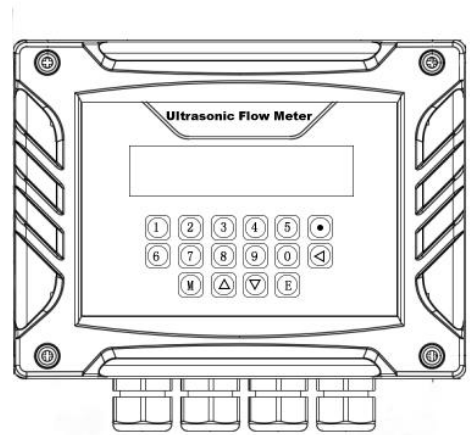
User Manual

Wall-Mounted Ultrasonic Flowmeter

U-004CSF-EN1



Preface

- Thank you for purchasing our product.
- This manual is about the various functions of the product, wiring methods, setting methods, operating methods, troubleshooting methods, etc.
- Please read this manual carefully before operation, use this product correctly to avoid unnecessary losses due to incorrect operation.
- After you finish reading, please keep it in a place where it can be easily accessed at any time for reference during operation.

Note

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

Version

U-004CSF-EN1

Safety Precautions

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

About this manual

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

Precautions for product protection, safety, and modification

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

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

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

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

- Please check the grounding protection regularly. Do not operate the product if you think that the protection, such as grounding protection and fuses, is inadequate.
- Ventilation holes on the product housing must be kept clear to avoid malfunctions due to high temperatures, abnormal operation, shortened life, and fire.
- Please strictly follow the instructions in this manual; failure to do so may damage the product's protective devices.

- Do not use the instrument if it is found damaged or deformed upon opening the package.
- Prevent dust, wire end, iron fines, or other objects from entering the instrument during installation, as this may cause abnormal operation or failure.
- During operation, to modify the configuration, signal output, startup, stop, and operation safety shall be fully considered. Improper operation may lead to failure and even destruction of the instrument and control equipment.
- Each part of the instrument has a certain service life, which must be maintained and repaired on a regular basis for long-term use.
- If the product comes to the end of its service life, it should be disposed of as industrial waste as a way of environmental protection.
- Disconnect the instrument when it is not in use.
- If you find smoke from the product, smell odor, abnormal noise, etc., please turn off the power switch immediately and contact the company in time.

Disclaimer

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

No.	Items	Quantity	Note
1	Wall-mounted ultrasonic flowmeter (main unit)	1	
2	Ultrasonic flow sensors	2	
3	5-meter cables	2	Longer lengths available
4	Power cable	1	
5	Silicone gel	1	
6	Steel straps for DN500	2	Wire ropes are provided for diameters above DN500
7	Installation accessory kit	1	
8	User manual	1	
9	Certificate	1	

After opening the box, please confirm the scope of delivery before starting the operation. If you find that the model and quantity are incorrect or there is physical damage to the product's appearance, please contact us.

Contents

1 Introduction

1.1 Overview

The wall-mounted ultrasonic flowmeter is suitable for continuous flow measurement of most single-phrase hoomogeneous liquids that do not contain high concentrations of suspended particles or air bubbles in industrial environments. It supports heat energy totalizing functions, which can be enabled by adding a pair of temperature sensors to the basic ultrasonic flowmeter to calculate thermal energy. This product is widely used in industries such as petroleum, chemical engineerign, electric power, food processing, and other industrial sectors.

Installation Types

There are two installation types: clamp-on and insertion types.

- **Clamp-on Ultrasonic Flowmeter**: require no interruption to the pipeline during installation—sensor are simply attached to the outer surface of the pipe, making the installation quick and convenient. This setup reflects the simplicity and ease of operation that ultrasonic flowmeters are known for.
- **Insertion ultrasonic flowmeters**: can also be installed without shutting down the pipeline. Using specialized tools, holes are drilled into the pressurized pipe, and the sensors are inserted into the pipe to complete the installation. Since the sensors are placed directly in the fluid, their transmitted and received signals pass only through the measured medium, without going through the pipe wall or lining. Therefore, measurement results are unaffected by the pipe wall or lining materials.

1.2 Measuring Principle

Ultrasonic flow meters measure flow based on the Transit-Time Difference Method. This method utilizes two ultrasonic sensors mounted to transmit and receive signals in opposite directions through the fluid medium. By measuring the difference in the propagation time of ultrasonic waves traveling with the flow (downstream) and against the flow (upstream), the fluid velocity is determined indirectly. The volumetric flow rate is then calculated based on this velocity and the pipe's cross-sectional area.

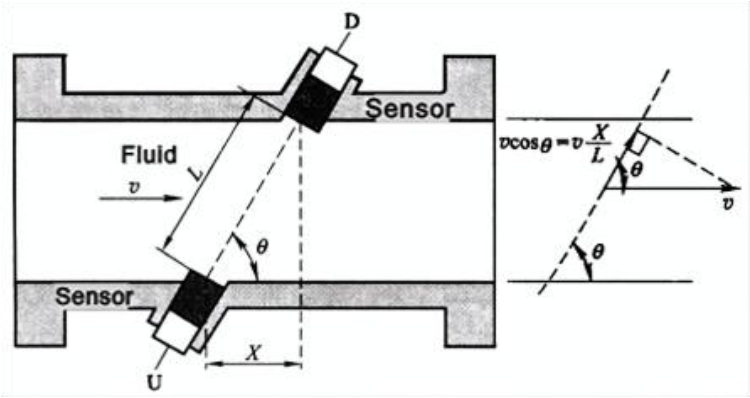


Fig.1

The flow velocity of the fluid between the upstream sensor (U) and the downstream sensor (D) can be calculated using Equations (1) and (2):

$$t_{ud} = \frac{L}{C + V_i \cos\theta}$$

$$t_{du} = \frac{L}{C - V_i \cos\theta}$$

By solving Equations (1) and (2), the average flow velocity and the sound speed C can be derived as:

$$v_i = \frac{L}{2\cos\theta} \times \frac{t_{du} - t_{ud}}{t_{du} t_{ud}} = \frac{L^2}{2X} \times \frac{t_{du} - t_{ud}}{t_{du} t_{ud}}$$

$$C = \frac{L}{2} \times \frac{t_{du} + t_{ud}}{t_{du} t_{ud}}$$

Where:

t_{du} — Transit time of the ultrasonic pulse from the upstream sensor (U) to the downstream sensor (D);

t_{ud} — Transit time of the ultrasonic pulse from the downstream sensor (D) to the upstream sensor (U);

L — Acoustic path length between the upstream and downstream sensors;

X — Axial distance between the upstream and downstream sensors;

v_i — Average flow velocity of the fluid;

θ — Acoustic propagation angle relative to the flow axis.

1.3 Features

- Applicable for a wide measurements of all pie flow.
- Features low starting flow, high measurement accuracy, and no pressure loss.
- Non-intrusive measurement unaffected by temperature, pressure, or fluid composition.
- Installation does not require pipe cutting, making it quick and easy without damaging the pipeline—an economical and efficient flow measurement solution.
- The wall-mounted remote transmitter can be installed on surfaces, inside distribution boxes, or instrument enclosures, enabling convenient long-term monitoring at fixed locations.
- The product also supports thermal energy measurement. By installing temperature sensors on both the supply and return pipes, it can measure heat consumption.

2 Technical Parameters

Table 1

Performance parameters		
Measured variables	Directly measured variable: Flow rate Calculated measured variable: Volume flow	
Typical flow rate range	0.3m/s~10m/s	
Nominal diameter	Clamp-on type: DN50~DN700 Insertion type: DN50-DN6000	
Accuracy	±1 %	
Resolution	0.001m/s	
Repeatability	0.2 %	
Operating frequency	100Hz	
Response time	0.2s	
Output		
Transmitter output	Output Type	(4~20)mA
	Output accuracy	0.1% FS
	Output Load	<500Ω
Communication output	Output Type	RS485
	Communication	MODBUS
Frequency/pulse output	Pulse Width	Self-adaptive
	Pulse coefficient	Configurable
Electrical specifications		
Power supply	AC: (85-265) V DC: (10~30) V	
Power consumption	1.5W	
Electrical interface	M20*1.5	
Process conditions		
Medium temperature	-30℃-90℃	
Environmental conditions		
Ambient temperature	-20℃-60℃	
Storage temperature	-40℃-80℃	
Protection level	IP65	

3 Structure and Dimensions

3.1 Measuring System

The measuring system of the ultrasonic flowmeter is composed of a transmitter (main unit) and a pair of sensors. The sensors are available in two types: clamp-on and insertion type, as shown in figure 2.

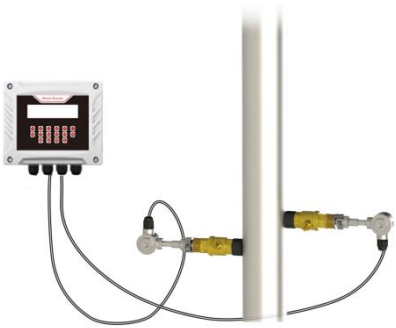
Clamp-on	Insertion
	

Fig.2 Measuring system

3.2 Dimensions

3.2.1. Dimensions of Main Unit

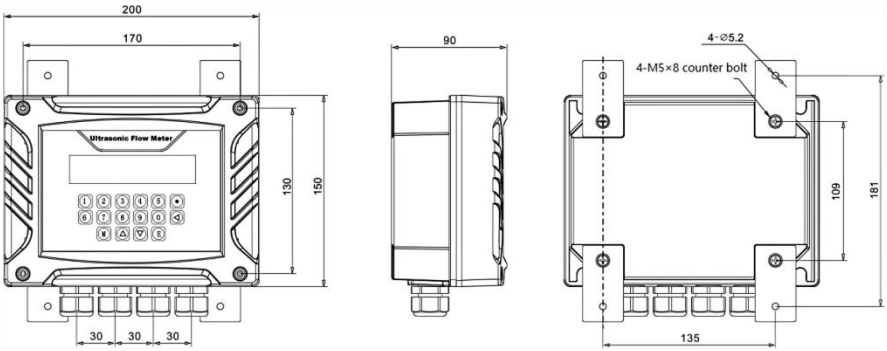


Fig.3 Main unit dimensions (unit: mm)

3.2.2. Clamp Type Dimensions

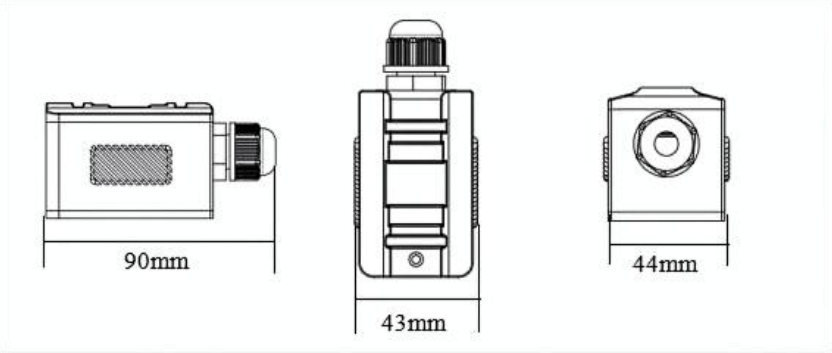


Fig.4 Dimensions

3.2.3. Insertion Type Dimensions

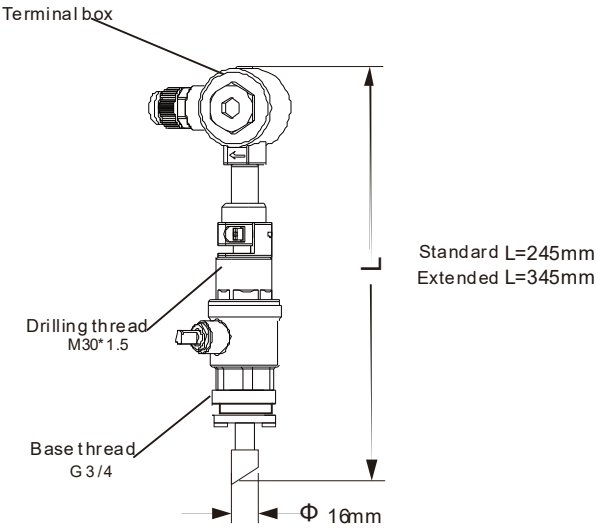


Fig.5 Dimensions

3.3 Material

Main unit: cast aluminum + engineering plastics

Clamp-on sensor : ABS engineering plastic (stainless steel optional)

Insertion sensor: 304 stainless steel

3.4 Weight

Main unit: 1.35kg

Clamp sensor : 0.2kg

Insertion sensor: Standard: 1.85kg

Extended type: 2kg

4 Installation

4.1 Upcoming and Unpacking

The standard items included with the ultrasonic flowmeter upon delivery are: the main unit, sensors, dedicated cables, silicone grease, a bag of hex key accessories, sensor fastening steel straps, and the user manual.

Users need to prepare the following tools themselves for installation: flathead screwdriver, Phillips screwdriver, utility knife, needle-nose pliers, measuring tape, positioning paper, angle grinder, etc.

4.2 Installation of the Main Unit

4.2.1. Installation Requirement

- The main unit should be away from interference source, such as high-voltage power lines and frequency converters.
- If the main unit is installed directly outdoors, its operating environment should be carefully considered.
- The installation should comply with the specified technical requirements and protection rating. Avoid exposing the main unit directly to outdoor conditions or direct sunlight, as this may shorten the lifespan of the LCD screen.
- The recommended installation height for the main unit is between 1.5 and 1.8 meters to facilitate observation.
- The distance between the main unit and the sensors should be as short as possible and should not exceed 200 meters.

4.2.2. Installation Method

The main unit of the ultrasonic flowmeter adopts wall-mounting way. Its installation dimensions is below:

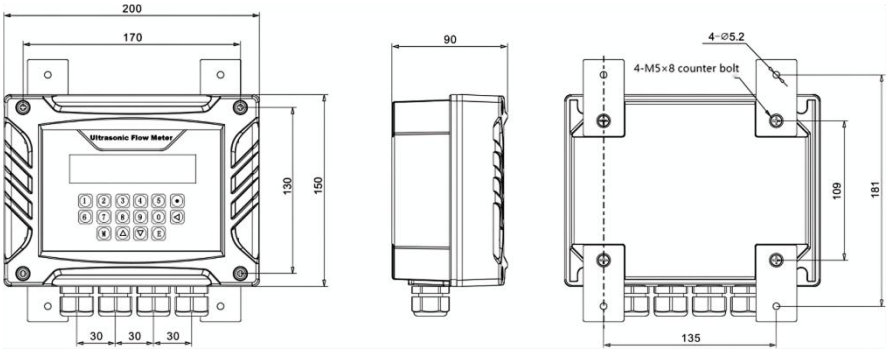


Fig.6 Main unit installation (unit: mm)

4.3 Installation Sites

Correct installation sites holds the key of measurement accuracy. The following factors should be considered into account: full pipe, stable flow, vibration, buildup, temperature, pressure, electromagnetic interference and among others.

(1) Full pipe

The following installation site can ensure the full pipe, and is therefore recommended.

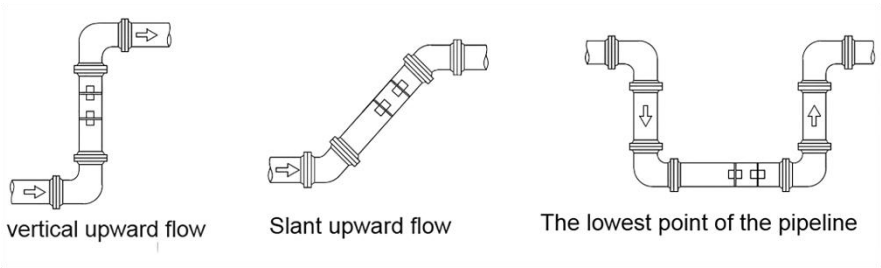


Fig.7 Full pipe installation site

(2) Stable flow

Stable flow facilitates the measurement accuracy, while the turbulent flow may disrupt the measurement readings.

The requirements of the stable flow

- To ensure steady flow, the pipeline should be kept away from pump outlets and partially open valves, with a straight pipe run of at least 10D upstream

and 5D downstream (D refers to the outer diameter of the pipe).

- The flowmeter should be installed at least 30D away from pump outlets or partially open valves.

Situations satisfying the requirements of ensuring stable flow：

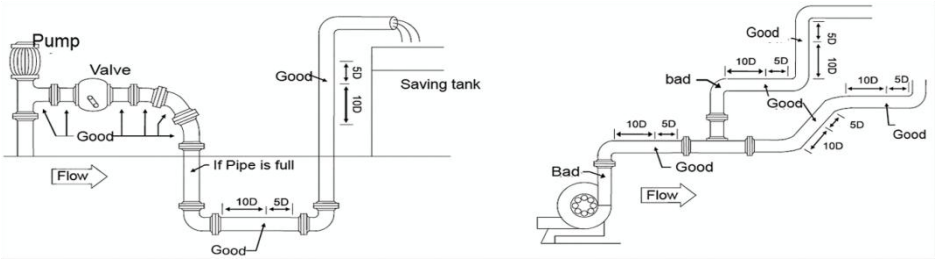


Fig.8 Installation sites for stable flow

(3) Vibration

Strong vibration should be avoid alongside the pipe of installation site; otherwise reinforcement is required.

(4) Buildup

The buildup inside the pipe slow the transmission of the ultrasonic signals and shorten the inner diameter of the pipe. The pipes with inside buildup may result in the malfunction of the flowmeter or influence the measurement accuracy. Therefore, Therefore, avoid selecting installation points where scaling is present inside the pipe.

(5) Temperature

The fluid temperature of installation site is required to be within he operating range of the sensor. Site with low temperature is preferred. In this sense,avoid installing the sensors at boiler outlets or heat exchanger outlets. Whenever possible, install them on the return water pipeline.

(6) Electromagnetic Interference

The main unit, sensors, and signal cables of the ultrasonic flowmeter are susceptible to electromagnetic interference from sources such as frequency converters, radio stations, TV stations, microwave communication stations, GSM base stations, and high-voltage power lines. Therefore, the installation points of the

sensors and the main unit should be kept away from such sources. The main unit housing, sensors, and the shielding layer of the ultrasonic cables must all be grounded. Do not power the flowmeter using the same power source as a frequency converter; use an isolated power supply for the main unit instead.

4.4 Installation and Commissioning of Clamp-on Sensors

Before installation, verify that the pipeline and fluid parameters are correctly set to ensure proper installation.

Installation procedure:

Select installation method→Input measurement parameters→Locate installation point→Prepare pipe surface→Install sensors→Secure sensors→Verify installation

4.4.1. Installation Methods

There are two installation methods for clamp-on sensors: the V-method and the Z-method.

(1) The V-method

For pipelines with diameters ranging from DN15mm to DN200mm, the V-method is preferred. During installation, the two sensors should be aligned horizontally, with their centerlines parallel to the axis of the pipe. Ensure that the transmission directions of the sensors face each other.

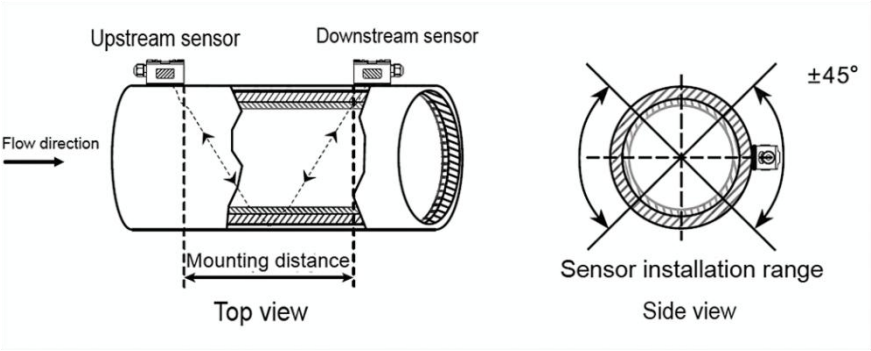


Fig.9 V-method installation

(2) The Z-method

For pipelines with diameters greater than DN200mm, the Z-method is preferred. It can also be used when the V-method fails to receive signals or yields poor signal

quality. During installation, ensure that the vertical distance between the two sensors along the pipe axis equals the specified installation spacing, and that both sensors are positioned on the same axial plane. Additionally, make sure the transmission directions of the sensors face each other.

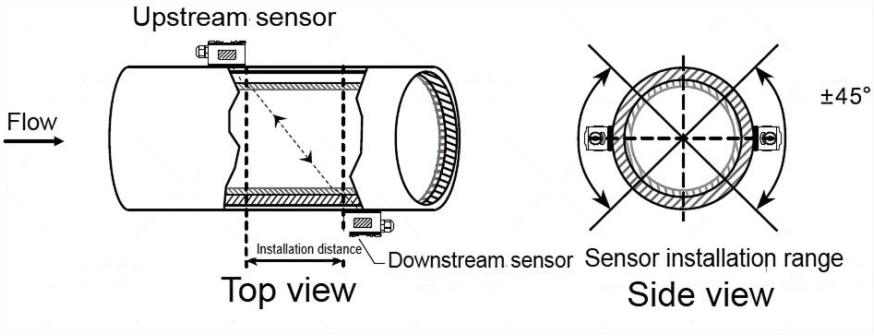


Fig.10 Z-method installation

4.4.2. Setting Installation Distance

A quick way to complete the initial setup is to configure the pipe size, medium, sensor type, and installation method via menus 10 to 24. Based on these settings, the sensor installation spacing (unit in mm) will be calculated and displayed in menu 25.

4.4.3. Deciding the Installation Site

(1) The V-method

The line connecting the upstream and downstream sensor installation points should be parallel to the pipe axis, and the distance between them should match the installation spacing displayed on the main unit. As shown in the figure: points A and B are the required installation positions to be located.

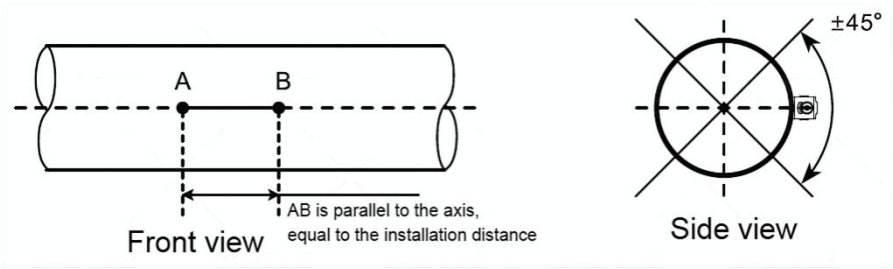


Fig.11 V-method installation site determination

(2) The Z-method

① According to the installation distance provided by the host device, first determine two installation points A and C on the same side of the pipe. The line AC connecting the two points should be parallel to the pipe axis, and the distance between A and C equals the installation distance.

② Install the downstream sensor by extending a length equal to half the pipe's circumference along the vertical direction of the pipe axis from point C to obtain point B.

③ Use a soft ruler to measure the distances from point A to B and from point C to B, obtaining lengths AB_1 and AB_2.

If $AB_1 = AB_2$, it indicates that point B is accurately located. Otherwise, adjust the positions of points C and B until the distances are equal.

④ As shown in the figure, A and B are the determined installation points for the upstream and downstream sensors.

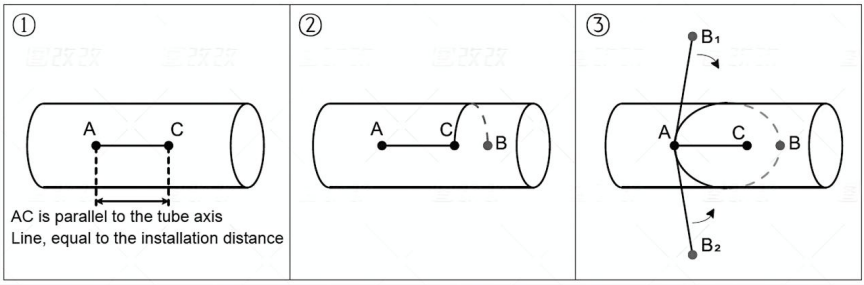


Fig.12 The Z-method site determination

4.4.4. Surface Treatment of Designated Mounting Points

For the determined installation points, it is necessary to remove paint, rust, and anti-corrosion coatings. It is best to use a grinder to polish the surface to a metallic luster, and then wipe away oil stains and dust, as shown in the diagram below.

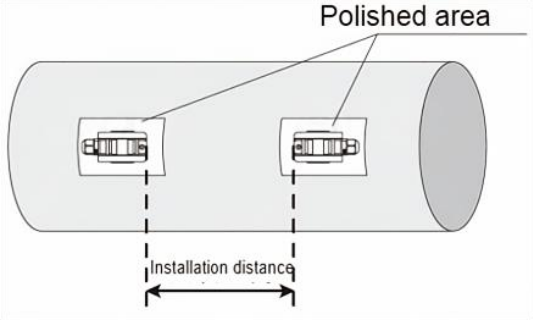


Fig.13

4.4.5. Sensor Installation

After completing the sensor wiring and sealing, apply a 2–3 mm thick, even layer of the supplied coupling agent to the sensor's transmitting surface. Then, mount the sensor onto the prepared pipe surface according to the specified installation distance, and secure it in place using a steel band or wire rope.

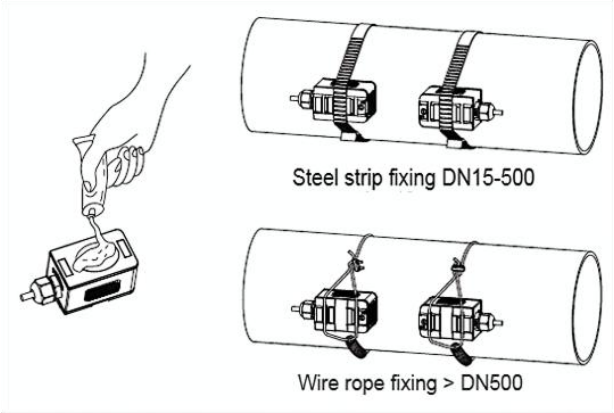


Fig.14

4.4.6. Post-installation Check

Refer to 4.6 post-installation check

4.5 Insertion Sensor Installation and Commissioning

Before installation, please check that the pipe parameters and fluid parameters are set accurately to ensure the correctness of the installation. Installation procedure: Select installation method → Enter measurement parameters → Locate installation points → Secure ball valve base → Perform under-pressure drilling → Install and commission sensors → Inspect the installation.

4.5.1. Installation Method

Insertion sensors can be installed in two ways: V method and Z method. Z method is preferred, but V method is used when installation space is insufficient.

(1) The V method

The V method can be used for pipes from DN50mm to DN 300mm. When installing, the two sensors should be aligned horizontally with their center lines parallel to the axis of the pipe. Note that the emission directions must be relative .

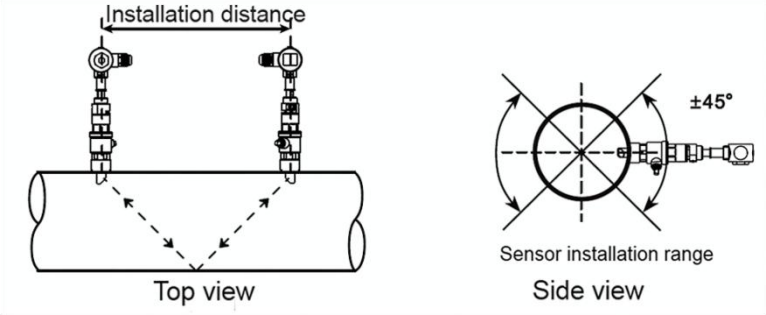


Fig.15 V method installation diagram

(2) The Z method

Pipes with a diameter of DN50 mm or above can adopt z-method. During installation, the vertical distance between the two sensors along the pipe axis is required to be equals the specified installation distance, and that both sensors are positioned on the same axial plane. Also make sure their transmitting directions face each other.

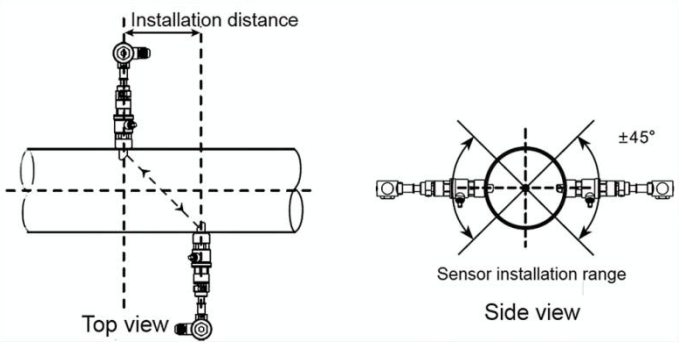


Fig.16 Z method installation diagram

(3) Parallel Insertion

If space is insufficient, or installation from the top pipe is necessary, parallel insertion of the sensor is feasible as long as the diameter≥DN300.

The following three points should be ensured:

- Installation distance:
- The two sensors should be guaranteed on the one level, the insertion depth is the inner diameter of 1/3.
- The distance between the the two sensors is settable for users, 3000mm~5000mm is recommended.

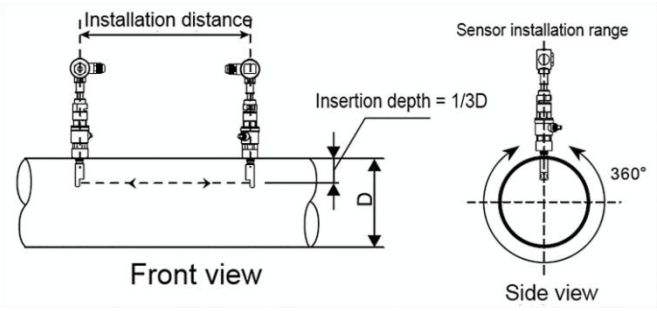


Fig.17 Parallel Insertion

4.5.2. Setting Installation Distance

Parameter configuration is needed before measurement. A quick way to complete the initial setup is to configure the pipe size, medium, sensor type, and installation

method via menus 10 to 24. Then, based on the previously entered parameters, the installation spacing of the sensors (in mm) will be provided in menu 25.

4.5.3. Sensor Installation Point Positioning

(1) The V-Method

The line connecting the upstream and downstream sensor installation points should be parallel to the pipe axis, and the distance between them should match the installation spacing displayed on the host unit. As shown in the diagram, points A and B represent the installation points to be located.

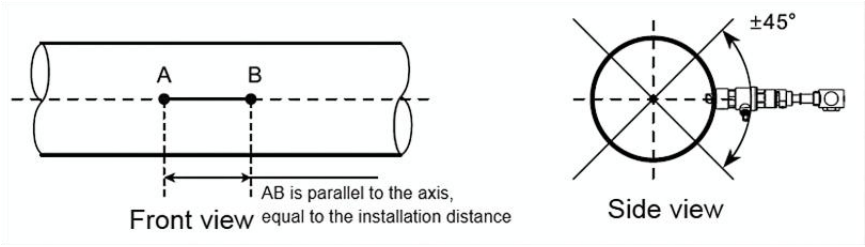


Fig.18 V method installation location

(2) The Z-Method

① According to the installation distance provided by the host device, first determine two installation points A and C on the same side of the pipe. The line AC connecting the two points should be parallel to the pipe axis, and the distance between A and C equals the installation distance.

② Install the downstream sensor by extending a length equal to half the pipe's circumference along the vertical direction of the pipe axis from point C to obtain point B.

③ Use a soft ruler to measure the distances from point A to B and from point C to B, obtaining lengths AB_1 and AB_2.

If $AB_1 = AB_2$, it indicates that point B is accurately located. Otherwise, adjust the positions of points C and B until the distances are equal.

As shown in the figure, A and B are the determined installation points for the upstream and downstream sensors.

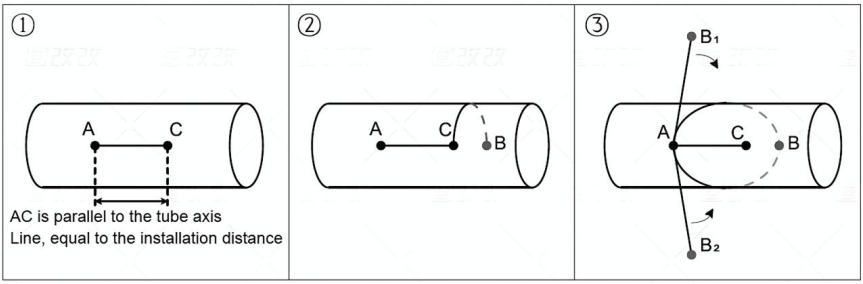


Fig.19 Z method installation location

4.5.4. Fixing the Ball Valve Base

(1) Welding the Ball Valve Base

For carbon steel pipes, the ball valve base can be directly welded onto the pipe. During welding, the center of the ball valve base must align precisely with the previously marked sensor installation point.

Welding precautions:

① Remove the PTFE sealing gasket inside the base before welding.

② Clean the pipe surface around the welding area thoroughly before welding. Avoid any air pockets during welding to prevent leakage and ensure adequate welding strength.

③ Prevent welding slag from falling onto the internal threads of the base.

④ Take care to avoid deformation of the base during welding.

⑤ After welding, firmly screw the ball valve into the base, ensuring the sealing gasket is tightly compressed.

(2) Fixing the Ball Valve Base with a Pipe Clamp

For pipes that cannot be welded directly—such as cast iron pipes, concrete pipes, copper pipes, or composite pipes—a custom pipe clamp must be used. When installing the clamp, ensure that the center of the base welded on the clamp aligns with the marked installation point. Make sure the clamp’s sealing gasket is tightly compressed to prevent water leakage.

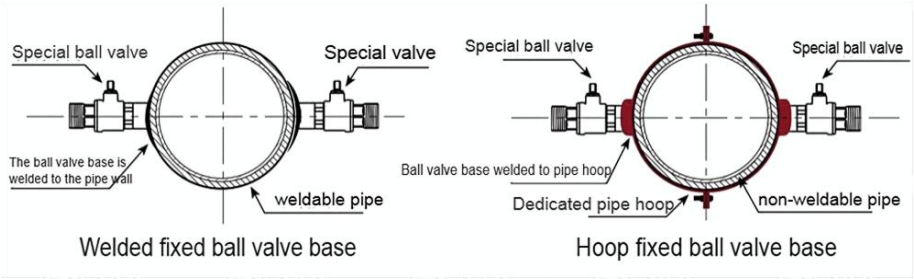


Fig.20 Fixing ball valve base

4.5.5. Drilling

After completing the installation of the base and the ball valve, connect the drilling device sealing sleeve to the external thread of the ball valve. Tighten it, open the ball valve, and push the drill rod straight to contact the pipe outer wall. Attach the electric drill to the drill rod and tighten it securely. Turn on the power to start drilling. During the drilling process, keep the drill at low speed and avoid excessive speed to prevent the drill bit from breaking. Once drilling is complete, withdraw the drill rod until the end of the drill bit is retracted into the ball valve core. Close the ball valve and remove the drilling device.

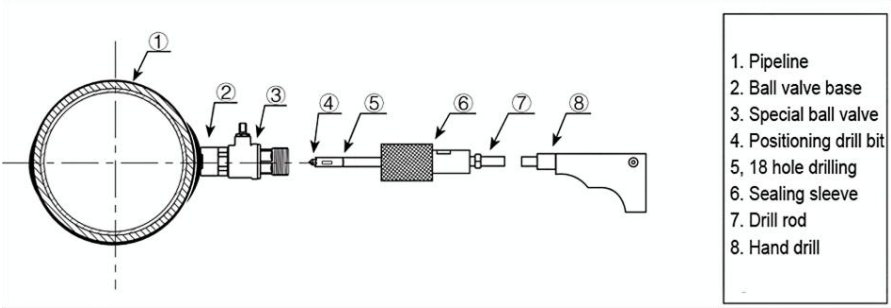


Fig.21 Drilling

4.5.6. Installation of Commissioning Sensor

Adjust the insertion depth and transmitting direction to obtain a good ultrasonic receiving signal. Once the insertion depth is set, align the transmitting direction. An arrow indicating the ultrasonic transmitting direction is marked on the sensor's

junction box. The transmitting directions of the upstream and downstream sensors should face each other ("→ ←") and be parallel to the pipe axis.

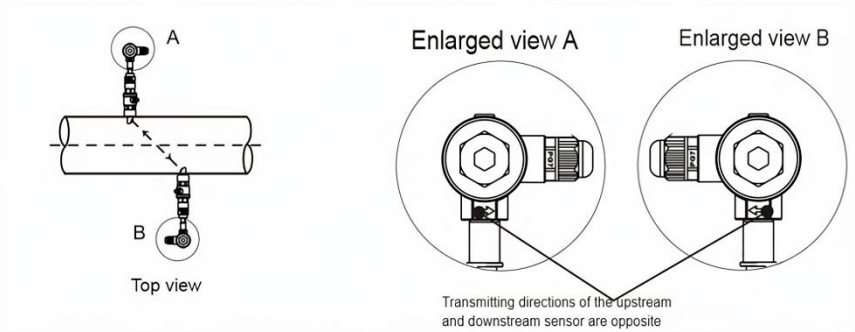


Fig.22 Adjusting transmitting direction

Operating procedures:

① Adjust the insertion depth scale, then screw the threaded adapter nut into the ball valve and tighten it.

② Open the ball valve, push the upstream probe rod in place, adjust the transmitting direction to be parallel to the pipe axis, and point it toward the installation position of the downstream probe. Once aligned, lock it in place.

③ Install the downstream probe following the same steps. Adjust the transmitting direction to optimize signal strength and quality. Then, check the transmission time ratio (M91); if it falls within the range of 97%–103%, tighten the probe rod and lock it with the screw. If it does not meet the requirement, adjust the insertion depth and transmitting direction up or down until the measurement criteria are satisfied.

4.5.7. Post-Installation Check

Refer to 4.6 post-installation check

4.6 Post-Installation Check

- Signal strength, signal quality (Q value), and the ratio of measured to theoretical transmission time are three important parameters to check whether the installation is correct.
- During installation, please note that the higher the signal strength and Q

value, the better. High signal strength and Q value facilitate long-term stable operation of the flowmeter and improve measurement accuracy.

Table 2 Installation result judgement

Signal strength, Q value	Installation result judgment
Below 60	Not working properly
60~75	The signal is poor and barely meets the working conditions
75~80	The signal is good and can ensure working status
80 and above	Excellent signal

- The M91 window displays the transmission time ratio (which should be 100% ±3% under normal operating conditions). if this value outside the range, it indicates incorrect parameter settings or installation distance. Please check both accordingly.

4.7 Installation Precautions

- Signal cables should be routed through cable trays or conduits, and must not run parallel to power or high-voltage cables. If parallel routing is necessary, it is recommended to place the signal cable in a separate conduit and ensure a vertical separation of at least 500 mm from power cables.
- After installation, be sure to clean up the site.

5 Electrical Connection

5.1 Connection Terminals

The terminals of the ultrasonic flowmeter is shown as below:

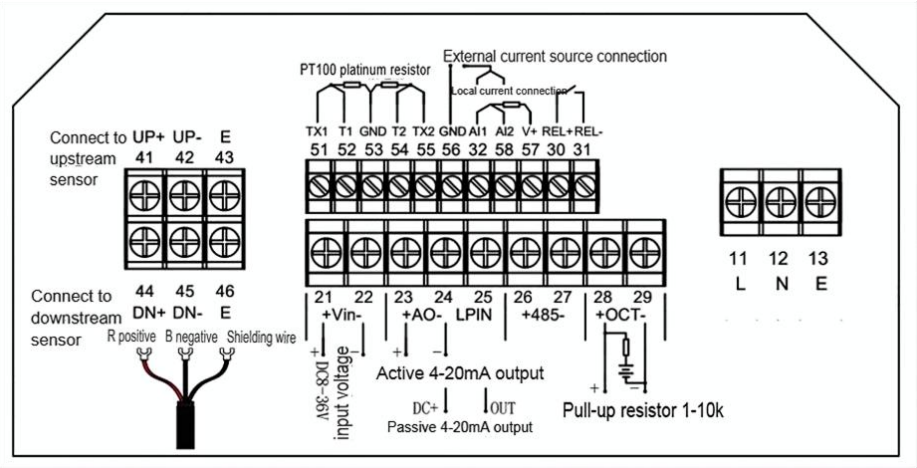


Fig.23

5.2 Signal Cable Connection

The host and sensors are connected via a dedicated two-core cable provided by us. Since the signals transmitted by the ultrasonic sensors are prone to attenuation and interference, it is essential to use only the dedicated cables we provide and ensure that both cables are of equal length. Please make sure to distinguish between the upstream and downstream sensors: connect the UP port to the upstream sensor and the DN port to the downstream sensor.

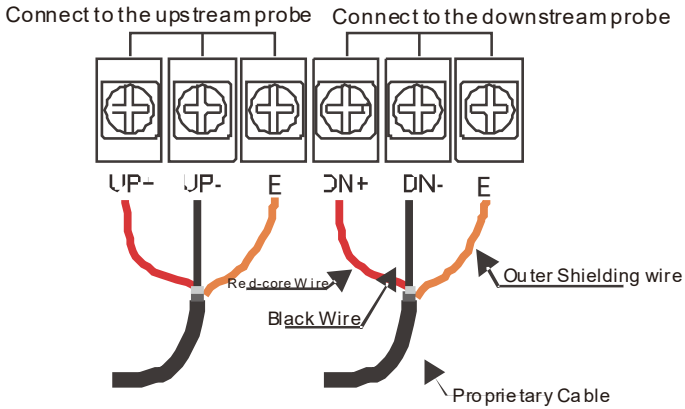


Fig.24 Sensor connecting to the host

5.3 Power Supply

For DC power supply, connect to the 24V+ and 24V- terminals. This product supports a wide voltage input range of 10 – 30 VDC.

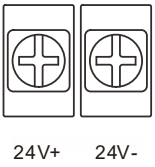


Fig.25 24VDC Power Supply Connection

For AC power supply, connect to the L/N/GND terminals—L to the live wire and N to the neutral wire. The product supports a wide input voltage range of 85 – 265 VAC.

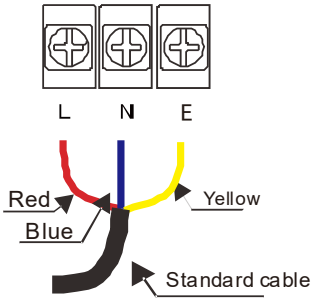


Fig.26 220VAC Power Supply Connection

5.4 OCT Pulse, Frequency Output

A pull-up resistor ranging from 1kΩ to 32kΩ must be connected in parallel with the OCT output circuit. Through this interface, various pulse or switch signal outputs based on the OCT circuit can be achieved by selecting the OCT output option in Menu 66. A common example is frequency output, where the OCT pulse equivalent is set in Menu 67. The maximum output frequency is up to 10 kHz.

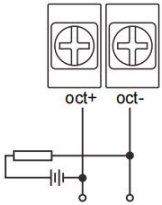


Fig.27 Pulse/frequency output wiring

5.5 Transmission Output

Set the current loop output mode via Menu 55, and configure the upper limit corresponding to 20 mA via Menu 56. The AO+ and AO− terminals can be used to achieve a 4-wire (4 – 20 mA) current loop output. Menu 57 allows you to view the current output value.

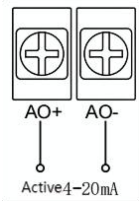


Fig.28 Analog Output Wiring

5.6 RS485 Communication

This product supports RS485 communication using the MODBUS-RTU protocol. To use the RS485 interface, serial port parameters must be configured. Set the serial port parameters in Menu 62; the factory default is “9600 n 81”. Set the device address in Menu 46; the default is 1. Select the MODBUS-RTU protocol in Menu

63; the default value is 0, which refers to the company’s proprietary protocol. For specific register addresses, please refer to the appendix. This product can also be compatible with third-party protocols—please contact technical support for details.

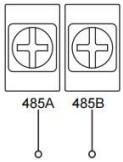


Fig.29 RS485 communication wiring

5.7 Heat Measurement (Optional)

This product also supports heat energy totalizing functionality. By installing temperature sensors on the supply and return pipes and connecting them to the TX1/ T1/ GND/ T2/ TX2 terminals of the device, heat measurement can be performed.

The product features two built-in heat calculation algorithms:

- One is the enthalpy difference method, compliant with national standard CJ128,
- The other is the temperature difference method, which uses specific heat.

The enthalpy method is applicable only for water-based media and within a temperature range of 0° C to 150° C. If the temperature exceeds this range or if a non-water medium is used, the temperature difference method must be adopted. The enthalpy method is the default setting.

Additionally, the product supports three commonly used platinum resistance types: PT100, PT500, and PT1000. For 2-wire PT1000 sensors, short the TX1 – T1 and TX2 – T2 terminals respectively.

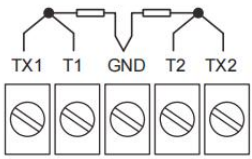


Fig.30 Heat Measurement Wiring

5.8 (4–20) mA Input (Optional)

This product supports two channels of (4–20) mA signal acquisition, which can be used to collect data from sensors with either active or passive (4–20) mA outputs—such as commonly used pressure transmitters, temperature transmitters, etc.

Example:

To collect signals from a two-wire (4–20) mA pressure transmitter, connect the V+ terminal to the positive power supply terminal of the pressure transmitter, and connect AI1 to the (4–20) mA output of the transmitter.

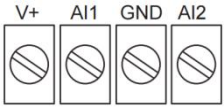


Fig.31 (4~20)mA input terminals

6 Operation

6.1 Display and Operating Unit

The operating panel of the ultrasonic flowmeter consists of 16 buttons and a display screen.

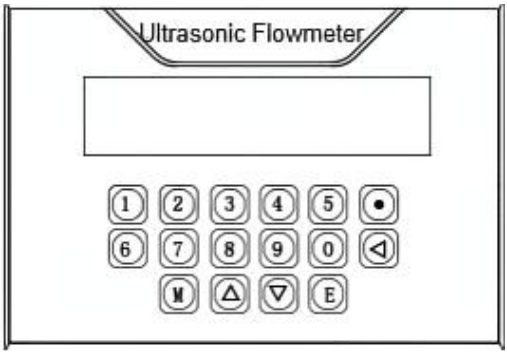


Fig.32 Display and operating unit

Table 3 Description of display and operating elements

Panel Information		Description
Display	LCD display	See menu description
Buttons	Numbers 0~9 and •	Used to enter numbers and menu numbers .
	◁	Used to backspace or delete the left codes.
	△ and ▽	Used to navigate to the previous menu or the next menu. When inputting numbers, it is equivalent to the plus or minus sign key.
	M (Menu key)	Used to access the menu. Press the key first, then enter a two-digit number followed by the confirm key to enter the corresponding menu.
	E (Enter key)	also known as the Confirm key, it is used to "confirm" the entered value or selected option. It can also be used to enter “edit” mode when pressed before inputting a parameter.

6.2 Operating Description

The ultrasonic flowmeter/BTU meter adopts a window-based software design. The shortcut method to access a specific window is to press the **[**M**]** key in any state, followed by the two-digit window address code, and then press the **[**E**]** key. For example, to input or view the pipe outer diameter parameter (window address 11), press **[**M**][**1**][**1**][**E**]**.

Another method to access windows is by scrolling. Use the **[**△**]** and **[**▽**]** keys along with the [E] key. For instance, if the current window is 66, pressing **[**△**]** will move to window 65, and pressing **[**△**]** again will move to window 64. Pressing **[**▽**]** will return to window 65, and pressing **[**▽**]** again will go back to window 66.

6.3 Menu Description

This product uses a flat menu window design. All input parameters, instrument settings, and measurement results are categorized into over 100 different windows/menus, labeled as M00, M01... M.9.

To quickly access a specific display window, press the **[**M**]** key, then enter the two-digit window number, and press **[**E**]**. For example, to enter window 35, press **[**M**][**3**][**5**][**E**]**. To move between adjacent windows (e.g., M39 and M41 are adjacent to M40), use the **[**△**]** or **[**▽**]** key. The windows are organized as follows:

- Windows 00 – 09: Display windows
- Windows 10 – 29: Initial parameter setup windows
- Windows 30 – 38: Flow unit configuration windows
- Windows 40 – 49: Selection setting windows
- Windows 50 – 83: Input/output configuration windows
- Windows 84 – 89: Heat measurement configuration windows
- Windows 90 – 94: Flow diagnostics windows
- Windows .0 – .9: Additional, less frequently used function windows

Table 4 Menu List

Menu		Display /parameters	Menu		Display /parameters
Flow / Accumulated flow display	00	NET:/Flow	Unit Settings	30	Measurement Unit
	01	Flow/Vel		31	Flow Rate Unit
	02	POS/Flow		32	Total Flow Unit
	03	NEG/Flow		33	NET/Flow
	04	E.T/EFR		34	NET/Flow
	05	POS E.T/NEG E.T		35	NET/Flow
	06	T1/T2		36	NEG Totalizer
	07	A11/A12		37	Totalizer Reset?
	08	Signal State		38	Manual Totalizer
	09	Net Flow Today		39	Language
Initial Setup	10	Pipe Outer Perimeter	Select Settings	40	Damping
	11	Pipe Outer Diameter		41	Start Flow
	12	Pipe Wall Thickness		42	Set Zero
	13	Pipe Inner Diameter		43	Reset Zero
	14	Pipe Material		44	Manual Zero Point
	15	Pipe Sound Velocity		45	Scale Factor
	16	Liner Material		46	Network IDN
	17	Liner Sound Velocity		47	System Lock
	18	Liner Thickness		48	Entry to Calib. Data
	19	Inside ABS Thinkness		49	RS485
	20	Fluid Type			
Initial Setup	21	Fluid Sound Velocity	Timing output	50	Logger Interval
	22	Fluid Viscosity		51	Flowmeter Mode
	23	Transducer Type		52	Virtual Run Flow
	24	Transducer Mounting	Simulation	53	Flowmeter mode
	25	Transducer Spacing		54	Virtual Run Flow
	26	Liquid Temp	Input and	55	CL Mode Select

Menu		Display /parameters	Menu		Display /parameters
	27	Empty Pipe Setup	output settings	56	CL 20mA Output Value
	28	Measurement Unit		57	CL Output Value
	29	Empty Pipe Setup		58	NET/Flow
Input and output settings	59	NET/Flow		78	NET/Flow
	60	YY-MM-DD/HH-MM-SS		79	NET/Flow
	61	Sw; S/M	Input and output settings	80	Flow/Vel
	62	RS232/RS485 Setup		81	NET/Flow
	63	RS232/RS485		82	Data Totalizer
	64	AI1 Value Range		83	NET/Flow
	65	AI2 Value Range	Heat Measurement	84	Energy Unit Sel
	66	OCT output Setup		85	Specific Heat Select
	67	OCT TotalFlow/Pulse		86	Temp Diff/Cutoff
	68	1# Alarm Lower Val		87	Ch 1: Sig Strength M87
	69	1# Alarm High Val		88	Fire Pulse Num
	70	LCD Backlight Option		89	Noise Threshold
	71	BKLight Setting	Diagnosis	90	Strength+Quality
	72	LCD Contrast		91	Quality+TOM
	73	Relay Setup		92	Fluid Sound Velocity
	74	Relay TotalFlow		93	TotaTime
	75	#2 Alarm Low Val		94	Max Vel Limit
	76	#2 Alarm High Val	Attachment	.0	Power On/Off Time
	77	Buzzer on Tm		.1	T1, T2 CaliOffset

Appendix A Communication Protocol

This product supports the standard MODBUS-RTU protocol. The flow data read are all input registers, which are read using the 0x04 command. The register list is as follows:

A.2 Register Address

Table 5 Register Address

Primary Address	Content	Type	Unit	Description
0	Instantaneous flow	float	m^3/h	IEE754 Floating Point, Sequence: CDAB
1				
2	Instantaneous heat	float	GJ/h	IEE754 Floating Point, Sequence: CDAB
3				
4	Integer part of net cumulative flow	uint32 Unsigned 32-bit integer	m^3	Order: CDAB
5				
6	Positive cumulative flow integer part	uint32 Unsigned 32-bit integer	m^3	Order: CDAB
7				
8	Negative cumulative flow integer part	uint32 unsigned 32-bit integer	m^3	Order: CDAB
9				
10	Net cumulative heat integer part	uint32 unsigned 32-bit integer	GJ	Order: CDAB
11				
12	Positive cumulative heat integer part	uint32 unsigned 32-bit integer	GJ	Order: CDAB
13				
14	Negative cumulative heat	uint32 unsigned 32-bit	GJ	Order: CDAB
15				

Primary Address	Content	Type	Unit	Description
	integer part	integer		
16	Decimal part of net cumulative flow	Unsigned 16-bit integer	0.001m^3	
17	Positive cumulative flow decimal part	Unsigned 16-bit integer	0.001m^3	
18	Negative cumulative flow decimal part	Unsigned 16-bit integer	0.001m^3	
19	Decimal part of net accumulated heat	Unsigned 16-bit integer	0.001GJ	
20	Positive cumulative heat fraction	Unsigned 16-bit integer	0.001GJ	
21	Negative cumulative heat fraction	Unsigned 16-bit integer	0.001GJ	
22	Reserve			
23	Reserve			
23	Instantaneous flow rate	float	m/s	IEE754 Floating Point, Sequence: CDAB
25				
26	Water level	Unsigned 16-bit integer	mm	
27	Battery voltage	Unsigned 16-bit integer	mV	
28	Hot junction temperature	Signed 16-bit integer	0.01℃	
29	Cold junction	Signed 16-bit	0.01℃	

Primary Address	Content	Type	Unit	Description
	temperature	integer		
30	Hot junction resistor	Unsigned 16-bit integer	0.1Ω	
31	Cold junction resistance	Unsigned 16-bit integer	0.1Ω	
32	The first analog input current value	Unsigned 16-bit integer	uA	
33	The second analog input current value	Unsigned 16-bit integer	uA	
34	The first analog input corresponds to the physical quantity	float		IEE754 Floating Point, Sequence: CDAB
35				
36	The second analog input corresponds to the physical quantity	float		IEE754 Floating Point, Sequence: CDAB
37				
38	Cumulative running time	uint32, unsigned 32-bit integer	Second	Order: CDAB
39				
65400	Device serial number	uint32, unsigned 32-bit integer		Sequence: CDAB, flowmeter serial number, same as displayed
65401				

A.3 Communication Example

Floating-Point Storage Order

During operation, floating-point numbers are stored in a specific byte order. For example, the four bytes 3F 9E 06 51 represent the IEEE 754 single-precision floating-point format for the value 1.2345678. In the MODBUS data stream, the byte order is 06 51 3F 9E.

How to Read the Data

The required data can be retrieved using a MODBUS-RTU command. Assume the address of the flowmeter is 1, and the master station sends the following command:

01 04 00 00 00 28 F0 14

The response received is:

SEND HEX > 01 04 00 00 00 28 F0 14

RECV HEX >

01 04 50 82 D0 44 FE 8B 88 42 31 00 C9 00 00 00 C9 00 00 00 00 00 00 00 03 00 00 00 03 00 00 00 00 00 00 01 E0 01 E0 00 00 01 76 01 76 00 00 00 00 00 00 CE 52 41 FC 00 00 13 24 0B B8 09 C4 4E 64 4E 64 00 00 00 00 00 00 00 00 00 00 00 00 73 23 00 00 0F D8

① **Instantaneous flow data**: 82 D0 44 FE

Its actual memory order is 44 FE D0 82, which corresponds to the IEEE 754 single-precision floating-point value 203.087890625.

Therefore, the instantaneous flow rate is 2036.087890625 m^3/h. Other data can be interpreted in a similar manner.

② **Net cumulative volume** – integer part: 00 C9 00 00

The actual memory order is 00 00 00 C9, which equals 201 (unit: m^3).

Net cumulative volume – decimal part: 01 1E

This gives 011E in hex, which equals 481 (unit: 0.001 m^3), or 0.481 m^3.

Total net cumulative volume = integer part + decimal part = 201 + 0.481 = 201.481 m^3.

Appendix B Common Parameters

Table 6 Common liquid sound velocity and viscosity

Liquid	Sound Velocity (m/s)	Viscosity		Liquid	Sound Velocity (m/s)	Viscosity
Water 20℃	1482	1.0		Glycerin	1923	1180
Water 50℃	1543	0.55		Gasoline	1250	0.80
Water 75℃	1554	0.39		66# Gasoline	1171	
Water 100℃	1543	0.29		80# Gasoline	1139	
Water 125℃	1511	0.25		0# Diesel Oil	1385	
Water 150℃	1466	0.21		Benzene	1330	
Water 175℃	1401	0.18		Ethylbenzene	1340	
Water 200℃	1333	0.15		Toluene	1170	0.69
Water 225℃	1249	0.14		Carbon tetrachloride	938	
Water 250℃	1156	0.12		Kerosene	1420	2.3
Acetone	1190			Petroleum	1290	
Methanol	1121			Turpentine	1280	
Ethanol	1165			Trichloroethylene	1050	
Alcohol	1440	1.5		Dagang jet fuel	1298	
Ethyl Ketone	1310			Daqing 0# jet fuel	1290	
Acetaldehyde	1180			Peanut oil	1472	
Ethylene glycol	1620			Castor oil	1502	
Aniline	1659	1.762		Ether	1006	0.336
n-octane	1192			o-Xylene	1360	
Chloroform	1001	0.383		Chlorobenzene	1289	
Glycerol	1923	1188.5		Acetic acid	1159	1.162

Liquid	Sound Velocity (m/s)	Viscosity		Liquid	Sound Velocity (m/s)	Viscosity
Methyl acetate	1181	0.411		Ethyl acetate	1164	
Diformic acid	1389			Heavy water	1388	1.129
Carbon disulfide	1158			Bromoform	931	
n-Propanol	1225			n-Pentane	1032	0.366
n-Ethane	1083	0.489		Light oil	1324	
Transformer oil	1425			Spindle lubricating oil	1342	15.7
Petroleum	1295			Gasoline	1250	0.4-0.5