7 Drawing and Editing Objects

Object Types

The basic task in designing layout is drawing *objects*, which represent the elements and patterns of the circuitry to be fabricated.

There are several types of objects you can draw. Each object type is associated with a tool on the Drawing toolbar which you use to draw the corresponding object.

Object type	*Icon*	*Description*
Box		A shape characterized by four 90° corners.
Polygon		A shape characterized by an arbitrary number of vertices connected by straight edges to form a closed (possibly self-intersecting) figure.
Wire		A shape consisting of one or more rectangular segments, of equal width, joined at common ends.
Circle		A shape characterized by a center (point) and a radius.

Object type	*Icon*	*Description*
Pie Wedge		A section of a circle characterized by a center, a radius, and a sweep angle.
Torus		A section of a circle characterized by a center, two radii (inner and outer), and a sweep angle.
Port		A point or box with associated text, used to label layout for documentation purposes.
Ruler		A line with a choice of end styles and optional tick marks, used to measure layout.
Instance		A symbolic representation of a cell at a specific location and orientation in another cell. For information on how to create an instance, see Creating Instances on page 1-424.

Selecting Layers and Drawing Tools

Before you draw an object, you must select a layer. When a layer is selected, the layer icon in the Layer palette is outlined, and the name of the layer appears in the drop-down list above the Layer palette. (See Layer Palette on page 1-36.) Any objects you create during a draw operation will be on the selected layer and will display the color and pattern specified for that layer.

You can select a layer in three ways:

- Click the icon on the Layer palette for the layer you want. You may need to scroll to the section of the Layer palette with the desired layer icon.
- Select the desired layer from the layer drop-down down list at the top of the Layer palette.
- Choose **Draw > Pick Layer** or press **A** to change the current layer to the layer of the last selected object (excluding instances). If no objects are selected, the current layer changes to the layer of the object closest to the pointer. If the pointer is over or near an instance, L-Edit checks inside the instance for the closest object.

After the current layer has been specified in the Layer palette, drawing an object involves two basic steps: (1) selecting a drawing tool and (2) executing a drawing operation.

Drawing Tools

The drawing tools are represented by buttons in the Drawing toolbar.

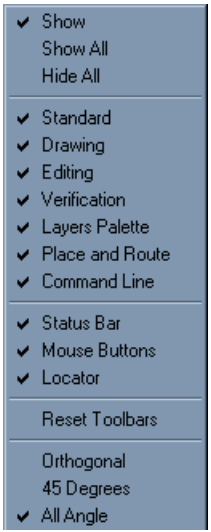
(For a description of each button, see Drawing Toolbar on page 1-31.)

To select a drawing tool, click a button with the CHOOSE (left) mouse button. The button corresponding to the selected tool remains pressed until you select another tool. Use the selection tool ( ) to select objects in the layout.

Display Modes

You can display the Drawing toolbar in three modes: orthogonal, 45 degrees, and all angle. There are two ways to change the display mode:

- Place the pointer in the Drawing toolbar and click the MENU (right) mouse button. Select **Orthogonal**, **45 Degrees**, or **All Angle** in the pop-up menu.



- Use **Setup > Application** and select the **General** tab. In the **Drawing mode** drop-down list choose **Orthogonal**, **45 Degrees**, or **All Angle**.

Drawing Objects

The starting point for drawing any object is its *anchor point*. To draw an object, select a drawing tool and position the crosshair pointer where you want the anchor point to be. Click the DRAW (left) mouse button to begin drawing the object.

While you are drawing or editing an object you can toggle rendering of that object from filled mode to a transparent outline-only mode so that objects below remain visible. Use the **Tab** key (or **Ctrl+I**) to perform this toggle. (See Displaying Instance Insides While Drawing and Editing on page 1-241 for more information.)

Note: You cannot draw on a layer that is currently locked. For further information on locking and unlocking layers, see Layer Palette on page 1-36.

Boxes

The anchor point is one of the corners of the box.

Hold the DRAW mouse button and drag the pointer away from the anchor point to determine the opposite corner (and therefore the length and width) of the box. Release the DRAW button at the desired opposite corner.

For information on editing boxes textually, see Boxes on page 1-281.

Circles

The anchor point is the center of the circle.

Hold the DRAW mouse button and drag the pointer away from the anchor point to determine the radius of the circle. Release the DRAW button at the desired radius.

For information on editing circles textually, see Circles on page 1-292.

Pie Wedges

The anchor point is the center of the pie wedge. The mouse buttons become VERTEX, BACKUP, and END, respectively.

To create a pie wedge, click the VERTEX (left) mouse button at the anchor point and drag the pointer away from the anchor point to determine the radius of the pie wedge (indicated by a thin line). Click or release the VERTEX mouse button at the desired radius. Drag the pointer again to determine the end angle of the pie wedge. The angle is always calculated counterclockwise. Click the VERTEX or END (right) mouse button to complete the pie wedge. Click the BACKUP mouse button to reverse each step before the pie wedge is completed.

For information on editing pie wedges textually, see Pie Wedges on page 1-294.

Tori

The anchor point is the center of the torus. The mouse buttons become VERTEX, BACKUP, and END respectively.

To create a torus, click the VERTEX (left) mouse button at the anchor point and drag the pointer away from the anchor point to determine the first radius of the torus (indicated by a thin line). Click or release the VERTEX mouse button at the desired first radius. Drag the pointer again to determine the sweep angle and the second radius of the torus. Click the VERTEX or END (right) mouse button to complete the torus. Click the BACKUP mouse button to reverse each step before the torus is completed.

For information on editing tori textually, see Tori on page 1-296.

Polygons and Wires

The anchor point is the first vertex of the polygon or wire. Polygons and wires can have any number of vertices. The mouse buttons become VERTEX, BACKUP, and END, respectively.

To create a polygon or wire, click the VERTEX (left) mouse button at the anchor point and drag the pointer away from the anchor point to determine the second vertex. Repeat the process for each successive vertex. Click the BACKUP mouse button to remove the last vertex that was placed.

Click the END mouse button at the last vertex to complete the object. When you click the END button, coincident vertices (two or more vertices occupying the same location) and colinear vertices (three or more vertices lying on the same straight line) are eliminated.

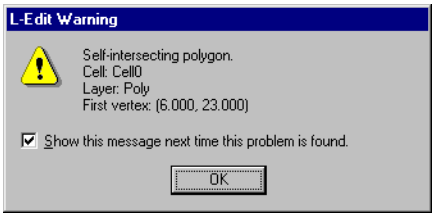
For information on editing polygons and wires textually, see Polygons on page 1-288 and Wires on page 1-290.

Warning: The appearance of a wire on the screen does not guarantee it will form a connection with an object when the chip is fabricated. Check with your manufacturer regarding the type of join and end styles to use in your design. (For information on available styles see End Styles and Join Styles on page 1-178. For information on wire style requirements for CIF and GDSII file formats see Wires on page 1-209 and Wires on page 1-217, respectively.)

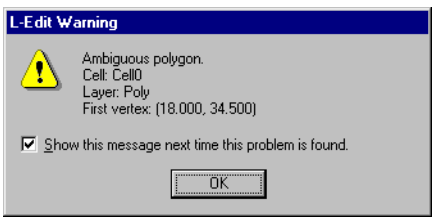
Self-Intersecting and Ambiguous Fill Polygons

Two common design errors involve self-intersecting polygons and polygons with ambiguous fills. Either could be misinterpreted by the manufacturer and result in an incorrect object mask.

If a polygon or wire intersects itself at any point, L-Edit will display a warning.



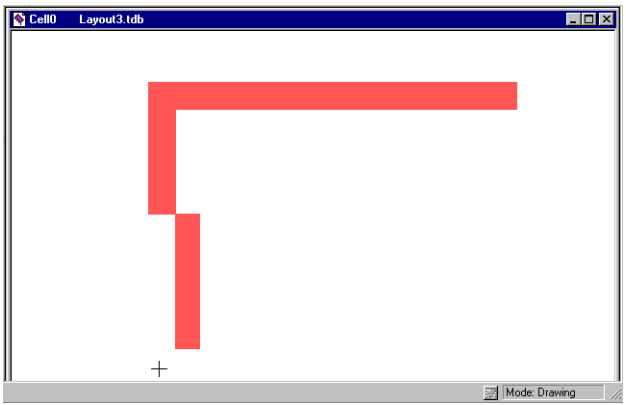
If a polygon is created with an ambiguous fill, L-Edit will display another warning.



You can turn off these and other warnings with **Setup > Application—Warnings**.

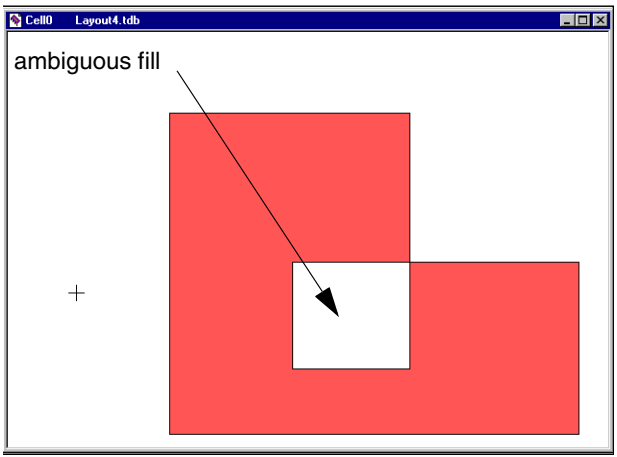
Self-Intersecting Polygons

An example of a self-intersecting polygon is shown below:

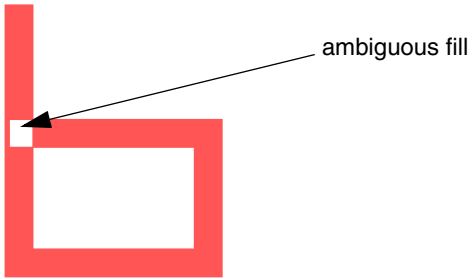


Ambiguous Fill Polygons

An example of a polygon with an ambiguous fill is shown in the following illustration. Depending upon the manufacturer's convention, the white enclosed box might or might not be filled when fabricated.

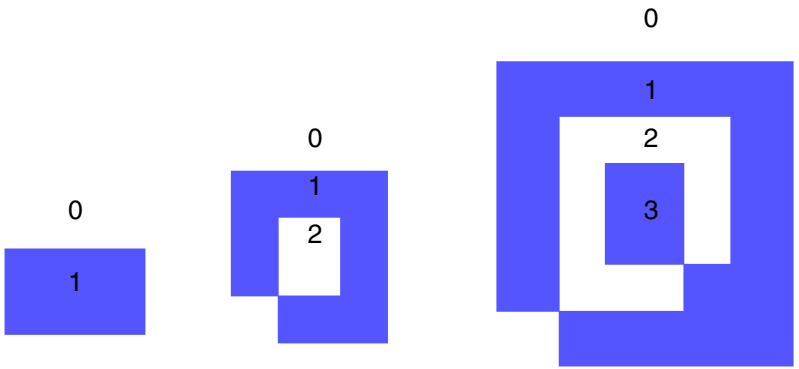


Similarly, in the figure below the desired fill in the region of intersection cannot be determined unambiguously.



Winding Number

In the illustration below, each value represents the *winding number*—the number of times that a point in the polygon is circumscribed when the figure is traced in one direction around its perimeter.

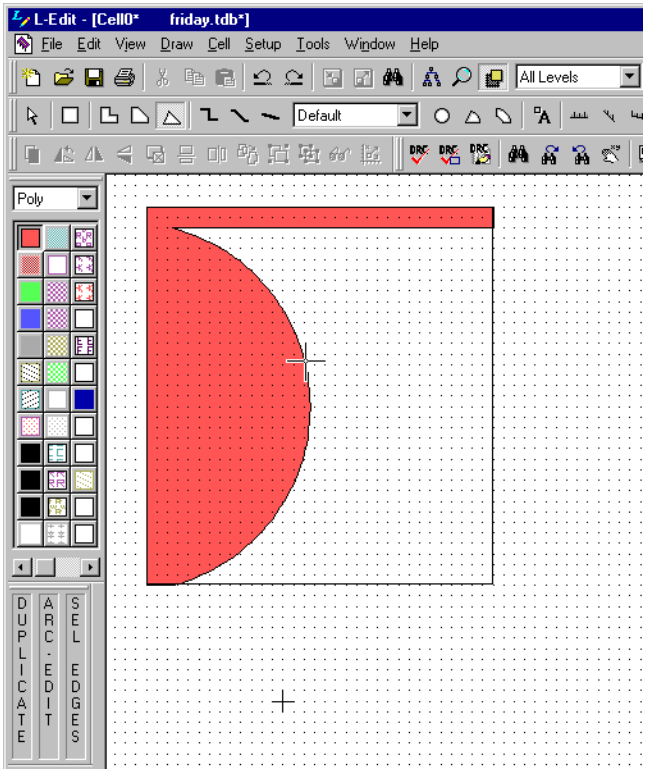


L-Edit interprets an area with winding number equal to zero as unfilled, an area with an odd winding number as filled, and an area with an even number as unfilled. Polygons with a winding number greater than or equal to two are identified as ambiguous polygons, since other CAD systems may interpret the filled area differently.

Curves

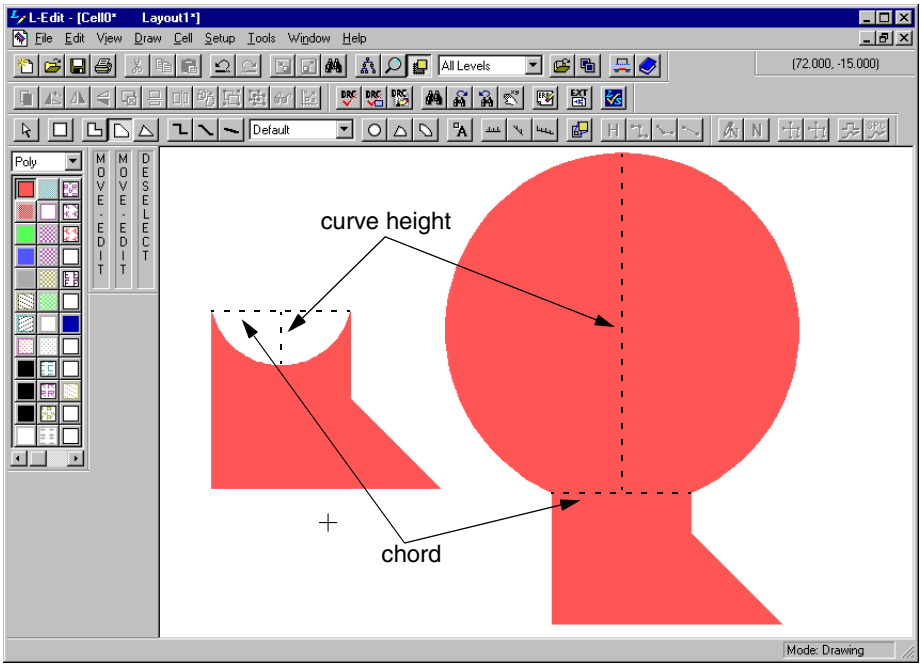
You can convert an edge of an existing polygon to a circular curve. This operation is only possible on existing polygons, however—it is not possible to directly draw polygons with curved edges.

To convert an edge to a curve, select the all-angle polygon tool on the Drawing toolbar (). Then select the object edge you want to change into a curve, using the ARC/EDIT mouse button (**Ctrl**+MOVE/EDIT or **Alt**+**Ctrl**+left mouse button). The selected edge will curve slightly, and you can drag the cursor to create a curve of the desired height. (For instructions on how to select an edge see Edge Selection on page 1-340.)


L-Edit - [Cell0* friday.tdb*]
File Edit View Draw Cell Setup Tools Window Help
All Levels
Default
Poly
DUPLICATE
ARC-EDIT
SEL EDGES

Note: To convert an edge to a curve, you must select only the edge of an object, not the entire object. If you select the entire object, it is only possible to add a vertex to any of its edges.

Each curve is defined by a specific *curve height*, illustrated in the following diagram:



Curve height is the perpendicular distance, in locator units, between the chord that connects the two endpoints of the curve and the midpoint of the curve. The

curve height will be positive or negative depending on the order in which the vertices of the polygon were created.

Note:

All polygons with curves are all-angle objects. You cannot nibble (**Draw > Nibble**), slice (**Draw > Slice > Horizontal** or **Draw > Slice > Vertical**), or merge (**Draw > Merge**) all-angle objects.

For more information on curve height and editing curves textually, see Curve Height on page 1-289.

Ports

A port can be a point, a line, or a two-dimensional box.

The anchor point is the location of the port. The anchor point of a point or line port is a corner of the port.

To draw a point port, position the pointer at the anchor point and press the DRAW mouse button.

To draw a box port, hold the DRAW mouse button and drag the pointer away from the anchor point to determine the opposite corner (and therefore the length and width) of the box. Release the DRAW button at the desired location of the opposite corner.

To draw a line port, hold the DRAW mouse button and drag the pointer away from the anchor point in a vertical or horizontal line. Release the DRAW button at the desired location of the opposite end of the line port.

When you release the DRAW mouse button, the **Edit Object(s)—Ports** dialog appears and prompts for the **Port name**. At this point you can also modify other attributes of the port, including GDSII data type, text size, coordinates, text orientation, and text alignment. If you don't specify a placement configuration, the text is automatically placed horizontally on the screen at the lower center of the port.

For more information on editing ports, see Ports on page 1-298.

Rulers

The anchor point is one of the endpoints of the ruler. Hold the DRAW mouse button and drag the pointer away from the anchor point to determine the other endpoint (and therefore the length and orientation) of the ruler. Release the DRAW button at the desired endpoint.

You can draw rulers on a specified layer or on a layer selected in the Layer palette. To modify default ruler settings including the layer on which rulers are drawn, text size, end style, and tick mark settings, use **Setup > Design—Drawing**.

For information on editing rulers, see Rulers on page 1-301.

Graphical Editing

You can edit objects graphically, using your keyboard and mouse. You can resize and reshape objects, perform stretch editing, add vertices to polygons or wires, and slice, merge, or nibble objects.

Drawing in Outline Mode

While you are drawing or editing an object you can toggle rendering of that object from filled mode to a transparent outline-only mode so that objects below remain visible. Use the **Tab** key or **Ctrl+I** to perform this toggle. (See Displaying Instance Insides While Drawing and Editing on page 1-241 for more information.)

Resizing and Reshaping

You can resize a box, port, or polygon by moving a vertex or an edge to change the object's dimensions. You can resize a circle by dragging its edge towards or away from the center, which changes the radius. You can resize a wire by selecting a wire edge and dragging it; you can add vertices to a wire by selecting it and choosing **Draw > Add Wire Section**. To change the width of a wire, however, you must use the **Edit Object—Wire** dialog (see Textual Editing on page 1-277).

You can explicitly select an object to resize or reshape it or, if no other objects are selected, click the MOVE/EDIT (middle) mouse button within the selection range of an object to implicitly select it. If you implicitly select an object it is automatically deselected after the operation. (For more information on selecting objects, see Selecting Objects on page 1-334.)

To modify an object's dimensions, position the pointer on or just inside or outside of a vertex or edge, click the MOVE/EDIT mouse button and drag the vertex or edge to the desired position.

Note: The distance between the pointer and the edge or vertex of an object determines whether the MOVE/EDIT mouse button moves or edits the object. You can set this distance with **Setup > Design—Selection** by modifying the values in the **Edit range** fields.

Pie Wedges and Tori

When you use the mouse to reshape and resize a pie wedge or torus, you can change the sweep angle or the radii. To change the sweep angle, position the pointer on one straight edge of the selected object, click the MOVE/EDIT mouse button and drag the mouse in the desired direction. To change the radii, place the pointer on the curved edge and drag it to the desired position. You can change either radius of a torus.

Stretch Editing

You can resize or reshape one or more boxes, polygons, wires, pie wedges, tori, or ports simultaneously by selecting and moving sets of their edges.

Select the edges of the desired objects. (For information on how to select an object's edge see Edge Selection on page 1-340.) To modify the selected objects, drag the edges in the desired direction with the MOVE/EDIT mouse button. All selected edges and objects will move the same direction and distance, subject to any constraints imposed by the objects themselves. Holding the **Shift** key with the MOVE/EDIT mouse button enables snapping, where edges can only be moved in the horizontal or vertical directions.

Adding Vertices

You can add vertices to all-angle polygons or wires after you create them. To add a vertex, select the object and position the pointer on the edge where you want the new vertex to be. Hold the **Ctrl**+MOVE/EDIT mouse button while dragging the new vertex into position.

Adding Wire Sections

You can insert new wire sections into an existing orthogonal or 45° wire. First select an orthogonal or 45° wire to enable the command. Use **Draw > Add Wire Section** to switch to **Add Section** mode, and click on the selected wire at the

point where you want to add a new wire section. L-Edit automatically draws the new section on the same layer on which the existing wire is drawn. To return to drawing mode, use the CANCEL mouse button. Areas where the wire intersects itself will be displayed as white.

Slicing

Divide selected objects along a horizontal line by choosing **Draw > Slice > Horizontal** or clicking the horizontal slice button (). Divide selected objects along a vertical line by choosing **Draw > Slice > Vertical** or clicking the vertical slice button ().

When you execute a slice command, the view automatically zooms to include all selected objects and a horizontal or vertical line appears, indicating where to slice (divide) the objects. The line moves with the pointer until you place it by clicking any mouse button, at which time each object splits into two new objects with coincident edges.

When you slice 45° objects, you must use a subgrid, as you would with any Boolean operation. For further information, see Working with 45° Objects on page 1-476.

Note: Circles, curved polygons, arcs, tori, ports, rulers, and instances cannot be sliced. If you select objects of these types, L-Edit ignores them during a slice operation.

Merging

Use **Draw > Merge** to merge multiple selected intersecting boxes, polygons (45° and 90° only), or wires (45° and 90° only) into one object. You can only merge intersecting objects that lie on the same layer. If you select objects from more than one layer, L-Edit merges each set of overlapping selected objects on the same layer into one object. You cannot merge all-angle objects (polygons and wires) with other objects.

Note: When a wire is merged with another object it becomes a polygon.

If you merge intersecting objects with different GDSII data types, L-Edit replaces their respective data type values with the data type for the layer (or 0 if no data type is set for the layer) without a warning.

Nibbling

To nibble, or cut out, a polygonal area from selected objects in the active cell, perform the following steps:

☑ Select the desired objects. They may be on multiple layers.

☑ Select the drawing tool to use for nibbling.

☑ Choose **Draw > Nibble**, press **Alt + X**, or click the nibble button () to draw the shape to nibble from the selected objects. An area equal to the shape is deleted from the objects.

You can only nibble certain objects. These are the same objects you can use as a nibbling tool. These objects are:

- Box
- 45° polygon
- 90° polygon
- 45° wire
- 90° wire

L-Edit ignores attempts to nibble circles, ports, and all-angle polygons and wires.

When you use a wire as a nibbling tool, the default wire width for the Drag Box Layer must be set to the width of the nibbling wire. (For information on changing wire parameters for a specific layer, see End Styles and Join Styles on page 1-178.) If the wire width for the Drag Box Layer is set to zero, you will not be able to use wires to nibble other objects.

Note: Polygons containing curves cannot be sliced, merged, or nibbled.

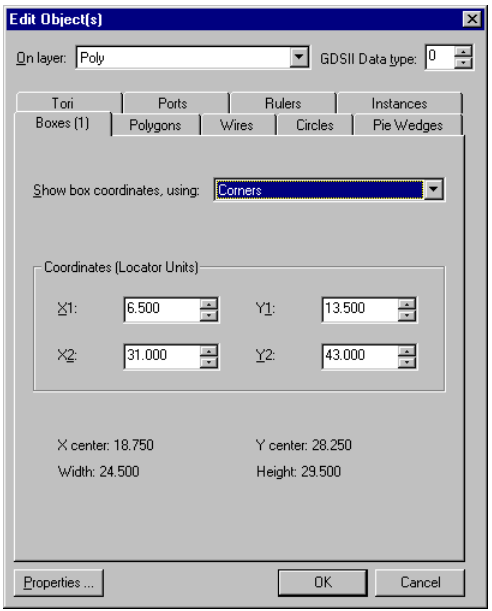
Approximating and Straightening Curves

If you export your design to CIF or GDSII format, you will need to approximate curves as a series of straight edges or remove the curves altogether. If you do not do so, L-Edit will automatically approximate them during the export process.

- Use **Draw > Curves > Approximate** to convert a continuous curve to a series of straight edges. This action converts the object to a true polygon. The number and length of segments L-Edit uses to approximate the curve is determined by the **Setup > Design—Curves** dialog. (See Curve Approximation Parameters on page 1-148 for information on this dialog.)
- Use **Draw > Curves > Straighten** to remove all curves from the polygon.

Textual Editing

To edit an object textually, select it and choose **Edit > Edit Object(s)**, press **Ctrl + E**, double-click the MOVE/EDIT mouse button, or click the edit object(s) button ( ). The **Edit Object(s)** dialog appears:



On layer and **GDSII Data type** are universal to all selected objects. If you select objects on different layers or with different data types, both fields will have a mixed-value appearance (see Multiple Object Editing, below).

On layer	The current layer on which the objects reside. This can be changed by selecting a layer from the drop-down list; all selected objects will convert to the new layer.
GDSII Data type	An integer ranging from 0-63, used primarily by GDSII database users who intend to export a GDSII file from L-Edit and read it into another program requiring additional information. Use this field to assign or reassign a GDSII data type value to the selected object(s).
Properties	Opens the **Properties** dialog for the selected object. The button is only available when a single object is selected; if more than one object is selected the button will be unavailable. For more information on object properties, see Properties on page 1-70.

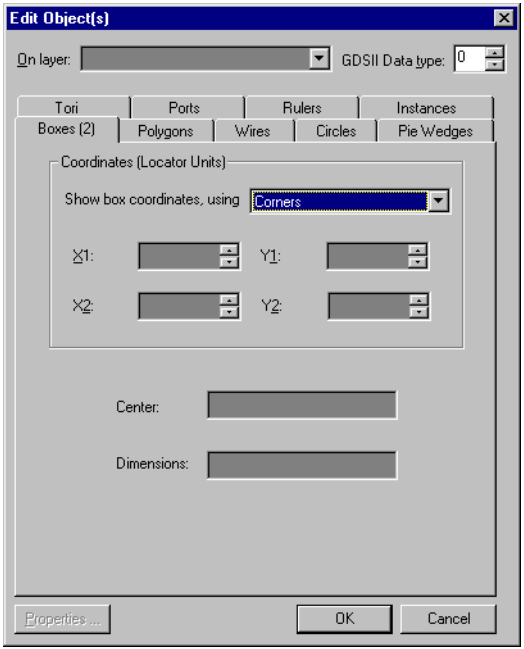
The **Edit Object(s)** dialog contains nine tabs:

- **Boxes** (see Boxes on page 1-281)
- **Polygons** (see Polygons on page 1-288)
- **Wires** (see Wires on page 1-290)
- **Circles** (see Circles on page 1-292)
- **Pie Wedges** (see Pie Wedges on page 1-294)
- **Tori** (see Tori on page 1-296)
- **Ports** (see Ports on page 1-298)
- **Rulers** (see Rulers on page 1-301)
- **Instances** (see Instances on page 1-304)

Multiple Object Editing

You can use the **Edit Object(s)** dialog to modify multiple selected objects simultaneously.

Each tab in the **Edit Object(s)** dialog contains the number of selected objects of that type next to the name on the tab. When multiple objects with different properties are selected, the affected fields appear as dark gray to represent that multiple values exist for those properties:



This is called *mixed-value appearance*. Unlike disabled (“grayed-out”) fields, which you cannot edit, mixed-value fields accept new data, and all selected objects take on the value entered. For example, if you modify the options **On**

layer, **GDSII Data type**, or any of the box coordinates, all selected objects will take on the entered values.

Note: In the preceding illustration, **Center** and **Dimensions** are read-only fields showing coordinates and dimensions derived from the values entered in the **Coordinates** group. No values can be entered in these fields.

Boxes

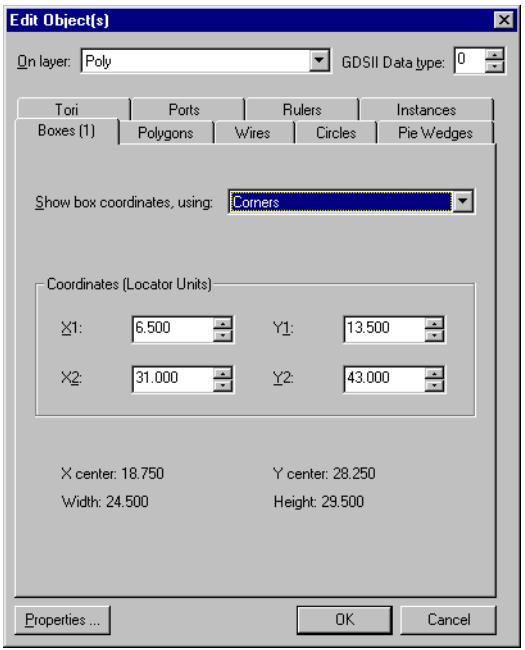
To change the coordinates or dimensions of a box, choose the **Edit Object(s)—Boxes** tab. This dialog provides three methods of displaying box coordinates and/or dimensions, which you choose from the menu **Show box coordinates, using**. Options include:

- **Corners**
- **Bottom left corner and dimensions**
- **Center and dimensions**

The read-only fields in the bottom half of the dialog display coordinates and/or dimensions derived from the values entered in the **Coordinates** group. The text can be selected and copied. After you edit a value in the **Coordinates** group, click any of the read-only fields to update it.

Corners

If you choose **Corners**, the dialog looks like this:



Options include:

Coordinates (Locator Units)

Coordinates of the selected box or boxes, in locator units. Values to be entered include:

- **X1**—X-axis position of the lower left corner of the selected box or boxes
- **Y1**—Y-axis position of the lower left corner of the selected box or boxes
- **X2**—Y-axis position of the upper right corner of the selected box or boxes
- **Y2**—Y-axis position of the upper right corner of the selected box or boxes

Read-only fields include:

X center and **Y center**

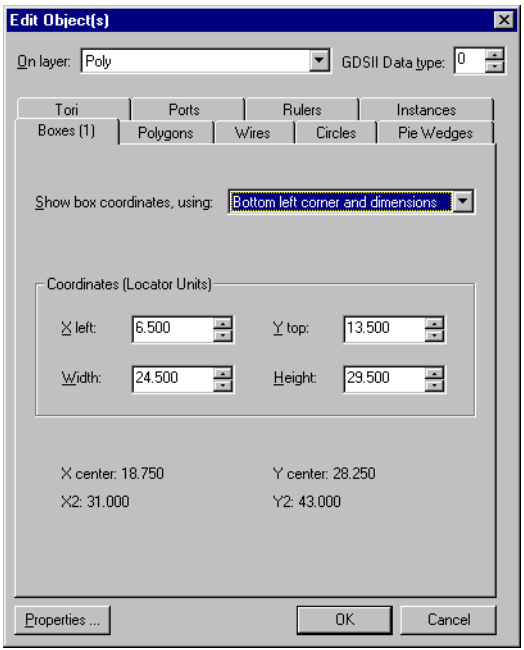
X- and Y-axis coordinates of the center of the selected box or boxes

Width and **Height**

Width and height of the selected box or boxes

Bottom Left Corner and Dimensions

If you choose **Bottom left corner and dimensions**, the dialog looks like this:



Options include:

Coordinates (Locator Units)

Coordinates and dimensions of the selected box or boxes, in locator units. Values to be entered include:

- **X Left**—X-axis position of the left edge of the selected box or boxes
- **Y Top**—Y-axis position of the top edge of the selected box or boxes
- **Width**—Width of the selected box or boxes
- **Height**—Height of the selected box or boxes

Read-only fields include:

X center and Y center

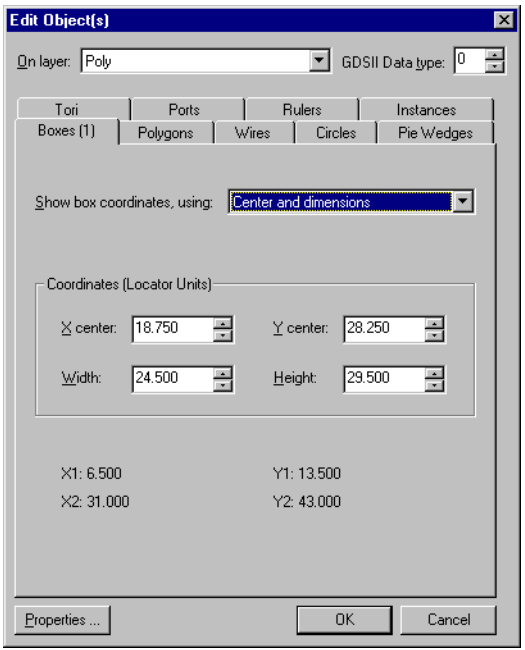
X- and Y-axis coordinates of the center of the selected box or boxes

X2 and **Y2**

X- and Y-axis coordinates of the upper-right corner of the selected box or boxes

Center and Dimensions

If you choose **Center and dimensions**, the dialog looks like this:



Options include:

Coordinates (Locator Units)

Coordinates and dimensions of the selected box or boxes, in locator units. Values to be entered include:

- **X center**—X-axis coordinate of the center of the selected box or boxes
- **Y center**—Y-axis coordinate of the center of the selected box or boxes
- **Width**—Width of the selected box or boxes
- **Height**—Height of the selected box or boxes

Read-only fields include:

X1 and **Y1**

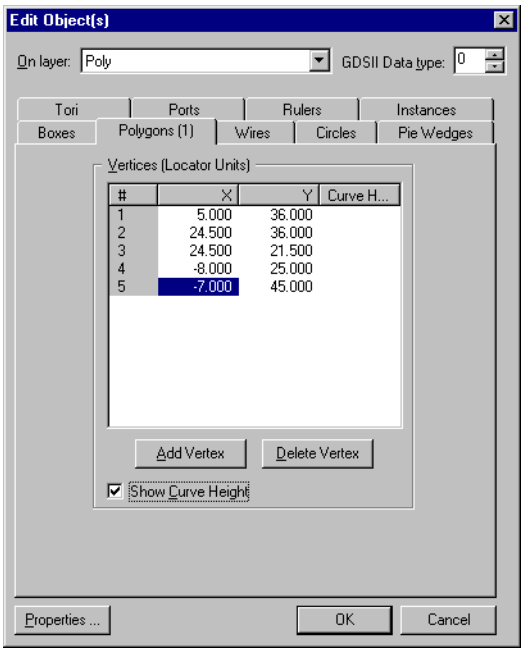
X- and Y-axis coordinates of the bottom-left corner of the selected box or boxes

X2 and **Y2**

X- and Y-axis coordinates of the upper-right corner of the selected box or boxes

Polygons

To modify a polygon, choose the **Edit Object(s)—Polygons** tab. This tab allows you to add, delete, or modify vertices and curves.



Note: If multiple polygons are selected, the **Vertices** list is disabled.

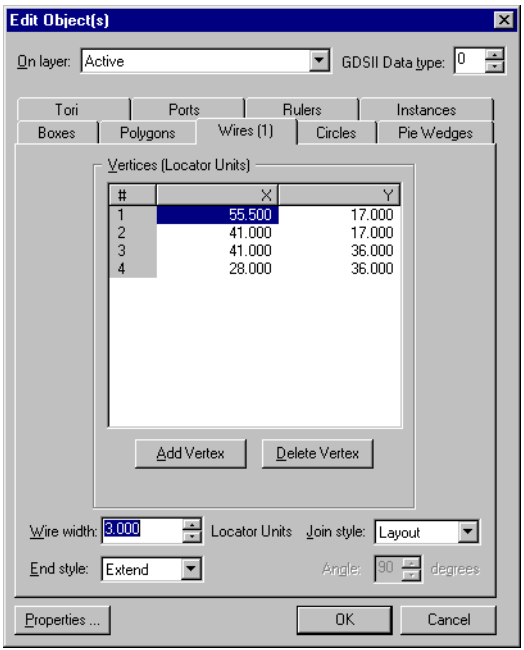
Vertices (Locator Units)	The **X** and **Y** coordinates of the vertices of the selected polygon. For convenience, the pound sign (**#**) numbers the vertices.
Add Vertex	Creates a new vertex with the selected coordinates.
Delete Vertex	Removes the selected vertex from the object.
Show Curve Height	If checked, column **Curve Height** is displayed in the **Vertices** list.

Curve Height

Curve height is the perpendicular distance between the chord that connects the two endpoints of the curve and the midpoint of the curve (For an illustration of curve height see Curves on page 1-264.) Curve height is positive or negative depending on the order in which the vertices were created. The following table summarizes curve height:

Wires

To modify, add, or delete a wire's vertices, or change a wire's width, end, or join styles, choose the **Edit Object(s)—Wires** tab.

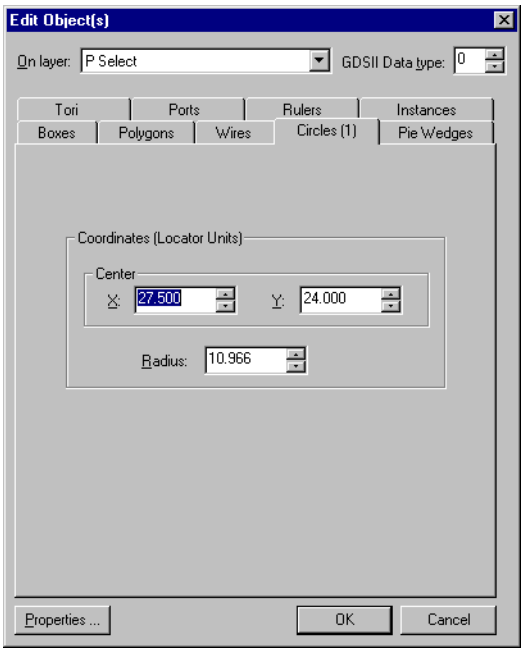


The following options are included. Refer to End Styles and Join Styles on page 1-178 for more detailed information these options. Note that if multiple wires are selected, the **Vertices** list is disabled.

Vertices (Locator Units)	The **X** and **Y** coordinates of the selected wire's vertices. **Add Vertex** creates a new vertex with the selected coordinates. **Delete vertex** removes the selected vertex from the object.
Wire width	The width of selected wires in locator units. Use **Setup > Layers** to set the default wire width, end style, and join style for each layer. See Layer Setup on page 1-155 for more information on layer setups.
Join style	The type of join for the wires. A drop-down menu lists four styles: **Layout**, **Round**, **Bevel**, or **Miter**.
End style	The type of end for the wires. A drop-down menu lists three styles: **Butt**, **Round**, or **Extend**.
Angle	The angle between two segments in a miter style join.

Circles

To modify the coordinates of the center and the radius of a circle, choose the **Edit Object(s)—Circles** tab.



Options include:

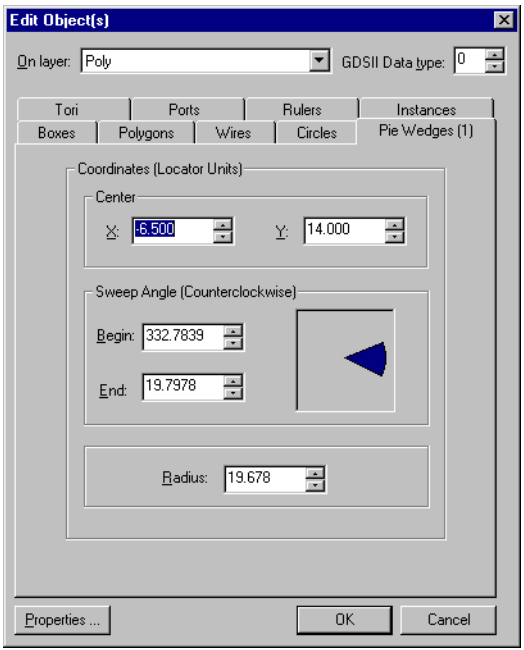
Coordinates (Locator Units)

Individual coordinate fields include:

- **X** and **Y** coordinates of the center of the selected circle
- **Radius** of the selected circle

Pie Wedges

To modify the coordinates of the center of a pie wedge, its sweep angle, and its radius, choose the **Edit Object(s)—Pie Wedges** tab.

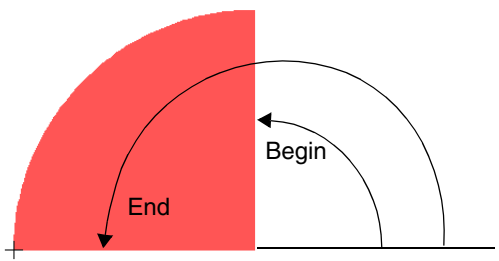


Options include:

Center Coordinates (Locator Units)	The X and Y coordinates of the center of the selected pie wedge.
Sweep Angle (Counterclockwise)	The angle from the horizontal (0°) to the **Begin** and **End** of the pie wedge.
Radius	The radius of the pie wedge.

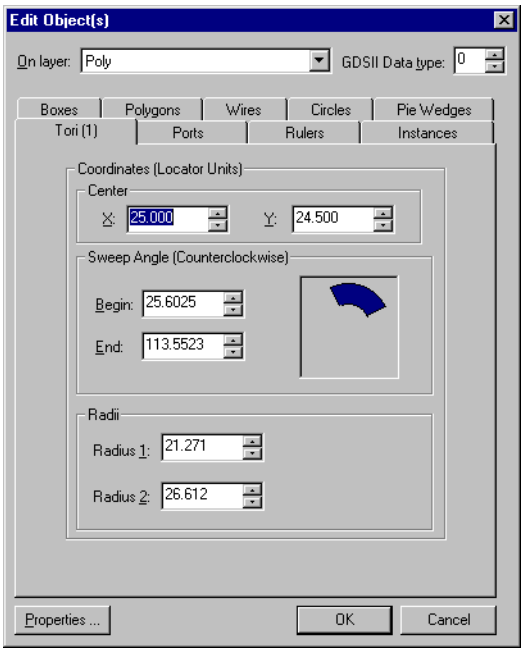
Sweep Angle

The **Sweep Angle** is calculated counterclockwise as the angle from the horizontal (0°) to the **Begin** and **End** of the pie wedge. In the illustration below, the **Begin** angle is 90° and the **End** angle is 180°.



Tori

To modify the coordinates of the center of a torus, its sweep angle, and its radii, choose the **Edit Object(s)—Tori** tab.



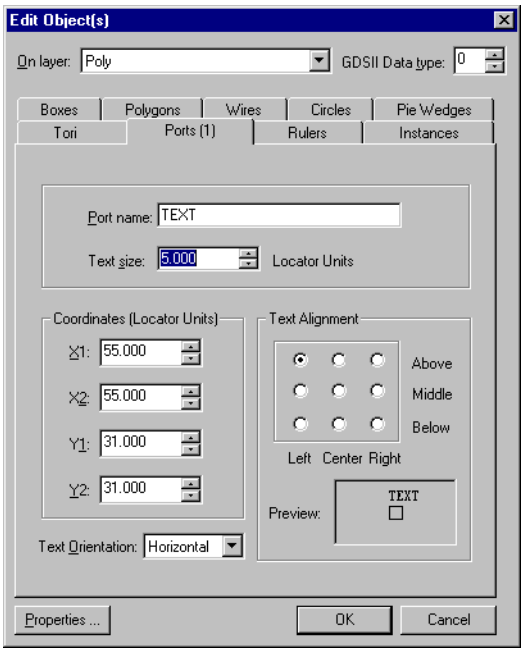
Options include:

Center Coordinates (Locator units)	The X and Y coordinates of the center of the selected torus.
Sweep Angle (Counterclockwise)	The angle from the horizontal (0°) to the **Begin** and **End** of the selected torus.
Radii	**Radius 1** is the first radius you create, whether it is to the inner or outer edge of the torus.

For information on how L-Edit calculates the **Sweep Angle**, see Sweep Angle on page 1-295.

Ports

To create a port or change the attributes of a port, choose the **Edit Object(s)—Ports** tab.



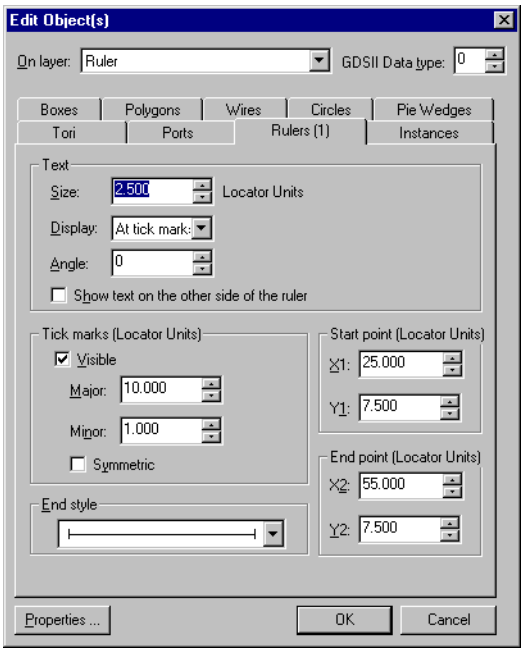
Options include:

Port name	The visible text associated with the port.
Text size	The size of the on-screen text. Use **Setup > Design—Drawing** to change the default port text size.
Coordinates (Locator units)	The coordinates of the lower-left and upper-right vertices of the port. If the port is a point, the coordinates are the same.
Text Orientation	Specifies the orientation of port text. Options are **Vertical** and **Horizontal**.
Text Alignment	The position of the text in relation to the port. For horizontal alignment, the options are **Left**, **Center**, and **Right**. For vertical alignment, the options are **Above**, **Middle**, and **Below**. The default position is the below the port and left-aligned.
Preview	Demonstrates options selected for **Text Orientation** and **Text Alignment**.

Note: If you change layers while creating a port, the GDSII data type will change accordingly. If you change layers while editing a port, however, the GDSII data type will not change unless you explicitly reset it.

Rulers

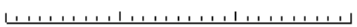
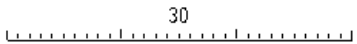
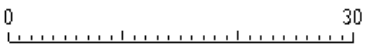
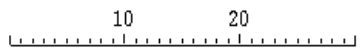
To change the attributes of a ruler, choose the **Edit Object(s)—Rulers** tab.



Options include:

Text	Specifies the size, display style, and character angle of the text and numbers associated with the selected ruler.
Show text on the other side of the ruler	Causes numbers and tick marks to appear on the opposite side of the selected ruler.
Tick marks (Locator units)	Specifies the distance between major and minor tick marks in the **Major** and **Minor** fields, respectively.
Visible	Displays tick marks for the selected ruler
Symmetric	Displays tick marks on both sides of the selected ruler.
End style	Specifies the end style for the selected ruler. Options include butt and arrow style.
Start point	Specifies the X and Y coordinates of the selected ruler's start point.
End point	Specifies the X and Y coordinates of the selected ruler's end point.

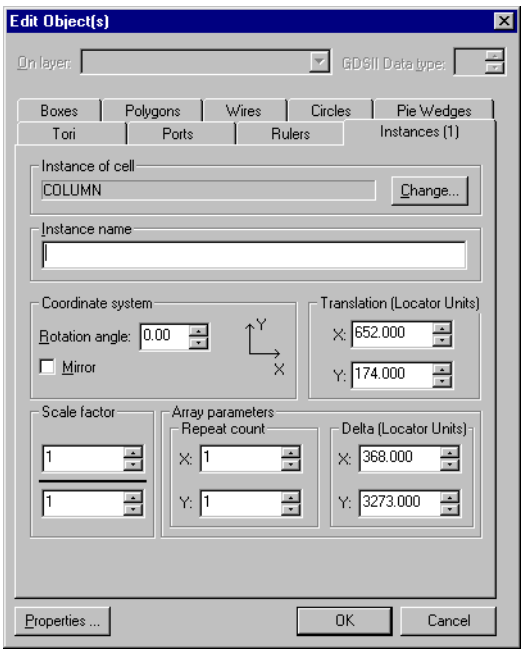
In the **Display** drop-down list you can choose one of four display types:

No text	No numbers are visible.	
Centered	The total length of the ruler is displayed in the center of the ruler.	
At end points	Numbers are displayed at the start and end points of the ruler.	
At tick marks	Numbers are displayed at each major tick mark along the ruler (default display).	

Note: To set default ruler settings, use **Setup > Design—Drawing**.

Instances

To edit an instance as an object, choose the **Edit Object(s)—Instances** tab. You can change the name of the instance and factors that affect the display of the instance.



Options include:

Instance of cell

Name of the instanced cell. Disabled when multiple instances are selected.

To instance a different cell, click the **Change** button to open the **Select cell to instance** dialog.

Instance name

Identifies the selected instance or array. Disabled when multiple instances are selected.

L-Edit automatically assigns a name if you leave this field blank. Each instance in a cell must have a unique name.

Coordinate system

Sets two options controlling the rotation of selected instances and their coordinate system.

- **Rotation angle**—the angle by which the instance is rotated, in increments up to .01 degree. The coordinate axes illustration is updated as the angle is changed. Coordinates of arrays are specified with respect to the instanced cell. If the underlying subgrid is insufficient for accurate rendering of the rotated instance, a warning appears, suggesting the grid be rescaled. This occurs if the mouse snap grid parameter is less than 100. The physical sizes of objects are unchanged.
- **Mirror**—when checked, flips the instance coordinate system horizontally. The coordinate axes illustration reflects the change.

Translation (Locator units)

The position of the instance with respect to the origin of the instancing cell. When you first create an instance, L-Edit places it at the center of the visible layout area. Moving the instance changes the *x*- and *y*- coordinates.

Scale factor

A fraction that defines the scaling of the instance relative to the original cell. This factor is applied to the X and Y coordinates of all objects in the instanced cell. Scaled instances maintain their proportions and geometry in both GDSII and CIF formats, but CIF output results in the creation of new cells which are scaled versions of the originals.

Array parameters

- **Repeat count**—number of times the instance is arrayed in the X and Y directions of the instanced cell's coordinate system.
- **Delta**—X and Y spacing between array elements. L-Edit measures the distance from the lower left corner of each array element in the instanced cell's coordinate system: Dx increases to the right, Dy increases upwards. If both of these numbers are zero, all of the array elements are placed exactly on top of one another.

Note: Instances are not affected by **On layer** or **GDSII Data type** changes in the **Edit Object(s)** dialog.

Command Line Editing

L-Edit includes a command line interface that allows you to use basic textual commands and their associated coordinates so that you can enter precise and repeatable object manipulations and command scripting with text files.

Opening the Command Window

To open the **Command Line** window, select **Tools > Activate Command Line**. The **Command Line** window will initially appear docked at the bottom of the application window, but can be moved by dragging any corner or edge.

You can also use the **`** key (grave accent, found below the tilde (~)) to toggle the command line window open and closed.

Using the Command Window

Click inside the window to make it active. Commands are entered at the command prompt (a flashing cursor) and are applied only to the layout window that is currently active.

The command window behaves much like a toolbar. It can be dragged to any locations on the desktop and hidden using either **Tools > Activate Command Line**, **View > Toolbars > Command Line**, or the hot key the **‘** (grave accent, found below the tilde (~)). This same hot key also toggles focus between the command line window and the layout window.

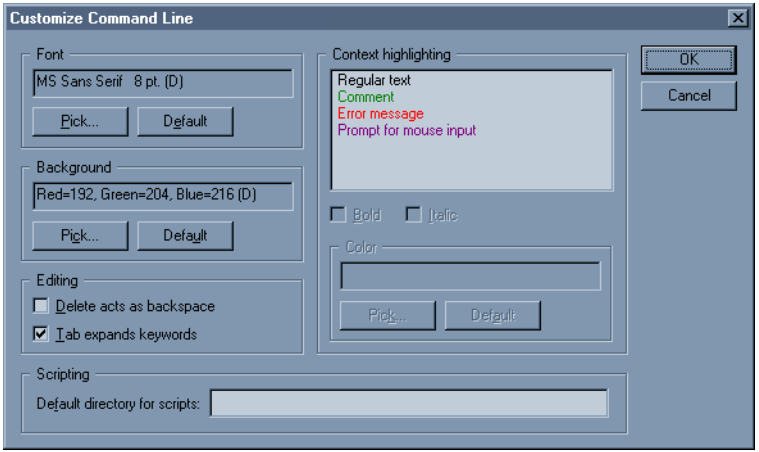
A log of previous commands is kept for display and reuse. Use the up and down (↑, ↓) arrow keys to scroll through and display prior commands. Text can also be copied and pasted to form new commands. Use the **Esc** key to cancel a command.

Command scripting is also supported, refer to Command Scripting on page 1-331 for details.

A right-click in the **command line** window opens a context-sensitive menu for performing the following functions:

Paste	Paste from Windows clipboard into **Command Line** window. Only first command is pasted if multiple lines were previously copied.
Copy	Copy selected text from **Command Line** window into the Windows clipboard. Text can then be pasted into another editor or into the Command window.
Copy to file	Save selected text to a **.tco** (Tanner commnad file) script file. For more information on object properties, see Command Scripting on page 1-331.
Delete last line	Delete the last line of text.
Clear all	Clears all commands from the command log.
Customize	Opens the **Customize Command Line** dialog (see below).

Customize Command Line is a dialog for configuring font size, color and background of the **Command Line** window. It also allows specification of a default directory for command scripts.



Syntax

The basic command syntax is as follows:

```
command  <arguments>  <options>  <mouse click>
```

Coordinate Entry Options

Arguments typically include a list of coordinates. Coordinates are relative by default (**x1, y1**). An exclamation point is used to designate absolute coordinates (**!x, !y**). Locator Units are used for relative and absolute coordinates.

For commands that support the entry of multiple coordinate pairs, the use of absolute coordinates sets the reference point for the relative coordinates that follow. For example:

```
box !x1 !y1 x2 y2
```

will draw a box with its reference point at absolute location **x1,y1** and opposing corner at (**x1 + x2, y1 + y2**).

A **-!** used in an argument specifies that all values that follow are in absolute coordinates. For example:

```
box -! x1 y1 x2 y2
```

will draw a box with one corner at absolute location **x1, y1** and the opposing corner at absolute location **x2, y2**.

Command Completion Using the Mouse

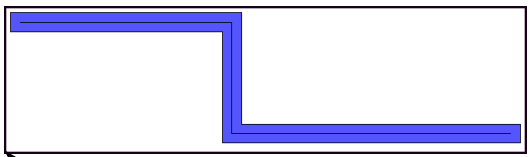
Some commands support coodinate entry using the mouse. In this case, after the partial command is typed it must be followed by the **Enter** key and then one or more mouse clicks to complete the command.

When multiple mouse clicks are required you use a left mouse button click to enter multiple coordinate locations, and a right mouse button click to complete the coordinate entry and execute the command.

Once the command is executed, the coordinate values entered using the mouse are displayed in the **Command Line** window. The **Esc** key can be used during mouse entry to abort a command.

Reference Point Location

The reference point differs depending upon the command and whether or not multiple objects are selected. When a single primitive object is selected, the reference point is the lower left corner of the minimum bounding box.

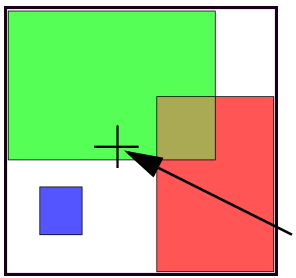


Reference point of single wire.

When a single instance is selected, the reference point is the instance origin.

Note: Note that the reference point does not snap to the grid.

When multiple primitive objects are selected, the reference point may be any point within a minimum bounding box for the objects, as determined by a mouse click.



A mouse click determines the reference point that will be used for multiple selected objects.

Special Characters

The special characters slash (/), space ( ), and quotes (") cannot be used in an argument. To use these characaters you must either enclose the entire string in double quotes or precede each individual special character with the backslash (\) escape character.

For example, the layer name **Not Poly** may be entered as **"Not Poly"** or **Not\ Poly**. Similarly, to include a pathname C:\TEMP\NEWFILE.TDB you would enter **"C:\TEMP\NEWFILE.TDB"** or "**C:\\TEMP\\NEWFILE.TDB".**

If a cell name includes a space or comma, it must be enclosed in quotes.

Keyboard Shortcuts

The **TAB** key functions as a position-sensitive shortcut within the command window. Depending on the cursor position in a command, **TAB** will cycle through the available values for commands, layer names, cell names, and file names. For example, in the command:

```
box !24 !14 !4 !1 -l <TAB>
```

pressing the **TAB** key will display the defined layer names in layer list order.

Typing a letter prior to using the **TAB** key will scroll the display to the first list element starting with that letter.

Command Reference

The following commands are available for the **Command Line**.

!!

Repeat and execute the last command. If the command requires mouse entry, that portion of the command is not executed.

↑, ↓

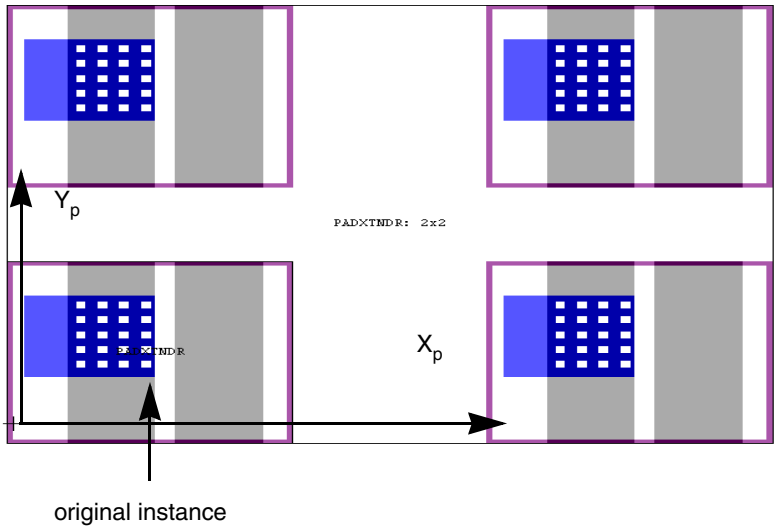
Scroll up or down through the log of command entries.

<Esc>

The **Esc** key cancels the current command.

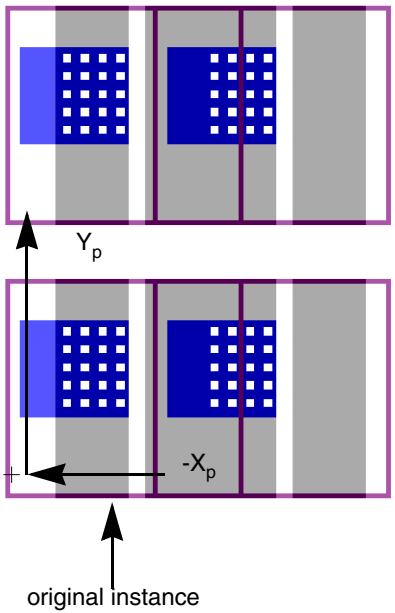
Array

Create an array of the selected instance(s) with the designated number of rows and columns. The argument **Xp Yp** determines the distance between the origin of each element in the array.



Argument	*Example*
array *Rows Cols* X_p Y_p	**array 4 6 10 14**

For positive pitch, array is performed in the positive **x** and **y** direction. For negative pitch, the array is performed in the negative **x** and **y** direction regardless of overlap, as shown below.



Box

Draw a box as follows. The option **-l** changes the designated layer.

Argument	***Description***
box *w h <mouse click>*	Draw a box of width ***w*** and height ***h*** with its center at the mouse click position.
Example: **box 4 10 -l Metal1 <mouse click>**	
box !x1 !y1 <mouse click>	Draw a box with corners at (x_1, y_1) and the mouse click position.
Example: **box 4 10**	
box !x1 !y1 !x2 !y2	Draw a box with corners at absolute locations (x_1, y_1) and (x_2, y_2).
Example: **box !42 !51 !46 !61**	
box *!x_1 !y_1 x_2 y_2*	Draw a box with corners at absolute location (x_1, y_1) and relative location $(x_1 + x_2, y_1 + y_2)$.
Example: **box !42 !51 49 62**	
box *-! x_1 y_1 x_2 y_2*	Draw a box with corners at absolute locations (x_1, y_1) and (x_2, y_2).
Example: **box -! 42 51 49 62**	

Copy

Copy the selected object(s) as follows. The option **-l** changes the designated layer. The option **-R** followed by two relative coordinates specifies an offset of the reference point from the lower left corner of the minimum bounding box.

If multiple objects are selected, this command prompts for a mouse click to determine the reference point that will be used when the objects are pasted.

Argument	*Description*
copy	Store the selected object(s) in the paste buffer.
copy *x y*	Copy the selected object(s) and paste with reference point at (Δx, Δy).
Example: **copy 4 6**	
copy *!x !y*	Copy the selected object(s) and paste reference point at absolute location (x, y).
Example: **copy 4 10 -l Metal1 <mouse click>**	
copy *-! x y*	Copy selected object(s) and paste reference point at the absolute location (x, y).
Example: **box 4 10 -l Metal1 <mouse click>**	

Goto

Shift the screen display.

Argument	*Description*
goto *x y*	Shift screen center by (Δx, Δy).
goto *!x !y*	Move screen center to absolute coordinate (x, y).
goto *-! x y*	Move screen center to absolute coordinate (x, y).

Instance

Create an instance of the selected cell. This command supports the use of Xref cells with the **-f** filename option, which creates an XrefCell instance of a cell from the specified file. If a cell name includes a space or comma, it must be enclosed in quotes.

Example:

```
instance "NAND 1" !14 !22 -f mainlib.tdb
```

creates a referenced instance of cell **NAND** from the **mainlib.tdb** file, with its origin at (14, 22).

Argument	*Description*
instance *cName x y*	Instance cell ***cName***, placing the cell's origin at position Δx, Δy relative to screen center.
Example: **instance "DFF R2" 0 3**	
instance *cName !x !y*	Instance cell ***cName***, placing the cell's origin at position x, y.
Example: **instance DFF !42 !136**	
instance *cName -! x y*	Instance cell ***cName***, placing the cell's origin at position x, y.
Example: **instance DFF -! 42 136**	
instance *cName* <mouse click>	Instance cell ***cName***, placing the cell's origin at the position given by the mouse click.

Layer

Change the active layer to the layer designated using either the layer name or GDSII layer number.

Argument	***Description***
layer *LayNum*	Change active layer to the designated GDSII layer number.
Example: **layer 42**	
layer *LayName*	Change active layer to the designated layer name.
Example: **layer "SubCkt ID"**	

Move

Move the selected object(s). The option **-R** followed by two relative coordinates specifies an offset of the reference point from the lower left corner of the minimum bounding box.

Argument	***Description***
move *x y*	Move selected object(s) by Δx, Δy.

Example: **move -40 -32**

move *!x !y* — Move the lower left corner of the selected object to (x, y). If multiple objects are selected, this command prompts for a mouse click to determine the reference point for the translation to (x, y).

Example: **move !42 !136 <mouse click>**

move *-! x y* — Move the lower left corner of the selected object(s) to the absolute location (x, y). If multiple objects are selected, this command prompts for a mouse click to determine the reference point for the translation to (x, y).

Example: **instance DFF !42 136**

Path

Draw a wire between mouse click points in the layout or absolute coordinate points. The option **-l** changes the designated layer. The option **-pw** changes the wire width.

Argument	***Description***
path ***<mouse click(s)> <right mouse click>***	Draw a wire segment between mouse click points. Drawing is ended with a right mouse click. Note that wires are drawn in outline mode until the drawing is complete.

Example: path -l Metal1 -pw 12 <mouse click> <mouse click> <right mouse click>

path ***!x !y <mouse click(s)> <right mouse click>***	Draw a wire from absolute location (!x, !y) to selected mouse click points, ending with a right mouse click.

Example: path !1092 !476 <mouse click> <mouse click> <right mouse click>

path $!x_1\ !y_1\ !x_2\ !y_2$ ...	Draw a wire with vertices at the absolute locations ($!x_n$, $!y_n$) entered.

Example: path !-12 !-14 !79.5 !16 !80.5 !9.5 !50 !-4.5 !23.5 !-15.5 !48.5 !-22.5

path *-! x_1 y_1 x_2 y_2 ...*	Draw a wire with vertices at the absolute locations ($!x_n$, $!y_n$) entered.

Example: path -! 4 10 11 15 20 20 30 45 45 60

Paste

Paste the selected object(s) into the layout. The option **-l** changes the designated layer.

Argument	***Description***
paste *x y*	Paste the selected object(s), translating the reference point of the objects in the paste buffer by (Δx, Δy).
Example: **paste 15 25**	
paste *!x !y*	Paste the selected object(s), translating the reference point of the objects in the paste buffer to the absolute location (x, y).
Example: **paste !1092 !476**	
paste *-! x y*	Paste the selected object(s), translating the reference point of the objects in the paste buffer to the absolute location (x, y).

Example: paste -! -12 -14

paste *<mouse click>*	Paste the selected object(s) with the reference point of the objects in the paste buffer to the mouse click point.

Example: **paste <mouse click>**

Polygon

Draw an all-angle polygon at the indicated absolute vertices. The option **-l** changes the designated layer.

Argument	***Description***
polygon *!x_1 !y_1 !x_2 !y_2 ...*	Draw a polygon with vertices at the indicated absolute coordinates.

Example: **polygon 15 25**

polygon *-! x_1 y_1 x_2 y_2 ...*	Draw a polygon with vertices at the indicated absolute coordinates.

Example: **polygon !1092 !476**

polygon *!x_1 !y_1 <mouse click>*	Draw a polygon with first vertex at (x_1 y_1) and additional vertices indicated by mouse clicks. A right mouse click completes the command.

Example: **polygon -! -12 -14**

polygon *<mouse click>*	Draw a polygon with all vertices indicated by mouse clicks. A right mouse click completes the command.

Example: **polygon <mouse click>**

Run

Execute the sequence of commands in the specified file.

Argument	*Example*
run *filename*	`run repwire.tco`

Text

Create a point port at the specified location. The option **-l** changes the designated layer.

Argument	*Description*
text label *!x !y*	Create a port at location (x , y) with the text string *`label`*.

Example: **text Gnd !4 !10 -lMet1**

text label -!x y	Create a port at location (x , y) with the text string *`label`*.

Example: **text Gnd -! 4 10 -lMet1**

label <mouse click>	Create a port at the mouse click position with the text string *`label`*.

Example: **txt Gnd**

Width

Set the wire width (in Locator Units).

Argument	***Option***
width	Sets the wire width to the default value for the active layer.
Example: **width**	
width *wire width*	Sets the wire width to the specified value.
Example: **width 3**	

Command Scripting

Command scripting is supported through the use of a **run** command that opens and executes a text file containing a list of commands. The file format for this command list is Tanner Command Files with a .**tco** extention.

You can use the **Copy to file** command (**Ctrl + L** from within the command line window) to save highlighted text from the command window directly to a .**tco** script file.

C++ style comments are supported in command script files. The **run** command cannot be nested. Note that commands using mouse completion are not generally supported in command scripts.