Instruction Manual

ECT-100 Temperature Controller

Version 1.5 (Jun, 2022)

1. Overview

This is an economical plug-n-play controller that can be used for Sous Vide cooking, and other low temperature control applications (<221°F or 105°C). It offers PID mode for heating control, as well as on/off control mode for either heating or cooling. The PID mode is suitable for precision temperature control such as Sous Vide cooking. The on/off control is suited for controlling devices that does not like to be switched on/off too frequently such as the compressor of the refrigerator.

This controller has a temperature sensor comes with it, which can measure temperature in the range of -50 ~ 120°C (-58 ~ 248°F). The power input can be either 120V AC or 240V AC. The output power will be supplied to the output socket, to which a load can be plugged. The output power is controlled by an internal electromechanical relay whose action synchronize with the OUT indicator on the front panel. The output voltage is the same as the input voltage.

2. Specification

Temperature control range	-50 ~ 105°C, -58 ~ 221°F
Temperature resolution	1°C (between -50 ~ 120°C) 1°F (between -58 ~ 248°F)
Temperature accuracy	0.5 °C or 0.9 °F
Control mode	On/off (heating or cooling), PID (heating)
Control output	10A at 120VAC, 8A at 240VAC
Operating input voltage	85 ~ 240V AC, 50/60Hz
Audio Alarm	High and low limit
Sensor type	Silicon band gap sensor
Sensor size	0.25" OD (6.35 mm) x 1" length (25 mm)
Sensor connection	3-pin connector
Sensor cable length	6 ft (2 m)
Dimension	3.4" x1.7" x 4.7" (85 x 47 x 118 mm)
Ambient temperature	-20 ~ 50°C (0°F ~ 120°F)
Power cable length	3 ft (1 m)
Warranty	One (1) year

3. Front Panel and Connectors

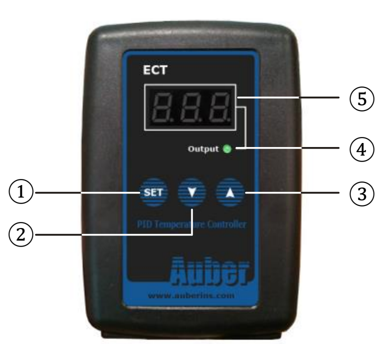

Figure 1. Front Panel.

Figure 2. Bottom Panel

① Set Key
② Down Key
③ Up Key/Mute
④ Output Indicator
⑤ Temperature Display
⑥ Power Output Socket
⑦ Power Input
⑧ Sensor Input

4. Temperature Setup

To change its preset temperature: Press SET key once to switch the display from actual temperature to set temperature. The display will start to blink. Press Up and Down keys to increase or decrease the setting temperature. When finished, press SET key once to confirm and exit.

Note: Parameter remains unchanged unless you press set key to confirm.

5. Parameter Setup

To enter parameter setting mode, press and hold SET key for 6s and it will show "AH" in the display window. Please see Table 1 for all parameters. Please refer to the flow chart in Figure 1 for how to change parameters.

Table 1. Parameter Settings and its initials.

Symbol	Display	Description	Range	Initial
AH	AH	High Limit Alarm	-99-999	210
AL	AL	Low Limit Alarm	-99-999	32
Mod	ñnd	Control mode	PID HEA (heating) COL (cooling)	PID
AS	AS	Anti-short cycle delay (only valid for cooling mode)	0-200	6
Hy	HY	Hysteresis band	0-999	3
P	P	Proportional band (in 1 degree)	0-999	18
I	I	Integral constant (second)	0-999	650
d	d	Derivative constant (second)	0-999	40
t	t	Cycle rate (second)	0-999	20
AT	At	Auto-tune	0=off, 1=on	0
C-F	C-F	Temperature unit	°C or °F	°F
oFS	oFS	Input offset	-99-99	0

Details about each parameter

- **AH**. High limit alarm. When process temperature is higher than AH, the internal audio buzzer will be energized. For example, if AH set to 290, the buzzer will be on at 291 and off at 290. When the buzzer is on, the display window will be flashing between “A-H” and the current process temperature. Press Up key to mute the alarm.
- **AL**. Low limit alarm. When process temperature is lower than AL, the internal audio buzzer will be energized. For example, if AL is set to 100. The buzzer will be on when temperature drop to 99. It will be turned off when temperature rise above 100. The low limit alarm is suppressed at powering up. It will be reactivated once the temperature has reached set point. When the buzzer is on, the display window will be flashing between “A-L” and the current temperature. Press Up key to mute the alarm.
- **Mod**. Control mode. Three control modes are available: **PID** (PID mode for heating), **HEA** (on/off mode for heating), and **COL** (on/off mode for cooling).
- **AS**. Anti-short cycle delay. This is the delay time to turn on the cooler (e.g., refrigerator). If the cooler is compressor based, compressor should not be turned on immediately when it is at high pressure (just after turned off). Otherwise, it may shorten the life of compressor. The anti-short cycle delay function can be used to prevent the rapid cycling of the compressor. It establishes the minimum time that the compressor remains off (after reaching cutout) before turns on again. The delay overrides any controller demand and does not allow the compressor to turn on until the set delay-time has elapsed. It gives time to release the refrigerant pressure through evaporator. It typically set to 6 (minutes). The unit is in minutes. This setting is only valid for cooling mode.
- **Hy.** Hysteresis band (or dead band). This parameter is valid only for on/off control mode (heating or cooling). In the on/off heating mode, the controller will stop sending power to the heater when temperature T is above the set value (SV), and start sending power again to the heater if T drops below (SV-Hy). For example, if SV=100 °C. Hy=3 °C, the heater will be turned off when the temperature rises above 100 °C; it will be turned on again as the temperature drops below 97 °C. For the on/off cooling mode, the compressor will be turned off when T<SV. It will be turned on again when T>SV+Hy.
- **P**. Proportional band. The unit is 1 degree. This parameter controls the output level based on the difference between the process temperature and set temperature. The greater P value, the weaker the action (lower gain). If P=7, the proportional band is 7 degree. When the sensor temperature is 7 degrees below the proportional band (10 degrees below the setting), 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 setting, 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. Please note the value of the P is temperature unit sensitive. If you found an optimized P value when operating the controller in Fahrenheit, you need to divide the P by 1.8 when changing the temperature unit to Celsius.
- **I**. Integral time. The unit is in seconds. This parameter controls the output of controller based on the difference between the measured and set temperature integrated with time. Integral action is used to eliminate temperature offset. Larger number means slower action. e. g. assuming the difference between the measured and set temperature is 2 degrees and remain unchanged, the output will increase continuously with time until it reaches 100%. When temperature fluctuate regularly (system oscillating), increase the integral time. Decrease it if the controller is taking too long to eliminate the temperature offset. When I=0, the system becomes a PD controller. For very slow response system such as slow cooker and large commercial rice cooker, set I = 0 will significantly reduce the temperature overshoot.
- **d**. Derivative time. The unit is in seconds. Derivative action contributes the output power based on the rate of temperature change. Derivative action can be used to minimize the temperature overshoot by responding its rate of change. The larger the number is, the faster the action will be. For example, when there is a disturbance causing the temperature dropping at a very high rate, the derivative action can change the controller output based on the rate of change rather than the net amount of change. This will allow the controller to act sooner. It will turn the heater to full power before the temperature drops too much.
- **t**. Cycle rate. The unit is in seconds. This unit determines how long for the controller to calculate each action. For example, if T is set to 20 seconds, when the controller decides the output should be 10%, it will turn on the heater 2 second for every 20 seconds. This parameter should set at 20 seconds for the internal mechanical relay. This setting is also recommended for controlling a solenoid valve or a compressor of refrigerator to reduce the frequency of on/off.

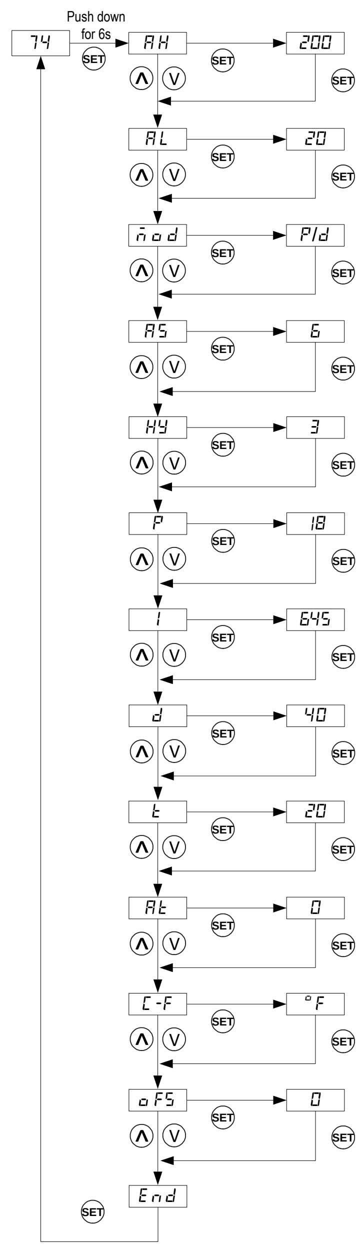

Figure 1. Flow chart of setting up parameters.

- **AT**. Auto-tune function. Set AT to 1 then exit the menu. The display will start to flash alternately between AT and the current temperature, which indicates auto-tuning is in progress. When the display stops flashing, the auto-tuning is finished. Now, the newly calculated PID parameters are set and are used for the system. The new parameters will store in the memory even the power is off
- **C-F.** Temperature display unit. You can set the unit either to Celsius or Fahrenheit.
- **oFS.** Input Offset. oFS is used to compensate the error produced by the sensor or input signal itself. For example, if the unit displays 37 degree when the actual temperature is 32, set parameter oFS = - 5 will make the controller display 32 degree. The displayed process temperature = actual measured temperature + oFS.

6. Recommended Parameter for Sous Vide Cooking

The default setting: P=18, I=650, d=40, and t=20 is optimized for Sous Vide cooking with rice cooker or steam table.

7. Connecting the Sensor to the Controller

The connector of sensor contains a slot for fitting pin connection. It also has a spring lock to prevent disconnections from accidental pulling on the cable. To install the to the unit, please align the slot of the female connector on the sensor to the red mark of the male connector on the unit, then hold the tail and push the female connector forward. To remove the connector, please pull the spring-loaded collar of the female connector. Please see the Figure 3 and Figure 4 below for details.

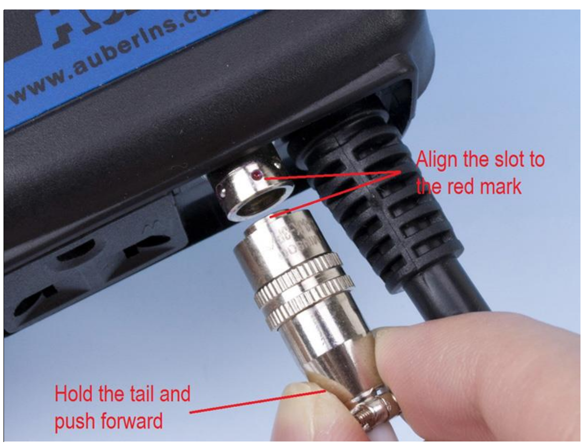

Figure 3. Install the Sensor.

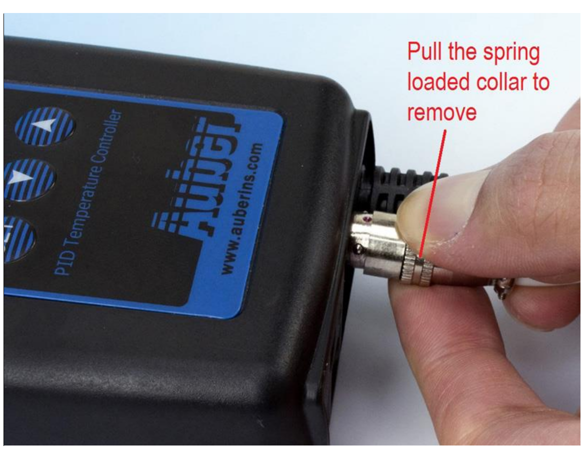

Figure 4. Remove the Sensor.

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