

## Using the Programmable Hotplate for Annealing TiO<sub>2</sub>

The programmable hotplate can store 8 programs, each with 32 segments. However, I have only figured out how to have it run the first stored program, "Program 0."

Program 0 will be used for annealing TiO<sub>2</sub> and these instructions will be for running Program 0 only. When we learn more about how to use this temperature controller (the instructions are egregiously complicated) I will update the SOP.

On the next page is a temperature vs. time graph of Program 0

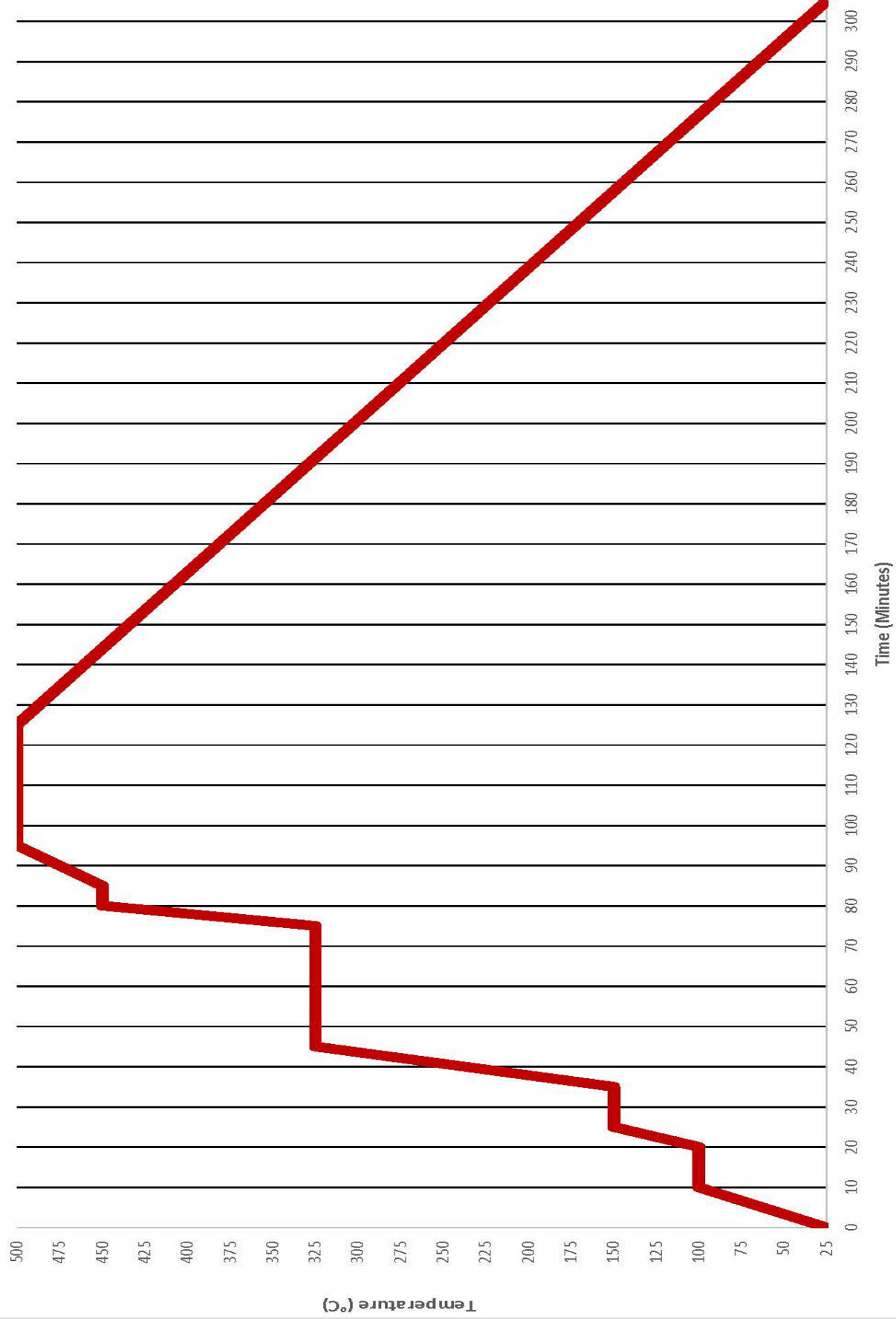
Program 0 starts by soaking for 1 min at 25°C and ends with a 3 hour ramp down back to 25°C

If the program is run all the way through, the hotplate will stop at the end of the final 3 hour ramp down to 25°C, and will remain at 25°C until the program is reset and run again.

I will give two instructions here in Section 1 and Section 2. Section 1 will be the instructions for running Program 0 after it has fully completed and is holding at the last 25°C step (I suspect this will be how most people will start it, i.e. you will start running Program 0 some time after someone else has already finished it running it earlier). Section 2 will be instructions for resetting it while it is running (say it is in the middle of its 3 hour ramp down to 25°C and you want to start it back up right away).

In Section 1 I will explain how to know if the program is completed or in the middle of running. **Start by reading Section 1.** In Section 1 you will be able to find out if it is in the middle of running, and you can skip to the appropriate step of Section 2.

Program 0 on Programmable Hotplate (for TiO<sub>2</sub>)



## Section 1

1. The first step is to turn on the temperature controller on the programmable hotplate. It is the big black I/O switch that is next to the temperature controller screen itself.
2. When you turn on the temperature controller the main screen will look like this (Fig 1.) **The big white number (PV) is the real temperature of the hotplate surface measured by a thermocouple. The small green number (SV) underneath it is the set temperature of the temperature controller (temperature it is trying to maintain).**



**Fig 1.**

The first thing you should do when you turn on the temperature controller is to look at the white number and the green number. The white number will let you know how hot the hotplate is (so you don't burn yourself) and if the **green number is not "25", you know right away that the program is in the middle of running and you should skip to section 2, step 1.**

3. If the green number is "25," the program still may be running (it could be in the middle of the final 3 hour ramp down to 25 C or the 1 min initial 25 C soak). To begin checking if the program is completed or in the middle of running press the curvy arrow button (see below Fig 2.) This is one of only two buttons you will ever press.



Fig 2.

4. When you press the curvy arrow button from the home screen in Fig 2, another screen will come up that says "A-M." Not sure what this is exactly, but it doesn't matter. Press the curvy arrow button again (Fig 3.)



Fig 3.

5. Now the screen will say "PGSG" in white letters (Fig 4). This means "Program Segments." Program 0 has 14 segments (Segment 0 – Segment 13). Underneath "PGSG" will be a green number. **If the green number is not 0.13 (if it is 0.00-0.12), the program is in the middle of running and you should go to section 2, step 3).** If it says 0.13, press the curvy arrow button again.



Fig 4

6. The white letters will now say "PRG" which stands for "Program" (Fig 5). This tells you which program it is running. The green number underneath should say "0" because I only know how to make it run Program 0. Press the curvy arrow button again (Fig 5)

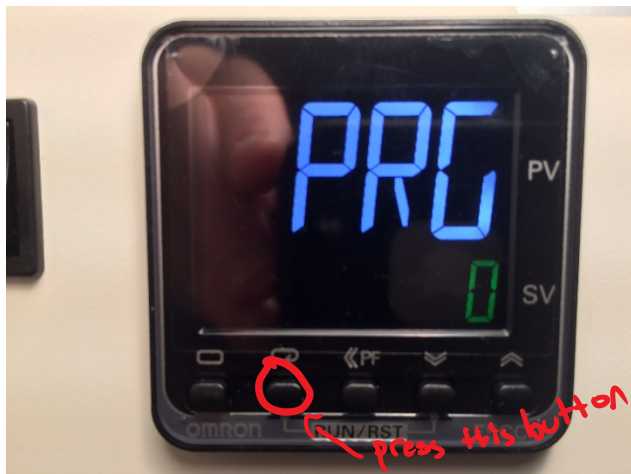


Fig 5

7. The screen should now say "PRGt" (Fig 6). This stands for "Program Time". Program 0 runs for 5 hours and 31 minutes. **If the green number under PRGt is less than 5.31, the program is in the middle of running. Go to section 2, step 6.** If the green number says 5.31, press the curvy arrow button again (Fig 6)

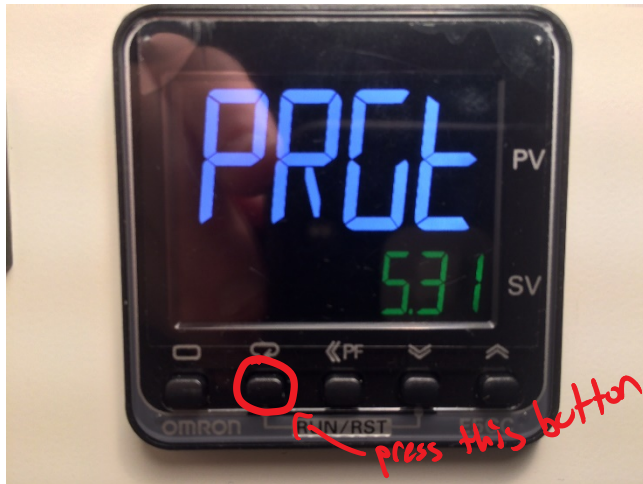


Fig 6

8. Now the screen will say "RPtM" (Fig 7). The green number underneath is saying how many times the program is set to repeat itself after it finishes. The green number should always be "0". Press the curvy arrow button again (Fig 7)

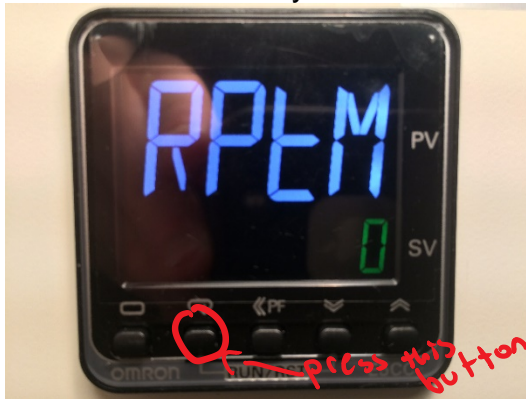


Fig 7

9. The screen should now say "R-R." **This is the most important screen.** This is where you tell the program to either reset itself or run. If the program has finished (PRGt in Fig 6 said "5.31"), the green letter under the "R-R" letters will still say "RUN." It is holding itself at the last setting of the previous program that ran (the 25 C in the case of Program 0). At this point you want to reset Program 0 so that it will go back to Segment 0 (the first step of the program). To do this, press the up arrow button on the right (see Fig 8). If the green letters already say "RST" that is OK, just read down a few sentences and skip to the part that is demarked with "- -"

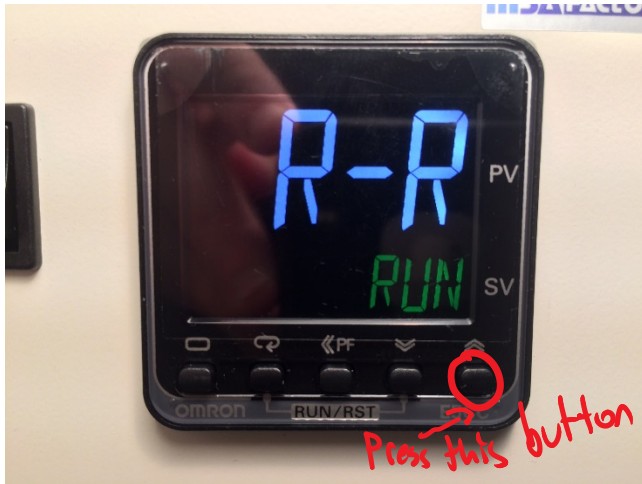


Fig 8

The green letters will change from “RUN” to “RST”, and the “RST” letters will blink for a few seconds. Wait until they stop blinking and the green letters read a steady “RST” (Fig 9).

-- When the “RST” letters become steady, a yellow box will also appear on the left that says “RST.” At this point, press the down arrow button (Fig 9).

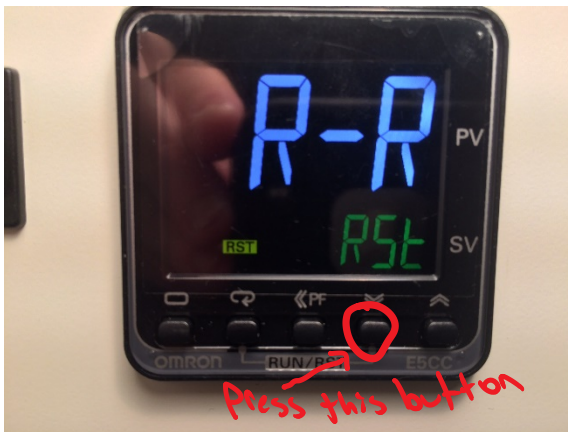


Fig 9

When you press the down arrow button, the green letters will change back to “RUN” (Fig 10) and they will blink for a few seconds. When the “RUN” letters become steady, the program has started running again from the beginning (Segment 0, i.e. step 1 of Program 0). When the “RUN” letters become steady, press the curvy arrow button again.



Fig 10

10. You should now be returned to the main screen that displays the real temperature in white and the set temperature in green. At first, they will both say "25" because remember, Program 0 starts with a 1 minute soak at 25 C. **Wait for at least 1 minute and look to see if the green number starts to increase (Fig 11).** If it starts increasing, the program has started running. Once it starts increasing you can leave and let the program run itself. Since the program has the 3 hour cool down ramp to 25 C at the end, and then just waits at 25 C until it is reset, you can just leave for as long as you want and come back when you are ready to get your samples.



Fig 11.

## Section 2

1. If the program is already running the green temperature may not say 25 on the home screen (although even if it says 25, the program might still be in the middle of its 3 hour cool down ramp to 25 C). Press the curvy arrow button on the temperature controller (Fig 12)

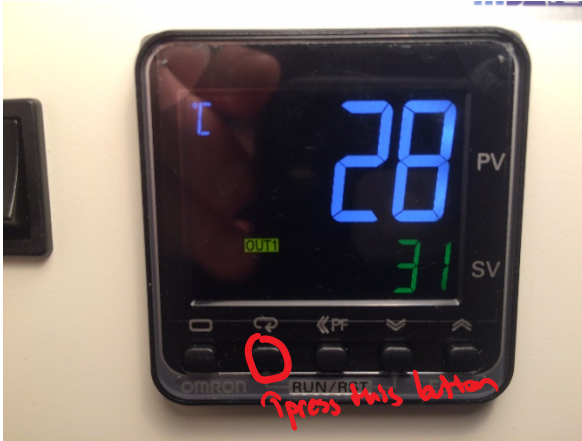


Fig 12.

2. When you press the curvy arrow button from the home screen in Fig 12, another screen will come up that says "A-M." Not sure what this is exactly, but it doesn't matter. Press the curvy arrow button again (Fig 13.)



Fig 13.

3. Now the screen will say "PGSG" in white letters (Fig 14). This means "Program Segment." Program 0 has 14 segments (Segment 0 – Segment 13). Underneath "PGSG" will be a green number. **When the program is in the middle of running, the number may be anywhere from 0.00-0.13 (this is because Program 0 consists of 14 segments (Segments 0-13)).** Press the curvy arrow button again (Fig 14)



Fig 14

4. The white letters will now say "PRG" which stands for "Program" (Fig 15). This tells you which program it is running. The green number underneath should say "0" because I only know how to make it run Program 0. Press the curvy arrow button again (Fig 15)

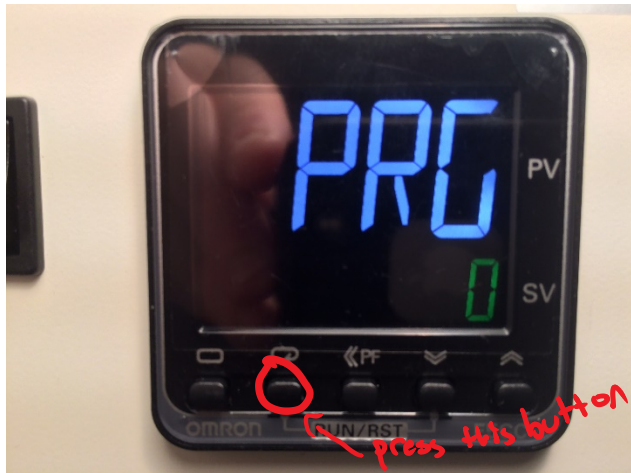


Fig 15

5. Now the white letters will say "Hold" and the green letters underneath should say "oFF" (Fig 16). I am not exactly sure what this screen does, but it doesn't matter. Press the curvy arrow button again (Fig 16).



Fig 16

6. Now the white letters will say "SEG" (Fig 17) and there will be a green number underneath. I believe this also tells you what segment the program is in when it's running, although I'm not exactly sure what the purpose of this screen is. Push the curvy arrow button (Fig 17).



Fig 17

7. The screen should now say "PRGt" (Fig 18). This stands for "Program Time". Program 0 runs for 5 hours and 31 minutes. **The green number under PRGt may be anywhere between 0.01 and 5.31 if the program is in the middle of running (Fig 18).** Press the curvy arrow button again (Fig 18)



Fig 18

8. Now the screen will say "RPtM" (Fig 19). The green number underneath is saying how many times the program is set to repeat itself after it finishes. The green number should always be "0". Press the curvy arrow button again (Fig 19)



Fig 19

9. The screen should now say "R-R." **This is the most important screen.** This is where you tell the program to either reset itself or run. If the program has finished (PRGt in Fig 6 said "5.31"), or if the program is in the middle of running (PRGt in Fig 18 said anything between 0.00 and 5.31), the green letter under the "R-R" letters will still say "RUN." At this point you want to reset Program 0 so that it will go back to Segment 0 (the first step of the program). To do this, press the up arrow button on the right (see Fig 20). If the green letters already say "RST" that is OK, just read down a few sentences and skip to the part that is demarked with "\_ \_"

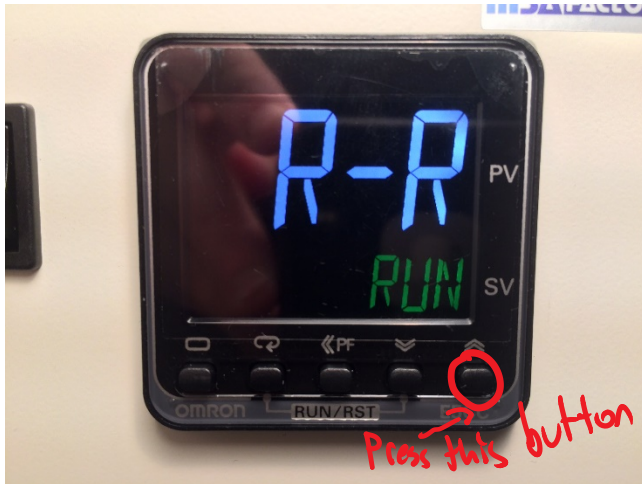


Fig 20

The green letters will change from “RUN” to “RST”, and the “RST” letters will blink for a few seconds. Wait until they stop blinking and the green letters read a steady “RST” (Fig 21).

-- When the “RST” letters become steady, a yellow box will also appear on the left that says “RST.” **If the real hot plate temperature was very high when you first started in step 1 of Section 1 (above maybe ~50 C), at this point you should press the curvy arrow button again and monitor the white temperature number until it gets reasonable low. Then go back to step 1 of section 2.**

Otherwise, at this point, press the down arrow button (Fig 21).

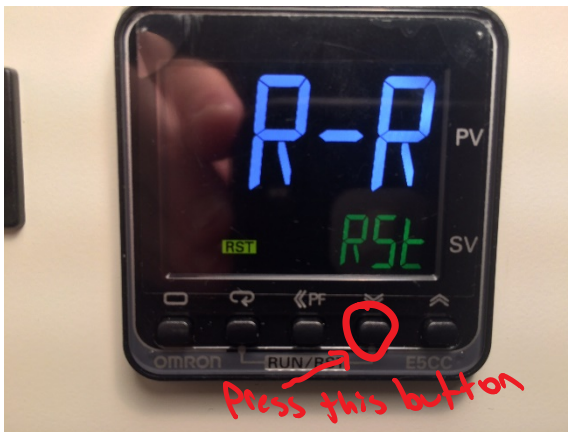


Fig 21

When you press the down arrow button, the green letters will change back to “RUN” (Fig 22) and they will blink for a few seconds. When the “RUN” letters become steady, the program has started running again from the beginning (Segment 0, i.e. step 1 of Program 0). When the “RUN” letters become steady, press the curvy arrow button again.



Fig 22

10. You should now be returned to the main screen that displays the real temperature in white and the set temperature in green. At first, they will both say "25" because remember, Program 0 starts with a 1 minute soak at 25 C. **Wait for at least 1 minute and look to see if the green number starts to increase (Fig 23).** If it starts increasing, the program has started running. Once it starts increasing you can leave and let the program run itself. Since the program has the 3 hour cool down ramp to 25 C at the end, and then just waits at 25 C until it is reset, you can just leave for as long as you want and come back when you are ready to get your samples.



Fig 23.

