ARTIFICIAL INTELLIGENCE

TEMPERATURE CONTROLLER

AI-208 (V7.8)

Operation Manual

I. Model Order Code

The type of AI-208 is made up of 4 parts:

AI-208	A	G	L2
Part 1 (Series)	Part 2 (Size)	Part 3 (Oupt)	Part 4 (AUX)

1. **(Part 1) Model Series**

   AI-208, standard temperature controller , 0.3%FS±1℃ accuracy.

   Multiple thermocouples and RTDs are selectable

   Suitable for 0~999℃ application. Maximum support two alarms contact output

   Universal supply power (100~240VAC)

2. **(Part 2) Front panel dimension**

Panel Size	Front Panel width×height	Cut Out width×height	Depth Behind Mounting Surface
A1	96×96mm	92×92mm	70mm
B1	160×80mm	152×76mm	70mm
D1	72×72mm	68×68mm	78.5mm
E1	48×96mm vertical	45×92mm	70mm
F1	96×48mm horizontal	92×45mm	70mm
A	96×96mm	92×92mm	100mm
B	160×80mm	152×76mm	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. **(Part 3 and 4) indicate the module installed in OUTP and AUX sockets.**

Allowed modules in each socket are as below:

Allowed Type / Module Socket	N	L	L0/L1	L5	G
3. OUTP (main output)		√			√
4. AUX (Auxiliary output)	√		√	√	

N   (or none) no module installed

L   Relay contact output module (Capacity: 5A/250VAC, normal open)

L0/L1 Relay contact output module (Capacity: 2A/250VAC, normal open/normal close, spark absorption at normal open, support AU1 alarm output)

L5   Dual relay output module Output module (Capacity: 2A/250VAC, normal open, support AU1 and AU2 alarm output)

G   SSR voltage output module (30mA/5VDC)

*   D1-sized controller is fixed to SSR output(G) and no module option provided, i.e. AI-208-D1-G, AI-208-D1-G-L0 or AI-208-D1-G-L5 must be specified upon order.*

II. TECHNICAL SPECIFICATION

1. **Input type : K, E, J, N** (thermocouples); **Pt100** (resistance temperature detector)

2. **Instrument Input range : K, E, J, N** (0~+999)℃, **Pt100** (0~+800)℃

3. **Measurement accuracy :** 0.3%FS±1℃

4. **Temperature display resolution :** 0 or 0.0 (0.0 just for 0~99.9 display)

5. **Control mode:**
   On-off control mode, or
   PID control with auto-tuning.

6. **Type of Alarm:** High limit alarm, Lower limit alarm, Deviation High Alarm and Deviation Low Alarm with alarm blocking at power on.

7. **Power supply voltage rating**: 100-240VAC, -15%, +10% / 50-60Hz.

8. **Power consumption:** ≤2W

9. **Ambient temperature:** -10~+60℃, Humidity: 0~90RH%

III. FRONT PANEL AND OPERATION

① Process Value(PV), or parameter code
② Set Value(SV), alarming code, or value of a parameter
③ Setup key, accessing parameter table, and confirming change.
④ Data shift key, also for activating auto turning
⑤ Data decrease key
⑥ Data increase key
⑦ Status display LED,
OP1 – Output
AU1 – Alarm 1
AU2 – Alarm 2
RUN – Controlling process running

Default display status:

When power is on, the process value (PV) and the set value (SV) are shown. If the input signal is out of the measurable range (for example, the thermocouple or RTD circuit is break or input specification is not correctly set), the upper display will blink "orA" and high limit or low limit of specified input. The instrument will automatically stop the output.

IV. OPERATION DESCRIPTION

● **Set Value Setting:**

During default display status, if the parameter lock "Loc" isn't locked, user can set setpoint (SV) by pressing ◁ ▽ △ keys. Press ▽ key to decrease the value, △ key to increase the value, and ◁ key to move to the dot to the desiired digit (acting as a pointer). Keep pressing ▽ or △ will speed up value change. The range of setpoint is limited by parameter SPH with default range 0 to 400.

● **Parameter Setting:**

During default display status, press and hold ↻ for 2 seconds will access Field Parameter Table (See **V. PARAMETER AND SETTING**). Press ↻ to proceed to the next parameter. If parameter table have not been locked, press ◁ ▽ △ will change the parameter. Press and hold ◁ for 2 second returns to the preceding parameter. Press ◁ (don't release) and then press ↻ simultaneously jumps out from parameter setting to the default status. The instrument will also jumps out auomatically from the parameter table if no key is pressed in 30 seconds. Setting Loc=808 and then press ↻ will access System Parameter Table (See **V. PARAMETER AND SETTING**)

● **AI artificial intelligence control and auto tuning**

When AI artificial intelligence control algorithm is selected (CrL=AI), the P,I, and D parameters can be calculated automatically by auto-tuning. In default display status, press and hold ◁ for 2 seconds, "At" auto-tuning parameter will show. Press △ to change the value of "At" from "oFF" to "on", then press ↻ to activate the auto-tuning. During auto-tuning, the instrument runs on-off control for two cycles. The instrument will calculate the optimal P, I and D control parameter values and returns to default display. If user want to interrupt the auto tuning process, press and hold the ◁ for 2 seconds. Change "At" from "on" to "oFF" and press ↻ to confirm. The auto-tuning process will be cancelled and new P, I and D values will be calculated.

Note 1: The P, I and D parameters obtained from auto-tuning are dependent to the set value. It is recommended to set a set value to an often-used value or mean value to perform auto-tuning. For the ovens with good heat preservation, the set value can be set at the highest applicable temperature. Depending on hardware setup, the auto-tuning may take from a few seconds to a few 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 set value due to the oscillation of input. Ctl is recommended to be 2.0.

Note 3: Self-learning function enables the instrument to control better and better after time.
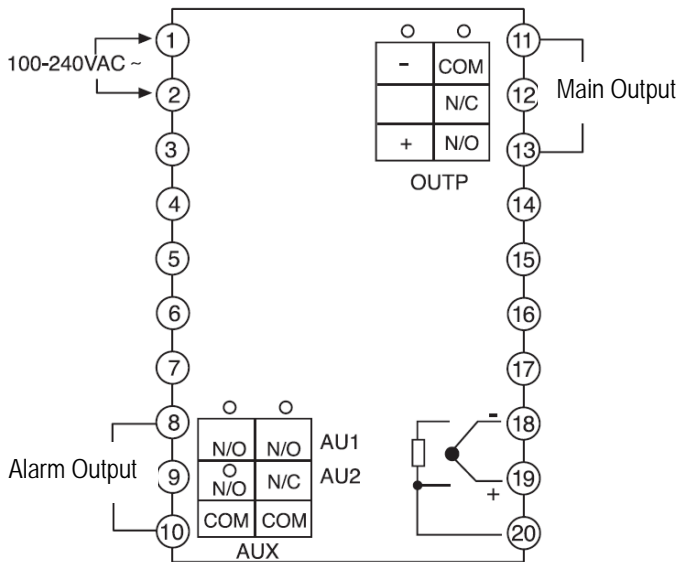
V. PARAMETER AND SETTING

Parameter	Title	Description	Range
Field Parameter Table (Press and hold ↻ for 2 seconds to access)			
HIA	High limit alarm	Alarm on when PV (Process Value) >HIA; alarm off when PV<HIA-AHY	0～999℃
LoA	Lower limit alarm	Alarm on when PV (Process Value) < LoA; alarm off when PV > LoA+AHY	0～999℃
HdA	Deviation high alarm	Alarm on when PV-SV>HdA; alarm off when PV-SV<HdA-AHY	0～999℃
LdA	Deviation low alarm	Alarm on when PV-SV<LdA; alarm off when PV-SV>LdA+AHY	0～999℃
Loc	Parameter lock	Loc=0: Allowed to change HIA, LoA, HdA, LdA and SV. Loc=1: Allowed to read only HIA, LoA, HdA, LdA but to change SV. Loc=2~3: Allowed to change HIA, LoA, HdA. LdA but read only SV. Loc=4~255: NOT allowed to change any parameters nor SV. Loc=808, Set to 808 and press ↻ to unlock the System Parameter Table.	0～255
System Parameter Table (Loc=808 to unlock)			
AHY	Alarm Hysteresis	Avoid frequent alarm on-off action because of the fluctuation of PV AHY=2 by default.	0~200
AOP	Alarm output assignment	(see table below) Example: AOP=901 refers to HdA assigned to AU1, LdA to AU2, without LoA and HIA to AU1.	0~922
CrL	Control mode	• onF : ON-OFF control. When PV>SV, output stops and heating stops. When PV<SV-AHY, output resumes. • AI : AI-PID control. The output time proportion can adjusted by parameter Ctl	
Act	Acting method	rE: Reverse acting. Increase in measured variable causes a 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. rEb: Reverse acting with low limit alarm and deviation low alarm blocking at the beginning of power on. drb: Direct acting with high limit alarm and deviation high alarm blocking at the beginning of power on.	rE , dr , rEb, drb
P	Proportion band	Proportion band in PID with unit ℃ or ℉ but not the percentage of the input scale.	1~999
I	Time of integral	Time of integral in PID. No integral effect when I=0	0~999 sec
d	Time of derivative	Time of derivative in PID with unit 0.1 second. No derivative effect when d=0	0~999 sec

AOP table:

|	HdA & LdA (x100)			LoA (x10)		HIA (x1)
0	×	×	0	×	0	×
1	AU1	×	1	AU1	1	AU1
2	AU2	×	2	AU2	2	AU2
5	AU1	AU1				
6	AU2	AU1				
7	×	AU1				
8	×	AU2				
9	AU1	AU2				

Ctl	Control period	Smaller value will result in higher control accuracy. For SSR output, generally 0.5 to 3 seconds. For Relay output, generally 15 to 40 seconds, because small value will cause the frequent On-Off of mechanical switch and shorten its service life. Ctl is recommended to be 1/4 – 1/10 of derivative time. When control under on-off control, Ctl is used as delay time to restart to protect the compressor.	0.5-300 sec
CHY	Control hysteresis	To avoid frequent relay on-off action, in ON-OFF control mode. PV > SV, Output turns OFF (Relay opens) PV < SV-CHY, Output turns ON (Relay closes)	0~200
InP	Input specification	<table><tr><td></td><td>Thermocouples & RTD</td></tr><tr><td>0</td><td>K</td></tr><tr><td>4</td><td>E</td></tr><tr><td>5</td><td>J</td></tr><tr><td>7</td><td>N</td></tr><tr><td>21</td><td>Pt100</td></tr></table>	0～21
dPt	Resolution	0 or 0.0 selectable. 0.0 is valid for 0~99.9 ℃ / ℉ display	
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.	-99～+99℃
FIL	PV input filter	Higher degree of FIL gives more powerful noise filtering. Large FIL value stabilized the input signal but the system response speed will be slow. Generally speaking, 1 to 3 will be used. If great interference exists, FIL can be gradually increase to limit the momentary fluctuation among 2 to 5 unit. When the instrument is being metrological verified, FIL should be set to 0 or 1 to minimize the response time.	0～40
Fru	Selection of power frequency and temperature scale	50C: 50Hz, ℃ 50F: 50Hz, ℉ 60C: 60Hz, ℃ 60F: 60Hz, ℉	
SPH	Upper limit of SV	Maximum value that SV allowed to be. When SPH=400, the SV range will 0~400℃	0～999℃

VI. INSTRUMENT INSTALLATION AND WIRING DIAGRAM

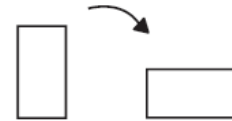**Panel dimension A1, B1, E1 or F1**   **Panel dimension A, B, E or F**
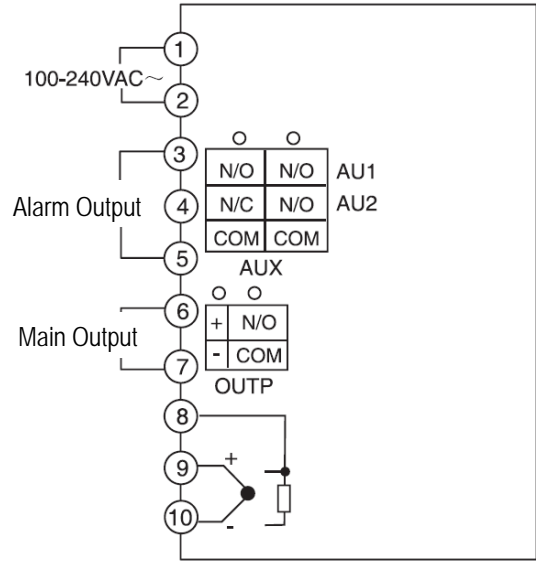
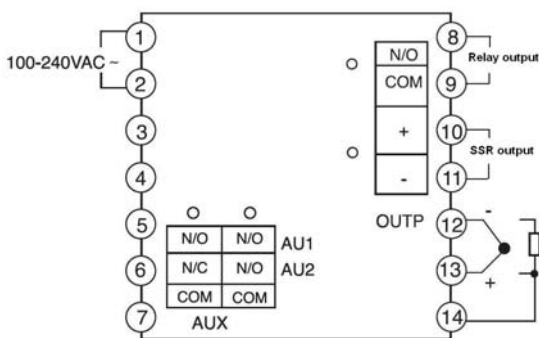
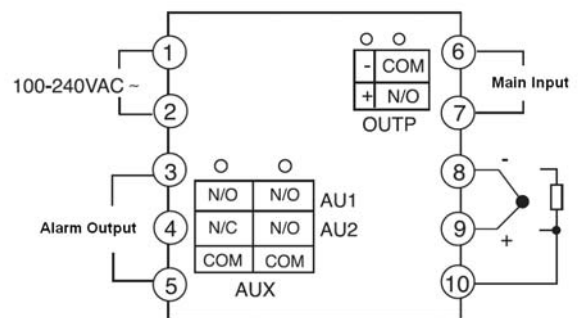The diagram illustrated is for upright panel dimension A/A1/E/E1.

For panel dimension B/B1/F/F1, please rotate the diagram clockwise by 90 degree.

Panel dimension D (72 x 72mm)   **Panel dimension D1/D2 (48 x 48mm)**

Remarks

1. Thermocouples compensate wires should be directly screwed to the back of the instrument. No extension by normal conducting wire should be used. Please pay attention to the polarity of the compensate wires.

2. The solid-state relay (SSR) externally connected should provide 2300 V isolation between input/output-to-power line. (CE requirement)