AI-7048 ARTIFICIAL INTELLIGENCE INDUSTRIAL CONTROLLER

Operation Instruction

Ver. 7.5

Dimension E5

Dimension D5

1. SUMMARY

AI-7048 is capable of measuring and controlling four channels of temperature, and every channel can define its own input specification.

AI-7048 can either work independently or cooperate with computer or PLC (Programmable Logic Controller). It features:

- Providing up to four channels of configurable inputs, and supporting multiple thermocouple inputs with auto reference junction compensation and linear voltage (mV) inputs with user defined scale. Every channel has its own digital filtering and can adjust its filtering degree.
- High performance hardware design, which greatly decreased temperature drift and the interference among the four channels. Therefore, this multi-channel instrument obtains the same measurement accuracy and anti-interference ability as that of single channel instrument.
- Every channel has independent high/low alarms, and the alarms can be allocated to different alarm outputs or to the same alarm output (Just available for Dimension E5).
- Friendly and customized operating interface leads to easy learning and simple manipulation. Up to 12 parameters can be promoted to immediate operator access in Field Parameter Table.
- Advanced communication functions, compatible with the communication protocol of other AI series instruments. One AI-7048 communicates with the host computer the same as four independent controllers.
- Universal power supply of 100-240VAC or 24VDC.
- New generation D5/E5 rail mounted dimension. The width of D5 is only 22.5mm. The instrument can be easily configured by connecting to handset display.
- ISO9001 and CE certified and satisfied with EMC standard, achieving world class level of quality, anti-interference ability and safety. The power and all I/O terminals passed 4KV/5KHz EFT test, and the instrument can work stably under interference.

2. Technical Specification

- **Input type:**
  Thermocouple: K, S, R, E, J, T, B, N, WRe5-WRe26
  Linear voltage: 0～20mV, 0～60mV, 0～100mV, 0～1V, etc.
- **Instrument Input range**
  K(0～1300℃), S(0～1700℃), R(0～1700℃), T(-200～+350℃), E(0～1000℃),
  J(0～1200℃), B(0～1800℃), N(0～1300℃), WRe5-WRe26(0～2300℃)
  Linear Input: -9990～+30000 units defined by user.
- **Measurement accuracy :** 0.2%FS ± 0.1℃
  Note 1: For thermocouple input with internal compensation, cold junction compensation error up to 1℃ should be considered.
  Note 2: B thermocouple can obtain the above measurement accuracy only at the range of 600～1800℃. If B type thermocouple apply to measure temperature at 60～600℃ will cannot obtain accuracy.
- **Sampling rate**: 250ms
- **Control period** : 0.48 sec / 4 channels
- **Output :** SSR voltage, 12VDC/20mA each channel
- **Temperature shift :** ≤0.01%FS /℃ (typical value is 60ppm/℃)
- **Electromagnetic compatibility (EMC) :** ±4KV/5KHz according to IEC61000-4-4;
  4KV according to IEC61000-4-5.

- **Isolation withstanding voltage :** Between power, relay contact or signal terminal ≥2300VDC; Between SSR voltage output and thermocouple input ≥600VDC
- **Power supply :** 100～240VAC, -15%, +10% / 50Hz; 120～240VDC; or 5VA.
- **Operating Ambient :** temperature (-10～60)℃; humidity ≤90%RH

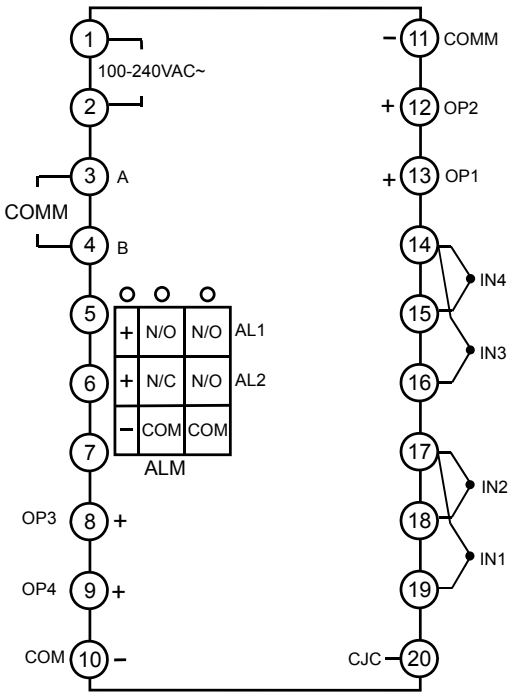
3. Rear Terminal Layout and Wiring

This is wiring graph for E5, and ALM is an optional alarm module.

In AI-7048 size E5(DIN rail), E(48X96)mm, F(96X48)mm and A(96X96)mm, those size can have the alarm action output after installed the following modules:

L1 : Relay output module (2A/240VAC, NO+NC)

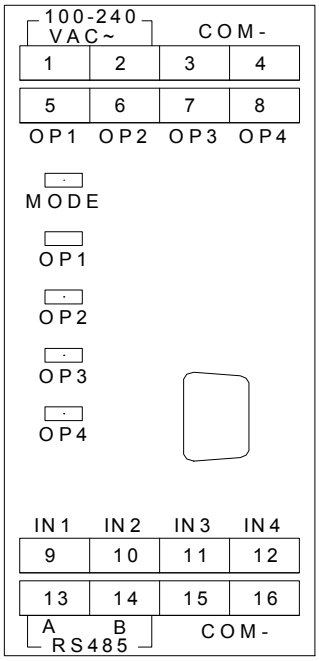
L5 : Dual relay output module (2A/240VAC, NO), can change to NC by mode by change the parameter " nonc"



The wiring layout of D5 size. (22.5 X 100)mm, DIN rail.
D5 size no dry contact alarm output.

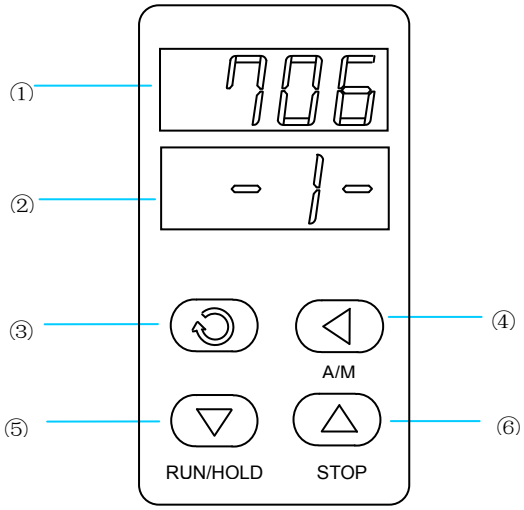
Terminal 1 and 2:
Power supply of 100~240VAC 50Hz or 24VAC/DC.
Terminal 9-12:
The positive poles of thermocouple inputs of channel 1-4;
Terminal 15 and 16:
The common
Negative pole of thermocouple inputs and can be free connected.
Terminal 5-8:
The positive poles of SSR voltage outputs of channel 1-4
Terminal 3-4:
The common
Negative pole of SSR voltage outputs, and be free connected. 12-16VDC/20mA with protection for short circuit.
Terminal 13 and 14:
RS485 communication.

"MODE" LED: indicate the status of communication and alarm.
"OP1-OP4" LED: indicate the output of channel 1-4.



4. DISPLAYS AND OPERATIONS

① Upper display window, displays PV, parameter code, etc.
② Lower display window, displays SV, parameter value, channel no. or alarm code.
③ Setup key, for accessing parameter table and conforming parameter modification.
④ Data shift key, or for switching the channel display in manual/auto.
⑤ Data decrease key, and also for displaying the previous channel.
⑥ Data increase key, and also for displaying the next channel.



Operation Instructions:

1. Switch between channels:

Press ⌄ to display to the previous channel
Press ⌃ to display the next channel.
Press < can switch between auto multi-channel circulating display status and normal display.

2. Set parameters:

Keep pressing ↻ about 2 seconds can access Full Parameter Table (When the parameter lock "Loc" isn't locked. Loc=808.)
Pressing ↻ can go to the next parameter,and pressing <、⌄ or ⌃ can modify a parameter.
Setpoints (SV) can be set by pressing <、⌄ or ⌃
Press ⌄ key to decrease the value.
Press ⌃ key to increase the value.
Press < key to move to the digit expected to modify.
Keep pressing ⌄ or ⌃, the speed of decreasing or inscreasing value gets quick. The range of setpoint is between the parameter SPL and SPH.
Pressing and holding < can return to the preceding parameter. Pressing < (don't release) and then press ↻ key simultaneously can escape from the parameter table.
When the parameter is locked, pressing ↻ can display Field Parameter Table which includes up to 12 parameters selected by user.
The instrument will escape auomatically from the parameter table if no key is pressed within 25 seconds, and the change of the last parameter will not be saved.

3. Alarm display:

The channel number is displayed in the lower display window.
When high or low limit alarm occurs, the first digital on the left side flickeringly displays H or L. When an input singal is out of range, for example, the thermocouple circuit is break, the upper window will display the upper limit or lower limit, and the lower window will flicker.

4. MODE indication light:

When the instrument is communicating with the host computer, the light will keep flashing in random speed.

When the instrument hasn't received signal from the host computer more than 6 seconds, the indication light should flicker with the same light on time and light off time.

It means:

The on-off period is as long as 1.6 second means no communication and no alarm (it can be treated as normal);

The light flashing with period 0.6 second means no communication and some general error occurs.

The light quickly flashing with period 0.3 second means no communication and severe error such as input over range occurs.

The light keeping off means the instrument power off or damaged; the light keep on (longer than 8 seconds) means the instrument power on but damaged.

5. Setting Parameters:

(Note: x means channel number. It can be 1~4.)

<table>
<tr><th>Parameter</th><th>Name</th><th>Remarks</th><th>Setting range</th></tr>
<tr><td>bAud</td><td>Baud rate</td><td>When COMM module interface is used for communication, bAud defines the baud rate range is 300~19200bit/s.</td><td>0 ~ 19.2K bit/S</td></tr>
<tr><td>Addr</td><td>Communication address</td><td>Every instrument in the same communication line should be assigned to different communication address. The communication applies AIBUS protocol. Every input channel takes one address. For example, if channel number Cn=3 and Addr=10, then the communication address 10~12 are assigned to the instrument.</td><td>0 ~ 80</td></tr>
<tr><td>SPx</td><td>Setpoint</td><td>Setpoints of channel 1~4.</td><td>-999~+ 3200℃</td></tr>
<tr><td>Atx</td><td>Auto tuning</td><td>0: Auto tuning function is disable
1: Active auto turning function to calculate the values of parameters P, I, d and CtI. After auto tuning is accomplished, “At” will be automatically changed to 0.</td><td>0~1</td></tr>
<tr><td>INPx</td><td>Input specification</td><td>Define the input specification of channel 1~ 4.
<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>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>Extended input spec.</td><td>11~24</td><td>Spare</td></tr>
<tr><td>25</td><td>0~75mV</td><td>26~27</td><td>Spare</td></tr>
<tr><td>28</td><td>0~20mV</td><td>29</td><td>0~100mV</td></tr>
<tr><td>30</td><td>0~60mV</td><td>31</td><td>0~1V</td></tr>
<tr><td>32</td><td>0.2~1V</td><td></td><td></td></tr>
</table></td><td>0 ~ 39</td></tr>
<tr><td>dPtx</td><td>Decimal point</td><td>dPtx is set to select display resolution for channel x
for linear inputs, the corresponding display resolution of dPt=0,1,2,3 are 0, 0.0, 0.00 and 0.000
For thermocouple inputs, when dPt=0, the display resolution is 1℃; when dPt=1, the resolution is 0.1℃.
Note: dPt only affects the display, and has no effect on internal data.</td><td>0~3</td></tr>
<tr><td>SCLx</td><td>Scale low limit</td><td rowspan="2">SCL and SCH define the corresponding scale range of linear inputs as mV.</td><td rowspan="2">-9999~+30000 units</td></tr>
<tr><td>SCHx</td><td>Scale high limit</td></tr>
<tr><td>Scbx</td><td>Input offset</td><td>For thermocouple, the units of Scb is 0.1℃. For example, when Scb=-100, the actual offset=-10℃, then the measured temperature will be 10℃ lower than that when Sc=0.</td><td>-1999~+4000 units or 0.1℃</td></tr>
<tr><td>FILx</td><td>Digital filter</td><td>The value of FIL will determine the ability of filtering noise.
FIL=0, no filtering;
FIL=1, filtering with mean;
FIL=2~40, filtering with mean and integral.
When a large value is set, the measurement input is stabilized but the response speed is slow. Generally, it can be set to 1 to 3.
If strong interference exists, then you can increase parameter FIL gradually to make momentary fluctuation of measured value less than 2 to 5.
When the instrument is being metrological verified, FIL can be set to 0 or 1 to shorten the response time.</td><td>0~40</td></tr>
<tr><td>Px</td><td>Proportional band</td><td>Proportional band in PID and APID control. Instead of percentage of the measurement range, the unit is the same as PV.
Generally, optimal P, I, D and CtI can be obtained by auto tuning. They can also be manually inputted if you already know the correct values.</td><td>10～9999 units</td></tr>
<tr><td>Ix</td><td>Time of Integral</td><td>Time of Integral in PID. No integral effect when I=0</td><td>0～9999 seconds</td></tr>
<tr><td>Dx</td><td>Time of derivative</td><td>Time of derivative in PID. No derivative effect when d=0</td><td>0～999.9 seconds</td></tr>
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<tr><td>H.ALx</td><td>Alarm high limit</td><td>x channel high alarm is triggered when PVx (the present value of x channel)>H.ALx; alarm releases when PVx<H.ALx - HYSx.</td><td rowspan="2">-999~+3200 ℃</td></tr>
<tr><td>L.ALx</td><td>Alarm low limit</td><td>x channel low alarm is triggered when PVx<L.ALx;
alarm releases when PVx>L.ALx+HYSx.</td></tr>
<tr><td>HYSx</td><td>Hysteresis</td><td>HYS is set to avoid high frequent alarm on/off actions caused by process input fluctuation. It also works at auto-tuning.</td><td>0~999.9℃</td></tr>
<tr><td>AOPx</td><td>Alarm output allocation (D5 size not support this function)</td><td><table><tr><td>Alarm / Output to</td><td>Low limit alarm</td><td>High limit alarm</td></tr><tr><td>None</td><td>0</td><td>0</td></tr><tr><td>AL1</td><td>3</td><td>3</td></tr><tr><td>AL2</td><td>4</td><td>4</td></tr></table>For example, AOP1=43 that the low limit alarm of channel 1 is sent to AL2, and high limit alarms sent to AL1</td><td>0~44</td></tr>
<tr><td>Cn</td><td>Number of input channels</td><td>Define actual number of input channels. Setting range is 1~4.
When Cn=2, the lower window display the present value of channel 2 instead of the channel number.</td><td>1~ 4</td></tr>
<tr><td>Cno</td><td>First display channel setting</td><td>If several of AI-7048 has used, this parameter can define the AI-7048 to display assigned channel number on display. For example, when Cno=6, the controller will display channel number from 6~9. (6, 7, 8, 9)</td><td></td></tr>
<tr><td>AF</td><td>Addition function setting 1</td><td>Parameter “AF” was defined as below:
AF=A x 1 + B x 2 + C x 3 + D x 4
A=0; Normal speed in channel cycle display;
A=1; Faster speed in channel cycle display;
B=0; C=0;
D=0; Normal application; D=1; Change all of the low alarm to be high alarm;</td><td></td></tr>
<tr><td>AF2</td><td>Addition function setting 2</td><td>Parameter “AF2” was defined as below:
AF=A x 1 + B x 2
A=0; Normal application;
A=1; Change all of the high alarm to be high deviation alarm; when deviation value (PV – SV) > H.ALx, it will trigger the alarm. When (PV – SV) < H.ALx – HYSx, alarm off, set the H.ALx value to maximum will disable the alarm function.
B=0; Normal application;
B=1; Change all of the low alarm to be low deviation alarm; when deviation value (PV – SV) < L.ALx, it will trigger the alarm. When (PV – SV) > L.ALx – HYSx, alarm off, set the L.ALx value to minimum will disable the alarm function.</td><td></td></tr>
<tr><td>nonc</td><td>NO/NC selection</td><td>Single channel relay module provides both normal open and normal close output, while dual relay output module L5 only provides normal open output. However, by parameter “nonc”, the NO output can be changed to NC output.
nonc = 0, AL1, AL2 (L5 is installed in ALM socket) are normal open output.
nonc = 127, AL1 and AL2 are normal close output</td><td>0, 127</td></tr>
<tr><td>Loc</td><td>Parameter lock</td><td>Loc=0, Allow to display and modify parameter “Loc” and the field parameters which is defined in EP1~EP12 .
Loc=1, Allow to display and modify parameter “Loc”, and only display field parameters, can’t modify them.
Loc=808, allow to display and set all parameters.
Note: This setting just effect on external display. Modify parameter by communication was always allowed.</td><td>0 ~9999</td></tr>
<tr><td>EP1-12</td><td>Field parameter</td><td>When configuration of the instrument is completed, most parameters will not need to be set by field operators. Furthermore, field operators may not understand many parameters, and may probably set parameters incorrectly by mistake and make the instrument unable to work.
EP1~EP12 define 0~12 field parameters for operators’ use in parameter table. Their parameter values are parameters except parameter EP itself, for example, H.AL1, L.AL1, .etc,
Parameters from EP1 to EP12 can define 12 field parameters at most, if the number of field parameters is less than 12(sometimes even none), it is necessary to define field parameters from EP1 to EP12 in order, the first unused EP should be set to none.
For example, four parameters of SP1 to SP4 (all channels’ setpoints) are</td><td>NonE~bAud</td></tr>
</table>

		need to be modified by field operators, the parameter EP can be set as : EP1=SP1, EP2=SP2, EP3=SP3, EP4=SP4, EP5=none, Loc=0 Then only parameter SP1~4 can be displayed and modified, but via communication, on the host computer, all parameters can be displayed and modified.	