AI Series Multi-channel PID Temperature Controller

(V9.2)

CONTENT

1.Summary

The multi-channel temperature controller uses a variety of optional inputs, such as thermocouples and thermal resistors, and the SSR solid-state relay voltage output. Each channel can have different input specifications, that is, it can be used independently, or it can be used online with a computer or a programmable controller PLC. The instrument can choose 24VDC/AC or 100~240VAC power supply voltage, and has passed ISO9001 quality certification, high reliability and meets EMC standards; its power supply and all I/O terminals have passed the 4KV group pulse (EFT) anti-interference test, and can work reliably in a strong interference environment. The new generation technology of Yudian Company is applied to make the multi-channel input achieve the same accuracy and anti-interference ability as the single channel measurement. The main functions of the instrument are as follows:

- It can support up to 4 programmable measurement input circuits and various input specifications,such as K, S, E, J, B, N, T, WRe5-WRe26, PT100 etc., as well as automatic cold junction compensation of thermocouple and can input linear signal and freely define scale. After digital correction input , each input circuit has digital filtering, and the filtering intensity can be independently adjusted or canceled
- High performance components are used to greatly reduce the temperature drift and mutual interference between the four channels, so that the accuracy and anti-interference performance of multi-channel measurement can also reach the same level as that of single channel measurement instruments.
- It can support the overall sizes of D5/E5/D71 DIN rail or panel mounted instruments. The rail type without display can be connected to E8 handheld display for display programming.

● Each circuit of the instrument can independently set the upper and lower limits or deviation alarm output functions, and its alarm output position (AL1 or AL2) can be specified by programming. The upper or lower limit alarm signals of different input circuits can be programmed to output from the same alarm channel or from different channels.

● With 12 field parameter settings, users can "customize" the instrument according to their own usage habits.

● It has the function of communicating with computers and is fully compatible with the communication protocols of commonly used AI-708 artificial intelligence regulators/temperature controllers; One AI-7048 is equivalent to four independent measuring and controling instruments when communicating, supporting AIBUS and MODBUS-RTU communication protocols, and switching through AF parameters

● AI-7048 is fully compatible with AI-7028 . AI-7028 is a control instrument with two channels of independent measurement. For wiring, only refer to the first two channels of AI-7048.

2.Ordering Code Definition

2.1 Selection of panel mounted instruments

The AI series instrument hardware adopts advanced modular design. The AI-7028/7048 instrument can be installed with up to 6 modules. The input, output, alarm, communication and other functions can be selected according to the needs. The modules can be purchased together with the instrument or separately, and can be combined freely. The AI-7028/7048 instrument model consists of 9 parts, such as:

AI-7048	A	J2	J2	G5	L3	G5	S	–	24VDC
①	②	③	④	⑤	⑥	⑦	⑧		⑨

This indicates an instrument: ① The basic function is AI-7048; ② Panel size is Type A (96 × 96mm）； ③ Two two-wire thermistor input circuits; ④ Two two-wire thermistor input circuits; ⑤ 2-way solid-state relay drive voltage output; ⑥ 2-way alarm relay output; ⑦ 2-way solid-state relay drive voltage output; ⑧ 1 RS485 communication interface; ⑨ The instrument power supply is 24VDC. The meanings of each part in the instrument model are as follows:

①Indicates the basic functions of the instrument

AI-7028 (level 0.2 precision 2-way PID temperature controller, AIBUS communication protocol)

AI-7048 (level 0.2 precision 4-way PID temperature controller, AIBUS communication protocol)

②Indicates the size of the instrument panel

A panel 96*96mm, opening $92^{+0.5*}92^{+0.5}$mm

B panel 160*80mm (wide*height), horizontal type, opening $152^{+0.5*}76^{+0.5}$mm

C panel 80*160mm (wide*height), vertical, opening $76^{+0.5*}152^{+0.5}$mm

D5 is only 22.5mm wide. This machine has no display part. It is not a panel mounted meter. It can be installed on DIN rail and can be programmed with an external display

D71 is only 22.5mm wide, DIN rail installation mode, special double row LED display, with key operation, and plug-pull terminal is used for power supply and communication

E panel 48*96mm (wide*height), opening $45^{+0.5*}92^{+0.5}$mm

E5 means I/O modular housing, no display part, non panel mounted meter, can be installed on DIN rail, and external display programming is available

F panel 96*48mm (wide*height), opening $92^{+0.5*}45^{+0.5}$mm

Note: Dimension D5 only needs to select the input type (currently only J1 or J2 input), and the main output is fixed as a solid-state relay driving voltage output with 1 RS485 for communication. 70482 does not have Dimension D5 and only Dimension D71 has an alarm;

D71 is a welded module, whose input specifications are fixed on the PCB. Please contact customer service for specific supported input and output.

③ **Module specifications of M1:** J0, J1, J2, J3, J4, J51, N indicates that they are not installed, the same below.
④ **Module specifications of M2:** J0, J1, J2, J3, J4, J51.
⑤ **Output module specifications for OP1 and OP2 of M3:** G5 and X6.
⑥ **Alarm (ALM) module specifications for M4:** modules such as L21 and L3.
⑦ **Output module specifications for OP3 and OP4 of M5:** G5 and X6.
⑧ **Module specifications for communication (COMM):** S and S4.
⑨ **Instrument power supply:** If left blank, it indicates that the 100~240VAC power supply is in use, and 24VDC indicates that the 24VDC or AC power supply is in use.

2.2 D71 guide rail table selection and type

AI-7048D71	J1	G5	G5	L3	S	-	24VDC
①	②	③	④	⑤	⑥		⑦

① Basic models: 7028 (2-channel), 7048 (4-channel)
② Input: J1, J2, J6. (D71 input is solidified, not modular.)
③ Main output (OUTP): G5, X6.
④ Auxiliary output (AUX): G5, X6.
⑤ Alarm (ALM): L2, L21, L4, L3, G, G5.
⑥ Communication slot (COMM): S.
⑦ Power supply: 220VAC or 24VDC;

Note 1: This instrument is a maintenance-free instrument that uses automatic zero adjustment and digital calibration technology. If the measurement calibration exceeds the tolerance, the problem can usually be solved by cleaning and drying the inside of the instrument. In case the accuracy cannot be restored due to drying and cleaning, the instrument should be returned to the factory for maintenance;

Note 2: Free warranty is provided during the warranty period. For instruments that require repair, please specify the fault and cause to ensure correct and overall repair.

3.Common Module Model

N (or not written) No module is installed.

J0 1 circuit of three-wire thermistor input module.

J1 2-way thermocouple input module, support mV voltage input as well.

J2 2-way two-wire thermistor input module.

J3 2-way voltage input module, which can support 0~5V, 1~5V and other input specifications.

J4 2-way current input module, which can support 0~20mA, 4~20mA and other input specifications.

J51 2 second-line transmitter input module with 24V feed power supply.

L21 an output module with a relay of small capacity and small volume for normally open+normally closed(capacity: 30VDC/1A, 250VAC/1A, suitable for alarm).

L3 two-way large capacity large volume relay normally open contact switch output module (capacity: 30VDC/2A, 250VAC/2A, suitable for alarm).

G5 two-way solid state relay drive voltage output module.

X6 two-wire linear current output module.

S photoelectric isolated RS485 communication interface module, which occupies 24V isolated power supply inside the instrument.

S2 photoelectric isolation RS485 communication module (suitable for D and D71)

S4 photoelectric isolated RS485 communication interface module, with isolated power supply.

4.Technical Specification

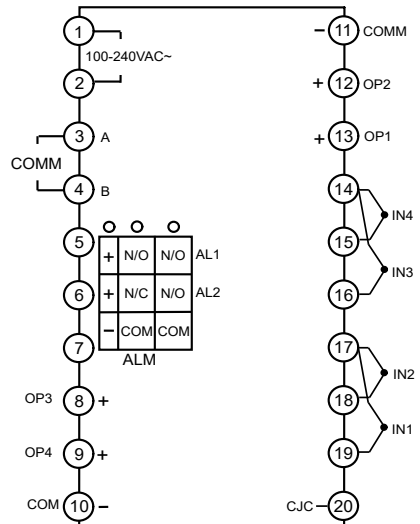
● Input specification:
Thermocouple: K, S, R, E, J, T, B, N, etc; Linear input: 0~20mV, 0~60mV, 0~1V, 1~5V, 4-20ma, etc.
● Measuring range:
K(-50~+1300℃), S(-50~+1700℃), R(-50~+1700℃), T(-200~+350℃),
E(0~+800℃), J(0~+1000℃), B(+200~+1800℃), N(0~+1300℃),
WRe3~WRe25(0~+2300℃), WRe5~WRe26(0~+2300℃), PT100(-200~+800℃)
Linear input: freely defined by user with SCH and SCL parameter
● Measurement accuracy: ± 0.2% FS ± 1 word
Note 1: When internal cold junction compensation is adopted for thermocouple input, 1 ℃ cold junction compensation allowable error shall be added.
Note 2:B scale thermocouple can be measured in the range of 60~600 C, but the accuracy can not reach the calibration accuracy. The measurement accuracy can be guaranteed in the range of 600~1800 C.
● Temperature drift: < 0.01%FS/C (typical value is 60ppm/C)
● Electromagnetic compatibility electrical IEC61,000-4-4 (electrical fast transient pulse group), ± 4KV/5KHz; IEC61,000-4-5 (surge), 4KV
● Isolation voltage withstand, isolation power supply end, relay contact and signal end shall be no less than 2300VDC; ≥ 600VDC between SSR voltage output and thermocouple input
● Control cycle: 0.48 seconds/4 circuits
● Output specification: SSR drive voltage, 12VDC/20mA per circuit, including short circuit protection function

- Power supply: 100~240VAC/50Hz or 24VAC/DC ＋10%, －15%; 5VA
- Operating environment: temperature - 10~+60 ℃, humidity ≤ 90% RH

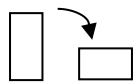
5.Wiring

Note: If the attached wiring diagram of the instrument is inconsistent with this manual due to technical upgrading or special ordering, the attached wiring diagram shall prevail.

7028/7048 wiring diagram of multi-channel temperature controller is as follows:



Note: wiring diagram of vertical panels A, C, E, E5, etc.



Turn this drawing 90 degrees clockwise to form the wiring diagram of B, F type horizontal panel instrument, and the terminal number remains

Layout of 7048D5 indicator light and terminal block is as shown in the figure:

MODE indicator light, indicating communication and alarm status;

OP1~OP4 indicator light, indicating 1~4 circuit output;

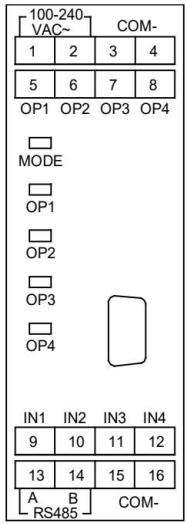
Terminals 1~2 are power input, 100~240VAC or 24VAC/DC input

Terminals 9~12 are respectively the positive input end of 1~4 loop thermocouples/input end of two-wire thermal resistance, and terminals 15~16 are the negative input end of thermocouples/input end of two-wire thermal resistance (the two terminals are common terminals, which can be connected at will)

Terminals 5~8 are respectively the positive pole of 1~4 loop SSR voltage output, and terminals 3~4 are the negative pole of SSR voltage output (the two terminals are common terminals, which can be connected at will). The output specification is 12~16VDC, 20mA, with short-circuit current limiting protection function

Terminals 13~14 are RS485 communication ports.

D5 type has no alarm output.



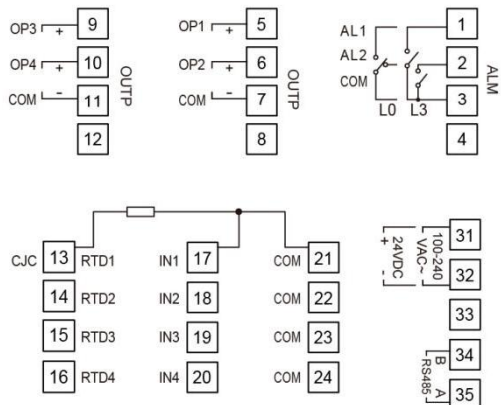
Wiring for three- wire thermistor(J7 or J0) of AI-7048/7028D71

① The three wires of a three-wire thermistor are connected to RTDx, INx, and COM respectively. Taking the first circuit as an example, two wires of the same color or with very small resistance values are connected to IN1 and COM, and the remaining wire is connected to RTD1.

② The main control outputs OP1-OP4 correspond to the positive values of four solid-state relays, with 7 representing the negative values of OP1 and OP2, and 11 representing the negative values of OP3 and OP4.

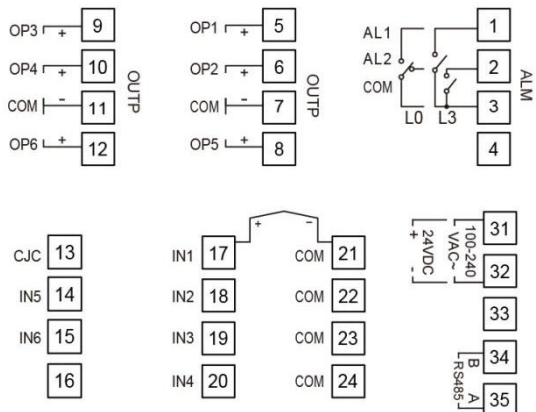
③ The alarm output can support up to 2 channels, with the first channel connected to AL1 and COM (terminal 3) and the second channel connected to AL2 and COM (terminal 3).

Note: When using the three-wire thermistor input mode, Cn needs to be set to a number less than or equal to 4.



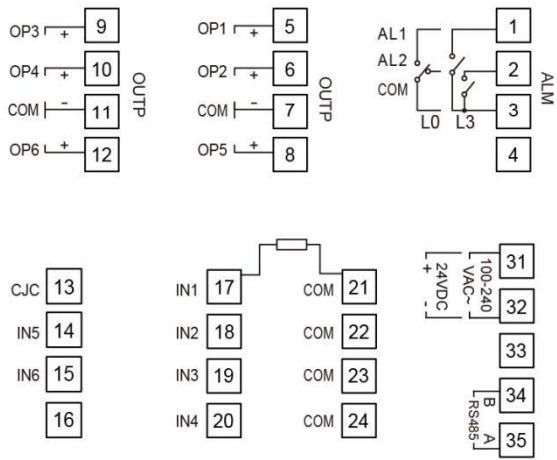
Wiring for non-isolated thermocouple input(J7 or J1) of AI-7048/ 7028D71

① Input thermocouples are positively connected to IN1 to IN6, and negatively connected to COM (terminals 21 to 24).
② Short circuiting CJC and COM (either terminal 21 to 24) can cancel the room temperature compensation of the thermocouple.
③ The main control outputs OP1 to OP6 correspond to the positive values of six solid-state relays, with 7 indicating the negative values of OP1, OP2, and OP5, and 11 indicating the negative values of OP3, OP4, and OP6.
④ The alarm output can support up to 2 channels, with the first channel connected to AL1 and COM (terminal 3) and the second channel connected to AL2 and COM (terminal 3).



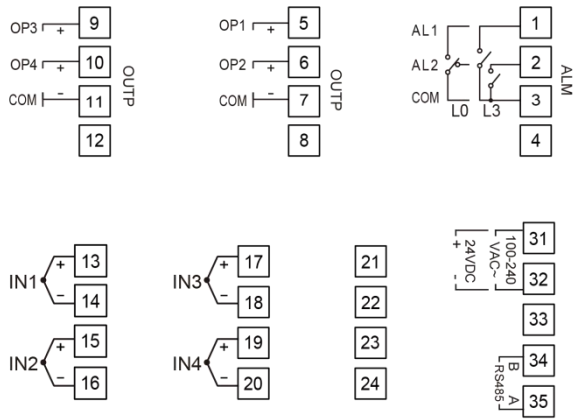
Wiring for two-wire resistor(J7 or J2) of AI-7048/7028D71

①One end of the input thermal resistor is connected to IN1 to IN6, and the other end is connected to COM (either terminal 21 to 24). Some versions require short circuiting of 13 and 17.
②The main control outputs OP1 to OP6 correspond to the positive values of six solid-state relays, with 7 indicating the negative values of OP1, OP2, and OP5, and 11 indicating the negative values of OP3, OP4, and OP6.
③The alarm output can support up to 2 channels, with the first channel connected to AL1 and COM (terminal 3) and the second channel connected to AL2 and COM (terminal 3).
Note: when selecting wiring of (2N+1)-wire resistor, the first circuit adopts wiring of three wires, while the second to sixth circuits adopt wiring of two wires; When the length and resistance of all wires are the same, the influence of lead resistance on the process values can be automatically offset.

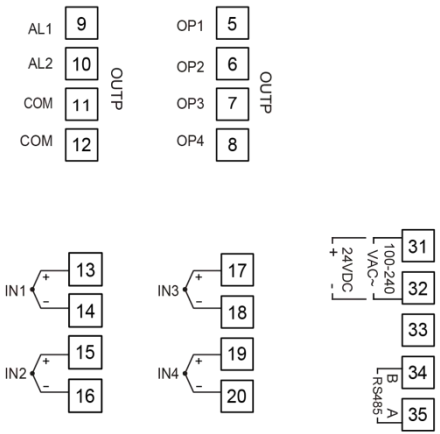


Wiring for J6 of AI-7048D71J6/7028D71

① Thermocouples are connected to IN1 to IN4, with odd numbers being positive and even numbers being negative.
② The main control outputs OP1-OP4 correspond to the positive values of four solid-state relays, with 7 representing the negative values of OP1 and OP2, and 11 representing the negative values of OP3 and OP4.
③ The alarm output can support up to 2 channels, with the first channel connected to AL1 and COM (terminal 3) and the second channel connected to AL2 and COM (terminal 3)



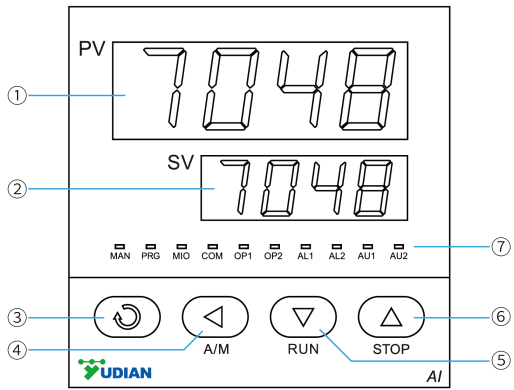
Wiring for multi-channel temperature controller of AI-70482D71



6.Operating Instructions

6.1Description of the instrument panel

① Upper display window, displaying measured value or parameter name
② Lower display window, displaying channel number or parameter value
③ Setting key (manual/automatic cycle display switching)
④ Data shift (also switch display setting of given value)
⑤ Data reduction key (also switch to display the previous channel)
⑥ Data increase key (also switch to display the next channel)
⑦ 10 LED indicator lights, PRG temporarily not used; MAN off, automatic cycle display, and MAN on, manual cycle display; MIO, OP1, OP2, AL1, AL2, AU1, AU2 correspond to module inputs and outputs respectively; COM on indicates it is communicating with the upper computer.



6.2 Operation instructions

1. Switch to display circuit: press ▽ to decrease the circuit number, Press ▽ to enter/exit the automatic cycle display.Press ◁ to enter/exit the automatic cycle display.

2. Setting parameters: When the parameter lock is not locked, press ↺ and hold for about 2 seconds, and release it after the parameter is displayed. Press ↺ again, and the instrument will display each parameter in turn, such as the upper limit alarm value H.AL1 of circuit 1, parameter lock Loc, etc. For the instrument configured and locked with the parameter lock, press ↺ to display the parameters (without holding for 2 seconds), and only the parameters that the operator needs to use (field parameters) will appear. The parameter value can be modified by pressing ▽, △, ◁ . Press ◁ first and then ↺ to exit the parameter setting state, and press ◁ to return to check the last parameter.

3. The lower display window of the instrument can display the circuit number. When there is an upper limit or lower limit alarm, the first digit on the left of the lower display window can display the flashing H. or L. When the signal of the circuit exceeds the range (such as thermocouple disconnection), the upper display window of the instrument displays the upper or lower range value, and the lower display window flashes.

4. If only two input circuits are set, the upper and lower display windows will display the process values of input circuits 1 and 2 respectively. When the input signal exceeds the range, the corresponding display value flashes.

5. Lead wire resistance compensation during two-wire wiring of thermal resistance: If the two-wire wiring mode is used for resistance signals such as Pt100 or Cu50, an offset value (parameter Sc) needs to be set to offset the

lead resistance value. The instrument can provide an operation to automatically set the offset value. The steps are as follows: (1) First, short-circuit both ends of the thermal resistance of the channel to be corrected (please note that the short-circuit point is at the sensor end rather than the instrument end). (2) Set parameter Loc=808, then press and hold for more than 2 seconds until the symbol A is displayed in the first digit on the right of the lower display of the instrument. If the alarm is set, the alarm can be canceled first to avoid the alarm symbol affecting the indication. (3) When the A displayed by the instrument disappears automatically, remove the short line at the sensor end, set Loc to 0 or 1, and restore the normal measurement state of the instrument. This operation enables the instrument to reverse the measured value and record the ScB parameter of the corresponding channel to compensate the measurement error caused by the lead resistance. If the measurement signal is not of the resistance type, or the line is not shorted, this operation will not work. After operation, check ScB parameter to know the lead resistance, which has been calculated as the value at 0 ℃.

6.3 D7/E7 Rail Instrument Panel Description

① The upper display window displays the measured value PV, parameter name, etc

② The lower display window displays the given value SV, alarm code, parameter value, etc

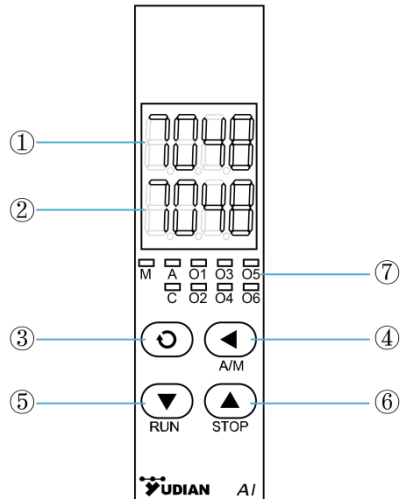
③ Setting key (also manual/automatic cycle display switch)

④ Data reduction key (also switch to display the previous channel)

⑤ Data increase key (also switch to display the next channel)

⑥ Data shift (also switch display setting of given value)

⑦ 9 LED indicator lights, with O1, O2, O3, and O4 corresponding to 4 outputs O5 and O6 corresponding to two alarms. C on indicates communicating with the upper computer, M on indicates switching channel manually while M off indicates automatic cyclic display



1. Switch to display circuit: press ▽ to decrease the circuit number, and press △ to increase the circuit number. Press ◁ to enter the setting state of the given value.

2. Setting parameters: When the parameter lock is not locked, press ↺ and hold for about 2 seconds, and release it after the parameter is displayed. Press ↺ again, and the instrument will display each parameter in turn, such as the upper limit alarm value H.AL1 of circuit 1, parameter lock Loc, etc. For the instrument configured and locked with the parameter lock, press ↺ to display the parameters (without holding for 2 seconds), and only the parameters that the operator needs to use (field parameters) will appear. The parameter value can be modified by pressing ▽, △, ◁. Press ◁ first and then ↺ to exit the parameter setting state, and press ◁ to return to check the last parameter.

3. The lower display window of the instrument can display the circuit number. When there is an upper limit or lower limit alarm, the first digit on the left of the lower display window can display the flashing H. or L. When the signal of the circuit exceeds the range (such as thermocouple disconnection), the upper display window of the instrument displays the upper or lower range value, and the lower display window flashes.

6.4 Instructions

The rail-mounted multi-channel temperature controller D5/E5 ca be connected to a dedicated display (E85) with a 1394 socket and dedicated wiring to program internal parameters. The display is show the figure, and functions are as follows:

① Upper display window, displaying process values or parameter names

② Lower display window, displaying channel number or parameter value

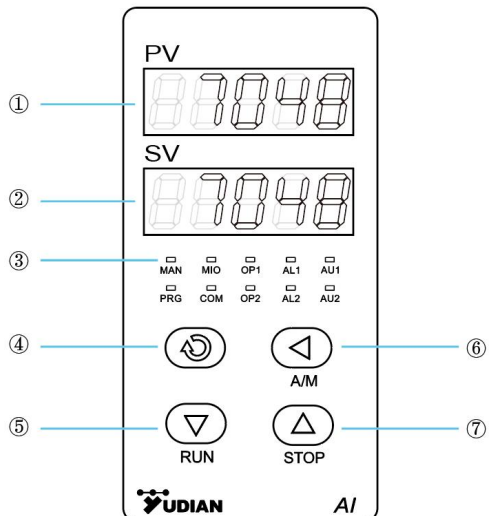
③ 10 LED indicator lights, PRG temporarily not used; MAN off indic automatic cycle display, MAN on indicates manual cycle display; MI OP1, OP2, AL1, AL2, AU1, AU2 correspond to module input and out respectively; COM on indicates communicating with the upper compu

④ Setting key (switch to manual/automatic cycle display)

⑤ Data reduction key (switch to display the previous channel)

⑥ Data shift (switching display of set values)

⑦ Data increase button (switch to display the next channel)



1. Switch to display circuit: press ▽ to decrease the circuit number, and press △ to increase the circuit number. Press ◁ to enter the setting state of the given value.

2. Setting parameters: When the parameter lock is not locked, press ↺ and hold for about 2 seconds, and release it after the parameter is displayed. Press ↺ again, and the instrument will display each parameter in turn, such as the upper limit alarm value H.AL1 of circuit 1, parameter lock Loc, etc. For the instrument configured and locked with the parameter lock, press ↺ to display the parameters (without holding for 2 seconds), and only the parameters that the operator needs to use (field parameters) will appear. The parameter value can be modified by pressing ▽, △, ◁. Press ◁ first and then ↺ to exit the parameter setting state, and press ◁ to return to check the last parameter.

3. The lower display window of the instrument can display the circuit number. When there is an upper limit or lower limit alarm, the first digit on the left of the lower display window can display the flashing H. or L. When the signal of the circuit exceeds the range (such as thermocouple disconnection), the upper display window of the instrument displays the upper or lower range value, and the lower display window flashes.

7. Parameters

The multi-channel temperature controller defines the input, output, alarm and communication modes of the instrument through parameters which is shown as the following:

Parm.	Meaning	Description	Rang
Addr	Communication address	Used to define the communication address of the instrument, with a valid range of 0~80. Instruments on the same communication line should be set with different Addr values to distinguish them from each other. The communication protocol AIBUS is adopted, as the multi-channel temperature controller has 2~4 circuits, occupying 2-4 addresses, which is equivalent to 2~4 single circuit instruments on the communication line. For example, if Cn=4, and Addr=1, then addresses 1~4 are used by the instrument, and addresses 1~4 are not allowed for other instruments. If Cn=3 and Addr=10, then addresses 10~12 are used by the instrument.	0~80
bAud	Baud rate	When the COMM slot is used for communication, the communication baud rate is defined by the parameter bAud, and the definable range is 1200~19200bit/s (19.2K).	0~19.2K BIT/S
SP1~4	Set value	Represent the set values of channels 1-4 respectively	-999~ +3200℃

<table>
<tr><td>At1~4</td><td>Auto-tuning</td><td>0, the auto-tuning function At is off.
1, start PID and Ctl parameter auto-tuning function, and automatically return to 0 after auto-tuning.
10, turn off the output</td><td>0~1,10</td></tr>
<tr><td>INP1~4</td><td>Input specifications</td><td>INP1~4 defines the input specifications of 1~4 channels respectively.
<table>
<tr><th>INP</th><th>Input Specifications</th><th>INP</th><th>Input Specifications</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>T</td></tr>
<tr><td>4</td><td>E</td><td>5</td><td>J</td></tr>
<tr><td>6</td><td>B</td><td>7</td><td>N</td></tr>
<tr><td>8</td><td>WRe3-WRe25</td><td>9</td><td>WRe5-WRe26</td></tr>
<tr><td>10</td><td>User specified extended input specifications</td><td>11~20</td><td>Standby</td></tr>
<tr><td>21</td><td>PT100</td><td>22~24</td><td>Standby</td></tr>
<tr><td>25</td><td>0~75mV</td><td>26~27</td><td>Standby</td></tr>
<tr><td>28</td><td>0~20mV voltage input</td><td>29</td><td>0~100mV；0-5V（J3）；0-20mA（J4）</td></tr>
<tr><td>30</td><td>0~60mV voltage input</td><td>31</td><td>0~1V</td></tr>
<tr><td>32</td><td>0.2~1V；
two-wire transmitter (J5)</td><td>33</td><td>1-5V（J3）；4-20mA（J4）</td></tr>
</table></td><td>0~33</td></tr>
</table>

		Note: The input specifications should correspond to the input module, with inputs of thermocouples and mV from J1, and inputs for two-wire resistors from J2. When InP3~4=41, channels 3~4 are the sum of the process values of the previous channels, which can be used as an adder; When InP3=42, PV3=PV2-PV1 is the subtractor; Set InP2=42 and InP1=22, measure humidity in the wet and dry bulb method.previous channels, which can be used as an adder; When InP3=42, PV3=PV2-PV1 is the subtractor; Set InP2=42 and InP1=22, measure humidity in the wet and dry bulb method.	
dPt1~4	Decimal point position	DPt1~4 is used to select the decimal point position and resolution of 1~4 channels respectively (1) For linear input, dIP=0, 1, 2, 3 corresponds to 0, 0.0, 0.00 and 0.000 display modes. (2) When thermocouple or thermal resistance input is used, dIP selects the resolution of temperature display, sets dIP=0, and the resolution of temperature display is 1 ℃. DIP=1, temperature display resolution is 0.1 ℃. Note: This setting is only valid for display. The internal temperature measurement resolution is fixed to 0.1 ℃ or 1 linear definition unit, so it does not affect the communication or transmission output effect. When the temperature display resolution is set to 0.1 ℃, the temperature measurement value above 1000 ℃ will automatically change to 1 ℃ resolution.	0~3

SCL1~4	Lower scale limit of input signal	Define the lower scale limit for linear input	-9990~+30000 linear units
SCH1~4	Upper scale limit of input signal	Define the upper scale limit for linear input	

Scb1~4	Input translation correction	The parameter ScB is usually used for translation correction of thermocouples to compensate for sensor or input signal errors, or to correct instrument cold junction compensation errors; When inputting the thermal resistor, Sc is used to correct the lead error of the two-wire thermal resistor. When inputting a thermocouple, the unit of ScB is 0.1℃. For example, setting ScB=-10.0 results in a decrease of 10.0℃ in the process value compared to ScB=0.0. When inputting a two-wire resistor: InP=19 ScB=6.25, 1 ohm. InP=20 ScB=25.0, 1 ohm. InP=21 ScB=6.25, 1 ohm. InP=22 ScB=1.25, 1 ohm. Taking InP=21 as an example, assuming that 20 ℃ (107.794 Ω) needs to be corrected to 25 ℃ (109.735 Ω), ScB needs to be set to (109.735-107.794) * 6.25 ≈ 12.1. When conducting annual metrological calibration of instruments, if the calibration error of instruments that have been used for a period of time in harsh environments exceeds the range, the internal parts of the instruments can be cleaned and dried first. If the accuracy still cannot be achieved, the ScB parameters can be modified for correction.	-1990~+9990 definition unit or 0.1 ℃

FIL1~4	Digital filter strength	FIL is used to set the strength of digital filtering. 0 does not have any filtering, 1 only takes median filtering, and 2~40 have both median filtering and integral filtering. The larger the FIL, the more stable the measured value, but the slower the response. Generally, when the measurement is greatly disturbed, the FIL value can be increased gradually to make the instantaneous runout of the measured value less than 2~5 words. When the instrument is calibrated in the laboratory, the FIL should be set to 0 or 1 to improve the response speed.	0~40
P1~4	Proportional band	Define the proportional band of APID and PID in the same units as the PV value, rather than using a percentage of the range. Familiar systems can directly input known correct P, I, D, Ctl without the need to activate the auto tuning (AT) function.	10~9999 unit
I1~4	Integration time	Define the integration time for PID, in seconds, and cancel the integration effect when I=0.	0~9999s
d1~4	Differential time	Define the derivative time of the PID in 0.1 seconds. Cancel differential action when d=0.	0~999.9 s
OPH1~4	Output upper limit	Limit he percentage of the maximum value output by OUTP.	0~100

H.AL1~4	Alarm value of upper limit absolute value	Represent the upper limit alarm values of 1~4 channels respectively. PV>H.ALx (x is 1-4, indicating the corresponding measurement channel, the same below), an upper limit alarm generated; PV<H.ALx HYSx, alarm disarmed. Setting unused alarms to limit values can prevent them from alarming.	-999~+3200℃
L.AL1~4	Alarm value of lower limit absolute value	Represent the lower limit alarm values of 1~4 channels respectively. PV<L.ALx, a lower limit alarm generated, PV>L.ALx+HYSx, alarm disarmed. The alarm can control the relay module on ALM, AUX, or OUTP, and be programmed by parameters AOP1~4.	-999~+3200℃
HYS1~4	Return difference	To avoid frequent alarms caused by fluctuations in inputting process values, and to avoid erroneous actions caused by interference in the process values during AT, resulting in incorrect PID parameters being automatically adjusted. also known as insensitive zone, dead zone, hysteresis, etc.	0~999.9℃

AOP1~4	Alarm Output Position Definition Parameters	AOP is used to define the positions of H.AL and L.AL alarm outputs, only supported by E5 instruments. The single digits of parameter AOP represent the output position of H.AL alarm, with a range of 0~4, where 0~2 indicates that the alarm is not output from any port, and 3 and 4 respectively indicate that the alarm is output by AL1 and AL2. The ten digits of this parameter represent the output position of the L.AL alarm, with the same meaning as above. For example, AOP1=43, it means that the upper limit alarm of circuit 1 is output by AL1, and the lower limit alarm is output by AL2. Another example, AOP2=34, it means that the upper limit alarm of circuit 2 is output by AL2, and the lower limit alarm is output by AL1.	0~77
Cn	Number of measurement channels	The single digit of parameter Cn indicates the number of measurement channels actually used by the instrument. AI-7048 can be set as 1~4. When Cn is set as 2, the lower display window of the instrument will not display the channel number but the measured value of circuit 2. At this time, the instrument is equal to a two-way control instrument.	1~4

Cno	Start number of channel display	Cno is used for the lower display window of the instrument to indicate the starting number of the channel sign. Generally, the instrument channel number is 1~4. However, the initial channel number can also be modified when multiple computers are used. For example, when the first instrument displays CH1~CH4, if the Cno parameter of the second instrument is changed from 1 to 5, the second instrument can display CH5~CH8.	
Ctl	Output cycle	The Ctl parameter value can be set between 0.5~5S. SSR (solid state relay) is used as the output actuator. It is generally recommended to set it for 0.5~2s to improve the control accuracy.	0.5~5

AF	System function selection	AF is used to select multiple functions, with the following meanings: AF=A*1+B*2+C*4+D*8+E*16+F*32+G*64+H*128 A=0, displayed cyclically at normal speed; A=1, displayed cyclically at a quick speed. The speed of the cycle only affects the display and does not change the internal scanning speed and alarm response time. B and C are used to define the input mode. When B=0 and C=0, the instrument uses a two-wire thermistor or thermocouple input; When B=1 and C=0, the instrument uses (2N+1)-wire thermal resistance input; When B=1 and C=1, the instrument uses a three-wire thermistor input. D=0, normal use; D=1, change each lower limit alarm L.AL to a upper limit alarm. E=0, normal use; E=1, only use one of the two-channel modules and connect to the first channel. F=0, standby. Standard communication protocol; F=1, communication protocol for expanding communication addresses. H=0, AIBUS; H=1, standard MODBUS.	

AF2	System function selection 2	AF is used to select some system functions, and its numerical meanings are as follows: AF2=A X 1+B X 2+C X 4+E X 16 A=0, normal use; A=1, change the upper limit alarm H.AL of each circuit on the instrument to the upper limit deviation alarm. When the deviation (measured value PV - given value SV) is greater than HAL1-4, the deviation upper limit alarm will be generated. When the deviation is less thanHAL1~4-HYS, the alarm will be released. Set HAL1~4 as the maximum, and the alarm function will be canceled. B=0, normal use; B=1, change the lower limit alarm L.AL of each circuit on the instrument into the deviation lower limit alarm. When the deviation (measured value PV - given value SV) is less than LAL1-4, a negative deviation alarm will be generated. When the deviation is greater than LAL1~4+HYS, the alarm will be released. Set LAL1~4 as the minimum, and the alarm function will be canceled. C=0, reaction (corresponding to heating); C=1, positive action (corresponding to refrigeration). E=0, 4-20mA output; E=1, 0-20mA output. (X6 module be selected)	

nonc	Normal on/off selection	The parameter nonc is used to define the alarm normally open output as normally closed output. nonc=C*4+D*8 C=0, AL1 normally open; C=1, AL1 is normally closed. D=0, AL2 normally open; D=1, AL2 is normally closed.	0~127
Po	atmospheric pressure	The dry and humidity bulb method is used to measure humidity, defining wind speed in meters per second (m/s). (Only 7028 has this parameter)	1~120.0
SPEd	wind speed	The dry and humidity bulb method is used to measure humidity, defining wind speed in meters per second (m/s). (Only 7028 has this parameter)	0.01~10.00
Loc	Parameter modification level	When Loc is set to a value other than 808, the instrument is only allowed to display and set 0~12 field parameters (defined by EP1~EP12) and Loc parameter itself. When Loc=808, users can set all parameters. The Loc parameter provides a variety of different parameter operation permissions. As follows: Loc=0, it is allowed to display and modify field parameters. Loc=1, only field parameters can be displayed, but cannot be modified. Loc=808, all parameters can be displayed and set. Note: This setting is only for external display, and it will not be affected if parameters are modified by communication.	0~9999

EP1~12	Field parameter definition	After the instrument is set, the parameters that do not need to be changed frequently can be shielded, leaving only the parameters that need to be changed frequently for the field operators to modify. EP1~EP12 parameters are used to define which parameters can be displayed (i.e. field parameters) when the parameter lock is locked, while other parameters are shielded and cannot be displayed or modified. EP1~EP12 in the parameter table can define 0~12 field parameters for field operators. EP1~EP12 in the parameter table can define 0~12 field parameters for field operators. The parameter values are other parameters besides EP parameters, such as H.AL1, L.AL1, etc. When Loc is locked, only the defined parameters or program settings can be displayed, and other parameters cannot be displayed and modified. This function can speed up the modification of parameters, and prevent important parameters (such as Sn1~6) from being modified by mistake. The parameters EP1~EP12 can define up to 12 field parameters. If the field parameters are less than 12 (sometimes there is no field parameter), the parameters to be used should be defined from EP1 to EP12, and the first parameter not used should be defined as nonE. For example, an instrument often needs to modify the given SP parameters of each channel on site, and the EP parameters can be set as follows: EP1=SP1, EP2=SP2, EP3=SP3, EP4=SP4, EP5=nonE, Loc=0	NonE~ bAud

		At this time, if the instrument uses an external display, it can only display and modify 4 parameters such as SP1~SP4, but the communication will not be affected.	

8. FAQs

8.1 How to enter the parameter list?

Press and hold  for two seconds to enter the parameter list, and then press  briefly to find the next parameter. If the parameters are locked, please find the password lock parameter LOC and set it to 808, then press  briefly to see all the parameters.

8.2 How to set auto-tuning?

When the measured value PV is room temperature, set the set value SV to about 60% of the common temperature, and then enter the internal parameter list to find the auto-tuning parameter At. At1~4 correspond to four channels respectively. Please change the At parameter to 1 to start auto-tuning and it shall automatically return to 0 after the self-tuning.

8.3 How to judge whether the instrument has output?

First, check whether the instrument output indicator light is on (check lights OP1, OP2, AU1, AU2 for panel mounted instruments, and lightso1~o4 for D7/E7 instruments). If it is not on, check whether the instrument operates normally, and then check whether the instrument parameters are set correctly; if it is not lit, check whether the instrument operates normally, and then check whether the instrument parameters are set correctly; if the output signal is normal but the rear

SSR does not work, you need to check other faults along the output line. If there is no output signal, it can be determined that the instrument output module is abnormal.

8.4 Common faults

The instrument PV value display - 208 indicates that no resistance signal is detected when the instrument input specification is Pt100, which is generally a wiring problem. The PV value display of the instrument is 1381, indicating that when the input specification of the instrument is K-type thermocouple and the instrument detects an open circuit of the input signal, it is necessary to check whether the thermocouple is connected properly.

8.5 How to set alarm parameters?

First, set the alarm parameters to the required values (for example, if 200 degrees is set for the upper limit alarm of the first channel, change the H.AL1 parameter to 200), then enter the internal parameters to find the AOP parameters to define the alarm signal output port(for example: If the upper limit alarm of the first channel needs to be output from AL1, set the AOP1 single digit to 3. For specific definitions, please refer to the AOP parameter introduction in the manual).

9 Display/Alarm Symbols

The basic display status starts after the instrument is powered on, and the SV display window can alternately display symbols to indicate status, shown as the following:

Symbols	Description	Method
CA 1	Start PID initialization and self-tuning after power on	Wait for it to stop flashing automatically, and turn off the setting in advance by changing the At1 parameter to 0. The same applies to other channels.
Ar 1	Automatically corrects the wire resistance	Wait for the automatic correction to end.
H.A 1	An upper limit alarm occurs in the first circuit	PV<H.AL1-HYS, the alarm turns off automatically, or change H.AL1= 3200.0 to turn off the alarm. The same applies to other channels.
L.A 1	An lower limit alarm occurs in the first circuit	PV>L.AL1+HYS, the alarm turns off automatically, or change L.AL1= -999.0 to turn off the alarm. The same applies to other channels.
Er 1	There are errors in the system, such as parameter loss	Need to be returned to the factory for repair

Note: The overrange of the multi-channel instrument is indicated by the maximum or minimum value displayed when PV flashes. At this time, check whether the input parameter specification is correct, whether the input wiring is correct and whether the input signal is normal.

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