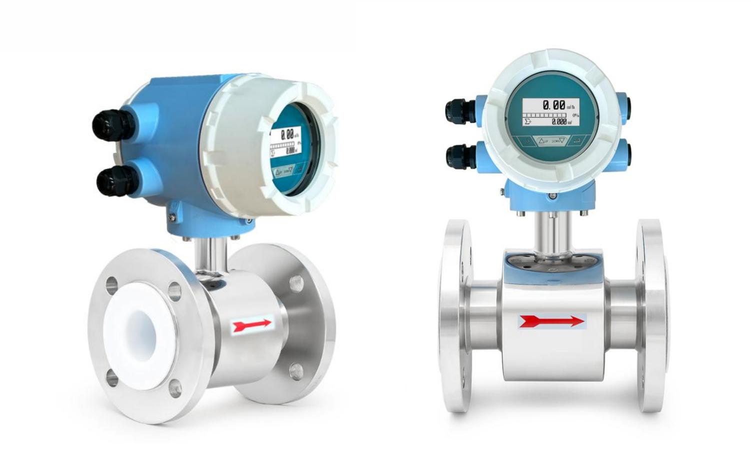
ZHEJIANG LEFOO CONTROLS CO., LTD
Http://www.lefoo.com TEL:0577-27822222
Address: No. 678, Punan 5th Road, Yueqing Economic Development Zone,
Wenzhou City, Zhejiang Province, 325600, China

LEFOO

Electromagnetic Flowmeter

User Manual



Please read this manual carefully before use and keep it in a safe place for future reference

Table of Contents

I. Safety Instructions

1.1 Manufacturer’ s Safety Instructions

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The manufacturer reserves the right to modify the content of this document (including this disclaimer) in any way, at any time, for any reason, without prior notice, and assumes no liability for any consequences arising from such modifications.

Product Liability and Warranty

The operator is solely responsible for determining whether the flowmeter is suitable for the intended purpose and bears all related risks. The manufacturer is not liable for any consequences resulting from incorrect use of the instrument by the operator. Incorrect installation or operation of the flowmeter (system) will void the warranty rights. In addition, the corresponding “Standard Sales Terms” apply, which form the basis of the purchase contract.

Information on the Document

To avoid injury to personnel or damage to the instrument, please read the information in this document carefully. In addition, the relevant national standards, safety regulations, and accident prevention rules of the country where the instrument is used must be observed.

If you do not understand the content of the document, please seek assistance from the manufacturer or the instrument supplier. The manufacturer cannot be held responsible for any property damage or personal injury caused by misunderstanding the information contained in this document.

This document will help you establish the correct operating conditions to ensure safe and effective use of the instrument. Important notes and safety measures required in this document are marked with the following icons.

Graphical Symbol Conventions

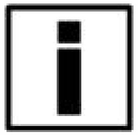
The following graphical symbols help you use this document easily:

Danger!

This symbol indicates safety warnings related to electricity.

Warning!

Such warnings must be observed. Even slight negligence may cause serious health hazards and may damage the instrument itself or the plant facilities in operation.



Note!

This symbol indicates important information related to the operation of the instrument.

1.2 Safety Instructions for Operators

Warning!

Only personnel who have received appropriate training and authorization are permitted to install, use, operate, and maintain this instrument. This document will help you establish operating conditions that will ensure safe and effective use of the instrument.

II. Instrument Description

2.1 Delivery Scope

Note!

Please carefully inspect the shipping carton for any damage or signs of rough handling. If damage is found, report it immediately to the carrier, the manufacturer, or the instrument supplier.

Note!

Please check the packing list to ensure that the delivered goods are complete.

Note!

Please check the instrument nameplate and confirm that the supplied items match your order. Verify that the power supply information on the nameplate is correct. If incorrect, please contact the manufacturer or the instrument supplier.

2.2 Measurement Principle of Electromagnetic Flowmeter

The operating principle of the electromagnetic flowmeter is based on Faraday's law of electromagnetic induction. As shown in Figure 1, the two electromagnetic coils at the top and bottom generate a constant or alternating magnetic field. When a conductive medium flows through the electromagnetic flowmeter, an induced electromotive force (EMF) is detected between the two electrodes on the left and right sides of the measuring tube wall. The magnitude of this induced EMF is proportional tothe flow velocity of the conductive medium, the magnetic flux density of the magnetic field, and the conductor width (inside diameter of the flowmeter measuring tube). The medium flow rate can then be calculated.

The induced EMF equation is:

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

where: E - Induced electromotive force;
K - Instrument constant;
B - Magnetic flux density
V - Average flow velocity across the measuring tube cross-section
D - Inside diameter of the measuring tube

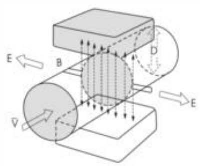


Figure 1

When measuring flow, the fluid flows through a magnetic field perpendicular to the direction of flow. The motion of the conductive fluid induces a voltage proportional to the average flow velocity. Therefore, the conductivity of the measured liquid must exceed the minimum threshold of 5 μS/cm. (In theory, the electromagnetic flowmeter can measure conductive media with conductivity greater than 5 μS/cm. However, in actual applications, the flowmeter should be used in media with conductivity of 30 μS/cm or higher —one to two orders of magnitude above the theoretical value — and the conductivity value obtained from online measurement must be used as the reference.)The induced voltage signal is picked up by the two electrodes and transmitted via cable to the converter. After a series of analog and digital signal processing, the totalized flow and instantaneous flow are displayed on the converter's screen.

2.3 Structure of Pipe-type Electromagnetic Flowmeter

As shown in Figure 2, the electromagnetic flowmeter mainly consists of the following components:
1 - Converter; 2 - Flange; 3 - Insulating liner; 4 - Electrode; 5 - Measuring tube;
6 - Excitation coil; 7 - Housing

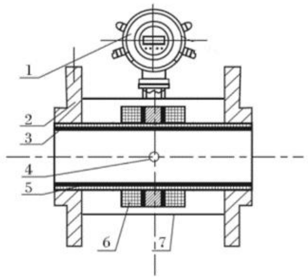


Figure 2

The electromagnetic flowmeter is primarily composed of a sensor and a converter. The sensor includes the flange, liner, electrodes, measuring tube, excitation coils, and sensor housing. The converter includes the internal circuit boards and converter housing.

(1) Converter: Supplies a stable excitation current to the sensor, amplifies the induced EMF obtained from the sensor, converts it into standard electrical or frequency signals, and displays real-time flow and parameters for flow display, control, and regulation.

(2) Flange: Used to connect to the process pipeline.

(3) Liner: A complete layer of electrically insulating and corrosion-resistant material on the inner side of the measuring tube and on the flange sealing surface.

(4) Electrode: A pair of electrodes is installed on the measuring tube wall perpendicular to the magnetic field lines to detect the flow signal. Electrode material can be selected according to the corrosiveness of the measured medium. One or two grounding electrodes are also provided for grounding the flow signal and for anti-interference.

(5) Measuring tube: The tube through which the measured medium flows. It is made of non-magnetic stainless steel welded to the flanges and lined with an insulating liner inside.

(6) Excitation coil: One set of coils is installed on the upper and lower outer sides of the measuring tube to generate the working magnetic field.

(7) Housing: Provides both protection for the instrument and sealing.

2.4 Instrument Description

The electromagnetic flowmeter is suitable only for measuring the instantaneous flow of conductive liquids or liquid-solid two-phase fluids and has a flow totalization function. Normally, the factory parameters of the instrument are preset according to the order requirements.

Users do not need to set parameters before use, but they must check that the parameters on the nameplate have been correctly preset and verify them against the actual operating conditions.

In theory, the electromagnetic flowmeter can measure conductive media with conductivity greater than 5 μS/cm. However, in actual measurement, the flowmeter must be used in media with conductivity of 30 μS/cm or higher. The medium conductivity must be measured online; otherwise, deviation in the measured conductivity value will occur.

2.5 Terminal Block Description

Integrated type

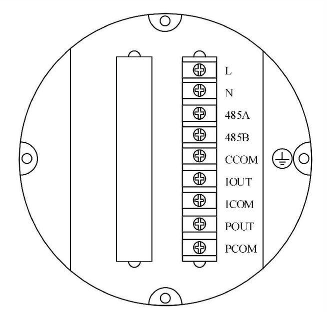


Figure 3

L, N:	220 V AC power supply
⏚:	Earth ground
POUT, PCOM:	Pulse/frequency output interface
485A, 485B:	RS485 serial communication interface
CCOM:	RS485 serial communication ground
IOUT, ICOM:	4–20 mA output interface

Separate type

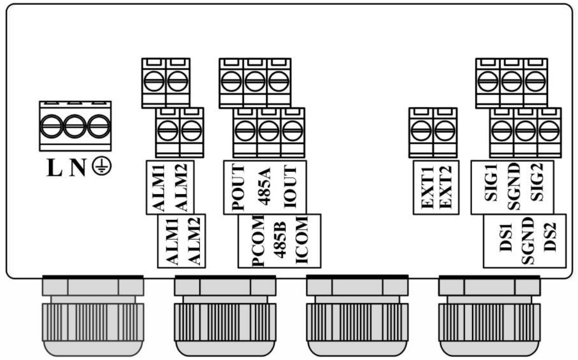


Figure 4

L, N:	220 V AC power supply
⏚:	Earth ground
ALM1, ALM2:	Alarm output
POUT, PCOM:	Pulse/frequency output interface
485A, 485B:	RS485 serial communication interface
IOUT, ICOM:	4–20 mA output interface
EXT1, EXT2:	Excitation signal
SIG1, SIG2, SGND:	Electrode signal
DS1, DS2:	Electrode shielding

2.6 Nameplate

Note!

Please check the instrument nameplate and confirm that the supplied content matches your order. Verify that the power supply information on the nameplate is correct.
The figure below shows the reference content of the nameplate.

Electromagnetic Flowmeter	
Model:	
Nominal Pressure:	Protection Class:
Nominal Diameter:	Ambient Temperature:
Power Supply:	Fluid Temperature:
Electrode Material:	Flow Range:
Lining Material:	Accuracy Class:
Flow Coefficient:	Production Date:
SN:	
⚠ DO NOT OPEN THE COVER WITH POWER ON	

Figure 5

III. Installation

3.1 Installation Notes

Note!

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Note!

Please check the packing list to ensure that the delivered goods are complete.

Note!

Please check the instrument nameplate and confirm that the supplied content matches your order. Verify that the power supply information on the nameplate is correct. If incorrect, please contact the manufacturer or the instrument supplier.

3.2 Storage

- Store the instrument in a dry, dust-free location.
- Avoid prolonged exposure to direct sunlight.
- Keep the instrument in its original packaging.

3.3 Installation Requirements

Note!

To ensure reliable installation, the following measures must be taken:

- Allow sufficient space on the sides for access.
- Do not subject the electromagnetic flowmeter to severe vibration.

3.4 Piping Design

When designing the piping, consider the following items:

(1) Location

- The electromagnetic flowmeter should be installed in a dry, well-ventilated area and should normally be kept away from locations prone to water accumulation.
- Avoid direct sunlight and rain. For outdoor installation, provide rain protection and sun shading. The ambient temperature range is -10°C to +60°C.
- Avoid installation in areas with large temperature fluctuations or near high-temperature radiation from equipment. If installation is unavoidable, provide thermal insulation and ventilation.
- Avoid environments containing corrosive gases. If installation is necessary, provide ventilation and anti-corrosion measures.
- Avoid locations with strong vibration. If the pipeline vibrates significantly, install fixed supports on both sides of the flowmeter.
- Sensors with IP68 protection (submersible to 3 m) may be placed underwater. Sensors with IP65 protection must not be submerged or installed outdoors.

(2) Avoidance of Magnetic Field Interference

Do not install the electromagnetic flowmeter near electric motors, transformers, or other power equipment that may generate electromagnetic interference. Do not install it near frequency converters or draw power from frequency converter distribution cabinets to avoid introducing interference.

(3) Straight Pipe Length

To ensure measurement accuracy, it is recommended that the upstream straight pipe length be at least 5 times the pipe diameter (5D) and the downstream straight pipe length be at least 3 times the pipe diameter (3D). (See Figures 6 and 7.)

(4) Maintenance Space

Sufficient installation space must be provided around the electromagnetic flowmeter for convenient installation, maintenance, and servicing.

(5) Pipelines Where Flow Interruption Is Not Permitted

When installing the electromagnetic flowmeter, add a bypass pipe and cleaning port as shown in Figure 8. This arrangement allows the system to continue operating while the flowmeter is taken out of service for cleaning.

(6) Support for the Electromagnetic Flowmeter

Do not install the electromagnetic flowmeter in isolation on a freely vibrating pipeline. A mounting base should be used to secure the measuring tube. When the flowmeter is installed underground, supports must be provided at both the inlet and outlet pipes, and a metal protective plate must be installed above the flowmeter.

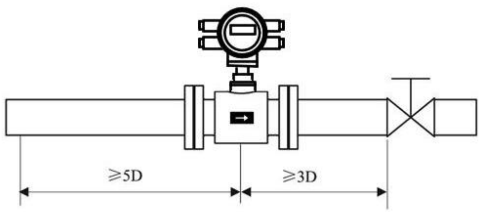


Figure 6 Valve located downstream of the sensor

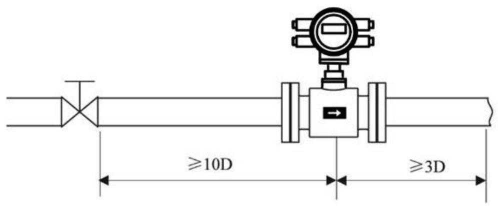


Figure 7 Valve located upstream of the sensor

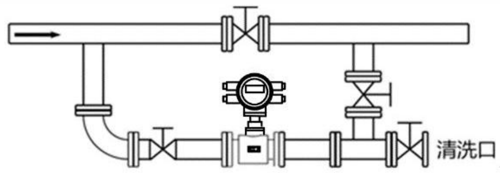


Figure 8

Bypass pipe arrangement for pipelines where flow cannot be interrupted

3.5 Electromagnetic Flowmeter Installation Requirements

(1) Flow Direction

This flowmeter can be configured for automatic detection of forward and reverse flow. The flow direction arrow on the sensor housing indicates the manufacturer-defined forward direction. In general, when installing the instrument, the arrow should align with the actual process flow direction.

Figure 9 shows the preferred installation positions for the electromagnetic flowmeter.

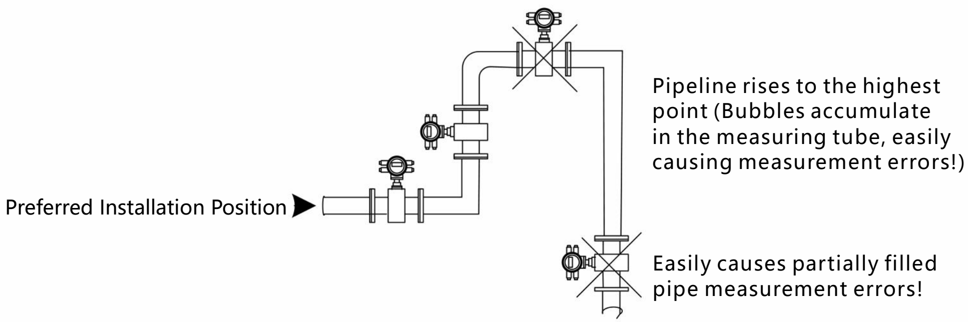


Figure 9

(2) Installation Orientation and Electrode Position

The sensor can be installed horizontally or vertically. When installed horizontally, the electrodes should be positioned horizontally. This prevents gas bubbles or sediment from adhering to the electrodes (which could cause the converter signal to open-circuit) or covering the electrodes (which could cause zero drift).

(3) Pipe Must Always Be Full of Liquid

The piping design must ensure that the measuring tube of the electromagnetic flowmeter remains completely filled with liquid at all times.

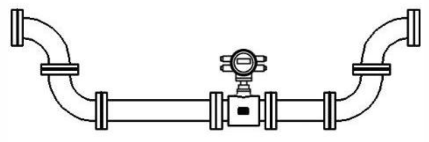


Figure 10

For liquids containing solid particles or slurries, vertical installation is recommended. This prevents phase separation of the medium, ensures more uniform wear on the sensor liner, and avoids sediment accumulation at the bottom of the measuring tube.

Flow direction must be upward to guarantee the measuring tube remains full.

(4) Do Not Install the Electromagnetic Flowmeter on the Suction Side of a Pump

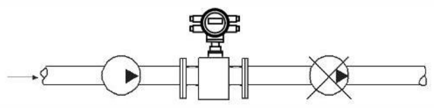


Figure 11

(5) For Long Pipelines, Install the Control Valve Downstream of the Electromagnetic Flowmeter

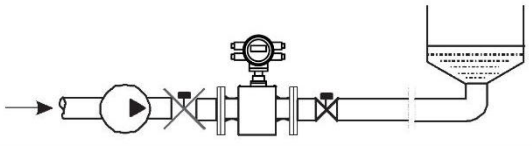


Figure 12

(6) For Open Discharge Pipelines, Install the Electromagnetic Flowmeter at the Lowest Section (Lowest Point of the Pipe)

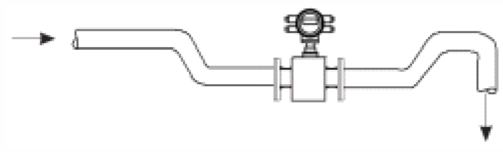


Figure 13

(7) For Pipelines with a Drop Greater Than 5 Meters, Install an Air Valve Downstream of the Electromagnetic Flowmeter

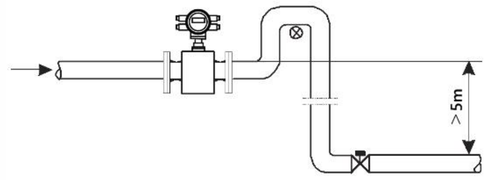


Figure 14

(8) Avoid Measurement Errors Caused by Entrained Gas and Vacuum Damage to the Liner

(9) No Air Bubbles in the Pipeline

Piping design must ensure that gas does not separate from the liquid.

The flowmeter should be installed upstream of valves, as valve action can reduce pipeline pressure and generate bubbles.

It should also be installed in low sections to minimize the effect of entrained bubbles on measurement.

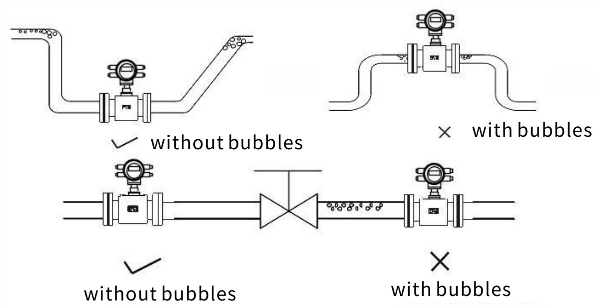


Figure 15

(10) Liquid Conductivity

Do not install the electromagnetic flowmeter where liquid conductivity is highly uneven. Chemical injection upstream of the instrument can easily cause non-uniform conductivity, seriously interfering with flow indication. In such cases, chemical injection should be performed downstream of the instrument. If upstream injection is unavoidable, a straight pipe section of at least 30 times the pipe diameter must be provided upstream to ensure thorough mixing.

(11) Grounding

Because the induced signal voltage of the electromagnetic flowmeter is very small and susceptible to external noise or other electromagnetic signals, the flowmeter must be grounded in many applications. Grounding creates a shielded internal space through the flowmeter housing, thereby improving measurement accuracy.

(11.1) Grounding of a sensor installed on a metal pipe

Separate-type

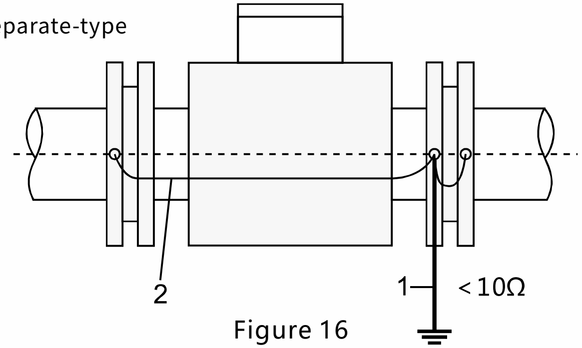


Figure 16

Integrated-type

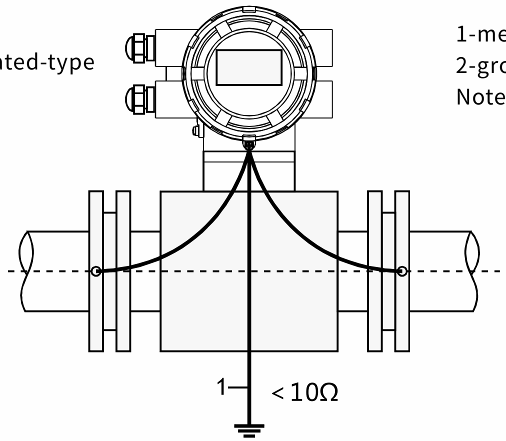


Figure 17

1-measurement ground;
2-grounding wire;
Note: The connecting wire shall be 2.5 mm² copper wire.

(11.2) Grounding of a sensor installed on an insulated pipe

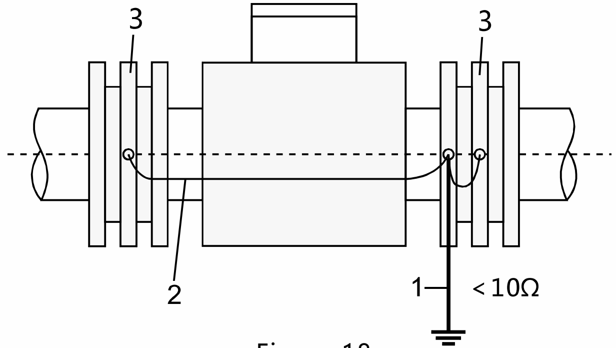


Figure 18

1-measurement ground;
2-grounding wire;3-Grounding ring;
Note: The connecting wire shall be 2.5 mm² copper wire.

(11.3) Grounding of a sensor installed on a cathodically protected pipe

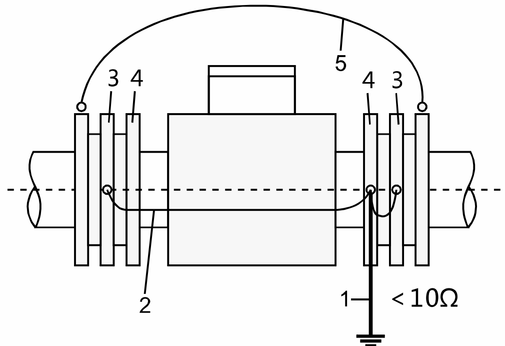
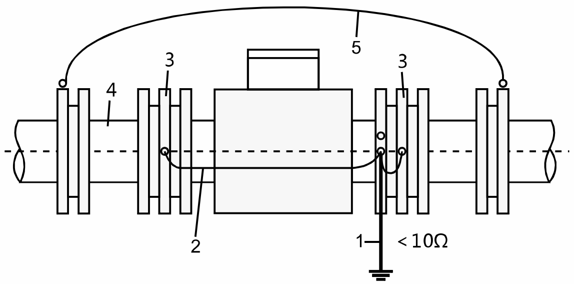


Figure 19

1-measurement ground;
2-grounding wire;3-Grounding ring;
4-Insulated bolt;5-Connecting wire;
Note: The connecting wire shall be 2.5 mm² copper wire.

(11.4) Grounding of a sensor installed on a pipe with very strong stray current



1-measurement ground;
2-grounding wire;
3-Grounding ring;
4-Insulated pipe;
5-Connecting wire;
Note: The connecting wire shall be 16 mm^2 copper wire.

Figure 20

3.6 Mechanical Installation

Installation of Flowmeter Piping

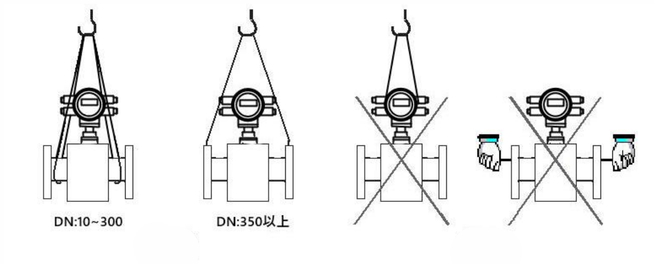
(1) Before installing the flowmeter, align the pipeline to ensure good coaxiality between the instrument bore and the user's pipeline. For sensors with nominal diameters 50 mm, the axis deviation must not exceed 1.5 mm; for 65–300 mm, it must not exceed 2 mm; for 350 mm, it must not exceed 4 mm.

(2) Newly installed pipelines usually contain foreign matter (such as welding slag). Before installing the flowmeter, flush out any debris. This prevents damage to the liner and avoids measurement errors caused by foreign objects passing through the measuring tube during operation.

Precautions

Operational Notes:

(1) Handle the instrument with care during unpacking to avoid damage. It is best not to unbox the instrument until it reaches the installation site. When lifting, use the lifting rings. Do not pass rods or ropes through the sensor measuring tube. See the correct lifting method in Figure 16.



Correct Wrong

Figure 21

(2) Prevent vibration, dropping, or heavy pressure on the instrument. In particular, the flange sealing surfaces must not bear force (this may damage the liner and prevent normal operation).

(3) Flange surface protection: After unpacking, protect the flanges. Do not place them directly on the ground or on uneven surfaces without padding.

(4) Do not open the terminal box cover until electrical wiring is to be performed. After wiring is complete, promptly pour the special sealing compound (provided by the manufacturer) into the terminal box, replace the cover, and tighten the screws to ensure sealing. If the electromagnetic flowmeter is ordered with IP68 protection, it is already factory-sealed against water.

(5) After installation, avoid leaving the instrument unused for long periods. If the instrument will not be used for an extended time, take the following measures:

A. Check the end covers and cable entry seals to ensure moisture and water cannot enter the instrument.

B. Perform periodic inspections. Check all the above measures and the condition inside the terminal box at least once per year. If there is any possibility of water ingress (e.g., after heavy rain), inspect the instrument immediately.

Flowmeter Installation

(1) The flow direction of the measured fluid must match the flow direction marking on the flowmeter.

(2) The flange gaskets installed between flanges must have good corrosion resistance and must not protrude into the pipeline.

(3) When welding or flame-cutting near the sensor, take isolation measures to prevent heat deformation of the liner.

(4) If installed in a manhole or submerged in water, after system installation and commissioning, seal the sensor terminal box with sealing compound. (If IP68 protection was selected, the instrument is already factory-sealed.)

(5) During field installation, connect the sensor flanges to the pipeline flanges using bolts. Tighten the bolts and nuts (threads must be intact and well-lubricated) together with flat and spring washers. Use a torque wrench according to the flange size and specified torque. Periodically retighten the bolts during use to prevent loosening.

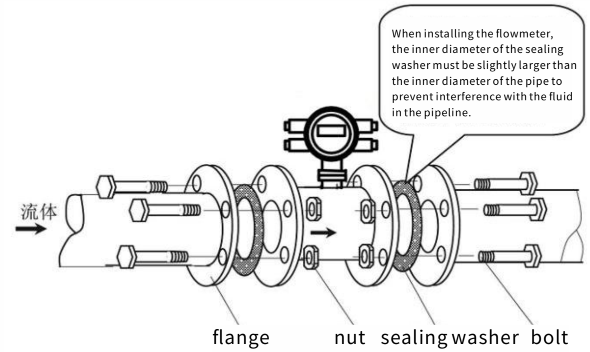


Figure 22

3.7 Dimensions of Sensor and Converter for Pipe-type Electromagnetic Flowmeter

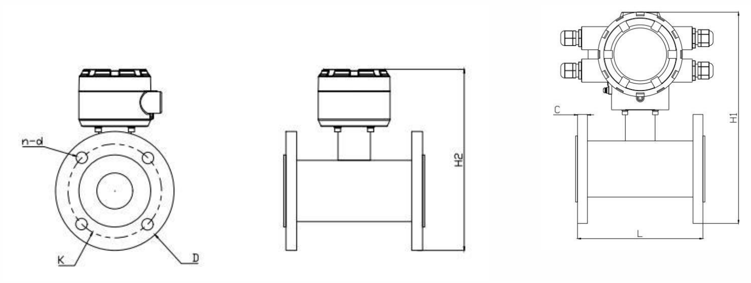


Figure 23

Nominal Diameter (mm)	Nominal Pressure (MPa)	External Dimensions(mm)			Connection Dimensions(mm)				
		L	H2	H1	D	K	d	n	C
15	≤4.0	200	220	280	95	65	14	4	14
20		200	220	285	105	75	14	4	16
25		200	220	295	115	85	14	4	16
32		200	220	320	140	100	18	4	18
40		200	220	330	150	110	18	4	18
50		200	225	340	165	125	18	4	20
65	≤1.6	200	225	360	185	145	18	8	22
80		200	275	370	200	160	18	8	24
100		250	285	380	220	180	18	8	22
125		250	315	410	250	210	18	8	22
150		300	345	440	285	240	22	8	24
200	≤1.0	350	400	495	340	295	22	8	24
250		450	465	570	395	350	22	12	26
300		500	505	620	445	400	22	12	26
350		550	575	670	505	460	22	16	30
400		600	625	720	565	515	26	16	32
450		600	670	765	615	565	26	20	36
500		600	725	820	670	620	26	20	38
600		600	835	930	780	725	30	20	42
700	≤0.6	700	915	1010	860	810	26	24	40
800		800	1015	1110	975	920	30	24	44
900		900	1115	1210	1075	1020	30	24	48
1000		1000	1215	1310	1175	1120	30	28	52

Note: The dimensions shown here may differ slightly from the actual product; refer to the physical instrument.

Integrated-type Converter External Dimensions: Unit:mm

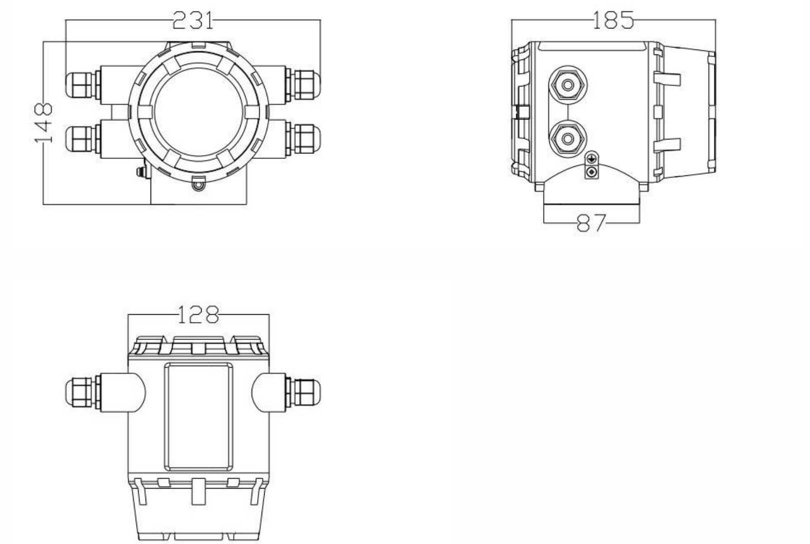


Figure 24

Separate-type Converter External Dimensions:

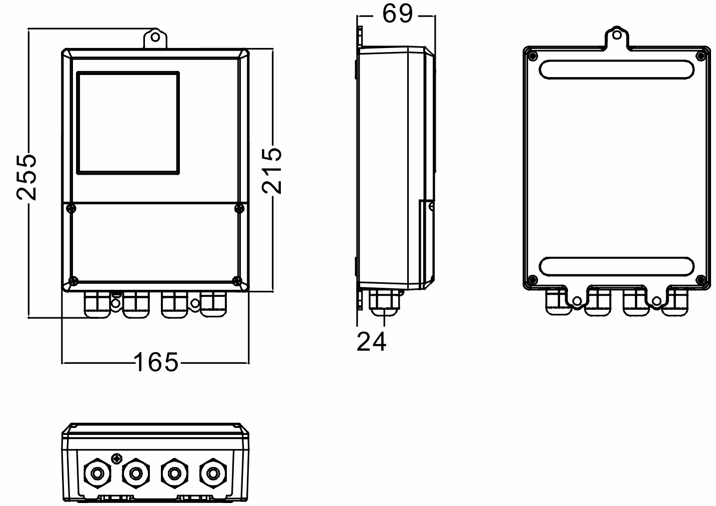


Figure 25

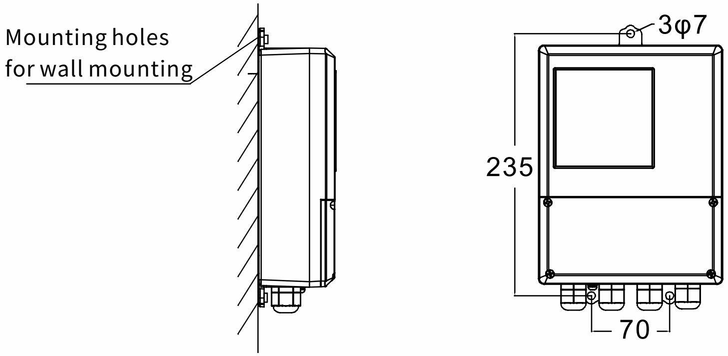
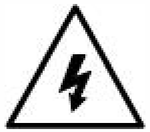


Figure 26

IV. Electrical Connections

4.1 Safety Prompts



Danger!

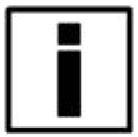
All electrical connection work must be performed with the power supply disconnected. Please refer to the power supply data on the nameplate!

Danger!

Comply with national installation regulations.

Warning!

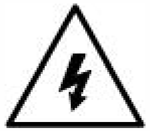
Strictly observe local occupational health and safety regulations. Only personnel who have received appropriate training are permitted to work on electrical equipment.



Note!

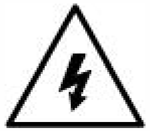
Please check the instrument nameplate and confirm that the nameplate content matches your order. Verify that the power supply information on the nameplate is correct. If incorrect, please contact the manufacturer or the instrument supplier.

4.2 Connecting Signal Cable and Excitation Cable



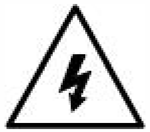
Danger!

Signal cables and excitation current cables may only be connected with the power supply disconnected.



Danger!

The instrument must be properly grounded to ensure safe operation.



Danger!

For instruments used in potentially explosive atmospheres, the safety instructions in the specific explosion-proof documentation must also be observed.

Warning!

Strictly observe occupational health and safety regulations. Only personnel who have received appropriate training are permitted to work on electrical equipment.

Separate-type Signal Wiring

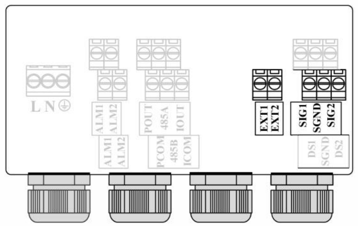


Figure 27

Wiring Instructions
Excitation cable: EXT1 — Positive terminal of the sensor excitation coil
EXT2 — Negative terminal of the sensor excitation coil

Signal cable: SIG1 — Positive electrode signal of the sensor
SIG2 — Negative electrode signal of the sensor
SGND — Signal ground

4.3 Grounding of the Measuring Sensor

Danger!

No potential difference is permitted between the measuring sensor and the housing or the converter protective ground. The electromagnetic flowmeter must be separately grounded during use. If it shares a ground with other instruments or electrical devices, leakage current in the grounding wire may cause common-mode interference to the measurement signal and, in severe cases, may render the electromagnetic flowmeter inoperable.

- The measuring sensor must be correctly grounded.
- The grounding conductor must not carry any interference voltage.
- Other electrical equipment must not be connected to the grounding conductor at the same time.

4.4 Converter Power Connection

Danger!

The instrument must be properly grounded to protect personnel from electric shock.

Integrated-type 220 VAC Power Supply

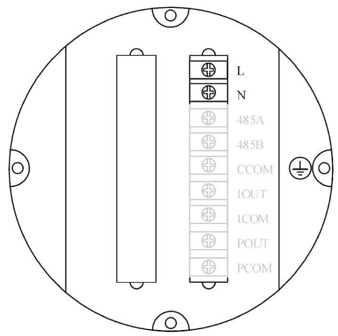


Figure 28

Separate-type 220 VAC Power Supply

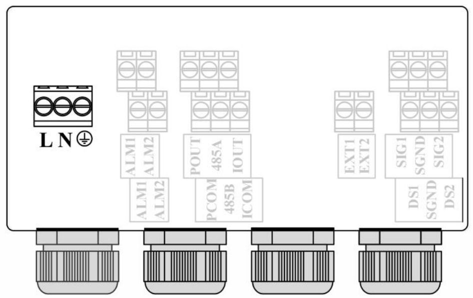


Figure 29

Note!

Acceptable range: 85 VAC – 250 VAC, 50 Hz –60 Hz

- L: AC phase line;·
- N: AC neutral line;
- Connect the ground wire to the grounding screw marked with the ⏚ symbol.

Integrated-type 24 VDC Power Supply

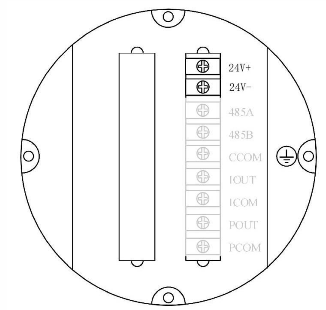


Figure 30

Separate-type 24 VDC Power Supply

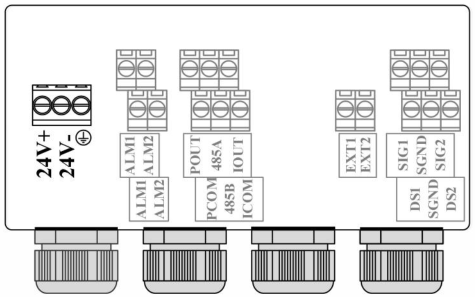


Figure 31

Note!

Acceptable range: 24 VDC ± 20%

- 24 V+: Positive pole of 24 VDC power supply;
- 24 V-: Negative pole of 24 VDC power supply;
- Connect the ground wire to the grounding screw marked with the ⏚ symbol.

4.5 Output Description

Warning!

Only personnel who have received appropriate training and authorization are permitted to install, use, operate, and maintain this instrument. This document will help you establish operating conditions that ensure safe and effective use of the instrument.

Integrated-type

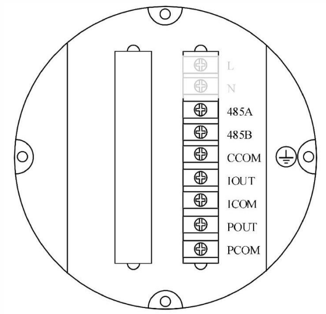


Figure 32

Separate-type

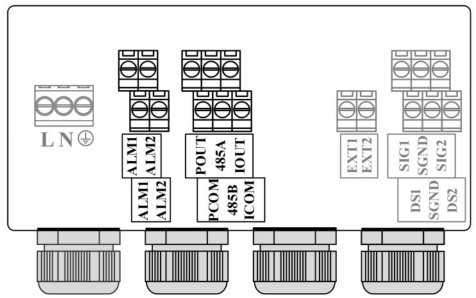


Figure 33

Current Output
- IOUT、ICOM: 4-20mA output;
- Active mode: Load $R_L \leq 750\Omega$, $I \leq 22mA$;
- Current corresponds to flow percentage.

Communication Output

- 485A, 485B: RS485 serial communication output;
- CCOM: RS485 serial communication ground;
- Protocol: Modbus RTU.

Pulse, Frequency, and Alarm Output

- ALM1, ALM2: Alarm output terminals (for integrated type, alarm output terminals are POUT, PCOM) POUT, PCOM: Pulse/frequency output terminals;
- Active mode: High level 24 V, drive current 5 mA;
- Output electrical isolation: Opto-isolation, isolation voltage > 1000 VDC;
- Frequency output: Frequency 2 kHz (configurable 0–5 kHz) corresponds to the upper limit of the flow range;
- Pulse output: Each pulse corresponds to a configurable flow volume; pulse width: 0.1 ms – 100 ms, duty cycle 1:1, Fmax≤5000 cps.

Wiring Diagram

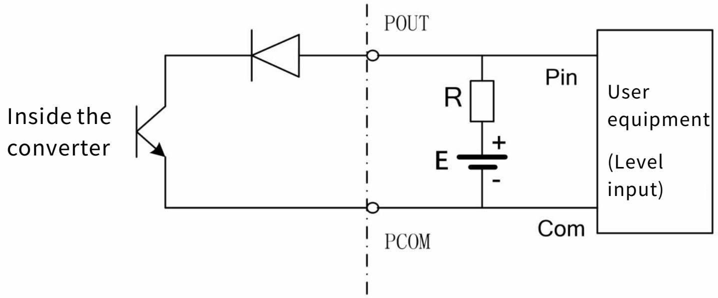


Figure 34

Supplementary Note: Pulse output is OC (open collector) type and requires external power supply. Most counters have built-in pull-up resistors, so the signal can be connected directly to the counter.

Manufacturer Recommendation: Use a 2 kΩ, 0.5 W pull-up resistor (R) and a 24 VDC power supply (E)

V. Startup

5.1 Power On

Before turning on the power, please verify that the equipment has been installed correctly. This includes the following checks:

- The flowmeter must be installed safely and in full compliance with regulations.
- The power connections must be made according to the specified requirements.
- Confirm that all electrical connections of the power supply are correct.
- Tighten the rear cover of the converter housing.

5.2 Converter Startup

The measuring instrument consists of a measuring sensor and a signal converter. It is supplied in a ready-to -use state. All operating parameters and hardware settings have already been configured according to your order requirements.

Once power is applied, the instrument will perform a self-test. After the self-test is completed, the measuring instrument will immediately begin measurement and display the current values.

Startup Screen

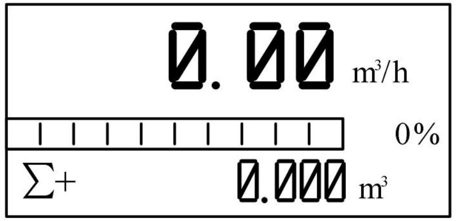


Figure 35

6.1 Flow Display Screen

Default Main Screen

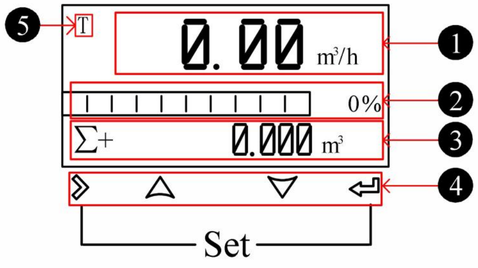


Figure 36

1. Flow Display Line 1

Default value: Instantaneous flow.

Selectable: Instantaneous flow, Σ+ forward totalizer, Σ– reverse totalizer, Σ net totalizer.

Configurable cycle: Instantaneous flow, Σ+ forward totalizer, Σ– reverse totalizer, Σ net totalizer, or off.

2. Flow Display Line 2

Default value: Flow bar graph.

Selectable: Instantaneous velocity, empty-pipe MT, flow bar graph, Σ+ forward totalizer, Σ– reverse totalizer, Σ net totalizer.

Configurable cycle: Instantaneous velocity, empty-pipe MT, flow bar graph, Σ+ forward totalizer, Σ– reverse totalizer, Σ net totalizer, or off.

3. Flow Display Line 3

Default value: Σ+ forward totalizer.

Selectable: Instantaneous velocity, empty-pipe MT, flow bar graph, Σ+ forward totalizer, Σ– reverse totalizer, Σ net totalizer.

Configurable cycle: Instantaneous velocity, empty-pipe MT, flow bar graph, Σ+ forward totalizer, Σ– reverse totalizer, Σ net totalizer, or off.

Notes:

(1) The fixed and cycling display values for Lines 1/2/3 can be modified in Flow Configuration 12. Each parameter cycles every 10 seconds.

(2) When an alarm occurs, the alarm information (empty-pipe alarm, flow upper-limit alarm, flow lower-limit alarm, pulse upper-limit alarm, or over-range alarm) cycles in Lines 2 and 3 at 5-second intervals for 2 seconds each, as shown below.

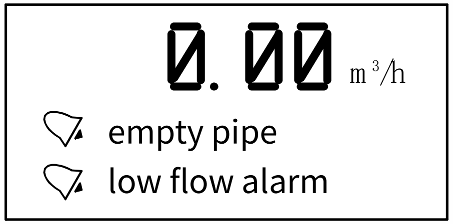


Figure 37

4. Operation Keys

Symbol	Measurement Mode	Menu Mode	Function Mode	Data Mode
›	-	Switch menu category	-	Move cursor right
⏎	Switch totalizer info	Switch menu item	Confirm function	Confirm data
△ ▽	-	-	Select function	Change data
› + ⏎	Enter menu mode	Exit menu	-	-

5. Test Flag

The test velocity is disabled by default ("N"). When the test velocity is enabled ("Y"), the test flag "T" appears in the upper-left corner of the main screen.

6.2 Flow Parameter Display Interface

Press and hold the △ key for 8 seconds on the main screen to enter the flow parameter display interface (shown below). Press the › key to exit.

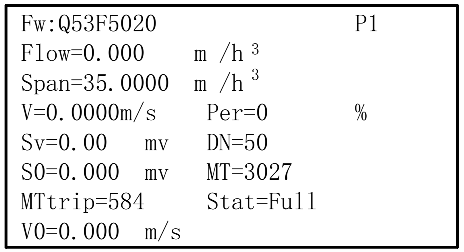


Figure 38

P1: Page 1

Parameter	Description
Fw	Program version number
Flow	Instantaneous flow
Span	Flow range
V	Velocity
Per	Percentage
Sv	Signal (mV)
DN	Nominal diameter
S0	Zero point (mV)
MT	Real-time conductivity ratio
MTtrip	Empty-pipe threshold
Stat	Empty-pipe status
V0	Zero-correction velocity

Press the△key on P1 to switch to Page 2 (P2).

```
Fw:Q53F5020                P2
Ks=1.00000         Kc=7.15925
Kf=1.00000         PGA=X3
Ia=0.1830A         EX=6.25Hz
Pls=0              Max=2000.0
EQ=1.000L/P
ADDR=008           BAUD=9600
```

Figure 39

P2: Page 2

Parameter	Description
Fw	Program version number
Ks	Sensor coefficient
Kc	Converter coefficient
Kf	Full-scale coefficient
PGA	Gain
Ia	Excitation current
EX	Excitation frequency
Pls	Pulse output type
Max	Frequency upper limit
EQ	Pulse output volume per pulse
ADDR	Communication address
BAUD	Baud rate

6.3 Mechanical Key Operation

To operate the mechanical keys, open the front cover of the converter.

For details on entering configuration mode using the mechanical keys, refer to the next section.

Integrated type

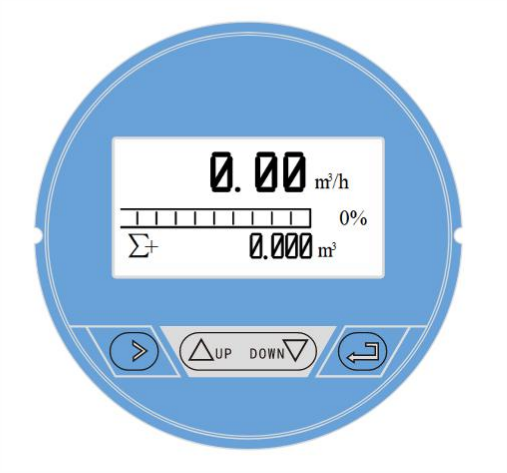


Figure 40

Separate type

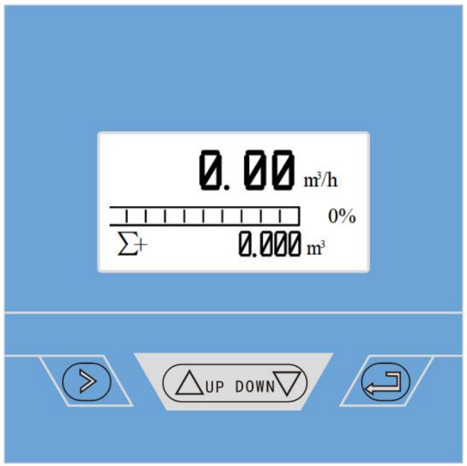


Figure 41

6.4 Operation Instructions

Parameter Selection and Adjustment

Press the ▷ and ↵ keys simultaneously to enter the parameter setting interface.

At this point, a password must be entered:

Initial user password: 2000000 (used to modify user-level parameters)

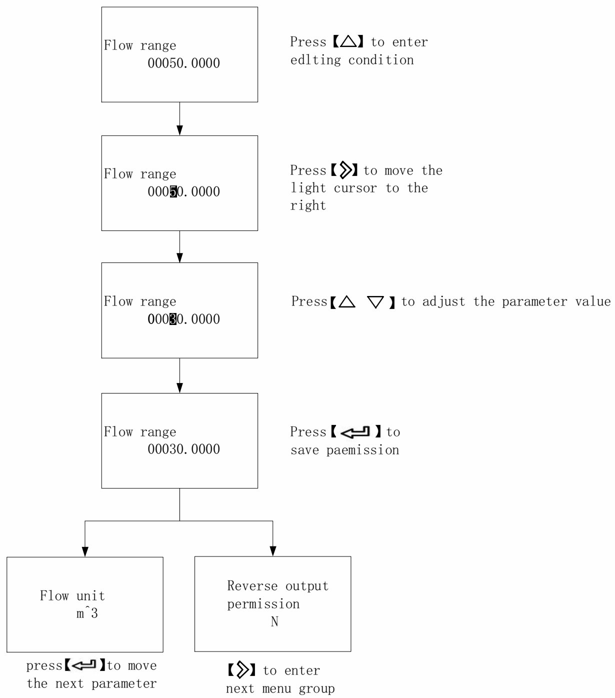
Initial manufacturer password: 100000 (used to modify manufacturer-level parameters)

Quick setup password: 300000

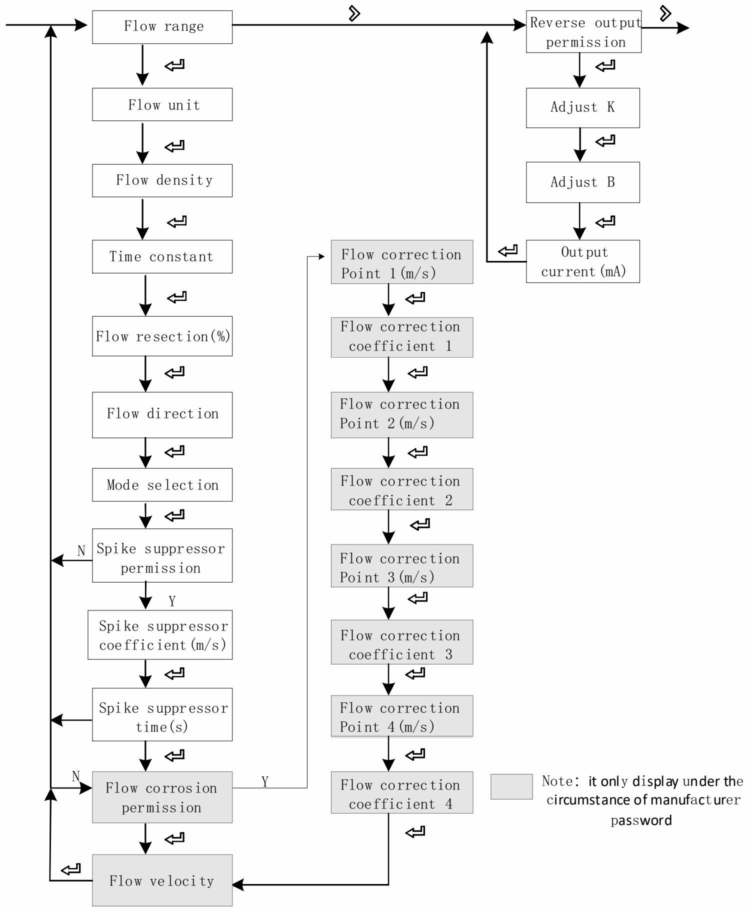
After entering the configuration menu, parameters can be modified as follows:

Use the ▷ key to switch between main menu pages, the ↵ key to move between parameters within a page (and automatically save the previous parameter’s value), and the △/▽ keys to adjust the value.

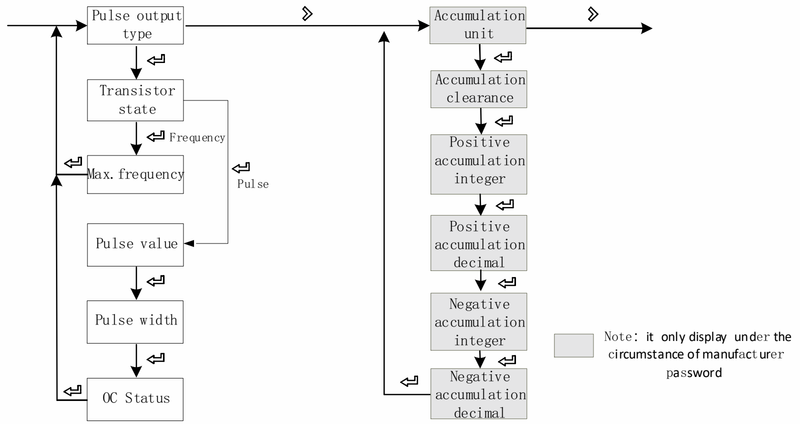
Example (adjusting “Flow Upper Limit”):



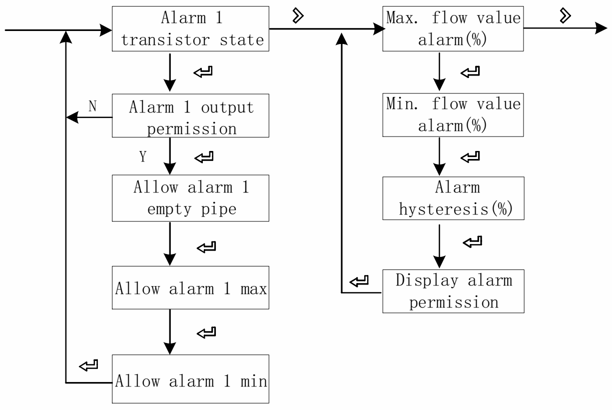
Flow Settings and Analog Output Menu



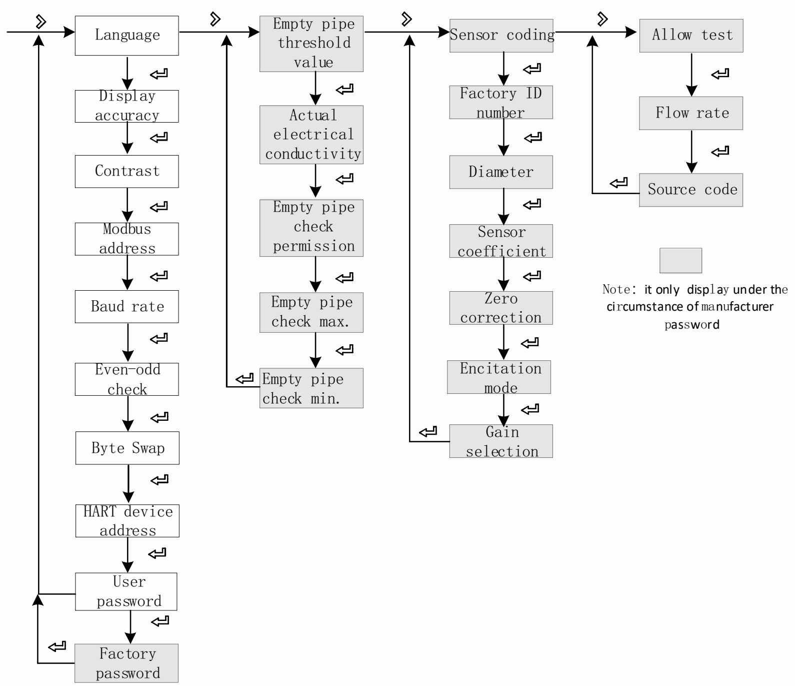
Pulse Output and Totalizer Settings Menu



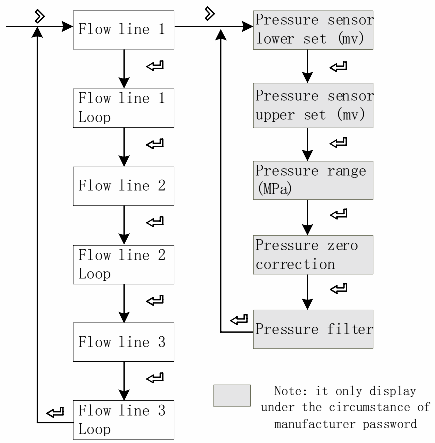
Alarm Settings Menu



System Function, Empty Pipe Function, Sensor Function, and Test Function Settings Menu



Display Parameters and Pressure Function Settings Menu



6.5 Detailed Flow Configuration

No.	Parameter Text	Setting Method	Password Level	Range	Default Value
1-Flow					
1-0	Flow range	Number	User	0-99999	35.000
	Sets the maximum upper limit value of the flow. This value is used for calculating the frequency upper limit, current output upper limit, alarm thresholds, and other threshold values.				
1-1	Flow unit	Select	User	L、m^3、gal、lgal 、Kg、t /s、min、h	m^3/h
	When volume units such as L, m³, gal, lgal are selected, density will not participate in the calculation. When mass units such as kg, t are selected, the 1-2 Fluid Density parameter must be set accordingly.				

1-2	Fluid density	Number	User	0.000-99.000	1.000
	Used for calculating mass flow rate, $Q_M = \rho V_M$ When the flow unit is a volume unit, this parameter will not be displayed.Density unit: g/cm³				
1-3	Time constant	Number	User	0-99S	2s
	Filtering damping coefficient. The average value within the selected time is used as the instantaneous flow.				
1-4	Flow cut-off	Number	User	0-10%	1%
	Flow below the set value is regarded as zero. 0 means this function is disabled.				
1-5	Flow direction	Select	User	Forward / Reverse	Forward
	Used to change the flow direction. This function is used when the signal wires are connected with reversed polarity or the sensor is installed in the reverse direction.				
1-6	Measurement mode	Select	User	Bidirectional / Forward / Reverse	Bidirectional
	Sets the flow measurement direction. Forward = measure only forward flow; Reverse = measure only reverse flow; Bidirectional = measure both directions.				
1-7	Spike suppression enable	Select	User	Y、N	N
	Enables or disables the spike suppression function. This function is used in applications with large interference signals to filter out noise. When set to N, menu items 1-8 and 1-9 are not displayed. When the signal fluctuation amplitude exceeds the value set in 1-8 and the duration is shorter than the time set in 1-9, the system considers it interference and will not display or totalize it.				
1-8	Spike suppression factor	Number	User	0.000-9.999m/s	0.800
	Spike amplitude (not displayed when Spike Suppression Enable is set to N).				
1-9	Spike suppression time	Select	User	0-9999s	0001
	Spike duration (not displayed when Spike Suppression Enable is set to N).				
1-10	Flow correction enable	Select	Manufacturer	Y、N	N
	Indicates whether to enable the flow non-linear correction function. Detailed description see the Flow Correction Function Operation Instructions chapter.				
1-11	Flow Correction Point 1	Number	Manufacturer	0.0-99.999	0
	Flow correction point 1. This parameter is not displayed when the flow correction function is disabled.				
1-12	Flow Correction Coefficient 1	Number	Manufacturer	0.0-99.999	1.000
	Flow correction coefficient 1. This parameter is not displayed when the flow correction function is disabled.				
1-13	Flow Correction Point 2	Number	Manufacturer	0.0-99.999	0
	Flow correction point 2. This parameter is not displayed when the flow correction function is disabled.				

1-14	Flow Correction Coefficient 2	Number	Manufacturer	0.0-99.999	1.000
	Flow correction coefficient 2. This parameter is not displayed when the flow correction function is disabled.				
1-15	Flow Correction Point 3	Number	Manufacturer	0.0-99.999	0
	Flow correction point 3. This parameter is not displayed when the flow correction function is disabled.				
1-16	Flow Correction Coefficient 3	Number	Manufacturer	0.0-99.999	1.000
	Flow correction coefficient 3. This parameter is not displayed when the flow correction function is disabled.				
1-17	Flow Correction Point 4	Number	Manufacturer	0.0-99.999	0
	Flow correction point 4. This parameter is not displayed when the flow correction function is disabled.				
1-18	Flow Correction Coefficient 4	Number	Manufacturer	0.0-99.999	1.000
	Flow correction coefficient 4. This parameter is not displayed when the flow correction function is disabled.				
	2 – Current Output				
2-0	Reverse Flow Current Output	Select	User	Y，N	N
	Determines whether 4-20 mA output (pulse/frequency) is required when flow is in the reverse direction. Forward direction output cannot be disabled.				
2-1	Current Output Coefficient Correction	Number	User	-99.999~+99.999	+01.000
	Used to adjust the current output value. Output current = coefficient × value + zero point				
2-2	Current Output Zero Point Correction	Number	User	-99.999~+99.999	+00.000
	Used to adjust the current output value, unit: mA. Output current = coefficient × value + zero point				
2-3	Current Output (display)	Display	User	4.00-20.00	--
	Displays the current output value in mA.				
	3 – Pulse / Frequency / Alarm Output				
3-0	Pulse Output Type	Select	User	Frequency, Pulse, Alarm	Frequency
	Select frequency / pulse volume / alarm.				
3-1	Transistor state	Select	User	High / Low Level	High Level
	Selects the output level status when there is no frequency output, no pulse volume output, or no alarm output.				
3-2	Frequency Output Upper Limit	Number	User	0-5000	2000
	Sets the frequency value corresponding to the flow upper limit. This parameter is displayed when frequency output is selected.				
3-3	Pulse Volume (L/P)	Select	User	0.001-999.999	1.0
	Sets the accumulated volume represented by each pulse. This parameter is displayed when pulse volume output is selected.				

3-4	Pulse Width (ms)	Select	User	50%、10、20、50、100、200	50%
	Sets the pulse width. This parameter is displayed when pulse volume output is selected.				
3-5	OC Gate Status	Select	User	Active / Passive	Active
	Selects OC gate status. Default is active.				
4 – Totalizer					
4-0	Totalizer Unit	Select	Manufacturer	m³、kg、t、gal、Igal、L	m³
	Unit of the accumulated totalizer.				
4-1	Totalizer Reset	Select	Manufacturer	Y、N	N
	Clears the accumulated totalizer.				
4-2	Forward Totalizer Integer	Number	Manufacturer	0-999999999	0
	Sets the integer part of the forward totalizer.				
4-3	Forward Totalizer Decimal	Number	Manufacturer	0.0-0.999	0.0
	Sets the decimal part of the forward totalizer.				
4-4	Reverse Totalizer Integer	Number	Manufacturer	0-999999999	0
	Sets the integer part of the reverse totalizer.				
4-5	Reverse Totalizer Decimal	Number	Manufacturer	0.0-0.999	0.0
	Sets the decimal part of the reverse totalizer.				
5 – Alarm Contact 1					
5-0	Alarm 1 Transistor Status	Select	User	High Level / Low Level	High Level
	Selects Alarm 1 transistor status. Default is high level.				
5-1	Enable Alarm 1 Output	Select	User	Y/N	N
	Master switch for Alarm Contact 1 output. When set to N, the following parameters are not displayed.				
5-3	Enable Alarm 1 Empty Pipe	Select	User	Y/N	N
	Enables empty-pipe alarm output. When the system detects an empty pipe, Contact 1 will automatically output an alarm signal. This parameter is not displayed when Enable Alarm 1 Output is set to N.				
5-4	Enable Alarm 1 Upper Limit	Select	User	Y/N	N
	Enables upper-limit alarm output. When the instantaneous flow exceeds the set upper limit, Contact 1 will automatically output an alarm signal. Detailed setting is described in 7-0. This parameter is not displayed when Enable Alarm 1 Output is set to N.				

5-5	Enable Alarm 1 Lower Limit	Select	User	Y/N	N
	Enables lower-limit alarm output. When the instantaneous flow falls below the set lower limit, Contact 1 will automatically output an alarm signal. Detailed setting is described in 7-1. This parameter is not displayed when Enable Alarm 1 Output is set to N.				
7 – Alarm Settings					
7-0	Alarm Upper Limit Value	Number	User	0-999.9%	100%
	Sets the alarm value for upper-limit alarm, as a percentage of the flow range.				
7-1	Alarm Lower Limit Value	Number	User	0-999.9%	0%
	Sets the alarm value for lower-limit alarm, as a percentage of the flow range.				
7-2	Alarm Hysteresis	Number	User	0-99.9%	1%
	Used to eliminate disturbance during alarm triggering. Upper-limit reset condition: instantaneous flow < upper limit – hysteresis Lower-limit reset condition: instantaneous flow > lower limit + hysteresis				
7-3	Enable Alarm Display	Select	User	Y/N	N
	Enables display of alarm information on the main screen.				
8 – System					
8-0	Language	Select	User	Chinese / English	Chinese
	Sets the language for configuration display.				
8-1	Display Precision	Number	User	0-4	2
	Number of decimal places for instantaneous flow.				
8-2	Contrast	Number	User	0-100%	50%
	Contrast of the LCD display.				
8-3	Communication Address	Number	User	1-247	8
	Instrument address based on RS485 Modbus RTU communication protocol.				
8-4	Baud Rate	Select	User	1200、2400、4800、9600、19200、38400、57600	9600
	Baud rate of the physical layer serial communication.				
8-5	Parity Check Method	Select	User	NONE /ODD/EVEN	NONE
	Parity check method of the physical layer serial communication.				
8-6	Byte Order	Select	User	2-1 4-3、3-4 1-2、4-3 1-2、1-2 3-4	2-1 4-3
	Byte exchange order of the physical layer serial communication.				

8-7	Device Address	Number	User	0-999999	00001
	HART device identification number.				
8-8	User Password	Number	User		200000
	User-level password used to view and modify user-level parameters. When entering with manufacturer password, this parameter is not displayed. Factory default: 200000				
8-9	Manufacturer Password	Number	Manufacturer		100000
	Manufacturer-level password used to view and modify manufacturer-level parameters. When entering with user password, this parameter is not displayed. Factory default: 100000				
8-18	Bluetooth	Select	User	Y、N	Y
	Bluetooth function is enabled by default and can be manually disabled. When using the Bluetooth applet, turn Bluetooth on and set to "Y".				
8-19	Factory Reset	Select	Manufacturer	Y、N	N
	Restore factory settings.				
	9 – Empty Pipe Parameters				
9-0	Empty Pipe Detection Threshold	Number	Manufacturer	0-100%	40%
	Threshold for empty-pipe alarm judgment.				
9-1	Measured Conductivity Equivalent Value	Select	Manufacturer		
	Displays the measured conductivity equivalent value of the fluid. For general natural water: full-pipe equivalent value < 200, empty-pipe > 1200 (actual value depends on conductivity and cable length; for cable lengths up to 20 m, double-shielded cable is recommended, otherwise empty-pipe detection may be affected).				
9-2	Empty Pipe Detection Enable	Select	Manufacturer	Y, N	Y
	Enables or disables the empty-pipe detection function.				
9-3	Empty Pipe Detection Upper Limit	Number	Manufacturer	0-9999	1200
	Equivalent value of measured conductivity when the pipe is empty. For general natural water, the default value can be used directly. For special fluids, observe the value in 9-1 when the pipe is empty and enter 9-3.				
9-4	Empty pipe check min	Number	Manufacturer	0-9999	174
	Equivalent value of measured conductivity when the pipe is full. For general natural water, the default value can be used directly. For special fluids, observe the value in 9-1 when the pipe is full and enter 9-4.				

9-5	Empty Pipe Detection Hysteresis	Number	Manufacturer	0-9999	30
	Hysteresis for empty-pipe detection judgment. For signal cable lengths within 20 m, the default value can be used directly.				
9-6	Empty Pipe Detection Count	Number	Manufacturer	0-99	05
	Number of consecutive detections required to trigger an empty-pipe alarm. When the empty-pipe signal is continuously detected for this number of times, an empty-pipe alarm is activated.				
	10 – Sensor				
10-0	Sensor Code	Figure / symbol	Manufacturer	16 digits	
	Used to identify the sensor.				
10-1	Sensor Tag Number	Number	Manufacturer	6 digits	000000
	Product factory serial number.				
10-2	Nominal Diameter	Select	Manufacturer	3-2000	50
	Bore size of the sensor.				
10-4	Sensor Coefficient	Number	Manufacturer	0-99.99999	
	The sensor manufacturer calibrates this coefficient according to the actual water flow volume.				
10-6	Zero Point Correction (m/s)	Number	Manufacturer	-9.9999~+9.9999	0.0000
	Used to correct sensor non-linearity at low flow rates (below 0.3 m/s). The upper display shows V as real-time velocity. Corrected velocity V = original V + zero point correction value.				
10-7	Excitation Mode Selection	Select	Manufacturer	3.125Hz、 6.25 Hz、12.5 Hz、 25 Hz	6.25Hz
	Selection of excitation frequency. Mode 1: 3.125 Hz Mode 2: 6.25 Hz				
10-9	Gain Selection	Select	Manufacturer	1/3/9	3
	Gain selection: Changing the instrument gain can alter the measurable flow velocity range. Available gain values: 1, 3, 9.				
	11 – Test Parameters				
11-0	Allow Test	Select	Manufacturer	Y/N	N
	When set to Y, the test velocity becomes active. The test flag "T" appears in the upper-left corner of the main screen. After power-off, it automatically reverts to N				
11-1	Test Velocity (m/s)	Number	Manufacturer	-12.000~12.000	1.000
	Sets the simulated velocity. This takes effect only after "11-0 Allow Test" is set to "Y".				
11-2	Test Source Code	Select	Manufacturer	Y/N	N
	When set to Y, the signal source code is displayed on the operating screen. This screen also displays the firmware version number and product serial number.				

12 – Display Parameters					
12-0	Flow Display Line 1	Select	User	Instantaneous flow, Forward totalizer, Reverse totalizer, Net totalizer	Instantaneous flow
	Select one parameter as the fixed display for Flow Display Line 1.				
12-1	Flow Display Line 1 Cycle	Select	User	Instantaneous flow, Forward totalizer, Reverse totalizer, Net totalizer, Off	Off
	Can be turned off or select one additional parameter as the cycling display for Line 1.				
12-2	Flow Display Line 2	Select	User	Instantaneous velocity, Empty pipe MT, Flow bar graph, Forward totalizer, Reverse totalizer, Net totalizer, Pressure	Flow bar graph
	Select one parameter as the fixed display for Flow Display Line 2. *Pressure is available only when pressure function is selected.				
12-3	Flow Display Line 2 Cycle	Select	User	Instantaneous velocity, Empty pipe MT, Flow bar graph, Forward totalizer, Reverse totalizer, Net totalizer, Pressure*, Off	Off
	Can be turned off or select one additional parameter as the cycling display for Line 2. *Pressure is available only when pressure function is selected.				
12-4	Flow Display Line 3	Select	User	Instantaneous velocity, Empty pipe MT, Flow bar graph, Forward totalizer,Reverse totalizer, Net totalizer, Pressure	Forward totalizer
	Select one parameter as the fixed display for Flow Display Line 3. *Pressure is available only when pressure function is selected.				
12-5	Flow Display Line 3 Cycle	Select	User	Instantaneous velocity, Empty pipe MT, Flow bar graph, Forward totalizer, Reverse totalizer, Net totalizer, Pressure, Off	Off
	Can be turned off or select one additional parameter as the cycling display for Line 3.				

6.6 Quick Setup Menu

How to Enter Quick Setup Menu

1. Press ≫ and ↵ simultaneously to enter the parameter setting interface.
2. Enter password: 300000.
3. Use the ↵ key to switch between menu pages, △/▽ keys to adjust values, and ↵ key to confirm.
4. The settable parameters are shown in the following table:
5. After completing changes, navigate to the "Exit Configuration" page, select Y, and confirm with ↵ .

No.	Parameter Text	Setting Method	Range	Default
1	Nominal diameter	Select	3-2000	50
2	Flow upper limit	Number	0-99999	35.000
3	Sensor coefficient	Number	0-99999	1.000
4	Zero correction	Number	0-99999	0.0
5	Totalizer reset	Select	Y、N	N
6	Flow cut-offT	Number	0-99%	1%
7	ime constant	Number	0-99S	03
8	Pulse output type	Select	Pulse / Frequency / Alarm	Pulse
9	Frequency upper limit	Number	0~5000.0	2 000.0
10	Pulse volume (L/P)	Number	0-999999.999	1.000

7.1 System Information

The flowmeter itself features a self-diagnostic function. In addition to power supply and circuit board hardware faults, it can correctly provide corresponding alarm information for general faults that occur during application.

Alarm Display Position on the Measurement Screen

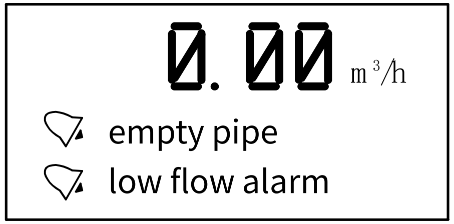


Figure 42

System Information Table

Display	Alarm Content
Empty Pipe Alarm	Sensor empty pipe
Flow Upper Limit Alarm	Current instantaneous flow exceeds the set upper limit
Flow Lower Limit Alarm	Current instantaneous flow is below the set lower limit
Pulse Upper Limit Alarm	Pulse output frequency exceeds the set frequency upper limit
Over-Range Alarm	Current instantaneous flow exceeds the user-set flow upper limit

7.2 Flow Correction Function Operation Instructions

This function is primarily used for linear adjustment at low flow rates (below 0.5 m/s). The correction calculation is performed on the original sensor flow coefficient curve. Therefore, the non-linear correction function should first be disabled and the sensor coefficient determined. Then the non-linear correction function is enabled, and correction coefficients are set accordingto the sensor's non-linearity for segmented correction. If the coefficients are set appropriately, no re-calibration is required. This function provides 4-segment correction, consisting of 4 flow velocity points and 4 correction coefficients.

The flow velocity corresponding to each correction point must satisfy:
Correction Point 1≥Correction Point 2≥Correction Point 3≥Correction Point 4≥0.

In the formula, the original velocity refers to the actual measured velocity, and the corrected velocity is called the corrected flow velocity. The correction calculation formula is as follows:

- When original velocity > Correction Point 1 interval: No correction; the original velocity is maintained.
- When Correction Point 1 > original velocity ≥Correction Point 2 interval: Corrected velocity = Correction Coefficient 1 × original velocity
- When Correction Point 2 > original velocity Correction Point 3 interval: Corrected velocity = Correction Coefficient 2 × original velocity
- When Correction Point 3 > original velocity Correction Point 4 interval: Corrected velocity = Correction Coefficient 3 × original velocity
- When Correction Point 4 > original velocity 0 interval: Corrected velocity = Correction Coefficient 4 × original velocity

Note: When the correction coefficient equals 1, no correction is applied. A coefficient greater than 1 increases the velocity; a coefficient less than 1 decreases the velocity.

Field Application Example 1:
Original velocity in the range 0–0.4 m/s, coefficient changed to 1.2 times.

Parameter Settings

Correction Point1(m/s)	Correction Point2(m/s)	Correction Point3(m/s)	Correction Point4(m/s)
0.4	0	0	0
Correction Coefficient1	Correction Coefficient2	Correction Coefficient3	Correction Coefficient4
1.2	1	1	1

Corrected Velocity

Original velocity is 0–0.4 m/s
Corrected to 1.2 × original velocity

Field Application Example 2:
First segment: original velocity in 0.2–0.4 m/s, coefficient changed to 0.9 times;
Second segment: original velocity in 0.4–0.5 m/s, coefficient changed to 1.1 times.

Parameter Settings

Correction Point1(m/s)	Correction Point2(m/s)	Correction Point3(m/s)	Correction Point4(m/s)
0.5	0.4	0.2	0
Correction Coefficient1	Correction Coefficient2	Correction Coefficient3	Correction Coefficient4
1.1	0.9	1	1

Corrected Velocity

Original velocity between 0.2–0.4 m/s	Original velocity between 0.4–0.5 m/s
Corrected to 1.1 × original velocity	Corrected to 0.9 × original velocity

Field Application Example 3:
First segment: original velocity 0.1–0.2 m/s, coefficient changed to 0.9 times;
Second segment: original velocity 0.2–0.3 m/s, coefficient changed to 1.1 times;
Third segment: original velocity 0.3–0.4 m/s, coefficient changed to 0.8 times.

Correction Point1(m/s)	Correction Point2(m/s)	Correction Point3(m/s)	Correction Point4(m/s)
0.4	0.3	0.2	0.1
Correction Coefficient1	Correction Coefficient2	Correction Coefficient3	Correction Coefficient4
0.8	1.1	0.9	1

Corrected Velocity

Original velocity between 0.1–0.2 m/s	Original velocity between 0.2–0.3 m/s	Original velocity between 0.3–0.4 m/s
Corrected to 0.9 × original velocity	Corrected to 1.1 × original velocity	Corrected to 0.8 × original velocity

Field Application Example 4:
First segment: original velocity 0.1–0.2 m/s, coefficient changed to 0.9 times;
Second segment: original velocity 0.3–0.4 m/s, coefficient changed to 1.1 times.

Parameter Settings

Correction Point1(m/s)	Correction Point2(m/s)	Correction Point3(m/s)	Correction Point4(m/s)
0.4	0.3	0.2	0.1
Correction Coefficient1	Correction Coefficient2	Correction Coefficient3	Correction Coefficient4
1.1	1	0.9	1

Corrected Velocity

Original velocity between 0.1–0.2 m/s	Original velocity between 0.3–0.4 m/s
Corrected to 0.9 × original velocity	Corrected to 1.1 × original velocity

Field Application Example 5:
First segment: original velocity 0–0.2 m/s, coefficient changed to 0.7 times;
Second segment: original velocity 0.2–0.3 m/s, coefficient changed to 1.1 times;
Third segment: original velocity 0.3–0.4 m/s, coefficient changed to 0.8 times;
Fourth segment: original velocity 0.4–0.5 m/s, coefficient changed to 0.9 times.

Parameter Settings

Correction Point1(m/s)	Correction Point2(m/s)	Correction Point3(m/s)	Correction Point4(m/s)
0.5	0.4	0.3	0.2
Correction Coefficient1	Correction Coefficient2	Correction Coefficient3	Correction Coefficient4
0.9	0.8	1.1	0.7

Corrected Velocity

Original velocity between 0–0.2 m/s	Original velocity between 0.2–0.3 m/s	Original velocity between 0.3–0.4 m/s	Original velocity between 0.4–0.5 m/s
Corrected to 0.7 × original velocity	Corrected to 1.1 × original velocity	Corrected to 0.8 × original velocity	Corrected to 0.9 × original velocity

7.3 Pulse / Frequency / Current Output

Pulse Volume Output

Mainly used for sensor manufacturer coefficient calibration and user metering.

Set in Group 3 configuration parameters:The pulse volume corresponds to the accumulated volume, indicating the volume represented by each pulse.

Example:
Parameter set to 0.1 L/p;
Current instantaneous flow = 3.6 m^3/h;
Number of pulses output per second = 3.6 × 1000 / 3600 / 0.1 = 10 pulses.

Note:
When the parameter is set to 0.4 L/p;
Current instantaneous flow = 3.6 m^3/h;
Number of pulses output per second = 3.6 × 1000 / 3600 / 0.4 = 2.5 pulses.

In the above case, the fractional part of the 2.5 pulses will automatically accumulate and be output in the next second. There will be no data loss.

When the flow in the pipeline is relatively large, the pulse volume per pulse should not be set too small; otherwise, the pulse output may exceed the upper limit, causing the main screen to display the Pulse Upper Limit Alarm. The user must then reset the pulse volume parameter.

Similarly, when the pipeline flow is relatively small, the selected pulse volume must not be too large; otherwise, it may take a very long time for the instrument to output one pulse, resulting in measurement error.

Pulse volume output differs from frequency output. Pulse output generates one pulse only after accumulating one full pulse volume; therefore, the pulse output is not uniform. When measuring pulse output, a counter instrument should be used — frequency meters must not be used.

Frequency Output

Mainly used for manufacturer coefficient calibration and user metering.

Set in the Group 3 configuration parameters: frequency corresponds to instantaneous flow, and the frequency upper limit corresponds to the maximum flow.

Note: The maximum settable frequency is 5000 Hz.

Current Output

Mainly used to transmit signals to other intelligent instruments, such as digital displays, recorders, PLCs, DCS, etc.

The output current type is 4–20 mA.

The current value corresponds to the instantaneous flow:20 mA corresponds to the upper limit of the range, 4 mA corresponds to the lower limit of the range.

Conversion formula:

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

Unit: mA

Explanation:

$Q_{real\text{-}time}$:instantaneous flow

Q_{max}:current instrument range

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

7.4 Serial Communication

This instrument provides a standard RS485 serial communication interface and adopts the internationally accepted Modbus-RTU communication protocol, supporting the 04 (Read Input Register) command.

Register Addresses

Communication Data and Register Addresses

Parameter	Type	Address	Description
Instantaneous flow	float	100	
Instantaneous velocity	float	102	
Flow percentage	float	104	50 stands for 50%
Conductivity	float	106	
Forward totalizer integer	ulong	108	
Forward totalizer decimal	ulong	110	The decimal part magnifies 1000 times 123stand for 0.123
Reverse totalizer integer	ulong	112	
Reverse totalizer decimal	ulong	114	The decimal part magnifies 1000 times 123stand for 0.123

Note: For float/ulong/long data, transmission follows byte order 2-1-4-3; for ushort data, transmission follows 2-1.

Communication Configuration

Communication address: 1–247;

Default address: 8;

Baud rate: 1200, 2400, 4800, 9600, 19200, 38400, 57600;

Default baud rate: 9600;

Parity: None, Odd parity, Even parity;

Default: None;

For 32-bit data (long integer or floating-point number), the byte arrangement in the communication frame is as follows:

Example: Long integer 16909060 (01020304H): 03 04 01 02

Floating-point number 4.00 (40800000H): 00 00 40 80

Example of Reading Real-time Floating-point Value:

Real-time floating-point read:

Send message: 08 04 00 63 00 02 81 4C;

Return message: 08 04 04 22 6E 41 3F 79 61 (instantaneous flow: 11.95).

Forward Flow Totalizer Read:
Send message: 08 04 00 6B 00 04 80 8C;
Return message: 08 04 08 00 6C 00 00 00 7B 00 00 D6 8E (accumulated integer: 108, accumulated decimal: 0.123, total accumulated: 108.123).

7.5 HART Communication

This instrument provides a HART 6.0 communication interface and supports the following commands.

HART Command 0: Read Identification Code
Returns the expanded device type code, version, and device identification code.

Request	
None	
Response	
Byte 0	254
Byte 1	Manufacturer ID
Byte 2	Device type
Byte 3	Minimum preambles required (Master->Slave)
Byte 4	Universal command revision
Byte 5	Device-specific command revision
Byte 6	Software revision
Byte 7	Hardware revision (first 5 bits) / Physical signal type (last 3 bits)
Byte 8	Device flag
Byte 9-11	Device ID number
Byte 12	Minimum preambles required for response (Master->Slave)
Byte 13	Maximum number of device variables
Byte 14-15	Configuration change counter
Byte 16	Additional device status (maintenance required / parameter alarm)

HART Command 1: Read Primary Variable (PV)
Returns the primary variable value in floating-point format.

Request	
None	
Response	
Byte 0	Primary variable unit code
Byte 1-4	Primary variable value

HART Command 2: Read Dynamic Variables and Primary Variable Current
Reads the primary variable current and percentage. The primary variable current always matches the AO output current of the device. The percentage is not limited to 0–100%; if it exceeds the primary variable range, it will track the sensor's upper/lower limits.

Request	
None	
Response	
Byte 0-3	Primary variable current (mA)
Byte 4-7	Primary variable percentage (%)

HART Command 3: Read Dynamic Variables and Primary Variable Current
Reads the primary variable current and 4 (or more) predefined dynamic variables. The primary variable current always matches the AO output current of the device. Each device type defines its own second variable (e.g., second variable = sensor temperature, third variable = forward totalizer integer (6 valid digits), fourth variable = forward totalizer fractional part (remaining data after the first 6 valid digits). Total accumulated = third variable + fourth variable.

Request	
None	
Response	
Byte 0-3	Primary variable current (mA)
Byte 4	Primary variable unit code
Byte 5-8	Primary variable value
Byte 9	Second variable unit code
Byte 10-13	Second variable value
Byte 14	Totalizer unit code
Byte 15-18	Forward totalizer integer
Byte 19	Forward totalizer fractional unit code
Byte 20-23	Forward totalizer fractional part

HART Command 6: Write Polling Address

This is a data link layer management command. This command writes the Polling address to the device. The address is used to control the primary variable AO output and provide the device identifier.

Only when the Polling address is set to 0 can the device's primary variable AO be output. If the address is 1–15 and the AO is in a non-active state, it will not respond to the application process.In this case, the AO is disabled (upper/lower limit alarm is invalid). If the Polling address is reset to 0, the primary variable AO returns to the active state and can respond to the application process.

The second byte returned by the device indicates whether the device is in current mode. The following commands can only be used when the current mode is enabled:

40#: Enter / Exit fixed current mode
45#: Adjust current zero point
46#: Adjust current gain
66#, 67#, 68#: Analog output mode

Request	
Byte 0	Device Polling address
Byte 1	Current mode code
Response	
Byte 0	Device Polling address
Byte 1	Current mode code

HART Command 14: Read Primary Variable Sensor Information

Reads the primary variable sensor serial number, sensor upper/lower limit and minimum span (Span) unit code, primary variable sensor upper limit, primary variable sensor lower limit, and sensor minimum span. The sensor upper/lower limit and minimum span (Span) unit are the same as the primary variable unit.

Request	
None	
Response	
Byte 0-2	Primary variable sensor serial number
Byte 3	Primary variable sensor upper/lower limit and minimum span unit code
Byte 4-7	Primary variable sensor upper limit
Byte 8-11	Primary variable sensor lower limit
Byte 12-15	Primary variable sensor minimum span

HART Command 15: Read Device Information

Reads the primary variable alarm selection code, primary variable transfer (Transfer) function code, primary variable unit code, primary variable upper limit, primary variable lower limit, primary variable damping value, write protect code, and manufacturer ID code.

The primary variable damping value is used for the device range percentage and time constant.

Request	
None	
Response	
Byte 0	Primary variable alarm selection code
Byte 1	Primary variable Transfer function code
Byte 2	Primary variable upper/lower range unit code
Byte 3-6	Primary variable upper limit
Byte 7-10	Primary variable lower limit
Byte 11-14	Primary variable damping value (unit: seconds)
Byte 15	Write protect code (fixed at 251 if no write protect function)
Byte 16	Manufacturer ID (group A5-0), default = 250
Byte 17	Primary variable analog output flag (whether it is a field device analog input channel)
Byte 18-20	Date

Command 34: Write Primary Variable Damping Value

This is a command related to the primary variable.

The primary variable damping value represents a time constant (when this time is reached, the output in response to a step change should be 63% of the steady-state value). Both analog and digital outputs of the variable use this value.

Request	
Byte 0-3	Primary variable damping value (unit: seconds)
Response	
Byte 0-3	Actual primary variable damping value (unit: seconds)

Command 35: Write Primary Variable Range Value

This is a command related to the primary variable range.

The primary variable upper and lower range limits are independent. Most devices allow the upper and lower range limits to be set independently to make the device work in reverse output.

The primary variable range unit received by this command does not affect the primary variable unit of the device. The primary variable range value is returned according to the received unit.

Request	
Byte 0	Primary variable range unit code
Byte 1-4	Primary variable range upper limit
Byte 5-8	Primary variable range lower limit
Response	
Byte 0	Primary variable range unit code
Byte 1-4	Primary variable range upper limit
Byte 5-8	Primary variable range lower limit

Command 40: Enter/Exit Fixed Primary Variable Current Mode

This is a command related to the fixed primary variable current mode.

The device is forced into fixed current mode. The response value displays the actual current value of the current device.

If the requested value is set to “0”, the device exits fixed current mode. When the device is powered off, it will also exit this mode.

Request	
Byte 0-3	Fixed primary variable current value (unit: mA)
Response	
Byte 0-3	Actual fixed primary variable current value (unit: mA)

Command 44: Write Primary Variable Unit

This is a command related to the primary variable unit.

Select a primary variable unit. Both the primary variable value and the range value are returned using this unit. The upper/lower limits of the primary variable sensor and the minimum span (Span) also use this unit as the unit.

Request	
Byte 0	Primary variable unit code
Response	
Byte 0	Primary variable unit code

Command 45: Adjust Loop Current Zero Point

This is a command related to loop current.

It adjusts the loop current value to 0 or the lower limit. It is usually set so that the loop current is 4.00 mA. The transmitted current value may be rounded or truncated, and the current value at that moment will be returned.

If the device has not entered the correct loop current mode or the current has not been set accurately to the minimum value, response code 9— (Incorrect current mode or value) will be returned.

Request	
Byte 0-3	External measured current value (unit: mA)
Response	
Byte 0-3	Actual measured primary variable current value (unit: mA)

Command 46: Adjust Loop Current Gain

This is a command related to loop current.

It adjusts the loop current value to the maximum. It is usually set so that the loop current is 20.00 mA. The transmitted current value may be rounded or truncated, and the current value at that moment will be returned.

If the device has not entered the correct loop current mode or the current has not been set accurately to the minimum value, response code 9--- (Incorrect current mode or value) will be returned.

Request	
Byte 0-3	External measured primary variable current value (unit: mA)
Response	
Byte 0-3	Actual measured primary variable current value (unit: mA)

Command 59: Write Number of Preamble Characters

This is a data link layer management command and is only used for asynchronous physical link layers, such as FSK.

This command is used before sending a response to select the minimum number of preamble characters to be sent. This number, which is included in the two preamble characters in the message header, can be set from 5 to 20.

Request	
Byte 0	Number of preamble characters to be sent in the response message
Response	
Byte 0	Number of preamble characters to be sent in the response message

Example: Adjusting Loop Current Zero Point

A 4–20 mA loop transmits a dynamic primary variable via an analog signal. This requires the loop current between the host and the field device to be consistent. The loop current command allows the host to force a loop current on the field device and perform a two-point adjustment (corresponding to zero and span) of the field device’s loop current value. The loop current adjustment procedure is as follows:

1. Use Command 40 to enter/exit fixed current mode and set the current to the device’s minimum value, typically 4 mA;
2. Use Command 45 to adjust the loop current zero point. After adjustment, the device returns the current value, which may have a slight deviation due to rounding or truncation compared with the value set by the host;
3. Use Command 40 to enter/exit fixed current mode and set the current to the device’s maximum value, typically 20 mA;
4. Use Command 46 to adjust the loop current gain;
5. If more precise settings are required, repeat steps 1–4. After the loop current has been properly calibrated, use Command 40 to exit fixed current mode (set to 0 mA).

VIII. Technical Specifications

8.1 Technical Parameters

Measuring System

Measuring Principle	Faraday’s law of electromagnetic induction	
Functions	Real-time measurement of instantaneous flow rate, flow velocity, mass flow (when fluid density is constant), and totalized flow	
Module Structure	Measuring system consists of one measuring sensor and one signal converter	
Protection Rating		
Integrated type	IP65	
Separate type	Sensor	Converter
	IP 65 or IP 68	IP 65
Pipe-type Sensor		
Nominal diameter	DN15-DN1200	
Flange	Compliant with GB/T 9112.1-2019 standard carbon steel (stainless steel flange optional). Other standard flanges can be customized.	
Rated Pressure Rating (High-pressure versions available on request)	DN15 – DN50, PN ≤ 4.0MPa	
	DN65 - DN150, PN ≤ 1.6MPa	
	DN200 – DN600, PN ≤ 1.0MPa	
	DN700 – DN1200, PN ≤ 0.6MPa	
Lining Material	Polyurethane rubber (PU), Thermoplastic polyurethane (TPU) Neoprene rubber (CR), Polytetrafluoroethylene (PTFE) Perfluoroalkoxy (F46/FEP), Melt-processible polytetrafluoroethylene (PFA/Teflon) Ceramic	
Electrode	316L, Hastelloy (HB and HC), Titanium, Platinum, Platinum-iridium alloy, Gold-plated electrode, Tantalum, Tungsten carbide stainless steel	
Medium Temperature Limit	Separate type	Integrated type
	-25 – 150 ℃	-10 – 80 ℃
Buried Depth	< 5 m (IP68 separate-type sensor only)	
Immersion Depth	< 3 m (IP68 separate-type sensor only)	
Sensor Cable	Separate type only; standard length 10 m; other lengths up to a maximum of 300 m (recommended)	

Functions

Communication	RS485, HART
Output	Current (4–20 mA), Pulse, Frequency, Status (switch)
Functions	Empty-pipe detection, Electrode contamination detection

Display User Interface

Graphic Display	Single-color LCD with white backlight, 128×64 pixels
	OLED display (green, 128×64 pixels) – optional for temperatures below –10 °C
Display Functions	3 measurement value screens (flow, status, etc.), with automatic cycling
Language	Chinese
Units	Units can be selected via the configuration menu. Refer to parameters 1-1 Flow Unit and 4-0 Totalizer Unit in Section 6.3 "Detailed Configuration Description".
Operation Unit	4 mechanical keys

Measuring Accuracy

Accuracy Class	0.5%
Repeatability	0.15 %
Maximum Measurable Velocity	Configurable in parameter 1-24; absolute default value 12 m/s

Operating Environment

Temperature	
Ambient	(OLED optional below –10 °C)
Storage	-40 ℃ – 65 ℃
Conductivity	
Water	minimum 20 μS/cm (actual measurable conductivity should be > 30 μS/cm)
Other media	minimum 5 μS/cm (actual measurable conductivity should be > 30 μS/cm)

Materials

Sensor Housing	Carbon steel / Stainless steel
Converter Housing	Standard die-cast aluminum

Electrical Connection

Power Supply Voltage	85-250VAC，50/60Hz；24VDC±20%
Power Consumption	Maximum 15 VA
Signal Cable	Separate type only
Shielded Cable	Signal section: RVVP 2×0.5

Output

Current Output		
Function	Volume and mass measurement (when density is constant)	
Setting	Range	4-20mA
	Upper Limit	20mA
	Lower Limit	4mA
Internal Voltage	24VDC	
Load	≤750 Ω	
Pulse and Frequency Output		
Function	Configurable as pulse output or frequency output	
Pulse Output	Basic	Output pulse width: 0.1 ms ~ 100 ms
		Duty cycle: 50 % (when pulse frequency > 5 Hz)
		F_{max} ≤ 5000 cp/s
	Setting	0.001L – 1m^3
Frequency	Upper Limit	F_{max} ≤ 5000Hz
	Setting	0-5000Hz
Active	Output voltage of active pulse/frequency: $U_{internal}$ ≤ 24VDC	
	Output current of active pulse/frequency I≤ 4.52mA	
Passive	$U_{externa}$ ≤ 36VDC	

Status Output	
Functions	Can be used as alarm status output
Passive	$U_{externa} \leq$ 36VDC
Active	Active output voltage: $U_{internal} \leq$ 24VDC
	Active output current: $I \leq$ 4.52mA

8.2 Flow Rate Table

	$Q_{100\%}$ Unit m^3/h				
V[m/s]	0.5	1	3	5	7
DN[mm]	Min flow	recommended flow rate			Max flow
15	0.32	0.64	1.91	3.2	4.45
20	0.56	1.13	3.39	5.7	7.91
25	0.88	1.77	5.30	8.8	12.39
32	1.45	2.90	8.69	14.5	20.27
40	2.26	4.52	13.57	22.6	31.67
50	3.53	7.07	21.21	35.3	49.48
65	5.97	11.95	35.84	59.7	83.62
80	9.05	18.10	54.29	90.5	126.67
100	14.13	28.27	84.82	141.3	197.92
125	22.09	44.18	132.54	220.9	309.25
150	31.81	63.62	190.85	318.1	445.32
200	56.55	113.10	339.30	565.5	791.70
250	88.35	176.71	530.13	883.6	1236.97
300	127.23	254.47	763.41	1272.3	1781.29
350	173.18	346.36	1039.08	1731.8	2424.52
400	226.19	452.39	1357.17	2261.9	3166.73
500	353.43	706.86	2120.58	3534.3	4948.02
600	508.95	1017.90	3053.70	5089	7125.30
700	692.7	1385.40	4156.20	6927	9697.80
800	904.8	1809.60	5428.80	9048	12667.20
900	1145.1	2290.20	6870.60	11451	16031.40
1000	1413.7	2827.40	8482.20	14137	19791.80
1200	2034.7	4069.44	12208.32	20347.2	28486.08

Conversion formula:Flow $Q = V \times \pi \times (DN/2)^2$, Unit m/s and m^3/h