User's Manual

Supmea

Wall-Mounted Ultrasonic Flowmeter

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U--SUP-1158S/R/G-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-SUP-1158S/R/G-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/ BTU meter	1	
2	User manual	1	
3	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 ultrasonic flowmeter/BTU meter is suitable for continuously measuring the flow rate of most homogeneous liquids — without high concentrations of suspended particles or air bubbles — in industrial environments. It also supports heat calculation functionality. By adding temperature sensors to the ultrasonic flowmeter, it achieves thermal energy measurement capabilities. This product is widely used in industries such as petroleum, chemical, electric power, food, and others.

1.2 Measuring System

Measurement System

Depending on the transmitter's structural design, the system can be classified into integrated and separated types. Refer to the diagram below:

Table 1 Typical Measurement Systems of Ultrasonic Flowmeters/BTU Meters

sensor / type	Clamp-on	Insertion	Inline
Remote			
Integrated type			

Note: By installing PT100 temperature sensors on the supply and return water pipes and connecting them to the ultrasonic flowmeter transmitter, thermal energy (heating/cooling) measurement can be achieved.

1.3 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.

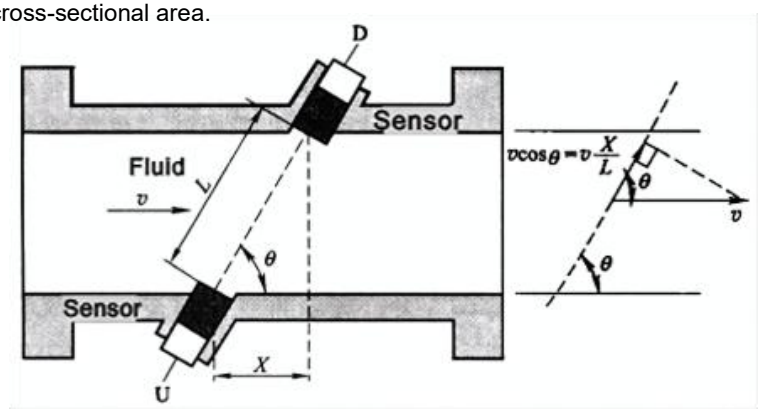


Fig.1

The flow velocity of the fluid between the upstream sensor (U) and the downstream sensor (D) can be calculated using Formula (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.

1.4 Features

- Suitable for measuring fluid flow across various pipe diameters.
- Flexible installation options: sensors can be installed in inline, insertion, or clamp-on configurations.
- Low start-up flow rate, high measurement accuracy, and zero pressure loss.
- Non-intrusive measurement; unaffected by temperature, pressure, or fluid composition.
- When using clamp-on sensors, installation requires no pipe cutting, making it not only simple and quick but also non-damaging to 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 meter 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 2

Performance parameters	
Measured variables	Flow; cold and heat energy
Nominal diameter	Clamp-on type: DN20~DN1200 Bracket type: DN20~DN700 Insertion type: DN50-DN6000 Inline type: DN15~DN1200
Accuracy	Level 1.0
Output	
Transmitter output	(4~20)mA current output, output accuracy 0.1%FS, load resistance ≤1000Ω
Communication output	RS485 interface, MODBUS
Frequency/pulse output	Pulse width (0~1000) ms, default 200ms
Relay output	One relay output
Electrical specifications	
Power supply	AC: (85-264)V DC: (8~36)V
Power consumption	1.5W
Electrical interface	PG7
Process conditions	
Medium temperature	Normal temperature type: (-30~90)℃ High temperature type: (-30~130)℃
Environmental conditions	
Ambient temperature	-20℃-60℃
Ambient humidity	(0~80%)RH
Protection level	Host: IP65 Sensor: IP65 or IP68

3 Structure and Dimensions

3.1 Components

- The ultrasonic flowmeter/BTU meter consists of the following:
- Ultrasonic Flowmeter = Transmitter (main unit) + Ultrasonic Sensor
- Ultrasonic BTU Meter = Transmitter (main unit) + Ultrasonic Sensor + Temperature Sensor

3.2 Dimensions

3.2.1. Dimensions of Main Unit

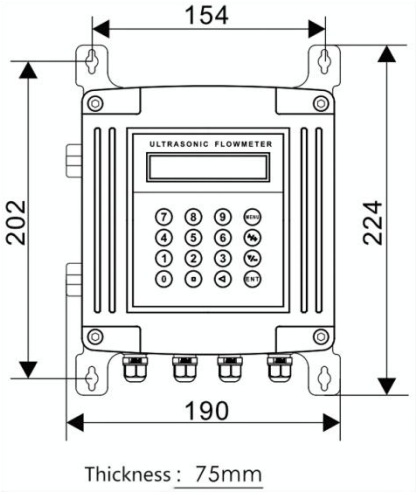


Fig.2 Main unit dimensions (unit: mm)

3.2.2. Dimensions of the Clamp-on Integrated Version

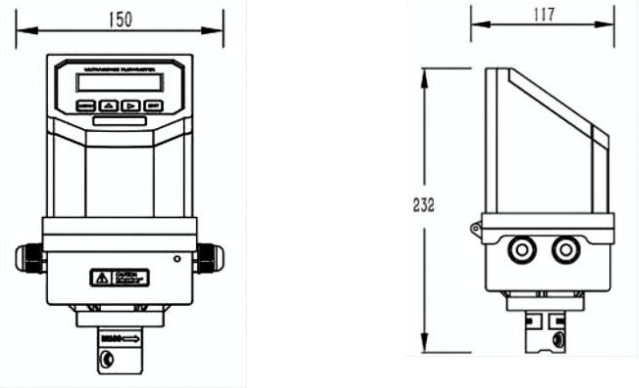


Fig.3 Dimensions of Integrated Inline Sensor (unit: mm)

3.3 Structure and Dimensions of Clamp-on and Bracket Type Sensor

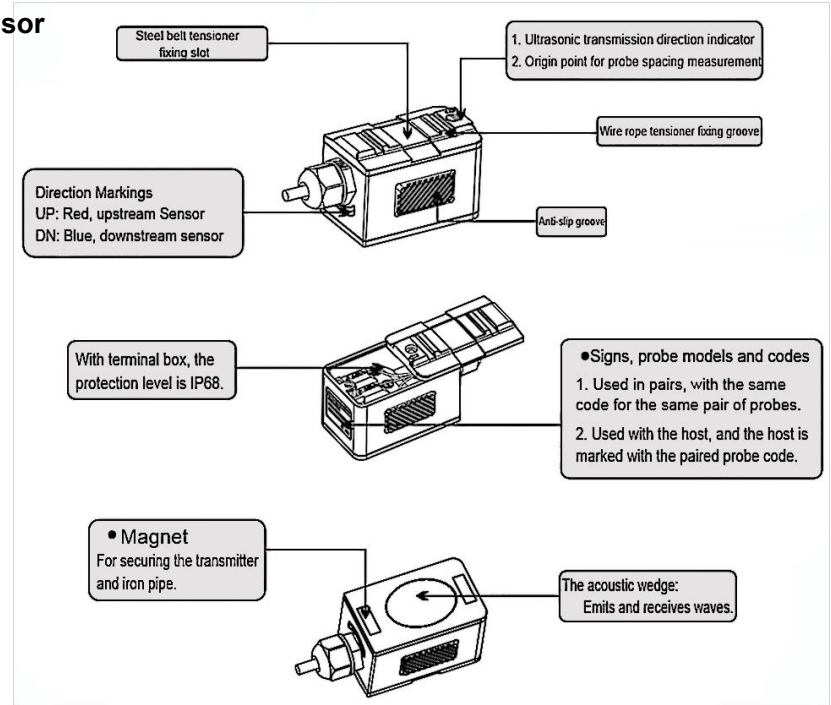


Fig.4 Diagram of the Clamp-on Flow Sensor Structure

Table 3 Clamp-on and Bracket Flow Sensor Types

Flow Sensors	Picture	Model	Measuring range	Medium temperature (℃)	Dimensions (mm)
External clamp		Small	DN 32~DN100	-30 ~ 90	45*25*32
		Medium	DN50~DN700		64*39*44
		Large	DN300~DN1200		97*54*53
High temperature clamp type		Small	DN 20~DN 100	- 30 ~ 130	45*25*32
		Medium	DN50~DN 700		64*39*44
		Large	DN300 ~DN1200		97*54*53
Bracket		Small	DN 15~DN100	-30 ~ 90	318*59*85
		Medium	DN 50~DN 300		568*59*85
		Large	DN 300~DN 700		188*59*49
High temperature bracket		Small	DN 15~DN100	- 30 ~ 130	318*59*110
		Medium	DN 50~DN 300		568*59*110
		Large	DN 300~DN 700		188*59*49

3.4 Structure and Dimensions of Insertion Flow Sensor

Table 4 Insertion Flow Sensor Types

Flow Sensors	Picture	Model	Measuring range	Medium temperature (℃)
Insertion type		Standard Insert	DN50 ~DN 6000	-30 ~ 1 3 0
		Extended insertion		
		Parallel Insertion	DN200 ~DN 6000	

3.4.1. Structure

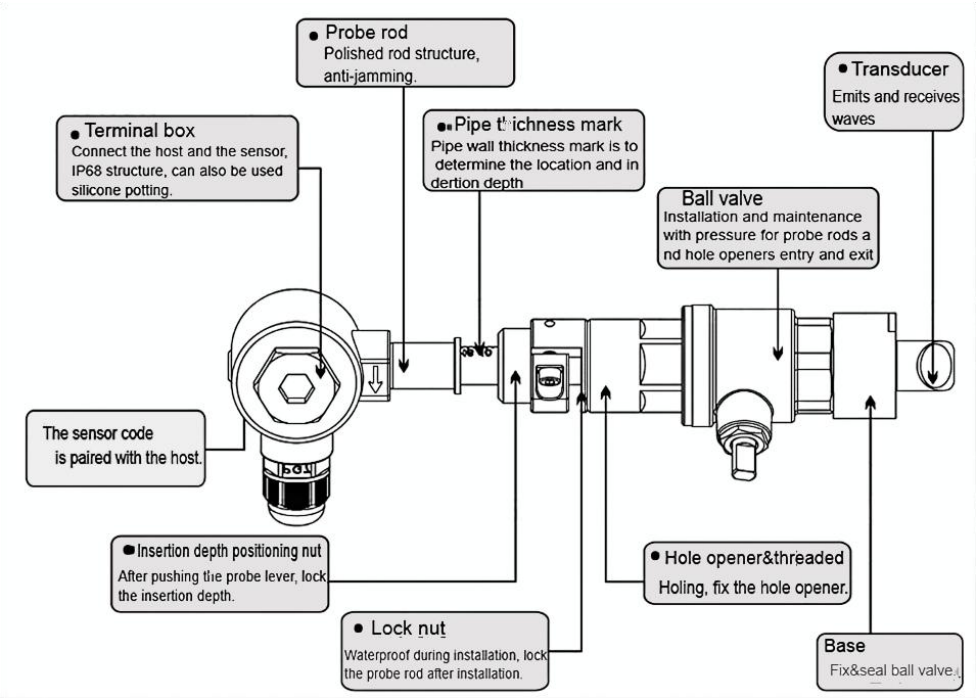
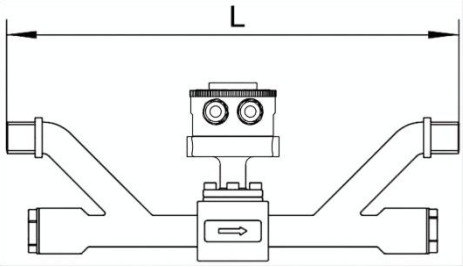


Fig.5 Insertion flow sensor structure diagram

3.5 Inline Sensor Structure and Dimensions

3.5.1. Small diameter inline sensor

(1) Threaded connection



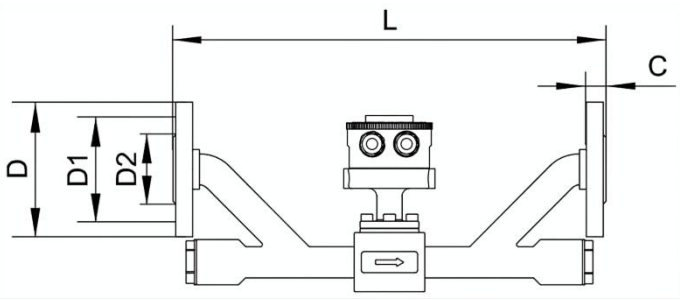
Process connection: GB/T 7307 thread

Fig.6 Dimensional diagram of threaded pipe segment sensor

Table 5 Threaded Inline sensor Size Table

Nominal diameter	Pressure level (P)	Length L (mm)	Connection thread	Effective thread length (mm)
DN15	2.5	320	G3/4B	18
DN20	2.5	360	G1B	15
DN25	2.5	390	G1 1/4B	16
DN32	2.5	450	G1 1/2B	22.5

(2) Flange connection



Process connection: GB/T 9119 flange

Fig.7 Dimensional Diagram of Flange-Connected Inline Sensor

Table 6 Flange Connection Inline Sensor Size Table

DN	L	Flange size (unit: mm)							PN
		OD	PCD(D1)	φ × n	D2	C	f	Thread	
DN 15	320	150	95	14×4	46	18	3	M16	PN25
DN 20	360	165	105	14×4	56	20	3	M16	
DN 25	390	185	115	14×4	65	20	3	M16	
DN 32	450	200	140	18×4	76	20	3	M16	

Note:

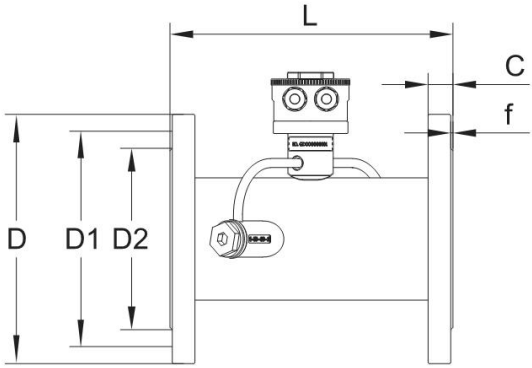
L: Tube length φ × n: Bolt hole diameter×quantity

D: Outer diameter (OD) D2: Sealing face diameter

D1: Bolt circle diameter C: Flange thickness

F: Raised face height PN: Nominal pressure

3.5.2. Standard Diameter Inline Sensor



Process connection: DN40~DN300, GB/T 9119 flange

DN350~DN1200, JB/T 81 flange

Fig.8 Dimensional Diagram of Remote Inline Sensor

Table 7 Dimensions of Standard Diameter Inline Sensor

DN	L	Flange size (unit: mm)							PN
		OD	PCD(D1)	φ×n	D2	C	f	Thread	
DN40	300	150	110	18×4	88	18	3	M16	PN16
DN50	300	165	125	18×4	102	20	3	M16	
DN65	300	185	145	18×4	122	20	3	M16	
DN80	225	200	160	18×8	138	20	3	M16	
DN100	250	220	180	18×8	158	22	3	M16	
DN125	275	250	210	18×8	188	22	3	M16	
DN150	300	285	240	22×8	212	24	3	M20	
DN200	350	340	295	22×12	268	26	3	M20	
DN250	450	405	355	26×12	320	28	3	M24	
DN300	500	460	410	26×12	378	32	4	M24	
DN3 50	550	505	460	22×1 6	430	30	4	M20	PN10
DN 400	600	565	515	26×1 6	482	32	4	M24	
DN 450	700	615	565	26×20	532	36	4	M24	
DN 500	800	670	620	26×20	585	38	4	M24	
DN 600	1000	780	725	30×20	685	42	5	M27	
DN 700	1100	860	810	26×24	775	40	5	M24	PN6
DN 800	1200	975	920	30×24	880	44	5	M27	
DN 900	1300	1075	1020	30×24	980	48	5	M27	
DN 1000	1400	1175	1120	30×28	1080	52	5	M27	
DN 1200	1500	1405	1340	33×32	1295	60	5	M30	

Note:

L: Tube length

φ × n: Bolt hole diameter×quantity

D: Outer diameter (OD)

D2: Sealing face diameter

D1: Bolt circle diameter(PCD)

C: Flange thickness

F: Raised face height

PN: Nominal pressure

3.6 Structure and Size of Temperature Sensor

Table 8 Flow sensor types

Temperature Sensor's installation	Picture	Measuring range	Temperature range	Installation requirements
Clamp-on		>DN50	-40° C~ 130 ° C	No need flow shutdown
Insertion		>DN50	-40° C~ 130 ° C	Requires flow shutdown
Hot-tap		>DN50	-40° C~ 130 ° C	No need flow shutdown
Small-bore insertion		<DN50	-40° C~1 30 ° C	Requires flow shutdown

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 for easy 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. It is fixed with 4× ϕ6mm expansion bolts or iron nails

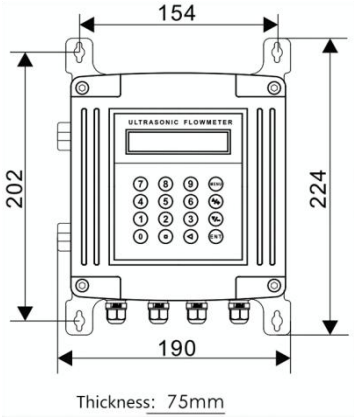


Fig.9 Main Unit Installation (unit: mm)

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.

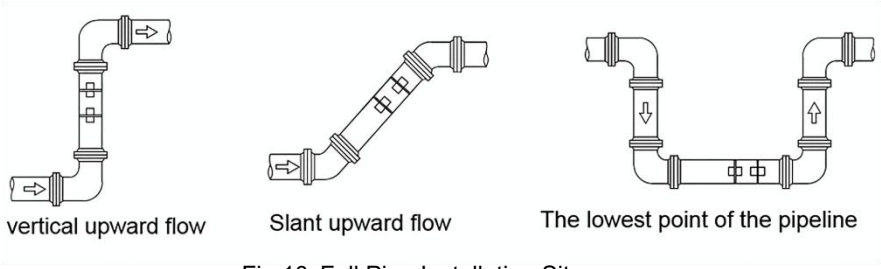


Fig.10 Full Pipe Installation Site

(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：

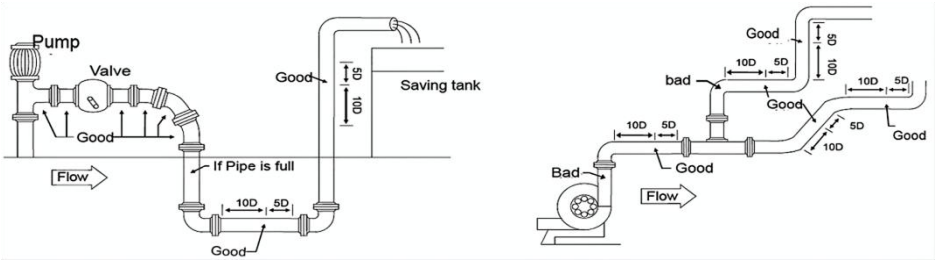


Fig.11 Installation Sites for Stable Flow

(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 with the same power source as a frequency converter; use an isolated power supply for the main unit instead.

(7) Meter Pit

A meter pit should be constructed for underground pipelines or measurement points where the flowmeter requires protection. To ensure sufficient space for proper installation, commissioning, and maintenance, the dimensions of the instrument pit must meet the following requirements.

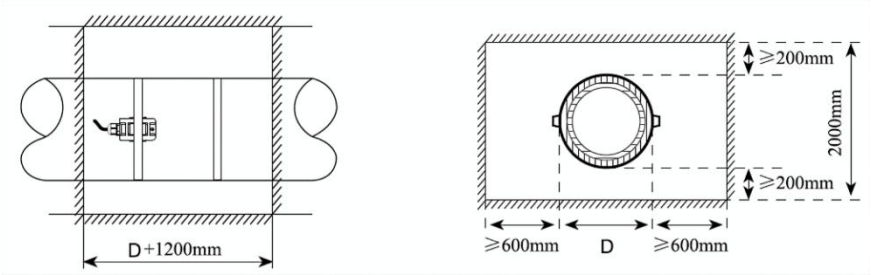


Fig.12 Meter Pit Dimensions

Note: D represents the pipe diameter.

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.

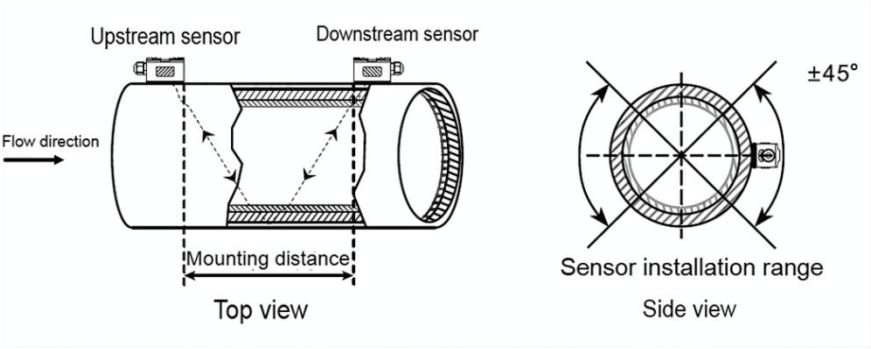


Fig.13 V-Method Installation

(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.

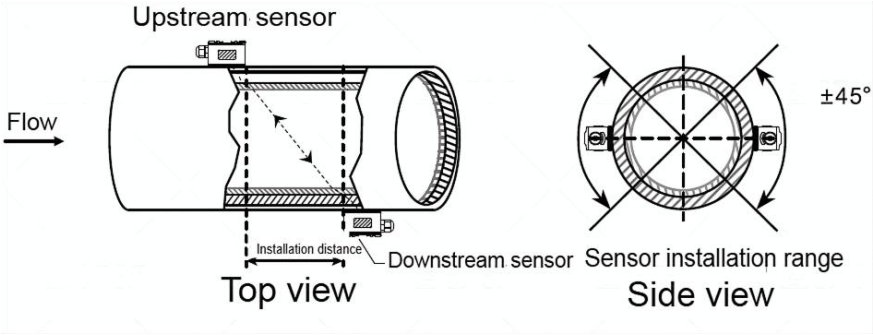


Fig.14 Z-Method Installation

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.

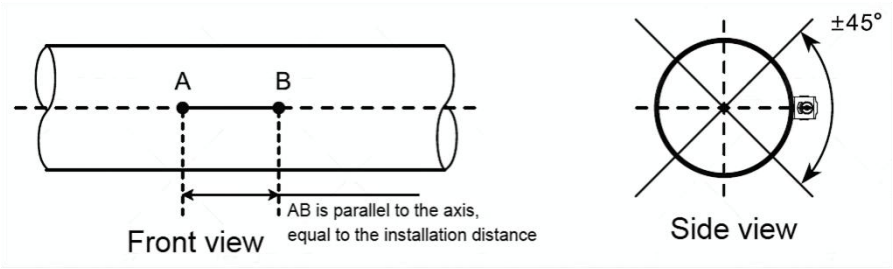


Fig.15 V-Method Installation Site Determination

(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.

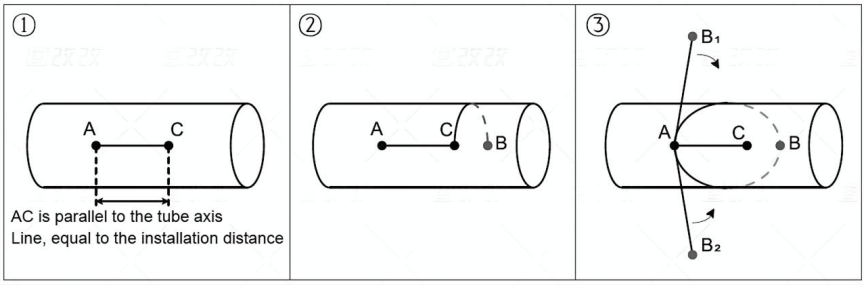


Fig.16 The Z-Method Site Determination

4.4.4. Surface Preparation 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.

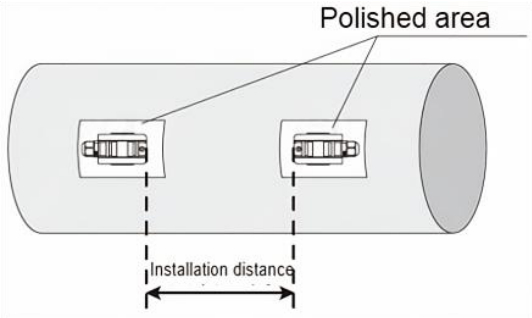


Fig.17 Diagram of Surface Preparation at Mounting Points

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.

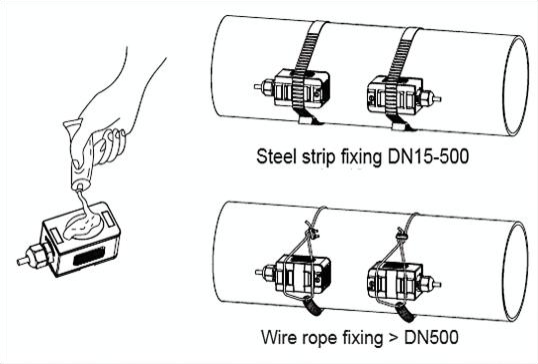


Fig.18 Fixing Diagram (V Method)

4.4.6. Post-installation Check

Refer to 4.7 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 → Post-installation check.

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 more suitable 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 .

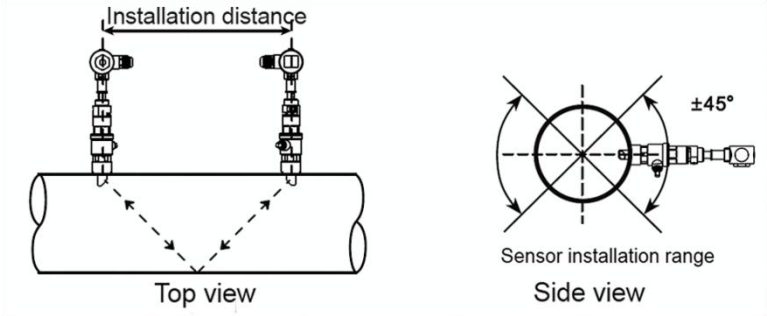


Fig.19 V Method Installation Diagram

(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.

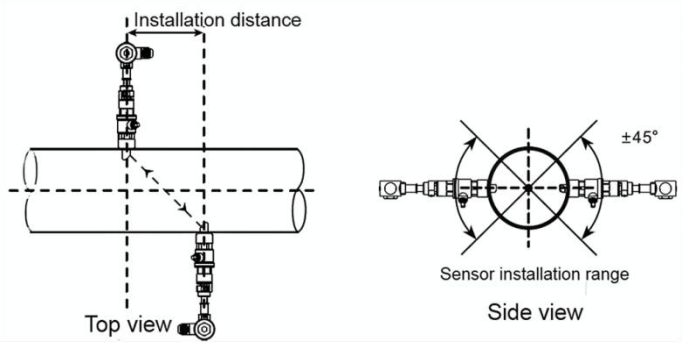


Fig.20 Z Method Installation Diagram

(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.

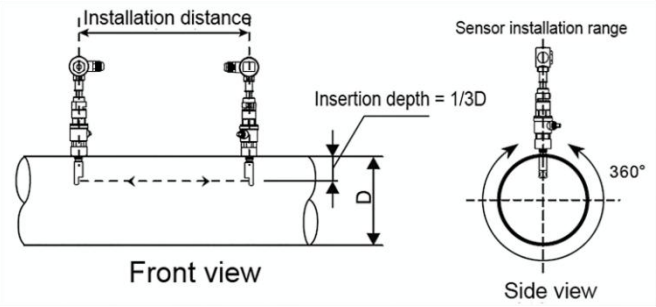


Fig.21 Parallel Insertion

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.

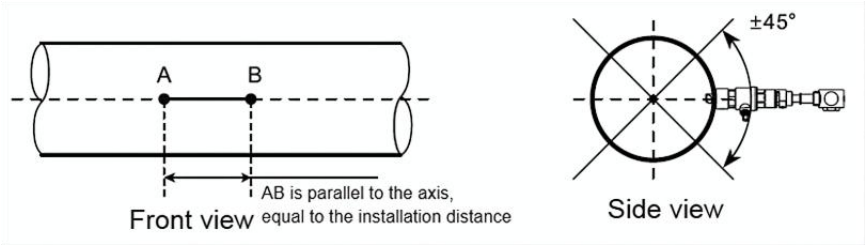


Fig.22 V-Method Installation Location

(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.

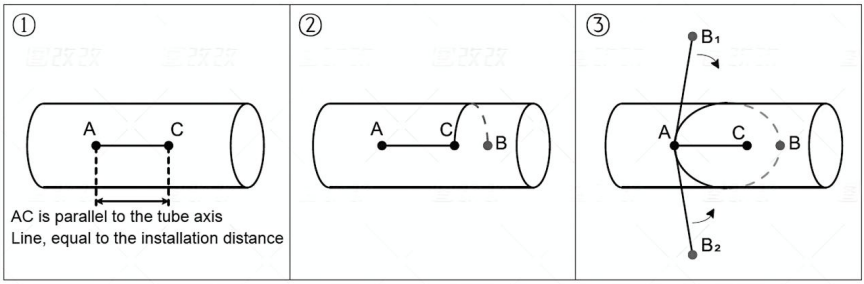


Fig.23 Z-method installation location

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.

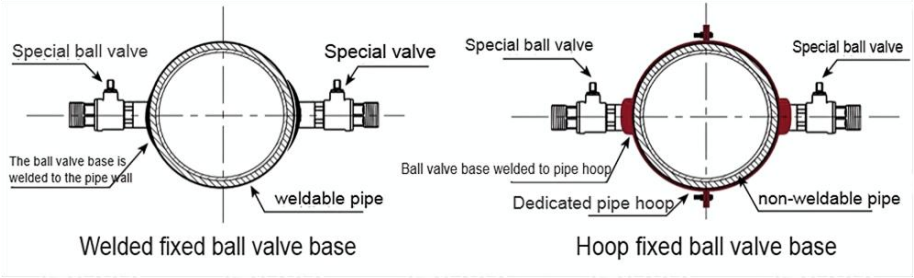


Fig.24 Fixing Ball Valve Base

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.

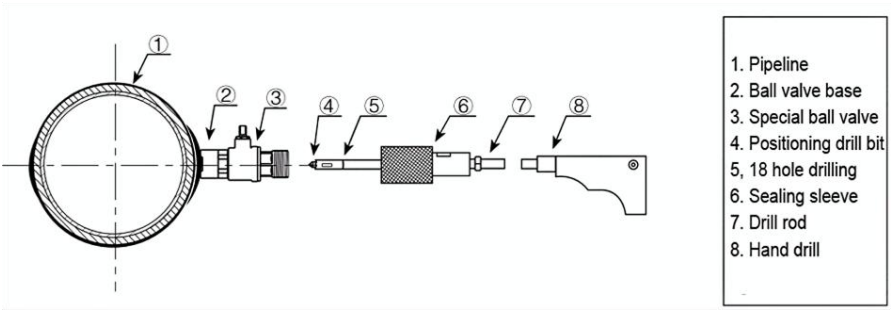


Fig.25 Drilling

4.5.6. Installation of Commissioning Sensor

Adjust the insertion depth and transmission direction properly to obtain an optimal ultrasonic receiving signal.

Insertion Depth Adjustment: Adjust the insertion depth scale according to the pipe wall thickness. Push the probe until it is in close contact with the locking nut to achieve the correct insertion depth.

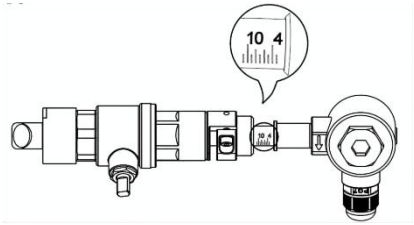


Fig.26 Insertion Depth Adjustment

After adjusting the insertion depth, determine the transmission direction. An arrow indicating the ultrasonic transmission direction is marked on the sensor’s junction box. The transmission directions of the upstream and downstream sensors should face each other (“→ ←”) and be parallel to the pipe axis.

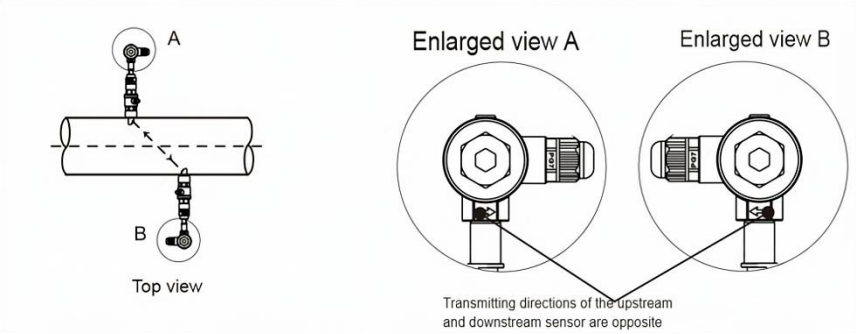


Fig.27 Adjusting transmitting direction

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 4.7 post-installation check

4.6 Installation and Adjustment of the Inline Sensor

After selecting a suitable installationsite, connect the inline sensor to the pipeline with matching flanges, and use dedicated ultrasonic cables to connect it to the ultrasonic flowmeter's main unit. This completes the installation.

4.6.1. Installation Methods

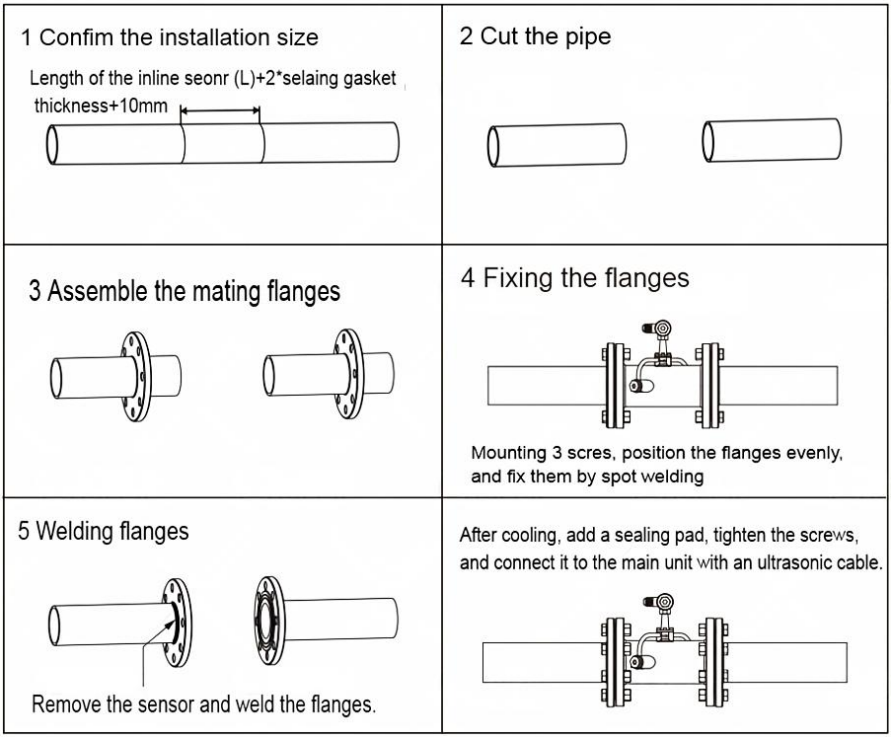


Fig.28 Installation Diagram

4.6.2. Post-Installation Check

Refer to 4.7 post-installation check

4.7 Post-Installation Check

The device is equipped with a diagnostic function. Menu M90 is used to check signal strength and signal quality, while menu M91 is used to check the ratio between the measured and theoretical transit times.

4.7.1. Checking Signal Strength and Signal Quality

The M90 window displays the upstream and downstream signal strength and signal quality (Q value) detected by the flowmeter.

- Signal strength is represented by a numeric value ranging from 00.0 to 99.9.

A reading of 00.0 indicates no signal received, while 99.9 indicates the maximum signal. A signal strength of ≥60.0 is required for the flowmeter to operate properly.

- Signal quality (Q value) is shown as a number from 00 to 99, with 00 being the worst and 99 the best. Under normal operating conditions, the Q value should be greater than 60.

During installation, be sure to adjust the sensors to maximize both signal strength and quality. This ensures long-term stable operation of the flowmeter and improves measurement accuracy.

Table 9 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

4.7.2. Checking Transit Time Ratio

The M91 window displays the transit time ratio. This ratio represents the percentage of the theoretical ultrasonic transit time—calculated based on the flowmeter's configured parameters—to the actual measured transit time. It reflects the consistency between the configured measurement parameters and the actual installation distance of the sensors.

This value should fall within the range of 97% to 103%. If the transit time ratio is outside this range, it indicates a mismatch between the configured measurement parameters and the actual sensor installation distance. In this case, please check both the parameter settings and the sensor installation distance carefully.

5 Electrical Connection

5.1.1. Connection Terminals

The terminals of the ultrasonic flowmeter is shown as below:

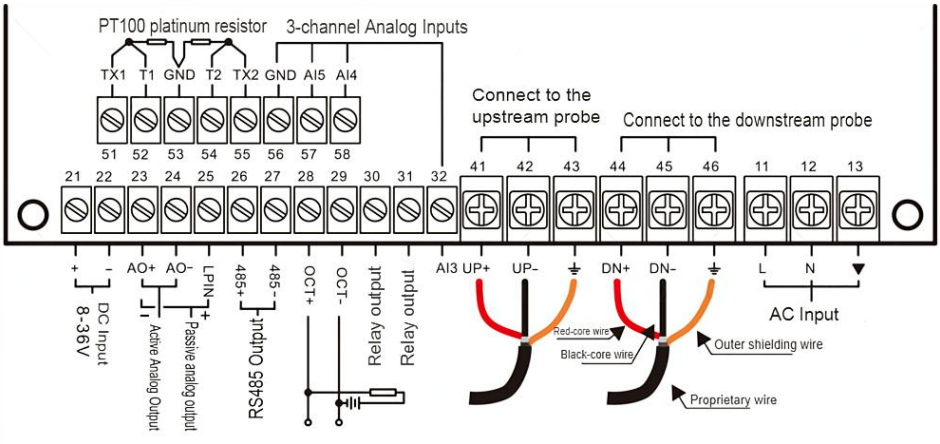


Fig.29 Wall-Mounted Host Terminal Block

5.1.2. Integrated Host Terminal

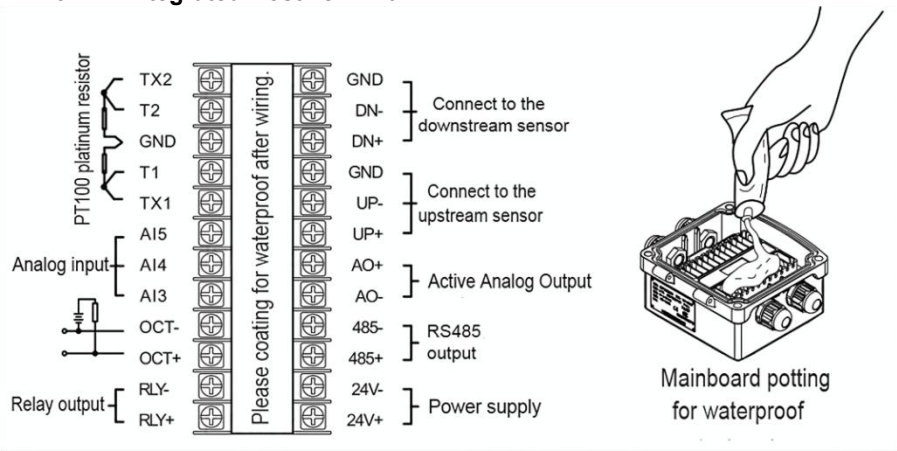


Fig.30 Integrated Host Terminal Block

After opening the cover and wiring, please pot the terminal slots with the provided silicone to make the motherboard waterproof.

5.1.3. Terminal Block of Clamp-on Sensor

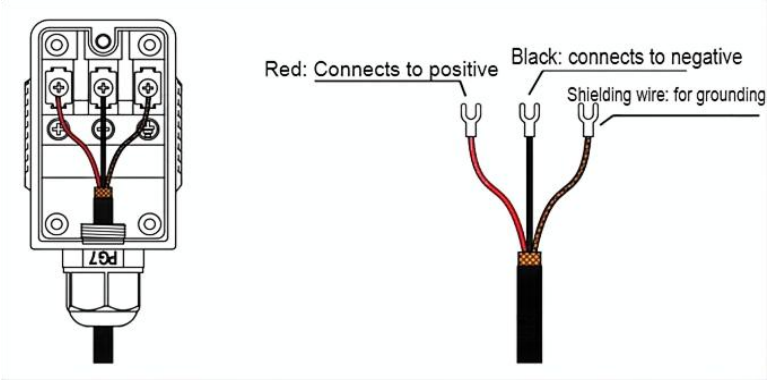


Fig.31 Wiring Diagram Of Clamp-On Sensor

5.1.4. Terminal Block of Insertion Sensor

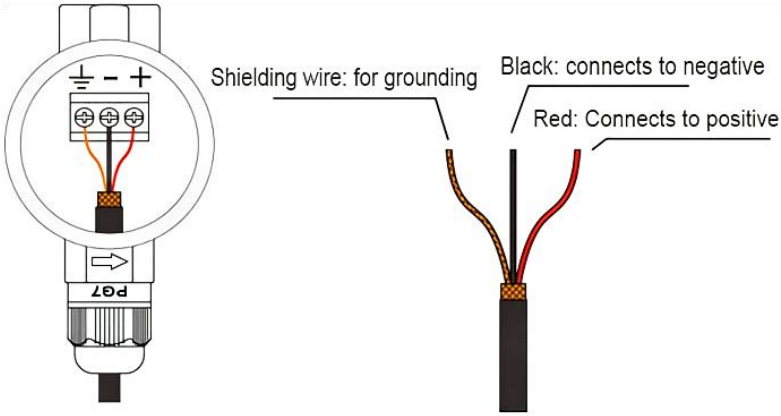


Fig.32 Wiring Diagram Of Insertion Sensor

5.1.5. Terminal Block of Inline Sensor

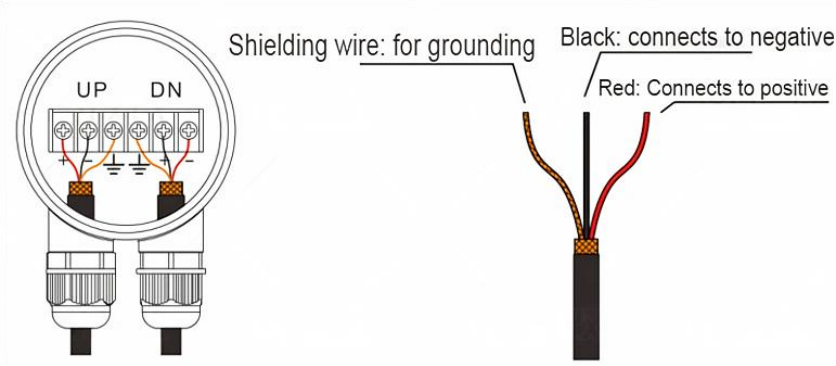


Fig.33 Wiring Diagram Of The Remote Inline Sensor

5.2 The Wiring of Host Unit and Sensor

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.

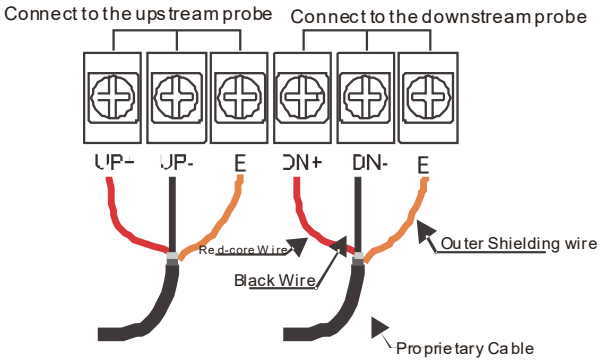


Fig.34 Sensor Connecting To The Host

5.3 Power Supply

For DC power supply, connect to the 24V+ and 24V- terminals. This product supports a wide voltage input range of 8 – 36 VDC.

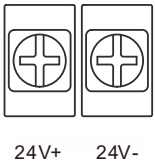


Fig.35 24VDC Power Supply Connection

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.

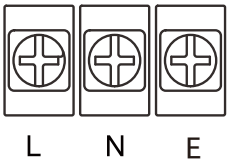


Fig.36 220VAC Power Supply Connection

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.

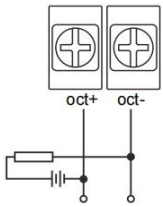


Fig.37 Pulse/Frequency Output Wiring

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.

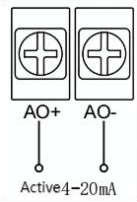


Fig.38 Analog Output Wiring

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.

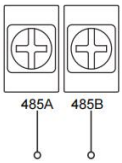


Fig.39 RS485 Communication Wiring

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.

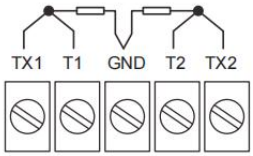


Fig.40 Heat Measurement Wiring

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.

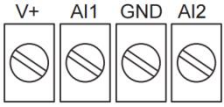


Fig.41 (4~20)mA Input Terminals

6 Operation

6.1 Display and Operating Unit

6.1.1. The Remote Version

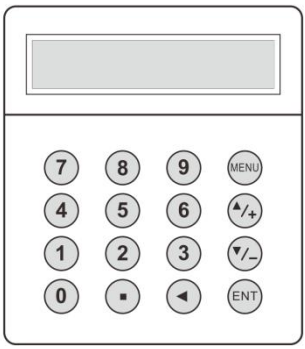


Fig.42 Display and Operating Unit

Table 10 Panel Description

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.
	MENU	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.
	ENT	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.

6.1.2. Integrated Version

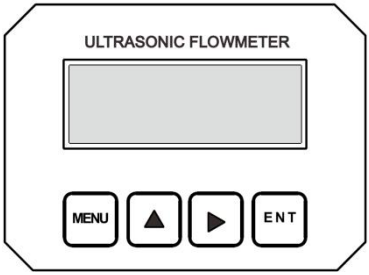


Fig.43 Display and Operating Unit

Table 11 Panel Description

Panel Information		Description
Display	LCD display	See menu description
	MENU	Menu key (M key for short), used to access the menu
	▲	Up key, move up the menu or select 0~9, +, - and .
	▶	Down key, move down the menu or move the cursor to the next digit
	ENT	Enter key, used to end menu input or enter a submenu

6.2 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 30–39: Flow unit configuration windows
- Windows 40–49: Selection setting windows
- Windows 50–81: Input/output configuration windows
- Windows 82～8▪: Heat measurement configuration windows
- Windows 90–95: Flow diagnostics windows
- Windows +0–-B: Additional, less frequently used function windows

Table 12 Menu List

Menu		Display content/parameter name
Flow/accumulative display	00	Display instantaneous flow rate/net cumulative volume, the display unit is adjusted in the M30~M32 window
	01	Display instantaneous flow rate/instantaneous flow velocity, the display unit is adjusted in the M30-M32 window
	02	Display instantaneous flow/positive cumulative flow, display unit is adjusted in M30-M32 window
	03	Display instantaneous flow/negative cumulative amount, the display unit is adjusted in the M30-M32 window
	04	Display date and time/instantaneous flow
	05	Display heat flow/total heat, display unit can be adjusted in M84 and M88 windows
	06	Display temperature input T1 , T2
	07	Display analog input AI3 , AI4
	08	Display system error codes
	09	Display today's net cumulative flow
Initial Setup	10	Enter the outer circumference of the pipeline
	* 11	Enter the outer diameter of the pipe. The value range is 0 ~ 18000
	* 12	Enter the pipe wall thickness
	* 13	Inner diameter of input pipe
	* 14	Select the pipe material type

Menu		Display content/parameter name
	15	Input pipe sound velocity
	16	Select lining type
	17	Input lining material sound velocity
	18	Enter the lining thickness
	19	Enter the absolute roughness of the inner wall
	*20	Select fluid type
	21	Input fluid sound velocity
	22	Input fluid viscosity
	*23	Select the sensor type, there are more than 20 different types to choose from
	* 24	Select sensor installation method
	* 25	Display sensor installation distance
	* 26	Parameter curing and setting
	27	Mount point installation parameter access
	28	Keep the last data when the signal gets worse. Select "Yes" to indicate that when the ultrasonic signal gets worse, the flow meter will display the correct data measured last time.
	29	Enter the signal strength when setting the empty pipe. For example, if you enter 65, it means that when the signal strength drops to 65, the flow meter will think that there is no fluid in the pipe, and the displayed flow value will be set to 0.
Flow unit setting	30	Select the unit system
	31	Select instantaneous flow unit
	32	Select the total flow unit
	33	Select the accumulator multiplication factor. The multiplication factor serves to enlarge the accumulated value range and is generally set to×1.
	34	Net accumulator switch
	35	Positive accumulator switch
	36	Negative accumulator switch

Menu		Display content/parameter name
	37	Restore factory parameter settings and clear accumulator
	38	Manual totalizer (for calibration), can display manual total amount, total time and instantaneous flow
	39	Select the language of the operation interface. There are 4 different languages (Chinese, English, Italian, Turkish) for international users to choose from.
Select Settings	*40	Damping coefficient.
	*41	Enter the low flow cutoff value.
	42	Sets the static zero point.
	43	Clear the zero setting and the manually set zero point, and restore the original value
	44	Manually set the zero offset value
	45	Instrument factor, correction factor
	46	Enter the network identification address code (instrument communication address)
	47	Password protection operation. After the instrument is set with a password, the menu can only be browsed but not changed.
	48	Linearity line correction data input. There are up to 11 line segments for users to correct instrument nonlinearity.
	49	Network online communication tester, in this window you can view the data sent by the host computer to determine communication problems.
Timing output	50	Data timing output option settings, select the output content for timing printing, there are more than 20 items to choose from.
	51	Timing output time setting.
	52	Print data flow control. By default, the print data will

Menu		Display content/parameter name
		flow to the thermal printer connected to the internal bus. The print data can be set to output to the external serial port (RS485 port).
AI5 Settings	53	Displays analog input AI5 (TDS16 version displays battery voltage in this window)
	53	Displays analog input AI5 (TDS16 version displays battery voltage in this window)
Input and Output Settings	54	OCT cumulative pulse output pulse width setting range is 6 ms to 1000 ms.
	55	Current loop output mode selection.
	56	Corresponding value when the current loop outputs 4mA or 0 mA .
	57	Corresponding value when the current loop outputs 20mA .
	58	Current loop output verification. Used to check and verify whether the current loop is normal.
	59	Current loop current output value.
	60	Date and time settings. The date and time of the new generation ultrasonic flowmeter is realized by the CPU , which will cause the time to run slowly when the software is upgraded. It is recommended to adjust the date and time in time to display correctly after the software is upgraded.
	61	Software version number and electronic serial number.
	62	Set serial port parameters
	63	Communication protocol selection (including compatible protocol selection) has two options. Selecting MODBUS-RTU means using the binary MODBUS-RTU protocol, and selecting MODBUS-ASCII+ original protocol means using the ASCII code protocol. At this time, multiple protocols

Menu		Display content/parameter name	
		can be supported at the same time, including MODBUS-ASCII, original version 7 protocol, Meter-BUS protocol, and multiple communication protocols of Huizhong Instruments.	
	64	Analog input AI3 corresponding value range	By inputting the value range, the flow meter will convert the current signal into a value range suitable for the user's needs, thereby displaying the physical parameter value corresponding to the corresponding analog input.
	65	Analog input AI4 corresponding value range	
Input and output settings	66	Analog input AI5 corresponding value range	
	67	Set the frequency output signal frequency range. The frequency signal output represents the instantaneous flow rate through the signal frequency. The default setting is 0~1000Hz , and the maximum range is 0 ~999Hz . The frequency signal is output through a dedicated frequency output unit.	
	68	Set the frequency signal output lower limit flow	
	69	Set the upper limit flow rate of frequency signal output	
	70	Display backlight control	
	71	Display contrast control	
	72	Working timer, records the working time of the instrument in seconds. Can be reset.	
	73	Set the lower limit flow value of #1 alarm	By setting the upper and lower limits of the alarm, a range can be determined. When the measured flow
	74	Set the upper limit flow value of #1 alarm	

Menu		Display content/parameter name	
	75	Set the lower limit flow value of #2 alarm	exceeds this window, an alarm signal output will be generated. The alarm signal can be output to the outside by setting OCT or relay.
	76	Set the upper limit flow value of #2 alarm	
	77	Buzzer setting options	
	78	Setting the relay open circuit (OCT) output option	
	79	Set relay (or OCT2) output options	
	80	Select the quantitative (batch) controller control signal	
	81	Flow quantitative (batch) controller	
Calorimetry	82	Daily, monthly and annual totalizer, view the accumulated flow and heat of each day, month and year	
	83	Automatically add a cut-off flow switch. Default is off. Please note that this function cannot be used under certain conditions.	
	84	Select the thermal unit, you can choose gigajoule, kilocalorie, kilowatt-hour, or BTU British thermal unit.	
	85	Select the temperature signal source. If you choose to input the temperature signal through AI3 or AI4, you need a temperature transmitter that can output 4-20 mA current signal.	
	86	Heat capacity, by default, uses the GB-CJ128 enthalpy difference method. The temperature difference method can also be used.	
	87	Heat accumulator switch	
	88	Heat accumulation multiplier	
Calorimetry	89	Display current temperature difference and set temperature difference sensitivity	

Menu		Display content/parameter name
	8 -	Choose whether to install the heat meter on the water supply pipe or the return pipe
diagnosis	* 90	Displays signal strength and signal quality
	* 91	Display signal transmission time ratio
	92	Displays the calculated fluid sound velocity
	93	Display total transfer time/time difference
	94	Display of Reynolds number and its pipe coefficient
	95	Display positive and negative heat accumulation and start the cycle display function
Additional Window	+0	Display power on and off time and flow rate
	+1	Display the total working time of the flow meter
	+2	Display the last power failure time
	+3	Display the flow rate when the power was last turned off
	+4	Display total power-on times
	+5	Scientific calculator
	+6	Fluid sound velocity threshold setting
	+7	Net cumulative amount this month
	+8	Net accumulation this year
	+9	Fault operation time (including power outage time)
Hardware Tuning Window	.2	Store static zero point
	.5	Q value threshold setting
	.8	Maximum instantaneous flow rate of the day and month
	.9	with CMM command output
	-0	Circuit hardware parameter adjustment entry (enter the password to enter the window below)
	-1	4-20 mA current loop calibration
	-2	AI3 analog input 4 mA input calibration
	-3	AI3 analog input 20 mA input calibration
	-4	AI4 analog input 4 mA input calibration
	-5	AI4 analog input 20 mA input calibration

Menu		Display content/parameter name
	-6	AI5 analog input 4 mA input calibration
	-7	AI5 analog input 20 mA input calibration
	-8	Platinum resistance at low temperature (＜40℃) Zero setting
Hardware Tuning Window	—9	Zero setting for high temperature platinum resistance (＞55 ℃)
	-A	Platinum resistance standard calibration at 50℃
	-B	Platinum resistance standard calibrated at 84.5 ℃

6.3 Quick Setup of Measurement Parameters

Accurate measurement parameters have a significant impact on both measurement accuracy and reliability. It is recommended to measure the actual pipe circumference and wall thickness on site. The wall thickness can be measured using an ultrasonic thickness gauge.

The initial parameter setup spans from MENU10 to MENU29 and should be completed step by step.

Before measurement, the ultrasonic flowmeter/BTU meter requires the following parameters to be entered:

- Pipe outer diameter (in millimeters)
- Pipe wall thickness (in millimeters)
- Pipe material
- Liner parameters (if any, including liner thickness and acoustic velocity of the liner)
- Liquid type
- Sensor type (as the host supports multiple sensor types)
- Sensor installation method

The general steps for entering the above parameters are as follows:

(1) Press【M】【1】【1】 to enter Window 11, input the pipe diameter, then press 【ENT】.

(2) Press【▽】to enter Window 12, input the wall thickness, then press【ENT】.

(3) Press 【▽】 to enter Window 13, press 【ENT】, then use 【△】 or 【▽】

to select the pipe material and press 【ENT】.

(4) Press 【▽】 to enter Window 16, press 【ENT】, then use 【△】 or 【▽】 to select the liner and press 【ENT】.

(5) Press 【▽】 to enter Window 20, press 【ENT】, then use 【△】 or 【▽】 to select the fluid type and press 【ENT】.

(6) Press 【▽】 to enter Window 23, press 【ENT】, then use 【△】 or 【▽】 to select the sensor type and press 【ENT】.

(7) Press 【▽】 to enter Window 24, press 【ENT】, then use 【△】 or 【▽】 to select the installation method and press 【ENT】.

(8) Press 【▽】 to enter Window 25, install the sensors according to the displayed installation distance and the previously selected installation method.

(9) Press 【MENU】 to enter Window 26 to save the parameters. The data will be retained even after a power outage.

7 FAQs

(1) How to Identify the Flow Direction in a Pipeline

After the sensor and wiring are properly installed, the positive display of the instantaneous flow represents the forward flow direction; that is, it flows from the upstream probe to the downstream probe. Similarly, the negative display value of the instantaneous flow display stands for the reverse flow direction.

(2) How to Eliminate Invalid Accumulation Using Zero-Cutoff

The value set in Window 41 is known as the low-flow cutoff. When the system detects that the absolute flow velocity is below this threshold, it treats the flow as zero. This helps prevent false accumulation caused by measurement errors when the actual flow is zero. Typically, this value is set to 0.03 m/s. Once the flow rate exceeds this cutoff threshold, the setting no longer affects measurement results in any way.

(3) How to Perform Zero Calibration

If the pipeline is filled with stationary water but the flowmeter still displays a non-zero reading, you can use Menu 42 to perform a zero calibration. Make sure the system remains undisturbed during this process. After calibration, use Menu M.2 to save the zero point to memory.

(4) How to Adjust the Meter Factor for Calibration

After extended use, the flowmeter may begin to drift, resulting in inaccurate readings. To correct this, you can update the meter factor (also called the scale factor) in Window M45. Simply input the ratio of the actual reference value to the measured value. This calibration value should be based on real test results to ensure accuracy.

(5) How to Use the (4 – 20) mA Current Loop Output

The ultrasonic flowmeter/BTU meter comes with a current loop output channel, featuring an accuracy better than 0.1%. You can configure it to output in formats such as 4 – 20 mA or 0 – 20 mA using Window M55.

- Set the flow rate corresponding to 4 mA in Window M56.
- Set the flow rate corresponding to 20 mA in Window M57.

If flow direction matters in your application, you can enable a 0 – 4 – 20 mA output mode. In this case, the meter outputs 0 – 4 mA when flow is in the negative direction, and 4 – 20 mA when it's positive. This output mode is selected in Window M155.

To verify the accuracy of the output signal, you can force the current loop to output a specific value using Window M58.

(6) How to Output Totalized Pulse Signals

The ultrasonic flowmeter/BTU meter can generate a pulse signal for each unit of flow that passes through the system. These totalized pulses are output only through hardware interfaces—either an OCT (open collector transistor) or a relay—so the corresponding hardware settings must also be configured (see Windows M78 and M79).

For example, to output forward totalized pulses via relay, with each pulse representing 0.1 m^3 of flow, follow these steps:

- In Window M32, set the totalized flow unit to "Cubic meters (m^3)"
- In Window M33, choose the multiplication factor: "2 × 0.1"
- In Window M79, select "Forward totalized pulse output"

Note: Be sure to select a suitable pulse value. If the pulse interval is too long (i.e., value too large), the update rate will be too slow. If the value is too small, the relay will activate too frequently, shortening its lifespan and potentially causing missed pulses due to rapid switching. A recommended output rate is 1 to 60 pulses per minute.

(7) How to Use OCT Output

The OCT (open collector transistor) output of the ultrasonic flowmeter/heat meter is electrically isolated and supports up to DC 60 V, 100 mA. You can configure its trigger conditions via Window M78. For wiring instructions, refer to the installation and wiring diagram on page 4.

(8) How to Use Relay Output

The relay output of the ultrasonic flowmeter/heat meter supports up to AC 125 V or DC 28 V at 1 A. Its activation conditions can be configured in Window M78.

(9) How to Use the Batch Controller (Quantitative Control)

The flowmeter/heat meter includes a built-in batch controller for performing volume-based control tasks. It can be triggered via keypad input or by detecting rising/falling edges of an analog input signal. Output signals can be routed through either the OCT or relay interface.

When using an analog input as the trigger signal:

- A current above 2 mA is interpreted as “on” (logic 1)
- A 0 mA signal is interpreted as “off” (logic 0)

Configuration steps:

- Use Window M80 to select the control input signal
- Use Window M78 (for OCT) or M79 (for relay) to select function 8: “Batch controller output”

This will allow the controller to send signals through the corresponding output channel.

The target batch volume is set in Window M81. Once entered, the batch controller begins its operation. Calibration data is temporarily stored in the main unit's RAM, which is protected against power loss. To save calibration results permanently, go to Menu M26 and select option “1” to store them in internal FLASH memory. This ensures data retention even if the backup battery is removed.

(10) How to Enter Linearization Data for Multi-Point Correction

The ultrasonic flowmeter/BTU meter supports multi-point linearization to correct for flow non-linearity, allowing up to 11 segments for piecewise correction. This function is disabled by default. To enable it, go to menu M48 and enter the password: 1111.

To avoid sudden jumps in the correction factor outside the measured flow range, two additional points are added beyond the actual test range:

- A 0 m^3/h point, assigned the same correction factor as your lowest measured flow point
- A 100000 m^3/h point, assigned the same factor as your highest measured flow point

This ensures a smooth transition at the boundaries. Once all points—including

these two—are ready, enter them into menu M48 in ascending order of flow rate. To disable this feature, simply set the number of segments to 0 in the same menu. The table below provides an example of a 5-point linear correction configuration.

Standard unit flow rate(m^3/h)	Indicated flow rate(m^3/h)	Correction factor (standard/indicated)
0	0	1
1.02	0.998	1.02
5.11	5.505	0.93
10.34	10.85	0.95
20.45	19.78	1.03
50.56	51.23	0.99
100000	100000	1

(11) How to Enable Heat Measurement

To enable thermal energy measurement, simply connect a 3-wire PT100 temperature sensor to the ultrasonic flowmeter. Once connected, the device can calculate heat transfer based on the measured flow and temperature differential. Refer to the wiring diagram for proper connection.

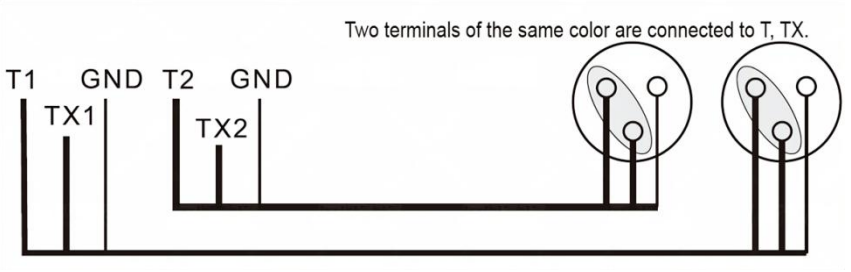


Fig.44

(12) How to Use the SD Card Storage Module

The external SD card module allows for high-capacity storage of both configuration parameters and measurement data.

The memory capacity of supported SD cards range from 512 MB to 4 GB (standard SD format only).

(Note: Some third-party SD cards may be incompatible. For best results, please purchase the cards provided by our manufacturer.)

To ensure the SD card functions properly, follow these setup steps:

① Use menu M50 to select which types of data you want to store.

② Use menu M51 to define:

- ❖ The start time (use **：**：**to indicate immediate start)
- ❖ The logging interval
- ❖ The number of records to store

(Setting the record count to 9999 enables continuous logging with no time limit.)

③ In menu M52, make sure to route the flowmeter's data to the "internal serial bus", which allows the system to transfer data to the SD card module correctly.

8 Fault Analysis and Troubleshooting

The ultrasonic flow meter/ heat meter is designed with a complete self-diagnosis function . The problems found are displayed in the upper right corner of the LCD display in the form of codes in chronological order . The M08 menu can display all existing fault problems in sequence.

Table 13 Error and Troubleshooting

Code	M08 menu corresponding display	Possible causes	Workaround
*R	The system is working properly	System normal	/
*J	Measurement circuit hardware error	Hardware failure	Contact us
*I	No reception signal detected	No signal received	Check whether the sensor is close to the pipe and whether there is sufficient coupling agent.
		The sensor is in poor contact with the pipe or the coupling agent is too little	Check that the sensor surface is free of rust, paint and corrosion; add sufficient coupling agent.
		Improper sensor installation	Check whether the initial adoption number is set correctly
		Excessive scaling on the inner wall	Clear the structure or change the test point
		New lining	Wait until the lining is solidified and saturated before testing
*H	The received signal strength is low and the	Low signal	Solution is the same as above
		Poor signal quality	

Code	M08 menu corresponding display	Possible causes	Workaround
	quality is poor		
*E	The current loop current is greater than 20mA (does not affect normal measurement, if the current output is not used, it can be ignored)	(4~20) mA current output overflow exceeds 100%	Recheck the settings or confirm whether the actual flow rate is too large
		Current output setting error	
*Q	The frequency output is higher than the set value (does not affect normal measurement, if the frequency output is not used, it can be ignored	Frequency output overflow 120% The frequency output setting is wrong or the actual flow rate is too large	Recheck the frequency output (see M66~M69 window instructions) to set or confirm whether the actual flow is too large.
*F	See Table 12	Problems found during power-on self-test	Re-energize and observe the information displayed on the display, and handle according to Table 12
		Permanent hardware failure	
*G	Gain adjustment in progress > S1	If the device stops at S1 or S2, or only switches between S1 and S2, it means that the received signal is too low or the waveform is not good.	
	Gain adjustment in progress > S2		
	Gain adjustment in progress > S3		
	Gain adjustment in progress > S4		
*K	Pipeline empty, M29 menu settings	No fluid in the pipe or wrong setup	If there is fluid in the pipe, enter a value of 0 in the M29 menu.

Ultrasonic flowmeters/BTU meters are generally checked for hardware failures every time they are powered on, and some hardware failures can be detected during normal operation.

The displayed errors are divided into two categories: one is circuit hardware error information, and the possible problems and solutions are shown in the table below. If a problem is found during the power-on self-test, "* F" will be displayed in the upper left corner of the display after entering the measurement state. You can power on again, check the displayed information, and take specific measures according to the table below. If the problem persists, please contact our company.

Table 14 LCD display errors and solutions

LCD display shows information	Possible causes	Troubleshooting
Program ROM checksum error	The system ROM is illegal or has errors	Contact us
Data storage read and write error	Memory parameter data is incorrect	1. Re-power on; 2. Contact our company
System data memory error	System storage data area error	1. Re-power on; 2. Contact our company
Measurement circuit hardware error	Sub-CPU circuit fatal error	1. Re-power on; 2. Contact our company
The main frequency is wrong! Check the crystal oscillator	System clock error	1. Re-power on; 2. Contact our company
Wrong time and date	System time and date error	Reset date and time
The monitor does not display or displays confusingly, does not work, and other strange phenomena	The cable connecting the panel is in poor contact	Check whether the cable connecting the panel is in good contact. This state does not affect normal measurement.
Buttons not responding	Connector contact is poor	Same as above

Appendix A Communication Protocol

The ultrasonic flowmeter/BTU meter comes with a built-in isolated RS485 interface and supports multiple commonly used communication protocols, including MODBUS, M-BUS, FUJI extended protocol, and other protocols used by domestic manufacturers.

By default, the device uses MODBUS-ASCII. If you need to switch to MODBUS-RTU, go to menu M63 and select MODBUS-RTU Only.Below is a table of commonly used addresses in the MODBUS protocol:

Table 15 Register Address

Register	Length	Register	Data	Description
0001-0002	2	Instantaneous flow	REAL4	Unit: cubic meter/hour
0003-0004	2	Instantaneous heat flow	REAL4	Unit: GJ/ hour
0005-0006	2	Fluid velocity	REAL4	Unit: m/s
0007-0008	2	Measuring the speed of sound in fluids	REAL4	Unit: m/s
0009-0010	2	Positive total flow	LONG	Units controlled by M32
0011-0012	2	Positive cumulative flow fraction	REAL4	Also called FLOAT
0013-0014	2	Negative total flow	LONG	
0015-0016	2	Negative cumulative flow decimal part	REAL4	
0017-0018	2	Positive accumulated heat	LONG	Units controlled by M84
0019-0020	2	Positive cumulative heat fraction	REAL4	
0021-0022	2	Negative cumulative heat	LONG	

Register	Length	Register	Data	Description
0023-0024	2	Negative cumulative heat fraction	REAL4	
0025-0026	2	Net cumulative flow	LONG	
0027-0028	2	Decimal part of net cumulative flow	REAL4	
0029-0030	2	Net accumulated heat	LONG	
0031-0032	2	Net accumulated heat fraction	REAL4	
0033-0034	2	Temperature 1/Water supply temperature	REAL4	Unit: ℃
0035-0036	2	Temperature 2/Return water temperature	REAL4	Unit: ℃

The FUJI extended protocol is based on the original communication protocol used in FUJI ultrasonic flowmeters from Japan, with additional enhancements. It uses character-based commands for both sending and receiving, which simplifies the development and debugging of communication programs. This protocol also supports a simulated keyboard, enabling virtual keypad operations.

The flowmeter also offers compatibility with various third-party protocols, including those used in water meters and by other domestic manufacturers. To help users integrate the ultrasonic flowmeter/BTU meter into data acquisition systems originally developed for other brands, the device supports up to eight types of compatible communication protocols. To use one of these, first select “MODBUS ASCII” in menu M63, then choose the desired compatible protocol from the list.

Additionally, the device can function as a basic RTU (Remote Terminal Unit). With MODBUS or FUJI extended protocols, you can control outputs such as the current loop and OCT (Open Collector Transistor), allowing for remote operation of external equipment. It also supports three channels of 4–20 mA analog input (AI3,

AI4, AI5), which can be used to capture external signals like pressure, level, or temperature.

If integration into a PROFIBUS network is adopted, the flowmeter can be easily connected via a MODBUS-to-PROFIBUS converter.

With a GPRS communication module, the device can transmit its measurement data over the internet using the RS-485 interface, enabling remote monitoring. All data exchange is handled through a command–response mechanism—the host system sends a command, and the flowmeter responds accordingly.

For data logging and monitoring, you can use our in-house developed general or dedicated flow/heat monitoring systems. These systems are tailored to the characteristics of our ultrasonic flowmeters/BTU meters and make full use of the device's hardware and software features. They offer a streamlined, cost-effective, and reliable solution.

For full technical details on supported protocols, please contact our company directly or visit our website to download the communication protocol documentation.

Appendix B Common Parameters

Table 16 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	Viscosity		Liquid	Sound	Viscosity

	Velocity (m/s)				Velocity (m/s)	
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

Table 17 Sound velocity of common materials

Tube material	Sound Velocity(m/s)		Lining material	Sound Velocity(m/s)
Steel	3206		Teflon	1225
Iron	3230		Ductile Iron	3000
Cast iron lead	2460		Stainless steel	3206
Lead	2170		Polyethylene	2640
ABS	2286		Titanium	3150
Aluminum	3048		Cement	4190
Brass	2270		Asphalt	2540
Cast iron	2460		Enamel	2540
Bronze	2270		Glass	5970
Fiberglass	3430		Plastic	2280
Glass	3276		PE	1600
PE	1950		PTFE	1450
Acrylic	2644		FRP	2505
PVC	2540		Rubber	1600
Mortar	2500		Asphalt Epoxy	2505