

Handheld

Ultrasonic Flowmeter / Heat Meter

User Manual



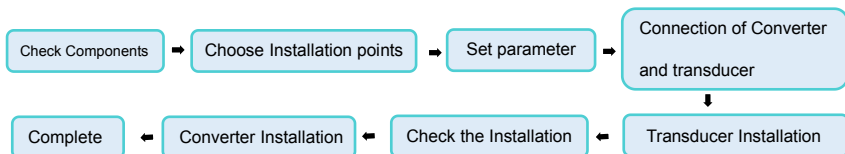
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You are welcome to purchase a handheld ultrasonic flow meter/heat meter.

This instruction manual explains the characteristics, configuration, measurement methods, how to use, causes of failure, and maintenance of handheld ultrasonic flowmeters/heat meters. To ensure proper use, please read the manual carefully before use. In addition, please keep this instruction manual in a place where the user can consult it at any time.

Installation Procedure



Chapter 1 Products Categories

1.1 Composition of Ultrasonic flow /Heat meter

Ultrasonic Flow meter = Converter + transducer + accessory

Ultrasonic Heat meter = Converter + transducer + temperature transducer + accessory

1.2 Confirmation of purchasing the mainframe

Please confirm the type of mainframe you purchased according to the classification of the mainframes..

Handheld Ultrasonic Flow meter	Handheld Ultrasonic Heat Meter
	

1.3 Confirmation of purchasing the sensor.

Please confirm the type of the sensor you purchased according to the classification of the sensors.

Flow transducer

Classification		Picture	Model	Measuring range	Temperature
external clamp type	normal temperature type		S1 (small)	DN15-100	-30~90℃
			M1 (medium)	DN50-700	
			L1 (large)	DN300-6000	
	high temperature type		S1-HT (small)	DN15-100	-30~160℃
			M1-HT (medium)	DN50-700	
			L1-HT (large)	DN300-6000	

temperature sensor

Classification	Picture	Model	Measuring range	Temperature range	Cutoff water
Clamp on		CT-1	≥DN50	-40~160℃	No need

1.4 Technical specs

Category	Performance, Parameters
Measurement accuracy	Flow rate $\pm 1\%$, heat $\pm 2\%$
Diameter range	15mm~6000mm
Pipe material	Steel, stainless steel, cast iron, PVC, copper, aluminum, and all dense pipes, allowing linings.
Measuring medium	Water, seawater, industrial sewage, acid-base liquid, alcohol, various oils, and other single and uniform liquids that can conduct

	ultrasonic waves
Display	4×8 Chinese or 4×16 Western dot-matrix backlit LCD
Language type	Chinese, English, Italian, Spanish, Turkish five languages
Buttons	16 + 2 touch keyboard
Communication interface	Type-C interface, can be connected to a computer or charged
Communication protocol	MODBUS
Data record	Built-in data recorder, can store 16,500 sets of measurement data
Power supply mode	Built-in high-capacity nickel-metal-hydrate rechargeable battery, can also use three alkaline batteries, supporting the flowmeter to work continuously for more than 10 hours; using a power adapter, can achieve uninterrupted measurement
Power consumption	1.1W
Shell material	Flame-retardant ABS

Chapter 2 Measuring Diagrams

2.1 Measurement composition diagram

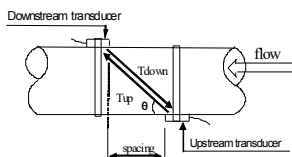
Flow measurement composition diagram	Heat measurement composition diagram.
	

2.2 working principle

When the ultrasonic beam propagates in the liquid, the flow of the liquid will cause a slight change in the propagation time, and the change in the propagation time is proportional to the flow velocity of the liquid. At zero flow rate, the time required for the two sensors to emit and receive sound waves is exactly the same (the only technology that can actually measure zero flow), and when the liquid is flowing, the sound wave transmission time in the countercurrent direction is greater than the sound wave transmission time in the downstream direction.

The relationship conforms to the following expression: :

$$V = \frac{MD}{\sin 2\theta} \times \frac{\Delta T}{T_{up} \bullet T_{down}}$$



Where:

θ : The angle between the beam and the direction of liquid flow.

M: The number of straight-line propagations of the sound beam in the liquid.

D: The inner diameter of the pipeline.

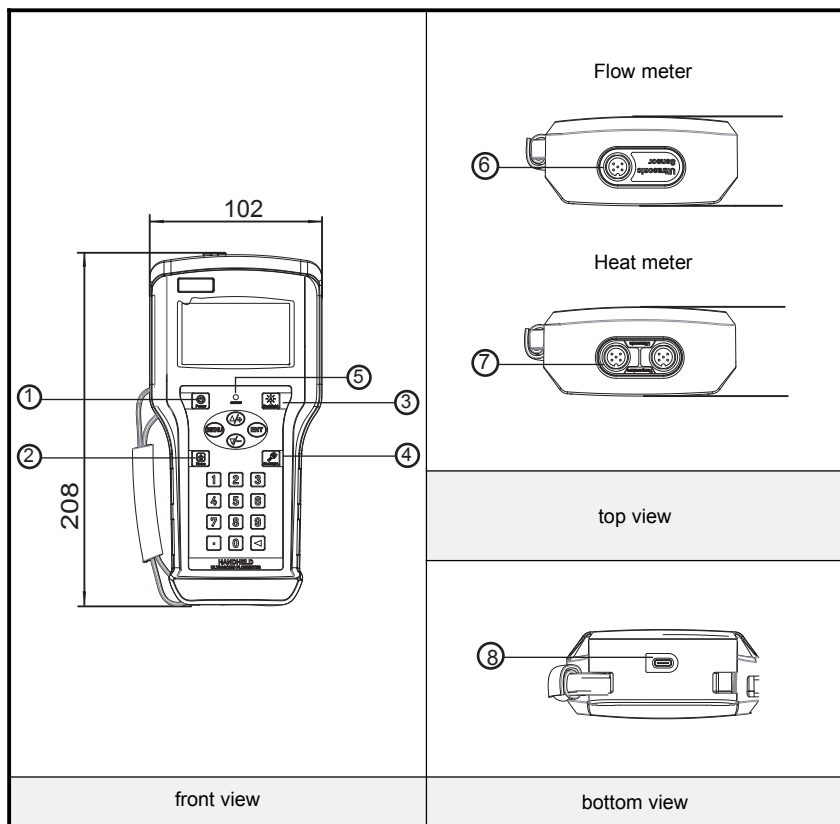
T_{up} : The propagation time of the sound beam in the positive direction.

T_{down} : The propagation time of the sound beam in the reverse direction.

$$\Delta T = T_{up} - T_{down}.$$

Chapter 3 Converter Installation and Wiring Diagram

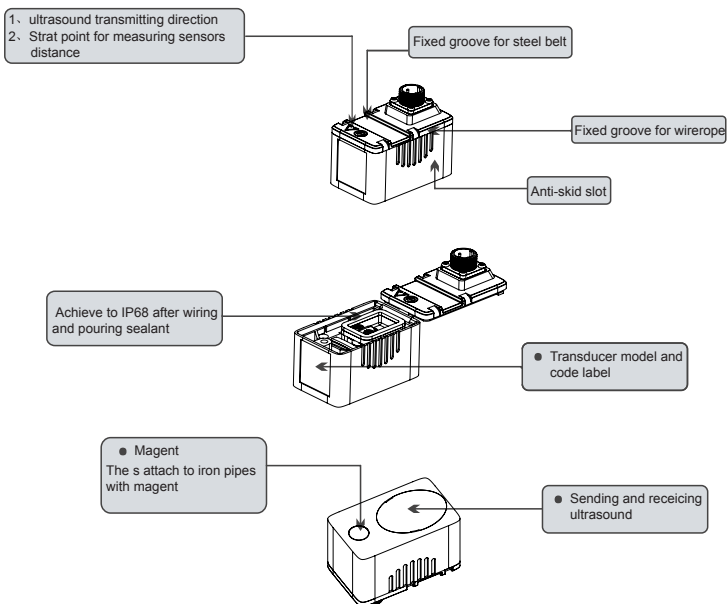
§1.6.2.2 Handheld ultrasonic flowmeter / heat meter.



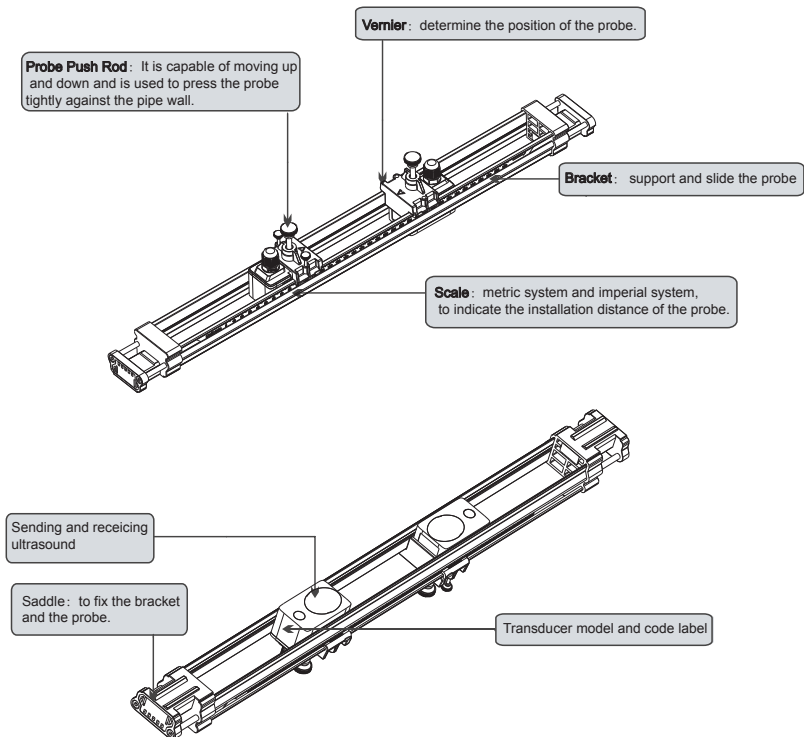
1. Power on/off key: Long press this key for 3 seconds to power on or off the device.
2. Home in-situ key: Press this key to return to the MENU 00 window.
3. Backlight Bluetooth key.
4. Flashlight: Press this key to turn on and off the flashlight at the back of the main unit.
5. Charging indicator light: Red light: charging; Green light: fully charged.
6. Flow sensor connection port.
7. Flow/heat sensor connection port.
8. Type-C interface: Can be connected to a computer or used for charging.

Chapter 4 Transducer Introduction and Wiring Diagram

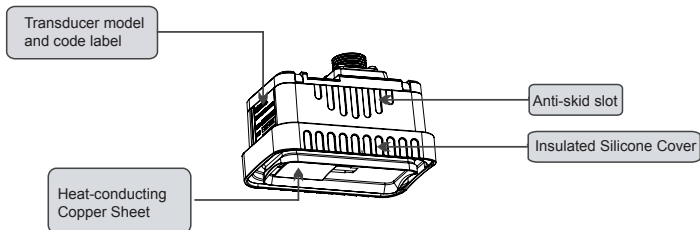
4.1 clamp-on sensor



4.2 bracket-type sensor



4.3 externally attached temperature sensor



Chapter 5 Display and Operation

5.1 Display and keyboard

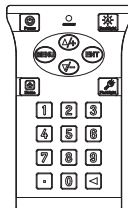
0-9 and "." are used for inputting numbers or menu number ;

⏮ is used for back left or delete the left character ;

▲/▶ and ▼/◀ are used for entering into the last and next menu. Also can be used as ± sign when inputting numbers.

MENU is used for accessing the menu. Press this key first, then type the number keys to enter into the matched menu.

ENT is the ENTER key, used for confirming the contents you input or choose



5.2 Menu Details

Window arrangement according to the following rules, keep in mind these window arrangements, can effectively improve the operation speed, but also facilitate the use of shortcut keys.

- MENU "0 ~ 9" is the basic information and Settings window ;
- MENU "00 ~ 09" is the flow / heat measurement display window ;
- MENU "10 ~ 19" is the measurement initial parameter setting window ;
- MENU "20 ~ 29" is the initial parameter setting window for heat measurement ;
- MENU "30 ~ 39" is the flow unit and cumulator setting window ;
- MENU "40 ~ 46" is the flow setting and correction window ;
- MENU "50 ~ 55" is the communication and data transmission setting window ;
- MENU "60 ~ 69" is the signal input and output setting window ;
- MENU "70 ~ 74" is the measurement status and quantitative control window ;
- MENU "90 ~ 95" is the hardware adjustment setting window ;
- MENU "+0 ~ +9" is the additional common function window.

5.3 Overview of Menu Windows

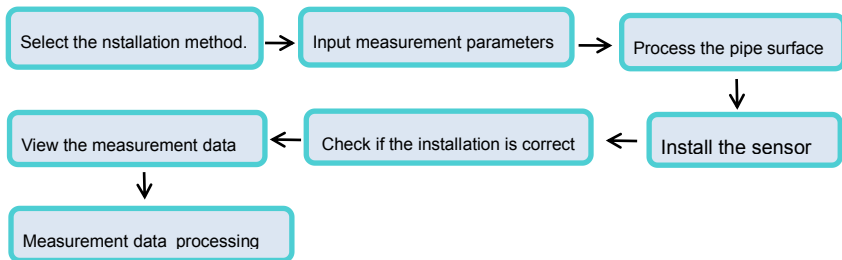
Flow / heat measurements display		Measurement initial settings	
M00	Display the instantaneous flow rate / flow rate / status bar	M10	Enter the pipe size
M01	Display the instantaneous flow / net cumulative flow / status bar	M11	Pipe material type
M02	Display the instantaneous flow / positive cumulative flow / status bar	M12	Select lining material
M03	Display the instantaneous flow / negative cumulative flow / status bar	M13	Select the fluid type
M04	Display the instantaneous flow rate / 4-20 mA histogram	M14	Select probe type
M05	Display instantaneous traffic/Pressure/temperature	M15	Probe installation distance
M06	Display the heat flow rate / total heat	M16	Read storage parameters
M07	Display heat flow rate/4-20mA bar chart	M17	Data handling
M08	Display temperature T1, T2 and corresponding resistance values	M18	Signal excision
M09	Display the current value corresponding to the analog input AI3/AI4	M19	Set flow range
Flow units and accumulator settings		Flow rate setting and correction	
M20	Flow Unit Settings	M30	Camping coefficient
M21	Instantaneous flow unit	M31	Low flow rate excision values
M22	Cumulative flow unit	M32	Set static zero
M23	Traffic multiplier factor	M33	Clear the static zero
M24	Cumulator switch	M34	Manual zero point setting
M25	Accumulator reset	M35	Instrument correction factor
M26	Manual Accumulator	M36	Correction of line coefficient
M27	Power outage flow compensation		
M28	Pressuer Unit		
Heat setting and corrections		Communication and data storage	
M40	Heat flow unit setting	M50	Address code
M41	Cumulative heat unit	M51	RS485 serial port settings
M42	Heat multiplicative factor	M52	Communication protocol selection
M43	Heat Accumulator Switch	M53	Timer set
M44	Select temperature source	M54	Data timing output
M45	Heat accumulation method	M55	Data output flow
M46	Installation method of heat meter		
M47	Temperature difference and		

Instructions for the Use of Handheld Ultrasonic Flowmeter/Heat Meter

	sensitivity		
M48	Zero temperature difference setting		
M49	Temperature correction		
M4+	Manual temperature correction		
Input / output signal settings		History query	
M60	Analog input range	M80	Current traffic query
M61	Analog Input Calibration	M81	Historical traffic query
M62	Analog input mode	M82	Current heat query
M63	Output value of Current loop	M83	Historical heat query
M64	Current value of Current loop	M84	Timing of working hours
M65	OCT output options	M85	Working time query
M66	OCT pulse width setting	M86	Power outage query
M67	RLY relay output	M87	Flow and heat query at power on time
M68	Frequency output settings	Measurements status is shown	
M69	Beeper setup	M90	Signal strength/quality
M70	#1 Alarm settings	M91	Transmission time ratio
M71	#2 Alarm settings	M92	Total propagation time difference
M72	Quantitative control start source	M93	Fluid sound velocity
M73	Quantitative controller		
M74	FlowBatch Controller		

Chapter 6 Flow Measurement

The flow measurement of the handheld ultrasonic flowmeter/heat meter is simple and convenient. Just select an appropriate installation point, input the pipeline parameters at the installation point on the main unit, and then install the sensor on the pipe surface according to the sensor installation distance provided by the main unit, and connect it to the main unit with a special ultrasonic cable to complete the flow measurement. The operation can be carried out as follows:



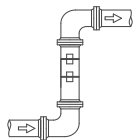
6.1 Choose installation points

Proper installation point is a key for transducer installation. Following factors must be considered:

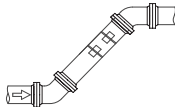
Full filled pipeline, shaking, steady flow, scaling, temperature, pressure, EMI, instrument well.

● 6.11 Full filled pipeline

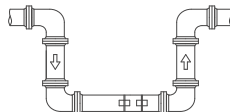
Following situations can be full filled of liquid



Vertical upward



Obliquely upward



Lowest point

● 6.12 Shaking

There cannot be obvious shaking on the installation point, otherwise it needs to be tightened.

● Steady flow

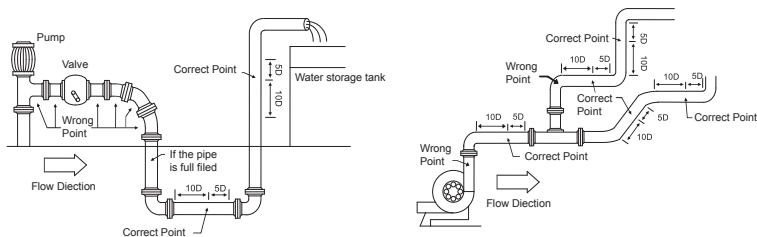
A stable flowing fluid helps to ensure measurement stability and accuracy. A fluid with chaotic flow state can make measurement data unstable or impossible to measure.

Standard requests for steady flow are:

① The pipe should be far away from pump outlet and half-open valve.

10D to upstream and 5D to downstream (D means outer diameter)

② 30D to pump outlet and half-open valve.



If the standard requirements of the steady-flow condition are not met, the following situations can also be attempted for measurement:

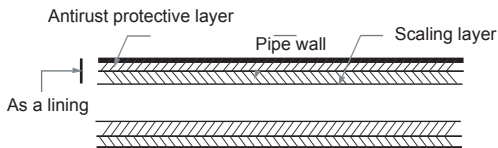
1. There are elbows or buffer devices between the pump outlet, the half-open valve and the installation point.
2. At the inlet of the pump and upstream of the valve.
3. The fluid flow rate is medium or low. (Low flow rate: flow rate < 1 m/s; Medium flow rate: flow rate 1 to 2 m/s; High flow rate: flow rate > 2 m/s).

● 6.13 scale formation

Scale formation on the inner wall of the pipe will attenuate the transmission of ultrasonic signals and will make the inner diameter of the pipe smaller. Therefore, a pipe with scale

formation on the inner wall will cause the flowmeter to not measure properly or affect the measurement accuracy. Hence, it is necessary to try to avoid selecting the place with scale formation on the inner pipe wall as the installation point. If it is impossible to avoid the installation point with scale formation, the following measures can be taken to eliminate or reduce the influence of the measurement due to scale formation on the inner pipe wall.

1. Use a hammer to strike the pipe at the measurement point forcefully until the signal strength at the measurement point increases significantly.
2. Select the Z-method for measurement and set the scale formation as the liner to obtain better measurement accuracy.
3. Replace the pipe at the measurement point anew.



● 6.14 temperature

Exceeding the operating temperature range of the sensor can easily cause damage to the sensor or significantly shorten the lifespan of the sensor. Therefore, the fluid temperature at the installation point must be within the installation and use range of the sensor, and it is better to choose the installation point with a lower temperature as much as possible. So, for the same pipeline, try to avoid the places such as the outlet of boiler water and the outlet of the heat exchanger as much as possible, and install it on the return water pipeline as much as possible (if conditions permit, it is best to measure the temperature at the installation point before measurement).

6.15 interference

The main unit, sensors and cables of the handheld ultrasonic flowmeter / heat meter are prone to interference from interference sources such as frequency converters, radio stations, television stations, microwave communication stations, mobile phone base stations,

high-voltage lines, etc. Therefore, when choosing the installation points of the sensors and the main unit, try to stay away from these interference sources as much as possible.

● 6.2 Input measurement parameters

Before the measurement starts, initial settings need to be carried out to complete the settings of menus 10 to 15. So as to obtain the installation distance of the sensor.

1. Outer diameter of the pipe.
2. Wall thickness of the pipe.
3. Type of pipe material.
4. Parameters of lining material (if any, which can include the thickness of the lining and the sound velocity of the lining material).
5. Type of liquid.
6. Type of sensor (because the main unit can support a variety of different sensors).
7. Installation method of the sensor.

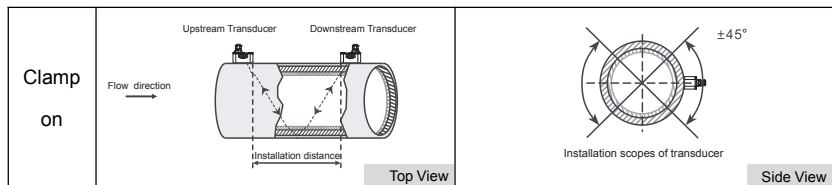
6.3 Installation and commissioning of the sensor.

● 6.3.1 Selection of installation method

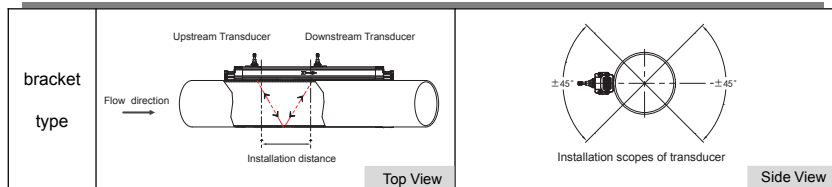
The installation methods of the clamp-on sensor include the V-method and the Z-method.

> > V-method

For pipes of DN15mm - 200mm, the V-method is preferred. When installing, the two sensors are horizontally aligned, and their centerlines are parallel to the axis of the pipe. It should be noted that the transmitting directions must be opposite to each other.

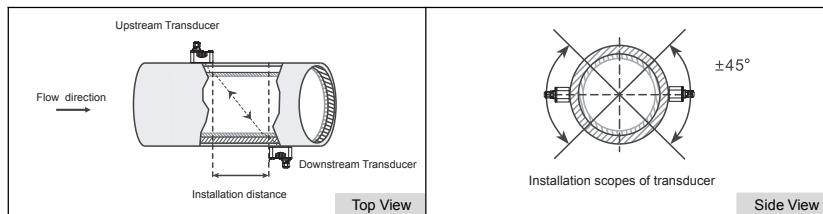


Instructions for the Use of Handheld Ultrasonic Flowmeter/Heat Meter



>> Z-method

For pipes of DN200mm - 6000mm, the Z-method is preferred. The Z-method can also be selected when the V-method cannot detect a signal or the signal quality is poor. When installing, make the vertical distance along the pipe axis between the two sensors equal to the installation distance, and ensure that the two sensors are on the same axial plane, and note that the transmitting directions must be opposite (the directions of the two sensors are facing inward). Since the Z-method is the direct transmission and reception of ultrasonic waves in the medium without reflection, the signal intensity attenuation is the smallest. Therefore, the Z-method has a higher signal strength and is suitable for occasions with a larger diameter, the medium contains impurities or bubbles, the pipeline has scale, and other situations where the ultrasonic signal attenuation is relatively large.



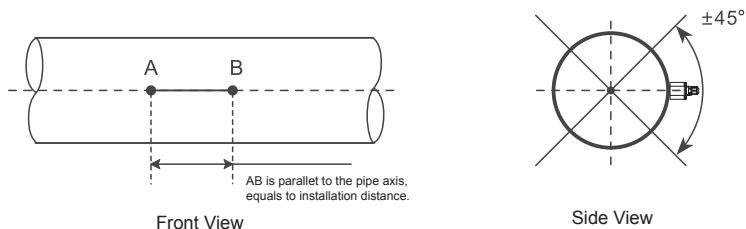
6.3.2 Input the measurement parameters to obtain the installation distance.

Before starting the measurement, it is necessary to perform initial settings on the flowmeter, usually setting item by item in the menus from No. 10 to No. 15. After the setting is completed, the sensor installation distance can be obtained in M15. This distance refers to the distance between the innermost edges of the two sensors (refer to Figure 6.3.1), and install the sensors according to this data.

6.3.3 Positioning installation points

>> V method

The line between two transducers is parallel to pipe axis, and equal to the distance shown in the converter. As shown, A, B are the two installation points.



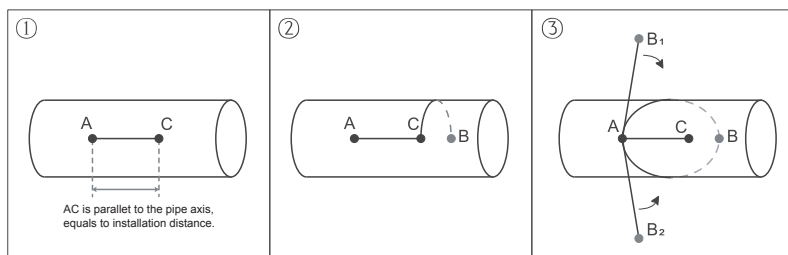
>> Z method

① Firstly according to the installation distance shown in converter, positioning two points A, C on the same side of pipeline. AC is parallel to pipe axis.

② Perpendicular to the pipe axis, opposite to point C, get Point B.

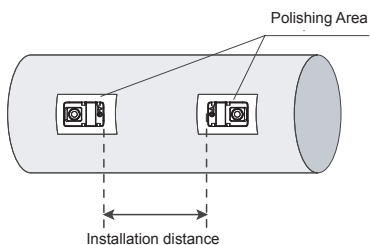
③ Check. Measure the length between A and B from both sides of the pipe, get AB₁ and AB₂. If AB₁ = AB₂, then B is the correct point. If not, need to positioning point B and C again.

As shown, A, B are the two installation points.



6.3.4 Deal with the installation points.

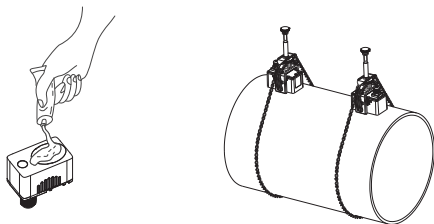
There are two installation points for the clamp-on sensor, which are divided into the upstream sensor and the downstream sensor. When dealing with these two installation points, the processing area of one installation point is approximately the same as the size of the sensor, and the processing area of the other installation point should be about twice the size of the sensor area (with the installation point as the center) to facilitate the debugging of the signal. First, clean the area outside the pipe where the sensor is to be installed, removing rust and paint. If there is a rust-proof layer, it should also be removed. It is best to polish to a metallic luster with a grinder, and then wipe off the oil and dust with a clean rag.



Schematic Diagram of the Surface Treatment at the Installation Point

6.3.5 Install transducers

After transducer wiring and sealing, please evenly smear 2-3mm couplant on the transducer emitting surface. Then put the transducers on the installation points, fixed with steel belt or steel rope.



6.3.6 The debugging of the sensor.

At the center position of the installation point with a larger processing area, apply 4 to

5 mm thick coupling agent attached randomly (applying the coupling agent is to isolate the air between the sensor surface and the pipe surface and reduce the loss when ultrasonic waves are propagating in different media), and then stick the sensor tightly to the pipe wall and glue it well. Note that the transmitting direction of the sensor should be correct, and there cannot be air or gravel between the sensor and the pipe wall. Based on the center point, first slightly move the sensor in the horizontal direction to find the maximum value of the signal intensity and Q value, and then slightly move the sensor in the vertical direction to find the maximum value of the signal intensity and Q value. Then slightly adjust the transmitting angle of the sensor to find the maximum value of the signal intensity and Q value. At this time, the sensor can be positioned. Notes: 1. The cleaner the pipe surface is treated, the higher the signal intensity and Q value may be. 2. When installing, the pipe area where the sensor is installed must be cleaned thoroughly to expose the original luster of the metal. Coupling agent should be applied around the contact part between the sensor and the pipe to prevent air, dust or rust from entering and affecting the ultrasonic signal transmission.

6.3.7 Check installation

This machine has a check function, and the menu M90 is used to check the signal strength and quality, as well as the measured and theoretical transmission time ratio

①Check signal intensity:

The signal strength is represented by numbers ranging from 00.0 to 99.9. 00.0 indicates no signal received, and 99.9 indicates maximum signal. The flow meter can only measure when the signal strength is ≥ 60.0 .

②Check signal quality:

The signal quality Q value is represented by numbers ranging from 00 to 99, with 00 indicating the worst and 99 indicating the best. The general normal working conditions are signal quality Q value > 60 .

When installing, please pay attention to adjusting the sensor to ensure that the signal strength and quality are as high as possible, in order to ensure the long-term stable operation of the flow meter and make the measurement results more accurate.

Signal strength and signal quality installation reference table

Signal strength	Q value
< 60	Can not work
60~75	general
75~80	good
> 80	excellent

③Check transmission time ratio: The transmission time ratio is the percentage ratio of the theoretical transmission time of ultrasound calculated based on the parameters set by the flowmeter to the actual measured transmission time. It represents the relationship between the set measurement parameters and the actual installation distance of the sensor. This value should be between 97% and 103%.

If the transmission time ratio is not between 97% and 103%, it indicates that the set measurement parameters are inconsistent with the sensor installation distance. If the set measurement parameters or sensor installation distance are incorrect, please check them separately.

6.3.8View the measurement data.

When the signal strength, signal quality, and transmission time ratio all meet the measurement requirements, the measurement data obtained at this time is accurate. The measurement data can be viewed in the menus from 00 to 09, including instantaneous flow rate, instantaneous flow velocity, positive cumulative amount, negative cumulative amount, date and time, heat flow rate, total heat, temperature, current value of analog input and corresponding value, and today's net cumulative flow rate, and so on.

Chapter 7 Energy Measurement

7.1 Overview

Energy measurement = Flow measurement + Temperature measurement + Energy accumulation.

Through flow measurement, temperature measurement and energy accumulation, ultrasonic flow meters achieve the measurement of heat/cooling capacity. It is widely used in the metering of energy consumption in industries such as heating, refrigeration, air conditioning, and heat exchange.

7.2 Flow measurement Flow measurement.

Refer to Chapter 4.

7.3 Temperature Measurement

The handheld ultrasonic flow meter/heat meter uses an externally attached PT100 three-wire platinum resistance to complete the temperature measurement. When measuring, just apply thermal conductive silicone grease to the thermal conductive copper sheet of the temperature sensor, then attach it to the water supply and return pipes respectively, and fasten it with a steel band. The other side is connected to the temperature sensor interface (Temperature) on the main unit panel. After waiting for 3 to 5 minutes, the measured temperature can be viewed in the M06 window.

7.4 Energy accumulation.

When the flow sensor and the temperature sensor are both correctly installed on the pipe, the heat flow rate and total heat can be viewed in the M05 window. Note: When

measuring energy, the ultrasonic energy meter defaults to installing the flow sensor on the water supply pipe. When the flow sensor needs to be installed on the return pipe, it is necessary to select in the menu M46: The heat energy meter is installed on the return pipe.

Chapter 8 Measurement Data Processing

8.1 Processing methods of measurement data

The measured data of the handheld ultrasonic flow meter/heat meter have various processing methods, and the data flow control setting can be performed in the M55 menu.

1. Output to internal storage (can store 16,500 sets of measurement data)
2. Output to RS485 (used for MODBUS communication)
3. Output to external storage (can be read directly and can be connected to a Bluetooth printer for printing)

8.2 Storage/printing of measured data

The measured data of the handheld ultrasonic flow meter/heat meter have various processing methods, and the data flow control setting can be performed in the M53 and M54 menus.

MENU53 Timer time setting

Start time: If it is necessary to start printing from the set time, just input the start time. (Note that when inputting the start time, it must be after the current time. Therefore, when using this function, it is necessary to perform time calibration in the M.3 menu to avoid unsuccessful timed printing.) **Interval time:** The unit is hour, minute, and second. The minimum interval is preferably not less than 5 seconds to prevent the printer from not keeping up. **Number of times:** 0 to 9999 times can be selected. Once the printing count reaches the set number of times, the printer stops working.

Next time:

MENU54 Regular data output

In the M54 menu, set the timed print output option to ON, and press ENT to enter the print option setting. Among the total of 22 timed print contents, the option selected as ON is included in the print content; the content selected as OFF will not be printed.

Chapter 9 How to Use

9.1 How to judge the direction of liquid flow in the pipeline

Step 1: Confirm that the flow meter is working properly.

Step 2: Assume that the sensor connected to the upstream wiring of the flowmeter main board is sensor A, and the sensor connected to the downstream wiring is sensor B.

Step 3: Look at whether the instantaneous flow value is a "+" number or a "-" number (the "+" sign is not displayed); if it is a "+" number, it indicates that the direction of the fluid flow is A→B; if it is a "-" number, the direction of the fluid flow is B→A.

9.2 How to change the measurement unit system of the system

Select to use the imperial system or the metric system in the M20 menu window.

9.3 How to select the flow unit and the cumulative flow unit

Select in the M21 and M22 menu windows. After selecting the flow unit, then select the time unit.

9.4 How to open and close the accumulators

Use window 24 to perform the operation of opening or closing the net, positive, and negative accumulators respectively.

9.5 How to realize the zero clearing of the flow accumulator

Use window 25 to select the accumulator to be zero cleared for zero clearing.

9.6 How to use the damper to stabilize the flow display

The function of the damper is to stabilize the flow display, and its essence is a filter. Enter "0" in the M30 window, indicating no damping. Of course, the larger the value, the more stable the instantaneous flow displayed by the flow meter. It is generally recommended that the value entered by the user is about 10 seconds, and the size of this value will not have any impact on the cumulative flow.

9.7 How to use zero cutoff to avoid invalid accumulation

The data in window 31 is called the low flow rate cutoff value. The flow meter regards the flow with the absolute value of the flow rate lower than this value as "0". In this way, this parameter can be set to avoid false accumulation due to the measurement error generated by the flow meter when the real flow is "0". Generally, this parameter is set to 0.03 m/s. When the actual flow rate of the fluid in the pipeline is greater than the low flow rate cutoff value, the low flow rate cutoff value has nothing to do with the measurement result and will never affect the measurement result.

9.8 How to statically calibrate the zero point

When the fluid flow in the pipeline completely stops, the flow meter will not show "0", but there is a very small "zero point value". At this time, the zero point can be set to achieve the purpose of accurate measurement. This function is completed through window M32. After confirming that the fluid flow in the pipeline must be completely stopped, enter window M32 and press ENT to start.

9.9 How to use the buzzer

The built-in buzzer of the ultrasonic flow meter/heat meter is programmable and is set in window M68.

9.10 How to use password protection

Adding a password lock protection to the flow meter can avoid incorrect modifications by irrelevant personnel and clearing of the accumulators. With the password lock added to the flowmeter, data can be viewed, but no modifications can be made. The password entered in window M.4 can consist of 1 to 4 digits; if there is no password lock, just press the ENT key directly, and when unlocking M.4, also press the ENT key directly. If the user forgets the password, please contact the manufacturer and present proof of identity.

9.11 How to modify the instrument coefficient (scale factor) for calibration and calibration

The instrument coefficient refers to the ratio of the "true value" to the "indicated value". For example, when the measured physical quantity is 2.00 and the instrument shows 1.98, then its instrument coefficient is $2/1.98$. It can be seen that the coefficient of the instrument is preferably always 1. But when the instrument is mass-produced, it is difficult to make the coefficient of each instrument be "1". The degree of difference or inconsistency is called the "consistency" of the instrument. Products with high quality must have good consistency. The instrument coefficient of the ultrasonic flow meter (energy meter) is all "1" when leaving the factory, because in the design, it is achieved that the instrument coefficient only depends on the frequency of the crystal oscillator and the two factors of the sensor, and has nothing to do with other circuit parameters. So the default value of the coefficient at the time of the instrument leaving the factory is all "1". Enter the ratio of the true value to the indicated value in window M35 to complete the correction.

9.12 How to use the manual accumulator

In the M38 window, press the ENT key to start accumulating, and then press the ENT key again to stop.

9.13 How to judge the medium

For example, in the application of oil-water separator, in order to judge whether the fluid flowing in the pipeline is water or oil, the lower limit flow velocity of water can be input in the M+6 menu. In this example, 1400 m/s is taken. Then when the fluid flow velocity measured by the ultrasonic flow module is less than 1400 m/s, an internal signal will be generated to indicate that the fluid may be another kind of fluid. This signal can be read out through the MODBUS protocol. When using it, it is necessary to ensure that there is no overlap in the flow velocities of the two fluids.

9.14 How to store and call common pipeline parameters

The handheld ultrasonic flowmeter/heat meter has a data area that can store 9 sets of common pipeline parameters for users. Users can store the common pipeline parameters in it for convenient use in the future. Use the M16 menu for storage and retrieval.

9.15 How to input the linearity broken-line input data

The ultrasonic flowmeter (energy meter) can realize the multi-point linearization correction of the non-linear flow. This function is closed in the product at the time of leaving the factory. Entering the menu M36 can use this function, and the password for this

function is: 12345.

The ultrasonic flowmeter (energy meter) can realize up to 11-segment broken-line correction.

Users can choose any number of points between 2 points and 12 points according to their actual situation to correct the instrument.

In order to illustrate the usage method, we assume that the following test data in the table is obtained through on-line calibration of the instrument:

参照标准装置流量 (m ³ /h)	仪表指示流量 (m ³ /h)	修正系数 (标准/示值)
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

In order to correct the flow that is beyond the flow range without generating sudden changes in the correction coefficient, we add two points (0 m³/h, 1.0) and (100000 m³/h, 1.0) based on the above five correction points. Among them, (0 m³/h, 1.0) is called the "minimum" flow correction point. This set of data is used to facilitate the generation of an appropriate correction coefficient when the indicated flow of the instrument is less than 1.02 m³/h. And (100000 m³/h, 1.0) is called the "maximum" flow correction point, and its function is to facilitate the processing of an appropriate coefficient when the indicated flow of the instrument is greater than 50.56 m³/h. Thus, we obtain the following data group arranged from smallest to largest.

(0, 1.00)

(0.998, 1.02)

(5.505, 0.93)

(10.85, 0.95)

(19.78, 1.03)

(51.23, 0.99)

(100000, 1.00)

There are a total of 7 sets of data. Enter menu M48 and input the above 7 sets of data in sequence (be sure to input them in ascending order), and then the multi-segment broken line correction function setting is completed.

If you need to cancel the broken line correction function, just input "0" in menu M48.

To re-enable the broken line correction function, input the number of data points (in this example, "7") in menu M48 again.

It must be noted that before the user calibrates the instrument, the broken line correction function must be closed first! If the calibration is carried out without closing the broken line correction function and the resulting correction data group must be reverse-corrected according to the original correction curve data before it can be re-input into the instrument. Reverse correction is very complicated and should be avoided as much as possible.

The advantage of the broken line correction function, where the user needs to add two maximum and minimum flow correction point data outside the calibration flow range by themselves, is that the user can achieve specific correction functions by inputting different maximum and minimum flow correction coefficients. For example, the following data points can be input (0, 0), (0.1, 1), (100000, 1) to introduce "non-linearity" between 0 and 0.1 for the instrument to avoid the "self-running" phenomenon of ultrasonic meters near the small flow rate - the actual flow is zero, but the instrument still has an indication. (The self-running phenomenon of ultrasonic meters near the "zero point" is essentially a side effect of the advantage that the ultrasonic flowmeter maintains a straight line near the zero point linearly. Most meters "force" the indicated value of the instrument to be zero through a low flow rate cut-off value.) In order to reduce this side effect, we can adjust and input different correction coefficients of the minimum flow point, select the appropriate correction curve of the instrument, and thus minimize the disadvantage of this side effect as much as possible.

Appendix

1.Common Parameters

Pipe material	sound velocity(m/s)
steel	3206
iron	3230
iron casting	2460
lead	2170
ABS	2286
aluminium	3048
brass	2270
iron casting	2460
bronze	2270
glass fiber reinforced plastics	3430
glass	3276
polyethylene	1950
propenyl	2644
PVC	2540
mortar	2500

. Sound velocity of commonly used materials

Lining material	sound velocity(m/s)
Teflon	1225
nodular cast iron	3000
stainless steel	3206
vinyl chloride	2640
titanium	3150
cement	4190
asphalt	2540
enamel	2540
glass	5970
plastics	2280
polyethylene	1600
teflon	1450
FRP	2505
rubber	1600
Asphalt epoxy	2505

Unit of sound velocity: m/s

2. Common liquid sound velocity and viscosity

Liquid	Sound velocity (m/s)	Viscosity	Liquid	Sound velocity (m/s)	Viscosity
water 20℃	1482	1.0	glycerol	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#gasoline	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		pine oil	1280	
ethanol	1168		tce	1050	0.82
alcohol	1440	1.5	Dagang Aviation Coal	1298	
Ethanone	1310		Daqing 0 # Aviation Coal	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
methyl acetate	1181	0.411	ethyl acetate	1164	
Dicarboxylic acid	1389		heavy water	1388	1.129
carbon disulfide	1158	0.290	Bromoform	931	
n-Propanol	1225		n-pentane	1032	0.366
n-ethane	1083	0.489	light oil	1324	
transformer	1425		Spindle lubricating oil	1342	15.7
petroleum	1295		gasoline	1250	0.4-0.5

For other liquids and materials, please contact the company for sound speed inquiries

Underwater Sound Velocity Table (at 1 standard atmosphere)

Unit: t (°C) v (m/s)

t	v	t	v	t	v	t	v
0	1402.3	25	1496.6	50	1542.5	75	1555.1
1	1407.3	26	1499.2	51	1543.5	76	1555.0
2	1412.2	27	1501.8	52	1544.6	77	1554.9
3	1416.9	28	1504.3	53	1545.5	78	1554.8
4	1421.6	29	1506.7	54	1546.4	79	1554.6
5	1426.1	30	1509.0	55	1547.3	80	1554.4
6	1430.5	31	1511.3	56	1548.1	81	1554.2
7	1434.8	32	1513.5	57	1548.9	82	1553.9
8	1439.1	33	1515.7	58	1549.6	83	1553.6
9	1443.2	34	1517.7	59	1550.3	84	1553.2
10	1447.2	35	1519.7	60	1550.9	85	1552.8
11	1451.1	36	1521.7	61	1551.5	86	1552.4
12	1454.9	37	1523.5	62	1552.0	87	1552.0
13	1458.7	38	1525.3	63	1552.5	88	1551.5
14	1462.3	39	1527.1	64	1553.0	89	1551.0
15	1465.8	40	1528.8	65	1553.4	90	1550.4
16	1469.3	41	1530.4	66	1553.7	91	1549.8
17	1472.7	42	1532.0	67	1554.0	92	1549.2
18	1476.0	43	1533.5	68	1554.3	93	1548.5
19	1479.1	44	1534.9	69	1554.5	94	1547.5
20	1482.3	45	1536.3	70	1554.7	95	1547.1
21	1485.3	46	1537.7	71	1554.9	96	1546.3
22	1488.2	47	1538.9	72	1555.0	97	1545.6
23	1491.1	48	1540.2	73	1555.0	98	1544.7
24	1493.9	49	1541.3	74	1555.1	99	1543.9

