

Draw dialect

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1. Abstract

Draw is a dialect (DSL) of Red language that provides a simple declarative way to specify 2D drawing operations. Such operations are expressed as lists of ordered commands (using blocks of values), which can be freely constructed and changed at run-time.

Draw blocks can be rendered directly on top of an image using the **draw** function, or inside a View face using the **draw** facet (see [View documentation](#)).

2. Draw commands

Commands can either be drawing instructions or settings for the drawing instructions. When a mode is set, it will affect all subsequent operations in the current Draw session (or until changed).

Most Draw commands require coordinates to be specified. The 2D coordinate system used is:

- x axis: increasing from left to right of the display.
- y axis: increasing from top to bottom of the display.

Some drawing commands require lengths to be specified. The length required is number of pixels.

[Coord-system] | [./images/coord-system.png](#)

2.1. Line

Syntax

```
line <point> <point> ...
```

<point> : coordinates of a point (pair!).

Description

Draws a line between two points. If more points are specified, additional lines are drawn, connecting each point in the provided order.

2.2. Triangle

Syntax

```
triangle <point> <point> <point>
```

<point> : coordinates of a vertex of the triangle (pair!).

NOTE | A vertex is the point at which two lines meet. They are points where edges join.

Description

Draws a triangle with edges between the supplied vertices.

2.3. Box

Syntax

```
box <top-left> <bottom-right>
box <top-left> <bottom-right> <corner>
```

```
<top-left>      : coordinates of the top-left of the box (pair!).
<bottom-right>  : coordinates of the bottom-right of the box (pair!).
<corner>        : (optional) radius of the arc used to draw a round corner (integer!).
```

Description

Draws a box using the top-left (first argument) and bottom-right (second argument) vertices. An optional radius can be provided for making round corners.

2.4. Polygon

Syntax

```
polygon <point> <point> ...

<point> : coordinates of a vertex (pair!).
```

Description

Draws a polygon using the provided vertices. The last point does not need to be the starting point, an extra line will be drawn anyway to close the polygon. Minimal number of points to be provided is 3.

2.5. Circle

Syntax

```
circle <center> <radius>
circle <center> <radius-x> <radius-y>

<center>    : coordinates of the circle's center (pair!).
<radius>    : radius of the circle (integer! float!).
<radius-x>  : (ellipse mode) radius of the circle along X axis (integer! float!).
<radius-y>  : (ellipse mode) radius of the circle along Y axis (integer! float!).
```

Description

Draws a circle from the provided center and radius values. The circle can be distorted to form an ellipse by adding an optional integer indicating the radius along Y axis (the other radius argument then becomes the radius along X).

2.6. Ellipse

Syntax

```
ellipse <top-left> <size>
```

<top-left> : coordinates of the ellipse's bounding box top-left point (pair!).

<size> : size of the bounding box (pair!).

Description

Draws an ellipse from the specified bounding box. The **size** argument represents the X and Y diameters of the ellipse.

NOTE

ellipse provide a more compact and box-oriented way to specify a circle/ellipse compared to **circle** command.

2.7. Arc

Syntax

```
arc <center> <radius> <begin> <sweep>
```

```
arc <center> <radius> <begin> <sweep> closed
```

<center> : coordinates of the circle's center (pair!).

<radius> : radius of the circle (pair!).

<begin> : starting angle in degrees (integer!).

<sweep> : angle between the starting and ending points of the arc in degrees (integer!).

Description

Draws the arc of a circle from the provided center and radius values. The arc is defined by two angles values. An optional **closed** keyword can be used to draw a closed arc using two lines coming from the center point.

2.8. Curve

Syntax

```
curve <end-A> <control-A> <end-B>
curve <end-A> <control-A> <control-B> <end-B>
```

```
<end-A>      : end point A (pair!).
<control-A>  : control point A (pair!).
<control-B>  : control point B (pair!).
<end-B>      : end point B (pair!).
```

Description

Draws a Bezier curve from 3 or 4 points:

- 3 points: 2 end points, 1 control point.
- 4 points: 2 end points, 2 control points.

Four points allow more complex curves to be created.

2.9. Spline

Syntax

```
spline <point> <point> ...
spline <point> <point> ... closed

<point> : a control point (pair!).
```

Description

Draws a B-Spline curve from a sequence of points. At least 3 points are required to produce a spline. The optional **closed** keyword will draw an extra segment from the end point to the start point, in order to close the spline.

NOTE	2 points are accepted, but they will produce only a straight line.
-------------	--------------------------------------------------------------------

2.10. Image

Syntax

```

image <image>
image <image> <top-left>
image <image> <top-left> <bottom-right>
image <image> <top-left> <top-right> <bottom-left> <bottom-right>
image <image> <top-left> <top-right> <bottom-left> <bottom-right> <color>
image <image> <top-left> <top-right> <bottom-left> <bottom-right> <color> border
image <image> <top-left> <top-right> <bottom-left> <bottom-right> <color> crop
<offset> <size>

```

```

<image>      : image to display (image! word!).
<top-left>   : (optional) coordinate of top left edge of the image (pair!).
<top-right>  : (optional) coordinate of top right edge of the image (pair!).
<bottom-left> : (optional) coordinate of bottom left edge of the image (pair!).
<bottom-right> : (optional) coordinate of bottom right edge of the image (pair!).
<color>      : (optional) key color to be made transparent (tuple! word!).
<offset>     : (optional) position for starting cropping (pair!).
<size>       : (optional) size of cropping (pair!).

```

Description

Paints an image using the provided information for position and width. If the image has no positioning information provided, then the image is painted at 0x0 coordinates. A color value can be optionally provided, it will be used for transparency.

NOTE

- Four points mode is not yet implemented. It will allow to stretch the image using 4 arbitrary-positioned edges.
- **border** optional mode is not yet implemented. It is unlikely that this feature will be supported:
- You can't use paths to specify images. Processing paths is expensive, so it's a bad fit for the **draw** dialect that's optimized for performance. Use selective evaluation (**compose**) instead.

2.11. Text

Syntax

```

text <position> <string>

<position> : coordinates where the string is printed (pair!).
<string>   : text to print (string!).

```

Description

Prints a text string at the provided coordinates using the current font.

NOTE

If no font is selected or if the font color is set to **none**, then the pen color is used instead.

2.12. Font

Syntax

```
font <font>

<font> : new font object to use (object! word!).
```

Description

Selects the font to be used for text printing. The font object is a clone of **font!**.

2.13. Pen

This command defines the outlines drawing mode for other commands. Many different options are available from a simple color, to nested custom shapes and gradients.

2.13.1. Color pen

Syntax

```
pen <color>

<color> : new color to use for drawing (tuple! word!).
```

Description

Selects the color to be used for drawing operations. All shapes will be drawn by the selected color until the pen is set to **off**.

2.13.2. Linear gradient pen

Syntax

```
pen linear <color1> <offset> ... <colorN> <offset> <start> <end> <spread>

<color1/N> : list of colors for the gradient (tuple! word!).
<offset>    : (optional) offset of gradient color (float!).
<start>     : (optional) starting point (pair!).
<end>       : (optional unless <start>) ending point (pair!).
<spread>    : (optional) spread method (word!).
```


Description

Sets a linear gradient to be used for drawing operations. The following values are accepted for the spread method: **pad**, **repeat**, **reflect** (currently **pad** is same as **repeat** for Windows platform).

When used, the start/end points define a line where the gradient paints along. If they are not used, the gradient will be paint along a horizontal line inside the shape currently drawing.

2.13.3. Radial gradient pen

Syntax

```
pen radial <color1> <offset> ... <colorN> <offset> <center> <radius> <focal> <spread>
```

<color1/N> : list of colors for the gradient (tuple! word!).

<offset> : (optional) offset of gradient color (float!).

<center> : (optional) center point (pair!).

<radius> : (optional unless <center>) radius of the circle to paint along (integer! float!).

<focal> : (optional) focal point (pair!).

<spread> : (optional) spread method (word!).

Description

Sets a radial gradient to be used for drawing operations. The following values are accepted for the spread method: **pad**, **repeat**, **reflect** (currently **pad** is same as **repeat** for Windows platform).

The radial gradient will be painted from focal point to the edge of a circle defined by center point and radius. The start color will be painted in focal point and the end color will be painted in the edge of the circle.

2.13.4. Diamond gradient pen

Syntax

```
pen diamond <color1> <offset> ... <colorN> <offset> <upper> <lower> <focal> <spread>
```

<color1/N> : list of colors for the gradient (tuple! word!).

<offset> : (optional) offset of gradient color (float!).

<upper> : (optional) upper corner of a rectangle. (pair!).

<lower> : (optional unless <upper>) lower corner of a rectangle (pair!).

<focal> : (optional) focal point (pair!).

<spread> : (optional) spread method (word!).

Description

Sets a diamond-shaped gradient to be used for drawing operations. The following values are accepted for the spread method: **pad**, **repeat**, **reflect** (currently **pad** is same as **repeat** for Windows

platform).

The diamond gradient will be painted from focal point to the edge of a rectangle defined by upper and lower. The start color will be painted in focal point and the end color will be painted in the edge of the diamond.

2.13.5. Pattern pen

Syntax

```
pen pattern <size> <start> <end> <mode> [<commands>]
```

<size> : size of the internal image where <commands> will be drawn (pair!).
<start> : (optional) upper corner for crop section within internal image (pair!).
<end> : (optional) lower corner for crop section within internal image (pair!).
<mode> : (optional) tile mode (word!).
<commands> : block of Draw commands to define the pattern.

Description

Sets a custom shape as pattern to be used for drawing operations. The following values are accepted for the tile mode: **tile** (default), **flip-x**, **flip-y**, **flip-xy**, **clamp**.

Starting default point is 0x0 and ending point is <size>.

2.13.6. Bitmap pen

Syntax

```
pen bitmap <image> <start> <end> <mode>
```

<image> : image used for tiling (image!).
<start> : (optional) upper corner for crop section within image (pair!).
<end> : (optional) lower corner for crop section within image (pair!).
<mode> : (optional) tile mode (word!).

Description

Sets an image as pattern to be used for drawing operations. The following values are accepted for the tile mode: **tile** (default), **flip-x**, **flip-y**, **flip-xy**, **clamp**.

Starting default point is 0x0 and ending point is image's size.

2.13.7. Turning off the pen

Syntax

pen off

Description

Stop all outline drawing operations for subsequent commands.

2.14. Fill-pen

This command defines the filling mode for other commands requiring filling operations (closed shapes). Many different options are available from a simple color, to nested custom shapes and gradients.

2.14.1. Color fill

Syntax

```
fill-pen <color>
```

<color> : new color to use for filling (tuple! word!).

Description

Selects the color to be used for filling operations. All closed shapes will get filled by the selected color until the fill pen is set to **off**.

2.14.2. Linear gradient fill

Syntax

```
fill-pen linear <color1> <offset> ... <colorN> <offset> <start> <end> <spread>
```

<color1/N> : list of colors for the gradient (tuple! word!).

<offset> : (optional) offset of gradient color (float!).

<start> : (optional) starting point (pair!).

<end> : (optional unless <start>) ending point (pair!).

<spread> : (optional) spread method (word!).

Description

Sets a linear gradient to be used for filling operations. The following values are accepted for the spread method: **pad**, **repeat**, **reflect** (currently **pad** is same as **repeat** for Windows platform).

When used, the start/end points define a line where the gradient paints along. If they are not used, the gradient will be paint along a horizontal line inside the shape currently drawing.

2.14.3. Radial gradient fill

Syntax

```
fill-pen radial <color1> <offset> ... <colorN> <offset> <center> <radius> <focal>  
<spread>
```

<color1/N> : list of colors for the gradient (tuple! word!).
<offset> : (optional) offset of gradient color (float!).
<center> : (optional) center point (pair!).
<radius> : (optional unless <center>) radius of the circle to paint along (integer! float!).
<focal> : (optional) focal point (pair!).
<spread> : (optional) spread method (word!).

Description

Sets a radial gradient to be used for filling operations. The following values are accepted for the spread method: **pad**, **repeat**, **reflect** (currently **pad** is same as **repeat** for Windows platform).

The radial gradient will be painted from focal point to the edge of a circle defined by center point and radius. The start color will be painted in focal point and the end color will be painted in the edge of the circle.

2.14.4. Diamond gradient fill

Syntax

```
fill-pen diamond <color1> <offset> ... <colorN> <offset> <upper> <lower> <focal>  
<spread>
```

<color1/N> : list of colors for the gradient (tuple! word!).
<offset> : (optional) offset of gradient color (float!).
<upper> : (optional) upper corner of a rectangle. (pair!).
<lower> : (optional unless <upper>) lower corner of a rectangle (pair!).
<focal> : (optional) focal point (pair!).
<spread> : (optional) spread method (word!).

Description

Sets a diamond-shaped gradient to be used for filling operations. The following values are accepted for the spread method: **pad**, **repeat**, **reflect** (currently **pad** is same as **repeat** for Windows platform).

The diamond gradient will be painted from focal point to the edge of a rectangle defined by upper and lower. The start color will be painted in focal point and the end color will be painted in the edge of the diamond.

2.14.5. Pattern fill

Syntax

```
fill-pen pattern <size> <start> <end> <mode> [<commands>]
```

<size> : size of the internal image where <commands> will be drawn (pair!).
<start> : (optional) upper corner for crop section within internal image (pair!).
<end> : (optional) lower corner for crop section within internal image (pair!).
<mode> : (optional) tile mode (word!).
<commands> : block of Draw commands to define the pattern.

Description

Sets a custom shape as pattern to be used for filling operations. The following values are accepted for the tile mode: **tile** (default), **flip-x**, **flip-y**, **flip-xy**, **clamp**.

Starting default point is 0x0 and ending point is <size>.

2.14.6. Bitmap fill

Syntax

```
fill-pen bitmap <image> <start> <end> <mode>
```

<image> : image used for tiling (image!).
<start> : (optional) upper corner for crop section within image (pair!).
<end> : (optional) lower corner for crop section within image (pair!).
<mode> : (optional) tile mode (word!).

Description

Sets an image as pattern to be used for filling operations. The following values are accepted for the tile mode: **tile** (default), **flip-x**, **flip-y**, **flip-xy**, **clamp**.

Starting default point is 0x0 and ending point is image's size.

2.14.7. Turning off the filling

Syntax

```
fill-pen off
```

Description

Stop all filling operations for subsequent commands.

2.15. Line-width

Syntax

```
line-width <value>

<value> : new line width in pixels (integer!).
```

Description

Sets the new width for line operations.

2.16. Line-join

Syntax

```
line-join <mode>

<mode> : new line joining mode (word!).
```

Description

Sets the new line joining mode for line operations. Following values are accepted:

- **miter** (default)
- **round**
- **bevel**
- **miter-bevel**

[Line-join] | *../images/line-join.png*

NOTE

miter-bevel mode selects automatically one or the other joining mode depending on the miter length (See [this page](#) for detailed explanation) .

2.17. Line-cap

Syntax

```
line-cap <mode>

<mode> : new line cap mode (word!).
```

Description

Sets the new line's ending cap mode for line operations. Following values are accepted:

- `flat` (default)
- `square`
- `round`

[Line-cap] | *../images/line-cap.png*

2.18. Anti-alias

Syntax

```
anti-alias <mode>

<mode> : 'on' to enable it or 'off' to disable it.
```

Description

Turns on/off the anti-aliasing mode for following Draw commands.

NOTE | Anti-aliasing gives nicer visual rendering, but degrades performance.

2.19. Matrix

Syntax

```
matrix <matrix-setup>
matrix 'pen <matrix-setup>
matrix 'fill-pen <matrix-setup>

<matrix-setup> : the matrix which is pre/post-multiplied to current matrix (block!).
```

Description

Performs matrix multiplication. The current transformation matrix is pre-multiplied by this matrix.

The `matrix-setup` block must have 6 numbers (number!) in it.

```
matrix [a b c d e f]
```

The block values are used internally for building following transformation matrix:

```
| a c e |  
| b d f |  
| 0 0 1 |
```

When the **'pen** or **'fill-pen** lit-words are used, the multiplication is applied respectively to the current pen or current fill-pen.

2.20. Reset-matrix

Syntax

```
reset-matrix  
reset-matrix 'pen  
reset-matrix 'fill-pen
```

Description

Resets the current transformation matrix to a unit matrix.

When the **'pen** or **'fill-pen** lit-words are used, the reset is applied respectively to the current pen or current fill-pen.

```
| 1 0 0 |  
| 0 1 0 |  
| 0 0 1 |
```

2.21. Invert-matrix

Syntax

```
invert-matrix  
invert-matrix 'pen  
invert-matrix 'fill-pen
```

Description

Applies an algebraic matrix inversion operation on the current transformation matrix.

When the **'pen** or **'fill-pen** lit-words are used, the inversion is applied respectively to the current pen or current fill-pen.

2.22. Push

Syntax


```
push <draw-block>
```

```
<draw-block> : block of Draw commands (block!).
```

Description

Saves the current state (transformations, clipping region, and pen settings) on the stack. You can then change the current transformation matrix, pens etc. inside the PUSH command block. After the PUSH command block, the current state is restored by pop from the stack. The PUSH command can be nested.

2.23. Rotate

Syntax

```
rotate <angle> <center> [<commands>]
```

```
rotate 'pen <angle>
```

```
rotate 'fill-pen <angle>
```

```
<angle>      : the angle in degrees (integer! float!).
```

```
<center>     : (optional) center of rotation (pair!).
```

```
<commands>  : (optional) Draw dialect commands.
```

Description

Sets the clockwise rotation about a given point, in degrees. If optional **center** is not supplied, the rotate is about the origin of the current user coordinate system. Negative numbers can be used for counter-clockwise rotation. When a block is provided as last argument, the rotation will be applied only to the commands in that block.

When the **'pen** or **'fill-pen** lit-words are used, the rotation is applied respectively to the current pen or current fill-pen.

2.24. Scale

Syntax

```
scale <scale-x> <scale-y> [<commands>]
```

```
scale 'pen <scale-x> <scale-y>
```

```
scale 'fill-pen <scale-x> <scale-y>
```

```
<scale-x>    : the scale amount in X (number!).
```

```
<scale-y>    : the scale amount in Y (number!).
```

```
<commands>  : (optional) Draw dialect commands.
```

Description

Sets the scale amounts. The values given are multipliers; use values greater than one to increase the scale; use values less than one to decrease it. When a block is provided as last argument, the scaling will be applied only to the commands in that block.

When the `'pen` or `'fill-pen` lit-words are used, the scaling is applied respectively to the current pen or current fill-pen.

2.25. Translate

Syntax

```
translate <offset> [<commands>]
translate 'pen <offset>
translate 'fill-pen <offset>

<offset>    : the translation amounts (pair!).
<commands> : (optional) Draw dialect commands.
```

Description

Sets the origin for drawing commands. Multiple translate commands will have a cumulative effect. When a block is provided as last argument, the translation will be applied only to the commands in that block.

When the `'pen` or `'fill-pen` lit-words are used, the translation is applied respectively to the current pen or current fill-pen.

2.26. Skew

Syntax

```
skew <skew-x> <skew-y> [<commands>]
skew 'pen <skew-x> <skew-y>
skew 'fill-pen <skew-x> <skew-y>

<skew-x>    : skew along the x-axis in degrees (integer! float!).
<skew-y>    : (optional) skew along the y-axis in degrees (integer! float!).
<commands> : (optional) Draw dialect commands.
```

Description

Sets a coordinate system skewed from the original by the given number of degrees. If `<skew-y>` is not provided, it is assumed to be zero. When a block is provided as last argument, the skewing will be applied only to the commands in that block.

When the `'pen` or `'fill-pen` lit-words are used, the skewing is applied respectively to the current pen or current fill-pen.

2.27. Transform

Syntax

```
transform <center> <angle> <scale-x> <scale-y> <translation> [<commands>]
transform 'pen <center> <angle> <scale-x> <scale-y> <translation>
transform 'fill-pen <center> <angle> <scale-x> <scale-y> <translation>
```

<center> : (optional) center of rotation (pair!).
<angle> : the rotation angle in degrees (integer! float!).
<scale-x> : the scale amount in X (number!).
<scale-y> : the scale amount in Y (number!).
<translation> : the translation amounts (pair!).
<commands> : (optional) Draw dialect commands.

Description

Sets a transformation such as translation, scaling, and rotation. When a block is provided as last argument, the transformation will be applied only to the commands in that block.

When the 'pen or 'fill-pen lit-words are used, the transformation is applied respectively to the current pen or current fill-pen.

2.28. Clip

Syntax

```
clip <start> <end> <mode> [<commands>]
clip [<shape>] <mode> [<commands>]

<start> : top-left corner point of clipping area (pair!)
<end> : bottom-right corner point of clipping area (pair!)
<mode> : (optional) merging mode between clipped regions (word!)
<commands> : (optional) Draw dialect commands.
<shape> : Shape dialect commands.
```

Description

Defines a clipping rectangular region defined with two points (start and end) or an arbitrarily shaped region defined by a block of Shape sub-dialect commands. Such clipping applies to all subsequent Draw commands. When a block is provided as last argument, the clipping will be applied only to the commands in that block.

Additionally, the combining mode between a new clipping region and the previous one, can be set to one of the following:

- **replace** (default)

- `intersect`
- `union`
- `xor`
- `exclude`

3. Shape commands

Syntax

```
shape [<commands>]
```

<commands> : shape dialect commands.

Description

The `shape` keywords gives access to the Shape sub-dialect drawing commands. The specific features of this drawing dialect are:

- the pen position for drawing can be moved independently of drawing operations.
- each drawing command starts from the current pen position.
- shapes are automatically closed (no need to draw the last stroke back to start position).
- the generated shapes can be fed to `fill-pen` for simple or sophisticated filling.
- coordinates can be absolute (like in Draw) or relative to the last pen position.

NOTE

All drawing commands are using absolute coordinates by default, using the lit-word version of the command switches the command to relative coordinates.

3.1. Move

Syntax

```
move <position>          (absolute)
'move <position>         (relative)
```

<position> : new pen position (pair!).

Description

Moves the pen to a new position. No drawing happens.

3.2. Line

Syntax

```
line <point> <point> ...    (absolute)
'line <point> <point> ...    (relative)

<point> : coordinates of a point (pair!).
```

Description

Draws a line between two points. If more points are specified, additional lines are drawn, connecting each point in the provided order.

3.3. Arc

Syntax

```
arc <end> <radius-x> <radius-y> <angle> sweep large    (absolute)
'arc <end> <radius-x> <radius-y> <angle> sweep large    (relative)

<end>      : arc's end point (pair!).
<radius-x> : radius of the circle along x axis (integer! float!).
<radius-y> : radius of the circle along y axis (integer! float!).
<angle>    : rotation angle of the underlying ellipse in degrees (integer! float!).
sweep      : (optional) draw the arc in the positive angle direction.
large      : (optional) produces an inflated arc (goes with 'sweep option).
```

Description

Draws the arc of a circle between the current pen position and the end point, using radius values. The arc is defined by one angle value.

3.4. Curve

Syntax

```
curve <point> <point> <point> ...    (absolute)
'curve <point> <point> <point> ...    (relative)

<point> : coordinates of a point (pair!).
```

Description

Draws a cubic Bezier curve from a sequence of points, starting from the current pen position. At least 3 points are required to produce a curve (the first point is the implicit starting point).

3.5. Curv

Syntax

```
curv <point> <point> ... (absolute)
'curv <point> <point> ... (relative)

<point> : coordinates of a point (pair!).
```

Description

Draws a smooth cubic Bezier curve from a sequence of points, starting from the current pen position. At least 2 points are required to produce a curve (the first point is the implicit starting point).

NOTE From <http://www.w3.org/TR/SVG11/paths.html>

"The first control point is assumed to be the reflection of the second control point on the previous command relative to the current point. (If there is no previous curve command, the first control point is the current point.)"

3.6. Qcurve

Syntax

```
qcurve <point> <point> ... (absolute)
'qcurve <point> <point> ... (relative)

<point> : coordinates of a point (pair!).
```

Description

Draws a quadratic Bezier curve from a sequence of points, starting from the current pen position. At least 2 points are required to produce a curve (the first point is the implicit starting point).

3.7. Qcurv

Syntax

```
qcurv <point> (absolute)
'qcurv <point> (relative)

<point> : coordinates of the ending point (pair!).
```

Description

Draws a smooth quadratic Bezier curve from the current pen position to the specified point.

NOTE | See: <http://www.w3.org/TR/SVG11/paths.html>

3.8. Hline

Syntax

```
hline <end-x>    (absolute)
'hline <length>  (relative)

<end-x> : ending position along X axis (integer! float!).
<length> : length of the line segment (integer! float!).
```

Description

Draws a horizontal line from the current pen position.

3.9. Vline

Syntax

```
vline <end-y>    (absolute)
'vline <length>  (relative)

<end-y> : ending position along Y axis (integer! float!).
<length> : length of the line segment (integer! float!).
```

Description

Draws a vertical line from the current pen position.

3.10. Line-width

Same as the Draw dialect.

3.11. Line-join

Same as the Draw dialect.

3.12. Line-cap

Same as the Draw dialect.

3.13. Pen

Same as the Draw dialect.

3.14. Fill-pen

Same as the Draw dialect.

4. Default values

When a new Draw session starts, the following default values are used:

Property	Value
background	white
pen color	black
filling	off
anti-alias	on
font	none
line width	1
line join	miter
line cap	flat

5. Sub blocks

Inside Draw code, commands can be arbitrarily grouped using blocks. Semantics remain unchanged, this is currently just a syntactic sugar allowing easier group manipulations of commands (notably group extraction/insertion/removal). Empty blocks are accepted.

6. Source position

Set-words can be used in the Draw code **in-between** commands to record the current position in Draw block and be able to easily access it later.

NOTE

If the Draw block length preceeding a set-word is changed, the original position will be changed accordingly, so the set-word will not point to the same reference anymore.

7. Draw function

It is possible to render a Draw block directly to an image using the `draw` function.

Syntax

```
draw <size> <spec>
draw <image> <spec>
```

<size> : size of a new image (pair!).
<image> : image to use as canvas (image!).
<spec> : block of Draw commands (block!).

Description

Renders the provided Draw commands to an existing or a new image. The image value is returned by the function.

8. Deprecated API

Fill-pen also supports a deprecated API which exists only for sake of compatibility with Rebol/Draw, it should not be used by new Red scripts.

Syntax

```
fill-pen linear <grad-offset> <grad-start-rng> <grad-stop-rng>
           <grad-angle> <grad-scale-x> <grad-scale-y> <grad-color> <offset>
           <grad-color> <offset> ...
```

```
fill-pen radial <grad-offset> <grad-focal> <grad-radius>
               <grad-angle> <grad-scale-x> <grad-scale-y> <grad-color> <offset>
               <grad-color> <offset> ...
```

```
fill-pen diamond <grad-offset> <grad-focal> <grad-radius>
                <grad-angle> <grad-scale-x> <grad-scale-y> <grad-color> <offset>
                <grad-color> <offset> ...
```

<grad-type> : gradient type (word!).
<grad-offset> : offset from where the gradient should be rendered (pair!).
<grad-start-rng> : beginning of the gradient range (integer!).
<grad-stop-rng> : end of the gradient range (integer!).
<grad-focal> : focal point of the gradient (pair!).
<grad-radius> : radius of the gradient (integer!).
<grad-angle> : (optional) rotation of the gradient in degrees (integer! float!).
<grad-scale-x> : (optional) scale X factor (integer! float!).
<grad-scale-y> : (optional) scale Y factor (integer! float!).
<grad-color> : color to use for gradient filling (tuple! word!).

Description

Sets the color gradient to be used for filling operations. The following values are accepted for the type: **linear**, **radial**, **diamond**.

For example:

```
fill-pen linear 0x100 0 400 red green blue box 0x100 400x300
```

[Grad-pen] | *../images/grad-pen.png*

NOTE | the gradient can be defined by up to 256 colors.

9. Graphics source code

The graphics in this documentation are generated using Red and Draw dialect, here is the source code (you can copy/paste it in a Red console to try/play/improve it):

```
Red [  
  Title: "Graphics generator for Draw documentation"  
  Author: "Nenad Rakocevic"  
  File: %draw-graphics.red  
  Needs: View  
]  
  
Arial: make font! [name: "Consolas" style: 'bold]  
small: make font! [size: 9 name: "Consolas" style: 'bold]  
  
save %line-cap.png draw 240x240 [  
  font Arial  
  text 20x220 "Flat"  
  text 90x220 "Square"  
  text 180x220 "Round"  
  
  line-width 20 pen gray  
  line-cap flat line 40x40 40x200  
  line-cap square line 120x40 120x200  
  line-cap round line 200x40 200x200  
  
  line-width 1 pen black  
  line 20x40 220x40  
  line 20x200 220x200  
]  
  
save %line-join.png draw 500x100 [  
  font Arial  
  text 10x20 "Miter"  
  text 170x20 "Round"  
  text 330x20 "Bevel"  
  
  line-width 20 pen gray  
  line-join miter line 140x20 40x80 140x80  
  line-join round line 300x20 200x80 300x80
```

```

line-join bevel line 460x20 360x80 460x80

line-join miter
line-width 1 pen black
line 140x20 40x80 140x80
line 300x20 200x80 300x80
line 460x20 360x80 460x80
]

save %coord-system.png draw 240x240 [
    font small
    text 5x5 "0x0"
    line-width 2
    line 20x20 200x20 195x16
    line 200x20 195x24

    line 20x20 20x200 16x195
    line 20x200 24x195

    font Arial
    text 205x12 "X"
    text 12x205 "Y"
]

save %grad-pen.png draw 400x400 [
    pen off
    fill-pen linear 0x100 0 400 red green blue box 0x100 400x300
]

save %grad-pen-more.png draw 600x400 [
    pen off
    fill-pen linear 0x0 0 200 red green blue box 0x0 200x200
    fill-pen linear 200x0 0 200 255.0.0 255.255.0 0.255.0 0.255.255 0.0.255 box 200x0
400x200
    fill-pen linear 400x0 0 200 255.0.0 0.1 255.255.0 0.2 0.255.0 0.4 0.255.255 0.8
0.0.255 .9 255.0.255 1.0 box 400x0 600x200
    fill-pen blue box 0x200 200x400 fill-pen radial 100x300 0 100 255.0.0 0.255.0
0.0.255 box 0x200 200x400
    fill-pen blue box 200x200 400x400 fill-pen diamond 300x300 0 100 30 255.0.0
0.255.0 0.0.255 box 200x200 400x400
    fill-pen diamond 500x300 0 100 30 3.0 1.5 255.0.0 0.255.0 0.0.255 box 400x200
600x400
]

```