

# Micro Bending Mass Flowmeter

## Operating Manual



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※Safe use instrument※

Thank you for purchasing the mass flowmeter from our company!  
The Coriolis Mass Flow Meter user manual records how to use this product correctly and safely. This product is a precision electronic instrument for flow measurement. In order to prevent damage to the instrument and achieve the best performance and stable operation, please read this manual carefully before installation and commissioning.

- ✧ After reading this manual, please keep it properly and keep it with this meter.
- ✧ Please submit this manual to the end User Technical Department for storage.
- ✧ The importance levels of the safety major items in this manual are classified by hazard attention.



Attention If you ignore this warning and perform the wrong operation, it may cause personal injury, or cause damage to the instrument and other property.

---



Danger If you ignore this warning and perform incorrect operations, personal injury or serious security accidents may occur.

---

The following identifiers may appear in the user manual used:



The picture on the left shows things that could pose a danger;



The picture on the left shows what needs attention;



The picture on the left shows what is prohibited

**Explosion-proof instruments are used in explosive environment applications**



Verify that there is an explosion-proof certification mark and a temperature group mark on the instrument nameplate. Instruments without this mark cannot be used in explosive environments

**The instrument explosion-proof temperature group must meet the environmental requirements of on-site explosion-proof and temperature**



When it is used in occasions with explosion-proof requirements, it is necessary to confirm the explosion-proof temperature group of the instrument to meet the requirements of on-site explosion-proof and temperature.



**Live operation is prohibited in explosive environment**

Before connecting cables, disconnect the power supply

**The protection level of the instrument should meet the requirements of the field working conditions**



The protection level of the instrument is tested and divided according to the relevant requirements in GB4208-93 (equivalent to IEC529). The protection level required on site should be lower than or equal to the protection level of the instrument to ensure a good working environment for the instrument.

**Confirm power supply type**



The user can choose between two power supply modes to power the meter, 22V-245V AC or DC. Verify that the power supply type matches the meter before installing power.

**Confirm instrument operating environment and medium temperature**



The maximum design temperature of the site environment and medium should be lower than the nominal value of the instrument (the nominal value is detailed in the Specification and Technical Parameters in this manual).



**When the medium temperature is too high, do not perform online installation and maintenance operations**

When the temperature of the measured medium is higher than the temperature borne by the human body or higher than the temperature that may be dangerous, it should be stopped or cooled down, and then operated when the safe temperature is reached. If there is no condition for online operation, it should be stopped to avoid danger.

**Verify the ambient pressure and medium pressure of the instrument**



The ambient pressure on site and the maximum design pressure of the medium should be lower than the nominal value of the instrument (the nominal value is detailed in the Specification and Technical Parameters in this manual).

**Additional requirements when measuring special media**



Some media characteristics are more special, the user needs to specify a special type of product according to the actual situation of the site, before the installation of the user to carefully check whether the product type meets the requirements of the site.

**Do not operate if you suspect that the instrument is faulty**



If the meter is faulty or damaged, please contact our technicians or qualified maintenance personnel for inspection.

## 1. Micro-bending Mass Flow Meter Overview

Micro-bending coriolis mass flow meter (CMF) is a new type flow meter which is designed according to Micro Motion and Coriolis principle. This kind of new flow meter can measure the fluid directly in a sealed pipeline. It consists of two sections: Sensor and Signal Transmitter.

### 1.1 Main Feature

- It can directly measure the mass flow of the fluid (which is of great significance to the measurement and control of the production process, such as energy measurement and chemical reaction)
- High Accuracy (accuracy can be guaranteed in 0.1% ~ 0.5%)
- Wide measure range, generally ensure the basic accuracy of the measurable ratio of 10:1 or 20:1
- wide range of applications, in addition to the normal fluid measurement can also measure the general fluid measuring instrument is difficult to measure the industrial medium, such as high viscosity fluid, all kinds of slurry, suspension, etc
- Measure the density and temperature of medium directly, and convert the concentration of the solute
- There is no requirement for the upstream and downstream straight pipe section of the instrument during installation
- Reliable operation, Low maintenance rate

### 1.2 Application

The CMF mass flow meter can be used in the following fields to meet the requirements of ingredient, mixing processes and commercial measurement.

- Chemical: containing chemical reaction system
- Petroleum: moisture content analysis
- Lipids: including vegetable oils, animal fats and other oils
- Pharmaceutical
- Painting
- Paper making
- Textile printing and dyeing
- Fuel: crude oil, heavy oil, coal slurry, lubricant and other fuels.
- Food: gas dissolving beverage, health drink and other liquid.
- Transportation: pipeline liquid measurement.
- High temperature fluid, the maximum temperature up to 200°C
- High pressure fluid, like slurry flow measurement for oil drilling cementing

### 1.3 Working Principle

If a pipe is rotated around a point (P) while liquid is flowing through it (toward or away from the center of rotation), that fluid will generate an inertial force, with reference to Figure 1.1:

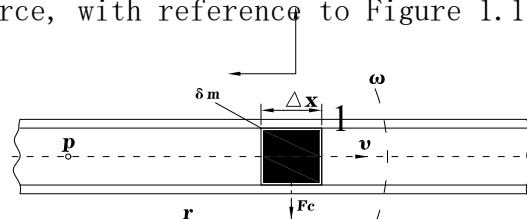


Figure 1.1

A particle ( $\delta_m$ ) travels at a constant velocity ( $v$ ) inside a tube. The tube is rotating around a fixed point (P) at angular velocity ( $\omega$ ), in this case, this particle will get two acceleration components:

- 1) Normal acceleration (centripetal acceleration), its value is equal to  $\omega^2 r$ , its direction is toward the point P
- 2) Tangential acceleration  $a_t$  (Coriolis acceleration), its value is equal to  $2\omega v$ , its direction is perpendicular to  $v$

The force generated by tangential acceleration is Coriolis force, its value is equal to  $F_c = 2\omega v \delta_m$ . In figure 1.1 fluid  $\delta_m = \rho A \times \Delta X$ , So Coriolis force can be expressed as:

$$\Delta F_c = 2\omega v \times \delta_m = 2\omega v \times \rho A \times \Delta X = 2\omega \times \delta_{qm} \times \Delta X$$

Wherein  $A$  is the duct cross-sectional area.

$$\delta_{qm} = \delta m / dt = v \rho A$$

For special rotational pipe, its frequency is constant,  $\Delta F_c$  only depends on  $\delta_{qm}$ . Therefore, directly or indirectly measuring the Coriolis force can be measured mass flow. This is how Coriolis mass flow meter works.

The actual flow sensor can't achieve rotational movement, replace by pipeline vibration. The principle is shown in Figure 1.2、Figure 1.3、Figure 1.4. Both ends of a bend pipe are fixed, and the vibration force is applied to the pipe in an middle of the two fixed points (according to the resonance frequency of pipeline), taking the fixed point as axis, making pipeline vibrate at its natural frequency ( $\omega$ ). When no fluid flows through the pipeline, the pipeline is only affected by vibration force, the vibration direction of two half-section of pipeline is the same, no phase difference. When fluid flows, by the influence of fluid medium dot Coriolis force  $F_c$  inside the pipeline (In the two half-section of pipeline, Coriolis

F1 and F2 are equal in magnitude and opposite in direction (Figure 1.2), two half-section of pipeline occur twist in the opposite direction to generate phase difference which is proportional to mass flow. The design of sensor is converting the measurement of Coriolis force to the measurement of phase difference for both sides of the vibrating tube. This is the working principle of Coriolis mass flow meter.

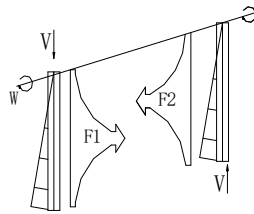


Figure1.2

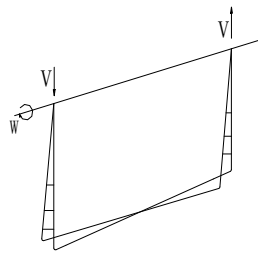


Figure1.3

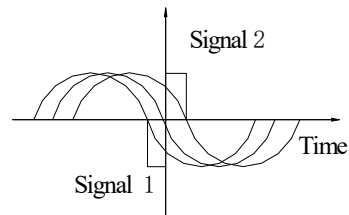


Figure1.4

## 1.4 Density Measurements

The vibration frequency of the measuring tube is a function of the fluid density.

Based on this principle, the transducer can obtain the density signal by monitoring the vibration frequency of the measuring tube

## 1.5 Temperature Measurements

The built-in temperature sensor monitors the temperature of the measuring tube and can be used to calculate the compensation factor for the temperature effect, but also as a process temperature output.

## 2. Micro-bending sensor

### 2.1 Structure and characteristics

#### 2.1.1 Sensor shape structure

The structure of the micro-bending sensor is shown in the following figure



Figure2.1

#### 2.1.2 Sensor structure

The sensor is composed of a measuring tube, a measuring tube driving device, a position detector, a supporting structure, a temperature sensor and a shell.

#### 2.1.3 Main Features

- The measurement signal is large, the measurement accuracy is easy to meet the requirements;
- Small installation stress effect;
- The shell structure has the function of secondary pressure protection and easy to achieve heat preservation;

- Loss of pressure;
- Easy to clean;
- Strong vibration resistance;
- Small installation size.

## 2.2 Sensor technical parameters

### 2.2.1 Sensor specifications and technical parameters

(1) Sensor specifications, range, zero stability Table 2.1

| Size | Diameter | Flow Range | Zero Stability |
|------|----------|------------|----------------|
|      | mm       | kg/h       | kg/h           |
| 008  | 8        | 0~1500     | 0.075          |
| 015  | 15       | 0~4500     | 0.23           |
| 025  | 25       | 0~15000    | 0.75           |
| 040  | 40       | 0~30000    | 1.5            |
| 050  | 50       | 0~60000    | 3              |
| 080  | 80       | 0~150000   | 7.5            |

Note: Flow range gives two parameters, the middle parameter is the standard flow range, generally factory inspection according to this range, and it is also suggested that the user choose the instrument within this range; The latter parameter is the upper flow range to ensure the stable operation of the sensor.

(2) Accuracy(Liquid) :

Measurement accuracy:  $\pm 0.1\% \pm (\text{zero stability/measurement value})\%$

Measurement accuracy:  $\pm 0.15\% \pm (\text{zero stability/measurement value})\%$

Measurement accuracy:  $\pm 0.2\% \pm (\text{zero stability/measurement value})\%$

Repeatability: 1/2 measurement accuracy %

(3) Density(Liquid) measuring range and accuracy (With series transmitter)

Range:  $0.3 \sim 3.000\text{g/cm}^3$  Accuracy:  $\pm 0.002\text{g/cm}^3$

(4) Temperature measuring range and accuracy (With transmitter):

Temperature measuring range:  $-50 \sim 200^\circ\text{C}$  Accuracy:  $\pm 1^\circ\text{C}$

(5) The working temperature of the measured medium:  $-50^\circ\text{C} \sim 200^\circ\text{C}$

(6) Ambient temperature:  $-40^\circ\text{C} \sim 60^\circ\text{C}$

(7) Material : The measuring tube SS316L Housing: SS304

(8) Working pressure:  $0 \sim 4.0\text{MPa}$

(9) Explosion-proof level : Exdbia II CT6Gb

## 2.2.4 Dimensions and weight

(1) Compact type flow meter Outline diagram

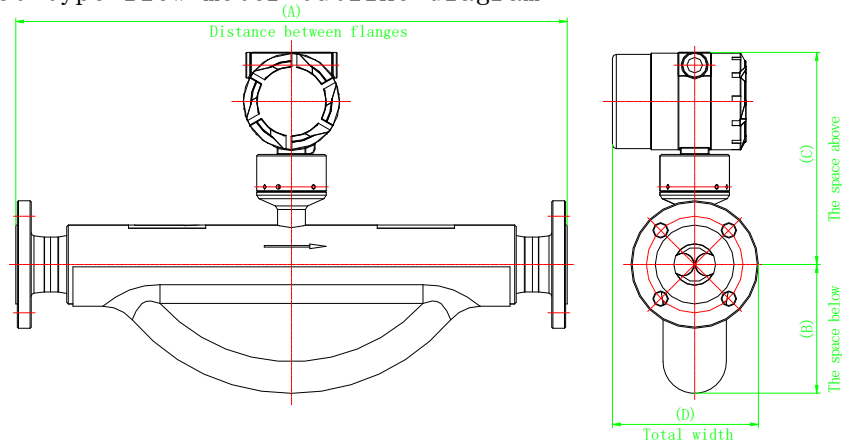


Figure2.2 Micro-bending sensor outline diagram  
(Sensor transmitter integrated)

(2) Compact type flow meter Installation Dimensions

Table 2.4

| Size | A   | B   | C   | D     | Weight |
|------|-----|-----|-----|-------|--------|
|      | mm  | mm  | mm  | mm    | kg     |
| 008  | 370 | 75  | 263 | 173   | 13     |
| 015  | 404 | 93  | 263 | 173   | 14     |
| 025  | 440 | 112 | 266 | 173   | 17     |
| 040  | 550 | 138 | 266 | 181.5 | 22     |
| 050  | 715 | 167 | 278 | 189   | 34     |
| 080  | 840 | 202 | 296 | 206.5 | 55     |

(3) Sanitary micro-bending tube mass flowmeter integrated outline diagram

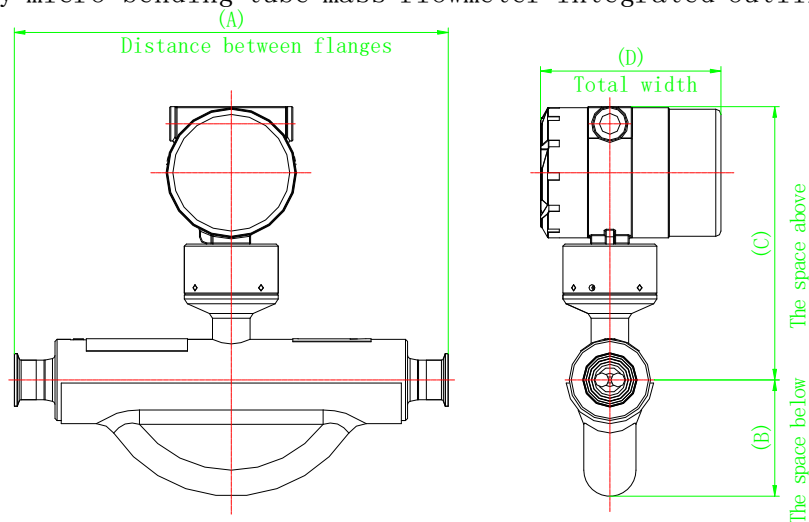


Figure2.3 Sanitary micro-bending sensor schematic diagram of appearance  
(Integrated sensor converter)  
(4) dimension table

Table 2.5

| Size  | A   | B   | C   | D     | Weight |
|-------|-----|-----|-----|-------|--------|
|       | mm  | mm  | mm  | mm    | kg     |
| 008WS | 351 | 75  | 263 | 173   | 12     |
| 015WS | 381 | 93  | 263 | 173   | 13     |
| 025WS | 417 | 112 | 266 | 173   | 15     |
| 040WS | 516 | 138 | 266 | 181.5 | 18     |
| 050WS | 667 | 167 | 278 | 189   | 29     |
| 080WS | 787 | 202 | 296 | 206.5 | 47     |

### 3. Selection, installation and use of micro-bending tube flowmeter

#### 3.1 Selection

The selection of mass flowmeter should generally consider the following principles:

##### 3.1.1 Media scope and safety

The testability of the medium: Coriolis mass flowmeter can measure a wide range of fluids, but there are some occasions not suitable for direct selection. For example, the mass flow rate (gas mixed together in a gas mass in a liquid fluid), the pulsating flow rate (fluid transported by a low-speed plunger pump), and so on. In these occasions need to use mass flow timing must take corresponding auxiliary measures.

Corrosion of the medium: the standard mass flow meter sensor tube material is 316L stainless steel, the housing is 304 stainless steel. When selecting, it must be confirmed that the sensor material (especially the vibration tube material) has good anti-corrosion ability for medium measurement. If the above materials are not suitable, anti-corrosion sensors should be selected.

Medium temperature, instrument pressure grade: standard model sensor medium suitable for the temperature range of  $-20 \sim 200^{\circ}\text{C}$ , pressure resistance of 4MPa, when the use of conditions beyond this range must be selected special specifications of the sensor.

Environmental conditions of use: The flowmeter technical manual indicates the ambient temperature conditions for the use of sensors and

transmitters. When the instrument is used beyond the specified conditions, it may not be displayed normally, and other phenomena must be paid attention to when it is installed outdoors in cold areas and used in high temperature environments, and corresponding measures must be taken.

Explosion-proof and protective performance: The explosion-proof standard of our product transmitter is flameproof type, and the explosion-proof standard of the sensor is safe spark type, and attention should be paid to whether the explosion-proof mark is suitable for the explosion-proof level of the use environment. The protection level of the transmitter is IP67, which can generally be installed and used directly outdoors, and corresponding measures should be taken when it is often wet.

### **3.1.2 Rationality of flow measurement parameters**

Coverage of the meter measurement range: Being able to cover the entire flow measurement range is required for the safe operation of the instrument. It is necessary to avoid blindly pursuing the measurement accuracy and choosing a smaller range, which may cause the measurement to exceed the range.

The use of the best measuring range and the accuracy of the instrument: the normal measuring range of the mass flowmeter is selected in 1/3 to 2/3 of the standard range. At this time, not only can the basic measurement accuracy be guaranteed, but also the pressure loss is relatively small. Use in too small range may cause a decrease in the actual measurement accuracy, and use in the upper range may cause an increase in pressure loss.

### **3.1.3 Allow for pressure loss consideration**

Instrument selection must consider the instrument pressure loss within a reasonable range (especially when reducing the size of the sensor), too large pressure loss will waste energy, blindly pursue to reduce the pressure loss, may increase the measurement error. range parameter table gives the standard range and the upper limit range, we suggest that the user should generally choose the range within the standard range.

### **3.1.4 Flowmeter maintainability and other related factors**

This includes the convenience of installation and maintenance of the instrument; The suitability of the instrument power supply; Signal transmission and monitoring needs.

## **3.2 Installation**

### **3.2.1 Preparation for flowmeter installation**

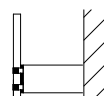
When unpacking the meter, make sure there is no visible damage during transportation. In case of damage, please contact the carrier for compensation.

Instruments have been thoroughly tested and inspected before shipping. If nothing else is required, the meter should include the following items:

- Mass flowmeter;
- Mounting bracket with split-type transmitter wall mount (not equipped with this device for one type);
- Operating instructions;
- Packing list and product certificate;
- Screwdrivers for meter mounting and terminal mounting;
- Factory and material proof as required by the contract.
- If any of these items are missing, please contact your nearest office.
- If your instrument requires a flange connection when ordering, the flange will be provided according to the order requirements. Please check the flange specifications according to your initial order.

### 3.2.2 Basic requirements for flowmeter installation

- 1) The sensor installation of mass flow meter should make the sensor flow direction mark consistent with the fluid flow direction, and the installation indicating arrow is on the side of the sensor nameplate bracket;
- 2) Coriolis mass flowmeter is a flow meter measured according to the principle of measuring pipe vibration, so the sensor installation should consider the relevant pipelines to do solid support, to avoid vibration of the instrument and related pipelines;
- 3) Allow to support the instrument body, it is recommended to install in the downstream of the pump (to prevent the measurement tube from vacuum-pumping);
- 4) If strong pipeline vibration is unavoidable, it is recommended to use flexible pipes to isolate the pipeline system from the instrument sensor;
- 5) The connecting flange faces should be parallel to each other during installation, so that the center of the two flanges is located on the same axis to avoid additional stress;
- 6) When measuring the liquid flow, ensure that the fluid flows from the bottom up as much as possible. At the same time, avoid installing the instrument at the highest point of the pipeline to prevent gas accumulation in the pipeline from affecting the normal operation of the instrument.
- 7) The meter can be installed horizontally, in an upward sloping pipe or vertically. For best results, vertical installation is recommended,



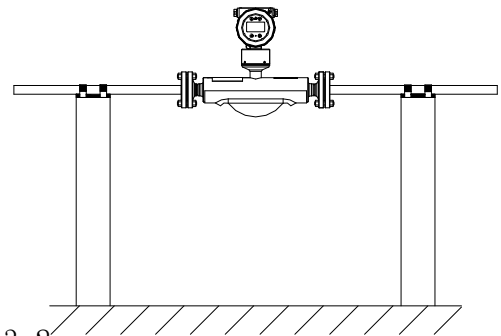
with the flow direction up but the lateral installation must be avoided (at this time, the vibration tube is not only affected by Coriolis force, but also by the gravity of the vibration tube, so that the measurement can not be carried out properly).

### 3.2.3 Installation of flow sensors

- 1) In general, when measuring the flow of liquid medium, small amount of particulate matter medium and gas medium, vertical installation should be adopted, installed at the lowest point of the vertical pipeline, and the medium flows upward to avoid gas or liquid accumulation in the vibration tube, affecting the normal measurement.

Figure3.1 Vertical installation of the sensor

- 2) If the measuring medium is pure liquid, you can also install it horizontally. You are advised to install the instrument at the lowest place in the entire system to ensure that the instrument is full to avoid gas accumulation and measurement errors.



The installation diagram is shown in Figure 3.2.

Figure3.2 Sensor horizontal installation diagram

- 3) When measuring the flow rate of liquid medium, small amount of particulate matter medium and gas medium, it can be installed at an Angle and the medium flows upward to avoid gas or liquid accumulation in the vibration tube and affect the normal measurement.

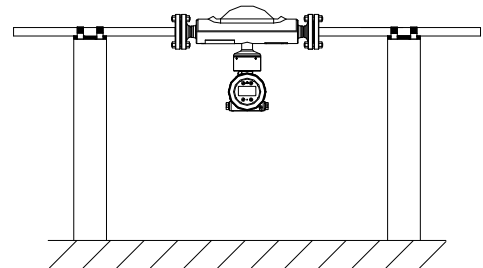
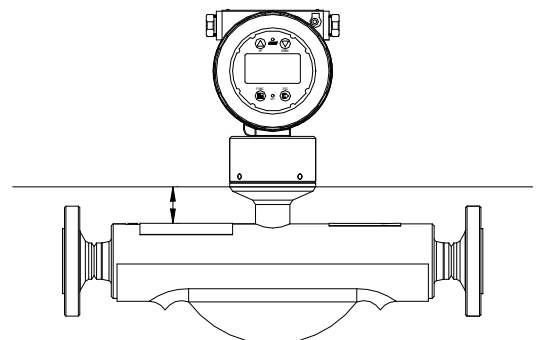


Figure3.3 Sensor Angle installation diagram

- 4) Insulation and heating installation. If insulation is required on site, a series of materials can be used for insulation



treatment, and the insulation layer should not exceed the position shown in the diagram.

Electric heating can be used, but it is important to note that the heating layer should not exceed the position shown in the diagram. The liquid/steam jacket heat tracing is installed according to the heat tracing interface provided by the instrument.

It is recommended to use reinforced flexible hoses to connect the heating sleeve to the heat source.

Figure3.4 Schematic diagram of the heat preservation and heating type micro-bend mass flowmeter

#### 5) Incorrect installation introduction

Horizontal installation, long distance vertical descent after flowing through the instrument, not recommended.

The flow meter is installed at the highest point of the pipe, which can cause air accumulation.

The flow meter is installed directly at the outlet of the downward vent pipe, and this installation is not recommended

Flow regulating valves are not allowed to be installed upstream of the flow meter. If necessary, install them downstream of the flow meter.

Transverse installation, the vibration tube is not only affected by Coriolis force, but also by the vibration tube gravity, so that the measurement can not be carried out normally.

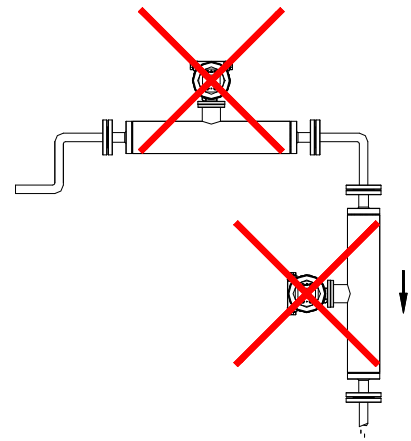


Figure3.5 Installation Introduction 1

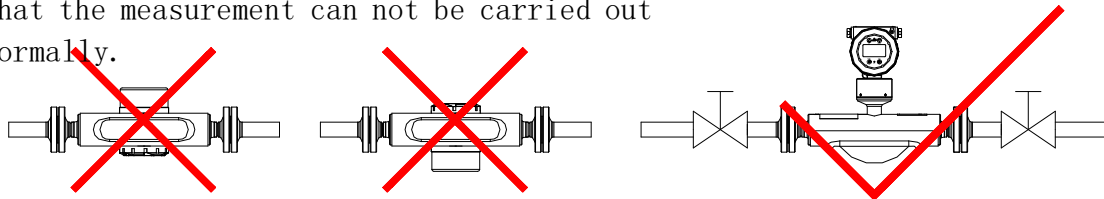


Figure3.6 Installation Introduction 2

#### 3.2.4 Flowmeter lifting

The following points should be noted during transportation:

- Do not remove the original packaging during transportation.

- Do not remove the protective cover on the process connector. Otherwise, the sealing surface of the process connector may be damaged mechanically during transportation or storage, and foreign matter may not enter the measuring tube.
- Use a mesh soft rope to wrap around the process connection at both ends. Do not wrap the rope around the transmitter shell or the shell of the cable connecting chamber. Do not use a chain to avoid damage to the shell. (Figure 3.7)

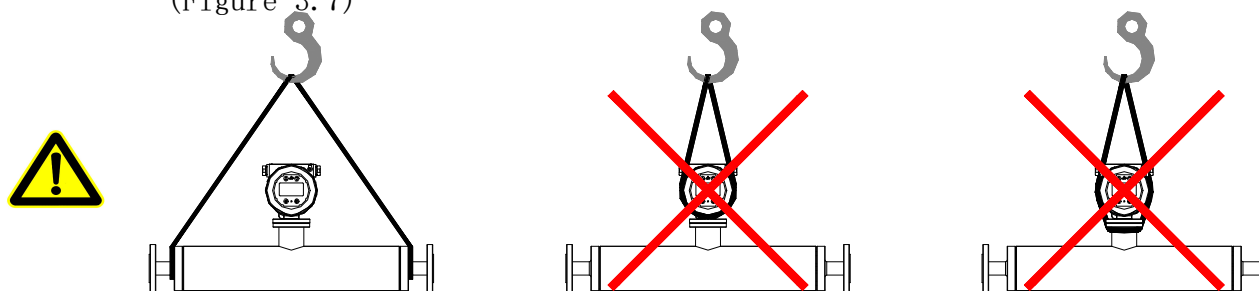


Figure 3.7 Flowmeter lifting

### 3.2.5 Flow meter cleaning

The instrument is sealed with dry protective gas at the factory, so entering any wet gas will damage the instrument. Do not disassemble the sealing structure of the instrument on site without authorization, otherwise the instrument will be damaged. If in doubt, contact the manufacturer for guidance.

Instrument cleaning can refer to the pipeline cleaning method, it is recommended to use CIP, but it must be carried out at the rated temperature and pressure of the instrument nameplate, the use of cleaning media to fully consider the material characteristics of the instrument, do not use hard objects during the cleaning process to dredge the internal pipeline, so as to avoid damage to the internal vibration pipe and affect the measurement accuracy.

In special cases, it must be disassembled and cleaned. Be sure to ensure that the front and back shell and fastening screws of the transmitter instrument are tightened, the explosion-proof plugs on both sides of the instrument are fully sealed, the sensor part can be invaded into the water, the instrument connection and the transmitter can not be invaded into the water, and can only be washed with low pressure water. As shown in the figure

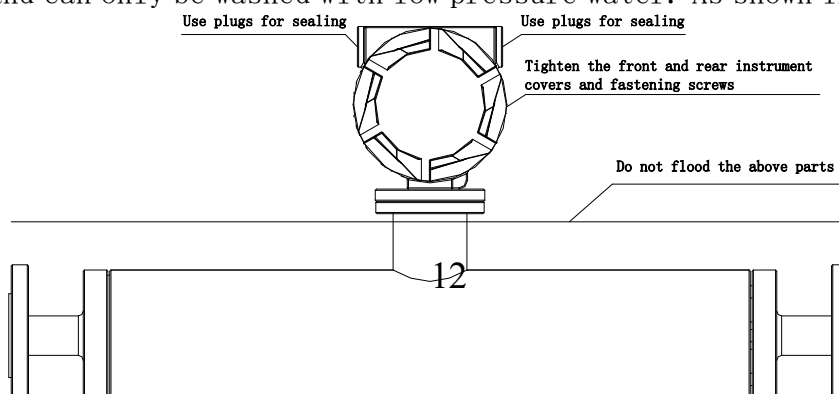


Figure 3.8 Flowmeter cleaning

## 4. Flow meter operation



### 4.1 Zero point adjustment of flowmeter

The initial installation of the flowmeter may produce installation stress, which may cause the zero point of the flowmeter to change, resulting in measurement errors. Therefore, the zero point of the flowmeter must be checked after the initial installation of the flowmeter. If the zero point changes, the zero point correction operation should be performed

※ Mass flowmeter is a full tube flowmeter, whether in the running or static state need to ensure that the full tube (completely empty is also regarded as full tube), dissatisfied tube will cause the meter measurement abnormal, serious will stop working!!!

#### 4.1.1 Prepare the conditions

- 1) After the flow meter is powered on, preheat for 10 minutes;
- 2) Make the measured fluid flow through the sensor until the temperature of the sensor is the same as that of the measured fluid;
- 3) Close the downstream and upstream valves of the sensor, if present, so that the fluid in the sensor is stationary, and confirm that the fluid has been cut off and the fluid has filled the sensor.
- 4) Before calibration, the density parameter of the instrument panel can be used to determine whether the flowmeter is in a full tube state (the density should be consistent with the density value displayed during operation).
- 5) Before calibration, be sure to ensure that the medium in the flow meter is full and does not flow, and there is no abnormal phenomenon such as deposition, wall hanging, and gas-liquid mixing during calibration!! Otherwise, it will cause zero deviation, which has a huge impact on the measurement accuracy!!

#### 4.1.2 Calibrate and wait for completion

Select "Basic Settings > Enter Password > Zero Calibration > Yes" from the system menu to perform calibration and wait for the calibration procedure to complete

#### 4.1.3 If zero calibration fails

- 1) Confirm that the sensor is full of fluid and the fluid is completely stationary;
- 2) Ensure that the fluid does not contain particles that may precipitate;
- 3) Repeat zero calibration procedure;
- 4) If the failure occurs again, contact the manufacturer.

### 4.2 Flowmeter operation and maintenance

The mass flowmeter is determined by its structural characteristics and generally does not require special maintenance in use. However, in some special use states, appropriate maintenance measures should be taken to ensure the accurate and reliable operation of the flowmeter. For example:

- 1) If there are particles in the fluid that may accumulate in the vibration tube, it should be checked and excluded regularly to avoid affecting the normal use of the flowmeter;
- 2) When the measuring medium may adhere to the inner wall of the vibration tube, it should be regularly purged to avoid affecting the normal use of the flowmeter;
- 3) When there are particles in the measuring medium and it is possible to wear the vibration tube, it should be checked and treated in time.

### 4.3 Common faults and solutions

During the first installation and use, if the flow meter is found to work abnormally, the cause of the failure should be determined.

Failure causes can be divided into two types: application problems and flowmeter system problems. The application problem is more complex, such as the measurement fluctuation error caused by the change of process and medium state, should be analyzed according to the actual situation.

**Common Troubleshooting Table**  
**Table 4.1**

| Fault phenomenon        | Reason                                                                                                                                                                                                                          | Solution                                                                                                                                                                        |
|-------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Large zero drift</b> | <ol style="list-style-type: none"> <li>1. Whether the medium in the flowmeter is full of tube and does not flow</li> <li>2. Whether the installation pipeline of the flowmeter is fixed, and whether there is strong</li> </ol> | <ol style="list-style-type: none"> <li>1. Make the flow meter full of liquid , close the valve at both ends of the flow meter</li> <li>2. Add holder or use flexible</li> </ol> |

|                                  |                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                             |
|----------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                  | source or frequency transmitter interference nearby<br>3. The sensor is installed with stress                                                                                                                                                                                                     | pipe connection<br>3. The connection pipe is coaxial with the flowmeter                                                                                                     |
| <b>Instantaneous flow error</b>  | 1. Whether the actual flow range exceeds the maximum set range of the flowmeter<br>2. Whether the installation pipeline of the flowmeter has strong vibration<br>3. Check whether the zero of the flow meter is normal<br>4. Check the FO and DP value to see if the flow meter is problem or not | 1. Reduce pipe flow or reset meter flow range<br>2. Add holder or use flexible pipe connection<br>3. Calibrate zero<br>4. If the flow meter problem, contact with factory   |
| <b>Density shows instability</b> | 1. Check the FO value in the transmitter or MODBUS, (Normal value >200HZ, and stable)<br>2. Check whether the sensor pin parameters are normal                                                                                                                                                    | 1. Check if there is bubble in the pipe and find the reason (The installation position of the regulating valve is not correct)<br>2. If problem please contact with factory |
| <b>Flow meter no display</b>     | 1. Check the power supply is normal or not<br>2. Measure whether the 24V power supply of the junction plate is normal                                                                                                                                                                             | Check the power supply voltage and wiring terminals to ensure the normal operation of 24V power supply                                                                      |
| <b>Communication no signal</b>   | Check the communication line for reverse connection or short connection                                                                                                                                                                                                                           | Check the wiring or AB switch the wiring                                                                                                                                    |

## 5. transmitter wiring and instructions

### 5.1 Hardware instruction

#### Normal working condition

- Atmospheric pressure: 86kPa ~ 106kPa
- Ambient temperature: -40°C to +60°C
- Relative humidity: 35% ~ 95%
- Power supply voltage: 22 ~ 245V AC or DC
- Power consumption: Power  $\leq 15W$
- Communication interface: 4 ~ 20mA current ring (error  $\leq \pm 0.005mA$ ), pulse 0 ~ 10kHz, RS485

#### 5.1.1 Install the transmitter

The compact transmitter requires no additional installation

Diagram of remote installation of the transmitter

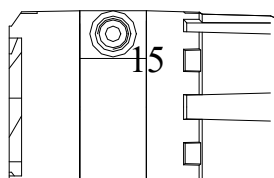
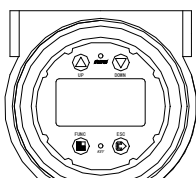


Figure 5.1 installation diagram of the remote transmitter



### 5.1.2 Rotate the transmitter housing and the display

#### 1) transmitter housing rotation

- Remove the fastening screws
- Carefully remove the transmitter cover
- Rotate the transmitter housing into position (90° in any direction)
- Tighten the fastening screws

#### 2) transmitter display rotation

- Unscrew the transmitter panel cover locking block.
- Unscrew the electronic component panel cover.
- Remove the screws fastening the display panel and remove the display panel.
- Rotate display panel to desired position, plug back into socket, and install 4 fastening screws.

Note: Make sure to align the installation with the socket!

- Replace cover and tighten by hand. Install locking block.

### 5.1.3 Connect cables to the transmitter terminal



Table show the name of terminals, Figure show the wiring method,

Current 2 have HART (optional) .

Table 5.1

wiring

Definition of

terminal

| The 1 <sup>st</sup> line signal terminals | Signal Descriptions |
|-------------------------------------------|---------------------|
| 1                                         | RS485+              |
| 2                                         | RS485-              |
| 3                                         | Current output 1+   |
| 4                                         | Current output 1-   |
| 5                                         | Current output 2+   |
| 6                                         | Current output 2-   |
| 7                                         | Frequency output +  |
| 8                                         | Frequency output -  |
| The 2 <sup>nd</sup> line signal terminals | Signal Descriptions |
| 1                                         | Power +             |
| 2                                         | Power -             |
| 3                                         | Shielding Grounding |

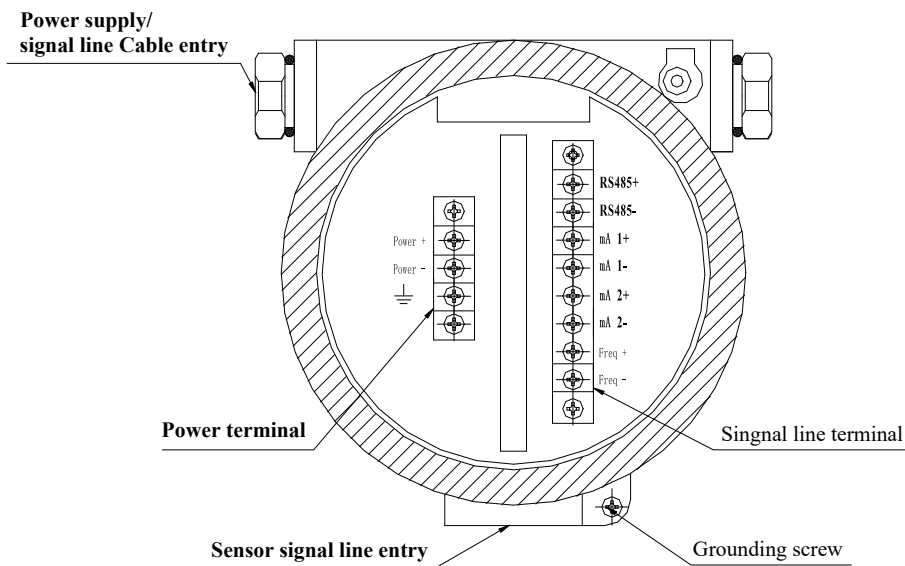


Figure5.2 Transmitter wiring mode

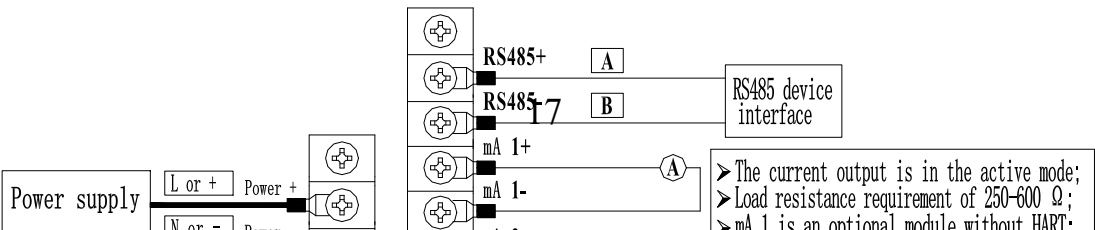


Figure 5.3 Transmitter wiring diagram



#### 5.1.4 Specific requirements for electrical wiring

##### 1) Special cables are used

The connection between the terminal box and the transmitter should be a special cable, can not be used with other cables, so as not to affect the measurement error (separate installation).

##### 2) Cabling Cables independently

The lead wire between the sensor and the transmitter should be routed separately. Do not cover the motor and other power equipment to avoid the impact of electromagnetic field on the measurement. The length of the lead wire should not exceed the maximum allowable distance of 100 meters (separate installation).

##### 3) Grounding

###### ● Grounding through the sensor terminal

If the pipeline system is connected to the ground, the sensor ground terminal can be directly connected to the pipeline system.

###### ● Ground through the transmitter terminal

If the pipe is not conducting or floating, the transmitter ground terminal can be directly connected to the meter protective ground access point.

Improper grounding may increase measurement errors. The grounding cable should be as short as possible, and the grounding resistance should be less than 1 ohm.

#### 4) Drip protection

- All housing screws, housing covers and cable inlet gran heads must be tightened.
- The shell sealing gasket must be kept clean and intact when inserted into the sealing slot. The gasket can be dried, cleaned and replaced if necessary
- All wiring should be set up drip protection, that is, the cable inlet of the flow meter, the cable and the threading pipe should be bent downward to avoid water, resulting in short circuit.
- In the absence of protective measures, all cable inlet face should not face upward.
- The unwanted cable inlet should be sealed with a plug.

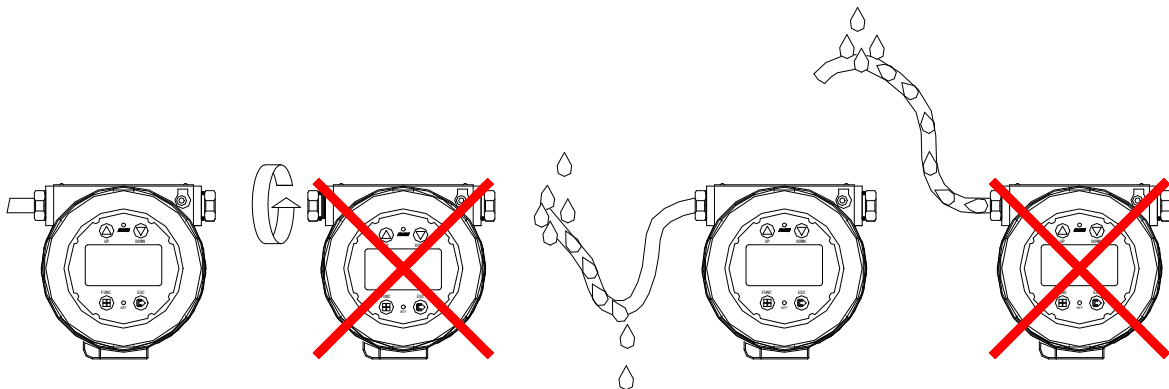


Figure 5.4 Schematic diagram of drip protection

## 5.2 Software operating procedure

### 5.2.1 List of software functions

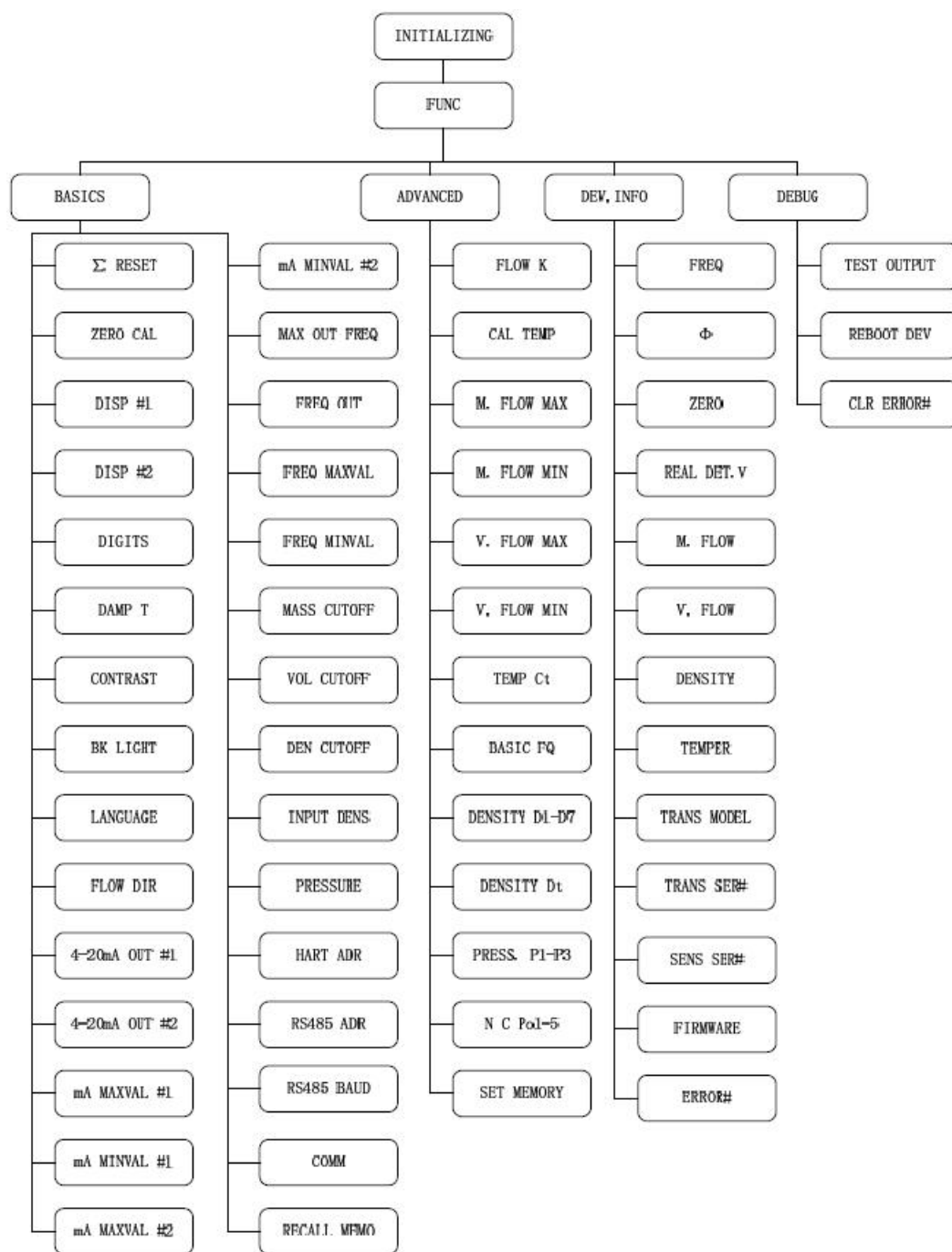


Figure 5.5 List of software functions

### 5.2.2 Button function

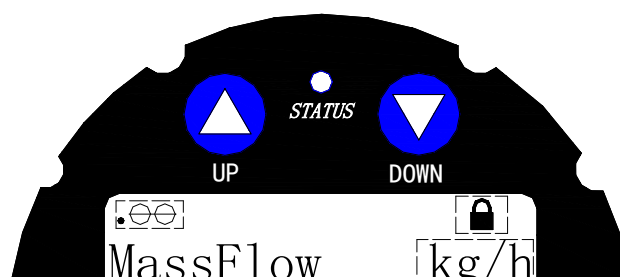


Figure 5.6 diagram of buttons

UP: move up the selection cursor

DOWN: move down the selection cursor

FUNC: function selection (main interface), confirm (setting interface)

ESC: exit the current menu

Note: The button is capacitive touch type, Use finger to touch the button to achieve the corresponding function

### 5.2.3 Interface description

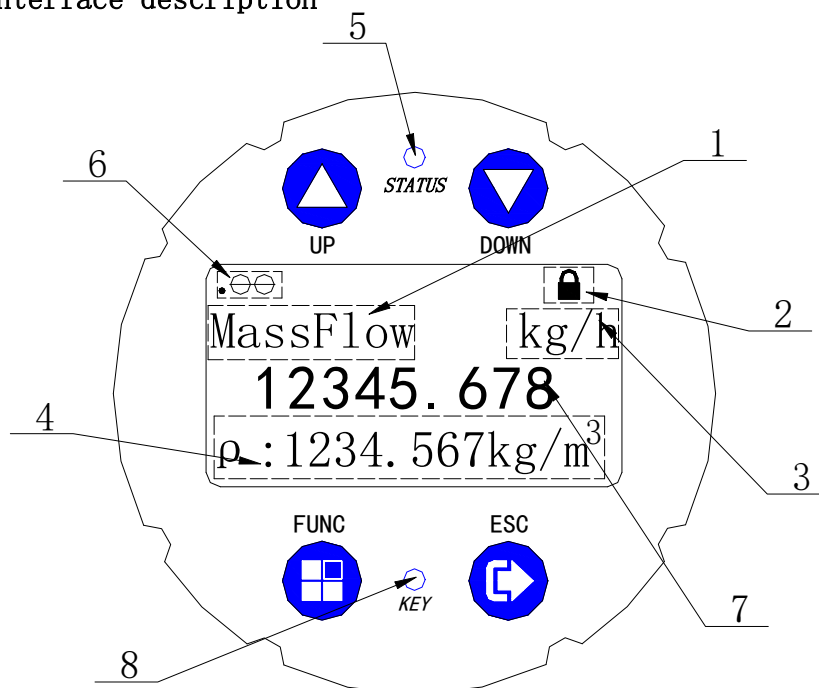


Figure 5.7 Display the interface

1) DISP #1

Any one of the following six variables can be displayed: mass flow, volume flow, total mass, total volume, density, temperature. User can set in “BASICS->DISP #1 menu” .

## 2) Keyboard lock logo

🔓: the keyboard has been unlocked

🔒: the keyboard has been locked

## 3) DISP #1 unit

User can set in “BASICS ->DISP #1 menu” .

## 4) DISP #2

Any one of the following six variables can be displayed: mass flow, volume flow, total mass, total volume, density, temperature. Also measurement value, unit and variable code of DISP #2 can be displayed. At the main interface, the auxiliary display variable can be switched by UP and DOWN keys.

You can set the unit of DISP #2 in “BASICS ->DISP #2 menu” .

Table 5.2 DISP #2 code

| Mass flow | Total mass | Volume flow | Total volume | Density | Temperature |
|-----------|------------|-------------|--------------|---------|-------------|
| $Q_m$     | $\Sigma m$ | $Q_v$       | $\Sigma v$   | $\rho$  | $t$         |

## 5) Keyboard status indicator lights

Green light is for unlocking and pressing keys

Red light is for locking or not pressing keys

## 6) Decimal cutoff indicate

When the integer length of DISP #1 or DISP #2 is too long, the display digits will be intercepted. You can set display digits in “BASICS -> DIGITS”

## 7) DISP #1 measurement value

Displayed updating time and damping time set by device is the same, with reference to damping

## 8) Key indicator

When the button is triggered, the indicator lights.

### 5.2.4 Lock and unlock

#### 1) Lock

If no operation lasts for 30 seconds, the screen will lock automatically, and lock screen icon will appear.

#### 2) 4.2 Unlock

Press and hold UP and DOWN buttons for 6 seconds, when the indicator light turns green, that means unlocking is successful, then unlocking icon will appear.

### 5.2.5 System menu setting structure

#### 1) Set the menu access method

In the main interface, press FUNC to enter system setting menu, and press UP or DOWN to select function.

Table 5.3 Main interface menu table

|           |
|-----------|
| BASICS    |
| ADVANCED  |
| DEV. INFO |
| DEBUG     |

#### 2) Selection function

Press the FUNC button to enter the selection function, you need to input password to enter BASICS and ADVANCED.

### 5.2.6 Set the basic menu structure

Enter the system setting menu and select BASICS, press FUNC to confirm, enter the password by direction button (initial password is 17), press FUNC to confirm and enter menu, press ESC to exit to the main interface.

## 1) Parameter Modification

Enter BASICS menu, using the UP and DOWN keys to select the submenu. Press the FUNC key to modify and select the parameters by the UP and DOWN keys. Press the FUNC key to confirm or press ESC to cancel.

Table 5.4 Basic Settings menu and parameters

| Serial No. | Menu          | Setting Method | Parameters Range                                                  |
|------------|---------------|----------------|-------------------------------------------------------------------|
| 1          | DISP #1       | Option         | Mass flow/volume flow/total mass/total volume/density/temperature |
| 2          | DISP #2       | Option         | Mass flow/volume flow/total mass/total volume/density/temperature |
| 3          | DIGITS        | Set data       | 0~3                                                               |
| 4          | DAMP T        | Set data       | 0~60.0s                                                           |
| 5          | CONTRAST      | Set data       | 25~50                                                             |
| 6          | BK LIGHT      | Option         | Open/close                                                        |
| 7          | LANGUAGE      | Option         | Chinese/English                                                   |
| 8          | FLOW DIR      | Option         | Positive/ reverse/ bidirectional/ absolute value                  |
| 9          | MASS CUTOFF   | Set data       | 0~50%                                                             |
| 10         | 4~20mA OUT #1 | Option         | Mass flow/volume flow/density/temp.                               |
| 11         | 4~20mA OUT #2 | Option         | Mass flow/volume flow/density/temp.                               |
| 12         | mA MAXVAL #1  | Set data       | -60000~60000<br>(unit is the same as range)                       |
| 13         | mA MINVAL #1  | Set data       | -60000~60000<br>(unit is the same as range)                       |
| 14         | mA MAXVAL #2  | Set data       | -60000~60000<br>(unit is the same as range)                       |
| 15         | mA MINVAL #2  | Set data       | -60000~60000<br>(unit is the same as range)                       |
| 16         | MAX OUT FREQ  | Set data       | 0.0000~10.0000kHz                                                 |
| 17         | FREQ OUT      | Option         | Mass flow/volume flow                                             |
| 18         | FREQ MAXVAL   | Set data       | -60000~60000<br>(unit is the same as range)                       |
| 19         | FREQ MINVAL   | Set data       | -60000~60000<br>(unit is the same as range)                       |
| 20         | MASS CUTOFF   | Set data       | 0~50%                                                             |
| 21         | VOL CUTOFF    | Set data       | 0~50%                                                             |
| 22         | DEN CUTOFF    | Set data       | 0.000~1.000g/cm <sup>3</sup>                                      |
| 23         | INPUT DENS    | Set data       | 0.0000~3.0000g/L                                                  |

|    |             |          |                     |
|----|-------------|----------|---------------------|
| 24 | PRESSURE    | Set data | 0.00~99.00MPa       |
| 25 | RS485 ADR   | Set data | 0~31                |
| 26 | RS485 BAUD  | Option   | 1200/2400/4800/9600 |
| 27 | COMM        | Option   | RS485/HART          |
| 28 | RECALL MEMO | Option   | Yes/No              |
| 29 | RESET       | Option   | Yes/No              |
| 30 | ZERO CAL    | Option   | Yes/No              |

### 5.2.7 Advanced Settings menu structure

Enter the main menu and select the ADVANCED setting, press the FUNC key to confirm, enter the password by direction key (User password 987), press FUNC key to confirm and enter the menu, press the ESC key to exit to the main interface.

Table 5.5 Advanced Settings menu and parameters

| Serial No. | Menu        | Setting Method | Parameters Range                             |
|------------|-------------|----------------|----------------------------------------------|
| 1          | FLOW K      | Set data       | 0~9999.99                                    |
| 2          | CAL TEMP    | Set data       | -50.0~100.0                                  |
| 3          | M. FLOW MAX | Set data       | 0~60000<br>Unit: t/h, kg/h, g/h              |
| 4          | M. FLOW MIN | Set data       | 0~60000<br>Unit: t/h, kg/h, g/h              |
| 5          | V. FLOW MAX | Set data       | 0~60000<br>Unit:m <sup>3</sup> /h, L/h, mL/h |
| 6          | V. FLOW MIN | Set data       | 0~60000<br>Unit:m <sup>3</sup> /h, L/h, mL/h |
| 7          | TEMP Ct     | Set data       | -999.999~999.999                             |
| 8          | BASIC FQ    | Set data       | 0~500.00                                     |
| 9          | DENSITY D1  | Set data       | -999.999~999.999                             |
| 10         | DENSITY D2  | Set data       | -999.999~999.999                             |
| 11         | DENSITY D3  | Set data       | -999.999~999.999                             |
| 12         | DENSITY D4  | Set data       | -999.999~999.999                             |
| 13         | DENSITY D5  | Set data       | -999.999~999.999                             |
| 14         | DENSITY D6  | Set data       | -999.999~999.999                             |
| 15         | DENSITY D7  | Set data       | -999.999~999.999                             |
| 16         | DENSITY Dt  | Set data       | -50~100.0                                    |
| 17         | PRESS. P1   | Set data       | -999.999~999.999                             |
| 18         | PRESS. P2   | Set data       | -999.999~999.999                             |
| 19         | PRESS. P3   | Set data       | -999.999~999.999                             |
| 20         | N C Po1     | Set data       | 0~150 -50~50.00                              |
| 21         | N C Po2     | Set data       | 0~150 -50~50.00                              |
| 22         | N C Po3     | Set data       | 0~150 -50~50.00                              |
| 23         | N C Po4     | Set data       | 0~150 -50~50.00                              |
| 24         | N C Po5     | Set data       | 0~150 -50~50.00                              |
| 25         | SET MEMORY  | Option         | Yes/No                                       |

Enter ADVANCED menu and select the submenu by the UP and DOWN keys. Press the FUNC key to modify and select the parameters by the UP and DOWN keys. Press the FUNC key to confirm and press ESC to cancel. The ADVANCED menu and parameters are shown in Table 5.5.

### 5.2.8 Display setting

#### 1) DISP #1 setting

DISP #1 can be set separately for mass flow, volume flow, total mass, total volume, density, temperature.

Table 5.6 Display variable type and unit

| Display variable | Display variable unit |                   |                     |       |                   |        |         |                   |
|------------------|-----------------------|-------------------|---------------------|-------|-------------------|--------|---------|-------------------|
| Mass flow        | g/s                   | g/min             | g/h                 | kg/s  | kg/min            | kg/h   | kg/day  | t/s               |
|                  | t/min                 | t/h               | t/day               | lb/s  | lb/min            | lb/h   | lb/day  |                   |
| Volume flow      | ml/s                  | ml/min            | ml/h                | L/s   | L/min             | L/h    | L/day   | m <sup>3</sup> /s |
|                  | m <sup>3</sup> /min   | m <sup>3</sup> /h | m <sup>3</sup> /day | Gal/s | Gal/min           | Gal/h  | Gal/day |                   |
| Total mass       | g                     | kg                | t                   | lb    | —                 | —      | —       | —                 |
| Total volume     | ml                    | L                 | m <sup>3</sup>      | Gal   | —                 | —      | —       | —                 |
| Density          | g/cm <sup>3</sup>     | g/L               | g/ml                | kg/L  | kg/m <sup>3</sup> | lb/Gal | —       | —                 |
| Temperature      | °C                    | °F                | —                   | —     | —                 | —      | —       | —                 |

Setting method for DISP #1: BASICS →Input password → DISP #1 setting  
 →Select the type of display variables →Select the display unit.

## 2) DISP #2 setting

Same as DISP #1

DIGITS Setting: BASICS →Input password → DIGITS → Set digits

## 3) DIGITS

DIGITS setting range is 0-3, when DISP #1 or DISP #2 automatically intercepts digits because of too long integer bits, “00” will be displayed at the upper left corner of the screen, which means the current displayed values have decimal digits to be intercepted..

DIGITS Setting: BASICS →Input password → DIGITS → Set digits

## 4) CONTRAST

Setting value is 25-50, set the contrast of the current LCD. LCD contrast setting method: BASICS →Input password → CONTRAST →Set the contrast value

## 5) BK LIGHT

You can select backlight-off when the transmitter LCD is in a bright place; You can select backlight - on under dark environment.

The setting method for BK LIGHT: BASICS →Input password → BK LIGHT  
 →Select the backlight state

## 6) LANGUAGE

Chinese and English are optional

Language setting methods: BASICS -> Input password -> LANGUAGE -> Select the language type

### 5.2.9 Measurement setting

#### 1) DAMP TIME

This setting is used to eliminate the small and dramatic fluctuations during measurement process. The damping value sets the reaction time of transmitter response to the change of process variable (Unit is second and setting range is 0-60S). This setting value will affect the response speed of mass flow, volume flow and density and not affect the total mass and total volume.

- Higher damping value makes the measurement value change significantly smoother, the change for display, current output and frequency output is slower;
- Lower damping value makes the measurement value change more quickly, the change for display, the current output
- and the frequency output is faster;
- Imposing higher damping value on fast and intense flow changes may result in measurement error;
- As long as the damping value is not zero, the measurement value will lag behind the actual change value, since the measurement value is an average over time; Generally, low damping value is preferred because of a low probability of data loss and shorter lag time between the actual changed value and the measurement value;
- For gas applications, it is recommended to set the damping to 2.56 or higher.
- Updating damping setting: BASICS -> Input Password -> DAMP T -> Modify

damp values

## 2) Small signal cutoff

This setting specifies the minimum measurement values, the measurement value which is lower than the cutoff value will be displayed as 0; This setting includes mass flow cutoff, volume flow cutoff and density cutoff.

Mass flow cutoff setting range is 0-50% of range, 2 display digits;

Volumetric flow cutoff setting range is 0-50% of range, 2 display digits;

Density cutoff setting range is 0-1g/cm<sup>3</sup>, 3 display digits;

Volume flow cutoff does not affect the measurement value of mass flow and density; Mass flow cutoff and density cutoff will affect the measurement value of volume flow; The measurement value of volume flow is calculated by the density;

Mass flow cutoff setting method: BASICS -> Input password -> MASS CUTOFF  
-> Modify the mass flow cutoff

Volume flow cutoff setting method: BASICS -> Input password -> VOL CUTOFF  
-> Modify the volume flow cutoff

Density cutoff setting method: BASICS -> Input password -> DEN CUTOFF  
-> Modify the density cutoff

Note: The Display of measurement value, frequency output and current output are to undergo the small signal cutoff.

## 3) INPUT DENS

For the volume flow measurement of the known fluid density, when the input density is not 0, then the volume flow calculation will ignore the actual density measurement value, use the input density as a reference of volume flow. Input the density unit is g/cm<sup>3</sup>, input range is 0-3g/cm<sup>3</sup>, display digit is 4.

Setting method: BASICS → Input password → INPUT DENS → modify the fluid density

#### 4) FLOW DIR

Flow direction will determine how the fluid forward flow and reverse flow affect the measurement value, the current output value and frequency output value.

- Forward flow: in accordance with flow direction arrow on the sensor;
- Reverse flow: in contrast to the flow direction arrow on the sensor;

Table 5.7 Flow option table

| Flow direction setting | The relation with sensor arrow                                                              | The relation with displayed value                                                                                                                                                                                                               |
|------------------------|---------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Forward                | Apply to the same in the direction of the flow arrow and most of the traffic situation      | Forward flow displayed value is the measurement value;<br>Direction flow displayed value is 0;<br>Forward flow total mass and total volume increase;<br>Reverse flow total mass and total volume are not changed.                               |
| Reverse                | Apply to the opposite in the direction of the flow arrow and most of the traffic situation  | Direction flow displayed value is 0;<br>Forward flow displayed value is the measurement value (no minus sign) ;<br>Forward flow total mass and total volume are not changed;<br>Reverse flow total mass and total volume increase.              |
| Absolute value         | Regardless of the direction of arrow                                                        | Forward flow displayed value is the measurement value;<br>Direction flow displayed value is the measurement value (no minus sign) ;<br>Forward flow total mass and total volume increase;<br>Reverse flow total mass and total volume increase. |
| Bidirection            | Apply to the forward flow and reverse flow, and forward and reverse flow can not be ignored | Forward flow displayed value is the measurement value;<br>Direction flow displayed value is the measurement value (with minus sign) Forward flow total mass and total volume increase;<br>Reverse flow total mass and total volume decrease.    |

- The effect of flow direction on current output

Flow direction will affect the current output type only when the current output configuration at mass flow or volume flow.

The influence of the flow direction on the current output depends on the current lower limit parameter:

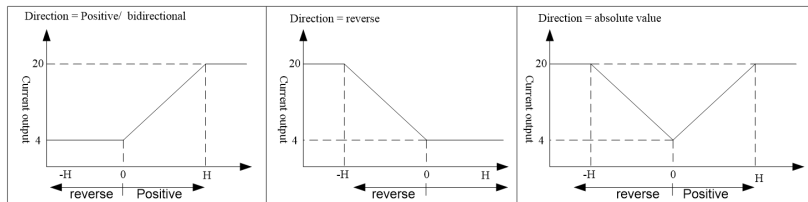


Figure 5.8

L=mA MINVAL #1 = 0  
H=mA MAXVAL #1

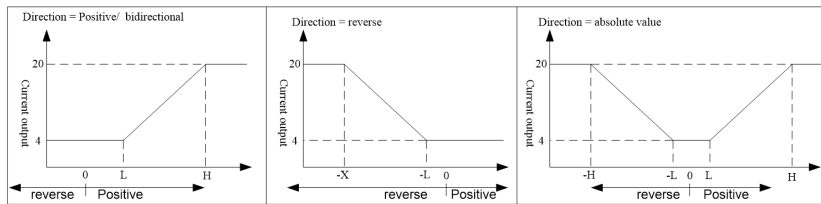


Figure 5.9

L=mA MINVAL #1 > 0  
H=mA MAXVAL #1

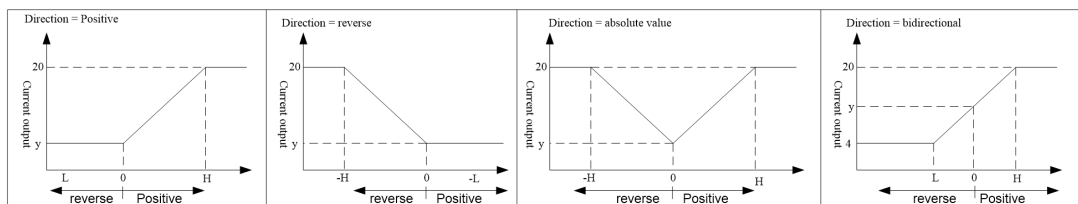


Figure 5.10

L=mA MINVAL #1 < 0  
H=mA MAXVAL #1  
 $y = (H/(H-L)) * 16 + 4 \text{ (mA)}$

If the current lower limit parameter =0, refer to Figure 5.8

If the current lower limit parameter is >0, refer to Figure 5.9

If the current lower limit parameter is negative, refer to Figure 5.10

The effect of flow direction on frequency output

Table 5.8 Flow direction influence on output frequency table

| Flow direction setting | Actual flow direction |           |          |
|------------------------|-----------------------|-----------|----------|
|                        | Forward               | Zero flow | Reverse  |
| Forward                | Output>0              | Output=0  | Output0  |
| Reverse                | Output=0              | Output=0  | Output>0 |
| Absolute value         | Output>0              | Output=0  | Output>0 |
| Bidirection            | Output>0              | Output=0  | Output>0 |

- The effect of flow direction on total mass

Table 5.9 Flow direction impact on total volume table

| Flow direction setting | Actual flow direction  |                        |                        |
|------------------------|------------------------|------------------------|------------------------|
|                        | Forward                | Zero flow              | Reverse                |
| Forward                | Total mass increases   | Total mass not changed | Total mass not changed |
| Reverse                | Total mass not changed | Total mass not changed | Total mass increases   |
| Absolute value         | Total mass increases   | Total mass not changed | Total mass increases   |
| Bidirection            | Total mass increases   | Total mass not changed | Total mass decreases   |

## 5.2.10 Current output Settings

This setting is used for the configuration scheme of the current output and the range value of the flow rate represented by the output current. (Includes current #1 and current #2)

### 1) Current configuration Setting

You can select mass flow, volume flow, density and temperature as the value of current output.

4~20mA OUT setting method: BASICS->Input user password ->4-20mA OUT ->Select value

### 2) 4~20mA MAXVAL and 4~20mA MINVAL

4~20mA output mass flow: value is -60000~60000, the unit is the same as mass flow range.

4~20mA output volume flow: value is -60000~60000, the unit is the same as volume flow range.

4~20mA output temperature: value is -250~400°C.

4~20mA output density: value is 0~3000, the unit is the same as density.

4mA is corresponding to the mA MIN value.

20mA is corresponding to the mA MAX value.

mA MAX value and mA MIN value setting method:

BASICS->Input user password -> mA MAX value ->Modify value

BASICS ->Input user password -> mA MIN value ->Modify value

Note :

- The current signal output by the current value represents the current measured value. When the actual value is less than the cut value, the measured value output is 0 and the current value output is 4mA.
- The parameter value of the lower current limit cannot be greater than the parameter value of the upper current limit; otherwise, the current will output an incorrect value.

### 5.2.11 Set frequency output

This setting is used for configuration scheme of frequency output, as well as the flow rate of the output frequency represents. Settings include frequency output configuration, frequency maximum value, pulse output equivalent, frequency minimum value.

#### 1) FREQ OUT

Mass flow and volume flow can be optional;

Setting method: BASICS ->Input user password -> FREQ OUTPUT ->Select mass flow or volume flow.

## 2) FREQ MAXVAL

Be used for setting the flow value which high frequency represents, unit is the same as that of device range, modify the scope of value (0-60000).

## 3) FREQ MINVAL

This value is identically equal to zero.

Setting method: BASICS ->Input user password ->FREQ MINVAL->Set value

## 4) MAX OUT FREQ

Be used for setting the frequency value corresponding to max flow.

## 5) Equivalent pulse calculation

The equivalent pulse is calculated as follows:

Equivalent pulse = (upper limit flow of pulse signal - lower limit flow of pulse signal)/upper limit frequency

For example, the pulse signal corresponds to the mass flow rate; The upper limit of flow is 36000kg/h, the lower limit of flow is 0kg/h, and the upper frequency is 10kHz.

Pulse equivalent =  $(36000-0) \div 3600 \div 10000=0.001$  kg/ pulse =1000 pulses /kg

Ps:  $\div 3600$  to convert the flow unit to /s

### 5.2.12 RESET

After reset, the total mass flow and total volume flow will accumulate again.

Setting method: BASICS ->Input password ->RESET-> Select yes.

### 5.2.13 ZERO CAL

After installation, modify the stored zero value to the zero value which is applied to the current application, the setting method is below:

**※Mass flowmeter is a full tube flowmeter, whether in the running or static state need to ensure that the full tube (completely empty is also regarded as full tube), dissatisfied tube will cause the meter measurement abnormal, serious will stop working!!!**

#### 1) Preparatory condition

- After the flow meter is energized, preheat for 10 minutes;
- Flow the measured fluid through the sensor until the temperature of the

sensor is the same as the temperature of the measured fluid;

- Close the downstream and upstream valves of the sensor, if present, so that the fluid in the sensor is stationary, and confirm that the fluid has been cut off and the fluid has filled the sensor.
- Before calibration, you can judge whether the flowmeter is in a full tube state by the density parameter of the instrument panel (the density should be consistent with the density value displayed during operation).
- 1 Before calibration, be sure to ensure that the medium in the flow meter is full and does not flow, and there is no abnormal phenomenon such as deposition, wall hanging, and gas-liquid mixing during calibration!!! Otherwise, it will cause zero deviation, which has a huge impact on the measurement accuracy!!

## 2) Calibrate and wait for completion

In the system menu, select "BASICS>Input password>ZERO CAL>Yes"

## 3) Troubleshooting for ZERO CAL

- Make sure the sensor has been filled with fluid and the fluid is completely static;
- Ensure that the fluid does not contain precipitated particles;
- Repeat the procedure of zero adjustment;
- Please contact with the manufacturer.

## 5.2.14 Communication Setting

### 1) COMM selection

In system menu select "BASICS-Input password-COMM-Select RS485 or HART"

### 2) RS485

If the current communication mode is RS485, the following Settings are valid.

- RS485 ADR: in system menu select “BASICS-input password-RS485 ADS-Input the address for the current device”, the range is 0-31
- RS485 BAUD: in system menu select “BASICS-input password-RS485 BAUD-select value”, 2400/4800/9600 can be optional.

#### 5.2.15 RECALL MEMO

In system menu select” BASICS-input password-RECALL MEMO-select Yes”, restore the current settings to the initial status

#### 5.2.16 Device status and output test

##### 1) Instrument information

Enter the system setting menu and select the DEV.INFO, press the FUNC key to enter and query by the direction key. Press ESC key to exit to the main interface. DEV.INFO is read-only mode and can not be modified.

DEV.INFO includes data info, closed loop data info, range info, series info, model info, firmware info and error code, shown as below:

|        |      |
|--------|------|
| M.FLOW | kg/h |
| 0      | 500  |
| V.FLOW | L/h  |
| 0      | 500  |

|         |                   |
|---------|-------------------|
| DENSITY | kg/m <sup>3</sup> |
| 0       | 2500              |
| TEMPER  | °C                |
| -15     | 200               |

|             |
|-------------|
| TRANS MODEL |
| 330         |
| TRANS SER#  |
| SN:151234   |

|               |
|---------------|
| SENS SER#     |
| SN:154321     |
| FIRMWARE      |
| VER. 00-12-34 |

|         |
|---------|
| ERROR # |
| XX      |

Figure 5.11

## 2) Debug Menu

Perform device output test function.

- TEST OUTPUT

Provide test function for frequency and current output. After enter this function, frequency and current output is stable value; After exit this function, return to normal output. This function can be used for adjusting current coefficient and verify the work status of device output part. After enter this function, the output value of frequency and current can be adjusted through adjusting percentage of output by UP or DOWN key.

- REBOOT DEV

Reboot the device.

- CLR ERROR#

Clear the error code of the device.

### 5.2.17 ADVANCED menu

This menu can be only set under the condition of field replacing sensor and calibration. When the device is working in the field, the parameters of this menu can not be adjusted, otherwise it may cause measurement error.

#### 1) Flow coefficient

When re-calibrating and replacing the sensor, if the error between the measured value and the actual flow value exceeds the error level of the instrument, the instrument can be calibrated by adjusting this coefficient, the adjustment method is as follows:

New flow coefficient = existing meter coefficient  $\times$  (1- error value)

The representation method in the sensor is the way of scientific counting. First, the value is changed to the calculated new flow coefficient value, the value range is 0 ~ 9.9999. Then change the power value to change the size of the value, the power value change range is 0 to 4.

Note: The flow value measured by the flowmeter needs to take the average value of multiple measurements (the number of measurements is greater than 3).

## 2) CAL TEMP

Calibration temperature is used for recording the fluid temperature when flow coefficient calibrate, which is for temperature compensation.

## 3) M.FLOW MAX/MIN

Mass flow range of the device, which is required to be set according to the connected sensor. Normally, M.FLOW MIN is set according to dynamic range setting. Device range unit: t/h, kg/h, g/h

Table 5.10 Meter range unit table

|     |      |     |
|-----|------|-----|
| t/h | kg/h | g/h |
|-----|------|-----|

## 4) V.FLOW MAX/MIN

Volume flow range of the device, which is required to be set according to the connected sensor. Device range unit: m<sup>3</sup>/h, L/h, mL/h

Table 5.11 Volume flow range unit table

|                   |     |      |
|-------------------|-----|------|
| m <sup>3</sup> /h | L/h | mL/h |
|-------------------|-----|------|

## 5) TEMP Ct

Temperature coefficient is used for temperature compensation. This is advanced setting and can not be changed. Please contact with the manufacturer for any changes, otherwise, any changes will make the measurement parameters (mass flow etc) inaccuracy when temperature is changed.

## 6) BASIC FQ

Basic frequency is the parameter used for density measurement. After sensor installation, record the vibration frequency when the pipe is empty and input the value here, which is used for the calculation of density. This is advanced setting and can not be changed. Please contact with the manufacturer for any changes, otherwise, any changes will make the measurement parameters (density/volume etc) inaccuracy.

## 7) DENSITY D1

This density D1 and basic frequency is used for calculating fluid density, the method of modification and calibration is the same as Flow coefficient.

#### 8) DENSITY D2~D7

This coefficient can be used only for adopting <JJG\_370-2007 Online vibration tube liquid density meter verification procedures>

#### 9) DENSITY Dt

This coefficient is used for recording fluid temperature when DENSITY D1 calibration, which is used for temperature compensation for density.

#### 10) Storage factory Settings

The current Settings are stored as factory Settings. If you select Restore factory Settings in the basic Settings, the storage status of the value is restored

#### 11) ADVANCED SETTING

Pressure coefficient P1-P3, N C Po1~5 is advanced setting, which can not be changed. Please contact with the manufacturer for any changes, otherwise, it will lead to inaccuracy in measurement.

### 5.3 Explosion protection of transmitter

When the instrument is used in explosion-proof occasions, explosion-proof instruments must be used to ensure safety.

The main explosion-proof form of the transmitter is flameproof type, and the connection part of the sensor is installed with intrinsic safety measures to ensure the explosion-proof performance of the sensor.

The transmitter housing is aluminum alloy housing. The connection between the outer cover of the terminal and the body, the connection between the outer cover of the transmitter display operation part and the body, and the sealing ring of silicone rubber between the transmitter display window and the housing are all sealed.

The transmitter external wiring cables (power and signal output cables) should be cables with an outer diameter of 8mm. Cables are connected to the table through M20x1.5 compression nuts, gaskets, and cable sealing rubber rings. After cables are connected, lock the nuts to ensure cable sealing.

A safety gate is installed at the wiring outlet of the transducer and the sensor to ensure the explosion-proof performance of the sensor.

In order to explosion-proof safety, the sealing structure of the flowmeter must not be damaged during use.

When the transmitter needs to open the cover, the instrument power

supply must be disconnected first. The transmitter is forbidden to open the cover in the energized state. Reclosing the cover must ensure that the transmitter is sealed, check and confirm before power.

The sensor housing should be grounded nearby, and the cross-sectional area of the wire should not be less than 1 square millimeter.

## CMF transmitter ModBus communication protocol description

Hardware Version : V11, File Version : 201609V11

ModBus communication protocol (RTU Format)

### 1. Read N variables

Host request information frame:

Meter address +0x03+ Register start address (2 bytes, high byte first)  
+ register read/write number 2\*N (2 bytes, high byte first) + CRC check code  
(2 bytes, low byte first)

Slave response message frame:

Meter address +0x03+ bytes of data 4\*N (1 byte) + register data (4\*N bytes,  
the high byte before) + CRC check

Code check (2 bytes, low byte first)

### 2. Write N variables

Host request information frame:

Meter address + Function code 0x10+ Register start address (2 bytes, high  
byte first) + register read/write number 2 x N (2 bytes, high byte first)  
+ data bytes 4 x N (1 byte) + data to be written (4 x N bytes, 4 x N bytes)  
High byte in front) + CRC check code (2 bytes, low byte in front) •

Slave response message frame:

Meter address + Function code 0x10+ Register start address (2 bytes, high  
byte first) Register read/write quantity 2 x N (2 bytes, high byte first) +  
CRC check code (2 bytes, low byte first)

Read and write variable addresses are shown in Table 1:

Table 1 CMF transmitter ModBus communication variable address

| No | Name                    | Access Type | Address (DEC) | Default                                                                                                           |
|----|-------------------------|-------------|---------------|-------------------------------------------------------------------------------------------------------------------|
| 1  | Mass Flow               | Read        | 2000          | floating-point number                                                                                             |
| 2  | Volume Flow             | Read        | 2002          | floating-point number                                                                                             |
| 3  | Medium Temperature      | Read        | 2004          | floating-point number                                                                                             |
| 4  | Medium Density          | Read        | 2006          | floating-point number                                                                                             |
| 5  | Total Mass L            | Read        | 2008          | floating-point number                                                                                             |
| 6  | Total mass H            | Read        | 2010          | Length shaping, the unit changes as the setting unit changes. Total amount =H* 1,000,000 +L                       |
| 7  | Total Volume L          | Read        | 2012          | floating-point number                                                                                             |
| 8  | Total Volume H          | Read        | 2014          | Length shaping, the unit changes as the setting unit changes. Total amount =H* 1,000,000 +L                       |
| 9  | Mass Flow Unit          | Read-write  | 2030          | 0~14 , 5<br>g/s, g/min, g/h, kg/s, kg/min, kg/h, kg/day, t/s, t/min, t/h, t/day, lb/s, lb/min, lb/h, lb/day       |
| 10 | Total Mass Unit         | Read-write  | 2032          | 0~3, 1<br>g, kg, t, lb                                                                                            |
| 11 | Volume Flow             | Read-write  | 2034          | 0~14, 5<br>ml/s, ml/min, ml/h, L/s, L/min, L/h, L/day, m³/s, m³/min, m³/h, m³/day, Gal/s, Gal/min, Gal/h, Gal/day |
| 12 | Total Volume Unit       | Read-write  | 2036          | 0~3, 2<br>ml, L, m³, Gal                                                                                          |
| 13 | Medium Temperature Unit | Read-write  | 2038          | 0~1 , 0<br>℃, ℉                                                                                                   |
| 14 | Medium Density Unit     | Read-write  | 2040          | 0~5, 0<br>g/cm³, g/L, g/ml, kg/L, kg/m³, lb/Gal                                                                   |
| 15 | Clear aggregate command | Read-write  | 2052          | Write 0, Total clearing volume; Read back 1                                                                       |

|    |                                  |            |      |                                                                                |
|----|----------------------------------|------------|------|--------------------------------------------------------------------------------|
| 16 | Calibration zero command         | Read-write | 2054 | Write 0, Total clearing volume; Read back 1                                    |
| 17 | Refresh Time                     | Read-write | 2056 | 0.0~60.0s, 0.5s                                                                |
| 18 | Decimal Digits                   | Read-write | 2058 | 0~3, 3                                                                         |
| 19 | Mass flow excision ratio         | Read-write | 2060 | 0.00~50.00%, 1%                                                                |
| 20 | Volume flow excision ratio       | Read-write | 2062 | 0.00~50.00%, 1%                                                                |
| 21 | Density-cut value                | Read-write | 2064 | 0.0000~1.0000g/cm <sup>3</sup> , 0.0050g/cm <sup>3</sup>                       |
| 22 | Input fluid density              | Read-write | 2066 | 0.0000~3000.0000g/L                                                            |
| 23 | Liquid Pressure                  | Read-write | 2068 | 0.00~99.99MPa                                                                  |
| 24 | Liquid Direction                 | Read-write | 2070 | 0~3, 1(Forward, reverse, bidirectional, absolute value)                        |
| 25 | Language                         | Read-write | 2072 | 0~1, 0<br>Chinese、English                                                      |
| 26 | Upper limit of mass range        | Read-write | 2074 | 0~99999, 6000                                                                  |
| 27 | Lower limit of mass range        | Read-write | 2076 | 0~99999, 0                                                                     |
| 28 | Mass Range Unit                  | Read-write | 2078 | 0~2, 1<br>t/h, kg/h, g/h                                                       |
| 29 | Upper limit of volume range      | Read-write | 2080 | 0~99999, 6000                                                                  |
| 30 | Lower limit of volume range      | Read-write | 2082 | 0~99999, 0                                                                     |
| 31 | Volume range unit                | Read-write | 2084 | 0~2, 1<br>m <sup>3</sup> /h, L/h, ml/h                                         |
| 32 | Upper limit of density range     | Read-write | 2086 | 0~3000, 3000                                                                   |
| 33 | Lower limit of density range     | Read-write | 2088 | 0~3000, 0                                                                      |
| 34 | Density Range Unit               | Read-write | 2090 | 0<br>kg/m <sup>3</sup>                                                         |
| 35 | Upper limit of temperature range | Read-write | 2092 | -200~400, 180                                                                  |
| 36 | Lower limit of temperature range | Read-write | 2094 | -200~400, -50                                                                  |
| 37 | Temperature range Unit           | Read-write | 2096 | 0<br>℃                                                                         |
| 38 | Current output 1 configuration   | Read-write | 2098 | 0~3, 0<br>Mass flow rate, volume flow rate, medium density, medium temperature |
| 39 | Current output 2 configuration   | Read-write | 2100 | 0~3, 1<br>Mass flow rate, volume flow rate, medium density, medium temperature |

|    |                                 |            |      |                                                                                                                       |
|----|---------------------------------|------------|------|-----------------------------------------------------------------------------------------------------------------------|
| 40 | Current 1 Upper limit parameter | Read-write | 2102 | Mass flow: -99999~99999<br>Volume flow: -99999~99999<br>Medium density: 0.0~3000.0<br>Medium Temperature: -250~400    |
| 41 | Current 1 lower limit parameter | Read-write | 2104 | Mass flow: : -99999~99999<br>Mass flow: : -99999~99999<br>Medium density : 0.0~3000.0<br>Medium Temperature: -250~400 |
| 42 | Current 2 Upper limit parameter | Read-write | 2106 | Mass flow: : -99999~99999<br>Mass flow: : -99999~99999<br>Medium density: 0.0~3000.0<br>Medium Temperature: -250~400  |
| 43 | Current 2 lower limit parameter | Read-write | 2108 | Mass flow: : -99999~99999<br>Mass flow: : -99999~99999<br>Medium density : 0.0~3000.0<br>Medium Temperature: -250~400 |
| 44 | Frequency output configuration  | Read-write | 2114 | 0~1, 0<br>Mass Flow, Volume Flow                                                                                      |
| 45 | Upper frequency parameter       | Read-write | 2116 | Mass Flow: -99999~99999<br>Volume Flow: -99999~99999                                                                  |
| 46 | Lower frequency parameter       | Read-write | 2118 | Mass Flow: -99999~99999<br>Volume Flow: -99999~99999                                                                  |
| 47 | Upper output frequency limit    | Read-write | 2122 | 0~10kHz, 10                                                                                                           |
| 48 | flow coefficient                | Read-write | 2124 | 0~10000.000, 8.1234                                                                                                   |
| 49 | Nominal flow temperature        | Read-write | 2126 | -50.0~100.0℃, 25.0                                                                                                    |
| 50 | Flow temperature coefficient    | Read-write | 2128 | -999.999~999.999, -51.08                                                                                              |
| 51 | Foundation vibration frequency  | Read-write | 2130 | 50.000~500.000Hz, 140.000                                                                                             |
| 52 | communication password          | Write      | 2216 |                                                                                                                       |
| 53 | Set communication password      | Write      | 2218 |                                                                                                                       |
|    |                                 |            |      |                                                                                                                       |

Note: Read-only data does not have password protection. Write data only after entering the correct password.

In the user Settings menu, if you select Restore factory Settings, the communication password will be restored to the factory default value, which is used to restore the communication password that the user forgot to set.

When setting the communication password, the original password must be written to the setting register before the password can be changed. For example, the communication password, the old password is 0124, the new password is 2018, then the setting, first write 0124 to address 2216, then write 2018 to address 2218, after receiving the data, the transmitter automatically checks whether the original password is correct, if correct, the 2018 password is set. Otherwise it is invalid.

\*Note:

Each register is 4 bytes, occupies two addresses (low address addressing), data

transmission using 32-bit single-precision floating-point number (high before);

Address 2052 corresponds to the total clear register, write 0 to the address to perform total clear operation; Return 1 when reading this register;

Address 2054 corresponds to the zero calibration register, write 0 to the address to carry out the total zero clearing operation; Return 1 when reading this register;

Table 2:Setting instructions

|                         |                   |                   |             |                |         |        |         |      |
|-------------------------|-------------------|-------------------|-------------|----------------|---------|--------|---------|------|
| Date                    | 0                 | 1                 | 2           | 3              | 4       | 5      | 6       | 7    |
| Mass Flow Unit          | g/s               | g/min             | g/h         | kg/s           | kg/min  | kg/h   | kg/day  | t/s  |
| Date                    | 8                 | 9                 | 10          | 11             | 12      | 13     | 14      |      |
| Mass Flow Unit          | t/min             | t/h               | t/day       | lb/s           | lb/min  | lb/h   | lb/day  |      |
| Date                    | 0                 | 1                 | 2           | 3              | 4       | 5      | 6       | 7    |
| Volume Flow Unit        | ml/s              | ml/min            | ml/h        | L/s            | L/min   | L/h    | L/day   | m³/s |
| Date                    | 8                 | 9                 | 10          | 11             | 12      | 13     | 14      |      |
| Volume Flow Unit        | m³/min            | m³/h              | m³/day      | Gal/s          | Gal/min | Gal/h  | Gal/day |      |
|                         |                   |                   |             |                |         |        |         |      |
| Date                    | 0                 | 1                 | 2           | 3              |         |        |         |      |
| Total Mass Unit         | g                 | kg                | t           | lb             |         |        |         |      |
|                         |                   |                   |             |                |         |        |         |      |
| Date                    | 0                 | 1                 | 2           | 3              |         |        |         |      |
| Total Volume Unit       | ml                | L                 | m³          | Gal            |         |        |         |      |
|                         |                   |                   |             |                |         |        |         |      |
| Date                    | 0                 | 1                 | 2           | 3              | 4       | 5      |         |      |
| Medium Density Unit     | g/cm³             | g/L               | g/ml        | kg/L           | kg/m³   | lb/Gal |         |      |
|                         |                   |                   |             |                |         |        |         |      |
| Date                    | 0                 | 1                 |             |                |         |        |         |      |
| Medium temperature Unit | ℃                 | ℉                 |             |                |         |        |         |      |
|                         |                   |                   |             |                |         |        |         |      |
| Date                    | 0                 | 1                 | 2           |                |         |        |         |      |
| Instrument range unit   | t/h               | kg/h              | g/h         |                |         |        |         |      |
|                         |                   |                   |             |                |         |        |         |      |
| Date                    | 0                 | 1                 | 2           |                |         |        |         |      |
| Flow range unit         | m³/h              | L/h               | ml/h        |                |         |        |         |      |
|                         |                   |                   |             |                |         |        |         |      |
| Date                    | 0                 | 1                 | 2           |                |         |        |         |      |
| Current configuration   | Mass Flow         | Volume Flow       | Density     |                |         |        |         |      |
|                         |                   |                   |             |                |         |        |         |      |
| Date                    | 0                 | 1                 |             |                |         |        |         |      |
| Frequency configuration | Mass Flow         | Volume Flow       |             |                |         |        |         |      |
|                         |                   |                   |             |                |         |        |         |      |
| Date                    | 0                 | 1                 |             |                |         |        |         |      |
| Language                | Chinese           | English           |             |                |         |        |         |      |
|                         |                   |                   |             |                |         |        |         |      |
| Date                    | 0                 | 1                 | 2           | 3              |         |        |         |      |
| Liquid Direction        | Forward direction | Reverse direction | bidirection | Absolute Value |         |        |         |      |

