

Generating Layers

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Introduction

Objects representing new technology layers can be generated by means of logical (Boolean) operations on objects residing on up to three existing, or source, layers. Each generated layer is defined with **Setup > Layers**. Objects on generated layers are automatically created (generated) with **Tools > Generate Layers**.

Note:

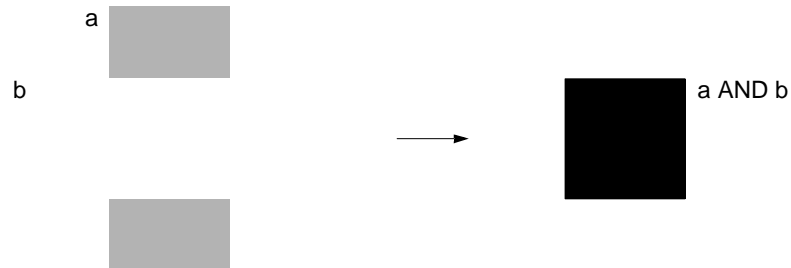
Tools > Generate Layers only operates on boxes and 45°/90° polygons and wires. It does not operate on circles or all-angle objects.

Operations

Four elementary operations exist for generated layers: **AND**, **OR**, **NOT**, and **Grow**. They can be used individually or combined to produce more complex formulas.

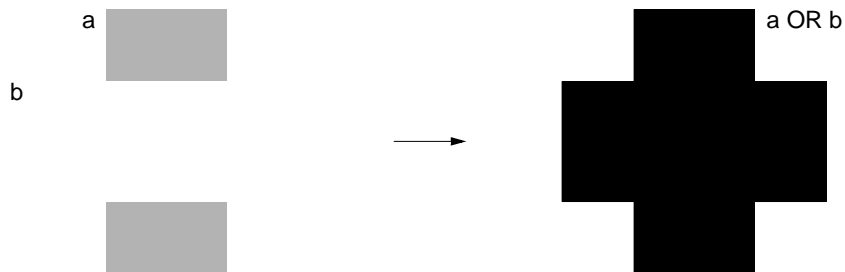
AND

The **AND** operation (abbreviated **&**) creates objects on a generated layer from the intersection of objects on two other layers.



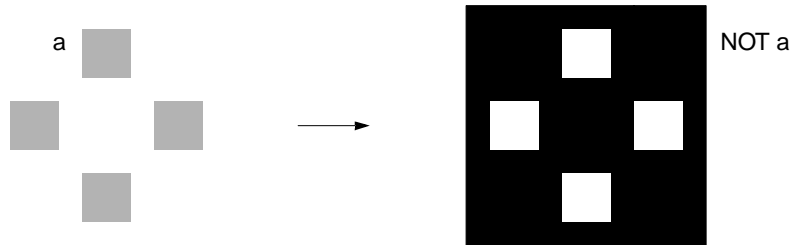
OR

The **OR** operation (abbreviated |) creates objects on a generated layer from the union of objects on two other layers.



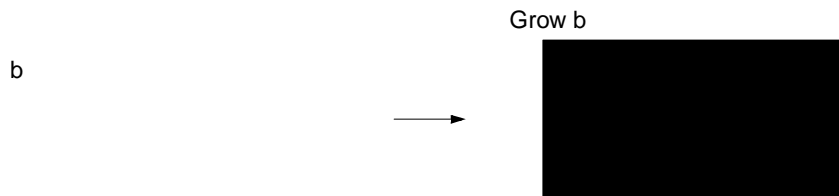
NOT

The **NOT** operation creates objects on a generated layer from the absence, or inverse, of objects on another layer. Mathematically, the generated layer should extend throughout the Layout Area wherever the original layer does not exist; this is impractical, however, and instead L-Edit imposes an artificial outer boundary as large as the area including all existing objects plus an additional area to account for the **Grow** operations. The artificial boundary applies to the smallest rectangle that can contain the set of all objects on layer *a* (called the minimum bounding box, or MBB); the operation always includes the entire area between objects on layer *a*.

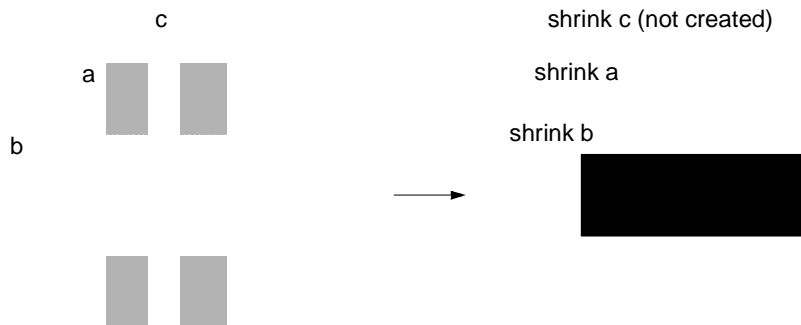


Grow

The **Grow** operation creates objects on a generated layer by increasing the size of each object on the original layer. Specifically, a **Grow** operation expands each side by a specified number of Locator Units.

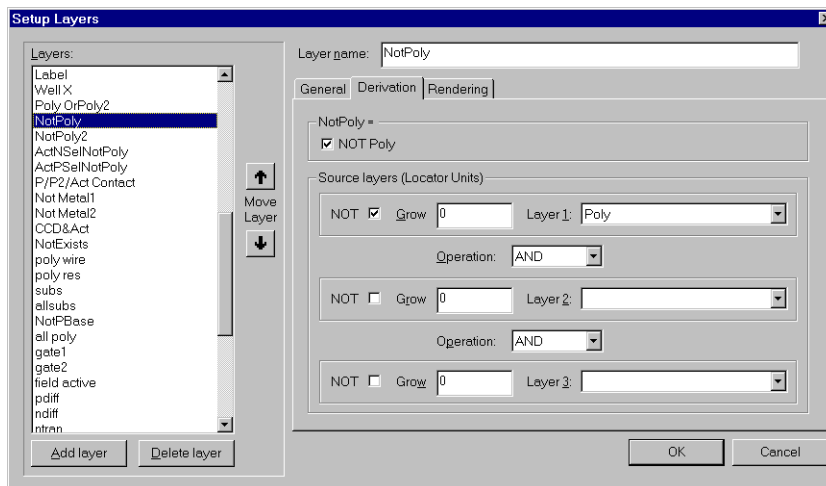


A negative **Grow** parameter causes a shrink operation, creating objects on a generated layer by decreasing the size of each object on the original layer by contracting each side by the specified number of Locator Units. If any dimension of an object is less than or equal to twice the shrink amount, then the new object on the generated layer is not created.



Defining Generated Layers

To define generated layers, select **Setup > Layers** and click on the **Derivation** tab. L-Edit will display the **Setup Layers – Derivation** dialog:



In this dialog you specify the name of the generated layer, up to three source layers, and the Boolean operations performed to create the new layer. You must

insert the new generated layer in the **Layers** list *after* the source layers, or move it so that the source layers occur above it.

Order of Operations

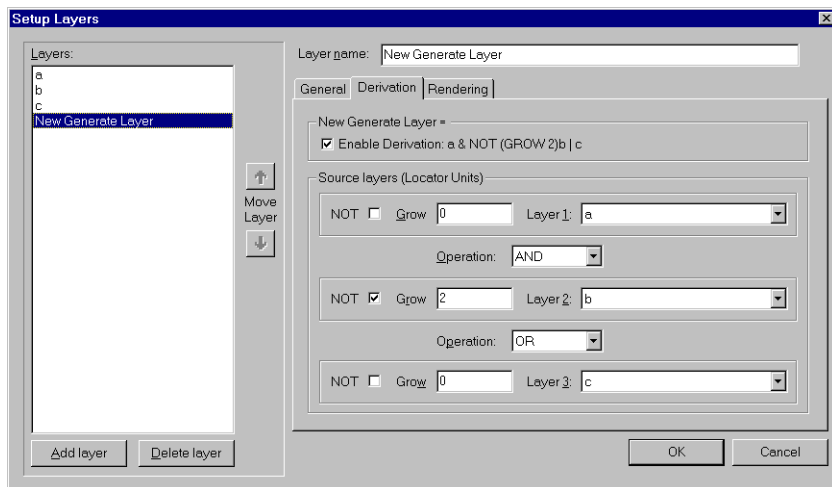
Boolean operations are performed on the source layers in the following order:

- [1] **Grow** (individually)
- [2] **NOT** (individually)
- [3] **AND/OR** (first to last)

For example, if the source layers consisted of layers *a*, *b*, and *c*, and you specified the following operations: **NOT** and **Grow 2** on *b*; **AND** between *a* and *b*; **OR** between *b* and *c* — then the actual result would be (*a* **AND** (**NOT**(**Grow 2** *b*))) **OR** *c*. That is, the operations would be performed as follows:

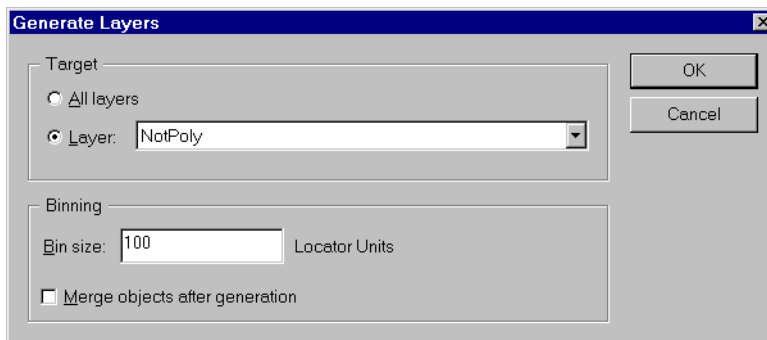
- [1] **Grow 2** on *b*
- [2] **NOT** on the result of step 1
- [3] **AND** between *a* and the result of step 2

OR between the result of step 3 and *c*.



Creating Generated Layers

After generated layers have been defined, they can be created in the active cell with **Tools > Generate Layers**. The **Generate Layers** dialog is displayed below.



In this dialog you specify the layers to be generated (a specific layer or all layers at once), and the size of the bin within which L-Edit will generate objects on the layers (see **Binning**). Turning on the **Merge objects after generation** check box causes objects on the same generated layer to be merged at the completion of the process. Choosing to merge objects can significantly increase the processing time for more complex layouts.

When the **Generate Layers** command is executed, all existing objects on generated layers are automatically deleted before the new layers are generated. Therefore, it is not necessary to run **Tools > Clear Generated Layers** first. Existing objects on generated layers are deleted whether they originated from a previous layer generation or from some other source.

Binning

Before generating layers, L-Edit divides the layout into a grid of square bins. The length of one side of each bin, in Locator Units, is determined from the **Bin size** field in the **Generate Layers** dialog. Layer generation then takes place within each bin. Generating layers in bins can significantly increase performance because L-Edit does not perform layer generation operations on objects that are considerably distant from each other. Choosing the optimal bin size, however, is crucial to optimizing performance.

Working with Generated Layers

Objects on generated layers are the same as other L-Edit objects. They can be edited, shown, and hidden in the same way.

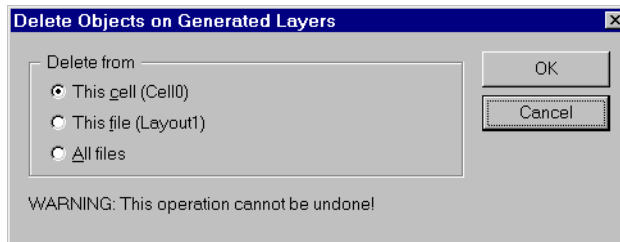
Showing and Hiding Generated Layers

Use the menu commands **View > Layers > Show Generated** and **View > Layers > Hide Generated** to show and hide generated layers. If the current layer is a generated layer, it will remain visible when generated layers are hidden.

Generated layers, like all other layers, can also be shown or hidden by using the context-sensitive menu on the Layer Palette. With the pointer over any *non-generated layer* icon, click the right mouse button and choose **Hide Generated**. All generated layers will be hidden and their icons shaded on the Layer Palette. To cause all generated layers *except* the selected one to be hidden, position the pointer over the desired *generated layer* icon and choose **Hide Generated** in the context-sensitive menu. Choose **Show Generated** to display all generated layers in all cells for the active file.

Removing Generated Layers

Tools > Clear Generated Layers removes all generated layers from the active cell, the active file, or from all open files.

**Warning:**

This command deletes all objects on the generated layers, regardless of how they were created. It cannot be undone.

Automatic Layer Generation with DRC and Extraction

Tools > DRC and **Tools > Extract** automatically invoke **Tools > Generate Layers** and **Tools > Clear Generated Layers** at the beginning and end of the process, respectively, if generated layers are used in design rule or extraction definitions. Objects residing on the generated layers are irreversibly deleted after execution of the commands.

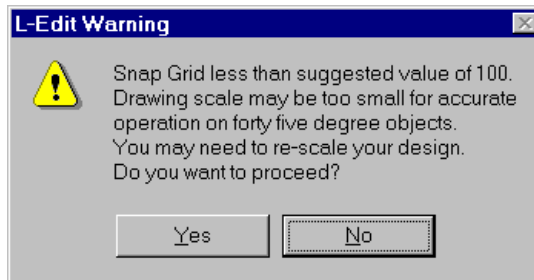
Working with 45° Objects

Layer Generation

Generation of layers containing 45° objects, either directly from **Tools > Generate Layers** or automatically via **Tools > DRC** or **Tools > Extract**, can produce off-grid vertices due to off-grid intersections of 45° polygons or conversion of 45° wires to polygons (see **Wires**). The coordinates of off-grid vertices are rounded to the nearest Internal Unit while still preserving angles of edges. If the dimensions of the source objects (measured in Internal Units) are small, then the resulting polygons may be distorted.

To prevent distortion of generated objects due to rounding of grid coordinates, a *subgrid* must be maintained. The subgrid is the smallest possible nonzero value, in Internal Units, of any edge length, wire width, distance between any two objects, or **Grow** distance. The best way to maintain a subgrid is to set the mouse snap grid parameter to prevent objects or spacings smaller than this value from being created (see **Setup Design – Grid**). A snap grid equivalent to at least 100 Internal Units is recommended for designs containing 45° objects.

When Generate Layers, DRC, or Extract is invoked, the snap grid parameter is checked. If it is less than 100 Internal Units, L-Edit assumes that edges or spacings smaller than 100 Internal Units may exist on the layout, and a warning appears suggesting that the layout may need to be rescaled.

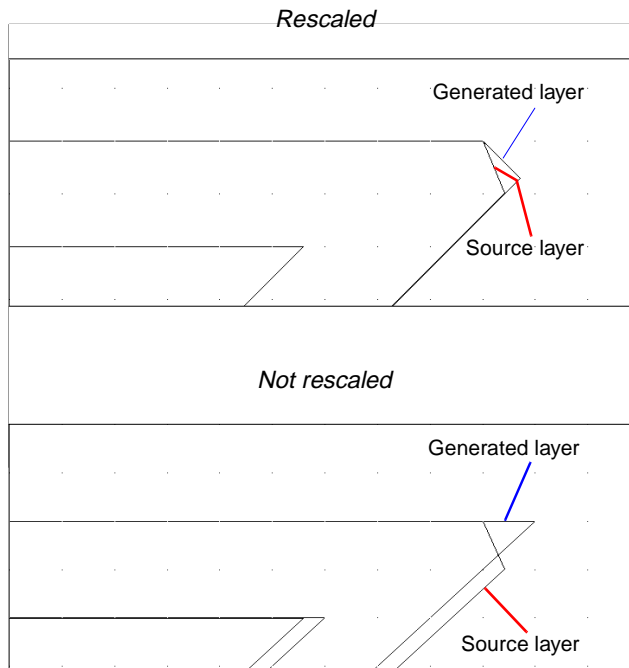


If you are certain that no edges, wire widths, spacing, or **Grow** values smaller than 100 Internal Units exist, then you may click **Yes** and proceed. Changing the snap parameter to an equivalent of 100 Internal Units prevents the warning from appearing (see **Setup Design – Grid**). The equivalent number of Internal Units is based on the snap grid value (in Locator Units) and the number of Internal Units per Locator Units. It is up to you to make sure that no objects smaller than the subgrid are created; the warning depends only on the current value of the snap grid, not on the actual size of objects in the layout. You can rescale the design by increasing the number of Internal Units per grid point. This can be done by increasing the number of Internal Units per Technology Unit.

Wires

Wires involved in layer-generation operations on the source layers are converted to polygons on the generated layer. However, some join styles on 45° wires result in wire edges that meet at non-45° angles. To ensure that the resulting objects are true 45° polygons when the layer is generated, the problem joins are modified. Round joins are processed as layout joins and round ends are processed as butt ends to satisfy the 45° polygon criteria.

Examples of a converted 45° source wire to a generated layer polygon are shown in the following figure:



After rescaling, the finer grid resolution (more Internal Units per grid unit) allows the generated polygon to approximate the source wire more closely. Without rescaling the design, the vertex of the generated polygon in the above example is forced to the nearest grid point that maintains a 45° angle.