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ARTIFICIAL INTELLIGENCE TEMPERATURE CONTROLLER

User Manual

AI-508/509 Version 7.5

I. Model Code Symbol

The type of AI-508/509 is made up of 5 parts:

AI-509	A	G	L2	L2
1	2	3	4	5

1. Basal function of instrument

AI-508 Economical Intelligent Temperature Controller 0.3%FS ± 0.1℃ (0 Decimal)

AI-509 Economical Intelligent Temperature Controller 0.3%FS ± 0.1℃ (0.0 Decimal)

2. Front 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
D4	48×48mm	45×45mm	95mm
E	48×96mm	45×92mm	100mm
F	96×48mm	92×45mm	100mm

3, 4 and 5 indicate the module installed in OUTP, ALM and AUX sockets. Allowed modules in each socket are as below:

Allowed Type / Module Socket	N	L4	L2	L5	G	G5	W1	W2	W5	K1	K3
3. OUTP (main output)		√	√		√		√	√		√	√
4. ALM (Alarm)	√	√	√	√		√			√		
5. AUX (Auxiliary output)	√	√	√	√		√			√		

N (or none) no module installed

L4 Relay contact output module (Capacity: 2A/250VAC, normal open and close terminal, can absorb spark)

L2 Relay contact output module (Capacity: 1A/250VAC, normal open and close terminal)

L5 Output module of dual normal open relay contact (Capacity: 2A/250VAC, support ALM1 and ALM2 alarm output)

G SSR voltage output module (30mA/12VDC)

G5 Duel SSR voltage output module (30mA/12VDC)

W1 TRIAC no contact normal open discrete output module, suitable for AC contactors up to 80A, and has low interference and long life.

W2 TRIAC no contact normal close discrete output module, suitable for AC contactors up to 80A, and has low interference and long life.

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

K3 Three phases TRIAC zero crossing trigger output module (For 100~380VAC), will plug in **OUPT** slot and **MIO** slot at same time.

Note1: For instrument of dimension D4, because of the volume limit, when L1 or L5 module is installed in ALM, L1 can't be installed in OUPT, but L2, which is smaller can be installed instead.

Note2: K3 can't be installed in instrument with dimension D or D4. There isn't AUX slot in D4 instruments. L5 module can't be installed in ALM slot of instrument with dimension D.

II. Technical Specifications

Input Type	**Thermocouple**						**RTD**
	K	S	R	E	J	N	PT100
Range ℃	0~1300	0~1700	0~1600	0~1000	0~1200	0~1300	-200~+800

Accuracy	
AI-508/509	0.3%FS ± 0.1℃

Temperature Display Resolution	
AI-508	1℃/1℉
AI-509	0.1℃/0.1℉

Control Method	ON / OFF Control
	AI PID Control with Auto Tuning (AT)

Output Type (Modularization)	Relay Output
	Voltage Ouptut for SSR
	Triac switch output
	Triac zero crossing trigger Output (1 or 3 phase)

Alarm (Modularization)	Limit High / Low
	Deviation High/ Deviation Low

Supply Voltage	100~240VAC (-15%, +10%)
	24 VDC (Modular)
	50~60Hz

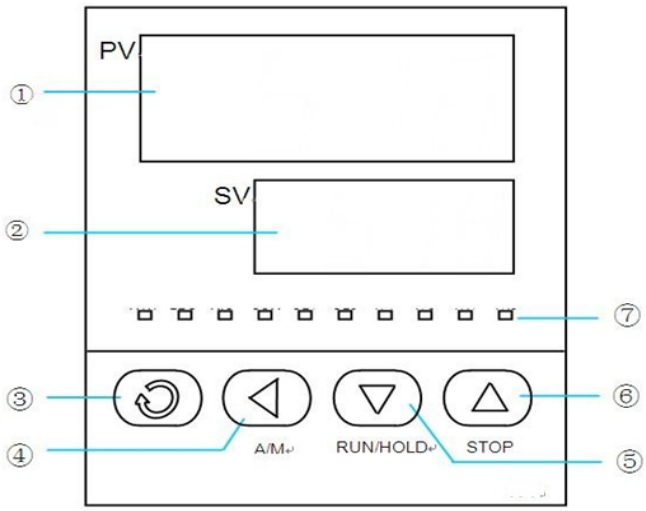
Power Consumption	≦ 3W

Operating Environments	Temperature: -10~+60℃ / 14~140℉ humidity: 0~90RH%

Electromagnetic compatibility (EMC)	IEC61000-4-4: ± 4KV/5KHz IECy1000-4-5: 4KV

DISPLAY AND OPERATIONS

① Upper display window, displays PV, parameter code, etc.
② Lower display window, displays SV, parameter value, or alarm
③ Setup key, for accessing parameter table and conforming parameter modification.
④ Data shift key, and auto tuning.
⑤ Data decrease key
⑥ Data increase key
⑦ LED indicator. MAN, PRG, MIO, COM and OP2 indicators is non-applicable.



OP1, AL1, AL2, AU1 and AU2 will indicate I/O operation of the corresponding module.

Basic display status:

When power on, the upper display window of the instrument shows the process value (PV), and the lower window shows the set-point (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. If the lower display window alternately display “HIAL”, “LoAL”, “HdAL” or “LdAL”, it means high limit alarm, low limit alarm, deviation high alarm, and deviation low alarm happening.

OPERATION DESCRIPTION

- **Set Value Setting:**
  In basal 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 decreasing or inscreasing value get 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. Pressing  can go to the next parameter; pressing  、  or  can modify a parameter. Press and hold  can return to the preceding parameter. Press  (don't release) and then press  key simultaneously can escape from the parameter table. The instrument will escape auomatically from the parameter table if no key is pressed within 30 seconds. Setting Loc=808 and then press  can access System Parameter Table.

- **AI artificial intelligence control and auto tuning**
  When AI artificial intelligence 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 2-3 times of on-off action, the instrument will obtain the optimal control parameter value. If you want to escape from auto tuning status, press and hold the  key 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: 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. Depending on the system, the auto-tuning time can be from several seconds to several hours.

Note 2: Parameter Ctl (on-off differential, control hysteresis) has influence on the accuracy of auto-tuning. Generally, the smaller the value of Ctl, the higher the precision of auto tuning. But Ctl parameter value should be large enough to prevent the instrument from error action around setpoint due to the oscillation of input. Ctl is recommended to be 2.0.

Note 3: The 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 excellent control result will be obtained after a period of time because of self-learning.

III. PARAMETER AND SETTING

Field parameter table (Primary parameters)

<table>
<tr><th>Code</th><th>Description</th><th>Remarks</th><th>Setting Range</th><th>Default</th></tr>
<tr><td>HIAL</td><td>High limit alarm</td><td>Alarm on when PV>HIAL
alarm off when PV<HIAL-AHYS
Set to 3000 will disable this function</td><td>-999—+3000</td><td>3000</td></tr>
<tr><td>LoAL</td><td>Low limit alarm</td><td>Alarm on when PV<LoAL;
alarm off when PV>LoAL+AHYS
Set to -999 will disable this function</td><td>-999—+3000</td><td>-999</td></tr>
<tr><td>HdAL</td><td>Deviation high alarm</td><td>Alarm on when PV-SV>HdAL;
alarm off when PV-SV<HdAL-AHYS
Set to 3000 will disable this function</td><td>-999—+3000</td><td>3000</td></tr>
<tr><td>LdAL</td><td>Deviation high alarm</td><td>Alarm on when PV-SV>HdAL;
alarm off when PV-SV<HdAL-AHYS
Set to -999 will disable this function</td><td>-999—+3000</td><td>-999</td></tr>
<tr><td>Loc</td><td>Parameter Lock</td><td>
<table>
<tr><th>Loc</th><th>Auto Tuning</th><th>SV</th><th>Primary Parameter</th><th>Secondary Parameter</th></tr>
<tr><td>0</td><td>√</td><td>√</td><td>√</td><td>X</td></tr>
<tr><td>1</td><td>X</td><td>√</td><td>√</td><td>X</td></tr>
<tr><td>2</td><td>X</td><td>X</td><td>√</td><td>X</td></tr>
<tr><td>3</td><td>X</td><td>X</td><td>X</td><td>X</td></tr>
<tr><td>808</td><td>√</td><td>√</td><td>√</td><td>√</td></tr>
</table>
√ : allow to modify data or execute AT
X : not allow to modify data or execute AT</td><td>0—255</td><td>0</td></tr>
</table>

System parameter table (Secondary parameters)

Set the parameter 'Loc'=808 to enter:

<table>
<tr><td>AHYS</td><td>Alarm Hysteresis</td><td>Avoid frequent alarm on-off action because of the fluctuation of PV</td><td>0—200</td><td>2</td></tr>
<tr><td>AOP</td><td>Alarm output assignment</td><td>
<table>
<tr><th>Alarm Output</th><th>LdAL (x1000)</th><th>HdAL (x100)</th><th>LoAL (x10)</th><th>HIAL (x1)</th></tr>
<tr><td>None</td><td>0</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>AL1</td><td>1</td><td>1</td><td>1</td><td>1</td></tr>
<tr><td>AL2</td><td>2</td><td>2</td><td>2</td><td>2</td></tr>
<tr><td>AU1</td><td>3</td><td>3</td><td>3</td><td>3</td></tr>
<tr><td>AU2</td><td>4</td><td>4</td><td>4</td><td>4</td></tr>
</table>
eg: AOP=101 means HdAL and HIAL are outputted to AL1 and LoAL and LdAL has no output.</td><td>0—4444</td><td>1111
Or
according to fixed module</td></tr>
<tr><td>CtrL</td><td>Control mode</td><td>onoF : On-off control
APId : AI PID control, high precision and no-overshot</td><td>onoF, APId</td><td>APId</td></tr>
<tr><td>Act</td><td>Acting Method</td><td>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.</td><td>rE / dr
rEbA/drbA</td><td></td></tr>
<tr><td>P</td><td>Proportion band</td><td>Proportion band in PID with unit ℃ or ℉</td><td>10—999</td><td>30</td></tr>
<tr><td>I</td><td>Time of Integral</td><td>No integral effect when I=0</td><td>1—9999 Sec</td><td>100 s</td></tr>
<tr><td>d</td><td>Time of Derivative</td><td>No derivative effect when d=0</td><td>0—999.9 Sec</td><td>50.0s</td></tr>
<tr><td>Ctl</td><td>Control period</td><td>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.</td><td>0.5—120 Sec</td><td>2 s
Or
20 s</td></tr>
</table>

<table>
<tr><td>CHYS</td><td>Control Hysteresis</td><td>CHYS is used for ON-OFF Control.
PV > SV, Output turns OFF;
PV<SV-CHYS, Output turns ON.</td><td>0—200</td><td>2</td></tr>
<tr><td>InP</td><td>Input specification</td><td><table><tr><th>InP</th><th>Input spec.</th><th>InP</th><th>Input spec.</th></tr><tr><td>0</td><td>K</td><td>1</td><td>S</td></tr><tr><td>2</td><td>R</td><td>3</td><td>Spare</td></tr><tr><td>4</td><td>E</td><td>5</td><td>J</td></tr><tr><td>6</td><td>Spare</td><td>7</td><td>N</td></tr><tr><td>8-20</td><td>Spare</td><td>21</td><td>Pt100</td></tr></table></td><td>0—21</td><td>0</td></tr>
<tr><td>dPt</td><td>Resolution
(only AI-509 have)</td><td>0 : 1 ℃/℉
0.0 : 0.1 ℃/℉</td><td></td><td>0.0</td></tr>
<tr><td>Scb</td><td>Input Shift</td><td>Parameter Sc is used to make input shift to compensate the error produced by sensor or input signal itself.
PV-after-compensation=
PV-before-compensation + Scb.</td><td>-200—+400</td><td>0</td></tr>
<tr><td>FILt</td><td>PV input filter</td><td>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.</td><td>0—40</td><td>1</td></tr>
<tr><td>Fru</td><td>Selection of power frequency and temperature scale</td><td>50C: 50Hz, ℃
50F: 50Hz, ℉
60C: 60Hz, ℃
60F: 60Hz, ℉</td><td>50C, 50F,
60C, 60F</td><td>50C</td></tr>
<tr><td>SPL</td><td>Low limit of SV</td><td>Limit minimum SV value</td><td>-999—3000</td><td>0</td></tr>
<tr><td>SPH</td><td>Upper limit of SV</td><td>Limit maximum SV value</td><td>-999—3000</td><td>400</td></tr>
</table>

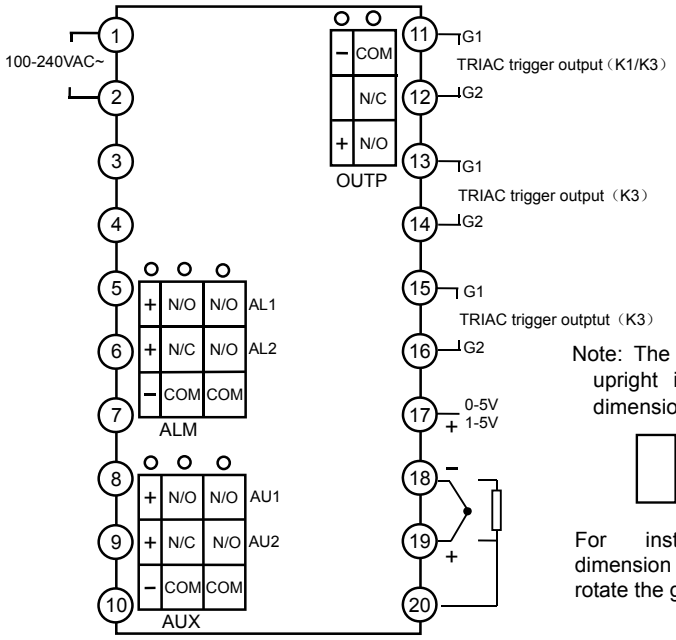
IV. Symbol Description

	Description
orAL	Input specification setting is incorrect Or Input wiring is disconnected Or Short circuited
HIAL	High limit alarm
LoAL	Low limit alarm
HdAL	Deviation high alarm
dLAL	Negative deviation alarm
EErr	IC Software error
8888	IC Software error

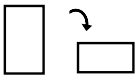
V. INSTRUMENT INSTALLATION AND WIRING

Wiring graph for instruments with dimension A, B 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.

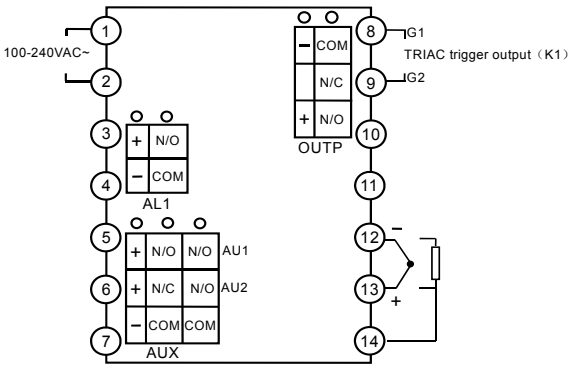


Note: The graph suits for upright intruments with dimension A or E



For instruments with dimension F, just clockwise rotate the graph 90 degree.

Wiring graph for D dimension（72mmX72mm）instruments



Wiring graph for D4 dimension（48X48mm）instruments：