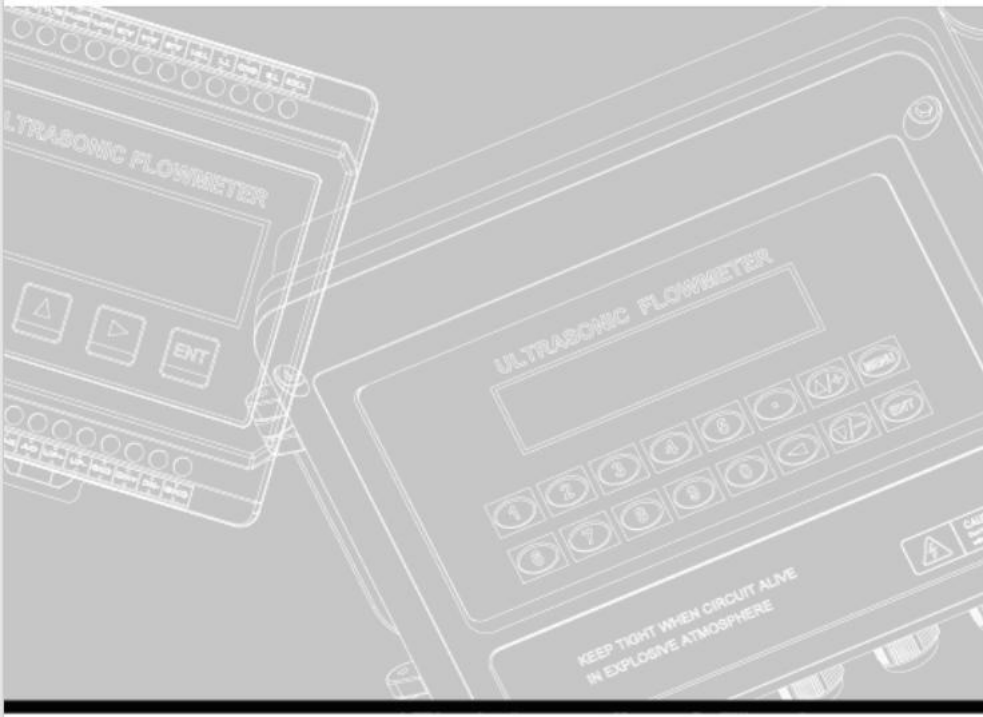
Ultrasonic Flow/Heat Meter

User Mannual



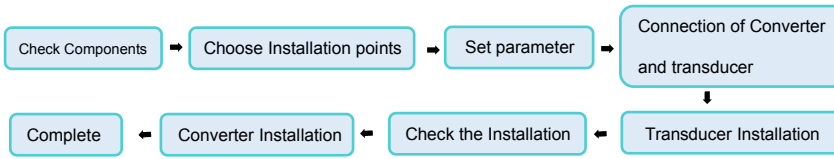
ISO9001

Contents

You are welcome to use our ultrasonic flow meter / heat meter.

Understanding product assortments helps you understand when to use the ordered product and helps you check the configuration of the ordered product. The ultrasonic flow meter is composed of a sensor and a host. It is divided into integrated ultrasonic flow meter and split ultrasonic flow meter.

Installation Procedure



Chapter 1 Products Categories

1.1 Composition of Ultrasonic flow /Heat meter

Ultrasonic Flow meter = Converter + transducer

Ultrasonic Heat meter = Converter + transducer + temperature transducer

1.2 Types of Converters

	Wall mount	Module
Picture		

1.3 Types of Flow transducers

Classification		Picture	Model	Measuring range	Temperature
Clamp on	Normal temperature		S1 (small)	DN15-100	-30~90℃
			M1 (medium)	DN50-700	
			L1 (large)	DN300-6000	
	High temperature		S1-HT (small)	DN15-100	-30~160℃
			M1-HT (medium)	DN50-700	
			L1-HT (large)	DN300-6000	
Insertion type			ATC-1 (standard)	DN50-6000	-30~160℃
			ATC-2 (extended)		
			ATP-1 (parallel)	DN200-6000	

1.4 Types of Temperature transducers

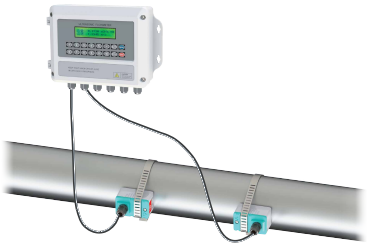
Classification	Picture	Model	Measuring range	Temperature range	Cutoff water
Clamp on		CT-1	≥DN50	-40~160℃	No need
Insertion		TCT-1	≥DN50	-40~160℃	Need
Insertion under pressure		PCT-1	≥DN50	-40~160℃	No need
Insertion small sizes		SCT-1	≤DN40	-40~160℃	Need

1.5 Check accessories

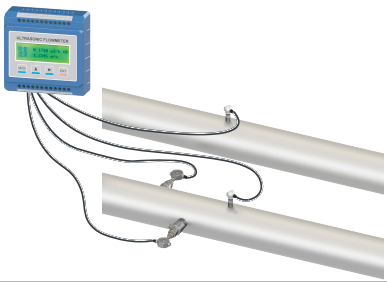
Test the completeness of accessories according to the packing list.

Chapter 2 Measuring Diagrams

2.1 Clamp-on ultrasonic flowmeter measurement

	
Flow measurement diagram	Heat Measurement Diagram

2.2 Insertion type ultrasonic flowmeter

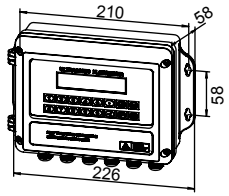
	
Flow measurement diagram	Heat Measurement Diagram

✧ Temperature and heat can be measured by connecting PT100 temperature sensors on both water supply and return pipes.

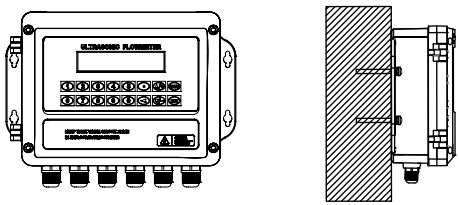
Chapter 3 Converter Installation and Wiring Diagram

3.1 Wall-mounted Separated Mounting

➢ Size



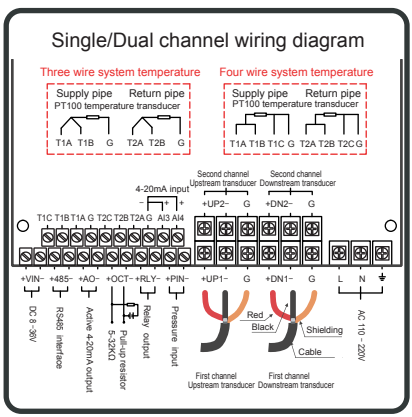
➢ Installation diagram



✧ Wall mounting

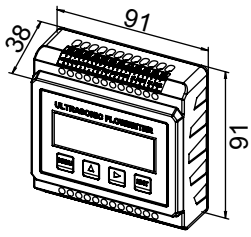
✧ Fix the converter with four Φ6 expansion bolts or normal nails.

➢ Wiring Diagram

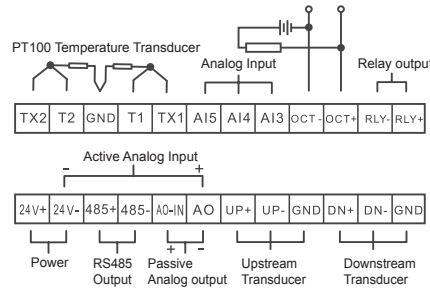


3.2 Module type

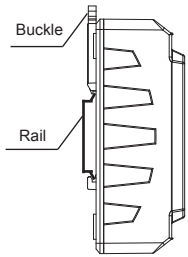
➢ Size



➢ Wiring Diagram



➢ Installation diagram



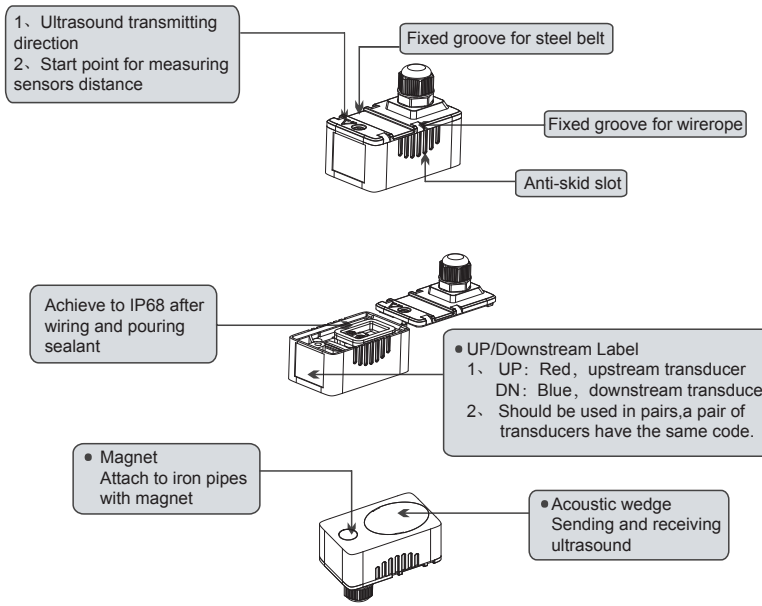
- ✧ The applicable guide rail width is 35mm
- ✧ Adjustable snap fastener, which needs to be lifted, fixed or removed before pressing down during installation or disassembly.

Chapter 4 Transducer Introduction and Wiring Diagram

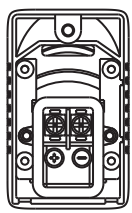
4.1 Clamp on type transducer

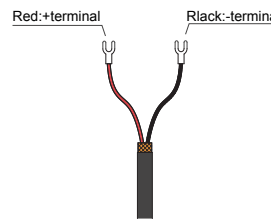
- **Clamp on type transducer**

✧ Introduction



✧ wiring diagram

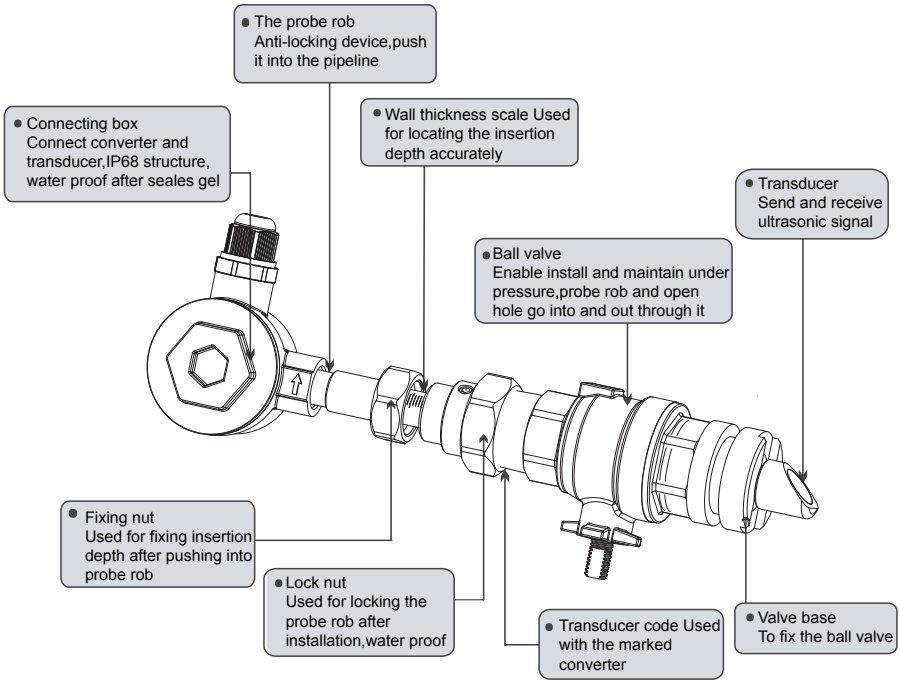




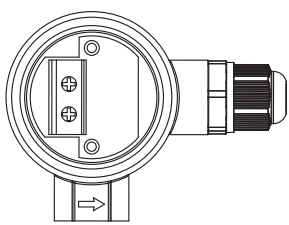
4.2 Insertion type transducer

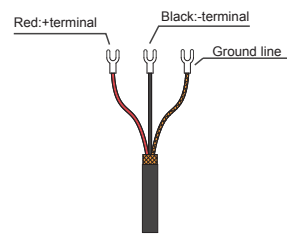
- **Insertion type transducer**

✧ Introduction



✧ Wiring Diagram

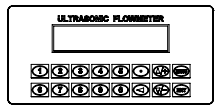




Chapter 5 Display and Operation

5.1 Display and keyboard

- 16-key Keyboard



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

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

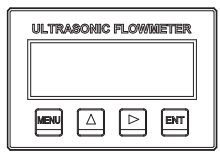
▲/+and**▼/-**are used for entering into the last and next menu.Also can be used as±sign when inputting numbers.

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

> > For details, see "Quick Set measurement parameters" on page 17.

- 4-key Keyboard



MENU : Used for entering into menus.

▲ : Used for menu up or choosing 0~9、+、-、•

▼ : Used for menu down or moving the cursor to next

ENT : Used for finishing menu inputting or entering into submenu.

Operation :

The user interface of this flow meter comprises about 100 different menu windows that are numbered by M00, M01... M+9.

Method to enter Menu: Press **MENU** first, and follow the two-digit number keys. Take M35 as an example, the correct key sequence is **MENU35**

To move between the adjacent menus, press **▲/+** and **▼/-** for 16-key keyboard; press ▲ and ▼ for 4-key keyboard.

5.2 Menu window

Menu	Details
M00	Display flow rate and NET totalizer. Unit selection in M30~M32.
M01	Display flow rate and velocity. Unit selection in M30~M32.
M02	Display flow rate and POS(positive) totalizer. Unit selection in M30~M32.
M03	Display flow rate and NEG(negative) totalizer.Unit selection in M30~M32.
M04	Display date and time, flow rate.
M05	Display heat flow rate and total heat. Unit selection in M84 and M88.
M06	Display temperatures, inlet T1, outlet T2
M07	Display analog inputs, AI3/AI4
M08	Display system error codes. 'R' stands for normal.
M09	Display today's total NET flow
M10	Input outer perimeter.
*M11	Input outer diameter. Available range is 0 to 18000mm.
*M12	Input pipe wall thickness
*M13	Input inner diameter.
*M14	Select pipe material.
M15	Input sound velocity of the pipe material.
M16	Select lining material.
M17	Input sound velocity of the lining material.
M18	Input the lining thickness.
M19	Input the absolute roughness of pipe inner wall.
*M20	Select the liquid type.
M21	Input sound velocity of the liquid.
M22	Input viscosity of the liquid.

*M23	Select the transducer type. Over 20 types can be selected.
*M24	Select the mounting method of transducer.
*M25	Display the transducer mounting distance.
M27	To save the installation point parameter.
M28	Maintain the last good value when poor signal condition occurs. YES is the default setup.
M29	Setup a signal strength as empty pipe. For example input 65, it means the pipe is treated as empty pipe when the signal is less than 65, and the flow rate display is 0.
M2A	Maximum instantaneous flow rate setting.
M2B	Set Q, greater than this value display *R
M30	Select metric or british system unit.
M31	Select flow rate unit.
M32	Select totalizer flow unit.
M33	Select the number of decimal places. The multiplying factor ranges from 0.001 to 10000. Factory default is×1.
M34	Turn on or turn off the NET totalizer
M35	Turn on or turn off the POS (positive) totalizer
M36	Turn on or turn off the NEG(negative) totalizer
M37	Totalizer reset.
M38	Manual totalizer used for easier calibration. Press a key to start and press a key to stop the manual totalizer.
M39	Language selection.
* M40	Damping factor. The damping factor ranges from 0 to255 seconds. 0 means there is no damping. Factory default is 5 seconds.
* M41	Cut-off low flow rate (or zero flow rate) to avoid invalid accumulation.
M42	Zero calibration/Zero point setup. Make sure the liquid in the pipe is not running while doing the setup.
M43	Clear the zero point value, and restore original value.
M44	Manual Zero point . Set up a flow bias. Generally this value should be 0.
M45	Flow rate scale factor. The default value is '1'. Keep this value as '1', when no calibration has been made.
M46	Networks address identification number. Any integer can be entered except 13(0DH, carriage return), 10 (0AH, line feeding), 42 (2AH), 38, 65535. Every set of the instrument in a network environment should have a unique IDN. Please refer

	to the chapter for communication.
M47	System locker to avoid modification of the system parameters. If password is forgotten, you could send a command 'LOCK0' to the serial input to unlock. Or you can write 0 to REGISTER49-50 under MODBUS protocol.
M48	Entry to linearity correcting data inputs. By using of this function, the non-linearity of flow meter will be corrected. Correcting data shall be obtained by careful calibration.
M49	Displays the input contents for the serial port. By checking the displays, you can know if the communication is ok.
M50	Switches for the built-in data logger. There are as many as 22 different items can be chosen. To turn this function, select 'YES' the system will ask for selecting the items.
M51	Time set for timing output.(data logger or printer)
M52	Data logging direction control. (1) If 'Send to RS485' is selected, all the data produced by the data logger will be transmitted out through the RS485 interface (2) If 'To the internal serial BUS is selected, the data will be transmitted to the internal serial bus which allows a thermal printer, or a 4-20mA analog output module, to be connected to it.
M53	Display analog inputs, AI5, current value and its corresponding temperature or pressure or liquid level value.
M54	Pulse width setup for the OCT (OCT1) output. Range from 6 mS to 1000 mS
M55	Select analog output (4-20mA current loop, or CL) mode.
M56	Set the value which corresponds to 4mA or 0mA output current (4mA or 0mA is determined by the setting in M55)
M57	Set the value which corresponds to 20mA output current
M58	Current loop verification Check if the current loop is calibrated correctly.
M59	Display the present output current of current loop circuit.
M60	Setup system date and time. Press ENT for modification.
M61	Display Version information and Electronic Serial Number (ESN) that is unique for each flow meter.
M62	RS-232/RS485 setup. All the devices connected with flow meter should have matched serial configuration.
M63	Select communication protocol. Factory default is 'MODBUS ASCII. this is a mode for MODBUS-ASCII, Meter-BUS, Fuji Extended Protocol, Huizhong's various protocols. If you are going using MODBUS-RTU you have to select 'MODBUS_RTU'.
M64	AI3 value range. Used to enter temperature/pressure values that are corresponding to 4mA and 20mA input current. The display values have no unit, so that they can present any physical parameter.
M65	AI4 value range. Used to enter temperature/pressure values that are corresponding to 4mA and 20mA input

	current.
M66	AI5 value range. Used to enter temperature/pressure values that are corresponding to 4mA and 20mA input current.
M67	Setup the frequency range (lower and upper limit) for the frequency output function. Valid range is 0Hz-9999Hz. Factory default value is 0-1000 Hz.
M68	Setup the minimum flow rate value which corresponds to the lower frequency limit of the frequency output.
M69	Setup the maximum flow Rate value that corresponds to the upper frequency limit of the frequency output.
M70	LCD display backlight control.
M71	LCD contrast control.
M72	Working timer. It can be cleared by pressing ENT key, and then select YES.
M73	Window to setup the lower limit of flow rate for Alarm#1. When the flow rate is below the set value, Alarm#1 equals 'on'
M74	Window to setup the upper limit of flow rate for Alarm#1. When the flow rate is above the set value, Alarm#1 equals 'on' There are two alarms in the flow meter, and every alarm can be pointed to alarm output devices such as the BUZZER or OCT output or RELAY output. For example, if you want the Alarm#1 is to output by the OCT circuit, you need to set M78 at selection item 6.
M75	Window to setup the lower limit of flow rate for Alarm#2.
M76	Window to setup the upper limit of flow rate for Alarm#2.
M77	Buzzer setup. If a proper input source is selected, the buzzer will beep when the trigger event occurs.
M78	OCT (Open Collect Transistor Output)/OCT1 setup By selecting a proper input source, the OCT circuit will close when the trigger event occurs.
M79	Relay or OCT2 setup By selecting a proper input source, the RELAY will close when the trigger event occurs
M80	Window for selecting the trig signal for the built-in batch controller. Available trig sources:
M81	The built-in batch controller
M82	View the daily, monthly and yearly flow totalizer and thermal energy totalizer value. The totalizer values and errors for the last 64 days, 32 last 32 months and last 2 years are stored in the RAM memory, To view them, use the 'ENT' and 'UP' 'Down' keys.
M83	Automatic Amending Function for automatic offline compensation. Select 'YES' to enable this function, select 'NO' to disable it. When the function is enabled, The flow meter will estimate the average flow uncounted (or 'lost') during the offline session and add the result to the totalizer. The estimation of the uncounted flow is made by computing the product of the offline time period and the average flow rate, which is the average of the flow rate before going offline and the one after going on line.

M84	Set the thermal energy unit: 0. GJ 1. KC 2.KWh 3. BTU
M85	Select temperature sources 0. from T1,T2 (factory default) 1. from AI3,AI4
M86	Select the Specific Heat Value. Factory default is 'GB'. Under this setting, the flow meter will calculate the enthalpy of water based on the international standard. If the fluid is other than water, you should select option '1. Fixed Specific Heat', and enter the specific heat value of the fluid.
M87	Turn on or turn off the Energy totalizer.
M88	Select thermal energy totalizer multiplying factor. Factory default is '1'.
M89	1. Display the temperature difference 2. Window for entering the lowest temperature difference.
M8 .	Choosing whether to install the heat meter on the supply or return line
*M90	Display signal strengths S (one for upstream and one for downstream), and signal quality Q value. Signal strength is presented by 00.0 to 99.9, the bigger the value, the bigger the signal strength will be, and more reliable readings will be made. Q value is presented by 00 to 99, the bigger the better.
*M91	Displays the Time Ratio between the Measured Total Transit Time and the Calculated time. If the pipe parameters are entered correctly and the transducers are properly installed, the ratio value should be in the range of 100±3%. Otherwise the entered parameters and the transducer installation should be checked.
M92	Displays the estimated fluid sound velocity. If this value has an obvious difference with the actual fluid sound speed, pipe parameters entered and the transducer installation should be checked again.
M93	Displays total transit time and delta time(transit time difference)
M95	Simulation operation
M+0	Browse the recorded instrument power-on and power-off date and time with the flow rate at the time of power on and off
M+1	Displays the total working time of the flow meter. When the backup battery is removed, the total working time will be reset to zero.
M+2	Displays the last power-off date and time
M+3	Displays the last power-off flow rate
M+4	Displays how many times of has been powered on and powered off.
M+6	Set fluid sound speed threshold Whenever the estimated sound speed (displayed in M92) exceeds this threshold, an alarms signal will be generated and can transmitted to BUZZER or OCT or RELAY.

	This function can used to produce an alarm or output when fluid material changes.
M+7	Displays total flow for this month(only for the time past)
M+8	Displays total flow for this year(only for the time past)
M+9	Display the not-working total time in seconds. The total failure timer will also include the time when power off, if the back-up battery is applied.
M-0	Entry to hardware adjusting windows only for the manufacturer
M-1	4-20mA output adjustment
M-2	4mA calibration for AI3 input
M-3	20mA calibration for AI3 input
M-4	4mA calibration for AI4 input
M-5	20mA calibration for AI4 input
M-6	4mA calibration for AI5 input
M-7	20mA calibration for AI5 input
M-8	Lower Temperature Zero setup for the PT100
M-9	Higher Temperature Zero setup for the PT100
M- +	Temperature Calibration
M.2	Entry to solidify the zero point. Password protected.
M.5	Setup the Q value threshold. If the present Q is below this threshold, flow rate will be set to 0. This function is useful when flow meter is installed in noisy environment or on airy pipes.
M.8	The maximum flow rates for today and this month.
M.9	Serial port tester with CMM command output for very second.
M . 1	Plant instrumentation factor
M . 2	Plant Instrumentation Factor
M . 3	Measurement method
M . 4	Signal Processing Method
M . 5	Direction Switching
M . 6	Reference Signal Channel
M . 7	Flow correction folded arrays

M . 8	Weak Signal Amplification
M . 9	Maximum flow rate
M . +	Enable Sign Check
M . 1	Set Totalizer

5.3 Quick setup of measured parameters

Accurate measured parameters can have a great influence on measuring precision and reliability. It is suggested to measure the practical perimeter and wall thickness of the pipeline. Ultrasonic thickness gauge can be used to measure the pipe thickness.

Measured parameters setup is from Menu10 to Menu25,Please complete one by one Following parameters need to be inputted before measurement:

①Outer diameter unit: mm

②Pipe thickness unit: mm

③Pipe material

④Lining parameters: thickness and sound velocity (If have lining)

⑤Liquid type

⑥Sensor type (because the host can support many different sensors)

⑦Sensor installation method

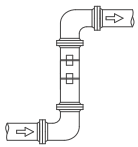
Chapter 6 Installation and Debugging of Transducers

6.1 Choose installation points

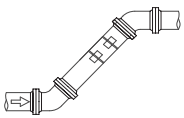
Proper installation point is a key for transducer installation. Following factors must be considered: Full filled pipeline, shaking, steady flow, scaling, temperature, pressure, EMI, instrument well.

- Full filled pipeline

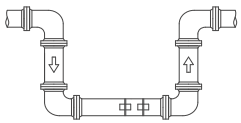
Following situations can be full filled of liquid



Vertical upward



Obliquely upward



Lowest point

- Shaking

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

- Steady flow

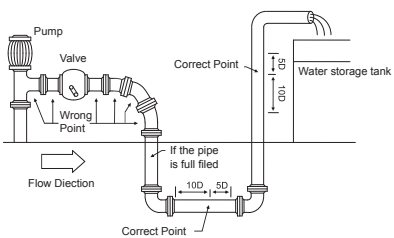
A stable flowing fluid helps to ensure measurement stability and accuracy. A fluid with chaotic flow state can make measurement data unstable or impossible to measure.

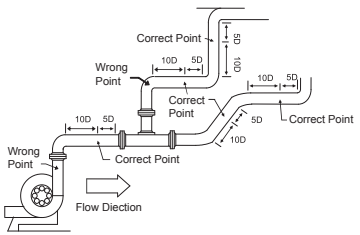
Standard requests for steady flow are:

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

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

②30D to pump outlet and half-open valve.





- Scaling

The inside scaling would have bad effect on ultrasonic signal transmission ,and would decrease the inner diameter as well.As a result,the measurement accuracy can not be guaranteed.Plaese try to avoid choosing the installation point with inside scaling.

- Temperature

The fluid temperature at the installation point must be within the range of use of the sensor. Try to choose installation points with lower temperatures. Therefore, the same pipeline should be avoided as much as possible from the boiler water outlet and the heat exchanger outlet, and should be installed on the return water pipeline as much as possible.

- Pressure

The maximum pressure that the DN15-40 pipe segment sensor can withstand is 2.5MPa.The maximum pressure that the DN50-2000 standard pipe segment sensor can withstand is 1.6MPa.Out this range need customized.

- EMI (electromagnetic interference)

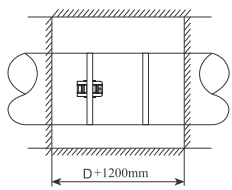
The ultrasonic flow meter, transducer and signal cable can be easily interfered by interference sources such as frequency changer, radio station, microwave station, GSM base station and high-tension cable. Please try to avoid these interference sources when choosing installation points.

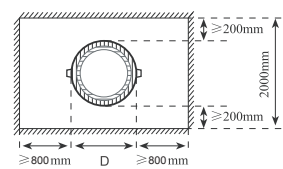
The shield layer of flow meter, transducer and signal cable should be connected to earth.

Better to use isolated power supply. Do not use the same power supply with the frequency converter.

- Instrument well

When measuring underground pipes or need to protect the measuring points, an instrument well is required. To ensure the enough installation space, the sizes of instrument well should meet the following requirements.



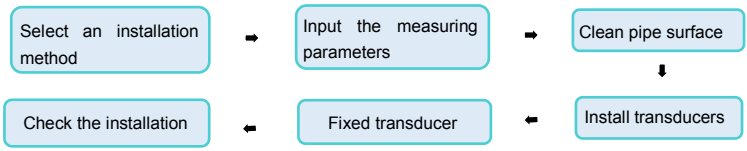


D means the pipe diameter

6.2 Clamp on transducer Installation

Before installation, please verify the parameters of pipeline and liquid. To ensure the installation accuracy.

6.2.1 Installation process

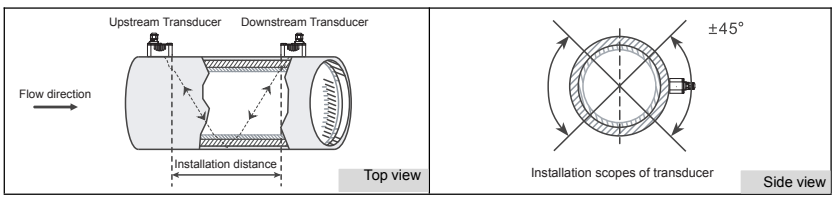


6.2.2 Select an installation method

There are two different methods for clamp on transducers: V method and Z method.

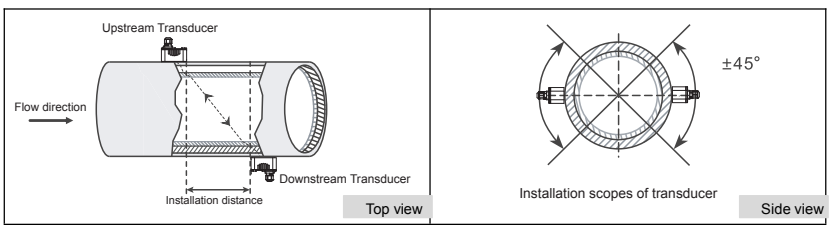
> > V method

The V method is preferred for DN15mm 200mm pipelines, and the two sensors are horizontally aligned during installation. The centerline should be parallel to the pipeline axis, and the emission direction should be relative.



>> Z method

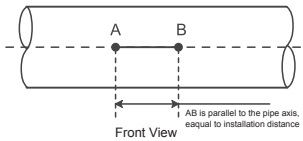
Z method should be priority selected for pipe sizes DN200 - DN6000. Also can be used when V method doesn't work well. Make sure the vertical distance of two transducers equals to the installation distance, and the two transducers are on the same axis surface.

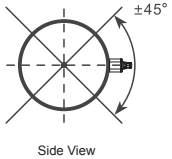


6.2.3 Positioning installation points

>> 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.





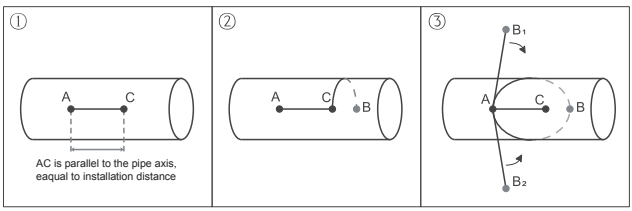
>> Z method

①Firstly 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.

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

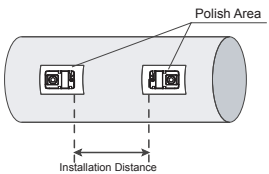
③Check. Measure the length between A and B from both sides of the pipe, get AB1 and AB2. If AB1 = AB2, then B is the correct point. If not, need to positioning point B and C again.

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



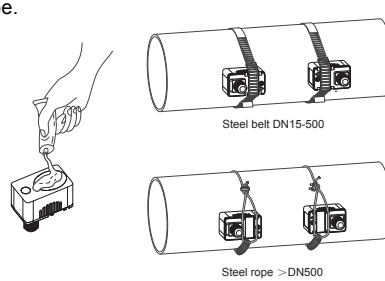
6.2.4 Clean the surface of installation points

Paint, rust and anti-corrosive coating on installation points need to be cleaned. It's good to use a polishing machine to get the metal luster.



6.2.5 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.



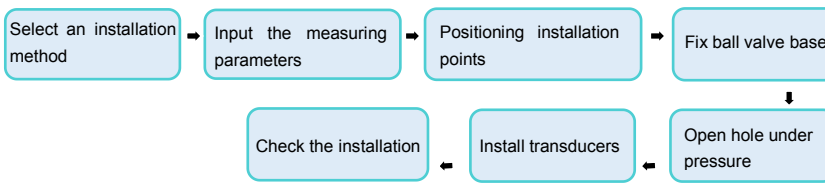
6.2.6 Check Installation

See page "Check for installation" for details

6.3 Insertion type transducer installation

Before installation, please verify the parameters of pipeline and liquid.To ensure the installation accuracy.

6.3.1 Installation procedure



6.3.2 Select installation method and positioning installation points

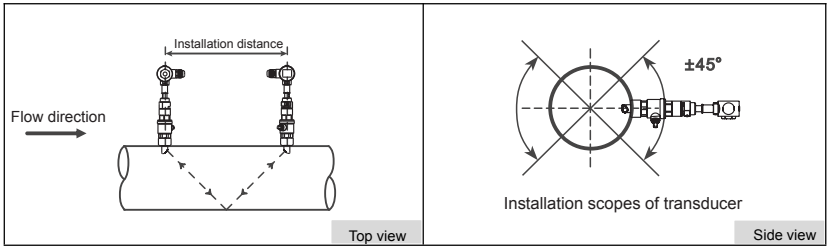
(1) Installation method

Insertion type transducers are suitable for pipe sizes > 50mm

Two different installation methods: V method and Z method. Generally use Z method, only use V method for lack of space.

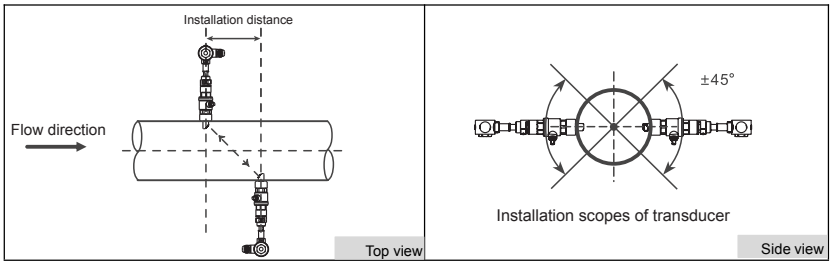
> > V method

V method can be used for DN50mm - 300mm. Let the pair of transducers horizontal alignment,the central line in parallel with the pipeline axis, and the transmit direction mush be opposite.



>> Z method

Z method can be used for all pipes > DN50mm. Make sure the vertical distance of two transducers equals to the installation distance, and the two transducers are on the same axis surface. The transmit direction mush be opposite.



>>Parallel insertion

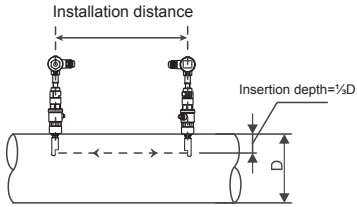
If there is insufficient installation space or the transducers can be only installed on the top of pipeline, parallel insertion transducer will be a good choice. (Pipe size ≥200)

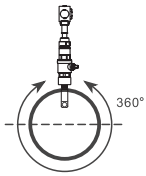
Positioning of parallel insertion transducer need to meet the 3 factors as follow :

Installation distance = Vertical distance of two transducers along the pipe axis direction.

Make sure two transducers are in the same horizontal line,Insertion depth = 1/3 inner diameter.

Users can set the distance between transducers by themselves. Recommend 300~500mm.



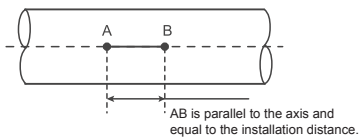


Installation scopes of transducer

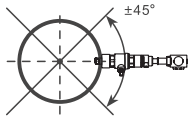
(2) Positioning installation points

>> 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.



Front View



Side View

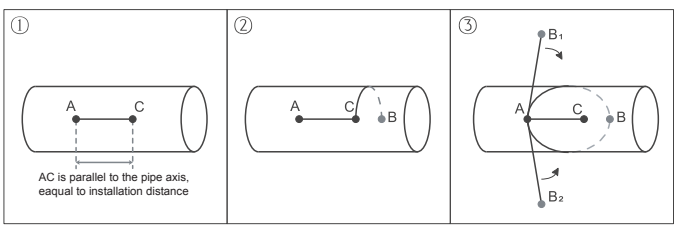
>> Z method

①Firstly 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.

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

③Check. Measure the length between A and B from both sides of the pipe, get AB 1 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.



6.3.3 Fix ball valve base

>> Welding Fix

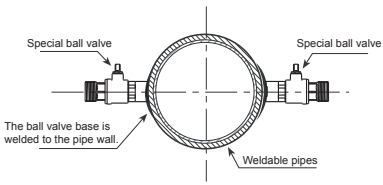
For carbon steel pipes, the ball valve base can be welded directly. Make sure that the central point of ball valve base is overlapped with the transducer installation point.
Matters need attention:
①Please take the PTFE sealing gasket out from the base before welding.
②Please clean the pipe surface around welding point before welding. Pay attention that there should not be any air hole during welding, which can avoid leaking. Welding strength must be ensured.
③Do not sputter welding slag on the base thread.
④Non-deformation ofbase during welding.

After welding, tighten ball valve into the base.

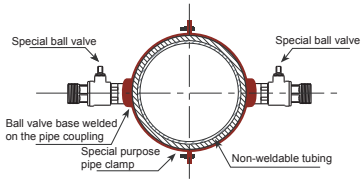
>> Pipe hoop Fix

For pipes can't be welded directly like cast iron pipe, cement pipe, copper pipe and composite pipe, customized pipe hoop is recommended.

The hoop center should be overlapped with the transducer installation point. Please compress the sealing gasket tightly to avoid leaking.



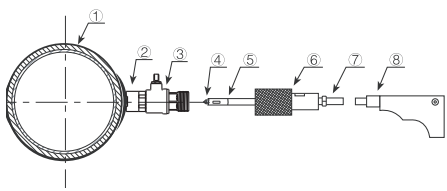
Welding fixed ball valve base



Clamp fixing ball valve base

6.3.4 Open hole

After the installation of the base and ball valve is completed, connect the sealing sleeve of the opening device to the external thread of the ball valve. After tightening, open the ball valve, push the drill pipe until it comes into contact with the outer wall of the pipeline, connect the electric hand drill and the drill pipe tightly, connect the power supply, and start drilling. During the drilling process, the electric drill should be kept at a low speed and the rotational speed should not be too fast to avoid getting stuck or even breaking the drill bit. After drilling through, pull out the drill pipe until the front end of the drill bit of the hole opener retracts to the ball valve core, close the ball valve, and remove the hole opener.



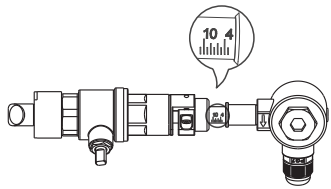
1. Pipeline
2. Ball valve base
3. Special ball valve
4. Drill
5. Supper hole cutter
6. Seal cover
7. Drill rod
8. Electric hand drill

6.3.5 Install transducer and adjustment

Adjust the proper insertion depth and transmit direction to get good ultrasound signal.

>> Insertion depth adjustment

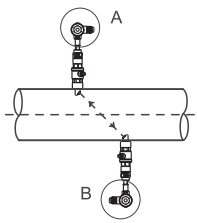
Adjust the depth scale according to pipe wall thickness, and completely push in the transducer rod.



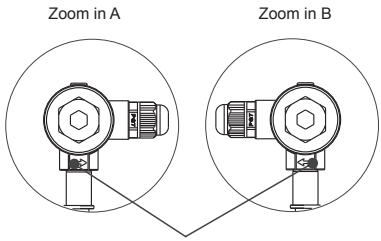
>> Transmit direction

After adjusting the insertion depth, locate the launch direction

There is a indicating arrow on the transducer junction box, the arrow direction on two transducers should be opposite"→←"and parallel to the pipe axis.



Front View



The upstream and downstream sensors are facing each other.

>> Operation steps

①Tighten the locknut into ball valve, adjust the insertion depth scale.

②Open ball valve, completely push in the upstream transducer rod. Adjust the transmit direction parallel with pipe axis, and point to the installation point of downstream transducer. Lock it after adjustment.

③Install downstream transducer in the same way. Adjust the transmit direction to get the best signal strength and watching M91, if the value is between 97% ~ 103%, the installation is correct. If not, need to re-adjust the insertion depth and transmit direction until meet the requirement.

6.4 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.

6.5 Finish

1、Setting of common parameters.

Place the display window at M00 or M01 according to the meter reading needs;

Choose the appropriate flow unit for M20-M22;

Selection damping coefficient for M30;

Calibration Date Time for M.3;

2、To avoid signal reduction and improve anti-jamming ability, it is better to use the customized signal cable from flow meter manufacturer.

3、The length of cables between converter and transducer should be as short as possible, cannot exceed 200m.

4、 The temperature and humidity of working environment should be in the range of technical specifications. Avoid direct sunlight on LCD.

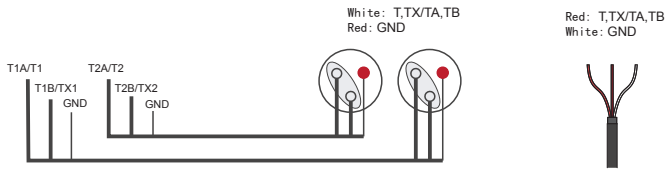
Chapter 7 Heat measurement

The ultrasonic flow meter can be connected to a temperature resistor to achieve heat measurement. This product provides three wire PT100, three wire PT1000, and four wire PT100 for temperature measurement. Users can choose any one to use.

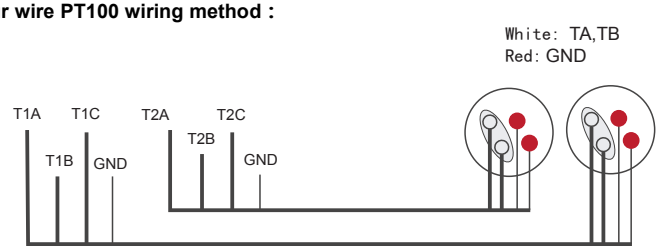
Weld the base onto the pipeline, and after the pipeline is cut off, use an electric drill to drill holes through the base with a diameter of Φ10 ， Put on the sealing ring, screw the protective sleeve into the base, and finally insert the temperature resistor into the protective sleeve to complete the installation.

Our company also provides a kit for installation with water and pressure, which needs to be ordered separately.

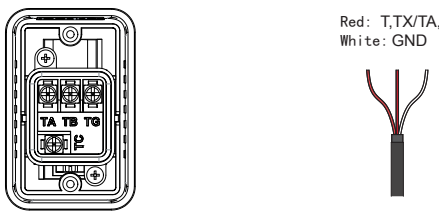
Three wire PT100/PT1000 wiring method：



Four wire PT100 wiring method：



Four wire PT100 wiring method：



Chapter 8 Communication interface and protocol

The ultrasonic flow/Heat meter itself has an isolated RS485 interface, and supports a variety of commonly used communication protocols, including MODBUS protocol, M-BUS, FUJI expansion protocol and other domestic manufacturers' protocols.

The MODBUS protocol supports MODBUS-RTU I by default, and MODBUS ASCII requires selecting 'MODBUS-RTU Only' from the M52 menu. The following is a commonly used address table in the MODBUS protocol:

Register	Length	Register name	Data type	Instruction
0001-0002	2	Instantaneous flow rate	REAL4	Unit: cubic meter/hour
0003-0004	2	Instantaneous heat flow rate	REAL4	Unit: GJ/hour
0005-0006	2	Fluid velocity	REAL4	Unit: meters/second
0007-0008	2	Measuring fluid sound velocity	REAL4	Unit: meters/second
0009-0010	2	Positive cumulative flow	LONG	Unit by M32
0011-0012	2	Fractional part of positive cumulative flow	REAL4	Also known as FLOAT format
0013-0014	2	Negative cumulative flow	LONG	
0015-0016	2	Negative cumulative flow fraction	REAL4	
0017-0018	2	Positive cumulative heat	LONG	
0019-0020	2	Fractional part of positive cumulative heat	REAL4	
0021-0022	2	Negative cumulative heat	LONG	
0023-0024	2	Negative cumulative heat fraction	REAL4	
0025-0026	2	Net cumulative flow	LONG	
0027-0028	2	Fractional portion of net cumulative flow	REAL4	
0029-0030	2	Net accumulated heat	LONG	
0031-0032	2	Fractional portion of net accumulated heat	REAL4	
0033-0034	2	Temperature 1/water supply temperature	REAL4	Unit: ℃
0035-0036	2	Temperature 2/Return water temperature	REAL4	Unit: ℃

Chapter 9 Frequently Asked Questions and Answers

1、How to distinguish the flow direction of fluid in pipelines

After correctly installing the sensor and wiring, if the instantaneous flow rate display value is positive, it indicates that the direction of the fluid is positive, that is, flowing from the upstream probe to the downstream probe. If the instantaneous flow rate is displayed as a negative value, it indicates that the flow rate is reversed and the upstream and downstream sensors need to be swapped and reinstalled.

2、How to Use Zero Cut to Avoid Invalid Accumulation

The data in window M31 is called the low flow rate cutoff value, and the system treats the flow rate below this value as "0". This parameter can be set to avoid false accumulation of measurement errors generated by the flow meter when the actual flow rate is "0". In general, set this parameter to 0.03m/s. When the flow rate is greater than the low flow rate cutoff value, the low flow rate cutoff value is independent of the measurement results and will never affect the measurement results.

3、How to set zero

When the pipeline is filled with static water and the instantaneous flow rate displayed by the flowmeter is not zero, use the M32 menu to zero, and do not perform any operations during the zeroing process.

4、How to modify the instrument coefficient (scale factor) for calibration and correction

When the flow meter runs for too long, it may cause errors in the flow meter. In this case, we can correct it by modifying the coefficient (scale factor), which is the ratio of the actual value to the measured value in the M35 window. The instrument coefficient must be input based on the actual calibration results.

5、How to use 4-20mA Current loop output

Ultrasonic flowmeter/heat meter with one Current loop output, accuracy better than 0.1%, and can be set to 4~20mA and 0~20mA and other output modes, which can be selected using window M62.

Enter the flow value represented by 4mA in window M63, and the flow value represented by 20mA in window M63.

If the flow direction is considered, the 0~4~20mA output mode can be selected. When the flow direction is negative, the output current is within the range of 0~4MA. When the flow direction is positive, the output current is within the range of 4-20mA. The output mode can be selected in window M62. Use window M61 to verify whether the Current loop itself has been "calibrated". Please refer to the page "Installation and Wiring Diagram of the Host" for the wiring diagram.

6、How to output cumulative pulses

Ultrasonic flowmeter/Heat meter can generate a cumulative pulse every unit flow.

Accumulated pulses can only be output through hardware OCT or relays. Therefore, it is also necessary to implement corresponding settings for the hardware OCT or relay (see windows M65, M67),

For example, to use a relay to output forward cumulative pulses, each pulse represents a flow rate of 0.1m3, the following settings can be made:

1. Select the cumulative flow unit in window M22: "cubic meter (m3)";
2. Select the multiplication factor in window M23: "2 × 0.1 ";
3. Select "9. Positive accumulation pulse output" in window M67.

Note: The cumulative pulse size should be selected appropriately. If it is too large, the output cycle will be too long; If it is too small, the relay will operate too frequently, affecting its service life, and if it is too fast, it will cause an error of losing pulses. Suggest using a rate of 1-60 pulses/minute.

7、How to use OCT output

OCT output of ultrasonic flowmeter/Heat meter is Galvanic isolation Open collector output. It can work at DC60V and 100mA. By setting M65, the conditions for its activation can be set. Please refer to the page "Installation and Wiring Diagram of the Host" for the wiring diagram.

8、How to use relay output

The relay output of ultrasonic flow/Heat meter can work at AC125V/DC28V, 1A. By setting M67, the conditions for its activation can be set. Please refer to the page "Installation and Wiring Diagram of the Host" for the wiring diagram.

9、How to use a quantitative (batch) controller

The ultrasonic flowmeter/Heat meter has built-in batch controller, which can control the flow quantitatively. Use the keyboard or the rising or falling edge of the analog input signal as the input for control, and the output can be controlled using OCT or relays. When using analog input as control signal, input current signal greater than 2 mA at the analog input terminal to indicate "1" status, and 0 mA current indicates "0" status.

Using window M72 to select the control input signal, using window M65 (OCT output) or M67 (relay output), selecting item 8 "as quantizer output" will generate an output signal on the OCT or relay output.

The quantitative value is entered in window M73. After inputting the quantitative value, start the batch controller.

10、How to Input Linearity Line Input Data

Ultrasonic flow/Heat meter can realize non-linear multi-point linearization correction of flow, and can realize more than 11 segments of broken line correction. When leaving the factory, this function is turned off and can be used by entering menu M36 with password: 12345.

In order to correct the flow beyond the flow range without causing sudden changes in the correction coefficient, we have added two flow points, 0m3/h and 100000m3/h, based on the measured flow points. The coefficient of 0m3/h is the coefficient of the minimum flow point we measured, and the coefficient of the maximum flow point we measured is used for 100000m3/h. Then, we input it into M36 in order of flow points from small to large。

If you need to cancel the line correction function, simply enter "0" in the number of line points in menu M36.

The following table provides an example of 5-point line correction:

Standard device flow rate (m^3/h)	Instrument indication flow rate (m^3/h)	Correction coefficient (standard/indication)
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

Appendix 1: Common Parameters

1. Sound velocity of commonly used materials Unit of sound velocity: m/s

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

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

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.