

AI708 Series Intelligent Temperature Controller User Manual



Features:

- ⊙ TC / RTD / Analog signal universal input, selected by software menu.
- ⊙ With display, alarm and adjusting function
- ⊙ Measuring Accuracy:0.3%F.S
- ⊙ Advanced Fuzzy algorithm & Two Degrees of Freedom PID Arithmetic.
- ⊙ Optional control output, modularization design.
- ⊙ Good anti-jamming.
- ⊙ Switching power supply 100-240VAC.
- ⊙ Applied to system temperature control application.

For your safe, please read the below content carefully before you use the temperature controller!

■ Safe Caution

- | |
|---|
| ※ Please read the manual carefully before you use the temperature controller. |
| ※ Please comply with the below important points. |
| ⚠ Warning An accident may happen if the operation does not comply with the instruction. |
| ⚠ Notice An operation that does not comply with the instruction may lead to product damage. |
| ※ The instruction of the symbol in the manual is as below. |
| ⚠ An accident danger may happen in a special condition. |

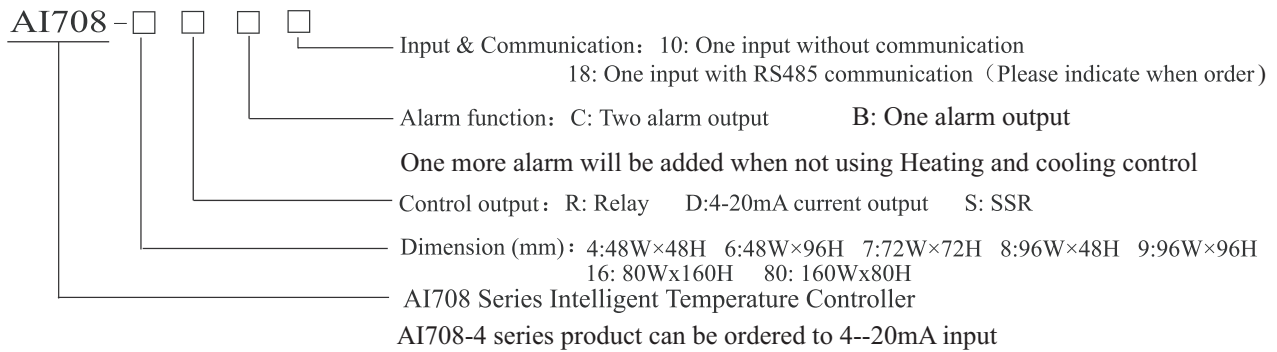
⚠ Warning

1. A safety protection equipment must be installed or please contact with us for the relative information if the product is used under the circumstance such as nuclear control, medical treatment equipment, automobile, train, airplane, aviation and equipment etc. Otherwise, it may cause serious loss, fire or person injury.
2. A panel must be installed, otherwise it may cause creepage (leakage).
3. Do not touch wire connectors when the power is on, otherwise you may get an electric shock.
4. Do not dismantle or modify the product. If you have to do so, please contact with us first. Otherwise it may cause electric shock and fire.
5. Please check the connection number while you connect the power supply wire or input signal, otherwise it may cause fire.

⚠ Caution

1. This product cannot be used outdoors. Otherwise the working life of the product will become shorter, or an electric shock accident may happen.
2. When you connect wire to the power input connectors or signal input connectors, the moment of the No.20 AWG (0.50 mm²) screw tweaked to the connector is 0.74n.m - 0.9n.m. Otherwise the connectors may be damaged or get fire.
3. Please comply with the rated specification. Otherwise it may cause electric shock or fire, and damage the product.
4. Do not use water or oil base cleaner to clean the product. Otherwise it may cause electric shock or fire and damage the product.
5. This product should be avoid working under the circumstance that is flammable, explosive, moist, under sunshine, heat radiation and vibration. Otherwise it may cause explosion.
6. In this unit it must not have dust or deposit, otherwise it may cause fire or mechanical malfunction.
7. Do not use gasoline, chemical solvent to clean the cover of the product because such solvent can damage it. Please use some soft cloth with water or alcohol to clean the plastic cover.

1. Model



2. Model Indication

	Model	Output 1	Output 2	Alarm	RS485
48*48 Size	AI708-4-RB10	Relay output	Relay output	1	No
	AI708-4-DB10	4-20mA current output	Relay output	1	No
	AI708-4-SB10	SSR output	Relay output	1	No
	AI708-4-RB18	Relay output	Relay output	1	RS485
	AI708-4-DB18	4-20mA current output	Relay output	1	RS485
	AI708-4-SB18	SSR output	Relay output	1	RS485
Other Size	AI708 -□- RC10	Relay output	Relay output	2	No
	AI708 -□- DC10	4-20mA current output	Relay output	2	No
	AI708 -□- SC10	SSR output	Relay output	2	No
	AI708 -□- RC18	Relay output	Relay output	2	RS485
	AI708 -□- DC18	4-20mA current output	Relay output	2	RS485
	AI708 -□- SC18	SSR output	Relay output	2	RS485

Note: OUT1: 4-20mA current output, load resistance 600Ωmax.

Relay output capacity: 3A/250Vac

SSR output capacity: 30mA/24Vdc

OUT2: Can be worked just under heating-cooling control(OT=3); under other control, worked as alarm 3 (size:48*48 worked as alarm 2)

Relay output capacity: 1A/250Vac.

Alarm: Relay output capacity: 1A/250Vac

3. Main Technical Parameters

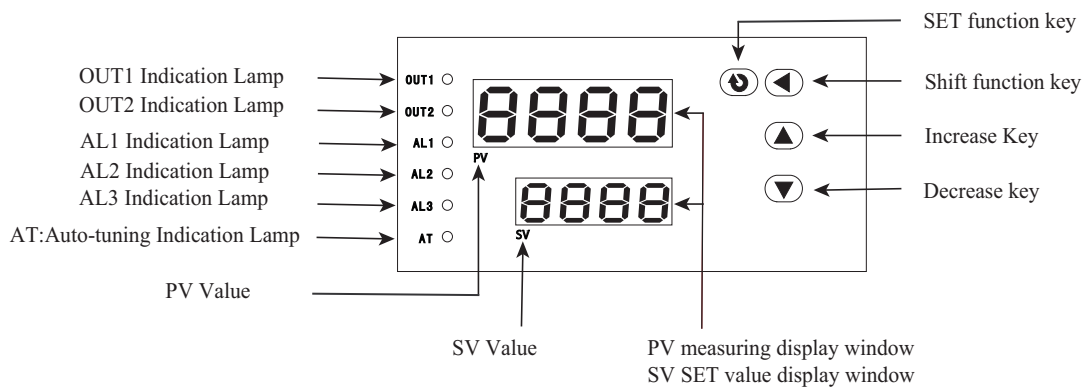
3.1 Whole controller parameters

Power supply	100-240VAC
Total current	<30mA (220VAC)
Ambient temperature	0-50℃
Ambient humidity	45-85%RH
Measurement accuracy	0.3%FS±3digits 25℃
Control mode	ON/OFF control, PID heating control, PID cooling control, PID heating & cooling control
Communication function	RS485 communication interface, MODBUS RTU protocol
Panel protection level	IP65
Temperature excursion	≤0.01%FS/℃
Dielectric strength	Between the connectors of power supply to relay output, power supply to signal input, relay output to signal input ≥2000VDC; Between the low voltage signal isolated with each other ≥ 600VDC.

3.2. Input signal table

No.	Symbol	Input signal	Measuring range	Resolution	Input impedance
0	K	K type thermocouple	-50~1300°C	1°C	>100K Ω
1	J	J type thermocouple	-50~1200°C	1°C	>100K Ω
2	E	E type thermocouple	-50~1000°C	1°C	>100K Ω
3	T	T type thermocouple	-50~400°C	1°C	>100K Ω
4	B	B type thermocouple	600~1800°C	1°C	>100K Ω
5	R	R type thermocouple	-10~1700°C	1°C	>100K Ω
6	S	S type thermocouple	-10~1600	1°C	>100K Ω
7	N	N type thermocouple	-50~1200°C	1°C	>100K Ω
8	000	Reserved			
9	Pt	PT100	-199.9~850.0°C	0.1°C	(0.2mA)
10	JPt	JPT100	-199.9~500.0°C	0.1°C	(0.2mA)
11	CU50	CU50	-50.0~150.0°C	0.1°C	(0.2mA)
12	CU100	CU100	-50.0~150.0°C	0.1°C	(0.2mA)
13	00	Linear voltage	0~50mV	0.01%FS	>100K Ω
14	0A	Linear current	4~20mA	0.01%FS	<110 Ω
15	0	Linear voltage	0~10V	0.01%FS	>100K Ω
16	rt	Linear resistance	0~400 Ω	0.01%FS	>100K Ω

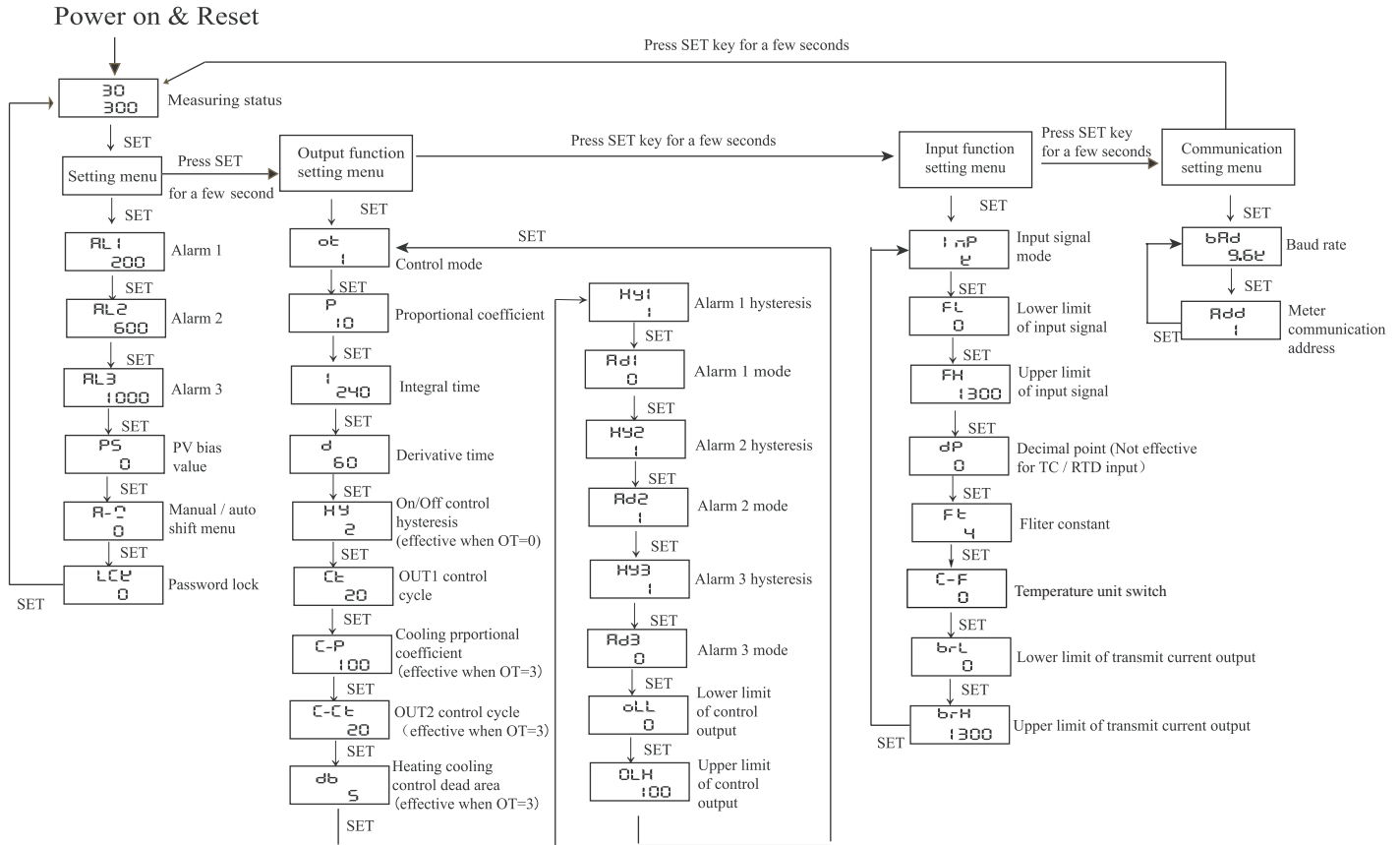
4. Panel Indication



5. Panel Key Operation

- (1) SET key: In normal display status, press SET key to show setting menu, press SET key for a few seconds to show advanced setting menu.
- (2) ◀ key: press ◀ key to make the parameters to flicker, the parameters can be changed.
- (3) ▲, ▼ key: to change parameters in setting status.
- (4) In advanced setting menu, press SET key for a few seconds to quit the menu and back to normal display status.
- (5) In normal display status, press ◀ key for 3 second to start Auto-tuning function, at this moment AT indicating lamp turns on.

6. Operation Sequence



7. Menu

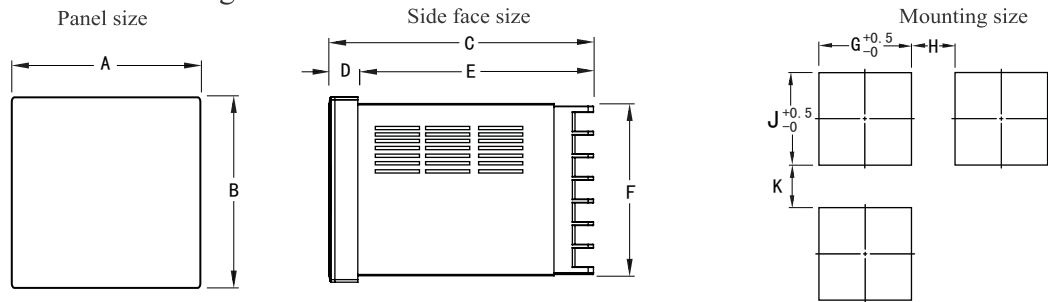
Parameter name	Indication	Setting range	Ex-factory setting
Setting menu			
AL1	Alarm 1 setting value	FL~FH	200
AL2	Alarm 2 setting value	FL~FH	600
AL3	Alarm 3 setting value	FL~FH	100
PS	Measured value amendment	-100~100	0
A-0	Manual / auto setting: 0: Manual; 1: half-auto (Start Auto-tuning manually) 2: auto (Start Auto-tuning automatically after power on)	0~2	1
LCK	If the units digit (4th digit from left to right) is 1, SV is prohibited to be changed; if the tens digit (3rd digit) is 1, menu parameters are prohibited to be changed.	0~9999	0
Output function setting menu			
Ot	Control mode. 0: ON/OFF control; 1: Heating control; 2: Cooling control; 3: Heating & cooling control	0~3	1
P	Proportional coefficient	0~9999	10
I	Integral time	0~3600	240
d	Derivative time	0~3600	60
HY	ON/OFF control hysteresis	0~1000	2
Ct	OUT1 control cycle Current is 0, SSR is 1, Relay is 4-20 can be choosed	0~250	20
C-P	Cooling proportional coefficient	1~200	100
C-Ct	OUT2 control cycle	1~250	20
db	Dead area for heating & cooling control	-100~100	5
HY1	Alarm hysteresis 1	0~1000	1
Ad1	Alarm mode 1	0~3	0
HY2	Alarm hysteresis 2	0~1000	1
Ad2	Alarm mode 2	0~3	1
HY3	Alarm hysteresis 3	0~1000	1
Ad3	Alarm mode 3	0~3	0
OLL	Lower limit of control output	0~99	0
OLH	Upper limit of control output	1~100	100

Input function setting menu			
inP	Input signal type	Please refer to input signal table	K
FL	Lower display limit of input signal	Please refer to input signal table	-50
FH	Upper display limit of input signal	Please refer to input signal table	1300
dP	Decimal point setting. Only effective for analog signal input	0~3	0
Ft	Filter constant	1~250	60
C-F	0: unit of celsius 1: unit of fahrenheit	0/1	0
brL	Display for 4mA transmit current output	FL~FH	0
brH	Display for 20mA transmit current output	FL~FH	1300
Communication setting menu			
bAd	Baud rate	4.8K, 9.6K	9.6K
Ad	Meter communication address	0~250	1

Alarm function table

Alarm code	Alarm mode	Alarm output (AL1, AL2 is independent with each other)	Formula
0	Direct (High limit)		Alarm: PV > AL Cancel: PV ≤ AL - HY
1	Inverse (Low limit)		Alarm: PV < AL Cancel: PV ≥ AL - HY
2	High relative to SV		Alarm: PV > AL + SV Cancel: PV ≤ SV + AL - HY
3	Low relative to SV		Alarm: PV < SV - AL Cancel: PV ≥ SV - AL + HY

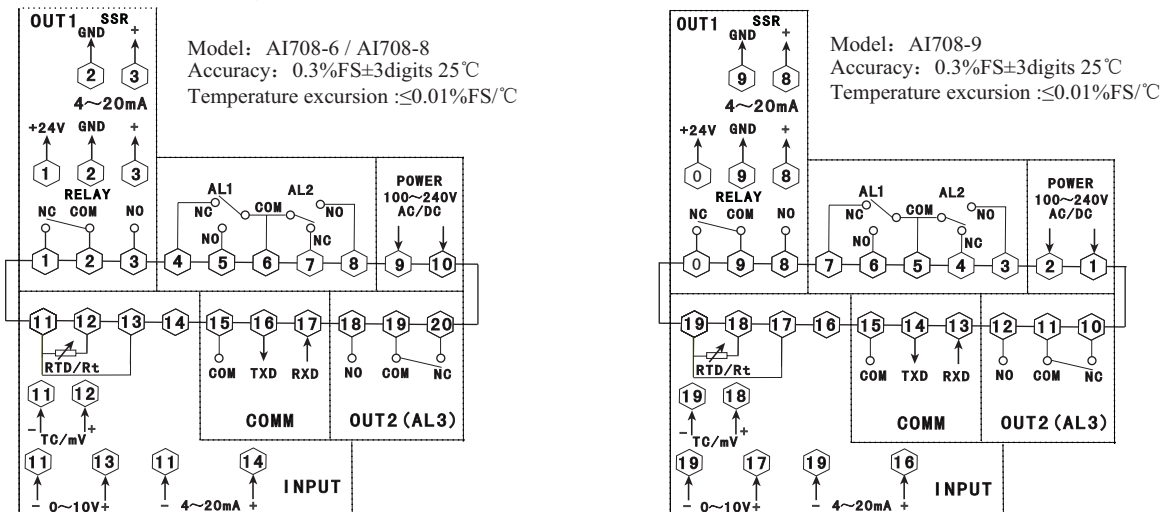
8. Appearance & Mounting Dimension

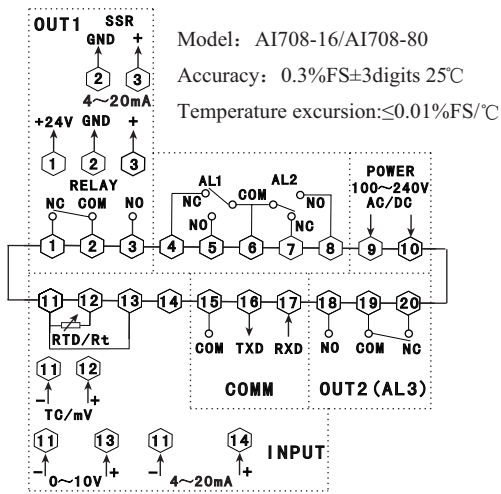


Model	A	B	C	D	E	F	G	H(Min)	J	K(Min)
AI708-4	48	48	97.5	6.5	91	45	45.5	25	45.5	25
AI708-6	48	96	97.5	9	88.5	89.5	45	25	90	25
AI708-7	72	72	97.5	9	88.5	67	67.5	25	67.5	25
AI708-8	96	48	97.5	9	88.5	44.5	90	25	45	25
AI708-9	96	96	97.5	9	88.5	91.5	92	25	92	25
AI708-80	160	80	96	13	83	75.5	155.5	30	76	30
AI708-16	80	160	96	13	83	155	76	30	155.5	30

Unit: mm

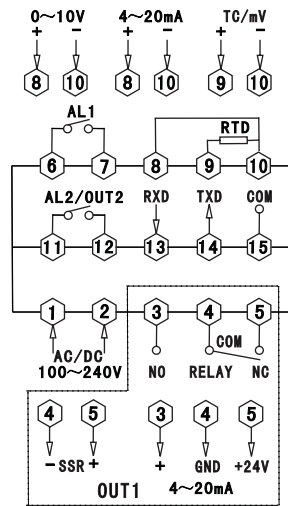
9. Connection Drawing



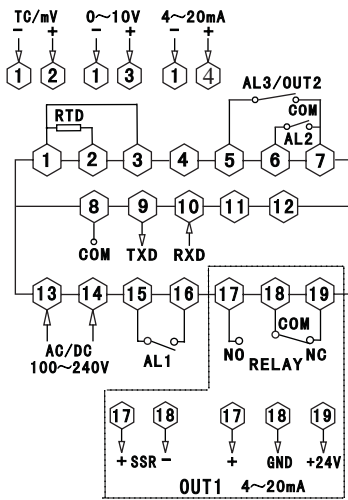


Model: AI708-16/AI708-80
 Accuracy: 0.3%FS±3digits 25°C
 Temperature excursion: ≤0.01%FS/°C

Model: AI708-4
 Accuracy: 0.3%FS±3digits 25°C
 Temperature excursion: ≤0.01%FS/°C



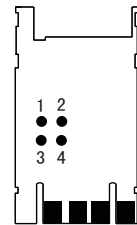
Model: AI708-7
 Accuracy: 0.3%FS±3 digits 25°C
 Temperature excursion: ≤0.01%FS/°C



when AI708-4 input 4~20mA, should change signal manually it must connect as follow:

main board picture

- 4~20mA: connect ② ④
- Not 4~20mA: connect ③ ④



10. Simple Problem Shooting

Dispaly Message	Shooting Method
Display HHHH	Input disconnect or over upper limit, please check input signal, FH value and ambient working temperature
Display LLLL	Input disconnect or under lower limit, please check input signal, FH value and ambient working temperature

11. Communication

AI708 series adjustor follow Modbus RTU communication protocol, and it can run RS485 half-duplex communication. Read function code is 0x03, write function code is 0x10, 16-bit CRC checking is applied. The coulometer can not return error message.

Data Frame flag:

Start bit	Data bit	Stop bit	Check bit
1	8	2	None

1. Read Multiple Registers

For example: The host computer read the float number AL1 (The value of Alarm 1 is 14.5). The address code of AL1 is 0x0000, for AL1 is float number (4bits), it will occupy 2 data register. Reference IEEE-574 standard the hexadecimal 16 result of the decimal float number is 0x41766666.

Request from the host computer (Read Multiple Registers)							
1	2	3	4	5	6	7	8
Unit Address	Function code	Start Address Hi	Start Address Lo	Data length Hi	Data length Lo	CRC code Lo	CRC code Hi
0x01	0x03	0x00	0x02	0x00	0x04	0xE5	0xC9

Correct answer from slave unit (Read Multiple Registers)								
1	2	3	4	5	6	7	8	9
Address	Function code	Data byte No.	Data1 Hi byte	Data1 Lo byte	Data2 Hi byte	Data2 Lo byte	CRC Code Lo	CRC Code Hi
0x01	0x03	0x04	0x41	0x76	0x66	0x66	0xE2	0xF4

2. Write Multiple Registers

For example: The host computer read the float number (setting value 600) ,

The address code for SV is 0x0000, for SV is float number (4bits), it will occupy 2 data register. Reference IEEE-574 standard the hexadecimal 16 result of the decimal float number is 0x41766666.

Request from the host computer (Write Multiple Registers)												
1	2	3	4	5	6	7	8	9	10	11	12	13
Unit address	Function Code	Start address Hi	Start address Lo	Data Length Hi	Data Length Lo	Data Length	Data 1 Hi	Data 1 Lo	Data 2 Hi	Data 2 Lo	CRC Lo	CRC Hi
0x01	0x10	0x00	0x00	0x00	0x02	0x04	0x44	0x16	0x00	0x00	0xFD	0xFC

Correct answer from slave unit (Read Multiple Registers)							
1	2	3	4	5	6	7	8
Unit address	Function Code	Start address 8 Hi	Start address 8 Lo	Data Length Hi	Data Length Lo	CRC Lo	CRC Hi
0x01	0x10	0x00	0x00	0x00	0x02	0x41	0xC8

AI708 Series table reference address

Code	Reference address	Number of Variable	Data Length	Read & Write allow	Remark
0	0x0000	Setting Value SV	2	R/W	
1	0x0002	Alarm value AL1	2	R/W	
2	0x0004	Alarm value AL2	2	R/W	
3	0x0006	Alarm value AL3	2	R/W	
4	0x0008	Correct value PS	2	R/W	
5	0x000A	Proportion rate P	2	R/W	
6	0x000C	Integral time I	2	R/W	
7	0x000E	Differentia ID	2	R/W	
8	0x0010	ON/OFF Control Hysteresis HY	2	R/W	
9	0x0012	Heating & cooling dead district DB	2	R/W	
10	0x0014	Alarm 1 Hysteresis HY1	2	R/W	
11	0x0016	Alarm 2 Hysteresis HY2	2	R/W	
12	0x0018	Alarm 2 Hysteresis HY3	2	R/W	
13	0x001A	Control output Lo OLL	2	R/W	
14	0x001C	Control output Hi OLH	2	R/W	
15	0x001E	Display Lo FL	2	R/W	
16	0x0020	Display Hi FH	2	R/W	
17	0x0022	Analog Lo Value	2	R/W	
18	0x0024	Analog Hi Value	2	R/W	
19	0x0026	Measuring Value	2	R	

Code	Reference address	Number of Variable	Data Length	Read & Write allow	Remark
20	0x0028	Manualswitch MAN	1	R	
21	0x002A	Lock LCK	1	R	
22	0x002C	Control output OT	1	R/W	
23	0x002E	Heating control Turn CT	1	R/W	
24	0x0030	Cooling proportion C_P	1	R/W	
25	0x0032	Cooling control Turn C_CT	1	R/W	
26	0x0034	Alarm 1 mode AD1	1	R/W	Note1
27	0x0036	Alarm 2 mode AD2	1	R/W	Note1
28	0x0038	Alarm 2 mode AD2	1	R/W	Note1
29	0x003A	Input signal select INP	1	R/W	Note2
30	0x003C	Decimal DP	1	R	
31	0x003E	Filter FT	1	R	
32	0x0040	Baud rate BAD	1	R	Note3
33	0x0042	Address ADD	1	R	

R: Read only; R/W: Read/Write

Parameter setting range , please according products user's manual

Note 1: Alarm parameter form

Note 2: Input Parameter form

Note 3:

Baud rate BAD	4.8K	9.6K
Data value	0	1

16 digit CRC verify program

unsigned int Get_CRC(uchar *pBuf, uchar num)

```

{
    unsigned i,j;
    unsigned int wCrc = 0xFFFF;
    for(i=0; i<num; i++)
    {
        wCrc ^= (unsigned int)(pBuf[i]);
        for(j=0; j<8; j++)
        {
            if(wCrc & 1){wCrc >>= 1; wCrc ^= 0xA001; }
            else
                wCrc >>= 1;
        }
    }
    return wCrc;
}

```