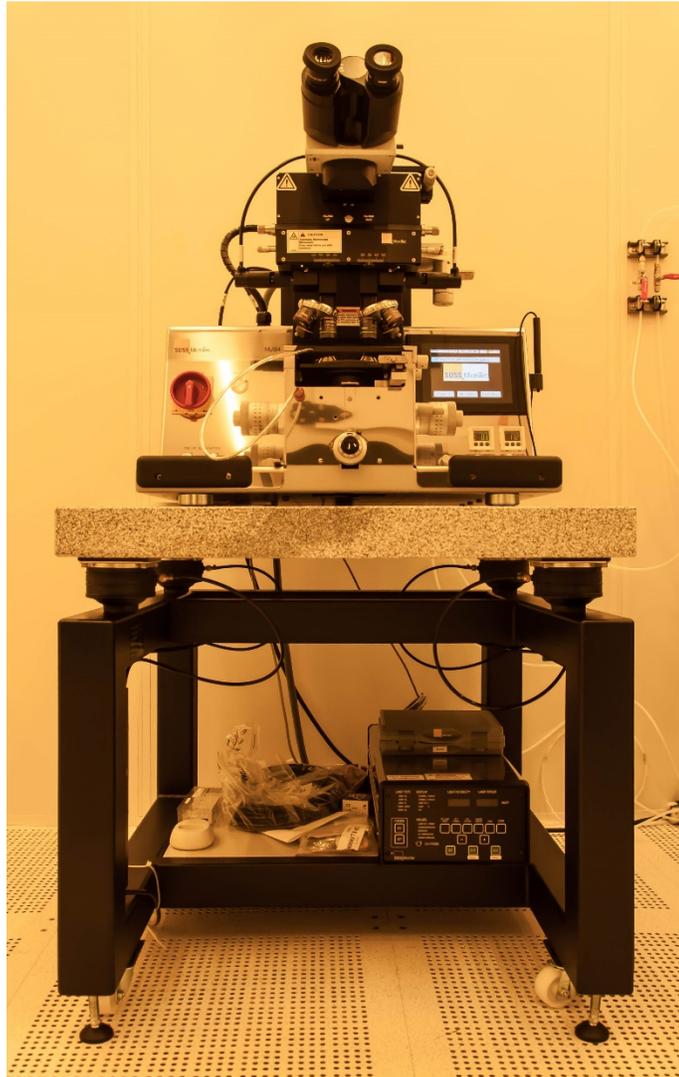


Suss MJB4 Mask Aligner



Introduction

The MJB4 Mask Aligner is a precision instrument for high-resolution photolithography and is intended for use in research laboratories, small-series production and pilot projects. It has been designed for exposing standard wafers and substrates and irregularly shaped substrates with a diameter of up to 100 mm and various thicknesses. After reading this manual, the user should be able to describe a typical MJB4 process for topside alignment, explain the theory of operation and state all hazards associated with the system. Only trained and approved users may use this tool.

Features

1. 350 W Hg Arc Lamp

With its “smart power supply”, The lamp is capable of operating in constant power or intensity modes. The default is constant intensity mode. The constant intensity mode ensures the same output level by adjusting the power automatically as the lamp deteriorates. Binocular upright double microscope

The microscope is capable of imaging two sets of alignment marks simultaneously.

2. Exposure control

The touch screen controller has four operating modes i.e. soft, hard, low vacuum and vacuum contact. Exposure time may be set on the screen during operation. In addition, users can create recipes to store key parameters.

3. Applicable Documents

Suss MJB4 Operating Manual – hardcopy located at the machine.

Safety

a. Moving Components

Users should be aware at all time of the moving components such as the microscope and lamp housing. Users must exert at most caution at all times such that limbs, fingers or any article of clothing do not become trapped and/or entangled (or worse violently detached) when components of the machine are in motion.

Attention!

Before exposure and during mask loading and unloading, the microscope moves up by 20mm and the exposure unit moves approx. 150 mm toward the operator.

Caution!

The machine warns by a beep prior to microscope movements in upward or forward direction. When the beep sounds, back off from the microscope immediately.



b. Ultraviolet Radiation

The MJB4 is equipped with a Hg arc lamp which emits UV radiation. Although indirect UV light that escapes the lamp house during the exposure is weak, users should be aware that excessive UV radiation is harmful to eyes and skin. Do not under any circumstances open any panels.

c. High Voltage

This machine is connected to HIGH VOLTAGE. Be very careful and aware of electrical hazards. DO NOT operate this machine with any component enclosures/panels open. DO NOT bring any liquids near the machine.

d. EMO

The EMERGENCY Off switch is available on the left side of the machine (Figure 1a). The EMO switch should be used only in an emergency. An emergency would be fire, smoke, electrocution or an injury to anyone caused by this machine. If EMO is pressed notify the staff immediately.

Startup/ Shut Down Procedures

1. Startup

1. Activate the equipment in FOM.
2. Ensure CDA, Nitrogen and Vacuum are on.
3. Press the ON/OFF button on the left-hand side of the MJB4 panel (See Figure 1b)
4. Make sure the display reads “STAND-BY” on the lamp power supply. (located under the table)
5. Press Power ON on the power supply (Figure 2). After pressing, the display should read “READY”.

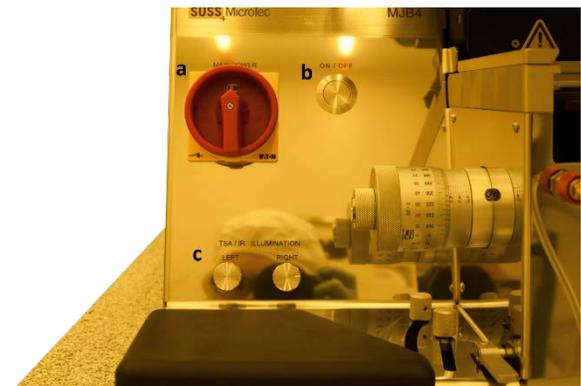


Figure 1: Left-hand side controls of the MJB4 a) EMO switch, b) ON/OFF switch c) Microscope illumination intensity adjusters

6. Press CP on the power supply. After pressing the display should read “START”
7. Press START

Allow about **5 min** for lamp to **warm up**. When the lamp warms up the display will read “IDLE”

8. Select one of the following depending on your process;

CH1: Constant intensity I-Line (365 nm)

CH2: Constant intensity H-Line (405 nm)

CP: Constant Power

Note that the intensity values are posted on the equipment. Adjust your exposure time accordingly.

Intensity of the lamp may be read during the exposure on the power supply display.



Figure 2: Lamp Power Supply startup sequence

2. Shut Down

1. Make sure you have unloaded your substrate and mask.
2. Press OFF on the lamp power supply (Figure 2)
3. Press the ON/OFF button on the left-hand side of the MJB4 panel for **more than 2 s**. (See Figure 1b)
4. Deactivate the equipment in FOM.

Machine will count down 10 m for lamp cooling. During this period, you may not be able to Start it up again.

Basic Exposure Modes

1. Distance Exposure

Wedge error compensation takes place in contact. After the substrate is adjusted to the mask, exposure is carried out at a specific distance up to 50 μm . The substrate intake vacuum is maintained during exposure.

2. Soft Contact Exposure

The mask and substrate are brought into contact. The structure resolution is better than in distance exposure. The substrate intake vacuum is maintained during exposure. The pressing force of

the substrate against the mask is equal to the force applied for wedge error compensation.

3. Hard Contact Exposure

This exposure type is similar to the soft contact exposure. After the substrate is in contact, the substrate intake vacuum is switched off and replaced with nitrogen overpressure. This guarantees better contact, even for exposing larger substrates.

4. Vacuum Contact Exposure

This exposure type ensures the highest structure resolution. It requires a vacuum-capable chuck with a sealing lip. The substrate is in a mini vacuum chamber from which the air is gradually extracted. The pre-vacuum ensures that the mask-substrate contact is established slowly. It also prevents gas bubbles from forming under the substrate. In the next stage the final vacuum is applied. The intake vacuum is then replaced with nitrogen overpressure. This results in the best possible contact between the mask and substrate. Following exposure, the mini chamber is flushed with nitrogen. Larger substrates increase the time required for extraction and ventilation. For the best results, it is recommended to start a test series with long times and then gradually reduce these times.

5. Low Vacuum Contact Exposure

This exposure type is identical to the vacuum contact exposure with one exception: The vacuum inside the vacuum chamber can be adjusted with the controller LOW VACUUM. The setting can be read at the display. This allows high structure resolution of the vacuum contact exposure to be combined with the least possible mechanical stress from the substrate and mask.

6. Flood Exposure

This type allows the entire substrate to be exposed without the mask. Once this exposure type is set in the Parameters menu, the sequence can be started by switching the contact lever. The substrate is exposed according to the set exposure time regardless of whether or not the mask holder was loaded.

Equipment Operation

1. Program Selection

This selection is activated by pressing the **Parameters** button in the main menu (Figure 3). Depending on the selected exposure program (button 1 and 2) in parameters menu (Figure 4) a choice of different parameters are displayed.

a. Pre-Vacuum Time

Sets the pre-vacuum time for LOW vacuum and vacuum contact.

b. Full Vacuum Time

Sets the main vacuum time before exposure for LOW vacuum and vacuum contact. **Hard Contact Time** This function is used to set the time for nitrogen pressure under the substrate before exposure.

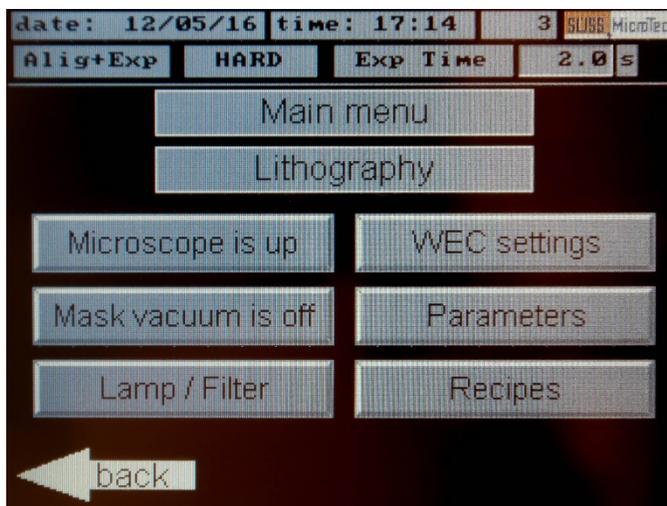


Figure 3: Main menu

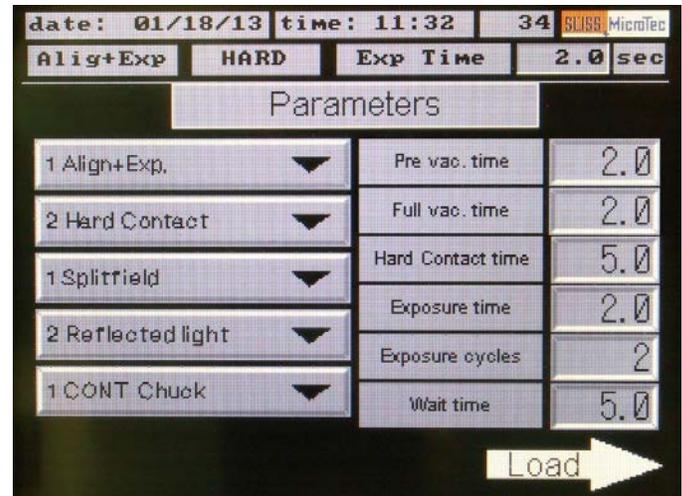


Figure 4: Parameters Menu

c. Exposure Time

Pressing this button opens a key board which allows you to enter the desired exposure time. Confirm your entry with the ENTER button. The display automatically switches back to the **parameters** menu and adds the value that you just set.

The correct exposure time for a photoresist is determined by the equation

$$\text{Exposure Time} = \frac{\text{Required Dose}}{\text{Channel Intensity}}$$

Example: If a photoresist requires 170 mJ/cm² dose and the channel intensity is 30 mW/cm², then the correct exposure time would be 5.7 s.

d. Exposure Cycles

If more than one exposure cycle is entered, the pause time between the individual cycles can be changed. Press **Wait time** on the display to do so.

Pressing the arrow key **Load** adds the set parameters.

2. Loading the Mask

Caution!



If the microscope is in the lower position when loading or unloading the mask, the microscope must be moved to the upper position by pressing the "Microscope is down" button. The button changes to "Microscope is up" and displays the actual position of the microscope.

1. Remove the mask holder by loosening both knurled screws on the mask holder frame (Figure 5b) and then place on a tray upside down.
2. Unload any mask if necessary.

For safety reasons the “**Mask vacuum is on**” button must be pressed for 2 seconds to switch off the mask vacuum (Figure 3).

The mask can be removed as soon as the button changes to “**Mask vacuum is off**”.

3. Replace the mask holder if necessary by unplugging the vacuum tube from the red push plug (Figure 5a) and plugging in the desired holder.
4. Place the mask on the mask holder against the stop pins.
5. Press the “**Mask vacuum is off**” button to switch on the mask vacuum.
6. With the top side facing up, push the mask holder into the alignment station and then fasten it in the mask holder frame using the knurled screws with only your thumb and index finger. No overtightening is necessary.

Attention!



Proper wedge error compensation is not possible if the mask holder is not clamped correctly in the alignment station. The exposure result will be insufficient!

3. **Loading the Substrate**

1. Pull out the transport slide as far as it is possible. Insert a suitable substrate chuck with the substrate resting on the stop pins.

There is a hand valve on the front right side of the transport slide that switches on the transport vacuum for the contact and vacuum chuck. (Figure 5d)

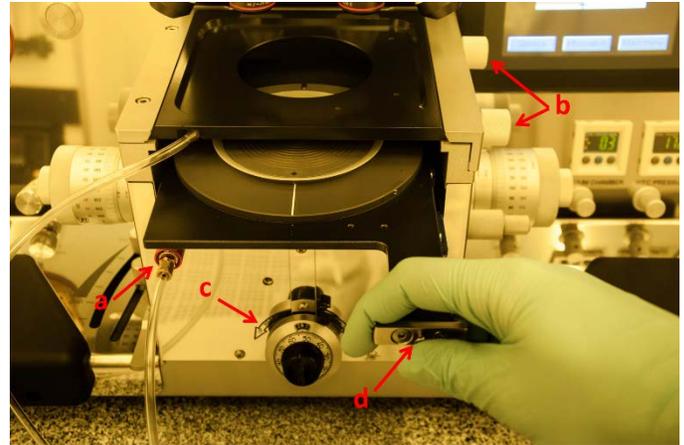


Figure 5: Mask and Substrate loading a) Mask Holder vacuum plug, b) Mask holder securing knobs, c) Contact Thickness Setting d) Substrate transfer vacuum valve

2. Carefully insert the transport slide until it reaches the end stop.

Attention!

Vacuum grooves on the chuck must be covered by your substrate! The chuck and the white vacuum seal must be clean. Use IPA and a clean wipe to remove any stains.



**!NEVER use acetone!
Ensure that the chuck and tool in general left in clean state when done!**

When a new mask or substrate is loaded the thickness setting must be reset. Refer to the next section to do so. Otherwise;

3. Make sure that the SEPARATION LEVER is in **contact** position. (Figure 6b)
4. Slowly close the CONTACT LEVER.

The **Exposure Menu** (Figure 7) on the screen should appear.



Caution!

As soon as the CONTACT LEVER closes Microscope moves down!

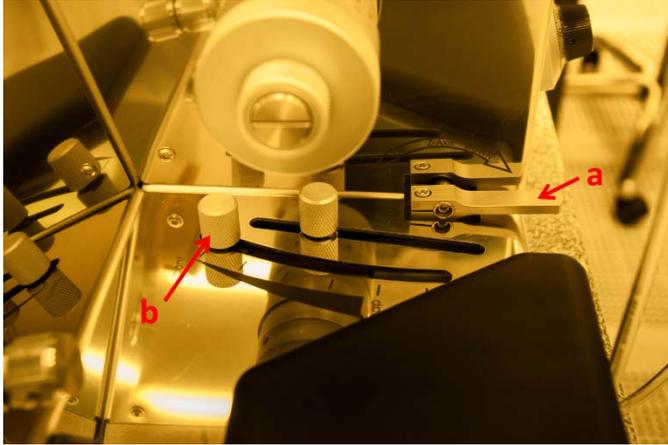


Figure 6: a) Contact Lever, b) Separation Lever



Figure 7: Exposure Menu

4. Wedge Error Compensation (WEC)

For newly loaded equipment, the thickness setting (Figure 5c) at the alignment station must be checked and reset if necessary. To do so;

1. Turn the thickness setting on the adjusting table clockwise until it is at its lowest position.
2. Now load the new equipment with mask and substrate.
3. In the main menu select **WEC settings**.

You will see “**Close contact lever**” on the screen (Figure 8)

4. Move the substrate towards the mask by pushing the contact lever forwards.

5. Turn the thickness setting upwards (counterclockwise) until the information “**WEC setting OK**” appears on the display.

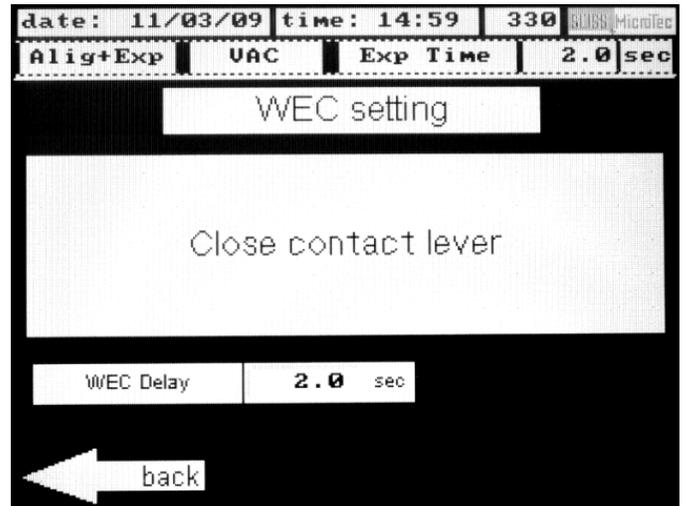


Figure 8: WEC Settings Menu

6. Clamp down the black lever on the setting knob to prevent it from rotating any further.
7. Pull back the contact lever in order to return to the **Main menu**.

5. Setting the Microscope

Select your desired magnification by rotating the objective turrets.

Adjust the illumination level with the illumination knobs on the left-hand side panel. (Figure 1c)

Adjust the course focus knob until you have focused on the mask. (Figure 9a)

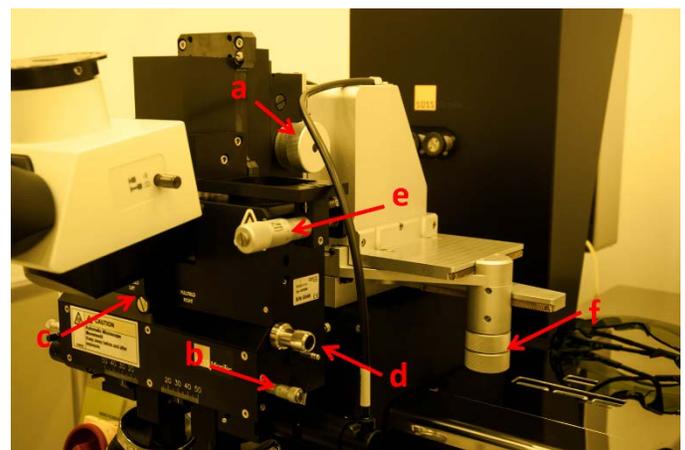


Figure 9: Microscope controls a) Coarse focus b) fine focus, c) Split field selector, d) Objective lateral translators, e) Yaw, f) Microscope position knob

Use two fine focus adjustment micrometers on each side of the microscope assembly to individually correct the focus. (Figure 9b)

The split field selector which is located under the binocular is used to individually select the picture in left, right of both objectives. (Figure 9c)

Two knurled knobs on each side of the microscope can be used to move objectives relative to each other in x direction. Minimum separation between two objectives is 32 mm. (Figure 9d)

The micrometer on the upper right adjusts the yaw. (Figure 9e)

The microscope assembly can be positioned relative to the mask with the big white knobs on the far upper right. (Figure 9f)

Minimum lateral separation between two objectives is 32 mm.

Note the image in the eyepieces is rotated by 180 degrees.



equipment.

Caution!
Microscope position cannot be changed when the microscope is up. Forcing to do so will damage the

6. Alignment

Refer to Loading the Substrate section for loading your sample.

Move the SEPERATION LEVER away from the contact position (Figure 6b). Alignment screen should appear.

Use the X, Y and Theta micrometer screws on the alignment table for this. Align the substrate alignment targets so that they are symmetrically centered to the alignment targets.

When satisfied with the alignment move the SEPARATION LEVER to the contact position. "Exposure Menu" should reappear.



Caution!
Never align the substrate if the mask and substrate are in contact! Doing so will

damage the mask and substrate.

You may choose to do one of the following;

e. Alignment Check

Machine will perform the contact routine depending on the exposure mode. It will not however expose the sample.

Note that in "Soft Contact" mode there is no alignment check button.

f. Exposure

Machine will perform the contact routine depending on the exposure mode and EXPOSE the sample by the time you have set in the parameters.

You need to confirm by pressing additionally **Yes** on the screen.

g. Parameters

You may change your parameters using this menu before the exposure. Refer to the "Program Selection" section above.

7. Unloading the Substrate

After the exposure completed pull the CONTACT LEVER slowly to back.



do so will damage the equipment.

NEVER move the CONTACT LEVER unless the SEPARATION LEVER is in contact position. Forcing to

Pull out the transport slide as far as it is possible and remove your sample.

8. Unloading the Mask

When your work is completed, remove your mask as described in the loading mask section above.

Place the mask holder back in its position.