



Kasper Mask Aligner Manual

1. Introduction

The Kasper Wafer Alignment System is an integrated optical-mechanical, pneumatic-electrical system which allows accurate alignment of sensitized semiconductor wafers with a mask and exposes them to ultraviolet radiation. It is a high precision piece of equipment and should be treated with care. It is imperative that you understand the machine completely before proceeding. Keep in mind that a great threat to long life for the Kasper Aligner is dirt. The exposure source is a 200 watt high pressure mercury arc lamp. It is left on at all times. Do NOT turn it off. If the lamp is off, do not turn it on as there is a special procedure for relighting. The N₂ purge switch, labeled purge under the right hand cowling of the machine, has to be on when the machine is in use. Turning it off will cause the aligner to malfunction.

2. Operating Procedure

1. Preliminary Set-Up

1. You will find the machine in standby mode.
2. POWER, PRESS CONT, MASK CLAMP, and MASK LOAD buttons should be lit.
3. TURN ON THE VACUUM by operating the toggle valve mounted on the table to the right of the machine. A hissing sound indicates that the vacuum is on.

2. Alignment System and Turret Positions

The alignment system consists of a precise X-Y stage which moves the wafer and mask together (scan) and a second X-Y stage which adjusts the wafer position with respect to the mask (align). Incorporated with the "align" stage is a rotating knob for angular alignment. Each stage is controlled by a hand disc. There are two degrees of alignment for the "align" stage. Shifting from 150:1 ratio to 3:1 ratio is done by pressing the button on the right-hand disc control. Rotational alignment is accomplished with either coarse linear actuated motion or a 700:1 rotational fine adjustment.

There are three positions for the optical turret. A "Row and Column" position allows coarse alignment with a lower power, single field microscope. A "Split Field" position allows fine alignment at a high power by simultaneous viewing of two separate areas of the wafer. The "Expose" position provides a reflector to direct the UV light down to the wafer.

3. Centering the Wafer with Respect to the Mask Holder Opening

1. Press the VISUAL ALIGN switch. The top portion of the mask aligner will automatically rise.
2. Slide the wafer chuck assembly out all the way towards you. With tweezers, center a test dummy wafer on the chuck (the dummy wafer should be found next to the Kasper). Align flat against the white plastic flat-finder.
3. Raise the plastic flat-finder out of the way. Slide the chuck assembly all the way back. Lift off the mask support plate.
4. Press the WAFER LOAD switch. Adjust the position of the wafer, using the second X-Y stage hand disc controller (on the right side of the Kasper), so that it is centered with respect to the opening in the mask holder.

4. Centering the Illumination Over the Mask and Wafer

1. Press the VISUAL ALIGN switch to lower the optical head.
2. Rotate the optical turret to the EXPOSURE position. Press the CONTACT switch.
3. Press the MANUAL EXPOSE button. Check that the illumination is centered over the mask holder opening. If it is not centered, adjust this with the first X-Y stage hand disc controller (on the right side of the Kasper), which moves the mask and the wafer together.

5. Loading the Mask

1. Press the VISUAL ALIGN switch to raise the top portion of the mask aligner.
2. Lift off the mask support plate and place your mask in the vacuum chuck opening with the emulsion or chrome side facing down (and load the masks always with the letters to the left). The mask should rest against the pins in the upper left corner. Center the mask support plate over the mask and press the MASK CLAMP button to fix mask plate to mask. Center mask and mask plate over the opening and press MASK LOAD to fix assembly to the mask vacuum chuck.

6. Gross Alignment of the Mask

1. Press the VISUAL ALIGN switch to lower the optical head. Turn up the power for the microscope illuminator. Turn the optical turret to the "Split Field" position. The alignment marks should be visible on each half of the split field image (adjust the focus, if necessary, with the knob on the back left of the optical head). If you don't see both of the alignment marks, or if the marks are not centered in the image field, align the mask as follows:
 1. Press the MASK LOAD switch to release the mask from the vacuum chuck.
 2. Move the mask plate (with the mask) very slowly and carefully until you find and center the alignment marks in the image field.
 3. Press the MASK LOAD switch again to fix the assembly to the vacuum chuck.

7. Loading and Aligning the Wafer

1. Slide the wafer vacuum chuck assembly out all the way towards you. With tweezers, center your wafer on the chuck. Align flat against the white plastic flat-finder. Push the wafer chuck 1 or 2 inches and listen to the click, this is the vacuum coming on. Raise the plastic flat-finder out and fully push the assembly back under the mask.
2. Press WAFER LOAD switch and the wafer will be raised under the mask and held in place. The SEP button should light, indicating that there is a separation between the wafer and the mask. The instrument goes into separation mode automatically.

3. Turn the optical turret to the "Row and Column" position and check that the instrument is in the SEP mode.
4. Roughly align the wafer pattern to the mask pattern in the desired position by first making the rotation adjustment and then the X-Y adjustment.
5. Turn the optical turret to the "Split Field" position to perform fine alignment of the wafer to the mask. Perform fine rotational and X-Y alignment with the rotation knob and X-Y alignment disc until the alignment marks on the wafer are perfectly centered within the mask alignment marks.
6. When alignment is complete, press the CONTACT button which brings the wafer into contact with the mask and actuates the positive pressure. Check to make sure the alignment is correct. If an adjustment is necessary, press the SEP button and realign.

8. Exposing the Wafer

1. Rotate the optical turret to EXPOSURE position, check the timer for correct setting, and press the MANUAL EXPOSE button. You can enter 3 digits on the timer for exposure. Be aware that the last number is in units of .1 seconds (e.g. a setting of 100 is 10.0 seconds!). The maximum timer setting is 99.9 seconds. Exposure cannot occur unless the wafer is in contact with the mask. An interlock system ensures the safe, correct exposure.
2. Slide the wafer vacuum chuck assembly out all the way towards you. Remove the wafer with tweezers, and then return the wafer vacuum chuck assembly to the alignment and exposure position.

9. Removing the Mask and System Shutdown

1. To remove the mask, press the VISUAL ALIGN button which raises the optical head. Press the MASK CLAMP button (light will go on) to release the mask support plate. Press MASK LOAD button (light will go on) to release the mask from the mask vacuum chuck.
2. Return the optical head to the down position by pressing the VISUAL ALIGN button.
3. Turn off the vacuum toggle valve. Decrease the power to the microscope illuminator in order to prolong bulb life.
4. Do not turn off power.

Kasper "Cliff Notes" for the students:

1. For first layer, when no wafer alignment is needed.
 - Pull out wafer chuck all way
 - Load wafer on chuck. Align flat against the white plastic flat finder.
 - Push the wafer chuck 1 or 2 inches. Listen to the click, this is the vacuum coming on.
 - Raise the plastic flat-finder out of the way. Push the wafer chuck all the way in.
 - Press the wafer load button near the front of the machine. The wafer should go up to the mask and the SEP light (on the panel at the left side) should come on.
 - Press CONT on the panel on the left.
 - Rotate the optical turret to EXPOSURE.
 - Press the EXP button on left, wait for the light to go ON and OFF and the wafer to come down.
 - Pull out the wafer chuck all the way. Remove your wafer.
2. When alignment of the wafer to the mask is needed.
 - Pull out wafer chuck all way

- Load wafer on chuck. Align flat against the white plastic flat finder.
- Push the wafer chuck 1 or 2 inches. Listen to the click, this is the vacuum coming on.
- Raise the plastic flat-finder out of the way. Push the wafer chuck all the way in.
- Press the wafer load button near the front of the machine. The wafer should go up to the mask and the SEP light (on the panel at the left side) should come on.
- Rotate the optical turret to ROW&COLUMN mode.
- Look through the eyepiece. Focus with the silver knob on the back left and adjust the focus if necessary.
- Align the wafer to the mask using the right paddle to move in X and Y and the black knob on the left to rotate. Move the wafer until there is a good match with the mask. Pressing the white button on the right paddle makes the wafer to move faster. NEVER touch the the LEFT paddle.
- When the alignment is roughly correct, turn the optical turret to SPLIT FIELD.
- Focus with the silver knob on the left.
- Check that the alignment marks on the mask are visible. The mask is the image that will not move when you move the right paddle. If the alignment marks are not visible, call the TA. -Rotate the wafer and move it with the right paddle until the alignment is good.
- Press CONT on the panel on the left. Check that the alignment is good. If the alignment is not good. press SEP on the panel on the left, align some more and repeat this step.
- If the alignment is good, rotate the optical turret to EXPOSURE.
- Press the EXP button on left, wait for the light to go ON and OFF and the wafer to come down.
- Pull out the wafer chuck all the way. Remove your wafer.

Kasper "Cliff Notes" for the TAs:

1. Turn on house nitrogen, house vacuum, and vacuum switches on rear of Kasper
2. The lights that should be lit are PRESS CONT, MASK CLAMP, and MASK LOAD
 - press VISUAL ALIGN to raise optical unit
 - turn the two intensity knobs on the left front panel to full intensity (clockwise)
 - pick up the mask clamp and put aside.
 - looking from above the chuck, move the right paddle to center the chuck
 - load mask, face down (the lettering is readable), with the letters to the left. The mask should rest against the pins in the upper left corner.
 - Put mask clamp down on mask, press MASK CLAMP
 - press VISUAL ALIGN to lower unit
 - rotate optical turret to SPLIT FIELD
 - focus (silver knob on left in rear) and adjust eyepieces
 - move mask to find alignment marks.
 - Turn the silver knob with the black sheath (on the front of the turret) to get both alignment marks to appear.
 - when alignment marks are in position, press MASK LOAD
 - pull out wafer chuck, load a dummy wafer, push the all the way in
 - press WAFER LOAD on front of Kasper
 - press CONTACT on panel on left
 - rotate optical turret to EXP position
 - press EXP on panel on left
 - adjust left pad to center light over wafer

- leave dummy wafer in position to be removed by first user
- aside - the focus in SPLIT FIELD can be brought closer to row and column by adjusting the eyepieces on the optical turret with the clamps - or raise head and turn by hand

3. Shut Down

- turn the two intensity knobs on the left front panel to minimum intensity (counterclockwise)
- press VISUAL ALIGN to raise unit
- press MASK CLAMP and MASK LOAD, remove mask clamp, remove mask
- remove dummy wafer
- press VISUAL ALIGN to lower unit
- turn off nitrogen switches