Blissplot

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Note

This paper has not been published and PMetO(Cardington) should be consulted before quoting from it.

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1 Introduction

Met O 14 now has a number of graphics devices, as follows:

1. LA100 Dot matrix printer.
2. LA50 Dot matrix printer.
3. LN03 Plus Laser printer.
4. VT241 Colour graphics monitor.

There is also software supplied with some of these devices, namely ReGIS, and Tektronix 4010/4014. ReGIS is for colour graphics on the VT241, and Tektronix is for monochrome graphics on both the VT241, and LN03 Plus, with a line type facility. This software is not the easiest to use, so we have written our own software, which is device independent, and user-friendly. This software is written in Fortran, and consists of a number of subroutine calls. These are GCLEAR, SETPLOT, GWRITE, PEN, NUMBER, TEXT and SETCOL. Others may be developed in the future. There is an example program in appendix B.

The calls are described below:

1.1 GCLEAR

CALL GCLEAR(IDEV,ILUN)

Starts a new 'page', and also clears a REGIS page. ILUN is the unit number to which the frame(s) will be written. IDEV is the device number as follows:

- IDEV=0 LA100
- IDEV=1 LN03 Plus Landscape Mode
- IDEV=2 LN03 Plus Vertical Mode
- IDEV=3 VT241 Monochrome

- IDEV=4 VT241 Colour
- IDEV=5 LA50 (Not yet in use)
- IDEV=6 VT241 Tektronix and LN03 Plus
- (IDEV=0 to 3, and 5 are sixel graphics, and IDEV=4 is ReGIS.)

1.2 SETPLOT

CALL SETPLOT(XMIN,XMAX,YMIN,YMAX)

This sets graph units for the whole of the plotting area.

1.3 GWRITE

CALL GWRITE

Writes frame to logical unit set by ILUN in CALL GCLEAR, and also ends a REGIS page.

1.4 PEN

CALL PEN(X,Y,INK)

This is the basic vector call. To move the pen position to X,Y without drawing a line, use INK=0. To draw a line from the current pen position to X,Y use INK= 1 through 6, which will give you different colours (if in ReGIS), or line types (if in Tektronix) as listed (with defaults) in Appendix A. The pen position will be left at X,Y.

1.5 NUMBER

CALL NUMBER(X,Y,INK,SIZE,VALUE,NDEC)

Prints a number (VALUE) at X,Y and with size SIZE. NDEC is the number of decimal places required, 0 giving no decimal places, but with a decimal point, and -1 giving an integer. The pen position will be left at the end of the number.

1.6 TEXT

CALL TEXT (X,Y,INK,SIZE,NCHAR,'Text String')!NCHAR=13 here or
CALL TEXT(X,Y,INK,SIZE,NCHAR,%REF(CHAR))

Writes text starting at X,Y, of length NCHAR and height SIZE, where the height is in units of YMAX-YMIN. The pen position will be left at the end of the text. In a future release of BLISSPLOT, to change from the normal horizontal orientation, SIZE will be negative.

Note on SIZE: This is in units of YMAX-YMIN. There are only 2 sizes in Tektronix mode, so if SIZE > (YMAX-YMIN)/30, the larger size is selected, and if SIZE < (YMAX-YMIN)/30, the smaller size is selected.

1.7 SETCOL

CALL SETCOL(INK,ICOL)

This is to change colours. INK can be between 0 and 3. ICOL is the colour specification. (See appendix B for full list).

Different colours for INK can be obtained by the call to SETCOL.

2 To use graphics on the VT241 and LN03 plus

ReGIS or Tektronix are opened by the value of IDEV in the call to GCLEAR. The default colours available for ReGIS are INK=1 - blue, INK=2 - red and INK=3 - green.

If the output is written to a file, use command REGIS to print that file on the VT241. When the output has been plotted on the screen, type p (or P) and hit RETURN to print the screen to the LA50, and just hit RETURN to see the next plot, or end as the case may be. If Tektronix has been selected, you can also LASER the file to print it on the LN03 laser printer. You must not LASER a file created by ReGIS commands. N.B. You may need to reset the terminal; use command CLS to do so, or, if that fails, press the 'set-up' key, use the arrow keys to move the cursor to the recall field, and then press the 'ENTER' key. This is the key at the bottom right of the keyboard, and not the RETURN key.

2.1 Extra Commands for IDEV=4 and 6

These must not be used if the output is to go to devices other than the VT241.

2.1.1 For IDEV=4

1. If x and y are 999.,999. in CALL TEXT or NUMBER, then the text will follow on from the current pen position.

2. Shading (Useful for histographs etc.)

   CALL SHADE(ION) Shading off and on. (0=off 1=on).
   CALL SHADEY(Y) Shade relative to a specified value of y.
   CALL SHADEX(X) Shade relative to a specified value of x.

3. INK=-1 Erases line (turns it to background colour)

2.1.2 For IDEV=6

1. If x and y are 999.,999. in CALL TEXT or NUMBER, then the text will follow on from the current pen position.

Appendix A, the default settings for INK

INK	ReGIS(default)	Tektronix (IDEV=6)
0	Black	Blank
1	Blue	Bold line
2	Red	Normal line
3	Green	Dotted line
4	Green	Dashed line
5	Green	Pecked line
6	Green	Dashed/dotted line
Greater than 6	Green	Normal line

Appendix B, the HLS settings for ICOL

1 Aquamarine
2 Aquamarine medium
3 Dark Black
4 Blue
5 Blue, cadet
6 Blue, cornflower
7 Blue, dark slate
8 Blue, light
9 Blue, light steel
10 Blue, medium
11 Blue, medium slate
12 Blue, midnight
13 Blue, navy
14 Blue, sky
15 Blue, slate
16 Blue, steel
17 Coral
18 Cyan
19 Firebrick
20 Gold
21 Goldenrod
22 Goldenrod, medium
23 Green
24 Green, dark
25 Green, dark olive
26 Green, forest
27 Green, lime
28 Green, medium forest
29 Green, medium sea
30 Green, medium spring
31 Green, pale
32 Green, sea
33 Green, spring
34 Green, yellow
35 Gray, dark slate
36 Gray, dim
37 Gray, light
38 Khaki
39 Magenta
40 Maroon
41 Orange
42 Orchid
43 Orchid, dark
44 Orchid, medium
45 Pink
46 Plum
47 Red
48 Red, indian
49 Red, medium violet
50 Red, orange
51 Red, violet
52 Salmon
53 Sienna
54 Tan
55 Thistle
56 Turquoise
57 Turquoise, dark
58 Turquoise, medium
59 Violet
60 Violet, blue
61 Wheat
62 White
63 Yellow
64 Yellow, green

Appendix C, example program

- CALL GCLEAR(IDEV,ILUN)
- set xmin, xmax, ymin and ymax
- CALL SETPLOT(XMIN,XMAX,YMIN,YMAX)
- ~
- ~
- CALL PEN(X,Y,INK)
- ~
- ~
- CALL TEXT(X,Y,INK,SIZE,NCHAR, 'text ')
- CALL TEXT(X,Y,INK,SIZE,NCHAR,%REF(TEXT))
- ~
- ~
- CALL NUMBER(X,Y,INK,SIZE,VALUE,NDEC)
- ~
- ~
- CALL GWRITE
- STOP
- END

Some notes on above. IDEV will be 0 to 6, and ILUN will be 1 to 99. If IDEV is incorrectly set, an error message will be issued and the program stopped. No checking is done on ILUN, nor is checking done in SETPLOT. In CALL PEN, if INK is greater than 3 for ReGIS, it will be set to 3 (default green), and if it is greater than 6 for Tektronix, it will be set to 2 (normal line). For multiple plots, after each CALL GWRITE, there must be a CALL GCLEAR(IDEV,ILUN).

If you know you only want to use idev=4 or 6 i.e. REGIS or TEKTRONIX then use CPEN CTEXT and CNUMBER instead of the usual PEN TEXT and NUMBER. This will reduce your tasks demands on system space by a large factor. If you then use another idev you will get a blank page.

3 Additional Graphics Subroutines

Subroutines for use with various graphics devices available on the Vax are described below. These subroutines were written at Cardington and use the more basic subroutines described in the Bracknell BLISSPLOT documentation. These subroutines and the BLISSPLOT subroutines are held in the user object library and will be automatically linked into any programme referencing them. In all the subroutines the (x,y) co-ordinates of any point in the plotting area are specified in centimetres from the origin, which is initially set in the lower left hand corner of the paper.

The plotting areas for different devices are.

- IDEV=2 High resolution REGIS file for the InkJet plotter.
- IDEV=3 Low resolution REGIS file for the InkJet plotter.
- IDEV=4 VT241, regis graphics
- IDEV=5 LA50/LA75, sixel graphics
- IDEV=6 VT241, Tektronix or LN03,

For compatibility all plotting frames should be restricted to 25·7cm in the x-direction and 16·0cm in the y-direction. However all devices except the LA75 have rather larger plotting frames of about 27·0cm by 20·0cm. However plots done on these frames will not fit onto the LA75.

LUN=3 is used for the plotter so that this LUN should not be used for any other dataset in the calling program.

In the descriptions of the subroutines that follow the implicit FORTRAN naming convention for variables is used,except where a variable is defined as a character.

3.1 SUBROUTINE DEVINI

SUBROUTINE DEVINI(IDEV,OUT)

This subroutine opens the plotting dataset, starts the first page (using SUBROUTINE GCLEAR), sets the plotting areas for each device and sets up the set of centered plotting symbols. The origin of the plot is at the lower left hand corner of the page (screen).

- IDEV – is the device number (See BLISSPLOT)
- OUT — is the output dataset (device) on the first call
- OUT — is 'RESET' on subsequent calls. These calls reinitialise the position of origins etc.

NOTE : DEVINI must be called before any of the other subroutines described below.

3.2 SUBROUTINE ORIGIN

SUBROUTINE ORIGIN(XORG,YORG)

Moves the position of the origin to the point (XORG,YORG). XORG and YORG are always in centimetres with respect to the initial origin in the LLH corner of the paper.The minimum change in the position of the origin is 1mm in both directions.

3.3 SUBROUTINE MAGNIF

SUBROUTINE MAGNIF(SCALE)

Sets a scale factor for movements of the pen and symbol sizes.If the position (X,Y) is specified in a subroutine call the pen will actually be moved to (SCALE*X,SCALE*Y). Similarly if the size of a symbol is specified as SIZE the size of the symbol that is actually plotted will be SCALE*SIZE.

3.4 SUBROUTINE SYMSIZE

SUBROUTINE SYMSIZE(SIZE)

- Changes the default size of symbols.
- SIZE – new default symbol size in cm.
- The initial default is 0·25 cm.

3.5 SUBROUTINE SYMBOL

SUBROUTINE SYMBOL(XPOS,YPOS,SIZE,INK,SYM)

Plots a symbol at position XPOS,YPOS. The size of the symbol, in centimeters, is given by SIZE. For regis INK determines the colour of the symbol. For non regis plots INK is ignored and all symbols are drawn using full lines.

ISYM is an integer which for centered plotting symbolslies between 1 and 9, or is the ASCII code for a printable character (>=32).

3.6 SUBROUTINE AXIS

SUBROUTINE AXIS(X0,Y0,ALEN,AMIN,AMAX,DIR,NSPCE, ITIC, NC,TITLE)

This subroutine draws an annotated graph axis.

- X0,Y0 – co-ordinates of the start of the axis relative to the current origin.

- ALEN – length of the axis in cm.
- AMIN – the number to be drawn against the first tick mark on the axis.
- AMAX – the number to be drawn against the last tick mark on the axis.
- DIR – direction of the axis in degrees measured anticlockwise from the x-axis. (Note DIR can only take the values 0·0 and 90·0).
- NSPCE – the number of spaces between tick marks on the axis (number of tick marks-1). If NSPCE is negative the use of large symbols on TEKTRONIX plots is suppressed.
- ITIC – =+n1 axis annotation is placed anticlockwise from the axis (suitable for annotating a y - axis with DIR=90.0).
- – =-n1 axis annotation is placed clockwise from the axis (suitable for annotating an x-axis, with DIR=0·0).
- ABS(ITIC)= n2 first and last numbers on axis are not written. (sign determines position of tick marks)
- ABS(ITIC)= n3 tick marks and axis title are produced but no numbers.
- ABS(ITIC)= n4 the numerical annotation is done as integers (up to nine characters long). Note that the subroutine does not check that the values corresponding to the tick marks are actually integers. Non-integers are truncated. ABS(ITICK)=n4 overrides the change to E format numbers. The values AMIN and AMAX are still entered as real numbers. The first digit of ITIC specifies the number of tick marks that are to be skipped between numerical labels. If n=0 or ITIC=±m, m=1-4 then all tick marks are labelled. If n=1 every other tick mark is labelled etc.
- ABS(NC) – number of characters in the axis title. if NC<0 the tick marks and axis annotation is put on opposite sides of the axis, if NC>0 the annotation and ticks are on the same side.
- TITLE – a character string containing the axis title. Multi-line titles are supported. To produce a multi-line title the lines in the string are separated by ^ characters. The ^ has to be counted in the value of NC. Up to four lines are possible with a maximum length of 64 characters on each line.

3.7 SUBROUTINE LGAXS

SUBROUTINE LGAXS(X0,Y0,ALEN,AMIN,AMAX,DIR,ITIC,NC,TITLE)

This subroutine draws an annotated log axis.

- X0,Y0 – co-ordinates of the start of the axis relative to the current origin.
- ALEN – length of the axis in cm.

- AMIN – number to be drawn against the first tick mark.
- AMAX – number to be drawn against the last tick mark.
- DIR – direction of the axis in degrees measured anticlockwise from the x-direction. (Note DIR can only take the values 0·0 and 90·0).
- ITIC) — Values for ITICK and NC are explained in the NC) — writeup for SUBROUTINE AXIS.
- Additionally ABS(ITIC)+4 integers are written against the tick marks within each log cycle.
- TITLE – character string containing the axis title.

- LGAXS will draw partial log cycles but the axis must always start and end at a tick mark, ie AMIN and AMAX should be of the form x.0 E±y. LGAXS therefore rounds the values of AMIN and AMAX so that this is the case. Local variables are used for this and the values AMIN and AMAX are not altered. If values are altered a warning message is written to SYS$OUTPUT.

3.8 SUBROUTINE PTLINE

SUBROUTINE PTLINE(XARRAY,YARRAY,LAST,SIZE,XLEN,YLEN, MODE,INK,SYM)

This subroutine plots the array YARRAY against the array XARRAY.

- XARRAY – an array which holds the x-values to be plotted.
- YARRAY – the array which holds the y-values to be plotted.
- LAST – the number of points to be plotted.
- SIZE – the size of the symbols to be plotted in cm.
- XLEN – the length of the x-axis in cm.
- YLEN – the length of the y-axis in cm.
- MODE – +1 symbols are plotted at each point and joined by lines.
- – = 0 symbols are plotted without connecting lines.
- – =-1 no symbols are plotted only the connecting lines.
- INK –For regis INK determines the colour of symbols and lines in the plot. For Tectronix/LN03 and the LA75 INK determines the type of line joining plotted symbols. Linetypes are given in the BLISSPLOT writeup.

- SYM – symbol to be plotted at each point if MODE= +1 or 0.SYM may be a character*1 constant or variable, or an integer constant or variable which gives the ASCII code of the symbol.

NOTE : The arrays XARRAY and YARRAY should have dimensions of at least LAST+2. ARRAY(LAST+1) and ARRAY(LAST+2) should hold the minimum and maximum values, respectively, of the axis.

All plotting is done with respect to the current origin.

3.9 SUBROUTINE LGLINE

SUBROUTINE LGLINE(XARRAY,YARRAY,LAST,SIZE,XLEN,YLEN, ITYPE,MODE,INK,SYM)

This subroutine plots array YARRAY against XARRAY with options for log-log, log-linear and linear-log plots.

- XARRAY – the array which holds the x-values to be plotted.
- YARRAY – the array which holds the y-values to be plotted.
- LAST – the number of points to be plotted.
- SIZE – the size of the symbols to be plotted in cm.
- MODE – =+1 symbols are plotted at each point and joined by lines.
- = 0 symbols are plotted at each point without connecting lines.
- =-1 no symbols are plotted only the connecting lines.
- XLEN – the length of the x-axis in cm.
- YLEN – the length of the y-axis in cm.
- ITYPE – determines the type of plot:
- =+1 gives a log-log plot.
- = 0 gives a log linear plot.
- =-1 give a linear-log plot.
- INK –same as in PTLINE.
- SYM – the symbol to be plotted if MODE=+1 or 0.

NOTE : the arrays XARRAY and YARRAY should have dimensions of at least LAST+2. ARRAY(LAST+1) and ARRAY(LAST+2) should hold the minimum and maximum values, respectively, of the axis.

All plotting is done with respect to the current origin.

LGLINE makes the same adjustments to the minimum and maximum values on the log axes as LGAXS. This is done so that data plotted by LGLINE are placed correctly relative to the axes. The rounding is done on local variables and XARRAY(LAST+1) etc are returned unaltered If adjustments are made a warning message is written to SYS$OUTPUT.

LGLINE ignores negative values in XARRAY or YARRAY and writes a warning to SYS$OUTPUT if it encounters any. If all points are negative an error message is also produced.

3.10 SUBROUTINE ERRPLT

SUBROUTINE ERRPLT(XARRAY,YARRAY,SIGMA,XLEN,YLEN,
NPLOT,ITYPE,AXIS,INK)

This subroutine plots error bars on data points.

- XARRAY The array which holds the plotted x values.
- YARRAY The array which holds the plotted y values.
- SIGMA Holds the standard deviation of the variable which is to have error bars drawn on.
- XLEN Length of x-axis in centimeters.
- YLEN Length of y-axis in centimeters.
- NPLOT Number of points to be plotted.
- ITYPE Type of plot =+1 log-log plot.
  = 0 log-linear plot.
  =-1 linear-log plot.
  any other value gives linear-linear plot.
- AXIS Axis along which error bars are to be drawn, X or Y (CHARACTER*1).
- INK - Colour of the ink used to draw error bars.

This subroutine only draws error bars, the data points should be plotted using PTLINE or LGLINE.

3.11 SUBROUTINE ARROW

SUBROUTINE ARROW(X,Y,RLEN,ANGLE,INK,OFILL)

Draws an arrow.

- X x-coord of base of arrow.

- Y y-coord of base of arrow.
- RLEN Length of arrow in cm.
- ANGLE Direction of arrow measured in degrees anticlockwise from the x-axis.
- INK Ink colour used to draw the arrow.
- OFILL logical*1 =.TRUE. arrow head is filled.
- =.FALSE. arrow head is left empty.

4 Description of Program Vaxgraph for use on the Vax

This program plots graphs on the graphics devices supported by the BLISSPLOT routines. The program includes a function evaluator so that functions of the input data can be plotted.

The first question asked by the program is whether a formatted or direct access dataset is to be used as input. In addition the name of the input dataset can be specified by using IN=dsn. If the name of the input dataset is not given then the default names GRAPHPLT.DAT or GRAPHPLT.DAC are used for formatted and direct access datasets respectively. If the input is formatted and you wish to keep the resulting direct access dataset use the keyword KEEP on the line. The direct access dataset generated by the program will be named GRAPHPLT.DAC.

5 Input Datasets

The data for plotting is read from a formatted dataset. The data are checked for invalid characters as they are read in. If the program detects invalid characters (the FORTRAN input error conversion) it will give a message saying where the error is. If a comma has been missed out the position of any further errors will not be given correctly. The data is split into a series of groups (for example all the data collected on a particular day). Within these main groupings the data is divided into subgroups (for example the data for a particular run). Data can be accessed by giving the names of the main and sub group it belongs to. The format of the dataset is as follows (note the <> brackets are part of the format).

- LABEL <NAME 1>
- VARIABLES <VAR1 VAR2 VAR3 .....>
- SCALES <SCALE1=VAL1,SCALE2=VAL2,.....>
- DEFINE DFVAR1=F(VAR1,VAR2,VAR3,...,VAL1,VAL2,....)
- DEFINE DFVAR2=F(VAR1,VAR2,VAR3,...,VAL1,VAL2,....,DFVAR1)

- DEFINE DFVAR3=F(VAR1,VAR2,VAR3,...,VAL1,VAL2,....,DFVAR1,DFVAR2)
- GROUP <NAME 1.1>
- .
- .
- DATA
- .
- .
- GROUP <NAME 1.2>
- .
- .
- DATA
- .
- .
- LABEL <NAME2>
- .
- .
- ETC
- .
- .

The various components in the datset are

5.1 LABEL <NAME 1>

This statement defines one of the main groups of data. The name of the group is given by the alphanumeric string NAME 1, which may be upto fifteen characters long. A maximum of 100 such groups can be defined.

5.2 VARIABLES <VAR1 VAR2 VAR3.....>

Defines the variables in the group NAME 1. The names VAR1 VAR2 etc. consist of upto four alphanumeric characters, but the first character must be alphabetic. A maximum of 25 variables can be defined.

5.3 SCALES <SCALE1=VAL1,SCALE2=VAL2,.....>

Defines constants SCALE1 SCALE2 etc. for the main group NAME 1. The names of the constants can consist of upto four alphanumeric characters, but the first character must be alphabetic. The values are real numbers terminated by commas. The maximum number of scales which can be defined is 10.

5.4 DEFINE DFVAR1=F(VAR1,VAR2,...VAL1,...)

Allows new variables to be created at input. The new variable name is consists of upto four alphanumeric characters and must not be the same as any names defined in the VARIABLE or SCALE statements. The new variable can be a function of any variable defined in the VARIABLE and SCALE statements and any defined variables which preceed it. Defined variables are treated in the same way as variables in VARIABLE and SCALE statements.

5.5 GROUP <NAME 1.2>

Defines a subgroup within NAME 1. The name of the subgroup NAME 1.2 consists of up to ten alphanumeric characters. Up to one hundred subgroups can be defined for each of the main group headings. If there is only to be one group for a particular label the GROUP statement is not needed.

Following each GROUP statement is the data. This is entered as real numbers separated by commas (there must be a comma following the last number in a line). There must be an entry for each variable defined in the VARIABLE statement. Missing values are denoted by an underscore (_). At present the maximum nunber of values for each variable which can follow a GROUP statement is 500.

The direct access dataset which is generated from the input dataset can be kept and used for input to the program. This is useful if the amount of data to be handled is large. The dataset generated by the program is called GRAPHPLT.DAC.

6 The Function Evaluator

A function evaluator is included in the program. The functions are entered as Fortran-type lines and can include the names of the variables and scales defined in the input dataset, as well as numerical constants. The program has the following features.

1. Six levels of parenthesis is supported with up to six sets of parenthesis at each level.

2. The simple operators ***,**,/,+,- are treated so that *** is dealt with before ** and / which are dealt with before + and -. ** and / are then dealt with according to position within the expression, as are + and -.

3. The following functions are supported.

- LOG log to the base e.

- EXP exponential function.
- SQRT square roots.
- SIN
- COS trig functions with arguments in radians.
- TAN
- COSD
- SIND trig functions with arguments in degrees.
- CSCS COS**COS with arguments in degrees.
- SNSN SIN**SIN with arguments in degrees.
- CSSN COS**SIN with arguments in degrees.
- ABS absolute value.
- PHIM non-dimensional wind shear, Dyer (1974).
- PSIM integrated version of PHIM.

Further functions can be added on request.

The arguments of the functions are enclosed in parenthesis. The arguments can be expressions involving the operators *,*,/,+,-. The function can include real constants in F or E format.

7 Plotting Loop

After reading in the data the program asks for the source of the commands. The commands can be entered from the terminal or from a command dataset. The first line in this dataset supplies the information on the graphics device to be used and the output plot file. It has the form

7.1 (Device to be used) OUT=(plotting file)

The devices are REGIS, LA75 and TEKTRONIX, although for TEKTRONIX the axis routines do not give very good results. If a plot file is not given the graphics output goes to a dataset VAXGRAPH.PLT. The following information has to be supplied either from the terminal or the command dataset. If the commands are entered from a terminal the following questions are asked.

1. TITLE OF GRAPH= The title of the graph can be upto 20 characters long and is placed above the plot.

2. VARIABLE X= This is the function involving the variables and constants defined in the input dataset which is to be taken as the x variable. (see the section on the function evaluator for details). The function can be upto 80 characters long.

3. TYPE OF X-AXIS [LOG/LIN DEFAULT=LIN] Gives the type of axis to be used (note: the default changes to the type of the axis which was last used so making the plotting of a large number of similar graphs easier).

4. TITLE OF X-AXIS [DEFAULT=VARIABLE NAME] Gives the title to be drawn on the axis and can be upto 20 characters long. If PREV is given the title used in the previous plot will be re-used.

5. MIN AND MAX VALUES ON X-AXIS [<CR>FOR AUTOMATIC SCALING, <PREV> TO USE PREVIOUS SCALES] The minimum and maximum values on the axis are given as two real numbers separated by a space.

6. Questions 1 - 5 are repeated for the y-axis.

Having given the details of the plot the plot is constructed using the following set of commands.

(Note: [ ] denote optional parameters, { } denote alternatives)

7.2 FETCH

FETCH[LABEL={NAME 1,ALL}][GROUP={NAME 2,ALL}][LIST]

This command fetches data and places it in the plotting arrays. The data is specified by the LABEL and GROUP names which were defined in the input dataset. NAME 1 must be followed by at least one space. The ability exists for a range of labels to be processed such that, LABEL=LABEL1:LABEL2, where all the labels between LABEL1 and LABEL2 in the input dataset are to be processed.

- If the LABEL and/or GROUP parameters are not specified the names given in the previous FETCH command are used.
- If LABEL=ALL is specified all the labels defined within the dataset are read.
- If GROUP=ALL is specified all the subgroups defined under the LABEL heading are read (Nb, the total number of points must not exceed 3000).
- If LIST is specified the data being put into the plotting arrays is listed on TI:

7.3 PLOT

PLOT[{SYMBOL=N, CURVE={FULL,DASH,DOT}}][INDEX=<STRING>]
[NOFRAME][NOANNOTATE][EXCLUDE]

This command causes the data in the plotting arrays to be sent to the plotter. The first plot command used for a graph also causes the axes and title to be drawn. After the data has been plotted the plotting arrays are re-initialised.

Options:

1. SYMBOL=N where 1< N < 9. A symbol given by the integer N is plotted at each point. No connecting lines are drawn.
2. CURVE={FULL,DASH,DOT} Plots lines between points. The available lines are full, dashed or dotted.
3. INDEX=<STRING> Creates a key of the symbols used in the plot. STRING can be upto 20 characters long and is written along side the plotting symbol.
4. NOFRAME stops the axes etc. being drawn by the first PLOT command. Ignored on subsequent commands
5. NOANNOTATE suppresses the axis annotation. A box is drawn around the plot and the title is written.
6. EXCLUDE removes points from the plot which lie ouside the plotting frame.

7.4 CHANGE

CHANGE {X=,Y=} FUNCTION

Allows the variable X or Y to be redefined. This can be useful when producing complex plots.

7.5 GENERATE

GENERATE{X=F(Y),Y=F(X),LSQFIT}FROM:min_value TO:max_value
INCR=increment

This command generates a series of X and Y values using the function F(X) or F(Y) or the regression calculated using the FIT command. The functions F(X) or F(Y) can contain only one variable, X or Y plus numerical constants and the supplied functions. The range of the independent variable is min_value(REAL) to max_value(REAL). If a leastsquare curve is being generated the dependent and independent variables are the same as specified in the FIT command that generated the coefficients. The increment between points is given by increment. The total number of points generated is (max_value-min_value)/increment+1. The generated curve is plotted using the PLOT command in the usual way. All of min_value max_value and increment must be supplied. The function should be followed by at least one space. Note that GENERATE uses the same arrays which are filled by FETCH so GENERATE should not be used when there is outstanding data to be plotted or vice-versa.

7.6 MARK

MARK{X=,Y=}value CURVE={FULL,DASHED,DOTTED}

Draws a line across the plot at a fixed value of X or Y. The type of line is determined by the CURVE= parameter. The default linetype is FULL.

7.7 FIT

FIT[ORDER=N] [(Y,X)] [DISPLAY] [ORIGIN] [RESIDUALS][RESET]

Does a least squares fit using the x and y values which are currently in the plotting arrays. The order of the fit is given by N. If ORDER=N is not specified a linear fit is done. A regression using y as the independent variable can be done by including (Y,X) on the command line. The curve can be made to pass through the origin by using the keyword ORIGIN in the command line.

1. RESIDUALS causes the residuals from the least squares fit to be calculated, which can then be plotted.
2. RESET Empties the plotting arrays after the fit has been made.
3. DISPLAY causes the regression coefficients to be printed to SYS$OUTPUT. The regression coefficients are available for the command GENERATE to use.

7.8 SET

SET[NORESTRICT [X] [Y]] [RESTRICT:{X,Y,<NAME>}=([LOWER], [UPPER])]

SET [NO]RESTRICT:<{A=,B=,C=}NAME>=([LOWER],[UPPER]) Sets limits on the values of X and/or Y which are put into the plotting arrays by the FETCH command. SET RESTRICT:{X Y} sets limits on either X or Y. Data for which either the X or Y value lies outside the limits LOWER and UPPER are not put into the arrays. Limits can be set on both X and Y independently. SET RESTRICT:<NAME> or RESTRICT:<{A=,B=,C=}NAME> checks the value of of upto three variable(s) and if they lie outside the limits then X and Y are not placed in the plotting arrays. The variables tested must be present in the original dataset, or have been created at input using a DEFINE statement. If the a variable is not present then this test is ignored and the program continues. Note that <NAME> is equivalent to <A=NAME>. If either LOWER or UPPER are not given they default to - or + 1E+09. The comma between LOWER and UPPER is always required. To remove the restrictions SET NORESTRICT X and/or Y and/or <NAME>.

7.9 SET BIN

SET BIN={X,Y} MIN=SMALL_BIN WIDTH=BIN_WIDTH [MEAN]

Puts data into bins based on either X or Y and calculates the standard deviation of the other variable. The lowest bin is given by SMALL_BIN and the bin width by

BIN_WIDTH. If the word MEAN is specified the standard deviation of the bin mean is calculated in place of the standard deviation of the the data within the bin. To stop the use of bins use SET NOBIN. The SET BIN and SET NOBIN commands can only be used before any FETCH commands have been issued or immediately after a PLOT command.

7.10 SET FRAME

[DEFAULT][XFRAME=XAXIS_LENGTH][YFRAME=YAXIS_LENGTH]
[XTICK=NO_OF_TICK][YTICK=NO_OF_TICK] [XORG=X_ORIGIN]
[YORG=Y_ORIGIN][SIZE=SYMBOL_SIZE]

Allows some aspects of the plotting frame to be changed. Except for changing the size of symbols this command must precede the first plot command.

1. [DEFAULT] Resets the frame to the default (X and Y axes 13 cm long, 6 tick marks per axis, origin at (6,2), symbol size 0·25 cm).

2. [XFRAME=XAXIS_LENGTH][YFRAME=YAXIS_LENGTH] changes the length of the X and/or Y axis. The length is in centimeters.

3. [XTICK=NO_OF_TICK][YTICK=NO_OF_TICK] changes the number of tick marks on the X and/or Y axis. The value NO_OF_TICKS is strictly the number of spaces between tick marks.

4. [XORG=X_ORIGIN][YORG=Y_ORIGIN] changes position of the origin of the plot. The position of the plot origin is specified in centimeters from the lower left of the screen/page. In resetting the position of the origin thought should be given to the axis annotation which might be cutoff.

5. [SIZE=SYMBOL_SIZE] changes the sizes of plotting symbols. The size is given in centimeters. The symbolsize can be changed at any time during plotting.

If any of the key words are given without a corresponding numerical value the parameter is reset to its default value.

7.11 NEWPLOT/[NOFRAME]/[SAVE]

Starts a new graph. The program loops around to the questions described at the beginning of the section. If SAVE is not specified the flags which are used by the SET commands are cleared. With save all SET command flags are retained for the next plot. NOFRAME allows subsequent plots to be done on the same frame.

Appendix D - the production of Postscript files

Since the routines described above were written (in the mid-1980's) most of the devices for which they were written have become obselescent and Tektronics in particular is no longer supported by current printers and screens (as of 2002). However the majority of modern printers do support Postscript and the following routines have been modified to produce encapsulated Postcript files when used with IDEV=8:

```
ENTRY PEN
ENTRY TEXT
ENTRY SETCOL
SUBROUTINE GWRITE
SUBROUTINE DEVINI
SUBROUTINE MAGNIF
SUBROUTINE ORIGIN
```

It should be noted that in POSTSCRIPT calls to MAGNIF and ORIGIN are cumulative so that repeated calls will further affect the image.

All other routines except NUMBER and SHADE use these basic routines and should also therefore produce Postscript files when called with IDEV=8.

The postscript files use centimetres as their unit of length (although basic postscript uses 1/72 inch) and have been set with an origin at the bottom left hand corner of the A4 paper in landscape mode. If using a program previously set up for TEKTRONIX or REGIS then after CALL DEVINI calls to ORIGIN and MAGNIF may be needed (or current calls amended) to get correct centering and scaling of the image - e.g.:

```
CALL DEVINI(8,'datasetname')
CALL ORIGIN(4.,4.)
CALL MAGNIF(0.85)
```

Subroutine PEN can be used with values of INK=1,2,3 or 4 which have the effect described previously for Tektronix.

The colour palette produced by SETCOL for postscript using an HLS (or HSB) scheme is limited to INK=0 to INK=16 with white for INK=0, black for INK=1 and a spectrum of colours from 2 to 14. This can be added to if required by reprogramming the subroutine.

A subroutine has been added which can be used with either REGIS or POSTSCRIPT. This is SUBROUTINE POLY which is used to colour fill a polygon defined by a series of X,Y co-ordinates. This subroutine was originally used by the PMAP colour contouring routine which was itself developed from the LCNTRS line contouring routine - see Appendix E for these routines. This subroutine is called as follows:

SUBROUTINE POLYF

SUBROUTINE POLYF(INK,RX,RY,N)

This subroutine fills a polygon with colour.

- INK – the ink to be used in colouring the polygon,for which the colour has previously been defined by calling SETCOL.

- RX – the array (of dimension N) of X coordinates defining the polygon.
- RY – the array (of dimension N) of Y coordinates defining the polygon.
- N – the number of vertices of the polygon.

Appendix E, Additional contouring

Three additional routines are described below. The first of these is LCNTRS which is a line contouring routine. Second is PMAP which is a colour contouring routine. Finally the routine PATTERNS plots streamlines with arrowheads from arrays of U,V velocity components. These routines are called as follows:

SUBROUTINE LCNTRS

```
SUBROUTINE LCNTRS(F,NX,NY,XGRD,YGRD,INK,CSTRT,CSPC,NCNT,DASH,
 XRECT,YRECT)
```

This subroutine draws a contour plot of a field F -defined on an array of NX*NY irregularly spaced points. The routine uses ENTRY PEN.

- F – field to be contoured
- NX,NY – X and Y dimensions of array F
- XGRD,YGRD – these arrays (both may be up to dimension NX,NY - see below) contain the coordinate values to be plotted.
- INK – the ink to be used for plotting.
- CSTRT – the value of F at the first contour
- CSPCE – the contour interval
- NCNT – the number of contours
- DASH – if DASH is .TRUE., dashed contours will be drawn.
- XRECT – if XRECT is .FALSE., then XGRD(NX,NY) contains the X coordinates of a non-rectangular grid in which the points lie on a series of lines parallel to the X axis
- YRECT – if YRECT is .FALSE.,then YGRD(NX,NY) contains the Y coordinates of a non-rectangular grid in which the points lie on a series of lines parallel to the Y axis

N.B. the array is rectangular with XGRD(NX) and YGRD(NY) -defining the irregularly spaced points on it provided XRECT and YRECT are .TRUE. If both XRECT and YRECT are .FALSE. the grid is totally random and requires both XGRD(NX,NY) and YGRD(NX,NY) to -define it.

SUBROUTINE PMAP

```
SUBROUTINE PMAP(F,NX,NY,XGRD,YGRD,INKS,CSTRT,CSPC,NCNT,DASH,
 XRECT,YRECT)
```

This subroutine draws a colour contour plot of a field F -defined on an array of NX*NY irregularly spaced points. The arguments in the CALL are similar to those used in the LCNTRS routine above. The INKS argument defines the first ink to be used in the colour cycle. All the inks in the colour cyle should have been previously defined by calls to SETCOL. The routine uses ENTRY PEN and SUBROUTINE POLY.

SUBROUTINE PATTERN

SUBROUTINE PATTERN(U,V,II,KK,X,Y,NIP,NKP,RLEN,INK)

This routine draws streamlines of wind defined by two arrays of X and Y wind components U and V defined on a grid of dimension II and KK. Arrowheads are positioned in the centre of each streak (streamline). The grid can have irregular Y co-ordinates. However if an irregular (i.e. non-rectangular) grid is used there is likely to be an error due to the fact that the integration routine probably assumes a rectangular grid box which is not the case if the Y grid spacing varies with X. The error should be small if Y only varies slowly with X. The errors have been found to be significantly smaller than if the original constant Y spacing routine is used when the Y spacing is actually varying! If used with a profile and a surface site is present, ensure that the height of the surface site is always set lower that that of any of the probes at all times. This routine (or its subroutines) calls SUBROUTINES PEN, ARROWHEAD, DRAW LINE, KUTMER and DERIV.

- U,V – wind velocity X and Y components of wind velocity.
- II,KK – X and Y dimensions of U,V arrays
- X – array of dimension II giving X co-ordinates of grid.
- Y – array of dimension II,KK giving Y co-ordinates of irregular grid.
- NIP, NKP number of points from which streaks (streamlines) emanate in X and Y directions. If NIP=II and NKP=KK, there is one streak per gridpoint which is usually not enough.
- RLEN – length of streak (streamline)
- INK – the ink to be used for the streaks