# Süss MA6Gen3 User Manual

Version of 2024-07-18.

1. Introduction

This manual explains how to operate the Süss MA6Gen3 mask aligner to expose wafers in first mask, top-side (TSA) alignment or backside (BSA) alignment mode.

2. Login on CAE

Login with your "CMi" username and password on the Zone 06 CAE accounting computer.

Select the "Suss MA6 Gen3 Mask Aligner"

| ❶	Z06 Suss MA6 Gen3 Mask Aligner
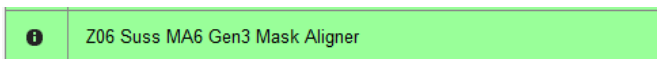
3. Check or start the Hg lamp

Note: Starting the lamp and waiting for the 15 minutes warm-up delay does not require CAE login.

Verify visually if the mercury (Hg) lamp is turned on. If it is on, green emission will be seen coming out of the lamp house on the right side of the equipment.

The lamp is started by pressing 3 keys consecutively on the CIC (constant intensity controller) lamp power supply.

The CIC display should read "STAND-BY" and usually you do:
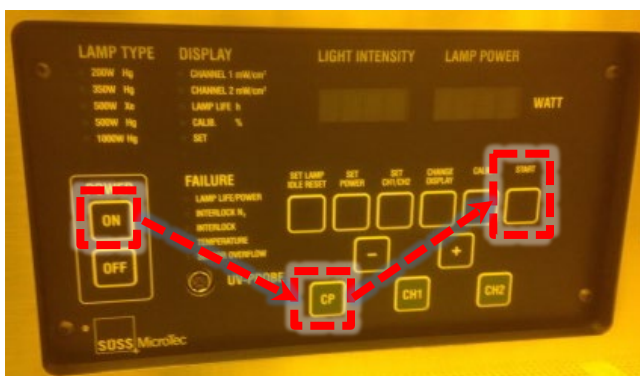
CIC Display shows: [light intensity/ lamp power]	Press the following buttons:
STAN D-BY	POWER ON
-REA DY--	CP
=>>S TART	START
IGNI TION	
LAMP COLD	**Wait 10-15 minutes!**
LIGHT INTENSITY LAMP POWER 0.0 855 WATT	**You're ready!**

After 10-15 minutes, the lamp is warm enough to give a stable intensity, the CIC shows the real-time intensity on the internal sensor (0.0 when not exposing) and the electrical wattage on the lamp (typically around 1000W). The electrical wattage applied to the lamp will be adjusted routinely by the CMi staff to maintain a constant intensity.

Note:

- I-line intensity: **20mW/cm^2 @ 365nm** with i-line filter installed. Internal sensor "365" calibrated correctly.
- Broadband intensity: **55mW/cm^2** without any filter installed. Internal sensor "405" calibrated correctly.
- DUV intensity: **6mW/cm^2 @ 250nm** with DUV filter installed. No Internal sensor (use constant power mode)!

4. Configure the light source

On the MA6Gen3, the users can select the part of the lamp spectrum that will be used to expose the wafers, by inserting band-pass filters in the light path.

WARNING: Check the installed filter each time you use the MA6Gen3. Chances are that the precedent user was not using the same configuration as you intend to use. Don't ruin your exposure by not checking.

Choose among following spectrum configurations:

Configuration	target λ[nm]	range λ[nm]	filter number
broadband	all	220-500	- no filter -
i-line	**365**	**350-390**	**175846**
g-line	436	420-480	173860
UV300	320	280-350	100000983
DUV250	250	220-270	100000984

The figure below superimposes the ranges of the filters with the spectrum of the Hg lamp:
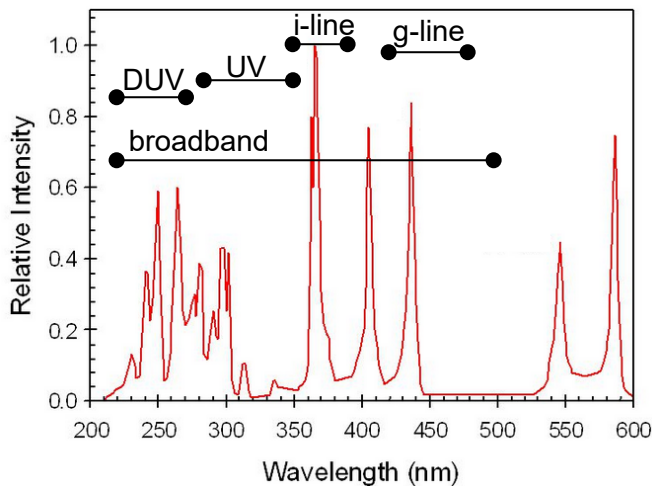
Check and configure the machine for each illumination:

A. Check/exchange the **wavelength filter**
B. Set the position of the **lamphouse** correctly

A. Filter exchange

Pull the lamphouse towards the right to get access to the filter holders in an optical bench setup.

Do not touch the holders on the right with the condenser lens, or on the left with the IFP.

If you must change, then unscrew (by hand) the wavelength filter holder in the center, until you can unseat it from the optical bench rail. Lift it out, exchange it, and screw the needed one back in.
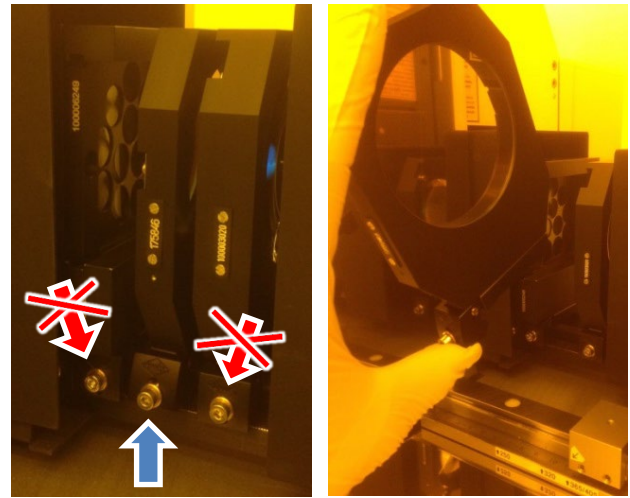
All filters are stored in the top-left drawer in the MA6Gen 3 shelve.

B. Set the position of the lamphouse

The lamp should be positioned at the correct distance from the mask. A stopper block is moved and screwed tight along a rail to align with indicated locations for DUV, UV "320" and i-line/broadband configurations.

Make sure to fix the stopper block so that its left side is matched with the arrow on the rail.

Move the lamp house gently towards the left, until it touches (not hits) the stopper block.

5. MA6Gen3 Graphical User Interface (GUI)
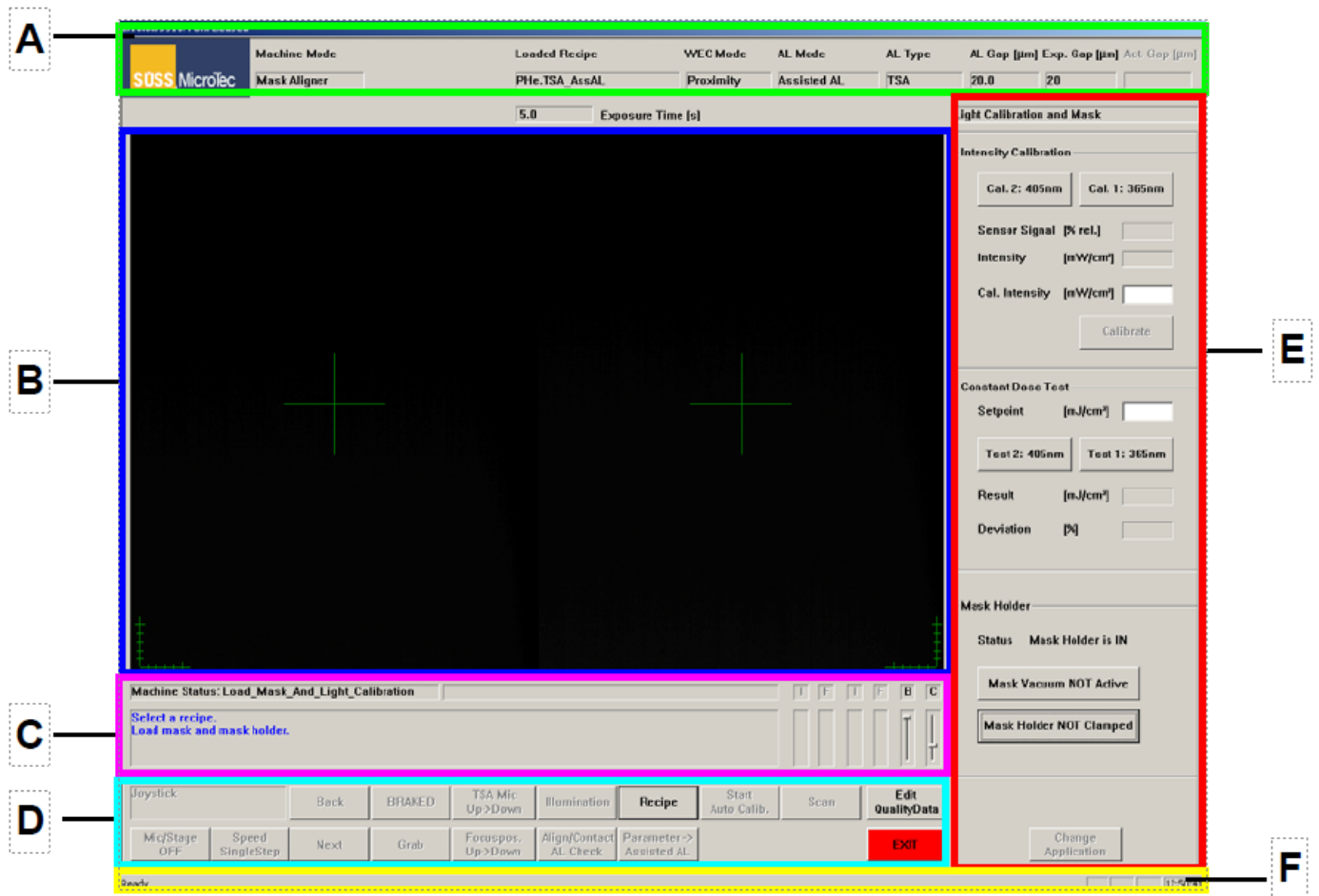
A - **Header** - Information on the currently-loaded recipe.

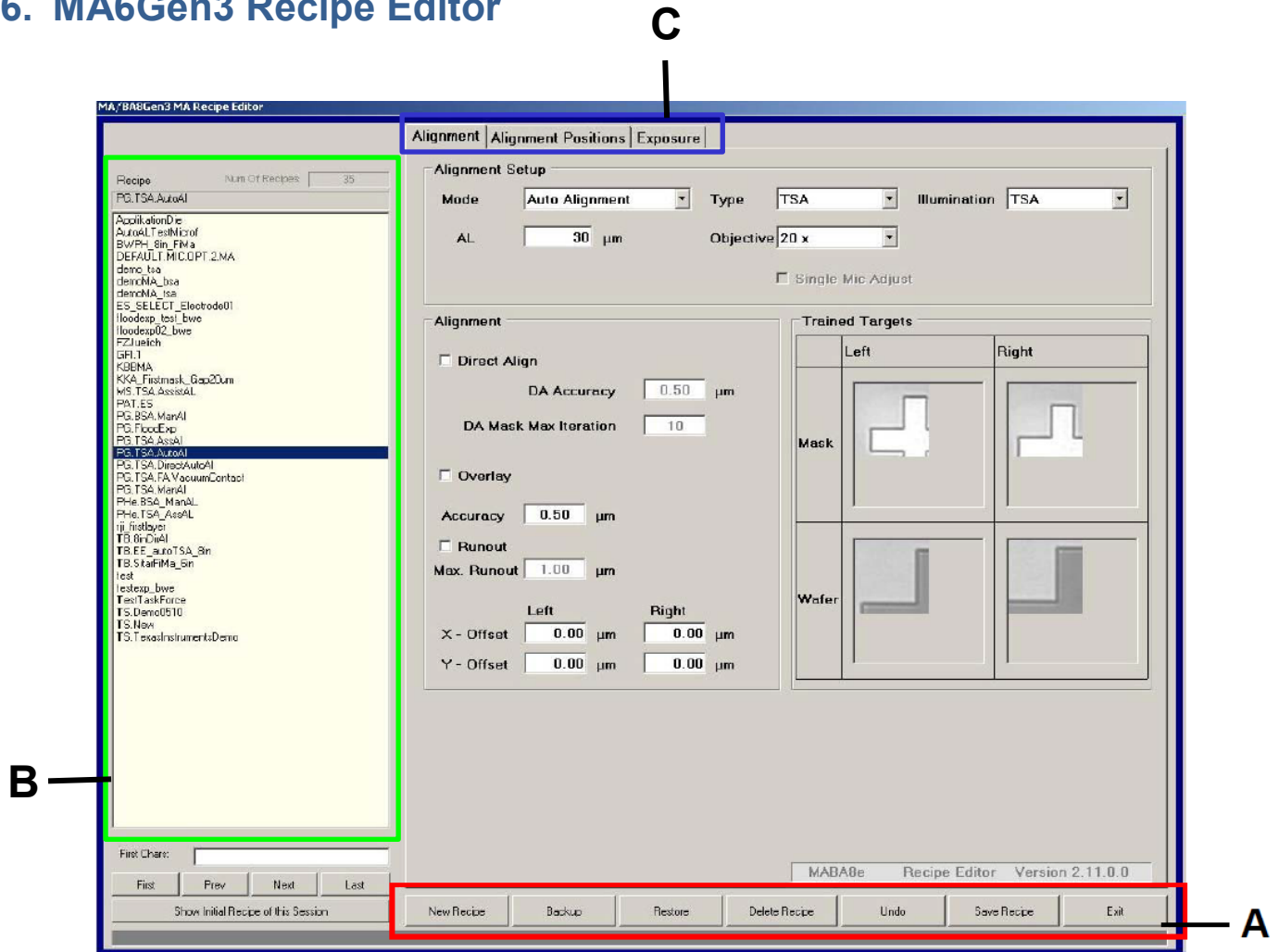**B** - **Camera View** - Used during the alignment procedure.

C - **Information Area** - Next step messages and operation instructions.

D - **Functional Buttons** - Containing available buttons.

E - **Additional Functional Area** - Pneumatic functions (mask vacuum, mask holder clamping). Intensity calibration (Staff only).

F - **Status Area** - Current system status, login etc.
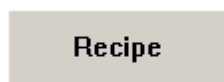
6. MA6Gen3 Recipe Editor

A - **Recipe management** - Options for creating, saving, deleting recipes.
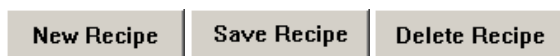
B - **Recipe list** - Please keep a maximum of 4-5 recipes.

C - **Recipe parameter tabs** – Alignment, position presets and exposure parameters.

The MA6Gen3 recipe editor is started by pressing on:

Recipe

Users can select, create, save and delete recipes with the appropriate buttons:

New Recipe   Save Recipe   Delete Recipe

If your recipe is already created, please scroll down this guide to section 7.

The recipe parameters are changed in the three main tabs: **"Alignment", "Alignment Positions", "Exposure"** (see section C in the image above).

A. "Alignment" tab

The alignment tab is used to select the option for mask-to-wafer alignment during the exposure. Some options are not available on our MA6Gen3 system. Please select between the following options:

Mode:

- **First Mask:** No alignment! The wafer and mask are centered relative to each other. The exposure takes place immediately after the WEC when the wafer has reached the exposure distance.

- **Manual Alignment:** Exposure with mask to wafer alignment. The stage stops at the alignment distance and provides the possibility to move the wafer.

- **Assisted Alignment:** Provides a video-based pattern recognition system for

assistance to manual alignment. Time consuming and not recommended.

- **Flood Exposure:** To expose the whole wafer without a mask. The exposure can be started from the initial state independent if a mask (and mask holder) is loaded or not.

- **Test Exposure:** Allows for multiple exposure with varying exposure times on a single wafer.

Type:

- **Top Side Alignment (TSA):** Uses the top side microscopes.

- **Bottom Side Alignment (BSA):** Uses the bottom side microscopes. For application with alignment targets at the bottom side of the substrate.

Illumination: Select the desired illumination combined with the microscope. (e.g. TSA microscope + BSA ext. => transmitted light from bottom side).

AL Gap: The default alignment gap value is 30um. It should be increased to 50-100um if there is a suspicion of wafer touching the mask during the alignment sequence (thick resist, bow/warp, etc…)

A. "Alignment positions" tab

You just inherit here the information of your last time using the recipe. This can be a real gain of time, when you already arrive with correct illumination and focus and x/y coordinates on the mask.

B. "Exposure" tab

The exposure tab contains all the related information about the exposure:
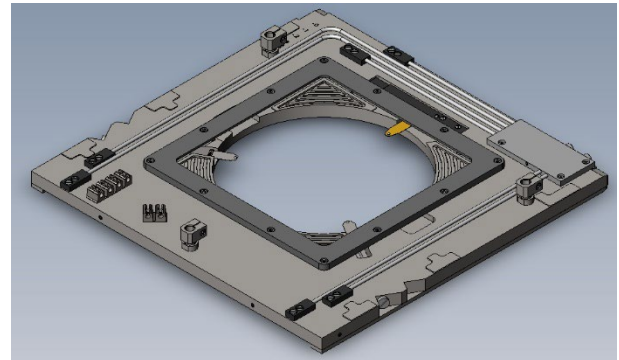
Maskholder:

Several mask holders are available, depending on the substrate size or specific applications. The system does recognize the holder. Therefore, it must be correctly specified from within the recipe editor:

The standard mask-holder used in CMi is **"100073398"**. It is designed **to expose 4inch wafers with 5inch Cr masks.**
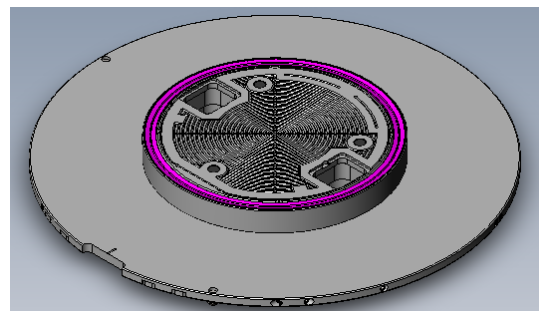

Other mask-holders are available to:

- Expose 6inch wafers with 7inch masks
- Expose wafers thin flexible transparent masks
- Expose piece parts with adjustable mask dimensions and position.

Please contact the CMi staff if you need any advice fore the selection of the mask-holder

Chuck:

Several chucks are available, depending on the substrate size or specific applications. The system does recognize the chuck. Therefore, it must be correctly specified from within the recipe editor:

The standard chuck used in CMi is **"100073255"**. It is designed **to expose 4inch wafers with the option for vacuum (VAC) contact mode.**

Other chucks are available to:

- Chuck for 6inch wafers and VAC contact mode
- Chuck for small diced samples
- Transparent glass chuck for random BSA marker positions or glass wafers

Please contact the CMi staff if you need any advice for the selection of the chuck.

WEC:

The wedge error compensation (WEC) procedure describe the initial approach of the wafer to contact the mask and allow for a compensation of the tilt.

The standard WEC mode for most CMi users & applications is "Contact", which means there will be contact during the wafer and the mask during the initial approach and tilt compensation.

Other WEC modes are:

- **Proximity:** the tilt correction will be done with three spacers placed in between the mask and rhe wafers and touching the outer edge of the wafer. An EBR is recommended in tis case
- **Non-Contact Gap (NCG):** the WEC will be done between the chuck and the mask (no wafer). The wafer is inserted in a second step. The user has to provide the exact thickness of the wafer (including PR).

Please contact the CMi staff if you need any advice for the selection of the WEC mode.

Exposure:

The standard exposure mode for most CMi users & applications is "Constant Dose", which uses a calibrated sensor to measure the real-time light intensity and calculates the opening time of the lamp shutter.

Users enter the optimal dose in [mJ/cm^2].

Warning: It is critical to use the correctly calibrated sensor in "CD channel":

- **CD Channel "365/240" to expose with i-line filter installed.**
- CD Channel "405/320" to expose in broadband mode (without filters).

Other exposure modes are:

- **Constant Power:** Users enter the exposure time in [s]. To be used when internal sensors are faulty or not-calibrated (DUV…)
- **Split Exposure:** During constant power, the light can be turned on and off. This is used to cool down the wafer in case of long total exposure time or allow outgassing with thick negative resist.

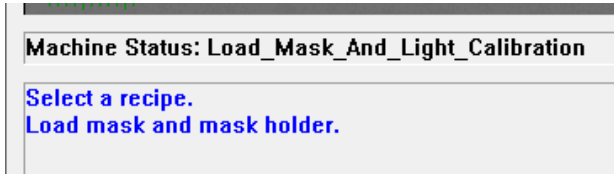Please contact the CMi staff if you need any advice on the exposure modes.

Contact:

In the contact section, users define how the contact is done between the wafer and the mask during the exposure. Below are the different exposure mode and the relevant parameters.

- **Proximity:** Allows to define a gap between mask and wafer during exposure. This is typically used, in combination with proximity WEC, to avoid contamination of the mask or with fragile wafers.

- **Soft Contact:** The wafer is fixed on the chuck by vacuum and the exposure gap is set to zero, creating a "mostly" pressure-free contact between the mask and the wafer. **Minimum resolution ~ 2um.**

- **Hard Contact:** The wafer is brought in direct contact with the mask. A nitrogen purge between substrate and exposure chuck is used to press the substrate against the mask. **Minimum resolution ~ 1um.**

- **Vacuum Contact:** A vacuum is created between mask and wafer. This is the strongest contact mode. **Minimum resolution ~ 800nm.**

Please contact the CMi staff if you need any advice on the contact modes.

7. MA6Gen3 Operation procedure (with alignment)

- When starting with the GUI, the operational message should be:

> Machine Status: Load_Mask_And_Light_Calibration
>
> Select a recipe.
> Load mask and mask holder.

- Select your recipe in the recipe editor, change the dose as well as any other parameter. Save and exit.

- The configuration should look like this:
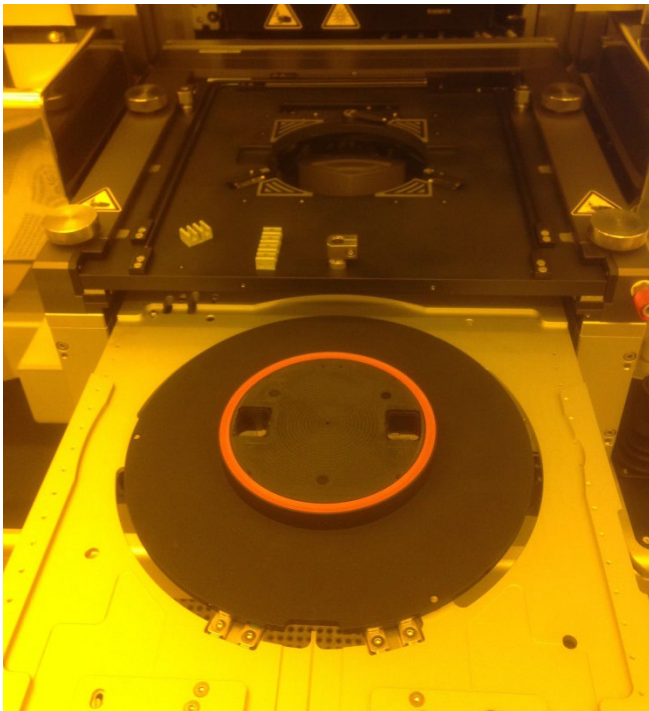
- Make sure the mask-holder corresponds to the one you need by checking the label on the top left corner. Usually it should be **"100073398"**, to load 5inch Cr masks.

Exchange the mask-holder if necessary.

- Make sure the chuck corresponds to the one you need by checking the label on its backside. Usually it should be **"100073255"**, to expose 4inch wafers with VAC contact option.

- Verify on the machine's pressure gauge that the WEC value is correctly set, as recommended in the recipe editor. Usually, it is **22.0 kPA** with the standard configuration.


Adjust with the rotatory knob (the lower one) until you reach the target value.

- Mask holder and substrate chuck are now inserted. Continue with clamping on the mask-holder:

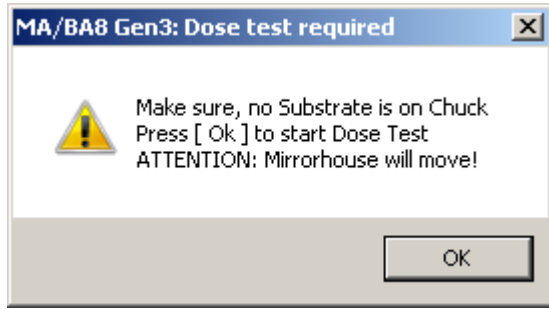> Mask Holder NOT Clamped
> ↓
> Mask Holder Clamped
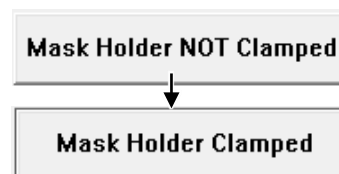
- Load the mask from the top **with chromium facing DOWN**. Push it in contact with the two screws on the top edge, and with the one screw on the left edge.

- Turn on the mask vacuum:

> Mask Vacuum NOT Active
> ↓
> Mask Vacuum Active
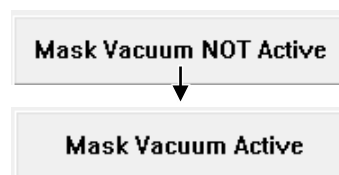
- A pop-up window will appear, asking to perform a dose test. Make sure no wafer is on the chuck and click "OK".

Note: the dose test needs a maximum time of about 200s to calibrate properly.

- At that point, the microscope platform should move down automatically in case of TSA alignment.

- The operational message should be:
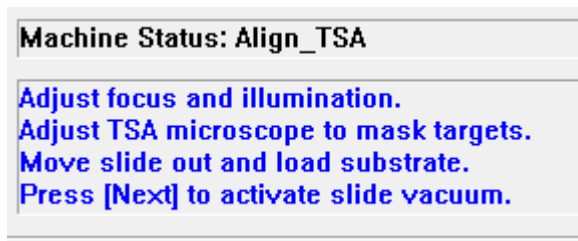

Now it is just following instructions.

A. Focus and illumination:

- For top-side alignment (TSA): To adjust the left and right objective **coarse focus**, there are micrometrics screws on each side of the objective platform.
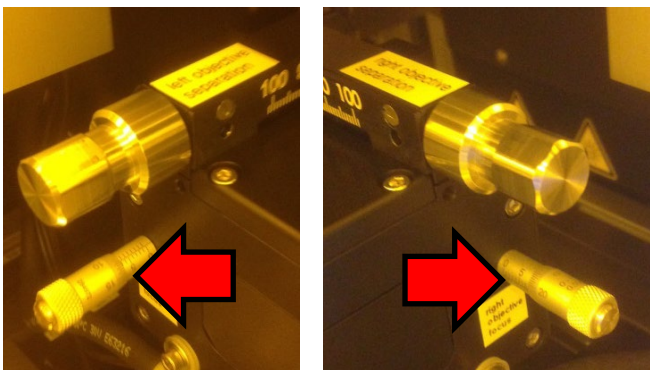
- For TSA and bottom-side alignment (BSA): Knobs to adjust the focus "F" and illumination "I" are available on the right-side panel of the machine. The absolute motor position is also visible in the software.

Note: When pushed down, they are faster.
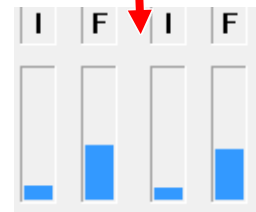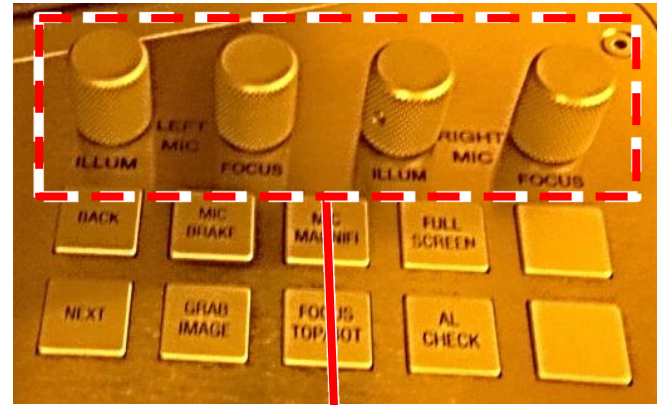
B. Microscope adjustment to mask targets:

It is typically recommended to move the microscope objectives to the mask alignment markers before loading the wafer.
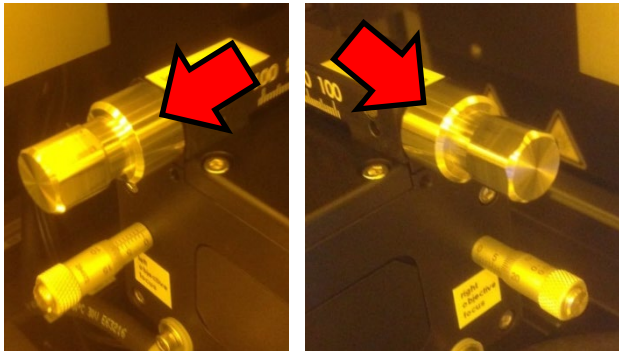
To move the microscopes to the mask targets, you will have to use the joystick.

- For TSA: The right button switches different speeds, e.g. 100%, 10%, 5%, 1%. **The joystick allows to control x- an y- position, as well as the rotation of the microscope platform.**

  The distance between the two objectives is adjusted manually using the spacer knobs on the left and right (see image below). The distance from the centre of the platform can be read on a scale to rapidly move to the position of the marks.


The microscope platform position can be found in the UI:

X [mm]	Y [mm]	T [°]
-5.247	1.510	0.760
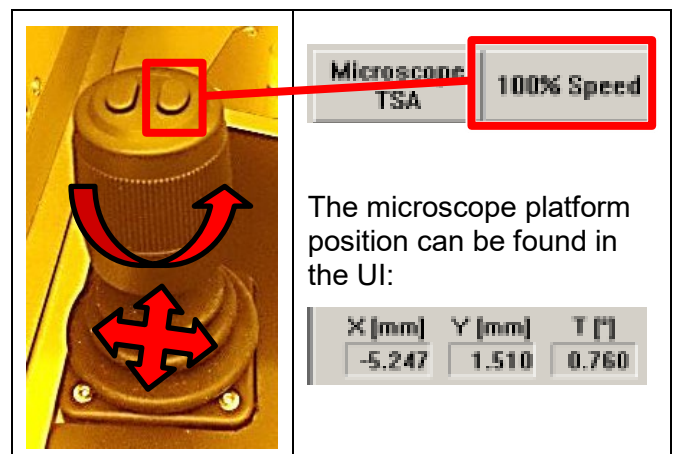
Objective separation knobs on each side of the microscope platform.

- For BSA: **The left button allows to switch between control of the left or right BSA objectives.** The right button switches different speeds, e.g. 100%, 10%, 5%, 1%. The joystick allows to control x- an y- position of each objective.

- **For BSA: The image of the mask target is captured at that point by clicking on "Grab":**
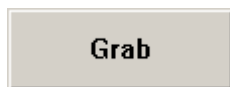

C. Loading and aligning the wafer

- Pull the wafer slide out and load the substrate, carefully, **always contacting with the three alignment pins on the chuck**.
- Click on "Next" to activate the transport slide vacuum.
- Push back the slide inside the machine.
- Click on "Next" to continue forward with the WEC procedure (and exposure in case of first mask mode).
- To align the wafer to the mask targets, you will have to use the joystick: **The left button allows to switch between control of the objectives or the wafer stage.** The right button switches different speeds, e.g. 100%, 10%, 5%, 1%, **but also step movement of**

10um, 1um and 50nm. The joystick allows to control x- an y- position, as well as the rotation of the wafer.

- Align until you are happy with the precision.
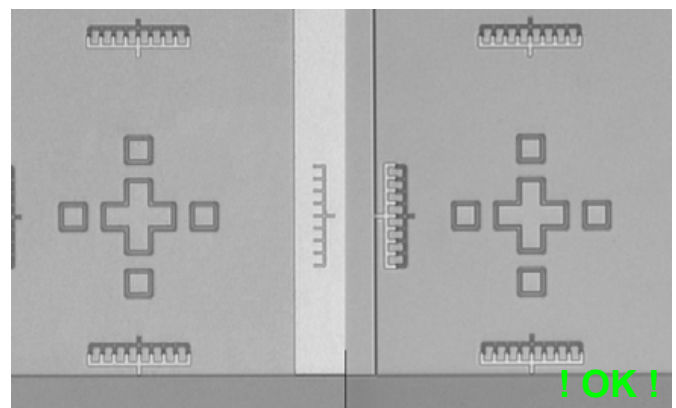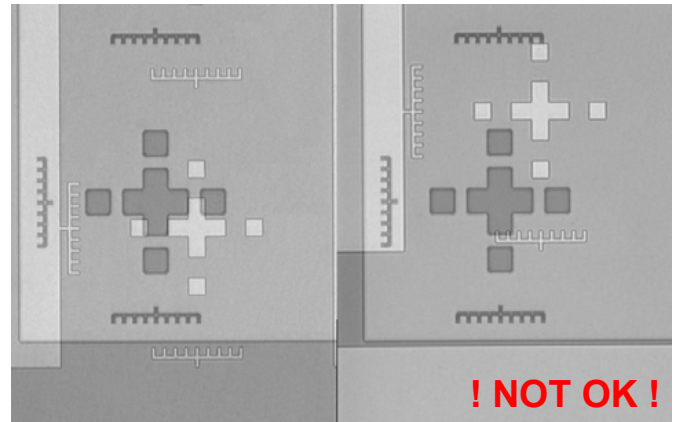
- Press "Alignment check" to move the wafer in contact with the mask, and a second time to perform the contact strategy (soft, hard or vacuum).
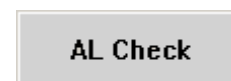
- Then, depending on exposure mode, you will eventually press "Exposure" and get your substrate illuminated.


- Next the equipment will ask you to pull the slide out and remove the wafer. The procedure should be repeated with additional wafers.

8. End of operation and Logout

The accounting system is billing usage time as long you are a) using recipe editor, or b) mask holder is clamped (loaded).

Therefore, if you want to log out of the accounting system, you should (in that order):

- Close the Recipe Editor

- Remove the mask-holder clamping:

Mask Holder Clamped
↓
Mask Holder NOT Clamped
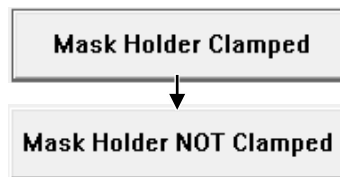
- Switch of the mask vacuum <u>and remove your mask</u>:

Mask Vacuum Active
↓
Mask Vacuum NOT Active
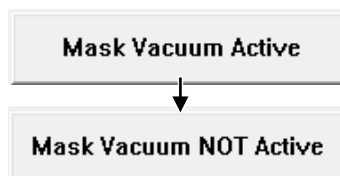
- Logout from Zone 6 CAE computer.
- If no one is using the MA6Gen3 within the next 2 hours, turn off the Hg lamp by pressing the "Power OFF" key on the CIC controller: