**CNF Autostep Notes**

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**Overview:**

1) Enable the tool using CORAL  
2) Log on to the Autostep, run AWALIVE  
3) Load your reticle(s) using RMSLOAD  
4) Load your wafers  
5) Run SETUP (optional)  
6) Run your job  
7) Unload your wafers  
8) Unload your reticle(s) using RMSLOAD  
9) Run AWALIVE, log out of Autostep  
10) Log out of CORAL

**Photoresists:**

Currently there are several recommended resists for this tool:

**OIR 620-7i**

This is useful for high-resolution work. It spins between 500 and 800 nm. Sub-0.5 µm l/s have been achieved using this resist.

**SPR220-3.0 & -7.0**

SPR220 can be spun from 2-13 µm in a single layer. SPR220 has excellent adhesion and plating characteristics, which make it ideal for thick film applications like MEMs.

**SPR955-CM 0.9 & 2.0**

SPR 955 CM can be spun from 700 nm to 3 µm. SPR955 exhibits very good adhesion and high resolution. 0.5 µm l/s have been achieved using this resist.

**SPR700-1.2L**

Excellent resolution and superior adhesion for wet etching; very good thermal properties.

**AZ nLOF 2020**

Negative i-line resist designed for Lift-off. Very fast with excellent resolution.

Most other resists at CNF are either obsolete or do not perform optimally on this tool.
Logging in:

At the command prompt type:

L_I_[XXX,YY] {the _ indicates a space}

where XXX,YY is your account number. You will then be prompted for your password. Once you are logged in type:

LISTF

This will display the files in your directory. If you have more files than can be displayed on the screen at any one time, use the <Hold Session> key located in the upper left hand portion of the keypad to stop the screen from scrolling. Pressing <Hold Session> a second time will resume scrolling.

Run AWALIVE:

At the command prompt type:

AWALIVE CHUK {chuck size}
LOAD

where {chuck size} is the wafer chuck you will use. See more detailed instructions in the AWALIVE section.

Loading reticles:

The Autostep has a fully automated reticle management system capable of storing up to 10 reticles at any one time. This system, referred to as RMS, will automatically load a reticle from a carrier cassette, place it onto the platen of the optical exposure column, and automatically align it. When your wafers are completed it will also automatically remove the reticle and return it to the appropriate cassette. To use this system properly you must have specific fiducial marks on your reticle. Please refer to the photolithography web page or the GCA Reticle Handbook for details.

At the command prompt type:

RMSDIR or RMSD

This will display the cassettes and reticles that are currently loaded in the RMS. Identify a cassette from the elevator that you want to use. If there are no empty cassettes, remove a reticle from any cassette EXCEPT the SETUP-01 reticle on floor 1. Please carefully place any reticles that you remove in an appropriate container or other safe place.
Note:

An empty cassette is designated by no text next to the corresponding position number in the displayed RMSDIR output. If the display reads NONE there actually is a reticle in that cassette; however, it does not contain an identifying barcode.

Once you have identified a cassette floor, type the following command:

RMSLOAD or RMSL

This will send the elevator to the reset position and free up the RMS turntable allowing it to be moved CAREFULLY without damaging it. Pull the chrome knob for the selected floor, remove the reticle cassette, open it carefully, and load your mask. Note the position marked for the BARCODE. Load the reticle chrome side DOWN.

Please note the following:

1) DO NOT REMOVE THE SETUP-01 RETICLE!!
2) You are responsible for any reticles that you remove from the stepper. If you remove any reticles, please put them in a safe place on a table, or return them to the same cassette they were found in when you are done with your exposures.
3) Do not leave reticles loaded in RMS if you are not using them again the same day.
4) If you break an RMS cassette your project will be charged $200.

After your reticle is loaded, press <Enter> or <Return> on the keyboard. The RMS system will begin an inventory of the reticles. The names and floor locations of loaded reticles will be displayed as they are read. When this operation is complete it will return you to the command prompt.

Loading wafers:

Automatic Wafer Loading:
(requires 100mm round non-transparent wafers, SEMI spec standard thickness, SEMI spec primary flat):

To use the AWH system, place your wafers face up (toward the ceiling) in the send cassette (left side or closest to the front of the chamber). The cassettes are always mounted H-BAR DOWN. Make absolutely certain that the cassette is positioned correctly and that your wafer is in the same slots on both sides of the cassette. If your wafer is slanted it may break.

Manual Loading:

Manual loading is to be done only be trained users. Please see the Photolith staff regarding training for manual loading.
**Running Setup:**

Setup is a job that automatically finds best system focus and optimizes several other parameters for the tool. To run setup, type the following command:

```
SETUP
```

You will see a script run on the monitor, and then you will be prompted to perform an alignment operation. When the GCA alignment key appears on the left side of the alignment monitor, use the right-hand set of arrow keys (on the number pad) to position the mark inside the cross hairs. Do NOT adjust theta. Once the mark is properly positioned, press the `<Expose>` key.

At this point, no further user intervention is required. However, you should observe the data being displayed on the Metrology monitor and verify that it looks normal. Failure of the operation to complete successfully after two attempts should be reported to the staff.

**IMPORTANT:** if the FOCUS graph looks flat instead of bell-shaped, terminate the job immediately (using Ctl-C, A, Return) and start over. DO NOT ALLOW IT TO FINISH!

**Writing job files:**

To create a new job type:

```
SPEC jobname
```

To edit an existing job type:

```
EDIT jobname
```

Jobs are organized into two parts: job specific information, and passes. Wafer size and stepping distance are specified in the job specific portion of the job. Information about the reticle, the type of alignment used, the exposure dose, focus, and the specified array are contained in each pass.

In general there are two types of passes, those that require some form of automated alignment, and those that only require exposure. The only type of pass that combines the two operations is a die-by-die (a.k.a DxD) alignment/exposure pass. A typical job will contain one or two alignment passes (no exposure information contained in these passes) and several exposure passes (no alignment or DxD alignment information contained in these passes).

**Helpful Hints:** If using MATCH with your reticles, the template used should be ORNL4, run every 25 wafers. Leave the Leveling Batch Size set to 1. Aperture Blade settings should be 12mm when using a 15mm die size. `<SHIFT>+6 will reset the Array or Plug pass layout. Terminate using Ctl-C, A, Return.
Running Job files:

To run a job that does not involve alignment in any way other than global alignment, type the following:

EXEC job\pass

To run a job that involves automated alignment of any kind (2 point, mapping, or die by die), type the following:

MAP job\pass

If multiple passes within a job are required for a given exposure (i.e. a mapping pass followed by an exposure pass) type the following

MAP job\pass1,pass2

where pass1 is the mapping pass and pass2 is the exposure pass.

Once this command has been entered the comment information for the job, pass, or passes will appear on the screen, followed by a series of interactive prompts. Read these prompts carefully. They will request that you verify the exposure dose, the name of the reticle, and the reticle transmission. All of these parameters can be changed at this time by entering new values. If you have no changes, press <Enter> or <Return> until the screen reads:

‘IAS LOAD COMPLETE’

At this time the RMS system should begin locating and loading the reticle. Once this has completed you will be prompted:

‘START AWH’

At this time you have three choices:

1) Press the <1st Level> key. If this is the first level in your exposure process; i.e. you are doing an unaligned exposure.
2) Press <S/C> on the keyboard. This will load the wafer with the intention that you are going to do wafer alignment.
3) Press <Manual> if you are manually loading a wafer.

If option 1 is used, the automatic wafer handler (AWH) will activate, lowering the wafer cassettes until a wafer is detected. The wafer will be brought to the prealigner, aligned with respect to the flat, and then moved to the exposure chuck. The exposure will commence and the wafer will be returned to the receive cassette automatically.
If option 2 is used, the same steps as above will occur, with the addition of the wafer alignment process. This will move the stage to make your alignment marks visible on the screen automatically, assuming that they are spaced 63.5mm apart, and your wafer is in reasonably good registry with the prealignment.

Global alignment methodology

Use the arrow keypad to adjust the X, Y, and rotational position of your wafer. When both of the alignment marks are close to being collinear and close to the cross hairs, press the <Enter> key on the number pad to switch to the fine stage travel mode (Speed). Align the right mark such that the X and Y markers are positioned uniformly within the cross hair. Align the left mark such that only the Y arms (the lines running horizontally on your mark) are aligned. Do not waste time trying to align this mark in X (lines running vertically on your mark); it accomplishes nothing. The left-side mark is for rotational adjustment only!

Useful commands for manual global alignment

O: adjusts the speed of the X, Y, and theta (rotation) travel. 5 is a good starting value for coarse adjustments. Use up to 10 if you have a lot of ground to cover (searching for your marks).

F: moves the stage in an outward spiral pattern allowing you to cover every possible field of view around your alignment mark.

A: toggles back and forth between your alignment marks if you have non-standard keys.

D: moves from die to die when X or Y is pressed.

T: moves the current alignment die under the opposite microscope when X is pressed.

E: ends operation of D or T.

Exposing wafers:

Once you are ready to expose, press the <Expose> key located on the upper right hand corner of the keypad.

If your job performs additional automated alignment, the procedure will commence at this time.

For Manual exposure, please see the tool manager for procedures.
If you are performing a first level job, all the wafers will be exposed in order using the AWH. If you are performing a job with manual global alignment, you will need to perform the manual alignment and exposure steps above for each wafer.

**Logging out:**

At the conclusion of your job you will be prompted with the following two questions:

Do you wish to continue the job? (Y or N)
Do you wish to return the reticle? (Y or N)

Answer these questions appropriately. When you are finished, your reticle has been removed from the RMS, and RMSLOAD is completed, type:

L_O  {the _ indicates a space}

This will log you out.

Please log out of CORAL and email any questions or concerns to the tool manager.

**Other useful commands and troubleshooting**

If you need to abort from a job while it is running type:

\(<\text{Ctrl}>+\text{C}\)

The system halts. The command prompt will change to the following:

::

If you type <Enter> the system resumes.

If you type A (for ABORT) at this prompt followed by <Enter>, the standard command prompt will appear.

If an AWH serial communication error occurs while you are starting your job, abort from the job as above and type:

RST

This will reset the AWH system.

If there is a reticle loading or alignment error, type:
RESET

This will reset the RMS system.

To take an inventory of the RMS elevator without executing RMSLOAD, type:

INV

To return a reticle to the library box, type:

RMSRET or RMSR

To remove a wafer from the exposure chuck while using the AWH, type:

REMF

If you are unhappy with the way that your substrate was prealigned and you think that the prealigner can do better (i.e. it has done better with your wafers in the past) press the 
<Retry> key.

If you are running a pass with a uDFAS alignment and you receive an “Auto Focus Failure” error message, you may have called the job and pass with EXEC, instead of MAP.
TO CHANGE WAFER MODES:

A new command has been added to the system: AWALIVE

If you type AWALIVE followed by <Enter> at the command prompt, you'll get a help message with the command syntax explained as follows:

:AWALIVE

Invalid parameter. Select value as follows:

man  use manual set of wafer loading offset values
awh  use AWH set of wafer loading offset values
chuck xxx  change chuck size to xxx where:
            xxx = 2, 3, 15, 82, 100, 125, 150, or 200

:awalive chuk 2  uses 3 inch chuck defaults with 2 inch wafer leveling points
:awalive chuk 15 uses 3 inch chuck defaults with 15mm wafer leveling points

NOTE: all non-standard leveling values are assigned 3 inch chuck defaults ONLY

Example:
:AWALIVE CHUK 3  {use 3 inch chuck}
:AWALIVE CHUK 2  {use 2 inch wafer leveling with 3 inch chuck defaults}
:AWALIVE MAN     {use manual loading correction values; i.e. FRONT LEFT}

IMPORTANT!
When finished you must return to default values as follows:

:AWALIVE CHUK 100   {changes chuck size to 100mm}
:AWALIVE AWH        {restores default loading correction values}
:LOAD               {moves wafer chuck to loading position}

DETAIL:

AWALIVE CHUK XXX  changes the chuck size defaults and leveling values
AWALIVE MAN       sets default loading correction to FRONT LEFT of stage
AWALIVE AWH       restores loading correction for automatic wafer loader

Note: for 5” Plate, 125mm, 150mm, and 200mm chucks the stage MUST be set for manual loading by using AWALIVE MAN followed by LOAD before mounting the chuck. Failure to do so may result in damage to the AWH system.
Common Problems and some suggested Solutions:

P: The fork for reticle loading is not responding.
S: Run commands like RMSRET, RMSLOAD, RESET

P: Error message “ACS system failure”
S: ACS is the Atmospheric Compensation System used to pressurize the lens. The controller is located on the far right corner inside the chamber next to the autoloader. See if any red LEDs are on. If so, press the red “RESET” button on the ACS. If the error persists after 5 minutes, ask one of the Photolith staff to reset the ACS for you. They may need to type in a series of ACS preset numbers after they reset it, so be patient.

P: Autofocus / Out of focus failure
S: 1. The machine is probably not in the correct chuck size mode. Refer to the AWALIVE instructions.
2. The array defined in the print job is bigger than the actual wafer.
3. The substrate thickness is not right. Make sure you use the correct chuck.

P: The printed array is shifted in the Y direction on the order of millimeters.
S: 1. Make sure you aligned to the correct row of dies.
2. The machine is probably not in the correct chuck size mode. Refer to the AWALIVE instructions.

P: The keyboard is not responding
S: 1. You are not logged into CORAL. Log in.
2. This can happen during an alignment if you’ve pressed more than one key simultaneously on the keyboard. This act will confuse the computer. (Keep in mind this is ancient software). You will need to end the Terminal session and start a new session. Using the white mouse in the cabinet below the system keyboard, select “Session”–“Exit Session” to end the Terminal session. In the upper right corner of the screen, click on the left-most icon to begin a new session. Press the <Enter> key to resume operation.

P: The brightness/contrast on the left or the right screen is poor during the alignment session.
S: During the alignment session, by default the <Inc> and <Dec> allow you to change the microscope focus. You can use the <.> key to toggle to brightness mode from focus mode.

P: A repetitive two-tone beeping sound is coming from inside the chamber
S: The ACS may have lost communication with the main operating computer. Press the red “RESET” button located on the ACS controller.

P: While executing a job a message regarding a “Failure to Read IAS Port” is displayed
S: A number of things can cause this. The most common cause is failure when trying to run MATCH without having the proper marks on the reticle. MATCH removes rotational misalignment from the reticle using four INSITU marks patterned on the mask...
located at 12, 3, 6 and 9 o’clock. The PG 3600F will not write these automatically. If you make your mask on the PG, INSITU marks must be included in your CAD in order to use the MATCH function. You can incorporate them by using the stepper template MASK_BLANK in your CAD.

REPORT ALL PROBLEMS WITH THIS SYSTEM TO THE TOOL MANAGER.
**AS200 Restart Instructions**

**Restart Procedure:**

Make sure that the Environmental Chamber is on and functioning. If not, check the Power Panel in the chase bay behind the stepper. If the panel is off, press the “ON” button. There is a 1.5 min. delay before the chamber will start up automatically.

**To reboot the Smart Set PC:**

Using the Smart Set keyboard, pressing <ESC> brings up the Smart Set menu; <6> followed by <ENTER> quits to the DOS prompt. <CTL-ALT-DEL> will reboot the PC.

**To restart the VT340 Terminal Emulation:**

Using the mouse in the cabinet below the system keyboard, select “Session”–“Exit Session” to end the Terminal session. In the upper right corner of the screen, click on the left-most icon to begin a new session.

**To reboot the AS200 System PC:**

Toggle the KVM switch on the Smart Set PC keyboard: press <SCROLL LOCK> twice rapidly, followed by the UP arrow. Pressing <CTL-ALT-DEL> will reboot the PC. At the prompt window, press <ENTER> twice. At the blue text screen, type <ALT-P>, then using the up/down arrow buttons highlight “Initialize Bus”, then press <ENTER>. Type <ALT-O>, highlight “Start”, then press <ENTER>. Once again press <SCROLL LOCK> twice rapidly, followed by the UP arrow.

The normal operating condition is for the KVM to be switched to the Smart Set PC.

**Theory of Operation:**

The AS200 operates using TWO computers simultaneously: the rack mounted RSX System PC in the Electronics rack, and the Smart Set PC in the Operator’s cabinet. Both computers share a keyboard, mouse, and monitor through a KVM switch located in the Operator’s cabinet. The shared monitor is the Smart Set monitor on the lower left of the cabinet, and the keyboard and mouse are located on a shelf inside the cabinet. Open the door below the system keyboard to access the shared input hardware.

The GCA system software is displayed on the top monitor screen, which shows the output of a DEC VT Lan 40 running VT340 terminal emulation software. This mimics the originally supplied VT340 terminal while eliminating the CRT failure modes and other inherent problems. The terminal software must be running before restarting the RSX system in order to operate the AS200.
The normal operating condition is for the KVM to be switched to the Smart Set PC. Pressing <ESC> brings up the Smart Set menu; <6> followed by <ENTER> quits to the DOS prompt. <CTL-ALT-DEL> will reboot the PC. A reboot brings the Smart Set PC to normal operating status.

To toggle the KVM switch: press <SCROLL LOCK> twice rapidly, followed by the UP arrow. All three button presses must be executed within a very short time period.

The system PC normally shows nothing on the Smart Set monitor while the AS200 is operating. To quit the RSX system: type <CTL-]> on the AS200 system keyboard. This should bring up a blue text-based screen on the Smart Set monitor; this is the RSX System Emulation program interface. Commands are entered from the KVM-attached keyboard. Rebooting the RSX PC will bring the system back to this same screen.

To restart the RSX System software: type <CTL-P>, then using the up/down arrow buttons highlight “Initialize Bus”, then press <ENTER>. Type <CTL-O>, highlight “Start”, then press <ENTER>. You should see the RSX System boot messages on the AS200 screen. At this point, you should toggle the KVM switch to the Smart Set PC.

Using the AS200 system keyboard enter the time and date information. Please note that the time is in 24 hour format, and the date is entered as follows: DD-MMM-YY where DD is the current day of the month, MMM is the three letter abbreviation for the current month, and YY are the last two digits of the current year.

At the AS200 keyboard, log into the AS200 system. At the prompt execute the following commands in any order: <RESET>, <RST>, <IASL>, <ORIG>. 