

Compact Electromagnetic Flowmeter

Supmea

Headquarters

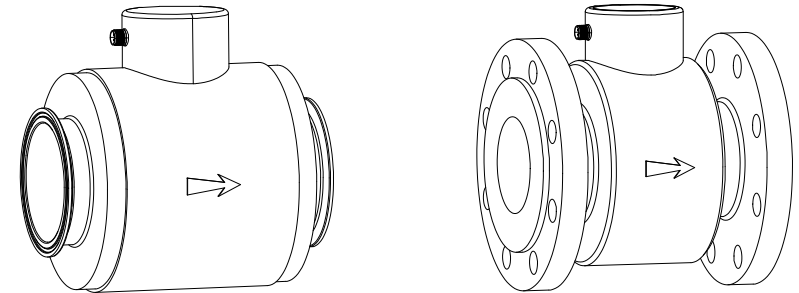
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Preface

- This manual provides an introduction to the product's basic functions, structure, and wiring methods. For information on product installation, operation, and communication protocols, please refer to the corresponding operation manual.
- Before operating the product, please read this manual carefully to ensure correct use and to avoid personal injury or unnecessary losses caused by improper operation.

Note

- The contents of this manual are subject to change without notice due to real-time factors such as function upgrades.
- We strive to ensure the accuracy of the manual. Nevertheless, if you identify any errors or inaccuracies, please contact us.
- Unauthorized reprinting or copying of this manual is strictly prohibited.
- We reserve the final interpretation of the manual.

Version

U-SUP-FMX400-EN2

Safety Precautions

For the safe operation of this product, please strictly follow the outlined safety precautions.

About this manual

- Please ensure the instrument operators have a careful reading of this manual.
- Prior to operation, please study this manual in detail to ensure a thorough comprehension of the device's functionality.
- This manual only describes the product's functions. The responsibility for the device's suitability for any special or personalized purpose lies solely with the operator.

Precautions for product protection, safety, and modification

- For your safety and the normal operation of the product and its controlling systems, the guidelines and precautions specified in this manual are supposed to be fully observed. Operating the instrument in ways not specified in this manual may compromise its protective features. Our company shall not be liable for any malfunctions or accidents resulting from non-compliance with the precautions described.
- When equipping the product and its controlling systems with lightning protection or separate safety protection circuits, it needs to be implemented by other devices.
- If you need to replace components or fittings of the product, please use the model specified by the company.
- This product is not designed for use in systems directly related to personal safety, such as nuclear power facilities, radioactive equipment, railway systems, aviation equipment, marine equipment, and medical equipment. If applied, it is the user's responsibility to implement additional equipment or systems to ensure personal safety.
- Do not modify this product.
- The following safety symbols are used in this manual:



Hazard: Failure to take appropriate precautions may result in serious personal injury, product damage, or major property loss.



Warning: Pay special attention to critical information related to the product or specific sections of this user manual.



- Confirm whether the supply voltage is consistent with the rated voltage before operation.
- Do not operate the product in areas containing flammable gases, explosive gases, or steam. Using the product in such environments is extremely dangerous.
- To prevent electric shock and operation errors, ensure proper grounding protection is in place.
- Thunder prevention engineering facilities must be well managed: the shared grounding network shall be grounded at the correct electric level, shielded, with wires properly routed, and an SPD surge protector applied as needed.
- Some internal components may carry high voltage. To avoid the risk of electric shock, do not open the front square panel unless it is being handled by trained personnel or maintenance staff authorized by our company.
- To avoid electric shock, disconnect the power before performing any checks.
- Check the condition of the terminal screws regularly. If loose, please tighten them before use.
- Unauthorized disassembly, modification, or repair of the product is not allowed, as it may lead to malfunctions, electric shock, or fire hazards.
- Wipe the product with a dry cotton cloth. Do not use alcohol, benzene, or other organic solvents, and avoid exposing the product to any liquids. If

the product falls into the water, please cut off the power immediately to prevent leakage, electric shock, or fire hazards.

- Please check the grounding protection regularly. Do not operate the product if you think that the protection, such as grounding protection and fuses, is inadequate.
- 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; failure to do so may damage the product's protective devices.



- Do not use the instrument if it is found damaged or deformed upon opening the package.
- Prevent dust, wire ends, iron fines, or other objects from entering the instrument during installation, as this may cause abnormal operation or failure.
- During operation, to modify the configuration, signal output, startup, stop, and operation safety shall be fully considered. Improper operation may lead to failure and even destruction of the instrument and control equipment.
- Each part of the instrument has a certain service life, which must be maintained and repaired regularly for long-term use.
- If the product comes to the end of its service life, it should be disposed of as industrial waste as a way of environmental protection.
- Disconnect the instrument when it is not in use.
- 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 terms beyond the scope of this product warranty.
- This company is not responsible for damage to the instrument, loss of parts, or unpredictable damage caused directly or indirectly by improper operation of the user.

No.	Items	Quantity	Note
1	Compact Electromagnetic Flowmeter	1	
2	Cable	1	
3	User Manual	1	
4	Certificate of Conformity	1	
5	Test Certificate	1	

After opening the package and before starting operation, check the package contents. If the model or quantity is incorrect, or if the product shows any physical damage, please contact us.

Note: Customized products may differ slightly from the standard configuration. Refer to the order for the actual scope of supply.

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1 Overview

1.1 Description

The compact electromagnetic flowmeter integrates the sensor and converter in a single unit and is designed for instantaneous flow measurement and flow totalization of conductive liquids in closed pipelines. It provides real-time local monitoring and display, and can simultaneously output (4–20) mA current, pulse, and RS485 digital signals for seamless connection to recording, regulating, and automatic control systems. Its compact design enables flexible installation and straightforward commissioning. It is widely used in municipal water supply, chemical processing, coal, environmental protection, textile, metallurgy, papermaking, and other industries.

The flowmeter parameters are normally factory-preset according to the ordering specifications. Therefore, users generally do not need to adjust parameters before operation. However, it is necessary for users to check that the parameters on the nameplate have been preset correctly and confirm that they are consistent with the actual operating conditions.

The electrical conductivity of a liquid is expressed by its conductivity value. In general, the minimum conductivity measurable by an electromagnetic flowmeter is in the $\mu\text{S}/\text{cm}$ range; the exact minimum depends on the product design and construction (see the Technical Parameters section for the minimum conductivity applicable to this model). Conductivity should be evaluated using an online measurement. During offline measurement, carbon dioxide and nitrogen oxides from the air may dissolve in the medium and cause a higher conductivity reading.

1.2 Measurement Principle

The electromagnetic flowmeter employs an advanced low-frequency square-wave excitation design, and its operating principle is based on Faraday's law of electromagnetic induction. As shown in Figure 1, two electromagnetic coils located at the upper and lower sides generate a constant or alternating magnetic field. When a conductive fluid flows through the flowmeter, an induced electromotive

force (EMF) is generated between the two electrodes mounted on opposite sides of the meter tube wall.

The magnitude of this induced EMF is proportional to: the flow velocity of the conductive medium, the magnetic flux density of the magnetic field, and the effective conductor width (i.e., the inner diameter of the flowmeter measuring tube). By processing this induced voltage signal, the flow rate of the medium can be calculated. The induced EMF can be expressed as:

(EMF: Induced electromotive force equation)

$$E=K \times B \times V \times D$$

Where: E—Induced electromotive force

K—Meter constant

B—Magnetic induction density

V—Average flow speed in the cross-section of the measuring tube

D—Inner diameter of measuring tube

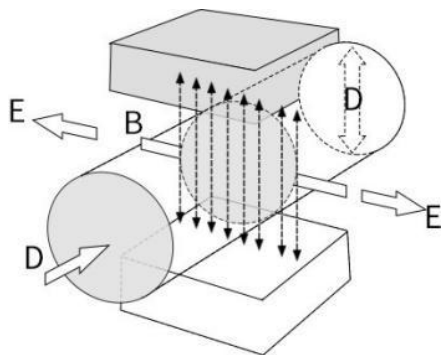


Fig.1

When measuring the flow, the fluid flows through a magnetic field that is perpendicular to the flow direction. The flow of conductive fluid induces a potential proportional to the average flow velocity, thus requiring the conductivity of the measured flowing liquid to be higher than the minimum conductivity. The induced voltage signal is detected by two electrodes and transmitted to the converter via a cable. After a series of analog and digital signal processing, the accumulated flow

and real-time flow are displayed on the converter screen.

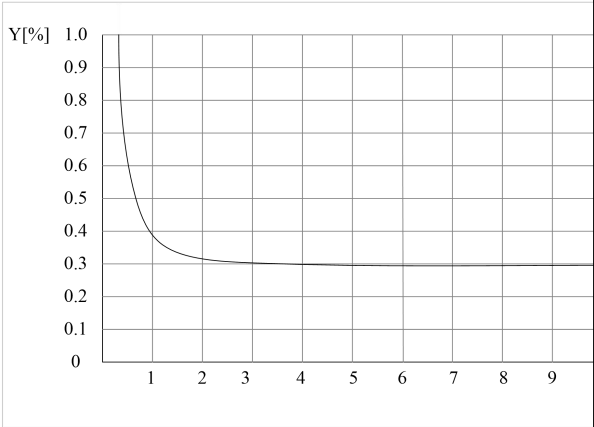
1.3 Features

- Measurement is unaffected by changes in fluid density, viscosity, temperature, pressure, or conductivity.
- Accurate measurement in both forward and reverse directions, independent of flow direction.
- High accuracy, stable zero point, and reliable long-term operation.
- Advanced low-frequency square-wave excitation provides strong resistance to interference.
- Integrated compact construction allows flexible installation and saves installation space.
- No moving parts, virtually maintenance-free, and suitable for reliable long-term operation.
- High-resolution OLED display with a built-in Chinese/English interface and freely selectable language.
- Adjustable meter-head orientation and display interface for convenient onsite reading.
- RS485 communication interface supporting the standard Modbus RTU protocol.
- Self-check and self-diagnostic functions.

2 Technical Parameters

Table 1 Technical parameters

Input			
Measured variable	Direct measurement: flow velocity Calculated value: volume flow, mass flow.		
Flow velocity	Typically range of flow velocity: 0.5m/s~5m/s		
Flow rate	See Table 2		
Nominal diameter	DN50~DN200		
Turndown ratio	10:1		
Output			
Current output	Function	Flow velocity, volumetric flow, or mass flow (Under the condition of constant medium density)	
	Range	Range	(4~20)mA
		Upper range limit	20mA
		Lower range limit	4mA
	Internal voltage	24VDC	
	Loading	≤750Ω	
Pulse output	Function	Set up pulse output	
	Pulse output	Basis	Output pulse width: 0.1ms~2000ms (This value is lower than the maximum duty cycle, with a maximum duty cycle of 1:1) $F_{\max} \leq 5000 \text{ cp/s}$
		Pulse coefficient	0.001~100000/unit
	Passive	$U_{\text{Outer}} \leq 30\text{VDC}$	
Communications	RS485; MODBUS-RTU;		

Power supply	
Supply voltage	18VDC~32VDC
Power consumption	≤5W
Cable entries	Model with display: M12-4 pin connector Model without display: M12-5 connector
Performance	
Reference operating conditions	Medium: water Temperature: 20℃ Pressure: 0.1MPa Installation requirements: Inlet run≥10DN, Outlet run≥5DN
Accuracy	±0.5% of measured value; Note: Applicable to the flow velocity range of 0.5 m/s to 5 m/s
Repeatability	0.16%
Flow velocity-deviation characteristic curve	 ①X[m/s]: Flow velocity ②Y[%]: Actual measured value deviation
Process	
Medium temperature	PTFE liner: -10℃~80℃

Rated pressure	PN6, PN10, PN16, PN25 or Class 150.
Conductivity	$\geq 20\mu\text{S/cm}$
Environment condition	
Operation temperature	-20°C~55°C
Storage temperature	-40°C~55°C
Protection level	Model without display: IP67 Model with display: IP65

Table 2 Flow characteristic parameters

Nominal diameter	Min value (m³/h)	Max value (m³/h)
DN50	3.5	35
DN65	6	60
DN80	9	90
DN100	14	140
DN125	22	220
DN150	32	320
DN200	56	560

3 Structure and Dimensions

3.1 Structure

The electromagnetic flow meters mainly consist of two parts: the sensor and the converter.

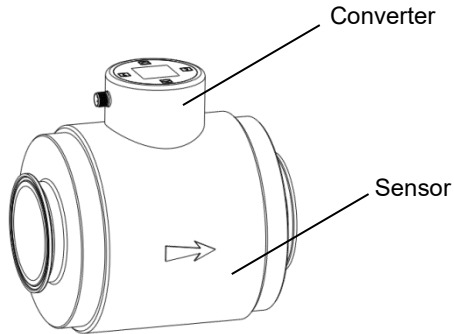


Fig.2 Structural diagram

3.2 Dimensions

3.2.1. Clamp connection

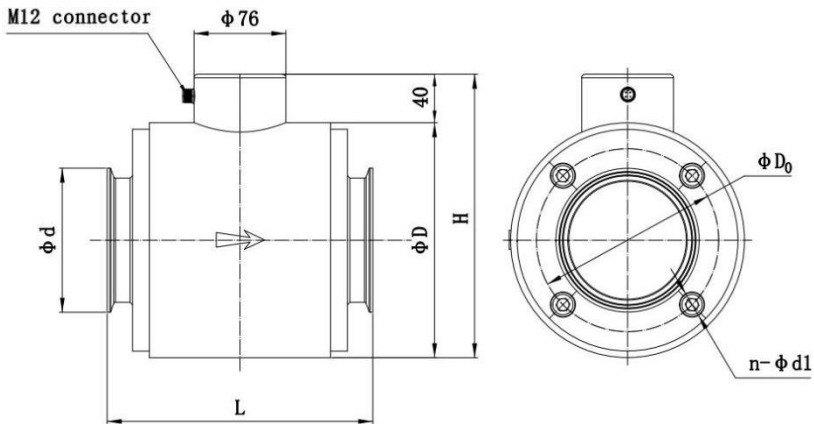


Fig.3 Structural diagram (unit: mm)

Table 3 Dimensions (clamps ISO2852-1993)

Unit in mm

Nominal Diameter (DN)	Overall Length (L)	Overall Height (H)	Outer diameter (D)	Clamp Outside Diameter (d)	Bolt Holes (n-d1)		Bolt Circle Diameter (D ₀)
					n*d1	Spec	
DN50	200	173	Φ133	Φ64 (default) Φ77.5(Customized)	4*7	M6	Φ100
DN65	200	180	Φ140	Φ77.5 (default)	4*7	M6	Φ110
				Φ91 (Customized)			
DN80	200	199	Φ159	Φ91 (default)	8*7	M6	Φ127
				Φ106 (Customized)			
DN100	220	234	Φ194	Φ119 (default)	8*9	M8	Φ160
				Φ130 (Customized)			
DN125	230	259	Φ219	Φ155 (default)	8*9	M8	Φ188

3.2.2. Flange Connection

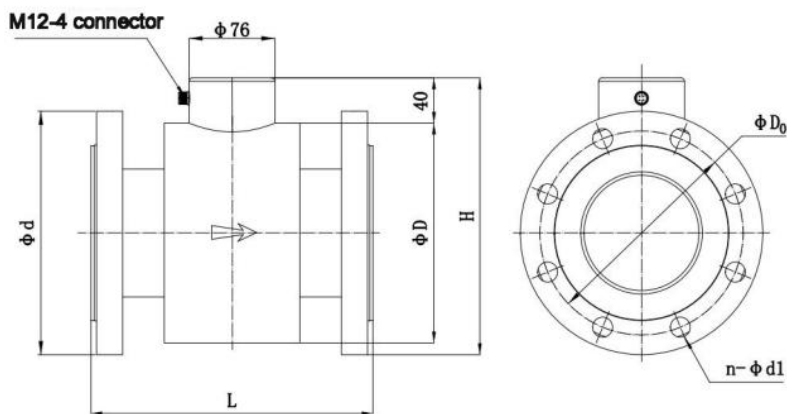


Fig.4 Structural diagram (Unit: mm)

Table 4 Flange connection dimension table (JB/T 81-2015, PN16)

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Unit: mm

Nominal Diameter (DN)	Overall Length (L)	Overall Height (H)	Outer diameter (D)	Clamp Outside Diameter (d)	Bolt Holes (n-d1)		Bolt Circle Diameter (D ₀)
					n*d1	Spec	
DN50	200	186.5	Φ133	Φ160	4*18	M16	Φ125
DN65	200	200	Φ140	Φ180	4*18	M16	Φ145
DN80	200	217	Φ159	Φ195	8*18	M16	Φ160
DN100	250	244.5	Φ194	Φ215	8*18	M16	Φ180
DN125	250	272	Φ219	Φ245	8*18	M16	Φ210
DN150	300	289.5	Φ219	Φ280	8*23	M20	Φ240
DN200	350	357.5	Φ300	Φ335	12*23	M20	Φ295

Table 5 Flange connection dimension table (ASME B16.5, Class 150)

Unit: mm

Nominal Diameter (DN)	Overall Length (L)	Overall Height (H)	Outer diameter (D)	Clamp Outside Diameter (d)	Bolt Holes (n-d1)		Bolt Circle Diameter (D ₀)
					n*d1	Spec	
DN50	200	181.5	Φ133	Φ150	4*19	M16	Φ120.7
DN65	200	200	Φ140	Φ180	4*19	M16	Φ139.7
DN80	200	214.5	Φ159	Φ190	4*19	M16	Φ152.4
DN100	250	252	Φ194	Φ230	8*19	M16	Φ190.5
DN125	250	277	Φ219	Φ255	8*22	M20	Φ215.9
DN150	300	289.5	Φ219	Φ280	8*22	M20	Φ241.3
DN200	350	362.5	Φ300	Φ345	8*22	M20	Φ298.5

Table 6 Flange connection dimension table (GB/T 9124.1, PN16)

Unit: mm

Nominal Diameter (DN)	Overall Length (L)	Overall Height (H)	Outer diameter (D)	Clamp Outside Diameter (d)	Bolt Holes (n-d1)		Bolt Circle Diameter (D ₀)
					n*d1	Spec	
DN50	200	189	Φ133	Φ165	4*18	M16	Φ125
DN65	200	202.5	Φ140	Φ185	8*18	M16	Φ145
DN80	200	219.5	Φ159	Φ200	8*18	M16	Φ160
DN100	250	247	Φ194	Φ220	8*18	M16	Φ180
DN125	250	274.5	Φ219	Φ250	8*18	M16	Φ210
DN150	300	292	Φ219	Φ285	8*22	M20	Φ240
DN200	350	360	Φ300	Φ340	12*22	M20	Φ295

3.2.3. Grooved Connection

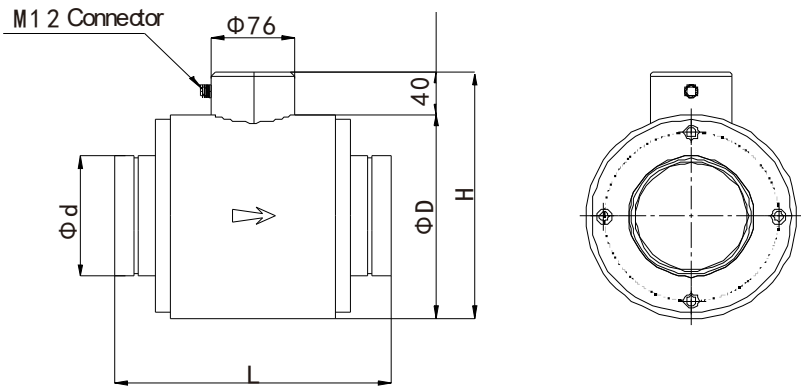


Fig.5 Structural diagram (Unit: mm)

Table 7 Grooved connection dimensions (unit: mm)

Nominal Diameter (DN)	Overall Length (L)	Overall Height (H)	Housing OD (D)	Groove OD (d)
DN50	238	173	Φ133	Φ60.3
DN65	238	180	Φ140	Φ76.1
DN80	238	199	Φ159	Φ88.9
DN100	261	234	Φ194	Φ114.3
DN125	271	259	Φ219	Φ139.7
DN150	288	300	Φ260	Φ159(customized)
				Φ168.3 (default)
DN200	339	340	Φ300	Φ219.1

3.3 Materials

Converter housing: 304 SS

Sensor housing: 304 SS

Lining: PTFE

Electrodes: 316L SS

4 Installation

4.1 Installation Notes

4.2 Installation tips

**Note!**

Please check whether the boxes are damaged or not, and whether they have been handled roughly or not. Please report the damage to the courier service and the manufacturer.

**Note!**

Please check the packing list to make sure the batch of goods that you have received is complete.

**Note!**

Please check the instrument nameplate and confirm whether the delivered contents are consistent with your order. Check whether the power supply indicated on the nameplate is correct. If not Correct, please contact the manufacturer.

**Note!**

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

4.3 Storage

- (1) Store the instrument in a dry, dust-free location.
- (2) Avoid prolonged exposure to direct sunlight.
- (3) Store the instrument in its original packaging.

4.4 Unpacking

(1) Unpacking precautions

Take care to avoid damage to the meter when you are unpacking. It is suggested not to unpack the box before transporting it to the installation site to avoid damage to the meter. It's prohibited to use a stick or rope to lead through the measuring tube of the sensor. Instead, follow the correct lifting as shown in the figure below.

(2) Avoid vibration

Avoid heavy falling or pressing, especially on the flange surface, which cannot be

stressed (otherwise, the lining may be damaged to disable the operation of the meter).

(3) Protection of the flange surface

After unpacking, pay attention to protect the flange. Do not place it on the unpadded floor or other uneven boards.

(4) Terminal box

It's not allowed to seal the terminal box cover before electrical wiring. After the wiring is completed, please apply the special sealant provided by our company to the terminal box as soon as possible. Then cover the terminal box and tighten the screws to ensure the tightness.

4.5 Pipeline design



The following items shall be considered when the pipes are designed.

- (1) Leave enough space on the side.
- (2) Do not make the electromagnetic flowmeter subject to violent vibration.

4.6 Pipe Design

(1) Location

- ① The electromagnetic flowmeter shall be installed in a dry and ventilated place. Places that could be flooded should be avoided.
- ② The electromagnetic flowmeter shall be kept away from the sunshine and rain. When it is installed outdoors, it shall be equipped with facilities against the sunlight and rain.
- ③ The electromagnetic flowmeter shall not be installed in places with large temperature variations, and avoid high temperature radiation from the equipment. If it must be installed therein, heat insulation and ventilation measures shall be taken.
- ④ The electromagnetic flowmeter shall not be installed in an environment containing corrosive gases. If it must be installed therein, ventilation and anti-corrosion measures shall be taken.
- ⑤ The electromagnetic flowmeter shall be installed to avoid as much strong

vibration as possible, such as violent pipe vibration. In this case, brackets for fixing pipes on both sides of the electromagnetic flowmeter shall be provided.

- ⑥ Part of the sensor of electromagnetic flowmeters with IP68 (3 m underwater) protection level can be placed in the water. The electromagnetic flowmeter with an IP65 protection level cannot be immersed in water or installed outdoors.

(2) Avoid interference with the magnetic field.

Do not install electromagnetic flowmeters near motors, transformers, or other power sources that are prone to cause electromagnetic interference, near the frequency converter, or obtain power from the power distribution cabinet of the frequency converter to avoid interference.

(3) Length of inlet and outlet runs

To ensure the measurement accuracy, it is recommended to keep the length of inlet runs of the sensor shall be at least 10 times of pipe diameter (10D), and the length of outlet runs at least 5 times of pipe diameter (5D).

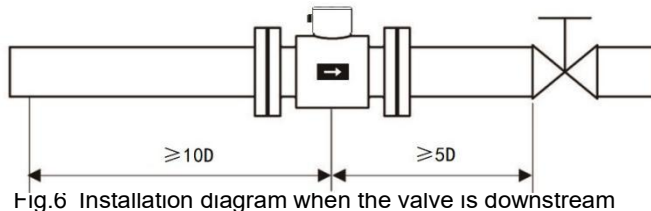


Fig.6 Installation diagram when the valve is downstream

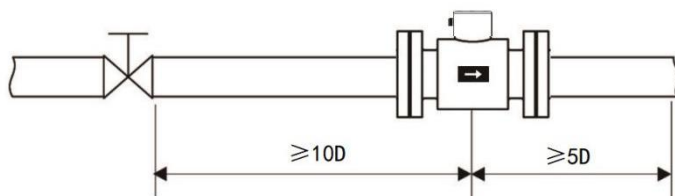


Fig.7 Installation diagram when the valve is upstream

(4) Maintenance space

For the convenience of installation and maintenance, enough installation space shall be reserved around the electromagnetic flowmeter.

(5) For pipes that do not allow flow disruption in the process

When installing the electromagnetic flowmeter, bypass pipes and cleaning ports shall be added. As shown in the figure below, these devices can ensure the continuous operation of the equipment system when the flowmeter is out of service.

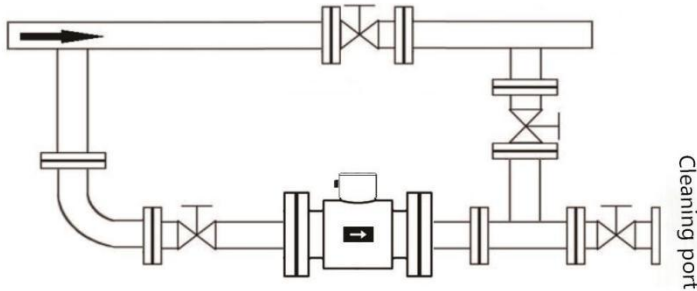


Fig.8

(6) Support of electromagnetic flowmeter

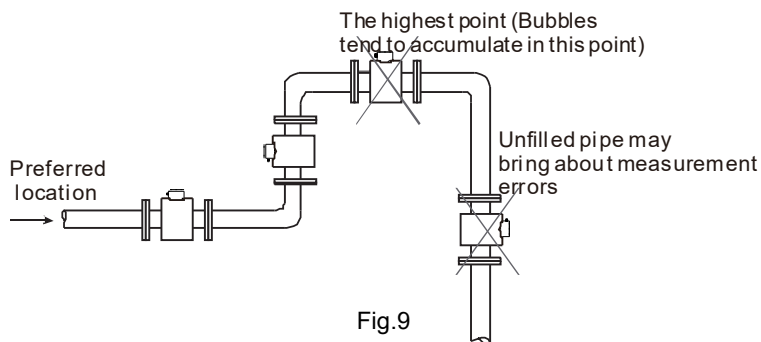
Do not install the electromagnetic flowmeter on a free-vibrating pipe without any support. Instead, a mounting base shall be used to secure the measuring tube. When the electromagnetic flowmeter is required to be installed underground, the pipes at both inlet and outlet ends shall be provided with support items, and a metal protection plate shall be installed above the flowmeter.

4.7 Sensor Installation

(1) Flow direction

The flowmeter can be configured to automatically detect forward and reverse flow. The arrow on the sensor housing indicates the manufacturer-defined forward direction. During installation, align this arrow with the normal process flow direction whenever possible.

The figure below shows the preferred installation positions for the electromagnetic flowmeter.



(2) Flowmeter orientation and electrode position

The sensor may be installed horizontally or vertically. For horizontal installation, position the electrodes horizontally. This prevents bubbles from collecting near the electrodes and causing an open signal circuit, and prevents deposits from covering the electrodes and causing zero drift.

(3) Keep the measuring tube full

The piping arrangement must ensure that the electromagnetic flowmeter measuring tube remains completely filled with liquid.

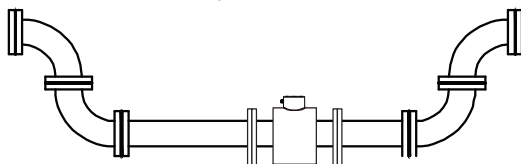


Fig.10

For liquids containing solid particles or for slurries, vertical installation is recommended. This helps prevent phase separation, promotes more uniform liner wear, and reduces sediment accumulation at the bottom of the measuring tube. Ensure upward flow so that the sensor measuring tube remains completely filled with the medium.

(4) Do not install the electromagnetic flowmeter on the suction side of a pump.

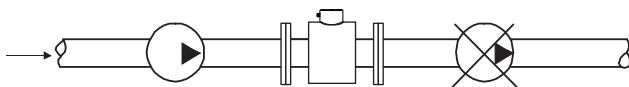


Fig.11

(5) For long pipelines, install the control valve downstream of the electromagnetic flowmeter.

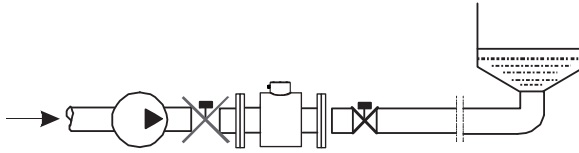


Fig.12

- (6) For open-discharge piping, install the electromagnetic flowmeter in the lower section of the pipeline.

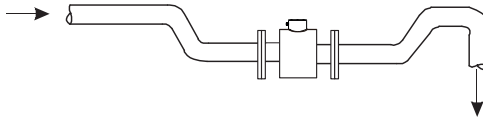


Fig.13

- (7) Where the pipeline has a vertical drop greater than 5 m, install an air valve downstream of the electromagnetic flowmeter.

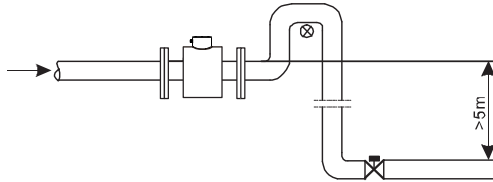


Fig.14

- (8) **Measurement errors caused by the ingress of foreign gas and damage to the lining caused by vacuum should be avoided.**
- (9) **No bubbles shall be observed in the pipes.**

Pipes shall be designed to prevent the air bubbles in the fluids from accumulating in the measurement pipe of a sensor. If a valve exists near the flowmeter, try to mount the flowmeter on the valve's upstream side to prevent a decrease in pressure inside the pipe, possibly, consequently avoiding the possibility of air bubbles.

Ensure that no gas can be separated from the liquid.

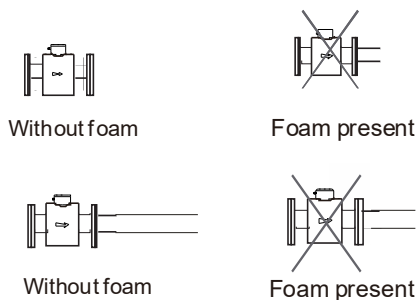


Fig.15

(10) Liquid conductivity

Do not install the electromagnetic flowmeter where the liquid conductivity is highly non-uniform. Chemical injection upstream of the flowmeter can cause conductivity non-uniformity and seriously disturb the flow indication. Injection downstream of the flowmeter is recommended. If upstream injection is unavoidable, provide at least 30 pipe diameters of upstream straight pipe to ensure thorough mixing.

(11) Grounding

Because the induced signal voltage of an electromagnetic flowmeter is very small, it is susceptible to external noise and electromagnetic interference. Grounding is therefore required in many applications to create an internal shield through the grounded housing and improve measurement accuracy. For non-conductive piping such as PVC, use a grounding ring of the appropriate size.

4.8 Mechanical Installation

4.8.1. Flowmeter Piping Installation

- (1) Before installing the flowmeter, align the pipeline so that the meter bore is sufficiently coaxial with the process piping. For sensors with a nominal diameter below 50 mm, axis offset must not exceed 1.5 mm; for 65–300 mm, it must not exceed 2 mm; and for 350 mm and above, it must not exceed 4 mm.
- (2) Newly installed piping may contain foreign matter such as welding slag. Flush the pipeline before installing the flowmeter. This prevents liner damage and avoids measurement errors caused by foreign matter passing through the measuring tube.

4.8.2. Flowmeter Installation

(1) Installation direction

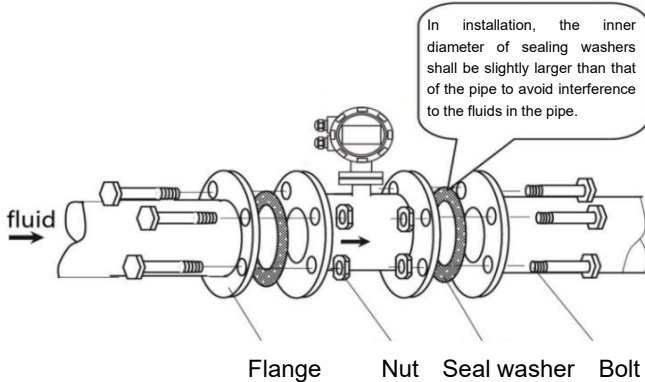
The flow direction of the measured fluid shall be consistent with the flow direction mark indicated on the flowmeter.

(2) Seal gaskets installed between flanges shall have good corrosion resistance and shall not protrude into the interior of the pipe.

(3) When welding or flame cutting is performed adjacent to the sensor pipe, isolation measures shall be taken to prevent the lining from being deformed due to heat.

(4) If it is installed in a well or immersed in water, apply sealant on the terminal box of the sensor after the system is installed and debugged. (If the protection level of the electromagnetic flowmeter is IP68 at type selection, it has been subject to waterproof sealing.)

(5) When the flowmeter is installed on the field, use bolts to connect the flange on the sensor to that on the pipe. Bolts, nuts, and their threads for securing meters shall be complete and free of damage and well lubricated. Use them with suitable flat washers and spring washers. A torque wrench shall be used to tighten the bolts according to the flange size and torque. Regularly tighten the bolts during daily use to prevent looseness of the bolts.



4.9 Post-Installation check

Table 8 Post-installation check

Checking Items	Results
Is the device free from damage (visual inspection)?	☐
Does the meter meet the technical specifications of the measuring point, e.g., medium temperature, process pressure, ambient temperature, nominal diameter?	☐
Is the installation direction of the sensor correct?	☐
Is the flow direction indicated on the meter consistent with the actual flow of the medium?	☐
Is the label or mark at the measuring point correct (visual inspection)?	☐
Are sufficient protective measures in place to prevent the instrument from exposure to direct sunlight or rain?	☐
Is a suitable wrench used to securely tighten the mounting screws?	☐

After installation, the meter should **Not** be left unused for long periods. If it is not used for an extended period, the following measures must be taken:

1. Check the sealing of the cable gland and entries to ensure that moisture and water do not penetrate the instrument.
2. Perform regular inspections. Check the conditions of the measures mentioned above at least once a year. In situations where water may enter the instrument (e.g., after heavy rainfall), the meter should be checked immediately.

5 Electrical Connection

5.1 Wiring for Models with Display

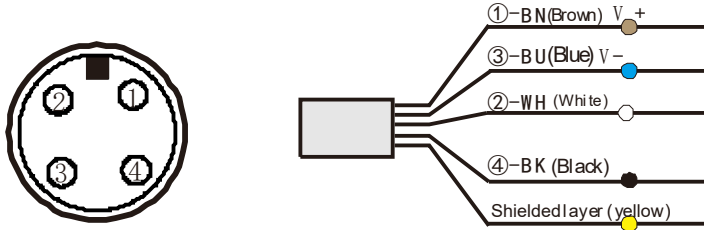


Fig.16 Terminal diagram

5.1.1. (4~20) mA Output Wiring

Table 9 (4~20) mA output cable definition

Pin No.	Cable color	Description
1	brown	24 V DC positive supply
2	white	(4~20) mA output (+)
3	blue	GND: 24 V DC negative supply
4	black	(4~20) mA output (-)
Outer shielding layer (yellow)		grounding

5.1.2. RS485 Communication Wiring

Table 10 RS485 communication cable definition

Pin No.	Cable color	Description
1	brown	24 V DC positive supply
2	white	RS485 A
3	blue	GND: 24 V negative supply
4	black	RS485 B
Outer shielding layer (yellow)		Grounding

5.1.3. Pulse Output Wiring

Table 11 Pulse output cable definition

Pin No.	Cable color	Description
1	brown	24 V DC positive supply
2	white	Positive pulse output is positive; requires an external pull-up resistor.
3	blue	GND: 24 V DC negative supply
4	black	negative pulse output
Outer shielding layer (yellow)		grounding

Note: Pins 2 and 4 of the signal output terminals can be configured as required via the menu.

5.2 Wiring for Models without Display

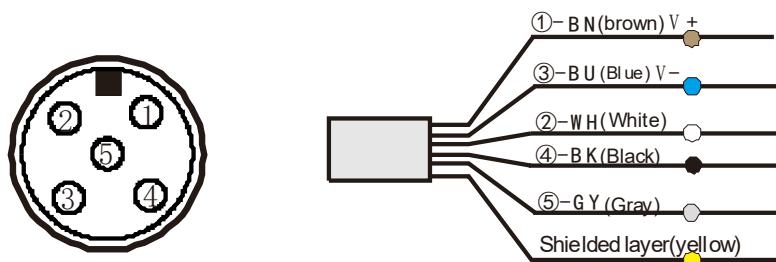


Fig.17 Terminal diagram

5.2.1. Three-wire (4-20)mA Output Wiring

Table 12 (4-20)mA cable definition

Pin No.	Cable color	Description
1	Brown	24 V DC positive supply
3	Blue	GND: 24 VDC(-) / (4-20) mA loop (-)
5	Gray	Current output
Outer shielding layer (yellow)		grounding

5.2.2. RS485 Communication Wiring

RS485 communication cable definition

Pin No.	Cable color	Description
1	Brown	24 VDC power supply (+)
2	White	RS485 output A
3	Blue	24 VDC power supply (-)
4	Black	RS485 output B
Outer shield (yellow)		Grounding

5.2.3. Pulse Output Wiring

Pulse output cable definition

Pin No.	Cable color	Description
1	Brown	24 VDC power supply
3	Blue	GND: 24 VDC(-) / (4–20) mA loop (-)
5	Gray	Pulse output; requires an external pull-up resistor.
Outer shield (yellow)		Grounding

6 Operation

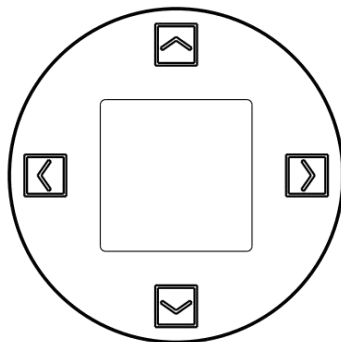


Fig.18 Terminal diagram

6.1 Display and Operating Unit

Table 13 Display screen

Display screen	Monochrome OLED display, 128 × 128 pixels
Display function	Multiple measurement-value screens (measurement, status, alarm status, etc.)
Language	Chinese and English
Unit	Units can be selected through the configuration menu.

6.2 Operation Unit

The operating unit consists of four mechanical buttons, the definitions of which are shown in the table below.

Table 14 Key Definition

Symbol	Buttons	Measurement status	Menu status	Modify status
	UP	View system alarm information	Return to the previous page	Return to the previous page
	Down	View cumulative amount and other information.	Switch menu	Modify data

Symbol	Buttons	Measurement status	Menu status	Modify status
	Left	/	Modify menu	Switch data bits
	Right	Enter menu mode	Enter the next level	Confirm changes

6.3 Interface Description

6.3.1. Main Interface

In the main interface state, the current flow rate, flow range percentage, alarm information, and information bar are always displayed.

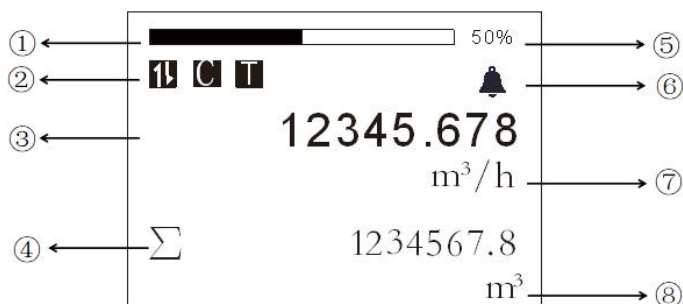


Fig.19 Home page

- (1) Progress bar showing the percentage of the instantaneous flow rate to the total flow rate
- (2) System status prompts (f indicates reverse flow; C indicates small flow cut-off status; T indicates simulation mode)
- (3) Instantaneous flow rate
- (4) Display of information such as cumulative amount (Σ +: forward accumulation; Σ -: reverse accumulation; Σ : net accumulation; v: current flow rate; MT: equivalent conductivity value)
- (5) Percentage of instantaneous flow rate to total flow rate
- (6) System alarm information
- (7) Instantaneous flow rate unit
- (8) Cumulative units

In the main interface state:

Press the **down key** , and then the system displays the net cumulative flow, positive cumulative flow, negative cumulative flow, and current flow rate in a loop.

System error: When a system error occurs, a bell icon will flash in the upper right corner. At this time, press the **up key** . You can access the alarm interface to view the specific error information.

6.3.2. User password interface

On the main screen, press right key  to enter the user password interface.

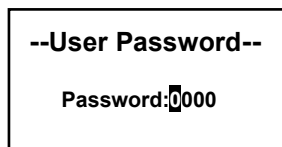


Fig.20 Password verification page

Quick configuration level password: 0000 (used to modify quick configuration level parameters)

User configuration level password: 1000 (used to modify user -level parameters)

6.3.3. Configuration settings interface

Different user passwords allow access to different configuration settings.

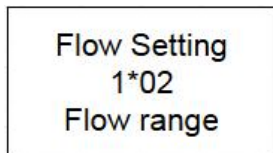


Fig.21 Password verification page

6.4 Quick Menu Settings

To facilitate the quick setting of important instrument parameters for manufacturers and users:

Press the right key  to enter the parameter settings interface:

You will then need to enter a password: 0000 (used to modify the quick settings menu)

Table 15 Quick setting parameter instructions

No.	Parameter	Setting mode	Parameter range	Default
1*01	Fluid direction	choose	Forward/Reverse	positive
1*02	Flow range	number	Maximum range 0.1 ~ Maximum range 1.2	Maximum range
1*03	Flow unit	choose	(L, kg, m ³ , t, ft ³ , US gal, US bbl, UK gal, UK bbl) / (h, min, s)	m ³ /h
1*04	Accumulated reset	choose	Positive cumulative clearing / Negative cumulative clearing	-
1*05	Address	number	1 ~ 247	8
1*06	Language	choose	Chinese, English	Chinese
1*07	Output signal	choose	Pulse, Current, RS485	Pulse output

6.5 Flow Setting Details

The configuration identifier style is "X * XX".

For example, the system setting category is 8*XX, and the built-in language subconfiguration is 8*01. Select the corresponding number to confirm that sub-menu item is selected.

Configuration-level password: 1000

Table 16 Detailed parameter description

No.	Parameter	Setting mode	Password level	Parameter range	Default
1- Quick Configuration					
1*01	Fluid direction	select	quick	Forward/Reverse	positive
	This function is used to change the direction of flow when the user signal line is reversed, or the sensor is installed in the wrong direction.				
1*02	Flow range	number	quick	Max. range 0.1 ~ Max. range 1.2	Max. range
	Sets the maximum flow rate limit. Used for calculating thresholds such as frequency, current output limit, and alarms.				
1*03	Flow unit	select	quick	(L, kg, m ³ , t, ft ³ , US gal, US bbl, UK gal, UK bbl)/(h, min, s)	m ³ /h
	When you enter this menu configuration option, you can use the right key to select the time unit/volume unit. If you choose volume units such as L or m³, density will not be included in the calculation. When choosing units of mass such as kg or t, density parameters must be considered.				
1*04	Accumulation reset	select	quick	Reset forward accumulation / Reset reverse accumulation	-
	Select the corresponding function and press the confirmation button ; the corresponding accumulated amount will be cleared. Net cumulative value = positive cumulative value - negative cumulative value. Resetting the cumulative value in either direction to zero will				

No.	Parameter	Setting mode	Password level	Parameter range	Default
	affect the net cumulative value.				
1*05	Address	number	quick	0 ~126	8
	Instrument address based on RS485 Modbus RTU communication protocol.				
1*06	Language	select	quick	Chinese and English	Chinese
	Used to change the system's display language; supports two languages.				
1 *07	Output signal	select	quick	Pulse, Current, RS485	Pulse output
	Configure output signal type				
2- Flow Settings					
serial number	type	select	Passwor d Level	Parameter range	default value
2*0 1	Bidirectional measurement	select	user	On/Off	Open
	When enabled, it allows measurement of flow from the reverse direction; when disabled, it only measures flow from the forward direction.				
2 *02	Flow direction	select	user	Forward/Reverse	positive
	Same as 1*01.				
2 *03	Flow unit	select	user	(L, kg , m ³ , t , ft ³ , US gal, US bbl, UK gal, UK bbl)/(h, min, s)	m ³ /h

No.	Parameter	Setting mode	Password level	Parameter range	Default
	Same as 1*03.				
2*04	Fluid density	number	user	(0.01~5) g/ cm ³	1
	Configure the current fluid density.				
2*05	Max. range	OR	user	-	-
	The maximum configurable range; this configuration item is OR.				
2*06	Flow range	number	user	Maximum range 0.1 ~ Maximum range 1.2	-
	Same as 1*02.				
2*07	Flow cutoff	number	user	0~10%	1%
	This indicates that flow rates below the set value are considered zero, and 0 indicates no cutoff.				
2*08	Damping time	number	user	0~99s	-
	The filter damping coefficient is selected by taking the average value over the specified time period as the instantaneous quantity.				
2*09	Filter	select	user	On/Off	OFF
	Specifically designed for pulsating or noisy flow signals, a digital filter is incorporated into the converter. This smooths the displayed readings and current output. Enabling the filter reduces the damping setting without affecting the converter's response time. The "Filter" mode is selected using the up or down keys and activated by pressing the ENTER key.				
2*11	Correction coefficient	OR	user	-	-
	Correcting the instantaneous flow rate				

No.	Parameter	Setting mode	Password level	Parameter range	Default
2*12	Accumulation unit	OR	user	L , m ³ , kg , t , ft ³ , US gal, US bbl, UK gal, UK bbl	m ³
	This unit is OR and is associated with the pulse output unit.				
2*13	Accumulation reset	select	user	Positive cumulative clear / Negative cumulative clear	-
	Same as 1*04				
3- Output Setting					
3*01	Pulse output type	select	user	High level/Low level	low level
	Selectable active high/low level output or passive high/low level output				
3 *02	Pulse coefficient	number	user	0.001~9999.9	-
	The default value of 10 is also affected by the highest frequency, ensuring that the frequency corresponding to the range does not exceed 5kHz. Settings outside the range will be limited to the range.				
3 *03	Pulse width	number	user	0.1 ~ 2000ms	-
	The maximum pulse width is limited by a duty cycle not exceeding 50%.				
3 *04	Pulse unit	select	user	L , m ³ , kg , t , ft ³ , US gal, US bbl, UK gal,	m ³

No.	Parameter	Setting mode	Password level	Parameter range	Default
				UK bbl	
	This unit also affects the accumulation unit.				
3*05	Address	number	user	1 ~ 247	8
	Same as 1*05.				
3*06	Baud rate	select	user	4800, 9600, 19200, 38400, 57600, 115200	9600
	Baud rate of serial communication				
3*07	Even-odd check	select	user	No parity, odd parity, even parity	No verification
	Serial communication verification methods				
3*08	Endianness	select	user	2143, 4321, 1234, 3412	2143
	Byte exchange order in serial communication				
3*09	Output current	number	user	3.6 ~22.8mA	0mA
	The converter has a fixed current output for calibration (4~ 20 mA output), with 0 mA representing normal output.				
3*11	4mA calibration	number	user	3.6mA~4.4mA	
	The 4mA calibration current value is written as the measured value when the output current is 4mA.				
3*12	20mA calibration	number	user	18mA~22.8mA	

No.	Parameter	Setting mode	Password level	Parameter range	Default
	The 20 mA calibration current value is written as the measured value when the output current is 20 mA.				
3*13	Output signal	select	user	Pulse, Current, RS485	Pulse output
	Same as 1*07				
4- Alarm					
4*01	Current test low	number	user	0-16384	-
	Low excitation alarm value				
4 *02	Current test high	OR	user	0-16384	-
	High excitation alarm value				
4 *03	Common mode voltage	OR	user	0-16384	-
	Equivalent value of electrode potential				
4 *04	instantaneous frequency	OR	user	0-6000	-
	Pulse output frequency				
4 *05	Error current selection	select	user	4mA, High, Low	4 mA
	When the system malfunctions, the output can be selected between high or low current or 4 mA.				
4*06	High error current value	select	user	23.5mA~24.5mA	24mA
	When the system malfunctions, the output current is high.				

No.	Parameter	Setting mode	Password level	Parameter range	Default
4*07	Low error current value	select	user	3.2mA~3.9mA	3.8mA
	When the system malfunctions, the output current is low.				
5- Empty Pipe Alarm					
5 *01	Empty pipe alarm	select	user	Turn on/off	Open
	Configure whether to enable the air Flow control detection function.				
5 *02	Alarm threshold	select	user	0~16000	-
	Threshold for air Flow control alarm judgment				
5 *03	Conductivity equivalent	OR	user	-	-
	This is the conversion value of the internal reading code value of the system, not the actual conductivity value. It is only used as a reference for judging conductivity (or judging whether the tube is empty or full).				
6 - Sensor Setting					
6*01	Sensor zero point	OR	user	-	-
	Sensor factory zero point, OR				
6*02	Sensor coefficient	OR	user	0.5~10	-
	Sensor coefficients				
6*03	Diameter	select	user	0 ~ 35 (caliber codes)	-
	Sensor aperture size				
6*04	Zero adjustment	number	user	-100~100	-

No.	Parameter	Setting mode	Password level	Parameter range	Default
	Sensor zero-point adjustment				
7 - Test Mode					
7*01	Simulation mode	select	user	Not simulated, Percentage	Not simulated
	This setting disappears after a power outage. This function simulates normal conditions and is used for testing.				
7*02	Simulation values	number	user	-	-
	This setting is effective after emulation mode is enabled and disappears after a power outage.				
8 - System					
8*01	Language	select	user	Chinese and English	Chinese
	Same as 1* 06				
8*02	Version	OR	user	-	-
	Display software version number				
8*03	TAG NO.	OR	user	-	-
	Display tag number information				
8*04	Factory reset	select	user	whether	no
	After using this function, the instrument parameters will be changed to the factory calibration parameters.				
8*06	LCD orientation	select	user	0°, 90°, 180°, 270°	0°
	The button definitions change accordingly as the screen rotates.				

6.6 Operating Instructions

6.6.1. Parameter selection and adjustment

In the main interface operation state, press the right key  to access the user password interface. Enter different user passwords to access different configuration settings.

After entering the corresponding configuration interface, the cursor indicates the current menu level. Press the key  to move the cursor, press  to add data, and press the right button  to confirm the selection and save.

Press the up key  to return to the previous menu within the permissions. After changing the password, the system will automatically return to the main monitoring interface. To re-enter the configuration interface, the corresponding password must be entered.

Quick configuration level password: 0000 (used to modify quick configuration level parameters)

User configuration level password: 1000 (used to modify user -level parameters)

Different passwords grant different menu display permissions.

For example, if you need to modify the flow rate range, the specific menu operation is as follows:

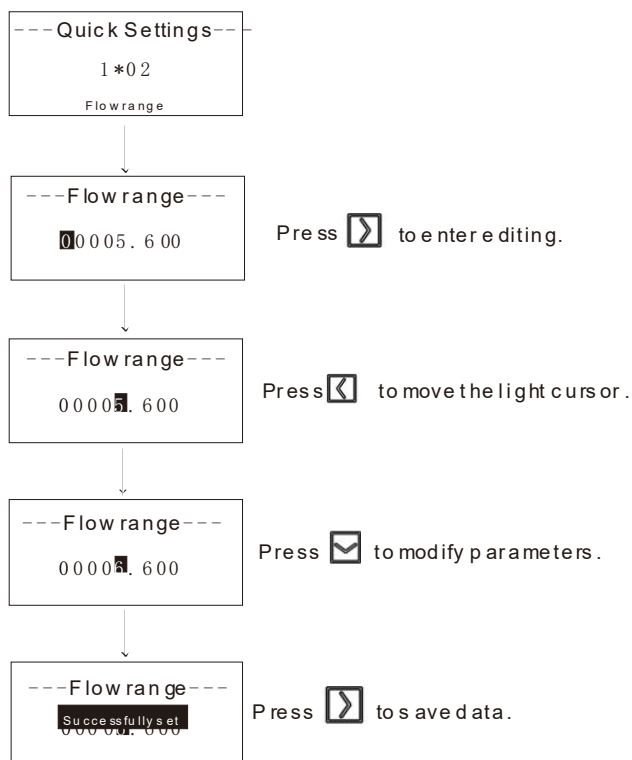


Fig.22 Menu operation

6.6.2. Measurement Page

This screen will be displayed when you turn on the computer.

“Σ+”: positive cumulative amount, “Σ-”: negative cumulative amount, “Σ”: net cumulative amount, “v”: current flow rate.

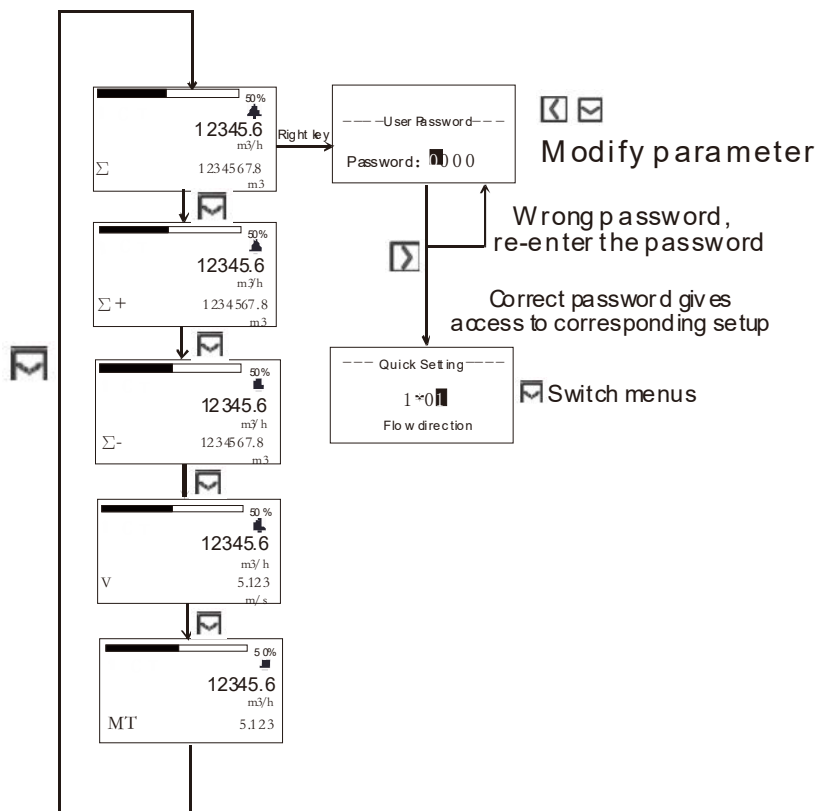


Fig.23 Measurement page

6.6.3. Flow Settings

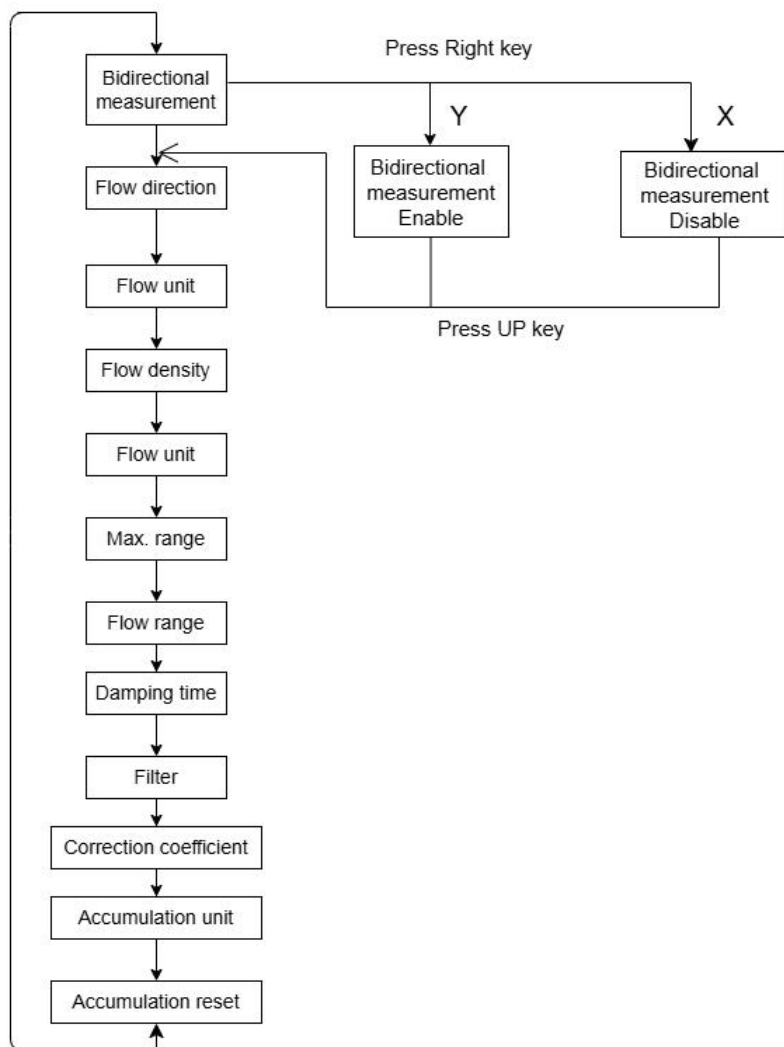


Fig.24 Measurement page

6.6.4. Output Settings and Fault Alarms

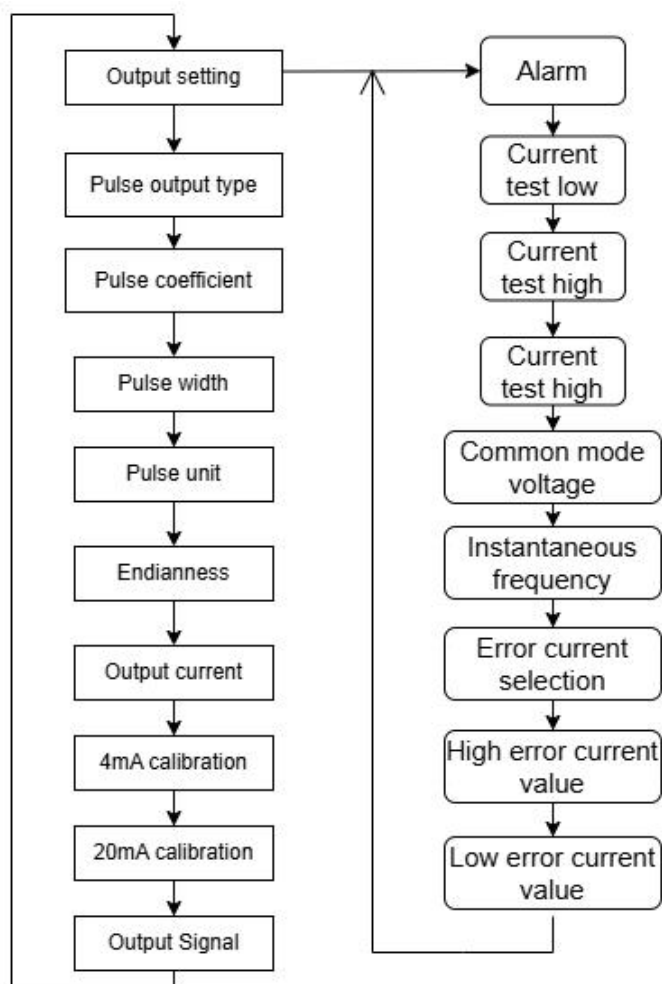


Fig.25 Output settings and fault alarm settings

6.6.5. Empty Pipe, Sensor, Test Mode, and System Function

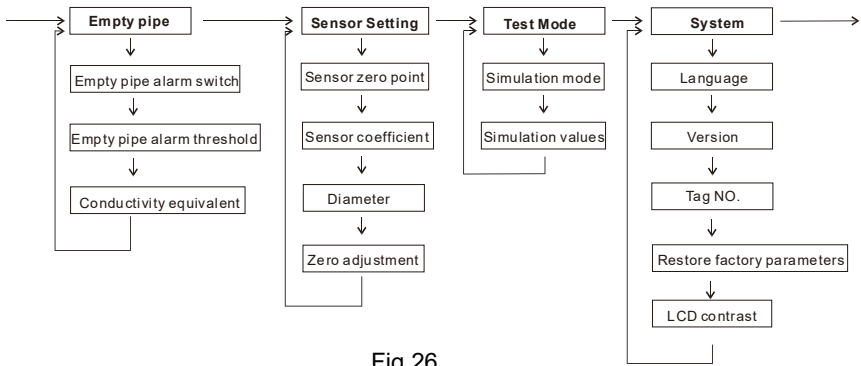


Fig.26

7 Functions

7.1 System Information

The meter itself has the self-diagnosis function, in addition to the power supply and circuit board hardware failures; it can correctly provide the corresponding alarm message to the fault in general applications.

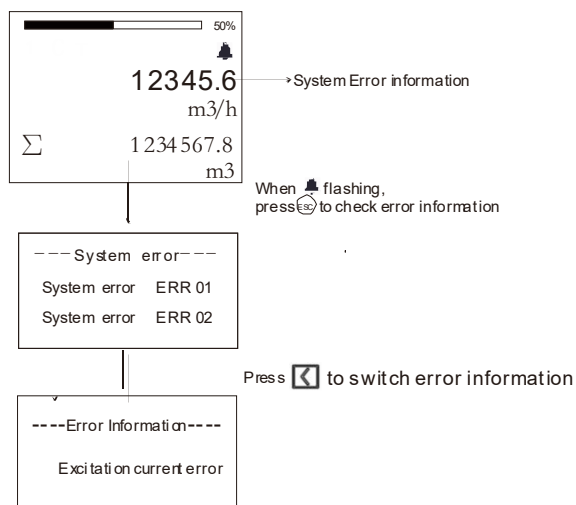


Fig.27 System error

Table 17 System information

Display	Alarm content
	On the main page, press [Back key] to check error information.
ERR01~04	System error.
ADC error	Signal acquisition chip malfunction
Signal saturation	The signal exceeds the sampling range.
Signal fluctuation overrun	The sensor signal is unstable, exceeding the testing range.
Empty pipe alarm	The liquid does not fully fill the pipe, or the sensor is

Display	Alarm content
	abnormally grounded.
Lower limit alarm	Detect that the flow exceeds the lower limit alarm.
Upper limit alarm	Detect that the flow exceeds the upper limit alarm.
Flow rate overrun	Detect that the flow exceeds the setting range
Output freq saturation	Output frequency exceeds the sampling range.
Units wrong settings	Unit setting error
 flashes	Reverse flow detected (not configured properly)
 flashes	Low flow cutoff mode
 flashes	Simulation mode

7.2 Pulse/Current Output

7.2.1. Pulse Output

It is mainly used for sensor manufacturer coefficient calibration and user measurement. In the third group of the configuration parameter settings:

The pulse coefficient corresponds to the number of pulses in a measured flow unit. If the pulse coefficient is changed, the totalized value will be retained in the selected unit. The pulse coefficient can be set from 0.001 to 100000 pulses per unit. The pulse coefficient for the pulse input shall be checked together with the selected flow range, pulse width (0.1 ms to 1000 ms), pulse unit (e.g. L, m³) or mass unit (e.g. g, kg), as well as the density correction factor. If any of these parameters is changed, the pulse width must not exceed 50% of the output frequency period at 100% flow rate (1:1 duty cycle). If the entered pulse width is too large, it will be automatically reduced to 50% of the period. The pulse output is intended for counter operation only and cannot be used with frequency meters.

7.2.2. Current Output

Mainly used for transmitting output to other intelligent instruments, such as digital display table, recorder, PLC, DCS, etc.

The current output type: (4 - 20) mA.

The current valve corresponds to real-time flow rate; 20mA is equivalent to the

upper limit of the range; 4mA refers to the lower limit of the range.

Conversion relationship

$$I_{\text{Real time}} = \frac{Q_{\text{Real time}}}{Q_{\text{max}}} 16.00 + 4.00$$

Note:

$Q_{\text{real time}}$ Indicate real-time flow rate

Q_{Max} Indicate current instrument range

$I_{\text{real time}}$ Indicate real-time current value

8 Warranty and After-Sales Service

Product quality failures that occur within the warranty period are covered by the applicable warranty terms, including free repair, replacement, or return, as appropriate. Products of standard models may be returned or exchanged within 7 days, except where damage results from misuse. For customized products, the warranty terms specified in the contract apply.

Disclaimer

The following conditions are not covered by the warranty, even if they occur within the warranty period:

- (1) Failure or damage caused by improper use, installation, or maintenance by the customer.
- (2) Failure or damage resulting from unauthorized disassembly, repair, or modification.

Appendix A Communication Protocol

A.1 Modbus Protocol Command Encoding Definition

The MODBUS function code definition is shown in the table below, and the electromagnetic flowmeter adopts the 04 function code.

Table 18

Function code	Name	Definition
01	Using coil read and write commands	Reserve
02	Using discrete input commands	Reserve
03	Using the Hold Register read command	Reserve
04	Using the Input Register read command	Read dynamic variables
06	Using a single holding register write command	Reserve
16	Using multiple holding registers, write command	Reserve

A.2 Register Address

Table 19 Register address (Function code 04)

Register number	Address	Parameter	Data type	Access	Range
3: 0100	0x0063	Instantaneous flow	float	R	
3: 0102	0x0065	Instantaneous velocity	float	R	
3: 0104	0x0067	Flow percentage	float	R	
3: 0106	0x 0069	Conductivity	float	R	
3: 0108	0x 006B	Forward flow cumulative integer	uint32	R	
3: 0110	0x 006D	Forward flow cumulative decimal	uint32	R	The decimal part is magnified 1,000 times, so 123 represents 0.123

Register number	Address	Parameter	Data type	Access	Range
3: 0112	0x006F	Reverse flow cumulative integer	uint32	R	
3: 0114	0x 0071	Reverse flow cumulative decimal	uint32	R	The decimal part is magnified 1,000 times, so 123 represents 0.123
...	...	Reserve	/	/	Reserve, do not operate.
3: 1001	0x03E8	Instantaneous flow	Float	R	0~Maximum
3: 1003	0x03EA	Forward flow accumulation	Double	R	0~99999999
3: 1007	0x03EE	Reverse flow accumulation	Double	R	0~99999999
3: 1011	0x03F2	Flow percentage	Float	R	0~120
3: 1013	0x03F4	Instantaneous flow velocity	Float	R	--

A.3 Communication Configuration

Communication address: 0~126

Default address: 8

Baud rate: 4800; 9600; 19200; 38400; 57600; 115200;

The default baud rate: 9600

Parity: None / Odd / Even (Default: None)

For 32-bit data (long plastic or floating point) arranged in the communication frame;

Example:

- ◆ Long integer 16909060 (01020304H): 03 04 01 02
- ◆ Floating number 4.00 (40800000H): 00 00 40 80
- ◆ Double 10.24 (40247AE147AE147B): 14 7B 47 AE 7A E1 40 24

A.4 Communication Examples

Read instantaneous flow:

Send message: 08 04 03 E8 00 02 F1 22

Send message: 08 04 04 22 6E 41 3F 79 61(Instantaneous flow: 11.95)

Read forward flow accumulation (Double):

Send message: 08 04 03 EA 00 04 D0 E0

Send message: 08 04 08 70 A4 0A 3D 53 D7 40 58 14 56 (Forward flow accumulation: 97.31)

Read reverse flow accumulation:

Send message: 08 04 00 6F 00 04 C1 4D

Return message: 08 04 08 00 D2 00 00 03 66 00 00 18 C7

Reverse flow accumulation: 210.87 (integer + (decimal/1000)); the integer part (210): 00 D2 00 00; the decimal part (870): 03 66 00 00)