

Laser-Scan Ltd.

FPP

Reference Manual

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1 Introduction

The Fast Plotter Program (FPP) is designed for producing high-quality cartographic plots from Laser-scan Internal Feature Format data (IFF). It is capable of generating line patterns, thick lines, area fill, complex symbols and texts. It uses the new Feature Representation Table (FRT) mechanism for finding the graphical representation for feature codes. FPP supports the new GKS (Graphical Kernel System) graphics standard which gives it a high degree of device independence.

FPP is available in versions to support a wide variety of output devices. See the FPP Software Product Specification for details.

2 Environment

FPP was written for use on VAX-11 computers running under the VMS operating system.

There are 3 main types of input files which may be used by the program:-

1. IFF files hold the actual cartographic data. There are various ways of holding map data in IFF format and the user should be aware of the way that FPP interprets it (see section on IFF Interpretation). Full information on IFF can be obtained from the 'IFF User Guide', in the MAPPING package documentation.
2. FRT files are the means of defining the graphical image required for each feature. Each feature code used in the IFF file must have an entry in the FRT table. Definitions of patterned lines and feature code group names are also set up in the FRT file. The FRT file is equivalent to a map legend so a different one would normally be required for each different map series. Further information can be found in the 'FRT User Guide' in the MAPPING package documentation.

The FRT file references special IFF files which are used for symbol and text definitions. These are the Symbol Representation Table (SRI) for symbols and the Text Representation Table (TRI) for text.

3. FPP command files are a shorthand means of specifying commands to FPP. A sequence of commands likely to be used frequently can be grouped together in a command file. This is read by the program on request. If the logical name LSL\$FPPINI is set up to point to a command file, then this file will be obeyed automatically when FPP is run.

Each type of file is held in a particular directory on a particular disk. As these are likely to be different for each installation, the program refers to them using logical device names:-

<i>File Type</i>	<i>Logical Name</i>
IFF	LSL\$IF
FRT	LSL\$FRT
FPP Command File	LSL\$FPP

The logical names LSL\$TEXT_ROUTINE and/or LSL\$SYMBOL_ROUTINE may be set to point to shared images that can be used to draw texts and symbols differently from the standard FRT routines used by FPP. More details of this facility are available in the LITES2 Reference Manual.

When areas are filled using software, rather than hardware the size of areas that can be handled are controlled by the logical names LSL\$FILL_POINTS_MAX and LSL\$FILL_CUTS_MAX. (See the device dependent FPP User Guide for details of how your plotter handles fill areas)

The logical name LSL\$FILL_POINTS_MAX allows the buffer size to be set to the required maximum size of area. The default value is 8192 points, with the minimum allowed being 100. Fill areas which exceed the limit for number of points will result in areas not being filled, although they should still be drawn in outline, albeit with some invisible lines visible.

Similarly the maximum number of times which a scan line may cross the boundary of an area may be controlled by defining the logical name LSL\$FILL_CUTS_MAX to be the required number. The default value is 100 intersections, with the minimum allowed being 10. Exceeding the limit for intersections will result in messages 'FILL_SIDE - Too many intersections found - ignored'.

Memory has to be allocated in proportion to these numbers, so unnecessarily large values should be avoided.

Sensible defaults logical names should be set up at each installation although individual users may set up their own.

3 IFF and FRT interpretation

3.1 IFF limits

The limits on some of the IFF entry values are:-

1. Feature numbers - 0 to 65535
2. Feature codes - 0 to 32767
3. Layer numbers - 0 to 32767

3.2 Feature types

Features can be any of 12 different types. The number of points a feature should have depends on the type:-

Type	No. of points
1. Line string (straight lines).	2 or more
2. Clockwise arc.	3
3. Anticlockwise arc.	3
4. Circumcircle arc.	3
5. Full circumcircle.	3
6. Interpolated curve.	2 or more
7. Unoriented symbol.	1
8. Oriented symbol.	1 or 2
9. Scaled symbols.	1 or 2

- | | |
|---------------------------------|-----------|
| 10. Text. | 1 or 2 |
| 11. Symbol string (unoriented). | 1 or more |
| 12. Areas. | 3 or more |

If a feature has an illegal number of points then an appropriate error message is produced. If too few points were given then the feature is ignored. If too many points are given then the program attempts to plot the feature using the first points only.

If an empty feature is found (ie no IFF ST entry) then it is ignored. No error message is produced since this is a legal IFF construct.

3.3 *Line features*

Line features may be line strings, circles/arcs or interpolated curves. They may be drawn as patterned lines and/or thick lines.

3.3.1 *Patterned lines*

A line feature will be drawn as a patterned line if the entry (corresponding to the feature code) in the FRT file has a secondary code. This secondary code specifies which pattern definition is required. A full description on pattern definitions can be found in the FRT Reference Manual though a brief description is given here:-

The basic pattern consists of a major dash and a minor dash, both of which are optional. The lengths of these and the period length are set in the FRT pattern definition. Repeat counts may be specified for one or both of these though the lengths of the dashes specified in the FRT definition should take account of such repeats. Repeat counts are extra counts (ie. in addition to the 1st one). It is illegal for the sum of the dash lengths to exceed the period length.

Symbols defined in the SRI file may be substituted for the dashes. The size of these symbols is set by the width entries in the FRT pattern definition and is completely independent of the dash length.

If the symbol specified is found not to exist or fails to plot sensibly, then an error message is output and subsequent occurrences of it within that feature are suppressed. If the FRT pattern definition does not make sense or if it contains illegal values (eg. negatives), then the feature attempting to use it will be ignored and an error message printed.

The individual bits in the flag word in the FRT pattern can be used to specify that:

1. the pattern should be scaled to fit the feature exactly
2. the pattern should restart at each vertex of the line
3. the symbols for every other dash should be inverted

4. the symbols should be drawn horizontal, irrespective of the direction of the line
5. the symbols should be drawn using the hardware, not from the definition in the SRI
6. the symbols should be stretched if the pattern is scaled
7. scale to fit whole units, rather than entire pattern repeats

3.3.2 *Thick lines*

Line thickness is set by the FRT width value. If this value is 0 then the default width (single line) is assumed. The dashes in patterned lines also assume thicknesses from the FRT width entry.

3.4 *Symbol features*

Symbol features may take angles or size values depending on their feature type and whether there was an IFF RO (rotation) entry given and/or an alignment (2 points in an ST entry).

Symbols may either be plotted using the plotter hardware or from the symbol definitions held in the SRI file. The plotter hardware is used to plot the symbol if the bottom bit of the flags word in the FRT for the symbol is set (and the plotter has the capability). When using the plotter hardware to draw symbols, the symbol number is taken from the H/W entry in the FRT; when using the SRI mechanism the symbol number is taken from the secondary code entry.

Unoriented symbols and symbol strings (multiple unoriented symbols) do not take any angle. Oriented and scaled symbols take angles defined by the RO entry. If no RO entry is given then the alignment, if any, is used. The default symbol angle is 0 (ie. upright symbols).

Unoriented and oriented symbols and symbol strings have a size set by the FRT size value. Scaled symbols have a size defined by the alignment (the 2 points define the unity length of the symbol). If no alignment for a scaled symbol is given then an error message is produced and the FRT size is used. If the FRT size is 0 then an error message is output and a default of 5 is used.

Symbol definitions held in the SRI file are held in normalised form. All coordinates in it must be in the range -1 to +1. It is the unit length which is scaled up to the required symbol size. For example, a centred symbol (using the full range -1 to +1) of size 5, would be drawn as -5 to +5 around its centre. A symbol such as an arrow which wants to rotate about its point would be defined in the range 0 to 1 (the arrow point at coordinate 0,0). If given size 5, then this would be drawn as 0 to 5.

3.5 Text features

The IFF RO entry is used to set the text angle. If there is no RO entry then any alignment is used. Failing this, the text is drawn horizontally.

By default, text is justified to the position stored in the FS entry (a value in the range 0-8), but this feature can be turned off, when all text is positioned by its lower left corner.

Text features usually take a height from the FRT size entry. If this is 0 then an error message is produced and a default size of 5 is used.

Alternatively the height may be obtained from the TH entry in the IFF file. By default, the value is taken to be a point size, and if it is not a legal point size the default value of 24 is used. It is also possible to read the value of the TH entry as 100ths of mm.

Different fonts can be used in the same plot by using the FRT secondary code to hold the font number (see FRT Reference Manual). Different fonts are held in different layers of the TRI file.

If the FRT secondary code is negative, then its absolute value is used to identify the font number, but the text is plotted in its italic form.

3.6 Area features

Area features may be drawn hollow, solid, hatched or patterned, according to the value of the secondary code in the FRT file (see FRT Reference Manual). Briefly, -1 gives solid, 0 gives hollow, and positive numbers give various hatch styles. Secondary codes less than -1 relate to area fill patterns which are defined in terms of hatched patterned lines.

For drawing hatched styles, the line width and hatch spacing are taken from the width and size entries in the FRT entry. If both these are 0.0 then the default values of 0.0 (minimum line width) and 5.0 (5.0 mm spacing) are used.

The values from the FRT can be overridden by using the +HATCH command, which can also be used to reset the line width and spacing values.

See details of the logical names LSL\$FILL_POINTS_MAX and LSL\$FILL_CUTS_MAX (above) for controlling the maximum size of area that can be drawn.

4 Running the program

The system is normally set up so that the program is initiated by typing 'FPP', or where several versions are available, possibly FPPxxx where xxx is the particular version name. Sometimes FPP is run from a command file which ensures that the appropriate output device is assigned and set up. A typical run could be:-

```
$ FPP
```

```
FPP (LP) V2.0 of 18:55:26 25-NOV-1988
```

```
FPP> ENLARGE 2
FPP> SCALE SHEET 250000
FPP> SCALE IFF 1000
FPP> SELECT FC CONTOURS GREEN 32-100 201
FPP> FRT FRTFILE
FPP> TRI FONT
FPP> IFF TESTPLOT
- the file is then plotted -
FPP> EXIT
$
```

4.1 More details

Whatever method is used for invoking FPP, it will eventually result in an image file LSL\$EXE:FPPxxx.EXE being run, where xxx is the appropriate device type e.g. LP for Laserplot. In most cases this image will be a small initialisation image (around 10 blocks in size) which sets up logical names and defaults, and then invokes the main image LSL\$EXE:FPPSHR.EXE (around 300 blocks). This in turn invokes the appropriate GKS driver image LSL\$EXE:GKSxxxSHR.EXE (around 50 blocks). Some of the versions driving devices with a family resemblance to Calcomp pen plotters use GKSHCBSSHR.EXE which in turn calls upon a Calcomp lookalike driver image LSL\$EXE:HCBSxxx.EXE (around 20 blocks). The driver images are located by logical name LSL\$GKSSHR for the GKS driver, and LSL\$HCBSSSHARE for the Calcomp lookalike if required. These logical names are set up by the initialisation program, so the images must reside in the search list LSL\$EXE if this is to work (the logical names are set up in user mode, and so disappear again at the end of the run). It is possible to set up the logical names manually and then run FPPSHR directly if required, but it may then be necessary to give a WORKSTATION command to set the workstation type, as the default may not be correct. The image FPPHCBS runs FPPSHR with LSL\$GKSSHR pointing to LSL\$EXE:GKSHCBSSHR.EXE, but leaves the user to point logical name LSL\$HCBSSSHARE to the appropriate Calcomp lookalike driver image.

5 Commands

Commands may be given in their full form (as listed below), or in an abbreviated, unambiguous form. They may be given singly or in groups on a command line.

Commands may be given directly, or they may be given via a command file. Command files may contain any number of commands. They are called using the form:-

@filename

Any parts of the filename not supplied will be taken from the default:

LSL\$FPP:FPP.COM

Such files are useful where the same sequence of commands is needed often.

If running FPP interactively (in particular, when SYS\$COMMAND is a terminal) the CTRL/C (pressing the CTRL and C keys simultaneously) may be used to terminate the plotting of an IFF file. CTRL/C is treated as though the end of file had

been reached.

5.1 *Command list*

The FPP commands follow in alphabetical order:

1. ADVANCE/CLEAR [i]
Advance the film by i (default 1) frames (if the hardware allows this), or clear screen. If this command is given before the first plot is started (for instance to load a diazo into the HRD) then the action is not performed until plotting starts.
2. ANNOTATION subcommand
Set the characteristics for annotations (labels).

 ANNOTATION ANGLE [r]
 Specifies the angle of labelling (in degrees). If r is missing, then align labels with feature (default).

 ANNOTATION COLOUR [i]
 Selects the colour (pen) used for labels. If i is missing, or is less than or equal to zero, then use the same colour as the feature being labelled (default).

 ANNOTATION FONT i
 Selects the font used for labels. The font must exist in the TRI file. By default, font 1 is used.

 ANNOTATION HWTEXT [n]
 Attempt to use hardware facilities to draw labelling text (rather than using the character shapes from the TRI file). The default is not to use hardware text. Hardware text is enabled if n is missing or 1, disabled if n is 0.

 ANNOTATION OFFSET r1 r2
 Specifies an x and y label offset (in mm). Default is no offset.

 ANNOTATION SIZE r
 Specifies the size of labels. By default, a size of 3mm is used.
3. [+/-]CENTRE
Centre (+CENTRE) the plot within the drawing area (default), or plot in the bottom left corner (-CENTRE). +CENTRE is equivalent to POSITION 4, and -CENTRE to POSITION 0 (qv).
4. [+/-]CLIP
Clip (+CLIP) the plot at the range value (either from the RANGE entry in the IFF file, or from the WINDOW command (qv)). The default is not to clip.
CLIP is useful in conjunction with WINDOW to selectively plot part of a file.
5. CONTOUR subcommand
Specifies various options for drawing contours

CONTOUR INDEX i1 i2

Specifies the index contour interval (i1) and selects the colour or pen (i2) to be used for plotting all index contours.
Cancels any CONTOUR LEVEL or CONTOUR INTERVAL commands.

CONTOUR INTERVAL i1 i2

Defines the contour interval (i1), and causes a repeated sequence of i2 colours (pens) to be used in plotting contours.
Cancels any CONTOUR LEVEL or CONTOUR INDEX commands.

CONTOUR LEVEL i1,i2 i3

Defines a range of contour values (i1 to i2), and the colour (pen) to be used in plotting any contour that falls within the range.
E.g. CONTOUR LEVEL 0,400 1 will cause any contour with a height of 0 to 400 inclusive to be plotted with pen 1.
Up to 100 ranges may be specified. Any contour not lying within one of the given ranges will not be plotted.
Cancels any CONTOUR INDEX or CONTOUR INTERVAL commands.

CONTOUR RESET

Cancels all contour selections.

[+/-]CONTOUR SELECT

+CONTOUR SELECT Causes only the index contours to be plotted.

-CONTOUR SELECT Deselects the index contour plotting option (default)

This command should be used in conjunction with the CONTOUR INDEX command

CONTOUR VALUE i1 i2

Allows the selective plotting of a contour value (i1) using a given colour (i2). Equivalent to CONTOUR LEVEL (qv) with a range of a single value.
Cancels any CONTOUR INDEX or CONTOUR INTERVAL commands.

6. DESELECT subcommand

Specifies features not to plot

The same subcommands are valid as for SELECT (qv) are valid, except ALL, and AC CANCEL.

7. DISABLE subcommand

Switches off various options. Same subcommands as ENABLE (qv).

8. ENABLE subcommand

Switches on various options

ENABLE ABSOLUTE

Take the coordinates specified in a WINDOW command to be in absolute IFF units (including any origin offset contained in the IFF files). By default, WINDOW coordinates are specified in IFF units local to each IFF file. Any window is cancelled by this command.

ENABLE BOX

Draw texts as their bounding boxes, rather than as a text string. These boxes will be drawn in the text colour, with a solid line of minimum line width.

This feature is disabled by default.

ENABLE DESCRIPTOR

Take map scale and offset from the IFF Map Descriptor (MD) entry, in preference to the Map Header (MH) entry (default).

ENABLE HEIGHT

Take text height from the TH entry in the IFF file. By default text sizes are taken from the FRT file.

ENABLE HWTEXT

Attempt to use hardware facilities to draw text (rather than using the character shapes from the TRI file) if the FRT hardware bit appears in the flags entry for a text feature code. The default setting for this option varies according to the plotting device in use. See the Plotters User Guide for details of whether a device supports hardware text. Attempts to use hardware text on a device which does not support it will result in text not appearing at all.

ENABLE LOG [n]

Causes a message to be displayed as each feature is plotted, enabling an approximate check on progress to be made. If the optional argument is given, then the message is displayed after each n features. Disabled by default.

ENABLE INTERPOLATION

Draw graphical type 6 features as interpolated curves (default) using the currently selected algorithm (see INTERPOLATE and TOLERANCE commands).

ENABLE PATTERN

Allow generation of patterned lines and fill areas (default). If disabled, then draw all lines solid and patterned fill areas as hatched.

ENABLE PSIZE

If ENABLE HEIGHT in force, then take the text sizes in the IFF TH entry to be in points (default). If disabled, then the size is taken to be in 1/100 mm.

ENABLE POSITIONING

Position text according to the justification code (0-8) stored in the FS entry (default). If disabled, then position all text by its lower left corner.

ENABLE REPORT

By default, layer numbers, TC lines, messages of number of features found, and timing information are output during plotting. This can be switched off by DISABLE REPORT. Error messages are always output.

ENABLE SORT

Draw features using their multiple prioritised representation held in the FRT. This will involve a pre-pass of the IFF file in order to build up a list in memory of feature representation parts to be drawn. The list is then sorted by priority and each part output in turn.

ENABLE THICK

Allow generation of thick lines (default) if the hardware permits. If disabled, then draw all lines are draw at the nominal thickness (thin).

9. **ENLARGE r**
Scaling factor (real number) required to enlarge the film plot up to full size (default 1). N.B. The command ENLARGE 2 will make the plot half the size it otherwise would have been, to allow for the subsequent enlargement. This command is the only method to scale the entire plot while retaining the relative size of texts, symbols, and linework.
10. **ESCAPE escid**
Used to communicate a device dependent function to the particular output device in use. See the Plotters User Guide for details of what functions are available.

FPPCAL5800, FPPVRSVGS, FPPBEN3000, FPPPI448 - escid = 1 uses a drawing mode in which the things drawn subsequently are opaque (things drawn already do not show through). escid = 2 uses a drawing mode in which everything drawn is superimposed (the inks are mixed). If necessary, then draw the file with some selections in force, then change the selections, give the ESCAPE command, and draw again.
11. **EXIT/QUIT**
Exit from the program. CTRL/Z or end of input has the same effect.
12. **FRT filename**
Specifies the FRT (feature representation table) file.
13. **GO**
Used in conjunction with the PAUSE command to start plotting again when the program has stopped between layers or after the required number of features.
14. **[+/-]HATCH [width separation]**
The line width and line separation of hatched and patterned fill area features are taken from the width and size entries in the FRT for the feature code of the feature. If both these are 0.0 then the default values of 0.0 and 5.0 mm are used.
The +HATCH command overrides the data from the FRT and uses the default values.
The -HATCH command returns to the default condition of only using default values for features with 0.0 entries in the FRT.
If arguments are given with the command then these values are used as the defaults.
For symbols and texts that have components that are hollow, solid or hatched fill areas, the width and size entries in the corresponding SCT are used to define the width and separation to be used. Entries of 0.0 mean that the default values are to be used. These default values are affected by the HATCH command, but it is not possible to override the values in the SCT.
15. **HEIGHT subcommand**
Defines the location of contour height values. Correct definition is essential if CONTOUR commands are to operate correctly.

HEIGHT AC
Height value is stored as a type 3 AC (default).

HEIGHT FSN/NF
Height value is stored as the FSN.

16. HELP [topic]
Gives help on FPP commands. If no topic is given, then a list of commands is output.
17. IFF filename
Specifies the IFF data file to be plotted. If running FPP interactively, then the plot may be terminated part way through by pressing CTRL/C.
18. INTERPOLATE subcommand
Set the interpolation algorithm to be used for graphical type 6 features if ENABLE INTERPOLATION is in force. Tolerances can be set using TOLERANCE CURDRAW.

INTERPOLATE AKIMA
Use Akima curve interpolation, a bicubic spline method which preserves linearity if possible (default).

INTERPOLATE MCCONALOGUE
Use McConalogue curve interpolation, a circular arc pair method.

19. LABEL subcommand
Sets up labelling of features with various attributes.
When an AC to be labelled is explicitly specified, the AC type can be given as a name or as the corresponding integer.

[+/-]LABEL AC type
Enable/disable labelling of features with the value of the specified AC. The format of the value displayed depends on the data type of the AC.

[+/-]LABEL ACINT type
Enable/disable labelling of features with the value (treated as an integer) of the specified AC.
This command is now redundant. LABEL AC should be used instead.

[+/-]LABEL ACREAL type
Enable/disable labelling of features with the value (treated as a real value) of the specified AC.
This command is now redundant. LABEL AC should be used instead.

[+/-]LABEL ACTEXT type
Enable/disable labelling of features with the text of the specified AC.

[+/-]LABEL CONTOUR
Enable/disable labelling with the (integer) value of the contour AC.
This is the same as LABEL AC Contour.

[+/-]LABEL FC
Enable/disable labelling with feature code.

[+/-]LABEL FSN/NF
Enable/disable labelling with feature serial number

[+/-]LABEL HEIGHT
Enable/disable labelling with the (real) value of the height AC.
This is the same as LABEL AC Height.

[+/-]LABEL INDEX
Enable/disable labelling of index contours. If enabled, then only feature whose height are multiples of the contour interval will be labelled.
Note: this command must be used in conjunction with the CONTOUR INDEX command

[+/-]LABEL LH
Enable/disable labelling with the text of the Left Hand Boundary AC.
This is the same as LABEL ACTEXT LH_boundary.

LABEL NONE
Cancel all labelling attributes.

[+/-]LABEL RH
Enable/disable labelling with the text of the Right Hand Boundary AC. This is the same as LABEL ACTEXT RH_boundary.

20. NOOVERRIDE
Cancel the effect of OVERRIDE (qv).
21. OFFSET r1 r2
Offset the whole plot by (r1,r2) mm on the enlarged plot.
Default is no offset.
22. ORIGIN r1 r2
Offset the whole plot by (r1,r2) in IFF units.
Default is no offset.
23. OVERRIDE i1 i2
Overrides the featurecode entries for all items in a layer, by a specified feature code, where i1 is the layer number, and i2 is the required feature code. Up to 256 such pairs may be given. Use NOOVERRIDE (qv) to cancel the settings.
24. [+/-]PAUSE subcommand
Causes plotting to pause part way through until the GO command is given.

[+/-]PAUSE FEATURE [i]
Pause plotting after i features. -PAUSE FEATURE cancels a previous PAUSE FEATURE command. After plotting has paused, the PAUSE command must be repeated if required. The number of features after which to pause defaults to the same number as used last time (initially 1). When prioritised drawing is enabled using ENABLE SORT, the PAUSE FEATURE command will pause after i feature REPRESENTATIONS.

[+/-]PAUSE LAYER

Pause before each selected layer and prompt for commands. -PAUSE LAYER cancels a previous PAUSE LAYER command, the rest of the file being plotted without interruption. PAUSE LAYER enables the scaling information to be checked before the first layer starts to plot - the program can be stopped if it is wrong. The PAUSE LAYER command does not work when performing prioritised drawing except to pause after the header is read but before feature are processed.

25. POSITION i

Set the plotting position within the drawing area. Position 0 is bottom left, 1 is centre left, 2 is top left, 3 is bottom centre, and so on up to 8 which is top right. The default is position 4 (centre). See also the CENTRE command.

26. [+/-]ROTATE [r]

[+]ROTATE r rotates the plot r degrees counter clockwise. The default value of r is -90 degrees.

-ROTATE returns to normal orientation and any argument is ignored.

27. SCALE subcommand

Sets scaling for the plot.

SCALE AUTO

Specifies that automatic scaling to fill up the available film area is required.

SCALE FACTOR r

Explicit scaling factor (real) to convert IFF units into mm on the final enlarged plot.

SCALE IFF r

Defines the IFF units. The real value is the number of ground mm represented by 1 IFF unit.

SCALE SHEET r

Defines the scale of the required plot (eg. 50000). The value is the number of ground units represented by one sheet unit. This command is used in conjunction with the SCALE IFF command.

28. SELECT subcommand

Selects which features to plot

SELECT AC type [subcommand]

Allows selection by ancillary code (AC) entries in features. The AC type may be either an integer, the corresponding name defined by Laser-Scan, or a name defined by the user in the FRT file. Selections for different AC types are logically ANDed together, so a feature must satisfy all the selection criteria to be selected.

SELECT AC type CANCEL

Cancels all selections based on the given AC type. The DESELECT command may not be used with CANCEL.

SELECT AC type [PRESENT]

Features must have an AC of the specified type. The value and text of the AC are not considered. PRESENT is the default

subcommand for the SELECT AC command, and may therefore be omitted.

The command DESELECT AC type PRESENT implies that features must not have an AC of the specified type.

SELECT AC type TEXT [[inequality] val1 [val2]]

Allows selection according to the contents of the AC text. If just a text string is specified (in double quotes if it contains spaces), then features will be selected if they contain an AC of the specified type whose text contains the given string (or does not contain the string for a DESELECT command). If an inequality and value(s) are given (as for the SELECT AC type VALUE command), then the given text string within the AC text must be followed immediately by a numerical value in the selected range. The datatype of the value may only be integer. A null text string (specified by "") followed by a value or range of values indicates that the numerical value occurs at the start of the AC text.

Example: SELECT AC DFAD_FADT TEXT fid 25

Features must contain a DFAD_FADT type AC in which the text contains the string "fid" followed by a value 25.

SELECT AC type VALUE [inequality] val1 [val2]

Allows selection according to the value contained in AC entries. Values must be specified in the correct format (integer, real, date, time, character) for the data type of the AC.

The inequality may be any of: = > >= < <= <>
 with synonyms: .EQL. .GTR. .GEQ. .LSS. .LEQ. .NEQ.
 and: .LT.

Inequality names may be abbreviated. If the inequality is omitted, then = is assumed. A range of values may be specified by giving two values (omitting the inequality, or specifying =), which will be taken to mean the range between and including the two values. The command may be repeated to specify additional values or ranges of values.

Example: SELECT AC HEIGHT VALUE >30.0 (height AC, value >30)

 SELECT AC HEIGHT 10.0 20.0 (height AC, values 10 to 20)

SELECT ALL

Cancels all previous SELECT or DESELECT commands and results in all features in the file being plotted.

SELECT FC fc1 fc2 ... fc_n

where fc_n can be a feature code (integer), a range of feature codes or a feature code group name.

Selects which feature codes should be plotted. SELECT FC must be the last command on a line since any following commands will be taken as group names.

ALL, FC, FSN and LAYER may not be used as group names.

SELECT FSN fsn1 fsn2 fsn_n

where fsn can be a feature serial number (integer) or a range of feature serial numbers.

Selects which features should be plotted.

SELECT LAYER lay1 lay2 layn
where lay can be a layer number (integer) or a range of layer numbers.

Selects which layers should be plotted.

29. SEPARATOR ESCAPE escid

Used to set up an ESCAPE function (see the ESCAPE command) which is performed automatically between each level of different priority when prioritised drawing is used. It is intended to ensure that devices which normally plot in a transparent manner draw each priority level in a new opaque layer. The command should not normally be necessary since a default value of 1 is used on the devices for which this is relevant (CAL5800, VRSVGS, BEN3000, PI448).

30. SHOW subcommand

Displays various settings.

SHOW LABELS

Displays the current labelling attributes

SHOW SCALES

Displays the scale which will be used to draw the next IFF file. Note that the sheet scale may be obtained from the map header in the file, in which case this may not be known. Also the size of the drawing area will not be known unless a file has already been drawn.

SHOW SELECTIONS

Displays the currently selected layers, FSNS and FCs

SHOW TOLERANCES

Displays the settings of various tolerances

31. SRI filename

Specifies the SRI (symbol representation IFF) file.

32. TITLE subcommand

Allows the user to add titling to the plot. Simple primitives to draw lines and text use existing feature codes to define pen colour, thickness, text font, etc.

NOTE: No titling can be undertaken until the first plot has been produced using the IFF command.

TITLE DISPLAY text

Defines a text string <text> (from the first non-spacing character to the end of the command line) that may be displayed during plotting by some versions of the program.

TITLE FC LINE i

TITLE FC TEXT i

Define the feature code to be used for lines or text during titling. The feature code <i> must refer to an entry in the current FRT, and this command must not precede the FRT command. For lines, the pen colour and the line-width only are taken from the FRT - any offset or pattern is ignored.

TITLE LINE x y

Draws a line from the 'current' position to (x, y). The coordinates are in millimetres on the enlarged sheet. A feature code must have been specified using the TITLE FC LINE command (qv).

TITLE MOVE x y

Moves the 'current' position to (x, y) in preparation for drawing lines or text. The coordinates are in millimetres on the enlarged sheet.

TITLE PROJECT plotsize

States the projected plot data size in bytes of IFF file. This is used by some versions of the program to report on plot progress.

TITLE TEXT angle text

Draws <text> (from the first non-spacing character to the end of the command line) at angle <angle> (in degrees anticlockwise from the positive X axis), starting at the 'current' position. A feature code must have been specified using the TITLE FC TEXT command (qv). Certain items may be included in the text using escape sequences (% followed by a character). The available escape sequences are:

- %C - the CPU time elapsed since plotting started
- %D - the date
- %E - the time elapsed since plotting started
- %I - the string given in a TITLE DISPLAY command (Ident)
- %R - the reduction factor (as specified by the ENLARGE command)
- %T - the time
- %x - include character x (where x is not one of the above)

Note that after use of %C or %E, the timer will be reset when the next plot is started. To include the character % in the text, use the sequence %%.

33. TOLERANCE subcommand

Sets various tolerances

TOLERANCE CIRDRAW a b c

Sets the point density for drawn circles (graphical types 2-5). The arguments are exactly as for TOLERANCE CURDRAW (qv).

The default setting is a=0, b=0.05, c=0, which gives an 'arc to chord' distance of 0.05mm. This corresponds to approximately 30 points in a circle of 10mm radius, the number being proportional to the square root of the radius.

TOLERANCE CURDRAW a b c

Sets the point density for drawn curves (graphical type 6). The three coefficients (a,b,c) control the spacing of interpolated points. The approximate separation of points (d) is given by:

$$d = a + 2 \cdot \text{SQRT}(2br) + cr \quad (r \text{ is radius of curvature})$$

which means (if other coefficients were zero) that

a gives a constant separation of a mm

b gives a constant 'arc to chord' distance of b mm

c gives a constant angular deviation of c radians ($2\pi/c$ points in a circle)

Trailing arguments may be omitted (the setting is unchanged). If no arguments are given, or all values are zero, then the default values are used.

The default setting is a=0.25, b=c=0, which gives 4 points per mm.

TOLERANCE JUSTIFY r

Each character in a font is usually terminated by some blank space, so that the characters in strings of text are separated. When the length of a text string is required (e.g. for right justification), this space must be subtracted from the last character.

The TOLERANCE JUSTIFY command sets the amount to be subtracted from a text string to represent this blank space. The argument is the proportion of the height of the text that is blank space. By default the value 0.333333 is used.

34. TRI filename
Specifies the TRI (text representation IFF) file.
35. [+/-]WINDOW [xmin ymin xmax ymax]
Select a region of the IFF file for plotting. The specified window will be used in preference to the RANGE entry in the IFF file when calculating the position of the plot. If +CLIP is used in addition, then no data outside the window will be plotted. Use -WINDOW or ENABLE/DISABLE ABSOLUTE to revert to using the RANGE entry (default). The values are specified in the units contained within the IFF file, unless ENABLE ABSOLUTE has been given, in which case the values include any origin offset contained within the file. An absolute window may be used to plot the correct region when several IFF files with different origin offsets are being plotted together.
36. WORKSTATION wtype [conid]
Used to set the GKS workstation type and connection identifier in some versions of FPP. The workstation may be changed during a run by re-issuing the WORKSTATION command. The values of wtype and conid which may be used depend on the particular GKS implementation in use. The WORKSTATION command may be used to force the program to close and re-open the workstation (values of wtype or conid different to the present values must be given). This can be useful in versions which generate disk file output, since a new file will be created.

FPPBEN,FPPCAL* (except 5800),FPPHCBS - wtype should be 100 plus the following values:
 1 if plotter is sheet based and pen should return to origin after plot, otherwise roll based and pen should advance past plot.
 2 if origin is at min x, max y, otherwise origin assumed to be at min x, min y.

 FPPTEKARGS - wtype should be 4014 for raw TEK4014, 7000 for ARGS, or 9900 for MUART TEK4014.

 FPPUIS - wtype should be 7000 if 8 planes are to be used, otherwise only 7 planes will be used.

FPPVRSVGS,FPPBEN3000,FPPPI448 - if wtype is 1000, then opaque drawing mode will be selected initially. The same effect is achieved using an ESCAPE 1 command.

Other versions - for workstation type values applicable to other version of FPP, see the appropriate section of the FPP Plotters User Guide, which is part of the Plotting Package manual.

5.2 Obsolete commands

The following commands are old synonyms for some of the preferred commands above. Most are retained for upwards compatibility.

1. [+/-]AKIMA [r]
Permit Akima curve interpolation (+AKIMA) or suppress curve interpolation regardless of type (-AKIMA). If interpolation is suppressed then curve features are drawn as straight lines. A real value may be given to specify the number of points to be generated per mm on the enlarged plot. This is equivalent to TOLERANCE CURDRAW 1/r. If no value is present, the tolerance is unchanged.
AKIMA 0 is equivalent to -AKIMA.
See ENABLE/DISABLE INTERPOLATION, TOLERANCE CURDRAW, and INTERPOLATE AKIMA/MCCONALOGUE commands.
2. AUTOSCALE
Synonym for SCALE AUTO
3. DESELECT
Synonym for DESELECT FC
4. ENABLE/DISABLE POINTSIZE
Synonym for ENABLE/DISABLE PSIZE
5. [+/-]INTERACTIVE
Old synonym for [+/-]PAUSE LAYER. This command has been withdrawn.
6. LABANG [r]
Synonym for ANNOTATION ANGLE [r]
7. LABCOL [i]
Synonym for ANNOTATION COLOUR [i]
8. LABOFF r1 r2
Synonym for ANNOTATION OFFSET r1 r2
9. LABSIZ r
Synonym for ANNOTATION SIZE r
10. LAYER lay1 lay2 ... layn
Synonym for SELECT LAYER
11. MAP r
Synonym for SCALE IFF r

12. NOLAYER lay1 lay2 ... layn
Synonym for DESELECT LAYER
13. [+/-]PATTERN
Synonym for ENABLE/DISABLE PATTERN
14. [+/-]PAUSE [i]
Synonym for [+/-]PAUSE FEATURE [i]
15. [+/-]POINT
Synonym for ENABLE/DISABLE PSIZE
16. [+/-]REPORT
Old synonym for ENABLE/DISABLE REPORT. This command has been withdrawn.
17. SCALE r
Synonym for SCALE FACTOR r
18. SELECT
Synonym for SELECT FC
19. SOURCESCALE r
Synonym for SCALE SHEET r
20. [+/-]THICK/THK
Synonym for ENABLE/DISABLE THICK
21. [+/-]TXPOS
Synonym for ENABLE/DISABLE POSITIONING
22. [+/-]TXSIZE
Synonym for ENABLE/DISABLE HEIGHT

5.3 Specifying filenames

Filenames need to be specified for the following files:-

	<i>File</i>	<i>Default Filename</i>
1.	IFF (Internal Feature Format)	LSL\$IF:IFF.IFF
2.	FRT (Feature Representation Table)	LSL\$FRT:FRT.FRT
3.	SRI (Symbol Representation IFF file)	LSL\$FRT:SRI.SRI
4.	TRI (Text Representation IFF file)	LSL\$FRT:TRI.TRI

The IFF filename must be given. The FRT, SRI and TRI names need not be given, in which case the above defaults are used. An exception to this is when the FRT is given, in which case the SRI and TRI will default to the FRT name (with the appropriate postfix).

eg. The command sequence:-

```
FRT TEST
IFF TESTFILE
```

will result in the files TEST.FRT, TEST.SRI, TEST.TRI and TESTFILE.IFF being used.

All the files defined must exist, even if the IFF file contains no symbols or text.

Filenames may be changed up until the point where plotting actually starts.

5.4 *Selecting*

The user can select the required data within the IFF file by feature code, feature serial number, layer, or ancillary code (AC) information.

Feature codes are selected using the SELECT FC and DESELECT FC commands. They can be specified explicitly (either singly or as ranges), or as group names (eg. 'SEL 20, 30-35, WATER, 100, BROWN'). Separators may be spaces or commas. Ranges are indicated by the '-' character.

The group names have to be defined in the FRT file. Since the FRT file required is unknown until the FRT command is given the legality of group names given is unknown. Consequently, SELECT and DESELECT commands are only checked for syntax initially. Once a FRT command has been given, and the FRT file successfully read, the stored-up SELECT FC and DESELECT FC commands are actually processed.

Layers are selected by layer number using the SELECT LAYER and DESELECT LAYER commands. Ranges of layer numbers may be specified in the same way as feature code selection, but group names are not allowed.

Features may be selected by feature serial number using the SELECT FSN and DESELECT FSN commands. Ranges of feature serial numbers may be specified in the same way as feature code selection, but group names are not allowed.

Features may be selected according to the presence or absence of particular AC (ancillary code) types using the SELECT AC and DESELECT AC commands. In addition, particular values, or ranges of values in the AC may be selected. The text part of an AC may be used for selections on the basis of its containing (or not containing) a particular text string, or its containing a particular string followed by an integer value.

Initially, and after a SELECT ALL command, if the first selection command for a particular category (FSN, FC etc.) is a SELECT (not a DESELECT), then all values other than those explicitly selected will be deselected.

Subsequently, any selections for a given category are just added to those already present.

In all cases, the SHOW SELECTIONS command will display the current state of the selections.

5.5 *Scaling*

There are 3 main mechanisms for specifying the scale:-

1. IFF Units and Sheet Scale (SCALE IFF/SHEET)

This is expected to be the most commonly used scaling mechanism. It defines the scaling necessary to convert from IFF units to mm on the final enlarged plot. The SCALE SHEET value is the number of ground units represented by one sheet unit, while the SCALE IFF value is the number of ground mm represented by one IFF unit. SCALE IFF defaults to 1000 (IFF units are ground metres) if not given.

IFF units may be either in terms of the paper map, or in terms of the ground. In the former case the SCALE FACTOR command should be used instead.

An example of using this mechanism (assuming a 1:25000 map):-

<i>IFF Units</i>	<i>SCALE SHEET Value</i>	<i>SCALE IFF Value</i>
Metres on ground	25000	1000

The effective formula used on the coordinates is:-

$$\text{mm (enlarged plot)} = \text{IFF units} * (\text{SCALE IFF} / \text{SCALE SHEET})$$

2. Explicit Scale (SCALE FACTOR).

This scaling mechanism allows the user to combine the SCALE SHEET and SCALE IFF values into 1 explicit command (FACTOR = IFF / SHEET).

It defines the scaling necessary to convert from IFF units to mm on the final enlarged plot. This mechanism is most appropriate if the IFF units are directly related to the units on the sheet, rather than on the ground.

3. Automatic Scaling (SCALE AUTO).

This scales the plot automatically so that it uses as much of the available film area as possible (without distorting the plot of course). The shape and extent of the plot is deduced from the IFF range entry or from the WINDOW command. Text and symbol features which cross the edges of the film area will be clipped.

Texts, symbols and patterns will not be scaled. They keep the sizes specified by the FRT file. This usually means that this mechanism is not satisfactory for maps containing texts and symbols.

The default action is to take the SHEET scale from the IFF Map Descriptor (MD) entry. If this is unset, or DISABLE DESCRIPTOR is used, then a scale from the IFF Map Header (MH) entry is used. If this is also unset, then SCALE FACTOR 1 is assumed. MCE and Ordnance Survey type map headers are supported. In order to return to the default behaviour after a SCALE SHEET command has been given, give a SCALE AUTO or SCALE FACTOR command, followed by an appropriate SCALE IFF command.

The ENLARGE command is normally used where a smaller film intermediate plot is produced to be photographically enlarged to final map size, and defines the scaling factor necessary to convert between mm on the intermediate plot and mm on the enlarged map. An enlargement value of 4, for example, implies that the enlarged plot is 4 times the size of the film plot - the film plot will be drawn

4 times smaller than the other scaling commands indicate. ENLARGE is used in conjunction with the SCALE FACTOR or SCALE IFF/SHEET mechanisms. The default enlargement factor is 1.

Texts, symbols and patterns will be scaled up or down according to the enlargement value.

Scaling commands can be changed up until the point where plotting actually starts. They can be changed between plots but not between layers.

5.6 *Plot positioning*

The position of the plot within the drawing area is controlled by the POSITION, CENTRE, OFFSET, ORIGIN, ROTATE, and WINDOW commands.

The default action is to place the area defined by the RANGE entry in the IFF file in the centre of the drawing area. ROTATE can be used to turn the plot by an arbitrary angle, possibly to take better advantage of the shape of the drawing medium. If a different position is specified using -CENTRE or POSITION then the (possibly rotated) area is then placed in the position requested. Any OFFSET or ORIGIN commands then displace the plot from this position. (The direction of the displacement is unaffected by ROTATE.)

The WINDOW command may be used to override the values from the RANGE entry in the IFF file, and may be useful when plotting several files together to avoid problems associated with the different RANGE entries in the files. The window values may be specified either in local IFF coordinates (default), or in absolute coordinates taking any origin offset into account (ENABLE ABSOLUTE).

If +CLIP is used, then any data outside the RANGE, or WINDOW values, will not be plotted at all. Note that data can only be clipped to a rectangular area parallel to the sides of the drawing area, thus if a rotation which is not a multiple of 90 degrees is specified, some data outside the specified window will be drawn.

If subsequent maps are plotted without giving any new scaling or positioning commands, then they will be positioned with regard to the local origin contained in the Map Descriptor or Map Header in the file, thus several maps may be positioned correctly relative to each other.

The commands causing the origin to be reset (i.e. the next map will be positioned without any origin shift, and its local origin will be used in positioning any subsequent maps are: OFFSET, ORIGIN, ENLARGE, ADVANCE/CLEAR, ROTATE, CENTRE, POSITION, and any of the SCALE commands.

5.7 *Labelling*

All graphical types except text may be labelled with their feature serial number, feature code, and various attributes from ancillary code (AC) entries.

The LABEL command is used to select labelling (qv).

By default, labels are plotted at the first coordinate point of the item, aligned using the first two points of the item. By default, the labels are drawn using font 1 from the TRI file at a size of 3mm, while the colour is taken from the feature being labelled.

The angle, colour, font, hardware option, offset, and size of labels may be set explicitly using the ANNOTATION ANGLE, COLOUR, FONT, HWTEXT, OFFSET, and SIZE commands respectively.

Each LABEL command will set an additional attribute, and all these attributes (if present) will be used to label each feature.

eg LABEL FSN
 LABEL FC
 LABEL AC Height

will cause labels of the form "fsn fc [height]" to be attached to each feature. The height will only occur if the feature has a Height AC (type 3) associated with it.

The LABEL NONE command should be used to cancel all labelling attributes.

6 Error messages

Error messages are written to the terminal output stream and are generally self-explanatory. There are 3 general categories of error message:-

1. Those concerning commands (direct commands or commands given within a command file). These normally indicate that there is an error in the command syntax, or that the command has been given out of context.
2. Errors produced when reading the FRT file. These indicate an illegal construct in an FRT entry.
3. Most errors will be those produced when reading the IFF file. These, where relevant, are followed by a line indicating the layer number, feature serial number and internal sequence number of the feature causing the error.
eg. 'Layer 100 - FSN 3142 - ISN 910'

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