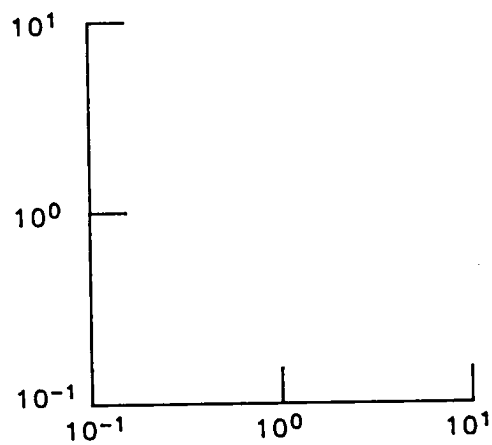
Example 25

Normally tick marks are generated for the left vertical axis and the lower horizontal axis only, but tick marks can be generated for the right vertical axis and the upper horizontal axis, thus enclosing all four sides of the plot as shown in Example 26.



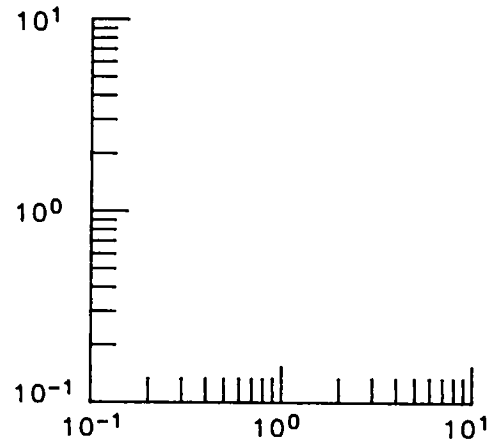
Example 26

For logarithmic plots the routines (AXESLOG or LOGRID) are used to generate tick marks. The use of major tick marks only for logarithmic scales is shown in Example 27.



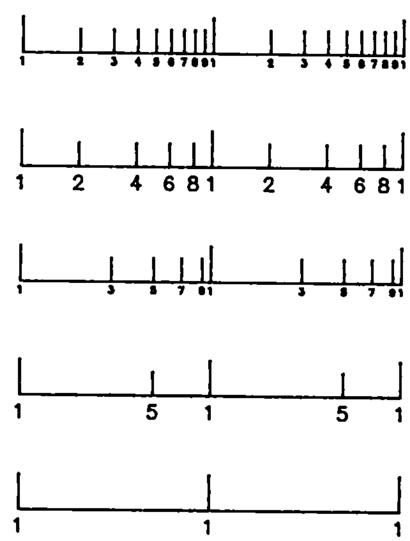
Example 27

The use of major tick marks and accompaning minor tick marks for logarithmic scales is shown in Example 28.



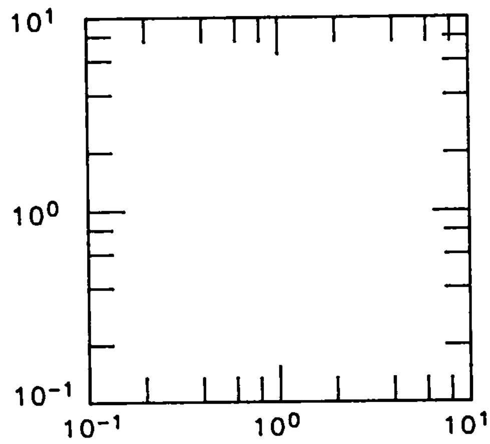
Example 28

There are several patterns of minor tick marks available for logarithmic plots as shown in Example 29. In this example, the minor tick marks are labeled, but the spacing of the minor tick marks does not allow the numeric labels to be the appropriate size for publication. Minor tick marks should not be labeled unless the pattern is large enough to allow the numeric labels to be the appropriate size for publication. The pattern that best suits the data presented should be chosen if the minor tick marks are needed.



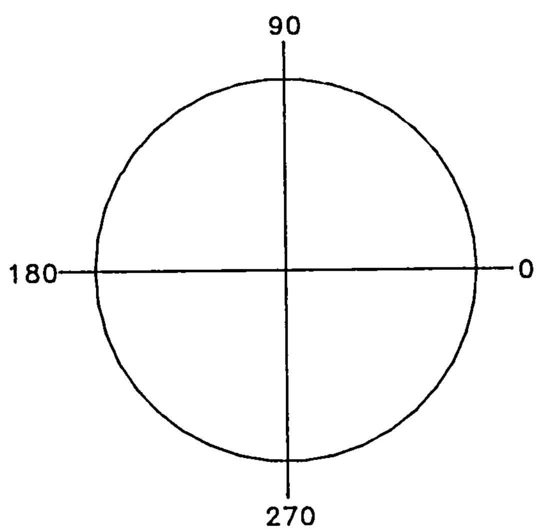
Example 29

Normally tick marks are generated for the left vertical axis and lower horizontal axis only, but tick marks can be generated for the right vertical axis and the upper horizontal axis, thus enclosing all four sides of the plot as shown in Example 30.



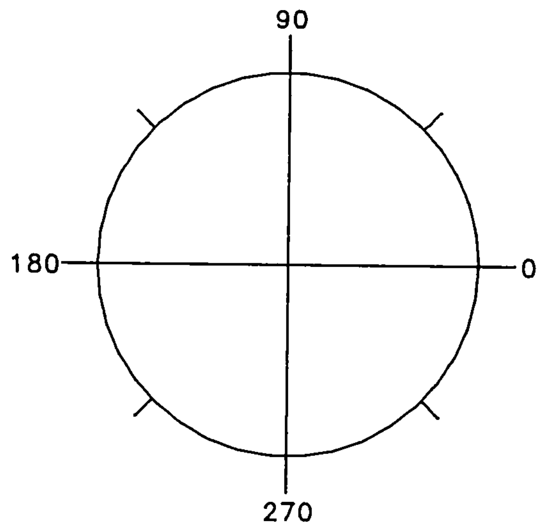
Example 30

The routine (POLRGRD) is used to generate tick marks for polar scales. The use of major tick marks only for polar scales is shown in Example 31. The major tick marks are drawn at the axes intersections only.



Example 31

The use of major tick marks and accompanying minor tick marks for polar scales is shown in Example 32. The major tick marks are generated at the axes intersection and the minor tick marks are generated every 45 degrees. Also, it is acceptable to use only the first quadrant.

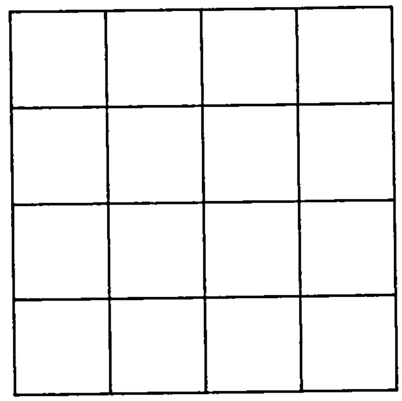


Example 32

Coarse Grids

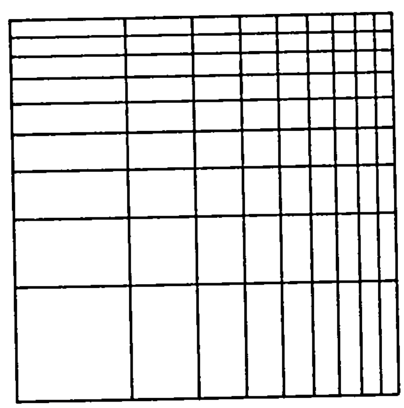
A coarse grid can be used for data that show trends and do not have to be read precisely.

A coarse grid pattern for rectangular scales, generated by GRID, is shown in Example 33.



Example 33

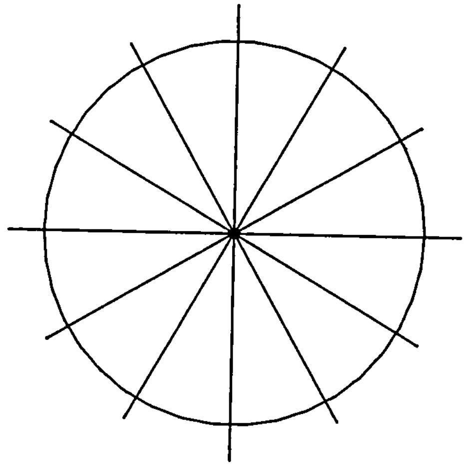
A grid pattern for logarithmic scales, generated by LOGRID, is shown in Example 34. Since this example is small and contains only one cycle, each scale increment is drawn, but for larger plots with more cycles, this grid pattern might be too fine.



Example 34

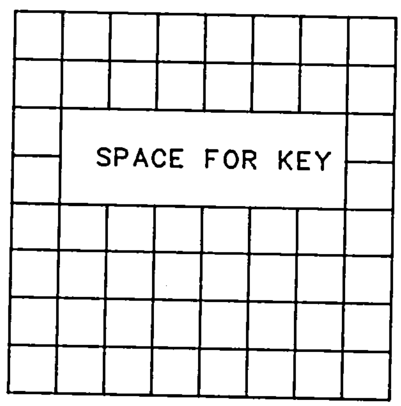
If possible, the grid for logarithmic scales should only be drawn at the beginning of each cycle. This would generate a pattern as shown in Example 33.

A coarse grid pattern for polar scales, generated by POLRGRD, is shown in Example 35. In this example a grid line is drawn every 30 degrees.



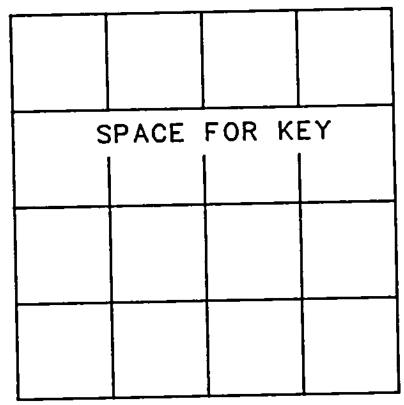
Example 35

A routine (GRIDB) is available to generate a coarse grid pattern for rectangular scales in which a blank area has been left for keys. If possible the blank area of the key should align with the grid lines as shown in Example 36.



Example 36

If the key cannot be aligned with the grid, then no outer boundary should be drawn around the blank area as shown in Example 37.



Example 37

A routine (LOGRIDB) is available to generate a coarse grid pattern for log-log or semi-log scales in which a blank area has been left for the key.

Preprinted Grid Paper

There are two types of preprinted grid paper recommended:

RED preprinted grid paper is used to retain grid.
BLUE preprinted grid paper is used to drop grid.

The preprinted grid is available in two patterns:

10 divisions/inch
20 divisions/inch

One of the major problems with publication of computer-generated plots is the requirement that the plots be generated on preprinted grid paper when the fine grid needs to be retained. You should carefully review the necessity of retaining the fine grid depending on the accuracy and type of data presented. If the fine grid does not have to be retained, you can use tick marks or a coarse grid and generate the complete plot on the plotter eliminating any hand labeling and blocking out of excess grid for the margins. If the fine grid does have to be retained, you must blank out areas for margins and generate the scale labels, axis labels, and keys on blank paper. At present there is no production plotter at the central site that can plot on correction paper, but labels and keys can be generated on the CalComp drum plotter using blank paper and be glued on the preprinted grid.

An example of generating the plots in frame 1 and the keys in frame 2 in an alternating pattern is:

```
CALL CALPLT(1.,1.,-3)
CALL GRIDCK
CALL AXES(0.,0.,0.,...
CALL AXES(0.,0.,90.,...
CALL LINPLT(XARRAY,YARRAY,...
CALL NFRAME

CALL KEY(0.,2.,,,
CALL NFRAME
```

Frames 1,3,5 can be plotted on the CalComp drum plotter using preprinted grid paper and frames 2,4,6 can be plotted on the CalComp drum plotter using blank paper by using the EDIT parameter in the postprocessor as shown below:

```
PLOT.CALPOST,11(EDIT(1,5,2))
CONT.//RED GRID, 10 DIVISIONS/INCH
CONT.  LEROY 3, BLACK INK
CONT.  PLEASE CHECK FOR GRID ALIGNMENT
CONT.  PUBLICATION FIGURES //

PLOT.CALPOST,11((EDIT(2,6,2))
CONT.//LEROY 3 PEN, BLACK INK, BLANK PAPER
CONT.  PUBLICATION FIGURES //
```

Another problem with using the preprinted grid paper is the effect of the atmospheric conditions on the paper. The atmospheric conditions can cause the paper to shrink or to expand; both conditions affect the accuracy of the paper. The routine GRIDCK is available to allow you to tell the plotting operator to stop the plotter and check for grid alignment at specified places. This was discussed in the Section entitled "Grid-Alignment Check."

AXIS ANNOTATION

The routines (AXES, AXISB, AXESLOG) generate an axis with scale labels and axis labels. Scale labels and axis labels are both placed outside the plot grid.

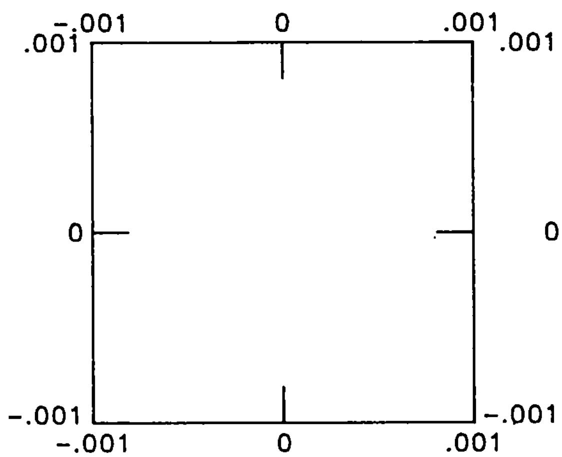
Scale Labels

The scale labels are written outside the grid area at specified increments and are always written horizontally for both the horizontal and vertical axes. The increments are usually indicated by major tick marks, a coarse grid, or heavy line intersections on preprinted grid paper.

There are two types of scale labels:

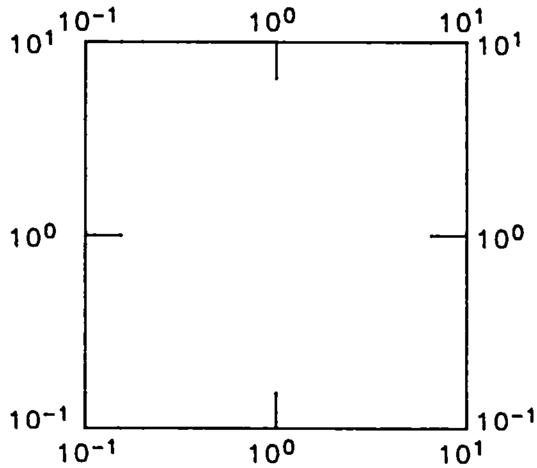
Numeric scale labels (AXES and AXESLOG)
Alphabetic scale labels (AXISB)

The routine (AXES) generates an axis with numeric scale labels for rectangular coordinates. The scale labels for both the horizontal and the vertical axes are written horizontally. The scale labels for the horizontal axis (X) are centered horizontally at the scale increments. The scale labels for the vertical axis (Y) are centered vertically at the scale increments and are right justified. Scale labels are written 0.063 inch (1.6 mm) from both axes as shown in Example 38.



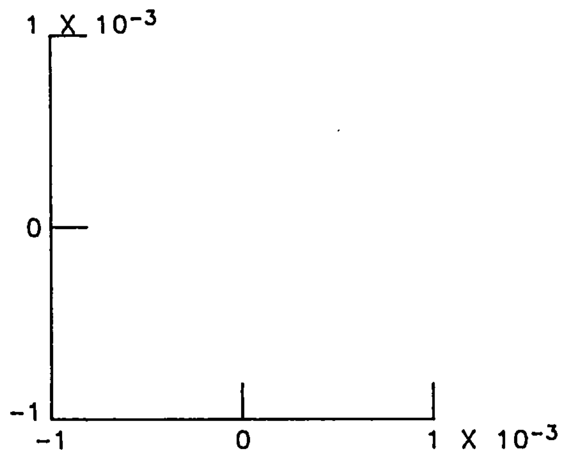
Example 38

The routine (AXESLOG) generates a logarithmic axis with scale labels. The numeric scales for logarithmic coordinates are written with the 10 to a power left justified for the vertical axis as shown in Example 39.



Example 39

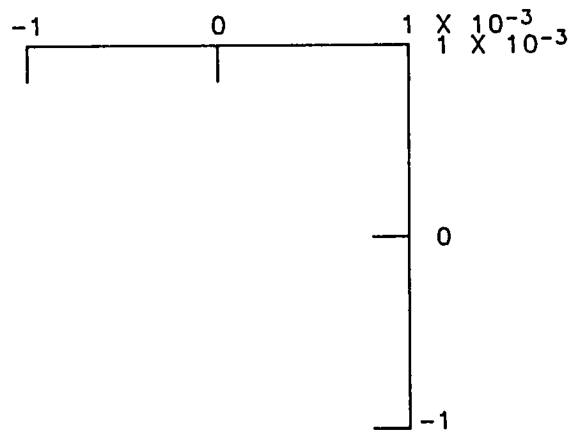
If the numeric labels are written to a power, the placement of X 10 to a power for the horizontal axis is placed to the right of the rightmost numeric label and for the vertical axis is placed to the right of the topmost numeric label as shown in Example 40. If the SI units are used, the prefixes for the units should be used in the axis label to replace X 10 to a power.



Example 40

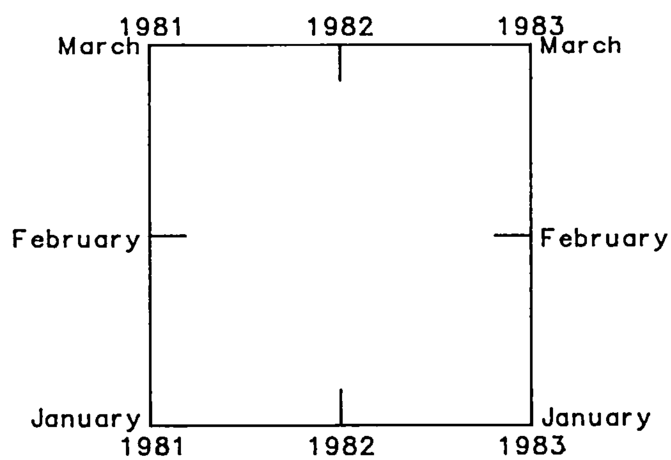
If the scales require X 10 to a power, it is recommended that X 10 to a power be part of the scale label and not be included in the axis label.

The placement of X 10 to a power for the top horizontal axis and right vertical axis is shown in Example 41. The placement of X 10 to a power on the left vertical axis would interfere with scales on the top horizontal axis.



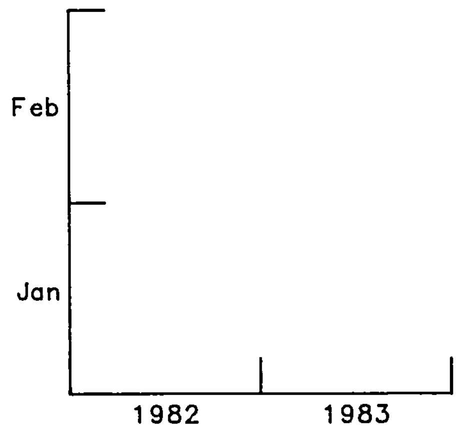
Example 41

The routine (AXISB) generates an axis with alphabetic scale labels. The scale labels are written horizontally for both the horizontal and the vertical axis. The alphabetic scale labels are written right justified for the left vertical axis and are written left justified for the right vertical axis. Only the first character of the first word should be capitalized. The alphabetic labels can be centered at scale increments for the horizontal axes as shown in Example 42.



Example 42

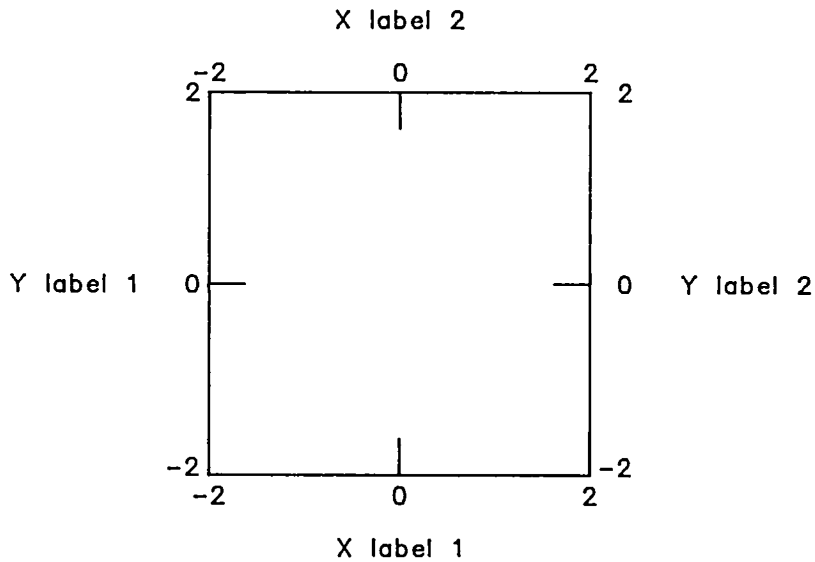
The alphabetic scale labels can also be centered between scale increments as shown in Example 43.



Example 43

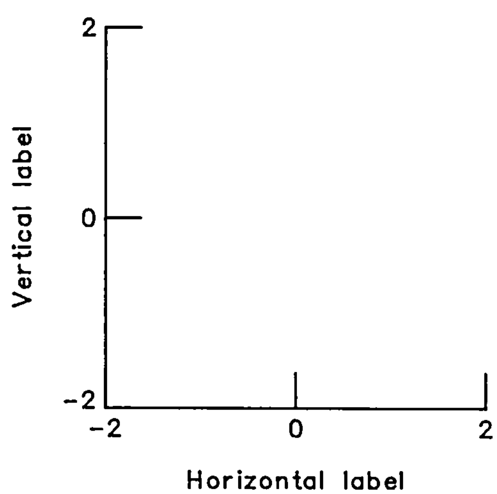
Axis Labels

If the Y axis label is less than 1 inch (25.4 mm) in length, then the preference is to write both the X and Y axis labels horizontally using HALABEL as shown in Example 44.



Example 44

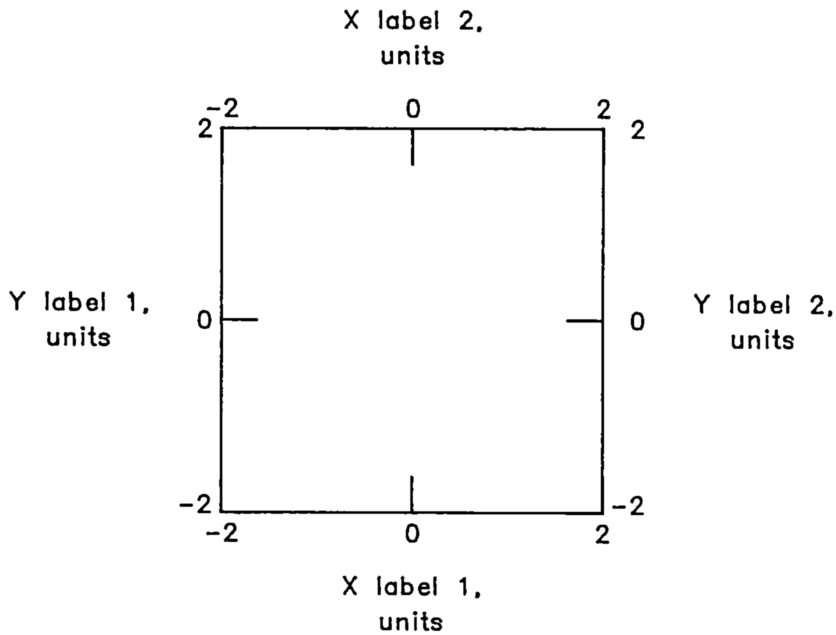
If the Y axis label is longer than 1 inch (25.4 mm), then the label should be written in a vertical fashion as shown in Example 45. If vertical labels are needed, then they should always read from the bottom of the plot to the top of the plot.



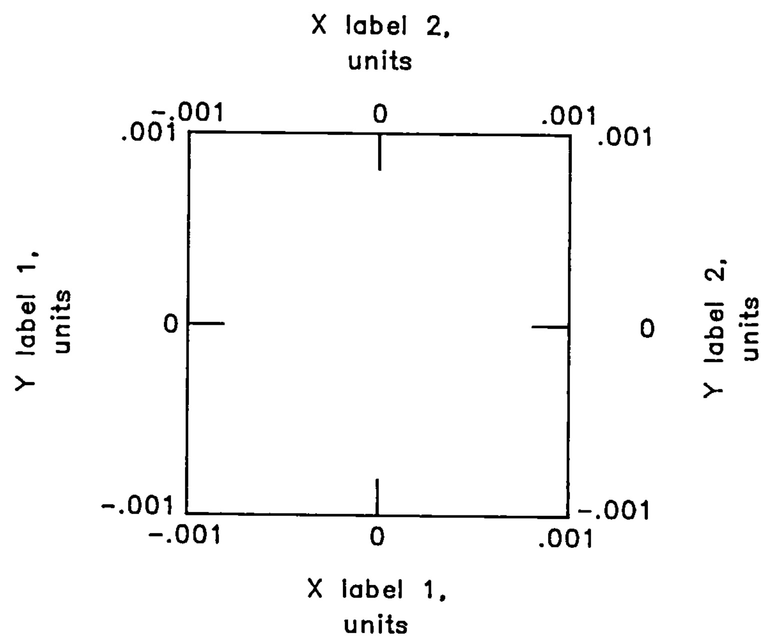
Example 45

The units should be included in the axis label and should be separated by a comma. Sometimes more than a one-line axis label is necessary. The routines (HALABEL, VALABEL) generate an axis label of more than one line. An axis label should not be cluttered with too many lines; usually three lines is a maximum number.

If more than one line is needed for the axis labels, then the labels should be centered as shown in Examples 46 and 47.



Example 46



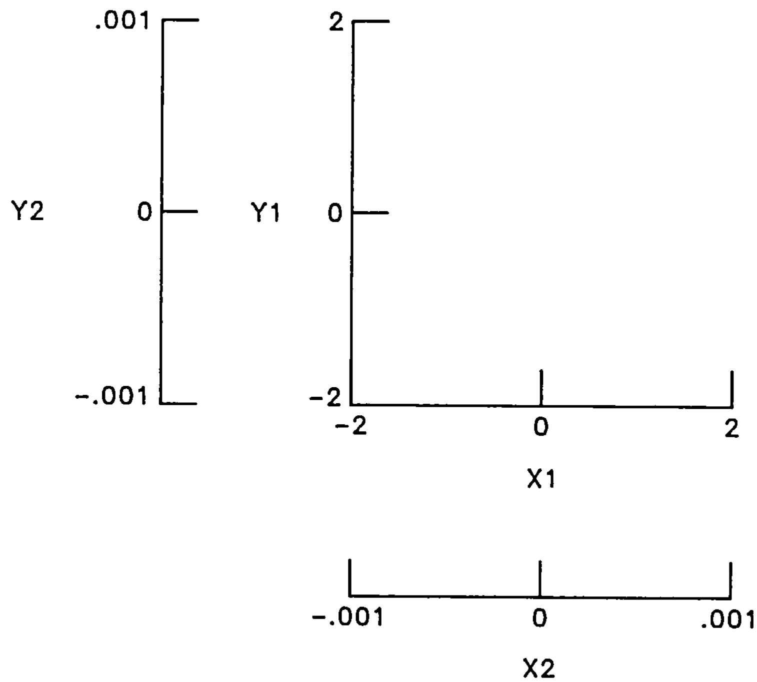
Example 47

There are two methods to identify a plot that needs two vertical scales and/or two horizontal scales.

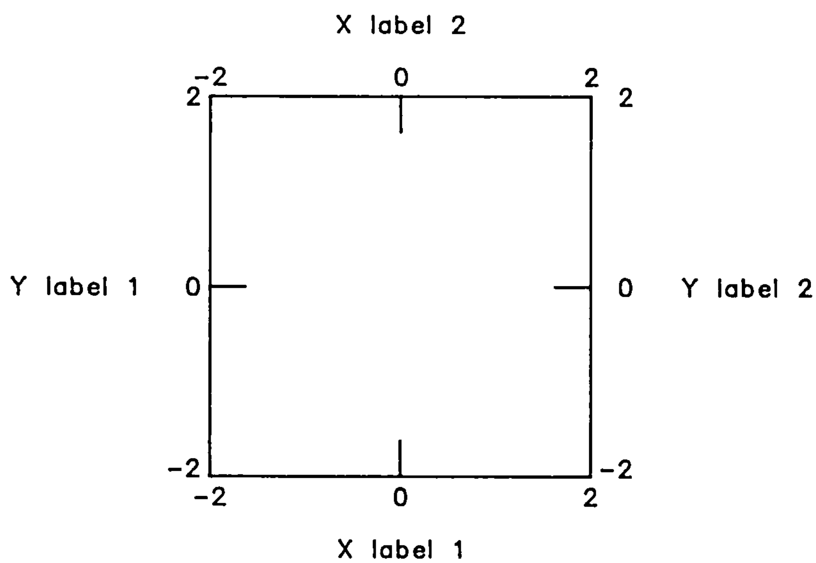
1. Both scale labels can be placed on the left side of the plot or on the bottom of the plot, respectively as shown in Example 48.

2. One vertical label can be placed on the left side and one on the right side or one horizontal label can be placed on the bottom and one on the top as shown in Example 49.

If both scales are on the same side, the SI units should be the closer to the plot. If scales are on different sides, the SI units should be on the bottom and/or left side.

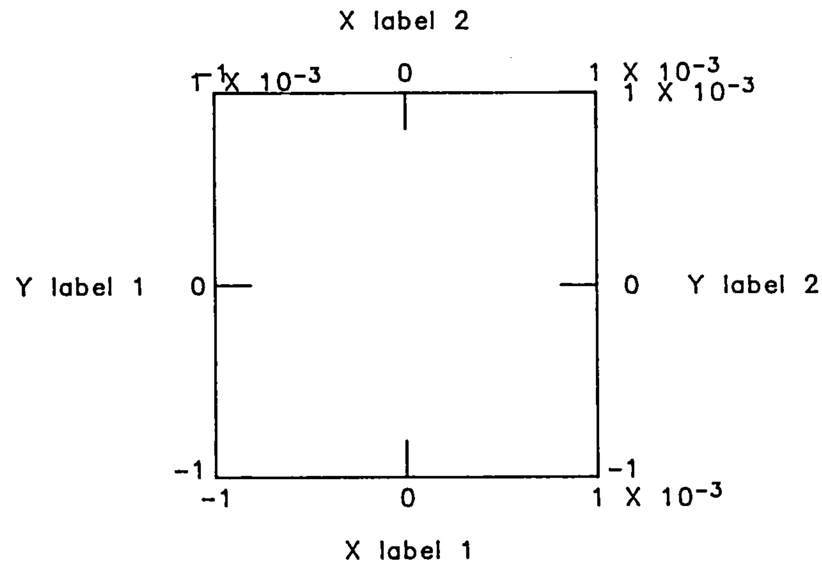


Example 48



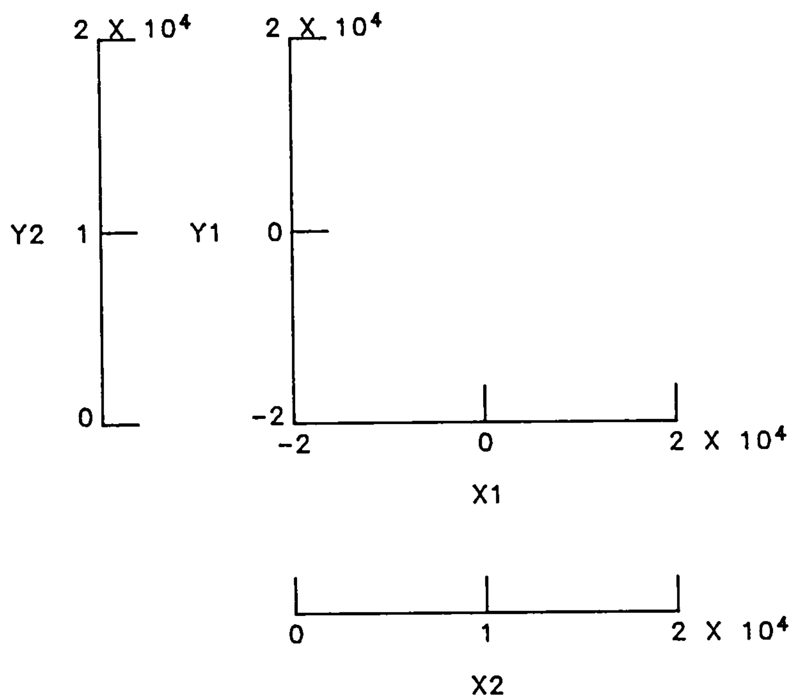
Example 49

If the scales are written to a power, then both scales should be on the same side to avoid an overwrite by X 10 to a power as shown in Example 50.



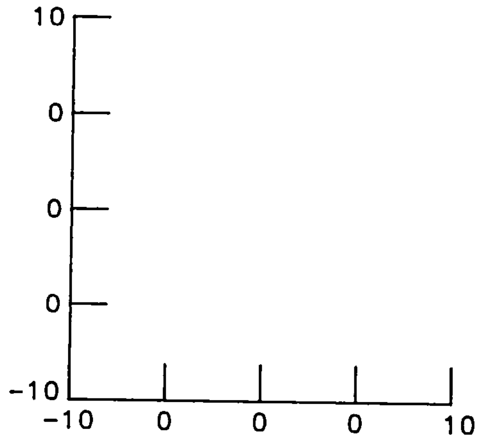
Example 50

The recommended positioning of scales when X 10 to a power is required is shown in Example 51.



Example 51

There are times when the plot is too complex if all the data are referenced from the same zero line. In this case, a staggered zero scale can be used as shown in Example 52.



Example 52

IDENTIFIERS

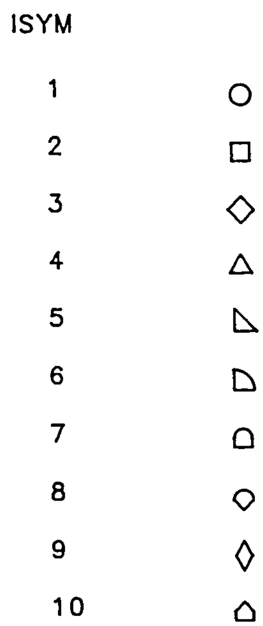
There are two basic types of identifiers for curve identification: the NASA symbol and the NASA recommended line pattern.

NASA Symbols

There are routines that will generate NASA standard symbols for rectangular plots, semi-log plots, log-log plots, or polar plots.

The recommended symbol size for publication quality is the same as the character height. If the publication parameters have been set, the symbol size will automatically be set to the same size as the characters in the labels. This capability will override the symbol size specified by the user in the subroutine call.

The recommended sequence of symbols generated by PNTPLT is shown in Example 53.



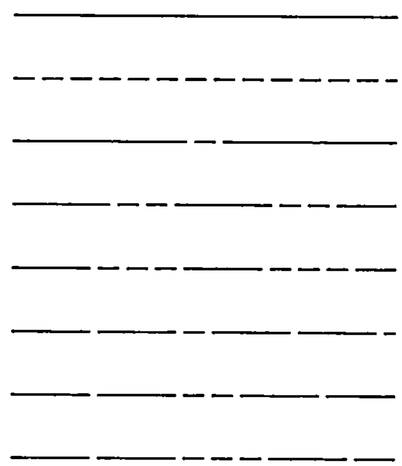
Example 53

When similar symbols are necessary for different sets of data, a flag can be added to the symbol as shown in Example 54.

Example 54

NASA Line Patterns

There are routines that draw the NASA recommended line patterns. These routines are LINPLT for rectangular coordinates, LGLIN for logarithmic coordinates, and RLINE for polar coordinates. These line patterns can be used to identify curves or can be used in conjunction with symbols to identify curves. The same line pattern should be used to represent the same condition throughout the report. The recommended NASA line patterns are shown in Example 55.



Example 55

DATA PLOTTING

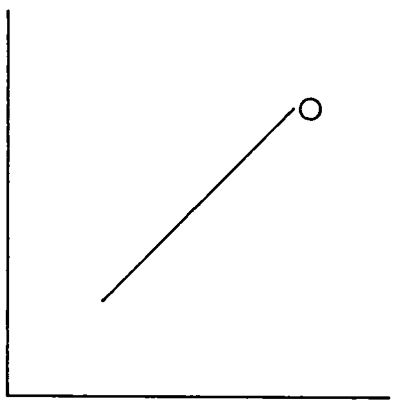
The NASA symbols and NASA recommended line patterns can be used as follows:

1. To identify curves with a single NASA symbol offset at the end of the line as shown in Example 56.

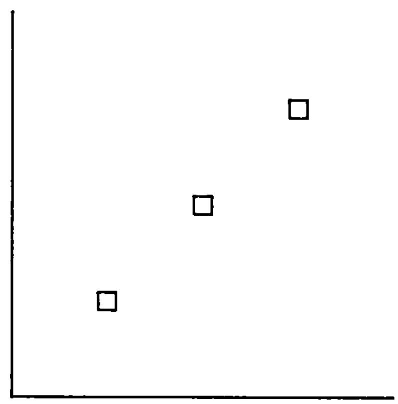
2. To plot a curve using symbols only as shown in Example 57.

3. To plot a curve using NASA symbols and using NASA recommended line patterns between symbols as shown in Example 58 and 59.

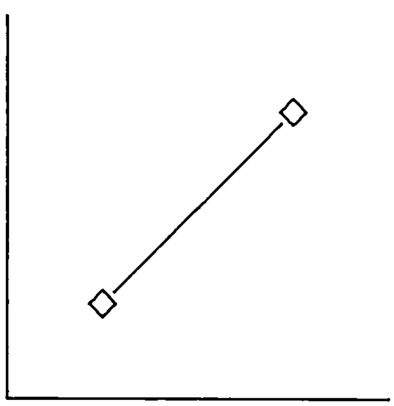
It is recommended that the lines be drawn between the symbols and not drawn through the symbols for a given curve.



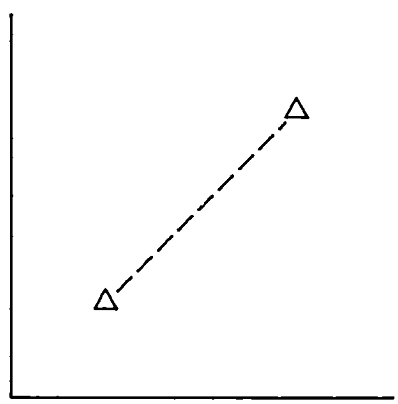
Example 56



Example 57



Example 58



Example 59

KEYS

The routine (KEY) generates a key using NASA standard symbols, NASA symbols with NASA recommended line patterns, and NASA line patterns. A key for a page size figure is set up with:

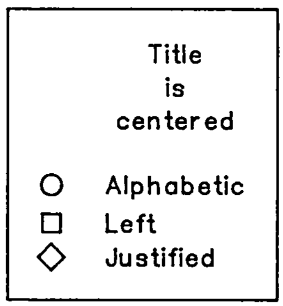
A 0.18 inch (4.8 mm) margin.
A 0.25 inch (6.4 mm) spacing between columns.
A 0.25 inch (6.4 mm) space between title and column identification.

The location of the key is dependent on the data, but a recommended location is the upper right-hand corner.

An option to draw a box around the key is provided in the subroutine KEY, but the preferred way is to exclude the box around the key. The box is drawn in these examples to illustrate the spacings used.

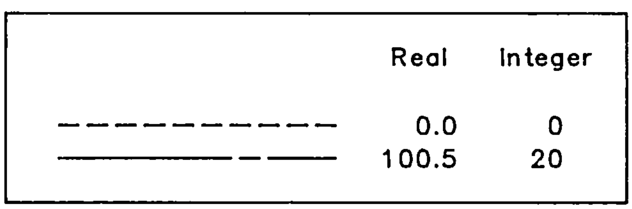
Usually most keys have titles for each column, and each title is centered over the identification column.

Any column that contains alphabetic information is left justified. An example of a simple key using NASA symbols and alphabetic identification with a title is shown in Example 60.



Example 60

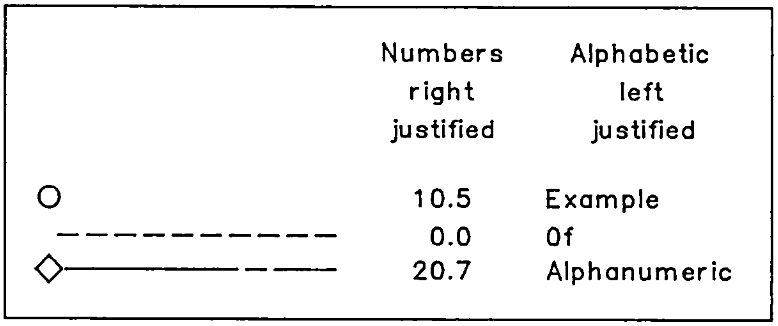
Any column that contains numeric information is right justified. An example of a simple key using NASA recommended line patterns with both FORTRAN I and F format is shown in Example 61.



Example 61

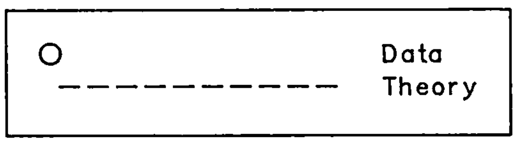
There should be a maximum of five columns of identification used in any one key. If more than five columns are necessary, some other provision such as a table should be used.

An example of a key containing NASA symbol, NASA symbol with line, and line pattern is shown in Example 62.



Example 62

In some cases a title is not necessary as shown in Example 63.



Example 63

COLOR AND SHADING

There is a capability to generate color plots and shaded plots, but any requirements for color or shading should be discussed first with the Publications Branch before any plots are generated.

Color printing is controlled by the Joint Committee on Printing, Congress of the United States; therefore, a memorandum justifying your color requirements, signed by your division chief, is required.

APPENDIX A

OUTLINE OF RULES

PLOTTER OUTPUT RECOMMENDED FOR PUBLICATION

CalComp 1055 Drum

Versatec

PAPER

Blank paper

Preprinted grid
  Red is used to retain the grid.
  Blue is used to drop the grid.

PEN

Leroy pen is recommended for publication.
- Size 3 for figures in the range of 9.2 X 7.1 to 16.5 X 13 inches (233.4 X 181.0 to 419.1 X 330.2 mm).
- Size 4 for figures in the range of 16.5 X 13 to 23.0 X 17.5 inches (419.1 X 330.2 to 584.2 X 444.5 mm).
- Size 5 for figures in the range of 23 X 17.5 to 40 X 29 inches (584.2 X 444.5 to 1016 X 736.6 mm).

Ballpoint pen is not recommended for publication.

INK COLOR

Black is the recommended color for publication.

TYPES OF FIGURES

The preferred type of figure is the vertical figure.

If the data necessitate, a horizontal figure is used.

PLOT ORIENTATION

If possible, all plots should be oriented the same throughout the report.

PLOT PERSPECTIVE

The plot perspective basic rule is that the plot should be read from one point.

The reader should not have to rotate the paper in order to read the entire figure except for a long vertical label.

AREAS

Image area is 7 1/8 X 9 3/16 inches (181.0 X 233.4 mm).

Legend area includes the legend and a 0.25 inch (6.4 mm) space separating the legend and the plot area.

Plot area is image area minus legend area.

LEGENDS

The legend for a figure includes the figure number and the title of the plot.

The legend is typed with an elite style type as a last step in the Langley publication process.

The legend is separated from the plot area by 0.25 inch (6.4 mm).

Each line of a legend takes 0.086 inch (2.2 mm) to write.

The legend and sublegend are separated by 0.188 inch (4.8 mm).

The distance between two lines of a legend is 0.081 inch (2.1 mm).

LABEL SIZES

All labeling on a plot should be the same size.

Subscripts and superscripts are 0.8 size of the base.

Character height of a full size character for a page size plot is 0.086 inch (2.2 mm).

CHARACTER SETS

The following character sets are recommended for publication:
Character set 3
Character set 4 for Greek letters

NUMBERS

Numbers are written in FORTRAN I or F format or as X 10 to a power.

SCALING

Scales should be chosen that allow the data to be easily read.

The same scale should be used throughout the report for the same type of data.

SCALE INCREMENT IDENTIFIERS

Tick marks are used for data that show trends.

Coarse grid is used for data that do not need to be read precisely.

Preprinted grid paper can be used for data that need to be read precisely.

TICK MARKS

Tick marks should be placed within the grid border.

Tick borders are usually given for two sides of the figure containing scale labels, (left vertical and bottom horizontal), but can be given for all sides.

Major tick marks are labeled.

Major tick marks are longer than minor tick marks.
Major tick marks for page size = 0.188 inch (4.8 mm).
Minor tick marks for page size = 0.125 inch (3.2 mm).

GRIDS

Only coarse grids should be generated.

GRIDS WITH BLANK AREAS FOR KEYS

If possible, the blank area of the key should align with the grid lines.

If the key area cannot align with the grid lines, then no outer boundaries should be drawn around the key.

PREPRINTED GRID PAPER

Divisions
- 10 divisions/inch
- 20 divisions/inch

Color
- Red is used to retain the grid.
- Blue is used to drop the grid.

AXIS SCALE LABELS

Scale labels are written outside the grid area at specified increments.

Increments are identified by one of the following:
- Tick marks
- Coarse grid
- Preprinted grid paper

Two types of scale labels are:
- Numeric
- Alphabetic

NUMERIC SCALE LABELS

Rectangular

Scale labels are written horizontally.

Scale labels are written 1/16 inch (1.6 mm) from the axis.

Scale labels are written right justified for the vertical axis and are centered at the grid intersections.

Scale labels are centered for the horizontal axis.

X 10 to a power for the horizontal axis should be placed to the right of the rightmost number.

X 10 to a power for the right vertical axis should be placed to the right of the top number.

X 10 to a power for the left vertical axis should be placed at the top above the tick mark.

Logarithmic

Scale labels written as a power of 10 are written with the 10 left justified for the vertical axis.

Scale labels should be written only at the beginning of the cycle unless the data require labels between cycles.

ALPHABETIC SCALE LABELS

Scale labels are written horizontally.

Scale labels are written right justified for the left vertical axis.

Scale labels are written left justified for the right vertical axis.

Only first letter of first word of scale label is capitalized.

AXIS LABELS

The horizontal axis label should be written horizontally.

The vertical axis label should be written horizontally if a single symbol is used or if the label is less than or equal to 1 inch (25.4 mm).

The vertical axis label is written vertically if the label is longer than 1 inch (25.4 mm).

If more than 1 line is needed for the axis label, the labels should be centered.

A vertical axis label written vertically should always read from the bottom of the plot to the top of the plot.

An axis label should not be cluttered with too many lines. Usually 3 is a maximum number of lines.

MULTIPLE AXIS LABELS

If a plot needs two horizontal axis labels, both labels can be placed at the bottom or one label placed at the bottom and one placed at the top.

If a plot needs two vertical axis labels, both labels can be placed on the left side or one label placed on the left side and one on the right side.

Except for units, only the first letter of the first word of the axis label is capitalized.

IDENTIFIERS

Two types of identifiers are:
- NASA standard symbols
- NASA recommended line patterns

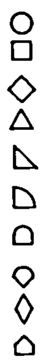
NASA SYMBOLS

The size of the symbol should be the same as the character height.

All symbols on a plot should be the same size.

Flagged symbols are sometimes used.

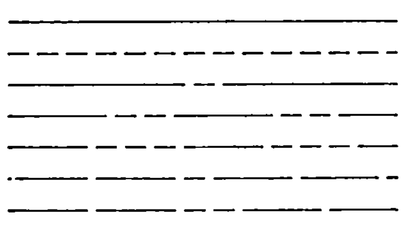
The recommended sequence of symbols is:



- circle
- square
- diamond
- triangle
- right triangle
- quadrant
- dog house
- fan
- long diamond
- house

LINE PATTERNS

The recommended sequence of line patterns is:



The same line pattern should be used to represent the same condition throughout the report.

DATA PLOTTING

For a given curve, lines should not be drawn through the symbols.

KEYS

A page size key has:
- A 0.188 inch (4.8 mm) margin
- A 0.25 inch (6.4 mm) space between columns
- A 0.25 inch (6.4 mm) space between title and column identification

A key should not be enclosed in a box.

Most keys have titles, unless a title is redundant.

Each title is centered over each identification column.

A column that contains alphabetic information is left justified.

A column that contain numeric information is right justified.

A key should contain no more than 5 columns.

When possible, the recommended location for a key is the upper righthand corner.

Listing of the FORTRAN V program used to generate all examples in this report.

```
      PROGRAM  EX(INPUT,OUTPUT)
      CHARACTER ALABEL(3)*10
      DIMENSION BOX(4)
      CHARACTER CHARA(6)*18
      CHARACTER CHARS*70
      CHARACTER CHARTA(6)*12
      DIMENSION FPN(3)
      DIMENSION ISYMA(10)
      DIMENSION LPA(3)
      DIMENSION NCHARTA(6)
      DIMENSION NCHARA(10)
      DIMENSION NLINEA(10)
      CHARACTER STAGLAB(5)*10
      DIMENSION XBOUND(7), YBOUND(7)
      DIMENSION XDATA(10), YDATA(10), YTDATA(10)
      DIMENSION XIMAGE(7), YIMAGE(7)
      DIMENSION XLINE(4), YLINE(4)
      DIMENSION XSYM(5), YSYM(5)
      DATA XBOUND/.25,4.25,4.25,.25,.25,0.,1./
      DATA YBOUND/.25,.25,2.75,2.75,.25,0.,1./
      DATA XDATA/-.002,0.,.002,.004,.006,.008,.010,.012,-.004,.004/
      DATA YDATA/-.002,-.001,.0005,.0025,.005,.009,.011,.013,-.004,.004/
      DATA YTDATA/-.001,0,.001,.003,.006,.010,.012,.014,-.004,+.004/
      DATA XIMAGE/0.,7.125,7.125,0.,0.,0.,1./
      DATA YIMAGE/0.,0.,9.1875,9.1875,0.,0.,1./
      DATA XLINE/0.,2.,0.,1./
      DATA YLINE/0.,0.,0.,1./
      DATA XSYM/1.,2.,3.,0.,2./
      DATA YSYM/1.,2.,3.,0.,2./
C VARIABLES
C     AL      ARROW HEAD LENGTH  (.125)
C     B       BOUNDARY
C     CHARS   CHARACTER STRING
C     DL      DASH LENGTH  (.25)
C     HA      HEIGHT ABOVE NORMAL BASE LINE OF CHARACTER STRING
C     HB      HEIGHT BELOW NORMAL BASE LINE OF CHARACTER STRING
C     HEIGHT  HEIGHT OF CHARACTER STRING
C     HEIGHT1 HEIGHT OF LINE 1
C     HEIGHT2 HEIGHT OF LINE 2
C     HGTK    HEIGHT OF KEY
C     HR      HEIGHT OF RECTANGLE FOR DEVICE BED
C     HSIZ    HORIZONTAL SIZE
C     I       INDEX
C     IN      CURRENT PEN CODE
C     IN1     INTEGER INPUT FOR KEY
C     IN2     INTEGER INPUT FOR KEY
C     IPENS   LEROY PEN SIZE (3,4,5)
C     LC      CODE TO CONTROL SCALE LABELS FOR LOGARITHMIC
C     LC1     CODE TO CONTROL SCALE LABELS FOR LOGARITHMIC
C     LP      LINE PATTERN CODE
C     NINCX   NUMBER OF INCREMENTS ALONG X AXIS
C     NINCY   NUMBER OF INCREMENTS ALONG Y AXIS
C     ORG     ORIGIN
```

```
C      PBCOL   DISTANCE BETWEEN COLUMNS IN KEY
C      PBLEG   DISTANCE FROM SUBLEGEND TO TOP OF LEGEND
C      PBLIN   DISTANCE BETWEEN LINES
C      PDKEY   DISTANCE FROM BOX ENCLOSING KEY TO KEY LABELS
C      PDLAB   DISTANCE FROM SCALE LABEL TO AXIS LABEL
C      PDLEG   DISTANCE FROM AXIS LABEL TO LEGEND
C      PDNUM   DISTANCE FROM AXIS TO SCALE LABEL
C      PHEXP   HEIGHT OF EXPONENT FOR X 10 TO POWER
C      PHKEY   HEIGHT OF KEY LABEL
C      PHLAB   HEIGHT OF AXIS LABEL
C      PHLEG   HEIGHT OF LEGEND
C      PHNUM   HEIGHT OF SCALE LABEL
C      PHSUB   HEIGHT OF SUBSCRIPTS AND SUPERSCRIPTS
C      PHX10   HEIGHT OF X FOR X 10 TO POWER
C      PSYMS   HEIGHT OF NASA STANDARD SYMBOL
C      PTMAJ   LENGTH OF MAJOR TICK MARK
C      PTMIN   LENGTH OF MINOR TICK MARK
C      R       RADIUS
C      REDUC   REDUCTION FACTOR
C      S       AXIS LENGTH
C      SFC     NUMBER OF INCHES PER CYCLE
C      SFX     SCALE FACTOR
C      SX      X AXIS LENGTH
C      SY      Y AXIS LENGTH
C      TICDEG  DEGREES SEPARATING TICK MARKS
C      TMAJ    DISTANCE BETWEEN MAJOR TICK MARKS
C      TMIN    DIVISIONS PER INCH FOR MINOR TICK MARKS
C      VSIZ    VERTICAL SIZE
C      W       WIDTH OF CHARACTER STRING
C      WIDTHK  WIDTH OF KEY
C      WR      WIDTH OF RECTANGLE FOR DEVICE BED
C      XGI     INTERVAL BETWEEN GRID LINES IN X LOG CYCLE
C      XIMAGEL X IMAGE LENGTH (7.125)
C      XKEY    X CALCULATED POSITION FOR KEY
C      XN      X POSITION NOW
C      XOFF    X OFFSET FOR Y AXIS
C      XP      X POSITION
C      XS      INCREMENT BETWEEN VERTICAL GRID LINES
C      XSC     INCHES PER LOG CYCLE FOR X
C      XUL     X UPPER LEFT COORDINATE
C      YGI     INTERVAL BETWEEN GRID LINES IN Y LOG CYCLE
C      YIMAGEL Y IMAGE LENGTH (9.1875)
C      YKEY    Y CALCULATED POSITION FOR KEY
C      YN      Y POSITION NOW
C      YOFF    Y OFFSET FOR X AXIS
C      YP      Y POSITION
C      YS      INCREMENT BETWEEN HORIZONTAL GRID LINES
C      YSC     INCHES PER LOG CYCLE FOR Y
C      YUL     Y UPPER LEFT COORDINATE
C ARRAYS
C      ALABEL  CHARACTERS FOR AXIS SCALE LABELS
C      BOX     COORDINATES OF BOX FOR BLANK AREA IN GRID
C      CHARA   CHARACTERS FOR MULTIPLE LINE LABELS
```

```
C     CHARTA  CHARACTERS FOR TITLE
C     FPN     FLOATING POINT NUMBERS
C     ISYMA   CODE SPECIFYING NASA STANDARD SYMBOL
C     LPA     CODE SPECIFYING NASA LINE PATTERNS
C     NCHARA  NUMBER OF CHARACTERS IN EACH LINE
C     NCHARTA NUMBER OF CHARACTERS FOR TITLES
C     NLINEA NUMBER OF LINES IN EACH COLUMN
C     STAGLAB CHARACTERS FOR STAGGERED ZEROS
C     XBOUND  X DATA TO DRAW DEVICE X BOUNDARY
C     XDATA   RECTANGULAR DATA FOR PLOT EXAMPLES
C     XIMAGE  X DATA TO DRAW X IMAGE
C     XLINE   X DATA TO DRAW LINE PATTERNS
C     XSYM    X DATA TO PLOT SYMBOLS
C     YBOUND  Y DATA TO DRAW DEVICE Y BOUNDARY
C     YDATA   RECTANGULAR DATA FOR PLOT EXAMPLES
C     YIMAGE  Y DATA TO DRAW Y IMAGE
C     YLINE   Y DATA TO DRAW LINE PATTERNS
C     YSYM    Y DATA TO PLOT SYMBOLS
C     YTDATA  RECTANGULAR DATA FOR PLOT EXAMPLES
C-----------------------------------------------------------------------
C INITIALIZATION
      CALL PSEUDO
      CALL CHARST1
      CALL CHARST4
      CALL CHARST3
      CALL PUBSET (1.)
      CALL GPHLAB (HEIGHT)
C     GET THE PUBLICATION PARAMETERS
      CALL GPHNUM (PHNUM)
      CALL GPHLAB (PHLAB)
      CALL GPHLEG (PHLEG)
      CALL GPHKEY (PHKEY)
      CALL GPHSUB (PHSUB)
      CALL GPHX10 (PHX10)
      CALL GPHEXP (PHEXP)
      CALL GPDNUM (PDNUM)
      CALL GPDLAB (PDLAB)
      CALL GPDLEG (PDLEG)
      CALL GPDKEY (PDKEY)
      CALL GPBLIN (PBLIN)
      CALL GPBLEG (PBLEG)
      CALL GPBCOL (PBCOL)
      CALL GPTMAJ (PTMAJ)
      CALL GPTMIN (PTMIN)
      CALL GPSYMS (PSYMS)
      CALL GIPENS (IPENS)
      CALL GREDUC (REDUC)
C-----------------------------------------------------------------------
C EXAMPLE 1
      CALL EXAMPLE (1.)
      CALL CALPLT (0.,.3,-3)
      XP = 0.
      YP = 0.
```

```
      B = .25
      HR = 3.
      WR = 4.5
      CALL RECT (XP,YP,HR,WR,0.,3)
      CALL LINPLT (XBOUND,YBOUND,5,1,0,0,0,2)
      CALL CHARWH (W,HA,HB,PHLAB,'FSH',3)
      XP = .5*(WR-W)
      YP = YP+PBLIN
      CALL CHARACT (XP,YP,PHLAB,'FSH',0.,3)
      XP = B+PBLIN
      YP = B+PBLIN
      CALL CHARACT (XP,YP,PHLAB,'DO = FO',0.,7)
      CALL CHARWH (W,HA,HB,PHLAB,'FSV',3)
      XP = WR-PBLIN
      YP = .5*(HR-W)
      CALL CHARACT (XP,YP,PHLAB,'FSV',90.,3)
      CHARS = 'DIMENSIONED FRAME AREA'
      CALL CHARWH (W,HA,HB,PHLAB,CHARS,22)
      XP = .5*(WR-W)
      YP = HR-B-PBLIN-PHLAB
      CALL CHARACT (XP,YP,PHLAB,CHARS,0.,22)
      CHARS = 'DEVICE BED $(OR PAPER$) AREA'
      CALL CHARWH (W,HA,HB,PHLAB,CHARS,28)
      XP = .5*(WR-W)
      YP = HR+PBLIN
      CALL CHARACT (XP,YP,PHLAB,CHARS,0.,28)
      CHARS = 'DO $(DEVICE ORIGIN$) + FO $(FRAME ORIGIN$)'
      CALL CHARWH (W,HA,HB,PHLAB,CHARS,42)
      XP = .5*(WR-W)
      YP = .5*(HR-PHLAB-PBLIN-.5*PHLAB)
      CALL CHARACT (XP,YP,PHLAB,CHARS,0.,42)
      YP = YP-PHLAB-PBLIN
      CHARS = 'FSH = FRAME SIZE HORIZONTAL $(DEVICE X$)'
      CALL CHARACT (XP,YP,PHLAB,CHARS,0.,40)
      YP = YP-PHLAB-PBLIN
      CHARS = 'FSV = FRAME SIZE VERTICAL $(DEVICE Y$)'
      CALL CHARACT (XP,YP,PHLAB,CHARS,0.,38)
      CHARS = '-      DEVICE X HORIZONTAL      +'
      CALL CHARWH (W,HA,HB,PHLAB,CHARS,31)
      XP = .5*(WR-W)
      YP = -PBLIN-PHLAB
      CALL CHARACT (XP,YP,PHLAB,CHARS,0.,31)
      CHARS = '-  DEVICE Y VERTICAL  +'
      CALL CHARWH (W,HA,HB,PHLAB,CHARS,23)
      XP = WR+PBLIN+PHLAB
      YP = .5*(HR-W)
      CALL CHARACT (XP,YP,PHLAB,CHARS,90.,23)
      CALL NFRAME
C------------------------------------------------------------------------
C EXAMPLE 2
      CALL EXAMPLE (2.)
      CALL ORGCK (.5,1.5)
      CALL CHARACT (0.,0.,.1,'FO',0.,2)
```

```
      CALL CALPLT (.5,.5,-3)
      CALL CHARACT (0.,0.,.1,'P0',0.,2)
      CALL RECT (0.,0.,.5,.5,0.,3)
      CALL NFRAME
C----------------------------------------------------------------
C EXAMPLE 3
      CALL EXAMPLE (3.)
      XIMAGEL = 7.125
      YIMAGEL = 9.1875
      CALL GPHLAB (HEIGHT)
      CALL RECT (0.,0.,YIMAGEL,XIMAGEL,0.,3)
      CALL CHARACT (1.,3.,2.*HEIGHT,'VERTICAL FIGURE',0.,15)
      XN = XIMAGEL-.5
      YN = 1.
      DL = .25
      AL = .125
C     IMAGE AREA
      CALL DASHLN (XN,0.,XN,YIMAGEL,DL)
      CALL PARROW (XN,0.,XN,YIMAGEL,-2,AL)
      CALL PARROW (XN,YIMAGEL,XN,0.,-2,AL)
      CHARS = 'IMAGE AREA'
      CALL CHARWH (W,HA,HB,HEIGHT,CHARS,10)
      XP = XN-.2-W
      YP = .5*(YIMAGEL-(HA-HB))
      CALL CHARACT (XP,YP,HEIGHT,CHARS,0.,10)
C     PLOT AREA
      XN = XN-1.5
      CALL DASHLN (XN,YN,XN,YIMAGEL,DL)
      CALL PARROW (XN,YN,XN,YIMAGEL,-2,AL)
      CALL PARROW (XN,YIMAGEL,XN,YN,-2,AL)
      CHARS = 'PLOT AREA'
      CALL CHARWH (W,HA,HB,HEIGHT,CHARS,9)
      XP = XN-.2-W
      YP = .5*(YIMAGEL-YN-(HA-HB))+YN
      CALL CHARACT (XP,YP,HEIGHT,CHARS,0.,9)
C     LEGEND AREA
      XN = XN-1.5
      CALL DASHLN (XN,0.,XN,YN,DL)
      CALL PARROW (XN,0.,XN,YN,-2,AL)
      CALL PARROW (XN,YN,XN,0.,-2,AL)
      CHARS = 'LEGEND AREA'
      CALL CHARWH (W,HA,HB,HEIGHT,CHARS,11)
      XP = XN-.2-W
      YP = .5*(YN-(HA-HB))
      CALL CHARACT (XP,YP,HEIGHT,CHARS,0.,11)
      CALL NFRAME
C----------------------------------------------------------------
C EXAMPLE 4
      CALL EXAMPLE (4.)
      XIMAGEL = 9.1875
      YIMAGEL = 7.125
      CALL GPHLAB (HEIGHT)
      CALL RECT (0.,0.,YIMAGEL,XIMAGEL,0.,3)
```

```
      CALL CHARACT (1.,3.,2.*HEIGHT,'HORIZONTAL FIGURE',0.,17)
      XN = XIMAGEL-.5
      YN = 1.
      DL = .25
      AL = .125
C     IMAGE AREA
      CALL DASHLN (XN,0.,XN,YIMAGEL,DL)
      CALL PARROW (XN,0.,XN,YIMAGEL,-2,AL)
      CALL PARROW (XN,YIMAGEL,XN,0.,-2,AL)
      CHARS = 'IMAGE AREA'
      CALL CHARWH (W,HA,HB,HEIGHT,CHARS,10)
      XP = XN-.2-W
      YP = .5*(YIMAGEL-(HA-HB))
      CALL CHARACT (XP,YP,HEIGHT,CHARS,0.,10)
C     PLOT AREA
      XN = XN-1.5
      CALL DASHLN (XN,YN,XN,YIMAGEL,DL)
      CALL PARROW (XN,YN,XN,YIMAGEL,-2,AL)
      CALL PARROW (XN,YIMAGEL,XN,YN,-2,AL)
      CHARS = 'PLOT AREA'
      CALL CHARWH (W,HA,HB,HEIGHT,CHARS,9)
      XP = XN-.2-W
      YP = .5*(YIMAGEL-YN-(HA-HB))+YN
      CALL CHARACT (XP,YP,HEIGHT,CHARS,0.,9)
C     LEGEND AREA
      XN = XN-1.5
      CALL DASHLN (XN,0.,XN,YN,DL)
      CALL PARROW (XN,0.,XN,YN,-2,AL)
      CALL PARROW (XN,YN,XN,0.,-2,AL)
      CHARS = 'LEGEND AREA'
      CALL CHARWH (W,HA,HB,HEIGHT,CHARS,11)
      XP = XN-.2-W
      YP = .5*(YN-(HA-HB))
      CALL CHARACT (XP,YP,HEIGHT,CHARS,0.,11)
      CALL NFRAME
C-----------------------------------------------------------------------
C EXAMPLE 5
      CALL EXAMPLE (5.)
      XOFF = 0.
      YOFF = 0.
      XIMAGEL = 7.125
      YIMAGEL = 9.1875
      CALL LINPLT (XIMAGE,YIMAGE,5,1,0,0,0,2)
      CALL GPHLEG (HEIGHT)
C     WRITE LEGEND LINE 2
      CHARS = 'L(INE) 2.'
      CALL CHARWH (W,HA,HB,HEIGHT,CHARS,9)
      XP = .5*(XIMAGEL-W)
      YP = 0.
      CALL CHARACT (XP,YP,HEIGHT,CHARS,0.,9)
C     REORIGIN AT LEGEND LINE 1 NORMAL BASE LINE
      CALL CALPLT (0.,PBLIN+HEIGHT,-3)
      YOFF = YOFF+PBLIN+HEIGHT
```

```
C     WRITE LEGEND LINE 1
      CHARS = 'F(IGURE 1. - )L(INE 1 OF LEGEND SHOULD BE TYPED HERE.'
      CALL CHARWH (W,HA,HB,HEIGHT,CHARS,53)
      XP = .5*(XIMAGEL-W)
      CALL CHARACT (XP,YP,HEIGHT,CHARS,0.,53)
C     REORIGIN AT SUBLEGEND NORMAL BASE LINE
      CALL CALPLT (0.,PBLEG+HEIGHT,-3)
      YOFF = YOFF+PBLEG+HEIGHT
C     WRITE SUBLEGEND
      CHARS = '$((A)$) S(UBLEGEND.)'
      CALL CHARWH (W,HA,HB,HEIGHT,CHARS,20)
      XP = .5*(XIMAGEL-W)
      CALL CHARACT (XP,YP,HEIGHT,CHARS,0.,20)
C     REORIGIN TO AXIS LABEL
      CALL CALPLT (0.,PDLEG+HEIGHT,-3)
      YOFF = YOFF+PDLEG+HEIGHT
      CALL GPHLAB (HEIGHT)
      CHARS = 'H(ORIZONTAL LABEL'
      CALL CHARWH (W,HA,HB,HEIGHT,CHARS,18)
      HEIGHT2 = HA-HB
      CHARS = 'X$UU'
      CALL CHARWH (W,HA,HB,HEIGHT,CHARS,4)
      HEIGHT1 = HA-HB
C     REORIGIN TO BOTTOM OF NUMERIC SCALE
      CALL CALPLT (0.,HEIGHT2+PBLIN+HEIGHT1+PDLAB,-3)
      YOFF = YOFF+HEIGHT2+PBLIN+HEIGHT1+PDLAB
C     REORIGIN TO X AXIS
      CALL CALPLT (0.,PHNUM+PDNUM,-3)
      YOFF = YOFF+PHNUM+PDNUM
C     CALCULATE Y AXIS LABEL WIDTH
      CALL GPHLAB (HEIGHT)
      CHARS = 'V(ERTICAL LABEL)'
      CALL CHARWH (W,HA,HB,HEIGHT,CHARS,16)
      CALL CALPLT (W,0.,-3)
      XOFF = XOFF+W
C     REORIGIN AT NUMERIC LABEL
      CALL CALPLT (PDLAB,0.,-3)
      XOFF = XOFF+PDLAB
C     WIDEST Y NUMERIC LABEL
      CALL GPHNUM (HEIGHT)
      CALL CHARWH (W,HA,HB,HEIGHT,'-4',2)
C     REORIGIN AT Y AXIS
      CALL CALPLT (W+PDNUM,0.,-3)
      XOFF = XOFF+W+PDNUM
C     CALCULATE LENGTH OF AXIS AND DRAW AXIS
      S = IFIX(XIMAGEL-XOFF)
      ORG = -.004
      SFX = .004
      CALL AXES (0.,0.,0.,S,ORG,SFX,1.,0.,' ',HEIGHT,-1)
      S = IFIX(YIMAGEL-YOFF)
      CALL AXES (0.,0.,90.,S,ORG,SFX,1.,0.,' ',HEIGHT,1)
      CHARA(1) = 'X$UU'
      CHARA(2) = 'H(ORIZONTAL LABEL'
```

```
      NCHARA(1) = 4
      NCHARA(2) = 18
      CALL HALABEL (0.,CHARA,HEIGHT,NCHARA,2)
      CHARA(1) = 'Y$DN$LM'
      CHARA(2) = 'V(ERTICAL LABEL)'
      NCHARA(1) = 7
      NCHARA(2) = 16
      CALL HALABEL (90.,CHARA,HEIGHT,NCHARA,2)
      CALL LINPLT (XDATA,YTDATA,8,1,0,0,0,2)
      CALL LINPLT (XDATA,YDATA,8,1,1,1,2)
      XUL = 2.
      YUL = 6.
      CHARA(1) = 'D(ATA)'
      CHARA(2) = 'T(HEORY)'
      CALL GPHKEY (HEIGHT)
      NCHARA(1) = 6
      NCHARA(2) = 8
      LPA(1) = 1
      LPA(2) = 2
      CALL KEY (XUL,YUL,CHARA,HEIGHT,NCHARA,2,-1,LPA,1)
      CALL NFRAME
C-----------------------------------------------------------------------
C EXAMPLE 5A
C EXAMPLE 5 USING PUBSET
      CALL PUBSET (1.)
      SX = 5.
      SY = 7.
      ORG = -.004
      SFX = .004
      CALL GPHLAB (HEIGHT)
      CALL AXESOF (XOFF,YOFF,0.,SX,ORG,SFX,1.,0.,' ',HEIGHT,-1,0,3,2)
      CALL AXESOF (XOFF,YOFF,90.,SY,ORG,SFX,1.,0.,'V(ERTICAL LABEL)',
     .             HEIGHT,16,0,0,1)
      CALL CALPLT (XOFF,YOFF,-3)
      CALL AXES (0.,0.,0.,SX,ORG,SFX,1.,0.,' ',HEIGHT,-1)
      CALL AXES (0.,0.,90.,SY,ORG,SFX,1.,0.,' ',HEIGHT,+1)
      CHARA(1) = 'X$UU'
      CHARA(2) = 'H(ORIZONTAL LABEL'
      NCHARA(1) = 4
      NCHARA(2) = 18
      CALL HALABEL (0.,CHARA,HEIGHT,NCHARA,2)
      CHARA(1) = 'Y$DN$LM'
      CHARA(2) = 'V(ERTICAL LABEL)'
      NCHARA(1) = 7
      NCHARA(2) = 16
      CALL HALABEL (90.,CHARA,HEIGHT,NCHARA,2)
      CALL LINPLT (XDATA,YTDATA,8,1,0,0,0.2)
      CALL LINPLT (XDATA,YDATA,8,1,1,1,2)
      XUL = 2.
      YUL = 6.
      CHARA(1) = 'D(ATA)'
      CHARA(2) = 'T(HEORY)'
      CALL GPHKEY (HEIGHT)
```

```
      NCHARA(1) = 6
      NCHARA(2) = 8
      LPA(1) = 1
      LPA(2) = 2
      CALL KEY (XUL,YUL,CHARA,HEIGHT,NCHARA,2,-1,LPA,1)
      CALL NFRAME
C-----------------------------------------------------------------------
C EXAMPLE 5B
C EXAMPLE 5 USING PIMAGE
      HSIZ = 7.125
      VSIZ = 9.1875
      CALL PIMAGE (HSIZ,VSIZ,3,2,'V(ERTICAL LABEL)',16,SX,SY)
      SX = IFIX (SX)
      SY = IFIX (SY)
      ORG = -.004
      SFX = .004
      CALL GPHLAB (HEIGHT)
      CALL AXESOF (XOFF,YOFF,0.,SX,ORG,SFX,1.,0.,' ',HEIGHT,-1,0,3,2)
      CALL AXESOF (XOFF,YOFF,90.,SY,ORG,SFX,1.,0.,'V(ERTICAL LABEL)',
     .             HEIGHT,16,0,0,1)
      CALL CALPLT (XOFF,YOFF,-3)
      CALL AXES (0.,0.,0.,SX,ORG,SFX,1.,0.,' ',HEIGHT,-1)
      CALL AXES (0.,0.,90.,SY,ORG,SFX,1.,0.,' ',HEIGHT,+1)
      CHARA(1) = 'X$UU'
      CHARA(2) = 'H(ORIZONTAL LABEL)'
      NCHARA(1) = 4
      NCHARA(2) = 18
      CALL HALABEL (0.,CHARA,HEIGHT,NCHARA,2)
      CHARA(1) = 'Y$DN$LM'
      CHARA(2) = 'V(ERTICAL LABEL)'
      NCHARA(1) = 7
      NCHARA(2) = 16
      CALL HALABEL (90.,CHARA,HEIGHT,NCHARA,2)
      CALL LINPLT (XDATA,YTDATA,8,1,0,0,0,2)
      CALL LINPLT (XDATA,YDATA,8,1,1,1,2)
      XUL = 2.
      YUL = 6.
      CHARA(1) = 'D(ATA)'
      CHARA(2) = 'T(HEORY)'
      CALL GPHKEY (HEIGHT)
      NCHARA(1) = 6
      NCHARA(2) = 8
      LPA(1) = 1
      LPA(2) = 2
      CALL KEY (XUL,YUL,CHARA,HEIGHT,NCHARA,2,-1,LPA,1)
      CALL PUBSET (1.)
      CALL GPHLAB (PHLAB)
      CALL GREDUC (REDUC)
      CALL NFRAME
C-----------------------------------------------------------------------
C EXAMPLE 5C
C EXAMPLE 5 USING PAXLEN
      SX = 5.
```

```
      SY = 7.
      CALL PAXLEN (SX,SY,3,2,'V(ERTICAL LABEL)',16,HSIZ,VSIZ)
      ORG = -.004
      SFX = .004
      CALL GPHLAB (HEIGHT)
      CALL AXESOF (XOFF,YOFF,0.,SX,ORG,SFX,1.,0.,' ',HEIGHT,-1,0,3,2)
      CALL AXESOF (XOFF,YOFF,90.,SY,ORG,SFX,1.,0.,'V(ERTICAL LABEL)',
     .             HEIGHT,16,0,0,1)
      CALL CALPLT (XOFF,YOFF,-3)
      CALL AXES (0.,0.,0.,SX,ORG,SFX,1.,0.,' ',HEIGHT,-1)
      CALL AXES (0.,0.,90.,SY,ORG,SFX,1.,0.,' ',HEIGHT,+1)
      CHARA(1) = 'X$UU'
      CHARA(2) = 'H(ORIZONTAL LABEL)'
      NCHARA(1) = 4
      NCHARA(2) = 18
      CALL HALABEL (0.,CHARA,HEIGHT,NCHARA,2)
      CHARA(1) = 'Y$DN$LM'
      CHARA(2) = 'V(ERTICAL LABEL)'
      NCHARA(1) = 7
      NCHARA(2) = 16
      CALL HALABEL (90.,CHARA,HEIGHT,NCHARA,2)
      CALL LINPLT (XDATA,YTDATA,8,1,0,0,0.2)
      CALL LINPLT (XDATA,YDATA,8,1,1,1,2)
      XUL = 2.
      YUL = 6.
      CHARA(1) = 'D(ATA)'
      CHARA(2) = 'T(HEORY)'
      CALL GPHKEY (HEIGHT)
      NCHARA(1) = 6
      NCHARA(2) = 8
      LPA(1) = 1
      LPA(2) = 2
      CALL KEY (XUL,YUL,CHARA,HEIGHT,NCHARA,2,-1,LPA,1)
      CALL NFRAME
C-----------------------------------------------------------------------
C EXAMPLE 6
      CALL EXAMPLE (6.)
      CALL CALPLT (.5,1.,-3)
      S = 2.
      ORG = -.001
      SFX = .001
      TMAJ = +1.
      TMIN = 0.
      CALL GPHLAB (HEIGHT)
      CALL AXES (0.,0.,90.,S,ORG,SFX,TMAJ,TMIN,' ',HEIGHT,+1)
      ORG = -1.
      SFX = 1.
      CALL AXES (0.,0.,0.,S,ORG,SFX,TMAJ,TMIN,' ',HEIGHT,-1)
      CHARA(1) = 'X$U2'
      CHARA(2) = 'A(XIS LABEL)'
      NCHARA(1) = 4
      NCHARA(2) = 12
      CALL HALABEL (0.,CHARA,HEIGHT,NCHARA,2)
```

```
      CALL CHNGSET (1)
      XP = 2.
      YP = S
      CALL CHARACT (XP,YP,PHNUM,'1  ] PHNUM',0.,10)
      YP = YP-.2
      CALL CHARACT (XP,YP,PHX10,'X  ] PHX10',0.,10)
      YP = YP-.2
      CALL CHARACT (XP,YP,PHNUM,'10 ] PHNUM',0.,10)
      YP = YP-.2
      CALL CHARACT (XP,YP,PHEXP,'3  ] PHEXP',0.,10)
      XP = S
      YP = -PDNUM-PHNUM
      CALL CHARACT (XP,YP,PHNUM,' ] PHNUM',0.,8)
      YP = YP-PDLAB
      CALL CHARACT (XP,YP-PHLAB,PHSUB,' ] PHSUB',0.,8)
      CALL CHARWH (W,HA,HB,PHLAB,CHARA(1),4)
      HEIGHT1 = HA-HB
      YP = YP-HEIGHT1-PBLIN-PHLAB
      CALL CHARACT (XP,YP,HEIGHT,' ] PHLAB',0.,8)
      YP = YP-PDLEG-PHLEG
      CALL CHARACT (XP,YP,HEIGHT,' ] PHLEG',0.,8)
      CALL CHNGSET (3)
      CHARS = 'F(IGURE) 1. - L(EGEND.)'
      CALL CHARWH (W,HA,HB,PHLEG,CHARS,23)
      XP = .5*(S-W)
      CALL CHARACT (XP,YP,PHLEG,CHARS,0.,23)
      CHARS = 'K(EY)$1    ] PHKEY$3 '
      CALL CHARACT (1.,1.,PHKEY,CHARS,0.,20)
      CALL NFRAME
C-----------------------------------------------------------------------
C EXAMPLE 7
      CALL EXAMPLE (7.)
      CALL CALPLT (.5,1.2,-3)
      S = 2.
      ORG = -1.
      SFX = 1.
      TMAJ = 1.
      TMIN = 0.
      CALL GPHLAB (HEIGHT)
      CALL AXES (0.,0.,0.,S,ORG,SFX,TMAJ,TMIN,' ',HEIGHT,-1)
      CHARA(1) = 'X$U2'
      CHARA(2) = 'A(XIS LABEL)'
      NCHARA(1) = 4
      NCHARA(2) = 12
      CALL HALABEL (0.,CHARA,HEIGHT,NCHARA,2)
      CALL CHNGSET (1)
      XP = S
      YP = -PDNUM
      CALL CHARACT (XP,YP,PDNUM,' ] PDNUM',0.,8)
      YP = YP-PHNUM-PDLAB
      CALL CHARACT (XP,YP,PDLAB,' ] PDLAB',0.,8)
      CALL CHARWH (W,HA,HB,PHLAB,CHARA,4)
      HEIGHT1 = HA-HB
```

```
      YP = YP-HEIGHT1-PBLIN-PHLAB-PDLEG
      CALL CHARACT (XP,YP,PDLEG,' ] PDLEG',0.,8)
      CALL CHNGSET (3)
      YP = YP-PHLEG
      CHARS = 'F(IGURE) 1. - L(EGEND.)'
      CALL CHARWH (W,HA,HB,PHLEG,CHARS,23)
      XP = .5*(S-W)
      CALL CHARACT (XP,YP,PHLEG,CHARS,0.,23)
      CALL NFRAME
C-----------------------------------------------------------------------
C EXAMPLE 8
      CALL EXAMPLE (8.)
      CALL CALPLT (1.4,1.2,-3)
      CHARA(1) = 'A(BCDE)'
      CHARA(2) = 'F(GHIJ)'
      CHARA(3) = 'K(LMNO)'
      CHARA(4) = 'P(QRST)'
      NCHARA(1) = 7
      NCHARA(2) = 7
      NCHARA(3) = 7
      NCHARA(4) = 7
      NLINEA(1) = 2
      NLINEA(2) = 2
      ISYMA(1) = 1
      ISYMA(2) = 2
      CHARTA(1) = 'T(ITLE)'
      CHARTA(2) = 'T(ITLE)'
      NCHARTA(1) = 7
      NCHARTA(2) = 7
      CALL KEYWH (WIDTHK,HGTK,CHARA,PHKEY,NCHARA,NLINEA,ISYMA,-1,0,
     .            CHARTA,NCHARTA,1,2)
      CALL RECT (0.,0.,HGTK,WIDTHK,0.,3)
      XUL = 0.
      YUL = HGTK
      CALL KEY (XUL,YUL,CHARA,PHKEY,NCHARA,NLINEA,ISYMA,-1,0,CHARTA,
     .          NCHARTA,1,2)
      CALL CHNGSET (1)
      CALL CHARWH (W,HA,HB,PDKEY,'PDKEY [ ',8)
      XP = XUL-W
      YP = HGTK-PDKEY
      CALL CHARACT (XP,YP,PDKEY,'PDKEY [ ',0.,8)
      XP = XUL+PDKEY
      YP = HGTK
      CALL CHARACT (XP,YP,PDKEY,' ] PDKEY',90.,8)
      XP = WIDTHK
      YP = 0.
      CALL CHARACT (XP,YP,PDKEY,' ] PDKEY',0.,8)
      XP = WIDTHK
      YP = -W
      CALL CHARACT (XP,YP,PDKEY,'PDKEY [ ',90.,8)
      CALL CHNGSET (3)
      CALL NFRAME
C-----------------------------------------------------------------------
```

```
C EXAMPLE 9
      CALL EXAMPLE (9.)
      CALL CALPLT (0.,.2,-3)
C     MAKE THIS EXAMPLE TWICE SIZE TO SHOW PBLIN
      CALL PUBSET (.5)
      CALL GPHLAB (PHLAB)
      CALL GPBLIN (PBLIN)
      XN = 0.
      YN = 1.
      S = 2.
      CHARS = 'L(INE) 1'
      CALL CHARACT (XN,YN,PHLAB,CHARS,0.,8)
      CHARS = 'X$S$U2$R$DL'
      CALL CHARWH (W,HA,HB,PHLAB,CHARS,11)
      HEIGHT1 = HA-HB
      YN = YN-PBLIN-HA
      CALL CHARACT (XN,YN,PHLAB,CHARS,0.,11)
      YN = YN+HB-PBLIN-PHLAB
      CHARS = 'L(INE) 3'
      CALL CHARACT (XN,YN,PHLAB,CHARS,0.,8)
      XP = S
      YP = YN+PHLAB
      CALL CHNGSET(1)
      CALL CHARACT (XP,YP,PBLIN,' ] PBLIN',0.,8)
      YP = YP+HEIGHT1+PBLIN
      CALL CHARACT (XP,YP,PBLIN,' ] PBLIN',0.,8)
      CALL CHNGSET (3)
      CALL PUBSET (1.)
      CALL GPHLAB (PHLAB)
      CALL GPBLIN (PBLIN)
      CALL NFRAME
C-----------------------------------------------------------------------
C EXAMPLE 10
      CALL EXAMPLE (10.)
      CALL CALPLT (-1.,.6,-3)
C     SUBLEGEND
      CHARS = '$((A)$) S(UBLEGEND.)'
      XN = 0.
      YN = 0.
      CALL CHARWH (W,HA,HB,PHLEG,CHARS,20)
      XN = .5*(XIMAGEL-W)
      CALL CHARACT (XN,YN,PHLEG,CHARS,0.,20)
      XP = XIMAGEL-1.
      YP = YN-PBLEG
      CALL CHNGSET (1)
      CALL CHARACT (XP,YP,PBLEG,' ] PBLEG ',0.,8)
      CALL CHNGSET (3)
C     LINE 1 LEGEND
      YN = YN-PHLEG-PBLEG
      CHARS = 'F(IGURE 1. - )L(INE 1 OF LEGEND SHOULD BE TYPED HERE.'
      CALL CHARWH (W,HA,HB,PHLEG,CHARS,53)
      XN = .5*(XIMAGEL-W)
      CALL CHARACT (XN,YN,PHLEG,CHARS,0.,53)
```

```
      CALL CHNGSET (1)
      YP = YN-PBLIN
      CALL CHARACT (XP,YP,PBLIN,' ] PBLIN',0.,8)
      CALL CHNGSET (3)
C     LINE 2 LEGEND
      CHARS = 'L(INE) 2.'
      YN = YN-PBLIN-PHLEG
      CALL CHARWH (W,HA,HB,PHLEG,CHARS,9)
      XN = .5*(XIMAGEL-W)
      CALL CHARACT (XN,YN,PHLEG,CHARS,0.,9)
      CALL CHNGSET (3)
      CALL NFRAME
C-----------------------------------------------------------------------
C EXAMPLE 11
      CALL EXAMPLE (11.)
      CALL CALPLT (0.,1.8,-3)
      CHARA(1) = 'A(BCDE)'
      CHARA(2) = 'F(GHIJ)'
      CHARA(3) = 'K(LMNO)'
      CHARA(4) = 'P(QRST)'
      NCHARA(1) = 7
      NCHARA(2) = 7
      NCHARA(3) = 7
      NCHARA(4) = 7
      NLINEA(1) = 2
      NLINEA(2) = 2
      ISYMA(1) = 1
      ISYMA(2) = 2
      CHARTA(1) = 'T(ITLE)'
      CHARTA(2) = 'T(ITLE)'
      NCHARTA(1) = 7
      NCHARTA(2) = 7
      CALL KEYWH (WIDTHK,HGTK,CHARA,PHKEY,NCHARA,NLINEA,ISYMA,-1,0,
     .            CHARTA,NCHARTA,1,2)
      CALL RECT (0.,0.,HGTK,WIDTHK,0.,3)
      XUL = 0.
      YUL = HGTK
      CALL KEY (XUL,YUL,CHARA,PHKEY,NCHARA,NLINEA,ISYMA,-1,0,CHARTA,
     .            NCHARTA,1,2)
      CALL CHNGSET (1)
      CALL CHARWH (W,HA,HB,PBCOL,'PBCOL [ ',8)
      XP = XUL+PDKEY+PSYMS+PBCOL
      YP = -W
      CALL CHARACT (XP,YP,PBCOL,'PBCOL [ ',90.,8)
      CALL CHARWH (W,HA,HB,PHKEY,CHARA,7)
      XP = XP+W+PBCOL
      CALL CHARACT (XP,YP,PBCOL,'PBCOL [ ',90.,8)
      XP = XUL+WIDTHK
      YP = YUL-PDKEY-PHKEY-PBCOL
      CALL CHARACT (XP,YP,PBCOL,' ] PBCOL',0.,8)
      CALL CHNGSET (3)
      CALL NFRAME
C-----------------------------------------------------------------------
```

```
C EXAMPLE 12
      CALL EXAMPLE (12.)
      CALL CALPLT (.2,.4,-3)
      S = 2.
      ORG = -1.
      SFX = 1.
      CALL GPHLAB (HEIGHT)
      CALL AXES (0.,0.,0.,S,ORG,SFX,1.,4.,' ',HEIGHT,-1)
      XP = S
      YP = 0.
      CALL CHNGSET (1)
      CALL CHARACT (XP,YP,PTMAJ,' ] PTMAJ',0.,8)
      CALL CALPLT (0.,1.,-3)
      CALL CHNGSET (3)
      S = S-.5
      CALL AXES (0.,0.,0.,S,ORG,SFX,1.,4.,' ',HEIGHT,-1)
      CALL CHNGSET (1)
      CALL CHARACT (XP,YP,PTMIN,' ] PTMIN',0.,8)
      CALL CHNGSET (3)
      CALL NFRAME
C-----------------------------------------------------------------------
C EXAMPLE 13
      CALL EXAMPLE (13.)
      CALL CHNGSET (1)
      CALL CALPLT (0.,.8,-3)
      XN = .2
      YN = 0.
      CALL PNTPLT (XN,YN,1,1)
      XP = XN+.2
      YP = YN-.5*PSYMS
      CALL CHARACT (XP,YP,PSYMS,' ] PSYMS',0.,8)
      YN = YN-.5
      CALL PNTPLT (XN,YN,2,1)
      YP = YN-.5*PSYMS
      CALL CHARACT (XP,YP,PSYMS,' ] PSYMS',0.,8)
      CALL CHNGSET (3)
      CALL NFRAME
C-----------------------------------------------------------------------
C EXAMPLE 14
      CALL EXAMPLE (14.)
      CALL CALPLT (0.,.7,-3)
      XP = 0.
      YP = 0.
      CALL NEWPEN (1)
      CALL GPHLAB (HEIGHT)
      CALL CHARACT (0.,1.5,.2,'TRY PEN',0.,7)
      CALL PLTSTOP ('TRY PEN')
      CHARS = '3 (FOR) L(EROY .3 MM PEN SIZE.'
      CALL CHARACT (XP,YP,HEIGHT,CHARS,0.,30)
      CALL NEWPEN (2)
      CALL PUBSET (.54)
      CALL GPHLAB (HEIGHT)
      CALL CHARACT (0.,5.,HEIGHT,'TRY PEN',0.,7)
```

```
      CALL PLTSTOP ('TRY PEN')
      YP = YP-HEIGHT-PBLIN
      CHARS = '4 (FOR) L(EROY .4 MM PEN SIZE.'
      CALL CHARACT (XP,YP,HEIGHT,CHARS,0.,30)
      CALL NEWPEN (3)
      CALL PUBSET (.39)
      CALL GPHLAB (HEIGHT)
      CALL CHARACT (0.,6.,HEIGHT,'TRY PEN',0.,7)
      CALL PLTSTOP ('TRY PEN')
      YP = YP-HEIGHT-PBLIN
      CHARS = '5 (FOR) L(EROY .5 MM PEN SIZE.'
      CALL CHARACT (XP,YP,HEIGHT,CHARS,0.,30)
      CALL NEWPEN (1)
      CALL PUBSET (1.)
      CALL NFRAME
C-----------------------------------------------------------------------
C EXAMPLE 15
      CALL EXAMPLE (15.)
      CALL CALPLT (1.,1.,-3)
      S = 2.
      ORG = -2.
      SFX = 2.
      CALL GPHLAB (HEIGHT)
      CALL SPHLAB (.5)
      CALL AXES (0.,0.,0.,S,ORG,SFX,1.,0.,'X',HEIGHT,-1)
      CALL AXES (0.,0.,90.,S,ORG,SFX,1.,0.,'Y',HEIGHT,+1)
      CALL PUBSET (1.)
      CALL NFRAME
C-----------------------------------------------------------------------
C EXAMPLE 16
      CALL EXAMPLE (16.)
      CALL CALPLT (0.,.5,-3)
      XP = 0.
      YP = 0.
      CALL GPHLAB (HEIGHT)
      CHARS = 'T(HIS IS AN EXAMPLE USING CHARACTER SET)'
      DO 100 I=3,4
      IF (I.EQ.3) CALL CHARST3
      IF (I.EQ.4) CALL CHARST4
      FPN(1)=I
      CALL CHARACT (XP,YP,HEIGHT,CHARS,0.,40)
      CALL WHERE (XN,YN,IN)
      CALL NUMBER (XN,YN,HEIGHT,FPN,0.,-1)
      YP = YP-PHLAB-PBLIN
  100 CONTINUE
      CALL CHNGSET (3)
      CALL NFRAME
C-----------------------------------------------------------------------
C EXAMPLE 17
      CALL EXAMPLE (17.)
      XP = 0.
      YP = .3
      CALL GPHLAB (HEIGHT)
```

```
      CHARS = 'NASA R(EPORT)'
      CALL CHARACT (XP,YP,HEIGHT,CHARS,0.,13)
      CALL NFRAME
C-----------------------------------------------------------------------
C EXAMPLE 18
      CALL EXAMPLE (18.)
      XP = 0.
      YP = .3
      CALL GPHLAB (HEIGHT)
      CHARS = 'X$S$U2$R$D(N)$LA$BC'
      CALL CHARACT (XP,YP,HEIGHT,CHARS,0.,19)
      CALL NFRAME
C-----------------------------------------------------------------------
C EXAMPLE 19
      CALL EXAMPLE (19.)
      XP = 0.
      YP = .3
      CALL GPHLAB (HEIGHT)
      CHARS = '$3C$D$4(Z$LB)$3'
      CALL CHARACT (XP,YP,HEIGHT,CHARS,0.,15)
      CALL NFRAME
C-----------------------------------------------------------------------
C EXAMPLE 20
      CALL EXAMPLE (20.)
      XP = 0.
      YP = .8
      CALL GPHLAB (HEIGHT)
      FPN(1) = 1234.5
      CALL NUMBER (XP,YP,HEIGHT,FPN,0.0,-1)
      XP = 1.
      YP = .8
      CALL NUMBER (XP,YP,HEIGHT,FPN,0.0,0)
      YP = YP-HEIGHT-PBLIN
      CALL NUMBER (XP,YP,HEIGHT,FPN,0.0,1)
      XP = 2.
      YP = .8
      CALL CHARWH(W,HA,HB,PHLAB,'10$U4',5)
      HEIGHT1=HA-HB
      CALL ENUMBER (XP,YP,HEIGHT,FPN,0.0,-4)
      YP = YP-HEIGHT1-PBLIN
      CALL ENUMBER (XP,YP,HEIGHT,FPN,0.0,-5)
      YP = YP-HEIGHT1-PBLIN
      CALL ENUMBER (XP,YP,HEIGHT,FPN,0.0,+4)
      YP = YP-HEIGHT1-PBLIN
      CALL ENUMBER (XP,YP,HEIGHT,FPN,0.0,+5)
      CALL NFRAME
C-----------------------------------------------------------------------
C EXAMPLE 21
      CALL EXAMPLE (21.)
      XN = .8
      YN = .5
      CALL GPHLAB (HEIGHT)
      FPN(1) = 1234.5
```

```
      FPN(2) = 0.0
      FPN(3) = -778.2
      DO 110 I=1,3
      CALL COLUM (XN,YN,HEIGHT,FPN(I),0.,1)
      YN = YN-PBLIN-HEIGHT
  110 CONTINUE
      CALL NFRAME
C-----------------------------------------------------------------------
C EXAMPLE 22
      CALL EXAMPLE (22.)
      CALL CALPLT (.5,.3,-3)
      S = 2.
      ORG = 0.
      SFX = 1.
      TMAJ = 1.
      TMIN = 1.
      CALL GPHLAB (HEIGHT)
      CALL AXES (0.,0.,0.,S,ORG,SFX,TMAJ,TMIN,' ',HEIGHT,-1)
      ORG = -20.
      SFX = 20.
      CALL AXES (0.,0.,90.,S,ORG,SFX,TMAJ,TMIN,' ',HEIGHT,+1)
      CALL NFRAME
C-----------------------------------------------------------------------
C EXAMPLE 23
      CALL EXAMPLE (23.)
      CALL CALPLT (.3,.3,-3)
      S = 2.
      ORG = -2.
      SFX = 2.
      TMAJ = 1.
      TMIN = 0.
      CALL GPHLAB (HEIGHT)
      CALL AXES (0.,0.,0.,S,ORG,SFX,TMAJ,TMIN,' ',HEIGHT,-1)
      CALL AXES (0.,0.,90.,S,ORG,SFX,TMAJ,TMIN,' ',HEIGHT,+1)
      CALL NFRAME
C-----------------------------------------------------------------------
C EXAMPLE 24
      CALL EXAMPLE (24.)
      CALL CALPLT (.3,.3,-3)
      S = 2.
      ORG = -2.
      SFX = 2.
      TMAJ = 1.
      TMIN = 10.
      CALL GPHLAB (HEIGHT)
      CALL AXES (0.,0.,0.,S,ORG,SFX,TMAJ,TMIN,' ',HEIGHT,-1)
      CALL AXES (0.,0.,90.,S,ORG,SFX,TMAJ,TMIN,' ',HEIGHT,+1)
      CALL NFRAME
C-----------------------------------------------------------------------
C EXAMPLE 25
      CALL EXAMPLE (25.)
      CALL CALPLT (.5,.3,-3)
      S = 2.
```

```
      ORG = -2.
      SFX = 2.
      TMAJ = 1.
      TMIN = 4.
      CALL GPHLAB (HEIGHT)
      CALL AXES (0.,0.,0.,S,ORG,SFX,TMAJ,TMIN,' ',HEIGHT,-1)
      ORG = -20.
      SFX = 20.
      TMIN = 10.
      CALL AXES (0.,0.,90.,S,ORG,SFX,TMAJ,TMIN,' ',HEIGHT,+1)
      CALL NFRAME
C-----------------------------------------------------------------------
C EXAMPLE 26
      CALL EXAMPLE (26.)
      CALL CALPLT (.3,.3,-3)
      S = 2.
      ORG = -2.
      SFX = 2.
      TMAJ = 1.
      TMIN = 2.
      CALL GPHLAB (HEIGHT)
      CALL AXES (0.,0.,0.,S,ORG,SFX,TMAJ,TMIN,' ',HEIGHT,-1)
      CALL AXES (0.,0.,90.,S,ORG,SFX,TMAJ,TMIN,' ',HEIGHT,+1)
      HEIGHT = 0.
      CALL AXES (0.,S,0.,S,ORG,SFX,TMAJ,TMIN,' ',HEIGHT,+1)
      CALL AXES (S,0.,90.,S,ORG,SFX,TMAJ,TMIN,' ',HEIGHT,-1)
      CALL NFRAME
C-----------------------------------------------------------------------
C EXAMPLE 27
      CALL EXAMPLE (27.)
      CALL CALPLT (.6,.3,-3)
      S = 2.
      ORG = ALOG10 (.1)
      SFC = 1.
      LC1 = 1
      LC = 0
      CALL GPHLAB (HEIGHT)
      CALL AXESLOG (0.,0.,0.,S,ORG,SFC,LC1,LC,' ',HEIGHT,-1)
      CALL AXESLOG (0.,0.,90.,S,ORG,SFC,LC1,LC,' ',HEIGHT,+1)
      CALL NFRAME
C-----------------------------------------------------------------------
C EXAMPLE 28
      CALL EXAMPLE (28.)
      CALL CALPLT (.6,.3,-3)
      S = 2.
      ORG = ALOG10 (.1)
      SFC = 1.
      LC1 = 1
      LC = -6
      CALL GPHLAB (HEIGHT)
      CALL AXESLOG (0.,0.,0.,S,ORG,SFC,LC1,LC,' ',HEIGHT,-1)
      CALL AXESLOG (0.,0.,90.,S,ORG,SFC,LC1,LC,' ',HEIGHT,+1)
      CALL NFRAME
```

```
C-----------------------------------------------------------------------
C EXAMPLE 29
      CALL EXAMPLE (29.)
      CALL CALPLT (.2,2.6,-3)
      S = 2.
      ORG = ALOG10(.1)
      SFC = 1.
      CALL AXESLOG (0.,0.,0.,S,ORG,SFC,0,1,' ',HEIGHT,-1)
      CALL CALPLT (0.,-.6,-3)
      CALL AXESLOG (0.,0.,0.,S,ORG,SFC,0,2,' ',HEIGHT,-1)
      CALL CALPLT (0.,-.6,-3)
      CALL AXESLOG (0.,0.,0.,S,ORG,SFC,0,3,' ',HEIGHT,-1)
      CALL CALPLT (0.,-.6,-3)
      CALL AXESLOG (0.,0.,0.,S,ORG,SFC,0,4,' ',HEIGHT,-1)
      CALL CALPLT (0.,-.6,-3)
      CALL AXESLOG (0.,0.,0.,S,ORG,SFC,0,5,' ',HEIGHT,-1)
      CALL NFRAME
C-----------------------------------------------------------------------
C EXAMPLE 30
      CALL EXAMPLE (30.)
      CALL CALPLT (.5,.3,-3)
      S = 2.
      ORG = ALOG10 (.1)
      SFC = 1.
      LC1 = 1
      LC = -2
      CALL GPHLAB (HEIGHT)
      CALL AXESLOG (0.,0.,0.,S,ORG,SFC,LC1,LC,' ',HEIGHT,-1)
      CALL AXESLOG (0.,0.,90.,S,ORG,SFC,LC1,LC,' ',HEIGHT,+1)
      HEIGHT = 0.
      CALL AXESLOG (0.,S,0.,S,ORG,SFC,LC1,LC,' ',HEIGHT,+1)
      CALL AXESLOG (S,0.,90.,S,ORG,SFC,LC1,LC,' ',HEIGHT,-1)
      CALL NFRAME
C-----------------------------------------------------------------------
C EXAMPLE 31
      CALL EXAMPLE (31.)
      CALL CALPLT (1.5,1.5,-3)
      R = 1.
      TMAJ = 1.
      TICDEG = 0.
      CALL GPHLAB (HEIGHT)
      CALL POLRGRD (0.,0.,R,TMAJ,TICDEG,HEIGHT,0.)
      CALL NFRAME
C-----------------------------------------------------------------------
C EXAMPLE 32
      CALL EXAMPLE (32.)
      CALL CALPLT (1.5,1.5,-3)
      R = 1.
      TMAJ = +1.
      TICDEG = +45.
      CALL GPHLAB (HEIGHT)
      CALL POLRGRD (0.,0.,R,TMAJ,TICDEG,HEIGHT,0.)
      CALL NFRAME
```

```
C-----------------------------------------------------------------------
C EXAMPLE 33
      CALL EXAMPLE (33.)
      S = 2.
      XS = .5
      YS = .5
      NINCX = S/XS
      NINCY = S/YS
      CALL GRID (0.,0.,XS,YS,NINCX,NINCY)
      CALL NFRAME
C-----------------------------------------------------------------------
C EXAMPLE 34
      CALL EXAMPLE (34.)
      XSC = 2.
      YSC = 2.
      XGI = +1.
      YGI = +1.
      CALL LOGRID (XSC,YSC,1,1,1.,1.,XGI,YGI)
      CALL NFRAME
C-----------------------------------------------------------------------
C EXAMPLE 35
      CALL EXAMPLE (35.)
      CALL CALPLT (1.3,1.3,-3)
      R = 1.
      TMAJ = -1.
      TICDEG = -30.
      CALL GPHLAB (HEIGHT)
      CALL POLRGRD (0.,0.,R,TMAJ,TICDEG,HEIGHT,0.)
      CALL NFRAME
C-----------------------------------------------------------------------
C EXAMPLE 36
      CALL EXAMPLE (36.)
      S = 2.
      XS = .25
      YS = .25
      NINCX = S/XS
      NINCY = S/YS
      BOX(1) = .25
      BOX(2) = 1.0
      BOX(3) = 1.75
      BOX(4) = 1.5
      CALL GRIDB (0.,0.,XS,YS,NINCX,NINCY,BOX)
      CALL GPHLAB (HEIGHT)
      XKEY = .45
      YKEY = BOX(2)+.5*(BOX(4)-BOX(2)-HEIGHT)
      CHARS = 'SPACE FOR KEY'
      CALL CHARACT (XKEY,YKEY,HEIGHT,CHARS,0.,13)
      CALL NFRAME
C-----------------------------------------------------------------------
C EXAMPLE 37
      CALL EXAMPLE (37.)
      S = 2.
      XS = .5
```

```
      YS = .5
      NINCX = S/XS
      NINCY = S/YS
      BOX(1) = .25
      BOX(2) = 1.25
      BOX(3) = 1.75
      BOX(4) = 1.5
      CALL GRIDB (0.,0.,XS,YS,NINCX,NINCY,BOX)
      CALL GPHLAB (HEIGHT)
      XKEY = .45
      YKEY = BOX(2)+.5*(BOX(4)-BOX(2)-HEIGHT)
      CHARS = 'SPACE FOR KEY'
      CALL CHARACT (XKEY,YKEY,HEIGHT,CHARS,0.,13)
      CALL NFRAME
C-----------------------------------------------------------------------
C EXAMPLE 38
      CALL EXAMPLE (38.)
      CALL CALPLT (.7,.3,-3)
      S = 2.
      ORG = -.001
      SFX = .001
      TMAJ = -1.
      TMIN = 0.
      CALL GPHLAB (HEIGHT)
      CALL AXES (0.,0.,0.,S,ORG,SFX,TMAJ,TMIN,' ',HEIGHT,-1,3)
      CALL AXES (0.,0.,90.,S,ORG,SFX,TMAJ,TMIN,' ',HEIGHT,+1,3)
      CALL AXES (0.,S,0.,S,ORG,SFX,TMAJ,TMIN,' ',HEIGHT,+1,3)
      CALL AXES (S,0.,90.,S,ORG,SFX,TMAJ,TMIN,' ',HEIGHT,-1,3)
      CALL NFRAME
C-----------------------------------------------------------------------
C EXAMPLE 39
      CALL EXAMPLE (39.)
      CALL CALPLT (.7,.3,-3)
      S = 2.
      ORG = ALOG10 (.1)
      SFC = 1.
      LC1 = 1
      LC = 0
      CALL GPHLAB (HEIGHT)
      CALL AXESLOG (0.,0.,0.,S,ORG,SFC,LC1,LC,' ',HEIGHT,-1)
      CALL AXESLOG (0.,0.,90.,S,ORG,SFC,LC1,LC,' ',HEIGHT,+1)
      CALL AXESLOG (0.,S,0.,S,ORG,SFC,LC1,LC,' ',HEIGHT,+1)
      CALL AXESLOG (S,0.,90.,S,ORG,SFC,LC1,LC,' ',HEIGHT,-1)
      CALL NFRAME
C-----------------------------------------------------------------------
C EXAMPLE 40
      CALL EXAMPLE (40.)
      CALL CALPLT (.6,.3,-3)
      S = 2.
      ORG = -.001
      SFX = .001
      TMAJ = 1.
      TMIN = 0.
```

```
      CALL GPHLAB (HEIGHT)
      CALL AXES (0.,0.,0.,S,ORG,SFX,TMAJ,TMIN,' ',HEIGHT,-1)
      CALL AXES (0.,0.,90.,S,ORG,SFX,TMAJ,TMIN,' ',HEIGHT,+1)
      CALL NFRAME
C-----------------------------------------------------------------------
C EXAMPLE 41
      CALL EXAMPLE (41.)
      CALL CALPLT (.4,.3,-3)
      S = 2.
      ORG = -.001
      SFX = .001
      TMAJ = 1.
      TMIN = 0.
      CALL GPHLAB (HEIGHT)
      CALL AXES (0.,S,0.,S,ORG,SFX,TMAJ,TMIN,' ',HEIGHT,+1)
      CALL AXES (S,0.,90.,S,ORG,SFX,TMAJ,TMIN,' ',HEIGHT,-1)
      CALL NFRAME
C-----------------------------------------------------------------------
C EXAMPLE 42
      CALL EXAMPLE (42.)
      CALL CALPLT (1.0,.3,-3)
      S = 2.
      ALABEL(1) = '1981'
      ALABEL(2) = '1982'
      ALABEL(3) = '1983'
      TMAJ = 1.
      TMIN = 0.

      CALL GPHLAB (HEIGHT)
      CALL AXISB (0.,0.,0.,S,ALABEL,3,TMAJ,TMIN,' ',HEIGHT,-1)
      CALL AXISB (0.,S,0.,S,ALABEL,3,TMAJ,TMIN,' ',HEIGHT,+1)
      ALABEL(1) = 'J(ANUARY)'
      ALABEL(2) = 'F(EBRUARY)'
      ALABEL(3) = 'M(ARCH)'
      CALL AXISB (0.,0.,90.,S,ALABEL,3,TMAJ,TMIN,' ',HEIGHT,+1)
      CALL AXISB (S,0.,90.,S,ALABEL,3,TMAJ,TMIN,' ',HEIGHT,-1)
      CALL NFRAME
C-----------------------------------------------------------------------
C EXAMPLE 43
      CALL EXAMPLE (43.)
      CALL CALPLT (.5,.3,-3)
      S = 2.
      ALABEL(1) = '1982'
      ALABEL(2) = '1983'
      TMAJ = -1.
      TMIN = 0.
      CALL GPHLAB (HEIGHT)
      CALL AXISB (0.,0.,0.,S,ALABEL,2,TMAJ,TMIN,' ',HEIGHT,-1)
      ALABEL(1) = 'J(AN)'
      ALABEL(2) = 'F(EB)'
      CALL AXISB (0.,0.,90.,S,ALABEL,2,TMAJ,TMIN,' ',HEIGHT,+1)
      CALL NFRAME
C-----------------------------------------------------------------------
```

```
C EXAMPLE 44
      CALL EXAMPLE (44.)
      CALL CALPLT (1.5,.5,-3)
      S = 2.
      ORG = -2.
      SFX = 2.
      CHARS = 'X (LABEL 1'
      CALL GPHLAB (HEIGHT)
      CALL AXES (0.,0.,0.,S,ORG,SFX,1.,0.,CHARS,HEIGHT,-10)
      CALL AXES (0.,0.,90.,S,ORG,SFX,1.,0.,' ',HEIGHT,+1)
      CHARA(1) = 'Y (LABEL 1'
      CALL HALABEL (90.,CHARA,HEIGHT,10,1,1)
      CHARS = 'X (LABEL 2'
      CALL AXES (0.,S,0.,S,ORG,SFX,1.,0.,CHARS,HEIGHT,+10)
      CALL AXES (S,0.,90.,S,ORG,SFX,1.,0.,' ',HEIGHT,-1)
      CHARA(1) = 'Y (LABEL 2'
      CALL HALABEL (90.,CHARA,HEIGHT,10,1,1)
      CALL NFRAME
C-----------------------------------------------------------------------
C EXAMPLE 45
      CALL EXAMPLE (45.)
      CALL CALPLT (.6,.5,-3)
      S = 2.
      ORG = -2.
      SFX = 2.
      CHARS = 'H(ORIZONTAL LABEL'
      CALL GPHLAB (HEIGHT)
      CALL AXES (0.,0.,0.,S,ORG,SFX,1.,0.,CHARS,HEIGHT,-17)
      CHARS = 'V(ERTICAL LABEL'
      CALL AXES (0.,0.,90.,S,ORG,SFX,1.,0.,CHARS,HEIGHT,+15)
      CALL NFRAME
C-----------------------------------------------------------------------
C EXAMPLE 46
      CALL EXAMPLE (46.)
      CALL CALPLT (1.4,.8,-3)
      S = 2.
      ORG = -2.
      SFX = 2.
      CALL GPHLAB (HEIGHT)
      CALL AXES (0.,0.,0.,S,ORG,SFX,1.,0.,' ',HEIGHT,-1)
      CHARA(1) = 'X (LABEL 1,'
      CHARA(2) = '(UNITS)'
      NCHARA(1) = 11
      NCHARA(2) = 7
      CALL HALABEL (0.,CHARA,HEIGHT,NCHARA,2,2)
      CALL AXES (0.,0.,90.,S,ORG,SFX,1.,0.,' ',HEIGHT,+1)
      CHARA(1) = 'Y (LABEL 1,'
      CHARA(2) = '(UNITS)'
      NCHARA(1) = 11
      NCHARA(2) = 7
      CALL HALABEL (90.,CHARA,HEIGHT,NCHARA,2,2)
      CALL AXES (0.,S,0.,S,ORG,SFX,1.,0.,' ',HEIGHT,+1)
      CHARA(1) = 'X (LABEL 2,'
```

```
      CHARA(2) = '(UNITS)'
      NCHARA(1) = 11
      NCHARA(2) = 7
      CALL HALABEL (0.,CHARA,HEIGHT,NCHARA,2,2)
      CALL AXES (S,0.,90.,S,ORG,SFX,1.,0.,' ',HEIGHT,-1)
      CHARA(1) = 'Y (LABEL 2,'
      CHARA(2) = '(UNITS)'
      NCHARA(1) = 11
      NCHARA(2) = 7
      CALL HALABEL (90.,CHARA,HEIGHT,NCHARA,2,2)
      CALL NFRAME
C-----------------------------------------------------------------------
C EXAMPLE 47
      CALL EXAMPLE (47.)
      CALL CALPLT (1.9,.7,-3)
      S = 2.
      ORG = -.001
      SFX = .001
      TMAJ = -1.
      TMIN = 0.
      CALL GPHLAB (HEIGHT)
      CALL AXES (0.,0.,0.,S,ORG,SFX,TMAJ,TMIN,' ',HEIGHT,-1,3)
      CHARA(1) = 'X (LABEL 1,'
      CHARA(2) = '(UNITS)'
      NCHARA(1) = 11
      NCHARA(2) = 7
      CALL HALABEL (0.,CHARA,HEIGHT,NCHARA,2,2)
      CALL AXES (0.,0.,90.,S,ORG,SFX,TMAJ,TMIN,' ',HEIGHT,+1,3)
      CHARA(1) = 'Y (LABEL 1,'
      CHARA(2) = '(UNITS)'
      NCHARA(1) = 11
      NCHARA(2) = 7
      CALL VALABEL (90.,CHARA,HEIGHT,NCHARA,2,2)
      CALL AXES (0.,S,0.,S,ORG,SFX,TMAJ,TMIN,' ',HEIGHT,+1,3)
      CHARA(1) = 'X (LABEL 2,'
      CHARA(2) = '(UNITS)'
      NCHARA(1) = 11
      NCHARA(2) = 7
      CALL HALABEL (0.,CHARA,HEIGHT,NCHARA,2,2)
      CALL AXES (S,0.,90.,S,ORG,SFX,TMAJ,TMIN,' ',HEIGHT,-1,3)
      CHARA(1) = 'Y (LABEL 2,'
      CHARA(2) = '(UNITS)'
      NCHARA(1) = 11
      NCHARA(2) = 7
      CALL VALABEL (90.,CHARA,HEIGHT,NCHARA,2,2)
      CALL NFRAME
C-----------------------------------------------------------------------
C EXAMPLE 48
      CALL EXAMPLE (48.)
      CALL CALPLT (2.,1.5,-3)
      S = 2.
      ORG = -2.
      SFX = 2.
```

```
      CALL GPHLAB (HEIGHT)
      CALL AXES (0.,0.,0.,S,ORG,SFX,1.,0.,'X1',HEIGHT,-2)
      CALL AXES (0.,0.,90.,S,ORG,SFX,1.,0.,' ',HEIGHT,+1)
      CALL HALABEL (90.,'Y1',HEIGHT,2,1,1)
      ORG = -.001
      SFX = .001
      CALL AXES (0.,-1.,0.,S,ORG,SFX,-1.,0.,'X2',HEIGHT,-2,3)
      CALL AXES (-1.,0.,90.,S,ORG,SFX,-1.,0.,' ',HEIGHT,1,3)
      CALL HALABEL (90.,'Y2',HEIGHT,2,1,1)
      CALL NFRAME
C-----------------------------------------------------------------------
C EXAMPLE 49
      CALL EXAMPLE (49.)
      CALL CALPLT (1.4,.5,-3)
      S = 2.
      ORG = -2.
      SFX = 2.
      CHARS = 'X (LABEL 1'
      CALL GPHLAB (HEIGHT)
      CALL AXES (0.,0.,0.,S,ORG,SFX,1.,0.,CHARS,HEIGHT,-10)
      CALL AXES (0.,0.,90.,S,ORG,SFX,1.,0.,' ',HEIGHT,+1)
      CHARA(1) = 'Y (LABEL 1'
      CALL HALABEL (90.,CHARA,HEIGHT,10,1,2)
      CHARS = 'X (LABEL 2'
      CALL AXES (0.,S,0.,S,ORG,SFX,1.,0.,CHARS,HEIGHT,+10)
      CALL AXES (S,0.,90.,S,ORG,SFX,1.,0.,' ',HEIGHT,-1)
      CHARA(1) = 'Y (LABEL 2'
      CALL HALABEL (90.,CHARA,HEIGHT,10,1,2)
      CALL NFRAME
C-----------------------------------------------------------------------
C EXAMPLE 50
      CALL EXAMPLE (50.)
      CALL CALPLT (1.5,.5,-3)
      S = 2.
      ORG = -.001
      SFX = .001
      CHARS = 'X (LABEL 1'
      CALL GPHLAB (HEIGHT)
      CALL AXES (0.,0.,0.,S,ORG,SFX,1.,0.,CHARS,HEIGHT,-10)
      CALL AXES (0.,0.,90.,S,ORG,SFX,1.,0.,' ',HEIGHT,+1)
      CHARA(1) = 'Y (LABEL 1'
      CALL HALABEL (90.,CHARA,HEIGHT,10,1,1)
      CHARS = 'X (LABEL 2'
      CALL AXES (0.,S,0.,S,ORG,SFX,1.,0.,CHARS,HEIGHT,+10)
      CALL AXES (S,0.,90.,S,ORG,SFX,1.,0.,' ',HEIGHT,-1)
      CHARA(1) = 'Y (LABEL 2'
      CALL HALABEL (90.,CHARA,HEIGHT,10,1,1)
      CALL NFRAME
C-----------------------------------------------------------------------
C EXAMPLE 51
      CALL EXAMPLE (51.)
      CALL CALPLT (1.6,1.5,-3)
      S = 2.
```

```
      ORG = -20000.
      SFX = 20000.
      CALL GPHLAB (HEIGHT)
      CALL AXES (0.,0.,0.,S,ORG,SFX,1.,0.,'X1',HEIGHT,-2)
      CALL AXES (0.,0.,90.,S,ORG,SFX,1.,0.,' ',HEIGHT,+1)
      CALL HALABEL (90.,'Y1',HEIGHT,2,1,1)
      ORG = 0.
      SFX = 10000.
      CALL AXES (0.,-1.,0.,S,ORG,SFX,1.,0.,'X2',HEIGHT,-2)
      CALL AXES (-1.,0.,90.,S,ORG,SFX,1.,0.,' ',HEIGHT,+1)
      CALL HALABEL (90.,'Y2',HEIGHT,2,1,1)
      CALL NFRAME
C-----------------------------------------------------------------------
C EXAMPLE 52
      CALL EXAMPLE (52.)
      CALL CALPLT (.5,.3,-3)
      S = 2.
      STAGLAB(1) = '-10'
      STAGLAB(2) = '0'
      STAGLAB(3) = '0'
      STAGLAB(4) = '0'
      STAGLAB(5) = ' 10'
      TMAJ = .5
      TMIN = 0.
      CALL GPHLAB (HEIGHT)
      CALL AXISB (0.,0.,0.,S,STAGLAB,5,TMAJ,TMIN,' ',HEIGHT,-1)
      STAGLAB(2) = '  0'
      STAGLAB(3) = '  0'
      STAGLAB(4) = '  0'
      CALL AXISB (0.,0.,90.,S,STAGLAB,5,TMAJ,TMIN,' ',HEIGHT,+1)
      CALL NFRAME
C-----------------------------------------------------------------------
C EXAMPLE 53
      CALL EXAMPLE (53.)
      CALL CALPLT (0.,3.2,-3)
      XP = 0.
      YP = 0.
      CALL GPHLAB (HEIGHT)
      CHARS = 'ISYM'
      CALL CHARACT (XP,YP,HEIGHT,CHARS,0.,4)
      CALL GPBCOL (PBCOL)
      CALL GPSYMS (PSYMS)
      YP = YP-PBCOL-PSYMS
      CALL CALPLT (.18,0.,-3)
      DO 120 I=1,10
      FPN(1) = I
      CALL NUMBER (0.,YP,HEIGHT,FPN,0.0,-1)
      CALL PNTPLT (1.0,YP,+I,1)
      YP = YP-.30
  120 CONTINUE
      CALL NFRAME
C-----------------------------------------------------------------------
C EXAMPLE 54
```

```
      CALL EXAMPLE (54.)
      CALL CALPLT (0.,.3,-3)
      XP = .2
      YP = 0.
      DO 130 IFLAG = 100,900,100
      CALL PNTPLT (XP,YP,IFLAG+1,1)
      XP = XP+.4
  130 CONTINUE
      CALL NFRAME
C-----------------------------------------------------------------------
C EXAMPLE 55
      CALL EXAMPLE (55.)
      CALL CALPLT (0.,2.5,-3)
      DO 140 LP=1,8
      CALL LINPLT (XLINE,YLINE,2,1,0,0,1,LP)
      CALL CALPLT (0.,-.33,-3)
  140 CONTINUE
      CALL NFRAME
C-----------------------------------------------------------------------
C EXAMPLE 56
      CALL EXAMPLE (56.)
      S = 2.
      ORG = -2.
      SFX = 2.
      HEIGHT = 0.
      CALL AXES (0.,0.,0.,-S,ORG,SFX,1.,0.,' ',HEIGHT,-1)
      CALL AXES (0.,0.,90.,-S,ORG,SFX,1.,0.,' ',HEIGHT,+1)
      CALL LINPLT (XSYM,YSYM,3,1,0,1,1)
      CALL NFRAME
C-----------------------------------------------------------------------
C EXAMPLE 57
      CALL EXAMPLE (57.)
      S = 2.
      ORG = -2.
      SFX = 2.
      HEIGHT = 0.
      CALL AXES (0.,0.,0.,-S,ORG,SFX,1.,0.,' ',HEIGHT,-1)
      CALL AXES (0.,0.,90.,-S,ORG,SFX,1.,0.,' ',HEIGHT,+1)
      CALL LINPLT (XSYM,YSYM,3,1,-1,2,1)
      CALL NFRAME
C-----------------------------------------------------------------------
C EXAMPLE 58
      CALL EXAMPLE (58.)
      S = 2.
      HEIGHT = 0.
      CALL LINPLT (XSYM,YSYM,3,1,2,3,2)
      ORG = -2.
      SFX = 2.
      CALL AXES (0.,0.,0.,-S,ORG,SFX,1.,0.,' ',HEIGHT,-1)
      CALL AXES (0.,0.,90.,-S,ORG,SFX,1.,0.,' ',HEIGHT,+1)
      CALL NFRAME
C-----------------------------------------------------------------------
C EXAMPLE 59
```

```
      CALL EXAMPLE (59.)
      S = 2.
      ORG = -2.
      SFX = 2.
      HEIGHT = 0.
      CALL AXES (0.,0.,0.,-S,ORG,SFX,1.,0.,' ',HEIGHT,-1)
      CALL AXES (0.,0.,90.,-S,ORG,SFX,1.,0.,' ',HEIGHT,+1)
      CALL LINPLT (XSYM,YSYM,3,1,2,4,2,2)
      CALL NFRAME
C-----------------------------------------------------------------------
C EXAMPLE 60
      CALL EXAMPLE (60.)
      XUL = 0.
      YUL = 1.6
      CHARA(1) = 'A(LPHABETIC)'
      CHARA(2) = 'L(EFT)'
      CHARA(3) = 'J(USTIFIED'
      CALL GPHKEY (HEIGHT)
      NCHARA(1) = 12
      NCHARA(2) = 6
      NCHARA(3) = 10
      ISYMA(1) = 1
      ISYMA(2) = 2
      ISYMA(3) = 3
      CHARTA(1) = 'T(ITLE)'
      CHARTA(2) = '(IS)'
      CHARTA(3) = '(CENTERED)'
      NCHARTA(1) = 7
      NCHARTA(2) = 4
      NCHARTA(3) = 10
      CALL KEY (XUL,YUL,CHARA,HEIGHT,NCHARA,3,ISYMA,-1,1,CHARTA,NCHARTA,
     .             3)
      CALL NFRAME
C-----------------------------------------------------------------------
C EXAMPLE 61
      CALL EXAMPLE (61.)
      XUL = 0.
      YUL = 1.1
      FPN(1) = 0.
      FPN(2) = 100.5
      WRITE (CHARA(1),'(F10.1)') FPN(1), FPN(2)
      IN1 = 0
      IN2 = 20
      WRITE (CHARA(3),'(I10)') IN1,IN2
      CALL GPHKEY (HEIGHT)
      NCHARA(1) = -10
      NCHARA(2) = -10
      NCHARA(3) = -10
      NCHARA(4) = -10
      NLINEA(1) = -2
      NLINEA(2) = -2
      LPA(1) = 2
      LPA(2) = 3
```

```
      CHARTA(1) = 'R(EAL)'
      CHARTA(2) = 'I(NTEGER)'
      NCHARTA(1) = 6
      NCHARTA(2) = 9
      CALL KEY (XUL,YUL,CHARA,HEIGHT,NCHARA,NLINEA,-1,LPA,1,CHARTA,
     .          NCHARTA,1,2)
      CALL NFRAME
C-----------------------------------------------------------------------
C EXAMPLE 62
      CALL EXAMPLE (62.)
      XUL = 0.
      YUL = 1.6
      CHARA(1) = '10.5'
      CHARA(2) = '0.0'
      CHARA(3) = '20.7'
      CHARA(4) = 'E(XAMPLE)'
      CHARA(5) = 'O(F)'
      CHARA(6) = 'A(LPHANUMERIC'
      CALL GPHKEY (HEIGHT)
      NCHARA(1) = 4
      NCHARA(2) = 3
      NCHARA(3) = 4
      NCHARA(4) = 9
      NCHARA(5) = 4
      NCHARA(6) = 14
      NLINEA(1) = -3
      NLINEA(2) = +3
      ISYMA(1) = 1
      ISYMA(2) = 0
      ISYMA(3) = 3
      LPA(1) = 0
      LPA(2) = 2
      LPA(3) = 3
      CHARTA(1) = 'N(UMBERS)'
      CHARTA(2) = '(RIGHT)'
      CHARTA(3) = '(JUSTIFIED'
      CHARTA(4) = 'A(LPHABETIC'
      CHARTA (5) = '(LEFT)'
      CHARTA(6) = '(JUSTIFIED'
      NCHARTA(1) = 9
      NCHARTA(2) = 7
      NCHARTA(3) = 10
      NCHARTA(4) = 12
      NCHARTA(5) = 6
      NCHARTA(6) = 10
      CALL KEY (XUL,YUL,CHARA,HEIGHT,NCHARA,NLINEA,ISYMA,LPA,1,CHARTA,
     .        NCHARTA,3,2)
      CALL NFRAME
C-----------------------------------------------------------------------
C EXAMPLE 63
      CALL EXAMPLE (63.)
      XUL = 0.
      YUL = .8
```

```
      CHARA(1) = 'D(ATA)'
      CHARA(2) = 'T(HEORY)'
      CALL GPHKEY (HEIGHT)
      NCHARA(1) = 6
      NCHARA(2) = 8
      ISYMA(1) = 1
      ISYMA(2) = 0
      LPA(1) = 0
      LPA(2) = 2
      CALL KEY (XUL,YUL,CHARA,HEIGHT,NCHARA,+2,ISYMA,LPA,1)
      CALL NFRAME
C-----------------------------------------------------------------------
      CALL CALPLT (0.,0.,999)
      STOP
      END
      SUBROUTINE EXAMPLE (EXNO)
      CALL CHARRET (NCS)
      CALL CHARST3
      X = .1
      Y = .1
      CALL GPHLAB (HEIGHT)
      CALL CHARACT (X,Y,HEIGHT,'E(XAMPLE) ',0.0,10)
      CALL WHERE (XNOW,YNOW,INOW)
      CALL NUMBER (XNOW,YNOW,HEIGHT,EXNO,0.0,-1)
      IF (NCS.EQ.-1) CALL CHAROFF
      IF (NCS.NE.-1) CALL CHNGSET (NCS)
      CALL CALPLT (0.,.3,-3)
      RETURN
      END
```

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
NASA TM-81908 (Revised)		

4. Title and Subtitle	5. Report Date
GUIDELINES IN PREPARING COMPUTER-GENERATED PLOTS FOR NASA TECHNICAL REPORTS WITH THE LaRC GRAPHICS OUTPUT SYSTEM	August 1983
	6. Performing Organization Code 992-16-05-03
7. Author(s) Nancy L. Taylor	8. Performing Organization Report No.
	10. Work Unit No.
9. Performing Organization Name and Address NASA Langley Research Center Hampton, Virginia 23665	11. Contract or Grant No.
	13. Type of Report and Period Covered Technical Memorandum
12. Sponsoring Agency Name and Address National Aeronautics and Space Administration Washington, DC 20546	14. Sponsoring Agency Code

15. Supplementary Notes

Supercedes TM-81908 (November 1980), Accession No. N81-12761.

16. Abstract

To respond to a need for improved computer-generated plots that are acceptable to the Langley publication process, the LaRC Graphics Output System has been modified to encompass the publication requirements, and a guideline has been established. This guideline deals only with the publication requirements of computer-generated plots. This report explains the capability that authors of NASA technical reports can use to obtain publication-quality computer-generated plots for the Langley publication process. The rules applied in developing this guideline and examples illustrating the rules are included.

17. Key Words (Suggested by Author(s))	18. Distribution Statement
Computer-generated plots	Unclassified-Unlimited Subject Category 61

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price
Unclassified	Unclassified	111	A06

NASA-Langley, 1983