AI-500/501

INTELLIGENT INDICATING/ALARM INSTRUMENT

Operation Instruction(V9.1)

1.Main Features

- Programmable and modular inputs, supporting multiple input types of thermocouples, RTDs, voltage/ current and two-wire transmitters. Suitable for measuring and displaying temperature, pressure, flow, level, humidity, etc with measurement accuracy of 0.3% full scale.
- Support up to 4 loops of alarms including 2 loops of high limit alarms plus 2 loops of low limit alarms. Alarms can be output to different relays or shared one.
- With functions of digital calibrating, digital filtering, and thermocouple cold junction auto compensating, it is free of maintenance and easy operated.
- Support RS485 communication interface and communicate with upper computer by installing S or S4 module. It is compatible with AI series instruments
- Support the temperature transmission and output with transmission accuracy of 0.5 grade, and adopt current output module X3 with high precision of grade 0.2.
- With "Fever" grade hardware design. Tantalum capacitors or ceramic capacitors are widely used to replace electrolytic capacitors, which provides lower power consumption, higher reliability, stability and wider temperature range than similar products; Both its power supply and I/O terminals have passed the 4KV/5KHz group pulse anti-interference test.
- Universal power supply 100-240VAC or 24VDC is possible. With the protection functions of lightning protection and 10 second protection against misconnection of 380VAC power supply.

2.TECHNICAL SPECIFICATION

- **Input type:**
  Thermocouple: K, S, R,T, E, J,B, N
  Resistance thermometer: Pt100, Cu50 ,Ni120
  Linear voltage: 0~5V,1~5V,0~100mV,0~60mV,0~20mV,20~100mV
  Linear current (should connect a external resistor or install I4 module in MIO slot): 0~20mA, 4~20mA
  Linear resistor: 0~80 ohm, 0~400 ohm
- **Measurement 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℃),
  PT100(-200~+800℃)
- **Measurement accuracy :** 0.3%FS±1
- **Temperature shift :** ≤0.015%FS/℃ (typical value is 75ppm/℃)
- **Electromagnetic compatibility (EMC) :** IEC61000-4-4, ± 4KV/5KHz;
  IEC61000-4-5, 4KV
- **Retransmission :**
  When X3 or X5 current module is installed in OUTP slot, process value (PV) can be retransmitted to standard current with maximum load resistor 500 ohm.
- **Alarm function :** High limit, low limit, second high limit and second low limit
- **Isolation withstanding voltage :**
  Between power, relay contact or signal terminals≥2300VDC; between isolated electroweak signal terminals≥600VDC
- **Power supply :** 100~240VAC, -15%, +10% / 50-60Hz;
  24VDC / AC, -15%, +10%
- **Power consumption:** ≤5W
- **Operating Ambient :** Temperature -10~+60℃ ; humidity ≤90%RH

3. Ordering Code Definition

The ordering code of AI-500/AI-501 is made up of 8 parts, for example:

AI-501	A	N	X3	L3	N	S4	—	24VDC
①	②	③	④	⑤	⑥	⑦		⑧

The meanings of the 8 parts of ordering code are as below:

① **Shows the model of instrument:**
AI-500 indicating/ alarm instrument with single display with linear voltage inputs like thermocouple, thermal resistance, mV, 5V etc and measurement accuracy of 0.3% FS.
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② **Shows the front panel dimension:**

AI-500	AI-501	Depth Behind (mm)	Front Panel Width×Height (mm)	Cut Out Width×Height (mm)	Light Bar (mm)
A0	A	100mm	96×96 mm	$92^{+0.5}\times92^{+0.5}$ mm	---
A10	A1	70mm			
	A2	100mm			25 segments, 4 levels, and 1% resolution
	A21	70mm			
B0	B	100mm	160×80 mm	$152^{+0.5}\times76^{+0.5}$ mm	---
B10	B1	70mm			
	B2	100mm			25 segments, 4 levels, and 1% resolution
	B21	70mm			
C0	C	100mm	80×160 mm	$76^{+0.5}\times152^{+0.5}$ mm	---
C10	C1	70mm			
	C3	100mm			25 segments, 4 levels, and 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	---
	D61	80mm	48×48 mm	$45^{+0.5}\times45^{+0.5}$ mm	---
	D7/D71	22.5×100mm, DIN rail mount. compact dual LED display, hot-plugged terminals			
E0	E	100mm	48×96 mm	$45^{+0.5}\times92^{+0.5}$ mm	---
E10	E1	70mm			
	E2	100mm			25 segments, 4 levels, and 1% resolution
	E21	70mm			
	E5	48×96 mm, DIN rail mount.			
F0	F	100mm	96×48 mm	$92^{+0.5}\times45^{+0.5}$ mm	---
F10	F1	70mm			

③ **Shows the module types of multiple input/output (MIO). Selectable modules are as follows:**
V24 or V10, 24V or 10V voltage output, available for external transmitters, load cells, etc
I4 expands 0~20mA or 4~20mA linear current input, and includes 24V/25mA power output, which can be directly connected to two-wire transmitter
I7 0~5A AC current input module
I8 0~500V AC voltage input module

④ **Shows the module types of main output (OUTP):**
Installing X3 or X5 (isolated type) current output module can retransmit process value (PV).

⑤ **Shows the module type of alarm output (ALM):**
Can output alarms by installing L0, L2, or L4 relay output module or L3 dual relay output module.

⑥ **Shows the module type of auxiliary output (AUX):**
Can output alarms by installing L0, L2, L4 or L3 relay output module.

⑦ **Shows the module type of communication (COMM):**
Installing S, S1 or S4 (standard MODBUS-RTU) for RS485 communication.

⑧ **Shows type of power supply:**
Null indicates 100~240VAC power supply, and "24VDC" indicates 20~32VDC/AC power.

Note 1: 4~20mA or 0~20mA standard current signal can be inputted by converting to 1~5V/0~5V voltage signal with a 250 ohm resistor or installingI4, module in MIO slot. I4 can supply 24VDC power to 2-wire transmitter.

Note 2: D dimension instruments have no MIO slot, and its COMM and ALM share the same slot and can't be installed at the same time. Its ALM only,support AL1 single loop alarm. D2 dimension instruments have only OUTP slot and COMM / AUX slot.

Note 3: Current module X3 and RS485 communication module S share the same power supply in the instrument, and are not electric isolated to each other. Therefore, if X3 current module is installed in OUTP slot and RS485 communication is need at the same time, then RS485 communication module should be S4 which itself has isolated power supply.

Note 4: The instrument shall be repaired free of charge during the warranty period. Any instrument that needs to be repaired must be clearly stated with the fault phenomenon and reason to ensure correct and comprehensive repair.

4.Front Panel Description

① Upper display window, displays PV, or code of a parameter
② Lower display window, displays alarming code or parameter value
③ Setup key, for accessing parameter tables, and confirming change
④ Data shift key
⑤ Data decrease key
⑥ Date increase key

⑦ Indicator lamps: OP1 and OP2 indicate the status of current retransmission. AL1, AL2, AU1and AU2 indicate the I/O actions of The corresponding modules

Basal display status : When power on, the upper display window of the instrument shows the process value (PV). This status is called basal 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.

5.Parameter Setting

In basal display status, press (↺) and hold for about 2 seconds, can access Field Parameter Table. If the parameter lock "Loc" isn't locked (Loc=0), we can modify the value of parameters by (◁) / (▽) 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 increasing or decreasing value get quick. Pressing (↺) can go to the next parameter. Press (◁) and hold can return to the preceding parameter. Press (◁) (don't release) and then press (↺) simultaneously can escape from the parameter table. The instrument will escape automatically from the parameter table if no key is pressed within 30 seconds.Setting Loc=808 and then press can access System Parameter Table.

When the parameters editing is done, press and hold (↺) key until the display status quits from parameter editing. The parameters will be saved.

5.1The Parameter Table

Code	Name	Description	Setting Range
HIAL	High limit alarm	Alarm on when PV(Process Value)>HIAL; Alarm off when PV<HIAL-AHYS	-9990~ +30000 units
LoAL	Low limit alarm	Alarm on when PV<LoAL; alarm off when PV>LoAL+AHYS	
HdAL	Second high limit alarm	Alarm on when PV>HdAL; alarm off when PV<HdAL-AHYS	
LdAL	Second Low limit alarm	Alarm on when PV<LdAL; alarm off when PV>LdAL+AHYS	
Loc	Parameter lock	Loc=0, it is allowed to modify the given value and field parameters; Loc=1, it is allowed to modify the given value, and it is prohibited to modify the field parameters; Loc=2~3, it is forbidden to modify the given value, and it is allowed to modify the field parameters; Loc=4~255 It is not allowed to modify any parameter other than Loc. Set Loc-808 and press OK to enter the system parameter table	0~9999

5.2 System parameter table (set Loc=808 and then press (↺) to access)

Code	Name	Description	Setting Range
AHYS	Alarm hysteresis	Avoid frequent alarm on-off action because of the fluctuation of PV. For temperature alarm, it is recommended to be 0.5~2℃ .	0~200
AoP	Alarm output allocation	Alarm / Output to: LdAL (x1000), HdAL (x100), LoAL (x10), HIAL (x1) None: 0 0 0 0 AL1: 1 1 1 1 AL2: 2 2 2 2 AU1: 3 3 3 3 AU2: 4 4 4 4 Example: AOP = 3 (LdAL) 3 (HdAL) 0 (LoAL) 1 (HIAL) ; shows that HdAL and LdAL are sent to AU1, LoAL has no output, HIAL is sent to AL1. Note : Installing L 5 dual relay output module in ALM or AUX can implement AL2 or AU2 alarm.	0~4444

INP	Input specification Code	0	K	20	Cu50	0~106
		1	S	21	Pt100	
		2	R	22	Pt100 (-80~+300.00℃)	
		3	T	25	0~75mV voltage input	
		4	E	26	0~80ohm resistor input	
		5	J	27	0~400ohm resistor input	
		6	B	28	0~20mV voltage input	
		7	N	29	0~100mV voltage input	
		8	WRe3-WRe25	30	0~60mV voltage input	
		9	WRe5-WRe26	31	0~1V	
		10	User-defined	32	0.2~1V	
		12	F2 radiation type pyromter	33	1~5V voltage input	
		15	4~20mA(installed I4 module in MIO)	34	0~5V voltage input	
		16	0~20mA(installed I4 module in MIO)	35	-20~+20mV	
		17	K (0~300.00℃)	36	-100~+100mV	
		18	J (0~300.00℃)	37	-5V~+5V	
		19	Ni120	39	20~100mV	
dPt	Radix point position	Four formats (0, 0.0, 0.00, 0.000) are selectable. For thermocouples or RTD inputs, only 0 and 0.0 are selectable, if use thermocouple type S, it's better select 0; Inp=17, 18, 22, the internal resolution is 0.01, 0.0 and 0.00 are selectable. For linear input, if the value of PV or any parameter is probably greater than 9999, format 0.000 is recommended, when value is greater than 9999, the display format will be 00.00.				
SCL	Signal scale low limit	Define scale low limit of input signal. It is also the scale of the low limit of retransmission output. For example, to transform 1~5V input signal into process value of 0~200.0, we shall set dPt=0.0, SCL=0, SCH=200.0				-9990~ +30000
SCH	Signal scale high limit	Define scale high limit of input signal. It is also the scale of the high limit of retransmission output. For example, to transform 0~5V input signal into process value of 1000~2000, we shall set dPt=0, SCL=1000, SCH=2000.				
Scb	Input shift adjustment	Scb is used to compensate the error produced by sensor or input signal. PV_after_compensation= PV_before_compensation + Scb. For example, for same input signal, if measured temperature PV is 500.0℃ when Scb=10.0, then PV should be 510.0℃.				-9990~ +4000
FILt	Input filter	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, it can be set to 1 to 3. 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 instrument is being metrological verified, "FILt" s can be set to 0 or 1 to shorten the response time.				0~40
CtrL	Control mode (only for AI-501)	POP, transmit PV; SOP, transmit SV, SV can be -9990~+30000. When CtrL=SOP, lower window shows transmit value and can be modified.				
OPt	Output Type	0-20: 0~20mA linear current retransmission output; 4-20: 4~20mA linear current retransmission output.				
SPL	Lower Limit for SV(only for AI-501)	Minimum value allowed for SV setting.				-9990~ +30000
SPH	Upper Limit for SV(only for AI-501)	Maximum value allowed for SV setting.				
SPSL	Lower limit of transmission output scale	When used to define the current transmission output, it is the defined value of the output lower limit scale.				
SPSH	Upper limit of transmission output scale	When used to define the current transmission output, it is the defined value of the output upper limit scale.				

AF	Advanced function	AF is used to select advanced function. The value of AF is calculated as below: AF=Ax1+Bx2+Ex16 A=0, HdAL and LdAL work as deviation alarms; A=1, HdAL and LdAL work as high and low limit alarms, and the instrument can have two groups of high and low limit alarms. B=0, Alarm and control hysteresis work as unilateral hysteresis; B=1, As bilateral hysteresis E=0, HIAL and LOAL work as high and low limit alarms respectively; E=1, HIAL and LOAL will become to deviation high alarm and Deviation low alarm, and the instrument can have four groups of deviation alarms. Note: AF=33 is recommended for ordinary usage.	0~255
AFC	Communication Mode	AFC is used to select communication mode. The value of AFC is calculated as below: AFC=Ax1+Dx8 A=0, Standard MODBUS Protocol; A=1, AIBUS Protocol; A=2, MODBUS compatible Protocol; A=4, compatible protocol with S6 module. D=0, no verification; D=1, even verification. Remark: Two command 03H (READ parameter and data) and 06H (WRITE a single parameter) when AFC is set as MODBUS protocol. When AFC=0 or 4, 03H command supports reading maximum 20 WORDs of data at one time. When AFC=2, 03H command reads 4 WORDs of data at one time. Details please refer to the separate protocol document.	0~12
Addr	Communication address	Each instrument should be assigned a unique address in one RS485 communication line.	0~80
bAud	Baud rate	The range of baud rate is 1200~19200 bit/s. Can be set to 4800, 9600 or 19200.	0~19.2K

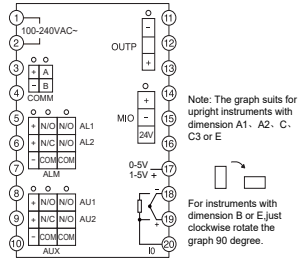
6. Rear Terminal Layout and Wiring

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.

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

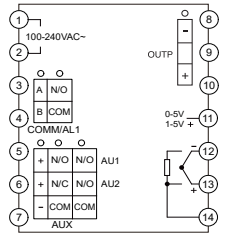
Note:

Note: Linear voltage signal with its range below 100mV can be inputted from terminals 19+ and 18-, 0~1V and 0~5V signal can be inputted from terminals 17+ and 18-, 4~20mA current signal can be converted to voltage signal with an 250 ohm external resistor and then inputted from terminals 17+ and 18-. If I4 module is installed in MIO slot, current signal can also be inputted from terminals 14+ and 15-, and 2-wire transmitter can be inputted from terminals 16+ and 14-.

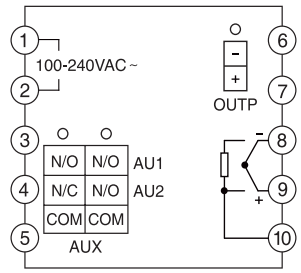


Wiring graph for dimension D (72X72mm)instruments:

Note: Linear voltage signal with its range below 100mV can be inputted from terminals 13+ and 12-, 0~1V and 0~5V signal can be inputted from terminals 11+ and 12-, 4~20mA current signal can be converted to 1~5V voltage signal with an 250 ohm external resistor and then inputted from terminals 11+ and 12-.



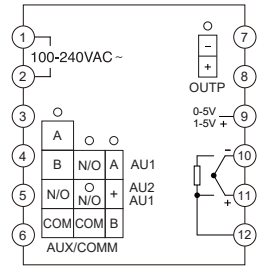
Wiring graph for D2 dimensio (48mmX48mm) instruments



Note 1: Dimension D2 instruments support neither 0~5V nor 0~5V linear voltage input. Instead, 0~5V or 1~5V signal can be converted to 0~100mV or 20~100mV respectively by external voltage divider while 4~20mA can be converted to 20~100mV by connecting a 5 ohm resistor in parallel, then be inputted from terminals 9 and 8.

Note 2: In COMM/AUX slot, S or S4 communication module can be installed for communication(COMM). If L2 module is installed to act as alarm at AU1. If L3 dual relay module is installed with parameter bAud = 0, it acts as AU1 and AU2 alarm output. If parameter bAud = 2, it acts as alarms at AU1 and AL1.

Wiring graph for D6 dimensio (48mmX48mm) instruments

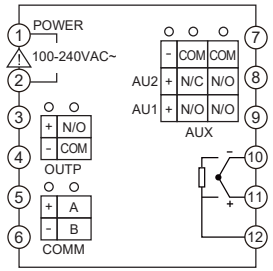


Note1: Linear voltage signal with its range below 100mV can be inputted from terminals 11+ and 10-, 0~1V and 0~5V signal can be inputted from terminals 9+ and 10-.;

Note2: 4~20mA linear current can be converted to 1~5V voltage with a 250 ohm resistor by terminals 10- and 9+.

Note3: In COMM/AUX slot, S or S4 communication module can be installed for communication(COMM). If L2 module is installed to act as alarm at AU1. If L3 dual relay module is installed with parameter bAud = 0, it acts as AU1 and AU2 alarm output. If SL module for RS485 communication and AU1 alarm output.

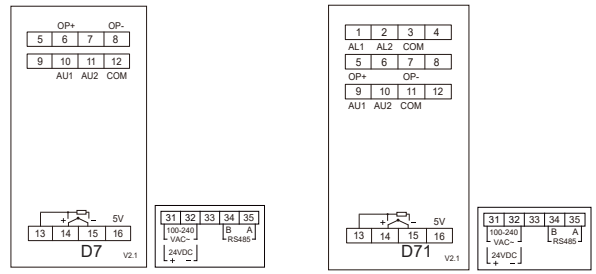
Wiring graph for D61 dimensio (48mmX48mm) instruments



Note 1: Dimension D61 instruments does not support 0~1V and above linear voltage input. Instead, 0~1V signal can be converted to 0~100mV by external voltage divider while 4~20mA can be converted to 20~100mV by connecting a 5 ohm resistor in parallel, then be inputted from terminals 11+ and 10-.

Note 2: Linear voltage signal with its range within 0~100mV and below can be inputted from terminals 11+ and 10-.

Wiring graph for D71 dimensio (22.5mmX100mm) instruments



Note 1: Input 0~5V/1~5V input from 16+, 15-. 100mV below input from 14+, 15-
4~20mA with 250ohm shunt resistor converted to 1~5V, input from 16+, 15-