Intelligent Temperature Controller

User Manual

Suitable for TF-E version series

CE

Features

⊙ Optional input signal types and models
⊙ With functions of measurement display, control output, alarm output, analog output, RS485 communication, etc.

⊙ Diffferent types of PID arithmetic and with auto-tuning function.
⊙ Optional PID heating and cooling function (refer to OT parameter)
⊙ Manual/automatic control switch (refer to A-M paramter)
⊙ This product is used in industrial machinery, machine tools, general measuring instruments and equipment.
⊙ Economy and easy operation.

National High-tech Enterprise/ National Standard Drafting Unit   ISO GB CMA

The instruction explain instrument set, connections,name and etc, please read carefully before using the temperature controller. Please keep it properly for necessary reference.

I. Safety Caution

⚠ Warning

1)When the failure or abnormal of products lead to a system of major accidents, please set the proper protection circuit in the external.
2) Please don`t plug in before completing wire connection.Otherwise it may cause electric shock, fire, fault.
3) Do not use outside the scope of product specification,otherwise it may lead to fire,fault.
4) Not allow to use in the place where is inflammable and explosive gas.
5) Do not touch power terminal and other high voltage part when the power on, otherwise you may get an electric-shock.
6) Do not repair or modify the product,otherwise it may cause electric shock, fire, fault.

⚠ Warning

1) The product should not be used in a nudear facility and human life associated medical equipment.
2) The product may occur radio interference when it used at home.You should take adequate countermeasures.
3) The product get an electric shock protection through reinforced Insulation. when the product is embedded in the devices and wiring,please subject to the specification of embedded devices.
4) In order to prevent surge occurs,when using the product in the place of over 30m indoor wiring and wiring in outdoor,you need to set the proper surge suppression circuitry.
5) The product is produced based on mounting on the disk.In order to avoid to touch the wire connectors, please take the necessary measures on the product
6) Be sure to observe the precautions in this manual, otherwise there is a risk of a major injury or accident.
7) When wiring, please observe the local regulation.
8) To prevent to damage the machine, the product is connected with power lines or large capacity input and output lines and other methods , install proper capacity fuse or other methods of protection circuit.
9) Don't put metal and wire dastic mixed with the product,otherwise it may cause electric shock, fault.
10) Please tighten screw torque according to the rules.If not,it may lead to electric shock and fire.
11) In order to not interfere the products to dissipate heat, don't plug casing around the cooling vent hole and equipment.
12) Please don't connect any unused terminal.
13) Please do the cleaning after power off, and use the dry clean cloth to wipe away the dirt. Don't use desiccant, otherwise, it may casue the deformation or discoloration of the product.
14) Please don`t knock or rub the panel with rigid thing.
15) User should have basic knowledge of electrical,control, computer and communications.
16) The illustration, example of data and screen in this manual is convenient to understand,instead of guaranteeing the result of the operation.
17) In order to use the product with safety for long-term,regular maintenance is necessary. The lifetime of some parts have some restrictions, but the performance of some will change for using many years.
18) Without prior notice, the manual may change. If you have questions or objections, please contact us.

⚠ Caution of Install & Connection

1. Installation：
1) This product is used in the following environmental standards.
（IEC61010-1）[Overvoltage categoryⅡ、class of pollution 2]
2) The product is used in the following scope:surrounding environment, temperature, humidity and environmental conditions. Temperature：0 ~ 50℃; Humidity：45 ~ 85%RH;
Environment condition：Indoor warranty,The altitude is less than 2000m.

3) Please avoid using in the following places:
Places where condensation may occur due to dramatic temperature changes; or where corrosive or flammable gases are generated; direct vibration or potential vibration impacting the product.Place with water, oil, chemicals, smoke, and steam, lot of dust, salt, and metal powder, clutter interference is large. Places with magnetic field or noise;The place where the airflow of the air conditioner or the heater blows directly , place with direct sunlight irradiated; the place where heat may be accumulated due to radiation, etc.
4) On the occasion of the installation, please consider the following before installation.
In order to protect heat saturated, please ensure adequate ventilation space.
Please consider connections , and ensure that the products have more than 50mm space.
Do not installed over the machine of the calorific value(Such as heaters, transformer, semiconductor operations, the bulk resistance).When the surrounding is more than 50℃, use force fan or cooling fans.But don't let cold air blowing directly to the product.
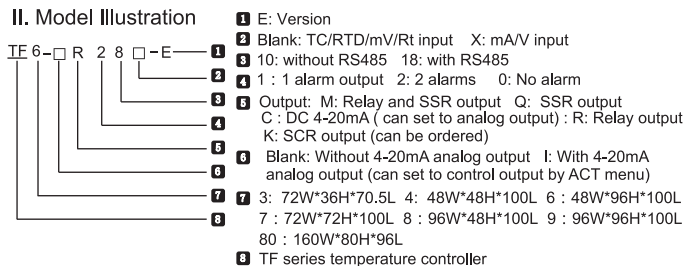To improve anti‐interference performance and security, stay away from high voltage machines.
Don`t install on the same plate with high voltage machine and the product.
The distance should be more than 200mm between the product and power line.
2.Cable caution：
1) Please use specified compensation wire for TC input; use insulated TC for heated metal.
2) Please use the cable of lesser resistance for RTD input,and the cable(3 wire) must be no resistance difference, and the total length is within 5m.
3) To avoid noise, put input signal away from meter cable,power cable,load cable to wiring.
4)To reduce the power cables and the load power cables on the effect of this product,please use noise filter . Do install it on the grounding of the disk if you use the noise filter,and make the wiring to be shortest between noise filter output side and power connectors.
Don`t install fuse and switch on noise filter output side,otherwise it may affect the result.
5) It takes 5s from input to output.If need interlocking actions of signal,please use timer relay.
6) Please use twisted pair with a shield for analog output line,to ensure the reliabilty of signal.
7) Please use twisted pair with a shield for remote RS485 communication cable,and deal with the shield on the host side earth, to ensure the reliabilty of signal.
8) The product don't have fuse; please set according to rated voltage 250V,rated current 1A if you need; fuse type:relay fuse.
9) Please use the suitable screw force and crimp terminal. The screw terminal size：M3X8 （with 7.0X7.0 square base）Recommended tightening torque：0.4N.m
Proper cables：0.25 ~ 1.65mm single cable/multiple core cable
10) Don`t put the Crimp terminal or bare wire part contact with adjacent connector.

II. Model Illustration

TF 6 ‐☐ R 2 8 ☐ ‐ E ‐ ☐

❶ E: Version
❷ Blank: TC/RTD/mV/Rt input   X: mA/V input
❸ 10: without RS485 18: with RS485
❹ 1：1 alarm output 2: 2 alarms   0: No alarm
❺ Output: M: Relay and SSR output   Q: SSR output
  C : DC 4-20mA（can set to analog output）: R: Relay output
  K: SCR output (can be ordered)
❻ Blank: Without 4-20mA analog output I: With 4-20mA analog output (can set to control output by ACT menu)
❼ 3: 72W*36H*70.5L 4: 48W*48H*100L 6：48W*96H*100L
  7：72W*72H*100L 8：96W*48H*100L 9：96W*96H*100L
  80：160W*80H*96L
❽ TF series temperature controller

Please note input signal type when choosing model. 1st type:TC/RTD/mV/Rt；2nd type: mA/V. There is only one 4 ~ 20mA output for the whole series meters. In size of 6, 8, 9, when the relay output,ssr output exsist together with 4-20mA output. "I" used to distinguish. Such as IR, IQ ect. But for 3, 4, 7 size, it does have this kind of model.

III. Common Model Selection

No.	Model	OUT1 control output			alarm output		analog output	Comm.	Auxilliary power
		RELAY	SSR	4~20mA	AL1 OUT2	AL2	4~20mA	RS485	24V
1	TF3-IQ28☐		●	●	●	●	◎	●	
2	TF3-IQ2☐		●	●	●	●	◎		
3	TF3-M28☐	●	●		●	●		●	
4	TF3-M2☐	●	●		●	●			
5	TF3-M1☐	●	●		●				
6	TF4-C2☐			●	●	●	◎		●
7	TF4-C18☐			●	●	●	◎	●	●
8	TF4-Q2☐		●		●	●			
9	TF4-Q18☐		●		●			●	
10	TF4-R2☐	●			●	●			
11	TF4-R18☐	●			●			●	
12	TF4-M1☐	●	●		●				
13	TF7-C28☐			●	●	●	◎	●	●
14	TF7-C2☐			●	●	●	◎		●
15	TF7-Q28☐		●		●	●		●	
16	TF7-R28☐	●			●	●		●	
17	TF7-M2☐	●	●		●	●			
18	TF7-M1☐	●	●		●				
19	TF6/8/9/80-C28☐			●	●	●	◎	●	●
20	TF6/8/9/80-C2☐			●	●	●	◎		●
21	TF6/8/9/80-IR28☐	●		●	●	●	◎	●	●
22	TF6/8/9/80-IR2☐	●		●	●	●	◎		●
23	TF6/8/9/80-R28☐	●			●	●		●	
24	TF6/8/9/80-IQ28☐		●	●	●	●	◎	●	●
25	TF6/8/9/80-IQ2☐		●	●	●	●	◎		●
26	TF6/8/9/80-Q28☐		●		●	●		●	
27	TF6/8/9/80-M2☐	●	●		●	●			
28	TF6/8/9/80-M1☐	●	●		●				

☐ : Blank: input signal is TC/RTD/Mv/Rt; "X"：input signal is 4 ~ 20mA/0 ~ 10V
● : Standard configuration function
◎ : The meter has this function, but it is combined with another function. The meter only have one 4~20mA output, and user can set ACT menu as main control output or analog output.

IV. Main Specifications

1. Electrical parameters:

Sample rate	2 times per second
Relay capacity	AC 250V /3A Life of rated load>100,000 times
Power supply	AC/DC 100 ~ 240V (85-265V)
Power consumption	< 6VA
Environment	Indoor use only, temperature: 0~50℃ no condensation, humidity < 85%RH, altitude<2000m
Storage enenvironment	-10 ~ 60℃, no condensation
SSR output	DC 24V pulse voltage, load<30mA
Current output	DC 4 ~ 20mA load<500Ω, temperature drift 250PPM
Communication port	RS485 port Modbus-RTU protocol, max input 30 units
Insulation impedance	Input, output, power VS meter cover > 20MΩ
ESD	IEC/EN61000-4-2 Contact ±4KV /Air ±8KV perf.Criteria B
Pulse traip anti-interference	IEC/EN61000-4-4 ±2KV perf.Criteria B
Surge immunity	IEC/EN61000-4-5 ±2KV perf.Criteria B
Voltage drop & short interruption immunity	IEC/EN61000-4-29 0% ~ 70% perf.Criteria B
Isolation voltage	Signal input, output, power: 1500VAC 1min , <60V low voltage circuit: DC500V , 1min
Total weight	About 400g
Cover material	The shell and panel frame PC/ABS (Flame Class UL94V-0)
Panel material	PET(F150/F200)
Power failure memory	10 years, times of writing: 1 million times
Panel Protection level	IP65(IEC60529)
Safety Standard	IEC61010-1 Overvoltage category Ⅱ , pollution level 2 , levelⅡ(Enhanced insulation)

2. Measured signal specifications :

Input type	Symbol	Measure range	Reso-lution	Accuracy	Input impedance /auxiliary current	Com. parm. code
K	Ⱪ	-50 ~ 1200	1℃	0.5%F.S±3digits	> 500kΩ	0
J	ⱼ	0 ~ 1200	1℃	0.5%F.S±3digits	> 500kΩ	1
E	E	0 ~ 850	1℃	0.5%F.S±3digits	> 500kΩ	2
T	ⱦ	-50 ~ 400	1℃	0.5%F.S±3℃	> 500kΩ	3
B	ь	250 ~ 1800	2℃	1%F.S±2℃	> 500kΩ	4
R	ⲅ	-10 ~ 1700	1℃	1%F.S±2℃	> 500kΩ	5
S	5	-10 ~ 1600	1℃	1%F.S±2℃	> 500kΩ	6
N	ⲛ	-50 ~ 1200	1℃	0.5%F.S±1℃	> 500kΩ	7
PT100	Pⱦ	-200 ~ 600	0.2℃	0.5%F.S±0.3℃	0.2mA	8
JPT100	JPⱦ	-200 ~ 500	0.2℃	0.5%F.S±0.3℃	0.2mA	9
CU50	ⱢU50	-50 ~ 150	0.2℃	0.5%F.S±3℃	0.2mA	10
CU100	ⱢU00	-50 ~ 150	0.2℃	0.5%F.S±1℃	0.2mA	11
0 ~ 50mV	ⲛ⌵	-1999 ~ 9999	12bit	0.5%F.S±3digits	> 500kΩ	12
0 ~ 400Ω	ⲅⱦ	-1999 ~ 9999	12bit	0.5%F.S±3digits	0.2mA	13
*4 ~ 20mA	ⲛA	-1999 ~ 9999	12bit	0.5%F.S±3digits	100Ω	14
*0 ~ 10V	ⵎ	-1999 ~ 9999	12bit	0.5%F.S±3digits	>1MΩ	15

* Pls indicate the requirement when choose the model.

3. Isolation diagram
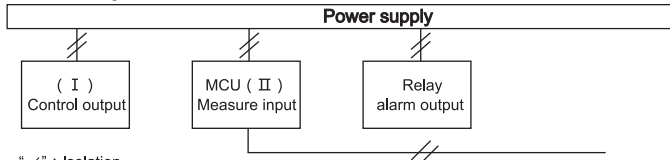
" ⫽ ": Isolation
Note : When the auxiliary power supply between (I) & (Ⅱ) is used as the power supply for external sensor, if the sensor is non-isolated, it does not isolate.

V. Dimension and installation size
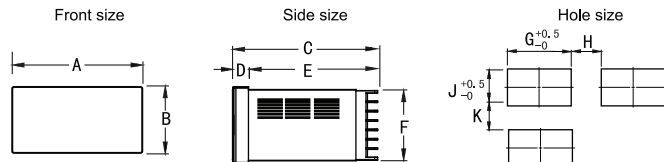
Model	A	B	C	D	E	F	G	H(Min)	J	K(Min)
3:(72*36)	72	36	70.5	6.5	64	32	68	25	33	25
4:(48*48)	48	48	97.5	6.5	91	45	45.5	25	45.5	25
6:(96*48)	48	96	97.5	9	88.5	89.5	45	25	92	25
7:(72*72)	72	72	97.5	9	88.5	67	67.5	25	67.5	25
8:(48*96)	96	48	97.5	9	88.5	44.5	92	25	45	25
9:(96*96)	96	96	97.5	9	88.5	91.5	92	25	92	25
80:(160*80)	160	80	96	13	83	75.5	155.5	30	76	30

VI. Wire Connections

TF3

TF4

TF6

TF7

TF8

TF9

TF80
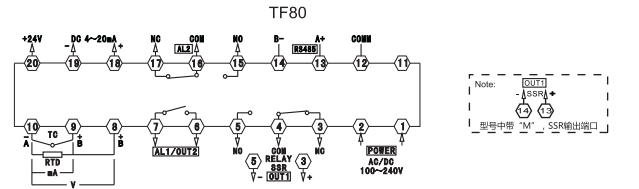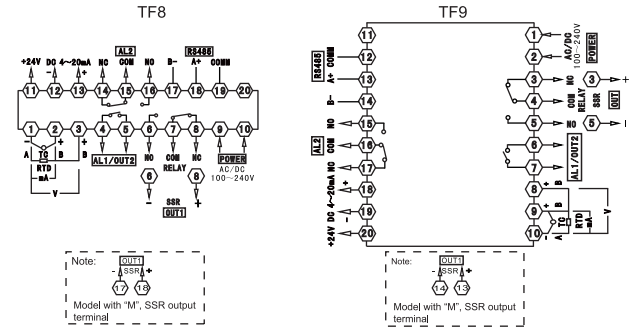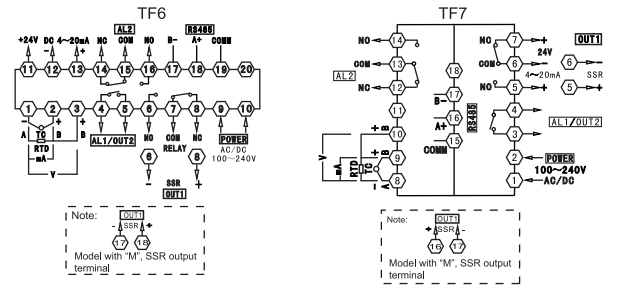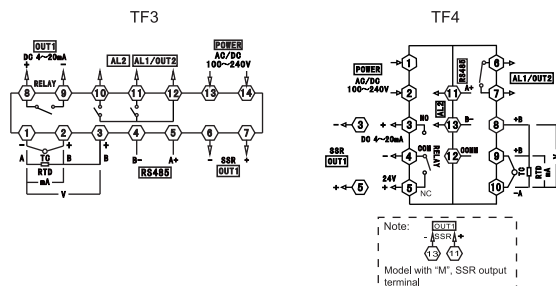
VII. Panel Illustration
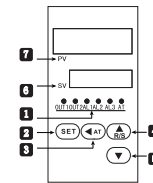
No.	Symbol	Name	Function
1	OUT1	OUT1 (red) *	Main control output indicator, lights on when output ON.
	OUT2	OUT2 (red) *	Cooling output indicator, lights on when output ON.
	AL1	Alarm 1# (red)	1st alarm output indicator, lights on when alarm output, lights off when no alarm output.
	AL2	Alarm 2# (red)	2nd alarm output indicator, lights on when alarm output, lights off when no alarm output.
	AL3	Alarm 3#	AL3: this product does not have this function.
	AT	AT indicator(green)	Auto tune indicator, lights on when it is under auto tune status.
2	SET	SET key	Menu key/confirm key, to enter or exit the modification mode, or to confirm and save the modified parameter.
3	≪AT	Shift/AT key	Activate key/ shift key/ AT auto-tuning key (in measure and control mode, long press to enter/exit auto-tuning
4	⌃R/S	Increase key/ R/S	Increase key, long press it to shift RUN/STOP mode under measure control mode.
5	⌄	Reduce key	Reduce key, check the menu in sequence
6	SV	Display (green)	Setting value/parameters display window,display "STP" =stop control
7	PV	Display (red)	Measured value/ parameter code display window

⋆ : Size "3" is green LED.

VIII. Operation process and menu illustration

1. Operation process & method
Measure control mode

Press "SET" > 3s

Press "SET" > 3s

Activation mode

When LCK=33

1st alarm — Password — Software version

1st alarm hystersis — Control cycle — Power on auto-tune — Display tracking

1st alarm mode — Overshoot limit — Control speed — Decimal point

Amend — Differential time — PID type setting — Temperature unit

Input signal — Integral time — 1st alarm extention — Digital filter coefficient

Control mode — Proportional band — Measure value low limit — Measure value high limit

(Common menu)

(Advanced menu)

a. After power on and under normal measure control mode, long press "(SET)" key more than 3s to enter the menu parameters checking mode.
b. In the menu checking mode, press "(SET)" key to check the menu parameters circularly.
c. In the menu checking mode, short press "(AT)" can flash the current menu parameters to enter the parameter modify mode, and every short press can move one position to the left in cycle.
d. In the parameter modifing mode, press "(▲)" or "(▼)" key once to add or reduce one of flashing data.
e. In the parameter modifing mode, after the modification, press "(SET)" to save the modified parameter, and exit to menu checking mode.
f. In the normal measure control mode, short press "(AT)" to enter SV value modifing status. The way of modifing SV value is same as that of modifing menu parameters.
g. In the normal measure control mode, long press "(AT)" more than 3s to enter auto tune state. During auto tune, PV value needs to be lower than SV value.
h. In the normal measure control mode, long press "(▲)" key more than 3s to enter or exit STOP model.

IX. Menu Illustration

▢ : Parameters will keep displaying all the time for all the model and all the setting
▨ : According to different model, control mode, these parameters will be hidden.

1. Regular Menu

No.	Symbol	Name	Illustration	Setting range	Factory setting
1	AL1	AL1	1st alarm value, note: the minus is dealed as absolute value when it is as a deviation value.	FL ~ FH	10
2	HY1	HY1	1st alarm hysteris	0 ~ 1000	1
3	Ad1	AD1 (1)	1st alarm mode,note: when AL1 is used as OUT2 (co-oling output), should set the value AD1=0 (close alarm function). When AD1>6, 2nd alarm function is invalid.	0 ~ 12	3
4	AL2	AL2	2nd alarm value, note: the minus is dealed as absolute value when it is as a deviation value.	FL ~ FH	5
5	HY2	HY2	2nd alarm hysteris	0 ~ 1000	1
6	Ad2	AD2 (1)	2nd alarm mode	0 ~ 6	4
7	PS	PS	Amend value, display value= actual measured value + amend value	FL ~ FH	0
8	InP	INP	Optional input signal. Note: after selecting the signal, pls properly set below relevant parameters: SV, AL1, HY1 ,AL2 , HY2 ,P , OVS , DB.	refer to input signal table (page 3)	K
9	ot	OT	Control type : 0. ON/OFF control; related pararmeter: DB 1. PID heating control , related parameter: P , I , D, OVS, CP, ST, SPD,PDC 2. ON-OFF cooling control , related parameter DB , when used for compressor cooling control , set parameter: PT 3. PID heating & cooling control (cooling control OUT2 make output by AL1 relay. related parameters: P, I, D, OVS, CP , CP1, PC, DB, ST , SPD, PDC 4. Over temperature cooling output , related parameter : DB 5, PID cooling , related parameters: P , I, D, OVS, CP, ST, SPD, PDC	0 ~ 5	1
10	A-n	A-M	Auto-manual control switch : AUTO(0) : auto control output , MAN(1): manual control output , AM(2): manual and auto shift	AUTO~AM	AUTO
11	P	P	Proportional band, the smaller the value is, the faster the system responds, otherwise, it is slower. When P=0, no PID control, unit same as PV	0 ~ 9999	30
12	I	I	Integral time, the smaller the value is, the stronger the integral action is, otherwise, it is weeker. When I=0, no integral action, unit: s.	0 ~ 9999	120
13	d	D	Differential time, the greater the value is, the stronger the differential actiontion is, otherwise, it is weeker. When D=0, no differential action. Set D=0 when controlling fast systems, e.g., pressure, speed; unit: s	0 ~ 9999	30
14	oVS	OVS	Overshoot limit, during PID control process, when PV(measured value) > SV(set value) + OVS (overshoot limit), force to close output. The smaller this value is, the smaller the PID adjustment range is, the worse the control stability is. Please set the appropriate value according to the actual situation.	0 ~ 9999	5
15	CP	CP	OUT1 control cycle, 1: SSR control output, 4-200: relay control output. Unit: s	1 ~ 200	20
16	CP1	CP1	OUT2 relay output cycle. Unit: s	4 ~ 200	20
17	PC	PC	OUT2 cooling proportionality coefficient, the higher of value,the stronger of cooling	1 ~ 100	10
18	db	DB	ON/OFF control hysteris(positive and negative numbers work the same); when OT=3, it is the dead zone for cooling control(positive and negative numbers work differently);after change the INP setting, please change this parameter according to the decimal point position.	-1000~1000	5
19	LCK	LCK	Lock function. 0001:SV value can't be modified. 0010: menu setting value only can be checked, can't be modified. 0033: can enter advanced menu. 0123: menus reset to factory setting.	0~9999	0

2. Advanced menu illustration

No.	Symbol	Name	Illustration	Setting range	Factory setting
20	ACt	ACT	Control output mode, 0:relay output; 1: SSR output control 2 : 4 ~ 20mA control outpuy, please note that for TF3,TF4,TF7 you need to set ACT as 3 to change 4-20mA to analog output.	0~2 (0~3)	0
21	AE1	AE1 (2)	1st alarm extensions function,refer to alarm extension function table	0~5	0
22	AE2	AE2 (2)	2nd alarm extensions function,refer to alarm extension function table	0~5	0
23	dP	DP	Decimal point setting, maximum 1 decimal place for TC & RTD input	0~3	0
24	dtr	DTR	PV fuzzy tracking value, properly set this value on some occasions, it can get a more stable control display value, this value is unrelated with actual measured value. Note: after setting this value, when alarm setting value is equal to SV set value, alarm output operation is subject to actual measured value. Set as 0 to close this function.	0.0 ~ 2.0 (0~20)	1.0 (10)
25	Ft	FT	Filter coefficient, the higher of value, the stronger of filter function	0 ~ 255	10
26	Ut	UT	Temperature unit: ℃: Celsius degrees. ℉: Fahrenheit degrees. Note: No unit for linear signal	(25)℃ (26)℉	(25)℃

No.	Symbol	Name	Illustration	Setting range	Factory setting
27	FL	FL	Measure range low limit, the set value must be less than measure range high limit	Refer to measured signal parameter table	-50
28	FH	FH	Measure range high limit,the setting value must be more than measure range low limit	Refer to measured signal parameter table	1200
29	brL	BRL	Analog range low limit, note: when this value is higher than analog range high limit,it is reverse analog output	FL~FH	-50
30	brH	BRH	Analog range high limit, note: when this value is lower than analog range low limit, it isreverse analog output.	FL~FH	1200
31	oLL	OLL	Output low limit, limit the output low limit current amplitude. Set value must be less than high limit setting	-5.0~100.0	0
32	oLH	OLH	Output high limit, limit the output high limit current amplitude. Setting value must be greater than low limit setting	0.0 ~ 105.0	100.0
33	St	ST	Auto-tune activation after power-on, 0: work normally after power-on, 1: automatically enter PID parameters auto-tune status after power-on; long press (AT) key to exit auto-tune.	0~1	0
34	SPd	SPD	PID control speed adjustment,option: 0 (N) no function, 1 (s) slow, 2 (ss) medium slow, 3 (SSS) very slow, 4 (F) fast, 5 (FF) medium fast, 6 (FFF) very fast	0~6	N
35	PdC	PDC	PID algorithm option: 0(FUZ): Advanced fuzzy PID arithmetic; 1(STD): normal PID arithmetic	0~1	FUZ
36	Pt	PT	Compressor start delay time, unit: s	0~9999	0
37	bAd	BAD	Baud rate 0 (4.8): 4800 ; 1 (9.6): 9600; 2 (19.2): 19200	0~2	9.6
38	Add	ADD	Communication ADD	0~255	1
39	Prty	PRTY	Communication parity check setting , 0 : NO 1 : ODD 2 : EVEN	0~2	N0
40	dtC	DTC	Communication data transport sequence 000; 1st bit function reserved; 2nd bit is byte sequence exchange; 3rd bit function reserved.	Refer to COM. protocol note③	0
41	CAE	CAE	User self-calibration enable function, this parameter is only for the input signals except TC/RTD; Y:enable the self-calibration parameters; N: don't use the self-calibration parameters.	0 (N) 1 (Y)	N
42	CAL	CAL	Self-calibration low limit input operation, after adding the low end signal to the signal input terminal, flash YES to activate, after confirm and display OK, the input signal low limit calibration is completed.	YES/OK	YES
43	CAH	CAH	Operation of user auto-calibrating high limit input,it is starting,when the YES flash after signal input add the high-limit signal. It finished calibration of high-limit input signal when it display OK.	YES/OK	YES
44	VEr	VER	Software version	———	

(1) Alarm parameters and output logic diagram:
Symbol description: "☆" means HY, "▲" means alarm value, "△" means SV value

Alarm code	Alarm mode	Alarm output (AL1 & AL2 are independent from each) Image:the hatched section means the alarm action
1	High limit absolute value alarm	
2	Low limit absolute value alarm	
3	※High limit deviation value alarm	
4	※Low limit deviation value alarm	
5	※High/low limit deviation value alarm	
6	※High/low limit interval value alarm	

Alarm code	Alarm mode	The below two alarm parameters(AL1,AL2) are used in combination, AL1 alarm output, AD2 must be set as 0
7	High and low limit absolute value interval alarm	
8	※High and low limit deviation value interval alarm	
9	※High limit absolute value and low limit deviation value interval alarm	
10	※High limit deviation value and low limit absolute value interval alarm	
11	High/low limit absolute value alarm	
12	High/low limit deviation value alarm	

※When the alarm value with deviation alarm is set as a negative number, it will be dealed as an absolute value.

X. Key function operation

1. Stop mode operation

1) Under the measure mode, press R/S for several seconds to enter stop mode;and on the SV window display "STOP" , main control output will stop or keep at minimum output.

2) under stop mode , short press R/S to exit stop mode , short press (AT) to modify SV value.

3) Under stop mode , alarm output and analog output can work normally.

2. PID Parameter auto-tuning operation:

1) Before auto-tuning, switch off the power supply of control output load at temporary or set the meter as stop mode.

2) Before auto-tuning PV value should meet the requirement: PID heating control , PV value is much lower than SV value , PID cooling control, PV value is much larger than SV value.

3) Before auto-tuning, set the proper alarm value,or remove the alarm effect to avoid the effect of alarm output,

4) Set PID type and SV value;the factory default is PID with fuzzy.

5) Set PID control,please set current output to proper range if it has OLL & OLH output limit; default set :OLL=0%,OLH=100%.

6) Exit stop mode or connect load power supply, and long press (AT) to enter auto-tuning mode, now, AT indicator will flash.

7）Auto-tuning need a period, to ensure the auto-tuning result,please don`t modify parameters or power-off during auto tuning.

8）When AT light is off , it will exit the auto-tuning. PID will update automatcially, and can get good control result.

9）During auto-tuning, long press "（**AT**）" key, measure beyond the range,display abnormally, shift to "STOP" status, power-off ect will stop the auto-tuning.

10）Note: In the place with current output amplitude limit , it may not get the best PID parameters even after auto-tuning.

11）Experienced users can set a proper PID parameter according to their experience.

3. PID heating & Cooling control operation

1）Set the control mode OT to 3.

2）PID heating control act on OUT1；Cooling control act on OUT2.

3）Cooling control OUT2 will make output by AL1 alarm relay.

4）Please set the cooling start offset to a value larger than 5 , to ensure the cooling would not affect PID heating control impact.

5）Please set the cooling control cycle CP1 to a proper value,and change the cooling scaling factor to a a proper value.

6）When PV value > SV+DB value,the cooling control start to effect;the bigger value of PV,the longer output time of OUT2

4. Manual control and automatic control mode switch

1）Enter the normal menu and set the A-M as AM

2）Back to measure and control status , press （**SET**）key to shift manual control or automatic control

3）Set as manual control mode , the lower line display shows the output scale : M0~M100 according to (0%~100%), press increase and decrease key to adjust the output scale .

4）Before switch manual control to auto-control , can press left key to modify the SV value to get better control result.

5）If set it as AM status , meter will work as manual control mode after power on and output 0%.

5. Fixed manual control output mode

1）Set A-M menu as MAN

2）Back to measure and control interface , can adjust the output scale by manual.

3）It will reset to manual output scale after power on again.

6. Signal linear auto-tuning function operation

1）Set up the INP type,and ensure one of inputs(0～50mV、 RT(0～400Ω)、4～20mA and 0～10V).

2）Add the input signal to a proper input channel.

3）Enter menu low-limit to calibrate CAL, press （**AT**）to flash "YES" ;and set the input signal to min value and input to meter.

4）When "YES" is flashing,and the min value of signal has input to meter,please press （**SET**） to ensure and save calibrating value.

5）After calibrating low-limit,enter the high limit to calibrate CAH in menu,and flash "YES" .

6）Set the input signal to max value to meter,and press（**SET**）to ensure and save the calibrating value when the "YES" is flashing.

7）After calibrating,it can enter CAE,and change "N" to "Y" then it can use calibrating value,or it will use the factory default value.

8）The linear signal value of high-limit input should not great than input standard value range ±10%.

9）If you are not satisfied with the calibrating result,you can reset.

XI. Checking methods of simple fault

Display	Checking methods
LLLL/HHHH	Checks whether the input disconnection and whether normal of FH/ FL value, working environment temperature and whether input signal is selected correctly.

XII. Communication procotol

Meter adoptS RS485 Modbus RTU communication protocol, RS485 half duplex communication. Read function code 0x03, write function code 0x10/0x06. Adopt 16 digit CRC check, the meter does not return for error check.
Data frame format:

Start bit	Data bit	Stop bit	Check bit
1	8	1	Set in Menu PRTY

Handling of abnormal communication:
When abnormal response , put 1 on the highest bit of function code. For example: Host request function code 0x03,and slave response function code should be 0x83.
Error code:
0x01--- Illegal function: the function code sent from host is not supported by meter.
0x02--- Illegal address: the register address designated by host beyond the address range of meter.
0x03--- Illegal data: Date value sent from host exceeds the corresponding data range of meter.
Communication cycle :
Communication cycle is the time from host request to slave response data, i.e.: communication cycle= time of request data sending +slave preparation time + response delay time + response return time, e.g.:9600 Baud rate:communication cycle of single measured data ≥250ms.
1. Read register
For example:Host reads integer SV(set value 200）
The address code of SV is 0x2000, because SV is integer(2 dyte), seizes 1 data register. The memory code of decimal integer 200 is 0x00C8. Note: when reading data, should read DP value or confirm DP menu value first to ensure the decimal point postion, after that transform the read data to get the actual value. Conversely, it should transform the data to corresponding ratio before writing the data in meter.

Host request (Read multi-register)

1	2	3	4	5	6	7	8
Meter ADD	Function code	Start ADD High bit	Start ADD Low bit	Data byte Length high bit	Data byte Length low bit	※CRC code low bit	※CRC code high bit
0x01	0x03	0x20	0x00	0x00	0x01	0x8F	0xCA

Slave normal answer(Read multi-register)

1	2	3	4	5	6	7
Meter ADD	Function code	Data byte Length	Data high bit	Data low bit	※CRC code low bit	※CRC code high bit
0x01	0x03	0x02	0x00	0xC8	0xB9	0xD2

Function code abnormal answer: (For example: host request ADD is 0x2011)

Slave abnormal answer(Read multi-register)

1	2	3	4	5
Meter ADD	Function code	Error code	※CRC code low bit	※CRC code high bit
0x01	0x83	0x02	0xC0	0xF1

2. Write multi-register
For example:Host use 0x10 function code write SV（setting value 150）
ADD code of SV is 0x2000,because SV is integer(2 dyte),seizes 1 data register.The hexadecimal code of decimal integer 150 is 0x0096.

Host request (write multi-register)

1	2	3	4	5	6	7	8	9	10	11
Meter ADD	Function code	Start ADD High bit	Start ADD Low bit	Data byte Length high bit	Data byte Length low bit	Data byte Length	Data high bit	Data low bit	※CRC code low bit	※CRC code high bit
0x01	0x10	0x20	0x00	0x00	0x01	0x02	0x00	0x96	0x07	0xFC

Slave normal answer (write multi-register)

1	2	3	4	5	6	7	8
Meter ADD	Function code	Start ADD High bit	Start ADD Low bit	Data byte length high bit	Data byte length low bit	※CRC code low bit	※CRC code high bit
0x01	0x10	0x20	0x00	0x00	0x01	0x0A	0x09

Host write SV with 0x06 function（set value 150）

Host request（write single-register）

1	2	3	4	5	6	7	8
Meter ADD	Function code	Start ADD High bit	Start ADD Low bit	Data high bit	Data low bit	※CRC code low bit	※CRC code high bit
0x01	0x06	0x20	0x00	0x00	0x96	0x02	0x64

Slave normal answer（write single-register）

1	2	3	4	5	6	7	8
Meter ADD	Function code	ADD High bit	ADD Low bit	Data high bit	Data low bit	※CRC code low bit	※CRC code high bit
0x01	0x06	0x20	0x00	0x00	0x96	0x02	0x64

Slave abnormal answer（write single-register)

1	2	3	4	5
Meter ADD	Function code	Error code	※CRC code low bit	※CRC code high bit
0x01	0x86	0x02	0xC3	0xA1

Meter parameters address mapping table

No.	Add(Register No①)	Variable name	Register	R/W	Remark
1	0x2000（48193）	Set value SV	1	R/W	
2	0x2001（48194）	1st alarm value AL1	1	R/W	
3	0x2002（48195）	1st alarm hysteresis HY1	1	R/W	
4	0x2003（48196）	2nd alarm valueAL2	1	R/W	
5	0x2004（48197）	2nd alarm hysteresis HY2	1	R/W	
6	0x2005（48198）	Display low limit FL	1	R/W	
7	0x2006（48199）	Display high limit FH	1	R/W	
8	0x2007（48200）	Analog output low limit BRL	1	R/W	
9	0x2008（48201）	Analog output high limit BRH	1	R/W	
10	0x2009（48202）	Control output low limit OLL	1	R/W	Default 1 decimal point
11	0x200A（48203）	Control output high limit OLH	1	R/W	Default 1 decimal point
12	0x200B（48204）	Overshoot limit OVS	1	R/W	
13	0x200C（48205）	Heat & Cool control dead zone DB	1	R/W	
14	0x200D（48206）	Proportional coefficient of cooling PC	1	R/W	Default 1 decimal point
15	0x200E（48207）	Amend value PS	1	R/W	
16	0x200F（48208）	PV fuzzy tracking value DTR	1	R	Engineering work without decimal point
17	0x2010（48209）	Measured value PV	1	R	
18	0x2011（48210）	Output percentage MV	1	R/W	0~100
19	0x2012（48211）	Auto-Manual switch A-M	1	R/W	0:Auto; 1: Manual
		Reserve			
20	0x2100（48449）	1st alarm mode AD1	1	R/W	
21	0x2101（48450）	2nd alarm mode AD2	1	R/W	
22	0x2102（48451）	1st alarm extended function AE1	1	R/W	
23	0x2103（48452）	2nd alarm extended function AE2	1	R/W	
24	0x2104（48453）	Control mode OT	1	R/W	
25	0x2105（48454）	Output mode ACT	1	R/W	
26	0x2106（48455）	RUN/STOP operation	1	R/W	1:RUN 2:STP 3:Run auto-tune 4:Stop auto-tune
27	0x2107（48456）	Decimal pointDP	1	R/W	
28	0x2108（48457）	Unit display UT	1	R/W	25（℃）26（℉）
29	0x2109（48458）	Filter constants FT	1	R/W	
30	0x210A（48459）	Proportional coefficient P	1	R/W	No decimal point
31	0x210B（48460）	Integral time I	1	R/W	No decimal point
32	0x210C（48461）	Differential time D	1	R/W	No decimal point
33	0x210D（48462）	Control speed fine-tune SPD	1	R/W	
34	0x210E（48463）	Heating control cycle CP	1	R/W	No decimal point
35	0x210F（48464）	Cooling control cycle CP1	1	R/W	No decimal point
36	0x2110（48465）	Cooling delay time PT	1	R/W	No decimal point
37	0x2111（48466）	Optional input signal INP	1	R/W	Refer to signal table
38	0x2112（48467）	Meter address ADD	1	R/W	
39	0x2113（48468）	Communication baud rate BAD	1	R	
40	0x2114（48469）	Com. data transfer sequence DTC	1	R	Note ③
41	0x2115（48470）	PID arithmetic type PDC	1	R	
42	0x2116（48471）	Lock LCK	1	R	
43	0x2117（48472）	Meter name	1	R	
44	0x2118（48473）	Output state	1	R	Note ②
45	0x2119（48474）	Parity Check PRTY	1	R	

R : Read only ; R/W : Read & write
Note①: The register number is the address converted to decimal plus 1 and then the register identification code 4 is added in front; for example: the register number of the data address 0x2000 is 8192 + 1 = 8193 and then 4 is added in front, that is, the register number 48193; Related applications can be seen, such as Siemens S7-200 PLC.
Note ②: Measurement status indication. When the data bit is 1, it means execution, and when it is 0, it means no execution.

D7	D6	D5	D4	D3	D2	D1	D0
STOP	HHHH	LLLL	AT	AL2	AL1	OUT2	OUT1

Note③: DTC communication data transmission sequence description
DTC : □ □ □ ── Reserve
　　　　　　　 └─ Byte transfer order: when it is 0, 1, 2, and when it is 1, 2, 1
　　　　　　└── Reserve
※16-bit CRC check code to get C 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;
}
```