YUDIAN

ARTIFICIAL INTELLIGENCE TEMPERATURE CONTROLLER

AI-509 (V9.0) Operation Manual

FEATURES

- Designed for plastic machinery, food machinery, packaging machinery, industrial kilns, furnace and environmental testing equipment. This is an economic and time-efficient controller. Operation interface is simple and user-friendly.
- Universal 100~240VAC or 24VDC supply power supported. Power frequency 50Hz/60Hz and C/F unit supported.
- Multiple thermocouples and RTDs are selectable. Advanced modular structure, conveniently providing various outputs options, and making quick delivery and easy maintenance.
- Artificial intelligence control algorithm with auto tuning applied. Precise control achieved with no overshooting.
- High quality and performance hardware design, using high performance tantalum capacitor or ceramic capacitor. Compared to competing models, it consumes less electricity, experiences less temperature shifting, provides higher stability and reliability and can work in a wider range of temperature.
- ISO9001 certification and CE certified, achieving world class level of quality, anti-interference ability and safety.

MODEL CODE DEFINITION

The model code of AI-509 is made up of 5 parts, for example:

AI-509	A	G	L0	L0
①	②	③	④	⑤

① **Model number**

AI-509 Economical artificial Intelligence Temperature Controller 0.3%FS ± 0.1℃

② **Panel Dimension**

Size	Front Panel width×height	Cut Out width×height	Depth Behind Mounting Surface
A	96×96mm	92×92mm	100mm
D	72×72mm	68×68mm	95mm
D2	48×48mm	45×45mm	95mm
E	48×96mm	45×92mm	100mm
F	96×48mm	92×45mm	100mm

③ **Modules available for main output (OUTP)**

L1 Relay contact output, capacity 2A/250VAC, large size, electrical sparks absorption only in normal open terminals

L2 Relay contact output NO+NC, capacity 1A/250VAC, compact size

G SSR voltage output, 12VDC/30mA

W1 TRIAC non-contact normally open discrete output, suitable for AC contactors ≤ 80A. Low interference and longer lifespan.

K1 TRIAC zero crossing trigger output. One loop of trigger output, suitable for single-phase power.

K3 Three phases TRIAC zero crossing trigger output. triggering 0~500A TRIAC, 2 inversely parallel connected SCR or TRIAC power module.

④ **Modules available for alarm (ALM), as first alarm channel**

N (or leaving blank) No module installed

L0 Relay contact output NO+NC, capacity 2A/250VAC, large size, supporting AL1 alarm

L2 Relay contact output NO+NC, capacity 1A/250VAC, compact size, supporting AL1 alarm

L3 Two channel relay contact output NO+NO, capacity 2A/250VAC, supporting both AL1 and AL2 alarms

⑤ **Modules available for alarm (ALM), as first alarm channel**

N (or leaving blank) No module installed

L0 Relay contact output NO+NC, capacity 2A/250VAC, large size, supporting AU1 alarm

L2 Relay contact output NO+NC, capacity 1A/250VAC, compact size, supporting AU1 alarm

L3 Two channel relay contact output NO+NO, capacity 2A/250VAC, supporting both AU1 and AU2 alarms

Note 1: For instrument of dimension D2, because of its limited volume, when L0 or L3 module is installed in AUX slot, L1 can't be installed in OUPT slot, but L2, which is smaller, can be installed instead.

Note 2: K3 can't be installed in instrument with dimension D or D2. There isn't ALM slot in D2 instruments. L3 module can't be installed in ALM slot of instrument with dimension D.

TECHNICAL SPECIFICATION

- **Input type :** K, S, R, E, J, N, Pt100
- **Measurement range :**
  K(0~1300 ℃), S(0~1700 ℃), R(0~1600 ℃), E(0~1000 ℃), J(0~1200 ℃), N(0~1300℃), Pt100(-200~800℃)
- **Measurement accuracy :** AI-509 : 0.3%FS±0.1℃
- **Temperature display resolution :** AI-509 : 0.1℃/℉
- **Control Mode:** On-Off Control or Artificial Intelligence PID control with auto tuning.
- **Output mode (modularized) :**
  L1 Relay contact output module (Normal open. Capacity: 2A/250VAC or 30VDC/2A)
  L2 Relay contact output module (Capacity: 1A/250VAC, small volume)
  G SSR voltage output module (12VDC/30mA)
  W1 TRIAC no contact normally open discrete output module (Capacity: 100~240VAC/0.2A, instantaneous current 2A with time<20ms and repeat period>5s)
  K1 Thyristor zero crossing trigger output module (can trigger TRIAC, a pair of inversely parallel connected SCRs or SCR power module with current rating of 5-500A)
  K3 Three phases TRIAC zero crossing trigger output. triggering 0~500A TRIAC, 2 inversely parallel connected SCR or TRIAC power module.
- **Alarm function :** High limit/low limit, and deviation high/deviation low alarm. Installing relay modules as alarm is optional.
- **Power supply :** 100-240VAC, -15%, +10% ; 50-60Hz
- **Power consumption:** ≤ 3W
- **Ambient :** Temperature of -10~+60℃ /14-140 ℉ ; humidity of 0~90RH%

FRONT PANEL AND OPERATION

① Upper display window, displays PV, or code of a parameter

② Lower display window, displays SV, alarming code , or value of a parameter

③ Setup key, for accessing parameter tables, and confirming change

④ Data shift key, also for activating auto turning

⑤ Data decrease key

⑥ Date increase key

⑦ Indicator lamps: (OP1, AL1, AL2, AU1and AU2 indicate the I/O actions of the corresponding modules)

Basal display status : When power on, the upper display window of the instrument shows the process value (PV). and the lower window shows the setpoint (SV).This status is called basic display status. When the input signal is out of the measurable range (for example, the thermocouple or RTD circuit is break, or input specification sets wrong), the upper display window will alternately display "orAL" and the high limit or the low limit of PV, and the instrument will automatically stop output.

OPERATION DESCRIPTION

● Setpoint Setting

In basic display status, if the parameter lock"Loc"isn't locked, we can set setpoint (SV) by pressing ◁ / ▽ or △ . Press ▽ key to decrease the value, △key to increase the value, and ◁ key to move to the digit expected to modify. Keep pressing ▽ or △ , the speed of increasing or decreasing value gets quick. The range of setpoint is between the parameter SPL and SPH. The default range is 0~400℃ .

● Parameter Setting

In basal display status, Press ↻ and hold for about 2 seconds can access Field Parameter Table. Pressin ↻ can go to the next parameter; pressing ◁ / ▽ or △ can modify the ralue of a parameter. Press and hold ◁ can return to the preceding parameter. Press ◁ (don't release) and then press ↻ simultaneously can escape from the parameter table. The instrument will escape automatically from the parameter table if no key is pressed within 25 seconds.Setting Loc=808 and then press ↻ can access System Parameter Table.

● Artificial Intelligence control and auto tuning

When AI PID control method is chosen (CtrL=APId), the PID parameters can be obtained by running auto-tuning. In basal display status, press ◁ for 2 seconds, the "At" parameter will appear. Press △ to change the value of "At" from "oFF" to "on", then press ↻ to active the auto-tuning process. During auto tuning, the instrument executes on-off control. After 2 cycles of on-off action, the instrument will obtain the values of PID parameter . If you want to escape from auto tuning status, press and hold ◁ for about 2 seconds until the "At" parameter appear again. Change "At" from "on" to "oFF", press ↻ to confirm, then the auto tuning process will be cancelled.

Note 1: AI-509 adopts artificial intelligence control algorithm with auto tuning function, avoiding the overshoot problem of standard PID algorithm and achieving precise control.

Note 2: If the setpoint is different, the parameters obtained from auto-tuning are possible different. So you'd better set setpoint to an often-used value or middle value first, and then start auto-tuning. For the ovens with good heat preservation, the setpoint can be set at the highest applicable temperature. It is forbidden to change SV during auto tuning. Depending on the system, the auto-tuning time can be from several seconds to several hours.

Note 3: Parameter CHYS (on-off differential, control hysteresis) has influence on the accuracy of auto-tuning. Generally, the smaller the value of CHYS, the higher the precision of auto tuning. But CHYS parameter value should be

large enough to prevent the instrument from error action around setpoint due to the oscillation of input. CHYS is recommended to be 2℃ .

Note 4: AI series instrument has the function of self-learning. It is able to learn the process while working. The control effect at the first run after auto tuning is probably not perfect, but optimal control result will be obtained after a period of time because of self-learning.

PARAMETERS AND SETTINGS

● Field parameter table (Press ⟲ and hold for 2 seconds to access)

Code	Name	Description	Setting Range	default
HIAL	High limit alarm	Alarm on when PV>HIAL; Alarm off when PV<HIAL-AHYS.Set to 3000 will disable this function.	-999~ +3000	3000
LoAL	Low limit alarm	Alarm on when PV<LoAL; alarm off when PV>LoAL + AHYS.Set to -999 will disable this function.	-999~ +3000	-999
HdAL	Deviation high alarm	Alarm on when PV-SV>HdAL; alarm off when PV-SV <HdAL-AHYS.Set to 3000 will disable this function.	-999~ +3000	3000
LdAL	Deviation Low larm	Alarm on when PV-SV<LdAL; alarm off when PV-SV >LdAL+AHYS;Set to -999 will disable this function.	-999~ +3000	-999
Loc	Parameter lock	0: auto-tuning and modification of field parameters and setpoint are allowed. 1: allowed to modify field parameters and setpoint value, but can't run auto-tuning. 2: allowed to modify field parameters, but can't change the setpoint or run auto-tuning. 3~255: can only modify "Loc". 808: setting Loc=808 and then pressing ⟲ can access system parameter table.	0~255	0

● System parameter table (set Loc=808 and then press ⟲ to access)

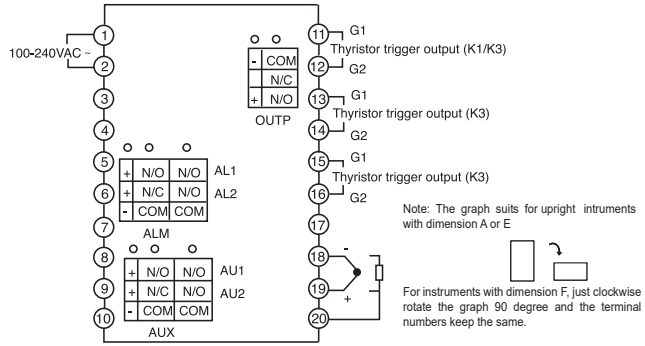
Code	Name	Description	Setting Range	default
AHYS	Alarm Hysteresis	Avoid frequent alarm on-off action because of the fluctuation of PV.	0~200	2
AdIS	Alarm display	oFF : No alarm message shown in the lower display even there is an alarm. on :Alternately showing alarm message and value in the lower display when there is an alarm. Recommended. FoFF: All alarm message disabled.		on
AoP	Alarm output assignment	Alarm / Output: LdAL (x1000), HdAL (x100), LoAL (x10), HIAL (x1) None: 0 0 0 0 AL1: 1 1 1 1 AL2: 2 2 2 2 AU1: 3 3 3 3 AU2: 4 4 4 4 Example: AOP = 0 (LdAL) 1 (HdAL) 0 (LoAL) 1 (HIAL) ; It shows that HIAL and HdAL are sent to AL1, and LoAL has no output.	0~4444	111
CtrL	Control mode	onoF : On-off control. APId : AI PID control, high precision and no-overshoot.	onoF, APId	APId
Srun	Running Status	run: Control is activated. StoP: Control is deactivated as is stopped. Lower display keeps flashing "StoP" . HoLd: Control is activated and kept active.		HoLd

Act	Acting Method	rE:Reverse acting. Increase in measured variable causes an decrease in the output, such as heating control. dr: Direct acting. Increase in measured variable causes an increase in the output, such as refrigerating control. rEbA: Reverse acting with low limit alarm and deviation low alarm blocking at the beginning of power on. drbA: Direct acting with high limit alarm and deviation high alarm blocking at the beginning of power on.	rE dr rEbA drbA	
P	Proportion band	Proportion band in PID with unit ℃ or ℉ .	1~999 Sec	30
I	Time of Integral	No integral effect when I=0.	0~9999 Sec	100s
d	Time of Derivative	No derivative effect when d=0.	0~999.9 Sec	50.0s
Ctl	Control period	Small value can improve control accuracy. For SSR or TRIAC output, generally 0.5 to 3 seconds. Large value can increase using life of relay. For Relay output, generally 15 to 40 seconds.	0.5~120 Sec	2s Or 20s
CHYS	Control Hysteresis	CHYS is used for ON-OFF Control to avoid frequent on-off actuon of relay. For a heating system,if PV > SV, Output turns OFF;PV<SV-CHYS, Output turns ON.	0~200	2
INP	Input specification	InP / Input type / InP / Input type 0 K 1 S 2 R 3 SPARE 4 E 5 J 6 SPARE 7 N 8~20 SPARE 21 Pt100	0~21	0
dPt	Resolution	0 : 1 ℃ / ℉ . 0.0 : 0.1 ℃ / ℉	0 / 0.0	0.0
Scb	Input Shift	Scb is used to make input shift to compensate the error produced by sensor or input signal. PV_after_compensation=PV_before_compensation+Scb.	-200~ +400	0
FILt	PV Input filter	The value of FILt will determine the ability of filtering noise. When a large value is set, the measurement input is stabilized but the response speed is slow. Generally, if great interference exists, then you can increase parameter "FILt" gradually to make momentary fluctuation of measured value less than 2 to 5. When the meter of the instrument is being examined at laboratory, "FILt" should be set to 0 or 1 to short the response time.	0~40	1
Fru	Power frequency / temperature scale	50C: 50Hz,display ℃ 50F: 50Hz, display ℉ 60C: 60Hz,display ℃ 60F: 60Hz, display ℉ Input will has maximum anti-interference ability when the corresponding power frequency is selected.	50C 50F 60C 60F	50C
SPL	Low limit of SV	Minimum value that SV allowed to be	-999~ 3000	0
SPH	Upper limit of SV	Maximum value that SV allowed to be		400

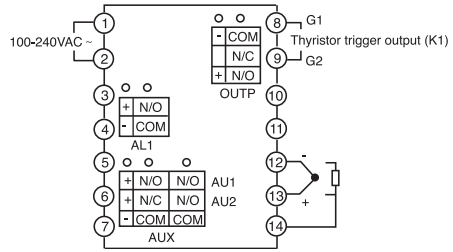
INSTRUMENT INSTALLATION AND WIRING

Wiring graph for instruments with dimension A, E or F

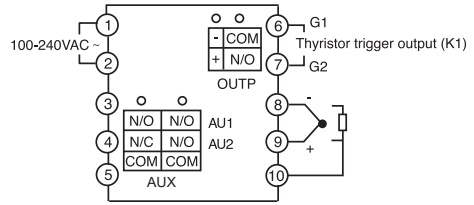
Note:The compensation wires for different kinds of thermocouple are different, and should be directly connect to the terminals. Connecting the common wire between the compensation wire and the terminals will cause measurement error.



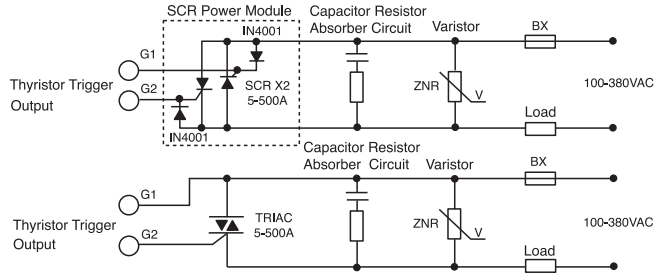
Wiring graph for D dimension(72mmX72m) instruments :



Wiring graph for D2 dimensio (48mmX48mm) instruments



Wiring graph for Thyristor Trigger Output



Note: it is recommended to use the SCR power module,which includes a pair of SCRs and diodes. Compared to TRIAC, it is more reliable and consumes less electricity.

Important note: Due to technical upgrade or customized order, the wiring diagram on the side on the instrument may vary with the the digram above. The version of the diagram on instrument shall prevail.

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