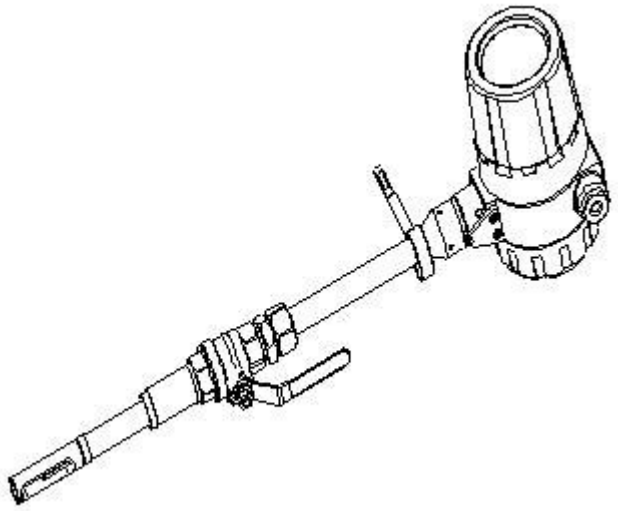
Thermal gas mass flowmeter



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Preface

Thank you for purchasing this product. Please read this manual carefully before operating and using it correctly to avoid unnecessary losses caused by wrong operation.

Note

- Modification of this manual's contents will not be notified as a result of some factors, such as function upgrading.
- We try our best to guarantee that the manual content is accurate, if you find something wrong or incorrect, please contact us.
- This product is forbidden to use in explosion-proof occasions.

Version

U-SUP-MF-EN1

Safety Precautions

In order to use this product safely, be sure to follow the safety precautions described.

About this manual

- Please submit this manual to the operator for reading.
- Please read the operation manual carefully before applying the instrument. On the precondition of full understanding.
- This manual only describes the functions of the product. The company does not guarantee that the product will be suitable for a particular use by the user.

Precautions for protection, safety and modification of this product

- Please read the operation manual carefully before putting into operation to avoid unnecessary losses due to wrong operation. Ensure the safe use of the product and it's control function, and understand the correct application methods.. If the instrument is operated in other ways not described in the manual, the protections that the instrument give may be destroyed, and the failures and accidents incurred due to violation of precautions shall not be borne by our company.
- When installing lightning protection devices for this product and its control system, or designing and installing separate safety protection circuits for this product and its control system, it needs to be implemented by other devices.
- If you need to replace parts of the product, please use the model specifications specified by the company.
- This product is not intended for use in systems that are directly related to personal safety.Such as nuclear power equipment, equipment using radioactivity, railway systems, aviation equipment, marine equipment, aviation equipment and medical equipment.If applied, it is the responsibility of the user to use additional equipment or systems to ensure personal safety.

- Do not modify this product.
- The following safety signs are used in this manual:

Hazard, if not taken with appropriate precautions, will result in serious personal injury, product damage or major property damage.

Warning:Pay special attention to the important information linked to product or particular part in the operation manual.

- Confirm if the supply voltage is in consistent with the rated voltage before operation.
- Don’t use the instrument in a flammable and combustible or steam area.
- To prevent from electric shock, operation mistake, a good grounding protection must be made.
- Thunder prevention engineering facilities must be well managed: the shared grounding network shall be grounded at is-electric level, shielded, wires shall be located rationally, SPD surge protector shall be applied properly.
- Some inner parts may carry high voltage. Do not open the square panel in the front except our company personnel or maintenance personnel acknowledged by our company, to avoid electric shock.
- Cut off electric powers before making any checks, to avoid electric shock.
- Check the condition of the terminal screws regularly. If it is loose, please tighten it before use.
- It is not allowed to disassemble, process, modify or repair the product without authorization, otherwise it may cause abnormal operation, electric shock or fire accident.
- Wipe the product with a dry cotton cloth. Do not use alcohol, benzine or other organic solvents. Prevent all kinds of liquid from splashing on the product. If the product falls into the water, please cut off the power

immediately, otherwise there will be leakage, electric shock or even a fire accident.

- Please check the grounding protection status regularly. Do not operate if you think that the protection measures such as grounding protection and fuses are not perfect.
- Ventilation holes on the product housing must be kept clear to avoid malfunctions due to high temperatures, abnormal operation, shortened life and fire.
- Please strictly follow the instructions in this manual, otherwise the product's protective device may be damaged.

- Don’t use the instrument if it is found damaged or deformed at opening of package.
- Prevent dust, wire end, iron fines or other objects from entering the instrument during installation, otherwise, it will cause abnormal movement or failure.
- During operation, to modify configuration, signal output, startup, stop, operation safety shall be fully considered. Operation mistakes may lead to failure and even destruction of the instrument and controlled equipment.
- Each part of the instrument has a certain lifetime, which must be maintained and repaired on a regular basis for long-time use.
- The product shall be scrapped as industrial wastes, to prevent environment pollution.
- When not using this product, be sure to turn off the power switch.
- If you find smoke from the product, smell odor, abnormal noise, etc., please turn off the power switch immediately and contact the company in time.

Disclaimer

- The company does not make any guarantees for the terms outside the scope of this product warranty.
- This company is not responsible for damage to the instrument or loss of parts or unpredictable damage caused directly or indirectly by improper operation of the user.

No.	Name	Quantity	Note
1	Thermal gas mass flowmeter	1	
2	Manual	1	
3	Certificate	1	

After opening the box, please confirm the package contents before starting the operation.If you find that the model and quantity are incorrect or there is physical damage in appearance, please contact us.

Contents

1 Introduction

1.1 Introduction

Thermal gas mass flow meter is designed on the basis of thermal dispersion, and adopts method of constant differential temperature to measuring gas flow. It has advantages of small size, easy installation, high reliability and high accuracy, etc.

The meter contains two platinum resistance temperature sensors. The thermal principle operates by monitoring the cooling effect of a gas stream as it passes over a heated sensor. Gas flowing through the sensing section passes over two sensors one of which is used conventionally as a temperature sensor, whilst the other is used as a heater. The temperature sensor monitors the actual process values whilst the heater is maintained at a constant differential temperature above this by varying the power consumed by the sensor. The greater the gas velocity, the greater the cooling effect and power required to maintain the differential temperature. The measured heater power is therefore a measure of the gas mass flow rate.

The format of gas velocity and power is shown as below:

$$V = \frac{K\left[Q / \triangle T\right]^{1.87}}{\rho_g} \quad \text{.....（1）}$$

Where : ρ_g--specific gravity of medium

V--velocity

K--balance coefficient

Q--heater power

ΔT--is differential temperature

The medium temperature range of meter is -40℃～300℃.

In the format (1), the specific gravity of medium is related to the density:

$$\rho_g = \rho_n \times \frac{101.325 + P}{101.325} \times \frac{273.15 + 20}{273.15 + T} \quad \text{.....（2）}$$

Where: ρ_g---medium density in working condition（kg/m^3）

ρn-- medium density in standard condition, 101.325kPa and 20℃（kg/m^3）

P--pressure in working condition（kPa）

T--temperature in working condition （℃）

In the formats (1) and (2), there is a certain functional relationship between the velocity and pressure in working condition, medium density,

the temperature in working condition.

Due to the sensor temperature is always 30℃ higher than the medium temperature (environment temperature), and the meter adopts method of constant differential temperature, therefore the meter do not

need to do temperature and pressure compensation in principle.

1.2 Features

- Measuring the mass flow or volume flow of gas.Do not need to do temperature and pressure compensation in principle with accurate measurement and easy operation.
- Wide range: 0.1Nm/s～ 120Nm/s for gas. The meter also can be used for gas leak detection.
- Good vibration resistance and long service life. No moving parts and pressure sensor in transducer, no vibration influence on the measurement accuracy.
- Easy installation and maintenance. If the conditions on site are permissible, the meter can achieve a hot-tapped installation and maintenance. (Special order of custom-made)
- Digital design, high accuracy and stability.
- Configuring with RS485 or HART interface to realize factory automation and integration

1.3 Technical parameters

Table 1 Technical parameters

Description	Specifications
Measuring Medium	Various gases (Except the C_2H_2, BCl_3, etc)
Pipe Size	DN65～ DN1000
Velocity	0. 1～ 100 Nm/s
Accuracy	±2.5%
Working Temperature	Sensor: -40℃ ~ +300℃ Transmitter: -20℃ ~ +45℃
Working Pressure	Medium pressure≤ 2.5MPa
Power Supply	24VDC or 220VAC, Power consumption ≥18W
Response Time	1s
Output	4-20mA (optoelectronic isolation, maximum load 500Ω), Pulse, RS485 (optoelectronic isolation) and HART
Alarm Output	1-2 line Relay, Normally Open state, 10A/220V/AC or 5A/30V/DC
Sensor Type	Standard Insertion
Construction	Compact
Pipe Material	Carbon steel, stainless steel, plastic, etc
Display	4 lines LCD: Mass flow, Volume flow in standard condition, Flow totalizer, Date and Time, Working time, and Velocity, etc.
Protection Class	IP65
Sensor Housing Material	Stainless steel (316)

2 Structure and dimensions

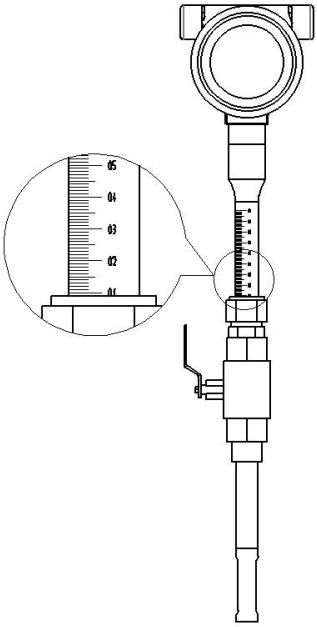


Fig.1 Standard Insertion Flow Meter

Structure description:

When the integrated plug-in diameter is less than 1000mm, it should be inserted into the axis of the pipeline to be tested, so the length of the measuring rod depends on the size of the measuring pipe. When the diameter exceeds 1000mm, it can be inserted between 1/8 and 1/2.

2.1 Dimensions

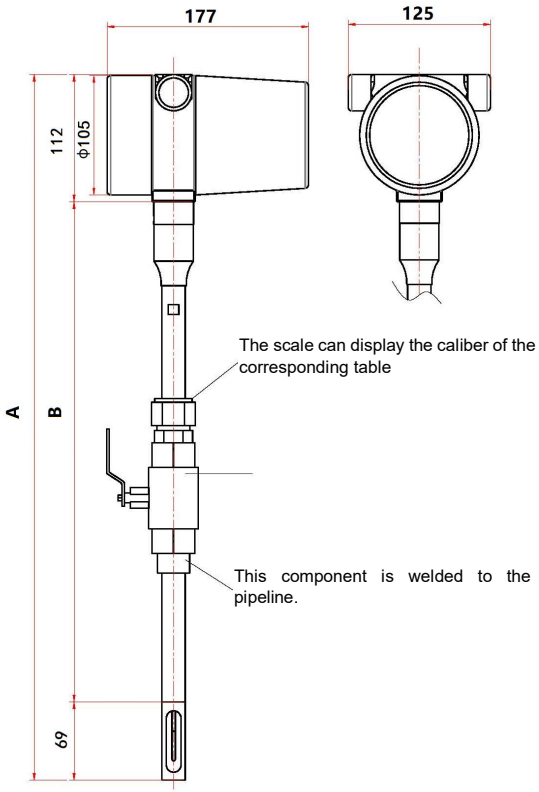


Fig.2 Insertion flow meter (Unit: mm)

Table 2

Nominal diamete	A	B
DN65~DN200	431mm	250mm
DN200~DN500	551mm	370mm
DN500~DN1000	811mm	630mm

3 Installation

3.1 Installation Position

- If the instrument is installed outdoors, the instrument sunshade should be added to avoid sunlight and rain.
- Prohibit installation in strong vibration
- It is forbidden to be exposed to an environment containing a large
- amount of corrosive gas.
- Do not share power with frequency converters, electric welders and other devices that pollute the power source. If necessary, install a clean power source for the converter.

3.2 Installation location and requirements for pipeline

When installing the instrument, keep away from elbows, obstacles, variable diameters, and valves to ensure a stable flow field. One side requires a longer upper limit straight pipe, the Inlet run length is greater than 10D, and Outlet run length is greater than 5D. The following figure shows the length of straight pipe required for several situations frequently encountered on site:

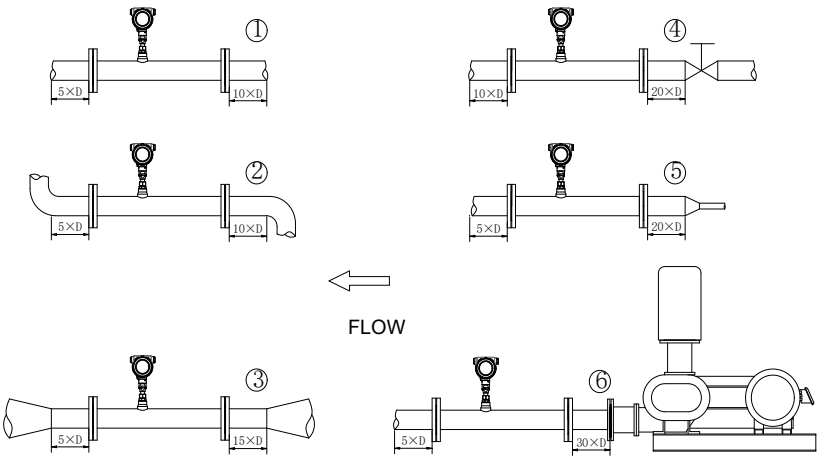


Table 3

Pipeline installation type	NO.	Inlet run	Outlet run
Horizontal tube	1	10D	5D
Elbow	2	10D	5D
Expansion tube	3	15D	5D
Downstream of valve	4	20D	5D
Contractile tube	5	20D	5D
Downstream of pump	6	30D	5D

When the on-site requirements for the straight pipe section cannot be met, a gas rectifier can be connected in series to significantly reduce the requirements for the straight pipe section

3.3 Installation steps

The base of thermal flowmeter

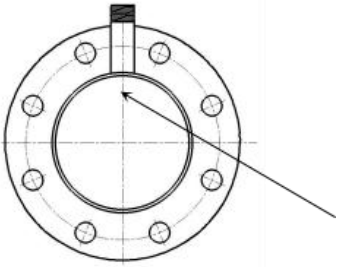
Fig.3 The base of standard insertion type

Note：

No welding in explosive environment Carry out the welding operation in accordance with the requirements of special environment.

When installing, place the base on the top of pipe, and make the through-hole of

base be perpendicular to axis of pipe. The good welding location of base and welding process is as below.



Before Welding, the base should be processed as the same as the circular arc of pipe to ensure sealing.

Fig.4 Good welding location of base

1) Please confirm the actual inner diameter and wall thickness of the pipe before installing the plug-in thermal gas mass flowmeter.

2) Put the rest of the thermal gas mass flowmeter into the special ball valve together, and calculate the depth to be inserted according to the actual pipe inner diameter and wall thickness. In this step, you can insert a rough size and tighten the nut by hand.

3) Rotate the sensor connecting rod so that the marked arrow is the same as the flow direction of the medium.

4) Convert the corresponding scale on the sensor connecting rod according to the data measured on the spot, and then tighten the nut.

4 Electrical connections

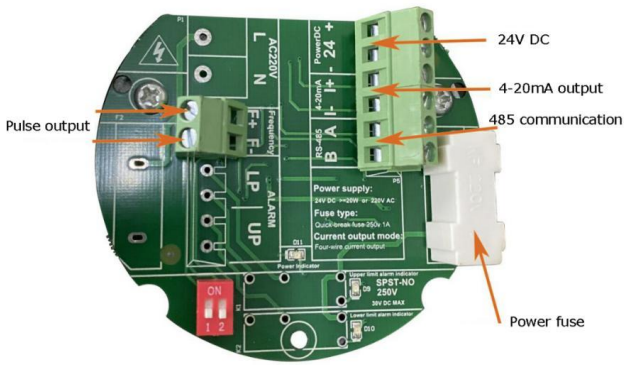
4.1 Instruction of sensor wirings

1	2	3	4
RT1	RT2	RH1	RH2

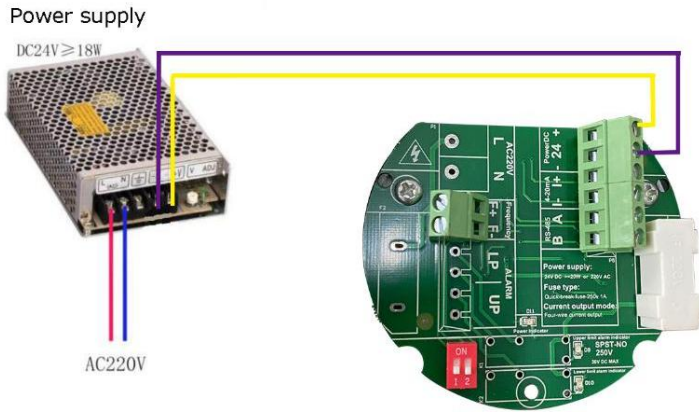
Temperature sensor (Pt1000)

Heater (Pt20)

4.2 Terminal description and wiring method

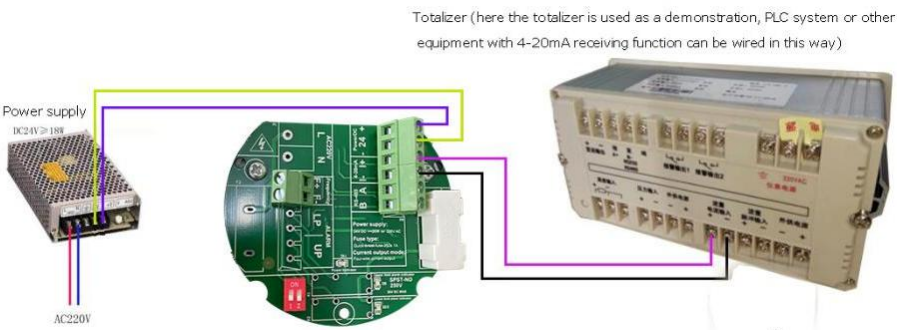


4.3 The power supply connection



4.4 Flowmeter output wiring

4-wire 4-20mA current output



5 Operation

5.1 Main interface under working condition

The prompt line:

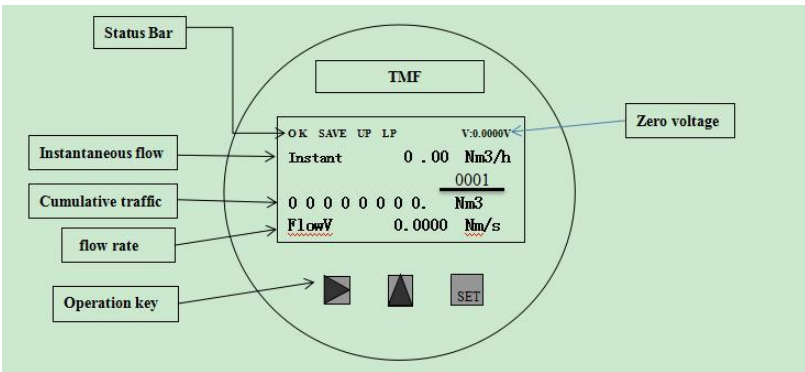


Fig.5 Main interface

1. The meter will perform self-check after power on, if the meter is running normally, it will prompt **OK**.

2. Different units can be selected according to different needs, including: NL/h, t/m, Nm³/h, NL/m, t/h, kg/m, g/s, L/h, Nm³/m, kg/h, and many other units.

3. The maximum accumulated flow is an 8-bit integer, and it will be automatically reset to zero after exceeding it, and the accumulated number of times will be accumulated in the overflow flag in the common parameter query

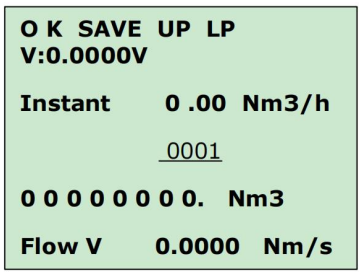
4. If the unit is changed during use, if it is not cleared to zero, the previous accumulated flow value will not automatically switch, but the accumulated value afterwards is after the change.

5. The instrument has three buttons. The main function of SHIFT is the shift function, which is the function of modifying the value. SET is the function of confirming the change. For specific use, please refer to the following introduction.

Note: Non-air media may require zero point calibration. Refer to page 15 for operation.

5.2 Parameters Setup

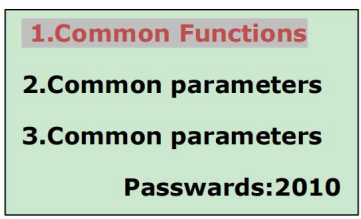
5.2.1 Main Menu



Under this interface, press (Shift) button to enter the setup menu;

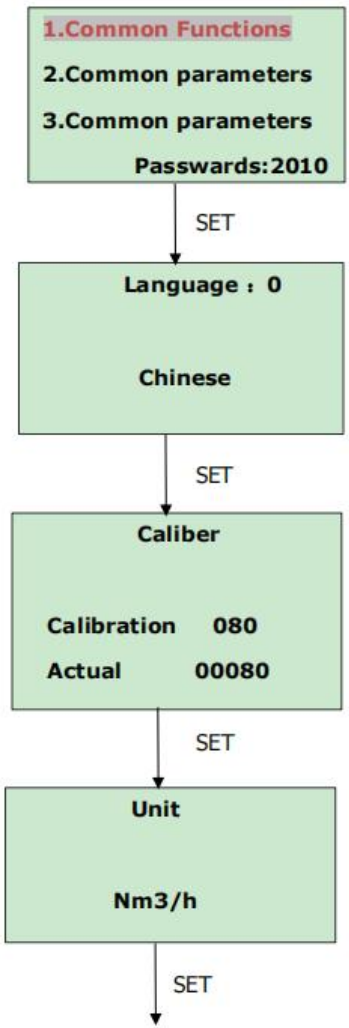
5.2.2 Parameter setting main interface

Press (Shift Select Menu)key



In the main interface, press the SHIFT key to enter the main menu interface. You can use the SHIFT key to select the corresponding menu item and press the SET key to enter. Frequently used function query does not require a password, the other two have to enter the password, press the SHIFT key to transfer to the corresponding menu item, then press SET to enable the password input, then press to adjust the password, and then the SET key to shift and confirm.

5.2.3 Parameter setting

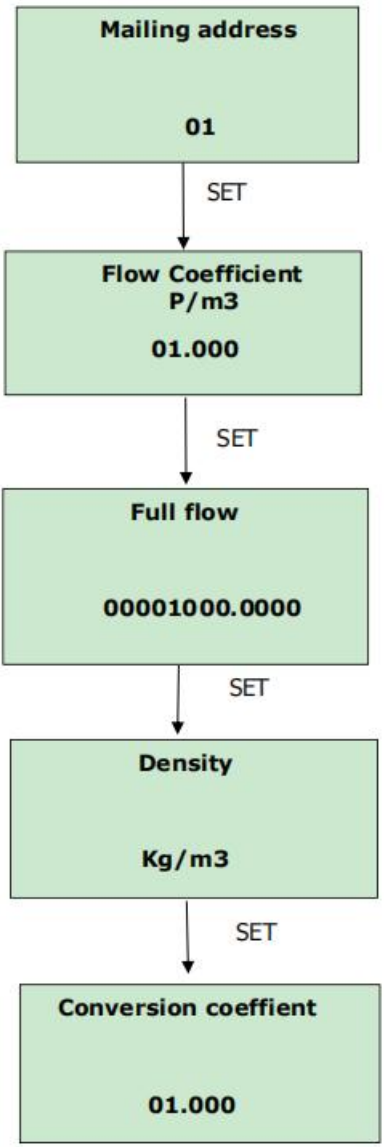


In the main interface, press the SHFIT key to enter the main menu interface. Press the SET key to move the cursor to the password, then press the key to change the corresponding password, and then press the SET key again to shift, and enter the password 2010 in sequence.

In the main interface, press the SHFIT Language selection, to set the language of the setting and display interface, select by pressing the key, there are English and Chinese.

Equivalent pipe inner diameter, set the inner diameter of the pipe measured by the instrument, the square pipe needs to be converted into the equivalent inner diameter input. The unit is millimeters. During the modification process, only need to change the actual column, do not change the calibration column at will

The final unit of the instrument is selected, and the unit can be adjusted by modifying the value behind the unit.



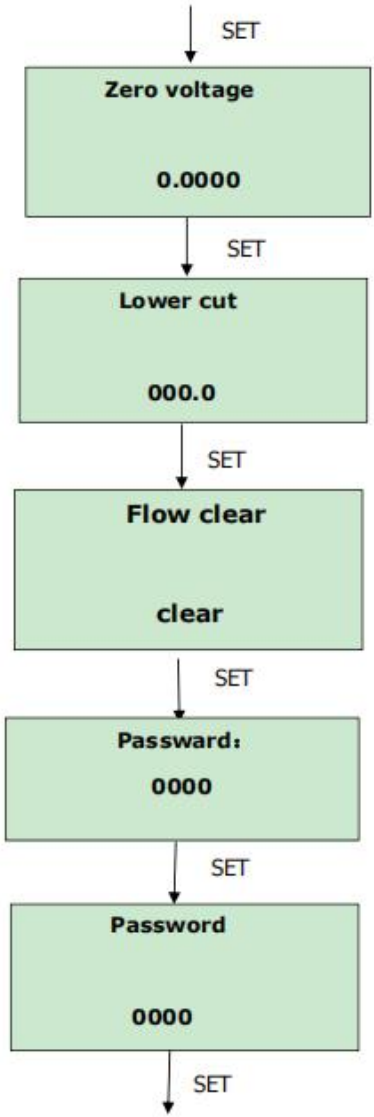
485 communication address, it is meaningful only if it is set on the instrument with 485 communication function.

The meter correction coefficient K, the coefficient defaults to 1, if you want to adjust the flow rate as a whole, you can adjust this position, and the final flow rate
Q=Q original*K

Full-scale flow, mainly the maximum value corresponding to 20mA at 4-20mA output, does not affect the meter display

The density of the medium is mainly used when calculating the mass flow rate of the medium.

Conversion coefficient, due to the air calibration used during calibration, flow conversion is required in actual use. The coefficient is obtained by experiment, and the conversion coefficient of common gases has been attached in the manual.



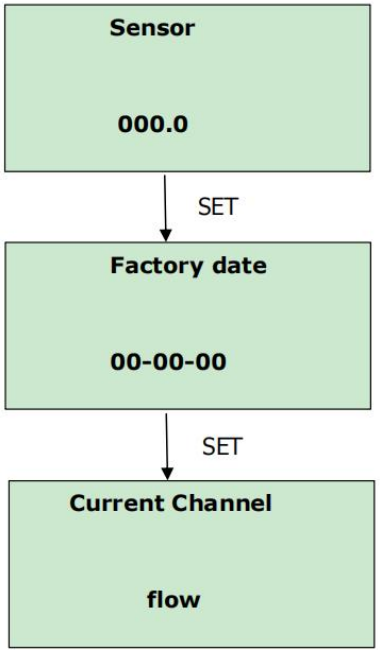
The zero-point voltage value when the meter is in a static state, used to adjust the zero drift of the meter.

The zero-point voltage value when the meter is in a static state, used to adjust the zero drift of the meter. The lower limit is cut off, and there is a part of the static flow caused by interference or other factors in the static state. By appropriately modifying this parameter, the flow rate lower than this parameter is not displayed.

Clear the accumulated flow. In this interface, directly press the middle button to reset.

The instrument password can be modified here. Press SET again to complete the setting and exit to the main interface.

Under the clear menu, press to save and enter the password setting menu. Press to save and go to the next menu, press to move the cursor position, and to modify the parameters. This menu sets the password for the frequently used function setting menu. Press under this menu to return to the main page.



The manufacturer's parameters cannot be modified when the customer uses them on site

Used to set the factory time

Current channel: you can choose the flow or flow rate corresponding to the 4-20mA full scale, pay attention to use with the full flow item

Press the set button again to return to the main interface

5.3 Steps to calibrate zero voltage value:

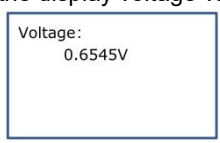
1. Install the instrument on the pipeline.

2. Close the back valve, and then open the front valve to fill the pipeline with the medium.

3. Press SHIFT on the main interface, then the menu interface appears

4. Press the SHIFT key to select common function query

5. Press the SET key to enter the display voltage value interface, as follows



6. When the voltage value is stable, then press.

Note: Do not perform zero point calibration in any running state, otherwise the flow may be seriously inaccurate

6 Troubleshooting and resolution

Table 4 Troubleshooting and Resolution

Issues	Possible causes	Solutions
No display	No power supply	Get power supply
	SMPS is damaged	Get power supply, if the power indicator light is out, it means that the SMPS is damaged, Please contact supplier.
	The wirings of DC24V are reversed	Check the wirings, make the wirings right
	The position of LCD is wrong	Reinstall the LCD
	The LCD is damaged	Check the power indicator light. If the light is on, it means that the LCD is damaged. Please contact supplier
Low velocity	The wirings of sensor are reversed	Rewiring or reinstall the sensor
	The sensor is dirty	Clean sensor
	The sensor is damaged	Return to supplier
	Some parameters of flow setting are wrong	Check the parameters setting
Abnormal velocity and large fluctuation	Some parameters of velocity setting are wrong	Check the parameters setting
	Fluid properties is pulsating in turn	Adjust the system filter

Issues	Possible causes	Solutions
	The sensor is dirty	Clean sensor
	The sensor is damaged	Return to supplier
Abnormal 4-20mA output	The setting of 20mA range is wrong	Right settings
	The Transmitter has fault	Return to supplier
	The connection is not a loop circuit	Check the connection
Abnormal frequency output	Some parameters of frequency setting are wrong	Right settings
	The Transmitter has fault	Return to supplier
	The connection cable is damaged	Check the connection
Abnormal alarm	Some parameters of setting are wrong	Right settings
	The meter has no alarm function	Contact supplier
	The relay is damaged	Return to supplier
Abnormal RS485 output	The settings of baud rate and address are wrong	Right settings
	The wirings are reversed	Rewiring
	The connection cable is damaged	Check the connection

7 Communication protocol

Mod bus Poll software RTU connection:

Display Option Floating Pt;

Command 03: HOLDING REGISTER;

Device ID: The internal address of the instrument;

Address: The starting address of the instrument parameters, from 0 to 11;

Length： Data length Length＋Address <= 11。

Parameter address:

40001-2: The medium temperature, liquid turbine and thermal gas flow meter always read 0 in this section;

40003-4: instantaneous flow rate;

40005-6: Instantaneous flow velocity (in Nm/s);

40007-8: Sensor voltage value;

40009-10: Accumulated traffic in hundreds or more (1234);

40011-12: Accumulated traffic below the hundredth (87.89);

Accumulated traffic=1234 * 100+87.89=123487.89;

Appendix A The Density and Conversion Coefficient of Common Gas

According to different gas on site, the calibration in lab translates the flow rate of actual gas on site into flow rate of air, and then begins to calibrate the flow rate at present. Therefore, when using the meter on site, the meter displays mass flow or volume flow of actual gas. When translating the flow rate of gas into flow rate of air, there is a conversion coefficient table of different gas.

Table 5 The Density and Conversion Coefficient of Common Gas

	Gas	Specific heat (Kal/g*℃)	Density (g/l, 0℃)	Conversion Coefficient
0	Air	0.24	1.2048	1.0000
1	Argon (Ar)	0. 125	1.6605	1.4066
2	Arsine (AsH3)	0. 1168	3.478	0.6690
3	Boron Tribromide (BBr_3)	0.0647	11. 18	0.3758
4	Boron Trichloride (BCl_3)	0. 1217	5.227	0.4274
5	Boron Trifluoride (BF_3)	0. 1779	3.025	0.5050
6	Borane (B_2H_6)	0.502	1.235	0.4384
7	Carbon Tetrachloride (CCl_4)	0. 1297	6.86	0.3052
8	Carbon Tetrafluoride (CF_4)	0. 1659	3.9636	0.4255
9	Methane (CH_4)	0.5318	0.715	0.7147
10	Ethylene (C_2H_4)	0.3658	1.251	0.5944
11	Ethane (C_2H_6)	0.4241	1.342	0.4781
12	Ally lene (C_3H_4)	0.3633	1.787	0.4185
13	Propylene (C_3H_6)	0.3659	1.877	0.3956
14	Propane (C_3H_8)	0.399	1.967	0.3459
15	Butyne (C_4H_6)	0.3515	2.413	0.3201
16	Butene (C_4H_8)	0.3723	2.503	0.2923
17	Butane (C_4H_{10})	0.413	2.593	0.2535
18	Pentane (C_5H_{12})	0.3916	3.219	0.2157

	Gas	Specific heat (Kal/g*℃)	Density (g/l, 0℃)	Conversion Coefficient
19	Carbinol (CH_3OH)	0.3277	1.43	0.5805
20	Ethanol (C_2H_6O)	0.3398	2.055	0.3897
21	Trichloroethane ($C_3H_3Cl_3$)	0. 1654	5.95	0.2763
22	Carbon Monoxide (CO)	0.2488	1.25	0.9940
23	Carbon Dioxide (CO_2)	0.2017	1.964	0.7326
24	Cyanide ($C_2 N_2$)	0.2608	2.322	0.4493
25	Chlorine (Cl_2)	0. 1145	3. 163.	0.8529
26	Deuterium (D_2)	1.7325	0. 1798	0.9921
27	Fluoride (F_2)	0. 197	1.695	0.9255
28	Germanium tetrachloride ($GeCl_4$)	0. 1072	9.565	0.2654
29	Germane (GeH_4)	0. 1405	3.418	0.5656
30	Hydrogen (H_2)	3.4224	0.0899	1.0040
31	Hydrogen Bromide (HBr)	0.0861	3.61	0.9940
32	Hydrogen Chloride (HCI)	0. 1911	1.627	0.9940
33	Hydrogen Fluoride (HF)	0.3482	0.893	0.9940
34	Hydrogen Iodide (HI)	0.0545	5.707	0.9930
35	Hydrogen Sulfide (H_2S)	0.2278	1.52	0.8390
36	Helium (He)	1.2418	0. 1786	1.4066
37	Krypton (Kr)	0..0593	3.739	1.4066
38	nitrogen (N_2)	0.2486	1.25	0.9940
39	Neon (Ne)	0.2464	0.9	1.4066
40	Ammonia (NH_3)	0.5005	0.76	0.7147
41	Nitric Oxide (NO)	0.2378	1.339	0.9702
42	Nitrogen Dioxide (NO_2)	0. 1923	2.052	0.7366
43	Nitrous Oxide (N_2O)	0.2098	1.964	0.7048
44	Oxygen (O_2)	0.2196	1.427	0.9861

	Gas	Specific heat (Kal/g*℃)	Density (g/l, 0℃)	Conversion Coefficient
45	Phosphorus Trichloride (PCl_3)	0. 1247	6. 127	0.3559
46	Phosphorane (PH_3)	0.261	1.517	0.6869
47	Phosphorus Pentafluoride (PF_5)	0. 1611	5.62	0.3002
48	Phosphorus Oxychloride ($POCl_3$)	0. 1324	6.845	0.3002
49	Silicon Tetrachloride ($S iCl_4$)	0. 127	7.5847	0.2823
50	Silicon Fluoride ($S iF_4$)	0. 1692	4.643	0.3817
51	Silane (S iH4)	0.3189	1.433	0.5954
52	Dichlorosilane ($S iH_2Cl_2$)	0. 1472	4.506	0.4095
53	Trichlorosilane ($Si HCl_3$)	0. 1332	6.043	0.3380
54	Sulfur Hexafluoride (SF_6)	0. 1588	6.516	0.2624
55	Sulfur Dioxide (SO_2)	0. 1489	2.858	0.6829
56	Titanium Tetrachloride ($TiCl_4$)	0. 1572	8.465	0.2048
57	Tungsten Hexafluoride (WF_6)	0.0956	13.29	0.2137
58	Xenon (Xe)	0.0379	5.858	1.4066

Appendix B Upper Range Value of Common Gas

According to different gas on site, the calibration in lab translates the flow rate of actual gas on site into flow rate of air, and then begins to calibrate the flow rate at present. Therefore, when using the meter on site, the meter displays mass flow or volume flow of actual gas. When translating the flow rate of gas into flow rate of air, there is a conversion coefficient table of different gas.

Table 6

Flow range				
Nominal Diameter(mm)	Air（Nm^3/h）	Extended range	Oxygen（O_2）	Combustible gas
10	0.5-28	0.03-30	0.5- 14	0.5-5
15	0.5-65	0.07-65	0.5-32	0.5- 10
20	0.5- 100	0. 12- 110	0.5-55	0.5-20
25	0.5- 175	0.18- 180	0.5-89	0.5-28
32	0.5-290	0.3-290	0.5- 144	0.5-45
40	0.5-450	0.5-450	0.5-226	0.5-70
50	1-600	0.5-700	0.7-352	0.7- 110
65	1.5- 1000	1- 1200	1.2-600	1.2- 185
80	2- 1500	1.5- 1800	2-900	2-280
100	3-2300	3-2800	3- 1420	3-470
125	4.5-3500	4-4400	4.5-2210	4.5-700
150	6.5-5200	6-6300	6.5-3200	6.5-940
200	12-9000	12- 11500	12-5650	12- 1880
250	18- 14500	18- 17500	18-8830	18-2820
300	25-21000	25-25000	25- 12720	25-4060
350	35-28000	35-34500	35- 17000	35-5600
400	45-36500	45-45000	45-22600	45-7200
450	60-46500	60-57000	60-29000	60-9200
500	70-57000	70-70000	70-35300	70- 11280

Flow range				
Nominal Diameter(mm)	Air（Nm^3/h）	Extended range	Oxygen（O_2）	Combustible gas
600	100-81000	100- 101000	100-50600	100- 16300
700	140- 110000	140- 138000	140-69000	140-22100
800	180- 150000	180- 180000	180-90000	180-29000
900	230- 185000	230-230000	230- 115000	230-36500
1000	290-230000	290-280000	290- 140000	290-45500
2000	1150-900000	1150- 1130000	1150-560000	1150- 185000

(Unit: Nm^3/h. The follow table can be extended)

The flow rate in standard condition: The flow rate is in the condition of 20℃ temperature and 101.325kPa pressure.

The unit of flow rate is optional : Nm3/h, Nm3/min, L/h, L/min, t/h, t/min, kg/h or kg/min.

The reduction formula of flow rate in working condition and flow rate in standard condition:

$$Q_{\mathrm{S}} = \frac{0.101325 + P}{0.101325} \times \frac{273.15 + 20}{273.15 + t} \times Q_{\mathrm{n}}$$

Flow velocity calculation

formula :

$$V = Q/(\pi \times (\frac{D}{2}/1000)^2)/3600$$

Q_s : The flow rate in standard condition (Nm^3/h).

Q_n : The flow rate in working condition (m^3/h).

T: The medium temperature in working condition (℃).

P: The medium pressure in working condition (Gauge pressure, MPa).

V: Medium standard condition flow rate (Nm/s)

Q : Standard state flow rate (Nm^3/h)

D: Measuring pipe diameter (mm)