MA6 Mask Aligner

Prepared by Richard Barber November 23, 2007

Safety:

1. **The MA6 uses a high intensity Hg arc lamp. This produces an intense illumination with a strong UV component. The UV light can cause conjunctivitis and burn exposed skin. Avoid looking at the lamp during exposures. Wear UV-rated eye protection if you need to observe the mask/wafer during exposure.**
2. **The UV lamp can produce ozone gas. The lamp cavity should be flushed and cooled with a stream of nitrogen gas to prevent the formation of ozone. The lamp cavity should be safely exhausted through the lab exhaust system. The lamp chamber is interlocked and the lamp will not operate if the nitrogen is off.**
3. **The MA6 has moving parts. Keep fingers and clothing clear during exposure.**
4. **The arc lamp contains Hg vapor. It is contained in an evacuated chamber, so accidental exposure is unlikely, except during lamp changes. Lamp replacement should be performed by authorized, trained personnel. In the event of a lamp breakage, do not remain in the area.**

Turning on the MA6

1. Before turning on the MA6, verify the services needed to operate the machine:
    a. Compressed air 5 bar
    b. Nitrogen 1 bar
    c. Vacuum <= 0.8 bar
    d. WEC pressure 0.2 bar

2. IMPORTANT! Make sure the POWER SWITCH ELECTRONIC is turned off before igniting the lamp. This protects the machine electronics from dangerous power surges.

3. On the lamp Constant Intensity Controller (CIC), turn the power ON. The CIC performs a self-test, then displays “ready”.
4. Press the CP (constant power) key. The display shows “wait” and then “Start”.
5. Press START. This ignites the lamp. The LED labeled “LAMP LIFE/POWER” flashes until the lamp reaches operating temperatures.
6. Allow the lamp to stabilize for 30 minutes.
7. Turn on the POWER SWITCH ELECTRONIC to activate the machine electronics.
8. Press LOAD

Setting up an Exposure Program

1. Most users will use the standard program, which on the G2N machine is Program 0.
2. If you need to modify the program, copy it to an unused program number. Load this new program, and make the required changes to the copy.
3. To edit the program, press EDIT PARAMETERS. Use the left and right arrow keys to select parameters. Use the up and down arrow keys to change parameter values.
4. Save the program. Use the left or right arrow keys to toggle to SAVE.

Loading an Exposure Program

1. Press the EDIT PROGRAM key.
2. Toggle to the desired program using arrow keys. (Normally, program 0 should be selected).
3. Press EDIT PROGRAM to load.

Loading the Mask

1. Press “CHANGE MASK”.
2. Carefully remove the mask holder from the machine.
3. Press ENTER to turn mask vacuum off.
4. Place the mask on the holder. It must be installed with the chrome- or emulsion-side away from the mask holder (i.e. so that the chrome side is toward the wafer when the mask holder is in place on the machine).
5. Make sure the mask is correctly oriented on the holder – that the major flat is correctly oriented for aligning the wafer.
6. Gently seat the mask against the positioning stops.
7. Press ENTER to turn mask vacuum on.
8. Slide the spring loaded clamps into place against the edge of the mask. (Note that on the 4-inch mask holder, these clamps are adjusted and secured using Allen screws).
9. Gently slide the mask holder back into the guides, taking care not to scratch the mask.
10. Press “CHANGE MASK” to secure the mask holder on the machine.

Loading the Wafer

1. Press “LOAD”. The display reads: ‘Pull slide and load wafer onto chuck’.
2. Pull out the transport slide.
3. Place the wafer against the prealignment pins. NOTE: the substrate must completely cover the vacuum channels and orifices. You may need to change the chuck, or use tape to cover exposed vacuum orifices. See the user prime or the lab technical staff for assistance if necessary.
4. Press “ENTER” to turn on the vacuum. The display should indicate: “move slide into machine and confirm with ENTER”.
5. Slide the transport and wafer into the machine. Press ENTER.

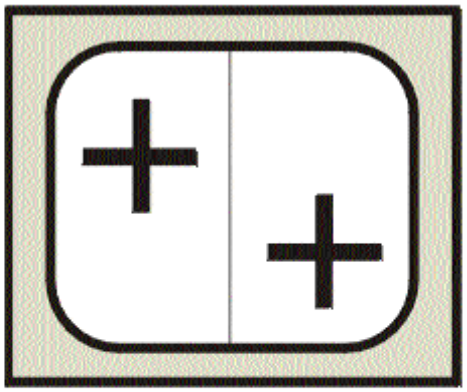
6. Wait for the message “Align Substrate” to appear before proceeding.

First Level Lithography

1. ‘Alignment’ of the mask to wafer is not necessary at this level, since no alignment targets are printed onto the wafer as yet. Thoughtful positioning of the mask to the wafer will simplify subsequent alignments.
2. Make sure the mask and the wafer are correctly mounted on their respective holders. Make sure they are positioned against the stops provided, in each case.
3. The mask will usually be designed so printable features extend beyond the edge of the wafer in all directions. Center the mask over the wafer so that a maximal number of printable die are achieved. Alternatively, position the mask so that the critical dice are away from the edges of the wafer.
4. Make sure suitable alignment targets are printed on both the left and right sides of the wafer (but not too near the edge, where they could be damaged by subsequent wafer handling).
5. Verify that exposure parameters are correct, as described in the “Loading and Exposure Program” section above.
6. Press EXPOSE. The wafer moves under the mirror, and is exposed for the dose specified in the exposure program.
7. The wafer moves to the unload position. The message “Unload substrate from the slide” appears on the display.

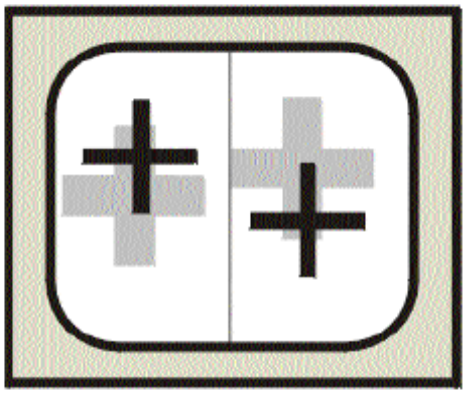
Top Side Alignment

1. Make sure the TSA:SPLITFIELD switch is on. This will allow images from the left and right-hand sides of the mask to appear on the monitor.
2. Adjust the illumination for satisfactory contrast. Turn the ILLUMINATION switch to TSA and adjust the potentiometer underneath.
3. Focus on the mask plane using the TSA Z-MOVEMENT knob (behind the TSA microscope).
4. Adjust the microscope to capture alignment targets on both the left and right side of the mask using the OBJECTIVE X-SEPARATION knobs.
5. Press the GRAB IMAGE key. The mask image is retained, and the focal point shifts to the wafer plane. (Pressing GRAB IMAGE again deletes the stored image and moves the focus to the mask plane).
6. Adjust the focus on the wafer plane using BOTTOM SUBSTRATE LEFT/RIGHT adjustment.
7. Use the x-y-theta micrometers to move the wafer targets into alignment with the mask targets.



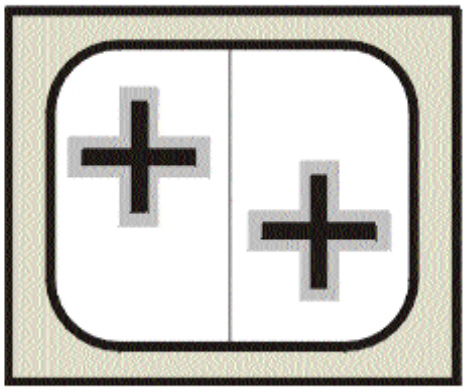
1.

Grabbed mask
alignment marks



2.

Superimposed wafer
alignment marks



3.

Alignment marks
central symmetrical aligned

Figure 7

8. Verify that your alignment is satisfactory.
9. Verify that the exposure parameters are correct (per your set-up in "Loading and Exposure Program" above.
10. Press EXPOSE. The wafer will move under the exposure mirror, and the shutter will open to deliver the light dose specified in the program. The wafer will then move to the unload position.

Unloading the Wafer

1. The display reads: “Pull slide and unload exposed wafer”.
2. Pull the slide completely out, and remove the wafer.
3. Load a new wafer for alignment, or remove the mask according to the following procedure.

Unloading the Mask

1. Press CHANGE MASK. The display will read: “Change mask – Press ENTER to toggle mask vacuum. Vacuum: ON”.
2. Gently pull the mask holder out.
3. Press ENTER to turn mask vacuum off.
4. Pull back the metal holders from the edge of the mask. (On the 4-inch mask holder, this requires loosening the Allen-screws fastening the sliding holders.)
5. Carefully remove the mask. Store it in the appropriate box.

Powering Down the Machine.

1. Turn off the MA6 electronics by turning the POWER SWITCH ELECTRONIC to the OFF position
2. **WARNING: Turn the electronics off BEFORE turning off the lamp, to avoid damage caused by electrical surges.**
3. Turn off the lamp power by pressing OFF on the CIC.
4. Sign your name in the log book, recording relevant comments and data.