# Plot Contents

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## Overview

Plot is a plotting package that provides business and scientific graphics.

Plots can be drawn directly from the J session, or included in a Windows form.

For example:

```
load 'plot'
plot */~ i.20
```

This loads the plot system and draws a simple plot.

There are two user verbs, `pd` (plot driver) and `plot`.

- `pd` is the low-level verb that handles all calls to Plot.
- `plot` is a cover verb for `pd` that will handle most simple uses of Plot.

For an introduction, see the lab *Plot Package*.

For examples illustrating the main facilities provided, see the demo *Studio|Demos...|plot*. In the demo, use *Options|View Definition* to view and experiment with the plot definitions.

To use the plot class, for example, to include plots on a Windows form, see Plot Class

## pd verb

`pd` is the low-level verb that handles all calls to Plot.

`pd` has three types of argument:

| | | |
|---|---|---|
| **commands** | set up and show a plot | Plot Commands |
| **options** | specify plot type, colors etc | Plot Options |
| **data** | data used in the plot | Plot Data |

Commands and options are given in a character list, delimited by semicolons. Data is a numeric or boxed array.

For example:

```
load 'plot numeric trig'    NB. load plot and some utilities

pd 'reset'                  NB. command reset
pd 'textc 500 950 My Plot'  NB. command textc
pd 'type line'              NB. option type
pd cos steps 0 8 100        NB. data
pd 'show'                   NB. command show
pd 'clip'                   NB. command clip
```

## plot verb

`plot` is a cover for `pd`.

The optional left argument is a list of commands and options, delimited by semicolons. The right argument is data.

`plot` and `pd` may be used together, for example:

```
   'type bar' plot >:?2 6$10       NB. draw a barchart

   pd 'print'                      NB. print it
```

## Plot Class

Plot is defined in class `jzplot`.

Public verbs are `pd` and `plot`.

Public nouns specify the Windows form and isigraph control id, where these differ from the default plot.

| Name | Description | Default |
|---|---|---|
| `PForm` | form handle | `plot` |
| `PFormhwnd` | form handle | defined when the form is created |
| `PId` | isigraph control id | `gs` |

**Example: create two plots**

The following draws two independent plots:

```
load 'jzplot'          NB. load plot class

a=: conew 'jzplot'     NB. create plot object a
b=. conew 'jzplot'     NB. create plot object b

plot__a */~ i.20       NB. draw plot in a
plot__b +./~ i.20      NB. draw plot in b
```

**Example: add plot to a form**

In this case, you need to define the public nouns `PForm, PFormhwnd` and `PId`. These override the default values.

```
load 'jzplot'

MYPLOT=: 0 : 0
pc myplot closeok;
xywh 2 2 125 100;cc g0 isigraph ws_border rightscale bottommove;
xywh 131 3 34 11;cc close button leftmove rightmove;cn "Close";
pas 2 2;pcenter;
rem form end;
)

myplot_close_button=: wd bind 'pclose'

wd MYPLOT

a=: conew 'jzplot'             NB. create plot object
PForm__a=: 'myplot'            NB. define PForm in a
PFormhwnd__a=: wd 'qhwndp'     NB. define PFormhwnd in a
PId__a=: 'g0'                  NB. define PId in a

'density' plot__a 7|i.25 25    NB. draw plot on the form
```

## Plot Types

| Type | 2D | 3D | Description |
|---|---|---|---|
| area | x | | shows area under one or more lines |
| bar | x | | bar chart |
| density | | x | density plot (2D representation of 3D data) |
| dot | x | | dot plot |
| errorbar | x | | error bars |
| hilo | x | | hi - lo plot |
| line | x | x | line plot (3D if x;y;z values given) |
| linefit | x | | fitted line plot |
| fbar | x | | floating bar chart |
| sbar | x | | step bar chart |
| pie | x | | pie char |
| point | x | | point plot |
| radar | x | | radar plot |
| stick | x | x | stick plot (vertical bars) |
| step | x | | step plot |
| surface | | x | surface plot |
| wire | | x | wire surface plot |

## Plot Commands

The units used in these commands are based on an isigraph window of 1000 by 1000. The point 0,0 is the bottom left corner.

Some of these commands refer to "gl" commands which are documented in the wd Commands online help.

| Command | Description |
|---|---|
| **reset [parent]** | reset plot with optional parent window id.<br><br>For example:<br>`pd 'reset'` |
| **new [window]** | starts new plot with optional window, sets user defaults. Use to set initial values, and when display multiple plots. The default window is 0 0 1000 1000.<br><br>For example, create a new plot window with xy position 100 100, and of size 400 by 600:<br>`pd 'new 100 100 400 600'` |
| **use window** | change window |
| **text, textc, textr arg** | text (left aligned), centered, right aligned.<br><br>Argument is x y text, where x y are coordinates relative to window.<br><br>For example, the following writes the text "J Graphics" centered at position 500 950:<br>`pd 'textc 500 950 J Graphics'` |
| **{options}** | sets plot options. See Plot Options<br><br>For example:<br>`pd 'backcolor white; frame 1'` |
| **{numeric data}** | sets plot data. More than one set of data can be given. |
| **clip [w h]** | copy plot to clipboard in wmf format<br><br>w h are clipboard width and height in 0.01 millimeters, default 10000 7500 |
| **show** | displays plot |
| **save [file flip w h]** | save plot to file in wmf format<br><br>flip 0 has orientation of 0 0 as lower left corner.<br>flip 1 flips for applications like Word with 0 0 as upper left corner.<br><br>w h are clipboard width and height in 0.01 millimeters, default 10000 7500 |

See also the definition of glsave

**savebmp [file w h]** save plot as 24bit color bitmap file.

w h are width and height

See also the definition of glsavebmp

## Plot Options

Plot options and their defaults are shown below. The defaults are set whenever you use the 'reset' or 'new' commands and are defined in script system\classes\plot\plotdefs.ijs.

Options are specified by providing the option name followed by its argument. Several options can be given at one time, separated by semicolons. Option values are stored as uppercase global variables.

Options whose names begin with 'x' apply to the x-axis; corresponding options apply to the y and z axes.

"Isigraph units" are based on graphics window size of 1000 by 1000.

Some of these options refer to "gl" commands which are documented in the wd Commands online help.

| Options | Type | Default | Description |
|---|---|---|---|
| **aspect** | n | 2r3 | ratio of graphics window height to width. Used to adjust ticmark lengths, and graph boxes for a pie chart. |
| **axes** | b | 1 1 | if x,y axes are shown |
| **backcolor** | color | WHITE | background color |
| **bandcolor** | colors | see Plot Colors | band color scheme |
| **border** | b | 0 | if a border is drawn |
| **bordersize** | n | 8 | size of border (isigraph units) |
| **boxed** | b | 1 | if drawn in a box (3D only) |
| **captionfont** | font | Arial 40 | font for x and y captions |
| **clear** | b | 1 | if clear the background before drawing plot |
| **color** | colors | see Plot Colors | plot colors |
| **edgecolor** | colors | BLACK | edge color (ellipse, pie, poly, rect) |
| **forecolor** | color | BLACK | foreground color (for axes, text) |
| **frame** | b | 0 | if plot is framed |
| **gridcolor** | color | GRAY | grid line color |
| **grids** | b | 0 0 | if x, y grids are shown |
| **itemcolor** | colors | see Plot Colors | item color scheme |
| **key** | c | {none} | key names (legend identifying plot items) |
| **keyfont** | font | Courier New 25 | font for key names |
| **keystyle** | n | 0 2 | 0=horizontal 1=vertical style<br>0-3 positions from top left |
| **labelfont** | font | Courier New 40 | font for labels |
| **labels** | b | 1 1 | if x,y labels shown |
| **mesh** | b | 1 | if a mesh is drawn (3D only) |
| **orientation** | n | 1 | 1=portrait, 2=landscape (printing only) |
| **penpattern** | v | see plotdefs | patterns used by pen styles |
| **pensize** | n | 1 | pensize (see definition of glpen) |
| **penstyle** | n | solid | pen style (see definition of glpen) |
| **plotbox** | n | 0 0 1000 1000 | position and size of plotting window. |
| **plotcaption** | c | Plot | plot caption |
| **polar** | b | 0 | if a polar plot, data is r;theta (2D only) |
| **rtic** | v | {none} | r tics (#major,#minor) (radar plot only) |
| **separator** | c | \| | separator for char matrix entries |

| | | | |
|---|---|---|---|
| **symbolfont** | font | Symbol 40 bold | symbol font used in point plots |
| **textcolor** | color | BLACK | text color |
| **textfont** | c | Arial 40 | text font |
| **ticmajor** | v | 12 | size of major tic marks (isigraph units) |
| **ticminor** | v | 8 | size of minor tic marks (isigraph units) |
| **tics** | v | 1 1 | if x, y tic marks shown |
| **title** | c | {none} | title text |
| **titlefont** | c | Arial 60 | title font |
| **type** | c | line | plot type (see Plot Types) |
| **viewcenter** | v | 0 0 0 | position of plot center (3D only) |
| **viewpoint** | v | 1.6 _2.4 1.5 | position of observer (3D only) |
| **viewsize** | v | 1 1 0.5 | relative sizes of viewbox |
| **viewup** | v | 0 0 1 | upwards direction (3D only) |
| **visible** | b | 1 | if plot is displayed |
| **xcaption** | c | {none} | x caption |
| **xgridpattern** | v | 3 5 | x grid pattern |
| **xint** | n | {none} | position of x-intercept |
| **xlabel** | c | {none} | x labels |
| **xlog** | n | 0 | if log applied to x values |
| **xrange** | v | {none} | range of x data - low,high |
| **xtic** | v | {none} | x tic (style) |
| **xticpos** | v | {none} | x tic positions |
| **xtitle** | c | {none} | x axis title |

| **Type** | **Description** |
|---|---|
| **b** | boolean 0 or 1 |
| **c** | character string |
| **color[s]** | color or color matrix – given by name or values |
| **font** | font specification |
| **n** | number |
| **v** | numeric list |

## Plot Data

Plot data may be given as either a numeric or boxed array.

A numeric array should be a vector or matrix.

- For a 2D plot, a vector is the y values and a matrix is treated as rows of y values. The x axis defaults to `i.{:$y .`
- For a 3D plot, the array should be a matrix and is treated as z values. The x axis defaults to `i.# z` and the y axis to `i.{:$z .`

A boxed array is either x;y values for a 2D plot, or x;y;z values for a 3D plot. The boxed values should conform in size.

- For a 2D plot, the x values should have the same shape as the y values, or be a vector of length `{:$y .`
- For a 3D plot, the x and y values should have the same shape as the z values, or the x values should have length `#z` and the y values of length `{:$z .`

## Plot Colors

Several color schemes are used in Plot.

Before any drawing is made, the *backcolor* is applied to the plot box. The axes, frame, ticmarks, labels and titles are then drawn in the *forecolor*.

Text specified with the `text/textc/textr` commands is drawn with the *textcolor*.

Data is colored in two ways, depending on plot type:

- where each data item is plotted in a single color (e.g. line plots), the items are drawn with the *itemcolor*
- where a data item is banded and requires several colors to plot, (e.g. density plots), it is drawn with the *bandcolor*.

The edges of filled-in shapes are drawn with the *edgecolor* (usually black).

Backcolor, forecolor, textcolor and edgecolor are single colors.

Itemcolor and bandcolor are lists of colors. Itemcolor typically contains quite distinctive colors to distinguish the different data items. Bandcolor is typically a graduated scale of colors, for example to indicate height. Typical lists of colors are defined in system\classes\plot\plotdefs.ijs.

The term *color* can also be used as an abbreviation to specify the itemcolor or the bandcolor depending on plot type. This convenient for simple plots where only one plot type is being drawn.

For example:

| | |
|---|---|
| `pd 'textcolor red'` | single color for text |
| `pd 'itemcolor blue,red,green'` | list of colors for items |
| `pd 'bandcolor bgclr'` | list of colors in color band |
| `pd 'color blue,red'` | item or band colors (depends on plot type) |

The script system\classes\plot\plotdefs.ijs defines several color schemes, for example:

- `STDCLR` is the color scheme used by default
- `RBCLR` is a red/blue color scheme that is appropriate for 3D surface plots