Heidelberg DWL 66FS Laser Writer

CORNELL NANOSCALE FACILITY

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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 20mm²/min
- **4.** 4mm write head -0.8 micron nominal resolution at 3.3 mm²/min

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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

CAD GUIDELINES:

- **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. Generator

\$				_ . ×
File	Version 1.03a DWL66			
File name	041714	.gd	ls	
Target	A\$200	-		
Barcode				
Label			Serif	-
	do			
Setup Comple	te			

- 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.

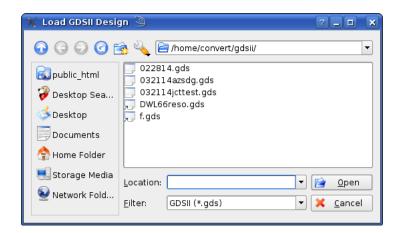
2. Select **File** - **New job**. The **Set New Job** window will appear. For job name use the following naming convention: **TodaysDateNameLX** where **X** represents the photolithog-raphy layer number. For example: 022514jctl1 would represent that the job data for the layer 1 photomask of the process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

🗙 Set New Job 🎱	7 🗙
Job Name :	
job_00	
Cancel	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:

CSource F	File ——		
<not sel<="" td=""><td>ected></td><td>-</td><td>Туре</td></not>	ected>	-	Туре
Add 👻	Rem	Options	<not selected=""></not>

The Load GDSII Design window will appear:



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

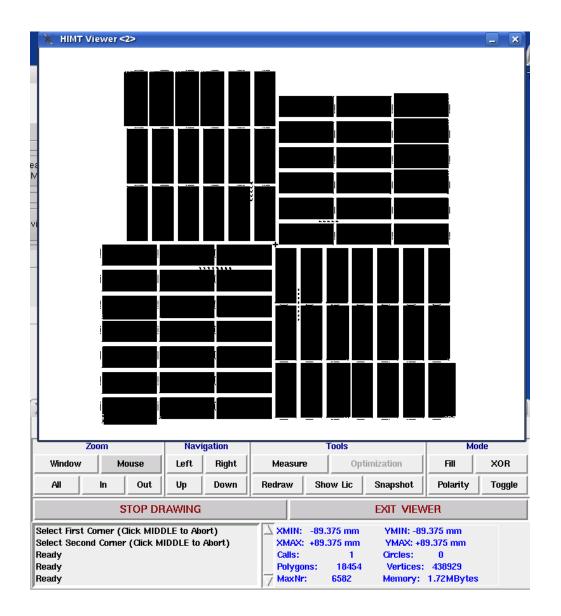
🗙 GDSII Options 🍥	7 🗙
GDSII Structure: Sqr2	Scale X: 1 Scale Y: 1
X Layer Nr. 0: 1 TEP	Layer: press step to select
	Array: 1 × 1
	[X] [Y]
	Step: 0 0
	[nm] [nm]
	X off: 0 [nm]
	Y off: 0 [nm]
	Mirror : no
	Rotation: no
Select All Unselect All View One View All	Default Update To All
Cancel Create	Create Default

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.

_HIMT File			
psmv3		Merge Files	Preview
Add Rer	n Options	Insert Text	Fleview



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.

💥 GUI HIMT CONVERT 2.21 🍥	
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📄 🖻 🚔 🕼 🥨	0
job_00]	
Source File	X
022814.gds	
HIMT File	
Add Rem Options Insert Text Add P	
Plate 0	
022814	
Write Lens: 4mm Stripe Width: 100 [pixel] Pixel Size: 200 [nm]	
Expose Window	
x: 0.300000 [mm] Design Width: 300000 [nm]	ן ר
y: 0.300000 [mm] Reset Design Height: 300000 [nm]	
Upper Border [mm]	
Left Border [mm] 0.312500 +/- 0 Right Border [mm]	
0.012500 Lower Border [mm] 0.312500	
+/- 0 0.012500 +/- 0 +/- 0	
Place	- I
X off 0 [mm] Mirror no Automatic Centering	
Y off 0 [mm] Rotate no	
Advanced Options	ר 🛛
Y 0 [nm] Design Label: General Inverted	
Greyscale Options —	
Complete Tasks	

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:

🗙 Save "job	_00" Job under	?_	. 🗆 🗙
Look <u>i</u> n: 🔄 /ł	nome/convert/Xgui/jol	bs/ 🔻 🗲 🖻 💣	•
i	🚞 job_00	📄 pyra32_4mm_sma	dl 🧰 Xm
🚞 BcLabel	🚞 linetest	🚞 reso10mm	mY 🧰
🚞 dave1	🚞 linetest_4mm	🚞 rkol_1_4mm	🚞 zko
🚞 dave2	🚞 linetest_short	🚞 rkol_2_4mm	🚞 zko
🧰 ed	🚞 noskip	🚞 skip	🚞 zki
🧰 ed1	🚞 ol_4mm_2_small	🚞 skip1	🗋 Bc
🚞 ed10	🚞 pyra32_4	🚞 skip2	🗋 da
🚞 ed2	🚞 pyra32_4mm	🚞 test1xELS	🗋 da
🚞 els_10mm	🚞 pyra32_4mmGS	🚞 test2×els	🗋 ed
•			••
File <u>n</u> ame: [ob	_00.job		<u>S</u> ave
File <u>t</u> ype: Hil	MT Job Files (*.job)	•	Cancel

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.

213robL1 🕐 😒 🛞		
Status:		
Done !		
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100%		
n]		

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.

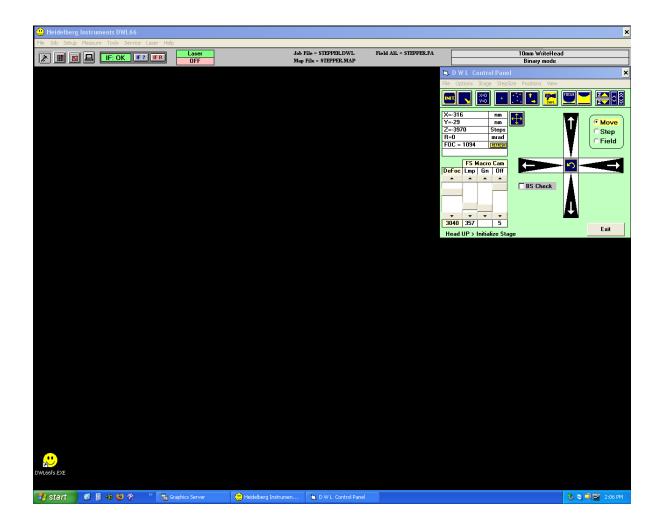
🗙 FTP Transfer 🎱			×
DWL Adress: DWL Partition:	170.168.10.135		
LIC Dir:	job_00_1		
Close	Transfer	Save	

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**.

🙂 Heidelberg Instruments DWL66		×
File Job Setup Measure Tools Service Laser Help		
	Job File = STEPPER.DWL Field Ali. = STEPPER.FA Map File = STEPPER.MAP	10mm WriteHead Binary mode

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

New Exposure Map	×
 C:\ A himt A vbmenu A wafer M stepper C mapname 	\himt\vbmenu\wafer\stepper stepper.dwl stepper.fa stepper.map stepper.rpt stepper.wa
Create Map Remove Map Set Environment to	Edit File Delete File stepper Exit

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:

Design Data Directories	5	×
Refresh List		Delete File
Directory of /h1		
Dir up 032214gb: 032214hgdf: BACH: BcLabel: XXXtest: Xm: Ym: job_00: job_00:st: reso10mm: speed:		
To Job	Convert.cfg Expose.c	fg Exit

For a **stepper** job the screen should appear as shown below (**contact** jobs will be different, with only two rows in **Edit Job**):

Constraints Constrain	Show Source Convert.cfg Expose.cf MAP	Delete File	Map File	Field 1 2 3 4 5 6 7	R.MAP b - STEP do Ali -1	PER.DWL	ff Design /h1/2Xm /h1/2X2214 /h1/032214 /h1/7Ym		Binary Use	Energy Comm. 70 70 70 70 70 70 70 70 70 70 70 70 70 70 70 70 70 70 70 70] :
To Job rotatos Scale	Show Source Convert.cfg Expose.cf MAP	Delete File	Fő	Edit Jo Edit Jo Edit I 2 3 4 5 5 6 6 7 8	b - STEP	Xoff Yof -1 1	/h1/Xm /h1/032214 /h1/032214		Use Defoc 3040 3040 3040 3040 3040 3040 3040 304	Energy Comme 70 70 70 70 70 70 70 70 70 70 70 70 70 7	
To Job	Convert.cfg Expose.cf			Field 1 2 3 4 5 6 7 8	-1 -1 -1 -1	1	/h1/Xm /h1/032214 /h1/032214		Defoc 3040 3040 3040 3040 3040 3040 3040 304	70 70 70 70 70 70 70 70 70 70 70 70 70 70 70 70 70 70 70	
Dir up 322140,01: 322140,01: AD3: 61: AD3: 61: Webst: m: m: b. 00: b.	Convert.cfg Expose.cf		Fie	Field 1 2 3 4 5 6 7 8	-1 -1 -1 -1	1	/h1/Xm /h1/032214 /h1/032214		Defoc 3040 3040 3040 3040 3040 3040 3040 304	70 70 70 70 70 70 70 70 70 70 70 70 70 70 70 70 70 70 70	_
Dir up 322140,01: 322140,01: AD3: 61: AD3: 61: Webst: m: m: b. 00: b.	Convert.cfg Expose.cf	a Exit		1 2 3 4 5 6 7 8	-1 -1 -1 -1	1	/h1/Xm /h1/032214 /h1/032214		3040 3040 3040 3040 3040 3040 3040 3040	70 70 70 70 70 70 70 70 70 70 70 70 70 70 70 70 70 70 70	nd
ACH: cLabel: xXtest: m: b_00:	Convert.cfg Expose.cf	a Exit		2 3 4 5 6 7 8	-1 -1	1	/h1/032214 /h1/032214		3040 3040 3040 3040 3040 3040 3040 3040	70 70 70 70 70 70 70 70 70	
ACH: cLabel: xXtest: m: b_00:	Convert.cfg Expose.cf	a Exit		4 5 6 7 8	-1		/h1/032214		3040 3040 3040 3040 3040 3040	70 70 70 70 70 70	
XXtest: m: b_00; b_00st; sol0mm: peed: To Job ap - STEPPER.A	Convert.cfg Expose.cf	a Exit		5 6 7 8	-1		/h1/032214		3040 3040 3040 3040 3040	70 70 70 70 70	
m: bb_00: bb_00tst: ses010mm: peed: To Job ap - <u>STEPPER.N</u>	Convert.cfg Expose.cf	a Exit		6 7 8	-1	1		-	3040 3040	70 70	
b_ODIst; scollam: peed: To Job up - STEPPER.A	Convert.cfg Expose.cf	a) Exit		8	-1	1	7h17Ym		3040	70	
To Job http://www.andle.com/commons/common/commons/comm	Convert.cfg Expose.cf	g Exit			•						
To Job hp - STEPPER.N	Convert.cfg Expose.cf	a Exit									
2	* = 9										
e665.exe											

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.)

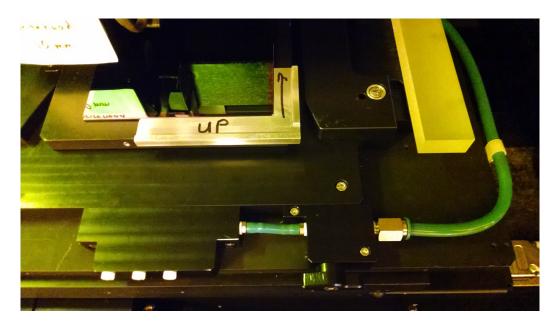
Next, back in the **Edit Job** window, click on the **Design** column of **Field 4**. In the **Design Data Directories** window, select your frame/label file name, then click **To Job**. (For **contact** jobs **Field 2** is the label data.)

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.

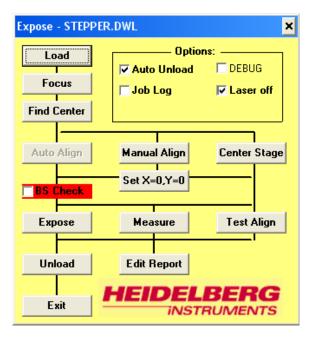
8. From the main menu, click on Job, then **Run Job**. The screen should appear as below (contact jobs will be slightly different):

UHeidelberg Instruments DWL66						×
File Job Setup Measure Tools Service Lase	Laser			ield Ali. = STEPPER.FA	10mm WriteHead	
Map - STEPPER.MAP		-	File = STEPPER.MAP		Binary mode	X
Commands Scale	Load	Options:			File Options Stage StepSize Positions View	
Number of Fields = 9	Foous	to Unload 🗖 DEBUG				
	Find Center	b Log 🔽 Laser off			X=-1879 nm	
					Z=-4074 Steps	C Step
	Auto Align Man	ual Align Center Stage			R=0 mrad FOC = 1056 [REFRESH]	CField
	BS Check	<=0,Y=0			FS Macro Cam	
7 8 9	Expose Me	asure Test Align	1		DeFoc Lmp Gn Off	
			·		BS Check	
	Unload Edit	Report				Λ
	Exit HE	IDELBERG			3040 357 5	
		INSTRUMENTS				Exit
<mark>;:</mark>)						
DWL66fs.EXE						
👪 start 🛛 🕫 📓 👍 🕹 🖻 👋	DWL MENU	B Graphics Server	Heidelberg Instrumen	D W L Control Panel	Expose - STEPPER.DWL	🌯 🔍 🗃 11:49 AM

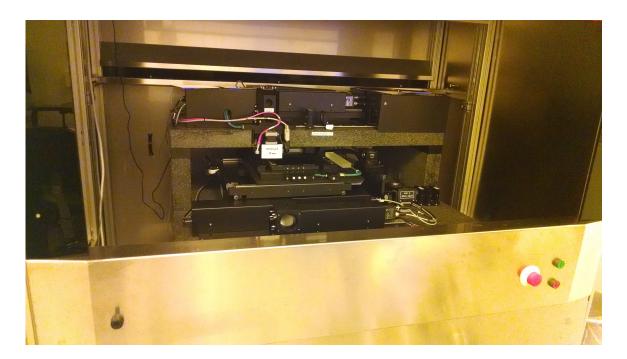
9. Click **Load** in the **Expose** window. The stage will move to the load/unload position. Open the chamber door using the toggle switch on the chamber front left. <u>Carefully</u> align the mask using the provided hardware, then turn the chuck vacuum on. **Any misalignment may make your mask unusable!** Be careful to avoid touching the mirrors on the sides of the stage, as this could cause system failure.



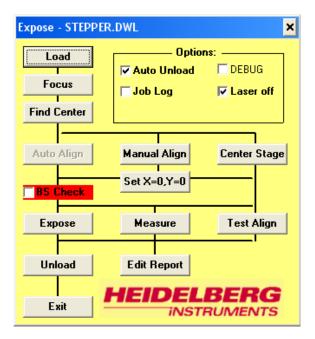
Close the chamber door. After is has fully closed, click **OK** in the popup window to finish the loading operation. The stage will move back to the center position.



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 Right edge found at Lo w er edge found at Upper edge found at	searching
Stop	Close

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

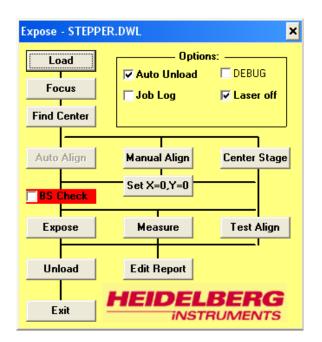
12. In the **Expose** window, click **Expose** to begin the exposure. The system will display a progress window during writing, and an estimate of remaining time will appear. This estimate is often inaccurate, so you should estimate your total time before starting.

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.