aobo

instrument

2023
PRODUCT
INTRODUCTION

ULTRASONIC FLOWMETER

Contents

I. Overview

Equipped with a high-precision time measurement system (reaching 10-12s), this instrument

adopts a high-speed mixed signal processing CPU, and has two characteristics of high dynamic response and high-precision measurement. The sensor adopts multi-channel ultrasonic design to measure the media flow rate of different fluid layers in the pipeline, and automatically compensate the surface flow rate of the media in the pipeline; at the same time, it has the function that the two channels are standby for each other. In other words, when one channel fails, the other channel can ensure the normal operation. The transducer adopts a welded seal without a special ball valve and plug device, in order to completely solve the problem of sensor leakage, and it has the non-stop flow maintenance and replacement function. The instrument has a temperature compensation circuit and a temperature compensation software algorithm, which is suitable for high temperature water measurement to ensure the accuracy of flow measurement at different temperatures. The use of hardware watchdog can prevent abnormal work in complex industrial occasions. In addition, it has the power loss storage function that the instrument data can be stored for more than 10 years after the power failure. The MODBUS communication technology with RS232/485 interface is adopted to realize networking with various networks or industrial buses and remote meter reading.

II. Main Technical Specifications

1) Multi-channel ultrasound;

2) Measurement accuracy: level 1.0;

3) 128*64 Industrial LCD screen display, Chinese/English menu;

4) Output signal: pulse equivalent 0-5000Hz (50ppm), instantaneous flow current 4-20mA (0.1%FS);

5) Input signal: 2-way ultrasonic signal

2-way platinum resistance signal

2-way pressure current signal

6) Communication interface: RS232/485, standard MODBUS protocol;

7) Working voltage AC：220v ± 10%，DC：9-24V/0.5A；Power consumption: less than 5W；

8) Working environment: temperature: -10~60℃; humidity 5-85% (no condensing).

9) Flow range：

Nominal diameter DN	Common flow Qp(m^3/h)	Maximum flow Qs(m^3/h)	Boundary flow Qp(m^3/h)	Minimum flow Qp(m^3/h)
50	15	30	2.0	0.6
65	25	50	3.0	1.0
80	40	80	5.0	1.6
100	60	120	8.0	2.4
125	100	200	13.0	4.0
150	150	300	19.0	6.0
200	250	500	33.0	10.0
250	400	800	53.0	16.0
300	600	1200	76.0	24.0

350	800	1600	103.0	32.0
400	1000	2000	135.0	40.0
450	1200	2400	170.0	48.0
500	1500	3000	210.0	60.0
600	1700	3400	300.0	68.0
700	2300	4600	410.0	92.0
800	2800	5600	540.0	112.0
900	3500	7000	680.0	140.0
1000	4300	8600	840.0	172.0
1200	6200	12400	1200	248.0
1400	8400	16800	1600	336.0
1600	11000	22000	2100	440.0
1800	14000	28000	2700	560.0
2000	17000	34000	3300	680.0

III. Working Principle

The multi-channel ultrasonic flowmeter realizes flow measurement with the principle of time difference. Multiple sensors are installed on the sections of the flow. By accurately measuring the time difference of ultrasound along the sound channel, the flow is calculated with the method of weighted integral, as shown below. Since the flow speed of each point is different in the large diameter pipe, if the flow is calculated based on the flow speed of one point, the error is often very large. The multi-channel ultrasonic flowmeter can solve this problem, and the flow measurement accuracy is greatly improved (Figure 1).

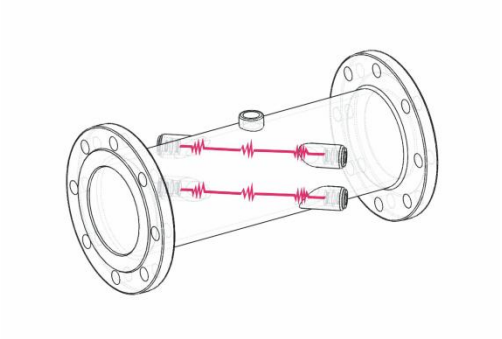


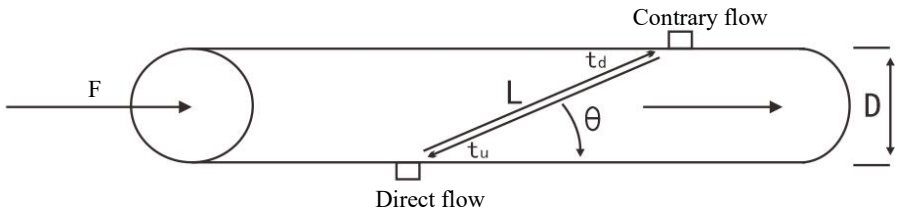
Figure 1

The transducers (sensor) are installed on both sides of the fluid line and separated by a certain distance. Assuming that the internal diameter of the pipeline is D, the path length of ultrasonic is L, the spacing between the two transducers is X in the pipeline direction, the time of ultrasonic propagation in the direct direction is tu. The time of ultrasonic propagation in the reverse direction is td, and the angle between the ultrasonic propagation direction and the fluid flow direction is θ (Figure 2), then td, tu and △t can be expressed in the following formula:

$$t_1 = \frac{L}{C+V\cos\theta} \qquad t_2 = \frac{L}{C-V\cos\theta}$$

$$\triangle t = t_2 - t_1 \qquad \triangle t = \frac{2Lv\cos\theta}{C^2}$$

$$V = \frac{\triangle t C^2}{2L\cos\theta}$$



In where, c is the ultrasonic wave velocity in a non-flow media; V is the flow speed of the fluid media.

I. e., the flow is：

$$Q_F = \frac{D^2}{4} \times \pi \times V$$

IV Product Overall Dimension and Installation

4.1 Product components

 	
Transducer	
	
Pipe section	Connecting

4.2 Pipe section dimension (Figure 3)

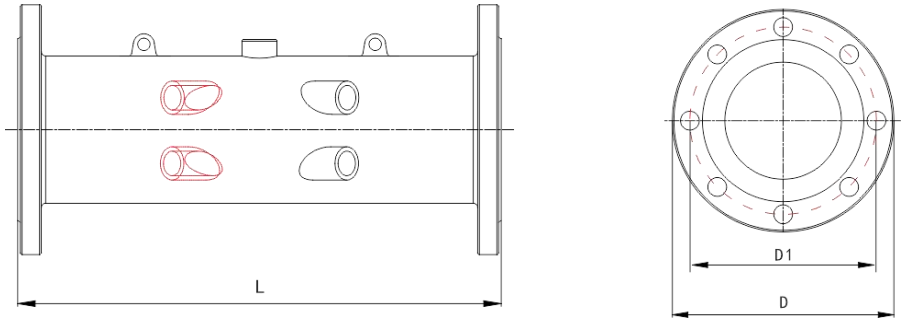


Figure 3

Nominal diameter DN	L (mm)	D (mm)	D1 (mm)
50	300+0/-2	165	125
65	350+0/-2	185	145
80	350+0/-2	200	160
100	350+0/-2	220	180
125	350+0/-2	250	210
150	500+0/-2	285	240
200	500+0/-2	340	295
250	600+0/-2	405	355
300	500+0/-2	460	410
350	550+0/-2	520	470
400	600+0/-2	580	525
450	625+0/-2	640	585
500	625+0/-2	715	650
600	750+0/-2	840	770

700	875+0/-2	910	840
800	1000+0/-2	1025	950
900	1230+0/-2	1125	1050
1000	1300+0/-2	1255	1170

4.3 Measurement point selection

The ultrasonic flow meter is the simplest and most convenient in installation of all flow meters. Flow measurement can be carried out by installing the sensor in the pipe, after selecting an appropriate measurement point and entering the pipe parameters of the measurement point selected into the flow meter (Figure 4).

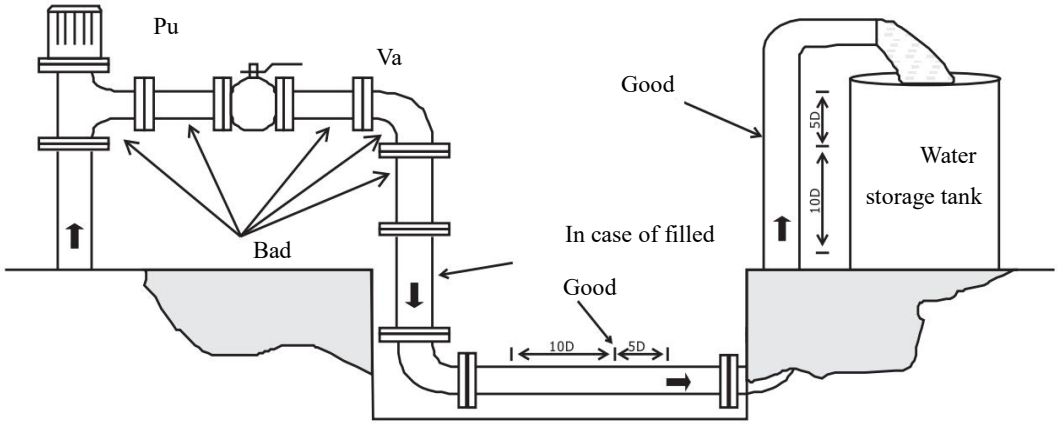


Figure 4

The pipe section with uniform flow shall be selected to ensure the measurement accuracy. The following principles shall be followed in sensor installation.

1. Select fluid-filled sections, for example, the vertical parts of the pipeline (the fluid must flow upward) or the horizontal sections filled with the fluid.

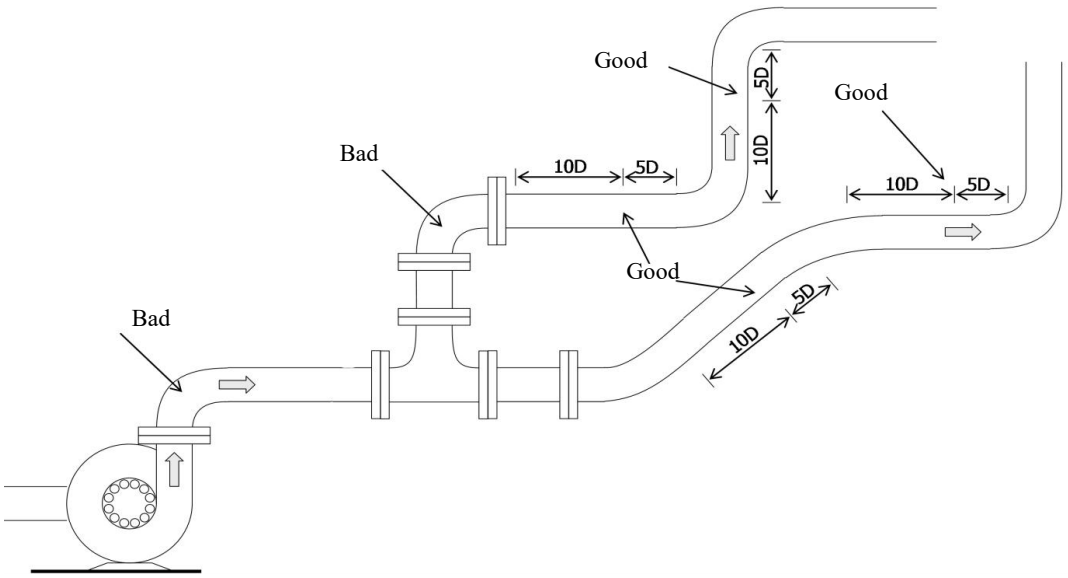


Figure 5

2. The measurement point shall be selected in the uniform and straight pipe section within 10 times diameter (10D) upstream and 3 times diameter (3D) downstream, without any valve, elbow, variable diameter and other devices that may interact the flow field. If there is a pump, T-way, regulating valve, throttle hole, gradual expansion pipe section or other device in front of the measurement point, the upstream straight pipe section is required to be 20 times diameter (20D). In the horizontal section, the sensor probe shall be generally installed at 9 and 3 o'clock (horizontal) positions of the pipe (Figure 5).

3. Avoid 6 and 12 o'clock (vertical) positions to avoid signal attenuation due to the pipe bottom sediment or bubbles and holes on the upper part of the pipe.

4. Ensure that the temperature at the measurement point is within the working range.

4.4 Installation and wiring of the converter

4.4.1 Converter installation

On the right is a "installation diagram". With 8mm drill bit, make 4 holes for installation in the positions with screw sign. Remove the rubber plug and the installation screws in the plastic bag, then hammer the rubber plug into the drilled hole, secure the installation bracket at the bottom of the flow meter, put the flow meter in the position for hole drilling, and then secure the flow meter with the screws (Figure 6).

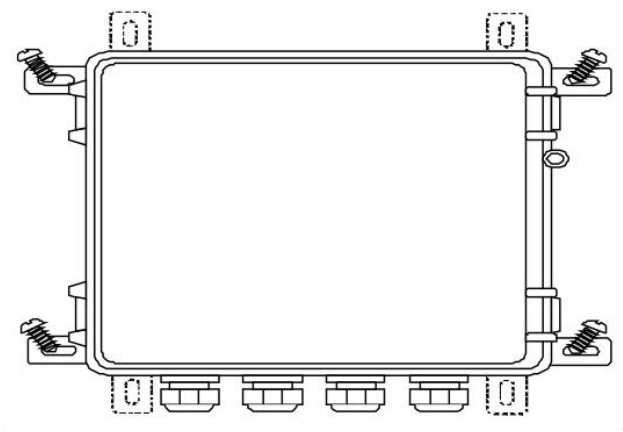


Figure 6

4.2 Wiring diagram for measurement signal and power supply

Once the flow meter is installed in the specified position as required, the wiring can be started. Open the upper cover of the host to see the terminal of the converter. Please refer to the specific wiring (Figure 7):

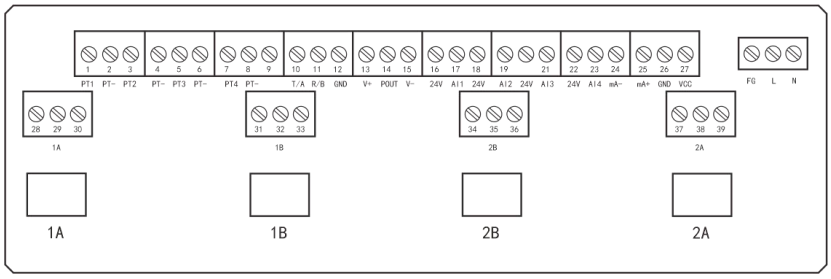


Figure 7

4.4.3 Pulse output wiring diagram

V+ Connected with power supply voltage：12-24V

Pout pulse output signal

V- Connected with the external power supply negative electrode

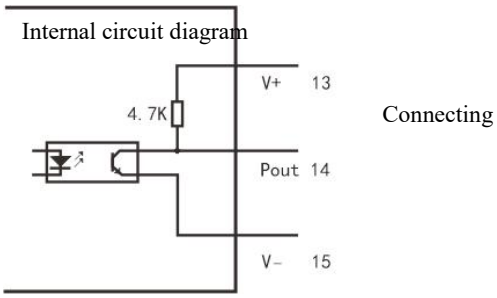
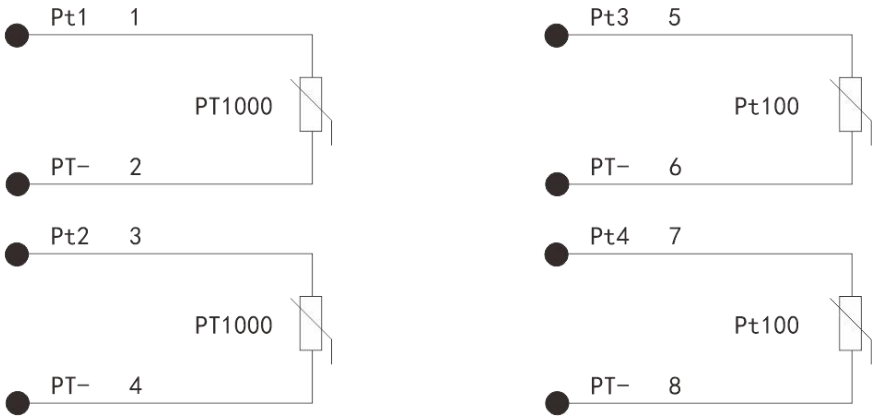


Figure 8

4.4.4 Temperature sensor wiring diagram



V. Equipment Operation Instructions

5.1 Panel components

The multi-channel ultrasonic interaction panel consists of a 128 * 64 LCD display screen and six keys.

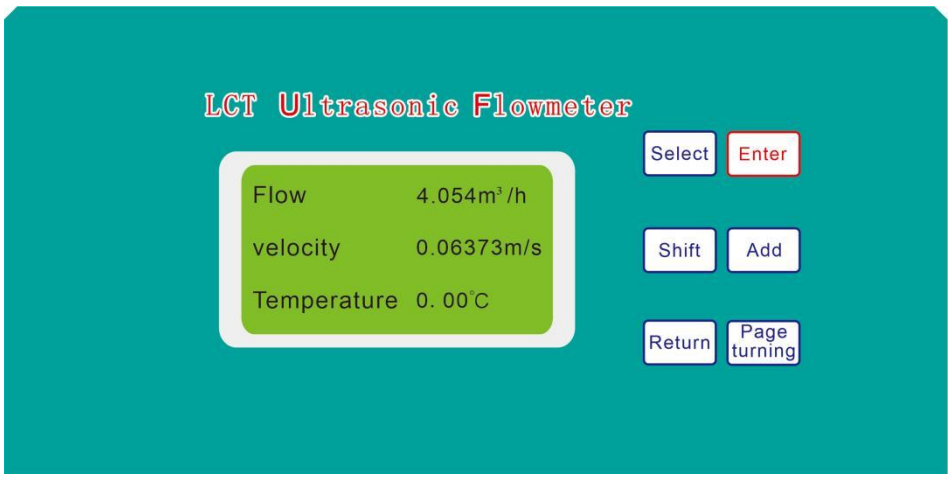


Figure 10

5.2 Keys

5.2.1 Key function

Select: parameter setting

OK: determine if the password is correct and go to the next menu.

Shift: set the numerical shift operation

Increase: increase the number

Return: exit the current setting item when changing the settings.

Page turning: turning for multiple pages

5.2.2 Operation method of increase key

Each time you press the "Increase" key, the selected number will be added by 1. Each

time you press the "Shift" key, the cursor will move right one bit. After setting the value you want, press "OK" again, the cursor will automatically move to the first place on the right, indicating that the value has been set successfully. After you press the Return key to return to the main screen, the modified parameters are automatically saved.

5.3 Main interface

The accumulated flow interface is displayed by default after starting (Figure 11)

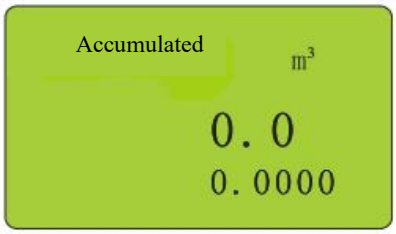


Figure 11

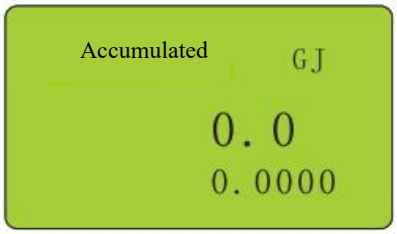


Figure 11-1

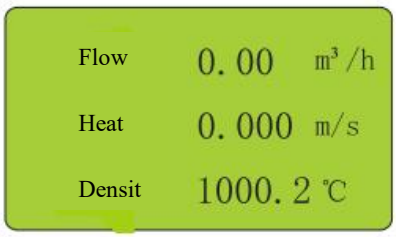


Figure 11-2

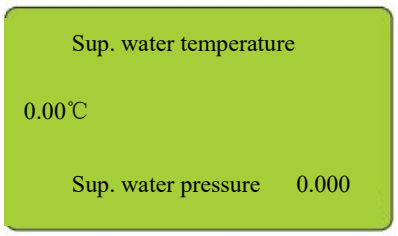


Figure 11-3

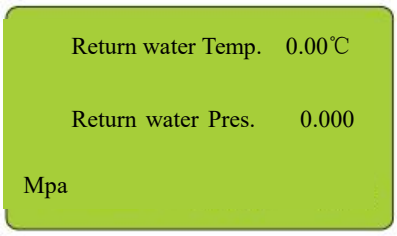


Figure 11-4

5.4 Basic operating parameters setting

The password input interface appears after pressing OK key in the interface of accumulated heat or accumulated flow as follows:

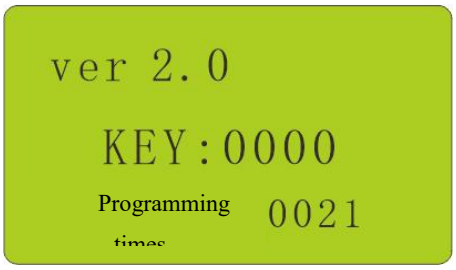


Figure 12

Version number showed in the first row.

Interface for parameter setting showed in the second row.

Total programming time(s) showed in the third row.

Enter the password and press "OK" to enter the parameter setting interface. The 6 internal parameters in the table are displayed as shown in Figure 13:

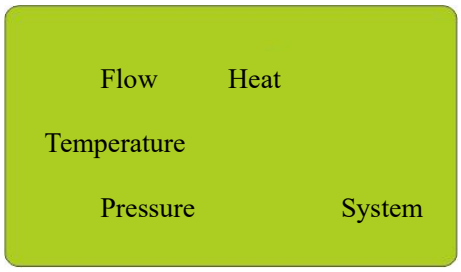


Figure 13

5.4.1 Internal parameter to be set for the instrument: flow items (Figure 14)

Caliber: input the caliber of the sensor for flow calculation (generally set at the factory)；

Flow factor: set according to the calibration data (generally set at the factory)

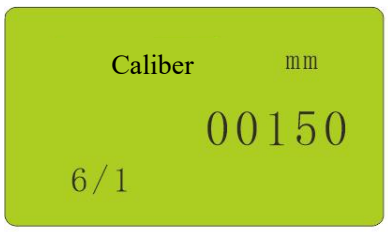


Figure 14

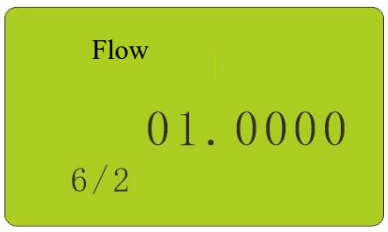


Figure 14-1

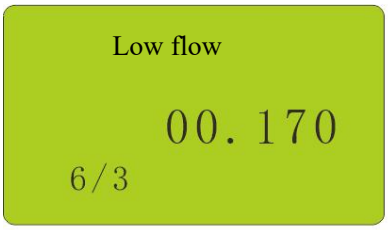


Figure 14-2

Figure 14-3

Figure 14-4

5.4.2 Internal parameter to be set for the instrument: heat items (Figure 15)

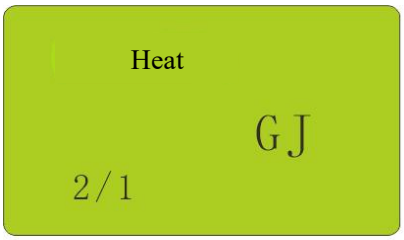


Figure 15

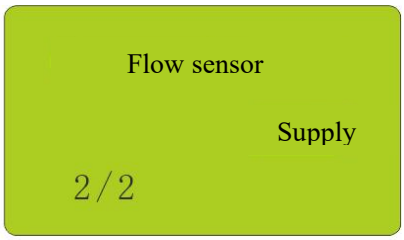


Figure 15-1

Heat unit: the unit of measurement can be selected according to the instrument diameter and the actual heat. The optional units includes GJ, MJ, MWh, kWh, etc. See the list of internal parameters for details.

Flow sensor position: choose the supply water pipe or return water pipe according to the site installation position of the instrument, and the instrument will conduct automatic temperature and pressure compensation calculation according to the setting. The instrument is built-in for 0.6MPa and 1.6MPa.

5.4.3 Internal parameter to be set for the instrument: temperature items (Figure 16)

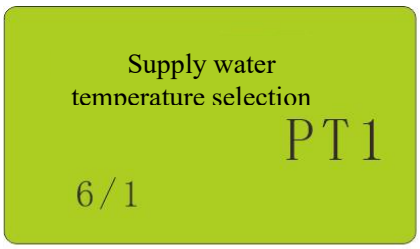


Figure 16

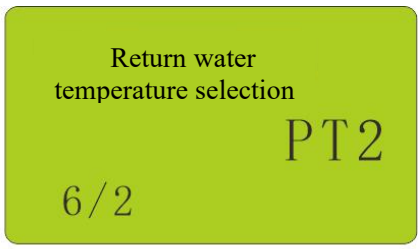


Figure 16-1

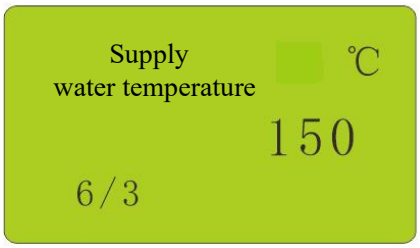


Figure 16-2

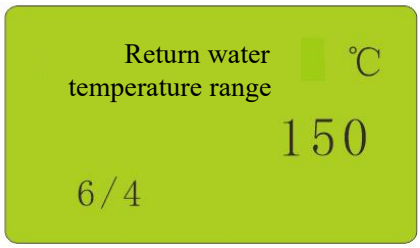


Figure 16-3

The input of temperature signal includes 9 types: Pt1, Pt2, Pt3, Pt4, Al1, Al2, Al3, Al4 and a fixed value; Pt1channel and Pt2 channel are for Pt1000 sensor, Pt3 channel and Pt4 channel are for Pt100 sensor, Al1-A14 channels are for (4-20) mA transmitter;

Supply water temperature selection: any of the 9 input channels can be selected. If one of A l1-A I4 channels is selected, then the corresponding range value shall be set for the temperature transmitter in Table 1 (See the parameter list for details).

Supply water temperature setting: set the fixed temperature value;

Return water setting is the same as the supply water temperature setting；

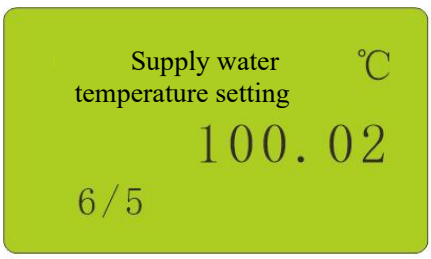


Figure 16-4

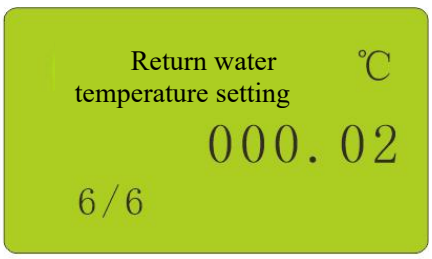


Figure 16-5

5.4.4 Internal parameter to be set for the instrument: pressure items (Figure 17)

The input of pressure signal includes 5 types : Al1, Al2, Al3, Al4 and a fixed value; AI1~AI4 channels are for (4-20) mA pressure transmitter：

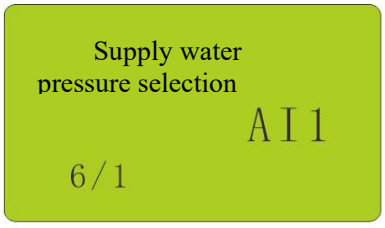


Figure 17

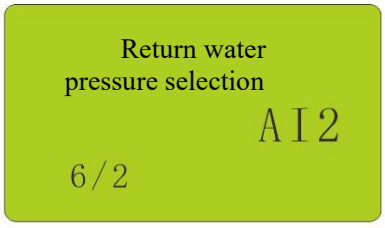


Figure 17-1

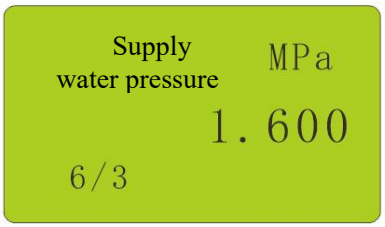


Figure 17-2

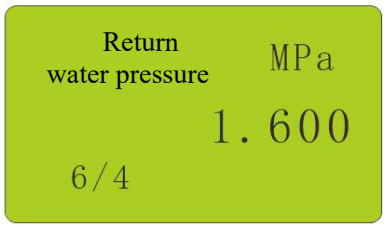


Figure 17-3

Supply water pressure selection: you can choose any of the five input channels. When one of AI1-A I4 channels is selected, the corresponding range value shall be set for the pressure transmitter in Table 1 (See the parameter list for details).

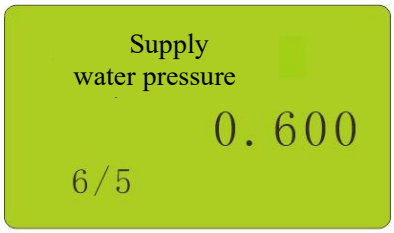


Figure 17-4

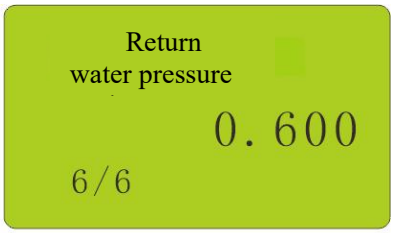


Figure 17-5

Supply water pressure setting: set the fixed pressure value.

Return water setting is the same as the supply water pressure setting.

5.4.5 Internal parameter to be set for the instrument: system settings (Figure 18)

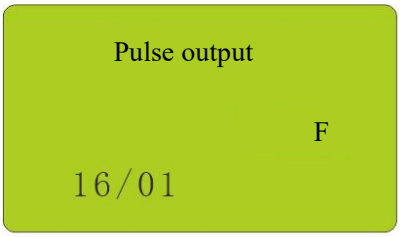


Figure 18

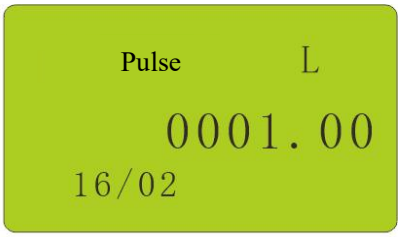


Figure 18-1

Pulse output selection: set the accumulated flow or accumulated heat corresponding to the pulse equivalent;

Pulse equivalent: Set how much L per output pulse represents (when selecting output flow) or how much MJ (when selecting output flow);

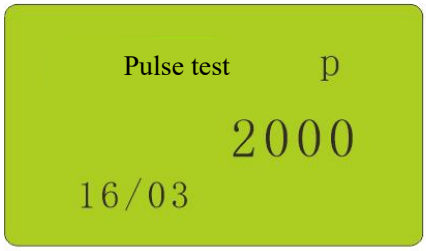


Figure 18-2

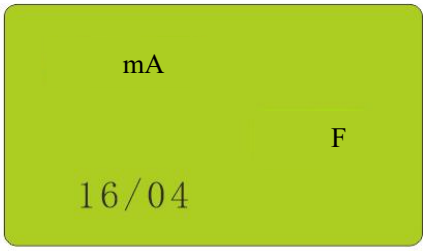


Figure 18-3

Pulse test: test whether the pulse output module is working normally. In this interface, the instrument output 2000 pulses per second for counter detection, and the function is invalid during normal use.

mA output: output the instantaneous heat or instantaneous flow corresponding to (4-20) mA standard current.

Figure 18-4

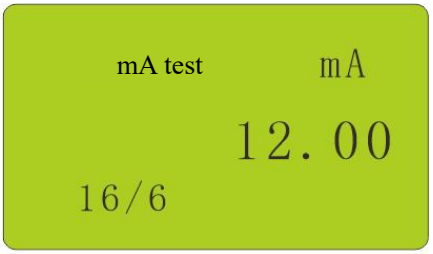


Figure 18-5

Output range: output the range of flow or heat corresponding to (4-20) mA standard current, that is, output the flow or heat value represented by the output of 20mA;

mA test: test whether the mA module is normal. In this interface, the meter output 12mA current, and the function is invalid when it is in normal use;

Figure 18-6

Figure 18-7

Communication Address: set MODBUS communication address, see the internal parameter list for details;

Communication baud rate: set MODBUS communication rate, see the internal parameters list for details;

Figure 18-8

Figure 18-9

Time setting: Set the internal clock time;

Zero clearing: after entering the password, press the OK key to clear all accumulated amount, including heat, flow and programming times;

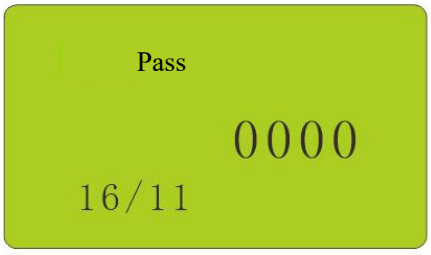


Figure 18-10

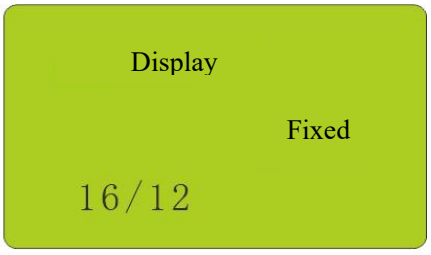


Figure 18-11

Password: set the password for programming;

Display modes: fixed display and cycle display; cycle display: cycle display of 5 main interfaces), fixed display: fixed display of the interface set as the "start display"); backlight time: 00, backlight often open; 1-99, backlight off without pressing any key after this time, unit: minute;

Figure 18-12

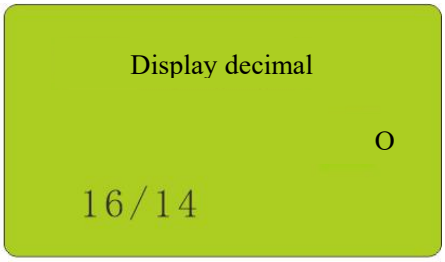


Figure 18-13

Display decimal digits: accumulated flow and accumulated heat display 1 decimal digit by default. After opening the display decimal digits function, an accumulated amount with 4 decimal digits will be displayed in the display interface for accumulated flow and accumulated heat, and which can be used to value reading during measurement or improve resolution for small flow measurement;

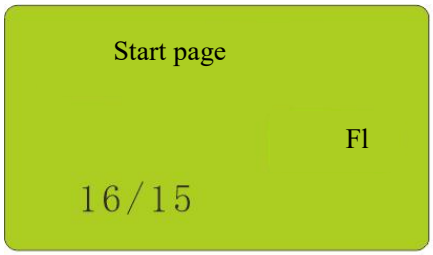


Figure 18-14

Figure 18-15

Start page: the first page after power up, and accumulated flow and instantaneous flow can be set;

Mode: switch between flow and heat;

VI. List of Parameters and Parameter Range

Parameter number	Parameter text	Setting method	Parameter range	Note
1	Instrument caliber	Set data	0～1200mm	Users can set the parameters according to the site flow and usage requirements.
3	CH1 null point	Set data	0～99.999m³/h	
4	CH1 null point	Set data	-99.999～+99.999	
5	CH2 null point	Set data	-99.999～+99.999	
6	Transducer type	Select	Hold	
7	heat unit	Select	GJ/MJ/MWh/KWh	
8	Flow sensor location	Select	Supply water / return water	
9	Supply water temperature selection	Select	PT1～PT4/AI1～AI4/set	
10	Return water temperature selection	Select	PT1～PT4/AI1～AI4/set	
11	Supply water temperature range	Set data	0～150	
12	Return water temperature range	Set data	0～150	
13	Supply water temperature setting	Set data	0～150.00	

14	Return water temperature setting	Set data	0～150.00	
15	Supply water pressure selection	Select	AI1～AI4/set	
16	Return water pressure selection	Select	AI1～AI4/set	
17	Supply water pressure range	Set data	0～2.500MPa	
18	Return water pressure range	Set data	0～2.500MPa	
19	Supply water pressure setting	Set data	0～2.500MPa	
20	Return water pressure setting	Set data	0～2.500MPa	
21	Pulse output selection	Select	Flow / heat	
22	Pulse equivalent	Set data	0.01～9999.99L	
23	Pulse test	Set data	0～5000Hz	
24	mA output selection	Select	0～999999	
25	Output range	Set data	0～999999	
26	mA test	Set data	0～20mA	
27	Communication address	Set data	0～255	

28	Baud rate	Select	1200/2400/4800/9600	
29	Time setting	Set data	Time format	
30	Zero clearing	Password	By default / Zero clearing	
31	Password	Set data	0000～9999	
32	Display mode	Select	Fixed display / cycle display	
33	Backlight timeout	Set data	0-99 minute(s)	
34	Display decimal digits	Select	Open / Close	

VII. Common Fault Analysis and Judgment

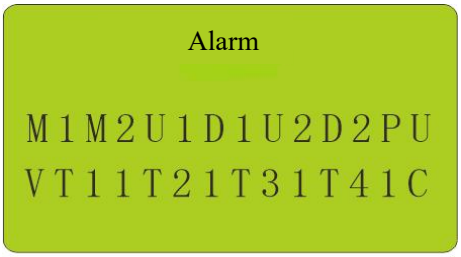


Figure 19

M1	Time unit failure for channel 1	M2	Time unit failure for channel 2
U1	Upstream probe failure for channel 1	D1	Downstream probe failure for channel 1
U2	Upstream probe failure for channel 2	D2	Downstream probe failure for channel 2
P	Memory failure	U	Sensor measurement module failure

V	Overflow speed failure	C	Incorrect data in the instrument
T11	Sensor short-circuit for temperature channel 1	T12	Sensor open-circuit for temperature channel 1
T21	Sensor short-circuit for temperature channel 2	T22	Sensor open-circuit for temperature channel 2
T31	Sensor short-circuit for temperature channel 3	T32	Sensor open-circuit for temperature channel 3
T41	Sensor short-circuit for temperature channel 4	T42	Sensor open-circuit for temperature channel 4