Standard Operating Procedure (SOP)

IPG IX-255 Excimer Laser Micromachining

(LMM-01)

In case of emergency please call 911

For any other major safety concern contact EHRS at: 215-898-4453 or via email: ehrs@ehrs.upenn.edu

If there is an error on the system/tool please report it on IRIS, we will take care of it

General safety tips and common mistakes

1) If the screen will not turn on, make sure you are logged into the tool on IRIS.
2) If you need to abort a recipe, you must run the footer: [Global] MacroFooter
3) For through cuts, you must adhere your sample to a base material such as a wafer to prevent the laser from machining the chuck.
4) Be sure that the "Processing State" (upper right) is in the IDLE state before starting a different macro. Otherwise the software will crash.

IPG IX-255 Excimer Laser Micromachining

Procedure Overview

1) Loading the Excimer
2) Loading the Excimer (IPG Chroma NET)
3) Unloading the Excimer
4) Changing the Laser Shape (Creating a Circular Laser):
5) Changing the Laser Shape (Creating a Rectangular Laser):
6) Using CAD Builder

Tool Overview:

The IPG IX-255 Excimer Laser is a highly flexible UV laser micromachining system for multi-purpose, R&D and production applications. The system combines a Class 1 workstation integrated with a proprietary UV (193nm) laser and beam shape selector (infinitely variable rectangular and discrete circular) to machine transparent samples such as plastic, glass, and PDMS.

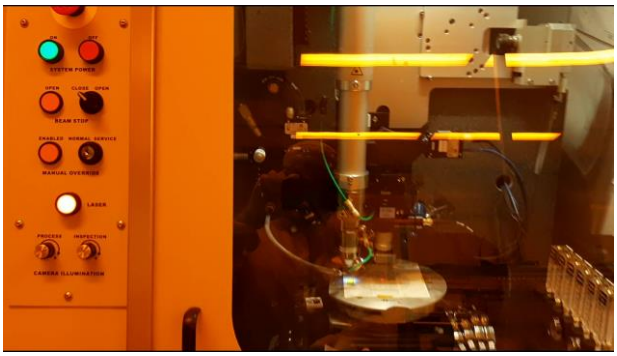
Full procedure:

Log into the tool via IRIS

1. Loading the Excimer Laser

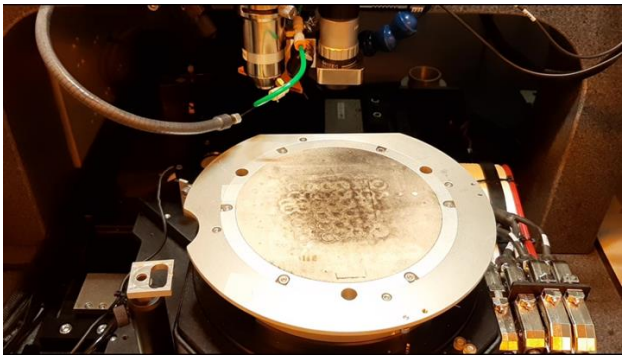
1.1. Confirm that the light for "**OPEN**" Beam Stop is **OFF**. If it is on, contact staff.

1.2. Open the door to the stage.



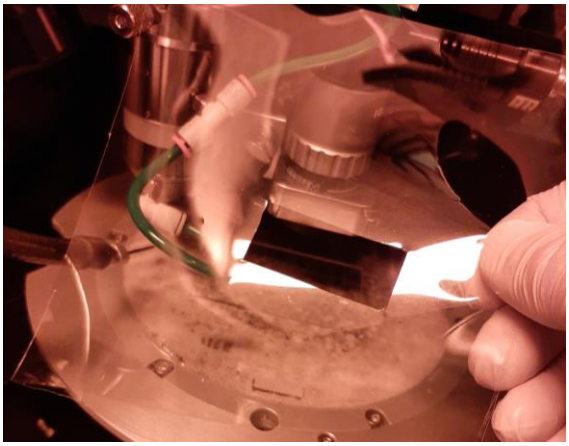
1.3. The Excimer's stage should be in the unload configuration. If it is not, refer to section 3 below.

1.4. The 6" diameter central area of the stage is a sintered ceramic chuck that allows for vacuum mounting of samples.



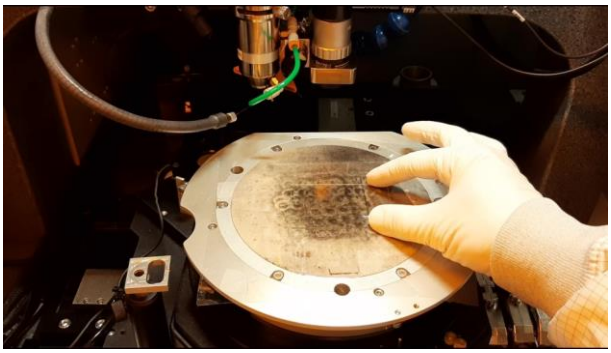
1.5. If the sample is smaller than the chuck, use a plastic film as shown to help with vacuum mounting.

Attention! The rectangular cut out must be smaller than the slide.



1.6. **If surface machining:**

1.6.1. Sample may be placed directly on the chuck.

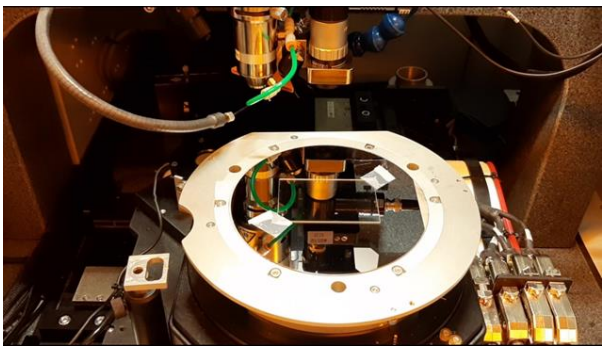


1.7. **If through-cut machining:**

1.7.1. Place a protective material such as a wafer or aluminum sheet over the chuck.

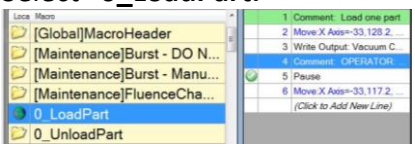
1.7.2. Secure the sample using tape. (Folding in one edge of the tape makes it easier to remove)

Attention! Make sure the wafer covers most of the stage to improve vacuum.



2. Loading the Excimer (IPG Chroma NET):

2.1. Select "**0_LoadPart.**"



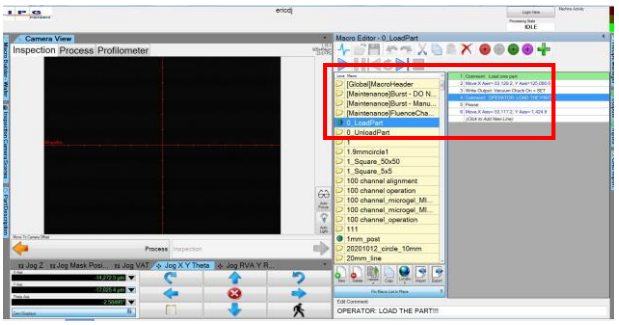
2.2. Select the Blue Triangle (Run Button) to begin the loading process.

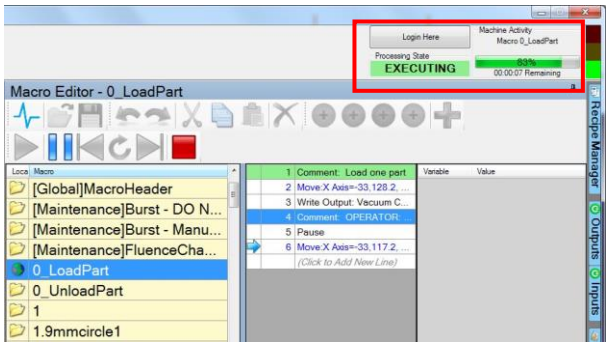
2.3. A red **PAUSE** icon will appear at the top right corner of the screen. This pause allows you to test that your sample is firmly held in place.

2.4. Press the "**Run**" button again to complete the program.

2.5. The **PAUSE** icon will change to **EXECUTING**.

2.6. Once **EXECUTING** changes to **IDLE** the program is complete and the stage has been successfully loaded.

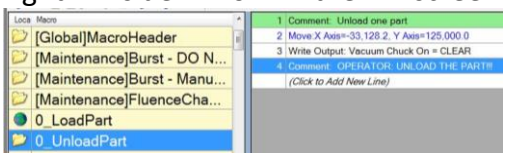




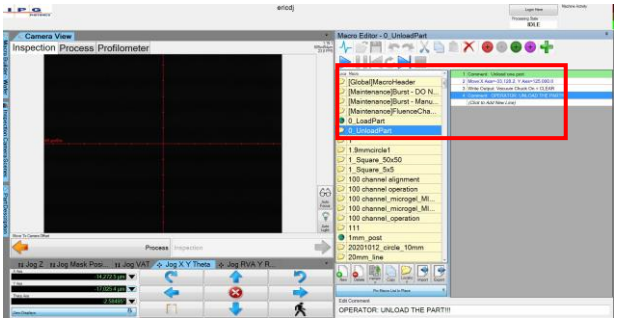
3. Unloading the Excimer:

3.1. Click on the "**0_UnloadPart**" folder.

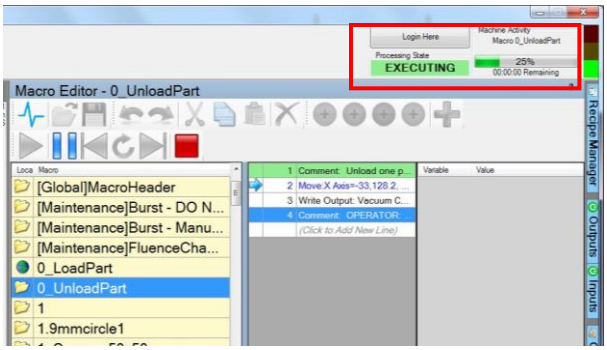
3.2. A dropdown menu will appear on the right side of the screen.



3.3. Select the blue play button. 



3.3.1. The action has been completed when the green "**EXECUTING**" icon changes to "**IDLE**."

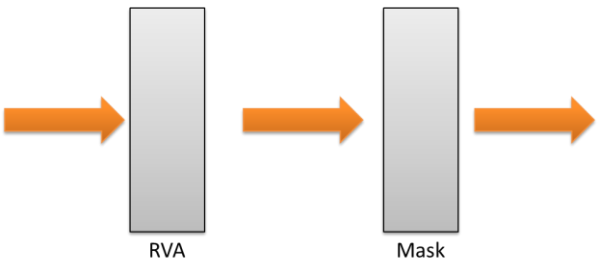


3.4. Open the door, and remove the sample.

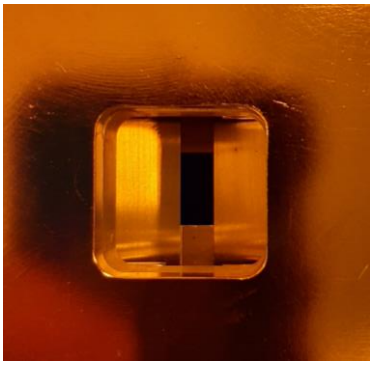
3.5. Close the door.

4. Beam Shaping

4.1. The laser can be shaped using the **RVA** and the **Mask Positioner**. The laser will pass through both apertures, so both must be altered to get the correct shape.

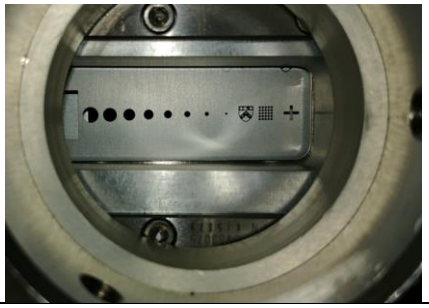


4.1.1. The RVA is a rectangular aperture of infinitely variable dimensions in x and y. If using the RVA, the Mask Positioner (below) must be set to a specific position as shown in section 4.4.



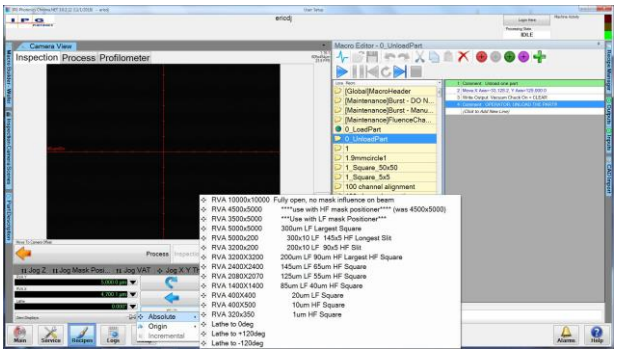
RVA

4.1.2. The Mask Positioner is set of discrete circular shaped apertures. If using the Mask Positioner, the RVA (above) must be set to a specific size as explained in section 4.3.



4.2. **Creating a Rectangular Laser**

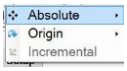
4.2.1. Using the RVA and the Mask Positioner, you can change the shape of the laser. The laser will pass through both pieces so both must be altered to get the correct shape.



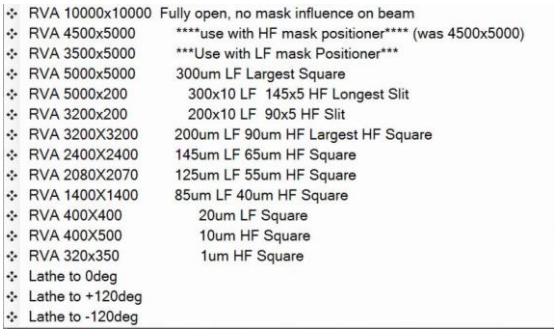
4.2.2. You can use the laser to cut rectangular shapes into your sample by selecting the Rectangular Variable Attenuator.

4.2.3. Click on “Jog RVA Y RVA X.”

4.2.4. Select the Clipboard and then select “Absolute.”



4.2.5. A dropdown menu of several sizes will appear.



4.3. Each shape will have a different size depending on whether or not the laser is in high fluence (HF) or low fluence (LF).

4.3.1. Example: RVA 2400X2400 145um LF 65um HF Square

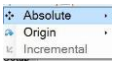
4.3.1.1. If the machine is set to low fluence, the laser will create a square that is 145um by 145um.

4.3.1.2. If the machine is set to high fluence, the laser will create a square that is 65um by 65um.

4.3.2. In order to get the correct shape, you will also need to move the “Mask Positioner” to the correct position

4.3.3. Select “Jog Mask Positioner.”

4.3.4. Select the Clipboard and then select “Absolute.”



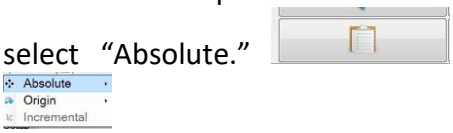
4.3.5. A dropdown menu of several sizes will appear. Select “Mask Rectangle (no Mask)”.

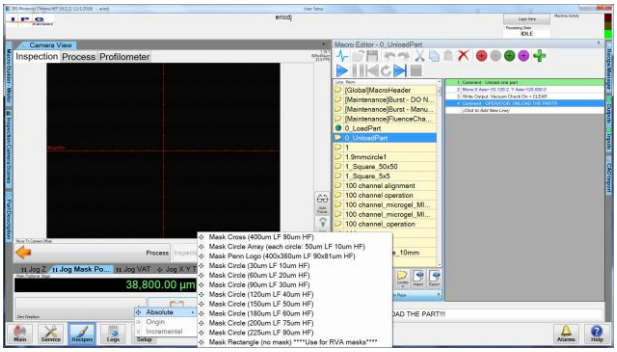
4.3.6. This will prevent the Mask Positioner from altering your rectangular

4.4. **Creating A CIRCULAR beam**

4.4.1. Select “Jog Mask Positioner.”

4.4.2. Select the Clipboard and then select “Absolute.”





4.4.3. A dropdown menu of several sizes will appear.

4.4.4. Each shape will have a different size depending on whether or not the laser is in high fluence (HF) or low fluence (LF) mode.

Attention! The current fluence of the laser can be checked by reading the sign above the laser door. It is normally in HIGH fluence, but can be moved to LOW fluence upon request.

4.4.5. Example: Mask Circle (30um LF 10um HF)

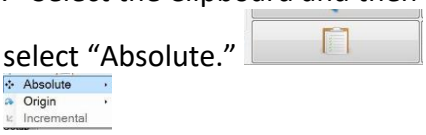
4.4.5.1. If the machine is set to low fluence, the laser will have a diameter of 30um.

4.4.5.2. If the machine set to high fluence, the laser will have a diameter of 10um.

4.4.6. In order to get the correct shape, you will also need to move the “Rectangular Variable Attenuator” to the correct position.

4.4.7. Click on “Jog RVA Y RVA X.”

4.4.8. Select the Clipboard and then select “Absolute.”



4.4.9. A dropdown menu of several sizes will appear. Select RVA 4500 x 5000 or 3500x5000 depending

on whether the laser is in high or low fluence

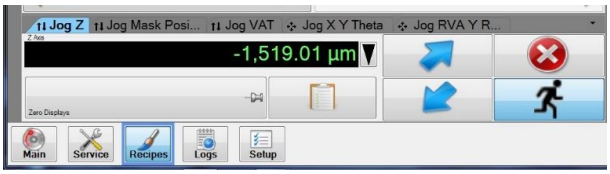
4.4.10. This will allow the laser to pass through the RVA unobstructed.

Also note these toggles:

 Fine motion

 Coarse motion

Zero display



5. Using CAD Builder

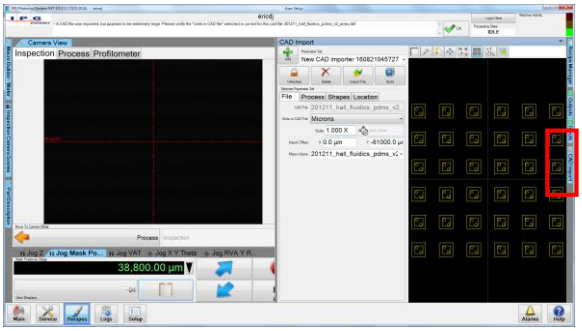
5.1. Before using the Excimer, make sure:

5.1.1. the origin is near or within the features

5.1.2. the CAD file is saved as a DWG or DXF

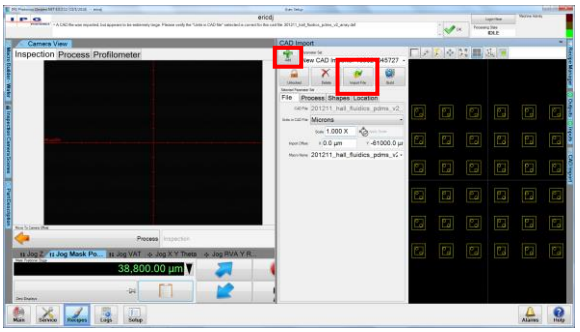
5.1.3. the file is on a USB drive

5.2. Insert the drive into the computer and select the CAD Import tab.

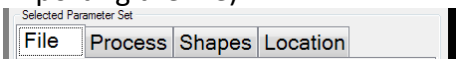


5.3. Once in CAD Import, select “Import File”

5.3.1. File explorer will open up. Find and select your file to import it.



5.4. Open the “File” tab in CAD Builder. (This is likely the tab that is open after importing the file)



5.5. At the top right of the screen you will see 7 icons

1 2 3 4 5 6

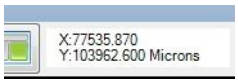
5.5.1. 1:  Zoom - Dragging the cursor vertically on the screen allows you to zoom out

5.5.2. 2:  Zoom window

5.5.3. 3:  Expands to the full field

5.5.4. 4:  Pan

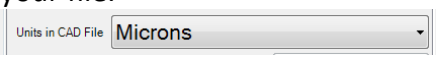
5.5.5. 5:  Hide and reveal the axes

5.5.6. 6: 

Cursor location field in microns

5.6. **FILE** tab

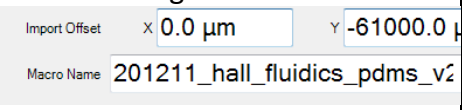
5.6.1. "Units in CAD File" SHOULD be the proper units imported from your file.



5.6.2. The software usually takes the units directly your file, but always confirm and change accordingly

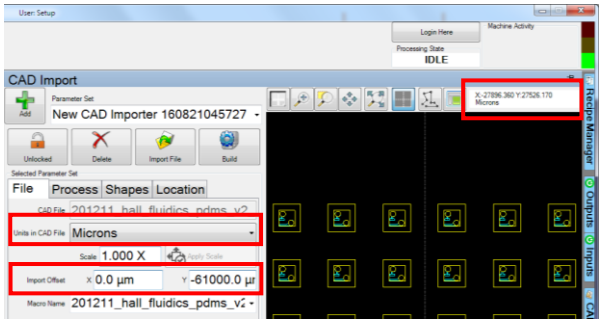
5.6.3. Confirm that the units are correct by moving the cursor across the display to the right and observing the values in field #6.

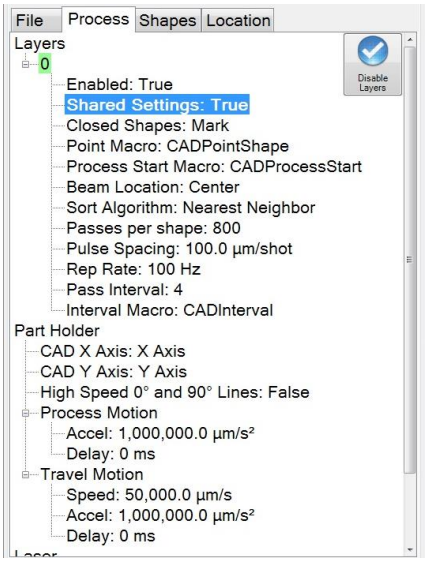
5.6.4. "Import Offset" allows you to offset the origin.



5.6.4.1. This is important if the origin is far from the features.

5.7. **PROCESS** tab: Sets values for how the layers and features are processed.



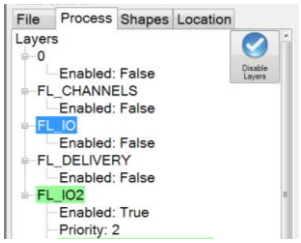


5.7.1. **Layers**

5.7.1.1. Enabled: Double-click to toggle layer from active to inactive. Only enabled layers will be written.

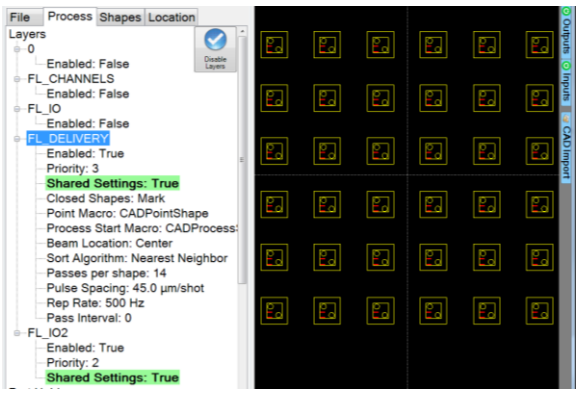
5.7.2. **Priority**

5.7.2.1. Defines which layer will run first, second, etc.



5.7.3. **Shared Settings**

5.7.3.1. "True" forces the first settings to be applied to all enabled layers.



5.7.4. **Closed Shapes**

5.7.4.1. "Mark" will cause laser to write on all lines.

5.7.5. **Process Start Macro**

5.7.5.1. The default is CADProcessStart.

5.7.6. **Beam Location**: The default is "Center."

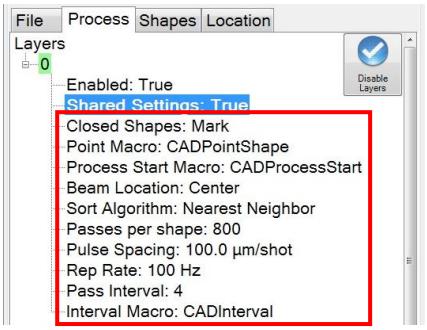
5.7.7. **Sort Algorithm:** This describes the order in which the features are cut. Default is "Nearest Neighbor".

5.7.8. **Passes per shape:** Program repeats entire pattern this number of times.

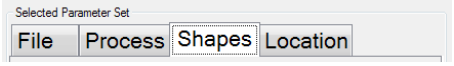
5.7.9. **Pulse Spacing:** Moves this distance between laser pulses.

5.7.10. **Rep Rate:** This is the number of laser pulses per second.

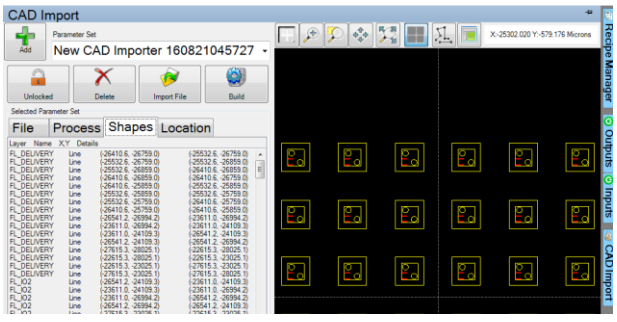
5.7.11. **Pass Interval:** The default is 0.



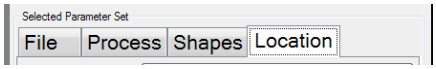
5.8. "Shape" Tab.



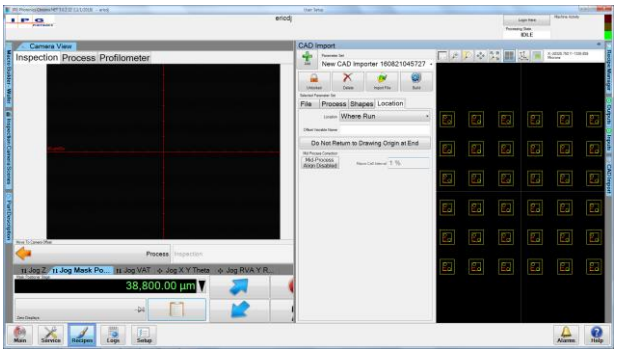
5.8.1. The possible shapes are displayed in the tab, but they cannot be edited.



5.9. “Location” Tab.

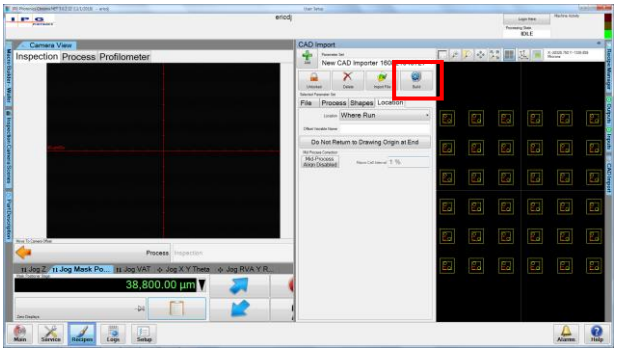


5.9.1. “Where Run” aligns the origin of the drawing with the position of the inspection camera on the substrate.

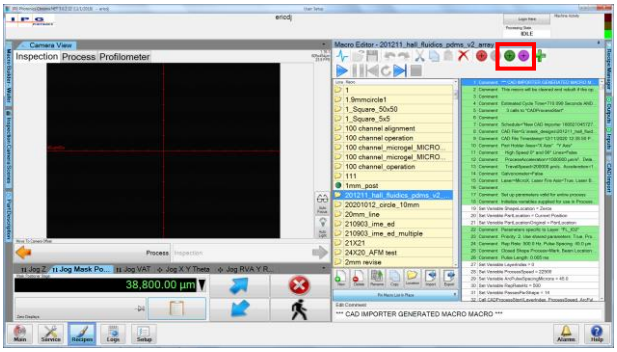


5.10. Select the Build Button to create a recipe for your design

5.10.1. You will be taken back to the main page of the IPG Software and where the new recipe is displayed.



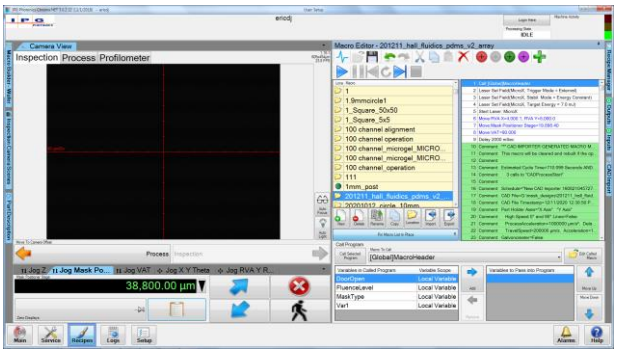
5.11. Header and Footer:The header and footer must be added for your recipe. Select on the first line of the program then click the Green plus button to add the header. 



5.11.1. This adds new text to the top of the recipe that locks the door and moves the stage into the correct position.

5.11.2. Scroll to the bottom of the recipe and click on “Add New Line”

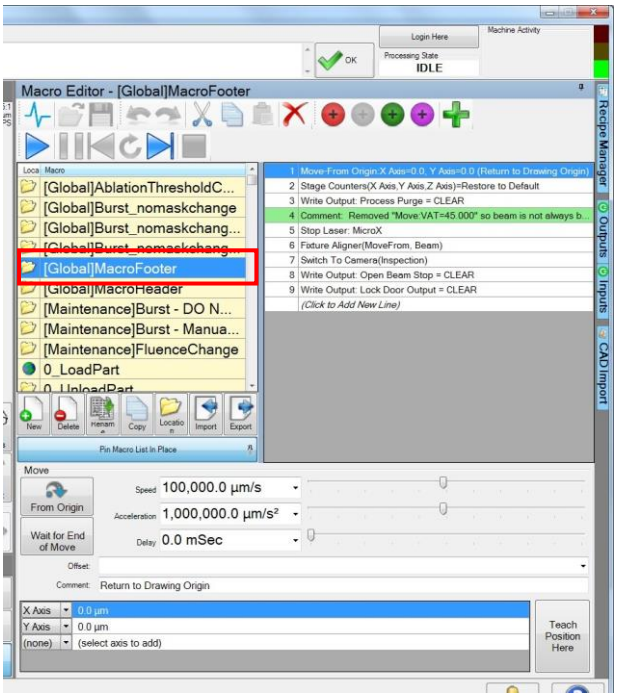
5.11.3. Click on the Purple plus button to add the footer 



5.11.4. Now your recipe is ready to be run. Click on the blue “Run” button to start your recipe 

5.11.5. If the process needs to be aborted, press the STOP button.

5.11.5.1. *Note: you MUST run the* [Global]MacroFooter *to return the stage to the inspection camera and unlock the door.*



Feel free to contact the staff members with any questions about your process and the tool.

Last modified: 6Dec2021 by Eric Johnston