

# SYL-1512A2 PID TEMPEARATURE CONTROLLER INSTRUCTION MANUAL

Version 1.0, Mar. 2009

Auber Instruments, 730 Culworth, Alpharetta, GA 30022

[www.auberins.com](http://www.auberins.com) e-mail: info@auberins.com Tel: 770-569-8420



## WARNING

### ·Wiring precautions

-Install an external protection circuit if failure of this instrument could result in damage to your system.

-In order to prevent instrument damage or failure, protect the power line and the input/output lines from high currents by using fuses with appropriate ratings. A very fast blowing fuse (such as an I<sup>2</sup>t fuse) is needed when the output device is a solid-state relay (SSR). Please check with your fuse supplier for the correct fuse for your SSR.

### ·Power supply

- Supply power of the specified rating.
- Do not turn on the power until all of the wiring is completed.
- Never use this instrument in the presence of inflammable gases or vapor.
- In order to prevent electric shock or burns, never touch the inside of the instrument.
- Do not attempt to modify this instrument.

### ·Maintenance

- Only authorized service engineers should replace parts.
- In order to use this instrument continuously and safely, conduct periodic maintenance. Some parts used in this instrument have a limited service life and may deteriorate over time.



## Caution

- Only clean the instrument when power is off.
- Please use a soft cloth or tissue to clean up stains on the display.
- Never use sharp & hard objects such as screwdrivers or ball pens to touch the buttons on the panel.

## 1. Specification

Input type	TC: K, E, S, R, J, T, B, WRe3-WRe25 RTD: Pt100, Cu50
Input range	See table 2.
Display	One lines, Four digits. °F or °C.
Display Resolution	1°C, 1°F, or 0.1°C, 0. 1°F, with Pt100
Accuracy	±0.2% or ±1 unit of full input range
Control mode	PID, On-Off. Limit
Output mode	Relay contact: 3A at 240 VAC, SSR: 8VDC, 40 mA.
Alarm	Process high/low alarm,
Power consumption	<2 Watt
Power supply voltage rating	85~260VAC/50~60Hz or 85-360 VDC
Dimension	24 x 48 x 75mm (1/32 DIN), (Mounting cut out 45x22 mm.)

## 2. Front Panel and Operation

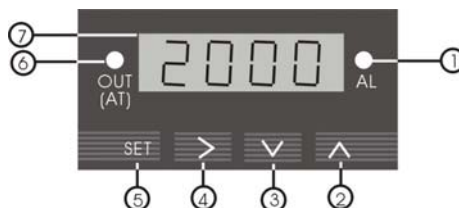


Figure 1

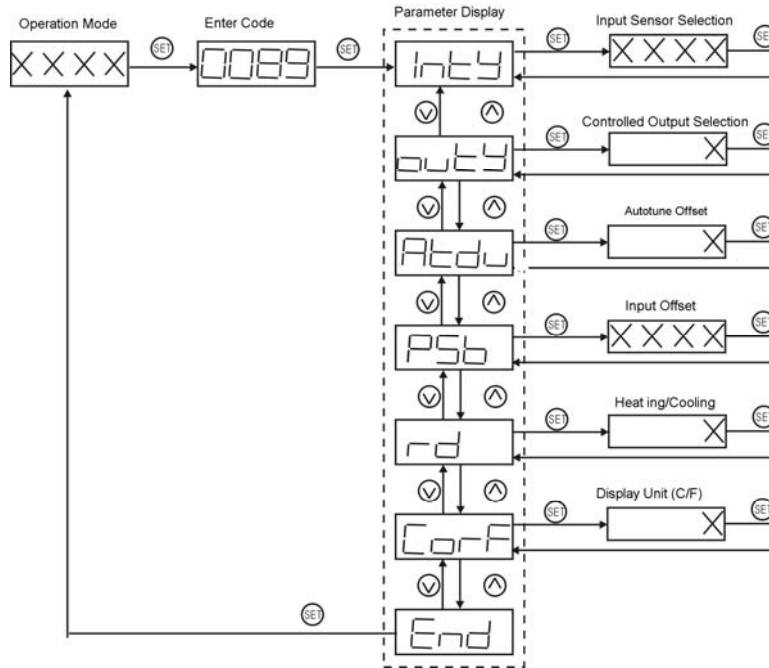
① AL- Relay J1 output indicator

- ② Select next parameter/value increment.
- ③ Select previous parameter/value decrement
- ④ Digit shift/Auto tuning
- ⑤ Set/Confirm, For limit control mode, press it for 5 second will start the control
- ⑥ OUT- SSR output indicator (AT) - blinking during auto-tuning process
- ⑦ Parameter Display

### 3. Parameter Setting

#### a) System Configuration Parameters

Press **SET**, enter code “0089” press **SET** again. Then, following the flow chart in Fig. 2



**Figure 2 Setup flow chart**

- 1) Press **SET** to enter setting mode;
- 2) Press **▷**, **▽** and **△** to enter parameters;
- 3) Press **SET** to confirm;
- 4) Press **▽** or **△** to select the new parameter

**Table 1, Configuration Parameter Setting**

Code	Description	Setting Range	Initial Setting	Note	
Inty	Inty	Input Type	See table 2	K	
outy	outy	Control output mode	0, 1, 2, 3, 4, 5	2	1
Hy	Hy	Hysteresis Band	0-9999	3	3
Atdu	Atdu	Autotune offset	0~200(deg)	10	2
PSb	PSb	Input offset	-100~100(deg)	0	
rd	rd	Control function	0: heating 1: Cooling	0	
CorF	CorF	Display Unit	0: °C 1: °F	1	
End	End	Exit			

**Note 1.** The value of **outy** determines the control mode. When it is set to:

- 0: Relay J1 as alarm output; SSR output disabled.
- 1: Relay J1 as PID controlled relay contact output. SSR output disabled.
- 2: Relay J1 as alarm output; SSR PID control output.
- 3: Relay J1 as alarm output; SSR On/off control output.
- 4: J1 as On/off control relay contactor output. SSR output disabled.
- 5: J1 as Limit control output

**Note 2.** The autotune offset will shift the SV value down by the Atdu value during the auto tune process. That will prevent the system from damaging due to over temperature during the autotune.

**Note 3.** Hysteresis Band (also called dead band, or differential), Hy, is used for on/off control and limit control. Its unit is degree (C or F). For on/off control mode, the output will be off when  $PV > SV$  and on again when  $PV < SV - Hy$  for heating. For cooling, the output will be off when  $PV < SV$  and on again when  $PV > SV + Hy$ . For limit control mode, the controller will not be reset (to turn on the output) when  $PV > SV - Hy$  for heating, and when  $PV < SV + Hy$

Table 2, Temperature sensor code.

Symbol	Description	Working Temperature Range
t	T Thermocouple	-200~400 °C; -320~752 °F
r	R Thermocouple	-50~1600 °C; -58~2900 °F
j	J Thermocouple	-200~1200°C; -320~2200 °F
WRE	WRe3- WRe25 Thermocouple	0~2300°C; 32~4200 °F
b	B Thermocouple	350~1800°C; 660~3300 °F
S	S Thermocouple	-50~1600°C; -58~2900 °F
K	K Thermocouple	-200~1300°C; -320~2400 °F
E	E Thermocouple	-200~900°C; -320~1650 °F
P10.0	Pt100 RTD	-99.9~600.0°C; -99.9~999.9 °F
P100	Pt100 RTD	-200~600°C; -320~1100 °F
Cu50	Cu50 RTD	-50.0~150.0°C; -60~300 °F

### b) PID Parameters

To enter PID parameter setting mode, press **SET**, enter code “0036”, press **SET** again. The parameter flow chart is similar to Fig. 2

Table 3, PID and relevant parameters

Symbol	Description	Setting range	Initial Setting	note
P	Proportional Constant	0.1~99.9 (%)	5.0	4
I	Integral time	2~1999(Sec)	100	5
d	Derivative time	0~399(Sec)	20	6
SouF	Damp constant	0.1~1.0	0.2	7
ot	Cycle rate	2~199(sec)	2	8
FILT	Digital filter strength	0~3	0	9
End	Exit			

The values of the P, I, and D parameters are critical for good response time, accuracy and stability of the system. Using the Auto-Tune function to automatically determine these parameters is recommended for the first time user. If the auto tuning result is not satisfactory, you can manually fine-tune the PID constants

for improved performance.

**Note 4.** Proportional Constant (P): P is also called the proportional band. Its unit is the percentage of the temperature range. e. g. For K type thermocouple, the control range is 1500 C. P=5 means the proportional band is 75 C (1500x5%). Assuming the set temperature (SV) = 200. When integral, I. and derivative, d, actions are removed, the controller output power will change from 100% to 0 when temperature increases from 135 to 200C. The smaller the P is, the stronger action will be for the same temperature difference between SV and measured temperature (PV). .

**Note 5.** Integral time (I): Brings the system up to the set value by adding a constant to the output that is proportional to how far the process value (PV) is from the set value (SV) and how long it has been there. When I decreases, response speed is faster but the system is less stable. When I increases, respond speed is slower, but system is more stable.

**Note 6.** Derivative time (d): Responds to the rate of PV change, so that the controller can compensate in advance before |SV-PV| gets too big. A larger number increases its action. Setting d-value too small or too large would decrease system stability, causing oscillation or even non-convergence.

**Note 7.** Damp constant: This constant can help the PID control further to improve the control quality. It uses the artificial intelligent program to damp the temperature overshoot. When its value is too low, the system might overshoot. When it is too high, the system will be over damped.

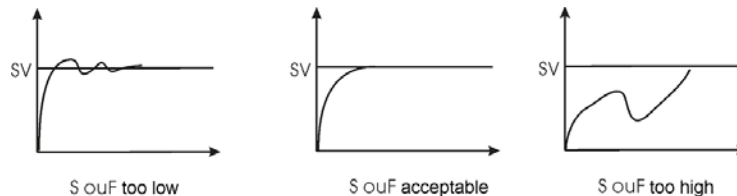


Fig 3.

**Note 8.** Cycle rate (ot). It is the time period (in seconds) that controller used to calculate its output. e. g. If ot=2, and controller output is 10%, the heater will be on 0.2sec and off 1.8 second for every 2 seconds. Smaller ot result in more precision control. For SSR output, ot is normally set at 2. For relay or contactor output, it should be set longer to prevent contacts wear out too soon. It normally set to 20~30 seconds.

**Note 9.** Digital Filter (Filt): Filt=0, filter disabled; Filt=1, weak filtering effect; Filt=3, strongest filtering effect. Stronger filtering increases the stability of the readout display, but causes more delay in the response to changes in temperature.

**c) Temperature setting and Alarm setting**

To enter the temperature and alarm parameter setting mode, press (SET), enter the code “0001”, and press (SET) again. The parameter flow chart is shown in Fig. 2

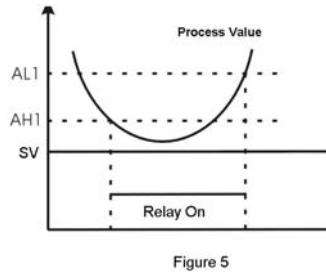
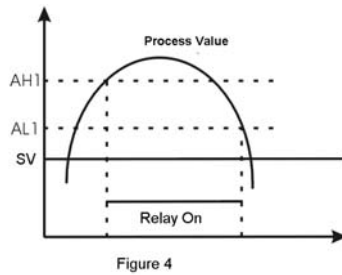
Table 4. Temperature and Alarm Parameter

Symbol		Description	Initial setting	Note
SV	SV	Target temperature (Set Value)	800	11
AH1	AH1	Alarm on temperature	800	12
AL1	AL1	Alarm off temperature	900	
End	End	Exit		

**Note 11.** The SV can also be set directly during the normal operation mode. Press (^) or (v) key to switch the display from process value (PV) to set value (SV). Press (^) or (v) key again to increase or decrease SV by 1 degree.

**Note 12, Relay J1 value (only available when Outy is set to 0, 2, and 3)**

- ① When AH1=AL1, relay is disabled,
- ② AH1 > AL1 is for absolute high alarm. See fig. 4.
- ③ AH1 < AL1 is for absolute low alarm. See fig. 5.



**4. Auto-Tuning**

Auto-Tuning function (also called self tuning) can automatically optimize the PID parameters for the system. The auto-tuning function will use the on/off mode to heat up the system until it pass the set point. Then let it cool down. It will repeat about three times. Based on the response time of the system, the built-in artificial intelligence program will calculate and set the PID parameters for the controller. If your system has a very slow response, the auto tune could take a long time.

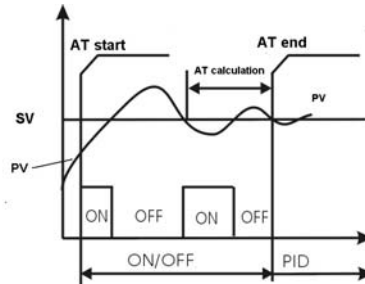


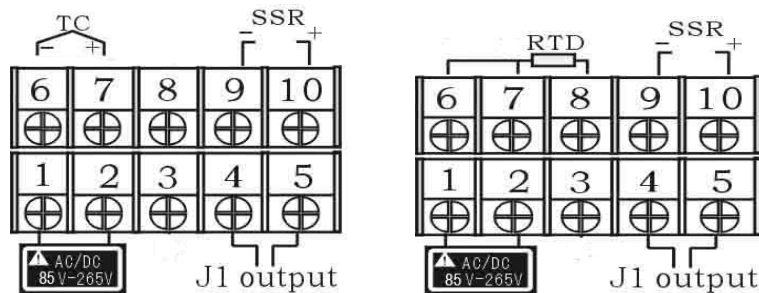
Figure 6

A) To activate auto-tuning, press and hold ⊕ key until the “AT” indicator starts to blink, which indicates auto-tuning is in progress. When “AT” stops blinking, the auto-tuning is finished. Now, newly calculated PID parameters are set and are used for the system. Please note that Auto-tuning is only for PID control mode (when “outy” is set at 1 or 2)

B) To stop the auto-tuning, press and hold ⊕ key until “AT” indicator stops blinking. Then, the previous PID parameters value are resumed,

**5. Terminal Wiring (back view)**

The polarity of power at terminal 1 and 2 do not matter.



**Figure 7.** Wiring diagram with thermocouple (TC) input on the left and RTD input on the right. Please note that if the RTD is connected by two wires instead of three wires (for short distance application), the terminal 6 and 7 need to be shorted.

**6. On/off control mode.**

On/off control mode is not as precision as PID control mode. But it is necessary for inductive load such as the motor, compressor, and solenoid valve that does not like to take pulsed power. It works like a mechanical thermostat. When the temperature passes the set point, the heater (or cooler) will be turned off. When the temperature drops back to below the hysteresis band (dead band) the heater will be on again.

To use the On/off mode, set Outy to 3 or 4 depending on the output device to be used. Then, set the Hy to desired range based on control precision requirement. Smaller Hy results in tighter temperature control but also cause the on/off action more frequent. In the PID parameters menu (code 0036), only ot and FILT is used. P, I, D and souf are not meaningful.

**7. Limit control mode.**

The limit control mode will shut off the heater when the (SV) is reached. The heater will not be turned on again until the controller is reset manually (press the SET for 5 seconds). When powered on, it will not start the heating until reset button pressed. The controller can't be reset when the temperature is within the hysteresis band (Hy).

To use the Limit control mode, set Outy to 5. Then, set the Hy to the range that you want reset to be blocked. To start the heating or cooling, press SET key for 5 second or until the AL LED is on.

**8. Application Example**

A furnace that can operate in the 0°C~1000°C range needs to be controlled at 800°C. Alarm (powered by the same line voltage) will go off if T > 850°C, Power source is 220VAC, Heating element is switched by a SSR. K type thermocouple is used as the temperature sensor.

a) Wiring diagram

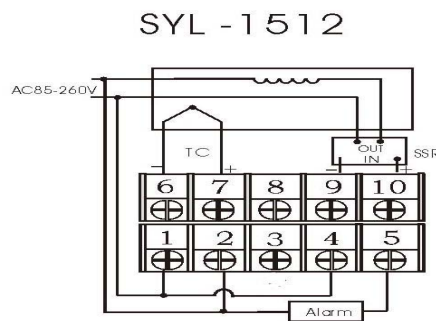


Figure 8,

b) Parameter setting,

(Inty) =K, (outy) =2, (PSb) =0, (rd) =0, (CorF) =0, (FILt) =0

Auto-tunig is used to set the PID parameters.

(SV) =800°C, (AH1) =850°C, (AL1) =848°C

Power up the controller. Press and hold the ⊙ key until “AT” starts to blink. The controller starts the Auto-tuning. When the “AT” stops blinking, the new PID parameters are generated for the system. The controller is in normal operation mode. The furnace will be maintained at 800°C .