

# MA6/BA6 Standard Operating Procedure

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## Karl Suss MA6/BA6 Mask Aligner Procedure

### General Overview:

- The intensities calibrated are i-line (365nm) and h-line (405 nm). These were last calibrated at 12.0 mW/cm<sup>2</sup> for 365 nm and 23.5 mW/cm<sup>2</sup> for 405 nm.
- Exposure Modes: Unless you have been specifically trained on other exposure modes, use only soft-contact and hard-contact mode. Using the other modes can cause damage to your sample, the masks, or the chuck holders.
- Make sure you change gloves before using the mask aligner if you have been using solvents or acids. The chuck holders and mask holders are expensive and can be damaged by solvent or acid residue.
- Maximum **combined** wafer and mask thickness should be < 6 mm.
- There is a red emergency button located on the left front panel. Only press in case of emergency.
- There is a mercury lamp in the equipment. If the lamp explodes, immediately leave the area, notify others in the lab to leave, and call the lab manager. If the lab manager is not available, call EH & S for possible mercury spill clean-up.
- Nitrogen failure for longer than 5 minutes automatically turns off the lamp. Do not attempt to turn on the lamp again. Contact the lab manager if the lamp turns off automatically.
- Occasionally, the video monitor begins flashing and cannot be adjusted to stop. If this happens, take out samples, do a “change mask” procedure to remove the mask, and turn the main power to the mask aligner off and back on. This usually fixes the problem.

### Restrictions:

- **You must be qualified to use the tool.**
- **Do not lean on the MA6/BA6 tool. It is on a pneumatic table.**

### Start-up Procedure:

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- Note: The equipment itself cannot be turned on first. The lamp must be illuminated before the MA6/BA6 tool itself is turned on.
- If the lamp is turned off: Press the toggle power switch on the power supply (under the table). The lamp will go through a start-up procedure. When the lamp is ready to be turned on, it will read **“rdy”** on the display. Press the **“start”** button (under the toggle switch).
- The lamp will fire and read **“cold”** on the display for a few minutes. When the lamp is ready to use, the display will read approximately **“275”** watts. We are using the lamp in constant intensity mode (CL1 is lit). This mode keeps the i-line lamp intensity constant over time. As the bulb ages, the number of watts displayed will change.
- If you have any trouble igniting the lamp, contact the lab manager.
- Toggle the on/off switch on the tool to **“on”** and then release the switch. The LCD screen on the tool will read **“Ready for Start-press LOAD Button”**
- Press the **“LOAD”** button on the machine. The display reads **“Watch out machine is starting!”**
- **If the chuck was not left in a centered position by the last user (see shutdown procedure for correct way to leave x,y, and theta settings upon leaving each time), an error may be displayed indicating the chuck is not centered. Before proceeding, you must center the chuck by moving x,y, and theta to the shutdown positions. Set the micrometers to X=10, Y=10, and theta=0. The last can be judged by the white cross-hair at the front of the tool below the chuck slide.**
- **Once the chuck is centered, the error will not be displayed and it will ready “Chuck is centered, confirm with enter” Hit the enter button and continue.**
- Wait for the microscope to lift out of the way.

## Choose a Program:

- Press the **“Select Program”** key to select either **“Soft Contact”** or **“Hard Contact.”** Pressing the button repeatedly takes you through all the contact types and then repeats the cycle after going through all contact types. In soft contact, the sample and mask are in contact, but the only force pressing the sample to the mask is exerted by the Wedge Error Compensation (WEC) head. The vacuum still holds the sample during exposure. In

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“**Hard Contact**” nitrogen pressure is used to press the sample against the mask after sample vacuum has been removed.

- Generally: Hard contact gives better results but results in more mask wear.
- **Do not select any of the other program modes unless you have specifically been trained to use these. Using these in the wrong situation can result in damage to samples, masks, and chuck holders (expensive)!!**

## Select Exposure/Alignment Conditions:

- Press “**Edit Parameter**” to change either the Alignment Gap (“**Al Gap (μm):**”) or Exposure Time (“**Exp Time (s):**”) values shown on the LCD screen.
- You will toggle between Alignment Gap, Exposure Time and WEC Type using the right /left arrow keys. Change the values up or down by selecting the up/down arrow keys.
- Typical alignment Gap is 100 μm, exposure time will be determined from your resist manufacturer’s data.
- **DO NOT SELECT PROXIMITY WEC UNLESS YOU SPECIFICALLY KNOW WHAT THIS IS USED FOR. Using this in the wrong way may damage your sample and mask.**
- **WEC type should be “Contact”.**
- **NOTE:** Once a sample is loaded, the parameters cannot be changed.

## Loading a Mask:

- Select “**Change Mask**” on the tool. Pull out the mask holder out carefully and flip it 180 degree so the mask is facing up. Place the mask holder on the support shelf to the left of the tool.
- The display reads “**Press Enter to Toggle mask vacuum**”
- If a mask is already on the holder, release the vacuum by pressing “**Enter**” The vacuum toggles on and off by pressing “**Enter.**” Release the mask vacuum to read “**Vacuum: off**” and place the mask on the holder. Release the spring clip carefully to secure the mask. Make sure the mask is placed against the pins on the holder.
- Press “**Enter**” again to pull a vacuum on the mask. The display should read “**Vacuum: on**”

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- Flip the mask holder again so the mask faces down, and carefully slide into the slots made for the mask holder.
- **DO NOT PRESS “ENTER” AGAIN. This will release the vacuum and your mask may drop off the holder.**
- Press “**Change Mask**” again. The mask holder itself is now held in the tool with a vacuum.

## Loading a Sample:

- The LCD screen should read “**Ready for LOAD.**” Press “**LOAD**” and pull the sample slide out to load a sample. If you need to change the chuck, do that first. The chucks are simply lifted out (see Note below). The alignment mark on the chuck should be lined up with the pin on the chuck holder base.
- The machine reads “ **Move slide into machine and confirm with ENTER**”
- **Note: If the slide is not pulled all the way out, there may be a vacuum holding the chuck and sample.**
- Load the sample, slide the chuck holder frame all the way in. Confirm with “**Enter**” key. The WEC starts automatically. The WEC adjusts the sample position so the sample and mask are parallel.

If alignment is needed, proceed with the Microscope/Sample Alignment instructions below. Otherwise continue to the “**Exposure**” Section

## Microscope Alignment :

### General Alignment Notes:

- X motion control is on the right, clockwise moves sample to the left
- Y motion control is on the left, clockwise motion moves sample toward the back
- A single full turn of the micrometer moves the sample 0.25mm, the full 1mm motion can be seen on the micrometer after 4 turns.
- Mechanical resolution is 0.1  $\mu\text{m}$  in X,Y, theta
- Alignment accuracy-down to approx 0.5  $\mu\text{m}$  topside, 1  $\mu\text{m}$  bottomside

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- **Assuming topside alignment:** Make sure the illumination switch is on TSA. The light intensity is controlled by the potentiometer under this switch.
- Turn the video monitor on. The view of the right and left objectives can each be seen individually or together on the video monitor. The view on the monitor can be changed using the “**left/right/splitfield**” switch.
- The spacing of the objectives is controlled by the two silver knobs on the side of the optical head.
- The coarse focus is controlled by the large knob above the optical head. Make sure that the top/bottom key LED is on and adjust the fine focus separately using the “**Top Substrate Right/Left**” regulator on the MA6/BA6 console.
- Position the microscope objectives so the alignment marks on the mask are in view. Note this location for future reference. These positions can be adjusted manually for the correct spacing between objectives if required using the silver knobs on the side of the optical head.
- Once the microscope right and left objectives have the desired spacing for the mask being used, the arrows on the console can be used to scan around the sample area. To do quickly, press “**Fast**”
- Be very careful that the longer objectives do not hit the mask holder when scanning around.
- Click “Grab Image” to get the image of the alignment marks onto the video screen.

## Sample Alignment:

- Bring the sample plane into focus by using the “**Bottom Substrate Right/Left**” control. If unable to bring into focus, use the large rough focus knob above the optical head.
- Find the wafer alignment marks. Note their position relative to the mask alignment marks and use x, y, and theta to get these two into alignment.
- When finished with alignment, you may want to check that there will be good alignment during exposure. To do this, press the “**alignment**” button. The sample will contact the mask. Note that the display reads “**Z in contact**” (previously the Z reading is the alignment gap, e.g. Z=-100 for 100 micron setting for the alignment gap).
- If there is not good alignment, press alignment again to separate the sample and mask. Then adjust x,y, theta. Repeat to check again.

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- When ready to expose, proceed as described below.

## **Exposure:**

Press “Expose” on the tool. The microscope will lift and the lamp housing will move over the sample for exposure. The exposure sequence is automatic. After finishing the exposure, the chuck moves down so the sample can be unloaded.

## **Unload Sample:**

- Wait until the message on the LCD screen reads “**Unload Substrate from the Slide**”
- Pull out the transport slide and unload the sample. If not pulled out all the way, the sample will remain under vacuum.
- If you want to expose additional samples, go back to the section titled “**Loading a Sample**”

## **Remove Mask:**

- Press “**Change Mask**” and the mask holder will be released from the tool.
- Pull the mask holder out and flip it 180 degrees. Place on the tray to the left of the tool.
- Hit “**Enter**” to switch off the mask vacuum.
- Pull back on the spring clip and remove the mask.
- Either change the mask (go back to load mask step) or place the mask holder back into the tool for shut-down. Proceed with Stand-by mode (below) before shutdown.

## **Stand-by Mode:**

- Before shutting off the equipment, do the following:
- Turn off the video monitor.
- Set the micrometers to X=10, Y=10, and theta=0. The last can be judged by the white cross-hair at the front of the tool below the chuck slide.
- Change the eyepiece turret to the shortest objective position (5X).

## **Shut Down:**

- Make sure you have removed the sample and mask as described above.

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- Place the mask holder back into the tool.
- Press **“Change Mask”** again. The LCD should read **“Ready for Load”**
- Note: If **“Enter”** is pressed first, then **“Change Mask”** and **“Enter”** have to be alternately pressed until **“Ready for Load”** appears. Because there is no mask in the holder, a vacuum error appears. Simply ignore the error and proceed until **“Ready for Load”** appears.
- Once **“Ready for Load”** appears, simply press F1 then **“Enter”**. The microscope will lower.
- Turn off the MA6/BA6 console switch (turn to **“off”** and release).
- If no is signed up to use the MA6/BA6 for at least 24 hours, turn off the lamp with the toggle switch on the power supply. Otherwise, leave the lamp on.