AI-700/701 Intelligent Measuring and Alarm Instrument

User’s manual (V9.2)

1. Main Features

- Programmable module, supporting thermocouple, thermal resistance, voltage, current and two-wire retransmitter input; Suitable for measuring and displaying various physical quantities, such as temperature, pressure, flow, liquid level, humidity, etc, with accuracy up to class 0.2.
- Support up to four-channel alarm function, including alarms of two-channel upper limit and two-channel lower limit, which can be output independently or share one way of relay output.
- It has the functions of digital correction, digital filtering and automatic compensation for thermocouple cold junction, which is maintenance-free and easy to use.
- Support RS485 communication interface, install S module to communicate with upper computer, and the communication protocol is compatible with AI series instruments.
- It supports temperature retransmission output and adopts a new generation of X3 high-precision (0.2) current output module, which can be used as a temperature transmitter with accuracy of 0.3℃ .
- Adopt "feverish" hardware, tantalum capacitor or ceramic capacitor to replace electrolytic capacitor, which has lower power consumption, higher reliability, stronger stability and wider temperature range than products of the same level; Its power supply and I/O terminals have passed the group pulse anti-interference test of 4KV/5KHz.
- The universal 100~240VAC or 24VDC power supply has the protection function of lightning protection and 10-second protection against misconnection of 380VAC power supply.

2. Technical Specification

- **Input Specification: (One instrument is compatible to the following)**
  Thermocouple: K, S, R, T, E, J, B, N, WRe3-WRe25, WRe5-WRe26, etc
  Resistance temperature detector: Cu50, Pt100
  Linear voltage: 0~5V, 1~5V, 0~1V, 0~100mV, 0~60mV, 0~20mV etc. 0~10V
  Linear current(module I44 installed at MIO): 0~20mA, 4~20mA etc.
  Linear resistance: 0~80 Ω, 0~400 Ω (used to measure the pressure of remote resistance)
- **Instrument Input range**
  K(-100~+1300℃), S(0~1700℃), R(0~1700℃), T(-200~390℃), E(0~1000℃), J(0~1200℃), B(600~1800℃), N(0~1300℃), WRe3~WRe25(0~2300℃), WRe5~WRe26(0~2300℃), Cu50(-50~-150℃), PT100(-200~+800℃)
- **Measurement accuracy :**class 0.2(0.2%FS±1℃)
- **Resolution:**0.1 ℃ (when the measured temperature is greater than 999.9 ℃ , it will be automatically converted to display by 1 ℃), and can be selected to display by 1 ℃
- **Temperature drift:**≤± 0.01% FS/℃ (typical value is about ± 50ppm/℃)
- **Electromagnetic compatibility(EMC):** ±4KV/5KHz according to IEC61000-4-4 (Electrical Fast Transient); 4KV according to IEC61000-4-5 (Electrical Surge).
- **Retransmission and output:**after the X3 module is installed at the OUTP, PV can be retransmitted and output as standard current, and the maximum load resistance is 500 Ω.
- **Alarm function:**4 types of alarm, high limit, low limit, deviation high limit and deviation low limit, relay module can be optionally installed to output alarm signals.
- **Isolation withstanding voltage:**Among power, relay contact or signal terminals ≥2300VDC. Among isolated electroweak terminals ≥600V
- **Power supply:** 100~240VAC, -15%, +10% / 50~60Hz; or 24VDC/AC, -15%, +10%.
- **Power consumption:** ≤5W
- **Operating ambient:**Temperature -10~+60℃ ; Humidity ≤90%RH

3. Ordering Code Definition

AI-701	A	N	X3	L3	N	S1	—	24VDC
①	②	③	④	⑤	⑥	⑦		⑧

The following is the meanings of the 8 parts:

① Instrument Model
AI-701 type measuring and alarm instrument, with double-row 4-position display panel, thermal resistance and linear voltage input thermocouple, such as 0~5V, 1~5V, etc., as well as measurement accuracy of class 0.2℃

② Panel Dimension

AI-700	AI-701	Depth (mm)	Dimension Width x Height (mm)	Opening Dimension Width x Height (mm)	Light Bar
A0	A	100mm	96×96 mm	$92^{+0.5}\times92^{+0.5}$ mm	---
A10	A1	70mm			
	A2	100mm			25 segments in 4 levels of luminosity at 1% resolution
	A21	70mm			
B0	B	100mm	160×80 mm	$152^{+0.5}\times76^{+0.5}$ mm	---
B10	B1	70mm			
	B2	100mm			25 segments in 4 levels of luminosity at 1% resolution
	B21	70mm			
C0	C	100mm	80×160 mm	$76^{+0.5}\times152^{+0.5}$ mm	---
C10	C1	70mm			
	C3	100mm			25 segments in 4 levels of luminosity at 1% resolution
	C31	70mm			
D0	D	95mm	72×72 mm	$68^{+0.5}\times68^{+0.5}$ mm	---
D20	D2	95mm	48×48 mm	$45^{+0.5}\times45^{+0.5}$ mm	---
	D6	95mm	48×48 mm	$46^{+0.5}\times46^{+0.5}$ mm	---
	D7	22.5*100, DIN rail mount, double-row LED, bus terminal			
E0	E	100mm	48×96 mm	$45^{+0.5}\times92^{+0.5}$ mm	---
E10	E1	70mm			
	E2	100mm			25 segments in 4 levels of luminosity at 1% resolution
	E21	70mm			
	E5	48*96, DIN rail mount. Optional external E8 keypad and display are required to be plugged for parameter setting and operation.			
F0	F	100mm	96×48 mm	$92^{+0.5}\times45^{+0.5}$ mm	---
F10	F1	70mm			

③ Module available in multiple functions I/O (MIO):
V24 or V10, 24V or 10V Voltage output can be used by external retransmitters, load cells, etc
I44 Used to expand the input of 0~20mA or 4~20mA linear current, including 24V/50mA power output, and can be directly connected to two-wire retransmitter
④ Module available in main output (OUTP):X3 module can be installed to retransmit and output current.
⑤ Module available in alarm (ALM): Single relay module L21 or double relay module L3 can be installed to output alarms.
⑥ Module available for auxiliary output (AUX): Relay modules L21, L3 can be installed to output alarms.
⑦ Module available for communication (COMM): Modules S, S1 can be installed for RS485 communication.
⑧ Power supply: If it is left blank, the power of the instrument is 100~240VAC. "24VDC" means the power supply of 20~32V DC or AC power.

Note 1: For 4~20mA/0~20mA standard current, 250 Ω resistance can be connected externally or I44 module can be installed at the MIO to convert to 1~5V/0~5V voltage. The latter also contains 24VDC power output, which can be directly connected to the two-wire retransmitter.

Note 2: There is no MIO module slot for D-type instrument, and COMM and ALM cannot be installed at the same time. When ALM is used, there is only single-channel alarm AL1; The D2 instrument has only module slots for OUTP and COMM/AUX.

Note 3: Free maintenance service is provided for the instrument during the warranty period. For the instrument that needs to be repaired, please write down the phenomenon and cause of the failure to ensure correct and comprehensive repair.

Note 4: If X3 module has been installed at OUTP and RS485 interface needs to be installed at COMM, S1 module with isolation power supply shall be installed at COMM to realize mutual isolation of input, current retransmission output and communication slot, or change the X3 module to X5.

4. Panel Description

① Upper display window: Displays PV, parameter code, etc.

② Lower display window: Displays unit symbols and parameter value
③ Setup key: For accessing parameter setting ststus and conforming parameter editing.
④ Data shift key
⑤ Data decrease key
⑥ Data increase key
⑦ LED indicators:OP1 and OP2 indicate the specifications of the current retransmission and output. OP1 and OP2 will be on synchronously only when OUTP is installed with X3 module; AL1, AL2, AU1 and AU2 correspond to the output of modules.

Note: After power-on, the upper display window of the instrument displays the process value (PV), which is the basic display status of the instrument. When the input measurement signal exceeds the range (i.e. thermocouple disconnection, thermoelectric blocking line or short circuit and error setting for input specification), the upper display window will alternately display "orAL" and the value of the upper or lower limit of measurement.

5. Operation Description

In the basic display state, press (◯) and hold for about 2 seconds to sccess the Field Parameter Table. If the parameter is not locked (Loc=0), press (▽) to decrease the data or press (△) to increase the data to modify the value, the decimal point of the value flashes (like the cursor). Press and hold the key to quickly increase or decrease the value, and the speed will automatically increase as the decimal point moves to the right (speed at class 3). Press (◁) to directly move the position (cursor) of the edited data. Press (◁) to display the next parameter. Press (◯) and hold to return to the previous parameter. Press (◁) first and then press (◯) again to exit the parameter setting status. If there is no key operation, it will automatically exit the parameter setting status after about 30 seconds. Set Loc=808 to access the System Parameter Table.

5.1 Field Parameter Table

Code	Name	Description	Setting Range
HIAL	High limit alarm	Alarm turns on when PV>HIAL Alarm turns off when PV<HIAL-AHYS	-9999~+30000 unit
LoAL	Low limit alarm	Alarm turns on when PV<LoAL Alarm turns off when PV>LoAL+AHYS	
HdAL	Deviation high alarm	Alarm turns on when PV>HdAL; Alarm turns off when PV<HdAL-AHYS	
LdAL	Deviation low alarm	Alarm turns on when PV<LdAL Alarm turns off when PV>LdAL+AHYS Note: Each type of alarm can be set freely to control the output of slots AL1, AL2, AU1 and AU2, or none needs to be done. For details, refer to the description of alarm output parameter AOP.	
Loc	Parameter Lock	Loc=0, allowed to edit set value and field parameters; Loc=1, prohibit to edit the field parameters, but allowed to edit the set value; Loc=2~3, allowed to edit the field parameters, but prohibit to edit the set value; Loc=4~255, not allowed to edit any parameter other than Loc. Loc=808, pressagain to enter the parameter table.	0~255

5.2 System Parameter Table

Code	Name	Description	Setting Range
AHYS	Hysteresis	Known as dead zone and hysteresis, used to avoid frequent alarm on/off because of PV fluctuation. 0.5~2 ℃ is recommended for temperature control.	0~9999 unit
AoP	Alarm output allocation	(see table below)	0~4444

Output to \ Alarm	LdAL (x 1000)	HdAL (x100)	LoAL (x10)
None	0	0	0
AL1	1	1	1
AL2	2	2	2
AU1	3	3	3
AU2	4	4	4

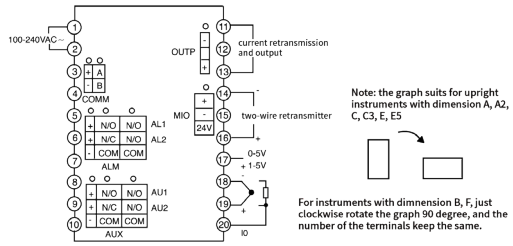
AOP = 3 (LdAL) 3 (HdAL) 0 (LoAL) 1 (HIAL) ;
It shows that HdAL and LdAL are sent to AU1, LoAL has no output, HIAL is sent to AL1.
Installing L3 dual relay output module in ALM or AUX, AL2 or AU2 can be used.

INP	Input specification Code	0	K	21	Pt100	0~37
		1	S	22	Pt100（-80~+300.00℃）	
		2	R	25	0~75 mV voltage input	
		3	T	26	0~100 ohm resistor input	
		4	E	27	0~400ohm resistor input	
		5	J	28	0~20mV voltage input	
		6	B	30	0~60mV voltage input	
		7	N	31	0~1V	
		8	WRe3-WRe25	32	0.2~1V	
		9	WRe5-WRe26	33	1~5V voltage input	
		10	Extended input specification	34	0~5V voltage input	
		12	F2 radiation type pyromter	35	-20~+20mV	
		13	T(0-300.00℃)	37	-5~+5V	
		15	MIO Enter 1(4~20mA I44 installed at MIO)	42	0~10V voltage input	
		16	MIO Enter 2 (0~20mA I44 installed at MIO)	43	2~10V voltage input	
		17	K（0~300.00℃）	44	-10V~+10V voltage input	
		18	J（0~300.00℃）	45	0~100mV voltage input	
		19	Ni120	46	20~100mV voltage input	
		20	Cu50			
dPt	Display Resolution	Four display formats 0, 0.0, 0.00 and 0.000 can be selected. Notice：When thermocouple or thermal resistance input is used, only 0 or 0.0 formats can be selected.When using S-type thermocouples, it is recommended to select the 0 format ; when InP = 17,18,22, the internal resolution of the instrument is 0.01 ° C, and two display formats of 0.0 or 0.00 can be selected. When linear input is used and the process value or other relevant parameters>=9999, it is recommended to use 0.000 instead of 0, because the display format will change to 00.00 when it is greater than 9999.				
SCL	Signal scale low limit	Used to define the lower limit value of the linear input signal. For example, when to display input signal 1~5V as 0~200.0 is required, set dPt=0.0, SCL=0, and SCH=200.0.				-9990~ +30000 unit
SCH	Signal scale high limit	Used to define the upper limit value of the linear input signal. For example, when to display input signal 0~5V as 1000~2000 is required, set dPt=0, SCL=1000, and SCH=2000. When used for retransmission, it can also be used as the output upper limit value.				
Scb	Input Shift Adjustment	Used to translate and correct the input value to compensate for the error caused by the automatic compensation of the cold end of the sensor or instrument. For example, assuming that the input signal is unchanged, when Scb=0.0 ℃ is set, the process temperature of the instrument is 500.0℃ ; When the instrument Scb=10.0 is set, the process temperature of the instrument is 510.0 ℃ .				-1999~ +4000 unit
FILt	PV input filter	The value of FILt determines the ability of filtering noise. The larger the value is set, the slower the response speed is. If great interference exists, it is allowable to increase “FILt” gradually until the displayed value is stable. When the instrument is being metrological verified, “FILt” s can be set to 0 or 1 to shorten the response time.				0~100
CtrL	Control mode	POP: PV retransmission, SOP: SV retransmission, the set value range is -9990~+30000. In SOP mode, the SV window displays the retransmitted value and can be edited. (701 only)				
OPt	Main output type	0-20: 0~20mA linear current retransmission and output. 4-20: 4~20mA linear current retransmission and output.				
SPL	Low limit of SV (701 only)	Minimum value that SV allows to be.				-9990~ +30000 unit
SPH	Upper limit of SV(701 only)	Maximum value that SV allows to be.				
SPSL	the output lower limit of retrans-mission	Used to define the defined value of the output lower limit scale when the current is retransmitted to output				
SPSH	the output upper limit of retransm-ission	Used to define the defined value of the output upper limit scale when the current is retransmitted to output				-9990~ +30000 unit
AF	Advanced function code	AF parameter is used to select advanced functions, and its calculation method is as follows: AF=A×1+B×2 +C×4 +D×8+E×16+F×32 A=0, HdAL and LdAL are deviation alarms; A=1, HdAL and LdAL are absolute value alarms, so the instrument can have two absolute value upper limit alarms and absolute value lower limit alarms respectively. B=0, the return difference of alarm and position adjustment is unilateral return difference; B=1, refers to bilateral backlash. C=0, the third row of instrument has a decimal point; C=1, there is no decimal point in the third row of the instrument (only the third row display is available). D=0, the password of entering the parameter table is public 808; D=1, the password is the parameter PASd value. Switch to on-site parameters and long press the left key to find LOC. E=0, HIAL and LOAL are absolute value upper limit alarm and absolute value lower limit alarm respectively; E=1, HIAL and LOAL are changed to upper limit and lower limit deviation alarms respectively, so there are four deviation alarms. F=0, fine control mode, internal control resolution is 10 times of the display, but the maximum display value is 3200 units in linear input; F=1 is the high resolution display mode, which is selected when the display value is required to be greater than 3200.				
AFC	Commun-ication mode	Select communication mode, its calculation method is as follow: AFC=A*1+D*8+G*64 A=0, standard MODBUS; A=1, AIBUS; A=2, MODBUS compatible mode; A=4, compatible with S6 module. D=0, no calibration; D=1, even calibration. G=0, AUX used normally; G=1, AUX used as event input. Note: AFC supports 03H (read parameters and data) and 06H (write a single parameter) under MODBUS. When AFC=0 or 4, the 03H can read up to 20 words at a time; When AFC=2, 03H reads 4 words. For more details, Please refer to the communication protocol description.				0~255
Addr	Commun-ication address	Used to define the communication address. The address of each instrument on the same RS485 bus must be different.				0~99
bAud	Baud rate	The bAud parameter defines the communication baud rate, ranging from 0 to 28800bit/s (28.8K); When COM location is not used for communication function, COM port can be used as other function by bAud parameter setting: bAud=0, COMM slot transmitted as a set value of 0-20ma for output; bAud=1, as an external switching value input, has the same function as the MIO position. When the MIO position is occupied, the I2 module can be installed in the COMM position. bAud=3, the COMM port is used for transmission and output function of the 0~20mA measurement value; bAud=4, the COMM port is used for transmission and output function of the 4~20mA measurement value ; bAud=8, the COMM port is used for transmission and output function of the 0~20mA set value; bAud=12, the COMM port is used for transmission and output function of the 4~20mA set value.				0~28.8K

6. Wiring Diagram

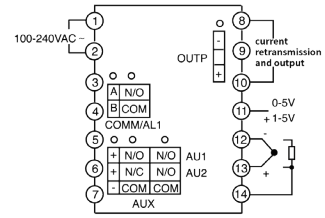
Different types of thermocouples use different thermocouple compensation wires. The compensation wires should be directly connected to the terminal block of the instrument rear cover, and cannot be turned into ordinary wires during the process, otherwise the measurement error will occur.

Wiring graph for instruments with dimension A、A2、B、C、C3、E、F、A1、A10、B1、B10、C1、C10、E1、E10、F1、F10：



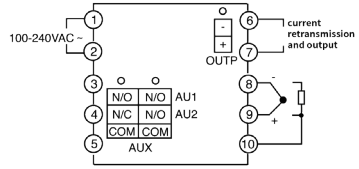
Note: The linear voltage signal below 1V is input from the terminals 19+ and 18-, the signal of 0~5V/1~5V is input from the terminals 17+ and 18-, and the 4~20mA current is input from the terminals 17+ and 18- after being shunted by an external 250 Ω precision resistor; When the I44 module is installed at the MIO, the current signal can be input from 14+, 15-, or from 16+, 14- after connecting to the two-wire retransmitter.

Wiring graph for instruments with dimension D(72*72mm)



Note: The linear voltage below 100mV is input from terminals 13+ and 12-, the signal of 0-1V or 0-5V is input from terminals 11+ and 12-, and the linear current input of 4~20mA can be converted to 1~5V voltage signal with a 250 Ω resistance and then input from terminals 11+ and 12-.

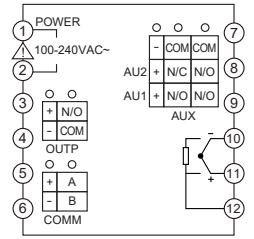
Wiring graph for instruments with dimension D2(48*48mm)



Note 1: Dimension D2 instrument does not support 0~1V and 0~5V linear voltage input; However, the voltage can be divided by external precision resistance, and the signal can be input after being converted to 0~100mV or 20~100mV; The input of 4~20mA linear current can use a 5 ohm resistor to convert the signal to 20~100mV and then input from the terminals 9 and 8.

Note 2: Install S or S4 communication module at COMM/AUX for communication (COMM); install L2 relay for AU1 alarm output; Install L3 double relay output module and set bAud=3 for AU1 and AU2 alarm output, Set bAud=2 for AU1 and AL1 alarm output.

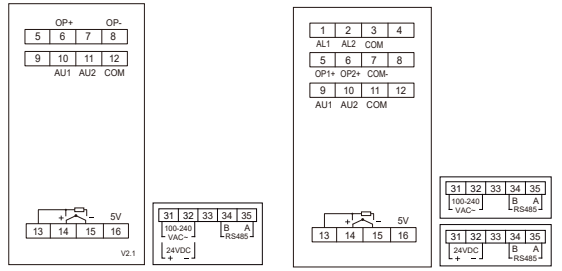
Wiring graph for instruments with dimension D61(48*48mm)



Note 1: D61 panel meter does not support direct input of linear voltages of 0-1V and above. If necessary, an external precision resistor should be used to divide the voltage and the signal should be converted to 0~100mV input; the 4~20mA linear current input is changed to 20~100mV with a 5 ohm high-precision resistor, and then input from the 11+ and 10- terminals.

Note 2: The linear voltage range of 0~100mV and below is input from the 11+ and 10- terminals.

Wiring graph for instruments with dimension D7(22.5*100mm)



Note 1: 0~5V /1-5V are input from 16+, 15-, 100mV and below signals are input from 14+, 15-; 4- 20mA linear current input and 250 ohm resistor into 1-5V, then input from 16+, 15-.

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