Heidelberg DWL 66fs Laser Writer

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The Heidelberg Instruments DWL 66fs is a direct write pattern generator. At CNF, the DWL 66fs accepts 5", 0.090" thick Cr on quartz mask plates. The unit has interchangeable write heads that determine the resolution and the speed of patterning. The smallest usable feature sizes are 2.5 microns and 0.8 microns with the 10mm and 4mm write heads, respectively.

The DWL 66fs system consists of the main system unit, a Windows XP-based PC for running job files, a Linux-based PC for data conversion, and a pattern generator (located in the service area). The system is equipped with an alignment system, including front-to-backside alignment, as well as a gray-scale exposure mode. The tool accepts files of various formats, but for best results we recommend using the semiconductor standard GDSII format.

GUIDELINES:

1. Mask writing is the default mode, wafer direct-write with Staff assistance.

2. Changing to a 4mm write head: Email manager and backup one week in a advance to request changeover to the 4mm write head. Changeover will be based on staff availability and will not occur on Friday or weekends. Changeover will be for overnight writes. Staff time and additional tool time will be applied to the user account.

3. 10mm write head – 2.5 micron nominal resolution at 20mm^2/min

4. 4mm write head – 0.8 micron nominal resolution at 3.3mm^2/min

Contents

0. Quick Guide: DWL 66fs Mask Making

1. Transfer GDSII files via CNF Lab Transfer Share into the gdsii directory

2. Use the **Frame Generator** to create a barcode (for the steppers) or label (for contact)

3. Using the **XConvert** DWL 66fs conversion program, read in your GDSII *pattern* file

4. Choose the correct write head, mirror and rotate the data (don't mirror backside contact masks)

5. Create a job file

6. Transfer job file

7. Repeat steps 3-6 for your GDSII *frame* file

8. Turn laser ON

9. Load job files in the job template

10. Check the Auto Unload and Laser Shutdown options, then click Load button

11. Load mask

12. Close the door, WAIT until the door is *fully closed*, then move the stage under the lens

13. Focus, find Center of the plate, Expose

14. Unload mask when exposure finishes, close the chamber door

15. **Make sure that the LASER is OFF when finished – LOG OUT**

16. Develop using the Hamatech and etch Cr using the Hamatech or the Trion RIE

1. Pattern Conversion

<u>CAD Guidelines:</u>

1. Use only GDSII files

2. Origin of CAD pattern corresponds to the center of the mask

3. CAD feature dimensions represent feature dimensions on the wafer – use the **XConvert** software for scaling stepper masks

4. Drawn Layer represents removed Cr

5. Use **LayoutBEAMER** to perform CAD layer inversions (for more information see CNF Computing resources). All Boolean operations must be done within the CAD package.

Transferring files to the Linux computer:

Linux conversion computer login and password are both **convert**

1. Using the CNF windows PCs navigate to the lab transfer share **V:** drive. Place GDSII file under **V:\Heidelberg DWL66fs**. Alternatively, using CNF SunRays, copy the GDSII file to **/cnflab/Heidelberg DWL66fs**.

2. Using the DWL 66fs convert computer: double click on the **Lab_Transfer_Share** desktop icon.

3. Right click on the file you wish to transfer.

4. Choose **Copy To** then click on **Home Folder** then **gdsii** then **Copy Here**.

1.1 PATTERN CONVERSION

1.1.1 Frame Generation

The **Frame Generator** program will create a GDSII file that will have a label for contact aligners, or fiducial (reticle alignment) marks for both the AS200 i-line and the 5X g-line steppers. The following marks are generated for the steppers: RMS, Insitu, barcode, label and 5X reticle marks.
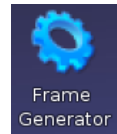
Using the Linux conversion computer, double-click on the **Frame Generator** icon.

1. **File name** field will already contain the date. You must use the following naming convention: **TodaysDateNameLXframe** where **X** represents the photolithography layer number. For example: 0222514jctL0frame would represent that the frame data for the layer 0 photomask of the process was converted on February 22, 2014. **DON'T USE** spaces, special characters, etc.

2. Select **Target** - **AS200** for a GCA stepper mask, or **Contact** for a contact mask. (**Note:** ASML masks **cannot** be exposed on the DWL 66fs.)

3. Input a **Barcode** – 10 Characters maximum – using only letters and numbers. If you leave this field blank a random code will be generated.

4. Input a **Label** – 10 Characters maximum – using only letters and numbers. Do not change default font.

5. Click **do**

   The frame template file will be saved under the **/home/convert/gdsii** directory. Click **File**, then **Close** to close the **Frame Generation** application.

1.1.2 Pattern Conversion

1. To start the pattern conversion software, double click on the **XConvert** icon.
The **GUI HIMT CONVERT . . . 2.21** menu will appear.

2. Select **File** - **New job**. The **Set New Job** window will appear. For job name use the following naming convention: **TodaysDateNameLX** where **X** represents the photolithography layer number. For example: 022514jctl1 would represent that the job data for the layer 1 photomask of the process was converted on February 25, 2014. Click **Ok**.
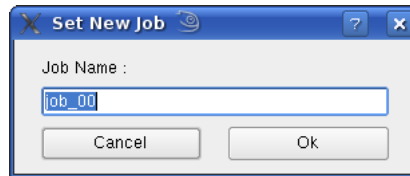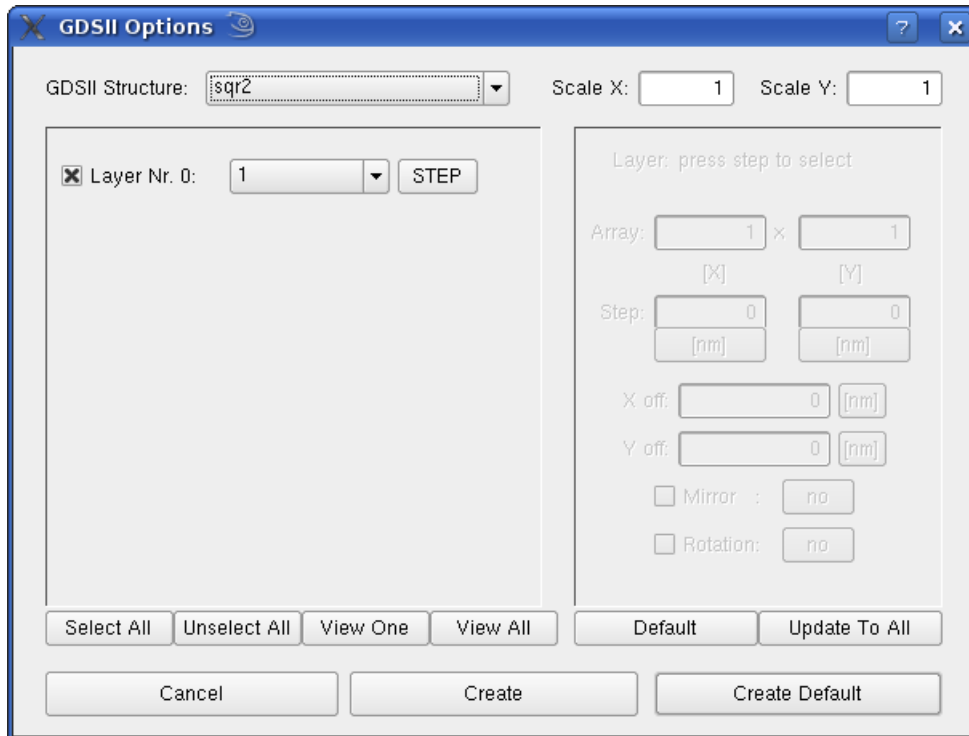

3. The **GUI HIMT Convert** window will expand to display job parameters, and the **Main Status Window** for your job will appear. Click **Add**, then **GDSII** within the **Source File** submenu:

The **Load GDSII Design** window will appear:
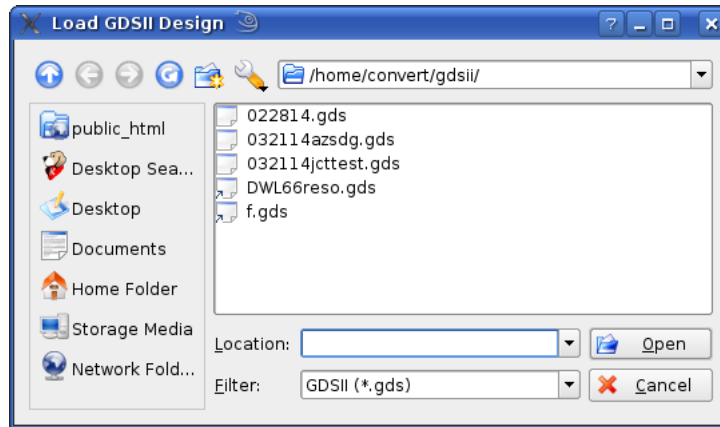
4. Select your GDSII pattern design file and click **Open**. The **GDSII Options** menu will appear:

5. Choose the top level **GDSII Structure** (Cell) of your pattern file. For **Frame Generator** files for **stepper** masks *make sure* to select **labelBC**, for **contact** masks select **frame**. The **Scale** for <u>both</u> **X** and **Y** should be set to 1 for **contact** masks and *all* **Frame Generator** files, or 5 for **stepper** masks. **Unselect All** layers (use the button below the layers – or uncheck manually), then check *only* the layer(s) you wish to convert. <u>NOTE:</u> **Layer Nr.** 0, 1, 2, 3, 4, etc are <u>NOT</u> GDSII layer numbers! GDSII Layer numbers are displayed in the field directly to the left of the **STEP** button.

6. Click **Create Default**.

7. View and check your pattern. Click **PREVIEW** button to view your pattern.
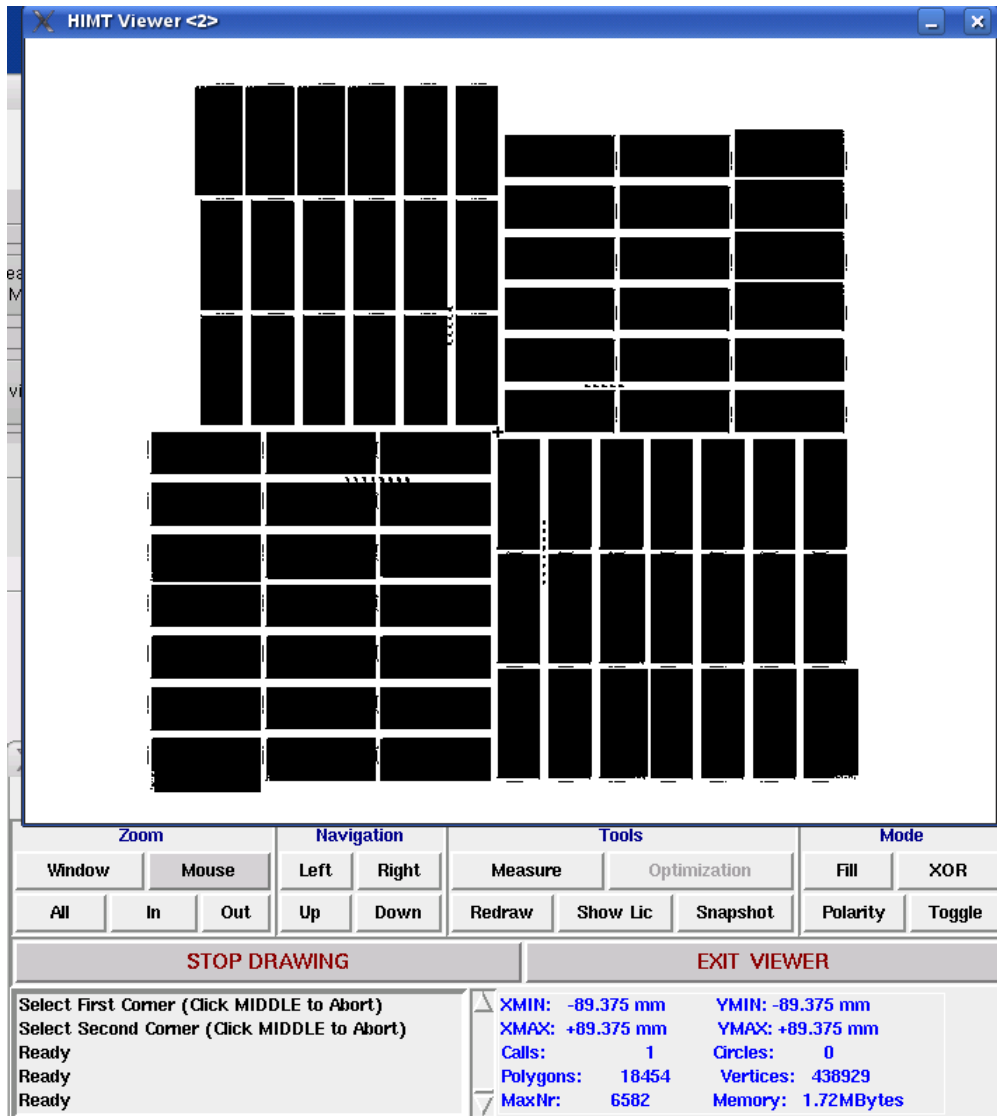
Click **Mode** - **Fill** within the viewer. All exposed features will be solid black. Click **Zoom** - **Mouse**, then click the left button on the location to zoom in, right button to zoom out, and middle button to stop zooming.

NOTE: The pattern is not yet mirrored and will be mirrored in a later step. Check the pattern extents (**XMIN**, **XMAX**, **YMIN** and **YMAX** values directly under the **EXIT VIEWER** button), as well as the details of the pattern. Exit viewer.
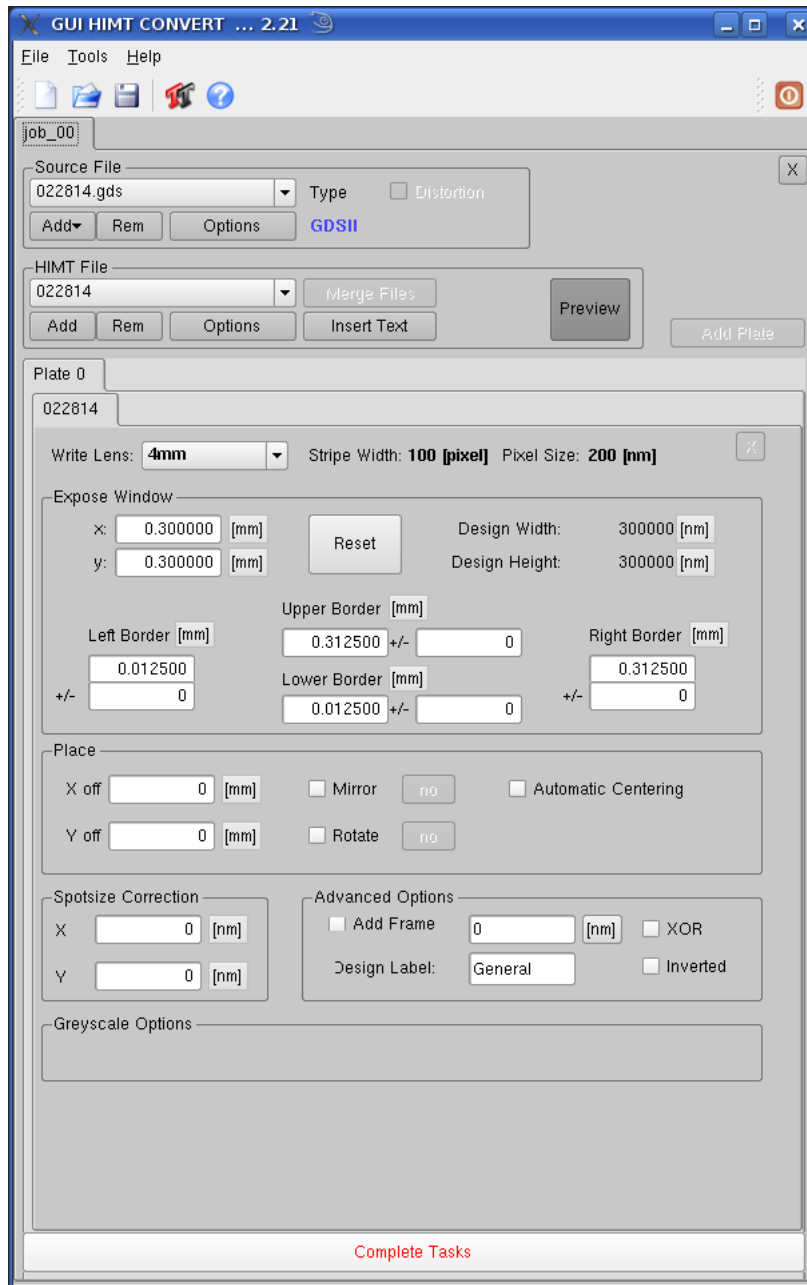
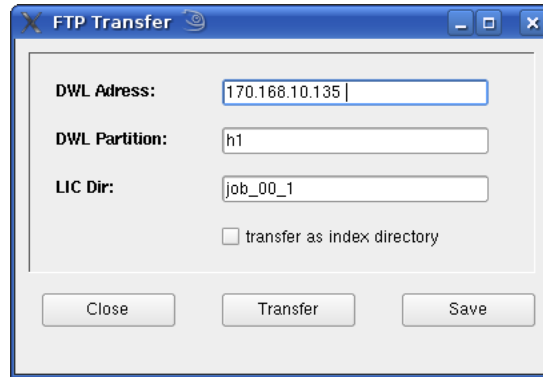**8.** Change **Write Lens** to **10mm**. (**Not GS** lens; indicates Gray-scale exposure.)

Within **Place** select **Mirror - at y**. If you are exposing a **stepper** mask, for *both* the **Job** file and the **Frame Generator** file select **Rotate - at 90**. Click **Complete Tasks** at the bottom. The **Save Job** menu will appear:
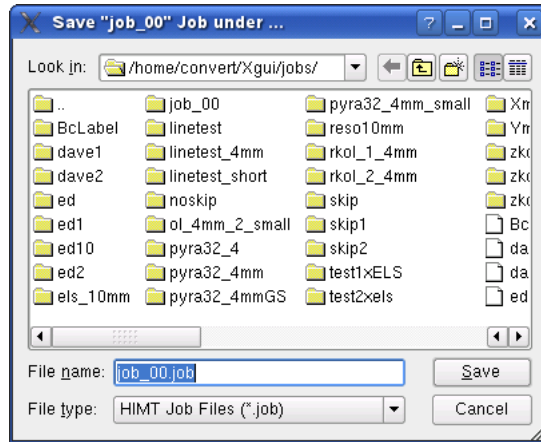
9. Click **Save**. Be sure to use the same naming convention as described previously (**TodaysDateNameLX**, should be the default). The **Prepare** menu will then appear and display conversion progress. <u>NOTE</u>: this step may take some time. Click **Finish** when completed.
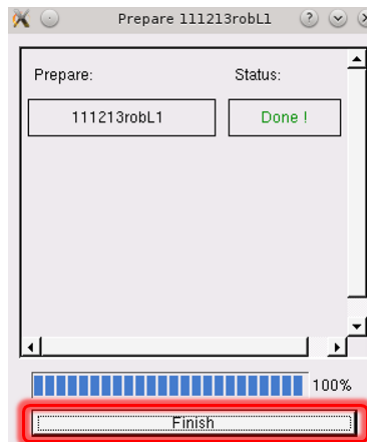
10. The **FTP Transfer** box will appear. Click **Transfer**, wait for it to complete, then click **Close**. In the **GUI HIMT Convert** window, click **Clear Tasks** at the bottom, then click the X box in upper right to close the job.

FTP Transfer

DWL Adress:	170.168.10.135
DWL Partition:	h1
LIC Dir:	job_00_1

☐ transfer as index directory

[Close] [Transfer] [Save]

11. Make certain to perform steps 2 - 10 of **Pattern Conversion** for **BOTH** files you generated.

2. DWL 66fs MASK WRITING

1. **CORAL IN** to enable keyboard and mouse. The **Heidelberg Instruments DWL66** window should already be open. If not, **notify Staff**. If the **DWL Control Panel** window is not open, click ⚒ to start the **DWL Control Panel** window.
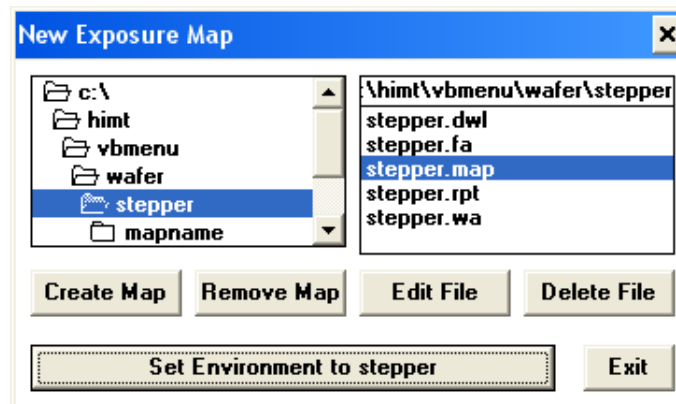
2. Laser Status should be **red** indicating that the laser is off.
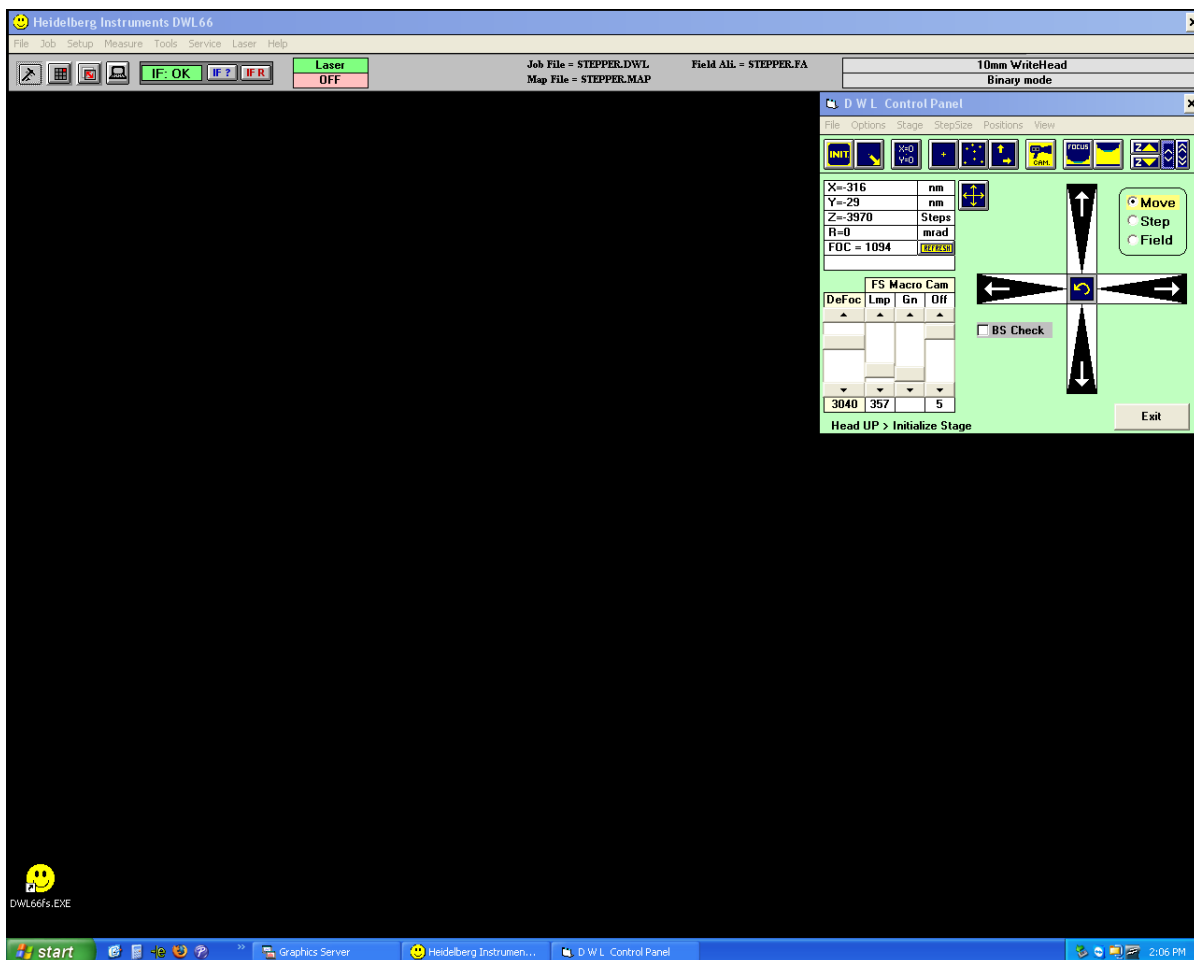
3. At the main menu, click **Laser**, then click **On**. The **Laser Status** box will change to green and display **On**.
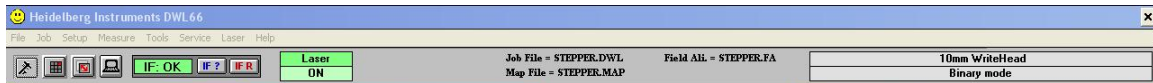

**4.** At the main menu, click on **Setup**, then **New**. The **New Exposure Map** window will open:

5. On the left side of the window double-click on either **stepper** or **contact**. On the right side of the window double-click on **stepper.map** or **contact.map**, depending on your first choice. Click on **Set Environment to (stepper or contact)**. Click **Exit**.

6. At the main menu, click on **Job**, then **Make Job**. Also at the main menu, click on **File**, then **Designs**. The **Design Data Directories** window will appear:
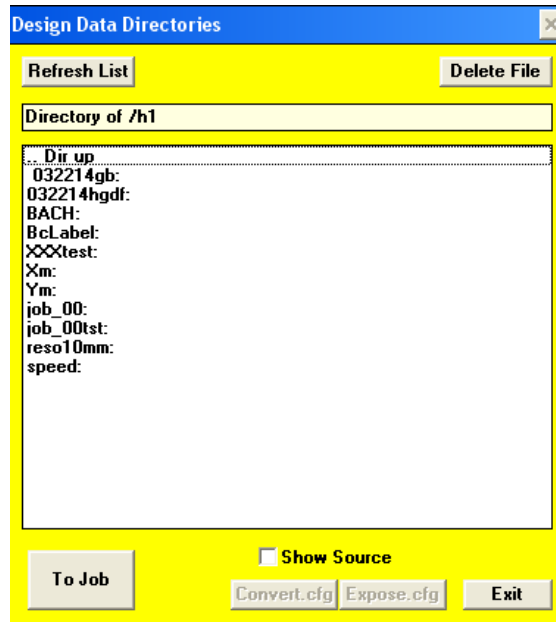
For a **stepper** job the screen should appear as shown below (**contact** jobs will be different, with only two rows in **Edit Job**):
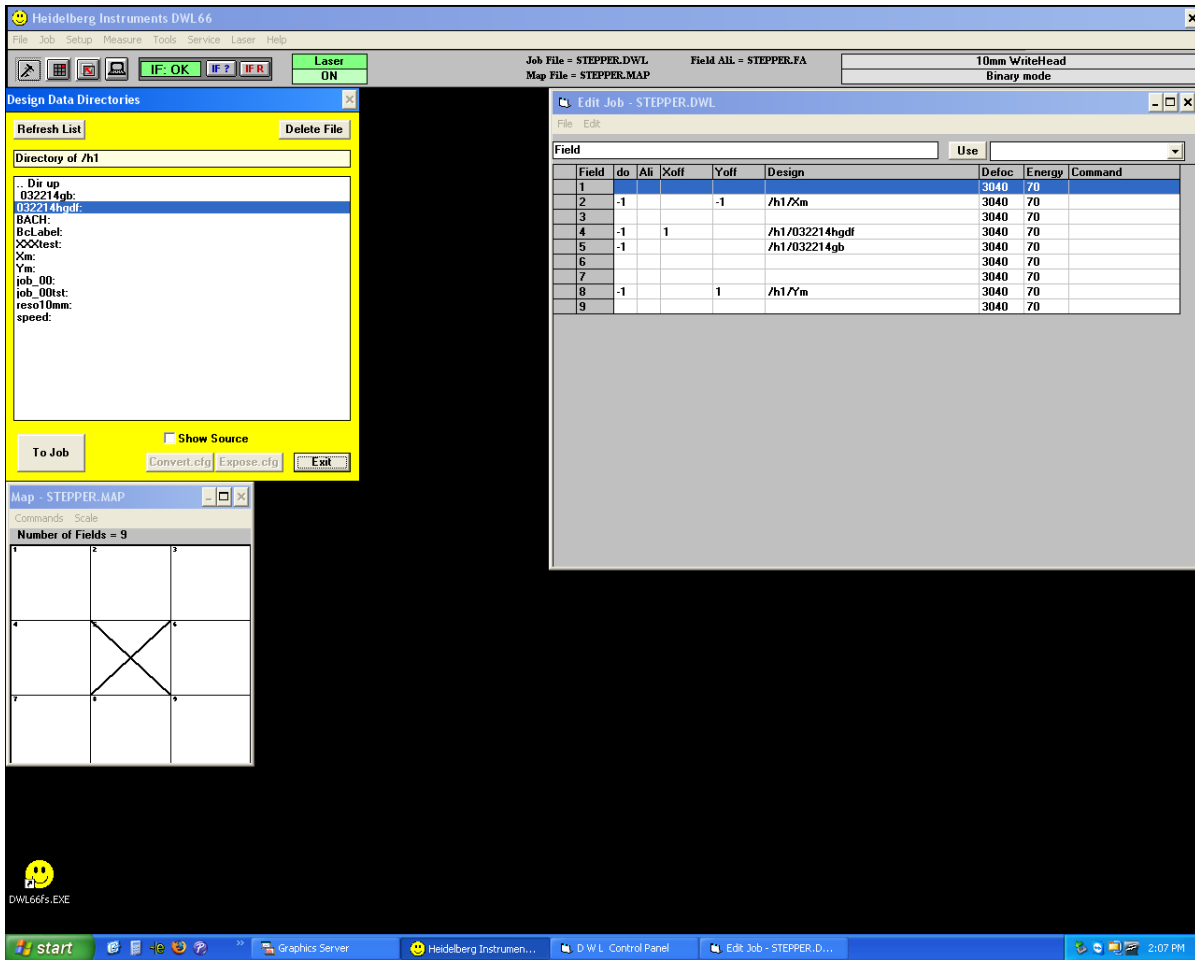
NOTE: Don't change **do**, **Defocus** or **Energy** values. **do** is always equal to -**1**, **Defocus** and **Energy** values will vary and may not be identical to the ones in the above figure. Check for posted current values.

Below the main menu, on the left side of the screen is the **Design Data Directories** window, on the right side of the screen is the **Edit Job** window, and the lower left of the screen displays the **Map** window.

7. In the **Edit Job** window, click on the **Design** column of **Field 5**. Then, in the **Design Data Directories** window click **Refresh List**, select your cell/GDSII file name, then click **To Job**. (For **contact** jobs **Field 1** is the job data.)

Next, back in the **Edit Job** window, click on the **Design** column of **Field 4**. In the **Design Data Directories** window, select your frame/label file name, then click **To Job**. (For **contact** jobs **Field 2** is the label data.)

If you do not include data in **Frame 4**, you will not print Fiducial Marks for the stepper. Click on **Exit** in the **Design Data Directories** window.

8. From the main menu, click on **Job**, then **Run Job**. The screen should appear as below (**contact** jobs will be slightly different):
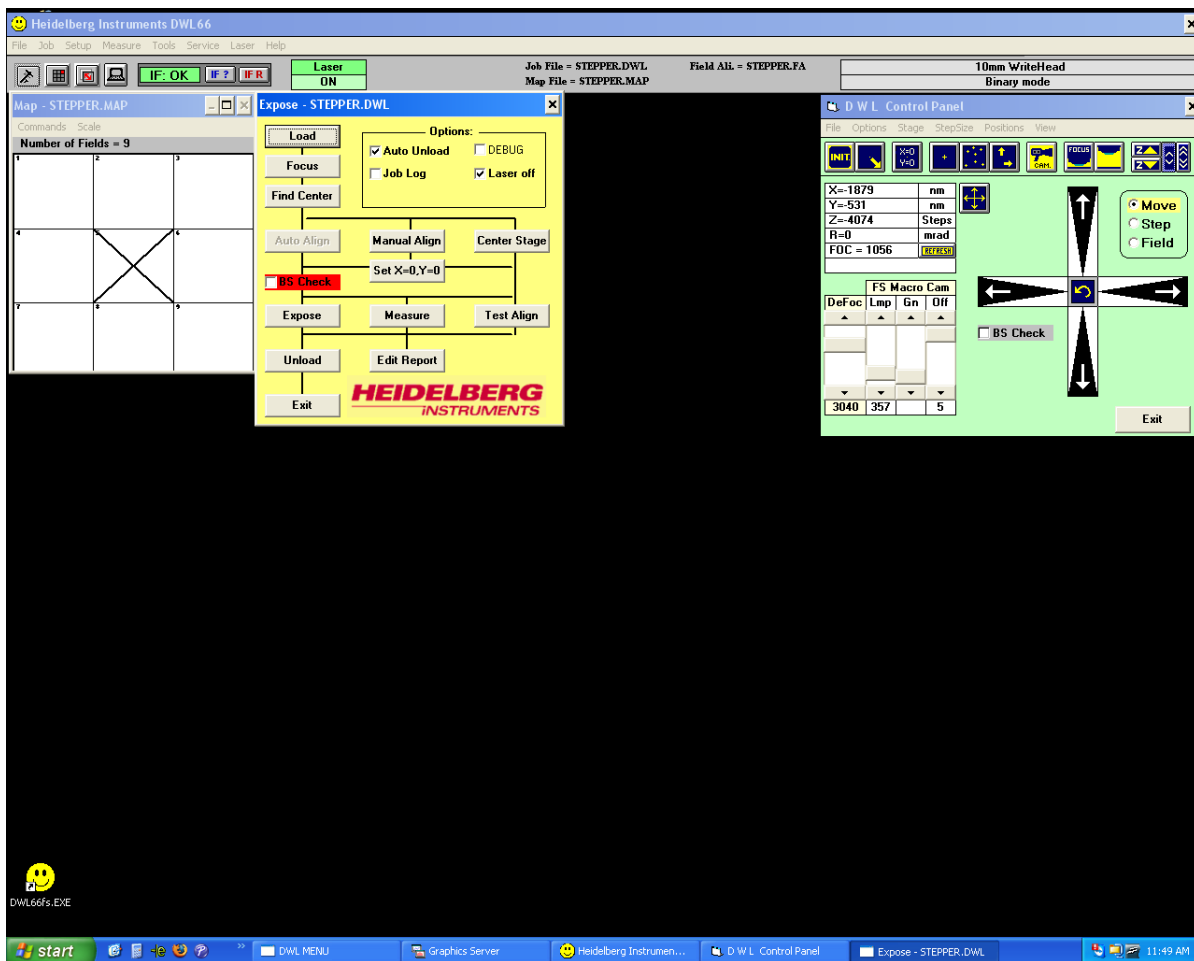
9. Click **Load** in the **Expose** window. The stage will move to the load/unload position. Open the chamber door using the toggle switch on the chamber front left. *Carefully* align the mask using the provided hardware, then turn the chuck vacuum on. **Any misalignment may make your mask unusable!** Be careful to avoid touching the mirrors on the sides of the stage, as this could cause system failure.
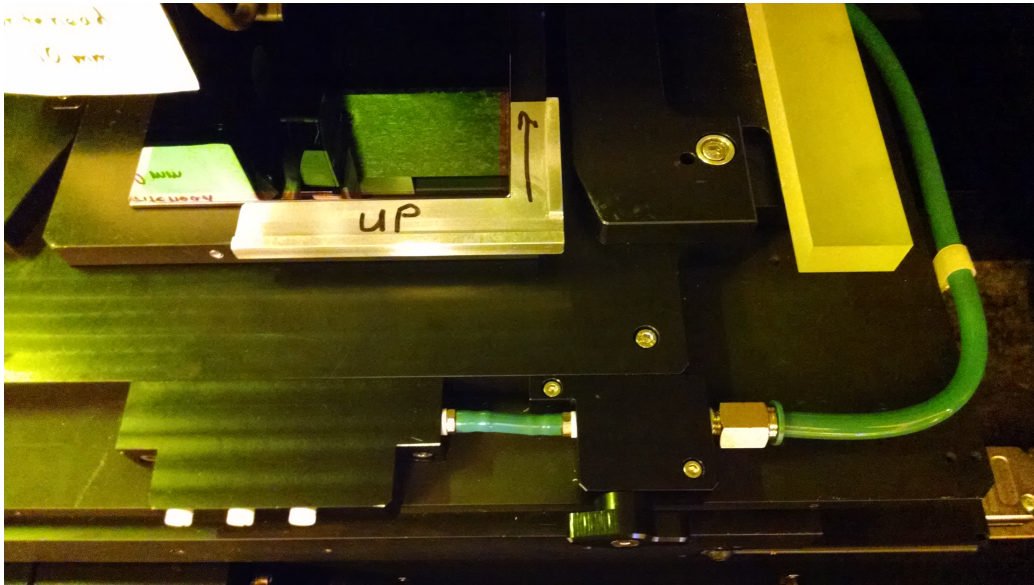

Close the chamber door. After is has fully closed, click **OK** in the popup window to finish the loading operation. The stage will move back to the center position.
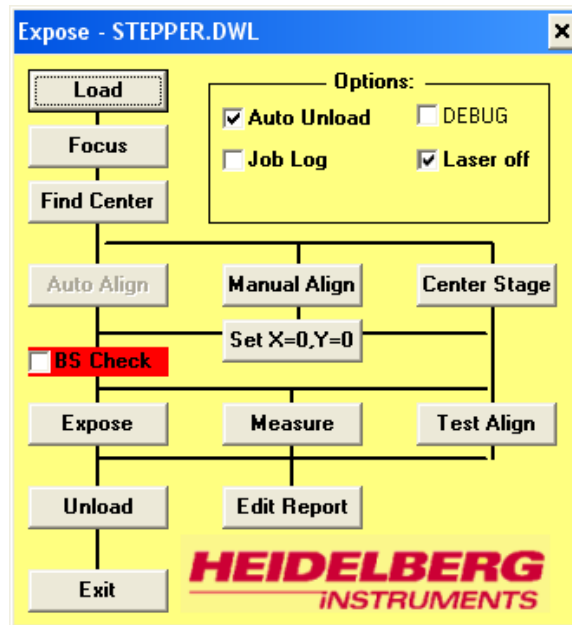
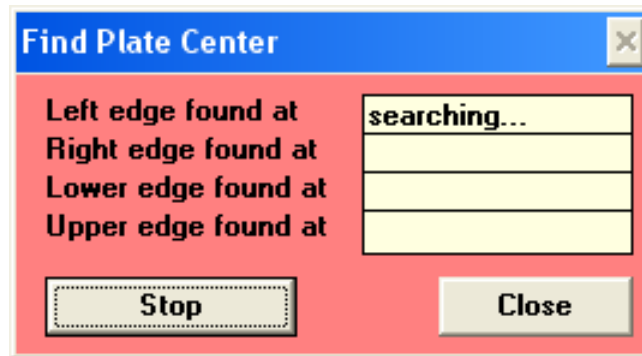Make sure that the **Auto Unload** and **Laser off** boxes are checked, and that all other boxes are open. Make *certain* that the mask is *under the exposure lens* before continuing.
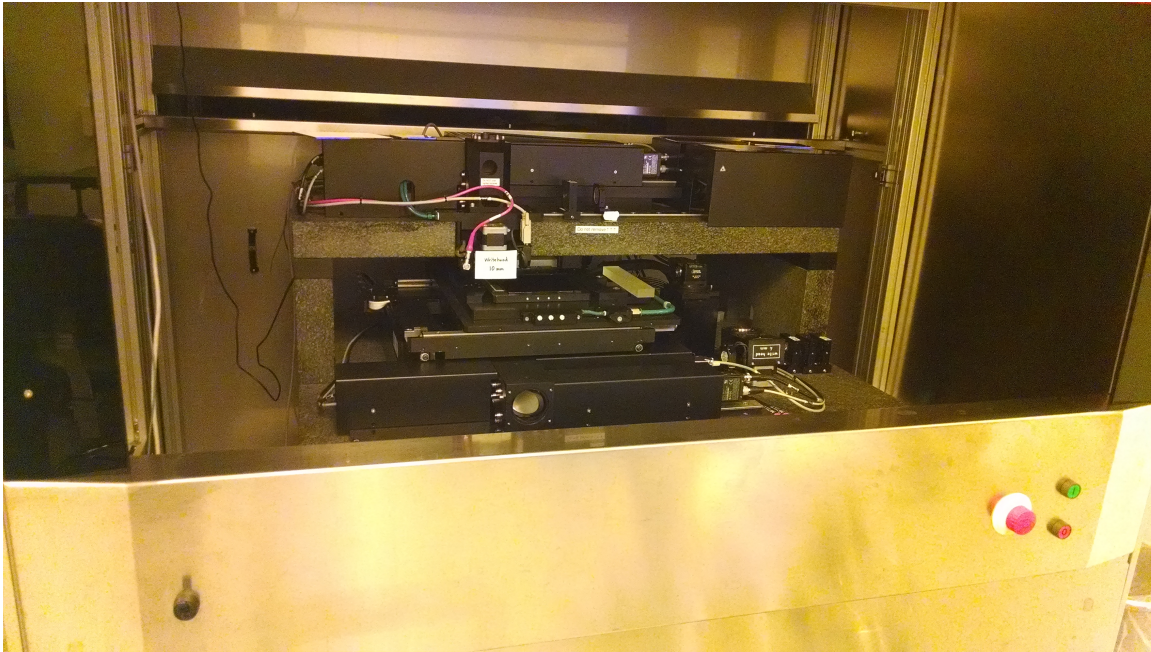
10. In the **Expose** window, click **Focus**. The value will display in a popup window as the system finds focus for the mask. When this completes properly, the popup box will disappear. If not, **alert Staff**.
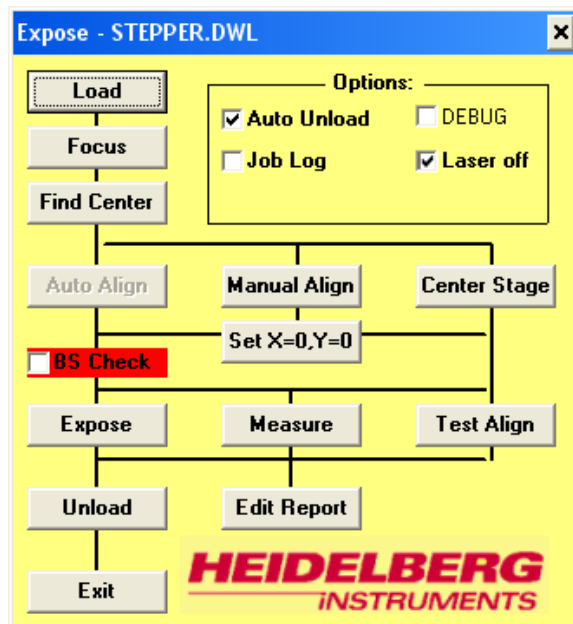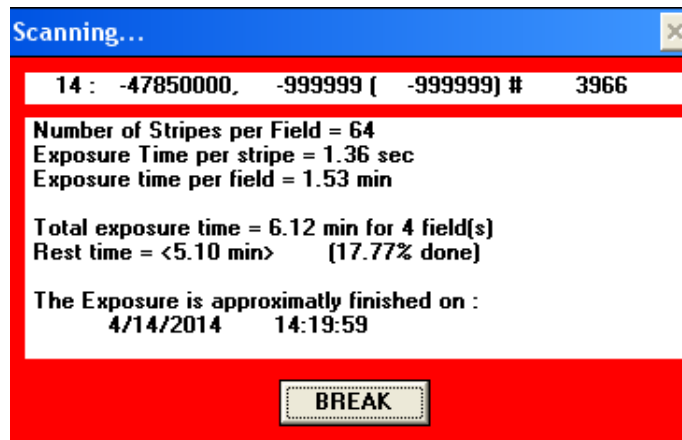
11. In the **Expose** window, click **Find Center**, then **Start** in the popup window. The system will display results as it centers the mask:

Find Plate Center

Left edge found at	searching...
Right edge found at	
Lower edge found at	
Upper edge found at	

[Stop]   [Close]

Make sure that this completes successfully. When it finishes, click **Yes**.

12. In the **Expose** window, click **Expose** to begin the exposure. The system will display a progress window during writing, and an estimate of remaining time will appear. This estimate is often inaccurate, so you should estimate your total time before starting.

Scanning...

    14 : -47850000,   -999999 (-999999) #   3966

Number of Stripes per Field = 64
Exposure Time per stripe = 1.36 sec
Exposure time per field = 1.53 min

Total exposure time = 6.12 min for 4 field(s)
Rest time = <5.10 min>   (17.77% done)

The Exposure is approximatly finished on :
    4/14/2014   14:19:59

[BREAK]

13. When the job is finished, click **OK** in the popup window. The stage will automatically move to the load/unload position (since the **Auto Unload** option was checked in the previous section). If the stage does not move to the load/unload position, or if you forgot to activate the **Auto Unload** option, click the **Unload** button in the **Expose** window.

NOTE: Tool will NOT move to the load/unload position if the main chamber door is open.

Click the **Exit** button in the **Expose** window.
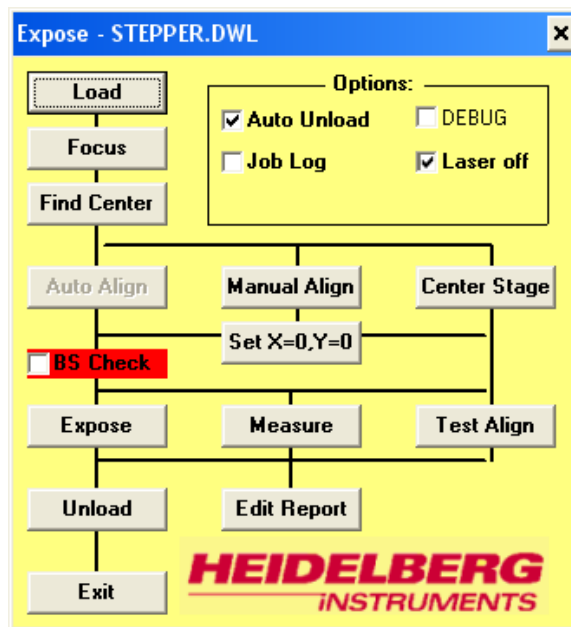
14. When the stage is in the load/unload position, open the chamber door using the toggle switch on the front left. Remove your mask and *close the chamber door*.

15. Log out of **CORAL**.

16. Develop the mask using the Hamatech Mask Processor recipe **2** and inspect. Etch the mask using the Hamatech Mask Processor recipe **1** and inspect. Strip the resist using the Hot Strip Bath.