MA-6 Operation

Overview
- Exposure methods are flood, proximity, soft contact, hard contact, low vacuum, and vacuum.
- Top side alignment and bottom side alignment with split field view capability.
- Channel 1 intensity is set for 9 mW/cm² at 365 nm (equates to ~17.8 mW/cm² at 405 nm).
- Channel 2 is set for 15 mW/cm² at 405 nm (equates to ~7.8 mW/cm² at 365 nm).

Restrictions & Precautions
- There is a RED EMERGENCY Off button located on the left of the front panel next to the main power switch. If it is pressed the machine gets isolated from the power supply. Press only in an event of danger.
- In case of lamp explosion; press the RED EMERGENCY Off button, immediately leave the area, and contact the staff. Lamp explosion results in the release of mercury.
- Invisible high energy UV light may damage your eyes or skin if the machine is not used as intended. Always wear UV protective safety glasses when using the system.
- Watch out for the microscope movement at all times.
- If mask and wafer are in contact (CONTACT INDICATOR on), don't align the wafer!
- Maximum wafer thickness: 6mm (does not apply to flood exposure with no mask holder).

Pre-Operation Checks

1. Verify that the system is fully powered on; the constant intensity controller (located beneath the floating table) should have either Channel 1 or 2 selected with an idle power value in the display below LAMP POWER, the system LCD display should be on (green display), and the Enhanced Image Storage System (EISS) program should be displayed on the system computer monitor.
   - If the constant intensity controller (CIC) and system are on but there is no program displayed on the system computer monitor, you will need to power on the computer (located on the floor to the left of the CIC). There will be 1 of 2 different computers (labeled PC 1 or PC2) installed on the tool, each one is powered on differently:
     - I.   PC1: Open the small door on the computer and flip the black rocker switch; the computer will boot-up and open the EISS program.
     - II. PC2: Open the small door on the computer and flip the black rocker switch; the computer will boot-up to the pre-boot system utilities menu. The screen will not be legible. Once it appears to have stopped, press the F1 key on the keyboard (located on top of the PC), the computer will boot-up and open the EISS program.
   - If the CIC is on but the chassis is not, power on the chassis by turning the power switch on the front panel clockwise to the ON position and release. The system will ask you to press the LOAD button and then go through a start-up process. The system will then ask you to choose MA6 (mask align) or BA6 (bond align) mode by using the Y-ARROW and ENTER keys. You should choose MA6 for mask align mode. The system computer may be off as well, see above for powering it on.
   - If the CIC is off (displaying STAND-BY) and the chassis is on, turn the chassis off before starting the CIC. To power on the CIC and ignite the lamp:
     - I.   Press the ON button and wait until READY appears on the display.
     - II. Verify that the LED next to 350W Hg under LAMP TYPE is lit, IF NOT STOP AND CONTACT STAFF!

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      III.   Press the CP button and wait until =>>START appears in the display.

      IV.   Press the START button, the display should read IGNITION and then LAMP COLD. It takes about 15 minutes for the lamp to warm up and stabilize.

      V.   Select the correct channel for your process by pressing either CH1 or CH2.

      VI.   Power on the chassis and, if needed, the system computer per above.

2. Facilities Checks (Front panel of system)
   - Compressed Air gauge reads 5 - 6 bar
   - Nitrogen gauge reads 2 - 3 bar
   - Vacuum gauge reads better than -0.8 bar
   - Vacuum Seal gauge reads 0.1 – 0.2 bar

TSA Operation

1. Load your photomask
   a. Select the correct mask holder for your mask, the mask holders are located in the cabinet next to the aligner. To change a mask holder; slide the red collar of the quick disconnect back to release the mask vacuum line and insert the vacuum line connection of the mask holder you require in until it clicks.
   b. If it is not already flashing, press the CHANGE MASK key.
   c. Place your mask, chrome side up (brown side up), onto the mask holder against the stop pins.
   d. Toggle the mask vacuum on by pressing the ENTER key.
   e. Flip the mask holder over and slide it into the machine. Clamp it by pressing the CHANGE MASK key.
2. Edit the exposure parameters
   a. Press the EDIT PARAMETER key.
   b. Adjust the exposure parameters by using the X-ARROW keys to cycle through the available parameters for the exposure mode you are using and the Y-ARROW keys to adjust the values for said parameters. Please reference the MA-6 Visual Aid for detailed information of all available settings.
      NOTE: It is possible to split the exposure into several intervals. The MULTIPLE EXPOSURE key must be activated for this (LED on).
   c. Press the EDIT PARAMETER key again to save your changes.
      NOTE: You will only be able to adjust the exposure time, alignment gap, WEC offset, and WEC type once you load your substrate. If you need to change any other parameters, you will have to unload your substrate (press UNLOAD).
3. Load your substrate
   a. Select the correct chuck for your substrate and mask size, the chucks are located in the cabinet next to the aligner. To change a chuck; pull out the transport slide until it stops, remove the chuck (it is not secured in any way), and place the chuck you require into the transport slide. Make sure to orient the chuck so that the white hash mark on the chuck is facing out toward you and lined up with the pin on the transport slide.
      NOTE: Most chucks have positioning pins that can be raised and lowered by turning the flat head screws on the back of the chuck.

    b. With the transport slide out, carefully place your substrate on the chuck. Manually manipulate your substrate as needed to get it positioned correctly on the chuck.

    c. Press the LOAD key and then the ENTER key to turn on the chuck vacuum. This is a good time to blow-off your substrate.

    d. The LCD display should read "Move slide into machine and Confirm with ENTER". Move the transport slide all the way in and press the ENTER key. Once you press the ENTER key, the WEC starts by automatically bringing the substrate briefly into contact with the mask to adjust it parallel to the mask (the CONTACT light will flash briefly during this sequence). After this, the substrate moves automatically to the alignment gap you specified in Step 2.

4. Alignment Controls

- Use the stage micrometers (X, Y and theta) to adjust your substrate position.
- Use the SEP. ARROW keys to adjust your alignment gap, this is displayed on the LCD display.
- The BSA MICROSCOPE key toggles the motor control and image processing between TSA (LED off) and BSA (LED on).
- Use the X and Y-ARROW keys to move the microscope. For BSA, the LEFT, BOTH and RIGHT keys allow you to select which objective(s) you want to move.
- Activating the FAST key (LED is ON) enables the movement of the microscope with fast speed, otherwise the movement is performed with the slow speed.
- The separation distance between the left and right TSA objectives is adjusted using OBJECTIVE X-SEPARATION knobs on the sides on the microscope.
- The theta for the TSA objectives is adjusted using the TSA Ө-MOVEMENT knob located to the right of the coarse focus knob on the top of the TSA microscope.
- The top side microscope objectives can be changed by manually rotating the turrets and the back side microscope magnification can be set to LOW or HIGH using the MAGNIFICATION BSA knob.
- If needed, the TSA microscope can be raised and lowered. Press the F1 key and then press the ENTER key. DO NOT PRESS THE Y-ARROW KEYS!
- To adjust the microscope illumination, first make sure the IILUMINATION knob is in the correct position BSA/IR or TSA.
  - i. The TSA illumination can be adjusted two different ways. Adjusting the TSA knob affects the light level for both left and right objectives simultaneously. Using the aperture slide levers above each set of objectives allows to you adjust each side independently.
  - ii. BSA/IR illumination is adjusted using the LEFT and RIGHT BSA/IR knobs.
- The SPLITFIELD knob is used to select which microscope side is being displayed on the monitor; LEFT, BOTH, or RIGHT.
- Focus is adjusted using the LEFT and RIGHT knobs under either TOP SUBSTRATE or BOTTOM SUBSTRATE. Use the TOP/BOTTOM key to select which set of knobs is active, TOP is selected when the LED is on. For TSA there is also a large coarse focus knob on the top of the TSA microscope.

- The SET REFERENCE key (activated when lit) allows you to store the microscope position of the TSA or BSA microscope as reference position. The microscope can then be moved to a new position and the SCAN key will allow you to toggle the position of the microscope between the current position and the reference position.
- The GRAB IMAGE key (activated when lit) allows you to superimposed a screenshot of what is currently being displayed on the monitor. A use for this would be to aid with alignment if you were having an issue getting both the substrate and mask into focus concurrently. This would be accomplished by moving your substrate alignment marks out of the field of view, focusing on the mask alignment marks, and pressing the GRAB IMAGE key. You would then have an image of the focused mask alignment marks on the screen and could bring the wafer alignment marks back into the field of view and focus on them.

5. Exposure
    a. Once you have your substrate properly aligned you can check your alignment by using two methods, the preferred method is the first one:
        i. The ALIGNMENT CHECK key allows you to check the possible influence of unexpected factors (particles, edgebead, etc.) before exposure. All parameters of the exposure program are triggered except the exposure itself. This key is active for the following exposure programs: Vacuum Contact, Low Vacuum Contact, and Hard Contact. Press this key again to release the wafer back into alignment gap or press the EXPOSURE key if the alignment is acceptable.
        ii. The ALIGN CONT/EXP. key basically puts the wafer into a soft contact state (WEC pressure only) regardless of the contact mode selected. Pressing the key again returns you to alignment mode (LED is lit). If the EXPOSURE key is pressed with this activated, the exposure program will commence and your substrate will be exposed.
        NOTE: If pressed when performing a proximity exposure, the substrate will be move to the exposure gap specified in Step 2.
    b. Press the EXPOSURE key - The substrate moves into the exposure position, the TSA microscope moves up, and your substrate is exposed.
    c. Once the exposure is completed the LCD display will read "Please wait…" and the TSA microscope will move down. After that the LCD display will read "Pull slide and unload exposed substrate".
    d. Pull the transport slide out, once it is all the way out the substrate vacuum will turn off.
    e. Remove your substrate and, if needed, load another per Steps 3.b. – 3.d..
    f. If you are finished with the system unload your mask; press the CHANGE MASK key, remove the mask holder, pull back the mechanical mask clamp, press the ENTER key to turn off the mask vacuum, and remove your mask.
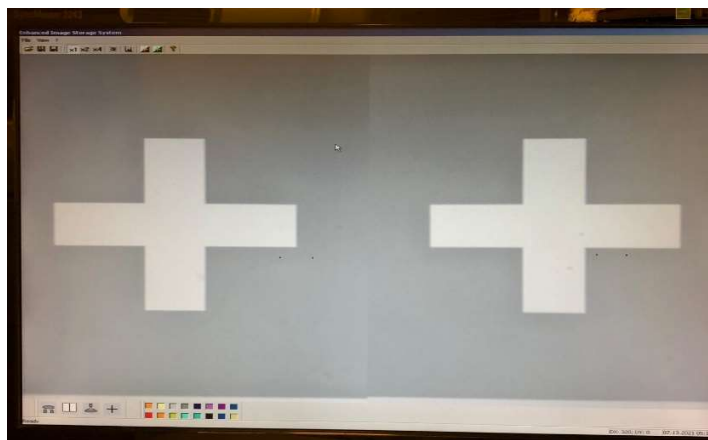
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BSA Operation

1. If the CHANGE MASK key is flashing, press it, then press the ENTER key. This will allow you to position the BSA cameras before loading your mask.
2. If the BSA MICROSCOPE key is not lit, press it to activate the BSA cameras.
3. Position the BSA cameras so they are in line with each other and separated at the approximate distance of your alignment marks. You may need to remove the chuck or pull out the transport slide to properly do this. The coordinates on the display are also useful as they show the location for each camera (i.e. Xl & Yl= left camera). Camera movement is the same as the TSA microscope (ARROW keys) with the difference being that the cameras can be made to move independently or in unison using the LEFT, RIGHT, or BOTH keys.
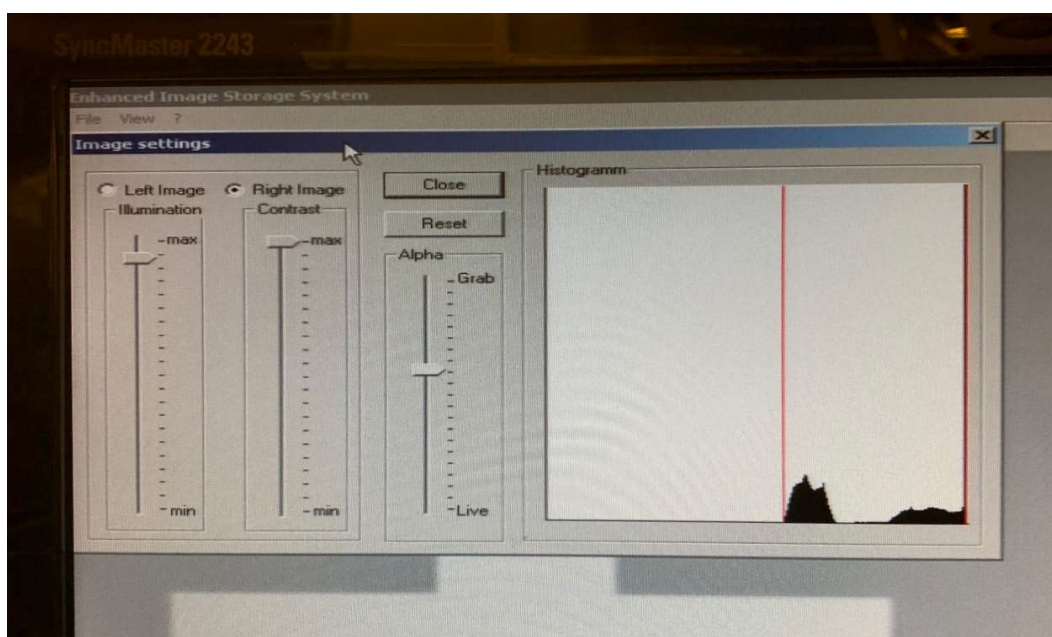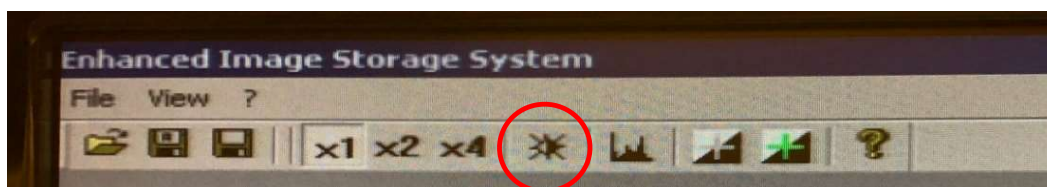

4. Load your photomask and chuck per the steps in the TSA Operation section.
5. Verify the following:
   - ILLUMINATION knob is set to the BSA/IR position
   - MAGNIFICATION BSA knob is set to the Low position
   - TOP BOTTOM key is lit, if not press it
6. Locate your mask alignment marks with the BSA cameras:
   - The SPLITFIELD knob is used to select which microscope side is being displayed on the monitor; LEFT, BOTH, or RIGHT
   - Camera focus is adjusted using the TOP SUBSTRATE LEFT and RIGHT knobs
   - Camera illumination is adjusted using the BSA/IR LEFT and RIGHT knobs
   - Camera magnification is adjusted using the MAGNIFICATION BSA knob

You want to get the left and right side mask alignment marks centered on each split-field like this:

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NOTE: If you are having issues getting proper illumination, you made need to make some adjustments in the EISS program. Make sure the SPLITFIELD knob is set to BOTH and then use the mouse to select the black and white sun icon to open the "Image settings". Adjust the Illumination slider close to max and Contrast slider to max, also verify the Alpha slider is at/near the middle. You will need to check this for both cameras by selecting Left and Right Image. When you are finished select Close.

7. Get the alignment marks in good focus at either low or high mag and then press the GRAB IMAGE key. The display should read "BSA/Image stored" and the mask image will be frozen on the computer allowing you to align your substrate to it.
   NOTE: The transport slide must be inserted during image grab, or it will error.
8. Edit the exposure parameters per the steps in the TSA Operation section.
9. Load your substrate per the steps in the TSA Operation section with the <u>alignment marks face down</u>.
10. Align your sample using only the stage micrometers, <u>DO NOT move the cameras</u>. The system should have automatically activated the BOTTOM SUBSTRATE focus knobs; you can verify this by making sure the TOP BOTTOM key is not lit.
11. Expose your sample per the steps in the TSA Operation section.
12. To expose more substrates, unload the exposed substrate, and push the empty transport slide back in. Press GRAB IMAGE key to store image again, and proceed to load the next substrate.