

## RDK-300 Supplementary Instruction Manual

Version 1.1 (July, 2015)

### 1. Introduction

This is a supplementary manual for the RDK-300 hot runner coil heater. Only the advanced parameter settings will be covered in this manual. Please check the main instruction manual for a quick guide. Advanced parameters are divided into groups and can be accessed by entering a special access code.

#### 2. Temperature control parameters (access code 166)

This group of parameter is for adjusting the temperature control performance. Table 1 shows the list of parameters, their range and the initial factory settings. For most of the heating coils and nails on the market, the **P**, **I**, and **d** do not need to be changed. Please **DO NOT** change them unless you are very familiar with manually tuning PID controllers. In most cases where the control result is not ideal, adjusting the "**oth**" should be able to solve the problem.

Table 1. Temperature control parameters and the initials (code 166).

Symbol	Display	Description	Range	Initial
$P$	p	Proportional band (in 0.1 degree)	0-999	125
$I$	I	Integral constant (second)	0-999	60
$d$	d	Derivative constant (second)	0-999	10
$\square \text{ } \text{E} \text{ } H$	OTH	Output high limit	0-100	100%
$\text{C} \text{ } - \text{ } F$	C-F	Temperature unit	C or F	F
$\text{A} \text{ } P \text{ } \square$	APO	Auto power-off timer	OFF, 1-999	60

#### 2.1 Details about each parameter

- **P**. Proportional band. The unit is in degrees. This parameter control the output of the controller based on the difference between the measured and set temperature. The larger the **P** value, the weaker the action (smaller gain). For example, if **P**=7, the proportional band is 7 degree. When the sensor temperature is 7 degrees below the set point, it is out of the proportional band, and the controller will have 100% output. When the temperature is 5 degree below the set point, the output is 71%. When the temperature is equal to the set point, the controller will have 0% output (assuming integral and derivative functions are turned off). This constant also affects both integral and derivative action. Smaller **P** values will make the both integral and derivative action stronger.
- **I**. Integral time. The unit is in seconds. This parameter controls the output of controller based on the difference between the measured temperature and the set temperature integrated with time. The integral action is used to eliminate temperature offset. Larger number means slower action. For example, when the difference between the measured and the set temperature is 2 degrees and remains unchanged, the output will increase continuously over time due to the contribution of the integral term until it reaches 100%. If the temperature fluctuate up and down constantly (system oscillating), increase the integral time **I**. If the controller is taking too long to eliminate the temperature offset, decrease the **I**. Usually this parameter do not need to be changed.
- **d**. Derivative time. The unit is in seconds. The derivative term contributes to

the output power based on the rate of temperature change. Derivative action can be used to minimize the temperature overshoot by responding to the rate of temperature change. The larger the **d** value, the faster the reaction. The derivative term changes the controller output based on the rate of temperature change rather than the net amount of temperature change. This will allow the controller to react to temperature change sooner. It can turn the heater to full power before the temperature drops too much. Usually this parameter do not need to be changed.

- **oth**. Output high limit. The unit is percentage (%). It allows you to set the high limit of the output. It can be used when you have an overpowered heater to control a small subject. For example, if you have a 250W heater and set the **oth** = 40, the heater will be used as a 100 watt heater (250x40%=100). User may need to change this parameter if you heater is not 250 watt and want to improve the performance. For example, set it to 50 if you have a 200 watt heater; set it to 100 if you have a 100 watt heater. Larger **oth** value makes the system heats up faster, but can cause temperature overshoot and fluctuation. Smaller **oth** increases the heat up time.
- **C-F**. Temperature unit setting. You can set the display to either Celsius or Fahrenheit.
- **APo**. Auto power-off time. This parameter is defined for how long the built-in timer will automatically shut off the controller. This mechanism will preserve the coil life and make the system safer, in case the user forgot to turn the power off. This timer will start to count once this controller is turned on. By default, it is set to 60 minutes. It can be set to maximum 999 minutes, or you can turn this function off.

#### 2.2 Accessing temperature control parameters.

The flow chart in Figure 1 shows how to access the parameters in this group.

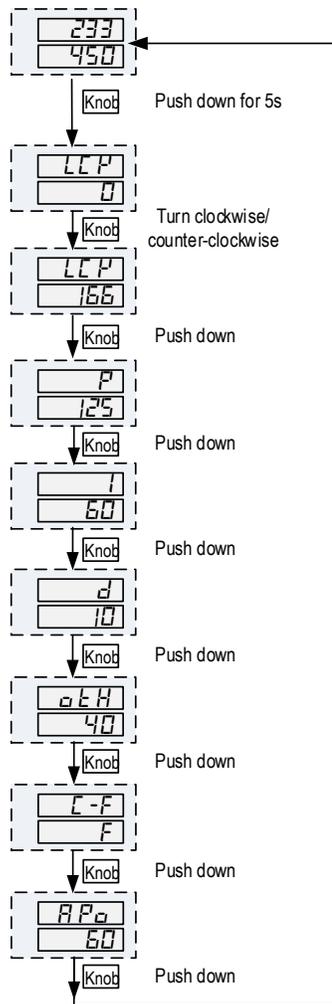


Figure 1. Flow chart of setting up parameters for temperature control.

- 1) Push down and hold the knob for 5 seconds until the top LED window displays "L L P" (symbol for "lock"), then release the knob. The display on the bottom window will show "0".
- 2) Turn the knob to adjust the number to 166 (which is the pass code) and push knob again to confirm. Turn the knob clockwise to increase the value; turn it counter-clockwise to reduce the value. Faster rotating speed will change the value. Small rotation for single digit adjustment.
- 3) The top window will display "P" and bottom window will show its value (default P is 125). Turn the knob clockwise or counter-clockwise to change the value. When finished, push the knob again to confirm the change. Then top display will show the next parameter.

**3. Temperature correction coefficient (access code 155)**

Two parameters, **PSL** (Temperature correction coefficient) and **HL** (Cut-off temperature) are included in this section.

HL is the parameter designed for setting a maximum controlling temperature. This feature can mechanically cut off the heater once the coil temperature got out of control; no matter it's due to an operation error or SSR failure. When reading temperature is over this cut-off temperature, the built-in relay will be activated to cut off the power to the coil immediately. This relay will be deactivated when reading temperature is equal or lower than HL. If your set

temperature **SV** < **HL**, it has no effect on the control; but if your **SV** > **HL**, it will heat up the coil above **HL**. Controller will cut off the power to the coil once it reaches **HL**, which makes the coil cannot go higher than **HL**.

PSL allows the user to adjust the displayed temperature so that it can closely show the surface temperature (of the object being heated by the coil heater) instead of the coil temperature. The temperature sensor, a type K thermocouple, is located at the tip of the coil. The actual temperature on the surface of the object is normally lower than the coil. Fig 2 shows temperature variations over the coil/nail assembly.



Fig 2a. An Infrared thermal image of Auber 15.8 mm coil/nail assembly. SV =550F. The temperature reading at the top left corner is from circle at the center.



Fig 2b. An Infrared thermal image of Auber flat coil/universal nail assembly. SV = 600F. Side view. The temperature reading at the top left corner is from circle at the center.

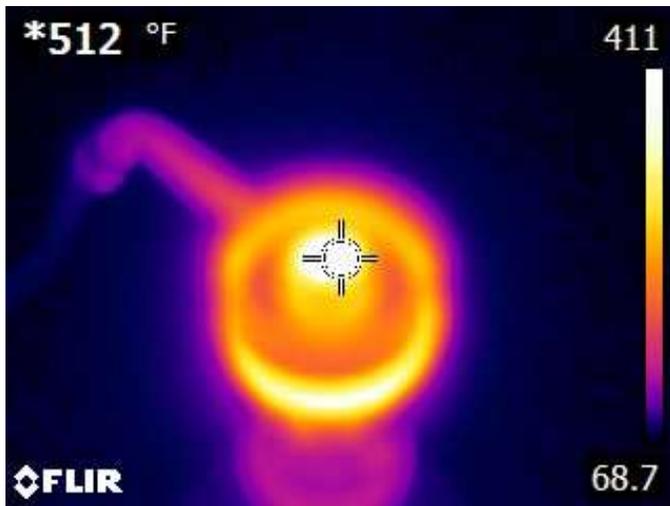


Fig 2c. An Infrared thermal image of Auber flat coil/universal nail assembly. SV = 600F (Top view). The temperature reading at the top left corner is from circle at the center.

The temperature difference is determined by the thermal conductivities, the surface/mass ratio, and the ambient temperature. This difference between the 3

sensor tip and ambient temperature is proportional to the coil temperature over the entire heating range. The correction is done by multiplying the measured temperature by a coefficient **PSL**. The default value is 1.00, which means no correction applied (see Table 2). **For the 15.8 mm coil and nail that we offer, PSL should be set to 1.28 if you want the display to show the nail temperature.**

Table 2. Temperature correction coefficient and its initial settings (code 155).

Symbol	Display	Description	Range	Initial
<i>PSL</i>	PSL	Temperature correction coefficient	1.00-9.99	1.00
<i>HL</i>	HL	Cut-off temperature	0-999	900

Table 3. PSL for all Auber coils and nails combinations.

PSL	Auber Coil	Auber Nail
1.28	15.8 mm coil	Either female nail or male nail
1.13	Flat coil	15.8 mm universal nail
1.03	20.0 mm coil	20.0 mm universal nail

**Note:** For coil and nail systems that are not provided by Auber, the user can measure the surface temperature of a nail with a thermometer. 1) The nail temperature can be measured by inserting a type K thermocouple with a fine tip such as Auber’s TC-K5 to the hole on the nail. User should not use the reading from a single point infrared thermometer because it is very sensitive to the measuring location, as shown in Fig 2. 2) Then, divide the coil temperature on the controller by the nail temperature will give you the **PSL** ratio. For example, if the surface measures 580F while as the controller reads 700 F, then, **PSL** = 700/580 = 1.20.

This parameter can be accessed by code 155. Figure 2 show a flow chart of how to change it. Push and hold the knob for 5 seconds until top LED window displays “LCK”, then release the knob. The display on the bottom window will show “0”. Turn the knob to adjust the display to 155 and push knob once. The top window will show the **PSL** and bottom window will show its value. Turn the knob clockwise or counter-clockwise to change the value. When finished, push the knob again to confirm the change. Then top display will show the next parameter.

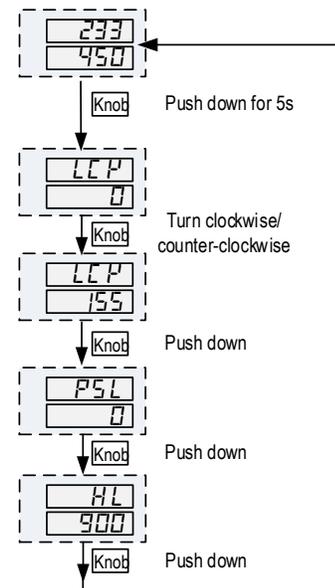


Figure 3. Flow chart of setting up the parameter under code 155.

4. Default Parameter Values

Table 4. Parameter access code and its initial settings.

Access Code	Symbol	Description	Range	Initial
166	<i>P</i>	Proportional band (in 0.1 degree)	0-999	125
	<i>I</i>	Integral constant (second)	0-999	60
	<i>d</i>	Derivative constant (second)	0-999	10
	<i>o L H</i>	Output high limit	0-100	40%
	<i>C -F</i>	Temperature unit	C or F	F
	<i>R P o</i>	Auto power-off timer	OFF, 1-999	60
155	<i>PSL</i>	Temperature correction coefficient	1.00-9.99	1
	<i>HL</i>	Cut-off temperature	0-999	900

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