

Approved by:

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Process Engineer

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Equipment Engineer

1 SCOPE

The purpose of this document is to detail the use of the Karl Suss MA150 Mask Aligner. All users are expected to have read and understood this document. It is not a substitute for in-person training on the system and is not sufficient to qualify a user on the system. Failure to follow guidelines in this document may result in loss of privileges.

2 REFERENCE DOCUMENTS

- Material Safety Data Sheet for the resist and developer that you are using.
- Appropriate Tool Manuals

3 DEFINITIONS

n/a



4 TOOLS AND MATERIALS

4.1 General Description

4.1.1 The Karl Suss MA150 may be set up to align and expose with various sized wafers and masks. The features on the mask will print the same size on the wafer so stepper masks will not work on this aligner. The aligner may use broadband or i-line for exposures.

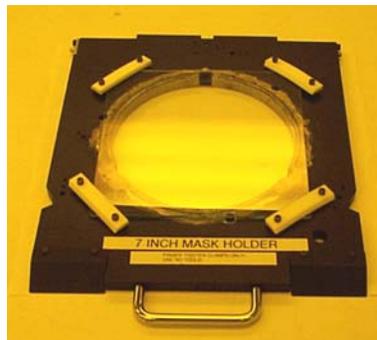
4.2 **Wafer Boats** - Either the black or orange polypropylene cassettes may be used.

4.3 **Mask Holders** - There are three different mask holders. See SMFL staff for training on changing aligner configuration.

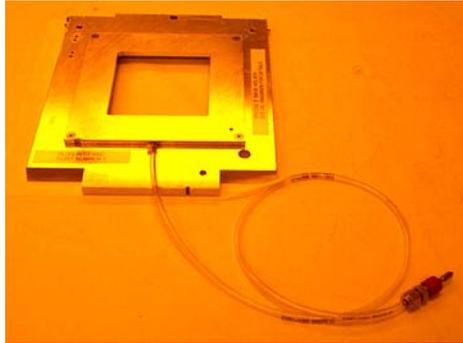
4.3.1 Standard 5-inch mask holder for contact and proximity modes for 4 inch wafers.



4.3.2 Modified mask holder for 7-inch glass, for contact mode only on 4 and 6 inch wafers.



- 4.3.3 Custom holder for 5-inch glass which holds the mask from the back, allowing 5-inch plates to be used on 6-inch wafers. (For contact mode only)



- 4.4 **Filters** - Two filters are available. A neutral-density filter which looks like a screen is used for reducing the intensity to provide greater process latitude. The other one is an i-line filter.



- 4.5 **Wafer Chucks** - A 4 inch wafer chuck and a 6 inch wafer chuck are available. See SMFL staff for training on changing a chuck.

5 SAFETY PRECAUTIONS

5.1 **Personal Safety Hazards**

- 5.1.1 The aligner has a mercury arc ultraviolet light source. Do not look into the direct light area without wearing special UV light protection.
- 5.1.2 Keep all body parts and objects out of the path of moving parts on the mask aligner.
- 5.1.3 Do not operate with guards out of place or try to bypass interlocks.
- 5.1.4 Broken pieces of silicon wafers very sharp and slivers may puncture or cut the skin.

5.2 **Hazards to the Tool**

- 5.2.1 Do not clean the aligner with acetone. IPA/De-ionized water solutions are acceptable to use.
- 5.2.2 Handle wafers only in a clean atmosphere, use wafer tweezers and appropriate clean room & ESD techniques.
- 5.2.3 Wafers need to be clean and kept free of contamination as much as possible.

- 5.2.4 It is a good idea to inspect the backs of the wafers as well as the mask for any resist that could gum up the system.
- 5.2.5 Make sure that the aligner is set up for the wafer size that you need to use.
- 5.2.6 The computer should be **off** when the lamp is being turned on or off.
- 5.2.7 Never remove any lenses or filters except the optional ones.

6 INSTRUCTIONS

6.1 Initial State Check

- 6.1.1 In the service chase, verify that the nitrogen and the compressed air are on.
- 6.1.2 The lamp is usually left on. If it is not on, turn on the **Lamp Power**. The display will cycle through self-testing.
- 6.1.3 Wait for **rdy** to be displayed.
- 6.1.4 Press the **START** button under the **Lamp Power Switch**. Unit will make an arcing noise as the lamp starts. The lamp must warm up before continuing or using.
- 6.1.5 **COLD** will flash on the display until the mercury lamp is warmed up.
- 6.1.6 Turn the **COMPUTER POWER** on to the MA-150 via the electric disconnect switch on the right lower front panel. This should be done *after* powering up the Lamp Power.
- 6.1.7 The monitor is usually left on. If it is off, turn it on with the rocker switch on the back of the monitor.
- 6.1.8 Wait for the machine to initialize. Initialization sequence will be displayed on the touch screen display located at the right front on the unit.
- 6.1.9 Login to by touching **LOGIN** on the touch screen. The username and password are both **xerox**.
- 6.1.10 Check calibration of channel 1 on the constant intensity controller. Refer to UV Light Calibration Check in Attachments to set the intensity and check the display reading.
- 6.1.11 Verify that your mask and substrates are clean. Dirty masks may be cleaned with acetone.
- 6.1.12 Verify that the system is set up for the correct wafer size, with the correct mask holder and the correct wafer chuck. See an SMFL staff member for assistance. Do not make any changes if you have not been properly trained.
- 6.1.13 Verify that which filter is in the housing and remove it if not needed.

6.2 Resetting the System

- 6.2.1 Remove all wafers from the system.
- 6.2.2 Place empty cassettes on the input and output elevators.
- 6.2.3 Make sure all covers are closed and all safety shields are in place.
- 6.2.4 Press the **Reset** button.

6.3 Operating the system

- 6.3.1 Check the intensity of the UV light by lifting up the mask holder and placing the probe on the chuck. Make sure that you are wearing UV protective eyewear.

- Press **System** on the touch screen and then **Light Measure** to open the shutter.
Press **Return** when done.
- 6.3.2 Place the mask on the mask holder and position the mask against the three locator pins. Mask is oriented chrome side down. Touch the **VACUUM** button to toggle **ON** vacuum to the mask. Push the mask platform in towards the machine and touch the **CLAMPING OFF** button to engage the clamp to the mask chuck. It will toggle **ON**. Touch **RETURN** to return to the main screen.
- 6.3.3 To load your program, touch the **CHANGE PRGR** button and then the **LIST** button. Highlight the appropriate program listed by touching **CURSOR UP** or **CURSOR DOWN** button, touch the **LOAD** button and then touch the **RETURN** button.
- 6.3.3.1 When writing or modifying a program note that the system can be used in hard contact mode with all combinations. Proximity contact can **ONLY** be used with 5-inch plates and 4-inch wafers. **VACUUM CONTACT MODE IS NOT AVAILABLE ON THIS TOOL**, even though it shows it as an option in the menus.
- 6.3.3.2 Exposures of up to 99.9 seconds can be performed with a recipe. Longer exposures must be run manually by commanding the shutter to open and timing the exposure with a stopwatch.
- 6.3.4 To reset the microscope/mask stage and get the best range of travel, go to the **System Menu** and choose **Reset Mic/Mask Stage**. The stage will reset. Select **Cancel** when finished.
- 6.3.5 Load the wafers to be processed on the right side and a blank cassette on the left side. Press the green **START/STOP** button to pre-align the first wafer, move it to the chuck and then raise it to the alignment position.
- 6.3.6 If the program is set up for a first mask exposure, the wafer will be exposed and then placed in the output elevator.

6.3.7 Manual Alignment

- 6.3.7.1 When aligning a wafer, first adjust the microscope so that it is centered over the alignment marks on the wafer. Next, adjust the mask so that it is aligned to the wafer.
- 6.3.7.2 Begin by toggling the enhanced/normal switch to **NORMAL** and the mask/wafer switch to **WAFER**.
- 6.3.7.3 Adjust the wafer illumination by turning the **ILLUMINATION** knob on left side of **Image Controller**.
- 6.3.7.4 Adjust wafer focus by turning wafer **FOCUS** knobs (left and right).
- 6.3.7.5 Press **MICROSC** button (top left joystick) to enable microscope stage movement.
- 6.3.7.6 By using the right joystick (X, Y movement controller) and the left joystick (theta rotation controller) find the alignment fiducials on the wafer. It may also be necessary to move the microscope objectives.
- 6.3.7.7 Press **MICROSC** button to disable microscope control (the red LED will turn off).
- 6.3.7.8 Press **MASK** button (top of left joystick) to enable mask control.
- 6.3.7.9 Adjust mask and wafer focus by turning **WAFER FOCUS** knobs.
- 6.3.7.10 By using the right joystick (X, Y movement controller) and the left joystick (theta rotation controller) find the alignment fiducials on the mask.
- 6.3.7.11 By pressing both the **MASK** and **MICROSC** buttons, the mask and microscope will move at the same time so that the wafer appears to move under a stationary mask.
- 6.3.7.12 Once alignment is acceptable, press **CONT. SEP.** button (top of the right joystick). The wafer will come to the exposure position and the **EXPOSURE** button will light on the control panel.
- 6.3.7.13 If alignment still looks acceptable, press the **EXPOSURE** button again.
- 6.3.7.14 The microscope assembly will rotate upward and the lamp shutter will move over the mask/substrate. The wafer will expose for the predetermined time after which the lamp shutter will retract and the transport arm will unload the wafer. The wafer will be moved to the output cassette while a new wafer, if present, will be moved from the pre-aligner position to the alignment station. The microscope will rotate back to position once the next wafer is in position.
- 6.3.7.15 Note if there is difficulty moving the wafer and mask separately or if there is evidence that the mask is scraping the wafer, the alignment gap in the recipe may need to be increased.

- 6.3.7.16 Cassettes may be removed or added from the output elevators during the automatic processing of the wafers at any time EXCEPT when a wafer is being transported from station to station, by opening the cover to the station. DO NOT REMOVE cassettes or open covers while a wafer is being exposed. Movements of the covers may cause vibrations that can blur the exposure image. Press **RESET** to recover from faults caused by opening the covers.
- 6.3.7.17 Some very thick resists may require the use of the Frame Grabbing Feature for alignment. See the appendix for instructions.
- 6.3.8.18 When finished with the aligner, remove the mask by touching the **Mask** button, the **Vacuum** button and the **Clamp** button.
- 3.6.8.19 Log out of the system by touching the **Logout** button twice.
- 6.3.8.20 Turn off the **Computer Power** before swiping out.

6.4 Short Program is used to process irregular substrates

- 6.4.1 Load the desired program and make sure that there is an *empty* cassette on each elevator.
- 6.4.2 Remove the mask holder and place the substrate on the wafer chuck.
- 6.4.3 Replace the mask holder and install the mask.
- 6.4.4 On the **Main Menu**, press the **System** button.
- 6.4.5 Press the **Short Program** button. You will get the following message **Watch out for Wafer Transport. Touch to Continue**. Touch to continue and use caution as transport arms will move.
- 6.4.6 Press **Mask** and turn **Vacuum ON** and **Clamping ON**. Press **Return**.
- 6.4.7 Press the green **Start/Stop** button (not on the screen) and the chuck will either come up for exposure or alignment, depending on the recipe.
- 6.4.8 If alignment is required, proceed as before.
- 6.4.9 Press the red **Reset** button twice. Wait for the handling to stop before retrieving wafer.
- 6.4.10 When finished remove the mask, mask-holder and substrate.

6.5 Errors during Run

- 6.5.1 Occasionally the touch screen will lock up. If this happens, turn the System Power switch off. Wait 20 seconds and then turn it back on. The system will take several minutes to reboot.
- 6.5.2 The wafer handling has difficulty removing wafers from the top half of the cassette. Try and place the wafers near the H-bar end of the cassette.

7 APPROPRIATE USES OF THE TOOL

- 7.1 Use caution when doing a hard contact exposure because the wafer may stick to the mask.
- 7.2 Irregular substrate sizes and wafer pieces may only be done with SMFL approval.
- 7.3 Only clean substrates may be processed.

8 ATTACHMENTS

8.1 Calibrating the Constant Intensity Meter

- 8.1.1 Check the calibration of Channel 1 on the constant intensity controller.
- 8.1.2 Touch **SYSTEM** on the touch screen.
- 8.1.3 Place the UV intensity meter sensor in the middle of the stage on the aligner. The sensor “eye” must be facing up towards the UV light source.
- 8.1.4 Touch **LIGHT MEASURE** on the Karl Suss touch screen.
- 8.1.5 Observe the intensity readings given by the panel of the Constant Intensity Controller and the UV meter on the stage. The readings on both displays should be within 0.2 mW of each other and the output as displayed by the UV meter on the stage should be within ± 0.1 mW of the process setpoint. Log in these readings as well as the bulb hours. Holding in the CI1 button on the Constant Intensity Controller Unit can access the usage hours for the bulb until the hours are displayed.
 - 8.1.5.1 If the panel meter does not match the stage meter, the panel display must be adjusted. Proceed to section 6.2.6.
 - 8.1.5.2 If the panel meter matches the stage meter but the stage meter is more than ± 0.1 mW of the process setpoint, proceed to section 6.2.7.
 - 8.1.5.3 If both meters match within 0.2mW and the stage meter is within +/- 0.1 mW of the process setpoint, the unit is reading correctly and is at the intensity setpoint, proceed to section 6.2.8.
- 8.1.6 Press and hold in the **CI 1** button on the **Constant Intensity Controller Unit** until the display “**set display**” lights up. Use up or down arrow button until readout on the **Constant Intensity Controller** matches the UV intensity stage meter readout. Log in the new readings along with the bulb hours and power.
- 8.1.7 When calibration is finished, touch **RETUR**” on the touch screen. You are now ready to proceed with production on the mask aligner.
- 8.1.8 Turn the UV Intensity Meter “OFF”, disconnect the probe and return items to storage case.
- 8.1.9 Be sure to select the proper channel when setting up the Karl Suss for the program being used. Incorrect channel and program matching can cause under or over exposure.

8.2 Use of Frame Grabbing Feature on Karl Suss MA-150

- 8.2.1 Toggle enhanced/normal switch to **NORMAL**.
- 8.2.2 Toggle mask/wafer switch to **WAFER**.
- 8.2.3 Adjust wafer illumination by turning **ILLUMINATION** knob.
- 8.2.4 Adjust wafer focus by turning wafer **FOCUS** knobs (left and right).
- 8.2.5 Press **MICROS** button (top left joystick) to enable microscope stage movement.
- 8.2.6 By using the right joystick (X, Y movement controller) and the left joystick, (theta rotation controller) find the alignment fiducials on the wafer.
- 8.2.7 Press **MICROSC** button to disable microscope control.
- 8.2.8 Press **MASK** button (top of left joystick) to enable mask control.
- 8.2.9 Adjust mask focus by turning **MASK FOCUS** knobs.
- 8.2.10 By using the right joystick (X, Y movement controller) and the left joystick (theta rotation controller) find the alignment fiducials on the mask.
- 8.2.11 Move the mask fiducials to the right until they do not appear on the monitor screen.
- 8.2.12 Toggle enhanced/normal switch top **ENHANCED**.
- 8.2.13 Press the **GRAB IMAGE** button.
- 8.2.14 Move the mask fiducials to the left so they appear on the monitor.
- 8.2.15 By using the right joystick (X, Y movement controller) and the left joystick (theta rotation controller) align the mask fiducials to the wafer fiducials.
- 8.2.16 Once alignment is acceptable, press **CONT. SEP.** button (top of the right joystick). The **EXPOSURE** button will light.
- 8.2.17 If alignment still looks acceptable, press **EXPOSURE** button.
Note: The microscope assembly will rotate upward and the lamp shutter will move over the mask/substrate. The lamp will expose for predetermined time after which the lamp shutter retracts and the transport arm will unload the wafer. The wafer will be moved to the output cassette while a new wafer (if present) will be moved from the pre-aligner position to the alignment station. The microscope will rotate back to position once the next wafer is in position.
- 8.2.18 If alignment does not look acceptable, press **CONT. SEP.** button and adjust alignment of wafer to mask.
- 8.2.19 Press **CONT. SEP.** when alignment is acceptable. Repeat step until alignment is acceptable and wafer is exposed.
- 8.2.20 Repeat steps for additional wafers if use of frame grabber is necessary, if frame grabbing is not needed, use normal operation

R·I·T

Title: Karl Suss MA150

Semiconductor & Microsystems**Fabrication Laboratory****Revision: E****Rev Date: 03/01/06****REVISION RECORD**

Summary of Changes	Originator	Rev/Date
Original Issue	Sean O'Brien	A-12/16/02
4.1.1 removed vac. contact, added 5.2.4, 5.2.5, 5.2.6, 6.1.11, 7.2, 7.3	Sean O'Brien	B- 01/23/03
Added 6.4, 5.2.7, 6.3.5.11, 6.3.5.15, removed 6.3.11, 6.3.12, other sections were clarified.	Sean O'Brien	C- 06/03/04
Added information on mask holders , 6.1.12, 6.1.13, 6.3.3.1, 6.3.3.2	Sean O'Brien	D-11/10/04
Added procedure for resetting the stage, clarified 6.4	Sean O'Brien	E- 03/01/06