Xactix XeF_2 OPERATION MANUAL

General Information

The Xactix e-1 is a xenon difluoride (XeF_2) isotropic silicon etcher. XeF_2 is a vapor phase etch, which exhibits very high selectivity of silicon to photo-resist, silicon dioxide, silicon nitride and aluminum.

Safety Hazards

WARNING: Proper use and safe operating of the equipment is the responsibility of the lab member. All lab members who work with, or exposed to this equipment must take precautions to protect themselves against possible serious injury. Do not be careless around this equipment.

1. Electrical: 120 VAC, 60 Hz voltages are present throughout this unit. Observe standard electrical safety precautions to avoid personal injury or damage to the equipment.
2. Covers: DO NOT remove any covers or touch any lead wires to avoid electrical shock.
3. Moving Parts: Keep hands, hair, tools and loose clothing away from any moving parts to avoid personal injury or damage to the equipment.

Emergency Shutdown Procedure

Depressing the Emergency Off (EMO) will instantly de-energize and remove all power to the system.

System Features

The XeF2 system etches silicon with high selectivity to most masking materials. The samples can be pieces, pixelated die, or any other silicon structures up to 6" diameter wafers. The etch process is computer controlled and the resulting etch details are captured by the control software. The etch progress can be visually monitored through the transparent chamber lid.

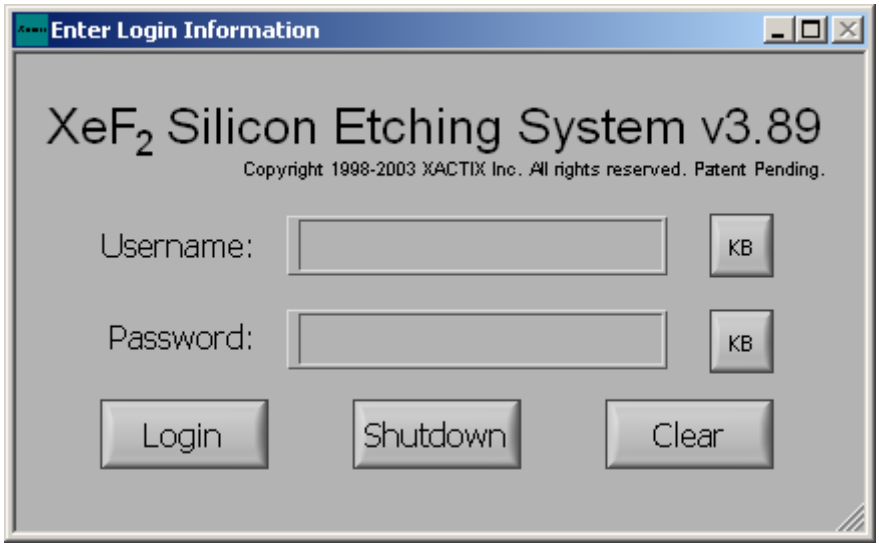
Tool Start-Up

If the system goes in to a gauge calibration routine, the total time is just over one hour. It is best to let the system complete the gauge calibration. Contact the CNM2 staff and they can adjust your Coral time to remove the gauge calibration charges.

1. Status Check: Check Badger for reservations, Shutdown, Problems or Comments, and to see if the etcher currently enabled by another lab member.

Logging on the System

1. Each user is required to log in to the system using their XeF2 Username and ID.
2. The KB button beside the Username and Password field can be used to access the on-screen keyboard.
3. Press the LOGIN button to access the MAIN MENU screen.

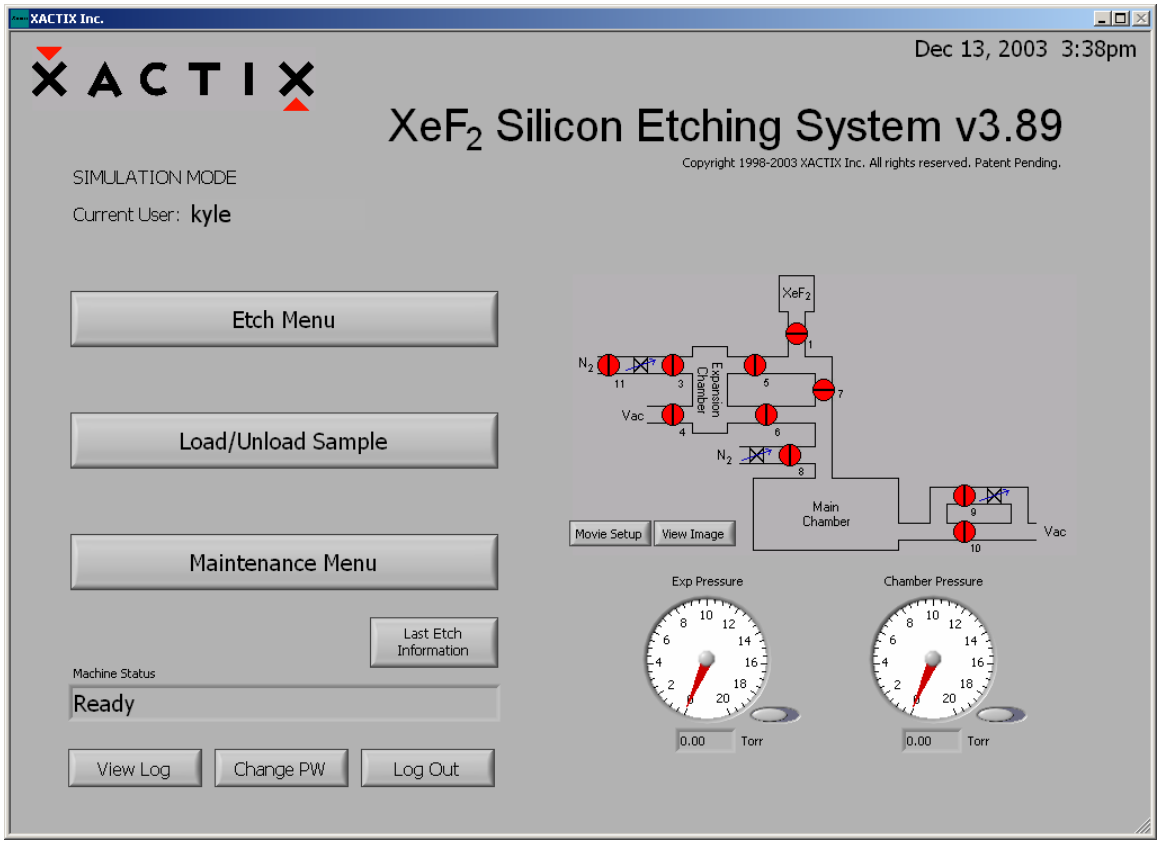


NOTE: If the system goes in to a gauge calibration routine, the total time is just over one hour. It is best to let the system complete the gauge calibration. Contact the CNM2 staff and they can adjust your Badger time to remove the gauge calibration charges.

Loading a Sample

1. Press Load/Unload sample on the Main Menu screen.

NOTE: If the chamber ventilation shroud covering the chamber is not fully forward, a request to close the shroud will display before venting the chamber. Move the shroud forward and acknowledge the prompt.

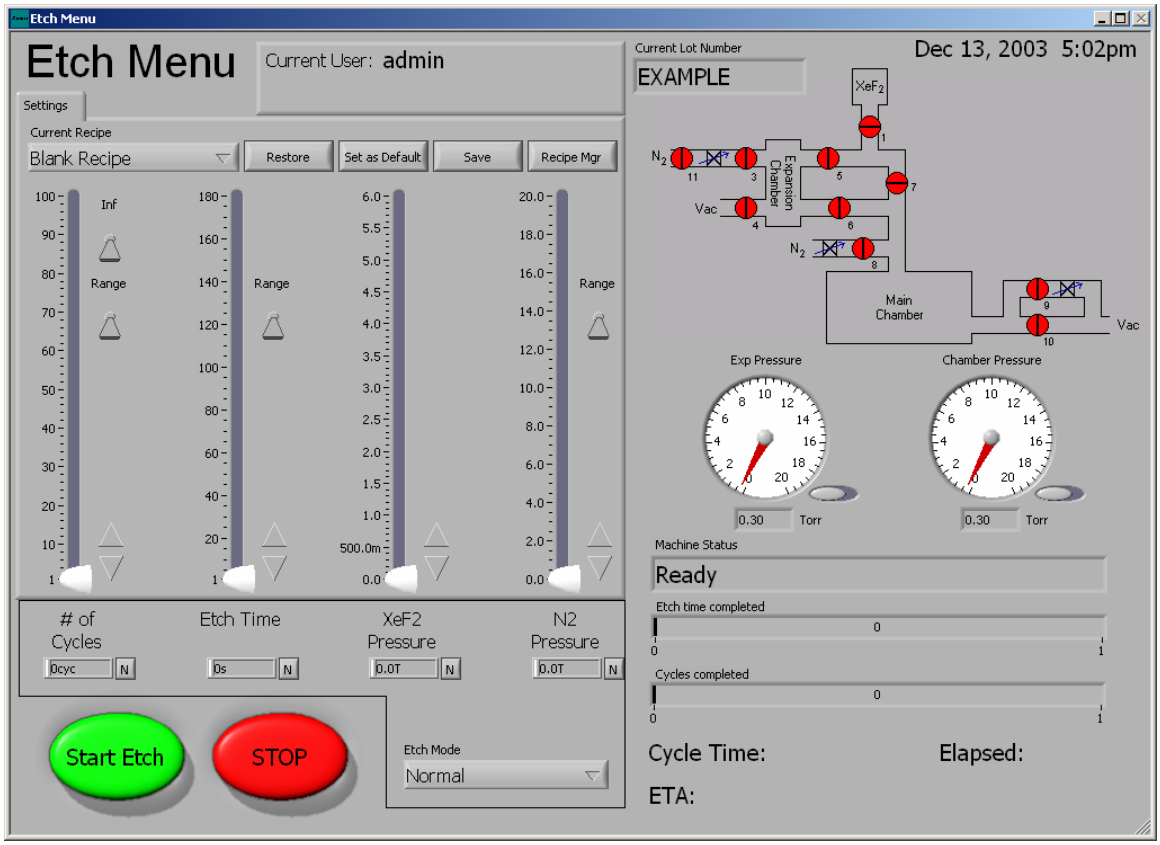


2. When the chamber is vented, the dialog box below will appear and you can open the chamber lid. Do not select the 'Examine' or 'Done' icon at this time. The lid will rest open on the stop behind chamber.
3. Inspect the O-ring. If necessary, wipe down the O-ring with a dry wipe.
4. Load your sample and close the lid.
   4.1. Make sure the lid is fully closed and the lid is seated against the O-ring.
5. Press Done on Pop-up screen.
   5.1. The system will go through a purging cycle prior to chamber pump-down. As a side note, the Examine button only pumps the chamber down, without purges, so that the system can be quickly vented to load the sample. This is very useful when examining a sample away from the system to prevent moisture from accumulating in the chamber. However, it is always necessary to press Done before etching the sample.

6. During the pumping cycle, a “click” sound will be heard that indicates that the ventilation shroud can be moved.

Running a Recipe

Select ETCH MENU from the Main Menu Screen. A prompt asking for a lot number will appear. Enter an alpha-numerical lot number. Press the DONE Button. The following Etch Menu will appear.

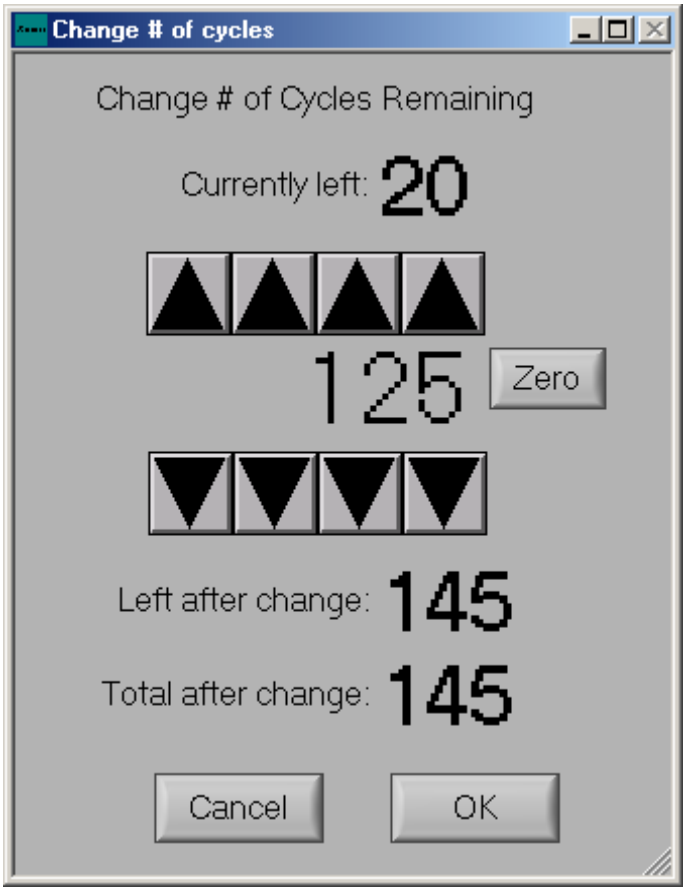


1. Under the CURRENT RECIPE pull-down, select the required recipe.
2. Verify the # of Cycles, Etch Time and XeF2 Pressure values are correct.
3. If any values are not correct, change them by either moving the slider or typing in the correct value in the required field.
4. Verify that NORMAL is selected under the ETCH MODE pull-down.
5. Press the START ETCH Button.
6. Progress of the etch can be monitored following the Etch Time Completed and Cycles Completed bars along with the Elapsed Cycle Time and the ETA.

Changing the Number of Cycles During an Etch.

1. The CHANGE CYCLES button can be used at any time during the etch to modify the number of cycles to the etch.
2. The top row of arrows will add cycles in this order, (right to left); ones, tens, hundreds, and thousands; the lower row of arrows, having the same values, will remove cycles.

3. Click on the designated arrow for the desired number of cycles needed to be added to the etch in-progress.
4. Example, an extra 125 cycles have been added to the etch by clicking the right most arrow (ones) five times, the next right most arrow (tens) twice, and the 2nd from left most arrow (hundreds) once.
5. Press OK to return to the ETCH MENU screen.



Unloading a Sample

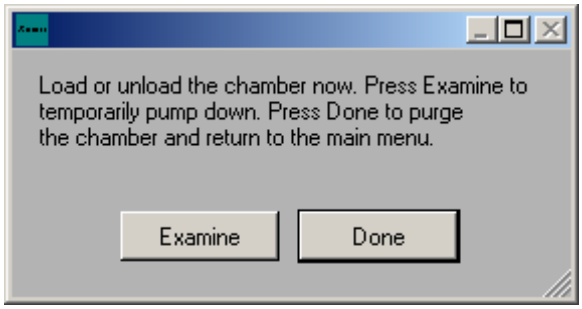
1. Press Load/Unload sample on Main Menu screen.
2. Press YES if you're sure, NO if you're not. The system begins chamber purges and flushing cycles to evacuate the chamber, shown below.
3. NOTE: If the chamber ventilation shroud covering the chamber is not pulled fully forward, a request to close the shroud will be displayed before venting the chamber. Move the shroud forward and acknowledge the prompt.
4. When the chamber is vented, the dialog box below will appear and you can open the chamber lid. The lid will rest open on the stop behind chamber.

Unload your sample.

1. Inspect the O-ring. If necessary, wipe down the O-ring with a dry wipe.
2. Close the lid.
3. Make sure the lid is fully closed and the lid is seated against the O-ring.

4. Press Done on the Pop-up screen.
5. The system will go through a purging cycle prior to chamber pump-down.

NOTE: Examine button only pumps the chamber down, without purges, so that the system can be quickly vented to load the sample. This is very useful when examining a sample away from the system to prevent moisture from accumulating in the chamber. However, it is always necessary to press 'Done' before etching the sample.



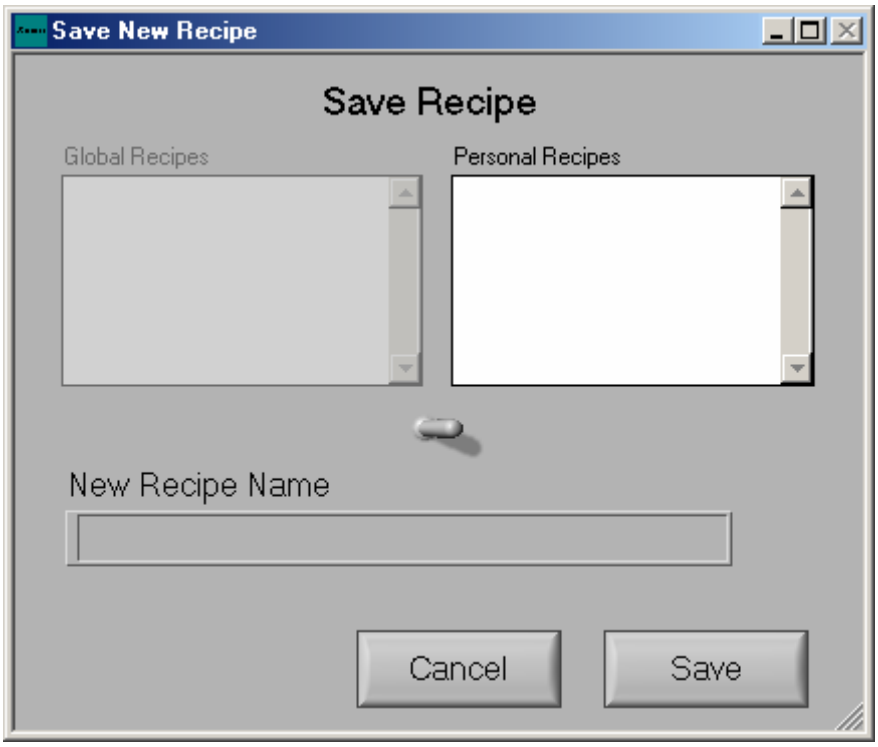
6. During the pumping cycle, a "click" sound will be heard that indicates that the ventilation shroud can be moved.

Viewing Detailed Etch Information

The Detailed Etch Information log is viewed by clicking on the VIEW LOG button on the Main Menu. The log file is a database that is queried by beginning date and ending date. The "Today": button will automatically set the dates to the current month, day, and year. The lot number, username, recipe, note's keyword(s) and/or etching mode used can further specify your search. Wildcard characters (*,?) may be used to fully specify the search criteria.

Creating or Changing a Recipe

1. Creating or changing recipes is done from the ETCH MENU screen.
2. Make the appropriate recipe changes
3. Save the recipe by clicking on the save button located near the top of the "perform etch screen".
4. The save new recipe screen will appear.



5. Global Recipes are starting recipe templates available to all users.
6. Use the toggle switch in the middle of the screen users can save the new recipe to their Personal Directory or the accessible Global Recipes.
7. Type in the name of your new recipe and Click on the SAVE button.

APPENDIX

Etch Recipe Parameters

Number of cycles

Since the e1 Series is a pulsed xenon difluoride etching system, the duration of etching is controlled by the number of cycles. A cycle consists of the xenon difluoride sublimating to the set pressure in the expansion chamber, etching for a set amount of time and evacuation of the main chamber and expansion chamber.

Etch Time

When the valve between the main chamber and expansion chamber is opened the pressure equilibrates and the etching process begins. The etch time is the time between the opening of the valve between the expansion chamber and the process chamber and the opening of the valve between the process chamber and the pump.

XeF_2 Pressure

In order to introduce the proper amount of xenon difluoride to the main chamber a set pressure of xenon difluoride is delivered to the expansion chamber. Because xenon difluoride has a vapor pressure of ~4T at room temperature the upper limit for the XeF2 pressure is approximately 4T. Due to the slightly elevated temperature inside of the etcher cabinet, you may be able to get considerably higher XeF_2 pressures, however.

N2 Pressure

Nitrogen is added to a recipe to improve selectivity. The pressure obtained in the expansion chamber likewise controls the amount of nitrogen introduced into the process chamber. The above variables can be set either by moving the white slider on the scroll bar or by tapping or depressing on the arrows at the top and bottom of the scroll bar to increment each value or by direct entry through the keyboard. Additionally, a range button is included for the number of cycles, etch time and nitrogen pressure so that the user can input higher values than the default range allows.

Processing Tid-Bits

1. XeF_2 etching is a chemical diffusion process. The etch rate and etch profiles can be highly dependent on loading effects. For example, etch rate differences can be observed between the center and the edge for wafers with high open areas.
2. Exposed silicon at the edge of the wafer can lead to more etch rate non-uniformity. This can be from photoresist edge bead removal or simply form loss of photoresist on the vertical edge of the wafer.
3. Patterns with differences in feature sizes can show different etch rates dependant on the feature size or to the proximity of two adjacent features.
4. The surface preparation prior to etch is important in achieving smooth etch surfaces. Etch roughness occurs through a mechanism similar to micromasking in dry etch.
5. XeF_2 etches native silicon dioxide, but at a different rate than silicon. Any surface contamination or variation in removal of the native oxide can lead to surface roughness.
6. The XeF_2-Si reaction is very exothermic. A delay step can be used to cool the wafer between etch cycles to minimize any observed thermal issues.