



University of Pittsburgh

## Nanoscale Fabrication & Characterization Facility

### Quintel Q4000 Mask Aligner Users Guide



The Mask Alignment Systems are integrated optical-mechanical, pneumatic-electrical systems, which allow accurate alignment of sensitized semiconductor wafers or substrates with a mask and exposes them to ultraviolet radiation to transfer the pattern of the mask to the substrate for further processing in an effort to produce a semiconductor or other microelectronic device. The Mask Aligners consists of several coordinated, inter- related systems including the substrate loading, holding and unloading system; the mask supporting system; the substrate/mask/scan/align/lock system; the viewing system (microscope and illuminators); and the exposing system.

## Operation Procedure:

- 1) Log into FOM.
- 2) Turn on the process N<sub>2</sub>, Compressed Air and the vacuum for the Quintel by opening the facility valves mounted on the wall.
- 3) Turn on the mercury lamp power supply by flipping the breaker. Then press and hold the start switch until the meters display a change in power.
- 4) Warning!! Do not attempt to restart the lamp once it is hot. Give it at least 30 minutes to cool before attempting to ignite a hot lamp. The lamp can explode.
- 5) Allow 10 minutes for lamp to stabilize.
- 6) Press the main system power button located just to the right of center on the main body. Once the start-up sequence is completed press "enter" on the "UniOp" controller to display the main screen.
- 7) Make certain the "Head Lock" button is on and the microscope is turned fully to the left.
- 8) With out any mask or wafer installed, gently slide the load stage fully out and then fully forward into the aligner. This will "reset" the stage.
- 9) Once the chuck is fully in, use the scan "joystick" to center the chuck in the opening of the mask stage. For coarse movement, press and hold the "Coarse Align" button located on the front left control panel while moving the right hand "joy stick".
- 10) Once the chuck is centered, press the "load" button to lift the chuck into the up position.
- 11) To prepare for your exposure it is first required to measure the lamp intensity. The lamp intensity

drops with age and this enables more consistent and quality results by verifying the intensity immediately before a run.

- 12) The intensity check should be performed each run. Uniformity does not need to be completed unless there is a problem or parts are replaced.
- 13) Press the headlock button and rotate the head to the middle and lock it again.
- 14) With the wafer chuck in the up position, turn on the meter, and place the intensity meter onto the center of chuck.
- 15) Rotate the head to the "exposure" position.
- 16) Activate the manual shutter control on the UniOP controller.
  - a. Press Enter
  - b. Press "4" for controls.
  - c. Press "2" to open the shutter.
- 17) Measure the output in order to calculate your exposure for your particular resist. On the controller channel A is 365nm and channel B is 405nm wavelength. The reading is in  $\text{mWcm}^2$ .
- 18) Press "2" once more to close the shutter.
- 19) Turn off the meter and remove the sensor from the wafer chuck.
- 20) Press the "clear" button located on the front right half of the panel. The wafer chuck should drop clear of the mask holder.
- 21) Press the headlock button and move the head out of the way to the left. Press the headlock to hold it into position.

- 22) Select "1-ExpTime" on the UniOp controller from the main menu for "Exp Time". Press "insert" and the cursor will blink to allow you to enter the desired exposure time. Select the exposure time based on the intensity calibration and the specifications for your given photo resist. Press enter to save.
- 23) Select the desired "contact printing" mode. Press "2-PrModes" on the UniOp controller.
  - a. "1" for Pressure Contact. This is the standard process. It is a balance between mask life and resolution. Good for features larger than 2 microns.
  - b. "2" for Vacuum contact. This is used for the highest resolution and critical dimensions below 2 microns.
  - c. "3" for Contact Calib. This is for features above 5 microns and when long mask life is required.
- 24) Place the mask onto the mask holder with the chrome-coated side down. Align the upper left hand corner of the mask with the alignment washers and press the "mask vacuum button" to secure the mask into position.
- 25) Pull the wafer stage fully out until it stops.
- 26) Place the wafer on the stage and align it to the major flat with the alignment bar.
- 27) Slowly push the stage in until the vacuum pulls the wafer to the chuck. Flip the alignment bar out of the way and then press the stage fully in until it stops. It is important to flip the alignment bar away from the chuck to prevent it from jamming.
- 28) Press the load button and the chuck will rise into contact and then drop to the separate mode allowing a 30-micron gap spacing for alignment.
- 29) Press the headlock button and return the microscope to the center position. Lock it there.

- 30) Turn on the microscope illumination lights on the shelf under the table. Turn on the monitor for the camera. The visible light controller is on the left and the IR for backside alignment is on the right.
- 31) Make certain the light switch on the left hand side behind the left joystick is in the desired position. It can be off, microscope, IR or both. Note there is a manual shutter between the microscope and the camera. Only one can be used at a time.
- 32) Rotate the lens head so the front label reads "low power". This is accomplished by holding the bar and gently rotation the microscope lenses. This allows you to view the mask with the microscope or the camera.
- 33) Use the left joystick to locate the alignment marks and align the sample using the microscope or the camera. Remember that the camera has a manual shutter between the camera and the optical microscope. This must be pressed in for the optical microscope and pulled out for the camera.
- 34) Adjust the viewing light intensity using the left and right knobs on the left panel. The top knobs are for the visible light and the bottom knobs are for the infrared light for backside alignment.
- 35) Split view can be utilized to view two unique alignment marks in two unique locations simply by rotating the lens head to the split view location. The distance between the two viewing lens can be changed by turning the knurled knob in the front of the unit. It moves from 1-2 inches apart approximately.
- 36) Use the joystick and the theta adjustment to compensate for alignment differences.

- 37) Press the contact/separate button to contact the wafer. If the alignment is still not satisfactory, press the contact/separate and repeat the alignment procedure once more.
- 38) Once the alignment is satisfactory, rotate the lens head to the expose position.
- 39) Press the expose button. After the exposure, the chuck will drop automatically from the mask stage.
- 40) Turn the microscope to the left and lock it into position.
- 41) Withdraw the wafer stage from the aligner and remove the wafer and mask from the system.
- 42) Press the wafer stage back under the mask stage.
- 43) Turn off the video monitor, turn off the UniOp controller by pressing enter and then press "6", turn off the lamp power supply, and the microscope illumination supplies under the table.
- 44) Turn off the N2 Compressed Air and vacuum supply valves on the wall.
- 45) Log the UV lamp hours in the logbook.
- 46) Log out of FOM.

## **Backside Alignment:**

- 1) If backside alignment is required contact the NFCF staff at least 24 hours prior to usage so that the unit may be converted.
- 2) Follow the same procedures as for normal front side alignment in the beginning of this guide.
- 3) Turn off the visible light controller and turn on the IR light source controller.
- 4) Adjust the intensity until the image of the mask and alignment marks are visible on the video screen. Remember to make sure the manual camera shutter is open.
- 5) Adjust the alignment of the wafer to the mask by using the joystick and the theta micrometer as in the previous instructions.
- 6) Verify the alignment by pressing the contact button and viewing the contact alignment.
- 7) Set up the exposure as before and set the time.
- 8) Rotate the lens head to the expose position and press the expose button.
- 9) Using normal microscope lighting may also be useful to verify alignment depending on the sample.
- 10) Follow the steps for removing the sample, the mask and shutting down the system that are in the previous pages of this guide.