HPLÔT

USERS GUIDE
FOR VERSION 1.5
NOVEMBER 1976

PROGRAM LIBRARY LONG WRITE-UP Y251
<table>
<thead>
<tr>
<th>Revision</th>
<th>Date</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>5/12/75</td>
<td>Initial printing</td>
</tr>
<tr>
<td>B</td>
<td>19/01/76</td>
<td>New routine HPLWIN</td>
</tr>
<tr>
<td>C</td>
<td>05/11/76</td>
<td>Minor changes to manual</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Slight changes in HPLCOM &amp; HPLINT</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(but routines are fully backwards</td>
</tr>
<tr>
<td></td>
<td></td>
<td>compatible)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Error messages introduced</td>
</tr>
<tr>
<td></td>
<td></td>
<td>LOG scales now working</td>
</tr>
<tr>
<td></td>
<td></td>
<td>New examples</td>
</tr>
</tbody>
</table>
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HPLOT is a FORTRAN callable facility for producing HBOOK (reference 1) output on graphic devices other than the line printer. Its main design objective is to be able to produce drawings and slides of a quality suitable for talks and publication. To this end, it does not produce all the numeric information of the HBOOK output routines (which give what can be regarded as working histograms) but, on the other hand, it is not restricted by the line printer resolution or character size.

HPLOT utilises the GD3 package (reference 2) at CERN because this produces a display file which can be used to produce pictures on a number of different devices (incremental PLOTTER, microfilm, TEKTRONIX display terminals, line printer etc.). The preferred HPLOT output device is the PLOTTER for which the size and positions of character strings have been optimised. Furthermore the PLOTTER output can be made either A3 or A4 paper size under user control (see section 2.2). However it is often useful to be able to use the line printer for HPLOT output during the debugging phase of picture development.

HPLOT has been written in ANSI STANDARD FORTRAN and can readily be implemented on machines other than CDC. For this purpose an Installation Guide has been prepared (reference 5). Obviously HBOOK must also be implemented, but there is no need to implement GD3. Full details are given in the Installation Guide.

Finally the author would like to acknowledge his thanks to the authors of HBOOK for making HPLOT possible. Many thanks are due to R. BRUN for helpful discussions on the detailed structure of HBOOK. Numerous people have contributed ideas and particular mention must be made of A. BERGLUND who pioneered the first HPLOT installation outside CERN. However the responsibility of errors and omissions must rest solely on my shoulders.

H. Watkins
CERN
DD DIVISION
December 1975
1.1 INTRODUCTION

THE BASIC H PLOT PACKAGE

1.1 THE BASIC H PLOT PACKAGE

The Basic H PLOT package consists of only seven user callable routines. They are described in greater detail in section 2. They are

- **HPLAX** Provides titles for the axes
- **HPLCOM** Allows the user to supply comments on the picture
- **HPLEND** Termination routine
- **HPLINT** Initialisation routine
- **HPLOPT** Allows the user to change various options
- **HPLLOT** The basic routine. It defines the histogram(s) to be plotted
- **HPLWIN** Allows the user to plot several histograms on one picture, each histogram being plotted in its own window (where a 'window' is a smaller part of the complete picture)

In addition to these routines, the user must have created his histograms with HBOOK. For its graphic output, H PLOT uses the GD3 package, but the user need not call any GD3 routines himself. For details of the GD3 control cards for the various output devices, see section 2.3.

H PLOT has some internal routines and common blocks. For ease of identification, and to avoid the user calling them by mistake, the internal routines have names such as HPLA, HPLB ...... and the common blocks HPL1, HPL2 ...... etc.

N.B. Either version of HBOOK, the LONG or the SHORT , may be used with H PLOT.
2.1 THE HLOT LIBRARY

HLOT exists as a library on the 6000 front-end machines and also on the 7600. The most convenient way of attaching the HLOT library is to use the CERNLIB macro -

\texttt{FIND,CERNLIB,ID=PROGLIB. CERNLIB,HLOT.}

This will automatically attach the libraries for HBOOK (Long) and the program library.
2.2 USING HPLOT ON THE CERN CDC MACHINES

H PLOT AND GD3

2.2 H PLOT AND GD3

GENERAL.

The H PLOT initialisation routine, HPLINT, must be called before any other H PLOT routines. Its function is to initialise the H PLOT options to their default values and also to define the GD3 display file.

As an example, suppose a user already utilises files INPUT, OUTPUT and TAPE1 and decides to use TAPE7 for the GD3 display file. He might code

```fortran
PROGRAM ONE(INPUT,OUTPUT,TAPE1,TAPE7)
   ...
   ...
   CALL HPLINT(7)
   ...
   ...
   HBOOK ROUTINES TO DEFINE THE HISTOGRAM
   ...
   ...
   CALL HPLOT(.....)
   ...
   CALL HPLEND
STOP
END
```

The call to HPLEND is required to close the display file.
2.3 CONTROL CARDS FOR THE GD3 DISPLAY FILE

If the user has declared the file TAPE7 to be his display file, he may obtain HPLOT output on the PLOTTER with the following control cards

CP PLOT, TAPE7.

Other interpreters are available as in the following table:

<table>
<thead>
<tr>
<th>CONTROL CARD</th>
<th>DEVICE</th>
</tr>
</thead>
<tbody>
<tr>
<td>PR PLOT</td>
<td>Line printer</td>
</tr>
<tr>
<td>CP PLOT</td>
<td>COMPUTER INSTRUMENTATION incremental</td>
</tr>
<tr>
<td></td>
<td>Pen plotter</td>
</tr>
<tr>
<td>MFILM(*)</td>
<td>35 mm roll film</td>
</tr>
<tr>
<td>MCARD(*)</td>
<td>Aperture cards</td>
</tr>
</tbody>
</table>

* not yet available. Contact PEO for further information

They are used in exactly the same way i.e. after the LGO step which creates the display file. As a final example consider

DISPOSE, PLOT, *PT, ST=CCP.

CERNLIB, H PLOT.

FTN.

LGO.

PR PLOT, TAPE7.

PLOT LIM, 40.

CP PLOT, TAPE7.
2.3 USING H PLOT ON THE CERN CDC MACHINES

CONTROL CARDS FOR THE GD3 DISPLAY FILE

In this example the user is producing output on both the line
printer and the plotter. The call to PLOT LIM is needed in cases
where the default time limit for plotting (20 minutes) needs to be
increased. In this example the user has requested 40 minutes plot
time. This represents about 8 one dimensional plots, the exact
number depending on the complexity of each plot. Scatter plots
take a long time, perhaps 20 minutes for one plot.

The DISPOSE card is necessary and tells the system to DISPOSE
the file PLOT (the file created by CP PLOT) to the plotter. The *
causes the file 'PLOT' to be disposed at the end of the job. The
parameter 'PT' will give either plain or squared paper, whichever
is available.

If the user requires squared (millimetric) paper he should code

DISPOSE,PLOT,*PT=CS1,ST=CCP.

If he requires plain white paper he should code

DISPOSE,PLOT,*PT=CPl,ST=CCP.

If one wishes to use the Tektronix Interpreter (for details see
the next section) on the Tektronix 4012's, a FILE card must be
supplied for the Display file

FILE,TAPE7,RT=W,BT=I
2.4 USING HPLLOT ON THE CERN CDC MACHINES

TEKTRONIX INTERPRETER FOR USE UNDER INTERCOM

2.4 TEKTRONIX INTERPRETER FOR USE UNDER INTERCOM

At the moment, there are two front-end machines MFA and MFB. Both front-ends support the INTERCOM terminal subsystem, and the GD3 interpreter known as ‘TV’.

Some of the displays have a HARD COPY unit attached to them, which means that, at any time, a copy of the contents of the display screen can be put onto paper simply by pressing a button. Information on how to become an INTERCOM user can be obtained from Mme C Ball or the Computer User’s Guide.

NON-INTERACTIVE USE OF THE TERMINALS

It is assumed that the user has already created a DISPLAY FILE and now wants to look at the different pictures contained within it.

To simplify the control statements which a user has to type in, a catalogued procedure of control statements (called TV) has been created.

We will assume that the display file has been catalogued on the front-end machine under the name ‘myfile’ with record type ‘RT=W, BT=I’ and user ID ‘userid’. The sequence of commands after the user has logged in should then be

<table>
<thead>
<tr>
<th>COMMAND</th>
<th>EXPLANATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>ETL,300.</td>
<td>Request suitable time limit</td>
</tr>
<tr>
<td>ATTACH,TV.</td>
<td>get TV</td>
</tr>
<tr>
<td>ATTACH,DISPLY,myfile,ID=userid.</td>
<td>attach display file</td>
</tr>
<tr>
<td>TV</td>
<td>execute TV</td>
</tr>
</tbody>
</table>

After this sequence the prompt TV CMD= is output to the screen to allow the user to input a command. For completeness we give here a brief summary of the available commands

a) GENERAL COMMANDS

A The picture will be plotted in a square area of the
screen (default)

B The picture will be plotted using the whole area of the screen, giving a rectangular picture

D Display all valid commands

E Erase the display screen

G Display a grid over the picture frame. This is intended for use with the S command

I Gives information on the current screen options

Sa,b,c,d
Used for selecting part of a picture for magnification. 'a,b' represents the X and Y values of the bottom left hand corner in grid units, and 'c,d' the magnification factors for X and Y. This command must be followed by a display command e.g. 'S12,12,3,4EC'

O Quit the program

d) SELECTION OF FRAMES (PICTURES)

N Display the next frame

C Display current frame again

Fn Find frame n and display it

R Rewind the display file

c) SELECTION OF MDES FOR DISPLAYING

U Turn off text output (hardware characters)

V Turn on text output (hardware characters)

Hn With this command the screen can be split into two side by side selections, if n=1 the following frames will be displayed on the left-hand side of the screen. If n=2 the frame will be on the right. If n=0 or is omitted then the full screen will be used.
TEKTRONIX INTERPRETER FOR USE UNDER INTERCOM

Notes
1. when each TV command is finished, the prompt TV CMD= is always output again.

2. when the user exits from the TV program (i.e. By typing Q) a return is made to the normal INTERCOM system and the prompt COMMAND - appears on the screen.

3. the assumed display is a Tektronix 4012. If a 4006 is being used, the command "T6" should be given before displaying the first picture. Similarly on a 4014 the command T14 should be given.

4. commands can be given together. Thus the first command on a 4014 might be a BET14N

SELECTING PICTURES TO BE PLOTTED.

Sometimes it is required to plot a selection of pictures instead of plotting all the pictures. This is possible with the program XPLOT

<table>
<thead>
<tr>
<th>COMMAND</th>
<th>EXPLANATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>ETL,100</td>
<td>request suitable time limit</td>
</tr>
<tr>
<td>ATTACH,XPLOT</td>
<td>get XPLOT</td>
</tr>
<tr>
<td>XPLOT,DISPLY</td>
<td>execute XPLOT on the load file 'DISPLY'</td>
</tr>
</tbody>
</table>

XPLOT will select frames and give the required paper type etc. according to the user's replies to the questions. Further details of XPLOT can be found in the CERN Computer Newsletter No. 120.
All HPLOT calls are of the type

    CALL HPL...(PAR1,PAR2,...PARN)

Where PAR1,PAR2,...PARN are the input parameters.

Some subroutines can be called with a shortened number of input parameters if desired (1, 2, or 3 instead of 4), the missing parameters are assumed to be zero by default. For example to plot everything (all slices, all bands, all projections for all scatter plots and all one-dimensional histograms) one can code

    CALL HPLOT(0,0,0,0)

or simply

    CALL HPLOT(0)
3.1 HPLAX

+--------------------------+
| I                       |
| I  CALL HPLAX(IXT,IYT)  |
| I                       |
+--------------------------+

ACTION
To print title(s) along the X and/or Y axes of the plot

PARAMETERS

IXT = array of characters to be printed on the X axis
(maximum of 80)

IYT = same for Y axis

SPECIAL VALUES

IXT(1) = 0  no X axis title to be printed
IYT(1) = 0  no Y axis title to be printed

REMARKS-

The arrays should contain the titles to be printed as a
continuous Hollerith string. If a Dollar sign is present it is
-treated as a text-string delimiter, and is not printed. A maximum
of 80 characters is allowed. (Note that, on some computers other
than CDC, the dollar sign is necessary).

Each title is printed either to the right and below the axis
(X) or at the top and to the left (Y).

The orientation of the characters of the Y axis title depends on
the GD3 interpreter used. With the PLOTTER the entire title is
rotated 90 degrees anticlockwise to follow the Y axis. This is not
possible with all interpreter (e.g. Line printer, TEKTRONIX T4012)
and in these cases the characters are printed upright one beneath
the other.

Other minor differences may also be observed between the GD3
interpreters

N.B. the titles are printed on the already existing picture, i.e.
HPLAX must be called after HPLOT.
3.2 HPLCOM

+---------------------------------------------------+
I    I
I  CALL HPLCOM(XM,YM,ITITLE)   I
I    I
+---------------------------------------------------+

ACTION
Prints a comment on the picture

PARAMETERS

XM  position of start of the line of characters in
YM  ITITLE. The units of XM and YM are in terms of the
    paper size

ITITLE = array of characters to be printed. (Maximum of 80)

SPECIAL VALUES

The absolute values of XM and YM are used, but if either are
negative, the comment will be centred on ABS(XM,YM) automatically.

If both are negative, the text will be left adjusted so it
finishes at ABS(XM,YM)

REMARKS

The same remarks concerning the termination of the character
string apply as for HPLAX.

The units chosen for XM and YM are in terms of the PLOTTER
output which gives the metric paper sizes A3 or A4. The sizes of
these formats are

\[
\begin{align*}
\text{A3} & \quad 29.73 \times 42.044 \text{ cm} \\
\text{A4} & \quad 21.022 \times 29.73 \text{ cm}
\end{align*}
\]
A comment can be placed at the centre of the picture with the following values of XM and YM:

<table>
<thead>
<tr>
<th></th>
<th>XM</th>
<th>YM</th>
</tr>
</thead>
<tbody>
<tr>
<td>A4 VERTICAL</td>
<td>10.511</td>
<td>14.85</td>
</tr>
<tr>
<td>A4 HORIZONTAL</td>
<td>14.865</td>
<td>10.511</td>
</tr>
<tr>
<td>A3 (HORIZONTAL OR VERTICAL)</td>
<td>21.022</td>
<td>14.865</td>
</tr>
</tbody>
</table>

N.B.

HPLCOM is used to put comments on an existing picture, i.e. it must be called after HPLOT.
3.3 HPLEND

+----------------------+
I                      I
I    CALL HPLEND      I
I                      I
+----------------------+

ACTION
Terminates the HPLOT package

PARAMETERS
None

REMARKS-
HPLEND must be called after all other HPLOT routines. Its chief function is to close the display file.
3.4 HPLINT

+---------------------------------------------------------+
I I CALL HPLINT(LUNIT,LMES) I
I I
+---------------------------------------------------------+

ACTION
Initialises the HPLOT package and defines the intermediate file, known as the display file, to be passed to the GD3 interpreters for graphical output.

PARAMETERS

LUNIT = logical unit number of file to be used for the display file

LMES = logical unit number of file for HPLOT messages

SPECIAL VALUES

LMES = 0 (or missing)
Only the HPLOT header page (showing the HPLOT version number, the date, new features etc.) and the HPLOT terminator page will be printed. The HBOOK 'Result file' (containing the HBOOK histograms, index etc.) will be used.

LMES = -1
No HPLOT output will be generated, except for error messages.

LMES = n
The logical unit number 'n' will be used for the HPLOT header page and terminator page. In addition each call to HPLINT, HPLOPT, HPLWIN, and HPLOPT will write information concerning the options initialised, the options set, the windowing conditions set and the histograms plotted.

REMARKS

Whatever the value of LMES, the HPLOT error messages will appear on the same output file as the HBOOK error message file.
HPLINT

The HBOOK result file can be changed by the HBOOK routine 
HOUTPU, and the HBOOK error message file can be changed by the 
HBOOK routine HERMES.

N.B.

HPLINT must be called before any other HPLOT routines.
3.5 HPLOPT

I CALL HPLOPT(IOPTN,N) I
I

ACTION
Allows the user to change the options defined by default in HPLINT. HPLOPT can be called any number of times, each option remains in effect until modified by further calls to HPLOPT.

PARAMETERS

IOPTN = array of options. Each word of the array defines a new option via a Hollerith string. Individual Hollerith strings have a maximum of four characters.

N = size of array in words

SPECIAL VALUES

Each word of IOPTN can be one of the following, where the values given under the heading 'DEFAULT' are set by HPLINT.

<table>
<thead>
<tr>
<th>DEFAULT</th>
<th>ALTERNATIVE</th>
<th>EFFECT</th>
</tr>
</thead>
<tbody>
<tr>
<td>2HA4</td>
<td>2HA3</td>
<td>Page size for the plotter (see Remark 4 below)</td>
</tr>
<tr>
<td>4HVERT</td>
<td>4HHORI</td>
<td>Orientation of plotter paper, the long side of the plot can be horizontal or vertical (see under Remark 4 below)</td>
</tr>
<tr>
<td>4HNOPG</td>
<td>2H*P</td>
<td>Suppresses (4HNOPG) or adds page numbers to the plot. '*' and '**' represent 1,2 and 3 digit numbers respectively. Once set, page numbers are incremented automatically</td>
</tr>
<tr>
<td>3H**P</td>
<td>4H***P</td>
<td></td>
</tr>
<tr>
<td>4HNEAH</td>
<td>3HEAH</td>
<td>3EAH plots error bars and histograms, if both are present. 4HNEAH Negates the EAH option, i.e. if error bars are present they are plotted without the histogram</td>
</tr>
</tbody>
</table>
4HNAST 3HAST
a function can be drawn with (3HAST) or
without (4HNAST) asterisks in each channel

4HNCHA 3HCHA
the scatter plot can be plotted either
with dots randomised within each bin
(4HNCHA) or by printing a single character
in the middle of the bin (3HCHA). The
latter option is much faster when plotting
or viewing on a Video Display Screen and
is therefore very useful when debugging

4HHARD 4HSOFT
either HARDware or SOFTWARE characters can
be used. Software characters allow Greek
letters, subscripts, superscripts, upper
case, lower case etc., but do not give
readable output on the line printer. With
software characters one can define the
character sizes required. See HPL0T
Advanced User’s Guide for further details
(reference 6)

4HNSQR 3HSQR
the option ‘SQR’ will reduce the size of
the plot to make it square. This option
will produce square plots for all
histograms - scatter plots, projections,
1-dimensional etc. If windowing is used,
individual windows will be square.
N.B. The plots will only be square on the
plotter, on other devices they will appear
reduced in one dimension or another.

REMARKS

1). the parameters can be supplied in any order in the array
IOPTN. If two mutually exclusive options are given, the last
one encountered is used i.e. IOPTN(2) takes precedence over
IOPTN(1).

2). at CERN the PLOTTER output is only 32 cm wide and consequently
it is not possible to plot A3 paper size vertically.
Therefore, if the option A3 is chosen, the plot will be made
horizontally even if the option 4HVERT is selected

<table>
<thead>
<tr>
<th>OPTION</th>
<th>length of X axis</th>
<th>length of Y axis</th>
</tr>
</thead>
<tbody>
<tr>
<td>A4 vertical</td>
<td>21.022</td>
<td>29.73</td>
</tr>
<tr>
<td>A4 horizontal</td>
<td>29.73</td>
<td>21.022</td>
</tr>
<tr>
<td>A3</td>
<td>42.044</td>
<td>29.73</td>
</tr>
</tbody>
</table>
3.5 HPILOT SUBROUTINE CALLS

HPLOPT

3). once a value for the page number has been given, it will automatically be incremented for each new picture. The position of the page number is dependant on the options A3/A4 and HORI/VERT. See example 2 in Appendix B for details.

4). if the options A3, A4, HORI or VERT are called, the windowing is turned off (i.e. a call is made to HPLWIN(1,1,1,0)). It is recommended that windowing is called after HPLOPT to avoid this problem.
3.6 HPLOT

+---------------------------------------------+
   CALL HPLOT(ID,ISAME,ICASE,NUM)           
+---------------------------------------------+

ACTION
Plots histogram id on the display file

PARAMETERS

ID = histogram identifier

ISAME = Hollerith string (4H$SAME$) to denote if the histogram is to be plotted on top of the previous picture

ICASE = hollerith string to select part of a 2-dimensional histogram e.g. Slices in x

NUM = integer to do further selection on ICASE, e.g. third slice in x

SPECIAL VALUES

ID = 0 gives all histograms, all projections, all slices etc. No other parameters are searched

ISAME = 4H$SAME$ causes the current histogram to be superimposed on the previous picture. The titles, axes, page numbers etc. are not re-drawn

ISAME = zero or missing causes the current histogram to be given a new picture complete with titles, axes, page numbers etc

ICASE = 0 gives all projections, bands and slices

   = 4HSLIX gives slices in x only
   = 4HSLIY gives slices in y only
3.6 HPLot Subroutine Calls

Hplot

= 4HBANX gives bands in X only
= 4HBANY gives bands in Y only
= 4HPROX gives projection in X only
= 4HPROY gives projection in Y only
= 4HHIST gives the histogram (scatter plot) only

NUM = 0 where ICASE refers to slices or bands, NUM=0 gives all slices or bands
= n where ICASE refers to slices or bands, NUM=n gives the nth slice/band only

Summary

Hplot(0) gives all information for all histograms
Hplot(ID) gives all information for histogram ID
Hplot(ID,0,4HBANX) gives all bands in X for histogram ID (and similarly for 4HBANY)
Hplot(ID,0,4HSLIX) gives all slices in X for histogram ID plotted on one frame (multiple slices). Similarly for 4HSLIX (but not for bands which are always plotted separately)
Hplot(ID,0,4HSLIX,N) gives the Nth slice in X for histogram ID. Similarly for 4HSLIX, 4HBANX, 4HBANY

Remarks

When superimposing histograms with the '4HSAME' parameter, the symbols for drawing the straight lines of the histogram, error bars and function are changed as follows:

first histogram ---- i.e. a solid line
second histogram -- (dash,blank,dash,blank)
third histogram -. (dash,dot,dash,dot)
fourth histogram .. (dot,blank,dot,blank)
fifth histogram .... (dot,dot,dot,dot)

If more than five histograms are superimposed, Hplot will loop round the symbols again
If three histograms are to be superimposed, but the second histogram requested does not exist, the third histogram will still be plotted with the third symbol (\texttt{-.--}). Similarly if the second histogram is a scatter plot, the third histogram will take the third symbol (\texttt{-.--}).

After the first histogram has been drawn, HPLLOT does not make further reference to the values on the axes – it is up to the user to call HCOMPA before plotting the histograms.
3.7 HPLWIN

+---------------------------------------------------
| I               CALL HPLWIN(IXWIN,IYWIN,IWINO,ISAME) I |
| I               I                                           |
+---------------------------------------------------

ACTION
Splits the picture into smaller parts, called windows. A complete histogram can be drawn in one of these windows.

PARAMETERS

IXWIN = number of windows in the X direction
IYWIN = number of windows in the Y direction
IWINO = first window to be plotted (see below under remarks)
ISAME = Hollerith string to allow windowing parameters to be reset on the current picture

SPECIAL VALUES

IXWIN)
IYWIN)
IWINO  if missing, a value of 1 is assumed, i.e.
the first window
ISAME = 4HSAME changes the default setting such that HPLWIN does not terminate the current picture
ISAME = anything else (or missing)
the next HPLOT call will start on a new picture

REMARKS

1). Windows are numbered from left to right, starting at the top of the picture. For example with

CALL HPLWIN(3,2,1)

the windows are numbered as follows
2). The window number is automatically incremented with each HPLOT call unless reset by a further call to HPLWIN. If, when the window number is increased, it becomes larger than the maximum allowed on a picture, then the next histogram plotted will be at window position 1 on a new picture. For example, assuming histograms 101-110 are 1-dimensional

```
CALL HPLWIN(3,2,1)
DO 10 I=101,110
   10 CALL HPLLOT(I)
```
gives

```
I   I   I   I
I 101 I 102 I 103 I
I   I   I   I
I 104 I 105 I 106 I
I   I   I   I
```

a further HPLLOT call will start plotting below histogram 108

3). It is important to understand the difference between the effects of the '4HSAME' parameters of HPLWIN and HPLLOT.

The 'HPLLOT-4HSAME' allows histograms to be superimposed without redrawing the axes or the titles. The 'HPLWIN-4HSAME' allows the windowing options to be reset on the current picture, and the next HPLLOT call will plot a histogram complete with axes and titles.

The 'HPLWIN-4HSAME' is normally used when plotting different
sized windows on the same plot, or when forcing a histogram into a particular window.

4). Different sized windows can be plotted together on one picture with a series of HPLWIN-HPLOT calls, all but the first containing the '4HSAME' parameter in HPLWIN. For example

\[
\begin{align*}
\text{CALL HPLWIN}(2,2,2) \\
\text{CALL HPLOT}(100) \\
\text{CALL HPLWIN}(2,2,4,4HSAME) \\
\text{CALL HPLOT}(101) \\
\text{CALL HPLWIN}(2,1,1,4HSAME) \\
\text{CALL HPLOT}(102)
\end{align*}
\]

will give

\[
\begin{align*}
\text{-------------} \\
\ I \ I \ I \\
\ I \ I \ 100 \ I \\
\ I \ 102 \ I---I \\
\ I \ I \ 101 \ I \\
\ I \ I \ I \\
\text{-------------}
\end{align*}
\]

This example also illustrates how one can force a histogram into a particular window

5). To terminate the windowing option one may code

\[
\begin{align*}
\text{CALL HPLWIN}(1,1) \\
\text{or} \quad \text{CALL HPLWIN}(1,1,0) \\
\text{or} \quad \text{CALL HPLWIN}(1,1,0,0)
\end{align*}
\]

The next HPLOT call will start on a new picture
6). For scatter plots, it must be remembered that

CALL HPLLOT(ID)

will give several pictures if slices/bands/projections are present. The above remarks must be read with this in mind.

N.B.
It is important NOT to change the paper size (options A3/A4 and HORI/VERT) in the middle of windowing. The routine HPLWIN should be called after HPLOPT if the options A3, A4, HORI or VERT are being changed.
The error messages and warnings of HPLLOT follow the same form as the HBOOK messages and are printed on the same file. For example

***** HBOOK ERROR NO=600 CALLED FROM HPLLOT ID=215

The HPLLOT errors and warnings are in the range 600 – 699.
4.1 LIST OF ERROR CONDITIONS

600 No entries for this histograms. HPLLOT will draw the
histogram box (X-axis,Y-axis etc.) to preserve the layout.
This is especially useful when windowing.

601 Log scales requested for a histogram with all entries
negative or zero.

602 Log scales requested and HMINIM called with zero or
negative argument. The HMINIM call is ignored.

603 Log scales requested, but minimum contents are the same as
the maximum contents, therefore no histogram is drawn.
A.1 CONTROL CARDS FOR THE CERN CDC MACHINES

The user must utilise the libraries of HPLLOT, HBOOK (long or short) and the program library

```
FIND, CERNLIB, ID=PROGLIB.
CERNLIB, HPLLOT.
```

If the GD3 display file was declared as TAPE7, HPLLOT output can be plotted on the COMPUTER INSTRUMENTATION PLOTTER with the cards

```
DISPOSE, PLOT, *PT, ST=CCP.
CPPLLOT, TAPE7
```

Use *PT for any available plotter, *PT=CS1 for squared (millimetric) or *PT=CPl for plain white paper.

HPLLOT output can be viewed on the Tektronix 4012 by cataloging a file on the Supermux front-end machine

```
FILE, TAPE7, RT=W, BT=I
.. CATALOG, TAPE7, myfile, ID=userid, ST=CCQ.
```

And then, after logging in

```
ETL, 300
ATTACH, TV.
ATTACH, DISPLY, myfile, ID=userid
TV
```
A.2 SUMMARY OF INFORMATION

HLOT SUBROUTINES

A.2 HLOT SUBROUTINES

HPLAX(IXTITL,IYTITL)
HPLCOM(XPOS,YPOS,ITITLE)
HPLEND
HPLINT(LUNIT,LMES)
HPOPT(IARRAY,N)
HLOT(ID,ISAME,ICASE,INUM)
HPLWIN(IXWIN,IYWIN,IWINO,ISAME)
A.3 HIERARCHY OF CALLS

Hopefully the following diagram is self-explanatory, see section 2 for further details of individual subroutines.

HPLINT

          HPLOPT

          HPLWIN

          HPLEND

          HPLAX

          HPLCOM

          HPLOT

It is safest to call HPLWIN after HPLOPT to avoid changing the paper size via 'A3'/A4' or 'HORI'/VERT' during windowing.
The first two examples for HPLIT sample output are similar to the example programs given in the HBOOK USERS GUIDE. The additional HPLIT calls are marked by a comment box of asterisks.

N.B. As far as possible, bearing in mind the limitations of incremental plotters, HPLIT output conforms to the CERN guide-lines recommended for the preparation of scientific papers (reference 4).
B.1 EXAMPLES OF H PLOT OUTPUT

A SIMPLE EXAMPLE

B.1 A SIMPLE EXAMPLE

The HB OOK example PROGRAM ONE has been used here to illustrate the generation of all booked histograms with only one H PLOT call. A call is also made to HPLOPT in order to generate page numbers and to plot the pictures horizontally.
EXAMPLES OF HPLOT OUTPUT

A SIMPLE EXAMPLE

SUBROUTINE UGI

EXAMPLE OF BASIC HBOOK USE

AUTOMATIC MEMORY ALLOCATION NOT AVAILABLE

COMMON// HMEMOR(2300)

*******************************************************************************
*                                                                         *
*                            DIMENSION IOPTN(2)                             *
DATA IOPTN/3H34P,4HHOR1/   *
*                                                                         *
*******************************************************************************

DATA X,ALPHA,COEF/5.,6,7./

RESERVE 200 LOCATION FOR OTHER BUSINESS

CALL HISTGO(201)

*******************************************************************************
*                                                                         *
*                            CALL HPLINT(7)                                 *
*                                                                         *
*******************************************************************************

  BOOK 1-DIMENSIONAL HISTOGRAM
  *
  100,0.,20.,0.)
  CALL HBOOK1(110,30H1-DIMENSIONAL HISTOGRAM

  BOOK SCATTER PLOT
  CALL HBOOK2(120,13HSCATTER PLOT ,100,0.,1.,40,-5.,5.,15.)

  BOOK TABLE
  CALL HTABLE(130,10HTABLE
  20,-4.,4.,30,-3.14,3.14,200.)
FILLING

DO 100 ITIME=1,4000

RNDM IS A FLAT RANDOM NUMBER GENERATOR
RANNOR IS A SUBROUTINE GENERATING 2 GAUSSIAN
RANDOM NUMBERS

CALL RANNOR(A,B)

CALL HFILL(110,2.*A+10.,0.,1.)
X=RNDM(ITIME)
Y1=X*COEF-XK+ALPHA*A
Y2=-X*COEF+XK+ALPHA*A
CALL HFILL(120,X,Y1,1.)
CALL HFILL(120,X,Y2,1.)
CALL HFILL(130,A,B,1.)

100 CONTINUE

**********************
*                     *
*                     *
CALL HPLOPT(IOPTN,2)
CALL HPLOTO(0)
*                     *
*                     *
**********************

EDIT ALL PLOTS WITH INDEX

CALL HISTDO

**********************
*                     *
*                     *
CALL HPLEND
*                     *
*                     *
**********************

RETURN
END
A MORE SOPHISTICATED EXAMPLE

This example starts with a call to HFETCH(0,4) to load the histograms from disc. The histograms have already been booked and filled with a program similar to the HBOOK USER GUIDE example Two. The main difference being the increased number of slices for the scatter plot. The histograms were stored on disc with

CALL HSTORE(0,4)

where the '4' is the logical unit number.

This is a useful approach because it is generally the filling which is most time-consuming, and one does not want to have to recreate the histograms just to alter the layout of the plots.

The first histogram contains comments and axis titles. Obviously the reaction would be better printed using Software characters (with lower case, Greek letters and superscripts). See the Advanced User's Guide (reference 6) for further details.

The next picture is an example of a windowed plot. The scatter plot is drawn with the option 'CHA' for speed of printing. All the slices in X are drawn on one picture -"multiple slices". This feature is automatic if no slice number is given in the HPLOT call i.e. either

CALL HPLOT(220,0,4HSLIY)

or

CALL HPLOT(220,0,4HSLIY,0)

This is not meant to replace a full 3-D viewing option (which may be added in the future). It is not possible to change the angle of the slices.

N.B. If there are too many slices, or the bins are too wide, it may appear as if the viewer is directly in front of the 'object'. i.e. each slice is directly behind the one in front. To avoid this one would have to reduce the number of slices or decrease the bin width.

The slices in X are drawn with the first slice appearing closest to the viewer, but the slices in Y are drawn in reverse order. (This avoids the scale of the x-axis going from positive to negative).

On one picture all slices have the same scale factor.
B.2

EXAMPLES OF HPLLOT OUTPUT

A MORE SOPHISTICATED EXAMPLE

On the third picture, different sized windows are used. On the left is a histogram with a fitted Gaussian, and a histogram with error bars drawn between limits set by HMAXIM & HMINIM. Note that if a channel is outside the limits defined by HMINIM & HMAXIM nothing is drawn, even though the tip of the error bar might be within the defined limits.

On the right three histograms are drawn. They are generated from one histogram (ID=210) by simply taking half and a quarter of the contents. Notice how HCOMPA is called first, before plotting.

The last example is a windowed plot with all features of the scatter plot drawn on one picture. The order of drawing the slices, projections etc. is exactly the same as for HBOOK, i.e.

- Scatter plot
- Projection in X
- Projection in Y
- Band(s) in Y
- Band(s) in X
- Slice(s) in Y
- Slice(s) in X

It is instructive to notice how the arguments are passed across to HPLOPT. This is done in two ways, firstly via the array IOPTN by selecting either the first two elements or the last three, and secondly by the call

HPLOPT(2HA3,1)

which is a useful way of passing across one argument.
SUBROUTINE UG2

**************************************************************************
* * EXAMPLE PROGRAM FOR HPLLOT USER GUIDE *
* * *
**************************************************************************

DIMENSION IOPT(6), IDVEC(3)
DATA IOPT/3H41P,3HEAH,4HNEAH,3HCHA,3HEAH,4HNAST/

C GET ALL HISTOGRAMS FROM DISC
CALL HFETCH(0,4)
CALL HPLINT(7)
CALL HTITLE(20HUSER GUIDE EXAMPLES$)

C PLOT HISTOGRAM 212 WITH AXIS TITLE AND COMMENT
CALL HPLOPT(IOPT,2)
CALL HPLLOT(212)
CALL HPLCOM(5.,20.,9HREACTIONS$)
CALL HPLCOM(5.,18.,37HPBAR P GIVES PBAR P PI-PLUS PI-MINUS$)
CALL HPLAX(4HMEVS,17HNUMBER OF EVENTS$)

C PLOT SCATTER PLOT WITH OPTION 'CHA' AND ITS SLICES ON A 2*2 PLOT
CALL HPLOPT(IOPT(3),2)
CALL HPLWIN(2,2,1)
CALL HPLLOT(220,0,4HHIST)
CALL HPLLOT(220,0,4HSLIV)
CALL HPLLOT(220,0,4HSLIX)

C WINDOWED PLOT SHOWING SOME OTHER FEATURES
CALL HPLOPT(3HAST,1)
CALL HPLWIN(2,2)
CALL HPLLOT(211)
EXAMPLES OF HPLOT OUTPUT

A MORE SOPHISTICATED EXAMPLE

C----
C SHOW EFFECT OF CALLING HMAXIM AND HMINIM
C----
CALL HPLWIN(2,2,3,4HSAME)
CALL HPLOPT(IOPT(5),1)
CALL HMAXIM(212,60.0)
CALL HMINIM(212,20.0)
CALL HPLOT(212)

C----
C SUPERIMPOSE SOME HISTOGRAMS, FIRST GENERATE THEM
C----
CALL HCOPY(210,310)
CALL HCOPY(210,410)
CALL HOPERA(210,1H+,210,310,0.50,0.0)
CALL HOPERA(210,1H+,210,410,0.25,0.0)
IDVEC(1)=210
IDVEC(2)=310
IDVEC(3)=410
CALL HCOMPA(IDVEC,3)
CALL HPLWIN(2,1,2,4HSAME)
CALL HPLOT(210)
CALL HPLOT(310,4HSAME)
CALL HPLOT(410,4HSAME)

C----
C NOW PLOT EVERYTHING RELATED TO THE SCATTER PLOT
C----
CALL HPLWIN(2,3)
CALL HPLOT(220)

C----
C FINISH
C----
CALL HPLEND
RETURN
END
Reaction

Pbar P gives Pbar P Pi-Plus Pi-Minus

With error bars

User Guide Examples
WITH A FUNCTION

WITH ERROR BARS

SUPERIMPOSITION

USER GUIDE EXAMPLES
SCATTER PLOT

SCATTER PLOT

SCATTER PLOT

SCATTER PLOT

SCATTER PLOT

USER GUIDE EXAMPLES
B.3 AN EXAMPLE OF WINDOWING

In this example, much use of the 'HSAME' parameters has been made both in H PLOT and HPLWIN. The same picture is produced twice once with linear scales and once with log scales. Notice how the Global title is altered via HTITLE to provide a different title for each picture. The calls to HMAXIM are to avoid the log-scaled pictures overwriting the insert.
EXAMPLES OF HPLOT OUTPUT

AN EXAMPLE OF WINDOWING

SUBROUTINE UG3
C
CALL HPLOPT(3H47P,1)
CALL HFETCH(0,4)
CALL HPLINT(7)

CALL HTITLE(14HLINEAR SCALES$)
DO 10 I=1,2

CALL HPLWIN(1,2,1)
CALL HPLLOT(1)
CALL HPLLOT(2,4HSAME)
CALL HPLAX(13HMASS (GEV)$,17HNUMBER OF EVENTS$)

CALL HPLWIN(2,4,2,4HSAME)
CALL HPLLOT(3)

CALL HPLWIN(1,2,2,4HSAME)
CALL HPLLOT(4)
CALL HPLLOT(5,4HSAME)
CALL HPLAX(13HMASS (GEV)$,17HNUMBER OF EVENTS$)

CALL HPLWIN(2,4,6,4HSAME)
CALL HPLLOT(6)

CALL HPLCOM(3.5,26.0,8HPI+/PI$)
CALL HPLCOM(3.5,13.,8HPI-/PI+$)

CALL HLOGAR(0)
CALL HTITLE(19HLOGARITHMIC SCALES$)
IF(I.EQ.2) GOTO 10
CALL HMAXIM(1,400.)
CALL HMAXIM(2,400.)
CALL HMAXIM(4,400.)
CALL HMAXIM(5,400.)

10 CONTINUE

CALL HPLEND
RETURN
END
PI+/PI-

PI-/PI+

LINEAR SCALES
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Reference manual for preparation of scientific papers
A. Jesse (DD-SIS, Draft 1976-02-13)

5) H. Watkins
HPLLOT Installation Guide
CERN, Data Handling Division, December 1975

6) H. Watkins
HPLLOT Advanced User's Guide
CERN, Data Handling Division, November 1976.
All requests for the above material should be addressed to

PROGRAM LIBRARY,
DATA HANDLING DIVISION,
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