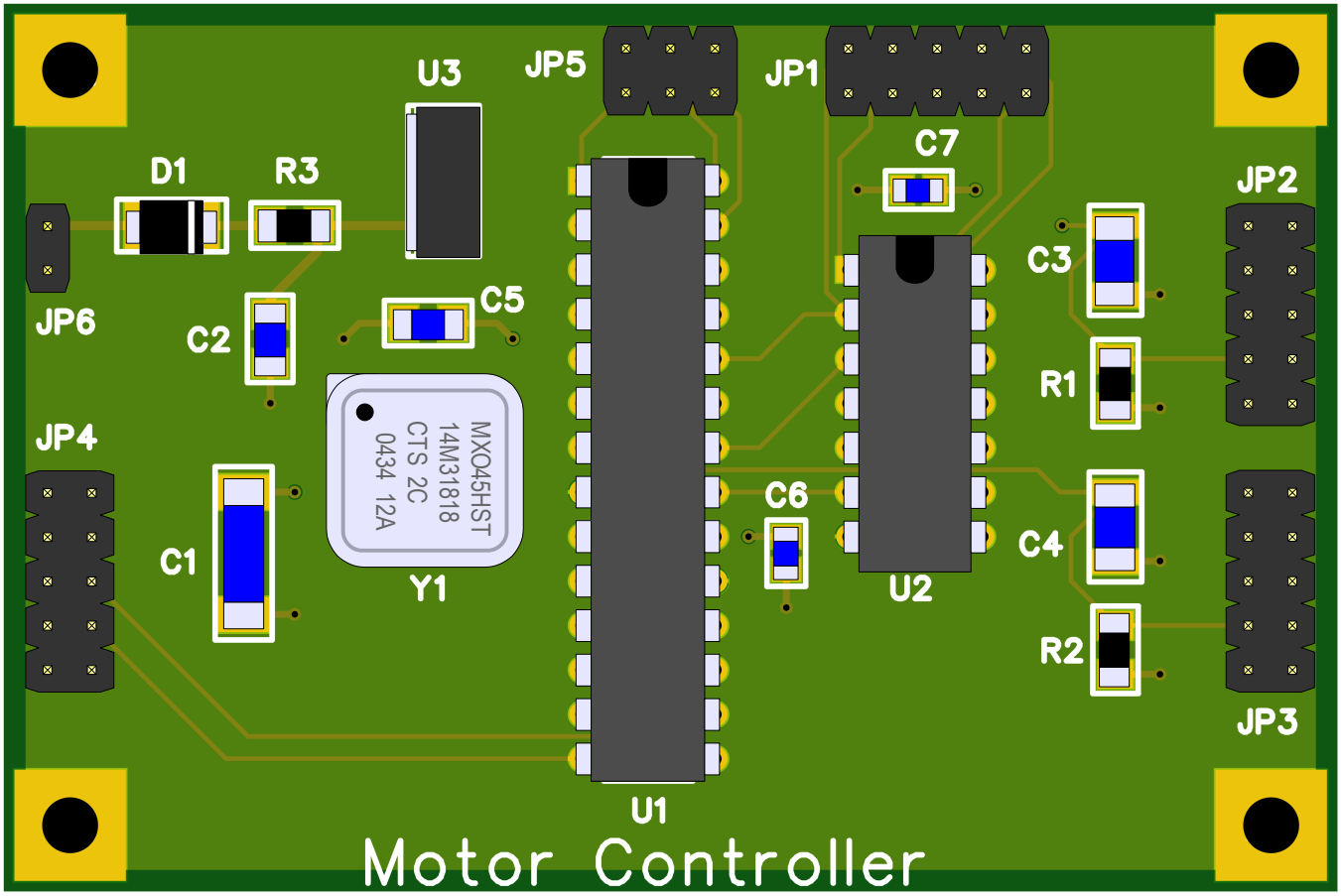
Application Note 101 - PCB Assembly Graphics in a Few Easy Steps



With this updated Application Note I will outline how to create an Assembly Graphic from existing board data. A few tools, all free are needed for this task:

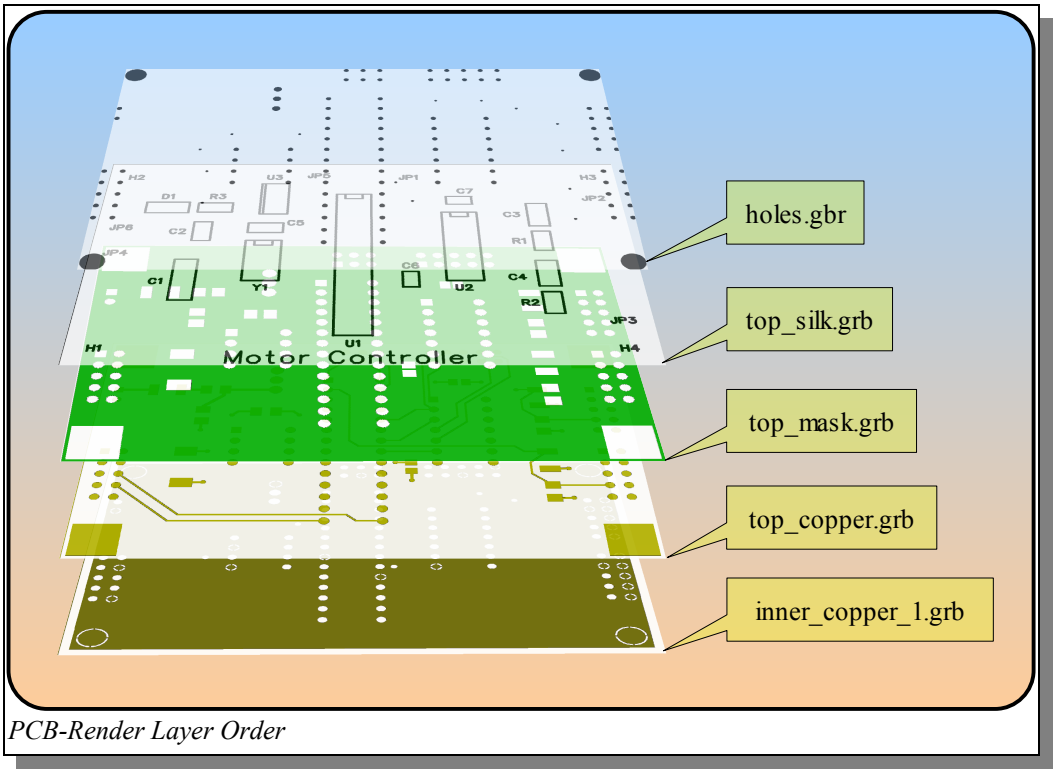
1. A PCB layout tool that generates RS-274X and Excellon data (FreePCB V1.307)
2. A means to convert Excellon drill data into RS-274X (FPCfab V1.20)
3. A multilayer Gerber renderer (PCB-Render V0.8.2)
4. A drawing tool with bit map graphics import (OpenOffice 2.0.2 Draw)

Since I wrote the original version of this note a few days ago, I familiarized myself with Guillaume Rosanis' excellent PCB-Tools tool set. The PCB-Render tool has the capability of directly producing high resolution graphics that far exceed the resolution I was able to achieve by Gerber viewer screen captures. In fact, with the proper settings in the job file, PCB-Render can output a graphic file ready for import in OpenOffice Draw without any editing. Zoom in on the graphic above and compare the detail to the illustrations on pages 4 and 11.

The only thing missing was a way to display the holes. Fortunately, FPCfab has all the information needed to output a Gerber version of the hole data. I quickly added an option to FPCfab to do that and the chain was complete.

FreePCB, FPCfab and PCB-Render can all be found at	http://www.freepcb.com/
OpenOffice can be found at	http://www.openoffice.org/

Step 1: Create the Board Image

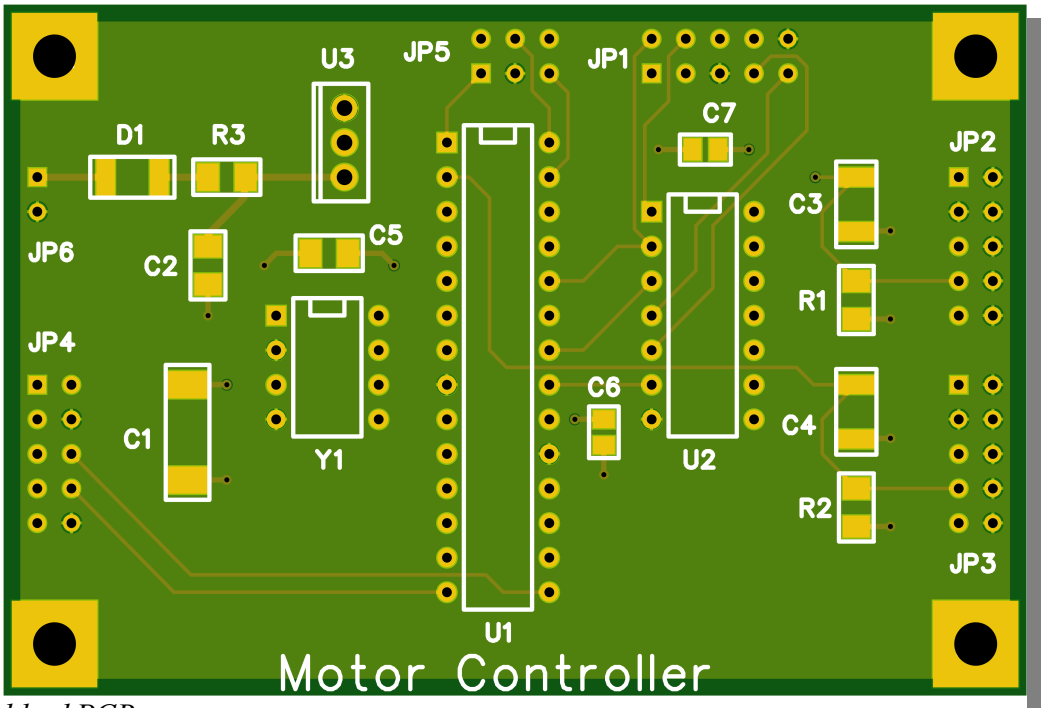


PCB-Render Layer Order

Generate Gerber with FreePCB to include the *Board Outline* but no *moires* or *layer description text*. Set the outline line width 0.001 inch.

Run FPCfab with the -G option to generate the holes.gbr: *FPCfab -ttop_silk.grb -gholes.gbr*

Now run PCB-Render to create the board graphic: *PCB-Render assy.pcbjob -o blankPCB.png*



blankPCB.png

Step 2: Create the *Assembly Drawing*

The next phase will use *OpenOffice Draw* to add graphic objects to the board image.

Open *Draw* and start a new drawing. Some setup steps are needed before anything else is done.

The new drawing starts with three default layers: Layout, Controls and Dimension Lines. Because two of these layers, Controls and Dimension Lines, have special properties that we don't want, we will leave them unused and add a fourth layer to hold the board image. To add a layer, place the cursor over the layer tabs, below the drawing area and to the left, and right click to bring up the layer menu. Click on **Add Layer** and name it *Bd Image*. A new layer tab called Bd Image will appear.

Next, with the cursor in the drawing area, right click to bring up the menu and click on **Page** and **Page Setup**. If necessary, click on the **Page** tab to bring it to the top and set the **Paper Format** to **Letter**, *8.50* by *11.00* and **Portrait**. Set all four **Margins** to *0.25* inches. This will produce a work area 8.0 inches wide.

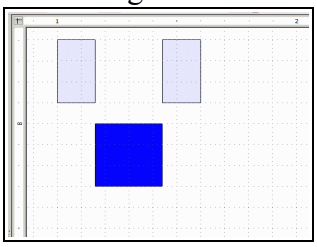
The final setup step is to set the snap grid. Right click within the draw area and click on **Grid**. Make sure all three items **Visible Grid**, **Snap to Grid** and **Grid to Front** are *checked*. Click **Tools > Options...** to open the Options window,expand the **OpenOffice.org Draw** entry and click on **Grid**. Make sure the **Synchronize Axis** box is *checked*. Set **Resolution** to *0.10* and **Subdivision** to *4*. This will give a 0.020 inch snap grid. If the grid marks are too faint for your taste, expand the **OpenOffice.org** item, at the top, and click on **Appearance**. Scroll down to **Drawing/Presentation,** about ¾ of the way down, and tweak the **Grid** color to your liking. When you are finished playing, click **OK** to save and close the options window.

The first thing to do is to import, position and protect the board image on the Bd Image layer. Click on the Bd Image layer tab and click on **Insert>Picture>From File** to open the **Insert Picture** window. Browse to the board image created in Step-1, highlight it and click open. After the board image appears, it should be selected. If it is not, click within the image to select it. Now, right click within the selected image and click on **Position and Size...** . First, make sure **Keep ratio** is checked. Next, set **Width** to *8.00*, **Position X** to *0.00*, **Position Y** to *1.00* and check the **Protect Position** box. This will scale, position and lock the image to the layer. Hit OK to close the window. Right click on the Bd Image layer tab and click on **Modify Layer...** to open the **Modify Layer** window. Make sure all three properties **Visible**, **Printable** and **Locked** are checked and hit OK. The whole layer is now locked.

Drawing Toolbar

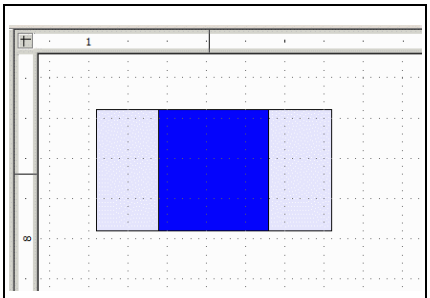
Now the fun stuff. Move to the Layout layer and zoom to an area roughly 2x2 inches somewhere below the board image. First some generic 2-pin chip parts. On the Drawing toolbar, at the bottom of the screen and to the left, find and click the **Rectangle**  tool.

Now click and drag a rectangle *0.30* high by *0.16* wide. Right click within the new rectangle and select **Area**. Change the area color to *Blue Gray* and hit **OK**. With the rectangle still selected, hit *Ctl-C* and *Ctl-V* to make a new copy. Click and drag the new copy *0.44* to the right. Make another rectangle 0.30 x 0.28 and change its color to light blue.



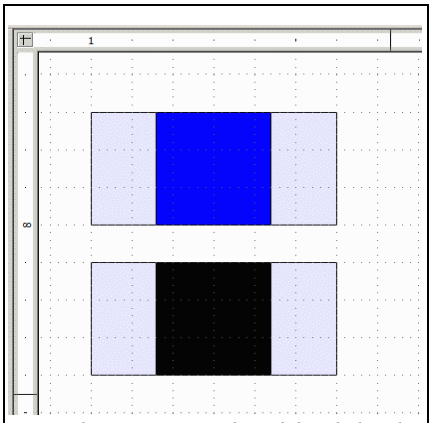
At this point, the rectangles should look something like the illustration at the left.

Click and drag the larger rectangle into alignment with the two smaller ones to complete the component geometry.



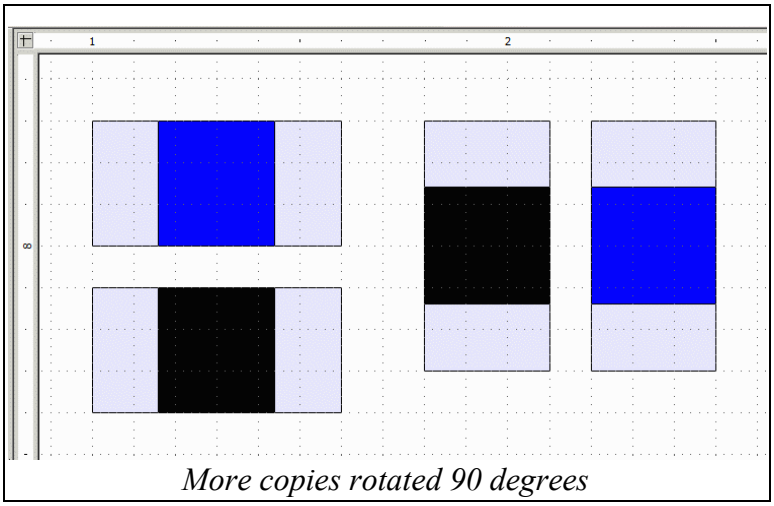
Finished Generic Part

The final step is to group all three rectangles together. To do that, click and drag to select all three, right click to open the context menu and select **Group**.



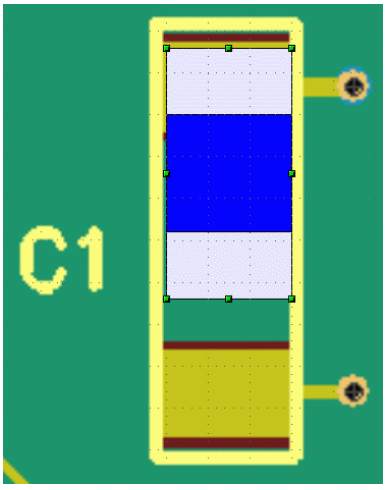
Another part with a black body

Next, make a copy of the part and slide it down below the original. While the new part is selected, right click and select **Enter Group**. The other parts will pale and any component within the group can now be accessed. Select the center and change its color to black. Unselect the part by clicking outside. Right click and hit **Exit Group** to get back to the drawing.

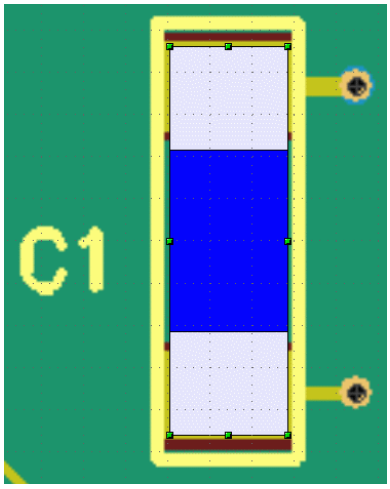


More copies rotated 90 degrees

Make a new copy of each part and slide it to the side. Select one of the new parts, right click and select **Position and Size**. Open the **Rotation** tab and enter *90.00°*. Hit OK to exit and rotate the part. Rotate the other part the same way.

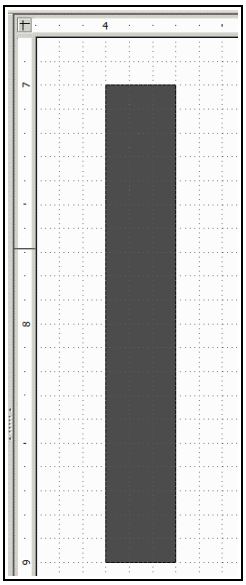


Position a copy of the Vertical Blue centered “Cap” part over the **C1** pads.

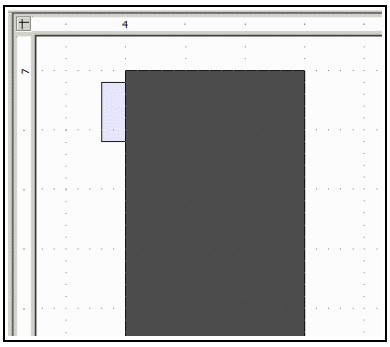


Grab the lower right knob and resize the part to fit the pad pattern.

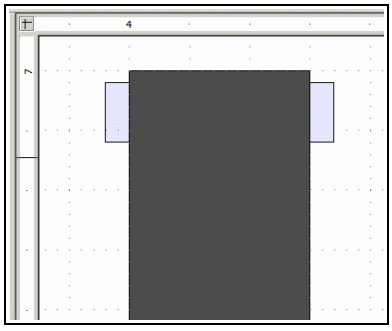
In like fashion, populate the other 2-pin “Blue” Cap and “Black” Res chip components.



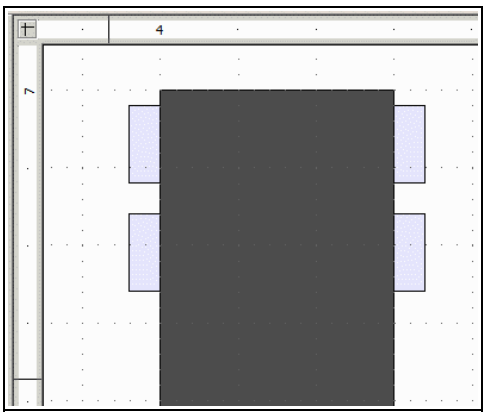
Moving on to chips, make a *70% Gray* rectangle *0.30* x *2.00.*



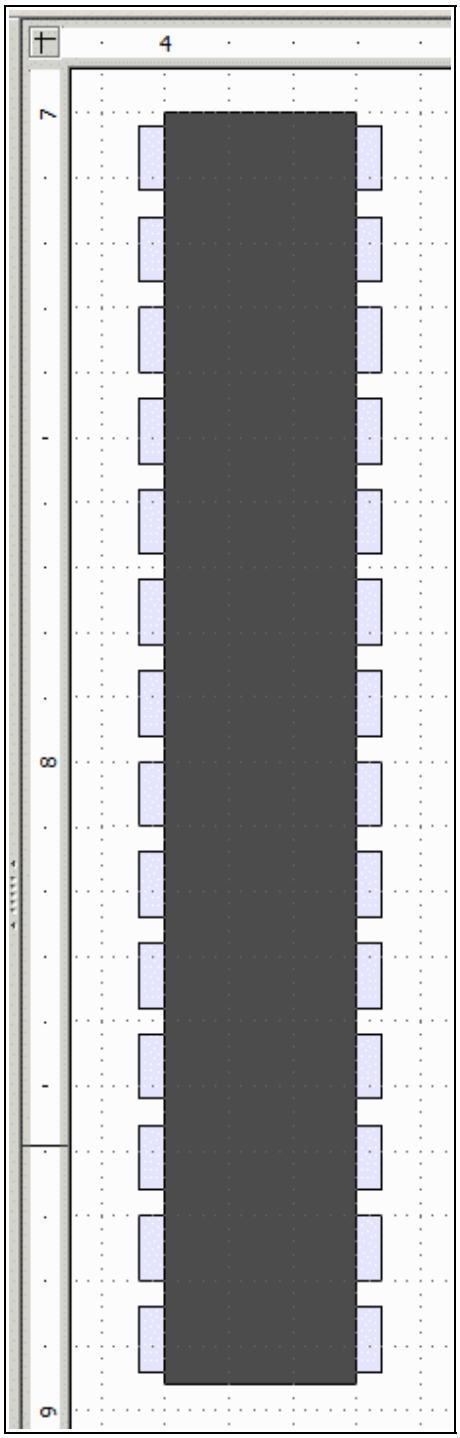
Add a *Blue Gray 0.04 x 0.10* rectangle as shown.



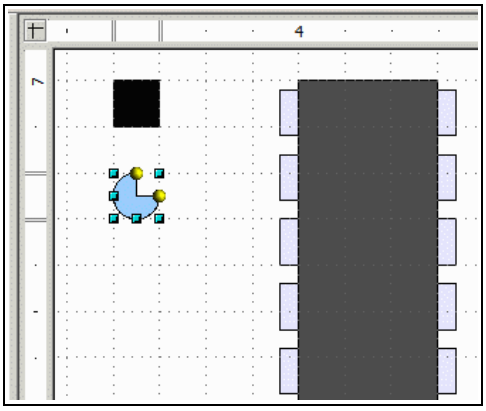
Add a copy on the right side.



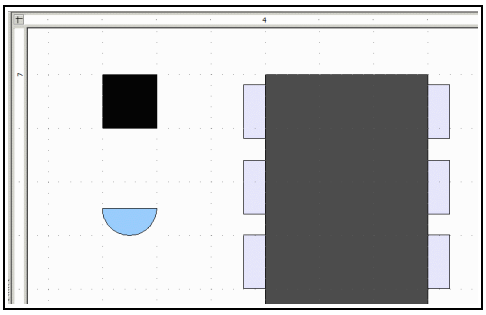
Group the two pins and make a copy. Move the copy down to form a *0.04* inch gap between pins. Ungroup both pin groups and regroup as four pins.



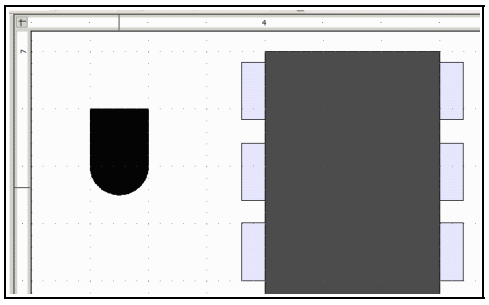
Continue copying four pin blocks until there are fourteen pins on each side. Shorten the body bottom 0.04 inches to match the top. Ungroup all groups.



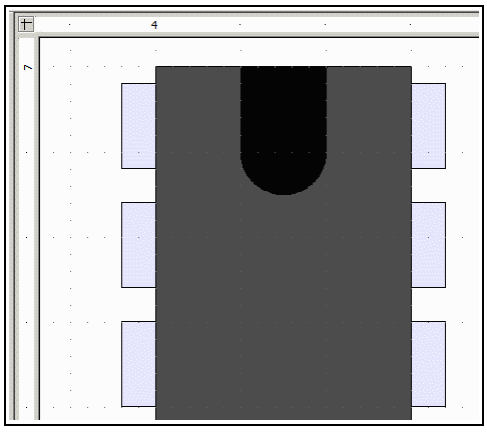
Make a black *0.10 x 0.10* rectangle. On the Drawing toolbar, find and open the Basic Shapes menu, along the bottom, by clicking the down arrow. Select the "Pie Circle" shape. Create a *0.10 x 0.10* pie circle as shown.



Grab the gold knob at 12 o'clock and swing it around to 9 o'clock to form a semi-circle. Change the color to Black.

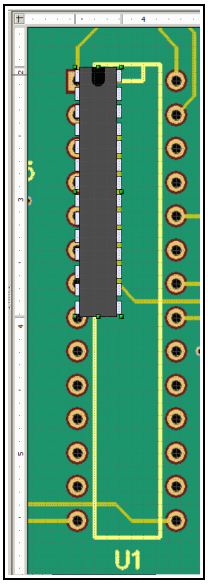


Move the semicircle up to join the square and notice that they don't match. "Long Click" the semicircle to position it, independent of the snap grid, until a good fit is found. (A bit of trial-and-error here.) Group the two figures.

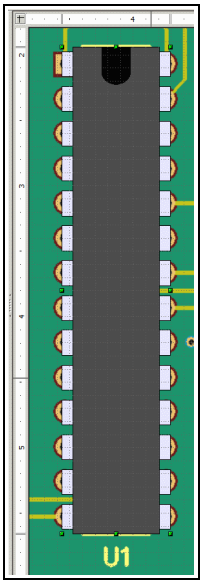


Center the new group on the top of the chip as shown and ungroup.

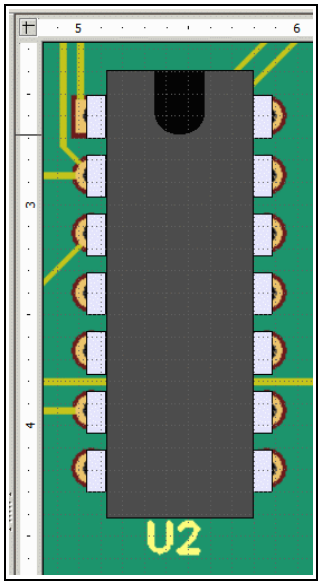
Select and group the whole component.



Move a copy of the new part over the **U1** pattern.



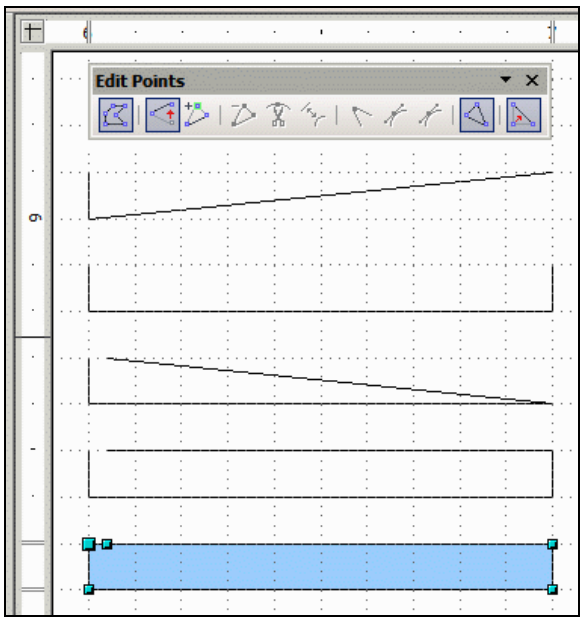
Grab the lower right knob and stretch the part to fit the pad pattern. Continue moving and resizing until the part matches the pad pattern. Remember to use “slow click” to position off grid.



Ungroup the original part and convert it to 14-pins by selecting and deleting the bottom 14 pins. Resize and position the body as shown. Regroup the part and move it over the **U2** pin pattern. Resize and position as needed to fit the pad pattern.

Pin headers next. On the Drawing toolbar, click the **Points** icon  to toggle it on.

Click the **Draw Line** icon  and draw a 1.00 horizontal line.



With the line selected, the **Edit Points** toolbar should appear. If it does not, open **View>Toolbars** and make sure *Edit Points* is checked.

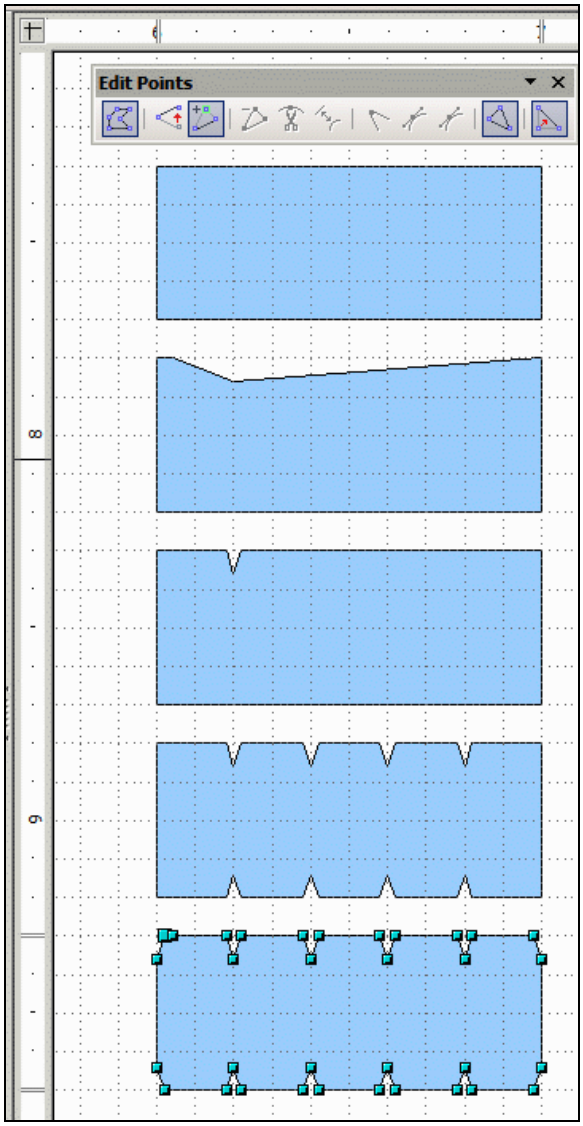
Click on **Insert Points** and **Eliminate Points**. Click in the line and drag the new point down and below the left point.

Add another point below the right point.

Drag the upper right point over near the upper left.

Add another point to replace the upper right point.

Click **Close Bézier** to convert the polyline into a polygon.



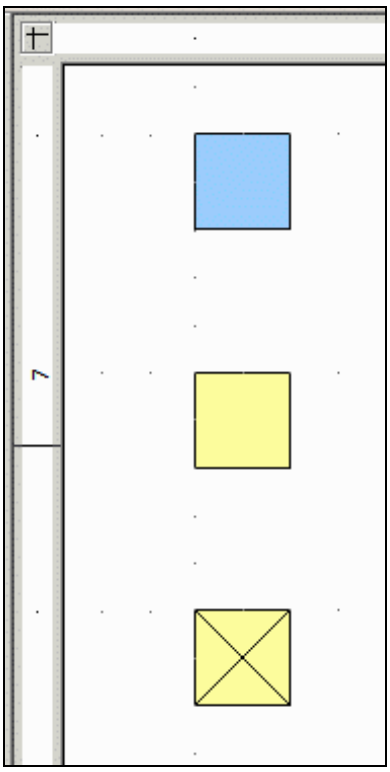
Stretch the polygon height to *0.40*.

Add a notch to the top *0.20* from the left by adding a point *0.06* below the top edge.

Add points *0.02* to each side of the first point to finish the notch.

Continue adding notches every *0.20* along the top and bottom.

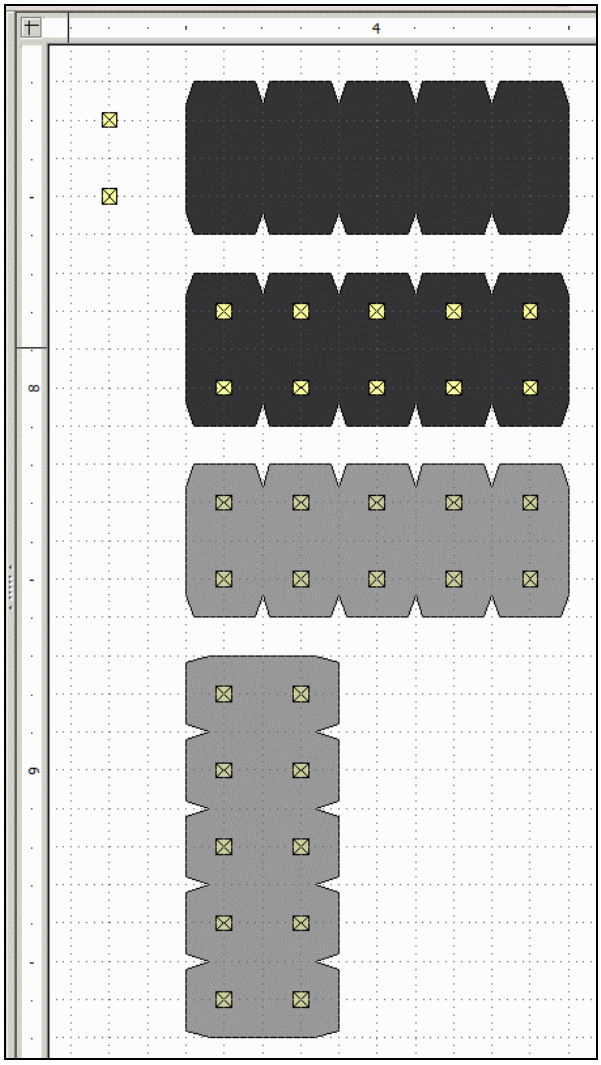
As a final touch, add half-notch chamfers to all four corners.



Pins are easy. Make a rectangle *0.04* x *0.04*.

Change its area color to *Yellow-2*.

And add diagonal lines.



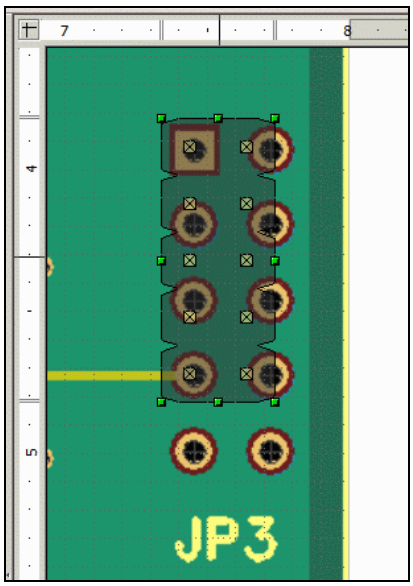
Place a copy of the pin *0.20* below it and group the the two pins.

Place copies of the group over the header body at *0.20* intervals.

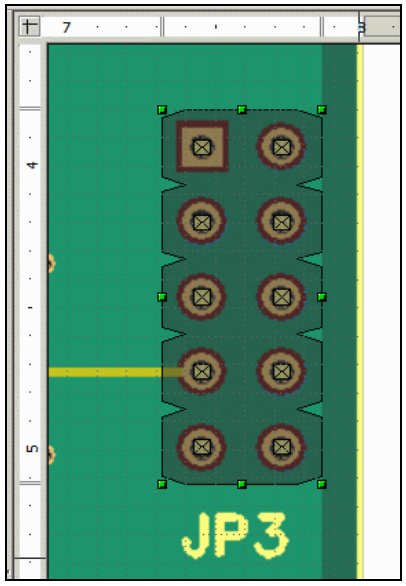
Group the body and pins to finish the header.

Enable the groups Area Transparency. The default *50%* should be fine.

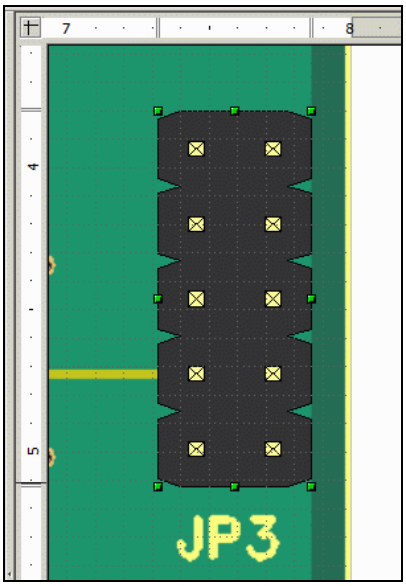
Make another copy rotated *90°*.



Position a copy of the vertical header over the **JP3** pad pattern.

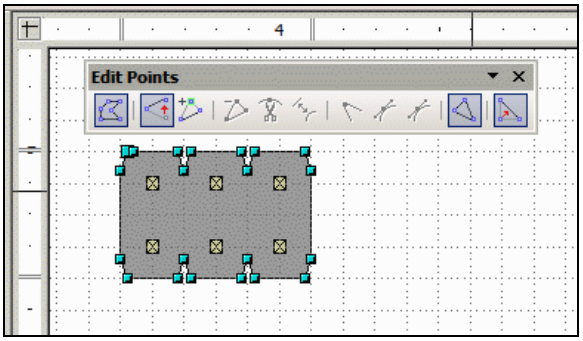


Stretch and reposition the header until it lines up with the pads.



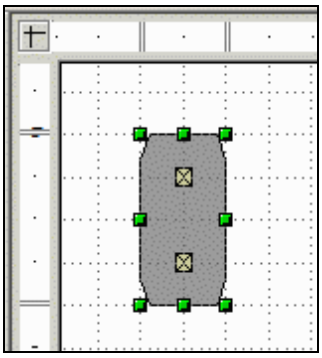
Turn off transparency to finish the part.

Use the same process to handle the other three 10-pin headers **JP1**, **JP2** and **JP4**.

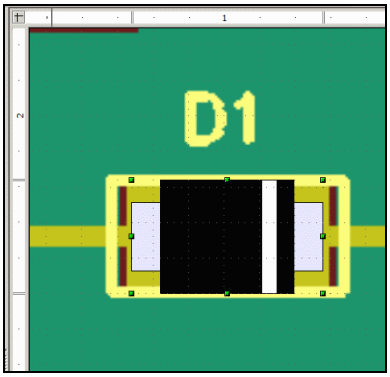


Convert the 10-pin master header into a 6-pin header by ungrouping the part, deleting four pins and, by *Eliminating Points*, shrink the body. Regroup to finish.

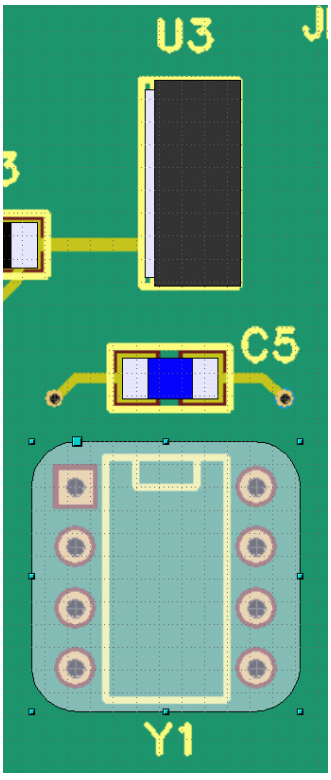
Place a copy over the **JP5** pads and fit it in as before.



Repeat the process one last time to make the 2-pin header for **JP6**.



For **D1**, place a copy of the black "Res" part on the **D1** pattern and ungroup it. Shrink the pins and fatten the body section. Add a thin white rectangle over the body. Regroup the part and fit it to the pads.

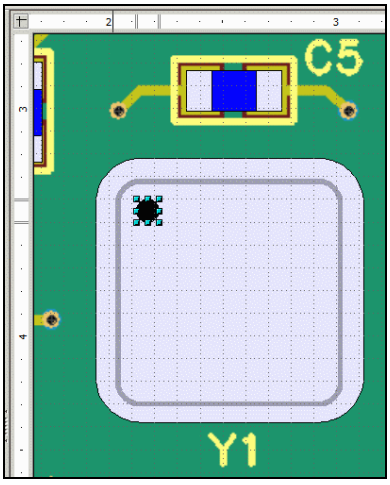


At this point only **U3** and **Y1** remain to be done.

U3 is just two rectangles: the larger body rectangle is *Gray 80%* and the smaller tab rectangle is *Blue Gray*.

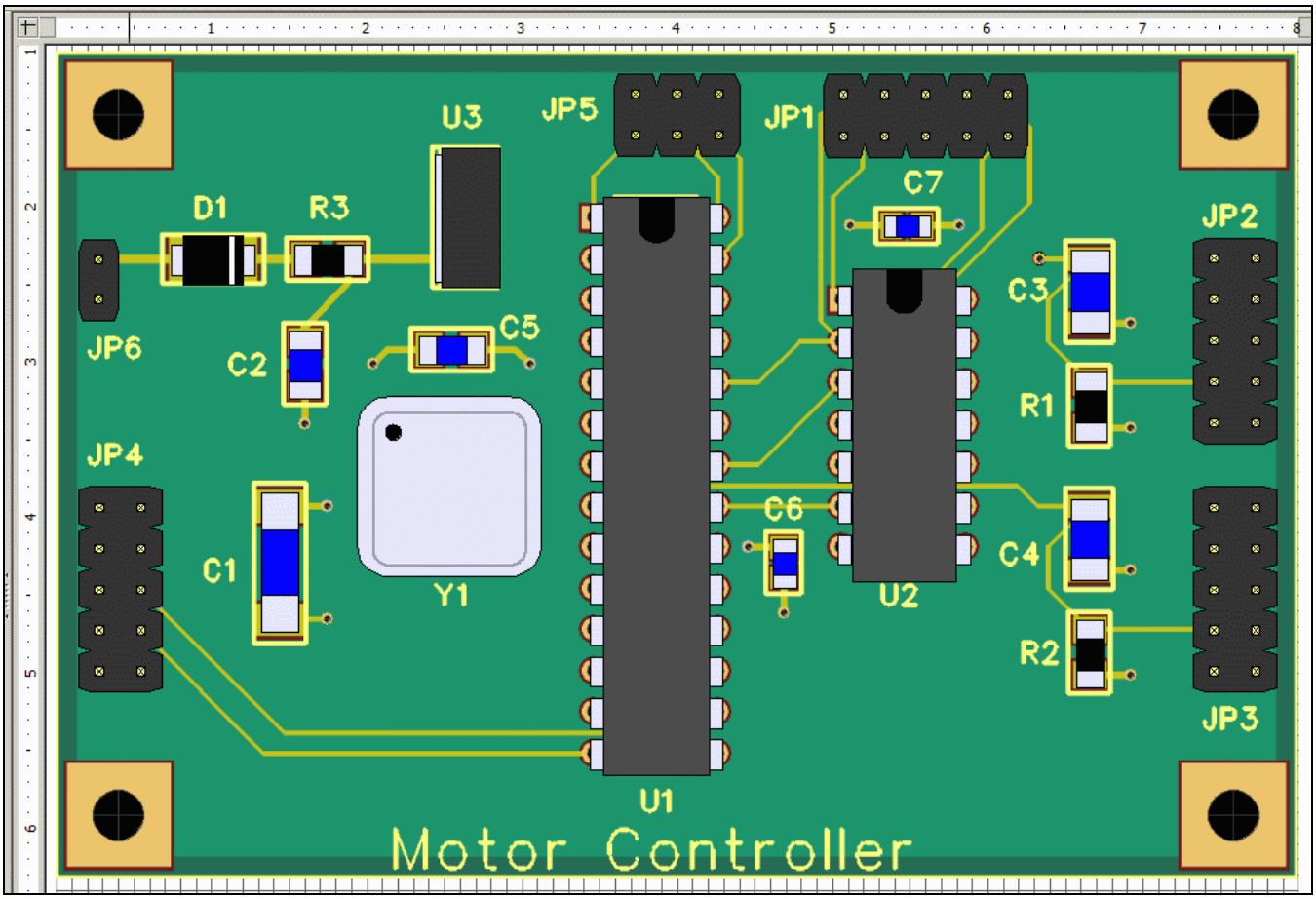
Place a rectangle over the **Y1** pattern. Set the area transparency to *50%.* Open the **Slant & Corner Radius** tab on the **Position and Size** menu and set **Corner radius** to *0.20*. Adjust the edges so the pads are roughly located in the center of the corner arcs. Change the color to *Blue Gray*.

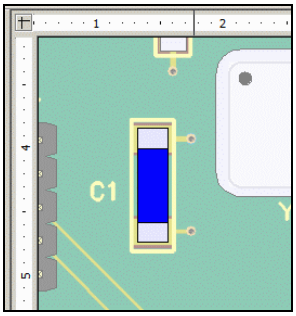
Add another *Blue Gray* rectangle inside the first. Set its corner radius to *0.10* and the Line Width to 0.02 with 70% transparency. Adjust the edges so the corner arcs appear concentric.



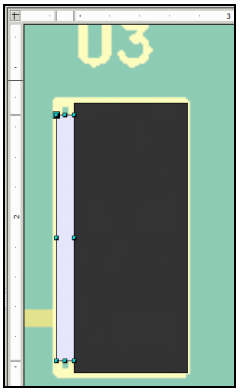
For a final touch, add a Black 0.10 diameter circle in the pin-1 corner.

Now let's step back and take a look at the whole board to see if anything is obviously wrong. First off, C1's pins are bigger (longer) than the pads. U3's tab is too thin and Y1 looks so empty and a bit strange. Let's fix these.



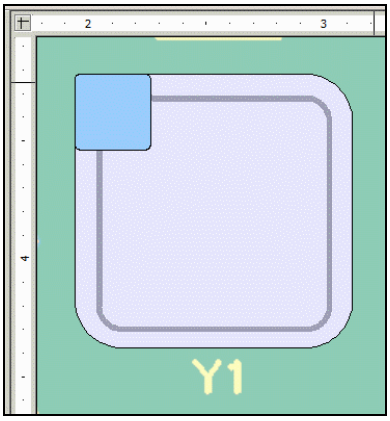


Select **C1** and *Enter Group*. Shorten the ends so they fit on the pads and stretch the center to match. Unselect (click outside the part) and *Exit Group*. So much for **C1**.

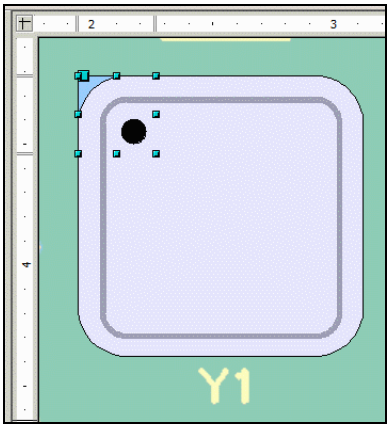


Enter the **U3** group, widen the tab to *0.06* and exit.

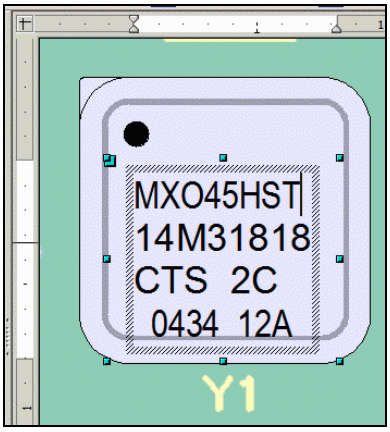
Using the CTS MXO45 data sheet as an example, the product photo on Pg-1 reveals that the outer package consists of two pieces: a metal base and a lid. While the lid has four equally radiused corners, the base has a much smaller radius on the pin-1 corner. We need to add the base.



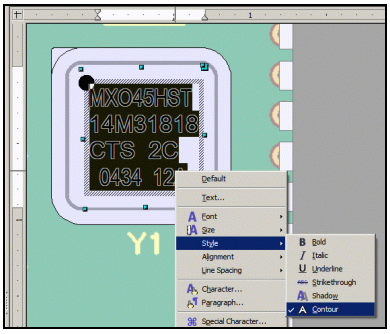
Enter the **Y1** group and add a rectangle that fully covers the package radius and is lined up with the top and left edges. Set the new rectangles corner radius to *0.02*.



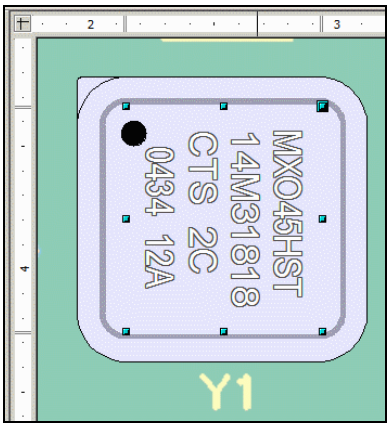
With the new rectangle selected, right click and select *Arrange*. Now hit *Send Backward* to move it back one layer. Do this two more times to place it under the package then change its color to Blue Gray so it matches the rest of the part.



The photo and data sheet also give a hint on how the part is labeled. Open a text box and select *11pt Arial Narrow* font. Enter the text something like what's shown. In the photo, the top and bottom lines appear to use a narrow font but the two middle lines are wider. Select the two middle lines of text and change the font to *Arial*. Now the text proportions match the photo fairly well but the text is still too bold.



With the text selected, right click, select *Style* and hit *Contour*. With the text still selected, right click again and select *Character...* to open the **Character** window. Hit the **Font Effects** tab and change the **Font Color** to *Gray 70%*.



Click outside the part to end text edit and unselect the text. Click once on the text to select the text item. Use **Position and Size** to rotate the text *270°*. Position the text symmetrically on the package.

That about does it.

Version 2 note: only the graphics on pages 1 and 2 have been updated. All other illustrations that include all or part of the PCB are using the older “screen capture” graphic of the blank pcb.

Appendix A – PCB-Render job file

Here is a copy of the job file used in the example on Pg-2.

file: assy.pcbjob

```
# PCB-Render job file for top assembly drawing

GLOBAL
{
   DPI = 1600;            # do high res
   AA = 0;                # maximize resolution
   MARGIN = 0.0;          # crop right at the outline
   MIRROR = FALSE;
}

BACKGROUND
{
   COLOR = 0.094,0.455,0.055;  # dark green background to handle the borders
}

LAYER
{
   GERBER = inner_copper_1.grb;
   ALPHA  = 1.0;
   COLOR = 0.573,0.753,0.028;
}

LAYER
{
   GERBER = top_copper.grb;
   ALPHA  = 1.0;
   COLOR = 0.925,0.769,0.047;
}

LAYER
{
   GERBER = top_mask.grb;
   COLOR = 0,0.2,0.1;
   INVERT = TRUE;
   ALPHA = 0.45;
}

LAYER
{
   GERBER = top_silk.grb;
   COLOR = 1,1,1;
}

LAYER
{
   GERBER = holes.gbr;
   COLOR = 0,0,0;
}
```