

AUTOSTEP 200

Standard Operating Procedure
GCA AutoStep 200 Projection Lithography Stepper
Edward Tang 2/28/05

Table of Contents

Section 1 - Overview

- Introduction
- Chassis
- Atmospheric Control System (ACS)
- Reticle Management System (RMS)
- Maximus (light source/optics)
- Stage
- Automatic Wafer Handler (AWH)
- Console

Section 2 – Basic Operation

- Prompt
- Logging In/Out
- Abort
- RMS Commands
- Resetting AWH
- Calibration

Section 3 – Loading Wafers and Reticles

- Loading Wafers
- Loading Wafers using the AWH
- Loading Wafers Manually
- Loading Reticles

Section 4 – Writing a Job

- General Job Specifications
- Pass Specifications

Section 5 – Executing a Job

- Focus/Exposure Matrix
- Executing a Job

Section 6 – Troubleshooting

- AWH errors
- RMS errors

Section 1 - Overview

Introduction

The AS200 stepper is an I-line 5x reduction stepper that is capable of submicron resolution with high accuracy alignment. It can accommodate wafer sizes of 1cm pieces to 6" wafers and has automated 4" wafer handling and alignment.

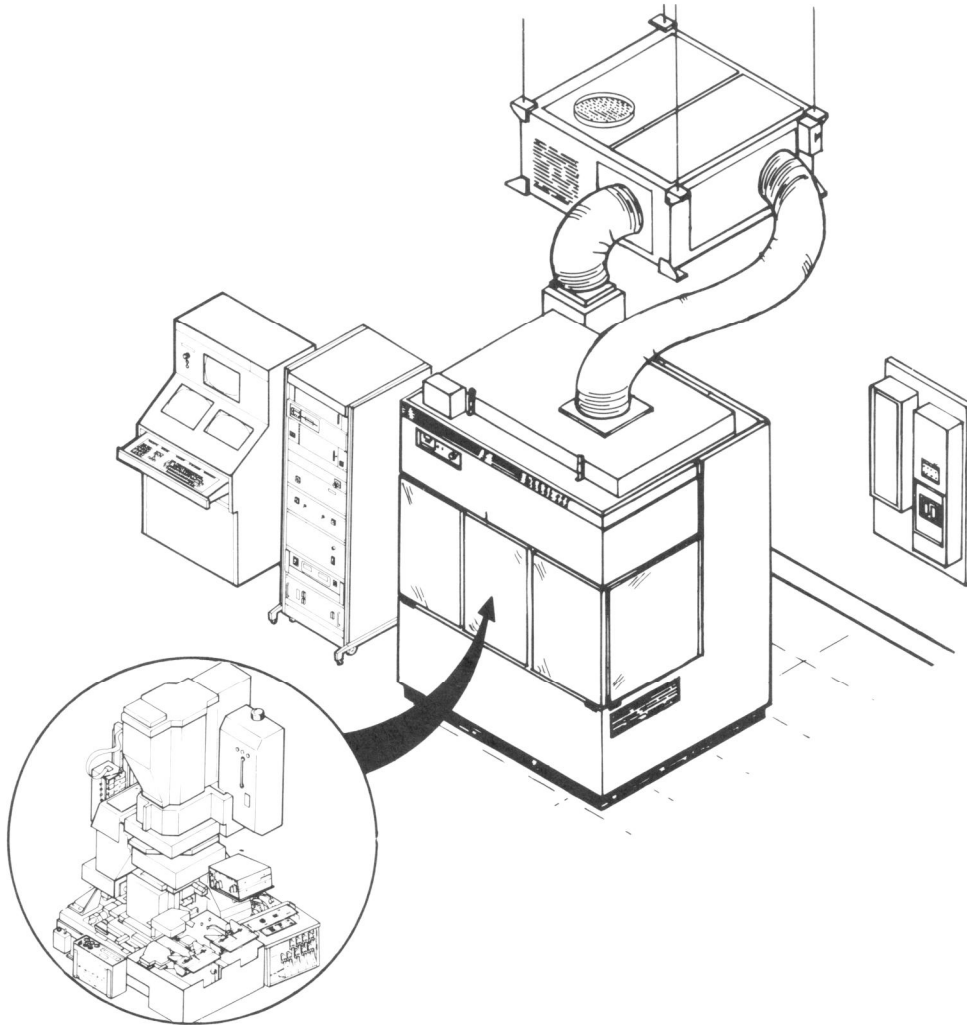


Figure 1 – Autostep 200

There are 7 major components on the tool, they are: Chassis, Atmospheric Control System (ACS), Reticle Management System (RMS), Maximus (light source/optics), Stage, Automatic Wafer Handler (AWH), and the Console.

Chassis:

The chassis houses all the electrical components of the AS200 system. These components are what control most of the physical components on the tool: RMS system, AWH system, Stage control as well as the lamp power supply and some computers.

Under normal circumstances a user should never access any of the chassis components.

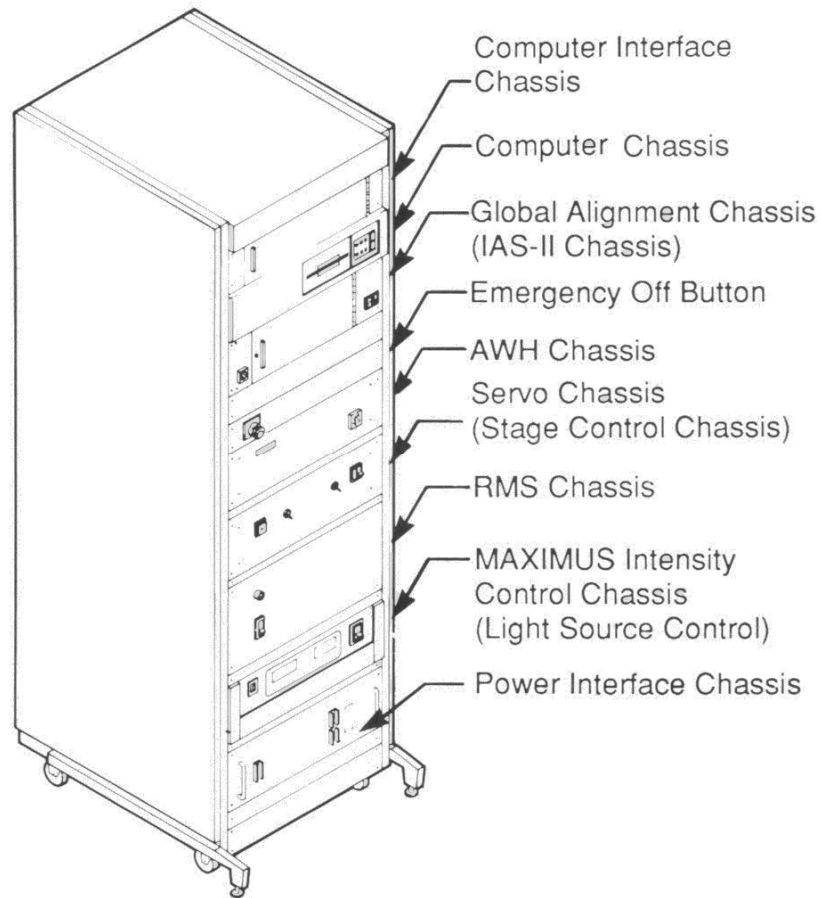


Figure 2 – Chassis

Atmospheric Control System (ACS):

The stepper uses an ACS because of the sensitive nature of optics; there are notable differences in optical performance with slight variations in temperature and humidity. The ACS is composed of the environmental chamber that the stepper resides in, the HVAC unit hanging above the chamber, as well as the monitor sitting on top of the computer console. On the front of the chamber there are the start/stop controls of the HVAC as well as the current temperature inside the chamber. The ACS monitor, located above the console, monitors the temperature, humidity, and pressure inside the chamber. It also monitors the optic temperature and can make fine focus and magnification adjustments to the optics.

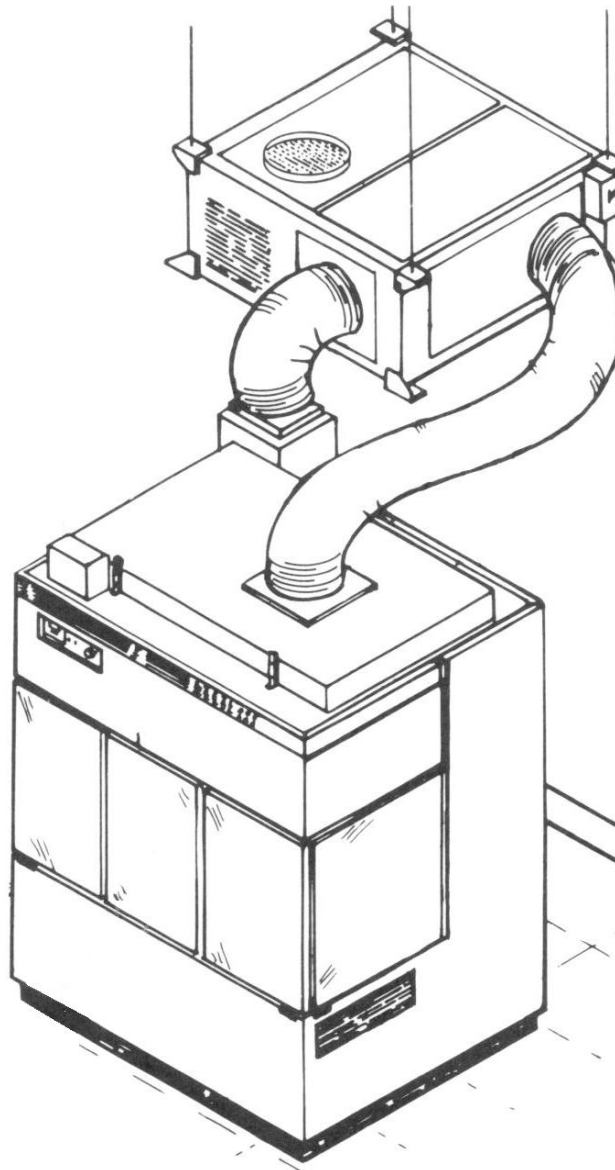


Figure 3 – Atmospheric Control System (ACS)

Reticle Management System (RMS):

The RMS is located inside the ACS chamber on the left. It is composed of the elevator, the turntable, and the reticle platen. The elevator holds up to 10 reticle cassettes at any given time; these reticle cassettes accommodate 5” mask plates. On the turntable there are 2 reticle forks, A and B. The A fork is used to remove the reticle from a cassette and load the reticle on to the platen, and the B fork does the opposite. Once the reticle is initially loaded onto the reticle platen, the RMS does an alignment to align the reticle to the stage by reading fiducials that have been written on to the reticle (refer to the reticle design handbook for more detail). This procedure is done through the Reticle Rotation System (RRS).

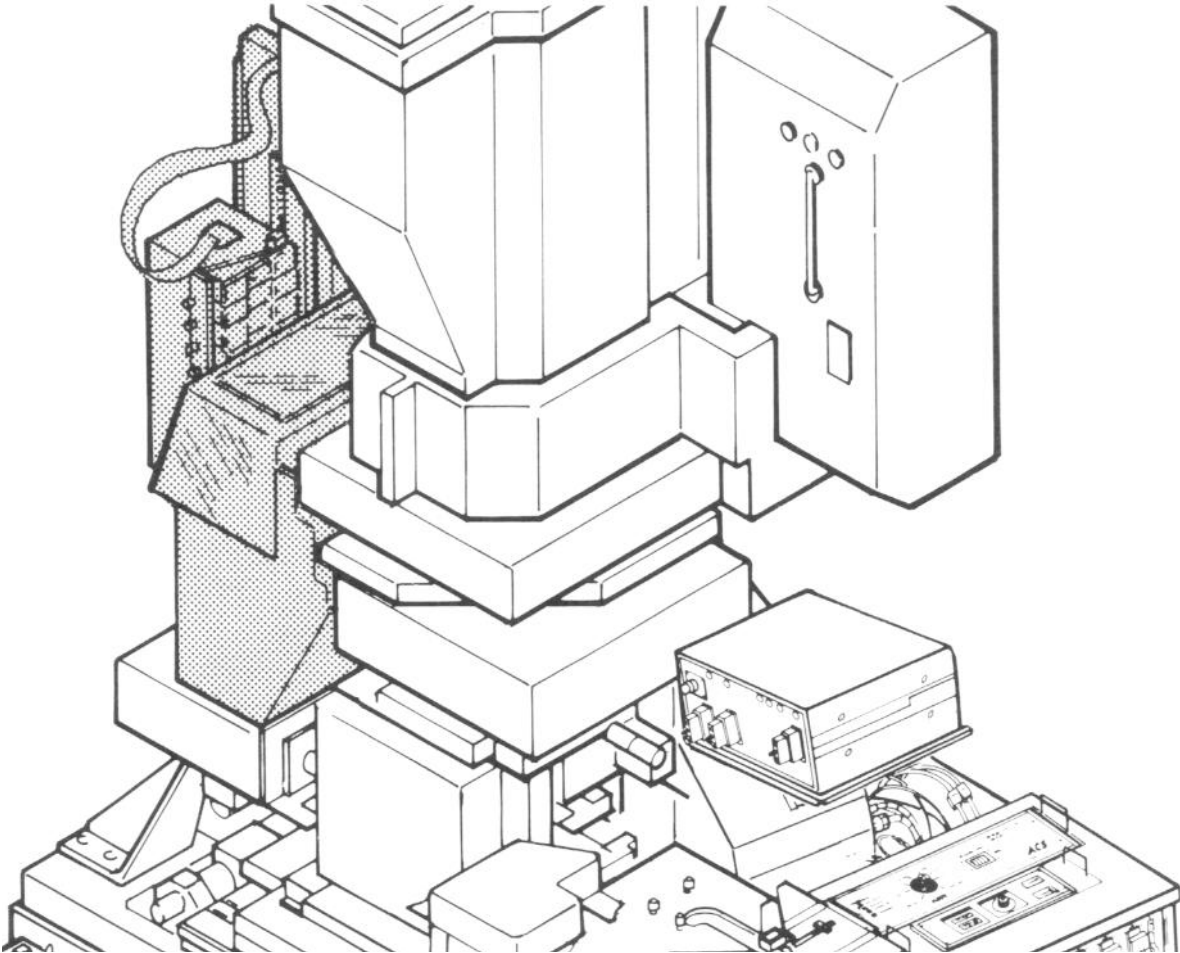


Figure 4 – Reticle Management System (RMS)

Maximus:

The Maximus is the large component found inside the chamber above the stage in the middle of the tool. It is composed of the lamp, the lamp housing, and the optics. The Maximus uses a 1000W I-line lamp running at 700W constant power and puts out approximately 500mJ of power.

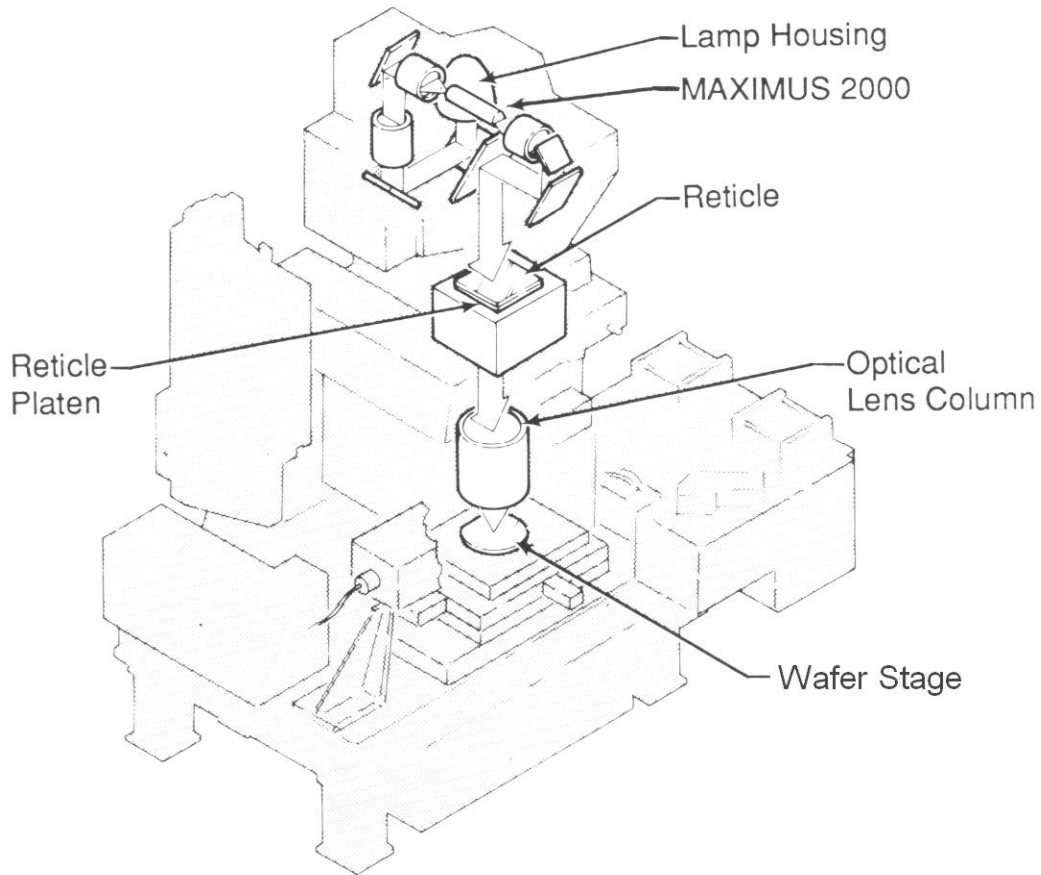


Figure 5 – Maximus and Light Path

Stage:

The stage is located at the very bottom of the tool inside the chamber. It rides on keys (rails) driven by electric servos and has X, Y, theta, and tilt correction. The stage has extreme precision movement capable of motion in units of .01 microns. On the top of the stage is where the wafer chuck is located. This wafer chuck is removable and replaceable to accommodate difference substrate sizes. **Extreme caution must be used when removing and replacing chucks** as there are very fragile optics located just millimeters above the surface of the chuck.

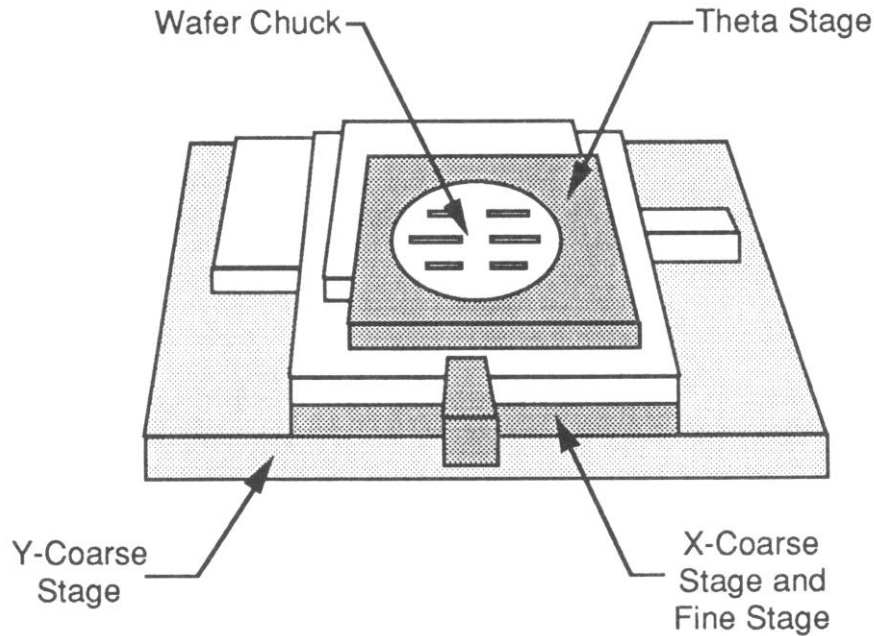


Figure 6 – Stage

Automatic Wafer Handler (AWH):

The AWH is located in the chamber at the right side of the tool. It is composed of an input wafer boat, an input arm, a prealigner, a loading arm, an unloading arm, an output arm and an output wafer boat. The AWH takes standard 25 wafer 4" wafer boats that the Suss ACS200 also uses. It always inputs wafers from the bottom of the boat, and outputs them at the highest free slot from the bottom of the output boat. The AWH cannot accommodate glass wafers. Please contact the tool owner if you plan on using glass wafers

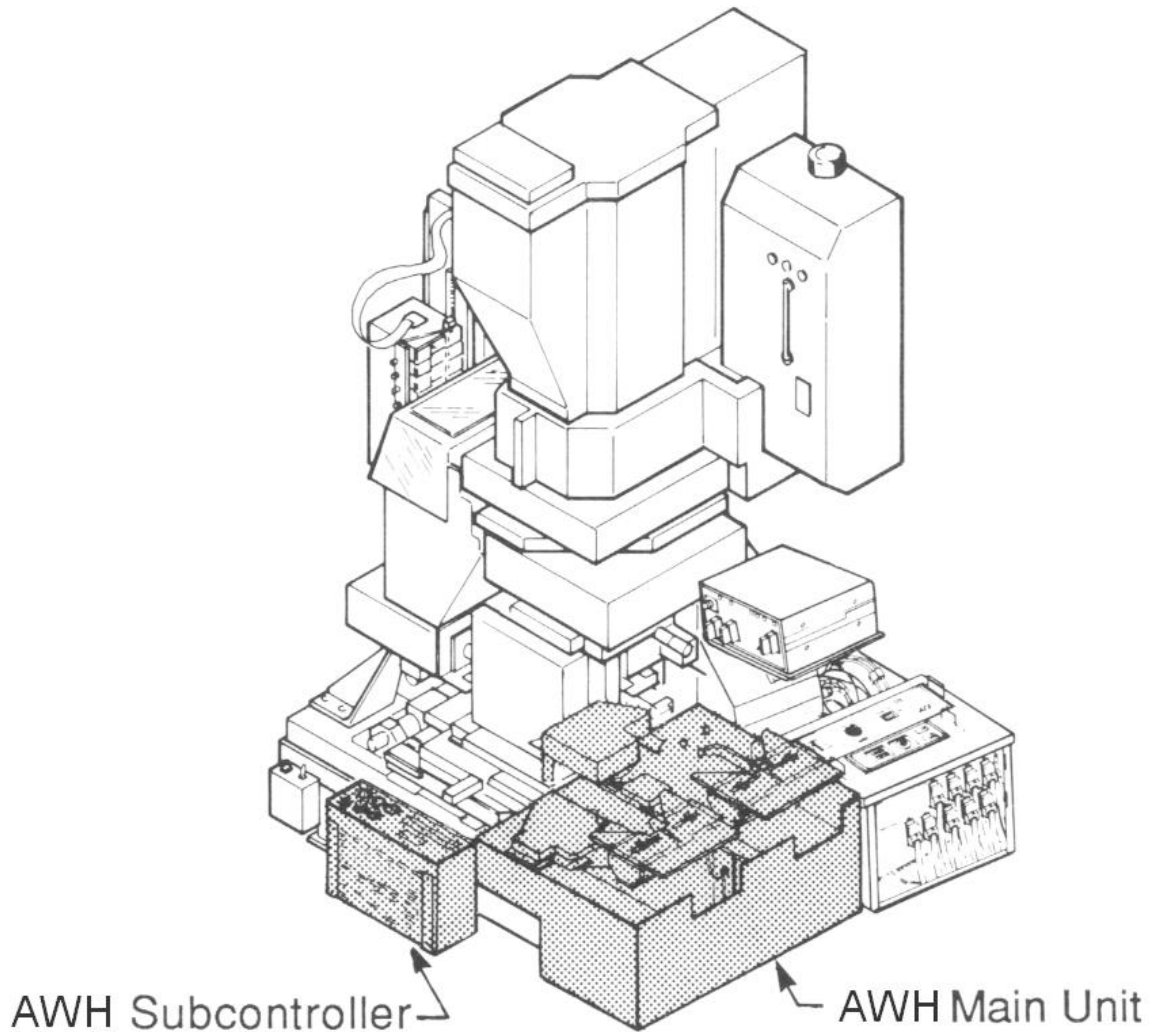


Figure 7 – Automatic Wafer Handler (AWH) System

Console:

The computer console is where the operator controls the tool. All diagnostics, alignment, metrology, programming and executing are done here. There are 3 screens; the top screen is the main console, the left screen is a metrology screen, and the right screen is an alignment screen. The main console is where all of the programming of the tool is done as well as executing any jobs or commands. The metrology screen is used to observe measurements done during alignment or calibration as well as showing exposure progress. The alignment screen is used during global alignment before exposure.

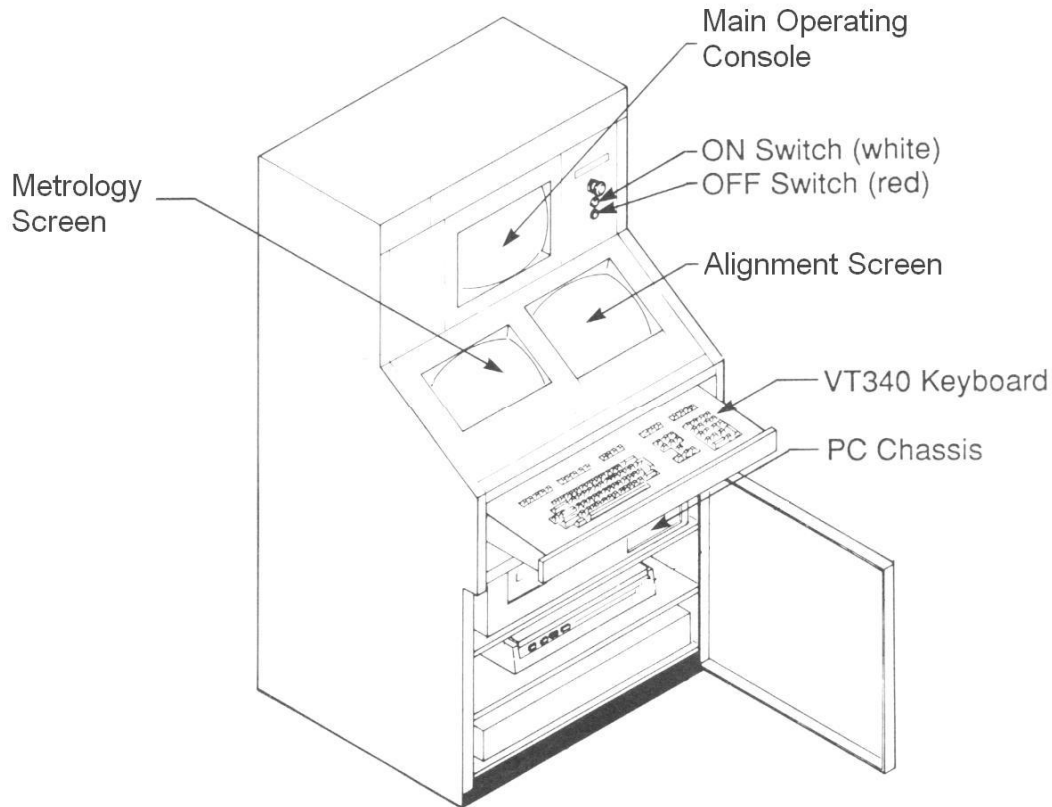


Figure 8 – Console

Section 2 – Basic Operation

Prompt

The tool should be in a state where there is a single semi-colon prompt “:” on the main console screen. The screen may be blank because of a screensaver, hit “Enter” and the screen should reappear with the “:” prompt. The single semi-colon prompt is the normal prompt and is where all the operation of the tool begins.

Logging In/Out:

The log in command is “L I [X, Y]” where X and Y is your log in account number. You will be prompted to enter a password after logging in. After successful log in, you should be returned to the “:” prompt.

To log out, type “L O”.

Abort:

The abort function is used very commonly to quickly quit out of jobs or menus and return you to the normal prompt. Please keep track of what has been done before you abort, in case certain portions of the tool are not where they should be due to the abort; you may need to reset certain systems on the tool and/or reposition the stage to return to normal operation.

To abort hit “[CTRL] C”

Then hit “A” and enter, this should bring you back to the “:” prompt.

Reset appropriate systems to return to normal operation.

RMS Commands:

To reset the RMS system type “RES”, please do this if there are any communication problems or errors with the RMS system.

To load a reticle into the RMS elevator type “RMSLOAD” and when finished, hit enter.

To return a reticle from the platen to its cassette, type “RMSRET”.

If you ever get into a serious problem with the RMS, it will kick you out of the normal prompt and into the RMS prompt which looks like “ RMS> ”

To perform a reset at the RMS prompt, type “ `RS ”.

To exit the RMS prompt to return to the normal prompt, type “ ~ ”.

Resetting AWH:

To reset the AWH, type “RST” and it should return the wafer boats and loading arms to the starting position. Please do this if there are any communication problems or errors with the AWH system. Also, please note if your wafer is still on the wafer stage, if so, it may need to be manually removed.

Calibration:

It is recommended to run the calibration on the tool at least once a day. If you have a very critical job you may choose to run it before your job or even before every exposure. The calibration utilizes the SETUP-01 reticle; this reticle should always be in the RMS elevator.

The calibration is done by the command “INS”.

This will pull up the INSITU menu, choose FULL SETUP.

It will ask you how many times to repeat, choose 1.

It will ask you the name of the reticle, it should already specify “SETUP-01”, so hit enter.

It will ask you the floor name and it is optional since you have specified the name, so hit enter.

It will load the reticle onto the platen, and a global alignment mark will come up on the left side of the alignment screen.

Do a manual alignment, or hit “ B ” for an automatic alignment.

When you are satisfied with the alignment, hit “EXPOSE” to continue.

The tool will run through several tests, taking 5-10 minutes to finish. If any of the tests fail, it will ask you if you want to repeat, please enter “Y” to repeat.

When the calibration is finished, you will be returned to the INSITU menu, type 8 to exit and you will be returned to the prompt.

Section 3 – Loading Wafers and Reticles

Loading Wafers

There are 2 ways to load wafers into the stepper. The first way is using the AWH, and the second way is manually loading wafers on to the chuck.

Loading Wafers using the AWH

The AWH system uses 2 boats, an input boat and an output boat. Load your wafers into the input boat and place the boat on the input side. There are 2 lines on the input side of the AWH (front) where the boat should line up to; you should feel the boat fall into place and you should not be able to slide the boat off. Place a boat on the exit side of the AWH (back), and make sure it has enough open slots at the bottom of the boat to receive wafers.

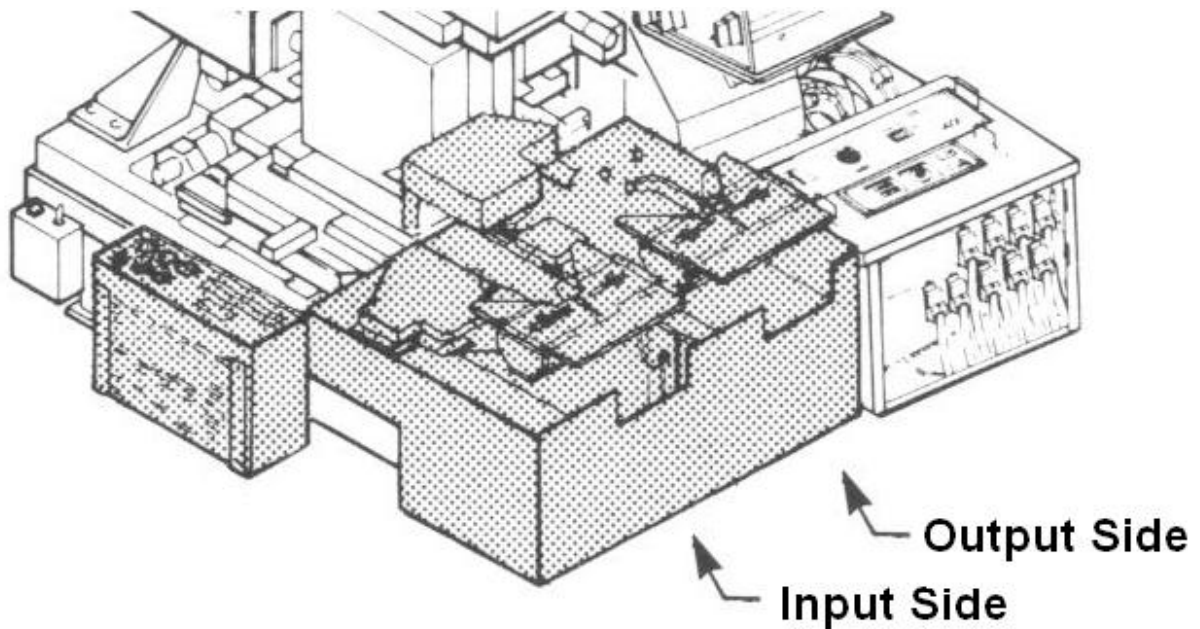


Figure 9 – Position of the Boats in the AWH

Please note that the AWH removes wafers from the bottom of the input boat. The AWH also outputs wafers in the highest free slot from the bottom of the output boat

Loading Wafers Manually

The AS200 has a removable chuck that allows you manually load wafers or remove wafers. Great caution must be taken when removing and replacing the chuck as the optics are located very close to the surface of the chuck.

Vacuum controls are used to control the vacuum to the AWH system, stage and chuck. There are three labeled switches to the left of the tool that control each of the vacuum lines.

To load wafers manually:

- Turn off the AWH vacuum, this makes the vacuum manually control
- Turn off the Stage vacuum, this releases the chuck from the stage
- SLIDE the chuck out dragging it along the bottom of the stage
- Turn off the Chuck vacuum
- Load/remove wafer
- Turn on Chuck vacuum
- SLIDE the chuck in, you may feel a bit of resistance/obstacles so you can tilt it a bit to help, but do not lift the chuck up off the stage.
- Continue sliding until you feel the “square” stop at the end of travel
- Turn on the Stage vacuum
- Leave the AWH vacuum off if you are doing an exposure with manual loading
- Turn on the AWH vacuum if you are leaving the tool or want to use the AWH

During exposure or focus-exposure matrix, when the system prompts for “Start AWH” input, you would hit the “MANUAL” button rather than “1st level” or “S/C.”

Loading Reticles

Please note the RMS can only accommodate 5” mask plates.

Before you can load your reticle into the RMS, it must first be placed in a reticle cassette. The reticle cassette has a spring loaded door, and 2 tabs on each side that are used to open the cassette fully. Pull on the 2 tabs and the cover should swing open. Place your reticle chrome side down in the cassette. The orientation should be as shown below.

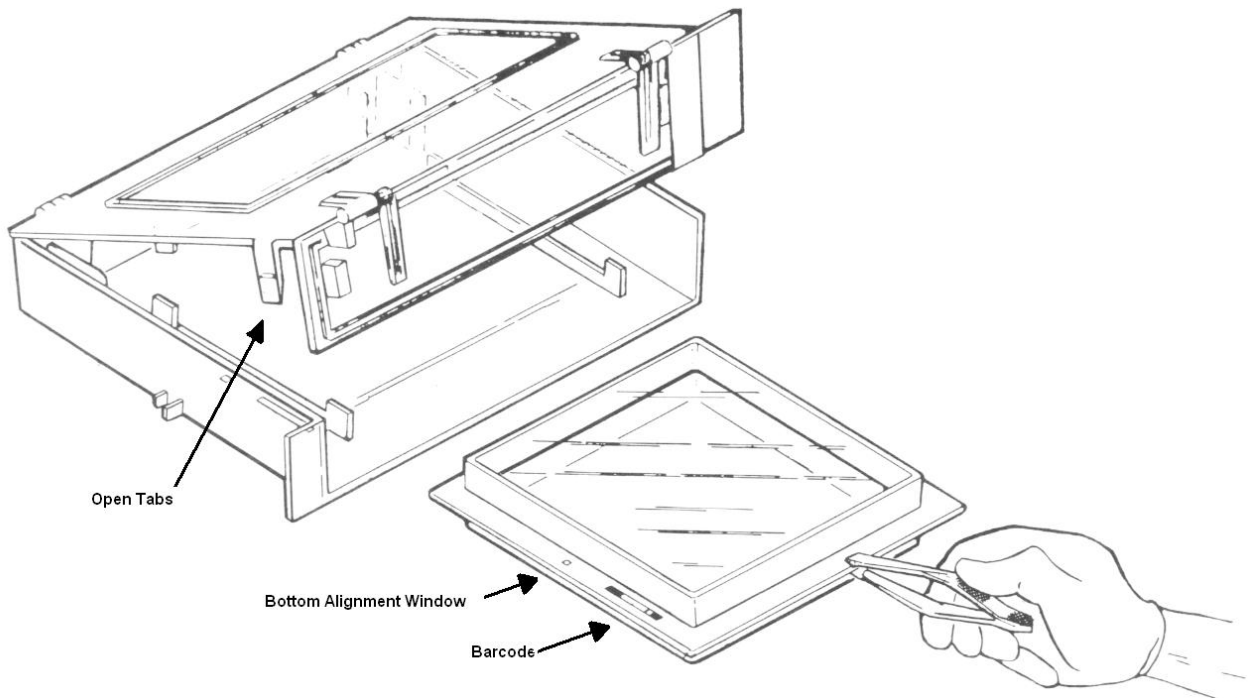


Figure 10 – Orientation of Reticle in Cassette

To load the cassette into the RMS elevator, type “RMSLOAD” at the command prompt, the elevator will move to the lowest position and the turntable will disengage and rotate freely. Pull the circular tab on the floor you want to load the cassette, slide the cassette into the floor, release the tab and the cassette should be locked into position. Hit “Enter” when finished and the RMS will take an inventory of the reticles in the elevator.

RMS Elevator

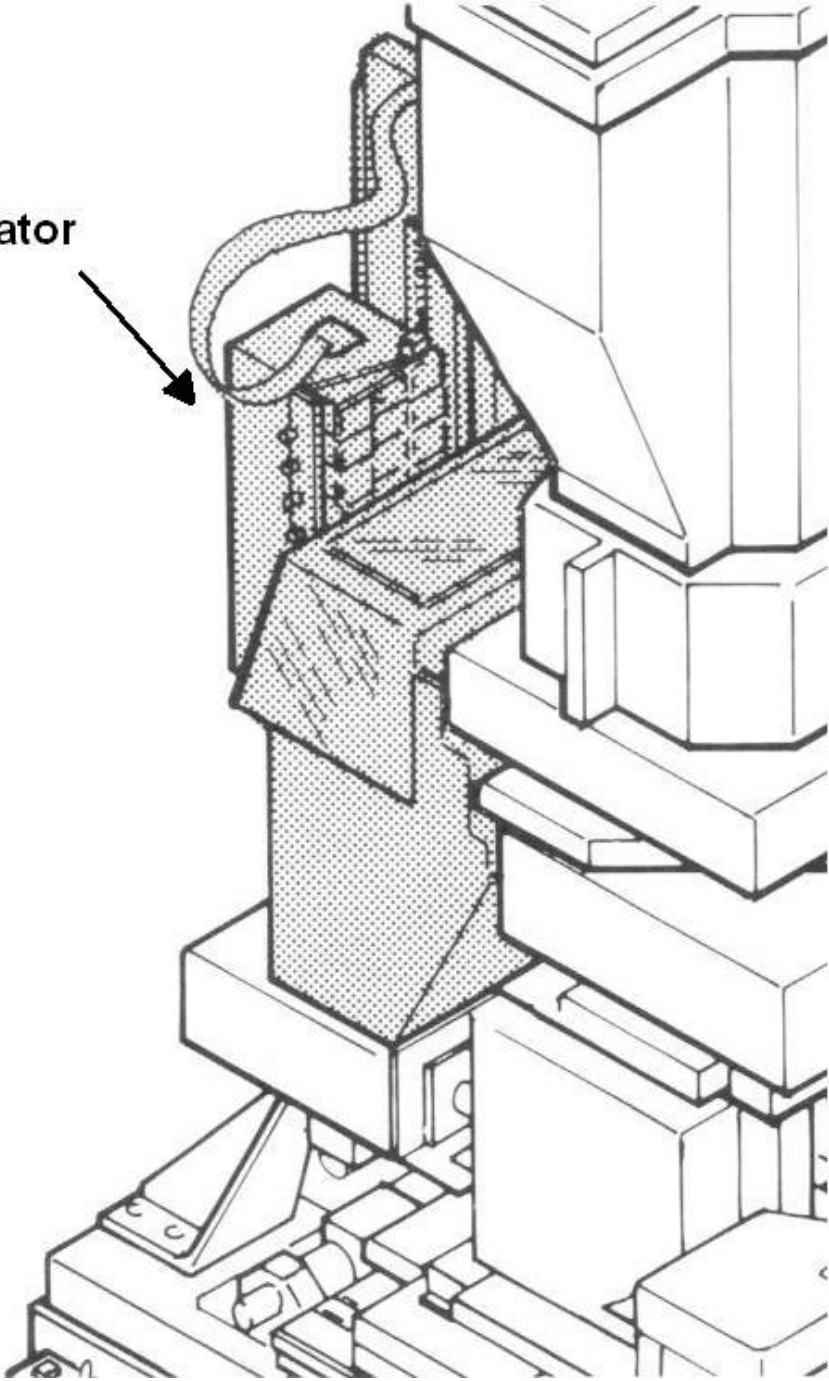


Figure 11 – RMS Elevator

Section 4 – Writing a Job

Jobs on the AS200 are separated into 2 portions, general job specifications and pass specifications. General job specs involve specs that remain the same for all passes (levels). For example, this would include things like array sizes, die sizes, step sizes, global alignment mark positioning, etc.

Pass specifications would include specs that may vary from pass to pass (level to level). For example, this may include things like aperture framing blades, offsets, exposure times, etc.

To create a job, type “SPEC ‘yourfilename’”. Be sure that your file name is 8 characters or less.

To edit a job, type “EDIT ‘yourfilename’”.

To display a job, type “DISP ‘yourfilename’”.

General Job Specifications

Enter a Job name; make sure it is 8 characters or less.

Enter a Job description, a description of what this job is making.

Enter a step size in X and Y (mm).

Choose how many columns/rows you want, “Count” will allow you to specify a specific number of columns/rows, and “All” will automatically fit as many as possible (given the correct wafer size)

Standard Keys should be Yes if your global alignment keys will fall 76.2mm apart, the tool will automatically choose the standard dies. You may also force the tool to look at other dies for alignment.

The Right Key Offset value should be the alignment key offset determined using the Reticle Design Guide.

You can choose to translate the origin, this is typically (0, 0).

Tolerance is usually set to 1, this defines the global alignment tolerance.

Scale corrections are set to (0, 0).

Orthogonality is set to 0.

Lever Batch Size is usually set to 1, this defines which wafers you want the stage to perform leveling on; Setting it to 1 means to level every wafer loaded.

Wafer Diameter (mm) is usually set to 100mm unless you are using a different size substrate.

EPI Shift is set to (0,0).

Once you have finished entering the general specifications, it will make you write your 1st pass; a job must have at least 1 pass.

Pass Specifications

You must have at least 1 pass per job.

Enter the pass name; You may choose numbers (1, 2, or 3, etc) or something meaningful (POLY, VIA, etc).

Enter the Pass Comments, a description of the current pass.

Use Local Alignment should be set to No, we may enable this feature in the future.

Microscope Focus Offset is usually zero, but you may set an offset if the layer is very thick.

AWA Parameter file name should be NONE.

You may choose the Pass Type to be Array or Plug. Array means that it will fill the entire array with dies, and allow you to drop out dies. Plug means it will not fill the array and allow you to drop in dies.

Pass Shift will start at (0, 0) for your first layer and should be shifted -0.2mm in X for each subsequent level of alignment. (Your alignment marks for each level are -0.2mm apart)

For exposure time (seconds), you may specify an exposure time here, or leave it at 0, you will be asked again for an exposure time when you execute the job

Exposure scale factor should be set to 1.

Focus offset may be specified here or leave it at 0, you will be asked again for a focus offset when you execute the job.

Use Match should be set to No.

Reticle Barcode should be set to your reticle name only if you have a barcode written on your barcode.

Phase of the Reticle Alignment Marks (P/N/X) is typically N. You will be asked this again when you execute the job.

Masking Aperture Setting (mm) is used to mask off the reticle using aperture blades.

Each blade has 100mm of motion; you may set X Left, X Right, Y Front, and Y Rear as shown below.

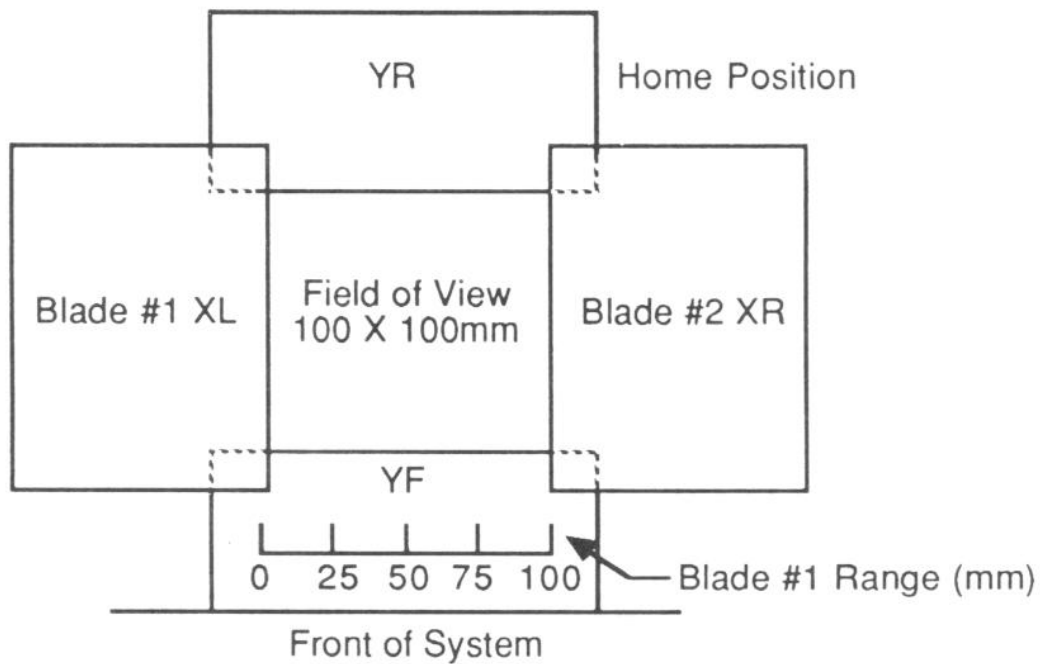


Figure 12 – RMS Aperture Blades

Reticle Alignment offset is typically set to 0.
Reticle Transmission is typically set to 0. Only adjust this value if you have a Clearfield reticle. You will be asked for this value again when you execute this job.

Section 5 – Executing a Job

Focus/Exposure Matrix

A focus/exposure matrix is an excellent tool used to characterize exposure and develop processes. You can shoot an array of die varying exposure times, focus, or both.

Load your reticle and both wafer boats.

You run a Focus/Exposure Matrix by typing: EXPO JOB_NAME

You will be asked to enter which pass.

Enter the starting row, the ending row, the starting column, and the ending column.

Choose C-oarse Focus Array, F-ine focus Array, E-xposure array, or R-ow.

Coarse Focus should never be used. Fine focus will allow you to vary focus through the array. Exposure will allow you to vary exposure through the array. Row will allow you to vary focus for each row and exposure for each column.

Then enter the starting focus/exposure values, and the incremental values.

Answer no to open frame tests. An open frame test runs the Focus/Exposure Matrix without the reticle in place.

Enter none for barcode, unless you have a barcode written on the reticle.

Enter the floor number of the reticle, unless you have specified the barcode.

Enter the alignment mark phase.

Enter the reticle transmission (typically 0, unless clearfield reticle).

The RMS will now load the reticle

‘START AWH’ is displayed

Hit “1st level” to begin the exposure. (or “manual” if you are not using the AWH)

When the exposure is done, it will ask you which die was the best, it doesn’t matter what you enter, just make sure not to update anything if it asks you to.

Executing a Job

Load your reticle and both wafer boats. Executing a job will expose all the wafers in the input wafer boat.

To execute your job, type: EX JOB_NAME

Enter the pass name.

Enter the exposure time.

Enter the focus offset.

Enter the reticle transmission (typically 0, unless clearfield reticle)

Enter none for barcode, unless you have a barcode written on the reticle.

Enter the floor number of the reticle, unless you have specified the barcode.

Enter the alignment mark phase.

The RMS will now load the reticle

‘START AWH’ is displayed

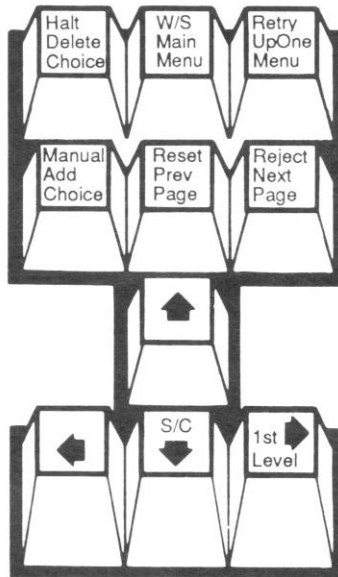


Figure 13 – AWH Operation Keypad

Hit “1st level” if it is your first level and no alignment is needed.

Hit “S/C” (start/continue) if you are doing alignment.

(or “manual” if you are not using the AWH)

Your wafer should now be loaded on to the stage (and exposed if doing 1st level).

The alignment marks should come up on the left and right side of the alignment screen if your job is programmed correctly.

To do a manual alignment used the numeric pad on the right side of the keyboard.
(or hit “B” to attempt an automatic alignment.)

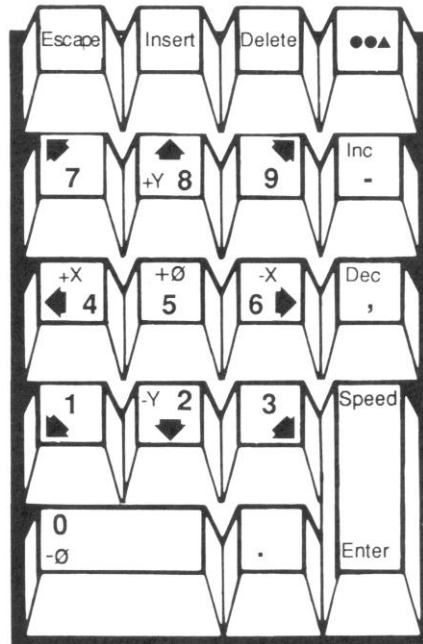


Figure 14 – Numeric and Alignment Keypad

The arrows move the wafer in the corresponding direction. 5 and 0 adjust theta. Inc and Dec adjust focus. Speed toggles between fast and slow rates.

Type O to change the actual rate of speed for fast and slow, they range from 0 – 10.

When satisfied with your exposure hit the “EXPOSE” button.

When the job is completed, you may choose to return the reticle to the cassette.

Section 6 – Troubleshooting

AWH Errors

Occasionally you will encounter AWH vacuum or communication errors. What you should do is first remove your wafer if it is in the tool, then try to do a software reset the AWH system by typing “RST.” It may take a few tries to get it to reset correctly, if it does, then you can continue using the tool.

If you are unable to reset the AWH through the software, you can do a hardware reset. Go to the electronics chassis, and turn off the AWH module, wait a few seconds, then turn it back on. Be sure to initialize the module in the software by doing a “RST” until it is successful.

RMS Errors

If there is an RMS error, please make sure you know where your reticle is and if there is a reticle on the platen. The first thing you should try is to do a software reset by typing “RES” a few times.

If your reticle is on the platen and can get it to successfully reset, you can try returning the reticle to the cassette by typing “RMSRET.”

If ever the operating system kicks you into a “RMS>” prompt you can type “RS” to do a software reset, or type “~” to leave the RMS> prompt back to the normal “.” prompt.

If there are any questions or concerns, please contact a staff member.