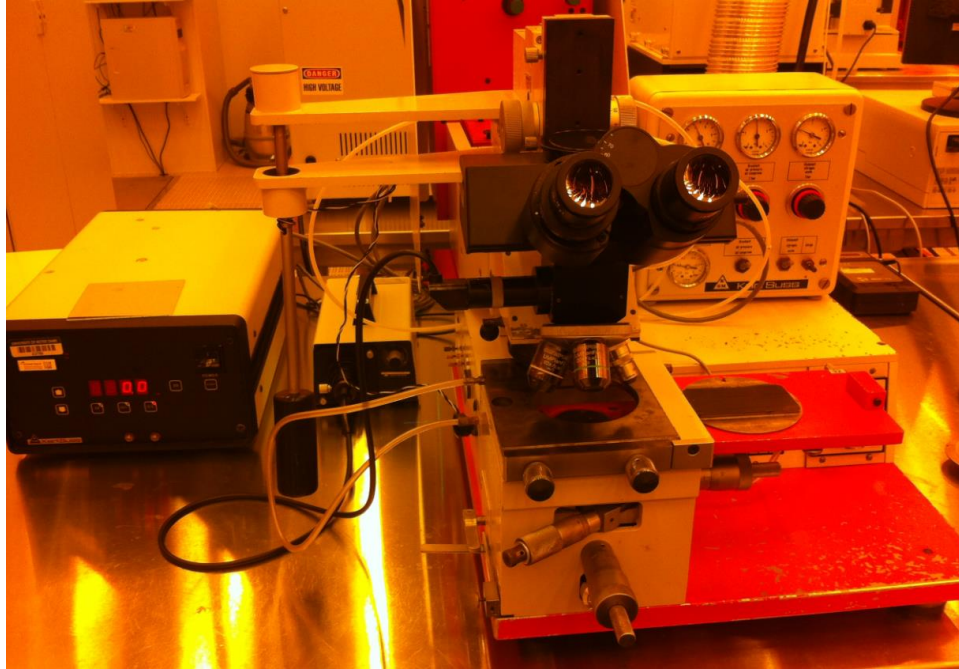


KARL SUSS MJB3 Contact Mask Aligner

Equipment Operation Manual



University of Notre Dame

Department of Electrical Engineering

CAUTION: During Exposure – DO NOT STARE DIRECTLY AT THE LIGHT. Prolonged exposure to UV light may damage your eyes. Safety glasses are to be worn during exposure.

Purpose:

The MJB3 offers front side illumination for contact lithography. The aligner is equipped with a 350 Watt mercury arc lamp that applies a typical intensity of ~20 mW/cm² at 405 nm wavelength.

Calibration Equipment:

Light intensity meter Model#1000

Protective Equipment Required:

Cleanroom Gloves and Safety Glasses

Training:

Only trained users may use the equipment – for training please contact Fei Cheng (fcheng2@nd.edu)

Contacts

For problems, clarification of procedures, or general information pertaining to this machine please contact lab staff at staff-ndnf-list@nd.edu.

**In Case of Emergency, Please Contact Notre Dame Security at
911**

Standby Conditions:

1. X and Y micrometers in MIDRANGE Position (Figure 1)
2. Contact lever rotated at FRONT of the machine (Figure 7)
3. Separation lever towards the BACK of the machine (Figure 7)
4. Z Micrometer unlocked (Figure 8)
5. Chuck Platform slide out of system
6. Air and Nitrogen ON (Figure 2)
7. Lamp Power Supply On and Set to CII 2 (Figure 3)
8. Main System power ON (Figure 4)
9. Mask holder with blank mask loaded and vacuum turned ON
10. Microscope Light turned OFF

Preparation:

- Spin/bake photoresist as per the resist manufactures specifications
- Ensure the backside of the sample does not contain resist
- Ensure chuck that will be used is clean
- Mask Clean (as needed)
 - o Acetone, Methanol, IPA rinse in solvent bench
 - o N2 Dry
 - o Drytec O2 clean as needed to remove resist
- Enable System in CORAL

Dose Reading – to be completed by lab staff only

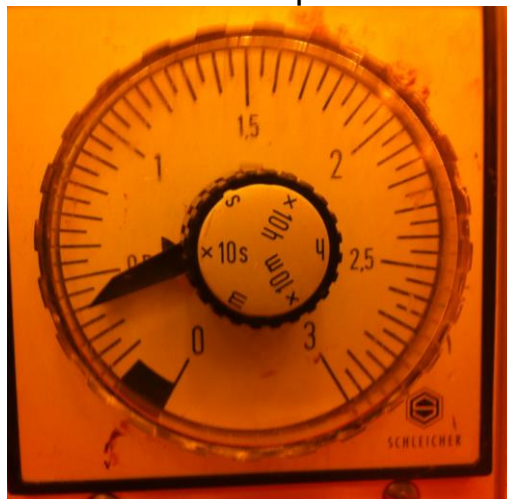
1. Remove the chuck from the system
2. Set exposure time to 1 min
3. Place machine in “Soft Contact” Mode
4. Turn on the Light Intensity Mirror
5. Centrally place the sensor under the exposure area
6. Place the system in “Contact”
7. Select “Expose”
8. Record the intensity from the meter
9. Adjust output on the power supply based on readings
10. Allow the system to complete the exposure and remove sensor
11. Turn off the Light intensity meter and return to the case.

Calculating the Exposure Time:

$$\text{Exposure Time (sec)} = \frac{\text{Photoresist Specific Required Dose } (\frac{\text{mJ}}{\text{cm}^2})}{\text{UV Light Intensity } (\frac{\text{mW}}{\text{cm}^2})}$$

Setting the Timer:

- 1 – select the multiplier required (1 s, 10 s, 1 m, 10 m, 1h, 10 h) by aligning the small Black Arrow (→) on the timer face plate with the multiplier
- 2 – Adjust the timer pointer (0-3) to the correct value
Ex. 4 sec exposure = “0.4” on the pointer and “10 s” on the multiplier



Ex. 90 sec exposure = “1.5” on the pointer and “1 m” on the multiplier



Loading a Mask:

NOTE – Do NOT Scratch the chuck or the mask holder – this can result in vacuum failure and broken masks.

1. With the mask holder on a flat surface, push the “Vacuum Mask” button to turn OFF the vacuum
2. Remove the blank mask and set it aside
3. Inspect the vacuum surface and groove – clean as needed
4. Center your mask on the mask holder – Chrome side should be facing down towards the table.
5. Press the “Vacuum Mask” button (light on) to secure the mask to the mask holder
6. CAREFULLY check to ensure the mask is held in place by the vacuum. Failure to do this can result in broken masks.
7. Pick up the mask holder, turn it over, and insert it into the stage (Figure 5).
8. Clamp the mask holder in place by tightening (Finger Tight) the two knobs (Figure 6) – Do not overtighten.

Microscope Setup:

1. Change objective lens to the lowest magnification
2. Focus the microscope
 - a. View the image through the view piece – adjust width as needed (Figure 10).
 - b. Focus on a feature on the mask.
3. Correct the sharpness of the image by adjusting the focus knob on the microscope (Figure 9).

Exposure Modes:

- High Precision (HP) Mode – In HP mode, a vacuum is pulled between the mask and the sample prior to exposure. Once the system is aligned and ready for exposure, the “Vacuum Chamber” button must be pushed to evacuate the chamber.
 - Only Chucks with Teflon vacuum gaskets can be used.



- Soft Contact (ST and SOFT CONT light ON) – During exposure, the vacuum holding the substrate to the chuck remains on and only the mechanical pressure of the chuck is used to hold the substrate to the mask.



- Standard Contact (ST and Soft Contact light OFF) – During exposure, the vacuum holding the substrate to the chuck is switched off and Nitrogen pressure is used to press the substrate against the mask.



Loading a Sample and Adjusting the Contact Height:

- 1 Select chuck, clean surface and place on loading block
- 2 Place sample on chuck
- 3 Slide loading block slowly into the system
- 4 Bring the chuck slowly up to the “Contact” position
 - If the chuck is too high, the sample will contact the mask prior to the contact level being switched 135° toward the back of the system. In this case, user will need to lower the contact height by turning the Z micrometer clockwise after returning the “Contact” lever to the down or non-contact position (Figure 8).
 - If the chuck is too low, the sample will not contact the mask – but the system will achieve the “Contact” position. In this case, the user will need to raise the contact height by turning the Z micrometer counterclockwise after returning the “Contact” lever to the down or non-contact position (Figure 8).
 - When Contact is properly achieved – Fringes will appear on the mask as it comes into contact with the samples photoresist. This is the Ideal setup.
 - Return the system to the non-contact position
 - If the micrometer doesn’t turn freely – disengage the lock on the side of the knob
 - Adjust the contact micrometer as needed. Each 360° turn of the micrometer moves the height by 150 μm
 - NEVER adjust the Z height with the system in the “Contact” position
 -
- 5 Repeat step 4 until the contact height is setup. At this point the sample may be ready for Exposure (if alignment is not needed).

Aligning a Sample to the Mask:

NOTE: Exposure Mode (HP, Standard, Soft Contact) must be set before aligning a sample. If you change modes after alignment, differences may be seen due to differences in vacuum being On/Off.

- 1- Pull the separation mask forward
 - a. "Contact" light should go OFF
 - b. "Separation" light should turn ON
 - c. Full separation travel is ~50 μm
 - d. IF the contact height is not set correctly, it is possible for the sample to stick to the mask. This is mostly seen when the sample does not physically move when making X, Y or Theta adjustments
 - i. Return Separation Level to OFF
 - ii. Lower system out of CONTACT position
 - iii. Make necessary adjustments to the Z-height adjustment
- 2- Start with the lowest magnification
- 3- Adjust micrometers to align features on sample to the mask
 - a. Start with Theta Adjustment – checking left and right sides first
 - i. Buttons on the microscope handle allow it to move X or Y
 - ii. Press both buttons simultaneously for full motion.
 - b. Adjust X and Y
 - c. Increase magnification and repeat step 3 for better alignment
- 4- Push separation lever back in
 - a. "Separation" light turns OFF
 - b. "Contact" light turns ON
 - c. Sample is placed back into contact with mask
 - i. Avoid bumping the table
 - d. If Using "HP" mode – press the "Vacuum Chamber" button to create vacuum between the sample and the mask
- 5- Sample Is Ready for "Exposure"

Exposure:

CAUTION: During Exposure – DO NOT STARE DIRECTLY AT THE LIGHT. Prolonged exposure to UV light may damage your eyes. Safety glasses are to be worn during exposure.

1 – Press the Green “EXPOSURE” button

- The microscope will elevate to allow it to clear the mask holder
- Mirror house will move over the mask
- When the mirror housing reaches position – the exposure shutter will open and exposure will take place for the amount of time set on the timer
- When the exposure is completed, the shutter will close, mirror house will move back, and the microscope will move to its lower position.

Unloading a Sample and Completing the Process:

- 1- Rotate “Contact” lever toward the front of the machine
- 2- Pull the chuck (transporter slide) out of the system
 - a. Remove exposed sample
 - b. Load new sample(s) as needed
- 3- Loosen the mask plate holder knobs and remove the mask plate with mask
- 4- Place the mask holder on the table and turn OFF the “Vacuum Mask”
- 5- Remove mask and place blank mask on holder
- 6- Turn ON “Vacuum Mask” and check to make sure mask is held in place
- 7- Place mask holder back onto the system – no need to tighten knobs
- 8- Clean up work area
- 9- Log Out Of CORAL

Appendix:

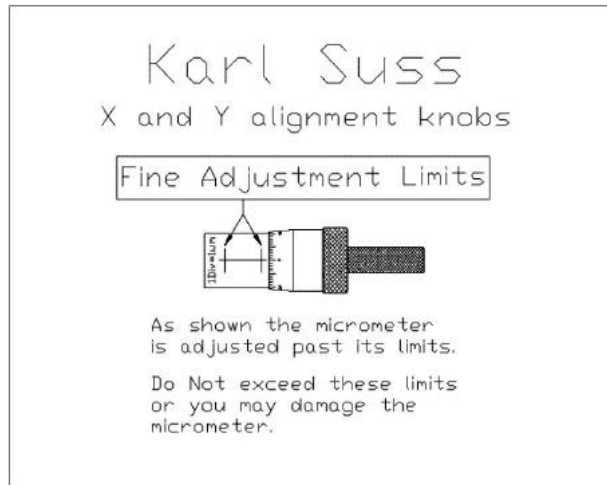


Figure 1 X&Y Micrometer Fine Adjustment Limits



Figure 3 Exposure Lamp Power Supply



Figure 5 Mounting of reticle in stage assembly



Figure 2 Manometer Box



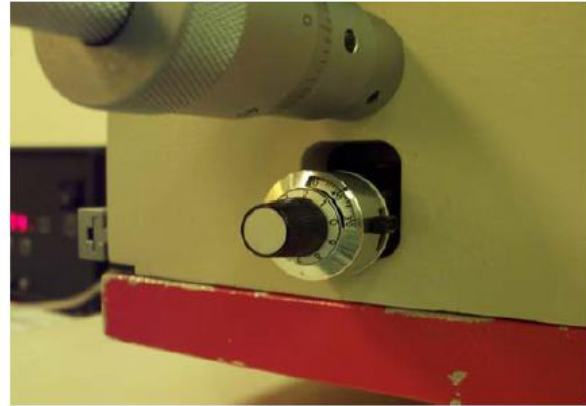
Figure 4 Karl Suss Control Panel



Figure 6 Reticle clamping knobs



Figure 7 Contact Lever (rotation shown in chuck lowered position) and Separation Lever (Slide shown in contact position)



Raise –	counter clockwise
Lower –	clockwise

Figure 8 Adjustable height (Z) micrometer with lock shown in the Unlocked position

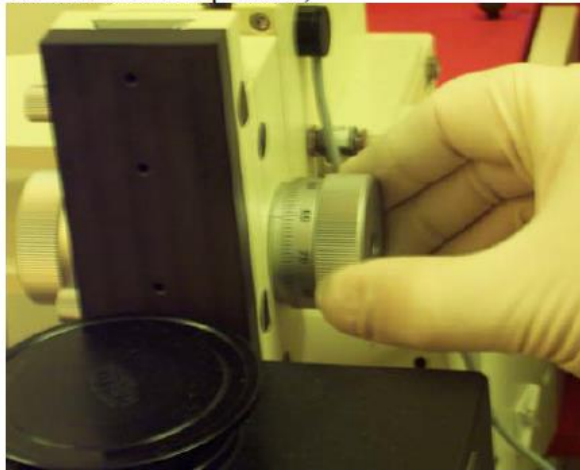
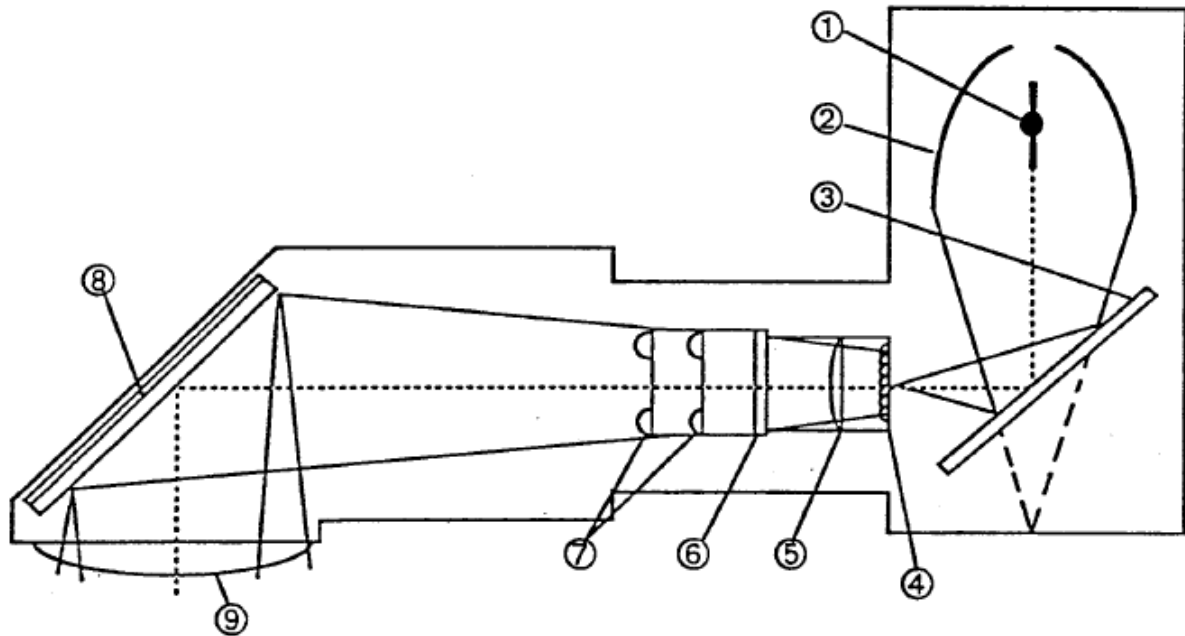


Figure 9 Microscope Focus adjustment



Figure 10 Microscope Eyepiece Adjustment



- | | |
|----------------------|------------------------------------|
| ① Lamp | ⑥ Frame for Filters |
| ② Ellipsoidal Mirror | ⑦ Diffraction Reducing Lens Plates |
| ③ Coldlight Mirror | ⑧ Turning Mirror |
| ④ Fly's Eye Lens | ⑨ Front Lens |
| ⑤ Condenser Lens | |

Figure 11 – Mirror house assembly and components