Chapter 3.3

GCAWS6 Reticle Design Guide

(gcaws6) ***(Bay 384)***

1.0 Process Summary

1.1 This document will guide you through the process of creating a GCAWS6 reticle.

2.0 Material Controls & Compatibility

2.1 All GCAWS6 reticles must be made from 5” soda lime plates, coated with chrome.

2.2 Plate thickness should be 0.090 inches.

2.3 The chrome coating on the plate can be any type of chrome; Low Reflective Chrome (LRC) is used for in-house mask processing. Recommended optical density is OD3.

2.4 It is recommended (but not required) that reticles have reticle alignment marks. These are two squares that ensure that the reticle is properly aligned to the optical column. Running without these marks may impact the accuracy of image placement.

2.5 The maximum field sizes are listed in the table. Note that the corners of the reticle will not print due to the circular nature of the lens. Do not put features in these areas (they will not print). The image below lists the dimensions of the printable area; all dimensions are in millimeters and are at reticle scale.

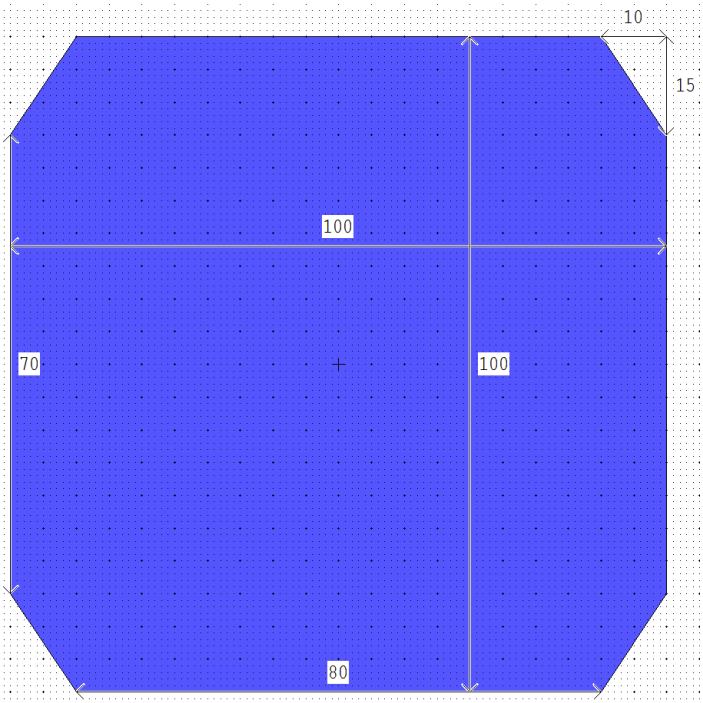
2.6 Additionally, the masking blades on the tool have sensors to prevent the blades from crashing into each other. This determines the smallest image that can be printed. The minimum field sizes are listed below. The maximum field sizes are also included, but see the note below about clipped corners.

	Wafer Level	Reticle Level
Maximum X	20.0 mm	100.0 mm
Maximum Y	20.0 mm	100.0 mm
Minimum X	2.0 mm	10.0 mm
Minimum Y	2.0 mm	10.0 mm

2.7 According to the manufacturer, the largest square that can be printed is 15.56 mm x 15.56 mm (wafer scale). We have successfully printed squares up to 18 mm x 18 mm, but we only monitor the uniformity on the 15.56 x 15.56 mm inside area. See the image below for the dimensions of the corners where features will not print.

2.8 Multiple images may be placed on the same reticle, but there needs to be 3.0 mm separation between images in order to print each image individually. It may be necessary to fine tune the masking blade positions to ensure individual images are printed on the wafer.

2.9 If the mask is made on Nanolab’s Pattern Generator, then no features can extend beyond the 125mm x 125mm square boundary found in the template.



3.0 Training Procedure & Applicable Documents

3.1 ZIP file with template files and barcode generator.

4.0 Definitions & Process Terminology

4.1 Reticle — the plate that contains the pattern, scaled up 5X from the desired printed pattern on the wafer. This plate is also frequently called a “mask”, but this can cause confusion, as a mask is also any layer that “masks” the substrate from the process.

4.2 RMS alignment windows — the reticle alignment windows at the top and bottom of the template file

4.3 Micro DFAS — alignment marks used for doing local alignment using the MAP feature; please see staff to determine if this type of alignment is required for your process.

4.4 Positive polarity — the reticle alignment marks are chrome squares in a clear background

4.5 Negative polarity — the reticle alignment marks are clear squares in a chrome background

5.0 Template Information

5.1 Download the GCAWS6 template and barcode generator from the link posted above.

5.2 There is one template available for use. There is a boundary on this design for a 15.56 mm x 15.56 mm die, the maximum recommended die size (wafer-scale). This boundary may be moved/deleted, but refer to the image above to ensure all features are within the imageable area.

5.3 There are 4 Micro DFAS alignment marks in the corners of the bounded area. If you are not using local alignment, you may delete these marks. If you are using 1 or 2 marks (instead of 4), you may move them to your desired location(s). Consult with staff for further guidance.

5.4 The global alignment mark is located in the center of the bounded area. This is the default position for the alignment mark. You may move this mark — if you do so, be sure to note the position so that the offset may be programmed into your job.

5.5 There are two reticle alignment marks for reticle alignment to the optical column on GCAWS6. To ensure that the marks have the correct dimensions and positions, these marks should be imported from the template file.

5.6 If you haven't yet, create your design. Work at your device scale (if you want a .80 µm line, draw a .80 µm line). You will scale up your design after inserting it into the template. This is particularly helpful if you need to work on multiple tools at different scales.

5.6.1 The GDS files will import three cells: "your_design", "export_gcapg_or_external" and "export_mla150". Use any name besides these when creating your cells to avoid overwriting your data when you import the GDS template.

6.0 Basic Import Procedure

6.1 Import the template using File > Import Mask Data > GDSII.

6.2 Import Options:

6.2.1 Choose whether you want to generate new layers or "prompt" for the incoming layers. Recommend that you choose "prompt" and map the layer in the template to the layer in your design file, but this is optional.

6.2.2 Choose whether to overwrite cells with similar names. Recommend that you select "none" to avoid overwriting design data.

6.3 Import.

1.1 Insert/draw your design in the cell "your_design". The "export_" cells are wrapper cells to ensure correct positioning depending on how the mask will be produced.

6.4 While viewing the template, instance your design cell in the template. Click **[Ctrl+E]** to edit the object and recenter your design cell as needed. In the lower left corner of the Edit Objects box is a scaling factor. Set the scale factor to 5:1 (5 above 1) to increase the scale of the design to reticle scale. See the video tutorial for a demonstration.

7.0 Basic Export Procedure

7.1 Choose File > Export Mask Data > GDSII.

7.2 Select the file name you want to export.

7.3 Select which cell you want to export.

7.3.1 If you are exporting to send your file to an external mask vendor, export the "export_gcapg_or_external" cell.

7.3.2 If you are exporting to send your file to the internal mla150, export the "export_mla150" cell.

7.3.3 If you are unsure, consult Nanolab staff.

7.4 If submitting to our in-house pattern generator (gcapg), be sure to select "Fracture polygons with more than 199 vertices". Polygons with more than 199 vertices will cause errors in the conversion process.

7.5 Export!

8.0 Optional: Add Barcode

8.1 If you haven't already done so, download the ZIP folder listed above with the C++ barcode generator file. Unzip the folder and move the C++ file to your desired directory.

8.2 Have the top cell open. This is the cell where you want to insert the barcode. This is called "top" in the templates we provide.

8.3 Go to Tools > Macro

8.4 Select Load

8.5 Select the C++ file you downloaded previously.

8.6 Now that the C++ file is loaded, you can run the macro. Select the macro and hit Run

8.7 Type in the desired string. Limit yourself to 10 characters. Allowed characters are alphanumeric characters (A - Z and 0 - 9) and the characters - . $ / + % and space. Other characters are ignored in the barcode but will be printed as text; you may not get the barcode you expect. Only use the allowed character set.

8.8 Choose the desired scale setting. If your design is at reticle scale, use the default value of 1. If your design is at wafer scale, use a value of 5.

8.9 Run the macro. It will automatically insert your barcode in the appropriate location in the template file.

9.0 Appendix: Useful Mark Locations

All measurements are at reticle scale.					
Description	X size (mm)	Y size (mm)	X pos (mm)	Y pos (mm)	Remarks
RMS alignment window #1	2	2	-11	57.5	Upper left part of the pattern
RMS alignment window #2	2	2	0	-57.5	Lower center part of the pattern
Global Alignment Mark	0.66	0.66	0	0	Mark may be moved anywhere within the image field. Both positive and negative phase targets can be used.
Micro-DFAS Marks	0.60	0.570			1, 2, or 4 marks may be used per field in combination with the global alignment target to optimize the alignment. Mark(s) can be placed anywhere within the image field. For the best results, the 2 targets should be placed across from each other in the field as close to the X-axis as possible; 4 marks per field should be located in the 4 corners, diagonally across from each other. Both positive and negative phase marks can be used.