

# Instructions for Micro Thermal Gas Mass Flow Meter

| version | instructions                                   | note |
|---------|------------------------------------------------|------|
| V1.0    | First Edit                                     |      |
| V1.1    | Modified aviation plug definition              |      |
| V1.2    | Modified some information on the Settings page |      |
| V1.3    | Adding Installation Information                |      |
| V1.5    | Modified schematic diagram                     |      |
| V1.6    | Optimized layout                               |      |

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## I、Product introduction

Micro gas mass flow meters is specially designed for the measurement and process control of various types of small flow gases. This series of sensors are made with advanced micro-electro-mechanical system (MEMS) flow sensing chips, and are suitable for all types of clean gases. The Unique packaging technology makes it suitable for a wide range of pipe sizes, low cost, easy installation, no temperature and pressure compensation, and can replace traditional volumetric or differential pressure flow meters.

## II、Product features

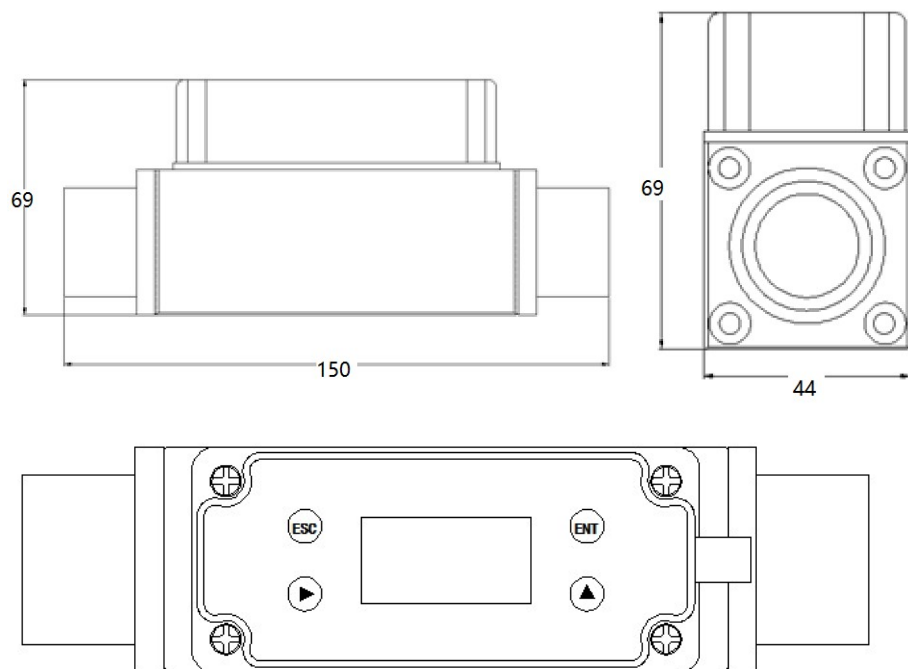
- Using MEMS flow sensor chip, the sensor has the characteristics of high precision, high sensitivity and strong anti-interference.
- This product has display screen and setting buttons, which is easy to operate and read directly.(optional)
- The zero point stability of the sensor is greatly improved compared with the ordinary thermal flow meters.
- Full range high stability.
- Full range precision and excellent repeatability.
- Combined with structural optimization, the flow meter can greatly reduce pressure loss and energy consumption compared with traditional mechanical instruments.
- LCD display instantaneous flow and cumulative flow, clear and intuitive, easy to read.
- 4~20mA standard signal output and second impulse output to choose.

## III、Technical parameters

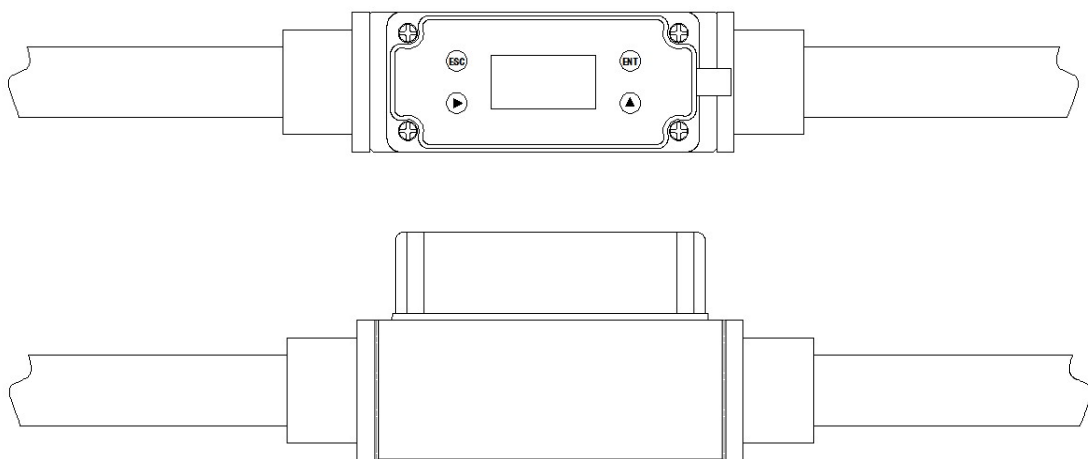
|                                |                                     |                               |                            |
|--------------------------------|-------------------------------------|-------------------------------|----------------------------|
| Precision(%)                   | $\pm(1.5+0.2FS)$                    | Medium temperature            | - 10 ~ 55                  |
| Response time (MS)             | 50-1000.                            | Humidity                      | <95%RH(no frost, no icing) |
| Maximum working pressure (Mpa) | 1.0                                 | Connector                     | G3/8, G1/2, G3/4           |
| Working power                  | 15v-24v 100mA                       | The overall power consumption | < 2.4 W.                   |
| Output model                   | 4-20mA, pulse (optional)            | Communication methods         | RS485(Modbus protocol)     |
| Display                        | Instantaneous flow, cumulative flow | Calibration                   | Air (20℃, 101.325kPa)      |

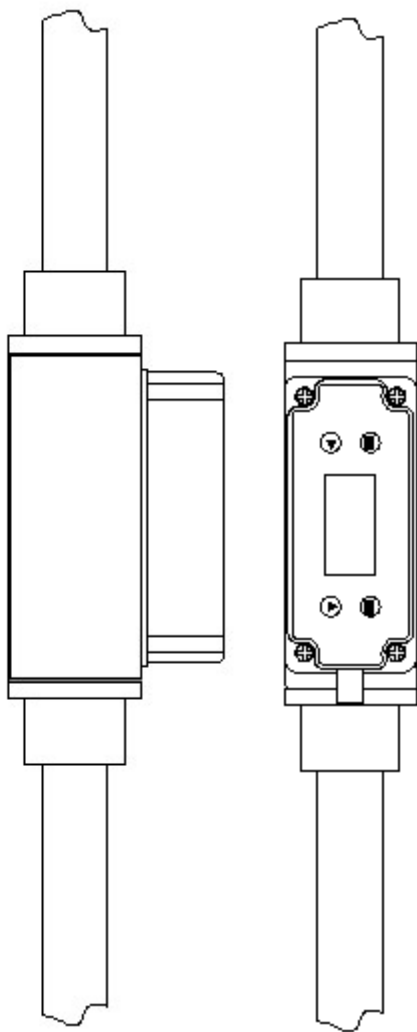
Note: The above data were measured at 20℃, 101.32kPa, dry air

#### IV、 Mechanical dimensions (mm)



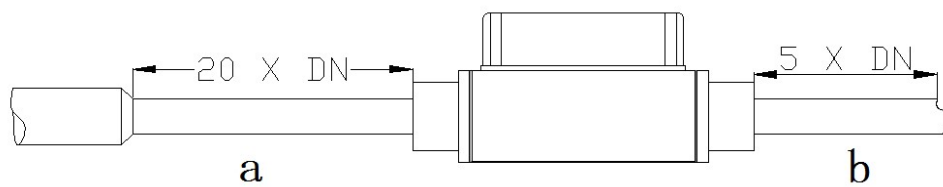
#### V、 installation



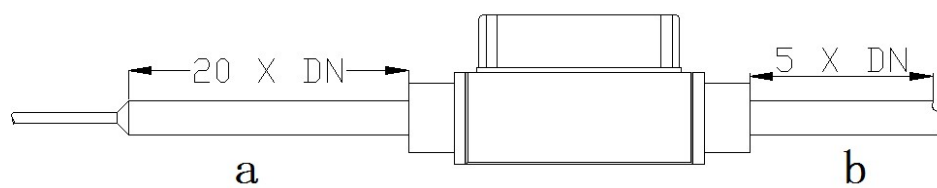


## VI、 Installation Notes

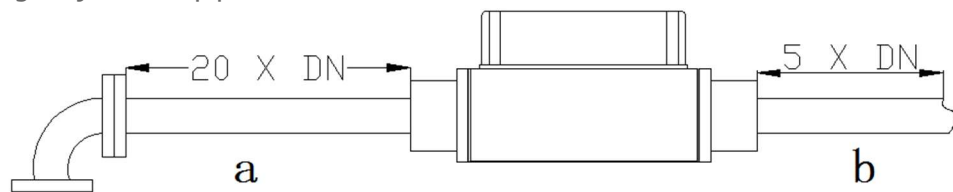
Reducing Coupling:



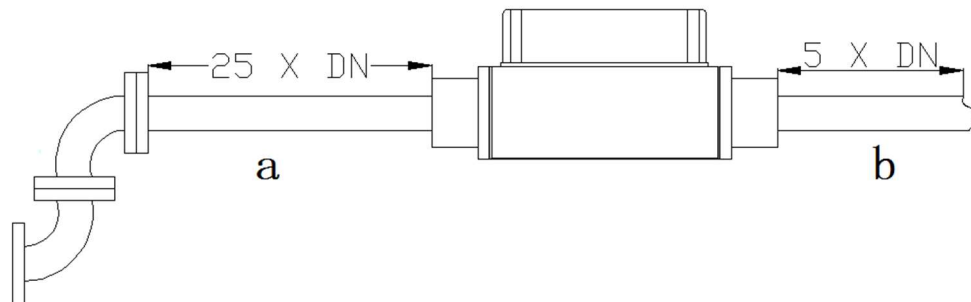
Expansion pipe:



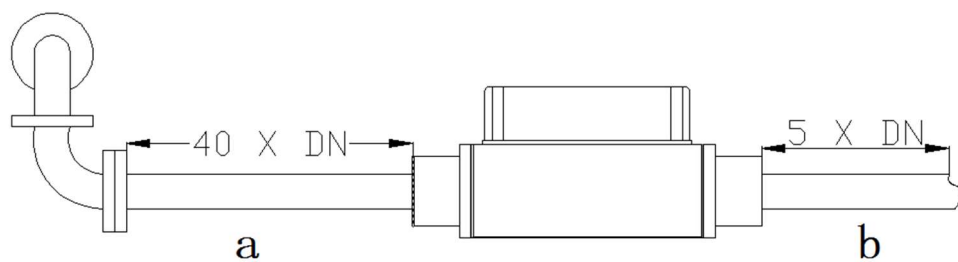
With a 90 degree joint or t-pipe:



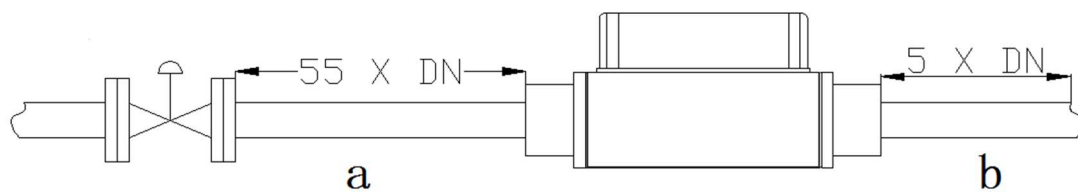
With two 90 degree joints:



With three 90 degree joints:



With control valve:



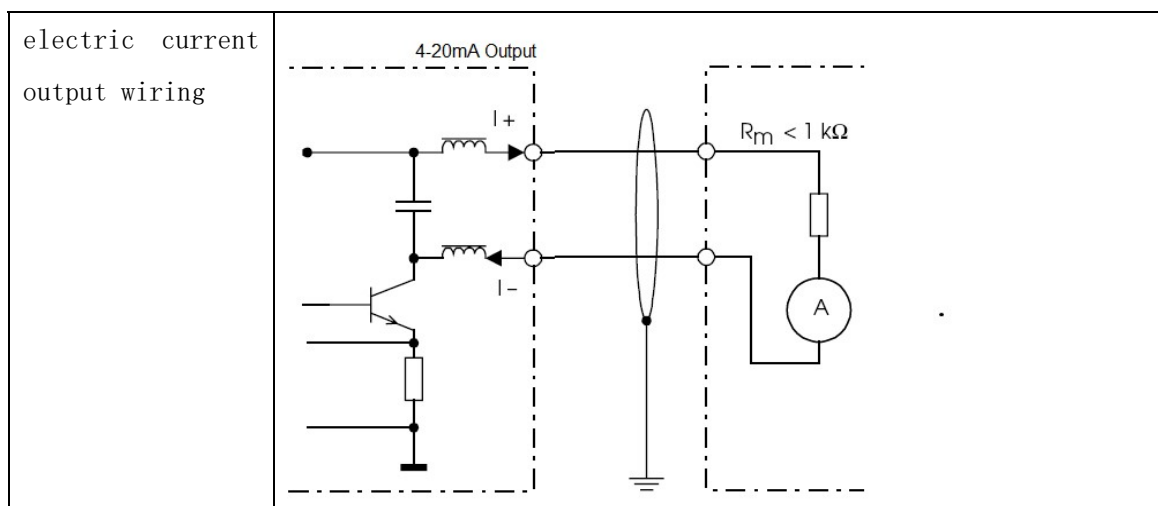
Note: When installing and using, it is necessary to ensure that the front pipe end and the back pipe end have the above distance, and the straight pipe section is concentric with the pipe on the flowmeter, and ensure that the flowmeter is fixed reliably. If the straight pipe segment cannot be guaranteed, the accuracy of the flowmeter will not be guaranteed.

## VII、 Wiring diagram

### 1) Description of wiring terminal:

| logo      | meaning                      |
|-----------|------------------------------|
| 1 - pink  | 24 V-/ electric current I-   |
| 2 - black | electric current (I) +       |
| 3 - blue  | PE                           |
| 4 - white | 24V+                         |
| 5 - brown | RS485 communication output A |
| 6 - gray  | RS485 communication output B |

## 2) Wiring connection:



## VIII、 Operation instructions:

### Button Description

| logo | meaning                      |
|------|------------------------------|
| ESC  | Cancel or exit the interface |
| ▶    | The shift key                |
| ◀    | Modify/page key              |
| ENT  | Confirm/Enter key            |

### 1) Menu description

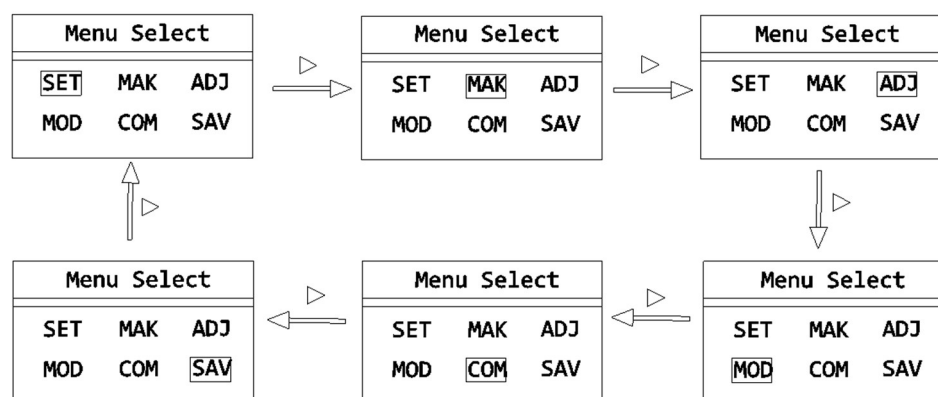
#### a) Display menu

|                                                                                                                                                                                                                                                                   |         |      |     |  |          |      |     |  |   |       |       |         |                                                                                                                                                                                                                                         |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------|------|-----|--|----------|------|-----|--|---|-------|-------|---------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <table border="1"> <tr> <td>Flow</td> <td>NL/m</td> </tr> <tr> <td>0.0</td> <td></td> </tr> <tr> <td>velocity</td> <td>Nm/s</td> </tr> <tr> <td>0.0</td> <td></td> </tr> <tr> <td>Σ</td> <td>0 Nm3</td> </tr> <tr> <td>v1.03</td> <td>04.00mA</td> </tr> </table> | Flow    | NL/m | 0.0 |  | velocity | Nm/s | 0.0 |  | Σ | 0 Nm3 | v1.03 | 04.00mA | <p>All information display Windows</p> <p>First line: Shows instantaneous flow rate</p> <p>Line 2: Shows instantaneous velocity</p> <p>Line 3: Shows cumulative flow</p> <p>Line 4: Display version number and 4-20mA output status</p> |
| Flow                                                                                                                                                                                                                                                              | NL/m    |      |     |  |          |      |     |  |   |       |       |         |                                                                                                                                                                                                                                         |
| 0.0                                                                                                                                                                                                                                                               |         |      |     |  |          |      |     |  |   |       |       |         |                                                                                                                                                                                                                                         |
| velocity                                                                                                                                                                                                                                                          | Nm/s    |      |     |  |          |      |     |  |   |       |       |         |                                                                                                                                                                                                                                         |
| 0.0                                                                                                                                                                                                                                                               |         |      |     |  |          |      |     |  |   |       |       |         |                                                                                                                                                                                                                                         |
| Σ                                                                                                                                                                                                                                                                 | 0 Nm3   |      |     |  |          |      |     |  |   |       |       |         |                                                                                                                                                                                                                                         |
| v1.03                                                                                                                                                                                                                                                             | 04.00mA |      |     |  |          |      |     |  |   |       |       |         |                                                                                                                                                                                                                                         |

#### b) Menu selection and password input

|                                                                                                                         |                                                                                                                                                                                                                                                                                                                                    |
|-------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <div>Press ENT menu to enter</div> <div><div>Menu Select</div><div><div>SETMAKADJ</div><div>MODCOMSAV</div></div></div> | <div>Menu selection</div> <div>SET: Basic parameter Settings</div> <div>MAK: Calibration Settings</div> <div>ADJ: set zero voltage, current calibration, cumulative flow zero</div> <div>COM: RS485 communication parameter setting</div> <div>SAV: Save and restore parameters</div> <div>MOD: Secondary correction of flow</div> |
| <div><div>INPUT PASS</div><div>*****</div><div>PASSWD</div><div>PRESS ENT</div></div>                                   | <div>SET, ADJ, COM, password: 1000</div> <div>MAK, MOD, SAV, password: 0603</div>                                                                                                                                                                                                                                                  |

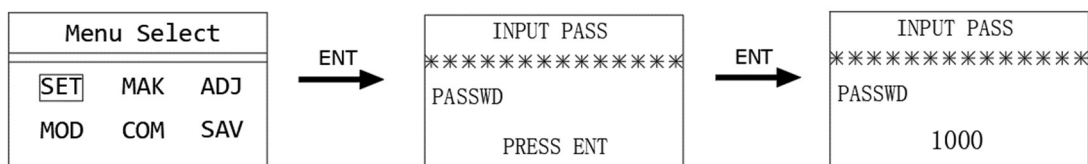
Select the function menu to enter through the shift key



Set Basic parameters menu, remove the black rectangle to the "Settings", press "ENT" key, the password input menu appears, press "ENT" key again, a flashing cursor appears, enter the password, after the password input is completed, press "ENT" key to confirm. if



the password is correct, it will directly enter into the parameter Settings menu. if the password is incorrect, "Error" will appear, Press ENT key again to re-enter.

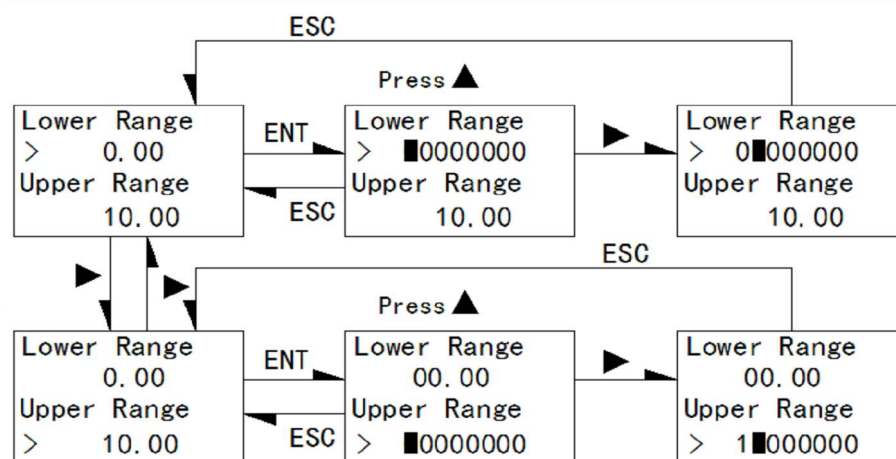


### c) The Settings menu

|                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                              |
|---------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <div>Language</div> <div>&gt; English</div> <div>Backlight</div> <div>Always</div>          | <p>Language: You can choose Chinese or English.</p> <p>Backlight: You can choose Always and Auto.</p>                                                                                                                                                                                                                                                                                                                        |
| <div>Flow Unit</div> <div>&gt; Nm3/h</div> <div>Totalizer Unit</div> <div>Nm3</div>         | <p>&gt; indicates that it can be set</p> <p>The flow unit: g/min, g/s, Kg/min, Kg/h, Nm3/h, Nm3/min, NL/h, NL/min, and mL/min</p> <p>The cumulative unit: G, Kg, Nm3, and NL</p>                                                                                                                                                                                                                                             |
| <div>MeterFactor</div> <div>&gt; 1.0</div> <div>I.Diameter mm</div> <div>10.0</div>         | <p>Meter Factor: calibration correction coefficient can be changed to compensate for the interference of fluid cross-section velocity distribution and the influence of specific application environment. Meter factor is a product coefficient of linear flow signal.</p> <p>Display value = (instrument coefficient) x (actual measured value)</p> <p>Pipe diameter: input according to actual application, unit is mm</p> |
| <div>Lower Range</div> <div>&gt; 0.00</div> <div>Upper Range</div> <div>10.0</div>          | <p>&gt; indicates that it can be set. Press the shift key to move '&gt;' between upper and lower ranges to switch.</p> <p>Press ENT key to enter setting, the first character flashes after entering</p>                                                                                                                                                                                                                     |
| <div>Damp Factor</div> <div>&gt; 2</div> <div>Signal CutOff &lt;%&gt;</div> <div>0.05</div> | <p>Damping coefficient: default 10, range 0-50</p> <p>Decreasing the damping coefficient can quickly detect the jump in flow, increasing the damping coefficient can smooth the current flow display value.</p> <p>Small signal excision: eliminate zero fluctuation as a percentage of range</p>                                                                                                                            |

|                                                                                   |                                                                                                                                                                                                                                                                                                                       |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <div> ImA Output Type<br/> &gt; Flow<br/> NoiseValue&lt;0-10&gt;<br/> 5.0 </div>  | <p>Current output type: you can choose flow rate and flow rate to determine whether the upper and lower ranges are converted by flow rate or flow rate.</p> <p>Noise threshold: the value is 0-10, which is used to eliminate noise signal, the greater the value, the greater the noise signal to be eliminated.</p> |
| <div> GasDichte &lt;kg/m3&gt;<br/> &gt; 1.2904<br/> Conver Factor<br/> 1.0 </div> | <p>Medium density: unit Kg/m3</p> <p>When the density of the measured medium is different from the calibrated medium, it can be used for density correction. Also used to convert between volume units and weight units.</p> <p>Conversion factor: conversion factor between calibrated gas and measured gas.</p>     |
| <div> LCD angle<br/> &gt; 0<br/> OutPut Type<br/> 4-20mA </div>                   | <p>Screen Angle: can be selected from 0 and 180 degrees, used to rotate the screen 180 degrees.</p> <p>Output Settings: 4-20mA output is currently available</p>                                                                                                                                                      |

After entering the setting menu, press ESC key to return to the menu selection interface, and press ENT to enter the value setting



#### d) correction

|                                                                        |                                                                                                                                                                                                                                |
|------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <div> I Output Mode<br/> &gt; 4-20mA<br/> Fixed Output<br/> 4.0 </div> | <p>Current output mode: 4-20mA and fixed current output</p> <p>When the fixed current output is selected, the fixed current output value can be set.</p> <p>Fixed current output value: 0 mA, 4mA, 8mA, 12mA, 16 mA, 20 mA</p> |
|------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                          |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <div style="border: 1px solid black; padding: 5px; margin: 5px;"> Adjust Iout Low<br/> &gt; 4.0<br/> Adjust Iout High<br/> 20.0 </div>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | <p>Example: The current output mode is 4-20mA</p> <p>When there is no flow, the output current measured with a multimeter is 3.89 mA</p> <p>Then adjust the current output zero to 3.89 mA</p> <p>At maximum flow, the output current measured with a multimeter is 19.75 mA</p> <p>Then adjust the current output zero to 19.75 mA</p>  |
| <p>Method of calibrating current output in fixed current output mode:</p> <p>The first step is to connect the multimeter in series with the current loop;</p> <p>The second step is to set the current output mode to fixed current output (Fixed);</p> <p>The third step, press the shift key, move the '&gt;' to the next line, press the confirm key to enter the setting state, press the modify/page key to select the output current value, select the 4mA output, and press the confirm key to exit the setting state;</p> <p>The fourth step, observe the multimeter display, if it is 4mA, no need to calibrate, if it is 3.90mA, press the modify/page key to enter the calibration menu, move '&gt;' to the zero current adjustment (Adjust Iout Zero), press the enter key Enter the setting, enter 3.90, and press the enter key to exit the setting.</p> <p>The fifth step, press the shift key and the modify/page key at the same time, the menu returns to the previous level, move '&gt;' to the next line, press the confirm key to enter the setting state, press the modify/page key to select the output current value, select 20mA output, press the enter key to exit the setting state;</p> <p>The sixth step, observe the multimeter display, if it is 20mA, no need to calibrate, if it is 19.90mA, press the modify/page key to enter the calibration menu, move the '&gt;' to the zero current adjustment (Adjust Iout Span), press the enter key Enter the setting, input 19.90, and press the enter key to exit the setting.</p> <p>The seventh step, press the shift key and the modify/page key at the same time, the menu returns to the previous level, move the '&gt;' to the next line,</p> <p>Press the Enter key to enter the setting state, press the Modify/Page key to select the output current value, and observe the displayed value on the multimeter at the same time. If it is consistent, the calibration is successful.</p> |                                                                                                                                                                                                                                                                                                                                          |
| <div style="border: 1px solid black; padding: 5px; margin: 5px;"> Zero Voltage<br/> &gt; 1.023<br/> Current Voltage<br/> 1.123 </div>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | <p>User zero and current voltage Settings</p> <p>When there is no flow in the pipeline, the table shows that the flow is not zero. You can modify the user zero to adjust the flow.</p> <p>To set the user zero point, click the arrow to the current voltage, press ENT twice to set the zero point voltage to the current voltage.</p> |
| <div style="border: 1px solid black; padding: 5px; margin: 5px;"> TotalizerDecimal<br/> &gt; 0.1257<br/> TotalizerInteger<br/> 230 </div>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | <p>Cumulative decimal and integer clear or set</p>                                                                                                                                                                                                                                                                                       |

#### e) Communications menu

|                                        |                                                                                    |
|----------------------------------------|------------------------------------------------------------------------------------|
| Device ID<br>> 001<br>BaudRate<br>9600 | MODBUS communication device ID,0-255<br>Baud rate choose 1200/2400/19200/4800/9600 |
| Parity<br>> None<br>StopBit<br>1bit    | Parity bit: None/Odd/Even<br>Stop bit: 1bit/2bit                                   |

#### f) Save recovery menu

The password 0603 can enter the save and restore menu. The current parameters can be used as a backup for saving the factory Settings. Generally, the factory Settings will be saved. Restore parameters You can restore backup parameters to factory Settings.

|                                                       |                                                          |                                                           |
|-------------------------------------------------------|----------------------------------------------------------|-----------------------------------------------------------|
| Save Parameters<br>> Save<br>Restore Factory<br>Reset | Save Parameters<br>> Save Ok<br>Restore Factory<br>Reset | Save Parameters<br>> Save Err<br>Restore Factory<br>Reset |
| Save the parameters                                   | Save success                                             | Save failed                                               |
| Save Parameters<br>Save<br>Restore Factory<br>> Reset | Save Parameters<br>Save<br>Restore Factory<br>> Reset Ok | Save Parameters<br>Save<br>Restore Factory<br>> Reset Err |
| Restore the parameters                                | Restore success                                          | Restore failure                                           |

## IX、 Quality assurance and after-sales service

Following the ISO9001:2000 quality management and control system, this product is produced with brand-new raw materials and components and has undergone strict factory testing. Product quality and product performance conform to relevant standards and technical texts. However, due to possible uncertainties during transportation or use, we promise the following service guarantee terms:

- Within two weeks from the date of delivery, if the product you purchased has an acceptable quality defect, we will replace it free of charge;
- Within two weeks from the date of delivery, if the product you purchased has an acceptable quality defect, we will replace it free of charge;

- Equipment damage caused by the following reasons in the process of use is not within the scope of free replacement or maintenance:
  - Any installation or use conditions in violation of the relevant requirements and provisions of this manual;
  - Wrong or in violation of the relevant instrument installation, wiring or use specifications of the country;
  - It can be used with other products that are not compatible with the product electrically or without exact quality assurance and valid certification.
  - Self-disassembly or maintenance;
  - Natural aging or wear out of equipment for more than one year;
  - Force majeure as defined by applicable law
- For the products within the warranty period, the user shall bear the cost of sending the products, and we shall bear the cost of replacing or repairing the products and sending back the products;
- When the products sent by users are confirmed by us to be free from defects or damage, the relevant shipping premiums shall be borne by users;
- Once the product sent by the user is confirmed, unless there are special circumstances, we will send the new or repaired product within 48 hours or two working days;
- If any defect or damage is found, please contact your local supplier or us.

## Appendix 1 Modbus register address table

Communication baud rate: 9600,8,1, NONE, floating point data arrangement: 2143

Reading data Function code: 03 (HOLDING REGISTER)

Meter address: can be set through the menu, 0-255, communication protocol to select MODBUS RTU

| Register address | Register name                  | Number of registers        | The data type | The data format       |
|------------------|--------------------------------|----------------------------|---------------|-----------------------|
| 4x0001-4x0002    | instantaneous flow rate        | 2                          | float         | IEEE754               |
|                  | send                           | 01 03 00 00 00 02 C4 0B    |               |                       |
|                  | receive                        | 01 03 04 00 00 00 00 FA 33 |               |                       |
| 4x0003-4x0004    | instantaneous flow velocity    | 2                          | float         | IEEE754               |
|                  | send                           | 01 03 00 02 00 02 65 CB    |               |                       |
|                  | receive                        | 01 03 04 00 00 00 00 FA 33 |               |                       |
| 4x0005-4x0006    | Current current value          | 2                          | float         | IEEE754               |
|                  | send                           | 01 03 00 04 00 02 85 CA    |               |                       |
|                  | receive                        | 01 03 04 00 00 00 00 FA 33 |               |                       |
| 4x0007-4x0008    | The cumulative integer         | 2                          | Unsigned long | Unsigned long integer |
|                  | send                           | 01 03 00 06 00 02 24 0A    |               |                       |
|                  | receive                        | 01 03 04 00 00 00 00 FA 33 |               |                       |
| 4x0009-4x0010    | The cumulative decimal         | 2                          | float         | IEEE754               |
|                  | send                           | 01 03 00 08 00 02 45 C9    |               |                       |
|                  | receive                        | 01 03 04 00 00 00 00 FA 33 |               |                       |
| 4x0011-4x0012    | Cumulant Floating point number | 2                          | float         | IEEE754               |
|                  | send                           | 01 03 00 0A 00 02 E4 09    |               |                       |
|                  | receive                        | 01 03 04 00 00 00 00 FA 33 |               |                       |
| 4x0013-4x0014    | Medium temperature             | 2                          | float         | IEEE754               |
|                  | send                           | 01 03 00 0C 00 02 04 08    |               |                       |
|                  | receive                        | 01 03 04 BA 4A 41 F8 CF 2F |               |                       |
| 4x0015-4x0016    | Current collected signal value | 2                          | float         | IEEE754               |

|               |                                                                   |                            |               |                       |
|---------------|-------------------------------------------------------------------|----------------------------|---------------|-----------------------|
|               | send                                                              | 01 03 00 0E 00 02 A5 C8    |               |                       |
|               | receive                                                           | 01 03 04 82 1F 40 36 52 5B |               |                       |
| 4x0017-4x0018 | Velocity lower limit                                              | 2                          | float         | IEEE754               |
| 4x0019-4x0020 | Upper limit of velocity                                           | 2                          | float         | IEEE754               |
| 4x0021        | Lower limit relay status                                          | 1                          | Unsigned int  | Unsigned integer      |
| 4x0022        | Upper limit relay status                                          | 1                          | Unsigned int  | Unsigned integer      |
| 4x0051-4x0052 | Product ID no.                                                    | 2                          | Unsigned long | Unsigned long integer |
| 4x0053        | The Modbus device ID                                              | 1                          | Unsigned int  | Unsigned integer      |
| 4x0054        | Baud rate                                                         | 1                          | Unsigned int  | Unsigned integer      |
| 4x0055        | Check digit                                                       | 1                          | Unsigned int  | Unsigned integer      |
| 4x0056        | Stop bit                                                          | 1                          | Unsigned int  | Unsigned integer      |
| 4x0057        | language                                                          | 1                          | Unsigned int  | Unsigned integer      |
| 4x0058        | Instantaneous flow unit                                           | 1                          | Unsigned int  | Unsigned integer      |
| 4x0059        | Cumulative flow unit                                              | 1                          | Unsigned int  | Unsigned integer      |
| 4x0060        | Current output mode                                               | 1                          | Unsigned int  | Unsigned integer      |
| 4x0061        | Fixed current output guidelines                                   | 1                          | Unsigned int  | Unsigned integer      |
| 4x0062        | The current fixes the PWM value corresponding to the output value | 1                          | Unsigned int  | Unsigned integer      |
| 4x0063        | Current PWM value zero                                            | 1                          | Unsigned int  | Unsigned integer      |
| 4x0064        | Current PWM value full point                                      | 1                          | Unsigned int  | Unsigned integer      |
| 4x0065        | The output pulse is still the frequency                           | 1                          | Unsigned int  | Unsigned integer      |

|               |                                      |   |       |         |
|---------------|--------------------------------------|---|-------|---------|
| 4x0066-4x0067 | The pulse width                      | 2 | float | IEEE754 |
| 4x0068-4x0069 | Pulse output corresponds to a scalar | 2 | float | IEEE754 |
| 4x0074-4x0075 | Zero current calibration             | 2 | float | IEEE754 |
| 4x0076-4x0077 | Full point current calibration       | 2 | float | IEEE754 |
| 4x0078-4x0079 | The lower limit range                | 2 | float | IEEE754 |
| 4x0080-4x0081 | Maximum range                        | 2 | float | IEEE754 |
| 4x0082-4x0083 | Alarm limit                          | 2 | float | IEEE754 |
| 4x0084-4x0085 | Alarm limit                          | 2 | float | IEEE754 |
| 4x0086-4x0087 | Lower limit alarm return difference  | 2 | float | IEEE754 |
| 4x0088-4x0089 | Upper limit alarm return error       | 2 | float | IEEE754 |
| 4x0090-4x0091 | Damping coefficient                  | 2 | float | IEEE754 |
| 4x0092-4x0093 | Small signal excision                | 2 | float | IEEE754 |
| 4x0094-4x0095 | Gas state density                    | 2 | float | IEEE754 |
| 4x0096-4x0097 | Gas conversion coefficient           | 2 | float | IEEE754 |
| 4x0098-4x0099 | The standby                          |   |       |         |
| 4x0100-4x0101 | The standby                          |   |       |         |
| 4x0102-4x0103 | Instrument coefficient               | 2 | float | IEEE754 |
| 4x0104-4x0105 | Pipe diameter                        | 2 | float | IEEE754 |
| 4x0106-4x0107 | Sampling time period                 | 2 | float | IEEE754 |
| 4x0108-4x0109 | Noise factor                         | 2 | float | IEEE754 |



## Appendix 2 Table of conversion coefficients of gases with respect to air

At present, the laboratory cannot calibrate the mass flow rate according to the gas flow rate actually used by users. When the user uses, the direct output shows the actual mass flow rate or volume flow rate of the gas.

The conversion of different gases is carried out by conversion coefficient, the conversion coefficient of a single component gas can be found in the table. The following table:

|    | The gas body                                                  | Specific heat (CAL/g °C) | Density (g/L 0°C) | Conversion factor |
|----|---------------------------------------------------------------|--------------------------|-------------------|-------------------|
| 00 | Air Air                                                       | 0.24                     | 1.293             | 1.0000            |
| 01 | Argon Ar                                                      | 0.125                    | 1.6605            | 1.4066            |
| 02 | The arsenic hydride AsH <sup>3</sup>                          | 0.1168                   | 3.478             | 0.6690            |
| 03 | Boron tribromide BBr <sub>3</sub>                             | 0.0647                   | 11.18             | 0.3758            |
| 04 | Boron trichloride BCl <sub>3</sub>                            | 0.1217                   | 5.227             | 0.4274            |
| 05 | Boron trifluoride BF <sub>3</sub>                             | 0.1779                   | 3.025             | 0.4384            |
| 06 | Borane B <sup>2</sup> H <sup>6</sup>                          | 0.502                    | 1.235             | 0.5050            |
| 07 | Carbon tetrachloride CCl <sub>4</sub>                         | 0.1297                   | 6.86              | 0.3052            |
| 08 | Carbon tetrafluoride CF <sub>4</sub>                          | 0.1659                   | 3.9636            | 0.4255            |
| 09 | Methane CH <sub>4</sub>                                       | 0.5318                   | 0.715             | 0.7147            |
| 10 | Acetylene C <sup>2</sup> H <sup>2</sup>                       | 0.4049                   | 1.162             | 0.5775            |
| 11 | Vinyl C <sup>2</sup> H <sup>4</sup>                           | 0.3658                   | 1.251             | 0.5944            |
| 12 | Ethane C <sup>2</sup> H <sup>6</sup>                          | 0.4241                   | 1.342             | 0.4781            |
| 13 | Propiolic C <sup>3</sup> H <sup>4</sup>                       | 0.3633                   | 1.787             | 0.4185            |
| 14 | Propylene C <sup>3</sup> H <sup>6</sup>                       | 0.3659                   | 1.877             | 0.3956            |
| 15 | Propane C <sup>3</sup> H <sup>8</sup>                         | 0.399                    | 1.967             | 0.3459            |
| 16 | Ding acetylene C <sup>4</sup> H <sup>6</sup>                  | 0.3515                   | 2.413             | 0.3201            |
| 17 | Butene C <sup>4</sup> H <sup>8</sup>                          | 0.3723                   | 2.503             | 0.2923            |
| 18 | Butane C <sup>4</sup> H <sup>10</sup>                         | 0.413                    | 2.593             | 0.2535            |
| 19 | Pentane C <sup>5</sup> H <sup>12</sup>                        | 0.3916                   | 3.219             | 0.2157            |
| 20 | Methanol CH <sup>3</sup> OH                                   | 0.3277                   | 1.43              | 0.5805            |
| 21 | Ethanol C <sup>2</sup> H <sup>6</sup> O                       | 0.3398                   | 2.055             | 0.3897            |
| 22 | Trichloroethane C <sup>3</sup> H <sup>3</sup> Cl <sub>3</sub> | 0.1654                   | 5.95              | 0.2763            |

|    |                                                    |        |        |        |
|----|----------------------------------------------------|--------|--------|--------|
| 23 | Carbon monoxide<br>CO                              | 0.2488 | 1.25   | 0.9940 |
| 24 | Carbon dioxide CO <sup>2</sup>                     | 0.2017 | 1.964  | 0.7326 |
| 25 | Cyanide gas C <sup>2</sup> N <sup>2</sup>          | 0.2608 | 2.322  | 0.4493 |
| 26 | Chlorine Cl <sup>2</sup>                           | 0.1145 | 3.163. | 0.8529 |
| 27 | Deuterium gas D <sup>2</sup>                       | 1.7325 | 0.1798 | 0.9921 |
| 28 | Fluorine F <sup>2</sup>                            | 0.197  | 1.695  | 0.9255 |
| 29 | Germanium<br>tetrachloride GeCl <sup>4</sup>       | 0.1072 | 9.565  | 0.2654 |
| 30 | Germane GeH <sub>4</sub>                           | 0.1405 | 3.418  | 0.5656 |
| 31 | Hydrogen, H. 2                                     | 3.4224 | 0.0899 | 1.0040 |
| 32 | Hydrogen bromide<br>gets                           | 0.0861 | 3.61   | 0.9940 |
| 33 | Hydrogen chloride<br>HCl                           | 0.1911 | 1.627  | 0.9940 |
| 34 | HF HF                                              | 0.3482 | 0.893  | 0.9940 |
| 35 | Hydrogen iodide HI                                 | 0.0545 | 5.707  | 0.9930 |
| 36 | Hydrogen sulfide<br>H <sub>2</sub> S               | 0.2278 | 1.52   | 0.8390 |
| 37 | Helium He                                          | 1.2418 | 0.1786 | 1.4066 |
| 38 | Krypton Kr                                         | 0.0593 | 3.739  | 1.4066 |
| 39 | Nitrogen N <sub>2</sub>                            | 0.2486 | 1.25   | 0.9940 |
| 40 | Neon Ne                                            | 0.2464 | 0.9    | 1.4066 |
| 41 | Ammonia NH <sub>3</sub>                            | 0.5005 | 0.76   | 0.7147 |
| 42 | Nitric oxide NO                                    | 0.2378 | 1.339  | 0.9702 |
| 43 | Nitrogen dioxide<br>NO <sub>2</sub>                | 0.1923 | 2.052  | 0.7366 |
| 44 | Nitrous oxide <sub>2</sub> O                       | 0.2098 | 1.964  | 0.7048 |
| 45 | Oxygen O <sub>2</sub>                              | 0.2196 | 1.427  | 0.9861 |
| 46 | Phosphorus<br>trichloride PCI <sub>3</sub>         | 0.1247 | 6.127  | 0.3559 |
| 47 | Phosphorus alkanes<br>PH <sub>3</sub>              | 0.261  | 1.517  | 0.6869 |
| 48 | Phosphorous<br>pentafluoride PF <sub>5</sub>       | 0.1611 | 5.62   | 0.3002 |
| 49 | Phopoci triclosan <sub>3</sub>                     | 0.1324 | 6.845  | 0.3002 |
| 50 | Silicon tetrachloride<br>SiCl <sub>4</sub>         | 0.127  | 7.5847 | 0.2823 |
| 51 | Silicon tetrafluoride<br>SiF <sub>4</sub>          | 0.1692 | 4.643  | 0.3817 |
| 52 | The silane SiH <sub>4</sub>                        | 0.3189 | 1.433  | 0.5954 |
| 53 | Dichlorosilane<br>SiH <sub>2</sub> Cl <sub>2</sub> | 0.1472 | 4.506  | 0.4095 |

|    |                                           |        |       |        |
|----|-------------------------------------------|--------|-------|--------|
| 54 | Trichlorosilicon<br>$\text{SiHCl}_3$      | 0.1332 | 6.043 | 0.3380 |
| 55 | Sulfur hexafluoride<br>$\text{SF}_6$      | 0.1588 | 6.516 | 0.2624 |
| 56 | $\text{SO}_2$                             | 0.1489 | 2.858 | 0.6829 |
| 57 | Titanium<br>tetrachloride $\text{TiCl}_4$ | 0.1572 | 8.465 | 0.2048 |
| 58 | Tungsten<br>hexafluoride $\text{WF}_6$    | 0.0956 | 13.29 | 0.2137 |
| 59 | Xenon $\text{Xe}$                         | 0.0379 | 5.858 | 1.4066 |