dispense action is in process, it will be terminated.
*In rare instances (heavy chuck, high rotation speed) a "Motion Error" may occur; the chuck will then coast to a stop. This does not damage the instrument.

5.5   PROGRAMMING THE G3P

With the G3P programmable spinner, you can enter multiple recipes and direct it to do complex operations.
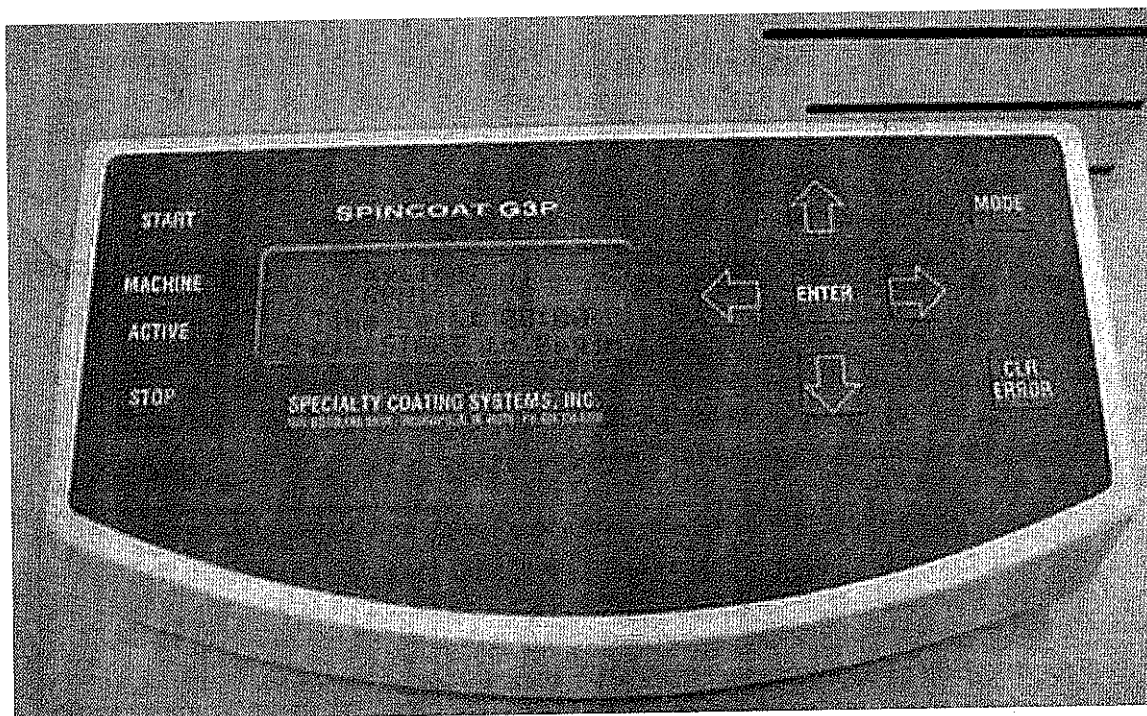

Figure 5-2: G3P Control Panel

5.5.1   G3P CONTROL PANEL

- **MODE:** This pushbutton moves the G3P between the **Program/Edit** mode and the **Run** mode. Each time you press it, you change to the other mode.

In the **Run** mode, the following G3P programmable spinner controls are active:

- **START:** This pushbutton starts a cycle, if all conditions are correct. (For example, the G3P must be in the run mode, the vacuum and purge N_2 sensors must be satisfied, and it may be necessary to open and close the load door.)

- **CLR-ERROR:** If the system is in the error mode, it will not reset or run. This pushbutton clears (resets) a system error so that the **MODE** and **START** buttons become active again.

- **STOP:** This pushbutton will stop rotation even if the G3P is in mid-cycle. NOTE: If the chuck and wafer have unusually great momentum, a Motion Error may occur and the electronic

breaking may fail; the chuck will coast to a halt. Do not open the door until you are sure the rotation has stopped completely.

In the **Program/Edit** mode, the following G3P controls are active. You are able to enter new recipes and modify the settings of existing recipes.

- **ENTER:** This pushbutton *"enters"* (stores) the data you just entered and *advances* the cursor to the next control block. It is important to use **ENTER** in order to make sure the data is stored in the recipe. (Without **ENTER,** the data is ignored.)

- The ↑ **and** ↓ ("Set Values"): Like the basic G3, the G3P has arrows that cause the control variables (seconds or RPM) to increase or decrease. (Press and *hold* to get bigger changes; the counter will speed up.)

- The → **and** ← ("Navigation"): These arrows can move the cursor to the next/previous data block. NOTE: The arrows are best used when moving around in a recipe to find an item you wish to change; always use the **ENTER** button after entering/changing an item, so that the data is stored.

5.5.2 G3P PROGRAMMING

In the Program/Edit mode (see Mode key, above), you can make and save up to 30 recipes (programs, cycles), and program up to 20 *steps* into each recipe. A step consists of setting up to five variables (Ramp, RPM, Dwell, Disp., and Time). See the following and the example (Figure 5-4). In the following, the text explains each display item, then the ☞ points out how to use that item.

NOTE that you must program for the size of chuck being used; this affects speed control parameters. Do this by setting the size in Step 0 (mentioned in the following steps).

Figure 5-3: G3P Display

1. Enter the Program/Edit mode by pressing the **MODE** button. A *pointer* will appear in the display, next to Recipe. (See the figure to the right.)

2. Recipe: (30 Recipes, identified by number) Select any recipe number to edit its variables or create a new set from scratch. [NOTE: To remove all the old programming from a recipe, select the recipe number and press **CLR/ERROR**, then press **ENTER.**]
   ☞ Use the ↑ **and** ↓ to select a recipe number, then press **ENTER.** The recipe number will be entered and the *pointer* will move to Step.

3. Step: (Step 0* plus 20 steps) Each step contains 5 variables, or commands, that you use to program the spinner (Ramp, RPM, Dwell, Disp, & Time). Steps are executed in order from 1 to 20; unlike computer programming, there are no "Do Loops" or "Jump To" commands. (If you don't need all 20 steps, refer to Programming Hint #2, on the following page.)
   ☞ The step number will normally increment properly as you program, and won't require changing; You accept the step # by pressing **ENTER** and the pointer will move to Ramp. [If you wish to modify any step, you can simply use the ↑ **and** ↓ to set the Step number to the desired step and then move with the → **and** ← to any item in that step and change it. Always press **ENTER** to make sure the changes are actually stored.]

4. Ramp: (0 to 25.5 seconds) This number tells the spinner how many seconds to take to accelerate or decelerate to the new speed (RPM). If Ramp is set to zero, the spinner will try to comply; but if the required change of speed is too great, a Motion Error may occur (see "Error Messages," page 17).
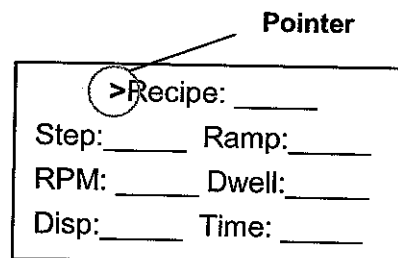
☞ When the pointer is at Ramp, use the ↑ **and** ↓ to set the Ramp Seconds. Then press **ENTER** and the number will be stored and the pointer will move to RPM.

5.   RPM: (0 to 9999 RPM) This is the rotational speed for the spinner for this step.
     ☞ When the pointer is at RPM, set the speed by using the ↑ **and** ↓. Press **ENTER** and the number will be stored and the pointer will move to Dwell.

6.   Dwell: (0 to 999 seconds) This is how long to spin at the RPM you just selected.
     ☞ When the pointer is at Dwell, set the time by using the ↑ **and** ↓. Press **ENTER** and the number will be stored and the pointer will move to Disp.

7.   Disp: (None, Coating, Edge, Solvent, N_2, [1, 2, 4, 6, 8, 10, 12]*) If you have the optional hardware, you can select which external dispense function (Disp) to control during this step. The function will be turned on at the beginning of Dwell; its duration will be controlled by the Time variable (next). Possible options are: coating material, N_2, solvent, edge bead removal, or none. This will not be activated unless the next variable (Time) is changed from zero.
     ☞ When the pointer is at Disp, select from these options by using the ↑ **and** ↓, then press **ENTER** to accept the choice, and the pointer will move to Time.

8.   Time: (0 to 10 seconds) This setting determines how long the Disp. function will be turned On. If Disp is set to "None," then the Time setting does nothing. Setting Time to something other than zero in the *Step 0* turns off Homing after a recipe is completed.
     ☞ When the pointer is at Disp, set how long to have that optional function turned On by using the ↑ **and** ↓. (If you set the Time to be longer than the Dwell setting, then dwell will be extended to accommodate the Disp. action.) Press **ENTER** and the number is stored and the pointer moves to the (next numbered) Step. Continue this process of entering steps until you have completed your recipe.

9.   After entering all of the desired steps for your recipe, use the following to exit properly.

     • If there are any leftover steps at the end with actions/numbers in them, you must remove them. Display an unwanted step. With the pointer at Step, press **CLR/ERROR** to clear it, and press **ENTER**. Use the ↑ **and** ↓ to examine the next steps and clear them if necessary.

     • When done cleaning up, be sure to press **ENTER** to store the changes or they will be lost.

     • Press MODE to return to operation, or select another recipe to edit/create (using → **and** ← and ↑ **and** ↓).

*   PROGRAMMING NOTE: "**Step 0**" allows you to tell the program what size vacuum chuck you will use with the recipe. This is important so that the spinner give the right amount of force to accomplish the desired ramps and speeds. REMEMBER to program in the chuck diameter in the <u>Disp</u> blank on Step 0. ALSO, setting the <u>Time</u> to something different than zero tells the spinner NOT to return the chuck to its original position after completing the recipe (by skipping the homing process, you save processing time).

5.5.3 PROGRAMMING HINTS AND TRICKS

Note the following hints to make it easier and faster to enter a recipe.

1.   **To remove an entire recipe**: Place the pointer at Recipe and select the desired recipe number; press **CLR/ERROR** and then **ENTER**. All steps will be removed.

2.   **To remove a step at the END of a recipe:** Place the pointer at Step and select the step number to be removed; then press **CLR/ERROR** and then **ENTER**. Check to see that there are no more steps after that.

3.   **To remove a step from the MIDDLE of a recipe**: (e.g., you discover you have entered a step twice, and want to remove the extra without moving all the rest of the steps) Set all of the variables to zero except the RPM; set that to be the same as the preceding step. Press **ENTER**

4. **To edit or modify a step's variables:** Go to those particular variables by using the **ENTER** or the **→ and ←** and then change the variable by using the **↑ and ↓**. REMEMBER to press **ENTER** afterwards, or the change will not be kept.

5. **To extend a function (dwell or dispense) beyond its normal time limit:** Use two similar steps. e.g., For a ramp from 1000 to 2000 RPM over 40 seconds, ramp from 1000 to 1500 over 20 seconds in the first step (and set Dwell to zero); then ramp from 1500 to 2000 over 20 seconds in the next step. Use the same idea for extra long dwell or dispense by employing two steps instead of one.

6. **To dispense before spinning:** Simply set the **RPM** to zero for the step. Select the dispense function and set the **Time** (if you want the chuck to remain still for some time *after the dispense is complete*, set the **Dwell** to be longer than the **Time**). Then use the next step to ramp up to the desired speed.

7. **To have two dispense operations, one right after the other (same or different):** Create a step that has the first dispense operation (Coating, perhaps) with zero Dwell time and Dispense time as desired. Use the next step to perform the second Disp. function without ramping up or down in speed.

8. Remember that you must press **ENTER** to accept any step's programming. If you move about using the navigation arrows (**→ and ←**), your changes are not entered and saved. If you change a setting, be sure to press **ENTER** next. (An **ENTER** at any time saves all previous changes that were made during that step.)

5.5.4 Recipe Example

Great flexibility is available in G3P recipes. Figure 5-4 shows RPM versus time for a recipe that demonstrates some of the different actions.
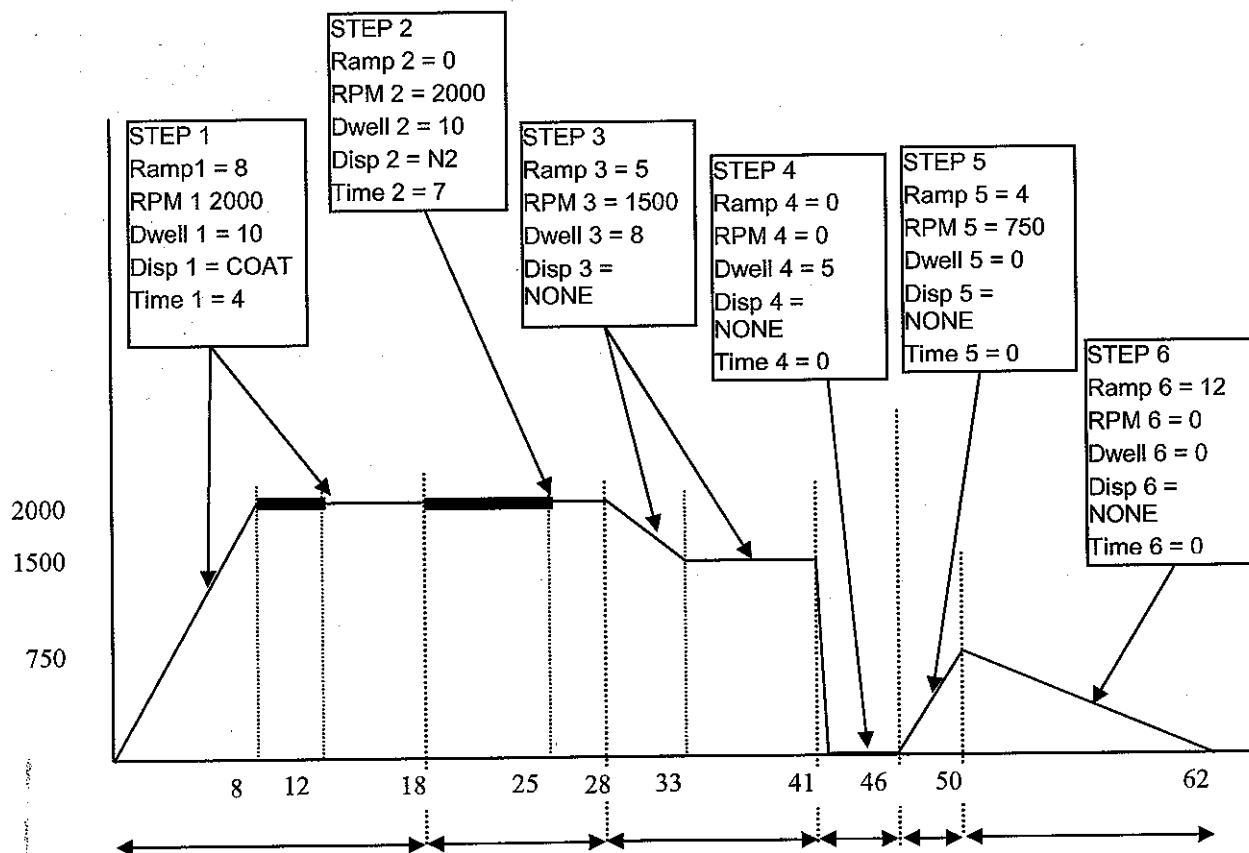

Figure 5-4: Example G3P Program

- The length of a step is shown across the bottom with an arrow. (Step 1 is 18 seconds, total.)
- Vertical lines and a number (total seconds) mark each event (start or stop of any ramp, dispense, or dwell).
- Heavy lines show the two dispense operations.
- The numbers at the left show the speeds (RPM) used in this recipe.
- Boxes across the top illustrate the recipe entries for the six steps.

Note some of the special capabilities accomplished by the recipe:

- Long periods at the same speed can be accomplished using multiple steps (Steps 1 & 2).
- Sudden speed changes are accomplished by setting Ramp time to zero or a very low number (Step 4). The actual time required is a function of the size of speed change and the amount of weight being spun.
- Pauses at zero RPM can be programmed into the middle of a recipe (Step 4). It is even possible to program a dispense step at zero RPM if desired.
- Dispensing (option): Two dispense options can be employed, one right after the other and at the same RPM (Steps 1 & 2). They could follow more closely if Dwell 1 were set to 4 instead of 10.
- Ramps to different speeds and employing different Accel/Decel rates can be combined (Steps 5 & 6).

Here is a more detailed explanation of the figure, listing and discussing each step. To help keep things straight, the settings for Step1 will be called Ramp1, RPM1, Dwell1, etc.

Step 0 is the step that tells the spinner *how large the vacuum chuck is*. Enter the size in the Disp blank by selecting the number that (most nearly) represents the diameter of the chuck. **Homing:** to stop the chuck from returning to the Home position at the end of the run, set the step 0 Time to some number other than 0.

Step 1 begins with a Ramp1-- 8 seconds up to an RPM1 of 2000. Dwell1 is set to keep the speed at 2000 for 10 seconds. Disp1 is set to COAT; the dispensing always begins as soon as the dwell does. The dispensing Time1 is 4 seconds (as shown by the heavy line), and the dwell continues until its 10 seconds is up.

Step 2 begins at 18 seconds. It has no Ramp2 time and also has the same speed (2000 RPM) so it appears to be a continuation of step 1. Its Dwell2 is set to 10 seconds (combined with step 1 this gives a *total* dwell of 20 seconds at 2000 RPM–longer than is possible with one single step). Disp2 is set to N_2 and the Time2 is 7 seconds (of N2 dispensing).

Step 3 begins at 28 seconds on the figure, and has a 5-second Ramp3 down to an RPM3 of 1500. The Dwell3 is set to 8 seconds and there is no Disp3.

Step 4 tries to cause an instant stop! The Ramp4 is 0, and the RPM4 is 0. If the motor can stop quickly enough, the cycle will continue–if the momentum is too great and the motor cannot stop quickly enough, there will be a "Motion Error." See the error messages on page 17. If necessary, the Ramp4 could be set to 0.5 seconds, to avoid the motion error.

Step 5 & Step 6 consist of two ramps with no dwell time. RPM5 simply goes up to 750 in the Ramp5 time of 4 seconds and RPM6 takes it back down to 0 in the Ramp6 time of 12 seconds.

5.6   SELECTING A PROGRAM TO RUN

After the spinner has completed its startup cycle, you can press **START** and it will attempt* to run whatever recipe is shown on its display. If there is no recipe, you must enter/select one.

To select a different recipe on the G3P press **MODE,** change the recipe number, press **ENTER,** and then exit the Program/Edit mode by pressing **MODE** again.

NOTE: The first step shown is numbered "0" and called Step Zero. It is used to tell the spinner what size vacuum chuck is being used (enter the diameter in inches in the step 0 Disp blank). This is important for the control mechanism, always use the chuck that matches the size called for in the recipe. If different size chucks are used, you can make recipes for each size of chuck.

ALSO in step 0 is the ability to turn off the automatic homing after each run (thus saving some time). Set the Time blank to some number larger than 0 to disable homing.

*Requirements for running must be met: Vacuum and Purge N_2 must meet requirements; Door open/close requirements must be met. See "Troubleshooting," page 18, in case of failure to run.

5.7   RUNNING

1. Make sure you are in the Run mode and the proper recipe is selected (select recipe in the Recipe/Edit mode).

2. Make sure you have the proper size chuck—corresponding to the size called for in the Disp blank of Step Zero.

3. Place the wafer on the vacuum chuck (wafer must be centered for proper operation).

4. Close door. Do not open the door during a cycle; the cycle will be terminated and there is potential for injury.

5. Go to the Run mode, and press **START** to begin a cycle.

6. During the cycle, the display will show the Recipe number, and the approximate RPM and time remaining.

7. At the end of each cycle, the vacuum chuck will slowly rotate to the "Home" position (unless programmed to **not** Home in the Step 0 programming). The display will say REMOVE COATED PARTS.

8. Open the door, remove the coated part, and place the next part on the chuck. NOTE: After each cycle, the spinner door must be opened and closed before the next cycle will run. This helps avoid spinning the same wafer twice by accident.

9. You can stop rotation at any time by pressing STOP (in some instances the inertia of the rotating chuck can overpower the motor brake and cause a "Motion Error"). A "Short Cycle" error will occur if the door is opened or the STOP button is pressed during a cycle.

10. The **CLR ERROR** button will reset the device if an error occurs. Pressing **Start** begins at the start of the current recipe.

11. If process is to be repeated, go to step 1.

5.8 ERROR MESSAGES

If the display light does not come on after connecting the power and turning on the power switch, check that the purge N_2 is connected and has a pressure of at least 2 psi. Correct the cause of the error and press **STOP/CLR ERROR** to ready the machine for operation.

Error Message	Reason	Remedy
CHECK VACUUM .	1. Unable to hold vacuum. OR... 2. No vacuum present.	1. Make sure wafer is on the chuck. 2. Check the vacuum line connection.
SHORT CYCLE	1. Unable to complete the process. Door is opened during cycle 2. Loss of vacuum. 3. Stop button is pushed during a cycle.	1. To start a new cycle, clear the error, open/close door. 2. Check connections. 3. To start a new cycle, clear the error, open/close door.
MOTION ERROR	1. Motor could not follow the instructions given by the Recipe. 2. Error in speed sensing circuitry.	1. Ramp time too short, allow more time; check step 0 chuck size. 2. Electronic or encoder problem– get service check step 0 chuck size.
LID OPEN	1. The lid switch indicates that the lid is open.	1. Close the lid or get switch fixed.
REMOVE COATED PARTS	1. Not an error, but a reminder that the cycle is complete and coated parts need to be removed.	1. Open lid, remove parts. Message will clear automatically.

NOTE: When there is a Motion Error, power to the motor is cut and the chuck coasts to a stop.

5.9   TROUBLESHOOTING

Refer to the Error messages in the previous section.

PROBLEM	POSSIBLE CAUSE	
Spinner will not power up.	Purge N_2 not present, or inadequate flow	Verify or provide purge N_2. Have maintenance check sensor FLS-1.
Cycle will not start	1. Error from previous cycle. 2. Wrong/invalid recipe. 3. Vacuum not present 4. Door open/close not sensed, or door still open.	1. Press CLR ERROR 2. Enter, check, or select a recipe 3. Verify or provide necessary vacuum. Have maintenance check sensors FLS-1, VS-1. 4. Open and close door. . Have maintenance check sensor S1.
Cycle starts, but immediately stops	1. Vacuum lost. 2. Recipe problem.	1. Check placement of substrate on chuck. Check vacuum supply. 2. Review, edit, and re-enter recipe as needed.
Displayed time or RPM does not seem exact.	The display is an approximation, only updated when the control circuitry has available time. Use it only to verify the correct recipe choice and steps, and as a rough report on time and speed.	For exact timing and speed, use external test equipment, and adjust the recipe as needed. Actual performance is very repeatable.
Recipe "breaks" when changing speed.	Steep ramps are harder for the motor to accomplish. If the motor cannot change the speed fast enough a Motion Error occurs. The motor/chuck spin freely to a halt and the error message is displayed.	Change the recipe to allow a more gradual speed change.
Other performance irregularities	**Chuck Size considerations.** The control program takes into account the chuck size (actually the chuck's moment of inertia). A customized chuck may cause some irregularities in performance if its mass/inertia are different from the anticipated chuck. If a custom chuck seems heavier than a similar sized standard chuck, select a larger size in "Step 0"; if the custom chuck seems lighter, choose a smaller size in "Step 0."	

5.10   SHUTDOWN

1.   Turn power OFF with the **POWER** switch located on the rear panel.

2.   Carefully remove vacuum chuck.

3.   Clean vacuum chuck and bowl thoroughly using the proper solvents.