

# DWL-66 Laser Lithography System Operating Procedure

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# 1 Introduction

## 1.1 Key Words

Laser Lithography System, Optical Lithography, Pattern Transfer

## 1.2 Purpose

This document provides instructions for operating the DWL66 laser lithography tool, which is a direct pattern generator by using laser beam exposure technique. It can work with most photo-resist while mask is not required. Use of this tool requires the understanding of the fundamentals of optical lithography and pattern design rules.

## 1.3 Applicability

### 1.3.1 Locations

The tool is located at **Clean room of Nanoscience Research Center.**

### 1.3.2 Safety

The safety concern is the system uses high voltage electricity and the laser on this machine is class 3B, meaning that it can cause serious injury to the eye if you stare directly at the beam.

### 1.3.3 Restrictions and Limitations

- Must be a qualified user of clean room and DWL-66 system.
- The limitation for the sample is that it must not damage the system (between 1X1 inches to 6X6 inches).


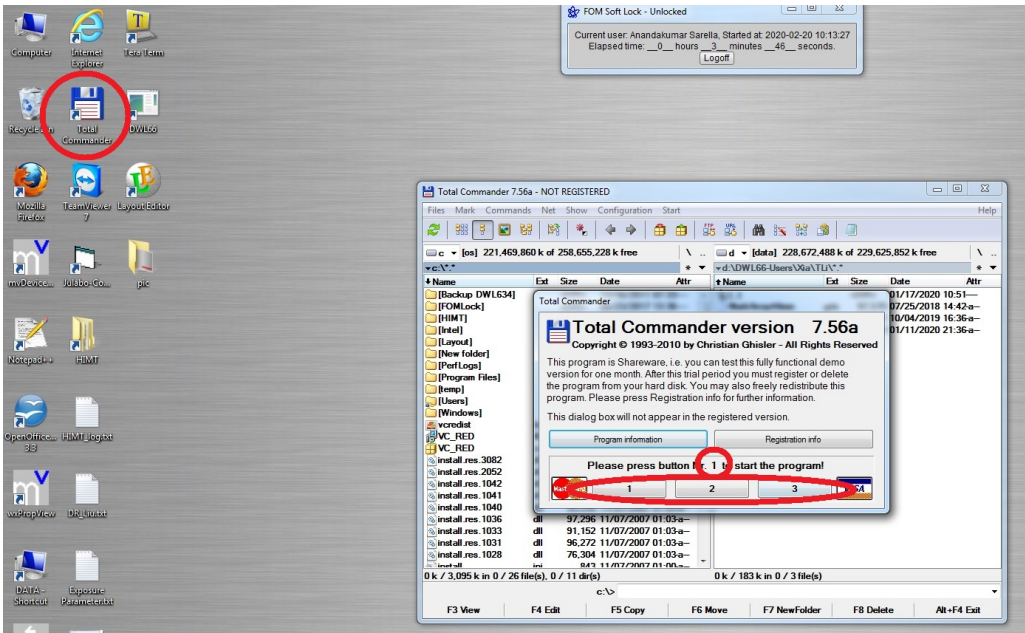
## 1.4 Restrictions on Working Alone

- Normal working hours are from 8am to 6pm M-F.
- Working alone is permitted with completion of an orientation to this written procedure and hands-on training from the specialist.
- Assistance from the specialist is available during working hours only. If an error occurs during off-hours, record the error in the Logfile and contact the specialist. **Do not try to fix or adjust anything by yourself.** Tool will be checked in the following work day. User will be notified when sample left in chamber is available for pickup.
- Problems with equipment malfunctions, breakage, etc. should be reported to the specialist and recorded in the tool Logfile. **Again do not try to fix or adjust anything by yourself.**
- In case of any emergency, turn the main switch to “OFF”, leave the room and close the door immediately. Contact the specialist right away.
- For any emergency involving injuries, fire, chemical spills, etc., call **911**.

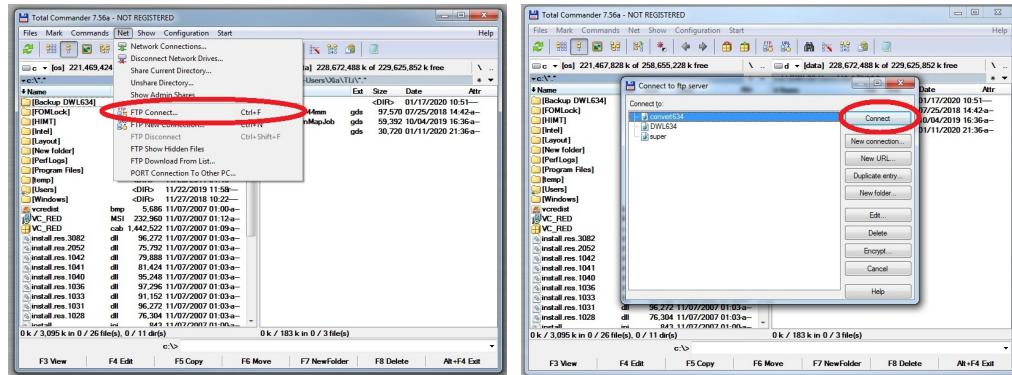
# 2 Preparations

- Receive this procedure from the specialist.

### 3 Execution (Step-by-step work breakdown)

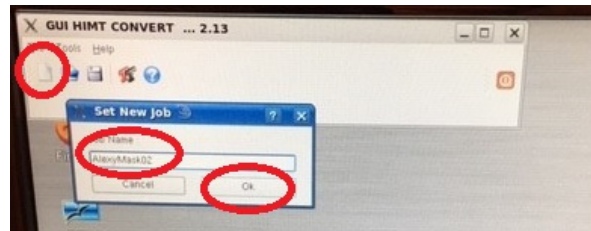
Step #	Action
1.	<p><b>Logon equipment through NCMN FOM software:</b></p> <ul style="list-style-type: none"> <li>Logon through NCMN FOM screen lock</li> </ul> 
2.	<p><b>Transfer pattern file:</b></p> <p>The user interface of the DWL66 system consists of two computers. <b>Left computer</b>, called “Convert” below for convenience, is for pattern conversion. <b>Right computer</b>, called “DWL” below for convenience, is for system operation.</p> <ul style="list-style-type: none"> <li>In DWL computer (<b>right computer</b>), copy the pattern file from network hard drive to the user folder of the local computer. <b>Note:</b> <b>Ensure the filenames contain no special characters like blank or dash etc.</b></li> <li>In DWL computer, open up the data transfer software by double clicking on the “Total Communication” icon on desktop. Press the corresponding number according to the initializing window to start the program.</li> </ul> 

- Start FTP link by clicking “Network” → “FTP”. In the pop-out window, select “Convert634” as remote computer and click “connect” button. Wait until the communication setup. In the program, there are two windows, the left one is Convert computer and the right one is the DWL computer. Go the correct user folder in both computers first. Transfer file can be done by dragging the pattern files from right window to the left.

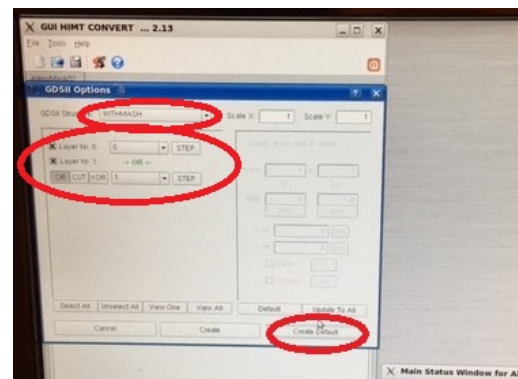
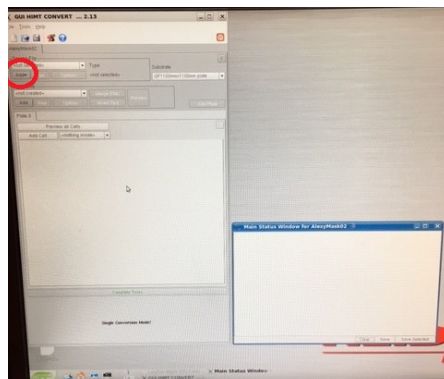


### 3. Convert pattern to Heidelberg exposure files:

- Login the Convert computer on left (user name: “convert”; password: “convert”).
- Start conversion job manager by clicking **ONCE** on “app66” icon on the desktop.
- Create new job through the menu. In the dialog window, create a name (no special characters) for the job. Click “OK” to confirm.

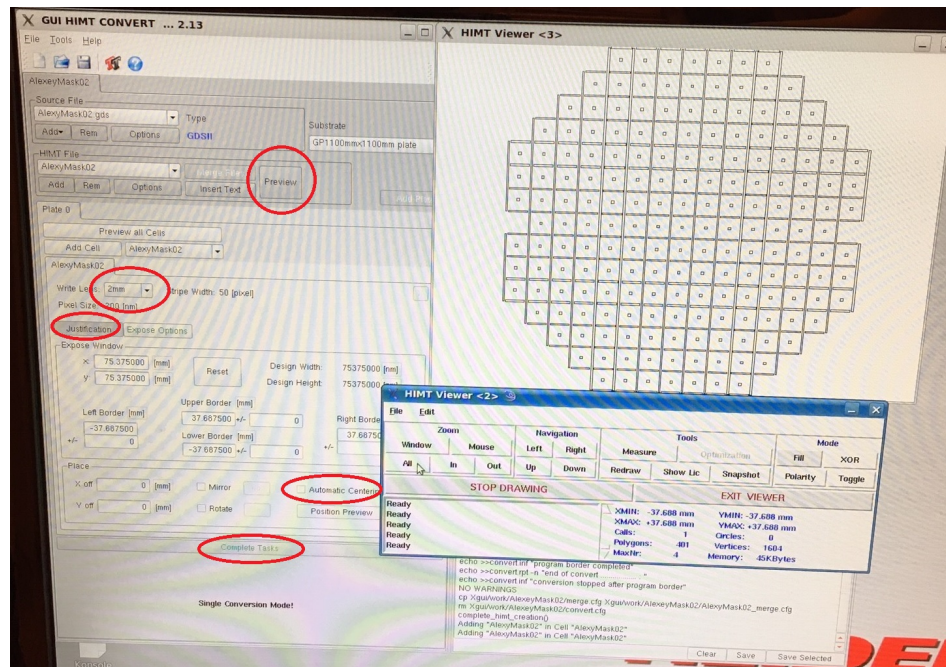


- Select the appropriate pattern file type to add by clicking “Add”. The folder containing those file types will automatically open. Select the file that was previously copied to the computer. The system support different types of pattern design files. **GDSII format is recommended.** Check proper **structures** and **layers**. Click “Create Default” in pop-out window to confirm.

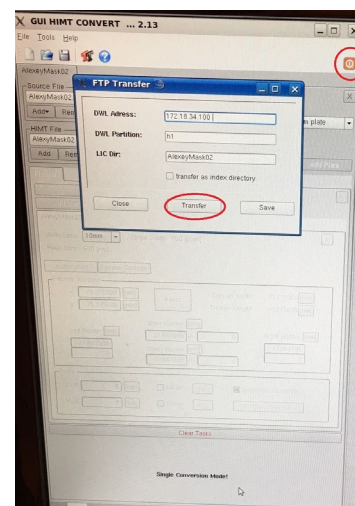
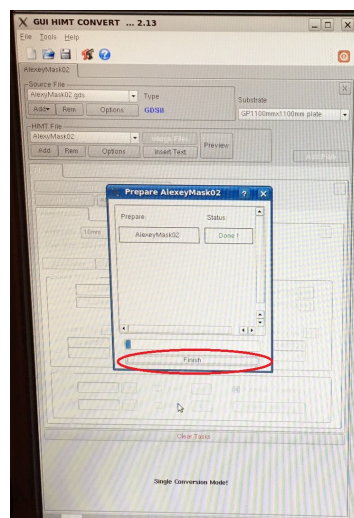




- Click “Preview” button and check the pattern is properly loaded.
- Set the appropriate justification parameters. First, choose the correct lens that the pattern will be written with (**Normally should be 10mm write head**). Next, the boundaries of the pattern may be changed if the whole pattern does not need to be written. Finally, automatic centering will place the center of the pattern at (0, 0).
- Set the appropriate exposure parameters. (Normally it is not necessary to change anything here unless you need some advanced adjustment.)

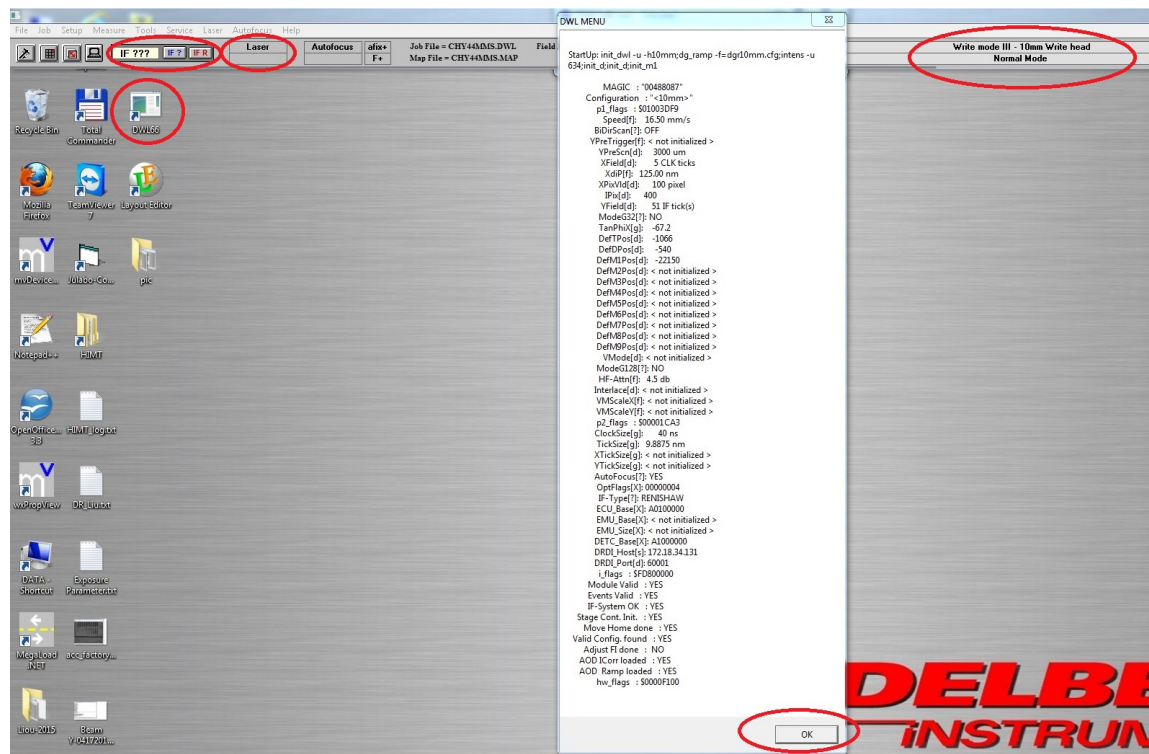


- Start conversion by clicking “Complete tasks”. Select ok to use the same expose job name (recommended). The pattern will now be converted into \*.lic files. When the conversion is complete, click “Finish”. In the pop-out window, Click “Save” and then click “Transfer” to send the converted pattern files to the mask writer operation server. Close the window and the software.




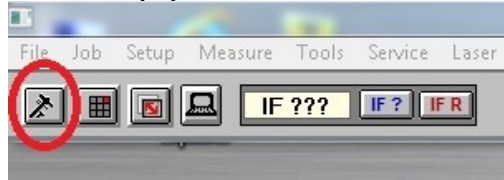
#### 4. Starting Software:



- Start the DWL66 user menu by double clicking the “DWL66” icon on desktop. The menu bar will appear on top of the screen. Wait ~5min, a window will pop out showing the current setting and communication status of the system. Click “OK” to confirm. **If an error message window pops out instead, contact specialist to rebuild the communication.**
- In the DWL66 menu, verify that the correct write head is loaded which is shown on the right end of the menu bar. **(Normally it should be 10mm write head)**. If not, please contact specialist for help.
- Verify that the laser interferometer works in normal condition, i.e. **IF: OK** shown in the menu bar. If not, click **IF ?** to check status. If it still doesn't work, please contact specialist for help.
- Switch on the laser source by clicking icon **Laser OFF** in the main menu. It takes about **10 minutes** before the laser beam stabilizes.

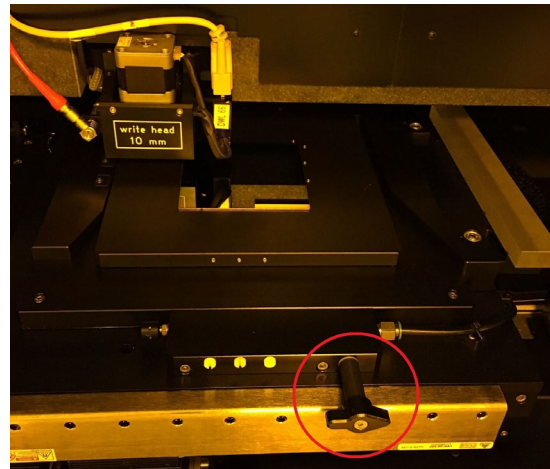
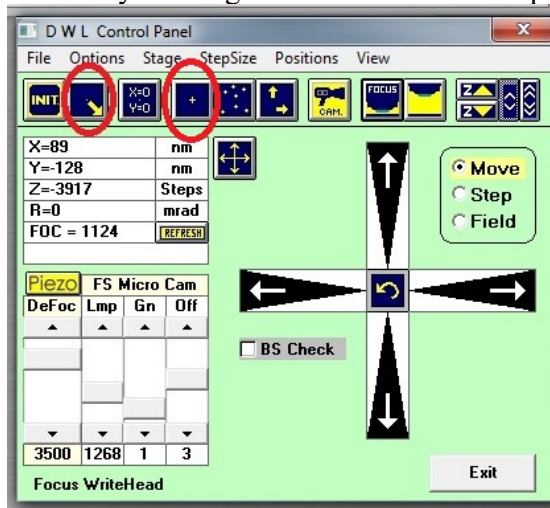


## 5. Loading the wafer/blank mask:



- Open the DWL Control Panel by clicking  icon in the menu bar. The Control Panel will pop-out below the menu bar.



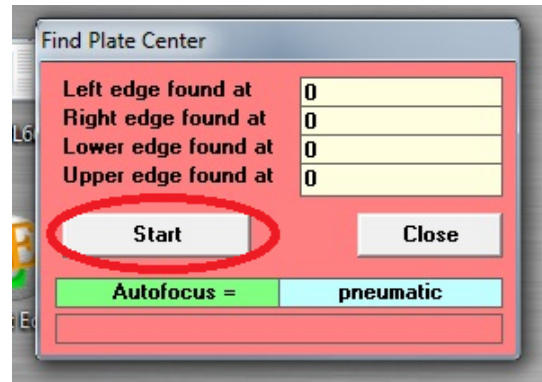
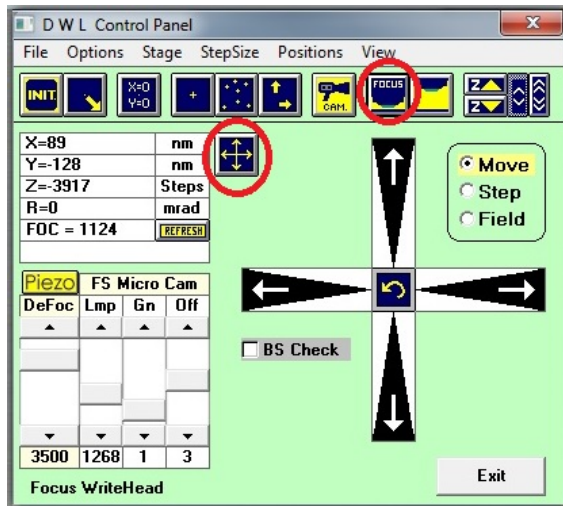
- Ensure the environmental chamber is closed. **Note: if it is open, the stage won't move.** If it is open, close it with the black switch on right side of the front panel of the chamber.
- Move stage to the loading position by click on  icon in the control panel. Open the environmental chamber. Place the wafer/blank mask in the center of the stage (align against pins if possible) and open the vacuum valve. Ensure that the wafer/blank mask will not move. **Close the chamber.** Move the stage back to (0, 0) by clicking  icon in the control panel.



## 6. Focus and Find wafer center:

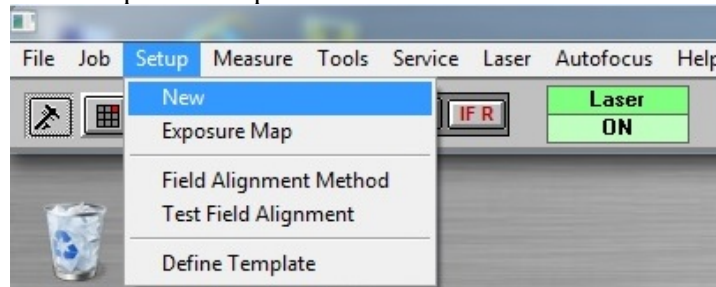
- Check the stage position and make sure lens locates on top of the wafer/sample center. Lower the lens into the focus position by clicking on  icon in the control panel. Wait until write head stop moving.
- To find the center of the wafer/blank mask, press Find Center  and then select **Start**. The stage will scan over the area of the wafer/blank mask and find the edges. Wait until the procedure finishes. Then select **Yes** in the prompted window to set (0, 0) at the plate center.



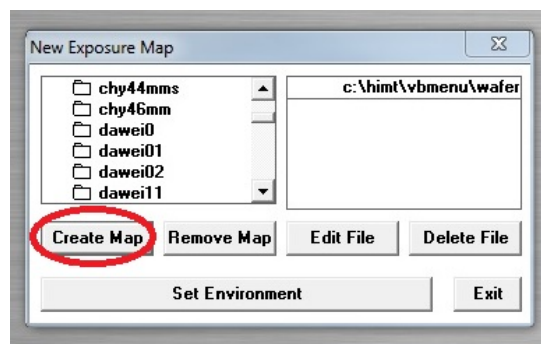


## 7. Setting up an exposure:

- Set exposure environment by clicking “**Setup**” in main menu. Click “**New**” to open “New Exposure Map” window.

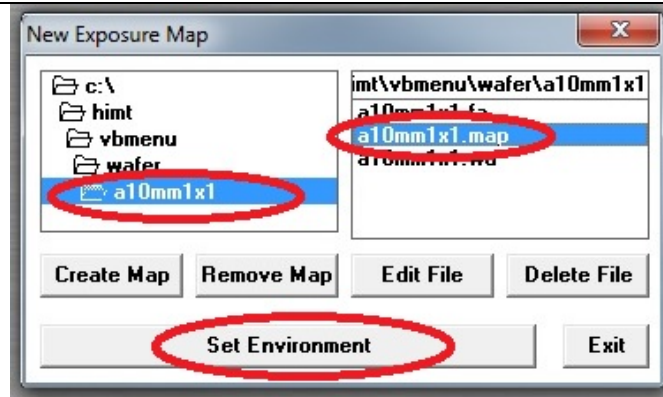


- To create a new exposure environment, Click “Create Map” button and enter the name (Max 8 characters and no special characters are allowed)

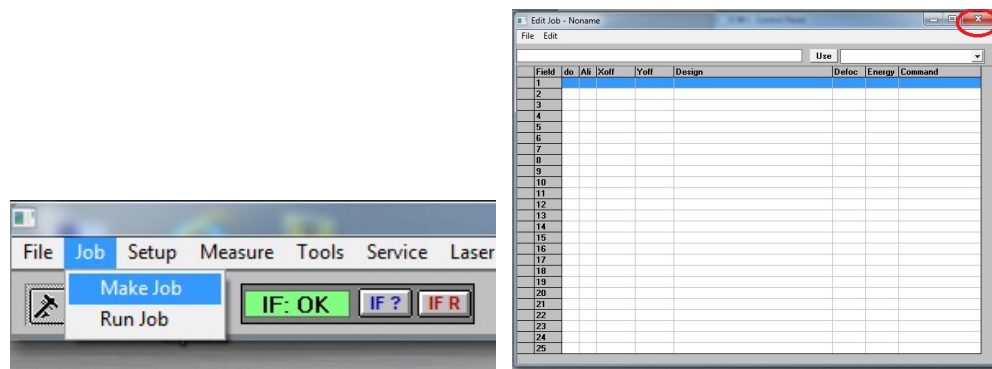


- Locate and double click the new created exposure map in left window (or open existing one that is created before). Files will show up in the right window. Double click “.map” file, then click “**Set Environment**” button.

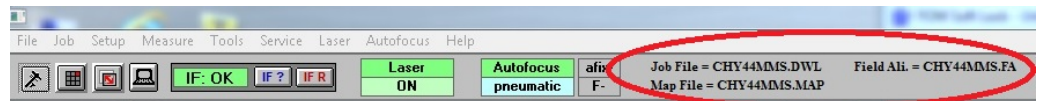




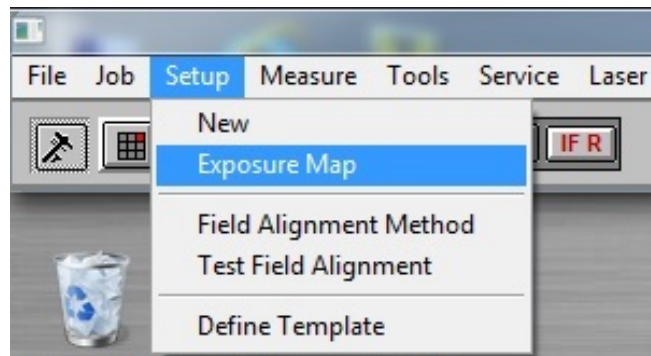
- Click “**Job**” → “**Make Job**” in the main menu. The edit job window will pop out. Close the window. Confirm to “save” if dialog pops out before closing.

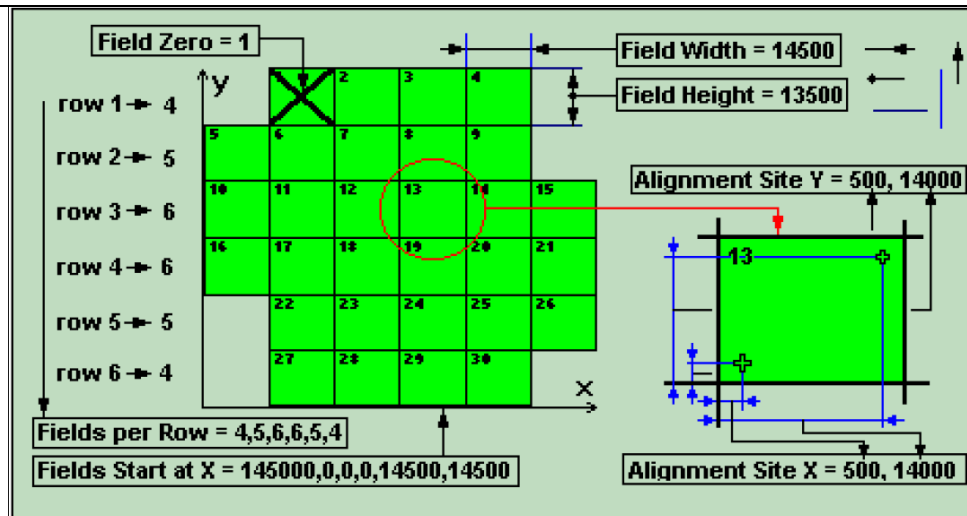


- Make sure Job file, Field Ali, and Map files share the same name.



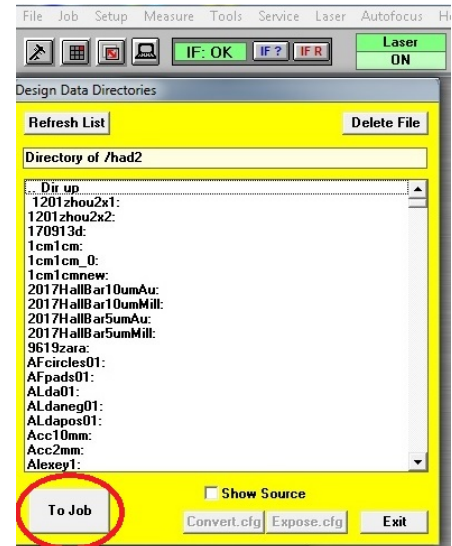
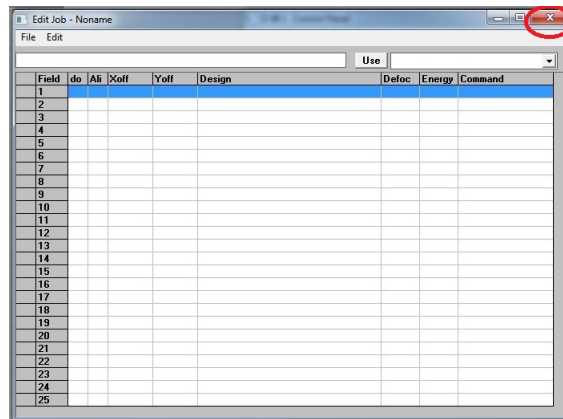
- Click “**Setup**” → “**Exposure Map**” in main menu. A window will pop out to edit the exposure map. All units are in micrometers. The alignment sites are only used if there are alignment marks on the mask. “Field Zero” is the zero point for the exposure (normally the center of the wafer / mask).

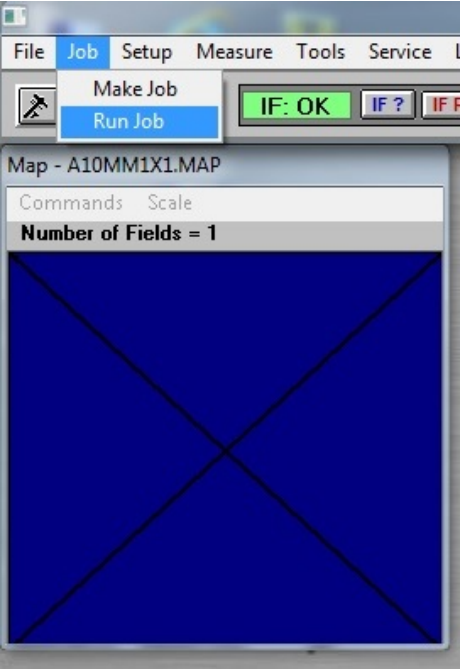
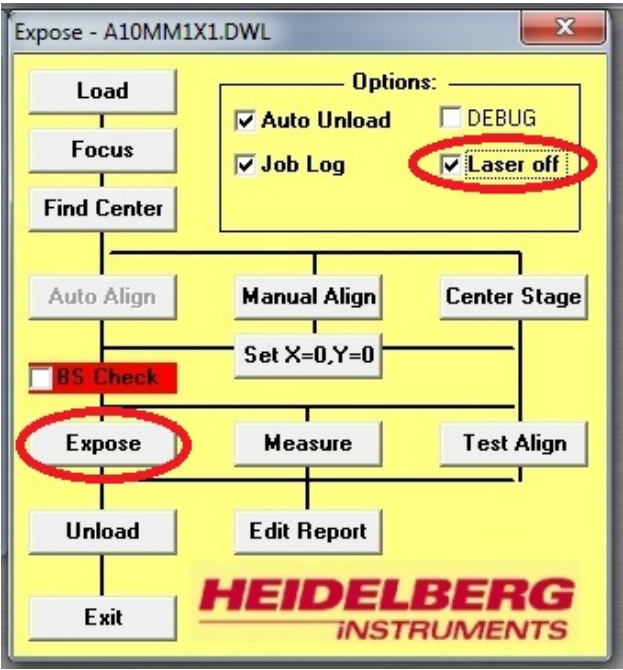

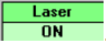




NOTE: 1. If field width/height is too small there will be overlapping.  
 2. “Field zero=” defines the center of this field is the zero point for the exposure! This has to match the coordinate origin (0, 0).

- Click “Job” → “Make Job” in the main menu. The edit job window will pop out. The first column gives the field number corresponding to the Exposure Map.
    - For field that need to expose, set do = “-1”. Otherwise leave it blank.
    - “Ali” column defines the alignment marks. **Contact specialist for further information.**
    - Click design cell, then click “File” → “Design” in the main menu. Design database window will pop-out. Select designed pattern on the list then click “To Job”. Close this window by clicking on “Exit” once it is finished.
    - Set the appropriate Defoc values for the write head being used. (For 10 mm head, Defoc: 3500)
    - Energy can choose 10, 20... 100. It is used for fine adjustment of dosage. (For S-1813 resist, Energy: 60)
- Once all fields have been set up, close the job and save it.



8.	<p><b>Exposing:</b></p> <ul style="list-style-type: none"> <li>Click “<b>Job</b>” → “<b>Run Job</b>” in main menu. The expose window will pop-out. Check “Laser off” in “Options”, which will turn off laser after exposure finishes.</li> <li>Click “<b>Expose</b>” to begin exposure. A window will open that provides an estimated write time. Also the exposure map will show which fields have been written (green), which one is in progress (yellow), which ones are remaining (blue), and which ones had errors (red).</li> </ul> <div style="display: flex; justify-content: space-around;">   </div>
9.	<p><b>Unloading the wafer/blank mask:</b></p> <ul style="list-style-type: none"> <li>After exposure finishes, stage will move to load/unload position if “Auto Unload” is checked in last step. Otherwise, manually unload the sample by clicking unload icon  in the control panel to move the mask to the unload position.</li> <li>Open the environment chamber. Close the vacuum valve and remove the wafer/blank mask. <b>Leave the stage at unload position and close the environment chamber.</b></li> </ul>
10.	<p><b>Switch off Procedures:</b></p> <ul style="list-style-type: none"> <li>Turn off laser source by clicking by clicking icon  in the main menu. <b>MAKE SURE the laser is off.</b></li> <li>Close the DWL66 user menu program.</li> </ul>
11.	<ul style="list-style-type: none"> <li>Clean up all samples, pens, and notebooks from the area.</li> </ul>
12.	<ul style="list-style-type: none"> <li><b>End of Procedure</b></li> </ul>

## **4 Post-Performance**

### ***4.1 Recordkeeping***

Completely fill out the logfile.

### ***4.2 Feedback***

Report any unusual or problematic behavior of the setup by contacting the specialist.

## **5 References**

### ***5.1 Technical References***

- MJB4 mask aligner User Manual

## **6 User Access Level**

Normal User – Requires specialist to be present

Expert User – Does not require specialist to be present