INKBIRD®

PID Temperature Controller

IPB-16S

User Manual

Version 1.0

Inkbird Tech.C.L

Support@ink-bird.com

www.ink-bird.com

Shenzhen, GD, 518000, China

Catalogue

7. Warranty and service

7.1 Technical Assistance

If you have any problems installing or using this thermostat, please carefully and thoroughly review the instruction manual. If you require assistance, please write us to **Support@ink-bird.com**. We will reply your emails in 24 hours from Monday through Saturday.
You can also visit our web site **www.ink-bird.com** to find the answers of the common technical questions.

7.2 Warranty

INKBIRD TECH. C.L. warrants this thermostat for one year from the date of purchase when operated under normal condition by the original purchaser (not transferable), against defects caused by INKBIRD's workmanship or materials. This warranty is limited to the repair or replacement, at INKBIRD's discretion, of all or part of the thermostat. The original receipt is required for warranty purposes.
INKBIRD is not responsible for injury property damage or other consequential damages or damages of third parties arising directly from an actual or alleged in mater of workmanship of the product.
There are no representations, warranties, or conditions, express or implied, statutory or otherwise, other than herein contained in the sale of goods act or any other statue.

6. Common Faults and Handling Methods

Faults	Reasons	Handling methods
PV and SV screen not work	Wrong input voltage	Check whether the input voltage is in accordance with the specification of the instrument
	Power cable is not well connected	Check whether the power cable is bad or wrongly connected
	Instrument fault or blowout	Contact the manufacturer or change the fuse with the same specification
OrAL displaying	Sensor fault	Change the sensor
	Wrong input sensor type selected	Select the correct input sensor type code
	Wrong sensor connection	Connect the sensor wire correctly
Wrong measured value	Wrong input sensor type selected	Select the correct input sensor type code
	Wrong sensor connection	Connect the sensor wire correctly
No control output	Wrong alarm setting	Refer to the instruction to select the correct alarm mode
	Fault of controller	Contact the manufacturer
No alarm output	Wrong wiring of the output	Connect the output wire correctly

1. Safety Precautions

- Ensure the product is using within the specification.
- Do not touch the terminals at least while power is being supplied. Doing so may occasionally result in injury due to electric shock.
- Do not allow pieces of metal, wire clippings, or fine metallic shaving or filings from installation to enter the product. Doing so may occasionally result in electric shock, fire, or malfunction.
- Do not use the product where subject to flammable or explosive gas. Otherwise, injury from explosion may occasionally occur.
- Never disassemble, modify or repair the product or touch any of the internal parts. Electric Shock, fire, or malfunction may occasionally occur.
- The max current of this controller is 15A. As for the U.S. and Canada AC 120V, the controller's load power limit is 1800W.
- The sensor must be in the controlled object when running the controller. Otherwise, the temperature of the controller will be low even if the controlled object is heating. Then the controller will provide heater with full power which may cause the controller over-heat, damage the device and even cause fire.
- Any abnormal indication or noise is being observed, turn off the controller, unplug the power, and contact the manufacturer before reusing.

2. Technical parameter

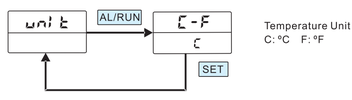
Input voltage	AC 100~240V 50/60Hz
Output voltage	AC 100~240V 50/60Hz
Max output current	Heat:15A for 120V AC, 12A for 220V AC
	PUMP : 8A for 120/250VAC (resistance load)
Heat output	Built-in optical isolated SSR of the output switch device with no-voltage crossbar switch.
Pump output	Relay output: AC 250V 8A（resistance load） Relay electric life: 100000 times
Character display	PV/SV: 14.2mm character height red high light LED
Sensor Type	NTC sensor (R25 °C=10KΩ)
Probe cable length	6.5 ft (2 meter)
Temperature resolution	0.1°C or 0.1 °F
Temperature Control Range	-50~125°C / -58~257°F
Unit display	Celsius or Fahrenheit
Sampling period	0.5 second
Weight	About 1250g
Dimensions	73x159x174mm
Working environmental temperature	-10~55°C/14~131°F (no freeze or condensation)
Working environmental humidity	RH 35-85%
Storage environmental temperature	-25~65°C/-13~149°F (no freeze or condensation)

P: Proportional band, to accelerate the response speed and improve the adjustment accuracy of the system. The response speed and adjustment accuracy of the system will be improved by increasing P, but this may easily bring the overshooting and even the instability to the system. The too small value of P will reduce the accuracy, slow the response speed, delay the adjustment time and even break the static and dynamic performance of the system.

2) I: Integration time, to eliminate the steady-state errors of the system. The larger I value, the faster the steady-state errors can be eliminated, but too large I value will cause the integral saturation phenomena at initial stage of response process. If I value is too small, it will be hard to eliminate the steady-state errors of the system and it will also affect the adjustment accuracy of the system.

3) D: Derivative time, to improve the dynamic performance of the system, and its main function is to restrain deviation's change in response process, and forecast the deviation change. But too large D value will advance the braking in response process, delay the adjustment time and will even degrade the anti-interference performance of the system.

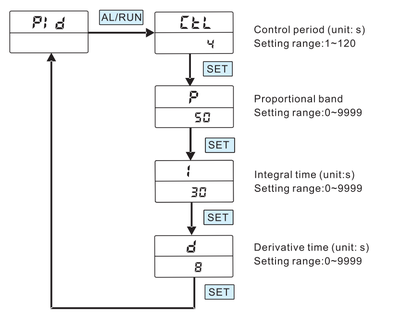
5.6 Unit Parameters Setting



Temperature Unit
C: °C F: °F

C-F: temperature unit: C for Celsius (°C); F for Fahrenheit (°F).

5.5 PID Parameters Setting



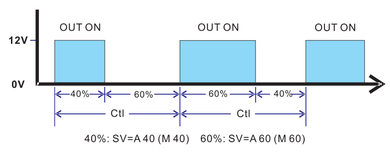
Control period (unit: s)
Setting range:1~120

Proportional band
Setting range:0~9999

Integral time (unit:s)
Setting range:0~9999

Derivative time (unit: s)
Setting range:0~9999

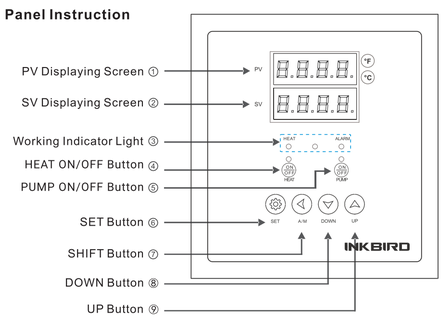
1) Ctl: Control period, setting range 0.5-120 seconds（0=0.5second）, the controlling accuracy will be higher if set Ctl within 4 seconds when in SSR control output, and normally set Ctl to 20 seconds when in relay control output. The time of Ctl can be shortened if there is not the satisfaction temperature controlling required. But based on the different heating system, the shorter control period will be accordingly shorten the working time of the mechanical switch.



40%: SV=A 40 (M 40) 60%: SV=A 60 (M 60)

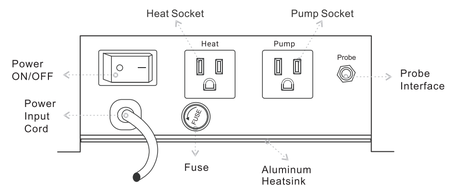
Time scale output figure

3. Panel Instruction



① **PV Displaying Screen:** Display the measuring value or the setting parameters.
② **SV Displaying Screen:** Display setting value or the set parameters readout.
③ **Working Indicator Light**
HEAT: Control Output Indicating
ALARM: Alarm Indicating
④ **HEAT ON/OFF Button:**Press it to turn on the heating output, the green lamp is on, and then press again to turn the heating output off , the green lamp is off.
⑤ **PUMP ON/OFF Button:** Press it to turn on the pump output, the green lamp is on, then press it again to turn pump output off, the green lamp is off.
⑥ **SET Button:** Press this button can read the value of control output and the set temperature. Hold and press this SET button for 3s or more will enter into the parameters settings mode.
⑦ **SHIFT BUTTON:** When setting the value or parameters,
A, Press this button will switch to the required value position.
B, Press this button will shift to the sub menu from the main menu.
C, Press this button can be freely switching to another mode from manual or the automatic operation.
⑧ **DOWN Button:** When setting the value, pressing the down button can be decrease the value that would be reduced rapidly by keeping press this button.
⑨ **UP Button:** When setting the value, pressing the up button can be increase the value that would be added rapidly by keeping press this button.

Flank Panel



Note: Please keep dry and ventilated at the bottom of the heatsink.

4. Display Modes

4.1 Display Modes

Note: Please get the flow charts in the following page.

- Display Model 1: When power on, with all LED displaying, and the version number of the software will display 1 second later. Then 1 second later, display temperature unit, such as C in display 1: temperature unit =°C, display F =°F.
- Display Mode 2: In operating mode, PV displays current temperature value, SV displays setting value.
- Display Mode 3: Press the shift button for 3 seconds to switch to the manual output mode, press the button again to switch back to the automatic output mode.
- Display Mode 4: Press SET for 3 seconds to enter into main menu, displaying with the parameters type; press shift button to enter into submenu to change parameters setting, for the detailed parameter definition, please see table 3 or setting flow chart.

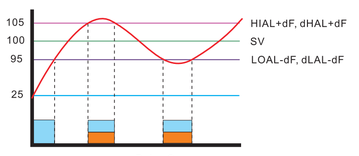
1) Alarm Mode
- Set to 0: Power on alarm prevent, this will avoid alarming if the room temperature is far lower(higher) than the alarm set value when power on.
Alarm will be activated at the first time when power on the controller, the PV value rise (drop) to the same value as the SV and reach the alarm set value.
- Set as 1: Power on with alarm, alarming will be activated once PV reach alarm set value. If need change the alarm control to heating (cooling) control output, it should be set to power no alarm prevent mode.

2) HIAL: High limit alarm, will be activated when measuring value higher than HiAL value, formula: PV＞HiAL+DF(Hysteresis value).
3) LOAL: Low limit alarm, will be activated when measuring value lower than LOAL value, formula: PV＜LOAL-DF(Hysteresis value).

4) DHAL: Positive deviation alarm, alarm will be activated when measuring value higher than DHAL value, formula: PV＞DHAL +DF(Hysteresis value).

5) DLAL: Negative deviation alarm, alarm will be activated when measuring value higher than DLAL value, formula: PV＞DLAL -DF(Hysteresis value).

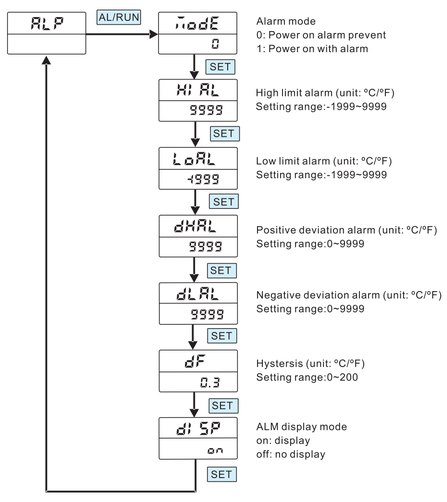
6) DF: Hysteresis, also called temperature hysteresis, setting range 0-200℃ or ˚F(0=0.3℃ or ˚F). Set to avoid the false operation with frequent on-off from alarm output caused by the fluctuation of the input measuring value. DF hysteresis is work on both ON/OFF control and alarm setting. Alarm setting example:



Alarm setting figure

1) DISP: Alarm display
- ON: The alarm sign will be flashed in PV display window when alarming.
- OFF: No alarm sign in PV display window when alarming.

5.4 Alarm Parameters Setting



Alarm mode
0: Power on alarm prevent
1: Power on with alarm

High limit alarm (unit: °C/°F)
Setting range:-1999~9999

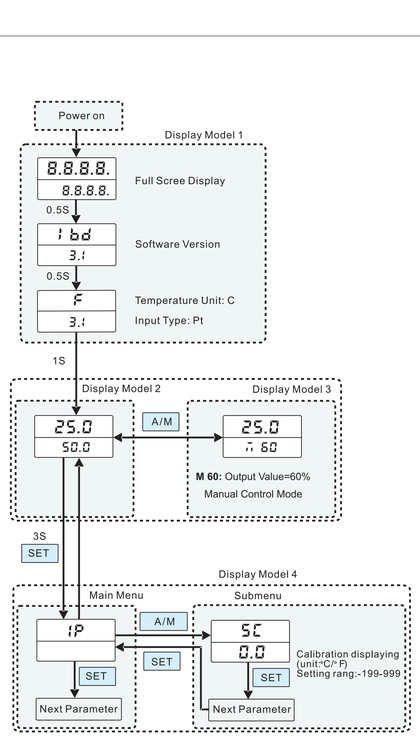
Low limit alarm (unit: °C/°F)
Setting range:-1999~9999

Positive deviation alarm (unit: °C/°F)
Setting range:0~9999

Negative deviation alarm (unit: °C/°F)
Setting range:0~9999

Hystersis (unit: °C/°F)
Setting range:0~200

ALM display mode
on: display
off: no display



4.2 Operation Instruction

4.2.1 Change Setting Value (SV)

Press ▲ or ▼ button then release, there will be flickering decimal point in the lower right corner at far-right of the SV setting value, then press ▲ or ▼ button to change the value; if need to change to larger value, then press the shift button to move the flickering decimal point to the position of the desired value, or press and hold ▲ or ▼button to get the desired value with rapidly changing; then press SET button to save the changed value, the flickering decimal point will turn off and operate. The controller will automatically save the changed value and operate after 15 seconds without any operation of the SET button or other buttons.

4.2.2 Change Displaying Mode

Display mode 2: in automatic running state, PV displays current temperature, SV displays set temperature; press A/M button for 3 seconds to enter display mode 3, PV displays current temperature, SV displays setting value of output. If you press the button again, it will return to display mode 2.

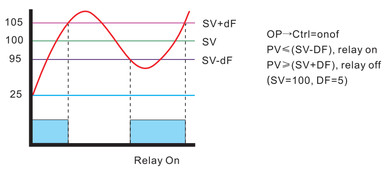
4.2.3 Automatic Mode/Manual Mode Conversion

Press the A/M (switch) button for 3 seconds to switch to the automatic or manual mode.
If you switch to the manual mode, the leftmost side of the SV will display M (eg: M0~M100).
In this mode, the output value can be set arbitrarily.

4.2.4 Self-tuning

The factory defaults setting is fuzzy PID control mode, if need to change to self-tuning mode, then enter into the menu to select OP (output type) - Ctrl (control mode)-At (Self-tuning). When in self-tuning, the temperature may exceed the setting temperature value (will be different value with different heating system) with On-Off controlling. At this time, there will be alternate displaying in SV (setting value) and "AT" value until the self-tuning finished.

1) Control Mode Ctrl
- PID: default control mode, can be used at the first using, if there is not the controlling accuracy required, then can be changed to Self-tuning mode.
- AT: Self-tuning control mode, can be set when there is not the required controlling accuracy by PID control mode, then the controller will be changed to on-off controlling. After 2-3 times switch actions of the temperature controlling, the microprocessor will analyze period, amplitude and oscillation wave caused by on-off control, then calculate the optimum parameter value. When in self-tuning, the temperature may exceed the setting temperature, and cause alarm, but there will be different value with different heating system. If there is not the required temperature value after self-tuning, then try to change the PID initial value before the self-tuning, or restart the self-tuning.
- R: Reset to Factory Defaults, the PID parameters will be recovered to the defaults. After set the R, the self-tuning can be activated by pressing the shift button for more than 3 seconds, same operation as setting the AT to activate the self-tuning. After the self-tuning, the controller will be automatically enter into the PID setting, there is the optimal parameters saved after the self-tuning.
- ON/OFF: On-Off Control, same as the mechanical thermostat, used in general controlling. The heating (cooling) will turn off when the temperature reach the set-point (set temperature value + temperature hysteresis value); and the heating (cooling) will turn on when the temperature drop to the set-point (set temperature value - temperature hysteresis value). The smaller hysteresis value set, the higher accuracy the controller control, but will cause the more frequent output control.



OP→Ctrl=onof
PV≤(SV-DF), relay on
PV≥(SV+DF), relay off
(SV=100, DF=5)

On/Off Control Figure

Control Operation Selection
- HEAT: Heating, the factory default with heating settings.
- COOL: Cooling, in cooling element control.

5.3 Output Parameters Setting

Control mode
AT: Self-tuning
R:Reset to Factory Defaults

Select the control system
H: Heating
C: Cooling

Operation Mode
DM: Manual inhibit
AUTO: Automatic
MANU: Manual

2) Calibration Displaying SC
And this can be calibrated by setting SC parameter with the range of -199~999℃ or ˚F, the formula: actual temperature –measuring temperature = SC setting value. This can be set at room temperature status.
e.g., Ensure there is default SC value before calibrating. If the actual temperature room temperature is 25°C, but the controlling measuring the temperature at 20°C, then set SC to 5.0°C as the formula: 25°C-20°C=5°C.

3) Digital Filtering DL
There is the built-in digital filtering system of the temperature controller, if there is displaying with the frequent changing temperature values caused by the input interference, this dL can be set to get the stable average value. dL=0—20, the larger dL value set, the more stable measuring value will get, but also the slower response.
If there is no interference from working environment, then the dL value can be increased gradually until the instant alteration of the measuring values within 2-5 units. When verifying the instruments, the dL value should be set to 0 to speed up the response.

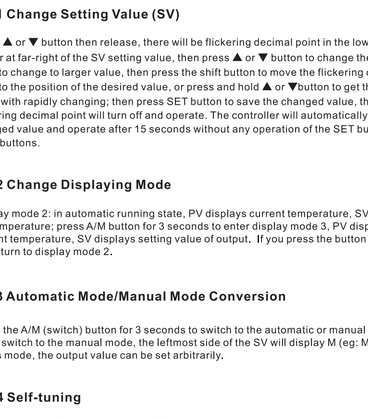
5. Parameter Setting

Main Menu Parameter	Function Setting	Description	Setting Range	Default	Note
IP	SC	Sensor Calibration	-199~999 °C or °F	0	5.2
	dL	Digital filtering	0~20	0	
OP	Ctrl	Control mode	PID: PID control AT: Self-tuning r: Reset to factory defaults ON/OF: On-Off control	PID	
	H-C	Control system	HERT: heating COOL: cooling	H	5.3
ALP	Mode	Alarm Mode	0：Power on alarm prevent 1： power on with alarm	0	5.4
	HIAL	High limit alarm	-1999~9999 °C or °F	9999	
	LoAL	Low limit alarm	-1999~9999 °C or °F	-1999	
	dHAL	Positive deviation alarm	0~9999 °C or °F	9999	
	dLAL	Negative deviation alarm	0~9999 °C or °F	9999	
	dF	Hysteresis	0~200 °C or °F	0.3	
PId	Ctl	Control Period	1~120 seconds	4	5.5
	P	Proportional band	0~9999 %	50	
	I	Integral time	1~9999	30	
	d	Derivative time	1~9999	8	
unit	C-F	Temperature Unit	C: °C F: °F	C	5.6

Note: You can get the detailed setting instructions in the following content according to the direction in the Note column.

5.1 Setup Flow Chart

Main Menu Operation Flow Chart



1) Press SET button for 3 seconds to enter into main menu, Output Parameters, Alarm Parameters, PID Parameters and Unit Parameters can be selected. Then press shift button to enter into the submenu if need to change the settings.

5.2 Input Parameters Setting