

Allwin21 Corp-AccuThermo AW610 Operation Manual



Process Capabilities

The system has two MFC controlled gas channels capable of annealing substrates in N₂, O₂, or forming gas (H₂:Ar) ambient. The system is a cold wall, quartz chamber, which is heated with top and bottom arrays of high intensity halogen lamps using a closed-loop temperature control using either a pyrometer (550C to 1150C) or a thermocouple (100C to 700C).

The anneal chamber consists of a quartz tray compatible with pieces (on a Si carrier wafer), 4" and 6" wafers.

Wafer Handling

The wafer to be processed is manually placed on a quartz tray that slides into the chamber. 4", 5" and 6" wafers can be ran. Pieces must be loaded on an appropriate bare silicon carrier wafer.

Training to Become a Qualified User

This tool requires a 1-hour training session for qualification.

Tool Start-Up and Facilities Check

1. Review the tool status on Badger for any comments or reported maintenance events.
2. Verify the tool is configured for the correct temperature range.
 1. Thermocouple for temperatures up to 700C.
 2. Pyrometer for temperatures greater than 550C.
3. Turn on the desired process gas (N₂, O₂ or forming gas), but opening up the main cylinder valve and the regulator shut-off valve. There are only 2 MFC channels. Contact the CNM2 staff to change gas supplies as required.
4. Verify the CDA supply, located in the service chase is on.
5. Turn on the house N₂, located in the service chase. Open the valve on partially, until you can hear the air flow from the process chamber.

6. Turn on the process chamber cooling water chiller (16C). The power switch is located on the back-right of the unit. Press the RUN button on the front control panel.
7. Turn on the pyrometer cooling water chiller. The power switch is located on the upper-left side of the unit. Verify the temperature is set at and maintaining the 20C set point.
8. Turn on the main power to the system, located on the front panel.
9. Inspect the process chamber to verify it is clean. If there is noticeable deposition on the top of the quartz chamber enter this as a 'Problem' in Badger prior to running an anneal.

Operating Procedures

Basic Operation Instructions

1. Verify the system has been enabled on Badger.
2. Read all Shutdown, Problems or Comments related to the too.
3. Log on to the control computer using your personal log-in account.
4. Verify the tool is configured for the correct temperature range.
 1. Thermocouple for temperatures up to 700C.
 2. Pyrometer for temperatures greater than 550C.
5. Loading a Sample. Push the chamber door handle down to the unlock position. Fully pull out the chamber door to gain access to the quartz tray.

WARNING: The pins on the wafer tray are extremely fragile and break easily. Do not load or unload any pieces from a carrier wafer while the wafer is on the sample tray.

Place the wafer on the quartz tray and close the door, making sure the handle has fully engaged the door lock.

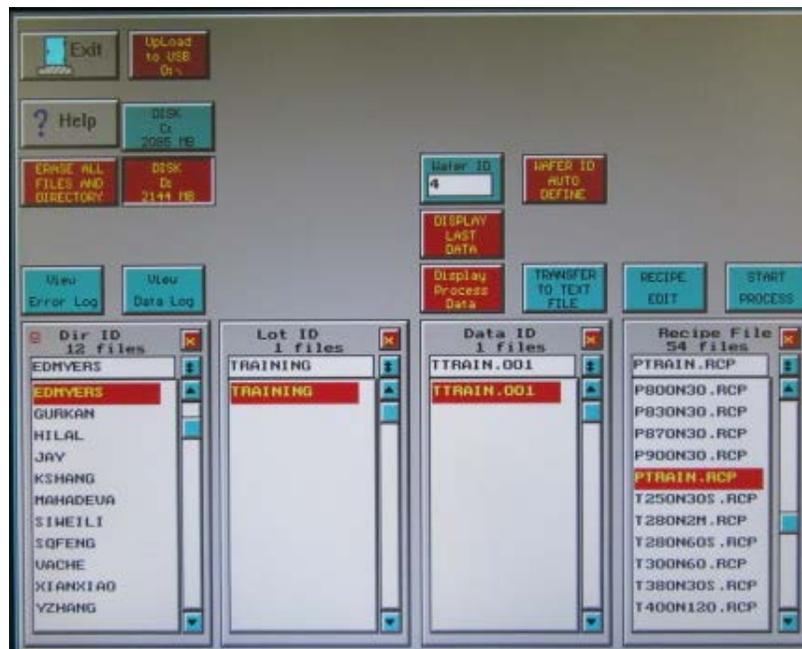


6. The RTP computer screen should display the main menu shown in Figure 1. If this screen is not displayed press the "Esc" on the keyboard until it appears.



Main Software Screen

- From the Main Menu, click 'Process for Engineer', which should bring up the Process for Engineer Process for Engineer Window. The 'Process for Engineer' window provides all the functionality for creating and reviewing recipes, running anneals and reviewing stored anneal profiles. Create your own Dir ID directory and Lot ID subdirectory for saving data. The Data ID data are the stored profiles from previous anneals.



Process for Engineer Window

- Selecting a Recipe. Scroll through list of recipes in the "Recipe File" and highlight the desired recipe. When the recipe is highlighted you can either edit the recipe or start the anneal process.

See the sections below for writing, editing or reviewing a recipe. Titles displayed in red for the ID and Recipe File columns are the active files and locations.

WARNING: Selecting a filename and pressing DEL on the keyboard permanently deletes the file.

9. Reviewing a Recipe. To review or modify the highlighted recipe press the 'Recipe Edit' icon. Click on the 'Exit' icon, or use the ESC keyboard key to return to the 'Process for Engineer' screen.
10. Running a Recipe. Verify you have highlighted your Dir ID, Lot ID and the desired Recipe in the Recipe File column. To begin the anneal click on the 'Start Process' icon.
11. Monitoring the Anneal. Once you have selected the 'Start Process' the screen will change to the 'RTP Auto Process' window.



RTP Process Window

The 'RTP Auto Process' screen tracks the all the parameters of your process. The x-axis is the process time and the y-axis are the values of the process parameters.

- Green: recipe temperature as defined by the Recipe.
- Black: Recipe defined temperature curve.
- Blue: real, measured temperature during the wafer process. Either pyrometer or thermocouple readout.
- Red: The lamp intensity (% lamp power).
- Light Blue: temperature feedback from the thermocouple (under thermocouple control).
- Pink: temperature feedback from the pyrometer (under pyrometer control).
- Gas flow

12. Aborting a Process. An anneal is stopped by pressing the "Abort" icon or the ESC key on the keyboard.
13. Completed Anneal. At the end of the process, "Process Over" will be displayed on the Process Monitor screen. Press any key to save the process data and exit back to the 'Process for Engineer' screen.

Tool Shutdown

1. Inspect the process chamber quartzware to verify it is clean. If there is noticeable deposition on the quartz chamber or wafer tray enter this as a 'Problem' in Badger.
2. Turn off the desired process gas (N₂, O₂ or forming gas) using the cylinder and regulator valves located in the chase.
3. Turn off the house N₂ located in the chase.
4. Turn off the process chamber cooling water chiller. The On-Off switch is located at the back-right of the chiller.
5. Turn off the pyrometer cooling water chiller. The On-Off switch is located at the upper-left of the chiller.
6. Turn off the power to the RTP unit.
7. Disable the tool on Badger.

Reviewing Saved Data

In the "Process for Engineering" window, click on the 'Display Last Data' icon. This will display the process data for the last anneal ran on the system. To view process data from previous runs, select the data to view from the 'Dir ID', 'Lot ID' and 'Data ID' column, and then click on the 'Display Process Data' icon. Use the 'left' 'right' arrows on the keyboard to move the 'Pink' trace to display the process parameters at any given time. The 'Display Recipe' displays the actual recipe used for the anneal.

Writing and Reviewing a Recipe

| No. | Step Temp Func | Time (sec) | Temp Intn (°C/°F) | Steady Intn Factor | Gas 1 N2 SLPM | Gas 2 H2 SLPM | Gas 3 GAS SLPM | Gas 4 GAS4 SLPM | Gas 5 GAS5 SLPM | Gas 6 GAS6 SLPM | Steady Intn |
|-----|----------------|------------|-------------------|--------------------|---------------|---------------|----------------|-----------------|-----------------|-----------------|-------------|
| 1 | Delay | 10.0 | 0.0 | 1.00 | 10.0 | 0.0 | 0.0 | 0.0 | 10.0 | 0.0 | 0.0 |
| 2 | Delay | 10.0 | 0.0 | 1.00 | 5.0 | 0.0 | 0.0 | 0.0 | 10.0 | 0.0 | 0.0 |
| 3 | Delay | 10.0 | 0.0 | 1.00 | 8.0 | 0.0 | 0.0 | 0.0 | 10.0 | 0.0 | 0.0 |
| 4 | Delay | 10.0 | 0.0 | 1.00 | 5.0 | 0.0 | 0.0 | 0.0 | 10.0 | 0.0 | 0.0 |
| 5 | Intn | 10.0 | 20.0 | 1.00 | 5.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 6 | Ramp | 20.0 | 800.0 | 1.00 | 5.0 | 0.0 | 0.0 | 0.0 | 5.0 | 0.0 | 0.0 |
| 7 | Steady | 120.0 | 800.0 | 1.00 | 5.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 8 | Delay | 120.0 | 0.0 | 1.00 | 5.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 9 | Finish | 0.0 | 0.0 | 0.00 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 10 | Finish | 0.0 | 0.0 | 0.00 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |

Recipe Window

1. To edit a recipe, select it from the "Recipe File" list, open it by clicking on the 'Recipe Edit' button.
2. To create a new recipe, open an existing recipe and change its name before modifying the parameters and saving it. Leave the EXT field as RCP. Pyrometer recipe names must begin with "P" and TC recipe names must begin with "T". Recipes not complying with this naming convention will be deleted at any time by the CNM2 staff.

WARNING: The 'SENSOR TYPE' must be set to either Thermocouple or Pyrometer as appropriate.

3. Thermocouple controlled recipes are used for temperatures <700C. Above 750C, the thermocouple can react with the silicon wafer destroying the accuracy of the thermocouple.
4. Pyrometer controlled recipes are used for temperatures >550C. Below 550C, the pyrometer accuracy is less than the thermocouple.
5. The recommended starting point (1.00) for all recipes are shown in the Recipe Window figure.
6. Four variables are used to fine-tune the anneal cycle - Gain, Sensitivity, Delay and Steady Intensity Factor. The influence of each setting is explained in more detail in the appendix.
 - a. Gain: The value for the gain of the temperature PID control for the process steps RAMP and STEADY.

- b. Sensitivity: The value for the coefficient of the gain in the STEADY period of the recipe. This makes the gain for a STEADY step different from a RAMP step. The gain value for STEADY is GAIN x SENSITIVITY. If the SENSITIVITY value is 1.0, there is no difference between the gain for a RAMP and a STEADY.
 - c. Delay: This is the value for the transient period from RAMP to STEADY. Normally the default value is 1.0.
 - d. Steady Intensity Factor: The Steady Intensity Factor is the coefficient used during the RAMP and STEADY steps. It is used at the beginning of the steps to correct the initial lamp power intensity.
7. The table portion of the recipe is used to enter the individual steps to the recipe. The first column defines the function of the step RAMP, INTN, STEADY, DELAY, or FINISH.
- a. Delay: The Delay field acts as a timer. No power is applied to the lamps but allows for gas flow.
 - b. Ramp: The Ramp step instructs the controller to increase the temperature at a constant rate until the specified temperature has been reached. The rate is calculated by dividing the difference between the target temperature specified in the step and the temperature from the previous step by the time specified in the step. Consecutive Ramp steps are not allowed.
 - c. Intn: The Intensity (Intn) applies a constant lamp power for the duration of the step. The value for the Intn step is percentage of 100% power. The Intn step is used to heat the wafer to a temperature where the wafer can be seen by the pyrometer. The minimum reliable temperature where the pyrometer can reliably measure the temperature is around 550°C.
 - d. Steady: The lamp intensity is controlled to maintain the specified anneal temperature. It then maintains that value for the duration of the step.
 - e. Finish: This ends the recipe. Any data in rows following a Finish statement will be ignored.
8. Other columns
- a. Time: This is the amount of time, in seconds for the current step.
 - b. Temp/Intn: This is the target temperature or intensity system strives for. If the step function is STEADY, then this is the set-point temperature that is to be maintained. If the step function is RAMP, then this is the ending temperature of the ramp. If the step function

is INTN, then this is the percentage of the lamp power intensity. If the step function is DELAY, then this field has no effect and the lamps are turned off during this step.

c. Steady Intn Factor: This is a coefficient used only during RAMP and STEADY steps. The initial value should start with 1.00. See the Appendix for fine tuning the system to understand how to use this parameter effectively.

d. Gas: The various gas columns specify the flow rate of each gas for each step. The highest allowable flow is 10 slpm and the minimum flow to prevent back diffusion is 3 slpm.

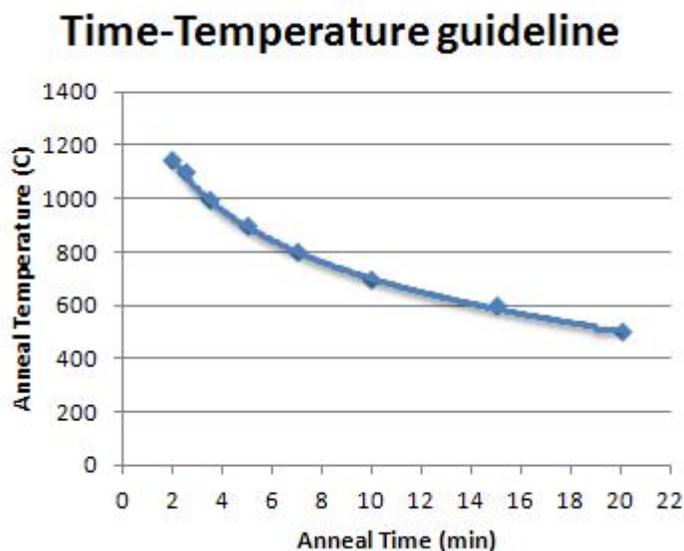
9. When entering data values into the data entry area, the recipe editor checks for out-of-range entries. If a value is out-of-range, the editor will alert you and will advise you of the proper range.
10. The recipe must be validated by clicking on the Recipe Validate icon. Once the recipe has been validated, Click the Save icon then the Exit to leave the Recipe Editor screen.
11. Refer to the Appendix for additional information on optimizing the recipe and temperature profile.

Requesting Pyrometer or Thermocouple Mode

Requests for conversion between pyrometer and thermocouple modes must be made at least two days in advance.

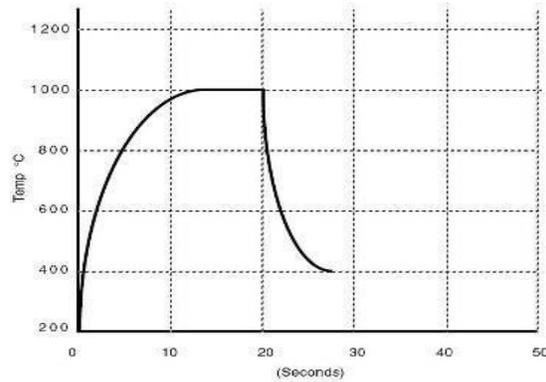
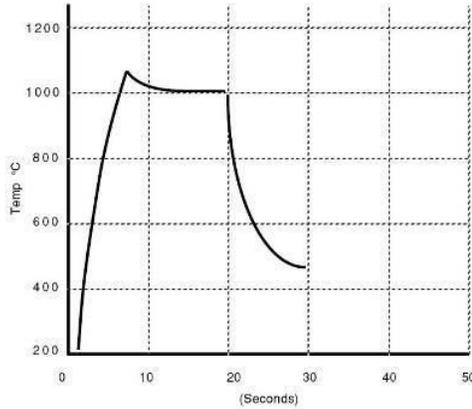
Guidelines for Time-Temperature

The system is not capable of performing long anneals over extended periods of time, especially at higher temperatures. The following chart serves as a broad guideline in determining allowable anneal time for the required temperature (roughly log dependence). When in doubt, contact the staff before you run a new recipe.



Optimizing the Temperature Profile

1. Overshoot and Undershoot: Overshoot and Undershoot are controlled in the Ramp step using the Steady-Intn-Factor. Decreasing the Steady-Intn-Factor can reduce the overshoot. Increasing the Steady-Intn-Factor can reduce the undershoot. NOTE: too high of a ramp rate can also contribute to significant overshoot in your process.



2. Steady State Temperature Oscillations: Oscillations at steady state are controlled by the SENSITIVITY value. Suppress oscillations decrease the SENSITIVITY value.

