

General Information

- This system is menu driven through the function keys on the drop-down keyboard. The function-keys, associated with a particular operation, are indicated by the gray tabs at the bottom of the screen. “Alt-A” is used to switch to other options. Escape may be used if you messed up. Once you are familiar with the navigation, it will become second nature. These operation procedures will assist you in remembering a few details that might not be intuitive. Generally, the tabs are descriptive enough so that you can navigate. A large more detailed manual is available in the cleanroom for use.
- The etching system uses a 1000 W 13.56 MHz ICP source and a 500 W 13.56 MHz RF bias on the substrate. The chuck temperature is set at $\sim 25^{\circ}\text{C}$ and is liquid cooled. Gases available are Cl_2 , BCl_3 , CF_4 (or SF_6), CHF_3 (or Ar), O_2 , and N_2 .
- The Ashing system can be heated to 250°C and generates up to 2000 W of ICP power using O_2 / CF_4 / N_2 .
- An Electrostatic Chuck (ESC) is used to clamp the wafer, so the carrier wafer must be electrically conductive. The voltages used are ± 1200 V. Back-side He cooling is provided. To ensure heat transfer, you should use diffusion pump oil to mount your sample to a 6” carrier. The recipes must all include a two-step N_2 plasma at the end of the process to uncharge the ESC. If you are unsure of this, please get your recipe checked by a qualified engineer. Standard recipes for various materials are listed in a later section. You may only change the etching time with these recipes.
- Some particulars about the ICP tool:
 1. ICP plasmas cannot be lit at low pressures. You must ignite all plasmas at 2 Pa or higher pressure.
 2. Once the plasma is lit, you can lower to pressure even to 1 mT.
 3. You cannot turn on RF bias and change pressure at the same time, as this will cause RF wave reflection errors. Change pressure first in one step, then turn on bias in the next step.
 4. Remember, unless you have a strong chemical etch, your etching will not begin until RF bias is turned on.
- Basic Rules of Thumb:
 1. ICP power controls both ion density (number of ions hitting surface, physical process) and Radical density (active chemical species, chemical process).
 2. Pressure: High pressure means longer residence time for gases (both input gases and reaction by-products). Higher pressure also tends to lower the DC built-in bias between the plasma and substrate (i.e. lower ion energy). If you are limited in etching due to the removal of etch byproducts, lower pressure can help (this is often a cause of Aspect Ratio Dependant Etching (ARDE)).
 3. RF Bias. Higher bias means higher ion energy (more physical, sputtering is generally characterized by activation energy).
 4. Gas flows: For a given pressure, a higher gas flow will mean a higher average concentration of the input gas. If your etch is limited by the availability of reactive gas (diffusion limited) higher flow can help. This is often a way to overcome open area dependent etches (known as loading). If your etch is reaction rate limited (plenty of gas, but the surface is saturated), gas flow will not strongly affect the process.
- The carrier wafer must have a standard flat for automatic detection of the wafer orientation.
- A wafer must be present in the system before running plasma-containing recipes.
- You must run a clean program after etching with this system. A list of clean programs and appropriate clean times are at the end of this document.
- All pressures are indicated in Pa. **1 Pa = 7.5 mTorr**

Beginning a run

1. Make sure system is in **Prep**, **Test**, or **Auto** Mode and Started. These modes are entered using the soft-key pad. When in Prep Mode; Pumping, Ready, and Start-Up Completed should be indicated on screen. If system says to push start, then press the green **Start** Button on the soft-key panel. If there is an error follow the Clearing Errors section.

2. Enter your name in the log book along with the recipe name, number, and time you will be etching.

Operation in Test Mode (Contains Wafer Collect Routine)

In Test mode, you will load and collect single wafers from slot one of cassette one into and out of selected chambers. You can also test/run multiple recipes on a single wafer if desired.

1. Press **Test** on soft key pad.
2. Make sure a wafer is loaded into slot one of cassette one.
3. Press **F6** to select Test.
4. Select Wafer Transfer (**F1**).
5. Select TrWIn (**F1**).
6. Select the chamber you desire to transfer the wafer into.
7. Press **Start** on soft-key pad and wait until finished.
8. Hit **F5** to return to main menu.
9. Press **F6** to select Test.
10. Select Chamber Test (**F2**).
11. Select the chamber you wish to test.
12. A recipe will now appear on the screen. To select a new recipe press Select (**F2**).
13. From the list of recipes, scroll down to the desired recipe and press Select (**F2**).
14. Within the recipe, change the desired parameters for your test run.
15. Press **F4** to Register the program into memory. **If you forget to hit F4, the system will run the last registered program!**
16. Press **Start** on soft-key pad to run the recipe. (To monitor the recipe, hit **F5** to return and **F3** (monitor), followed by **F1**(E-Ch) or **F2**(A-Ch) to monitor the status. **F5** will again bring you back to the main menu).
17. Repeat Steps i) through p) to run more than one recipe.
18. When done, press **F5** to return to main menu.

- **Wafer Collect Routine**

1. Press **F6** to select Test
2. Press **F1** to select Wafer Transfer
3. Select WfCollect (**F2**)
4. Press **Start** on soft-key pad and wait until finished.
5. When done, press **F5** to return to main menu.

Operation in Automatic Mode

In Automatic mode, you will also load and collect single wafers from slot one of cassette one into and out of selected chambers, but wafer loading/unloading and process execution will be done automatically. You can run up to 5 recipes automatically on a single wafer using this mode. For automatic mode, recipes to execute on the wafer are set into a Multi-Recipe file that is loaded in and executed from the main menu.

1. Press **Auto** on soft key pad.
2. Make sure a wafer is loaded into slot one of cassette one.
3. Press **F1** to select Recipe
4. Press **F1** to select Multi-Recipe.
5. From the list of multi-recipes, scroll to the desired number.
6. Press **F1** (selection) again followed by **F1** (No1) to load this recipe into the cassette one execution buffer.
7. Hit **F5** to return to main menu. You will see the multi-recipe name and chamber recipe numbers in the execution box, on the computer screen, for cassette one.
8. Press **Start** on soft-key pad to run the recipe.
9. To monitor the recipe, hit **F5** to return and **F3** (monitor), followed by **F1**(E-Ch) or **F3**(A-Ch) to monitor the status. **F5** will again bring you back to the main menu).
10. When the process is done, the wafer will be back in the slot and a musical tune will play. To end the music, lift up the wafer cassette.

Make/Modify Chamber Recipes

Chamber recipes are stored by numbers from 101-399. Numbers 101-199 are etch chamber recipes, 201-299 are ashing chamber recipes, and 301-399 are rinse chamber recipes. Each recipe will have an 8-character identifier so that you can find recipes more easily. There are only 99 recipes that can be stored for each chamber. We will therefore set up standard recipes that all users should use for general etching of materials, with only the time to be modified. **You may not change plasma conditions on standard recipes!** For specialized needs, please work with the process engineer to establish a recipe for your needs. This recipe may be useful for other users needs as well and needs to be documented.

1. Make sure you are in either **Test** or **Auto** mode.
2. Press **F1** followed by **F2** for a single chamber recipe list.
3. To create a new recipe, go to an empty recipe number and press **F2**(Set).
4. To edit a recipe, go to the desired recipe number and press **F2** (Set).
5. To copy a recipe, press **F4**, select the from and to recipe numbers, and hit **Enter** on the keyboard.
6. From within the recipe sheet, you can now scroll to different parameters using the arrow keys. Changes are made with the number pad keys.
7. Page one includes all gas, pumping, and RF settings. Page two is for the ESC and back-side He settings, and page three is for end-point detection settings. (For a complete description of these parameters, see the main manual, a brief description follows). Use **F1** to toggle between pages.
8. Page setting descriptions: See pages 7.2-7 to 7.2-11.
9. **All etch chamber recipes must contain two N2 plasma steps at the end for ESC decharging. See program "SiOetch" to make sure your program has all the correct settings for these two steps. Also, the last step must be all zeros. Make sure the "Last Step" Box is set to the correct last step number.**
10. After all changes are made, you must hit **F4** to register the changes. **Failure to hit F4 will result no changes to the program!**
11. Hit **F5** to return to main menu.

Make/Modify Multi-Recipes

Multi-recipes are stored by numbers from 01-99. Each multi-recipe can contain up to five chamber recipes that will be run in that sequence. Auto-Mode only runs multi-recipes.

1. Make sure you are in Auto mode.
2. Press **F1** followed by **F1** for a multi-chamber recipe list.
3. To create a new recipe, go to an empty recipe number and press **F2**(Set).
4. To edit a recipe, go to the desired recipe number and press **F2** (Set).
5. You can scroll to the multi-recipe name or chamber recipe number boxes. Enter/modify the name or chamber recipe number.
6. When done, press **F4** to register.
7. Hit **F5** to return to main menu.

Wafer Mounting Options

Thermal transfer between the sample and the carrier is important for many processes using high ion flux and/or RF bias power. There are a few ways to contact your sample to the carrier.

- Use Santovac 5 diffusion pump oil (for low temperature processes). Place a few drops on the sample and press the sample down with a Q-tip. This oil is completely dissolved in Acetone. **This is the preferred technique.**

Clearing Errors

1. Note all error numbers in the log book.
2. Press **Error Reset** soft-key. **NOTE: He Pressure Error cannot be reset this way. Follow procedure on machine.**
3. If this does not work, press the **System Reset** soft-key.
4. You may need to press the **Start** soft-key to begin the system. The computer screen will tell you.
5. If you had a wafer in the system, you will need to collect this wafer in test mode (described above in operation in test mode section) before continuing.
6. If the error cannot be cleared, contact an engineer.