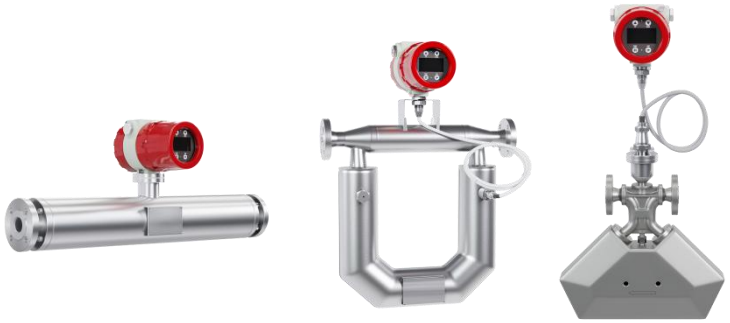
Coriolis Mass Flow Meter



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Preface

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

Note

- Modification of this manual's contents will not be notified as a result of some factors, such as function upgrading.
- We try our best to guarantee that the manual content is accurate, if you find something wrong or incorrect, please contact us.
- The content of this manual is strictly prohibited from reprinting or copying.

Version

U-SUP-FCC300-EN1

Safety Precautions

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

About this manual

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

Precautions for protection, safety and modification of this product

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

- The following safety signs are used in this manual:

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

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

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

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

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

Disclaimer

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

No.	Name	Quantity	Remarks
1	Coriolis Mass Flow Meter	1	
2	Operating Instruction	1	
3	Certificate	1	
4.	Inspection report	1	

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

Contents

1. Product Overview

1.1 Product Description

Coriolis mass Flow Meter is a new type of flow measurement instrument developed according to the principle of Coriolis force. It can directly measure the mass flow rate of fluid in closed tubeline, medium density and temperature. It can be widely used in chemical industry, petroleum, food, pharmaceutical, paper making and other industries.

The implementation standard of this product is GB/T 31130-2014 Coriolis mass Flow Meter.

1.2 Measurement 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 Fig.1:

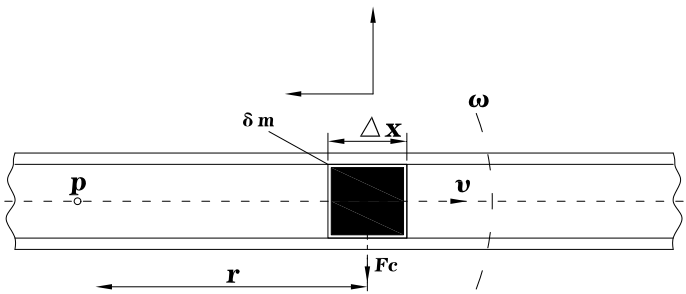


Fig.1 Principle of mass flow measurement

The particle of mass δm moves to the right in the tube at a uniform speed υ, while the tube rotates around a fixed point P at an angular velocity ω. At this time, the particle will have two acceleration components:

(1) Normal acceleration α_r **(Centric acceleration), its value is equal to** $\omega^2 r$, which is directed towards point P.

(2) Tangential acceleration α_t **(Corioli acceleration), whose value is equal to 2ωυ, and the direction is** α_r perpendicular.

The force produced by the tangential acceleration is called Coriolis force, and its

magnitude is equal to $Fc=2\omega\upsilon\delta_m$In Fig.1 the fluid

$\Delta_m=\rho A\times\Delta X$, so the Coefficient of friction can be expressed as:

$\Delta Fc=2\omega\upsilon\times\delta_m=2\omega\times\upsilon\times\rho\times A\times\Delta X=2\omega\times\delta qm\times\Delta X$

Where A is the cross-sectional area of the tube

$\Delta qm=\delta dm/dt=\upsilon\rho A$

For a specific rotating tube, its frequency characteristics are certain, ΔFc depends only on δqm. Therefore, the mass flow can be measured directly or indirectly by measuring the Coriolis force. The Coriolis principle mass Flow Meter works according to the above principle.

The actual Flow Meter does not achieve rotational motion but instead relies on tube vibration. The principle is illustrated in Figures 2, 3, and 4. One end of a bent tube is fixed, and a vibration force (at the resonant frequency of the tube) is applied to the middle position between the two fixed points, causing the tube to vibrate with its natural frequency ω around the fixed point. When there is no fluid flow in the tube, it only experiences an external vibration force, and the two halves of the tube vibrate in the same direction without any phase difference. When fluid flows through the tube, the particles of the flowing medium exert a Coriolis force Fc (as shown in Figure 2, where the Coriolis forces F1 and F2 in the two halves of the tube are equal in magnitude but opposite in direction). The two halves of the tube then twist in opposite directions, creating a phase difference (Figures 3 and 4), which is proportional to the mass flow rate. The design of the Flow Meter converts the measurement of the Coriolis force into the measurement of the phase difference between the two sides of the vibrating tube, which is the working principle of the Coriolis mass Flow Meter.

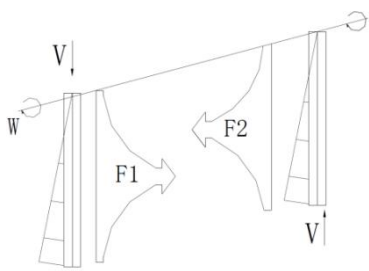


Fig.2

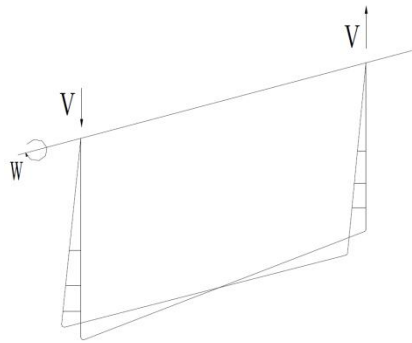


Fig.3

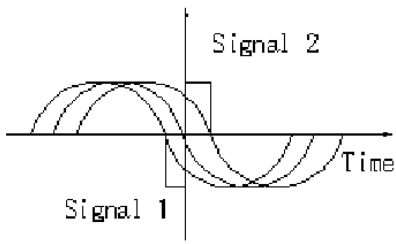


Fig.4

1.3 Product characteristics

- The mass flow of the fluid can be measured directly.
- The measurement range is wide and the accuracy is high.
- The installation requirements are low, and there is no requirement for front and rear straight tube sections.
- It has a wide range of applications. In addition to normal fluid measurement, it can also measure industrial media that are difficult to measure by general fluid measurement instruments, such as high viscosity fluid, various slurry and suspension.
- The density, temperature and other parameters of the measured medium can be measured online, and the concentration of solute in the solution can be derived from this.
- Reliable operation and low maintenance rate.

2. Technical Parameter

Table 1 Technical Parameter

Measurand	Mass flow, density, temperature
Nominal Diameter	Straight tube type: DN8~DN80 U type: DN20~DN150 Triangle split type: DN3~DN15
Flow Range (L/min)	See also Table 2, Table 3
Density Range	（0.3～3.000）g/cm^3
Temperature Range	（-200～300）℃
Output	
Transmitter output	(4~20)mA, output load (250~600)Ω
Communications output	RS485 interface, MODBUS-RTU communication protocol; Hart
Frequency (pulse) output	Pulse width: 50% Active: output current 10mA, open circuit voltage 24V
Power Supply	
Power Supply Voltage	24VDC / 220VAC
Power dissipation	≤15W
Electrical interface	M20*1.5
performance parameter	
Accuracy	Flow: 0.2%, 0.5% Density: ±0.002g/cm^3 Temperature: ±1℃
Repetitiveness	1/2 of the measurement error
Process conditions	
Medium temperature	Standard type: (-50~ 200)℃, (-20~ 200)℃ High temperature type: (-50 ~ 300) ℃ Low temperature type: (-200~200) ℃
Process Pressure	（0～4.0）MPa
Pressure Loss	Maximum flow corresponds to pressure loss of 100kPa

	(water as medium)
Ambient Condition	
Temperature	- 40℃～+60℃
Humidity	35%～95%
Protection level	IP 67

Table 2 Flow range of straight tube mass Flow Meter

DN (mm)	Flow range（kg/h）	Flow range of sanitary Flow Meter（kg/h）	Zero Stability （kg/h）
8	0～960～1440	/	0.096
10	0～1500～2250	/	0.15
15	0～3000～4500	/	0.3
20	0～6000～9000	0～4500	0.6
25	0～9600～14400	0～9000	0.96
32	0～18000～27000	0～14400	1.8
40	0～30000～45000	0～27000	3
50	0～48000～72000	0～45000	4.8
80	0～120000～180000	/	12

Table 3 Flow range of non-direct tube mass Flow Meter

DN (mm)	Flow range（kg/h）	Flow range of High pressure Flow Meter （kg/h）	Zero Stability （kg/h）
3	0～96～144	/	0.0096
6	0～540～810	/	0.054
8	0～960～1440	/	0.096
10	0～1500～2250	/	0.15
15	0～3000～4500	/	0.3
20	0～6000～9000	0～3000～4500	0.6
25	0～9600～14400	0～6000～9000	0.96
32	0～18000～27000	0～9600～14400	1.8
40	0～30000～45000	0～18000～27000	3

DN (mm)	Flow range（kg/h）	Flow range of High pressure Flow Meter （kg/h）	Zero Stability （kg/h）
50	0～48000～72000	0～30000～45000	4.8
80	0～120000～180000	0～75000～90000	12
100	0～192000～300000	/	19.2
150	0～360000	/	36

Note: The flow range gives two parameters. The middle parameter is the standard flow range, which is generally tested according to this range, and it is also recommended that users choose the instrument within this range; the latter parameter is the upper limit flow range to ensure the stable operation of the Flow Meter

3. Product Structure and Dimensions

Coriolis mass Flow Meters are divided into straight tube Coriolis mass Flow Meters and non-straight tube Coriolis mass Flow Meters according to the shape of the converter

3.1 Straight Tube Coriolis Mass Flow Meter dimensions

3.1.1 Ordinary straight tube mass Flow Meter integrated overall size

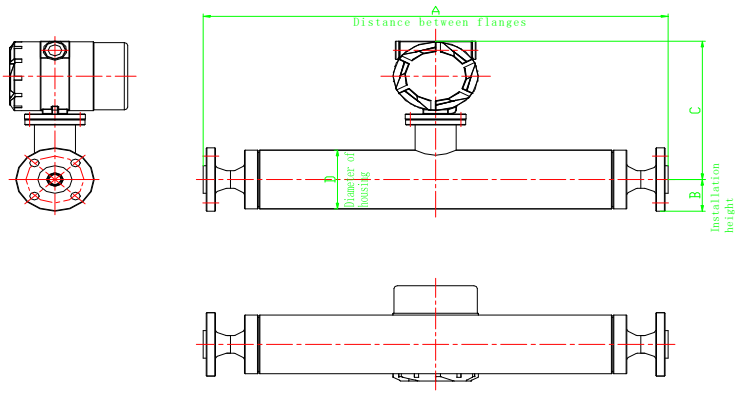


Fig.5 Schematic diagram of the integrated shape of the ordinary straight tube mass Flow Meter

Table 4 The ordinary type straight tube mass Flow Meter has an integrated size

DN (mm)	A	B	C	D	Weight
	mm	mm	mm	mm	kg
DN 8	492	45	235	82	10
DN 10	542	47.5	238	87	12
DN 15	622	52.5	238	87	13
DN 20	685	57.5	251	106.5	18
DN 25	751	70	257	117	23
DN 32	867	70	264	137	31
DN 40	963	78.5	279	157	37

DN (mm)	A	B	C	D	Weight
	mm	mm	mm	mm	kg
DN 50	1053	82.5	279	157	42
DN 80	1185	115	311.5	219	66

3.1.2 Sanitary straight tube mass Flow Meter integrated shape size

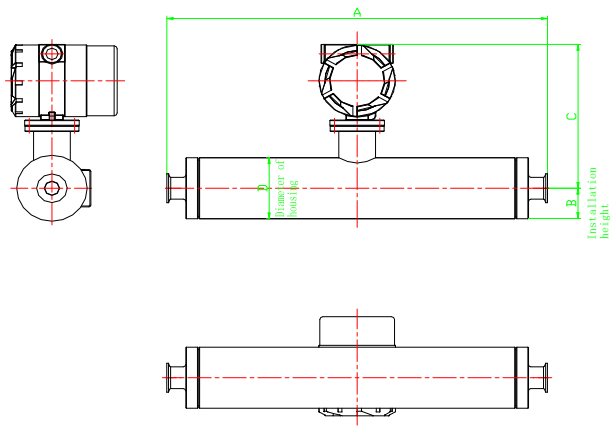


Fig.6 Schematic diagram of sanitary straight tube mass Flow Meter

Table 5 External dimensions of sanitary straight tube mass Flow Meter

DN (mm)	A	B	C	D	Weight
	mm	mm	mm	mm	kg
DN20	598	54	257	108	17
DN25	680	66.5	261	133	23
DN32	680	66.5	261	133	23
DN40	792	70	273	140	28
DN50	864	79.5	283	159	36
DN65	948	79.5	283	159	42

3.2 External dimensions of non-straight tube Coriolis mass Flow Meter

3.2.1 U type Coriolis mass Flow Meter dimensions

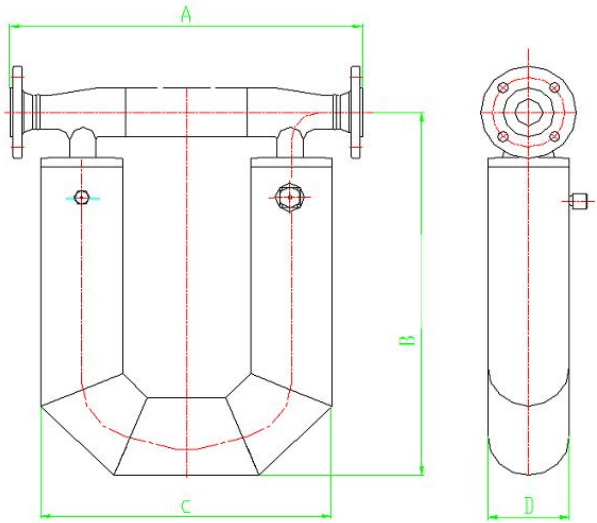


Fig.7 Schematic diagram of the shape of the split U type Coriolis mass Flow Meter

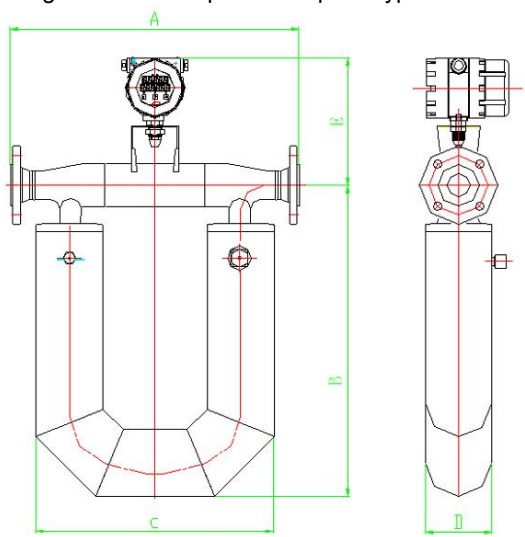


Fig.8 Schematic diagram of the shape of an integrated U-type Coriolis mass Flow Meter

Table 6 U-type structure sensor size

DN (mm)	A	B	C	D	E	Weight
	mm	mm	mm	mm	mm	kg
DN 10	450	324	380	60	236	7.2
DN 15	456	324	380	60	236	7.5
DN 20	540	478	468	108	245	17
DN 25	540	492	468	108	245	17.5
DN 32	544	517	468	108	245	24
DN 40	600	635	500	140	267	32
DN 50	606	653	500	140	267	36
DN 80	866	857	779	219	316	87.5
DN1 00	950	977	833	273	340	165
DN1 50	1300	1223	1144	324	340	252

Note: E represents the size of the center height increase after the installation

3.2.2 Triangle Coriolis mass Flow Meter overall dimensions

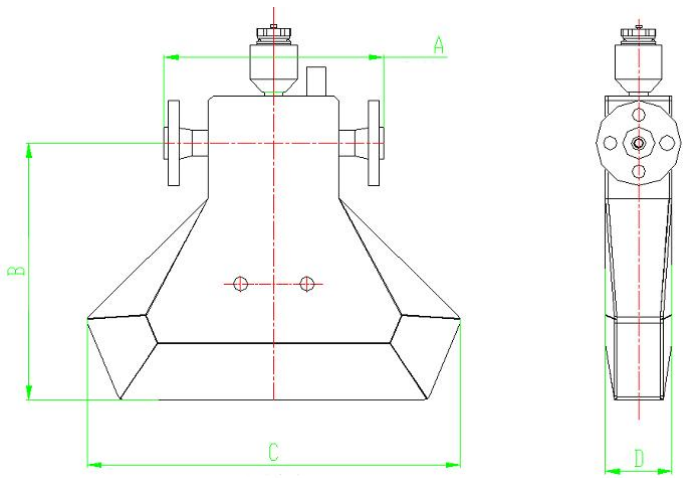


Fig.9 Schematic diagram of DN3~DN8 split type triangular Coriolis mass Flow Meter

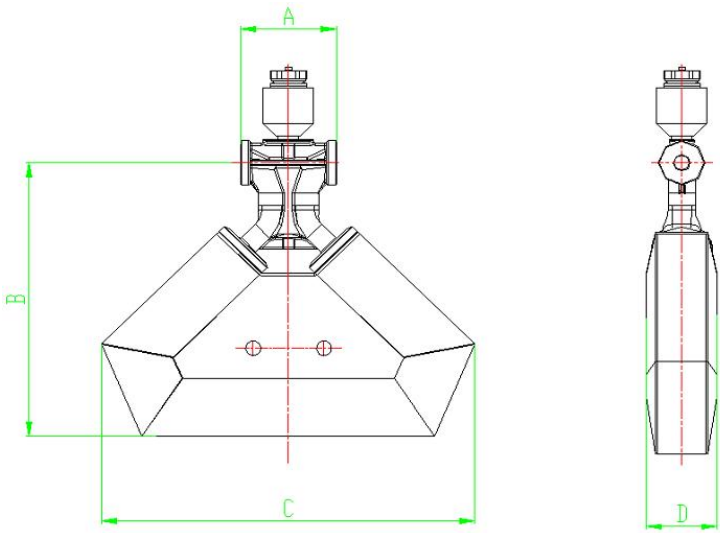


Fig.10 Schematic diagram of DN10~DN15 Split Triangular Coriolis Mass Flow Meter

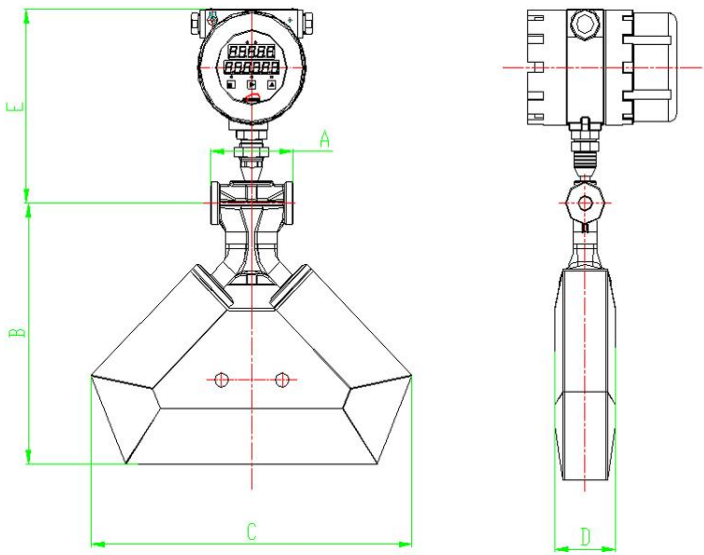


Fig.11 Schematic diagram of integrated triangular Coriolis mass Flow Meter

Table 7 .Triangle Coriolis mass Flow Meter size

DN(mm)	A	B	C	D	E	Weight
	mm	mm	mm	mm	mm	kg
DN3	196	176	250	54	270	4.8
DN6	250	263	360	70.5	289	8.1
DN8	250	275	395	70.5	289	8.2
DN10	95	283	370	70.5	264	6.5
DN15	95	302	405	70.5	264	6.5

Note:

(1) The size of A will vary according to the change of connection mode. Here it is only a reference size. For the split DN10~DN15 specification Flow Meter, it is the clamping section size, and for other specifications, it is the standard configuration flange size.

(2) E represents the size of the increased total height after the integrated installation of the converter

3.3 Process Connections

Flange: HG/T20592 flange standard.

Clamps: ISO 2852 clamp standards.

3.4 Material

Converter housing : aluminum alloy

Body : 304SS

Measuring tube: 316SS

4. Installation

4.1 Installation prompt

point out!

Please check carefully whether the packing box is damaged or has been loaded and unloaded brutally. If there is damage, please report the damage to the deliveryman and the manufacturer or instrument supplier.

point out!

Please check the packing list to ensure that you have received the goods intact.

point out!

Please check the nameplate of the instrument and confirm that the content of the supply is the same as your order. Check whether the power information on the nameplate is correct. If not, please contact the manufacturer or instrument seller.

The installation diagram is for reference only. Please refer to the actual product.

4.2 Notes for installation

- The installation of the mass Flow Meter should make the sensor flow direction consistent with the fluid flow direction, and the installation indicator arrow should be on the side of the sensor nameplate bracket.
- The mass Flow Meter is a Flow Meter based on the principle of measuring tube vibration. Therefore, when the sensor is installed, the relevant tubeline should be supported firmly to avoid vibration of the instrument and related tubeline.
- Allow the support of the instrument body, and it is recommended to install it downstream of the pump (to prevent the measurement tube from being evacuated).
- If strong tube vibration is inevitable, it is recommended to use flexible

tubes to isolate the tube system from the instrument sensor.

- When installing, the connecting flange faces should be parallel to each other, so that the center of the two flanges is on the same axis to avoid additional stress.
- When measuring liquid flow, the fluid flow should be as far as possible from bottom to top, and the instrument should be avoided from being installed at the highest point of the tubeline to prevent gas accumulation in the tubeline from affecting the normal operation of the instrument.
- The instrument can be installed horizontally, in an upwardly inclined tube, or vertically. For optimal results, vertical installation is recommended, with the flow direction upward but always avoid lateral installation (in this case, the vibrating tube is not only affected by the Coriolis force but also by the weight of the vibrating tube, which prevents normal measurement).

4.3 Installation

4.3.1 Straight tube type mass flow rate installation

(1) In general, when measuring the flow of liquid medium, small amount of particulate medium and gas medium, the vertical installation method should be adopted, and the installation should be at the lowest point of the vertical tube, with the medium flowing upward to avoid the accumulation of gas or liquid in the vibrating tube, which will affect the normal measurement. The installation diagram is shown as follows:

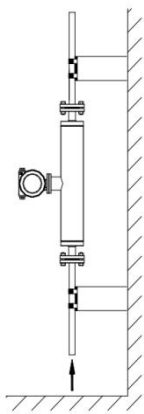


Fig.12 Schematic diagram of the vertical installation

(2) If the measuring medium is pure liquid, it can also be installed horizontally. It is recommended to install it at the lowest point of the whole system to ensure that the instrument is full tube and avoid gas accumulation, which will cause measurement error. The installation diagram is shown in the following figure:

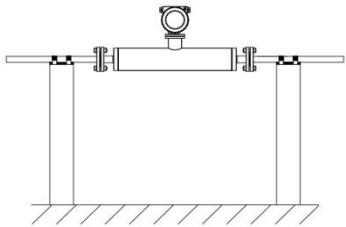


Fig.13 Schematic diagram of the horizontal installation

(3) When measuring the flow of liquid medium, small amount of particulate medium and gas medium, the installation can be installed at an angle so that the medium flows upward to avoid the accumulation of gas or liquid in the vibration tube, which will affect the normal measurement. The installation diagram is shown as follows:

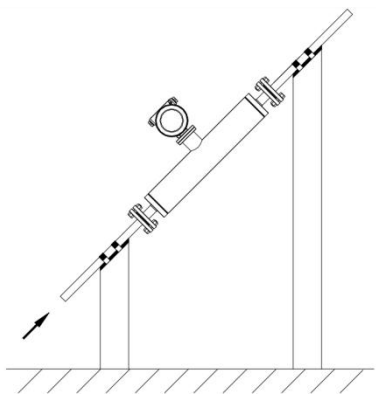


Fig.14 Schematic diagram of angle installation

(4) When using or installing instruments with sanitary process connections, ensure that the instrument is well supported and clamped due to its weight. The 3A certification requires the instrument to be "self-draining," so it must be installed

vertically with the flow moving from bottom to top. The main body of the instrument should also be supported and clamped.

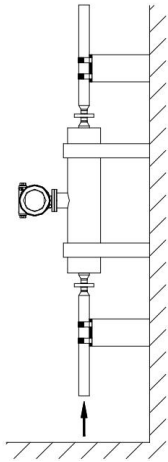


Fig.15 Schematic diagram of sanitary straight tube mass Flow Meter installation

(5) Thermal insulation and heating installation. If insulation is required on-site, a series of materials can be used for this purpose. Note that the thermal insulation layer should not exceed the indicated position. Electric heating can be used, but ensure that the heating layer does not exceed the indicated position. For liquid/steam jacketed heating, install according to the heating interface provided by the instrument. It is recommended to use reinforced flexible hoses to connect the heating jacket to the heat source.

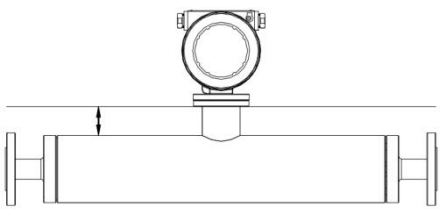


Fig.16 Schematic diagram of thermal insulation and heated straight tube mass Flow Meter

(6)Error installation introduction

●Horizontal installations with long vertical drops after flow through the meter

are not recommended for this type of installation.

●Flow Meter is installed at the highest point of the pipeline, which can cause air to build up.

●The Flow Meter is installed directly at the outlet of the downward venting pipe, which is not recommended.

●It is forbidden to install flow control valves upstream of the Flow Meter, if necessary, please install them downstream of the Flow Meter.

●Horizontal mounting, when the vibrating tube is not only subject to the action of the Coriolis force, but also subject to the action of the vibrating tube gravity, so that the measurement can not be carried out properly.

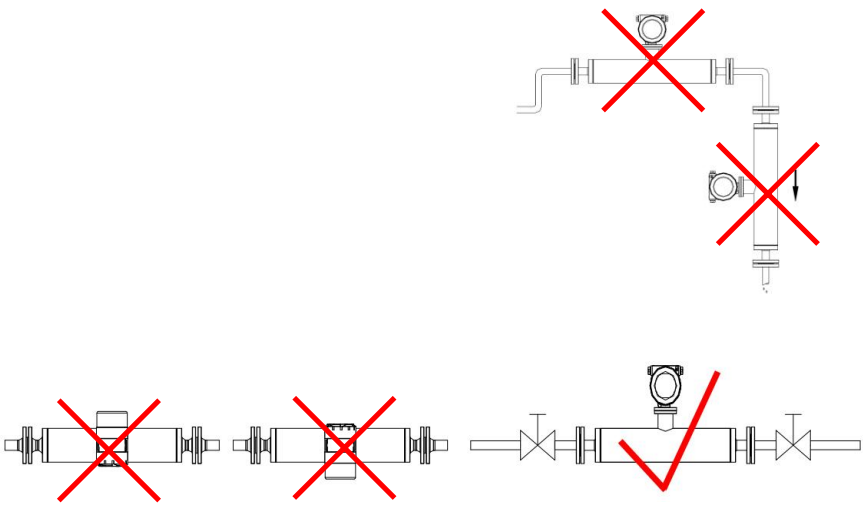


Fig.17 Installation introduction

(7) Fix

The Coriolis mass Flow Meter is a vibrating instrument. During operation, the two oscillating tubes remain in a vibrating state. Therefore, external vibrations or tubeline vibrations may affect its performance, leading to severe cases where it fails to function properly. Thus, when installing the sensor, both ends should be secured with supports, and the main body of the instrument can also be fixed. The mounting brackets should be installed on a stable and vibration-free surface.

If it is not possible to guarantee a fixed bracket, or if the tubeline connection

cannot be guaranteed to avoid vibration, the sensor can also be installed on a stable interface and connected to the tubeline with a flexible hose.

(8) Flow Meter lifting

The following points should be noted in the process of transportation:

●Do not remove the original packaging when transporting.

●Do not remove the protective cover on the process connector to prevent mechanical damage to the sealing surface of the connector during transportation and storage, and prevent debris from entering the measuring tube.

●When lifting, use a mesh soft rope to wrap around the process connection between the two ends. Do not wrap the lifting rope around the converter housing or the wiring chamber housing. Do not use chains to avoid damaging the housing.

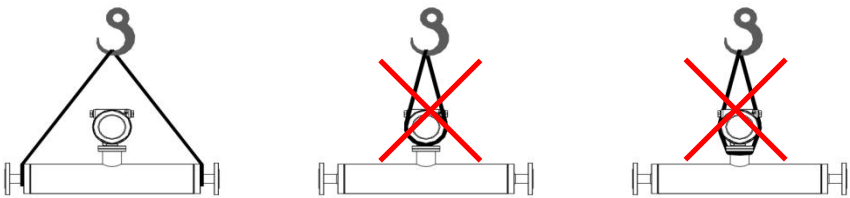


Fig.18 Flow Meter lifting

4.4 Non-straight tube type mass flow installation

Non-straight type mass flow can be installed vertically downward, vertically upward, or flag (vertical) installation or inclined flag (vertical) installation, but it must avoid lateral installation (in this case, the tube is not only subjected to the action of Coriolis force, but also subjected to the action of the tube gravity, so that the measurement cannot be carried out normally).

（1）In general, when measuring the flow of liquid medium, the vibrating tube should be installed vertically downward to avoid the accumulation of gas in the vibrating tube, which will affect the normal measurement. The installation is shown in the following figure:

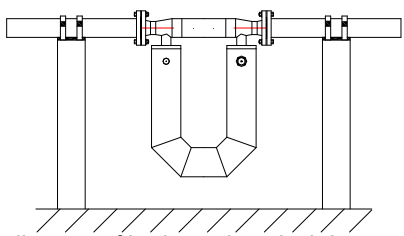


Fig.19 Schematic diagram of horizontal vertical downward installation

(2) In general state, when measuring the gas medium flow, the vibrating tube should be installed vertically upward to avoid liquid accumulation in the vibrating tube affecting normal measurement. The installation is shown in the following figure:

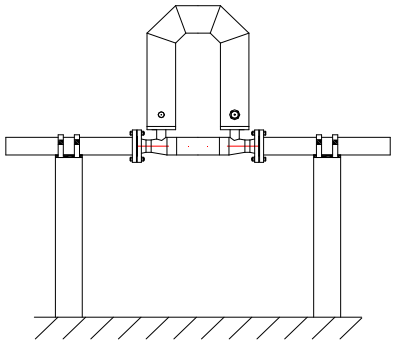


Fig.20 Schematic of the horizontal and vertical mounting facing up

(3) If there may be particles in the measuring medium, the flag (vertical) installation method should be adopted to avoid the accumulation of particles in the vibrating tube and affect the normal measurement. The installation is shown in the following figure:

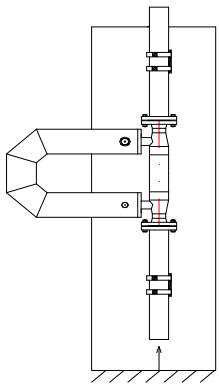


Fig.21 Schematic of the vertical (flag-type) installation

(4) Fixing of flow sensor

The Coriolis mass Flow Meter is a vibrating instrument, with both vibrating tubes always in a vibrating state during operation. Therefore, external vibrations or tubeline vibrations may affect its performance, leading to severe cases where it fails to function properly. Thus, when installing the sensor, both ends of the sensor

should be fixed with supports (the fixed connection parts should be connected, while the vibrating tubes should remain in a free state), as shown in Figures 19-21. The mounting brackets should be installed on a stable, vibration-free surface.

If it is not possible to guarantee a fixed bracket, or the tubeline connection cannot be guaranteed to avoid vibration, the sensor can also be installed on a stable interface, and the sensor is connected to the tubeline with a flexible hose.

Small-diameter Flow Meters (triangular) have finer connecting tubes, making it difficult to ensure the sensor is vibration-free during tube connection and fixation. Therefore, when manufacturing small-diameter sensors, two installation holes are left in the sensor housing, allowing users to fix the sensor on a bracket through these holes. Of course, the bracket should be installed on a stable surface. The installation diagram for the sensor is as follows:

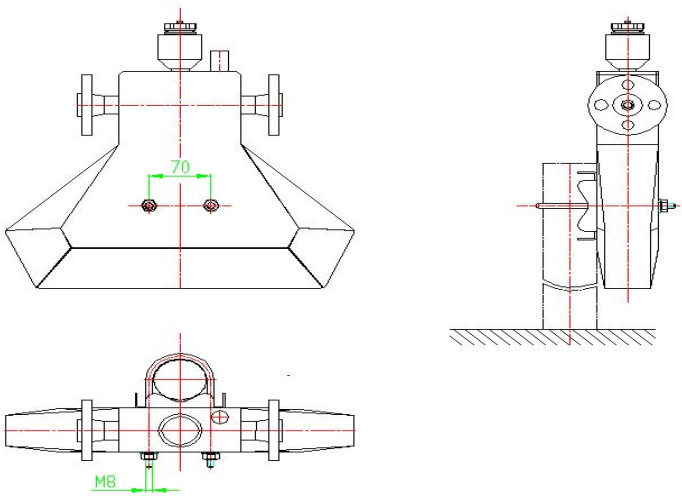


Fig.22 Schematic diagram of bracket fixing

(5) Split converter is fixed

The split mass Flow Meter is generally equipped with a 2m long converter signal line and flexible converter installation bracket, as shown in the installation diagram:

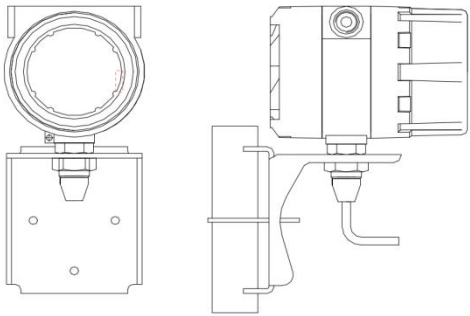


Fig.23 Schematic diagram for fixing the converter with a bracket

5. Electrical Connections

5.1 Wiring terminals

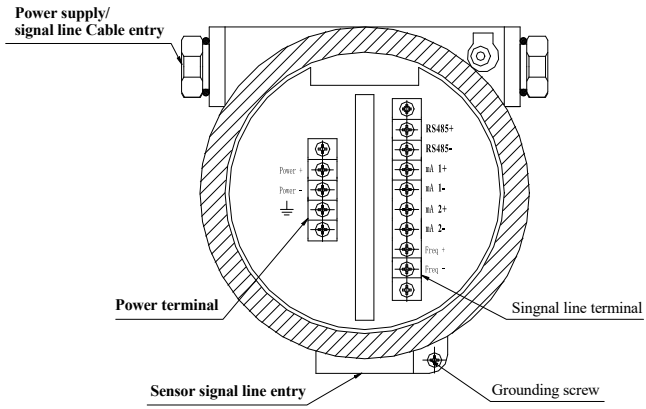


Fig.24 Flow Meter wiring terminal

Table 8 Terminal definition

Symbol	Explain
RS485+、RS485-	RS485 serial communication interface
mA1+、 mA1-	First wire (4~20)mA output interface
mA 2+、 mA 2-	Second wire (4~20)mA output interface
	Hart output interface (optional)
Freq+、 Freq-	Frequency (pulse) output interface
Power+、Power-	Power interface
⏚	Converter instrumentation protective grounding

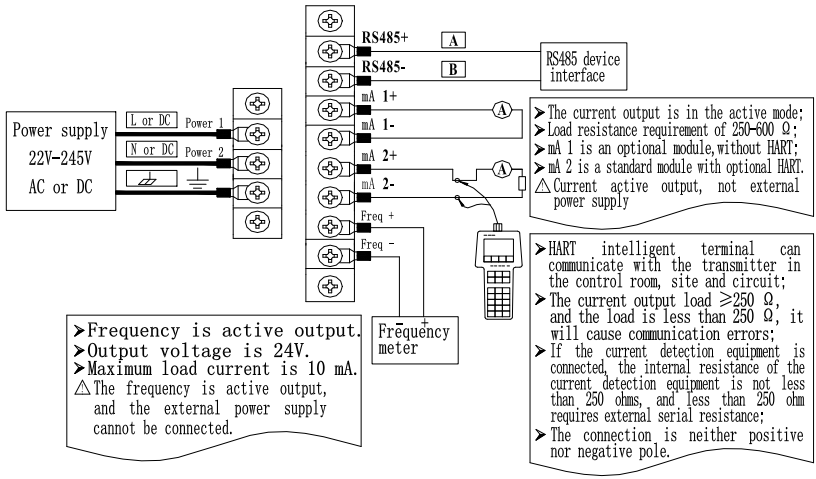


Fig.25 Transmitter wiring diagram

5.2 Specific requirements for electrical wiring

(1) Use special cables

The connection between the terminal box and the converter should be made by a special cable, not by other cables, so as not to affect the measurement error (separate installation).

(2) Separate wiring

The lead between the sensor and the converter should be routed separately, and should not be covered on the motor and other power equipment to avoid the influence of electromagnetic field on the measurement. The lead length should not exceed the maximum allowable distance of 100 meters (separate installation).

(3) Grounding

●By grounding the sensor end, such as connecting the tubeline system to the earth, the sensor grounding terminal can be directly connected to the tubeline system.

●By grounding the converter terminal, if the tube is not conductive or floating, the converter ground terminal can be directly connected to the instrument

protection ground access point. Improper grounding may lead to increased measurement error, and the grounding wire should be as short as possible, and the grounding resistance should be less than 1Ω.

(4) Drip protection

●All housing screws, shell covers and cable entry nuts must be tightened.

●The housing gasket must be clean and intact when inserted into the sealing groove. If necessary, the gasket can be dried, cleaned and replaced

●All wiring should be equipped with drip protection, that is, the cable inlet of the Flow Meter, cable and conduit should have a downward bend to avoid water in, resulting in a short circuit.

●All cable entry surfaces shall not be oriented upwards without protective measures.

●The cable inlet that is not needed should be sealed with a plug.

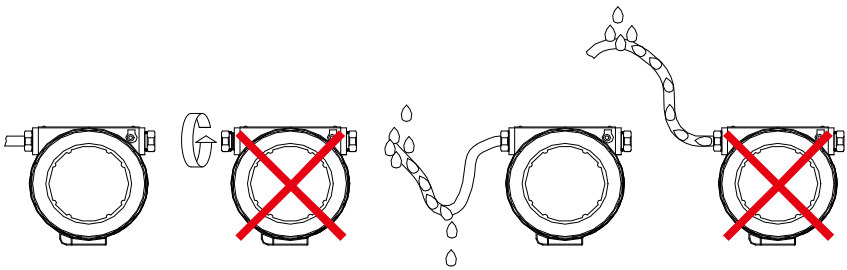


Fig.26 Schematic diagram of the drip protection

6. Operation

6.1 Display and operation unit

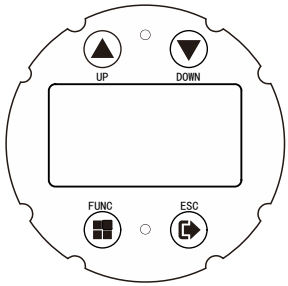


Fig.27 Schematic diagram of panel

Table 9 button definition

Order No.	Button	Button Function
1	UP	Move up to select the cursor.
2	DOWN	Move down to select the cursor.
3	FUNC	Under the main interface, enter the Settings menu. In the Settings interface, confirm.
4	ESC	Exit from the current menu.

Note: The button is a capacitive touch button, and the corresponding function is realized by touching the corresponding button with your finger.

6.2 Interface description

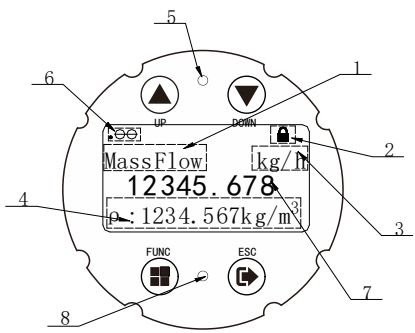


Fig.28 Main interface

Table 10 Interface description

Order No.	Meaning	Explain
1	Displays the variable #1 type name	Any of the following 6 variable names can be displayed: mass flow, volume flow, total mass, total volume, fluid density, and fluid temperature. Settings can be made in the Basic Settings->Display Variables #1 menu.
2	Keyboard lock symbol	In The flag indicates that the keypad is unlocked, In flag indicates that the keypad is locked.
3	Displays the unit of variable #1	The current measurement unit of variable #1 can be displayed, which can be set in the “Basic Settings->Display Variable #1” menu.
4	Displays the variable #2 type name	Any of the following 6 variable names can be displayed: mass flow rate, volume flow rate, total mass, total volume, fluid density, and fluid temperature. The measured value, unit and variable code of variable #2 are displayed. In the main interface, you can use the UP and DOWN buttons to switch the secondary display variables; if you want to set the default display variable #2 and the unit of the variable, you need to set it in the “Basic Settings->Display Variable #2” menu;
5	Keyboard status indicator light	Displays green when the keypad is unlocked and keys are pressed, and red when keys are not unlocked or no keys are pressed.
6	Decimal point cut-off indicator	When the integer length of display variable #1 or display variable #2 is too long, the display bits will be intercepted, which indicates that the currently displayed variable has been intercepted. The number of display bits can be set in the “Basic Settings->Display Bits” menu.
7	Displays the	Displays the measured value of variable #1.

Order No.	Meaning	Explain
	measured value of variable #1	Note: The refresh time of the display is the same as the damping time set by the device, refer to (9.1 Damping Time).
8	Key indicator light	This indicator lights up when a key is triggered.

6.3 Interface lock screen / unlock

6.3.1 Lock

After 30 seconds of no operation on the interface, the screen automatically locks the screen. At this time, the lock screen icon appears on the screen.

6.3.2 Release

Hold the UP and DOWN keys for 6 seconds at the same time, when the indicator light turns green, it indicates that the unlock is successful, and the unlock icon appears on the screen.

6.4 Setup menu

On the main interface, press FUNC to enter the system Settings menu, and select the function through UP or DOWN. The basic Settings and advanced Settings menus need to be entered with a password before entering.

BASICS
ADVANCED
DEV.INFO
DEBUG

Fig.29 Main menu interface

6.4.1 Basic Setup Menu

Enter the main menu and select basic Settings, press the FUNC key to confirm, enter the password (user password is 17) through the direction key, press the FUNC key to confirm and enter the menu, press the ESC key to exit to the main interface. The menu structure is shown in the table below:

Table 11 Basic settings menu and parameters

NO.	Menu	Setting Method	Parameter Range
1	DISP #1	select	Mass flow/volume flow/mass total/volume total/ fluid density/fluid temperature
2	DISP #2	select	Mass flow/volume flow/mass total/volume total/ fluid density/fluid temperature
3	DIGITS	Placement numbers	0～3
4	DAMP T	Placement numbers	0s～60.0s
5	CONTRAST	Placement numbers	25～50
6	BK LIGHT	select	On/off
7	LANGUAGE	select	Chinese/English
8	FLOW DIR	select	Positive/negative/bidirectional/absol ute value
9	MASS CUTOFF	Placement numbers	0～50%
10	4~20mA OUT #1	select	Mass flow/volume flow/density/temperature
11	4~20mA OUT #2	select	Mass flow/volume flow/density/temperature
12	mA MAXVAL #1	Placement numbers	-60000~60000 same range unit
13	mA MINVAL #1	Placement numbers	-60000~60000 same range unit
14	mA MAXVAL #2	Placement numbers	-60000~60000 same range unit

NO.	Menu	Setting Method	Parameter Range
15	mA MINVAL #2	Placement numbers	-60000~60000 same range units
16	MAX OUT FREQ	Placement numbers	0.0000～10.0000kHz
17	FREQ OUT	select	Mass flow/volume flow
18	FREQ MAXVAL	Placement numbers	-60000~60000 same range unit
19	FREQ MINVAL	Placement numbers	-60000~60000 same range unit
20	MASS CUTOFF	Placement numbers	0%～50%
21	VOL CUTOFF	Placement numbers	0%～50%
22	DEN CUTOFF	Placement numbers	0.000～1.000g/cm^3
23	INPUT DENS	Placement numbers	0.0000～3.0000 g/L
24	PRESSURE	Placement numbers	0.00～99.00MPa
25	RS485 ADR	Placement numbers	0～31
26	RS485 BAUD	select	1200/2400/4800/9600
27	COMM	select	RS485/HART
28	RECALL MEMO	select	Yes/no
29	RESET	select	Yes/no
30	ZERO CAL	select	Yes/no

6.4.2 Advanced Setup Menu

Enter the main menu and select Advanced Settings, press the FUNC key to

confirm, enter the password (user password is 987) through the direction key, press the FUNC key to confirm and enter the menu, press the ESC key to exit to the main interface, the menu structure is shown in the following table:

Table 12 Advanced settings menu and parameters

NO.	Menu	Setting Method	Parameter range
1	FLOW K	Placement numbers	0~9999.99 (scientific notation)
2	CAL TEMP	Placement numbers	-50.0～100.0
3	M.FLOW MAX	Placement numbers	0~60000 unit: t/h, kg/h, g/h
4	M.FLOW MIN	Placement number	0~60000 unit: t/h, kg/h, g/h
5	V.FLOW MAX	Placement numbers	0~60000 units: m^3/h，L/h，mL/h
6	V.FLOW MIN	Placement numbers	0~60000/m unit^3/h，L/h，mL/h
7	TEMP Ct	Placement numbers	-999.999～999.999
8	BASIC FQ	Placement numbers	0～500.00
9	DENSITY D1	Placement numbers	-999.999～999.999
10	DENSITY D2	Placement numbers	-999.999～999.999
11	DENSITY D3	Placement numbers	-999.999～999.999
12	DENSITY D4	Placement numbers	-999.999～999.999
13	DENSITY D5	Placement numbers	-999.999～999.999

NO.	Menu	Setting Method	Parameter range
14	DENSITY D6	Placement numbers	-999.999～999.999
15	DENSITY D7	Placement numbers	-999.999～999.999
16	DENSITY Dt	Placement numbers	-50～100.0
17	PRESS.P1	Placement numbers	-999.999～999.999
18	PRESS.P2	Placement numbers	-999.999～999.999
19	PRESS.P3	Placement numbers	-999.999～999.999
20	N C Po1	Placement numbers	0～150 -50～50.00
21	N C Po2	Placement numbers	0～150 -50～50.00
22	N C Po3	Placement numbers	0～150 -50～50.00
23	N C Po4	Placement numbers	0～150 -50～50.00
24	N C Po5	Placement numbers	0～150 -50～50.00
25	SET MEMORY	select	Yes/No

6.5 Description of the basic menu parameters

6.5.1 Display Settings

(1)Displays variable #1 Settings

Set the type of display variable #1 and the unit of display variable. The display variables that can be set are mass flow, volume flow, total mass, total volume, fluid density and fluid temperature.

Table 13 Displays the variable types and units

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^3/s
	m^3/min	m^3/h	m^3/day	Gal/s	Gal/min	Gal/h	Gal/day	
Total mass	g	kg	t	lb	—	—	—	—
Total volume	ml	L	m^3	Gal	—	—	—	—
Density	g/cm^3	g/L	g/ml	kg/L	kg/m^3	lb/Gal	—	—
Temperature	℃	℉	—	—	—	—	—	—

(2)Displays variable #2 Settings

Set display variable #2 with the same Settings as display variable #1.

(3)Digits

Set the number of display digits for the measurement value display, set the range 0~3, when the display variable #1 or the sub-display variable is automatically truncated due to the excessive length of the integer digit, 00 is displayed in the upper left corner of the screen to indicate that a decimal digit of the current display value has been truncated.

(4)Contrast

Set the value to 25~50 to set the contrast of the current LCD display. Set it to the clearest display according to the environment.

(5)Backlight

The LCD of the converter can be displayed clearly without backlight in bright places. You can choose to turn off the backlight. If the display is not clear in dark environment, you can choose to turn on the backlight.

(6)Language

Used to switch between Chinese and English display languages.

6.5.2 Measurement Setting

(1) Damp Time

This setting is used to eliminate small but intense fluctuations during the measurement process. The damping value sets the response time of the converter to changes in process variables (set in seconds, ranging from 0s to 60s). This setting affects the response speed of mass flow, volumetric flow, and density values. It has no impact on the total mass or total volume.

- The higher damping value makes the change of the measured value more smooth, and the change of the display, current output and frequency output is slower.
- The lower damping value makes the measurement value change more quickly, and the display, current output and frequency output change more quickly.
- Applying a high damping value to fast and intense flow changes may lead to measurement errors.
- As long as the damping value is not zero, the measured value will lag behind the actual change value, because the measured value is the average value over a period of time; usually the low damping value is preferred, because the probability of data loss is lower, and the lag time between the actual change value and the measured value is shorter.
- For gas applications, it is recommended to set the damping to 2.56 or higher.

(2)Small signal cut-off

This setting specifies the minimum limit of the measurement value, and the measurement value below the cut-off value will be displayed and output as 0; this setting includes mass flow cut-off, volume flow cut-off, and density cut-off.

The range of mass flow cut-off setting is 0~50% range, and the number of display digits is 2;

The range of volume flow cut-off setting is 0~50%, and the number of display digits is 2;

The density removal setting range is (0~1) g/cm^{3}The display number is 3 digits.
The volume flow cut does not affect the mass flow and density measurement value, the mass flow cut and density cut setting values will affect the volume flow measurement value, the volume flow measurement value is calculated by the mass Flow Meter density value.
Note: The display of the measured value, the frequency output and the current output are all after the small signal cut.

(3)Input DENS

Volume flow measurement of a fluid with known density, when the input density is not 0, the volume flow calculation will ignore the actual density measurement value and use the input density as the basis for the volume flow. The input density unit is g/cm^3, The input range is 0~3, and the display number is 4 bits.

(4)Fluid DIR

The direction of flow determines how forward and reverse flow of fluid affects the measurement value, current output, and frequency output value.

- Forward flow: flow in the direction of the flow arrow on the sensor;
- Reverse flow: flow in the opposite direction of the flow arrow on the sensor;

Table 14 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; Direction flow displayed value is 0; Forward flow total mass and total volume increase; Reverse flow total mass and total volume are not changed.
Reverse	Apply to the opposite in the direction of the flow	Direction flow displayed value is 0; Forward flow displayed value is the measurement value（no minus sign）;

Flow direction setting	The relation with sensor arrow	The relation with displayed value
	arrow and most of the traffic situation	Forward flow total mass and total volume are not changed; Reverse flow total mass and total volume increase.
Absolute value	Regardless of the direction of arrow	Forward flow displayed value is the measurement value; Direction flow displayed value is the measurement value（no minus sign）; Forward flow total mass and total volume increase; 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; Direction flow displayed value is the measurement value（with minus sign） Forward flow total mass and total volume increase; Reverse flow total mass and total volume decrease.

- The effect of the flow direction on the output

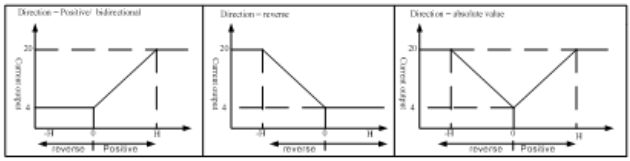
Flow will affect the way of current output, only in the current output configuration in the mass flow or volume flow, flow will affect the current output;

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

If the current lower limit parameter =0, refer to Figure 30

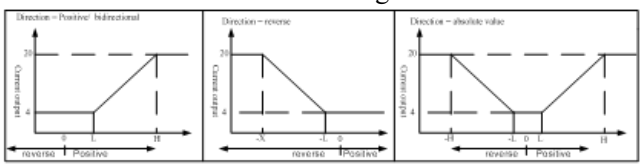
If the current lower limit parameter is >0, refer to Figure 31

If the current lower limit parameter is negative, refer to Figure 32



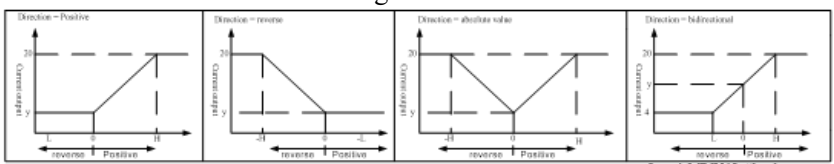
L=mA MINVAL #1 = 0
H=mA MAXVAL #1

Figure 30



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

Figure 31



L=mA MINVAL #1 < 0
H=mA MAXVAL #1
y= (H/(H-L))*16+4 (mA)

Figure 32

- The effect of flow on frequency output

Table 15 Table of the flow direction influence on the output frequency

Flow direction setting	Actual flow direction		
	Forward	Zero flow	Reverse
Forward	output>0	output =0	output =0
Reverse	output =0	output =0	output>0
Absolute value	output>0	output =0	output>0
Bi-direction	output>0	output =0	output>0

- The effect of flow on total volume

Table 16 Table of table flow on total volume

Flow direction setting	Actual flow direction		
	Forward	Zero flow	Reverse
Forward	Total increase	The total remains unchanged	The total remains unchanged
Reverse	The total	The total	Total increase

Flow direction setting	Actual flow direction		
	Forward	Zero flow	Reverse
	remains unchanged	remains unchanged	
Absolute value	Total increase	The total remains unchanged	Total increase
Bi-direction	Total increase	The total remains unchanged	Total reduction

6.5.3 Current output Settings

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

(1)Current configuration Settings

Mass flow, volume flow, density and temperature can be selected as output values of current.

(2)Upper current limit parameter and lower current limit parameter

The configuration for mass flow rate ranges from-60,000 to 60,000, with the unit being the same as the mass flow range unit; for volumetric flow rate, the value range is also-60,000 to 60,000, with the unit being the same as the volumetric flow range unit; for fluid temperature, the range is (-250 to 400)℃; for fluid density, the range is 0 to 3000, with the unit being the same as the displayed density unit (units can be set in display variable #2). The current of 4mA corresponds to the lower limit parameter of the current, while 20mA corresponds to the upper limit parameter of the current.

pour:

●The current signal output by the current value represents the current measurement value. When the actual value is less than the cut-off value, the measurement value is output as 0 and the current value is output as 4mA;

●The lower limit parameter value of current should not be greater than the

upper limit parameter value of current, otherwise the current will output an error value.

6.5.4 Frequency output settings

This setting is used for the configuration scheme of frequency output, and the flow value represented by the output frequency. The setting includes frequency output configuration, upper limit of frequency flow, pulse output equivalent, and upper limit of frequency output.

(1)Frequency output configuration

Can be selected as mass flow and volume flow;

(2)Upper frequency flow rate

Used to set the maximum frequency to represent the flow value, the unit is the same as the range unit of the device, and the modified range value is 0~60000.

(3)Lower frequency flow rate

This value is always 0.

(4)Upper limit frequency output

The frequency value corresponding to the upper limit flow is set;

(5)Equivalent pulse calculation

The equivalent pulse calculation formula is 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 the flow rate is 36000kg/h, the lower limit of the flow rate is 0kg/h, and the upper limit frequency is 10KHz.

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

Note: Divide by 3600 to convert the flow unit to /s

6.5.5 Zero out the total amount

When the total amount is zero, the total mass flow and the total volume flow are re-added to the flow value.

6.5.6 Zero calibration

Zero calibration, used after equipment installation to modify the stored zero value

to a zero value suitable for the current application to improve the measurement error of the actual fluid. Settings process:

The mass Flow Meter is a full tube Flow Meter. It needs to be full tube (complete emptying is also regarded as full tube) whether in operation or stationary. If not full tube, the Flow Meter will be abnormal and stop working in serious cases!

(1)Prepare conditions

- After the Flow Meter is powered on, preheat for 10 minutes;
- Let the measured fluid flow through the sensor until the sensor temperature is the same as the measured fluid temperature;
- Close the downstream and upstream valves (if any) of the sensor in sequence to stop the fluid in the sensor, and confirm that the fluid has been cut off and filled the sensor.
- Before calibration, the density parameter on the instrument panel can be used to determine whether the Flow Meter is in the full tube state (the density should be consistent with the density value displayed during operation).
- Before calibration, it is necessary to ensure that the medium in the Flow Meter is full and not flowing. During calibration, there is no abnormal phenomenon such as sedimentation, wall hanging and gas-liquid mixing in the medium! Otherwise, it will cause zero deviation, which will have a great impact on the measurement accuracy!

(2)Calibrate and await for completion

Select "Basic Settings> Enter Password> Zero Calibration> Yes" in the system menu to calibrate and wait for the calibration program to complete.

(3)If the zero-point calibration fails

- Verify that the sensor is full of fluid and the fluid is completely stationary;
- Ensure that the fluid does not contain particles that may precipitate;
- Repeat the zero calibration procedure;
- If it fails again, please contact the manufacturer.

6.5.7 Communication Settings

(1)Communications options

In the system menu, select "Basic Settings> Input password> Communication>

Select communication mode" to select the communication mode, which can be RS485 or HART.

(2)RS485 Settings

When the communication mode is selected as RS485, the following Settings are valid.

●RS485 address: In the system menu, select "Basic Settings> Input password> RS485 address> Enter the current devices address" to set the range 0~31;

●RS485 communication baud rate: In the system menu, select "Basic Settings> Input password> RS485 baud rate> Select baud rate" to select 2400/4800/9600.

6.5.8 Restoring factory settings

In the system menu, select "Basic Settings> Enter Password> Restore Factory Settings> Select Yes" to restore the current Settings to the initial state of the manufacturer.

6.5.9 Device status view and output test

(1) Instrument information

Enter the system Settings menu and select device information. Press the FUNC key to enter and use the direction keys to query. Press the ESC key to exit to the main interface. Device information is in read only mode and cannot be modified.

It includes original data information, closed-loop data information, range information, number information, model information, version information and fault code query.

(2)Debug menu

Perform equipment output test function.

●Output port test

Provides frequency and current output testing functions. Once this function is activated, the frequency and current output remain constant, not reflecting changes in measurement values. Exiting this function restores normal output. It can be used to adjust the current coefficient and verify the operating status of the devices output section. After entering this function, adjust the percentage value of the output through the UP and DOWN buttons to change the frequency and current output values.

●Flow Meter reset

Start the Flow Meter softly.

●Clear the fault code

Clear the fault code generated by the device.

6.6 Advanced Settings menu description

This menu may be set only when the manufacturer leaves the factory, on-site sensor replacement, equipment calibration, etc. When working on site, the setting parameters of this menu shall not be adjusted, otherwise it may cause measurement error.

6.6.1 Discharge coefficient

When recalibrating or 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,

6.6.2 Calibration temperature

The fluid temperature used to record the flow coefficient calibration is used for temperature compensation.

6.6.3 Upper and lower limit of mass range

The mass flow range of the instrument needs to be set according to the connected sensor. The lower limit of the range is usually set according to the dynamic range of the whole meter.

Table 17. Table of instrument range units

t/h	kg/h	g/h

6.6.4 Upper and lower limit of volume flow range

As above, the setting needs to be made according to the connected sensor.

Table 18. Table of volume flow range units

m^3/h	L/h	mL/h

6.6.5 Temperature coefficient Ct

Used for temperature compensation. This setting is set as advanced Settings and cannot be changed. If you need to change it, please contact the manufacturer.

This change will cause inaccurate measurement of mass flow and other parameters when temperature changes.

Base frequency: The parameter used for density measurement. After the sensor is connected, the vibration frequency of the sensor when it is empty is recorded here for calculating fluid density. This setting is set as advanced Settings and cannot be changed. If you need to change it, please contact the manufacturer. This change will cause inaccurate measurement of parameters such as density and volume.

6.6.6 Density coefficient D1

The fluid density is calculated according to this density coefficient and the fundamental frequency, and the modification and calibration method is the same as the flow coefficient.

6.6.7 Density coefficient from D2 to D7

This coefficient is used when calibrating density parameters using the method specified in JJG_370-2007 Calibration Code for Online Vibrating Tube Liquid Density Meters.

6.6.8 Density coefficient Dt

The fluid temperature used to record the calibration of density coefficient D1 is used for temperature compensation of density.

6.6.9 Store ex-factory settings

Store the current Settings as factory Settings, and select Restore factory Settings when setting up the basic Settings to restore to this storage state.

6.6.10 Advanced Settings menu items

Menu pressure coefficient P1~P3, N C Po1~5 are advanced menu items, which cannot be changed at will. If you need to change, please contact the manufacturer for confirmation before making any changes, which will introduce unnecessary errors.

7. Maintenance and Maintenance

7.1 Maintenance of the Flow Meter

The Flow Meter is generally not required to use special maintenance due to its structural characteristics. However, appropriate maintenance measures should be taken in some special use conditions to ensure the accurate and reliable operation of the Flow Meter, such as:

- When particles may accumulate in the flow tube, regular inspection and removal should be carried out to avoid affecting the normal use of the Flow Meter;
- When the measuring medium is likely to adhere to the inner wall of the vibrating tube, regular blowing should be carried out to avoid affecting the normal use of the Flow Meter;
- When there are particles in the measuring medium and the vibration tube may wear, the inspection and treatment should be carried out in time, etc.

7.2 Cleaning of the Flow Meter

The instrument is sealed with dry protective gas when it leaves the factory, so any humid gas will damage the instrument. Do not disassemble the sealing structure of the instrument on site, otherwise it will cause damage to the instrument. If you have any questions, please contact the manufacturer for guidance.

Instrument cleaning can refer to tubeline cleaning methods. It is recommended to use on-site cleaning (CIP), but it should be carried out at the rated temperature and pressure of the instrument nameplate. The cleaning medium should be used fully considering the material characteristics of the instrument. Do not use hard objects to clear the internal tube during the cleaning process, so as to avoid internal vibration tube damage and affect measurement accuracy.

In special cases, disassembly and cleaning must be carried out. It is essential to ensure that the front and rear casings and securing screws of the converter instrument are tightened, and that the explosion-proof plugs on both sides of the instrument are fully sealed. The sensor section can be immersed in water, but the instrument connections and converter must not be submerged in water; only low-pressure water rinsing is allowed. As shown in the figure:

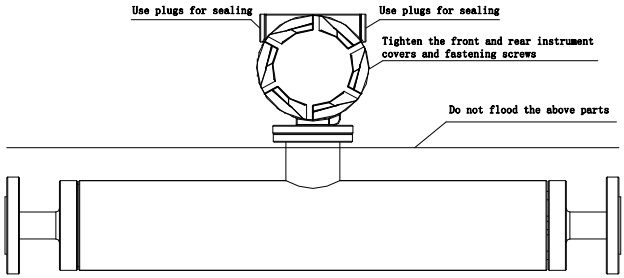

Use plugs for sealing
Use plugs for sealing
Tighten the front and rear instrument covers and fastening screws
Do not flood the above parts

Figure 32

8. Fault analysis and troubleshooting

The following table lists the possible problems and solutions for Flow Meters. If your problem is not listed or the solution does not address your problem, please contact us.

Table 19. Common troubleshooting

Fault phenomenon	Possible causes	Exclusion methods
The zero drift is large	Whether the medium in the Flow Meter is full and not flowing	Fill the Flow Meter with material, and close the valves at both ends of the Flow Meter
	Whether the Flow Meter installation tube is fixed, whether there are strong vibration sources or frequency converters and other interference nearby	Add support or switch to hose connection
	The sensor is stressed	The connection tube and the sensor interface should be on the same axis
Instantaneous flow display is abnormal	Whether the actual flow rate of the tubeline exceeds the maximum range set by the instrument.	Reduce the flow of the tube or reset the maximum flow of the Flow Meter
	Check if there is strong vibration in the sensor tubeline.	Add support or switch to hose connection
	Check whether the zero point of the Flow Meter is normal.	Calibrate the zero point under the condition of meeting the calibration

Fault phenomenon	Possible causes	Exclusion methods
		conditions.
	Check the frequency and zero point value of the instrument to determine whether the instrument is working normally.	If the instrument does not work properly, contact the manufacturer for after-sales service
The density display is unstable	Check whether the frequency value is normal through the LCD screen or communication software (normal value>200Hz, and the value is stable)	Whether there are bubbles in the tube and find the cause of the bubbles (such as incorrect installation position of the control valve)
	Check whether the sensor pin parameters are normal	If not normal, contact the manufacturer for after-sales service
The instrument does not display	Whether the instrument power supply is normal	Check the power supply voltage and terminal to ensure that the power supply works properly
	Measure whether the power supply of the terminal board is normal	Check the power supply voltage and terminal connections to ensure that the power supply is working properly
Communication signal lost	Check whether the communication line is reversed or broken	Check the wiring or swap A and B connections

Appendix A. Communication protocol

A.1 Physical interface

The electromagnetic Flow Meter has a standard RS485 communication interface and adopts Modbus-RTU standard protocol.

A. 2 The ModBus communication protocol

(1) Read the N variables

Host request information frame:
Instrument address +0x03+ register starting address (2 bytes, high byte first) + register read/write quantity 2*N (2 bytes, high byte first) + CRC check code (2 bytes, low byte first)
From the machine response information frame:
Instrument address +0x03+ number of bytes occupied by data 4*N (1 byte) + register data (4*N bytes, high byte first) + CRC check code (2 bytes, low byte first)

(2) Write N variables

Host request information frame:
Instrument address + function code 0x10 + register starting address (2 bytes, high byte first) + number of registers to read/write 2*N (2 bytes, high byte first) + number of bytes for data 4*N (1 byte) + data to be written (4*N bytes, high byte first) + CRC check code (2 bytes, low byte first)
From the machine response information frame:
Instrument address + function code 0x10 + register starting address (2 bytes, high byte first) Register read/write quantity 2*N (2 bytes, high byte first) + CRC check code (2 bytes, low byte first)
3

A.3 Register address

Table 20. ModBus Communication variable address

NO.	Name	Type	Address (DEC)	Description	Windows default
1	flow mass	read only	2000	floating number	

NO.	Name	Type	Address (DEC)	Description	Windows default
2	volume flow	read only	2002	floating number	
3	medium temperature	read only	2004	floating number	
4	Medium density	read only	2006	floating number	
5	Total mass L	read only	2008	floating number	
6	Total mass H	read only	2010	The length of the shape changes with the change of the setting unit. Total =H * 1000000 + L	
7	Total volume L	read only	2012	floating number	
8	Total volume H	read only	2014	The length is changed with the change of the setting unit. Total =H * 1000000 + L	
9	Unit of mass flow	read-write	2030	0~14, respectively represent: 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	5
10	Unit of mass quantity	read-write	2032	0~3, respectively represent: g，kg，t，lb	1
11	Unit of volume flow	read-write	2034	0~14, respectively represent: ml/s, ml/min, ml/h, L/s, L/min, L/h, L/day, m^3/s， m^3/min，m^3/h，m^3/day，Gal/s，Gal/min，Gal/h，Gal/day	5
12	A unit of total	read-wri	2036	0~3, respectively represent:	2

NO.	Name	Type	Address (DEC)	Description	Windows default
	volume	te		ml, L, m^3, Gal	
13	Unit of medium temperature	read-write	2038	0～1，℃,℉	0
14	Unit of medium density	read-write	2040	0~5, respectively represent: g/cm^3, g/L, g/ml, kg/L, kg/m^3, lb/Gal	0
15	Clear total command	read-write	2052	Write 0, clear the total; read and return 1	
16	Calibrate the zero point command	read-write	2054	Write 0 and calibrate the zero point; read back 1	
17	refresh time	read-write	2056	0.0s～60.0s，0.5s	0.5s
18	decimal digits	read-write	2058	0～3	3
19	Mass flow cut-off ratio	read-write	2060	0.00%～50.00%	1%
20	Volume flow cut-off ratio	read-write	2062	0.00%～50.00%	1%
21	Density resection value	read-write	2064	$0.0000g/cm^3$～$1.0000g/cm^3$	$0.0050g/cm^3$
22	Enter fluid density	read-write	2066	0.0000g/L～3000.0000g/L	
23	fluid pressure	read-write	2068	0.00MPa～99.99MPa	
24	Direction of	read-wri	2070	0~3, respectively represent:	1

NO.	Name	Type	Address (DEC)	Description	Windows default
	flow	te		forward, reverse, bidirectional, absolute value	
25	display language	read-write	2072	0~1, respectively represent: Chinese, English	1
26	Upper limit of mass range	read-write	2074	0～99999	6000
27	Quality range lower limit	read-write	2076	0～99999，0	
28	Unit of mass range	read-write	2078	0~2, respectively represent: t/h, kg/h, g/h	1
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, respectively represent: m^3/h，L/h，ml/h	1
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 measurement unit	read-write	2090	0kg/m^3	
35	Upper limit of temperature range	read-write	2092	-200～400	180
36	Lower limit of temperature range	read-write	2094	-200～400	50

NO.	Name	Type	Address (DEC)	Description	Windows default
37	Temperature range unit	read-write	2096	℃	
38	Current output 1 configuration	read-write	2098	0~3, respectively represent: mass flow, volumetric flow, medium density, medium temperature	0
39	Current output 2 configuration	read-write	2100	0~3, respectively represent: mass flow rate, volume flow rate, medium density, medium temperature	1
40	Current 1 upper limit parameter	read-write	2102	Mass flow rate: -99999~99999 Volume flow rate: -99999~99999 Medium density: 0.0~3000.0 Medium temperature: -250~400	
41	Current 1 lower limit parameter	read-write	2104	Mass flow rate: -99999~99999 Volume flow rate: -99999~99999 Medium density: 0.0~3000.0 Medium temperature: -250~400	
42	Current 2 upper limit parameter	read-write	2106	Mass flow rate: -99999~99999 Volume flow rate: -99999~99999 Medium density: 0.0~3000.0	

NO.	Name	Type	Address (DEC)	Description	Windows default
				Medium temperature: -250~400	
43	Current 2 lower limit parameter	read-write	2108	Mass flow rate: -99999~99999 Volume flow rate: -99999~99999 Medium density: 0.0~3000.0 Medium temperature: -250~400	
44	Frequency output configuration	read-write	2114	0~1, mass flow, volume flow	0
45	Frequency upper limit parameter	read-write	2116	Mass flow rate: -99999~99999 Volume flow rate: -99999~99999	
46	Frequency lower limit parameter	read-write	2118	Mass flow rate: -99999~99999 Volume flow rate: -99999~99999	
47	Upper limit of output frequency	read-write	2122	0Hz～10kHz，	10kHz
48	discharge coefficient	read-write	2124	0～10000.000	8.1234
49	Flow calibration temperature	read-write	2126	-50.0℃～100.0℃	25.0℃
50	Flow	read-wri	2128	-999.999～999.99 9	-51.08

NO.	Name	Type	Address (DEC)	Description	Windows default
	temperature coefficient Ct	te			
51	Base vibration frequency	read-write	2130	50.000Hz～500.000Hz	140.000 Hz
52	Communications password	write only	2216		
53	Set a communication password	write only	2218		

Description: Read-only data has no password protection, write data requires entering the correct password before executing the write command.

In the user setting menu, if you select Restore Factory Settings, the communication password will be restored to the factory default value, which is used for restoring the setting of the communication password that the user has forgotten to set.

When setting the communication password, you need to write the original level of the password to the setting register correctly before you can change that password. For example, communication password, the original password is 0124, the new password is 2018, then when setting, first write 0124 to address 2216, then write 2018 to address 2218, after the converter receives this data, it will automatically check whether the original password is correct, if it is correct, then the 2018 password is set, otherwise it is invalid.

**Note::

Each register is 4 bytes, occupies two addresses (low address addressing), the data transmission adopts 32-bit single-precision floating-point number (the high bit is in the front); address 2052 corresponds to the total zero register, write 0 to the address to carry out the total zero operation; return to 1 when reading the register;

Address 2054 corresponds to zero calibration register, write 0 to this address to perform total zero operation; return 1 when reading this register.