ZL-7817A Temperature Controller
V4.0

Introduction

Optional PID and on/off control.
Integrated SSR output with **5A rated power** driving ability.
An auxiliary output: timer on/off, and/or high temperature protection.

Specification

Sensor: NTC, R = 10K@25℃, B = 3470K
Setting range: -40.0 ~ 130.0℃
Power supply: 100 ~ 240Vac, 50/60Hz
Output R1: **5A**, 250Vac (**rated current**)
Output R2: **7A**, 250Vac (**resistive**)
Working: -10 ~ 45℃, 5 ~ 85%RH without dew
Case materials: PC + ABS fire proof
Protection level: IP65 (Front side only)
Dimension: W78 x H34.5 x D71 (mm)
Installation drilling: W71 x H29 (mm)

Display

Display

Display	Function	On	Blinking
	Heater status	Heater output R1 is energized	
	Timer output status	Timer on, output R2 energized	Over temperature protecting, output R2 energized
	PID auto tune status		PID auto tuning
	Failure		Warning
	Set status	Setting	Start to set
E1	Failure		Sensor failure
Hi	Failure		High temperature warning
tHi	High temperature protecting		High temperature protecting
Lo	Failure		Low temperature warning
iA	Failure		External warning input effective
UnL	Restore to factory settings	Will restore to ***factory settings***	
At1	Auto tuning fails		Temperature not stable during Auto tuning
At2	Auto tuning fails		Temperature vibration level not satisfied
At3	Auto tuning fails		Temperature vibration period not satisfied
At4	Auto tuning fails		Auto tuning time out
SUC	Auto tuning finished		Auto tuning finished successfully

Model, version display

After reset, the model (7817 A) and version (4.0) will display consecutively:

Operation

Set set-point (SP). Factory default set is 35.0℃

Keep〖S〗depressed for 3 seconds to enter into temperature setting status:
blinks, the SP value displays.
Press〖▲〗or〖▼〗to set the value. Press〖S〗to save and exit the status.
The status will exit, and the value will be saved, when there is no key operation for 30 seconds.

Set parameter

Keep〖P〗depressed for 3 seconds to enter into parameter setting status:
blinks, dispay shows “U10”, the 1st parameter code.
Press〖▲〗or〖▼〗to select parameter code.
Press〖S〗to show the value of the parameter. Press〖▲〗or〖▼〗to set the value of the parameter.
Press〖S〗to return back to parameter code selection.
In this way, we can check and/or set all parameters.
Keep〖P〗depressed for 3 seconds to save and exit the status.
The status will exit, and the value will be saved, when there is no key operation for 30 seconds.

If parameter U99 value is not “0000”, the password (the value of U99) is required to enter into parameter setting status:
After〖P〗depressed for 3 seconds, display shows “---0”.
Press〖▼〗to select the digit of password, press〖▲〗to set the value of the digit.
After 4 digits are set, press〖S〗to enter the password.
If the password is correct, enter into the parameter setting status. Else exit.

Parameter table:

Code	Function	Range	Remark	Factory Setting
U10	Set-point (SP)'s low limit	-40.0 ~ 130.0℃		25.0℃
U11	Set-point (SP)'s high limit	-40.0 ~ 130.0℃		39.0℃
U12	Low temperature warning point (relative)	0.0 ~ 130.0℃	Absolute low temperature warning point: SP - U12	35.0℃
U13	High temperature warning point (relative)	0.0 ~ 130.0℃	Absolute high temperature warning point: SP + U13	0.3℃
U14	Hysteresis	0.0 ~ 20.0℃	Only effective when U74 = 1	0.2℃
U15	High temperature protecting(relative)	0.0 ~ 99.9℃	Absolute protecting temperature point: SP+U15 0.0: disable the function	2.0℃
U30	Sensor calibration value	-20.0 ~ 20.0℃		0.0℃
U40	Output R2 timer on period's time unit	0 ~ 2	0: Second; 1: Minute; 2: Hour	0
U41	Output R2 timer on period's time	1 ~ 9999		30
U42	Output R2 timer off period's time unit	0 ~ 2	0: Second; 1: Minute; 2: Hour	1
U43	Output R2 timer off period's time	1 ~ 9999		60
U46	Output R2 working mode	0 ~ 3	0: Timer on/off 1: Over temperature protection 2: Timer on/off + Over temperature protection 3: Disable R2's function	2
U47	Control R2 during auto tuning	0 ~ 1	0: Always run; 1: R2 de-energized in auto tuning	1
U60	External input warning working mode	0 ~ 2	0: Disable; 1: Normal open; 2: Normal close	0
U70	PID proportional coefficient Kp	0.1 ~ 999.9		2.6
U71	PID integration coefficient Ti	0 ~ 9999		500
U72	PID differential coefficient Td	0.0 ~ 999.9		50.0
U73	PID output amplitude	10 ~ 100%	Percent of full heater power rate.	50%
U74	Control method	0 ~ 1	0: PID control; 1: hysteresis control	0
U76	Buzzing alarm	0 ~ 1	0: disable; 1: enable	1
U77	Enable heating output R1	0 ~ 1	0: disable heating output; 1: enable heating output	1
U99	Password	0000 ~ 9999	If 0000, password disabled	0000

Control

Timer output R2

When R2 is set as timer output (U46 = 0, or 2):

During timer on period (U41, U40), the R2 will be energized. During timer off period (U43, U42), the R2 will be de-energized.

Temperature control

PID control (U74 = 0)

PID control. The output for heater is R1.

Hysteresis control (U74 = 1)

When measured temperature ≥ Set-point (SP), R1 de-energized.

When measured temperature ≤ Set-point (SP) – U14, R1 100% energized.

Over temperature protection

When the protection function is enabled (U46 = 1 or 2), and if measured temperature ≥ high temperature warning point (SP + U13), R2 will be energized.

Over temperature alarm

If measured temperature ≥ high temperature warning point (SP + U13), buzzer beeps.

If measured temperature ≤ low temperature warning point (SP - U12), buzzer beeps.

High temperature protection

If measured temperature ≥ high temperature protecting point (SP + U15), display "tHi", beeps, R1 is disconnected.

If measured temperature ≤ SP, R1 will work again.

External input warning working mode

U60 = 0: Disable. The external input warning function is disabled;

U60 = 1: Normal open. When closed, warning, the R1 will be de-energized, the R2 still works;

U60 = 2: Normal close. When open, warning, the R1 will be de-energized, the R2 still works;

Buzzer alarm

When there is failure or warning, the buzzer beeps. Press 〖P〗 can stop beeping.

When the failure or warning disappears, the buzzer stops beeping.

Sensor

The sensor has tolerance. After calibration (U30), the absolute sensing accuracy could be 0.1 degree.
When the sensor fails (open or short), the display blinks, and there will be warning, the R1 will be de-energized, the R2 still works.

Restore system parameters to factory settings.

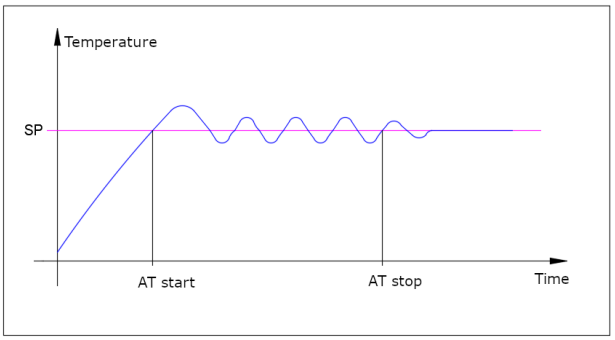
Keep 〖P〗 and 〖▲〗 depressed simultaneously for 5 seconds, display shows "UnL". Press 〖▼〗 twice, all system parameter settings will be restored to factory setting.

PID parameters Auto Tuning (AT)

With auto tuning, we can find optimized PID parameters for most control system.

Auto tuning step:

1. Set driving power rate (percent of full heater power rate, U73), or set it in step 4.
2. Set Set-point (SP).
3. In control status (not setting status), keep 〖▲〗 and 〖▼〗 depressed for 5 seconds to enter into auto tuning mode. U73's value displays, ⊖ blinks.
4. Press 〖▲〗 and 〖▼〗 to set the amplitude value (U73).
5. Press 〖P〗 to start auto tuning.



The measured temperature will rise, vibrate around SP for several times.

When ⊖ disappears,

if "At1/At2/At3/At4" displays, auto tuning fails.

if "SUC" displays, auto tuning finished, and the PID parameters got, and start to control immediately.

Press any key, the "At1/2/3/4, SUC" disappeared.

If the temperature is not able to reach SP within 180 minutes, show "At4", set bigger value of U73, tune again.

Note:

PID control, or hysteresis control?

Try hysteresis control 1st (U74 = 1):

1. Now is full power rate heating. If room temperature is not able to reach SP at reasonable time, increase the heater power rate.
2. If the temperature overshoot to SP ≤ 0.2℃, or over falling to (SP – U14) ≤ 0.2℃: auto tuning is not able to get the PID parameters correctly. In fact, this kind of system may be unnecessary with PID control.
3. If all are ok, try PID auto tuning.

Try auto tuning (U74 = 0). If the PID control result is good, then use PID control.

The following will also make auto tune failure, or get wrong parameters:

- The room temperature vibration amplitudes differ too much.
- The room temperature vibration periods differ too much.
- The room temperature changes not smoothly, because of some interference.

Try to get best parameters

If there is no heating element except the electrical heater:

Set setpoint (SP) 10-15 degree higher than the environment temperature during auto tuning.

Set setpoint (SP) 5-10 degree higher than the environment temperature during PID control.

If there is heating element besides the electrical heater, like tungsten lamp, some kind of motor, and if these element can heating the room N degree high, the setpoint (SP) should add N degree.

If the environment changed a lot, if the deposit goods inside the room changed a lot, if the heater changed, if the air flow speed inside the room, around the heater, around the sensor changed a lot, auto tuning again.

Remark for auto tuned PID parameter

The auto tuned PID parameter is "just no overshoot" parameter.

The condition to realize the control with "just no overshoot", we should remove the interference: there is no heating element besides the electrical heater. If there is, please heating the room by these elements, by setting the setpoint to zero degree (heater will not work). After the room temperature does not rise any more, remove power supply and supply power supply to reset the controller. Set setpoint (SP), start PID control.

The real heating system is complex. The "just no overshoot" may not work as wish. We could change the parameters manually.

Parameter calculation:

"just no overshoot"	KpV3	TiV3	TdV3
Super slow parameter	= 0.72 * KpV3	= 1.9 * TiV3	= 0.78 * TdV3
Fast parameter	= 3 * KpV3	= 0.42 * TiV3	= 1.3 * TdV3
Parameter auto tuned by ZL-7817A lower versions	= 1 * KpV3	= 0.83 * TiV3	= 0.65 * TdV3

Fast parameter: strong feedback, has a bigger temperature overshoot.
Super slow parameter: week feedback, do not place beside windows, better work in air conditioner environment.

Manual tuning principle

Manual tuning could change the control result.
Increase Kp (U70), increase the speed of control, but more overshoot and bigger vibration.
Increase Ti (U71), get more accurate temperature, but need longer time to reach SP after stating heating.
Increase Td (U72), fast reaction to temperature changes, but add more “small noise” to the control result.

We could auto tune during normal PID control

If hope no temperature overshoot, we could set setpoint (SP) lower for auto tuning. Set back after tuned.

PTC heater

PTC has a Curie point parameter. When PTC’s temperature is high than Curie point, its power rate will be reduced to almost zero, the PID control will fail.
With higher Curie PTC heater, with good dissipator for heater, with high air flow speed around heater to avoid the failure.

PID Attention

Avoid using heating elements besides electrical heater, like tungsten lamp, some hot motor fan.
Avoid the sensor “see” the heater, and tungsten lamp if use it, so the IR light will increase the sensed temperature.
For PID control, every time the temperature falls, it will overshoot the setpoint (SP). So, try to open the door, exhaustion air in shorter time

Installation

Attention

- Wiring work should be manipulated by certified technicians.
- Wrong connection could damage the controller, and the loads.
- Sensor and input signal wires should not be laid together with power supply wire, and even in same pipe.
- Sensor wire is better as short as possible. Not wind the redundant length wire to electrical noise equipment.
- The loads should be within the specification of the controller output driving ability. If using ac/dc module as load, or tungsten lamp, or motor, following the below requirements to avoid surging current damaging or shorten the life time of the controller outputs:

For ac/dc module as load, the rated current should be no more 1/10th of output specification **under pure resistance**.
For tungsten lamp as load, the rated current should be no more 1/15th of output specification **under pure resistance**.
For motor, the rate current should be no more 1/5th of output specification **under pure resistance**.

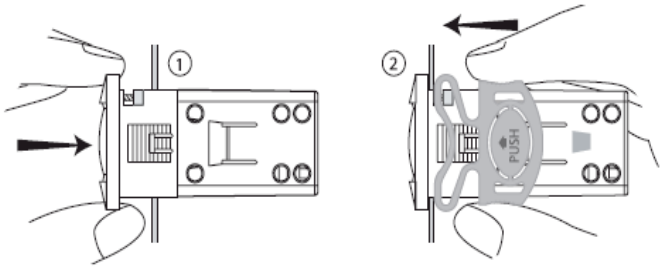
For example: if drive a 1100W tungsten lamp with 5A (**pure resistance** spec.) relay, the **relay contactor will be burnt immediately**.

- Don’t touch inside components;
- Avoid installing controller in the following environment:

More wet than 90%RH, or easily dew; Vibrating, or will be shocked; Possible sprayed; Under erosive air; Under explosive air.

Step

1st: Insert into drilling hole 2nd: Clamp



Electrical Wiring