Eurotherm 3504 Controller Auto Tuning

The Eurotherm 3504 controller has a function known as auto-tuning that allows the controller to determine the optimum PID settings for furnace operation. Deltech recommends tuning your furnace at a temperature that the furnace will be operated at the majority of the time. This will ensure that the controller will provide the best control possible for your application.

The following steps outline the tuning procedure for the Eurotherm 3504. It can be tuned at three temperatures and switch between three sets of PID values. In order to switch from one PID value to the next, a boundary value is utilized. The boundary value tells the controller when to switch from one set of PID values to another set of PID values. The default values provided with this controller are 500 °C for Boundary 1-2 and 1000 °C for Boundary 2-3. These values can be modified in the LP1 – PID menu (please see the configuration set-up sheet for detailed instruction).

To find the ideal boundary values for your application, Deltech recommends setting the values to temperatures that are halfway between the three temperatures that are most critical to your process. I.e. if the furnace is going to dwell at temperatures of 300, 1000 and 1400 °C for the majority of a program, boundary value 1-2 should be set to 650 °C while boundary value 2-3 should be set to 1200 °C.

In the following example, the controller is tuned at 1500 °C. However, this program can be modified to tune the controller at any temperature. The only requirement is that there must be at least a 50 °C temperature increase for the tuning to be accurate. I.e. If the controller is going to be tuned for 900 °C, the program should be ramped up to 850 °C and then the tuning should begin. NOTE: Although the furnace can be tuned from a cold start, it is better for your furnace if you ramp up to a temperature that is 50-200 degrees below the temperature you would like to tune at. A cold start will cause full power to be applied to the furnace, which can thermal shock ceramics and shorten the life of heating elements. Also, the controller should never be tuned at or within 50 degrees of the furnace's maximum temperature because of the overshoot involved in the tuning procedure.

1. **Turn Element Power Switch Off**

2. **Enter Level 3:**

Press and hold ☐ until ACCS appears in the upper display Goto Level 1 appears in the lower display
Press ▲ ▼ until Level 3 appears in the lower display   Pass Code   appears in the lower display
Press ▲ ▼ until   3   appears in the lower display   Pass   appears in the lower display
The controller is now in Level 3

3. **Set Manual Set Point Temperature.**

Press ☐ and ↺ together

(The furnace temperature appears in the upper display and the current manual set point appears in the lower)

Press ▲ ▼ until **1450** appears in the lower display. Once the program has completed, this is the temperature the furnace will dwell at.

4.   Enter and run a program to ramp the furnace to 1450 °C at 100 °C/hour, (See Chapter 2.8 in the Eurotherm 3504 User Guide for detailed programming information)

Program is the first parameter; use the ▲ ▼ keys to select **1**

Press ↻ until the up/down icon is next to Ramp Units; use the ▲ ▼ keys to select **Min**

Press ↻ until the up/down icon is next to Segment; use the ▲ ▼ keys to select **1**

Press ↻; the up/down icon is next to Segment Type; use the ▲ ▼ keys to select **Time**

Press ↻; the up/down icon is next to Target SP; use the ▲ ▼ keys to select **1450**

Press ↻; the up/down icon is next to Ramp rate; use the ▲ ▼ keys to select **14:30:00**

Press ↻ until the up/down icon is next to Segment Type; use the ▲ ▼ keys to select **End**

Press ↻; the up/down icon is next to End Type; use the ▲ ▼ keys to select **Reset**

5.   Run Program #1

Press ⬚ until Program Status appears in the upper display

Program is the first parameter; use the ▲ ▼ keys to select **1**

Press ↻; the up/down icon is next to Status; use the ▲ ▼ keys to select **Run**

6. Turn Element Power Switch On

7. After the program completes, repeat step 3 to set the manual set point to the 1500 °C tuning temperature

8. Turn Element Power Switch Off

9. Auto-tuning:

Press ⬚ until   `LP1-Main` appears in the upper display

Press ▲ ▼ until `LP1-Tune` appears in the lower display

Press ↻; the up/down icon is next to Enable; use the ▲ ▼ keys to select **On**

Press ⬚ and ↻ together

10. Turn Element Power Switch On

11.   Complete tuning indication:

When flashing 'Loop 1 Auto-Tune/SP' disappears and furnace temperature is in the upper display, the tuning is complete.

12.   Follow instructions 3-9 for each tuning zone.