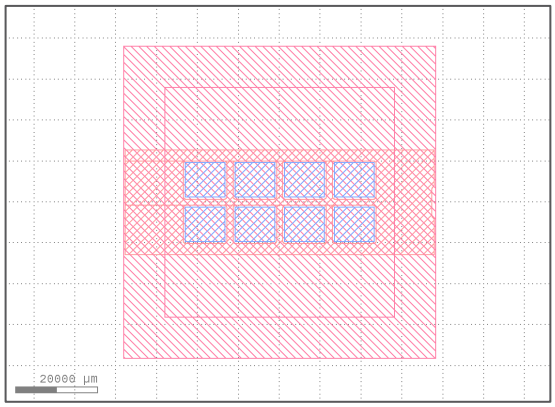
Photomask Layout Creation for the ibidi Micro Illumination System



Microstructuring with the ibidi Micro Illumination System requires a custom-designed 3-inch photomask containing the desired pattern. Photomask layouts can be generated using various design tools, depending on the experimental requirements.

This Application Note provides a step-by-step workflow using the free software KLayout Editor and an ibidi template for the µ-Slide 8 Well ^{high}. The resulting layout includes arrays of circles as well as an ibidi logo motif positioned within the recommended pattern area.

The finalized design is exported in the **GDSII format**, which is the industry standard file type used by commercial photomask manufacturers such as Compugraphics.

Related Documents

- Instructions ibidi Micro Illumination System (PDF)
- Application Note 72: RGD Micropatterning Using the ibidi Micro Illumination System for Spheroid Generation and Cultivation (PDF)
- Application Note 73: 2D Whole Protein Pattern Based on a PLL-PEG-Passivated Coverslip Surface Using the ibidi Micro Illumination System (PDF)
- Application Note 74: 3D Hydrogel Constriction in the µ-Slide I Luer Using the ibidi Micro Illumination System (PDF)
- Application Note 75: Structuring a Photoresist-Coated Wafer With Photolithography Using the ibidi Micro Illumination System (PDF)
- Photomask Templates (ZIP)

1 Software

- KLayout Editor (version 0.29.11 or higher)

2 Importing Labware Templates Into KLayout Editor

Important Note: Labware Templates

The ibidi Micro Illumination System uses 3-inch photomasks. Therefore, all provided templates comply with these dimensions.

Because the alignment accuracy between the photomask and the labware is finite, the recommended pattern area includes a defined safety margin around the actual well or channel dimensions. This ensures that the illuminated pattern remains fully within the intended well or channel during exposure.

The labware templates are provided in **GDSII format**. Most photomask manufacturers also support additional formats, such as **Gerber** and **OASIS**.

1. Open the KLayout Editor.
2. Import the specific labware template, which you can find here.
3. Make sure that the “Mask_Base” cell is displayed in bold in the left panel.
4. Verify that the labware area and the recommended pattern area are correctly visualized and displayed on their respective layers (see Figure 1).

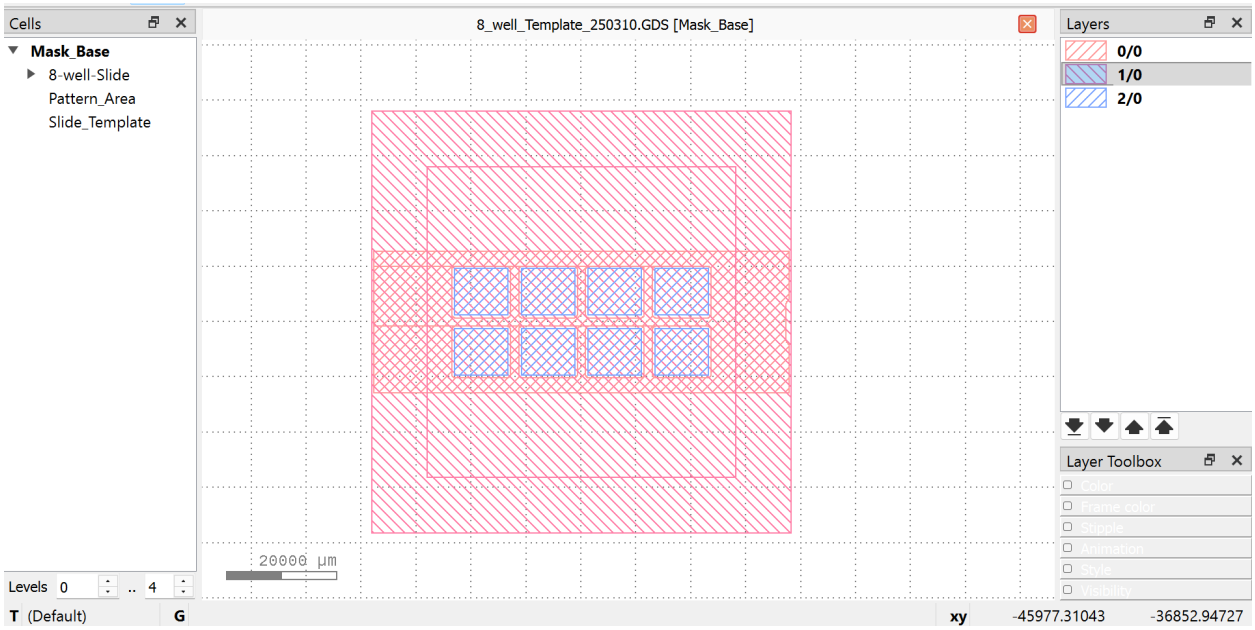


Figure 1: Template of the µ-Slide 8 Well^{high} *on a 3-inch photomask in the GDSII format, displayed in KLayout Editor.* ***Layer 0/0*** *represents the labware outline,* ***Layer 1/0*** *displays the full 3-inch photomask area, and* ***Layer 2/0*** *indicates the recommended pattern area.*

3 Adding Geometries to the Photomask

Important Note: Drawing of Structures

This Application Note describes the workflow for generating photomask layouts using the provided template for the µ-Slide 8 Well ^{high}. The examples describe array generation with basic geometries (e.g., circles) and the import of vector graphics. More complex geometries can also be designed using the **KLayout Editor.**

1. Create a new layer by navigating to: Edit → Layer → New Layer. Make sure to create the new layer with a number (e.g., 3/0) that does not already exist.
2. Create a new cell by navigating to: Edit → Cell → New Cell.
3. Name the cell appropriately and set a suitable window size for your structures (see Figure 2).

   Note: KLayout shows the active cell only. When creating a new cell, the newly created cell is shown, and no content will be displayed until you add your geometries. To switch between the cells, right-click on the respective cell in the left panel and select “Show As New Top” (see Figure 5).
4. Right-click on the new cell and select “Show As New Top”
5. In the library, you will find various shapes such as circles and ellipses. Select circle and drag it into the center of the layout view.
6. The “Instance Properties” window opens, displaying the PCell parameters, including the current layer and the circle radius (see Figure 3).
7. Switch to the “Geometry” tab to adjust the circle dimensions and the position of the cell origin (see Figure 4).

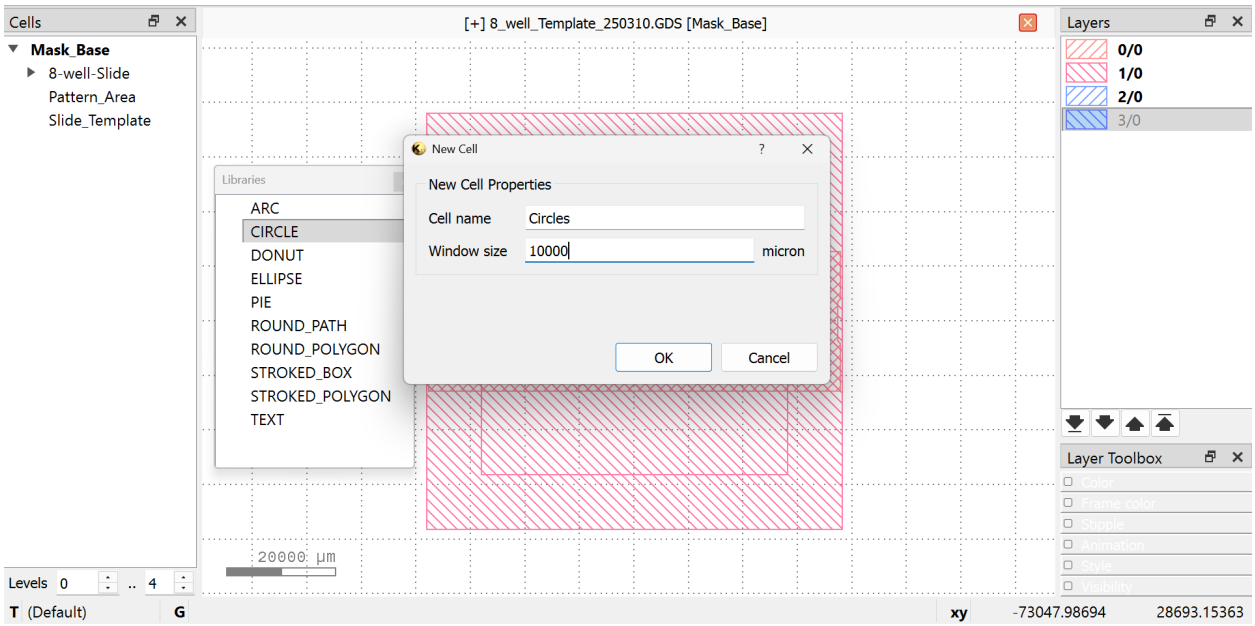


Figure 2: Creating a new cell containing the desired structure.

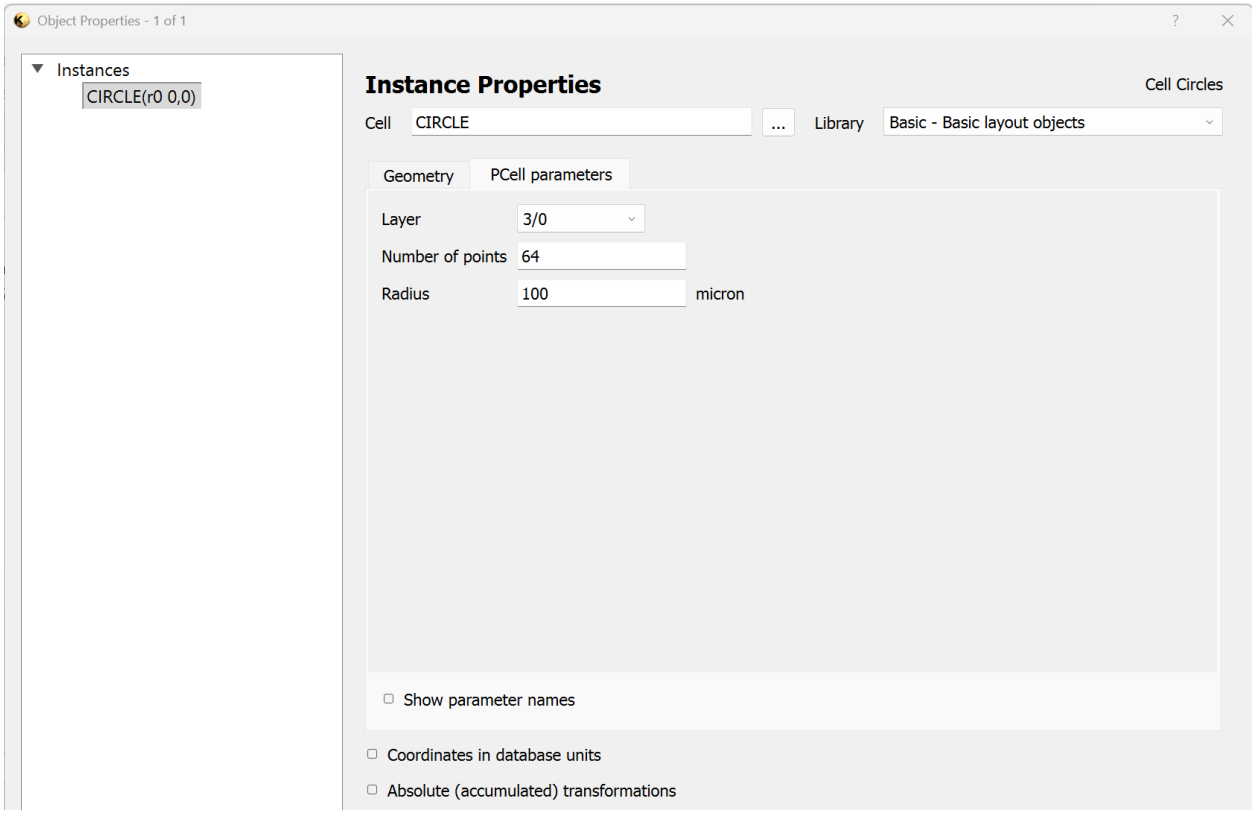


Figure 3: PCell parameters within the Instance Properties of the implemented circles.

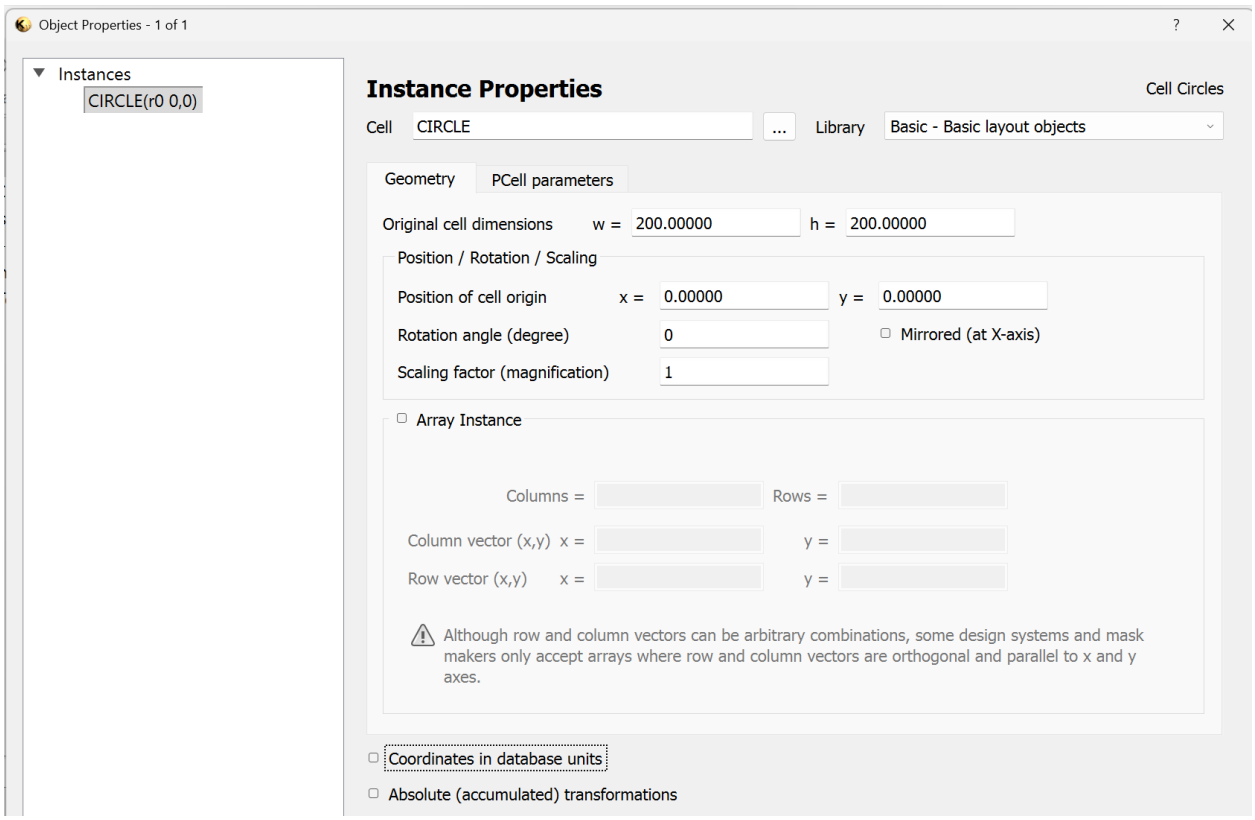


Figure 4: Geometry within the Instance Properties of the implemented circles.

8. After defining the circle geometry, confirm that Mask_Base is set as the top cell, as shown in Figure 5.
9. Drag and drop the circles cell onto the area displaying the photomask and labware.

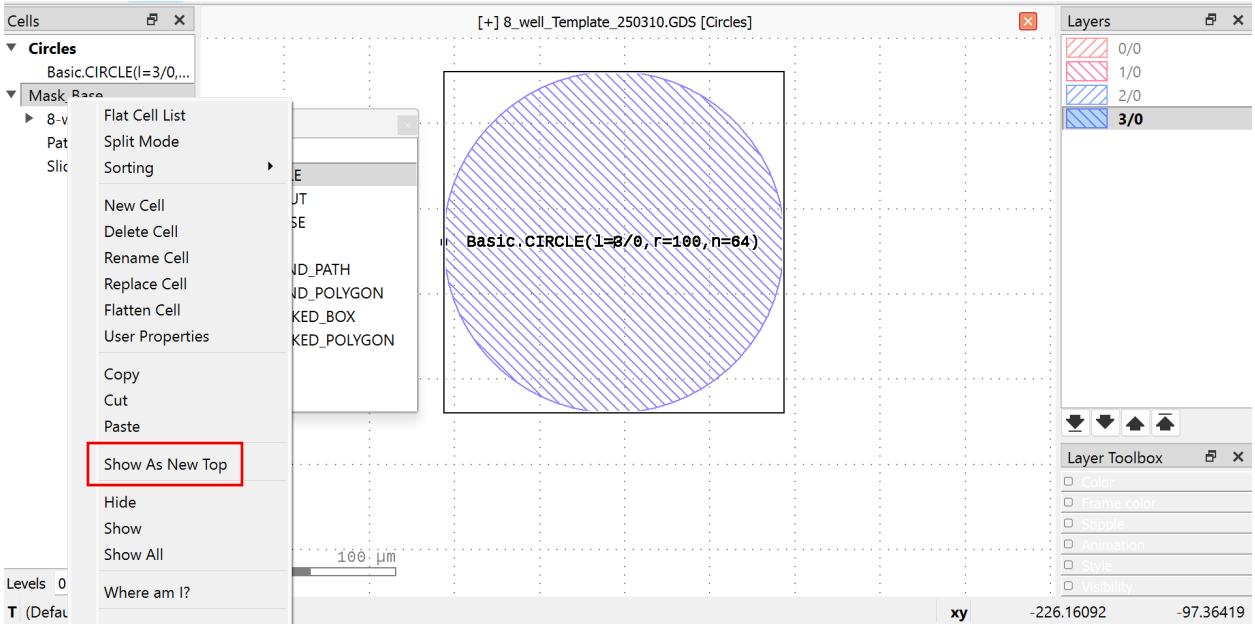


Figure 5: Management of the cells on the left side.

10. When you drag and drop the circle cell into the main cell, a dialog window will appear (see Figure 6).
11. You can choose to use a single structure within the cell or create an array of the drawn structure.
12. Arrays can be created by selecting the “Array Instance” checkbox and adjusting the number of columns and rows, as well as the spacing between each structure (see Figure 6 and Figure 7).
13. By adjusting the position of the cell origin, you can align the structures so that they match the wells of the µ-Slide 8 Well ^{high}.

    Figure 8 shows an array of circles overlaid on the labware at the original XY coordinate (0/0).

    Figure 9 illustrates the circle array adjusted to fit within the well and the recommended pattern area.

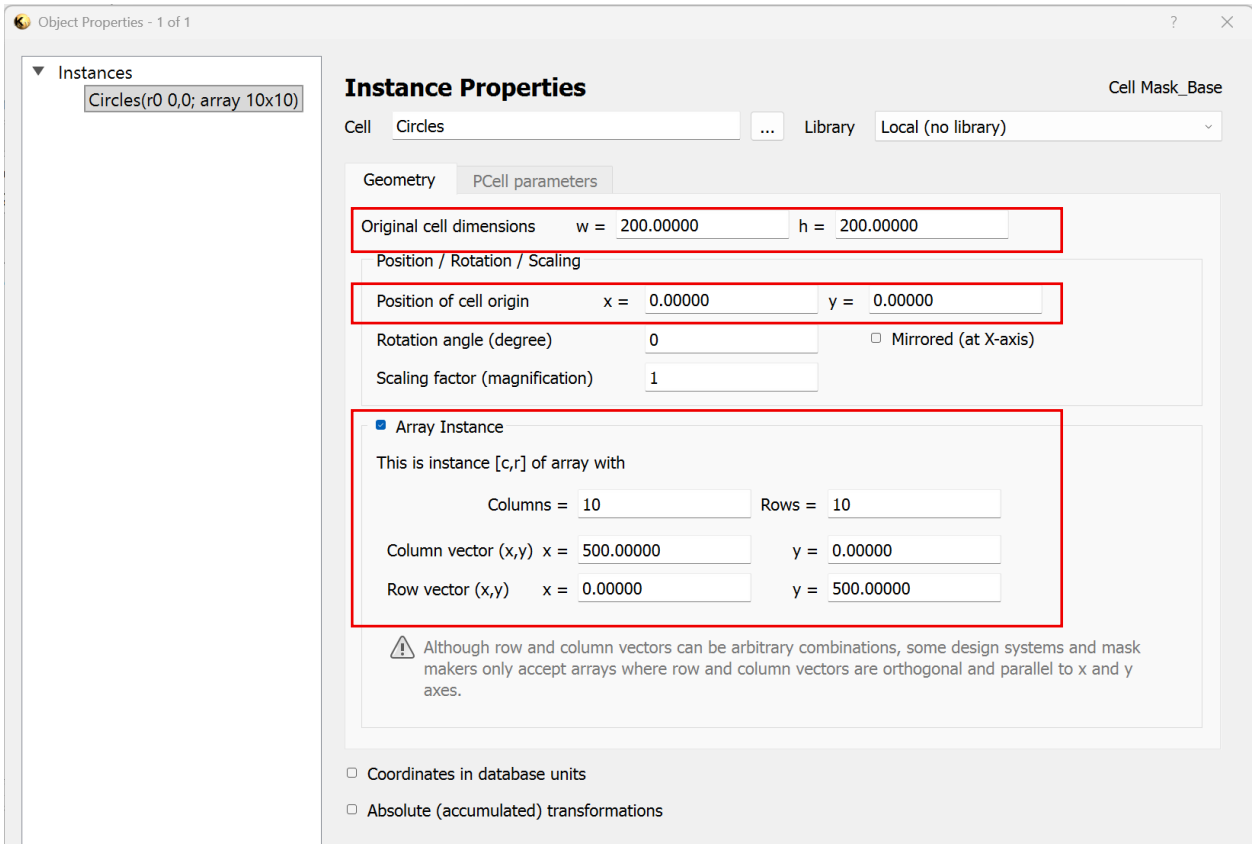


Figure 6: Adjusting the cell dimensions as well as the position of cell origin within the Instance Properties.

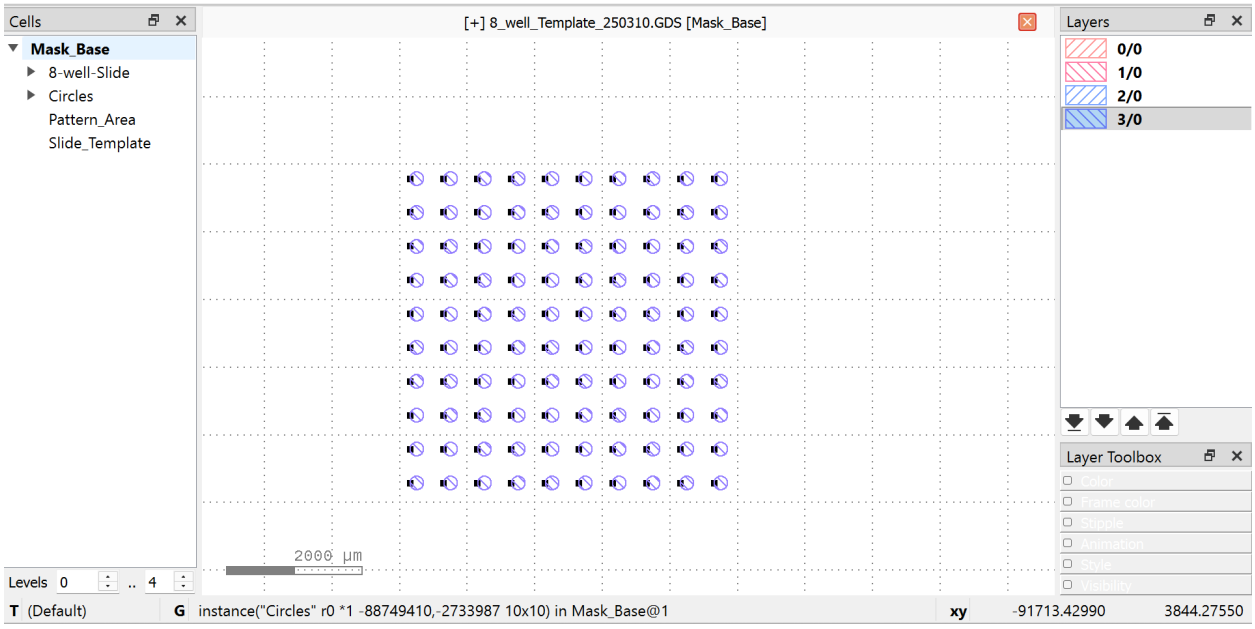


Figure 7: Illustration of a 10 x 10 array of the drawn circle structures.

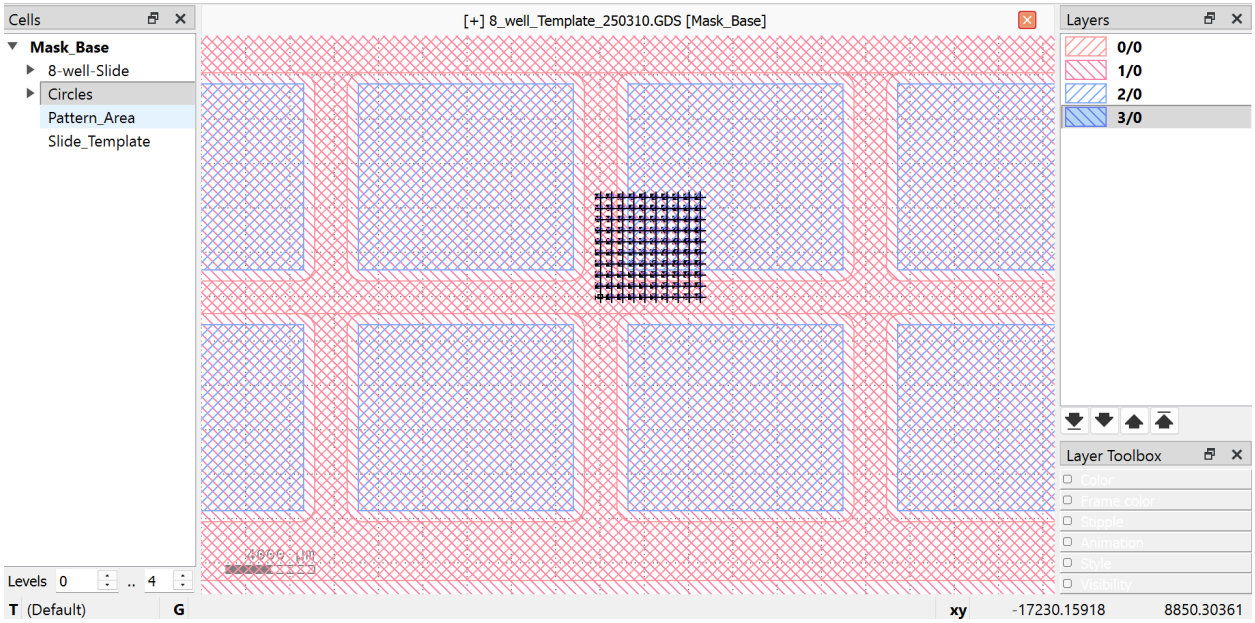


Figure 8: Array of circles overlaying the µ-Slide 8 Well^{high} *with a position of (0/0) of the array.*

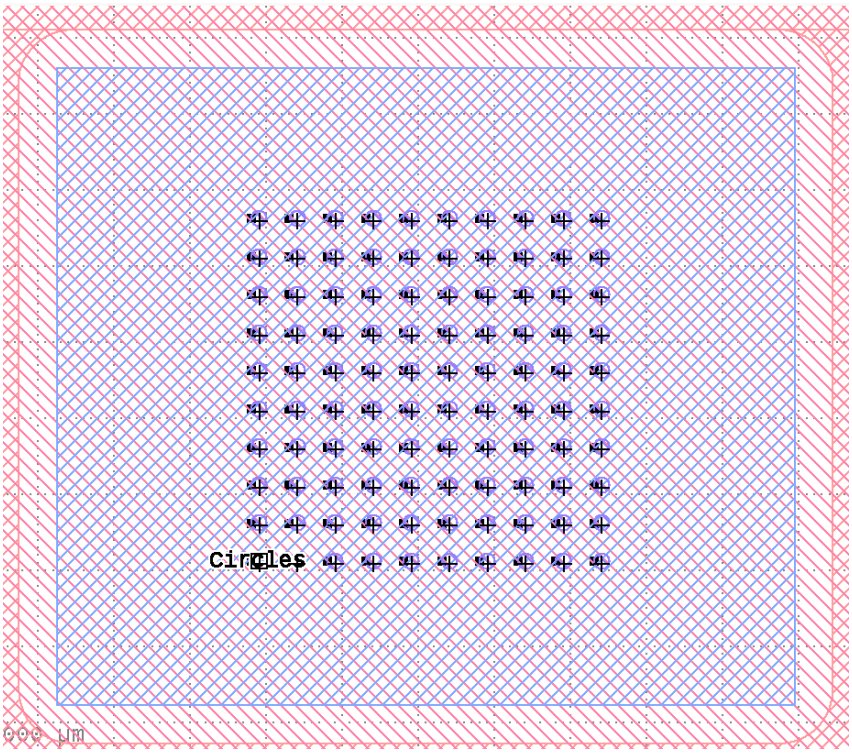


Figure 9: Adjusted array to the center of a well.

4 Import of .dxf Vector Graphics Into KLayout Editor

For more complex structures, it is recommended to create or use existing vector graphic files and import them into the **KLayout Editor**.

1. Export the desired drawing in .dxf format.
2. Drag and drop the file into the KLayout Editor.
3. The “Open Layout Options” window will appear (see Figure 10).
4. Select “Open layout in new panel”.
5. The imported .dxf file will be displayed in a new tab, for example, *HappyCell_fullEyes.dxf* (see Figure 11).
6. Select the entire drawing and copy it.
7. Switch back to the tab containing the template for the specific labware.
8. Create a new cell and name it according to the drawing (see Figure 12).
9. Assign a layer to this cell.
10. Paste the copied drawing into the cell.
11. Drag and drop the cell into the top cell.
12. In the pop-up window, you can adjust scaling, create arrays, and modify the position of the imported drawing.
13. Figure 13 shows the “Happy Cell” positioned within the recommended pattern area of the µ-Slide 8 Well ^{high} template.

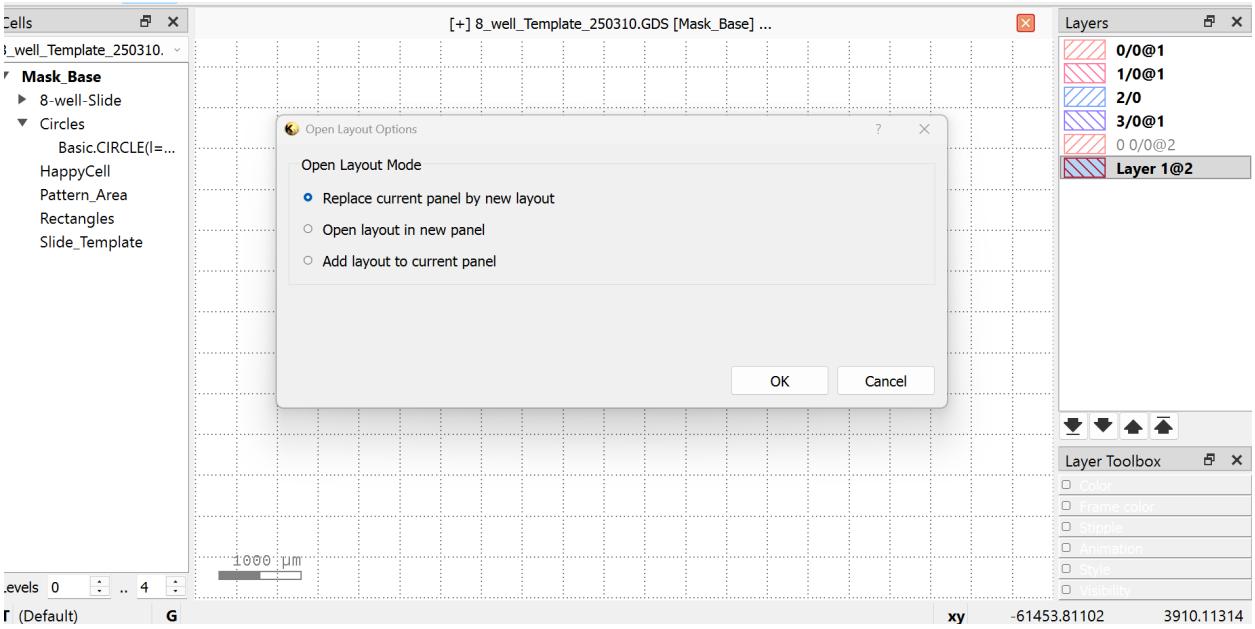


Figure 10: Import of .dxf files into KLayout Editor.

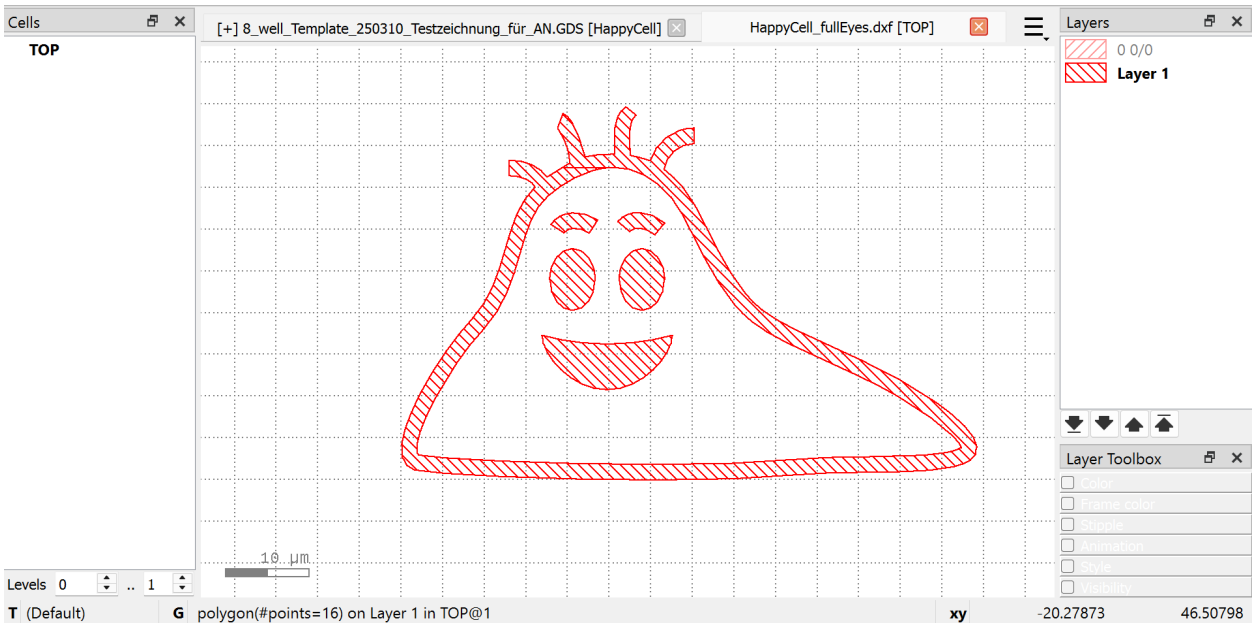


Figure 11: The imported .dxf-file shown in a new tab.

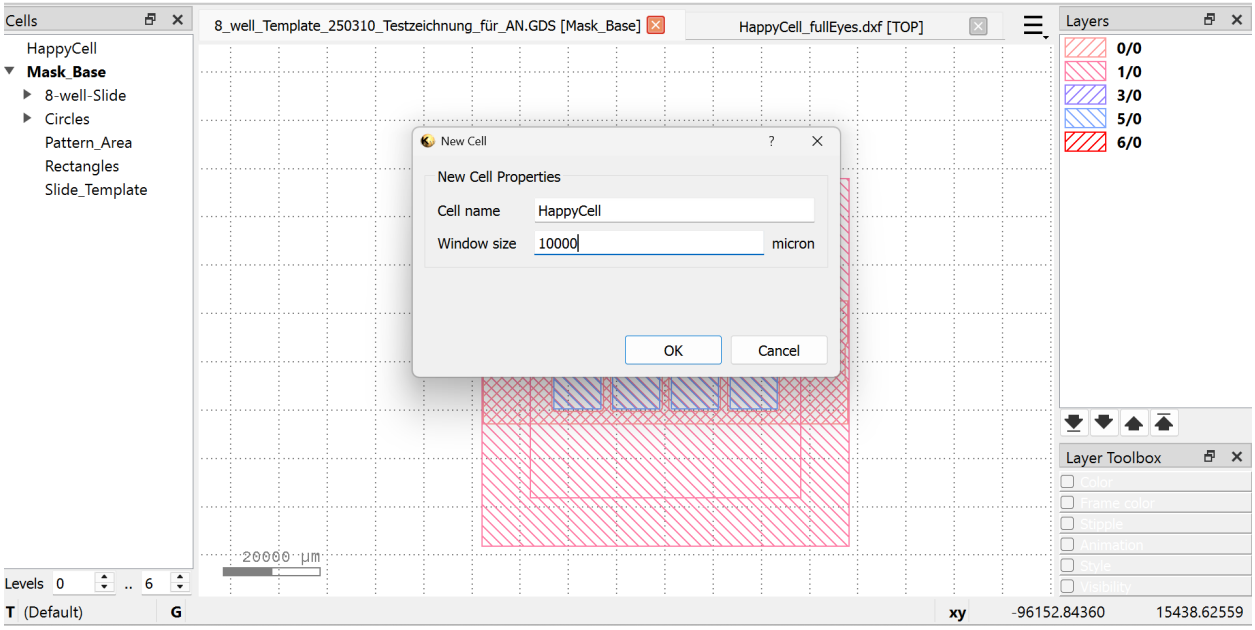


Figure 12: Creation of the new cell which contains the drawing of the imported .dxf-file.

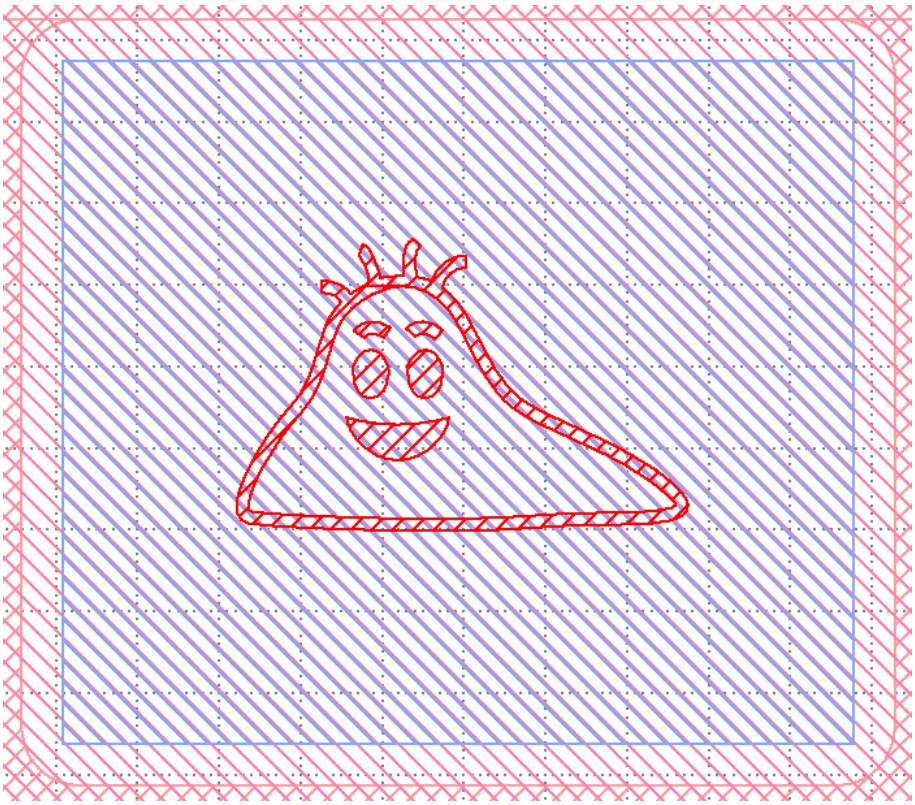


Figure 13: Imported .dxf data within the recommended pattern area.

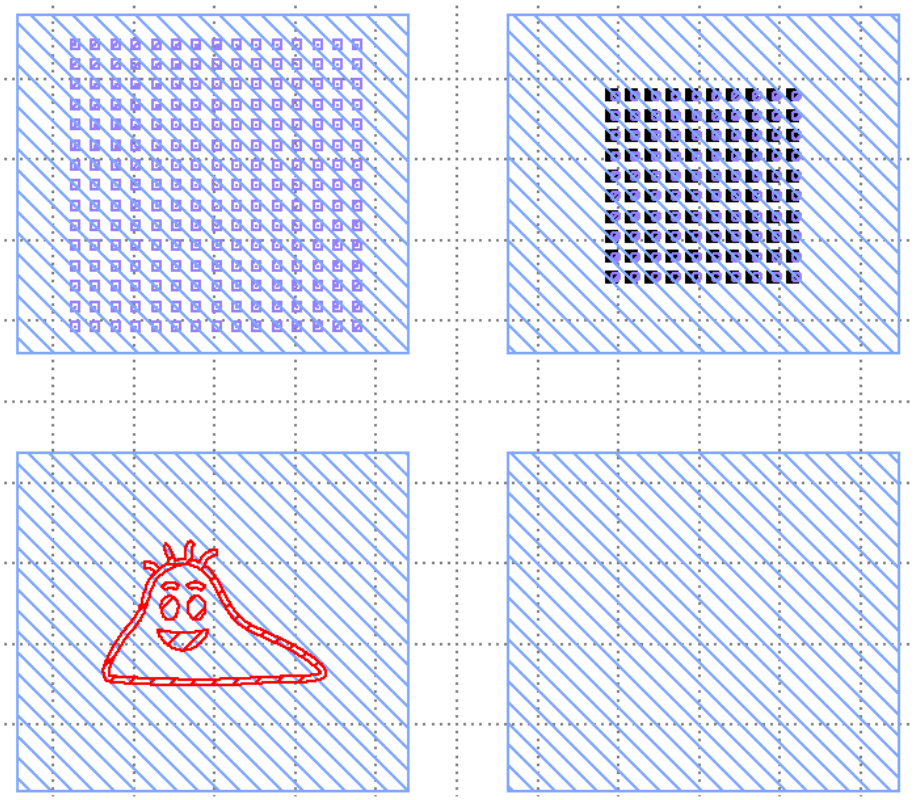


Figure 14: Exemplary wells showing several different geometries and structures.

5 Ordering the Photomask

Complete and double-check the drawings, ensuring that you know which layers contain the important manufacturing-related information (e.g., your newly created patterns and not the labware template). Figure 15 and Figure 16 illustrate the role of the different layers. In this example, only **layers 3/0 and 4/0** contain the structures required for photomask fabrication; these layers must be specified when ordering the photomask.

If needed, ibidi can recommend photomask suppliers (e.g., Compugraphics) based on prior projects. The supplier may request additional details, or you can provide this information upfront when placing the photomask order.

Below is a list of key parameters for ordering a photomask for the µ-Slide 8 Well ^{high}, as created in this Application Note:

Size and Material	3-inch quartz
GDS/OASIS File	Provide / upload / attach your file
Top cell	Mask_Base
Quality	N/A
Orientation	Chrome
Polarity	Darkfield (drawn structures become glass)
Layers	3/0, 4/0
Mask title	8-well slide: 200 µm circles and rectangles

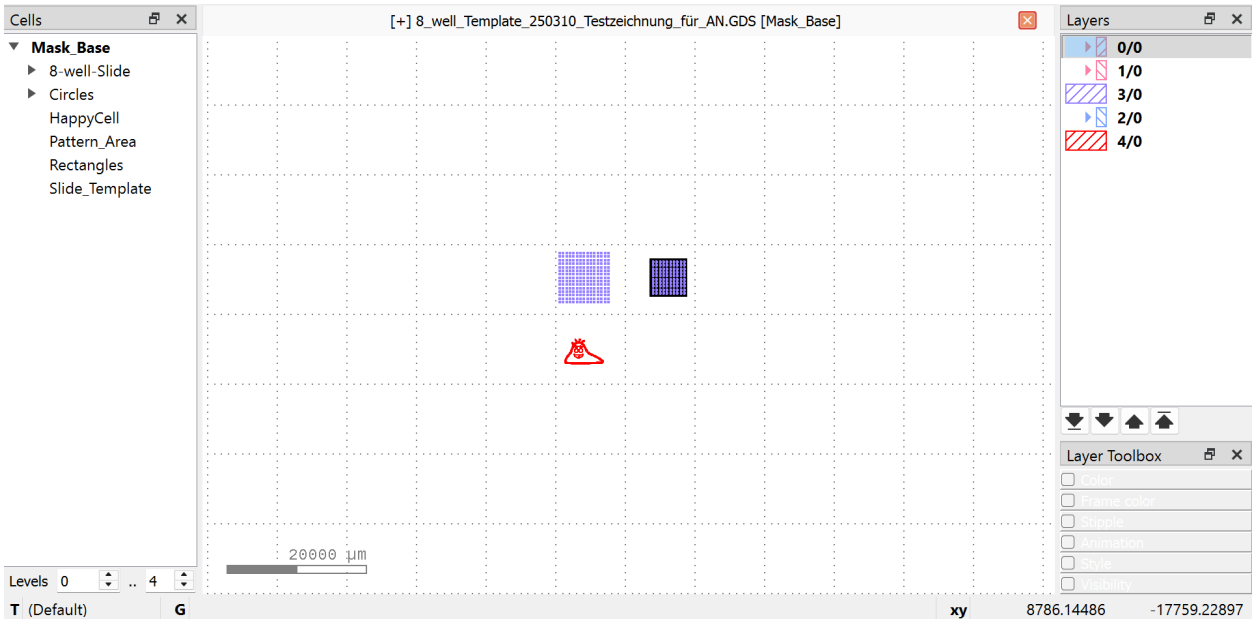


Figure 15: Layers 3/0 and 4/0 display the manufacturing-related information.

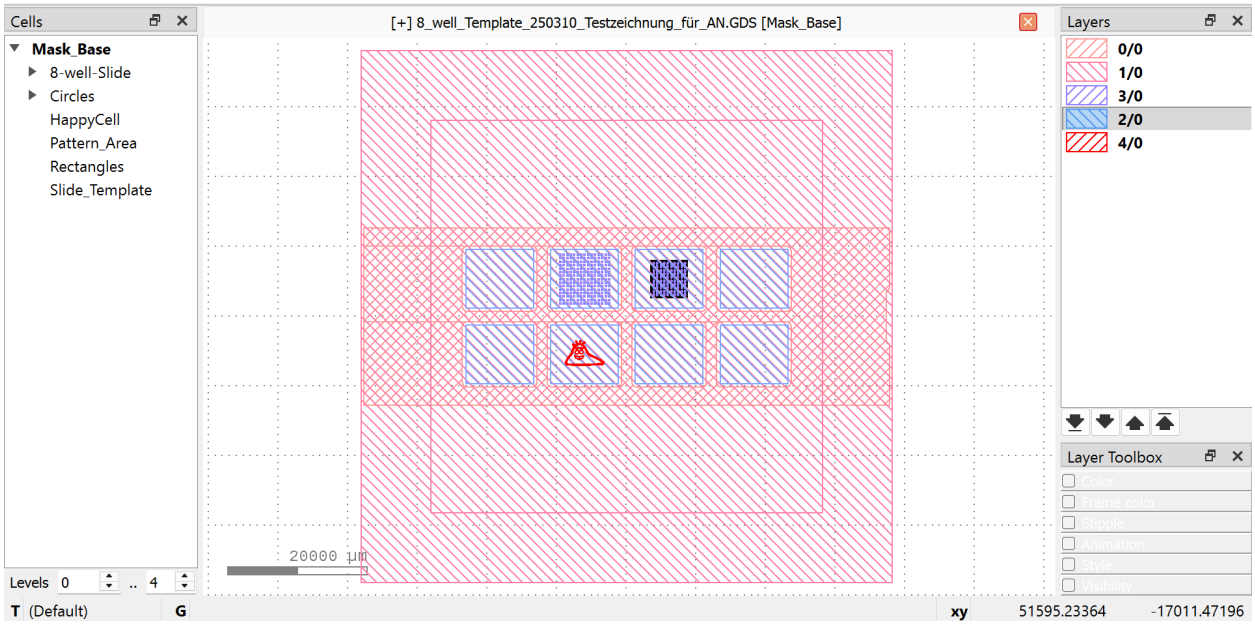


Figure 16: Displaying all layers to verify the drawn structures within the µ-Slide 8 Well ^{high}.