TR Series Intelligent temperature controller User's Manual

Features:
⊙ Universal input : Tc , Rtd , analog signal
⊙ With display , alarm and adjustment function
⊙ PID control , with PID auto-tuning function. Optional control output and modularized design
⊙ High anti-interference ability
⊙ Can be applied to system temperature control

■ Safe Caution

※ For your safe, please read the below content 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:
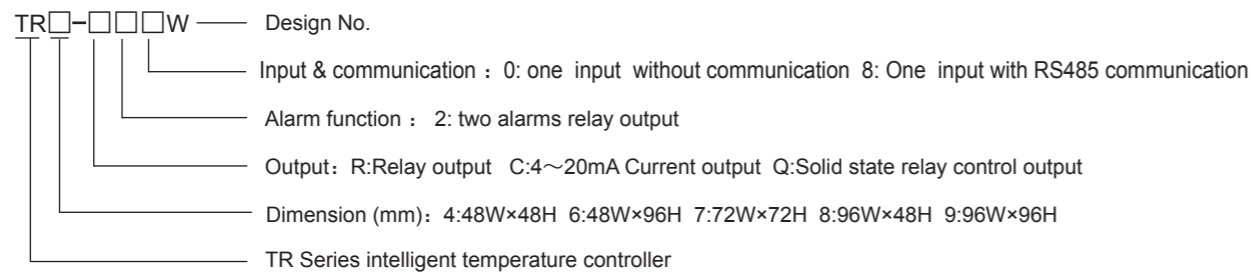⚠ An accident danger may happen in a special condition.

⚠ 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, entertainment or safety equipment, etc. Otherwise, it may cause serious loss, fire or person injury.
2. Apanel 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 connector or signal input connectors, the moment of the No.20AWG (0.50 mm2) scrwew 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 specifications. Otherwise it may cause fire after the working life of the product becomes shorter.
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.
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.

■ Model Illustration

TR□-□□□W   Design No.

Input & communication : 0: one input without communication 8: One input with RS485 communication

Alarm function : 2: two alarms relay output

Output：R:Relay output C:4～20mA Current output Q:Solid state relay control output

Dimension (mm)：4:48W×48H 6:48W×96H 7:72W×72H 8:96W×48H 9:96W×96H

TR Series intelligent temperature controller

■ Ordering Model

Model	Alarm	OUT1	Communication
TR□-R20W	2	Relay control output	without
TR□-Q20W	2	SSR control output	without
TR□-C20W	2	4-20mA current output	without
TR□-R28W	2	Relay control output	RS485(MODBUS)
TR□-Q28W	2	SSR control output	RS485(MODBUS)
TR□-C28W	2	4-20mA current output	RS485(MODBUS)

Note: OUT：Max loading resistance of 4-20mA analog current is 600Ω. Loading capability of relay output is 3A/250VAC.

Loading capability of SSR output is 30mA/24VD   Alarm：Loading capability of relay output is 1A/250VAC

Size 48Wx48H is not available for communication function.   Page 01

■ Main Technical Parameter

1. Technical Specifications

|	
Supply Voltage	100～240V AC/DC
Total current	＜30mA（220VAC/50Hz）
Transmit output	4～20mA transmit current,load resistance 600Ωmax
Control output	Relay output load capability:3A/250VAC
Alarm output	Relay output load capability：1A/250VAC
Aux.voltage output	DC 24V＜30mA
Dielectric strenth	Among power supply terminal,relay contact point, signal input terminals>2000VAC 50Hz/1min
Communication	RS485 communication interface，MODBUSRTU Protocal
Panel protect level	IP65
Ambient Temperature	0～50℃ 45～80RH%
Stock Envirenment	-10～60℃ 25～85RH%

2.Input Parameters

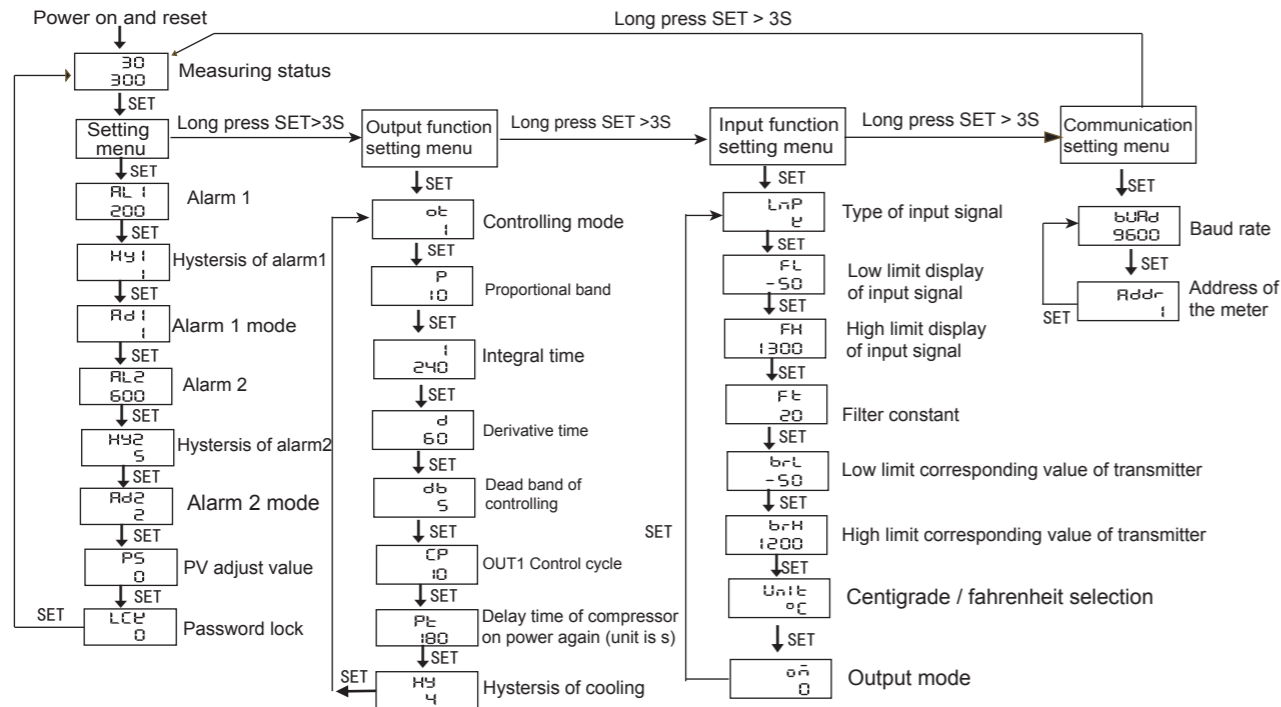| S/N	Symbol	Input Type	Measuring Range	Resolution	Accuracy	Input resistance
0	ᴸ	K type Tc	−50～1200℃	1℃	±0.5%F.S±3digits	>100KΩ
1	J	J type Tc	0～1200℃	1℃	±0.5%F.S±3digits	>100KΩ
2	E	E type Tc	0～850℃	1℃	±0.5%F.S±3digits	>100KΩ
3	ᵵ	T type Tc	−50～400℃	1℃	±0.5%F.S±3digits	>100KΩ
4	ᵬ	B type Tc	600～1800℃	1℃	±0.5%F.S±3digits	>100KΩ
5	r	R type Tc	500～1600℃	1℃	±0.5%F.S±3digits	>100KΩ
6	5	S type Tc	−10～1600	1℃	±0.5%F.S±3digits	>100KΩ
7	n	N type Tc	−50～1200℃	1℃	±0.5%F.S±3digits	>100KΩ
8	Pᵵ	Pt 100	−199.9～650.0℃	0.1℃	±0.5%F.S±3digits	（0.2mA）
9	CU5/CU50	Cu 50	−50.0～150.0℃	0.1℃	±0.5%F.S±3digits	（0.2mA）
10	CU1/CU00	Cu 100	−50.0～150.0℃	0.1℃	±0.5%F.S±3digits	（0.2mA）
11	ᾱᵛ	linear voltage 0～50mV	0～50mV	1digit	±0.5%F.S±3digits	>100KΩ
12	ᾱA	linear current 4～20mA	0～20mA	1digit	±0.5%F.S±3digits	<150Ω
13	ᵙ	linear voltage 0～10V	0～10V	1digit	±0.5%F.S±3digits	>47KΩ
14	rᵵ	linear resistance 0～400Ω	0～400Ω	1digit	±0.5%F.S±3digits	>100KΩ

3.Unit code table

S/N	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
Code	ᾱ	Cᾱ	ᾱᾱ	ᵏG	G	ᾱG	ᴬPᾱ	Pᴬ	ᵬᴬ	ᾱᵬᴬ	n	ᵙ	ᵏᵛ	rPᾱ	Hᵶ	ᵏHᵶ	ᾱᵛ	ᵙ	ᵏᵛ	ᾱᴬ	ᴬ	ᵏᴬ	r	ᵏr	℃	℉
Unit	M	cm	mm	kg	g	mg	Mpa	pa	ba	Mba	N	W	KW	RPM	Hz	KHz	mV	V	KV	mA	A	KA	Ω	KΩ	℃	℉

■ Panel indication
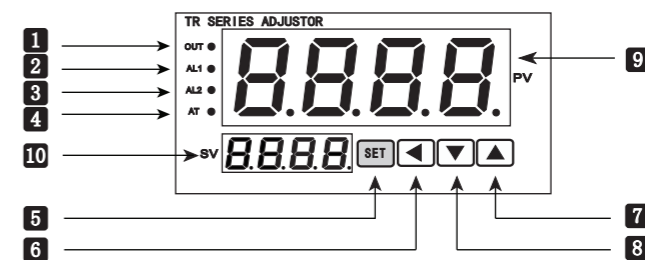
| S/N	Code	Name	Function Indication
1	OUT	OUT indicating light	
2	AL1	Alarm 1 indicating light	Alarm 1 indicating light (the light on means alarming , and relay gives an action)
3	AL2	Alarm 2 indicating light	Alarm 2 indicating light (the light on means alarming , and relay gives an action)
4	AT	Auto-tuning indicating light	PID auto-tuning function, long press ◄ to enter pid auto-tuning status
5	SET	SET function key	Parameter select and confirm , enter/exit menu
6	◄	Menu modifying key（SHIFT）	Modify the parameter value
7	▲	Increase key	Increase key
8	▼	Decrease key	Decrease key
9	LED	PV display window	Display measuring value/setting parameter
10	LED	Parameter displaying window（unit code display）	Display parameter value and unit code

Page 02

■ Operation Process

Operation Process flow diagram:

Power on and reset → 30 / 300 Measuring status

Long press SET > 3S (top return path)

Measuring status →(SET)→ Setting menu

- Setting menu →(SET)→ RL1 / 200 Alarm 1
- →(SET)→ HY1 Hysteris of alarm1
- →(SET)→ Rd1 Alarm 1 mode
- →(SET)→ RL2 / 600 Alarm 2
- →(SET)→ HY2 / 5 Hysteris of alarm2
- →(SET)→ Rd2 / 2 Alarm 2 mode
- →(SET)→ PS / 0 PV adjust value
- →(SET)→ LCR / 0 Password lock

Long press SET>3S → Output function setting menu
- →(SET)→ ot / 1 Controlling mode
- →(SET)→ P / 10 Proportional band
- →(SET)→ 1 / 240 Integral time
- →(SET)→ d / 60 Derivative time
- →(SET)→ db / 5 Dead band of controlling
- →(SET)→ CP / 10 OUT1 Control cycle
- →(SET)→ Pt / 180 Delay time of compressor on power again (unit is s)
- →(SET)→ HY / 4 Hysteris of cooling

Long press SET >3S → Input function setting menu
- →(SET)→ InP / t Type of input signal
- →(SET)→ FL / -50 Low limit display of input signal
- →(SET)→ FH / 1300 High limit display of input signal
- →(SET)→ Ft / 20 Filter constant
- →(SET)→ brL / -50 Low limit corresponding value of transmitter
- →(SET)→ brH / 1200 High limit corresponding value of transmitter
- →(SET)→ Unit / °C Centigrade / fahrenheit selection
- →(SET)→ on / 0 Output mode

Long press SET > 3S → Communication setting menu
- →(SET)→ bURd / 9600 Baud rate
- →(SET)→ Addr / 1 Address of the meter

■ Menu of the Meter

| Parameter	Indication	Setting range	Ex-factory setting
Menu setting			
RL1	Setting value of alarm 1	FL~FH	200
HY1	Hysteris of alarm 1	0~9999	1
Rd1	Mode of alarm 1	1~5	1
RL2	Setting value of alarm 2	FL~FH	600
HY2	Hysteris of alarm 2	0~9999	5
Rd2	Mode of alarm 2	1~5	2
PS	Adjust value of measuring	−1000~1000	0
LCR	When the unit digit set to 1 , SV couldn't be modified . The ten's digit set to 1 , the menu couldn't be modified	0~9999	0
Input function menu			
ot	Controlling mode 0：ON/OFF；1：Heating control；2：Cooling control	0~2	1
P	Proportion	0~9999	50
1	Integral constant of PID menu	0~3600	200
d	Derivative time	0~3600	50
db	Dead band of ON/OFF control (Effective only for ON/OFF control)	0~1000	5
CP	Controlling cycle of OUT 1	0~255	20
Pt	Delay time of the compressor on power again (unit is second)	0~3600	180
HY	Hysteris of cooling	0~9999	4
InP	Type of input signal	Refer to input parameter table	K
FL	Low limit display of input signal	Refer to input parameter table	−50
FH	High limit display of input signal	Refer to input parameter table	1200
Ft	Filter constant	1~255	255
brL	Low limit corresponding value of transmitter	FL~FH	−50
brH	High limit corresponding value of transmitter	FL~FH	1200
Unit	Centigrade ℃ / fahrenheit ℉ selection	℃~℉	℃
on	Ouput mode: 0:Relay or SSR output; 1: 4~20mA control output ; 2: 4~20mA analog output, In output mode 2 ,the control output is changing to analog output , no PID contol function . (Digital indicator)	0~2	0
Communication setting menu			
bURd	Communication baud rate	4800；9600	9600
Addr	Address of the meter	1~255	1

Alarm function

| Alarm code	Alarm mode	Alarm output (AL1,AL2 are separated)
1	Low limit absolute alarm	Temperature dropping — HY — AL
2	High limit absolute alarm	HY — AL — Temperature rising
3	Low limit bias value alarm	Temperature dropping — HY — SV−AL — SV
4	High limit bias value alarm	HY — SV — SV+AL — Temperature rising
5	Apparent limits of an interval alarm	Temperature dropping — HY — SV−AL — HY — SV+AL — Temperature rising

■ Connecting Drawing

TR4, TR7, TR9, TR6, TR8 connecting diagrams
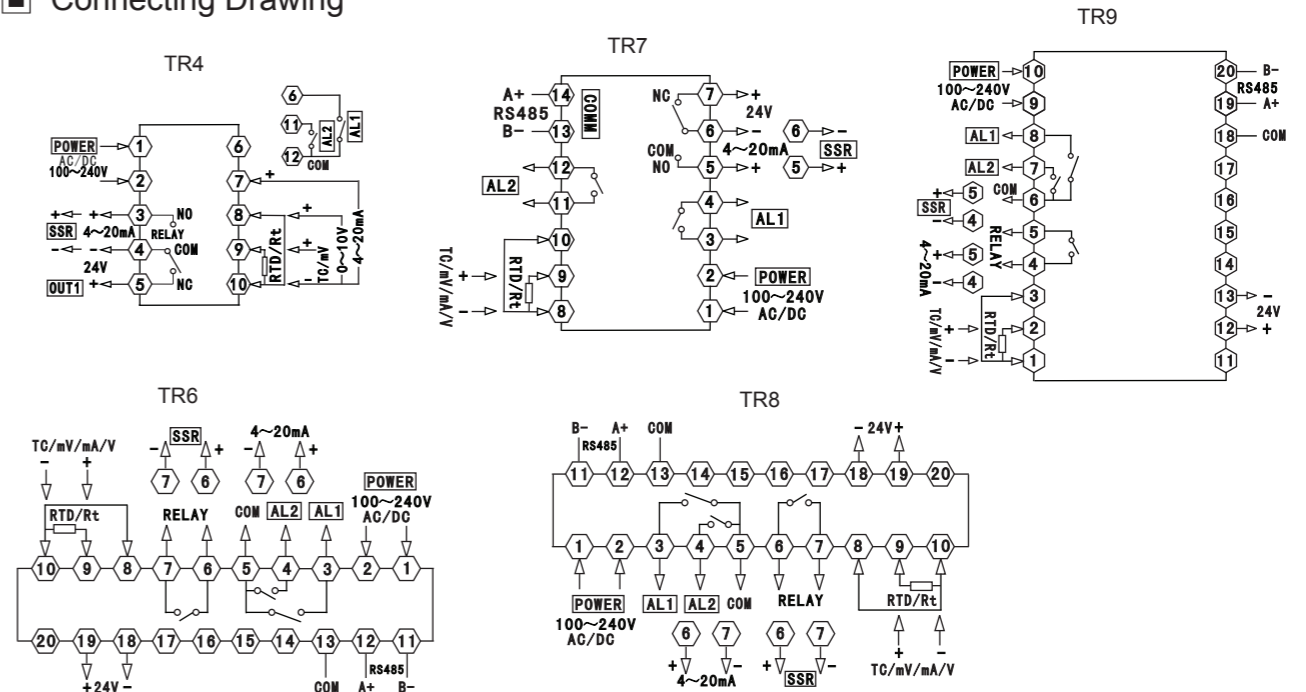
Note:Please subject to the connecting drawing on the actual product if any changes.

■ Dimension

- 4:48H*48W
- 6:96H*48W
- 7:72H*72W

8:48H*96W

9:96H*96W
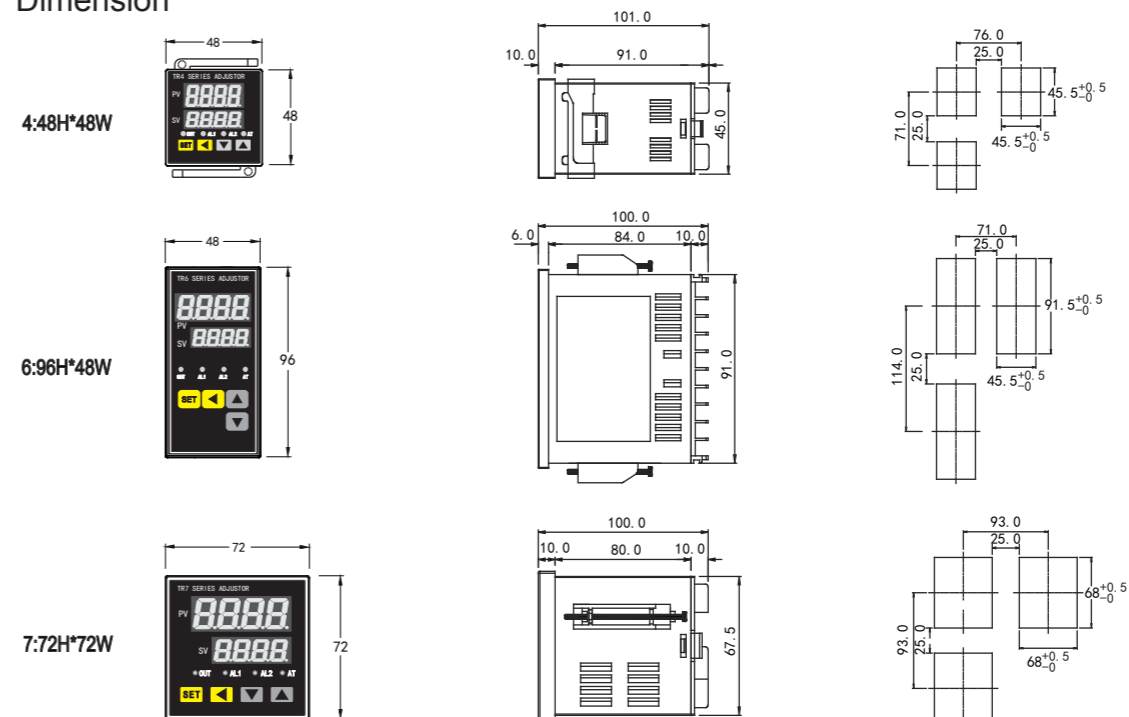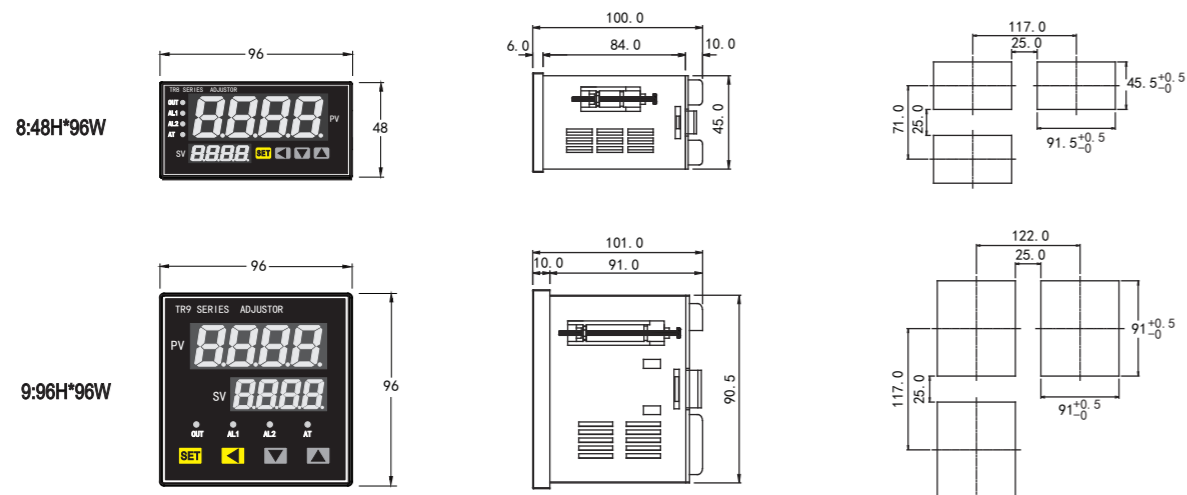
Simple Problem Shooting

Display Message	Method
Display HHHH	Check input wire connects well or not / beyond the highest limit or not .Check input signal / FH and ambient temperature
Display LLLL	Check input wire connects well or not / beyond the lowest limit or not . Check input signal / FL and ambient temperature

Communication protocol

TR series meter adpots Modbus RTU communication protocol,RS485 half duplex communication,read function code 0x03,write function code 0x10, adpots 16 bits CRC check .

Data frame format:

Start bit	Data bit	Stop bit	Check bit
1	8	2	without

1. Read register

For example, master unit reads float data AL1 (the value is 200)

The address code of AL1 is 0x0000, because AL1 is float data(4 byte), it covers 2 data registers .According to IEEE-754 standard, the hexadecimal memory code of decimalist float data 200.00 is 0x00004843

Master unit request (read multi-register)							
1	2	3	4	5	6	7	8
Meter address	Function code	High bit of start address	Low bit of startaddress	High bit of data byte length	Low bit of data byte length	Low bit of CRC code	High bit of CRC code
0x01	0x03	0x00	0x00	0x00	0x02	0xC4	0x0B

Slave unit normal answer (read multi-register)								
1	2	3	4	5	6	7	8	9
Meter address	Function code	Data byte length	High bit of data 1	Low bit of data 1	High bit of data 2	Low bit of data 2	Low bit of CRC code	High bit of CRC code
0x01	0x03	0x04	0x00	0x00	0x48	0x43	0x8D	0xC2

2. Write multi-register

For example：The master unit write floating data AL1（setting value is 600）

Address code of AL1 is 0x0000， because AL1 floating data (4 bytes), it covers 2 data registers . According to IEEE-754 standard, the hexadecimal memory code of decimalist float data 600 is 0x00001644

Master unit request (Write multi-register)												
1	2	3	4	5	6	7	8	9	10	11	12	13
Meter address	Function code	High bit of start address	Low bit of start address	High bit of databyte length	Low bit of databyte length	Data byte length	High bit of data 1	Low bit of data 1	High bit of data 2	Low bit of data 2	Low bit of CRC code	High bit of CRC code
0x01	0x10	0x00	0x00	0x00	0x02	0x04	0x00	0X00	0X16	0x44	0xFD	0xFC

Slave unit normal answer (Write multi-register)							
1	2	3	4	5	6	7	8
Meter address	Function code	High 8 bits of start address	Low 8 bits of start address	High bit of databyte length	Low bit of databyte length	Low bit of CRC code	High bit of CRC code
0x01	0x10	0x00	0x00	0x00	0x02	0x41	0xC8

KKTRWE01–A/1-20190418

TR series meter address code table

S/N	Address code	Variable name	Type	Byte No.	Read/Write allow	Remark
0	0x0000	1st alarm value AL1	float	4	R/W	
1	0x0001	1st arlarm hystersis HY1	float	4	R/W	
2	0x0002	1st alarm mode AD1	float	4	R/W	Note①
3	0x0003	2nd alarm value AL2	float	4	R/W	
4	0x0004	2nd alarm hystersis HY2	float	4	R/W	
5	0x0005	2nd alarm mode AD2	float	4	R/W	Note①
6	0x0009	Adjust value PS	float	4	R/W	
7	0x000A	Input signal type INP	float	4	R/W	Note②
8	0x000B	Display high limit FH	float	4	R/W	
9	0x000C	Display high FL	float	4	R/W	
10	0x000D	Decimal point DP	float	4	R/W	
11	0x000E	Filter constant setting	float	4	R/W	
12	0x000F	Low limit value of analog BRL	float	4	R/W	
13	0x0010	High limit value of analog BRH	float	4	R/W	
14	0x0012	Unit setting	float	4	R/W	
15	0x0013	Communication baud rate BUAD	float	4	R/W	Note③
16	0x0014	Communication address ADDR	float	4	R/W	
17	0x0015	Lock password setting	float	4	R/W	
18	0x0016	Menu shielding	float	4	R/W	
19	0x0032	Measured value	float	4		
20	0x0033	Read alarm 1 status	float	4	R	Note①
21	0x0034	Read alarm 2 status	float	4	R	Note①
22	0x0037	Setting value	float	4	R/W	
23	0x0038	Controlling mode	float	4	R/W	
24	0x0039	Proportion band	float	4	R/W	
25	0x003A	Integral time	float	4	R/W	
26	0x003B	Derivative time	float	4	R/W	
27	0x003C	ON/OFF controlling hystersis	float	4	R/W	
28	0x003D	Controlling cycle	float	4	R/W	
29	0x003E	Cooling proportion band	float	4	R/W	
30	0x003F	Cooling control cycle	float	4	R/W	
31	0x0040	Dead band of heating and cooling	float	4	R/W	
32	0x0041	Cooling protection delay time	float	4	R/W	

R:Read only ；R/W: Read / Write

Note①：Alarm mode

Alarm mode	low limit absolute alarm	high limit absolute alarm	Low limit bias value alarm	High limit bias value alarm	Apparent limits of an interval alarm
Corresponding value	1	2	3	4	5

Alarm status	ON	OFF
Corresponding value	1	0

Note②：Input signal(please refer to input parameter table)

Note③：Code and data contrast（Please refer to unit code table）

Program for obtaining the 16 digits CRC checking code

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;
}
```

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