

Stencil Apertures

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Overview

The Stencil Apertures module can be found under “Tools/Stencil Apertures”. It is used for creating solderpaste stencil openings from rectangular pads. These opening are called apertures and they will be generated as polygons, replacing the pads.

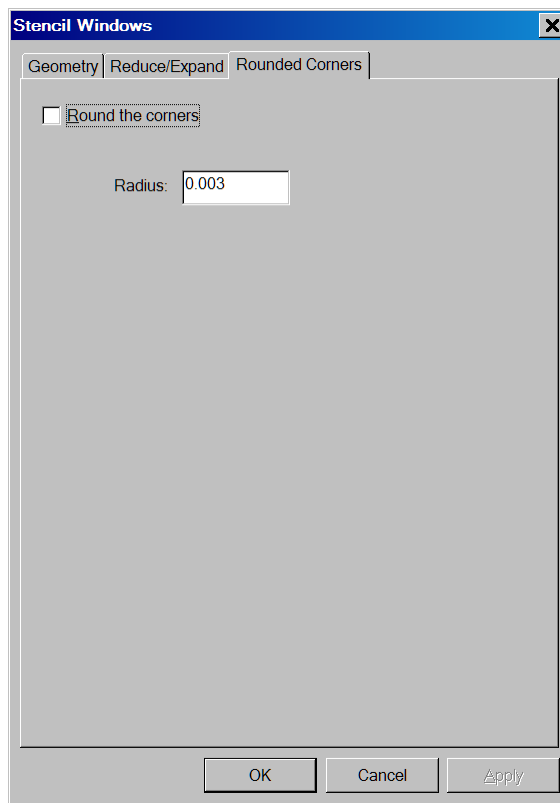
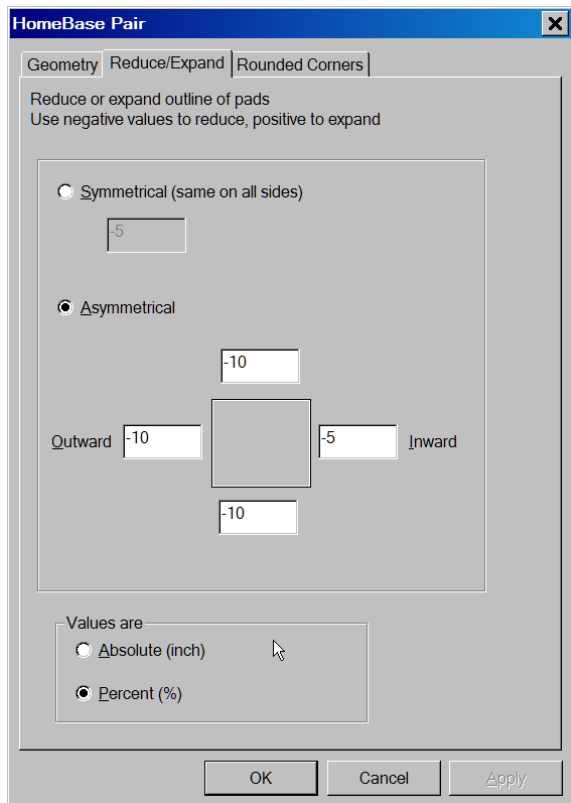
There are three groups of operations:

- o To split pads into “window panes”
- o To replace pairs of rectangular pads with homebase apertures or D Code shape based apertures
- o To generate apertures for components

There are two dialog tabs that are common to all commands.

The “Reduce/Expand” tab is used to specify swelling values to be applied to the rectangular pads. The swelling can be asymmetrical (different values for different sides) and can be given as absolute values (inch etc) or in percent of the original pad dimensions. Negative values will reduce, while positive values will expand the dimensions.

The “Rounded Corners” tab can be used to add rounded corners (of the specified radius) to all vertices of the resulting polygons, where two straight edges meet.



Windows

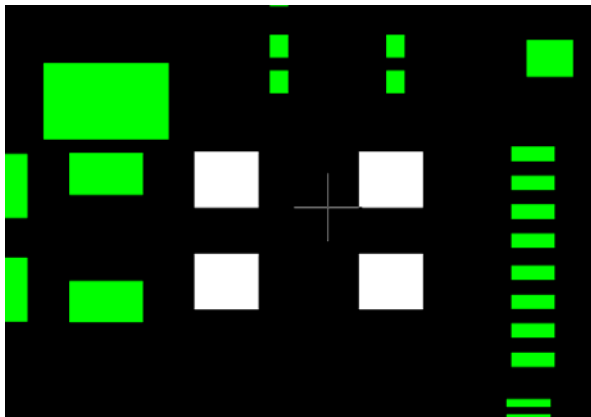
Cutting a pad into multiple smaller apertures give the effect of a window with panes. The panes can be created with horizontal and vertical cuts or with diagonal cuts. This operation is also known under the name of “pad split”.

The sequence of steps for splitting pads into windows is as follows:

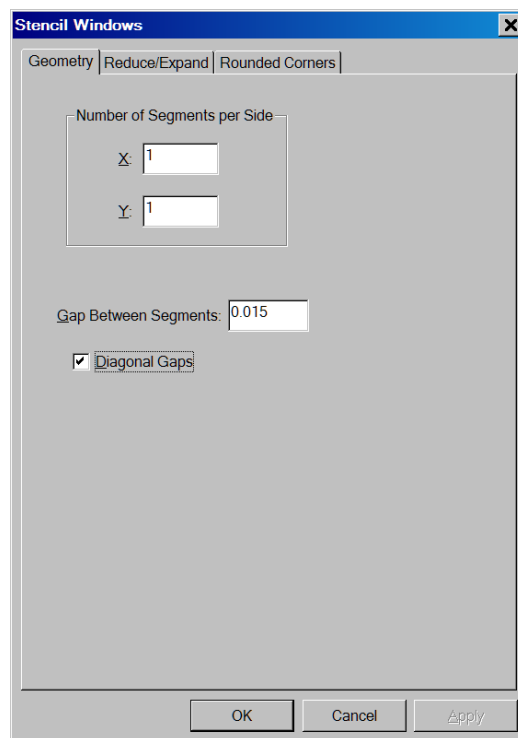
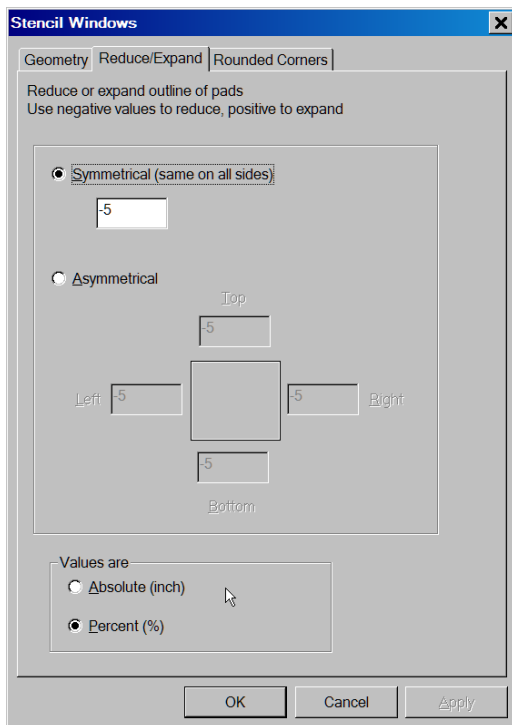
- Select any number of rectangular pads
- Do “Tools/Stencil Apertures/Windows”
- Specify the desired parameters in the displayed dialog

The selected pads will be replaced with polygons that generate the desired split.

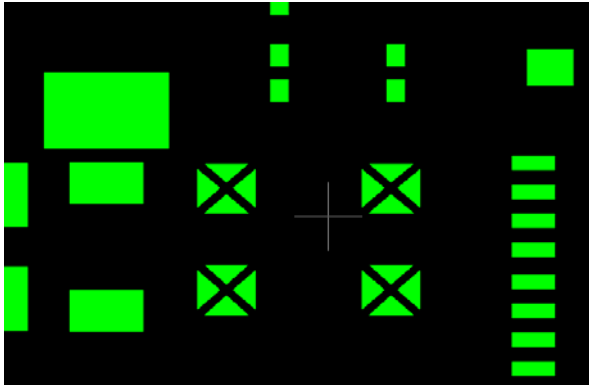
An example is shown below. Start with the following selection:



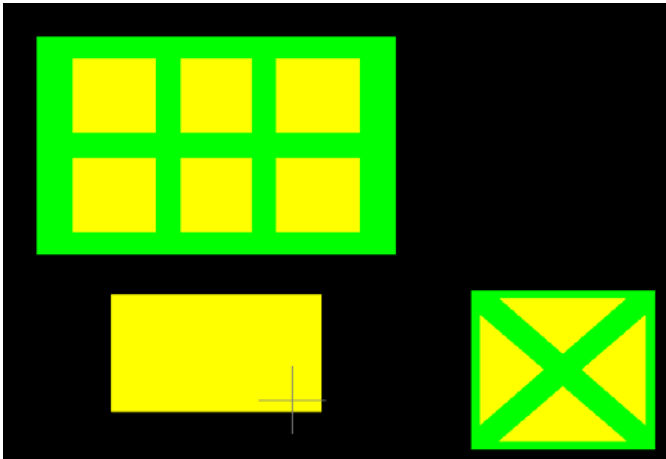
Set the parameters as shown:



The result is as shown. Diagonal gaps were chosen, so the 4 rectangular pads are replaced with 16 triangular polygons.



Another example, with different parameters, is shown below with the resulting windows superimposed over the original pads:



Note that if the “Number of Segments Per Side” parameters are both set to 1, then only the “Reduce/Expand” part will be applied and this is a way to change the dimensions of desired pads without splitting them. Rounded corners can be added if desired.

Operations On Pairs

Facing pairs of rectangular apertures can be replaced with homebase polygons or D Code shape based polygons. This is often the case with landing pads for resistors and capacitors.

The Homebase apertures are also called Homeplate and their name comes from the fact that they resemble the home plate on a baseball field. We will first show an example for creating Homebase apertures:

- Select two facing rectangular pads (aligned vertically or horizontally).
- Do “Tools/Stencil Apertures/Homebase” or “Tools/Stencil Apertures/Inverted Homebase”. An alternative place for these commands is the context menu (mouse right click). These commands will appear in the context menu only after two rectangular pairs have been selected.
- Specify the desired parameters in the displayed dialog

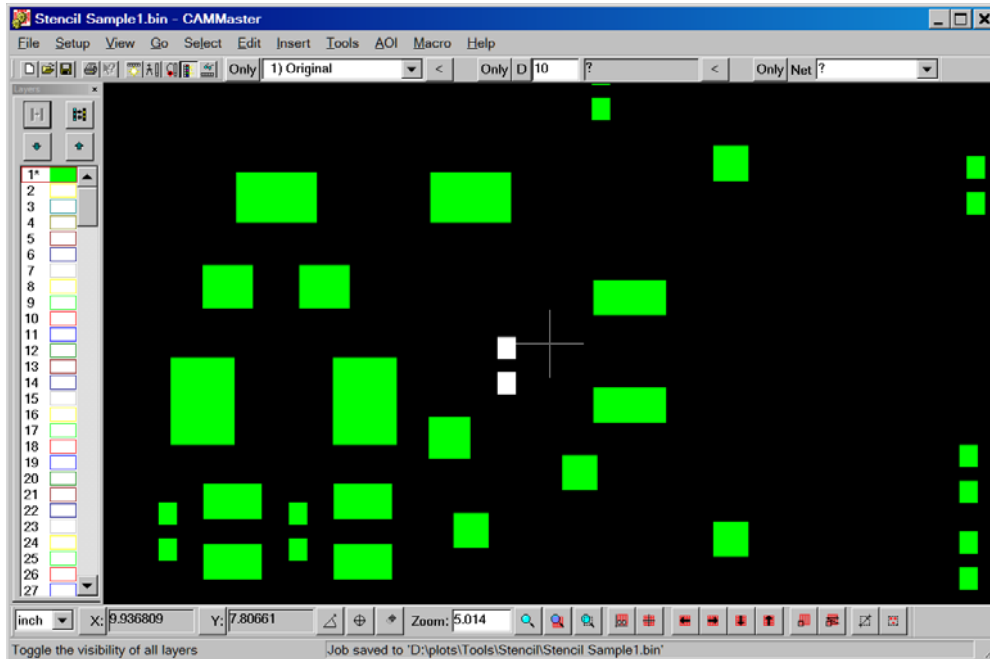
The two pads will be replaced with the desired homebase polygons.

At this stage, if more such pads exist then one can apply the same transformation to all of them by:

- o Selecting all the desired pads
- o “Tools/Stencil Apertures/Use Existing Model”

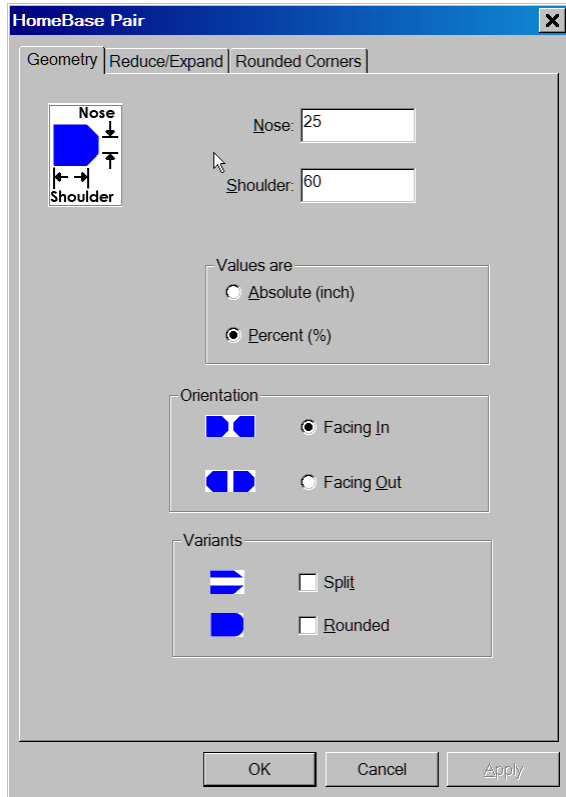
This model will be remembered until it is replaced with another model or the database is cleared.

An example is shown below:

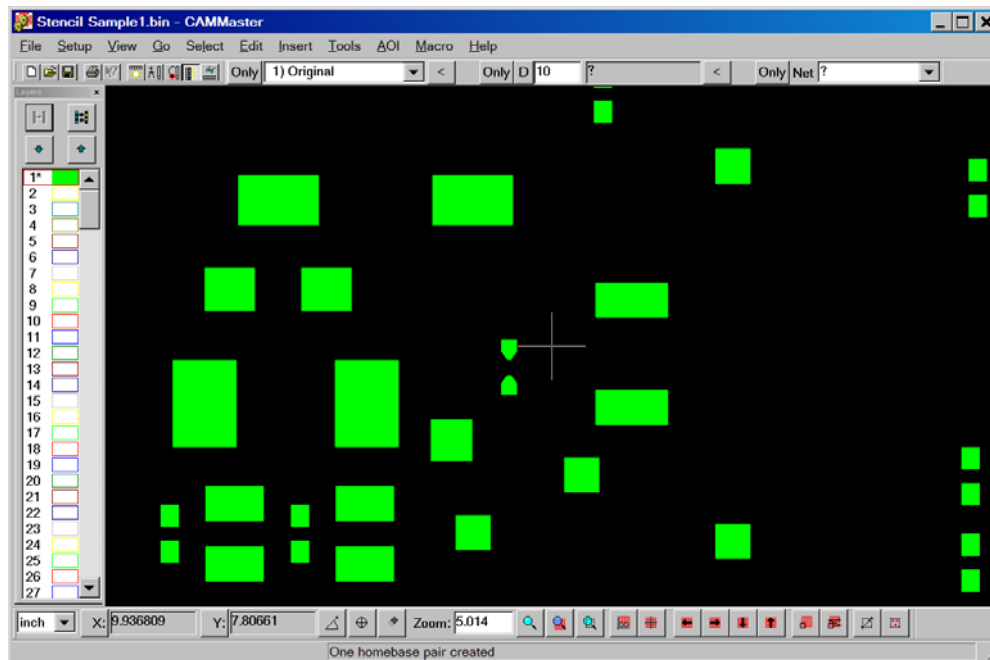


Two pads have been selected.

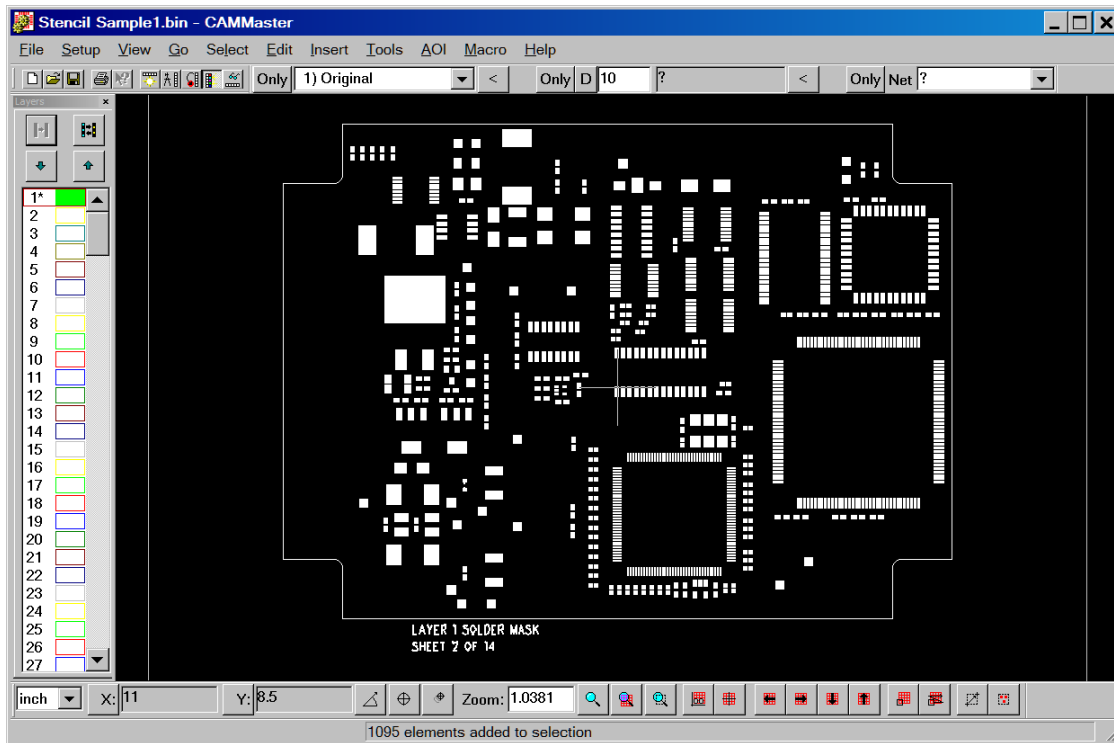
One can now do “Tools/Stencil Apertures/Homebase” or right-click the mouse to get the context menu and pick “Stencil Homebase Pair”. Either way one gets the dialog with the parameters to set.



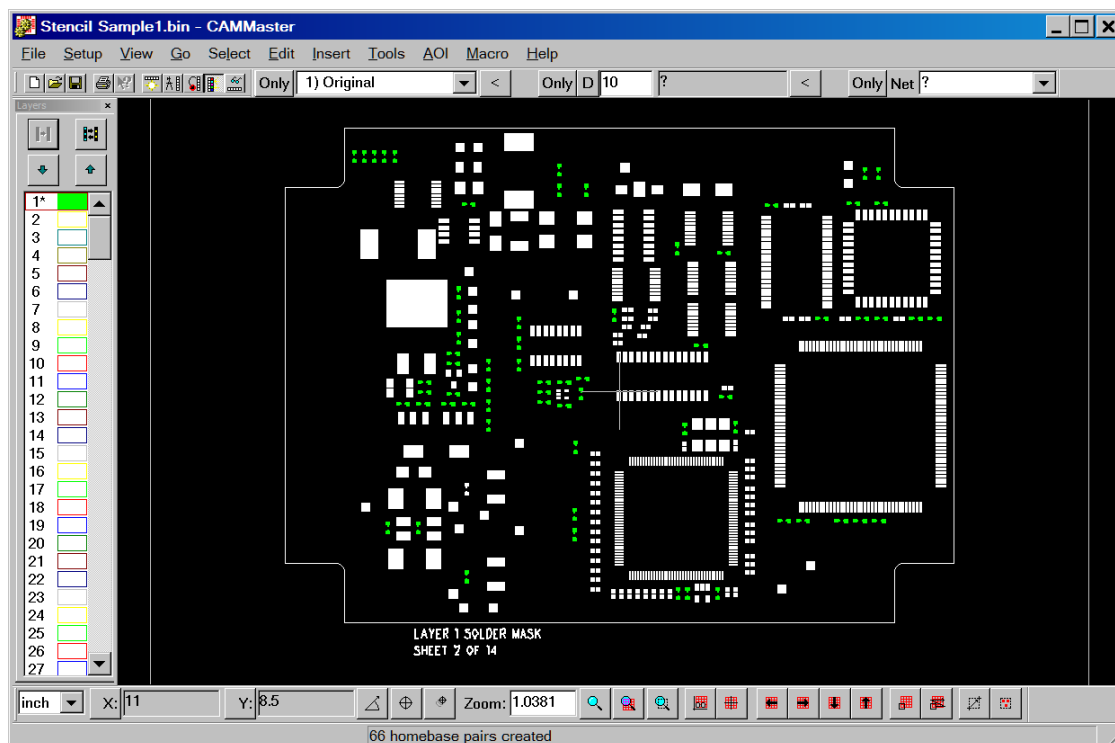
One can also set swelling values in the “Reduce/Expand” tab (as with all the other stencil commands) and also the radius for rounded corners, if desired. After clicking OK the two selected pads will be replaced with the corresponding homebase polygons as shown in the next image.



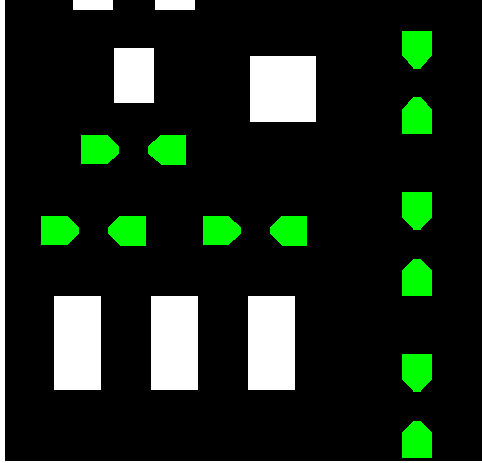
At this stage, if one desires to apply this transformation to the whole layer one can select all elements, “Select/Select All” (Ctrl+A). Alternatively one could select just a group of pads and then the operation would only be applied to those.



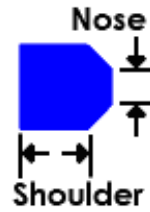
And now one can do “Tools/Stencil Apertures/Use Existing Model” or, from the context menu, “Stencil Using Model”.



66 pairs of pads are converted during this operation and they are shown unselected (green). As one can see by zooming in, both vertical and horizontal pairs are replaced during this operation. Only pairs that have rectangular shapes that match the model and pad to pad spacing matching the model (horizontally or vertically) are converted.



There are two homebase patterns supported. The normal pattern defined by two dimensions:

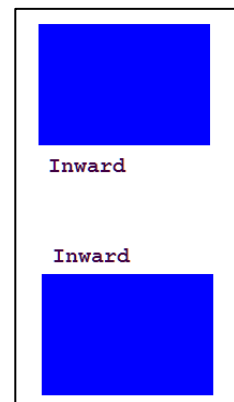
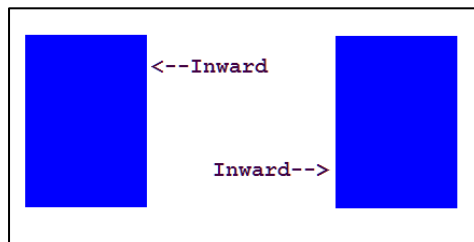


And the inverted pattern (sometimes called a "C" pad, because it resembles the shape of the letter C) which is defined by three dimensions:

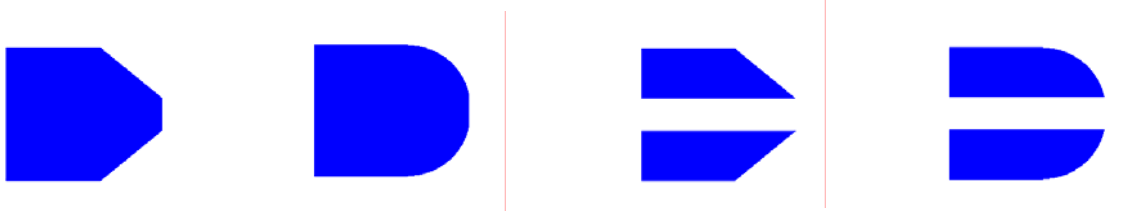


The resulting shapes will be generated based on the swelled (reduced) pads. If values are expressed in percent, they will be based on the value resulting from the "reduce/expand" operation, so basically "reduce/expand" is done first, then the "nose", "shoulder" etc. parameters are computed from the reduced/expanded dimensions.

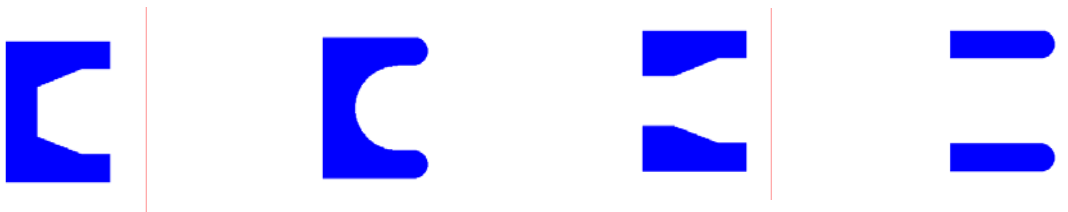
For asymmetrical swelling the dialog has sides labeled "Inward" and "Outward". The "Inward" side is shown to the right, but it can in fact be on any side of the pad. It is defined as the side which faces the opposing pad in the pair.



The result can be further modified with two checkboxes: "Split" and "Rounded". Each of them can be checked independently, giving four possible results, as shown below:



For the Inverted Homebase the four possibilities are:

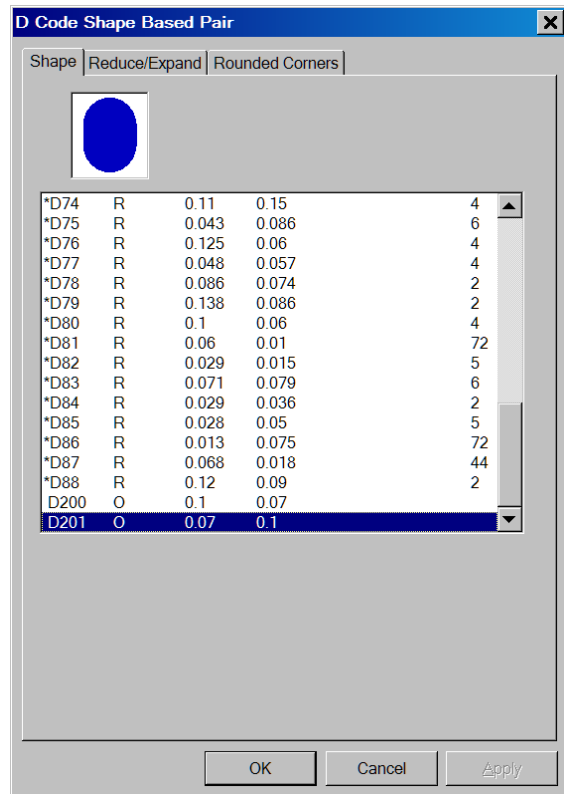


The third pair-based aperture (in addition to homebase and inverted homebase) is based on existing D Code shapes ("Tools/Stencil Apertures/D Code Shape"). The apertures will be derived from the shape of a user-picked D Code but will be polygons and scaled to match the destination rectangle.

The dialog is shown to the right.

The picked shape (in this case an obround) will be scaled to match the rectangles (after Reduce/Expand) and polygons of that shape will be generated. As a result, only the shape (and geometry) of the picked D Code matters, not its dimensions. For instance picking any rectangular D Code (of type R) will give the same results independent of the X and Y dimensions of the D Code picked.

Any shape can be used, even custom shapes (M-type). Rounded corners can be applied if desired, using the "Rounded Corners" tab.



Component Based Apertures

Apertures can also be generated for general components. A component is an arrangement of rectangular pads in a pattern of rows. There can be one, two or four rows (for quad packs). The pads need not have the same dimensions, but they must be rectangular (shape R or S).

The sequence of steps is the same as for homebase apertures. One must first select all the pads in a component (and nothing else). Then replace them with apertures using "Tools/Stencil Apertures/General Component". The apertures will be rectangular polygons, but they may be reduced or expanded, possibly with different values on the four sides of the rectangle.

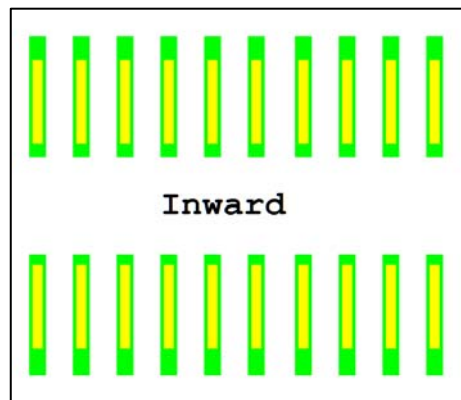
This arrangement of pads now becomes a model that can be used later with "Tools/Stencil Apertures/Use Existing Model" on any selection of pads.

There is a special rule for components with just one row. When the number of pads is larger than two, the component is considered as having one row. When the number of pads is equal to two, the component is considered as having two rows of one pad each, similar to the scenario with the homebases. This matters only when the swelling is asymmetrical, because then there is a concept of "inward" and "outward" and the two pads of the row will be considered as facing each other, whereas if three or more pads exist in the row than the inward concept has no meaning.

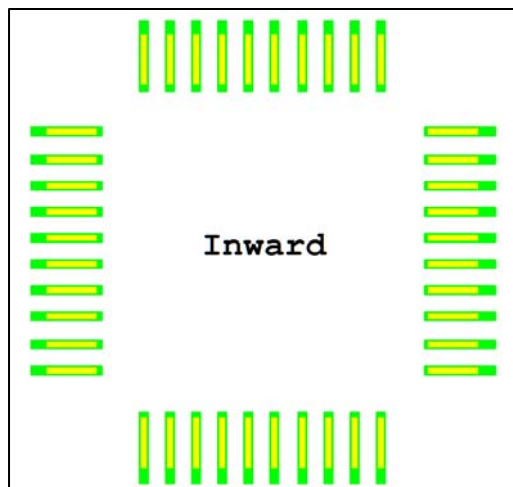
One row of landings:



Two rows of landings:



Four rows of landings:



If a model is used to replace components in a selection, all four 90 degree rotation of the model are considered. In most cases only two of these are relevant and sometimes only one (for a symmetrical, four row component).

Selecting Components

How does one select pads that belong to one component?

One way is to manually select all the pads in one component using the selection tool ("S") or by double clicking on the pads in the component (while pressing the Shift key, which will cause the currently selected item to be added to the selection).

The other method is to use component information in the CAM database, if it exists.

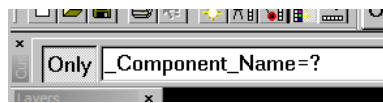
Currently component information can be imported from IPC-356 (netlist) files and from ODB++ files and it is stored as custom properties attached to database elements. These are:

- o "_Component_Name": for the name of the component
- o "_Component_Type": for the type of the component. This does not exist in IPC-356 files and is only extracted out of ODB++ files
- o "_Component_Pin": for the name of the pin (usually a number, but can be alphanumeric)

Note that these properties start with an underscore, because they are system custom properties, with predefined meaning in the PentaLogix CAM software.

They can be inspected and used via the custom properties toolbar ("View/Toolbars/Custom Properties"). When this toolbar is visible, it will display the custom properties of the currently selected element or the currently inspected element (via "Go/Active Element/Closest" or Shift+A).

When the "Only" button next to it is pressed, the property shown can be used as a criterion in the selection. The concepts involved in custom properties are explained in a separate document, but below is an example which will select all elements that have a component name:



Note that the "Only" button is pressed and the box contains "_Component_Name=?".

If at this point one does a global selection ("Select/Global/New" or V), all the elements that have a component name (any name, since "?" matches all names) will be selected.

There is also a separate command to select components: "Select/Components". The dialog that comes up shows all component names (or types) in two panes.

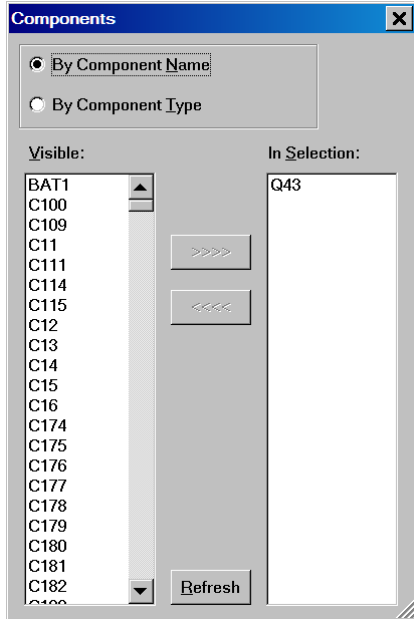
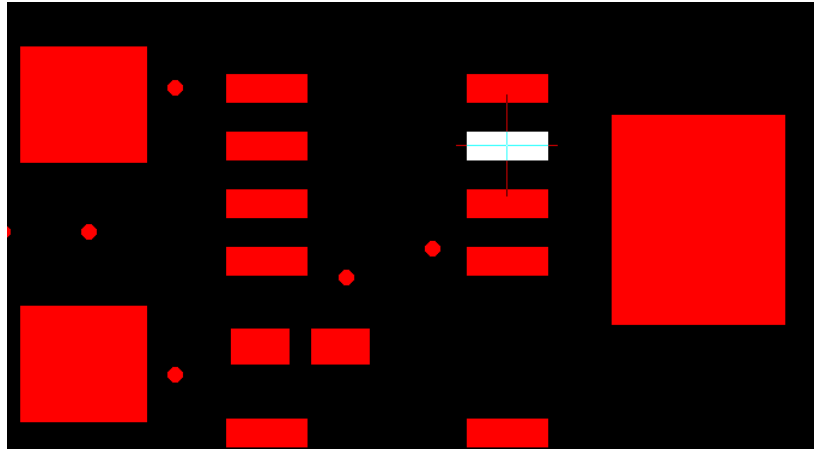
The left pane, labeled "Visible" shows all components that are currently visible.

The right pane, labeled "In Selection" shows the components that have elements in the selection (if any).

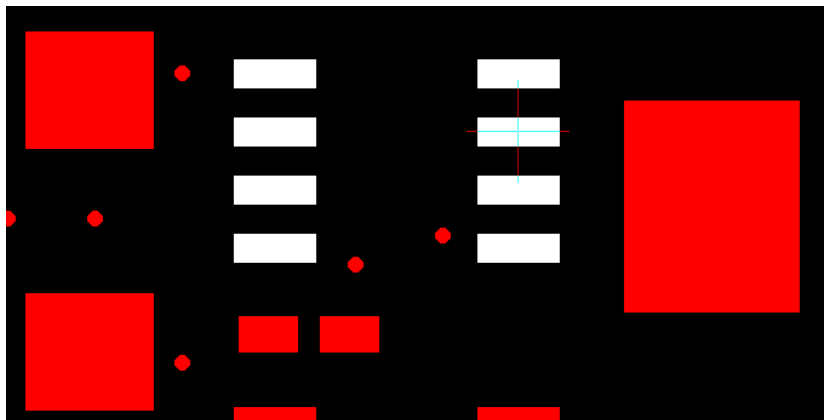
One can select and deselect elements of certain component names (or types) by picking the components in the panes and then clicking the buttons to transfer them from one pane to the other (the ">>>>" or "<<<<" buttons). This dialog will stay up until closed and one can have access to the main view at the same time. However, it does not refresh automatically when changes are done to the main view. If a refresh is needed, please click on the "Refresh" button.

A sample sequence of steps for using component names in selecting is shown below. In this sample file a pad has been selected, by double clicking on it.

After "Select/Components" the following dialog comes up:



It shows that the selected pad had component name "Q43". If we now want to select all elements with this component name, we can pick "Q43" from the "Visible" pane and then push ">>>>". Alternatively, we can pick "Q43" from the "In Selection" pane (because it is easier to find) and then transfer focus to the view (by clicking on it, or via Ctrl+PgUp) and do a global select (V). The selection is shown below, with all pads of this component selected.



Note that one could have used the selection frame to select these pads also. And finally, when doing a selection inside the "Select/Components" dialog, the "Only" buttons are also taken into consideration, so one can limit the selection to specific layers, D Codes, etc.

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