

# Intelligent Temperature Controller User Manual

For TP-C Version



## Features

- Multi input signal and multi models for option.
- With measured display, control output, alarm output, RS485 communication, etc.
- Multi PID algorithms for option, with auto tune function.
- This product can be used in industrial machinery, machine tools, general measuring instruments and equipment.

National High-tech Enterprise/ National Standard Drafting Unit



Hotline: 400-0760-168

Version code: KKTP-C01E-A/4-20220707

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

## I. Safe 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 all the wire. Otherwise it may lead to electric shock, fire, fault.
- 3) Not allow to 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 remove, repair and modify this product, otherwise it may lead to electric shock, fire, fault.

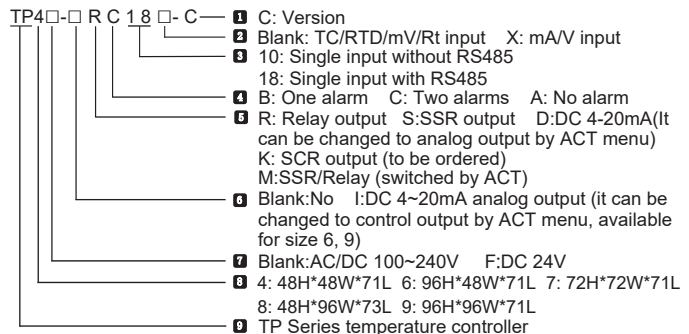
### ⚠ Caution

- 1) The product should not be used in a nuclear 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 this 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 and prevent to machine failure, the product is connected with power lines or large capacity input and output lines and other methods please install proper capacity fuse or other methods of protection circuit.
- 9) Please don't put metal and wire clastic mixed with this product, otherwise it may lead to electric shock, fire, fault.
- 10) Please tighten screw torque according to the rules. If not, it may lead to electric shock and fire.
- 11) In order not to interfere with this products to dissipate heat, please 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 cleaning cloth to wipe away the dirt. Please 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) The readers of this manual 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 this product with safety for long-term, regular maintenance is necessary. The life of some parts of the equipments are by some restrictions, but the performance of some will change for using many years.
- 18) Without prior notice, the contents of this manual will be change. We hope these is no any loopholes, 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 category II, class of pollution 2]
  - 2) This product is used in the following scope: environment, temperature, humidity and environmental conditions. Temperature: 0~50°C; humidity: 45~85%RH; Environment condition: Indoor warranty. The altitude is less than 2000m.
  - 3) Please avoid using in the following places:
    - The place will be dew for changing temperature; with corrosive gases and flammable gas; with vibration and impact; with water, oil, chemicals, smoke and steam facilities with dust, salt, metal powder; and with clutter interference, static electric and magnetic fields, noise; where has air conditioning or heating of air blowing directly to the site; where will be illuminated directly by sunlight; where accumulation of heat will happen caused by radiation.
  - 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 environment, and ensure that the products below for more than 50mm space. Please avoid to installed over the machine of the calorific value (Such as heaters, transformer, semiconductor operations, the bulk resistance). When the surrounding is more than 50, please using the force fan or cooling fans. But don't let cold air blowing directly to the product. In order to improve the anti-interference performance and security, please try to stay away from high pressure machines, power machines to install. Don't install on the same plate with high pressure 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 in the place of TC input; Please use insulated TC if the measured device is heated metal.
  - 2) Please use the cable of lesser resistance in the place of RTD input, and the cable (3 wire) must be no resistance difference, but the total length is within 5m.
  - 3) In order to avoid the effect of noise, please put the input signal away from meter cable, power cable, load cable to wiring.
  - 4) In order to reduce the power cables and the load power cables on the effect of this product, please use noise filter in the place where easy to effect. You must 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 the wiring of noise filter output side, otherwise it will reduce the effect of noise filter.
  - 5) It takes 5s from input power to output. If there is a place with interlocking actions circuit signal, please use timer relay.
  - 6) Please use twisted pair with a shield for analog output line, can also connect the common-mode coil to the front-end of the signal receiving device to suppress line interference if necessary, to ensure the reliability 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 reliability of signal.
  - 8) This product don't have the fuse; please set according to rated voltage 250V, rated current 1A if you need; fuse type: relay fuse.
  - 9) Please use suitable slotted screwdriver and wire. Terminal distance: 5.0mm. Screwdriver size: 0.6X3.5, length of slotted screwdriver >130mm. Recommended tightening torque: 0.5N.m. Proper cables: 0.25 ~ 1.65mm single cable/multiple core cable
  - 10) Please don't put the Crimp terminal or bare wire part contact with adjacent connector.

## II. Model Illustration



## III. Models

No.	Model	OUT1 control output		Alarm output		Analog output	Comm	Auxiliary power
		RELAY	SSR	4~20mA	AL1 OUT2	AL2	4~20mA	RS485
1	TP4-DC18□			●	●	●	●	●
2	TP4-DC10□			●	●	●	●	●
3	TP4-RC18□	●			●	●	●	
4	TP4-SC18□		●		●	●	●	
5	TP4-MC10□	●	●		●	●		
6	TP7-DC18□			●	●	●	●	●
7	TP7-DC10□			●	●	●	●	●
8	TP7-MC18□	●	●		●	●		●
9	TP7-MC10□	●	●		●	●		●
10	TP6/8/9-IMC18□	●	●	●	●	●	●	●
11	TP6/8/9-IMC10□	●	●	●	●	●	●	●
12	TP6/8/9-DC18□	●	●	●	●	●	●	●
13	TP6/8/9-DC10□	●	●	●	●	●	●	●
14	TP6/8/9-MC18□	●	●	●	●	●	●	●
15	TP6/8/9MC10□	●	●	●	●	●	●	●

□: 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. This series only have one loop 4~20mA output, but the user can modify menu ACT to set it as main control output or analog output.

## IV. Specifications

### 1. Electrical parameters:

Sampling 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) ,DC 24V
Power consumption	< 10VA
Environment	Indoor use only, temperature: 0~50°C no condensation, humidity < 85%RH, altitude<2000m
Storage environment	-10 ~ 60°C, no condensation

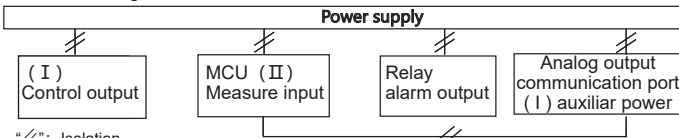
SSR output	DC 24V pulse voltage, load<30mA
Current output	DC 4 ~ 20mA load<500Ω, temperature drift 250PPM
Communication port	RS485 port Modbus-RTU protocol, max input 30 units
Insulation impedance	Input, output, power VS meter cover > 20MΩ
ESD	IEC/EN61000-4-2 Contact ±4KV /Air ±8KV perf.Criteria B
Pulse triap 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	PC
Power failure memory	10 years, times of writing: 1 million times
Safety Standard	IEC61010-1 Overvoltage category II, pollution level 2, levelII (Enhanced insulation)

2. Measured signal specifications:

Input type	Symbol	Measuring range	Resolution	Accuracy	Input impedance/auxiliary current	Comm. parameter code
K1	⌈ 1	-50 ~ 1200	1°C	0.5%F.S±3digits	>500KΩ	0
K2	⌈ 2	-50.0 ~ 999.9	0.2°C	0.5%F.S±1°C	>500kΩ	16
J1	⌈ 1	0 ~ 1200	1°C	0.5%F.S±3digits	>500KΩ	1
J2	⌈ 2	0.0 ~ 999.9	0.2°C	0.5%F.S±1°C	>500KΩ	17
E1	⌈ 1	0 ~ 850	1°C	0.5%F.S±3digits	>500KΩ	2
E2	⌈ 2	0.0 ~ 850.0	0.3°C	0.5%F.S±1°C	>500KΩ	18
T1	⌈ 1	-50 ~ 400	1°C	0.5%F.S±3°C	>500KΩ	3
T2	⌈ 2	-50.0 ~ 400.0	0.4°C	0.5%F.S±3°C	>500KΩ	19
B	⌈ b	250 ~ 1800	1°C	1%F.S±2°C	>500KΩ	4
R	⌈ r	-10 ~ 1700	1°C	1%F.S±2°C	>500KΩ	5
S	⌈ s	-10 ~ 1600	1°C	1%F.S±2°C	>500KΩ	6
N1	⌈ n 1	-50 ~ 1200	1°C	0.5%F.S±1°C	>500KΩ	7
N2	⌈ n 2	-50.0 ~ 999.9	0.2°C	0.5%F.S±1°C	>500KΩ	20
PT100-1	⌈ P 1	-200.0 ~ 600.0	0.2°C	0.5%F.S±0.3°C	0.2mA	8
PT100-2	⌈ P 2	-200 ~ 600	1°C	0.5%F.S±3digits	0.2mA	9
JPT100-1	⌈ J P 1	-200.0 ~ 500.0	0.2°C	0.5%F.S±0.3°C	0.2mA	21
JPT100-2	⌈ J P 2	-200 ~ 500	1°C	0.5%F.S±3digits	0.2mA	22
CU50-1	⌈ C U 50 1	-50.0 ~ 150.0	0.2°C	0.5%F.S±3°C	0.2mA	10
CU50-2	⌈ C U 50 2	-50 ~ 150	1°C	0.5%F.S±3°C	0.2mA	23
CU100-1	⌈ C U 100 1	-50.0 ~ 150.0	0.2°C	0.5%F.S±1°C	0.2mA	11
CU100-2	⌈ C U 100 2	-50 ~ 150	1°C	0.5%F.S±3digits	0.2mA	24
0 ~ 50mV	⌈ 0 ~ 50mV	-1999 ~ 9999	12bit	0.5%F.S±3digits	>500kΩ	12
0 ~ 400V	⌈ 0 ~ 400V	-1999 ~ 9999	12bit	0.5%F.S±3digits	0.2mA	13
* 4 ~ 20mA	⌈ * 4 ~ 20mA	-1999 ~ 9999	12bit	0.5%F.S±3digits	<50Ω	14
* 0 ~ 10V	⌈ * 0 ~ 10V	-1999 ~ 9999	12bit	0.5%F.S±3digits	>1MΩ	15

\*: Need to indicate the input signal requirement when the order is made.

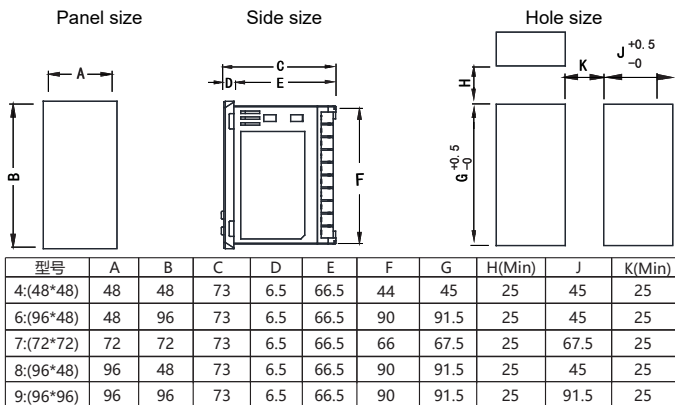
3. Isolation diagram:



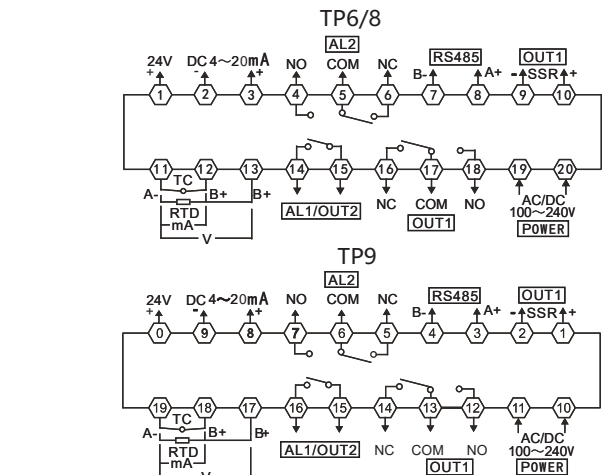
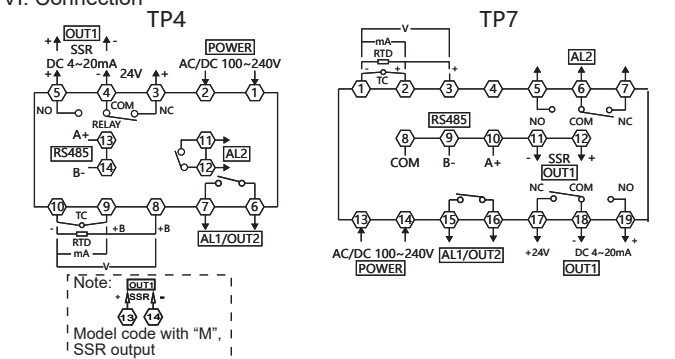
"//": Isolation

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

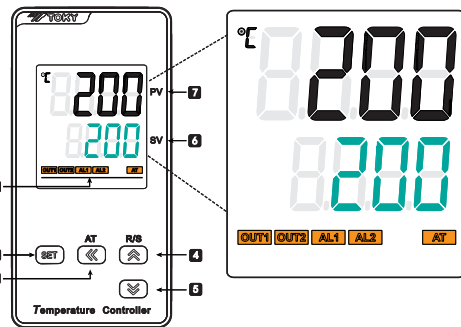
V. Dimension



VI. Connection



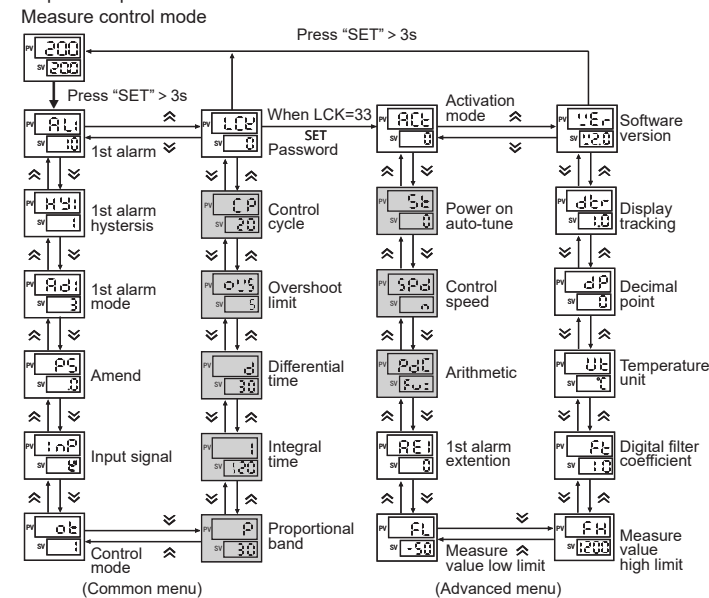
VII. Panel Illustration



No.	Symbol	Name	Function
1	OUT1	OUT1 (orange)	Main control output indicator, lights on when output ON.
	OUT2	OUT2 (orange)	Cooling output indicator, lights on when output ON.
	AL1	Alarm 1# (orange)	1st alarm output indicator, lights on when alarm output, lights off when no alarm output.
	AL2	Alarm 2# (orange)	2nd alarm output indicator, lights on when alarm output, lights off when no alarm output.
	AT	AT indicator (orange)	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	⏪	Shift/AT key	Activate key/ shift key/ AT auto tune key (in measure and control mode, long press to enter/exit auto tune)
4	➦	Add key/R/S	Add key, in measure and control mode, long press to shift RUN/STOP mode, or check the menu in reverse order.
5	⏩	Reduce key	Reduce key, check the menu in sequence
6	SV	Display (green)	Set value / parameter display window, the control is stopped when it displays "STOP"
7	PV	Display (white)	Measured value/ parameter code display window

VIII. Operation process and menu illustration

1. Operation process & method



- After power on and under normal measure control mode, long press "SET" key more than 3s to enter the menu parameters checking mode.
- In the menu checking mode, press "SET" key to check the menu parameters circularly.
- In the menu checking mode, short press "⏪" key to flash the current menu parameters to enter the parameter modify mode, and every short press can move one position to the left in cycle.
- In the parameter modifying mode, press "➦" or "⏩" key once to add or reduce one of flashing data.
- In the parameter modifying 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 “ $\llcorner$ ” to enter SV value modifying status. The way of modifying SV value is same as that of modifying menu parameters.
- g. In the normal measure control mode, long press “AT” key 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 “R/S” key more than 3s to enter or exit STOP mode.

### IX. Menu Illustration

- No matter what model, what control mode it is, it will always display these parameters.
- 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 dealt as absolute value when it is as a deviation value.	FL ~ FH	10
2	HY1	HY1	1st alarm hysteresis	0 ~ 1000	1
3	AD1 (1)	AD1 (1)	1st alarm mode, note: when AL1 is used as OUT2 (cooling 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 dealt as absolute value when it is as a deviation value.	FL ~ FH	5
5	HY2	HY2	2nd alarm hysteresis	0 ~ 1000	1
6	AD2 (1)	AD2 (1)	2nd alarm mode	0 ~ 6	4
7	PS	PS	Amend value, display value= actual measured value + amend value	-1999 ~ 9999	0
8	INP	INP	Optional input signal. Note: after selecting the signal, please properly set below relevant parameters: SV,AL1,HY1,AL2,HY2,P,OVS,DB.	refer to input signal parameters table (page 3)	K1
9	OT	OT	Control mode, 0:ON/OFF heating control, relevant parameter: DB. 1: PID heating control, relevant parameters: P, I, D, OVS, CP, ST, SPD, PDC. 2: ON/OFF cooling control, relevant parameter DB; need to set PT when it is used for compressor control. 3:PID heating & cooling control(cooling control OUT2 will output through AL1 relay), relevant parameters: P, I, D, OVS, CP, CP1, PC, DB, ST, SPD, PDC. 4: Over temperature cooling output, relevant parameter: DB 5. PID cooling, relevant parameter: P, I, D, OVS, CP, ST, SPD, PDC.	0 ~ 5	1
10	A-M	A-M	Auto-manual control switch, AUTO(0): auto control only; MAN(1): manual control only; AM(2): auto-manual shortcut switch	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 weaker. 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 action is, otherwise, it is weaker. 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	0.1 ~ 100.0	10.0
18	DB	DB	ON/OFF control hysteresis (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 SV can be checked only, can't be modified. 0033: can enter to advanced menu. 0123: menus reset to factory setting, need to reboot.	0~9999	0

#### 2. Advanced menu illustration

No.	Symbol	Name	Illustration	Setting range	Factory setting
20	ACT	ACT	Control execution mode. 0:relay or SSR control output. 1:SSR control output only. 2: 4~20mA control output, setting should comply with the selected configuration of the meter. 3: 4~20mA retransmission output for size 4/7 products. When this menu is set as 0 or 1, 4-20mA output is used as retransmission output, for size 6/8/9 products.	0~2 (0~3)	0
21	AE1 (2)	AE1 (2)	1st alarm extensions function, refer to alarm extension function table	0~5	0
22	AE2 (2)	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: °C: Celsius degrees. °F: Fahrenheit degrees. Note: No unit for linear signal	(25)°C (26)°F	(25)°C

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 is reverse 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.	-5.0~100.0	0
32	OLH	OLH	Output high limit, limit the output high limit current amplitude. Set value must be greater than low limit.	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, 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	0~247	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 add the low end signal to the signal input terminal, flash YES to activate, after confirm and display OK, the input signal low end calibration is completed.	YES/OK	YES
43	CAH	CAH	Self-calibration high limit input operation, after add the high end signal to the signal input terminal, flash YES to activate, after confirm and display OK, the input signal high end calibration is completed.	YES/OK	YES
44	VER	VER	Software version		

(1) Alarm parameters and output logic diagram:

Symbol description: “ $\Delta$ ” means HY, “ $\blacktriangle$ ” means alarm value, “ $\triangle$ ” means SV value

Alarm code	Alarm mode	Alarm output (AL1 & AL2 are independent from each other) 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	
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 value, it will be dealt as an absolute value.

#### (2) Alarm extension function table

AE1/AE2 value	Alarm handling method when it displays HHHH/LLLL	Power on, alarm inhibition
0	Alarm status remains the same	Power on, no alarm inhibition (As long as the alarm condition is met, alarm output immediately.)
1	Forced alarm output	
2	Forced alarm close	
3	Alarm status remains the same	Power on, alarm inhibition (After power on and before the PV value reaches the SV for the first time, the alarm will not output. After that alarm work normally)
4	Forced alarm output	
5	Forced alarm close	

### X. Key function operation

- Stop mode
  - Under the measure mode, long press “R/S” key to enter the STOP mode, SV window will display “STOP”, main control output will stop or keep the minimum output.
  - Under STOP mode, long press “R/S” key to exit STOP mode, press “ $\llcorner$ ” key to modify SV value.
  - Under STOP mode, alarm output and retransmission output work normally.
- PID auto-tune operation:
  - Before auto-tune procedure, please switch off the control output load power, or set the meter as STOP mode.
  - Before auto-tune procedure, PV value should meet below condition: when it is PID heating control, PV needs to be much smaller than SV; when it is PID cooling control, PV needs to be much larger than SV.



- 3) Before auto-tune procedure, please set a proper alarm value or eliminate the alarm condition, in order to prevent the auto-tune procedure from being affected by alarm output.
  - 4) Set PID type and SV value; the factory default setting is fuzzy PID.
  - 5) Set as PID control, if there is OLL & OLH output limiting, please set the output to a proper range; factory default setting is OLL=0%, OLH=100%.
  - 6) Exit STOP mode, or switch on the load Power, immediately long press "AT" key to enter auto-tune mode, then the AT indicator light is on.
  - 7) The auto-tune procedure will take some time, in order not to affect auto-tune result, please don't modify the parameters or power-off.
  - 8) When AT light goes out, it automatically exits auto-tune mode, PID parameters will be updated automatically, and then the meter will control automatically and exactly.
  - 9) During the auto-tune procedure, below actions will cause the termination of the process, long press "AT" key, measure beyond the scope, abnormal display, switch to STOP mode, power-off, etc.
  - 10) Note: In the occasions with output limiting operation, sometimes, even if the auto-tune is carried out, the best PID parameters still cannot be obtained.
  - 11) Experienced users can set proper PID parameter according to experience.
3. PID heating and proportional cooling control operation
- 1) Set the control mode OT as 3.
  - 2) PID heating control acts on OUT1; proportional cooling control acts on OUT2.
  - 3) Proportional cooling control OUT2 outputs via AL1 alarm function terminals.
  - 4) Please set the cooling start hysteresis DB to a value greater than 5, to ensure the cooling output will not affect the PID heating control.
  - 5) Please change the cooling control cycle CP1 and the cooling proportionality coefficient to 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. Auto-manual switch function
- 1) Enter common manual, set parameter A-M as "AM".
  - 2) After return back to measure control interface, press " " key to switch auto-manual operation.
  - 3) When it is switched to manual control, lower line LED will display output percentage: M0~M100 (corresponding to 0%~100%), press Add Key or Reduce Key to modify the output percentage.
  - 4) Before the switch from manual control to auto control, in order to ensure the smooth switch, please press Left Key to modify the SV value first.
  - 5) After the meter is rebooted, the default setting is manual control and output 0.
5. Fixed manual control function
- 1) Set A-M parameter as "MAN".
  - 2) After return back to measure control interface, user can modify output percentage by manual.
  - 3) After the meter is powered on again, the manual output percentage can be restored.
6. Linear signal self calibration function operation
- 1) Set up the INP type, and ensure it is one of these input 0~50mV, RT(0~400Ω), 4~20mA and 0~10V.
  - 2) Add the input signal to the correct input channel.
  - 3) Enter menu low-limit calibration menu CAL, press "AT" to flash "YES"; and set the input signal to minimum value and input it to the meter.
  - 4) When "YES" is flashing, and the minimum value of the signal has been input to the meter, please press " " to ensure and save the calibrating value.
  - 5) After calibrating low-limit, enter the high-limit calibration menu CAH, and flash "YES".
  - 6) Set the input signal to maximum value and input it into the meter; when the "YES" is flashing, press " " to ensure and save the calibrating value.
  - 7) After calibrating, enter menu CAE, change "N" to "Y" to enable the calibrating value; otherwise, it still use the factory default value.
  - 8) The calibrated high-limit input linear signal value should not exceed the input standard value range ±10%.
  - 9) If not satisfied with the calibrating result, could calibrate again.

## 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 protocol

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: Data 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 position, 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 value AL2	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	
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 2:Auto-Manual switch
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 (°C) 26 (°F)
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 ij;
    unsigned int wCrc = 0xFFFF;
    for(i=0; i<num; i++)
    {
        wCrc ^= (unsigned int)(pBuff[i]);
        for(j=0; j<8; j++)
        {
            if(wCrc & 1){wCrc >>= 1; wCrc ^= 0xA001;}
            else
                wCrc >>= 1;
        }
    }
    return wCrc;
}

```