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LEFOO

INTELLIGENT VORTEX FLOWMETER

User Manual

CONTENTS

I. PRECAUTIONS FOR USE

1. Upon receiving this product, please check for any signs of impact, scratches, or other damage that may have occurred during transportation.

2. Verify that the model and configuration on the product nameplate match the model and specifications you intended to purchase.

3. Whenever possible, use the original packaging provided by our company to transport the flow meter directly to the installation site.

4. Avoid strong impacts and prevent the product from getting wet during transportation.

5. When storing the product, try to use the original packaging from our company, and ensure the storage location meets the following conditions:

(1) A place free from rain or water exposure.

(2) A location with minimal vibration or impact.

(3) Temperature: -40℃ to +55℃

(4) Humidity: 5% to 90%

6. If storing a used flow meter, thoroughly clean any residual liquids or adhered substances from the interior, and seal the power interface to prevent moisture from entering.

7. Use the flow meter within the specified operating conditions. Operating outside these conditions is not advisable, and any damages incurred due to such misuse will be your responsibility for repair costs.

8. If any issues arise with the flow meter, please contact us or a service provider as soon as possible to resolve the problem efficiently.

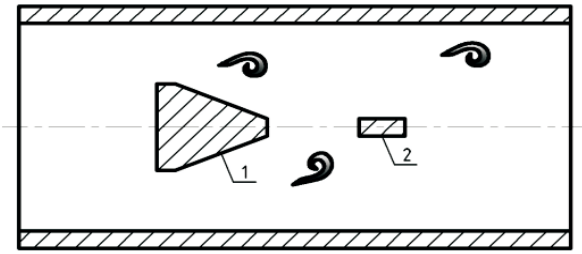
II. OVERVIEW AND TECHNICAL SPECIFICATIONS

2.1. Overview

The vortex flow meter is a crucial instrument for flow measurement and automatic control, suitable for measuring the flow of gases, liquids, and steam. It is widely used in various industries such as petroleum, chemical, metallurgy, thermal power, textiles, paper-making, electric power, environmental protection, and municipal construction.

2.2. Working Principle

A non-streamlined bluff body (vortex generator) is placed within the fluid, causing two alternating rows of regular vortices to form on either side of the bluff body. These vortices are known as Kármán vortex streets, as illustrated in Figure 1.



1. Vortex Generator 2. Piezoelectric Sensor (Figure 1)

The vortex streets are asymmetrically arranged downstream of the vortex generator. Let f be the vortex shedding frequency, V be the average velocity of the measured medium, d be the width of the vortex generator facing the flow, and D be the diameter of the flow meter body. According to the Kármán vortex street principle, the following relationship holds:

$$f = stv/d \quad \text{(Equation 1)}$$

Where:

f - Kármán vortex frequency generated on one side of the vortex generator
st - Strouhal number (dimensionless)
v - Average velocity of the fluid
d - Width of the vortex generator

Thus, by measuring the frequency of the Kármán vortex shedding, the instantaneous flow rate can be calculated.

2.3. Main Functions and Features

- Wide measurement range, high accuracy, and low pressure loss, with high reliability and long-term stability.
- Simple structure, easy installation and maintenance, with no moving parts and no mechanical wear.
- New exterior design with a precision-forged body, offering an attractive appearance and high-temperature resistance.
- Common output signals include pulse or analog signals, which are stable and have strong anti-interference capabilities.

2.4. Technical Specifications

- Measured Medium: Liquids, general gases, steam; the medium should not be corrosive.
- Nominal Diameter: DN15~DN300 (inline type), DN150~DN2000 (insertion type); diameters above DN2000 are available upon agreement.
- Medium Temperature: -40~100℃ (normal temperature), 100~250℃ (medium temperature), 250~320℃ (high temperature).
- Nominal Pressure: 1.6 MPa, 2.5 MPa, 4.0 Mpa

・Accuracy: ±1%R, ±1.5%R (inline type), ±1.5%R, ±2.5%R (insertion type).
・Power Supply: 12VDC (three-wire pulse output), 24VDC (three-wire pulse output and two-wire current output), 3.6V lithium battery, or dual power supply.
・Body Material: Carbon steel; other materials available upon agreement.
・Protection Level: IP65; other protection levels available upon agreement.
・Environmental Conditions: Temperature 20℃~55℃, relative humidity 5%~90%, atmospheric pressure 86~106 kPa.

The selection of the flow meter's diameter is crucial and should follow certain principles. Diameter selection should consider the maximum, typical, and minimum flow rates of the measured medium; the maximum, typical, and minimum pressures; the highest, typical, and lowest temperatures; and whether the flow measurement falls within the optimal operating range of the instrument (i.e., between 1/2 and 2/3 of the upper flow limit).

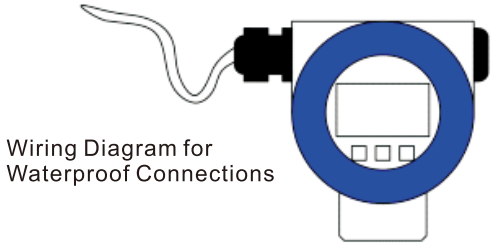
III. FLOW RANGE

Unit: m^3/h

Sensor Diameter (mm)	Liquid (Calibration Medium: Ambient Temperature Water)	Gas (Calibration Medium: Air at 20°C and 101,325 Pa)
15	0.8-6	7-21
20	1-8	8-50
25	1.5-12	10-80
40	2.5-30	25-200
50	3-50	30-300
65	5-80	50-500
80	8-120	80-800
100	12-200	120-1200
125	20-300	160-1600
150	30-400	250-2500
200	50-800	400-4000
250	80-1200	600-6000
300	100-1600	1000-10000
400	200-3000	1600-16000
500	300-5000	2500-25000
600	500-8000	4000-40000
Note: 400-600 are insertion types		

IV. HOW TO PROPERLY USE THE INSTRUMENT

・Each flow meter has a specific operating range. Before installation, please confirm that the purchased flow meter matches the site conditions (flow rate, temperature, pressure).
・The vortex flow meter can measure liquids, gases, and steam, but it is not interchangeable between different media. Within the same type of medium, the meter is available in three temperature specifications: low temperature, medium temperature, and high temperature, which are also not interchangeable.
・Avoid installing the meter near strong electrical equipment, high-frequency devices, or high-power switching power supplies. The power supply for the instrument should be separated from these devices as much as possible.
・Avoid direct exposure to high-temperature heat sources and radiation sources. If installation near such sources is necessary, ensure there are heat insulation and ventilation measures in place.
・Avoid high humidity environments and areas with strong corrosive gases. If installation in such environments is unavoidable, ensure proper ventilation measures are implemented.
・Explosion-proof sensors and transmitters should be installed in hazardous locations, while associated equipment such as safety barriers, display instruments, power supplies, and computers must be installed in safe areas. The sensor and transmitter should have reliable grounding, and the explosion-proof grounding wire must not be shared with the protective grounding of the high-power electrical system.
・The flow meter should ideally be installed on pipes with minimal overhang, as sagging pipes can lead to sealing leaks between the flow meter and the flange. If installation on such pipes is necessary, support points should be placed at 2D upstream and downstream of the flow meter.
・The vortex flow meter should avoid installation on pipes with strong vibrations. If installation on such pipes is unavoidable, additional pipe fastening devices and anti-vibration pads, brackets, or flexible hoses should be installed at 2D upstream and downstream to enhance vibration resistance.
・It is best to install the instrument indoors. If it must be installed outdoors, take precautions against water, moisture, and sunlight. Special attention should be paid to forming the cable into a "U" shape at electrical interfaces to prevent water from entering the amplifier housing through the cable.



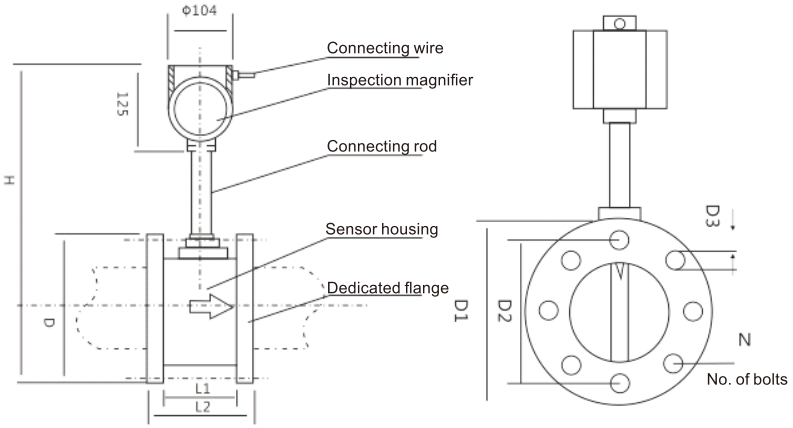
Wiring Diagram for Waterproof Connections

・The pipeline where the flow meter is installed must comply with the specified upstream and downstream straight pipe sections as outlined in this manual. Failure to do so may affect the measurement accuracy of the flow meter and, in severe cases, damage the flow meter.
・When installing the flow meter, it must not be on the pipeline during welding of flanges or pipes to prevent damage to the internal components of the flow meter.
・The flow meter can be installed on horizontal or vertical pipelines. If installed on a vertical pipeline and the measured medium is a liquid, the flow must move upward from the bottom.

・The flow meter should not be installed too close to the valve outlet, as the valve's operation may affect the lifespan of the flow meter and, in severe cases, damage it. To facilitate maintenance, a bypass pipeline should be installed, especially in processes where fluid flow cannot be interrupted.
・Before operating the flow meter, carefully check whether the installation and wiring are correct.
・After powering on, observe the LCD screen to check if there is a flow display.
・Slowly open the valve, taking no less than 2 minutes to do so. Stop at a low pressure and check for any leakage around the sensor, and observe whether there is a flow display on the LCD screen.
・If everything is normal, fully open the valve, allow it to stabilize, and then observe whether the flow displayed on the LCD screen is correct.
・The user must follow the instructions and warnings in this manual to ensure the correct and safe use of the instrument.

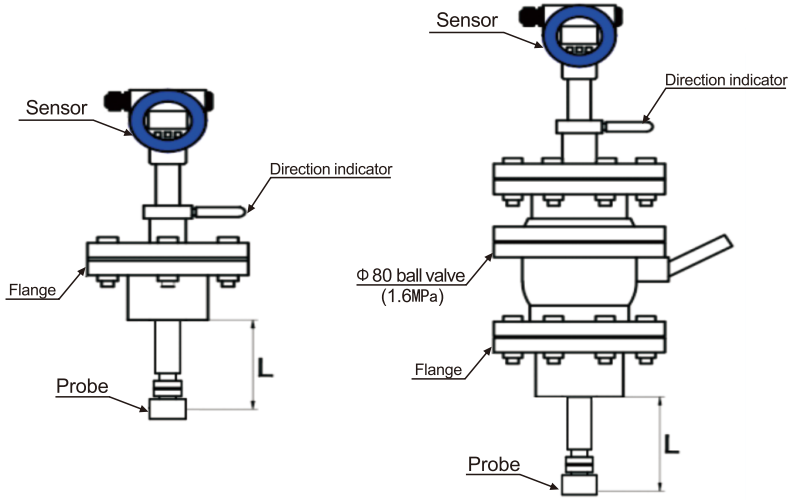
V. DIMENSIONS OF THE FLOW METER

5.1. Flanged Vortex Flow Meter Dimensions



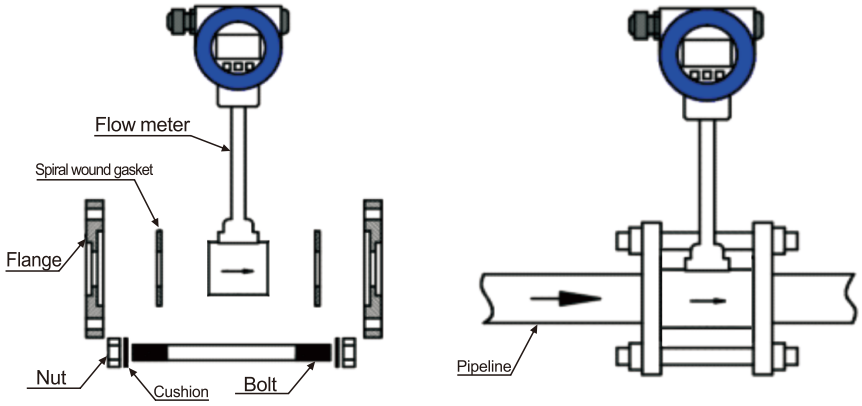
Caliber	L1	L2	D1	D2	H	D3	N
20	65	95	125	100	460	13	4
25	65	95	125	100	460	13	4
40	75	109	145	110	470	13	4
50	75	109	160	125	481	17	4
65	75	117	180	145	497	17	6
80	80	122	195	160	510	17	6
100	90	132	230	190	544	17	8
125	100	146	245	210	564	17	8
150	120	170	280	240	594	21	8
200	150	200	335	295	646	21	12
250	160	214	405	355	708	21	12
300	170	224	460	410	760	21	12

5.2. Insertion Vortex Flow Meter Dimensior



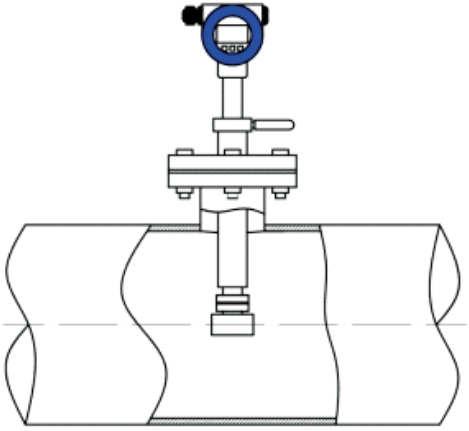
VI. INSTALLATION PRECAUTIONS

6.1. Piping Installation for Flanged Type



・Perform tack welding to position the flange and pipe.
・Remove the flow meter, weld the flange according to the requirements, and clean up all protruding parts inside the pipe.
・Install a sealing gasket with the same diameter as the pipe into the inner groove of the flange. Place the flow meter into the flange, ensuring that the flow direction indicator aligns with the fluid flow direction, and then tighten it securely with bolts.

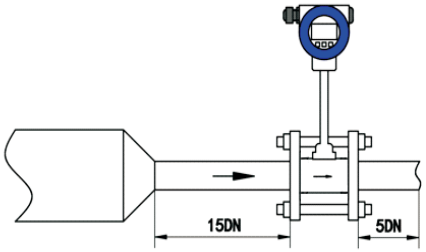
6.2. Installation of Insertion Vortex Flow Meter



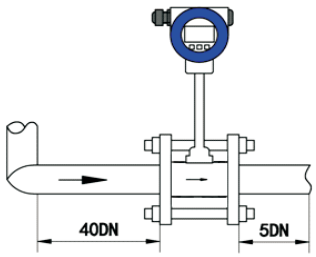
・Use gas welding to create a 90mm diameter circular hole in the pipe, and clean up any burrs around the hole to ensure smooth rotation of the probe. Weld the manufacturer-provided flange onto the pipe at the circular hole, ensuring that the flange axis is perpendicular to the pipe axis.
・Install the ball valve and sensor onto the welded flange.
・Ensure that the fluid flow direction aligns with the arrow indicated on the flow direction marker.
・Evenly tighten the fixing bolt nuts between the flange and the ball valve.
・Check that all connections are properly secured, then slowly open the valve and observe for any leaks (pay special attention to personal safety). If any leaks are detected, repeat the previous step.

6.3. Piping Installation Requirements for the Instrument

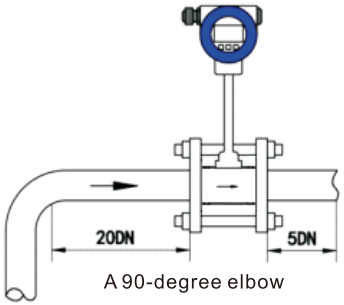
The vortex flow meter has certain requirements for the upstream and downstream straight pipe sections at the installation point. Failure to meet these requirements can affect the smooth flow of the medium in the pipeline and, consequently, the accuracy of the meter's measurements. The required lengths for the upstream and downstream straight pipe sections are as follows:



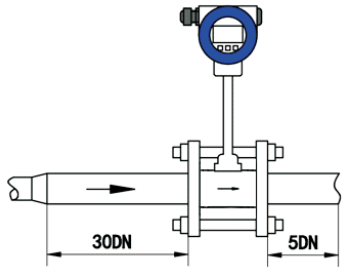
Fully open concentric reducing valve



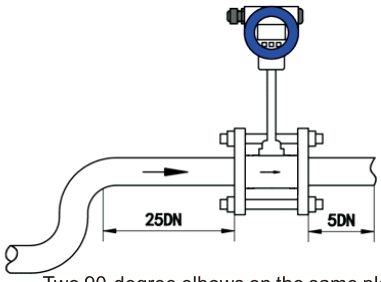
Two 90-degree elbows on different planes



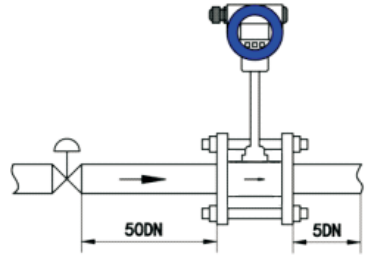
A 90-degree elbow



Concentric pipe expander



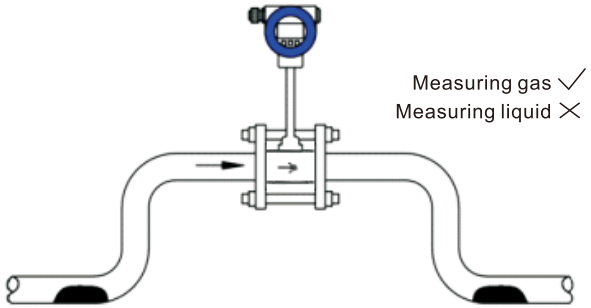
Two 90-degree elbows on the same plane



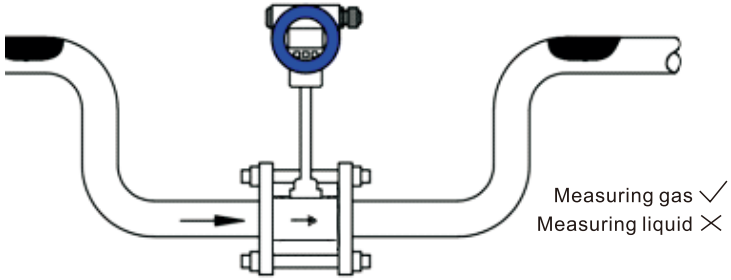
Partially open control valve (not recommended)

Note:

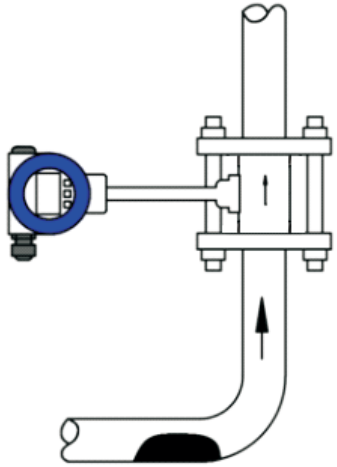
・DN refers to the nominal diameter of the instrument, in millimeters.
・The control valve should preferably not be installed upstream of the vortex flow meter but rather downstream at a distance of 10D from the meter. The inner diameters of the upstream and downstream piping should be the same as the flow meter's body diameter. If there is a difference, the inner diameter of the piping (Dp) and the body diameter of the vortex meter (Db) should satisfy the following relationship: $0.98Db < Dp \leq 1.05Db$.
・The upstream and downstream piping should be concentric with the flow meter body, and the misalignment between them should be less than 0.05Db.
・The sealing gasket between the meter and the flange should not protrude into the pipe during installation, and its inner diameter should be 1-2 mm larger than the body diameter of the meter.
・Installation of pressure and temperature measurement points: When temperature and pressure transmitters need to be installed on the measured pipeline, the pressure measurement point should be located 3-5D downstream, and the temperature measurement point should be 6-8D downstream.
・When measuring high or low-temperature media, insulation measures should be taken into consideration. The temperature inside the converter (within the housing) should generally not exceed 70°C. Low temperatures may cause condensation inside the converter, reducing the insulation resistance of the printed circuit board, which can affect the normal operation of the instrument.
・The instrument can be installed horizontally, vertically, or at an incline on the pipeline.
・On horizontal pipelines, when measuring gases that contain small amounts of liquid, the flow meter should be installed at a higher point in the pipeline, as shown in the diagram.



· On horizontal pipelines, when measuring liquids that contain small amounts of gas, the flow meter should be installed at a lower point in the pipeline, as shown in the diagram.



· On vertical pipelines, when measuring gas, the instrument can be installed in any direction of gas flow. However, if the pipeline contains small amounts of liquid, to prevent liquid from entering the meter's measuring tube, the gas flow should move from bottom to top. When measuring liquid flow, the liquid should flow from bottom to top, as shown in the diagram.



VII. INSTALLATION

7.1 Installation Requirements

(1) The installation site must be free from strong vibrations and strong magnetic interference. If there is significant vibration, vibration-damping measures should be taken, such as using vibration-damping supports or shock-absorbing rubber pads.
(2) The installation site should ensure convenient access for installation and maintenance operations.
(3) The installation site should not be filled with corrosive gases, and there should be no risk of flooding.
(4) For vortex flow meters with local displays, they should not be exposed to direct sunlight or extreme heat. If such conditions are present, necessary shading measures should be taken.
(5) The direction of the flow arrow on the vortex flow meter should align with the direction of fluid flow within the pipeline.
(6) When measuring liquids, it is essential to ensure that the pipeline is fully filled. If vertical installation is required, the fluid should flow from bottom to top.
(7) A flow control valve should not be installed upstream of the flow meter; instead, it should be placed downstream of the flow meter.
(8) The vortex flow meter should have sufficient lengths of straight pipe sections upstream and downstream, based on the conditions at the installation site.

7.2 Installation Methods

(1) Installation of Split-Type Vortex Flow Meter with Temperature and Pressure Compensation: When pressure or temperature compensation is required, a pressure transmitter and a temperature transmitter should be provided. The pressure tapping point should be positioned 3 to 5 DN downstream of the sensor, with a tapping hole diameter of 3 to 13 mm. The temperature measurement point should be located 6 to 8 DN downstream of the sensor.
(2) Flange-Clamped Vortex Flow Meter Installation: When installing a flange-clamped vortex flow meter on a pipeline, to ensure accurate and reliable installation, first connect the vortex flow meter to the clamping flange using bolts, and then weld the clamping flange to the pipeline. To prevent damage to the vortex flow meter due to excessive heat during welding, perform tack welding first, then remove the vortex flow meter before completing the welding.
(3) Bypass Pipe Installation: To facilitate maintenance and inspection, a bypass pipe can be installed. The bypass pipe should be located on the outside of the straight pipe sections upstream and downstream of the vortex flow meter to prevent interference with the flow meter's measurements.

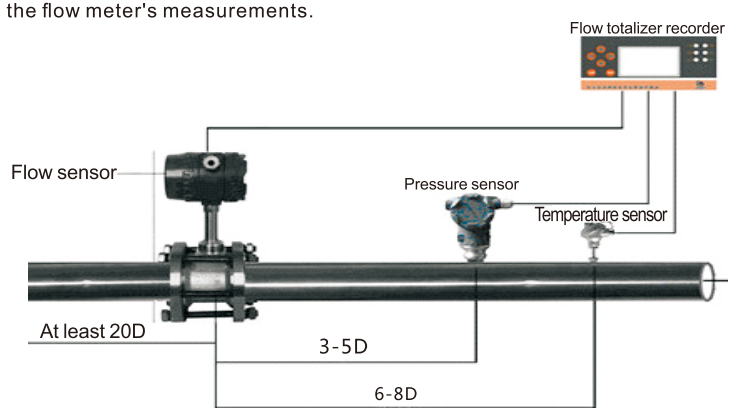


Figure 1: Illustration of Split-Type Installation with Temperature and Pressure Compensation

VIII. TERMINAL MARKING AND INSTRUCTIONS

8.1 4-20mA Two-Wire Circuit Wiring

Main Power Supply and Output Signal Terminal(Left-side 2-position lift-and-clamp terminal)

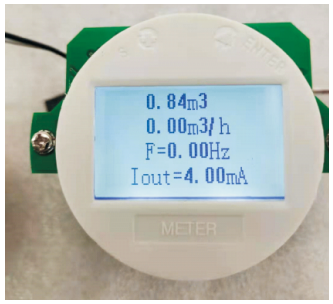
24V+	24V-

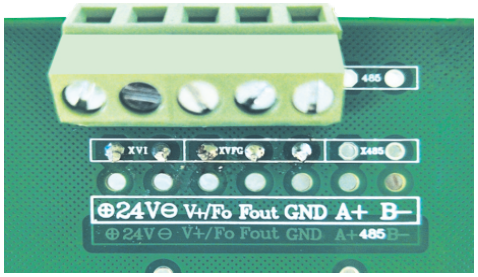
24V-: The 4-20mA current output terminal. **24V+**: The "+" terminal for 15-24V power supply. 24V+ is connected to the +24V external power supply, and the current output flows from the "24V-" terminal to the sampling resistor of the computer or display meter. After passing through the sampling resistor and other loads, the current returns to the "-" terminal of the power supply.

Pulse Wiring (3-position small terminal)

V+	FOUT	GND

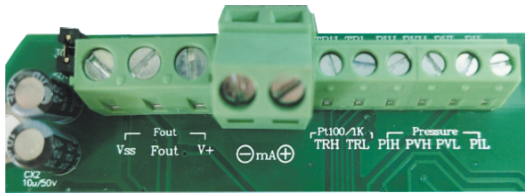
V+: Connect to the "+" terminal of the power supply (+12V). **Fout**: Pulse output signal terminal.
GND: Connect to the ground "-" terminal of the power supply.
This pulse output must be used while the main current loop is powered. The output is an uncorrected optically isolated raw pulse with 50Hz suppression, typically used during calibration. The output signal is an open-collector output with a 1.5kΩ pull-up resistor.





8.2 Three-Wire Circuit Wiring for Temperature and Pressure Compensation Pulse

Terminal Connections and Display Labels Explanation



Main Power Supply and Output Signal Terminal (Left-side 3-position lift-and-clamp terminal)

Vss	FOUT	V+	-mA	mA+

Vss: The "-" terminal of the power supply. **Fout**: Pulse output terminal.
V+: The "+" terminal for the external 12V~24V DC power supply.
When "V+" and "Vss" are connected to an external power supply, the circuit operates (for battery-powered types, it switches to active mode), and the pulse output is drawn from "Fout."

When collecting two-wire 4-20mA signals

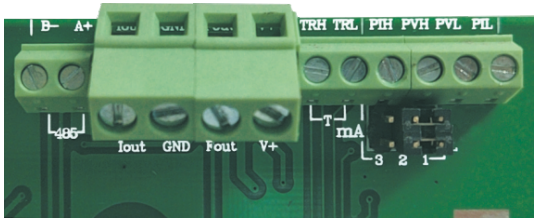
-mA: The 4-20mA current output terminal. **mA+**: The "+" terminal for the 15~24V power supply. **mA+** is connected to the +24V external power supply, and the current output flows from the "**-mA**" terminal to the sampling resistor of the computer or display meter. After passing through the sampling resistor and other loads, the current returns to the "-" terminal of the power supply.

Auxiliary Wiring (small terminal)
The dual-pin jumper between the main terminal and the auxiliary terminal acts as a battery switch; shorting the pins connects the circuit, while removing the jumper disconnects it.

+3V6	3V6-	CMB	CMA

1) Battery Wiring: (Rightmost 1st and 2nd positions of the small terminal)
+3V6: Connect to the "+" terminal of the 3.6V lithium battery. **3V6-**: Connect to the "-" terminal of the 3.6V lithium battery.
2) Communication Wiring: (Leftmost 1st and 2nd positions of the small terminal)
This terminal is not provided for models without RS485 communication.
CMB: Connect to the "-" terminal of the RS485 communication. **CMA**: Connect to the "+" terminal of the RS485 communication.

8.3 RS485 Circuit Wiring



B-	A+	IOUT	GND	FOUT	V+

B-: Connect to the "-" terminal of the RS485 communication.
A+: Connect to the "+" terminal of the RS485 communication.
IOUT: Connect to the "+" terminal of the 4-20mA current output.
FOUT: Connect to the "+" terminal of the pulse output.
V+: Connect to the "+" terminal of the 24V power supply.
GND: Connect to the "-" terminal of the 4-20mA signal output.
GND: Connect to the "-" terminal of the pulse signal output.
GND: Connect to the "-" terminal of the 24V power supply.

After the power is turned on, the instrument first performs a self-check. Once completed, it enters the primary display mode on Screen 1.

IX. INSTRUMENT INTERFACE INTRODUCTION

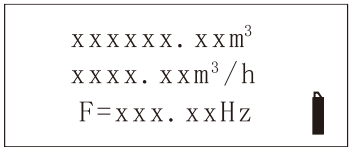


Figure 1: Three-Wire Operation Screen 1 Interface

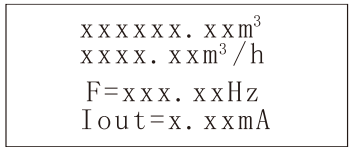


Figure 2: Two-Wire Operation Screen 1 Interface

First Line: Total Volume; displayed with two decimal places, with automatic decimal point carryover. The unit is consistent with the non-time portion of the instantaneous flow rate unit.
Second Line: Instantaneous Flow Rate; displayed with two decimal places. The flow rate unit details can be found in the menu settings.
Third Line: Flow Signal Frequency Value; displayed as F=XXXX.XXHz, with two decimal places.
Fourth Line: Output Current Value; displayed as I=XX.XXmA, with two decimal places (only for the 2W model).

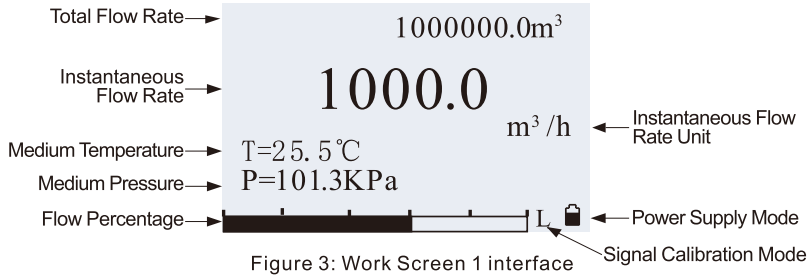


Figure 3: Work Screen 1 interface

In the three-wire mode, the bottom right corner shows the battery level indicator. When the instrument is powered by a battery, the battery level is displayed.

Press the "<" key or the "+" key to switch between Work Screen 2 and Work Screen 1, and press the "S" key or the "E" key to switch between Work Screen 2 and Work Screen 1.

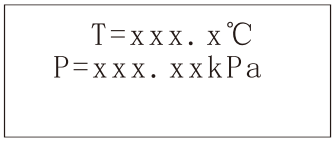


Figure 4: Work Screen 2 Sub-interface

First Line: Temperature Setting Value; used for temperature compensation calculations. Displayed as T=999.9°C, with one decimal place.
Second Line: Pressure Setting Value; used for pressure compensation calculations. Displayed as P=99999.99kPa, with two decimal places.
Third Line: Password for entering the setting mode.

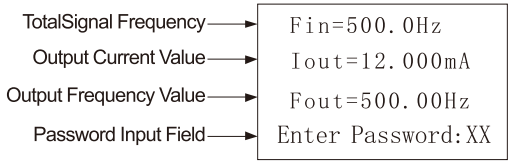


Figure 5: P Work Screen 2 Sub-interface

X. MENU INSTRUCTIONS

10.1 Four-Button Operation Instructions

10.1.1 Password: User menu password is 2010.
10.1.2 User Parameter Settings:
- Press the "**S**" key to exit the input mode.
- Press the "**E**" key to confirm and save the input.
- Press the "**+**" key to cycle through and change the value or symbol at the cursor position.
- Press the "**<**" key to move the current input cursor one position to the right.
- You can input a maximum of 8 characters (including symbols and decimal points).

10.1.3 Menu Operation:
During menu navigation:
- Press the "**+**" key to scroll down. - Press the "**<**" key to scroll up.
- Press the "**E**" key to enter a submenu.
- Press the "**S**" key to return to the Work Screen 2 interface.

In the submenu: - Press the "**S**" key to exit.
- Press the "**E**" key to enter edit mode.
- In edit mode, to modify a selection, press the "**+**" key to move down the options or the "**<**" key to move up the options, then press the "**E**" key to confirm.
- If editing an input field, follow the standard input procedure.

10.2 Two-Button Operation Instructions

10.2.1 Password: User menu password is 22.
10.2.2 User Parameter Settings:
- Press the "**S**" key to modify parameters.
- Press the "**E**" key to move the cursor.
- Long press the "**S**" key to exit the input mode.
- Long press the "**E**" key to confirm.

Note: When setting parameters, the displayed content must be confirmed by pressing the "E" key for it to be saved; otherwise, the settings will be invalid.

10.3. User Menu Instructions

Enter the password to access the user menu. The functions and parameter meanings for each menu are as follows:

No.	Menu Name	Function Description
1	Unit Selection Default: m³/h	Set the instantaneous flow rate unit based on the selected flow algorithm type. Options: Volume-based: m³/h; m³/m; l/h; l/m Mass-based: t/h; t/m; kg/h; kg/m
2	Algorithm Selection Default: Conventional Volume Flow	Set the flow algorithm. The instrument compensates the measured instantaneous flow rate according to the selected algorithm. Options: Conventional Volume Flow (for non-specific gas or liquid flow conditions) Conventional Mass Flow (must set working density) Standard Condition Gas Volume Flow Conventional Gas Mass Flow (must set standard condition density) Saturated Steam Temperature Compensation Saturated Steam Pressure Compensation Superheated Steam Temperature and Pressure Compensation Specific Algorithm (for user customization)

3	Flow Coefficient Default: 3600.0	Flow coefficient required for calculating flow. Unit: P/m³ (pulses per cubic meter).
4	Density Default: 1000.0	Set the fluid density value. Unit: kg/m³ (cannot be set to 0). This value is necessary for mass-based algorithms and is not used for volume-based algorithms.
5	Full-Scale Flow Default Value: 1000.0	Set the instantaneous flow rate corresponding to the 20mA current output (cannot be set to 0). The unit must match the unit selected in "Unit Selection."
6	Lower Limit Cutoff Flow Default Value: 0%	Set the percentage of full-scale flow for the cutoff flow. When the actual measured flow is below this percentage, the flow rate is calculated as 0, and 4mA current is output.
7	Upper Limit Alarm Flow Default Value: 990.0	Set the upper limit alarm flow threshold. When the flow rate exceeds this value, an alarm is triggered. The unit is the same as the selected unit.
8	Lower Limit Alarm Flow Default Value: 10.0	Set the lower limit alarm flow threshold. When the flow rate falls below this value, an alarm is triggered. The unit is the same as the selected unit.
9	Damping Time	Set the value between 2 to 32 seconds for smoothing the display and current output. The default value is 4 seconds.
10	Communication Address	Set the 485 Modbus device address, range 0-254. The default value is 0.
11	Clear Total Volume	Clear the total volume to 0. The reset password is "70".

Note: When setting parameters, the displayed content must be confirmed by pressing the "E" key for it to be saved; otherwise, the settings will be invalid.