Ultrasonic BTU And Flow Meter
TP4000 AND SF880 Clamp-on & Insertion
User's Manual

（For TP4000/SF880）

USonic Metering
444 W 52nd St.
New York, NY 10019
United States of America
Tel: +1 774 325 8000
Fax: +1 914 565 4000
E-mail: sales@usonicmetering.com

Notice

- Please check the items list to ensure the received goods and the ordered goods are same.
- Please read the manual carefully before installing and operating.
- Please follow all the warnings and requirements before installing, operating and maintaining.
- Please operate the products according to the manual only. If the users don't operate the products as the manual, our company will not assume any responsibility for the damages incurred.
- All the figures are only for reference. Please refer to the real products when operating or contact us.
- All products are strictly inspected before delivery. If users disassemble the products personally, our company can't be held liable for any damages and warranty could be voided.
- Please read name plate carefully to ensure the flow meter is produced according to your order. Please check whether the power and voltage on name plate are correct.
- Please check the products carefully before installing, please contact us if have any obvious transportation damage.
- Please keep the manual handy for your reference anytime.
- Please contact us if the product can't work properly or needs repaired.

Warning

To avoid damaging users' benefits, please read the manual carefully and follow all the warnings and instructions.

Security Warning

To avoid any financial loss and personal injury, please follow safety instructions and operate the products properly.

① The products are precision measurement instruments, please handle with care to avoid any damage.

② About AC power supply:

* When wiring, please pay attention to the name plate voltage data!
* Strictly comply with local occupational health and safety regulations. Only properly trained personnel are allowed to work on electrical equipment.
* Strictly comply with local occupational health and safety regulations. Only properly trained personnel are allowed to work on electrical equipment.
* It is strictly forbidden to remove the meter transducer and enclosure in the state of live measurement.
* Instruments must be grounded as required to protect operators from electric shocks.
* The measurement transducer must be properly grounded.
* The ground cable shall not transmit any interference voltage.
* Grounding cable shall not connect multiple instruments at the same time.
* Do not touch the power plug with wet hands to avoid personal injury caused by electric shock.
* Do not pull, tie, cut, or excessively bend the power cord, or place heavy objects on the power cord.
* If the insulation layer of the power cord is damaged, do not use, to avoid personal injury caused by leakage.
* When the product is not used for a long time and stored, please disconnect the power supply, so as to avoid fire caused by electric shock and heat.
* Please try to avoid sharing power with other large equipment. If it is unavoidable, necessary measures such as power purification should be taken. Otherwise, it may affect the normal operation of the meter.
* Install lightning protection devices when lightning strikes are possible in the use environment.

③ Do not cover the product with any corrosive liquid, otherwise it will accelerate the aging of the product material.

④ Do not change the length of the transducer cable, otherwise it will affect the metering performance of the product.

⑤ Before confirming the location of the installation point, you should read/understand the installation requirements and precautions of the "technical parameters" in the instructions. If the "technical parameters" are beyond the scope, it may lead to unforeseen consequences such as the meter not working normally.

CONTENTS

1. Summary

1.1 Introduction

TP4000 and SF880 transit-time ultrasonic flow meter utilizes transit-time principle, including clamp-on and insertion. When install clamp-on transducer, without flow stop and pipe cutting, simple installation and convenient for online comparison. Different sizes of transducers can measure different sizes' pipe. Insertion installation effectively solves clamp-on flow meter can not accurately measure with scaling pipe and non-conductive media. Insertion transducer has stop ball valve, without flow stop or pipe cut, easy to install. User also can mount hoops on non-weldable pipe surface. Optional thermal energy measuring function. Widely applied in processing monitoring, water balance test, district heating balance test, energy efficiency monitoring etc.

1.2 Measuring Principle

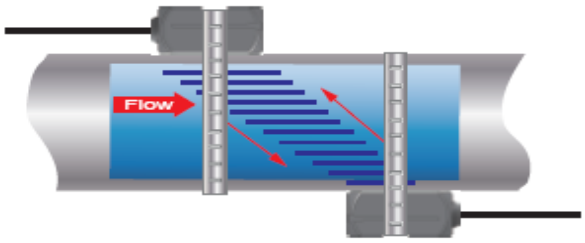
Transit-time ultrasonic flow meter utilizes the difference of ultrasonic pulse forwarding and reversing flow rate to measure flow. Use a pair of transducers to transmit and receive signal alternately. Transducer signal travels faster downstream than upstream. Obtain transit-time △t by measuring signal travel time in downstream and upstream, the average flow velocity can be detained according to △t and velocity V. The volume flow Q can be calculated out of the flow velocity V and pipe profile S.

$V=K*\triangle t$

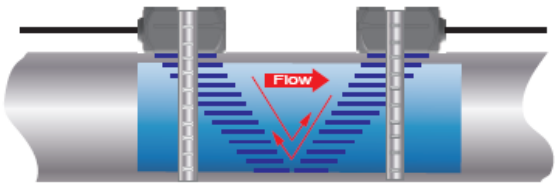
$Q=S*V$

K: Constant

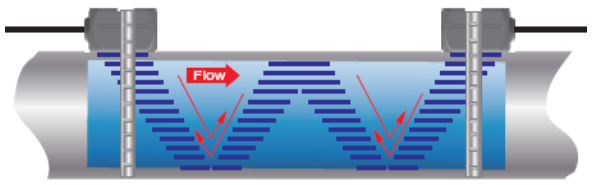
S: Pipe sectional area



Z Method



V Method



W Method

1.3 Application

- Water Utility
- Water Conservancy & Resource
- College & University
- HVAC
- Manufacturing
- Draining Company
- Heating Supply Industry
- Petrochemical Industry

1.4 Features

※Six lines of color liquid crystal display can display flow rate, instantaneous flow rate, cumulative flow rate and meter running status on one screen;

※ Non-contact installation outside the tube, no need to stop the flow, pipe break;

※ Online insertion installation, no need to stop the flow, broken pipe, can be widely used in cement pipe, ductile iron pipe, plastic (PE/PVC) pipe and other materials;

※ Outside the pipe clamping transducer can measure the temperature range of the fluid body -40℃~+260℃;

※ Online plug-in transducer can measure the fluid temperature range -40℃~+160℃;

※ Optional built-in data storage;

※ Equipped with temperature transducer, can realize heat measurement;

※ Different types of transducers are used to measure the flow of DN20-DN6000 pipe.

※ The online insertion type can realize the measurement of the diameter DN65-DN6000 pipeline flow;

※ Bidirectional flow velocity measurement from 0.01m/s to 12m/s.

1.5 Specification

Transmitter

Measuring Principle	Transit-time
Velocity	0.01 - 12 m/s, Bi-directional measurement
Resolution	0.25mm/s
Repeatability	0.1%
Accuracy	± 1.0%R, ± 0.5%R (flow rate > 0.3m /s); ± 0.003m /s (flow rate < 0.3m /s)
Response Time	0.5s
Sensitivity	0.003m/s
Damping	0-99s(settable by user)
Suitable Fluid	Clean or tiny amounts of solids, air bubbles liquid, Turbidity <10000 ppm
Power Supply	AC: 85-265V DC:24V/500mA
Installation	Wall Mounted
Protection Class	IP66
Operating Temperature	-40℃ ~+75℃
Enclosure Material	Fiberglass
Display	LCD 6 rows display, display flow rate, instantaneous flow, cumulative flow and meter running status, backlight
Measuring Unit	Meter, Ft, m^3, liter, ft^3, gallon, barrel etc.
Communication Output	4~20mA, OCT, Relay,RS232, RS485 (Modbus-RUT), Date Logger, GPRS
Energy Measuring Unit	Unit :GJ, Opt: KWh
Security	Keypad Lockout, System Lockout
Size	244*196*114(mm)
Weight	2.4kg

Transducer (Clamp On)

Protection Class	IP67
Fluid Temperature	Std. transducer -40℃~85℃(Max.120℃) High Temp -40℃~260℃
Pipe Size	20mm~6000mm
Transducer Size	S (20mm~50mm) M (40mm~1000mm) L (1000mm~6000mm)
Transducer Material	Std. Aluminum alloy, High Temp. (PEEK)
Temperature Transducer	PT1000
Cable Length	Std. 10m (or customized)

Transducer (Insertion)

Protection Class	IP68
Fluid Temperature	Std. transducer -40℃~85℃(Max.120℃) High Temp -40℃~160℃
Pipe Size	65mm~6000mm
Transducer Size	Standard transducer, extended transducer
Transducer Material	Stainless Steel
Temperature Transducer	PT1000
Cable Length	Std. 10m (or customized)

1.6 Presentation

Transmitter

Clamp-on transducer

Insertion transducer

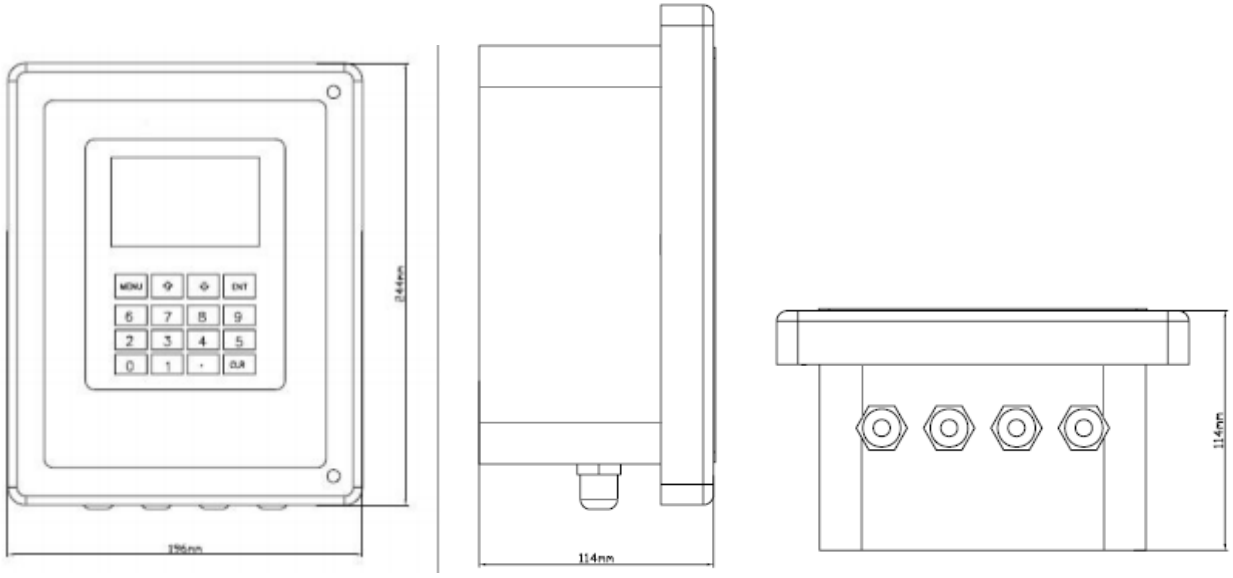
PT1000 clamping（optional）

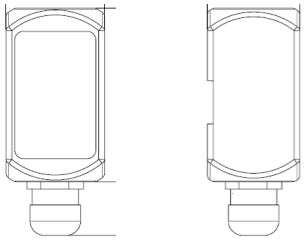
PT1000 insertion（optional）

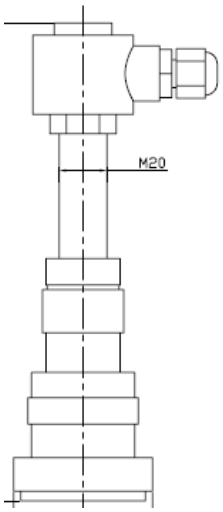
Stainless steel belt

1.7 Dimension

Transmitter







Clamp-on transducer

Insertion transducer

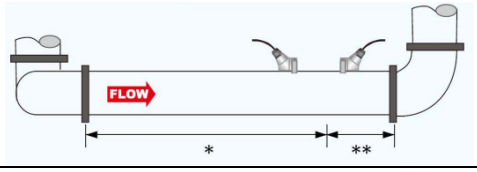
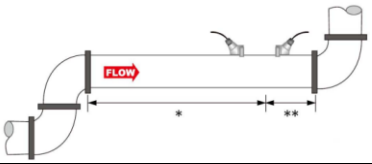
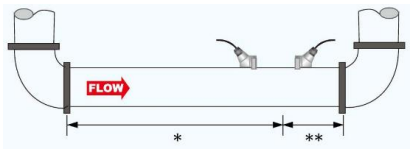
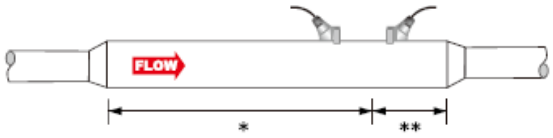
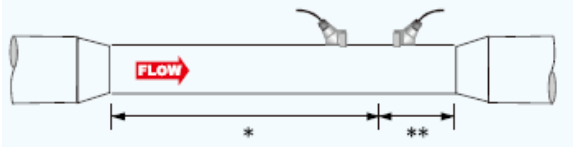
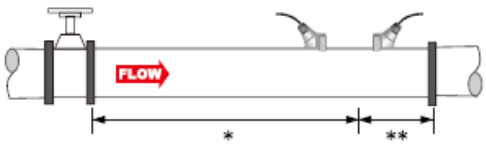
2. Clamp-on transducer installation

2.1 Measuring point selection

Ultrasonic flow/BTU meter is simplest and most convenient to install among all flow meters, just need to select one suitable measuring point and input the pipe parameters into flow meter, finally bundle transducer on the pipe.

To keep measuring accuracy, users need to select uniform flow field when choosing measuring point, generally follow below principles:

- Choose pipe full of fluid, such as the vertical part of pipeline (fluid flows upward) or horizontal pipeline full of fluid.
- Keep the temperature of measuring point in workable range.
- Keep far from electromagnetic interference source, shaking pipe, frequency conversion and ultrasonic radial area.
- Measuring point must have necessary straight pipe, generally upstream is 10D(D is diameter of pipe, same as below) downstream is 5D. Specific installation of straight pipe please refer to below figure：

Pipeline type and transducer installation point	Upstream distance	Downstream distance
	Diameter D	Diameter D
	24	5
	14	5
	10	5
	10	5
	8	5
	24	5

.

2.2 Installation Preparation

When the location of the transducer installation is decided, the condition of the pipeline must be taken into account. The bare metal surface of the mounting point (slightly larger than the probe plane) must be cleaned before the probe is tied to the pipe surface. This means removing all lacquer, rust, mud, dirt, etc. to ensure that the couplant is well coupled to the pipe. If it is a plastic (PE/PVC) pipe, remove all paint and resin glue to ensure smooth and clean installation surface.
The transducer centerline is designed to be parallel to the centerline of the mounting pipe. Do not install the transducer on elbows, bends or throttles and equipment meters (e.g. electromagnetic flow meters). An effort must be made to make the transducer parallel to the pipe axis.
If the transducer cannot be mounted symmetrically horizontally due to the space limitation of the installation site, the transducer can be installed vertically or at an inclination Angle under the condition of ensuring that the upper part of the tube is free of bubbles. For the case of partially buried pipelines, please consult the factory technicians for installation methods.

2.3 Couplant usage (Only for Clamp On Type)

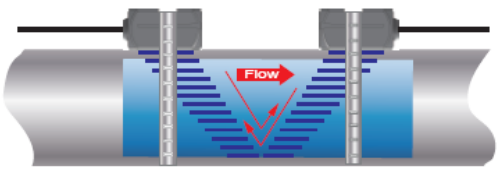
Couplant is also an important part of the ultrasonic flow meter measurement, the use of couplant is directly related to the effect and accuracy of the measurement, when the transducer is installed, enough force should be used to make the coupling agent fill the gap between the transducer and the outer wall of the pipeline. Coupling agent is recommended for normal temperature application. If necessary, special waterproof glue can be used for waterproof sealing. High temperature couplant are recommended at high temperatures. It can also be replaced by other similar products.

2.4 Transducer mounting method

There are 4 kinds of mounting methods “V”, “Z”, “W” and “N”(“W” and “N” method are uncommonly used).

2.4.1 V Method (common method)

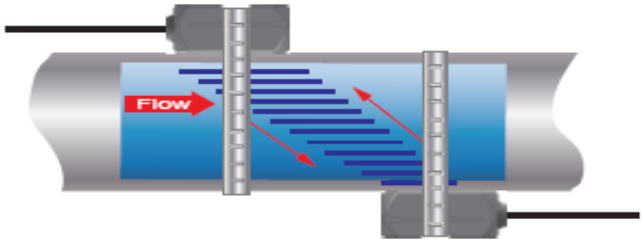
In general, the V method is a commonly used standard installation method, which is convenient to use and accurate to measure. Suitable for all uniform dense material pipe, liquid type for the majority of the flow measurement. The measured pipe diameter range is DN20 to DN200; When installing the transducer, pay attention to the horizontal alignment of the two transducers, and their center line is horizontal to the axis of the pipeline.



V method

2.4.2.Z-method (the most common method)

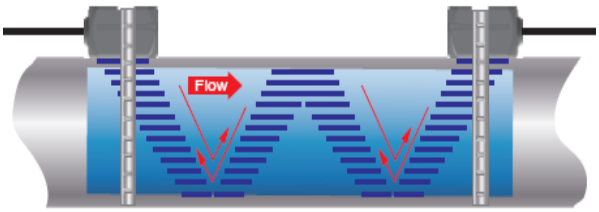
When the pipe is large, too small or there are suspended solids in the measuring medium, the tube wall scaling is too thick or the lining is too thick, resulting in weak V method installation signal, the instrument can not work normally, you need to use Z method installation, Z method is characterized by direct transmission of ultrasonic in the pipeline, no reflection (mono), signal attenuation is small; For actual installation of flow timing, Z method is recommended for old pipelines and pipelines over 200mm. When part or most of the pipelines are buried, V-shaped installation should be adopted.



Z Method

2.4.3 W and N Methods (less commonly used methods)

The characteristics of W method and N method are to improve the measurement accuracy of small pipe diameter by extending the ultrasonic transmission distance, and they are suitable for measuring small pipe diameter below 50mm. When installed using the W method, the ultrasound beam is reflected three times in the tube and passes through the fluid four times (called the four-path). When mounting using the N method, the ultrasound beam is reflected twice in the tube and passes through the fluid three times (called the triple path). N is rarely used and will not be explained here.



W Method

2.5 Transducer cable selection

The transducer connection of the ultrasonic flow meter must use high-frequency twisted pairs. This is because the transceiver circuit adopts balanced transmission and balanced reception. The advantage of using high-frequency twisted pairs is that the anti-interference performance can be greatly improved. If single-shielded conventional high-frequency cables are used, the performance of the machine will be degraded, and normal measurement will not be possible when the external interference signal is large. The upstream transducer is connected to

TRANSMIT and the downstream transducer is connected to RECEIVE. It is recommended that special cables be used under normal circumstances. The special cable has small signal loss and good anti-interference performance, which can ensure long-term reliable operation of the instrument.

2.6 Installation of clamp-on transducers

Before installing the transducer, select the dense part of the pipe for transducer installation. Clean the area outside the pipe where the transducer is to be installed and remove all rust and paint. It is recommended to grind and polish with an angle grinder, then wipe away the oil and dust with a clean rag, and then Coat the central part of the transducer and the pipe wall with enough couplant, and then tie the transducer tightly to the pipe wall.

Notice:
1. The two transducers should be installed at the horizontal position of the pipeline;
2. The installation direction of the transducer;

When installing the transducer, be careful that there are no air bubbles or gravel between the transducer and the pipe wall. On horizontal pipe sections, the transducer should be installed on the horizontal axis of the pipe section to prevent air bubbles from possibly existing in the upper part of the pipe.

If the transducer cannot be installed horizontally and symmetrically due to space limitations at the installation site, the transducer can be installed vertically or at an angle while ensuring that there are no bubbles in the upper part of the pipe.

2.6.1 Transducer installation distance

The transducer spacing is based on the innermost distance edge of the two transducers. After inputting the required parameters, check the number displayed in the display window 25, and make the transducer spacing consistent with the "Transducer Distance" data in the "Pipeline Parameter Settings" window.

2.7 Installation of insertion transducers

Features of insertion transducers.

1. Solve the problem of weak signal and abnormal measurement when using external clip-on transducer due to scaling or serious corrosion on the inner wall of the pipeline;
2. It can be installed on pipes made of non-weldable materials such as cement pipes and cast iron pipes (the pipe hoop needs to be customized according to the actual pipe outer diameter);
3. The special drilling tool used allows the transducer to be installed under pressure without

stopping water, ensuring normal and stable production operation, and there is no need to stop water for future maintenance;

4. The ultrasonic transmitting probe of this transducer is in direct contact with the liquid being measured, which improves the measurement accuracy and the operating stability of the machine;

5. Compared with electromagnetic flow meters, it is economical, reliable and accurate to use on large-diameter pipelines.

2.7.1 Installation site

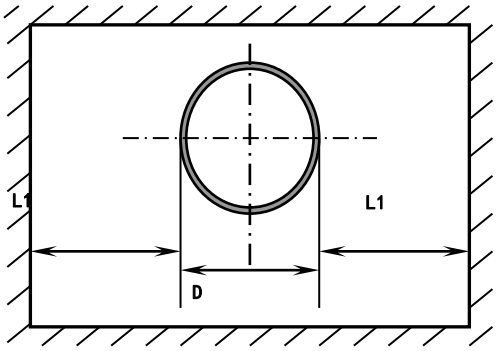
Installing plug-in transducers requires a certain amount of space. Generally speaking, the distance from the outer wall of the pipe in the well to the wall is at least 700mm.

Requirement.

1. Installation site

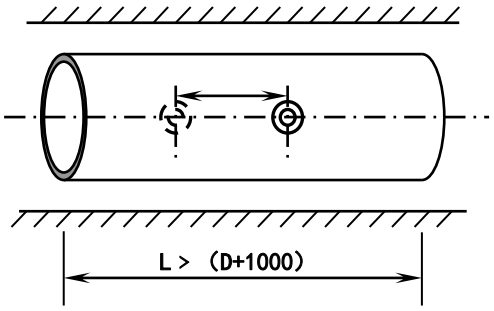
Installing plug-in transducers requires a large space. For pipes that can be directly welded, such as carbon steel pipes and stainless steel pipes, the distance L1 between the pipe wall and the wall in the instrument well must be at least 540mm, that is, the width of the instrument well W > (D+540× 2) mm; for pipes that cannot be directly welded, such as plastic (PE/PVC) pipes, cast iron, and cement pipes, the distance L1 between the pipe wall and the wall in the instrument well must be at least 700mm, that is, the width of the instrument well W > (D+700× 2) mm (as shown in Figure 1).

Figure 1



Longitudinal pipe length L> (D+1000) mm.（Figure 2）

Figure 2



Installing an ultrasonic flowmeter requires a certain straight pipe section, generally greater than 10D upstream, greater than 5D downstream (D is the diameter), and greater than 30D away from

the pump outlet or valve.

2.7.2 Tool

Installing a insertion transducer requires a tape measure, a slotted screwdriver, a Phillips screwdriver, a hand drill, special drilling tools, a adjustable spanner, and raw material tape.

2.7.3 Set the parameters

In the host initial settings submenu

Press the ENT key to enter the menu and select "Initial Settings - Pipe Parameter Settings - Insert Type B"

Press the ENT key to enter the menu and select "Initial Settings-Pipeline Parameter Settings-Transducer Installation Method Z Method"

Press the ENT key to enter the menu and select "Initial Settings-Pipeline Parameter Settings-Measurement Channel Settings: Channel 1 (Cannot be modified)"

Measuring a channel means selecting the corresponding channel settings.

Press the ENT key to enter the menu and select "Initial Settings-Pipeline Parameter Settings-Transducer Installation Distance"

The transducer installation distance is the installation distance, which refers to the distance between the centers of two plug-in transducers along the pipe axis. (As shown in Figure 2)

2.7.4 Installing process

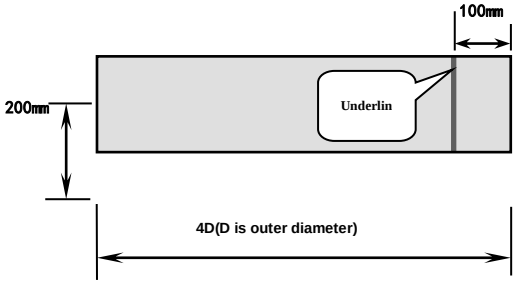
1. Position

Input the pipeline parameters into the host computer, calculate the installation distance (due to the use of plug-in transducers, it is recommended to use the direct measurement method, that is, the Z installation method) and determine the positions of the two transducers. The installation distance is the center distance of the two transducers.

Note: The two transducers must be on the same axis.

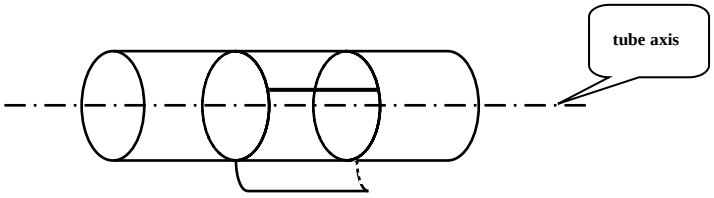
Make positioning paper: Take a rectangular paper tape 4D long (D is the pipe diameter) and 200mm wide (or D), and draw a line about 100mm from the edge; (Figure 3)

Figure 3



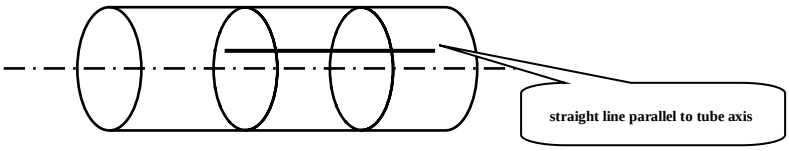
Wrap the positioning paper around the cleaned pipe. Pay attention to aligning both sides of the paper so that the drawn line is parallel to the pipe axis; (Figure 4)

Figure 4



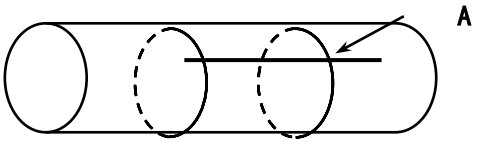
Extend the straight line on the positioning paper to draw a straight line on the pipe; (Figure 5)

Figure 5



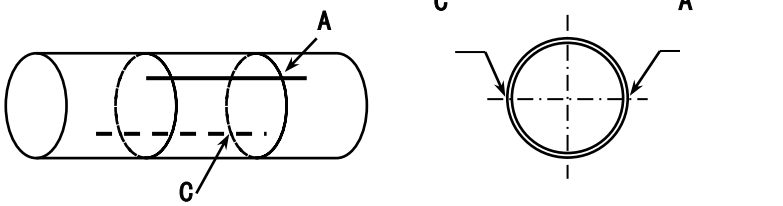
The intersection point between the drawn straight line and one edge of the positioning paper is A; (Figure 6)

Figure 6



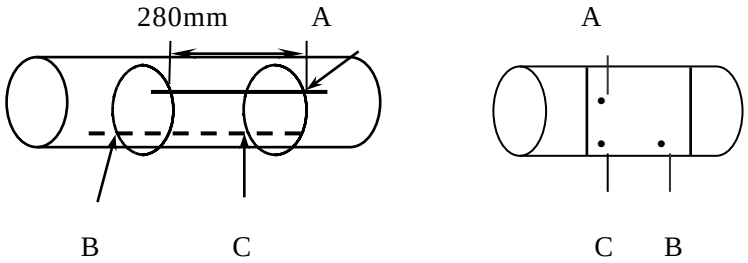
Starting from point A, measure 1/2 of the circumference of the pipe along the edge of the positioning paper. This point is C. Draw a straight line perpendicular to the edge of the positioning paper at point C; (Figure 7)

Figure 7



Remove the positioning paper, start from point C, and measure the installation distance L on the drawn straight line to determine point B. In this way, points A and B are the installation positions; for example, L=280mm (as shown in Figure 8)

Figure 8



Weld the ball valve base to points A and B respectively.

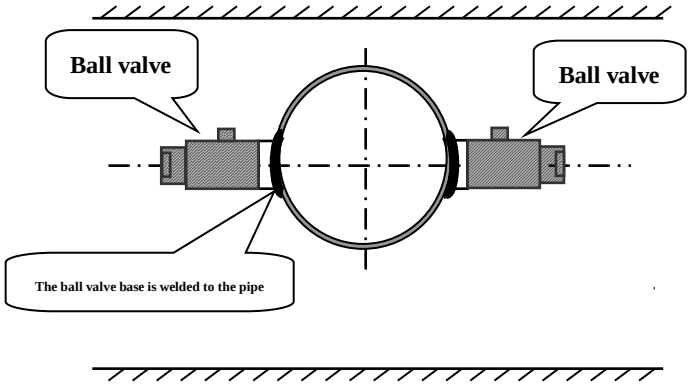
Note that the center point of the ball valve seat must coincide with points A and B respectively.

2. Install the ball valve base (as shown in Figure 9)

For weldable pipes (such as carbon steel, stainless steel, etc.), you only need to weld the ball valve base directly to the outer wall of the pipe. (Before welding, clean the surface of the pipe near the welding point.) When welding, be careful not to include pores to prevent water leakage or even fracture.

For pipes that cannot be directly welded (such as cast iron, cement pipes, PE/PVC, etc.), a customized special hoop (with sealing rubber pad) needs to be used. The ball valve base has been welded to the pipe hoop in advance, and the hoop is directly tightened. Go to the pipe under test and ensure that the center point of the ball valve base coincides with points A and B. Fasten the ball valve base to the outer wall of the pipe and make sure it is sealed to prevent water leakage. Wrap the raw material tape around the base of the ball valve and screw on the ball valve.

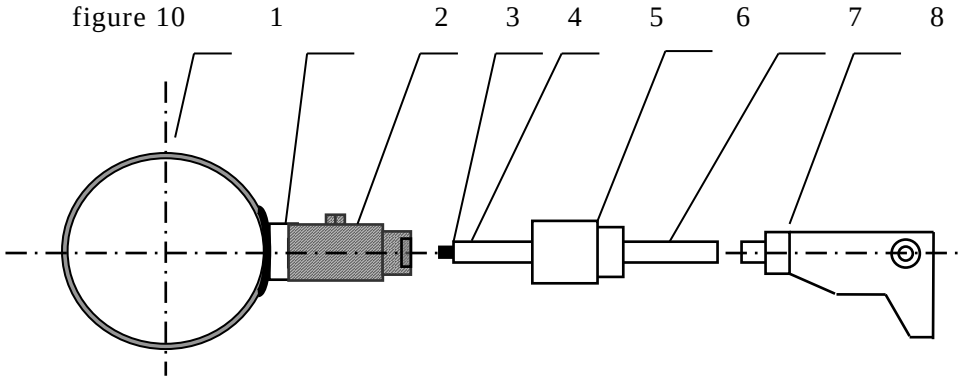
Figure 9



2. Drilling (as shown in Figure 10)

Connect the sealing sheath of the hole opener to the external thread of the special ball valve. After tightening, open the ball valve, push the drill rod until it contacts the outer wall of the pipe, connect the hand electric drill and the drill rod and lock them, turn on the power, and start drilling. During the drilling process, keep the electric drill at a low speed and do not drill too fast and drill slowly to avoid the drill getting stuck or even the drill bit breaking. After you feel that the hole is drilled through, pull out the drill rod until the front end of the drill bit of the hole opener retreats behind the ball valve core, close the ball valve, and remove the drill bit. Remove the hole opener (it is best to open the ball valve a little, and let water wash away the iron filings to facilitate the installation of the transducer).

figure 10

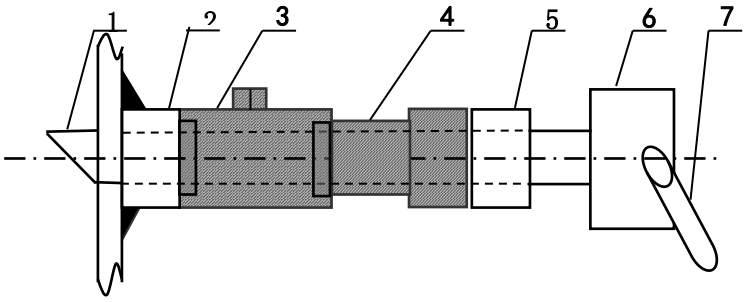


1. Pipe 2. Ball valve base 3. Special ball valve 4. Positioning drill bit 5. □19 hole drill 6. Sealing sleeve 7. Drill pipe 8. Hand electric drill

4.Installing the transducer (as shown in Figure 11)

Screw the lock nut to the bottom of the transducer and screw the transducer into the guide thread of the special ball valve. When the ball valve core is reached, open the ball valve and continue to screw in the transducer until the front end of the transducer protrudes from the inner wall of the pipe. Adjust the angle of the transducer (two The transducer cable entry hole should be upward or downward at the same time), tighten the locking nut, and finally connect the wires and seal the wiring joint with silicone rubber.

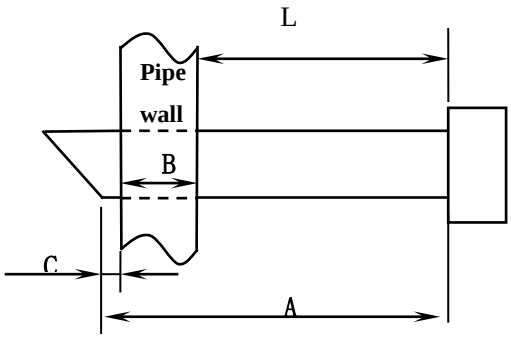
Figure 11



1. Transducer 2. Ball valve base 3. Ball valve 4. Guide thread 5. Locking nut 6. Junction box 7. Signal cable

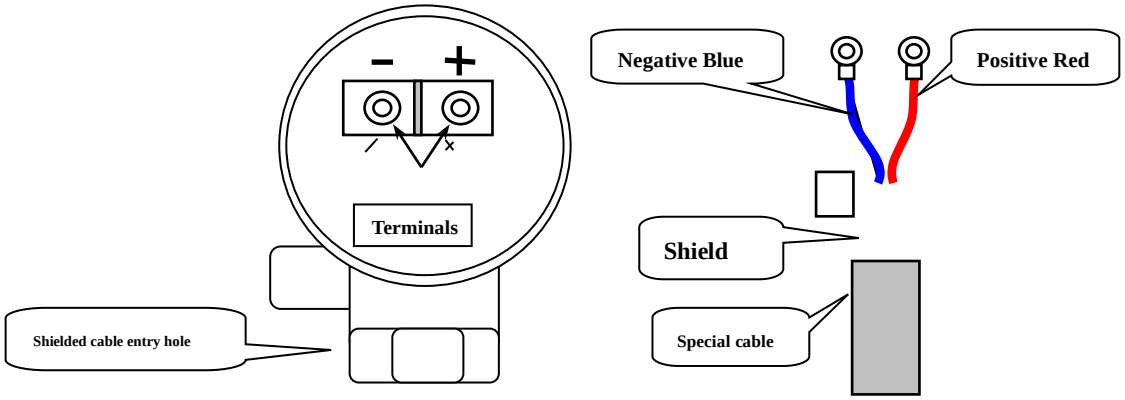
5. Calculation of the size of the transducer extending into the inner wall of the pipe (Figure 12) The length a of the transducer and the thickness b of the pipe wall are known. The length L of the transducer left on the outside of the pipe can also be measured, as long as L = a – b and c = 0.

Figure 12



6. Wiring diagram (Figure 13)

Figure 13



7. After the wiring is completed, lock the cable entry hole nut, then fill the junction box with waterproof glue, and finally screw on the box cover.

2.8 Check installation

Checking the installation refers to checking whether the transducer installation is appropriate and whether it can receive correct and strong enough ultrasonic signals to make the machine work normally, so as to ensure the long-term and reliable operation of the machine. Determine if your installation is optimal by checking received signal strength, total transmission time, time difference, and transmission time ratio.

The quality of the installation is directly related to the accuracy of the flow value and whether the flow meter can operate reliably for a long time. In most cases, the measurement results can be obtained by simply applying couplant to the probe and sticking it to the outside of the pipe wall. To ensure the best measurement results and ensure long-term reliable operation of the flow meter, it is recommended to perform the following inspections.

2.8.1 Signal strength

Signal strength (represented by RSSI in the upper left corner of the LCD screen) refers to the strength of received signals in both upstream and downstream directions. Use numbers from 0 to 99.9 to represent relative signal strength. 0 means no signal is received; 99.9 means maximum signal strength.

Generally speaking, the greater the signal strength, the more stable and reliable the measurement value is, and the more reliable it can run for a long time.

During installation, try to adjust the position of the probe and check whether the adjustment position is sufficient to ensure maximum signal strength. The condition for the system to work properly is that the signal strength in both directions is greater than 50.0. When the signal strength is too low, you should recheck the installation position of the probe, the installation spacing, and

whether the pipeline is suitable for installation or use the Z method for installation.

2.8.2 Signal quality (Q value)

Signal quality, referred to as Q value (represented by Q in the upper left corner of the LCD screen), refers to the quality of the received signal. Use numbers from 00 to 99 to indicate signal quality. 00 means the worst signal; 99 means the best signal, generally above 40.0.

The reason for poor signal quality may be large interference, poor installation of the probe, or the use of poor quality, non-dedicated signal cables. Under normal circumstances, the probe should be adjusted repeatedly to check whether the position is adequate until the signal quality is as high as possible.

2.8.3 Transmission time

The "transmission time" displayed in window F can reflect whether the installation is appropriate, because the internal measurement calculation of the flow meter is based on these two parameters, so when the "time difference" display fluctuates too much, the displayed flow rate and flow rate will also The signal will jump sharply. This situation indicates that the signal quality is too poor. It may be due to poor pipeline conditions, improper installation of the probe, or incorrect parameter input.
Under normal circumstances, the fluctuation of time difference should be less than ±20%. But when the pipe diameter is too small or the flow rate is very low, the fluctuation in time difference may be slightly larger.

2.8.4 Transmission time ratio

The "transmission time ratio, transmission time ratio" displayed in window F is used to confirm whether the probe installation distance is correct. The transmission ratio should be 100±3% if installed correctly. The transmission time ratio can be viewed by typing in the FUCK function menu.

When the transmission ratio exceeds the range of 100±3%, you should check whether the parameters (pipe outer diameter, wall thickness, pipe material, lining, etc.) are entered correctly, whether the installation distance of the probe is consistent with the data displayed in the transducer distance, and whether the probe is When installed on the same straight line as the axis of the pipeline, whether there is too thick scaling, whether the pipeline at the installation point is elliptically deformed, etc.

2.8.5 Things to note when installing

1）The input pipeline parameters must be correct and consistent with the actual situation, otherwise the flow meter will not work properly.

2）When installing, be sure to determine the position and adjust the transducer. When viewing the signal strength and signal quality values displayed by the host, slowly move the probe near the installation point until the strongest signal and maximum signal quality value are received. The larger the pipe diameter, the larger the probe movement range. Then confirm whether the installation distance matches the probe installation distance given by the host and whether the probe is installed on the same straight line as the pipeline axis. Pay special attention to pipes made from rolled steel sheets because they are irregular. If the signal strength is always 0.00, it means that the flowmeter did not receive an ultrasonic signal. Check whether the parameters (including all pipe-related parameters) are entered correctly, whether the probe installation method is selected correctly, whether the pipe is too old, whether its lining is too thick, whether the pipe has It is not filled with fluid, it is too close to the valve elbow, there are too many bubbles in the fluid, etc. If it is not for these reasons and the signal is still not received, it is recommended to change to another measuring point for debugging.

3）Confirm whether the flow meter is working normally and reliably: the greater the signal strength and the higher the signal quality Q value, the longer the flow meter can work reliably for a long time, and the higher the credibility of the flow value it displays. If the environmental electromagnetic interference is too large or the received signal is too low, the reliability of the displayed flow value will be poor, and the possibility of long-term reliable operation will be smaller.

4）At the end of the installation, power on the instrument again and check whether the results are correct.

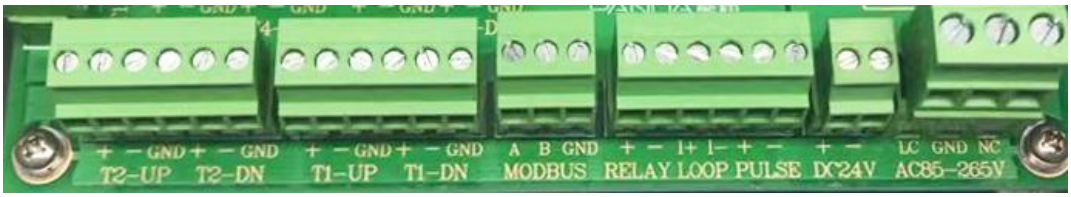
Transmitter Installation, Wiring And Keyboard Operation

3.1 Transmitter installation options

The transmitter should be installed in a place that is convenient for maintenance, calibration and observation of display readings. The location should meet the following conditions:

- The place is virtually vibration-free;
- No corrosive fluid falling;
- The ambient temperature is limited to the specified temperature range of the instrument;
- Avoid direct sunlight, as sunlight may increase the temperature inside the transmitter beyond the maximum limit.

3.2 Transmitter wiring



——85-265VAC AC power supply, the power cord is connected to the three sets of terminals corresponding to the picture (GND, LC, NC).

——24VDC DC power supply, the power cord is connected to the corresponding DC24V (+, -) terminal as shown in the figure.

(This series of instruments has universal functions of 220VAC and 24VDC, users can choose according to on-site needs)

—Channel 1—

T1- UP (+, -, GND) and T1-DN (+, -, GND) are used for transducer wiring. T1- UP represents the upstream transducer and T1-DN represents the downstream transducer. "+" is connected to the red signal wire, "-" is connected to the blue signal wire, and "GND" is connected to the black shielded wire.

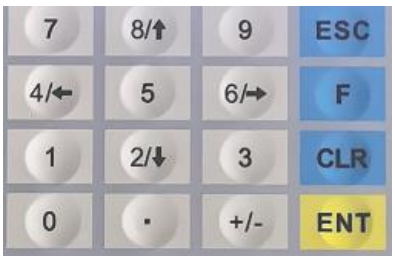
The positions of the two sets of transducers are equal, and there is no need to specify transmitting and receiving. If a negative number is displayed, please swap the wiring of the two sets of transducers.

——T1 (+, -) and T2 (+, -) are used for platinum resistance transducer wiring, T1 represents the water inlet temperature transducer, and T2 represents the water outlet temperature transducer.

It is connected to the channel 1 terminal block, represented by T1-UP/T1-DN.

3.3 Keypad

The ultrasonic flowmeter keyboard is shown on the right, and the description is as follows:



- 0~9 and . keys are used to enter numbers or menu numbers;
- The ESC key is used to return;
- Numeric keys 2, 4, 6, and 8 correspond to ↑↓ and →←, which are used to enter the previous menu or the next menu;
- The ENT key is used to enter the menu. First type the ESC key to select the corresponding submenu and then type the ENT key to enter the corresponding menu window. For example, enter the outer diameter of the pipe. Type ECS to enter the initial settings. Type the ENT key to enter the pipe parameter setting and select the pipe outer diameter. diameter is enough.
- The F key is used for related functions to view heat value, temperature, transmission time, and channel 1 transmission time ratio.

3.4 Keypad operating

The ultrasonic flowmeter adopts a windowed software design. All input parameters, instrument settings and displayed measurement results are unified and subdivided into independent windows. Users can enter parameters, modify settings or display measurement results by "accessing" a specific window. Purpose, the window uses buttons to enter, etc. The window number, or window address code, represents a specific meaning. For example, the pipe parameter setting window No. 11 indicates that the pipe outer diameter parameters are input in this system. For details, see the chapter "Window Detailed Explanation".

A quick way to access a window is to type the ESC key and then the ENT key from any state. For example, enter or view the pipe outer diameter parameter, type ECS to enter the initial settings, type ENT key to enter the pipe parameter settings, and select the pipe outer diameter.

There are certain rules for the arrangement of window addresses (see the next section and the "Window Detailed Explanation" chapter). Users do not need to remember them one by one. They only need to remember the address codes of commonly used windows and the general locations of uncommon windows. That’s it. When using it, temporarily enter a generally adjacent window, and then press the ↑ and ↓ keys to find the window you want to access.

In short, by organically combining the shortcut method and the mobile method, you can find that the operation method of accessing the window is actually simple and convenient.

The windows themselves are mainly divided into three types: selection type.

A selection window allows you to view the selected options. If you want to make modifications, you must first press the ESC key and ENT. At this time, a menu window will appear on the screen, indicating that you have entered a modifiable selection state. The user can use the ↑ and ↓ keys to remove the desired selection and then press the ENT key to confirm. For example, if the material of the pipe is stainless steel, press the ESC key to enter the initial settings, and press ENT to enter the pipe parameter settings. Type ENT, select pipe material, select stainless steel.

Pipe material: Stainless steel

Under normal circumstances, if you want to perform a "modify" operation, you must first type the ENT key.

3.5 Menu categories

Ultrasonic flow meters are characterized by full window operation.

Windows are arranged according to the following rules:

- The main interface window is a display window that can display net cumulative flow, positive cumulative flow, negative cumulative flow, instantaneous flow, instantaneous flow rate, date and time, signal strength, and signal quality.
- The initial setting is the initial parameter operation window. In these windows, parameters such as pipe outer diameter, pipe wall thickness, fluid type, probe type, probe installation method, etc. are entered, and the installation distance, heat parameter settings, etc. are displayed.
- The output setting window is the setting and operation of RS485 output, RS-232 output, relay output, current loop output, remote transmission (NB) output and other functions.
- The system settings window includes date, time, backlight, language settings, etc.
- The factory setting window includes settings and operations such as device serial number, flow adjustment factor, and restoring factory settings. Rarely used in actual operation and use.

3.6 Quick installation setup and steps

The following parameters need to be entered during routine measurement of ultrasonic flowmeter:

1. Pipe outer diameter
2. Pipe wall thickness
3. Pipes
4. Lining material parameters (if any, can include lining thickness and lining material sound speed)

5. Fluid type

6. Transducer type

7. Transducer installation method

The input steps for the above parameter conditions generally follow the following setting steps:

Type ESC to enter the initial setting window and type ENT to select the pipeline parameter.

4. Menu

4.1 Menu Table

Main Interface	Flow/Volume display	Channel 1
		Signal strength
		Display instantaneous flow/negative totalizer
		Display time/instantaneous flow rate
		Display instantaneous flow rate
Original Setup	Pipe parameter setting	Pipe outer diameter
		Pipe thickness
		Lining thickness
		Pipe inner diameter
		Pipe/lining material
		Fluid type/transducer type/transducer installation
		Zero point setting/damping coefficient setting
		Empty pipe signal settings
		Measurement channel settings
		Static zero reset
		Liquid temperature
		Transducer distance
	Flow Unit	Instantaneous flow unit
		Accumulated flow unit
		Cumulative amount multiplier factor
	Total flow	Positive accumulator
		Negative accumulator
		Accumulator cleared
	Low flow resection m/s	
	Flow scale factor settings	
	Thermal Setup	Thermal Measuring
		Thermal Unit setup
		Net Total open/close
		POS total/NEG total
		Cumulative multiplier factor
		Inlet temperature calibration
		Outlet temperature calibration
		Hypothermic resection
Output Setup	Modbus Output	Modbus address setup
		Baud rate setup
		Check setup
		Stop bit
	Relay Output	Relay Output
		Relay Type
		Relay Flow Unit
		Relay Thermal Unit
	Pulse Output	Pulse output
		Pulse Type
		Pulse flow unit
		Pulse thermal unit

	Current loop output	Current loop output
		Current loop calibration/current loop output calibration
		Current loop mode
		Current loop mode
		Minimum output value/Maximum output value
		Current output
	SD card	Log output
		Log interval
	NB output	NB output
		NB reporting type
		Cycle reporting start time
		Periodic reporting interval
		Scheduled reporting time 1/2/3/4
Date	Date	
	Time	
	Backlight settings	
	Language settings	
Others	Net accumulated heat	
	Positive accumulated heat	
	Negative accumulated calories	
	Instantaneous heat	
	Input and output temperature	
	Transmission time	
	Devise serial number	
	Version number	
	Operating hours	
	Date	

4.2 Menu Introduction

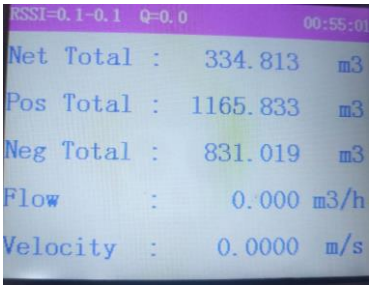
Please refer to the real product when reading this chapter for well understanding.

The shortcut to enter display window is pressing the ESC, then press ENT to Site

Shift window, Using ▲ and ▼

Main Interface

Positive Volume / Negative Volume / Net Volume / Flow/Velocity/S，Q Value

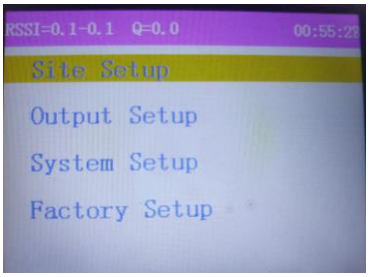


This window displays signal strength and quality Q value.

Signal strength uses 00.0～99.9 to represent. 00.0 means without receiving signal, 99.9 means maximum signal. Normally, signal strength should be≥60.0.

Signal quality Q used 00～99 to represent, 00 means worst quality, 99 means best. Normally signal quality Q should be >60.0.

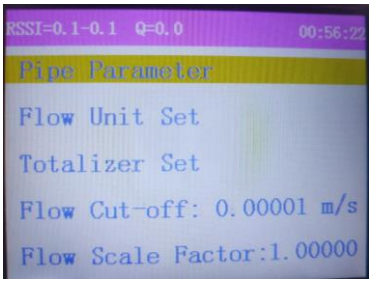
Main Menu



Site Setup / Output Setup / System Setup / Factory Setup

The main menu is used for setting all parameters. Press “ESC” can enter this interface, then press “ENT” can enter Submenu.

Site Setup Menu



Pipe parameter / Flow Unit Set / Totalizer Set / Flow Cut-off/Flow Scale Factor/Energy Measuring Set

This window is used for set some parameters, including pipe, flow, totalizer, thermal etc. Press ▲ and ▼ can choose corresponding function, press “ENT” to confirm and modify.

Pipeline parameter settings

Pipe outer diameter/pipe wall thickness/lining thickness/pipe inner diameter/pipe material/lining material/fluid type/transducer type/installation method/zero point setting/damping coefficient setting/empty pipe signal setting/measurement channel setting/static zero point/liquid temperature /transducer distance

This window is used for on-site installation and debugging and for setting related parameters such as pipe sections. You can use the ↑ and ↓ keys to select the corresponding function and type ENT to modify. After modification, type ENT to save.

Pipe outer diameter

This window is used to directly input the outer diameter of the pipe. The range of pipe outer diameter must be greater than 65mm and less than 6000mm. Enter the outer diameter size and type ENT to save.

Pipe outer diameter：612mm

Pipe thickness

This window is used to enter the pipe wall thickness. Enter the pipe wall thickness and type ENT to save.

Pipe thickness: 5 mm

Lining thickness

This window is used to enter the pipe wall thickness. Enter the pipe wall thickness and type ENT to save.

Lining thickness ：0.0mm

Pipe outer diameter

This window is used to enter the inner diameter of the pipe. Enter the pipe wall thickness and type ENT to save. If the pipe outer diameter and pipe wall thickness have been entered, they can be overridden using the ↓ key.

Pipe outer diameter：150 mm

Note: Just enter one of the pipe wall thickness and pipe inner diameter.

Pipe material

This window is used to input pipe material. There are the following options to choose from (select the pipe material according to the site and type ENT to save):

Pipe material：Carbon steel

0.Carbon steel	5. PVC
1.Stainless steel	6. Aluminum
2.Cast iron	7. Asbestos
3.Ductile iron	8. Fiberglass
4.Copper	9. Others

The 9th item "Others" is used to input other materials not included in the first 8 items. If the user selects this option, the corresponding sound velocity of the pipe must be entered in the window.

Lining material

This window is used to lining material. There are the following options to choose from (select the pipe material according to the site and type ENT to save):

0. No liner	6. Polystyrene

1. Tar Epoxy	7. Polyester
2. Rubber	8. Polyethylene
3. Mortar	9. Ebonite
4. Polypropylene	10. Teflon
5. Polystryol	11. Others

Item 11 "Custom" is used to input other materials not included in the first 10 items.

Fluid Type

Window for selecting fluid type familiar liquids types:

0. Water	8. Other
1. Sea Water	9. Diesel Oil
2. Kerosene	10 .Castor Oil
3. Gasoline	11.Peanut Oil
4. Fuel oil	12.Gasoline #90
5. Crude Oil	13.Gasoline #93
6. Propane at -45℃	14. Alcohol
7. Butane(0℃)	15. Water(125℃)

Transducer Type

This window is used to select the type of probe. There are the following probes to choose from. Select according to the on-site conditions. Type ENT to save.

Transducer type: Insertion C

0. Small transducer	4. B-HT
1. Medium transducer	5. Inserstion B
2. Large transducer	6. Insertion C
3. A-HT	7. Other

If the user selects "Other", they must enter another set of probe parameters (2 in total), including: sound wedge angle, sound wedge sound velocity, ultrasonic delay time and distance between the sound beam center and the edge of the probe. Please contact the company's technical personnel for specific usage methods.

Transducer installing

This window is used to select the probe installation method.

Transducer installing: Z method

Select according to the site conditions. Type ENT to save the following 4 methods for selection:

0. V (V method installation, 2 sound paths, common installation method)

1. Z (Z method installation, 1 sound path, the most commonly used installation method, this installation method is recommended)

2. N method small pipe installation (N method installation, 3 sound paths, uncommon installation method)

3. W method small pipe installation (W method installation, 4 sound paths, extremely uncommon installation method)

Zero point setting

Divided into: automatic zero, artificial zero, static zero, factory zero

This item generally selects automatic zero.

Automatic zero point When ready, press the ENT key.

Damping coefficient setting

The damping coefficient ranges from 0 to 99. , select according to the on-site conditions, and type ENT to save.

Damping coefficient setting: 10

0 means no damping, 99 means maximum damping. Damping serves to smooth the displayed data. Its principle is just like a single-section RC low-pass filter, and the damping coefficient value is equivalent to the time constant of the circuit. Usually enter 10~30 in the application.

Empty pipe signal setting

This value is used to resolve possible empty pipe issues. , select according to the on-site conditions, and type ENT to save. When the pipe is empty, the flowmeter may display "normal operation" because the signal is transmitted through the pipe wall. In order to avoid this situation, set this value so that the flowmeter will not measure when the signal is smaller than this value. If the flow meter can automatically stop measuring when the pipe is empty, please also enter a value of 30~40 in this window. To ensure that the flowmeter can not measure when the pipe is empty.

Empty pipe signal setting: 30

Measurement channel settings

This channel setting is to select the corresponding channel according to the scene, select the channel according to the scene, and type ENT to save.

Channel number 1 is 1 channel.

Static zero reset

When the fluid is static, the indication value of the instrument is called the "zero point". When the "zero point" of the flow meter is not zero, the zero point will be superimposed on the true flow value at any time, causing deviation in the measurement of the flow meter. Select on or off according to the scene and type ENT to save.

Static zero reset: Off

Fluid temperature

Display the current temperature of the pipe network, select the pipe network temperature according to the site, and type ENT to save. If the temperature transducer is not installed, it does not need to be set.

Fluid temperature:
℃

Transducer distance

This window displays the probe installation distance. The user must install the probe according to this size (note that the installation distance must be measured accurately when installing). This data is automatically given by the machine after the user inputs the pipeline parameters.

Transducer distance:
590mm

Flow unit setting

This window displays settings for flow unit, instantaneous flow unit, instantaneous flow unit, and accumulation multiplier factor settings.

Instantaneous flow unit

This window is used to select the flow rate and time unit of the instantaneous flow unit.

Instantaneous flow unit: M3/h

Flow unit options:
0. cubic meter (m3)
1. Liter (L)
2. US gallon (gal)
3. Imperial Gallon (IGL)
4. US megagallon (MGL)
5. Cubic feet (cf)
6. American barrel (bal)
7. Imperial barrel (ib)

Accumulated flow unit

This window is used to select the flow unit of the accumulator. The available unit selections for instantaneous flow are the same. Users can choose according to actual needs. The factory default unit is cubic meters (m3).

Accumulator multiplier

The function of the multiplier is to expand the representation range of the accumulator. The multiplier acts on both positive, negative and net accumulators. The following factors can be selected according to the actual traffic volume:

0. x 0.001 (1E-3)
1. x 0.01
2. x 0.1

Accumulator multiplier
X0.001

3. x 1
4. x 10
5. x 100
6. x 1000
7. x 10000(1E+4)

Factory default factors：x1

Totalizer settings

This window displays the functions used for integer accumulator, negative accumulator switch, and accumulator clearing.

Positive totalizer switch

Positive totalizer: ON

This window is used to turn on or off the positive totalizer. When "ON", the flow meter accumulates. When closed, the display of the positive totalizer in the main interface window will no longer change. The factory default value is "ON".

Negative totalizer switch

Negative totalizer: OFF

This window is used to turn on or off the negative accumulator switch. When "on", the flow meter accumulates. When closed, the negative totalizer display in the main interface window will no longer change. The factory default value is "On".

Accumulator cleared

Accumulator cleared: NO

This window is used to clear the accumulator and clear all setting parameters. Type ENT and use the up and down arrow keys to select "Yes" or "No". After confirming that you want to clear "Yes", you will have the following options to choose from:

Do not clear
Clear all
Net Accumulator Cleared
Positive accumulation
Negative accumulation

Low flow cutoff value

Low flow cutoff value: 0.03 m/s

This window is used to cut off low flow rates. This allows the system to display a "0" value at low flow rates to avoid invalid accumulation. For example, if the cutoff value is set to 0.03, the machine will regard all measured values within the flow rate ±0.03 as "0". Typically enter 0.03 in the application

Flow scale factor settings

Flow scale factor settings: 1

This parameter is also called the instrument factor and is used to correct the measurement results. The factory default value is 1 or the calibrated value. Please set this parameter according to the calibration sheet provided with the instrument. If it is really necessary, the user can adjust this parameter based on the actual recalibration results.

Heat parameter settings

This window is mainly connected to a platinum resistance temperature transducer. Together with the flow transducer, it can measure temperature and flow on site and be combined into a calorimeter. This window is mainly used for on-site settings during heat measurement.

Heat measurement

Heat measurement:ON

This window mainly measures the measurement switch settings. After opening the heat.

Heat unit settings

Heat unit settings

The main heat units in this window are set to "GJ" and "KWh" as heat measurement units. The factory default heat unit is KWh

Positive totalizer switch

Positive totalizer: ON

This window is used to turn on or off the positive totalizer. When "ON", the calorimeter accumulates. When closed, the display of the positive totalizer in the main interface window will no longer change. The factory default value is "ON"

Negative totalizer switch

Negative totalizer: ON

This window is used to turn on or off the negative accumulator switch. When "on", the calorimeter accumulates. When closed, the negative totalizer display in the main interface window will no longer change. The factory default value is "On".

Accumulator cleared

Accumulator cleared: NO

This window is used to clear the accumulator and clear all setting parameters. Type ENT and use the up and down arrow keys to select "Yes" or "No". After confirming that you want to clear "Yes", you will have the following options to choose from.：

Do not clear

Clear all

Positive accumulation

Negative accumulation

Accumulator multiplier

The function of the multiplier is to expand the representation range of the accumulator. The multiplier acts on both positive, negative and net accumulators. The following factors can be selected according to the actual traffic volume:

0. x 0.001 (1E-3)
1. x 0.01
2. x 0.1
3. x 1
4. x 10
5. x 100
6. x 1000
8. x 10000(1E+4)

Default ： x1

Accumulator multiplier: X1

Inlet Temperature Calibration

This window is to calibrate inlet temperature.

Inlet Temperature Calibration: ℃

Outlet Temperature Calibration

This window is to calibrate outlet temperature.

Outlet Temperature Calibration: ℃

Low Temperature Difference Cut-off

This window is to cut off the low temperature difference.

Low Tem. Difference Cut-off: ℃

Thermal Totalizer On/Off

This window is to open or close thermal totalizer. Choose “open” means open thermal totalizer, and choose “off” means close thermal totalizer.

Output Setting

This window is to set flow meter’s output, including Modbus, Relay, Pulse, Current and SD card. Please choose corresponding output according to working site.

Modbus Output

This window is to set Modbus, including address, baud rate, check and stop bit.

The meter default address is 1, baud rate is 9600, check is none, and stop bit is 1, customer can set parameters according to working site.

Modbus Address: 1 **Baud Rate: 9600** Check: None Stop Bit: 1

Relay Output

This window is to set relay output. Relay is normally open to control external device.

Available optional are one of following trigger events:

0. NO Signal

1. Poor Signal

Output: off **Type: Total flow** **Flow Unit: m^3** Thermal Unit: GJ

2. Not Ready

3. Reverse Flow

4. AO Over 100%

5. FO Over 120%

6. Alarm #1

7. Alarm #2

8. Batch Control

9. POS Int Pulse

10. NEG Int Pulse

11. NET Int Pulse

12. Energy Pulse

13. ON/OFF Via RS-232

14. Fluid Changed

15. Not Using

Pulse Output

This window is to set pulse output, including pulse output. Including pulse output on/off, pulse type, flow unit and thermal unit.

Output： Off
Type：Pos Flow
Flow Unit：L
Thermal Unit：KJ

Current Loop

This window is to set current loop output, including on/off and pulse output on/ff.

Current Loop Calibration

This window is to calibrate 4mA, 20mA, use ammeter to measure current output, and press ↑or↑ to adjust. Observing the ammeter until it shows 4.00 and stop to adjust, then it means already calibrate 4mA. At this time, press “ENT” to calibrate 20mA, same method. The calibration result will be stored in EEPROM, and it won’t loss even if power off.

CL Calibration ： 4mA

Current Loop Output Checkup

This window is to check whether current loop is calibrated or not. Press “ENT” and press↑or↓to show 44mA、8mA、12mA、16mA、20mA，at the same time use ammeter to check whether current loop output corresponding value, if over than error limit, please calibrate current loop again.

Mode Checkup： 4mA
Press ENT after prepared

Current Loop Output Mode

4-20mA is the most commonly used mode.

CL Mode： 4-20mA

Minimum Output Value

This window is to set the minimum flow value corresponding to 4mA or 0mA.

Min. Value ： 0 m3/h

Maximum Output Value

This window is to set the maximum flow value corresponding to 20mA.

Max. Value ： 0 m3/h

Current Output Value

This window is to show current value. For example: display 4.0000mA, it means current loop output value is 4.0000mA. If current loop output value has big difference with the displayed value, then please calibrate current loop again.

Current Value: 4.0000 mA

SD Output

This window is to set SD card, including time interval. To save current data.

Data Logger ： **Open Time Interval：** **00：01:00**

NB Output

This window is to test network communication.

NB Output： On

NB Report Type：

This window is to choose data report mode. If hope to report timing, please choose “report timing”and press “ENT” to confirm.

NB Report Mode： **Report timing**

Report Start Time

This window is to set report period, including start time, time interval, and timing 1, timing 2, timing 3, timing 4.

If press “.” **.**.** means report data from current time. If set 23:10:10 means report data from 23:10:10. if press **.**.** in the duration, means timing report lasts for an infinite time.

Start Time： 00 **Report Time： 00** **Time Interval： 00** **Timing 1：00**

System Setup

This window is to set date, time， backlit and language.

Date 21-12-14 **Time 14:28:16**

Date and Time Setup

This window is to modify system date and time. Time is 24 hours. Press “ENT” will show “>” then can modify.

Backlit Setup

This window is to set LCD backlit, the value is bigger means the LCD is lighter.

Backlit：
1. Always on

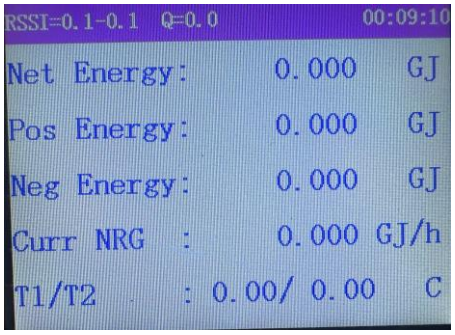
Language Setup

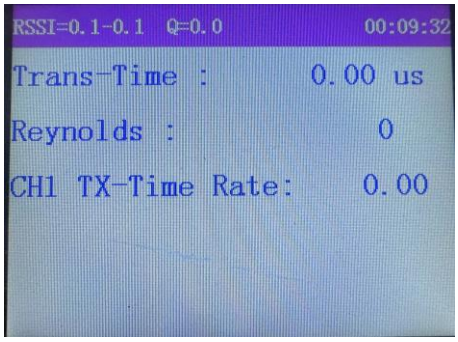
This window is to choose language, English and Chinese optional.

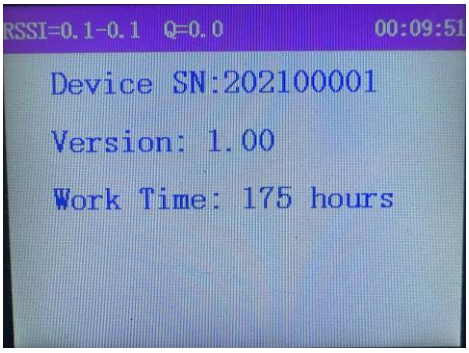
Language： English

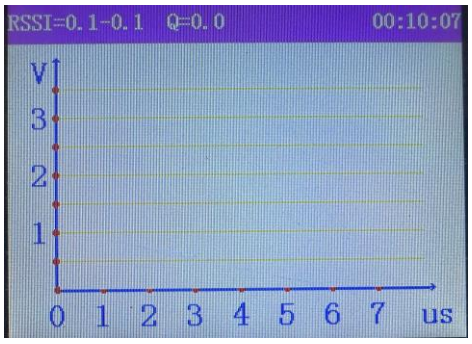
Function Setup

Press “FUNC” then press “ENT”, this window is to display Net thermal, Positive Flow, negative thermal, instantaneous thermal, output/input temperature, transmission time, Reynolds number, transit time ratio, version, working time. As following pictures show:









5. Operation Introduction

5.1 How to judge flow meter work properly

If display“*R” it means flow meter work properly. If display “E” in the window, that means the output of current loop is out of range 100%, which is related to window “Output Setup→Current Loop Output” Increasing the output value in Current Loop Output window, “E” will disappear, if don’t use current loop, can ignore that.

If display “H” it means that receiving ultrasonic signal is bad. About solution please refer to chapter of “Error information code”.

If display “G” it means the instrument is gain adjusting automatically before measuring. If it’s

always in this status, that means the machine is wrong.

“I” means the instrument can’t receive ultrasonic wave signal, check whether probe cable connect properly and stably.

“J” means the instrument hardware has faults. Some software faults are temporary, can try to power on again. About the details, please refer to the chapter “Error information code”.

5.2 How to distinguish flow direction in pipe

First step, confirm flow meter is on work.

Second step, transducer A is connected on the upstream connection of main board, transducer B is connected on the downstream connection.

Third step, view the flow rate value is “+” or “-” (“+” not display), if it is “+” that means fluid flow direction is A→B, if it is “-” that means fluid flow direction is B→A.

5.3 How to Select Flow Unit

Initial setup→flow unit, choose Metric or British system as flow unit.

Method: Press “ECS” then press “ENT” to choose flow unit, press “ENT” and press↑or↓to choose wanted, then press “ENT” to confirm.

5.4 How to Select Flow Rate and Cumulative Flow Unit

Initial setup→flow unit, choose Metric or British system as flow unit.

Method: Press “ECS” then press “ENT” to choose flow unit, press “ENT” and press↑or↓to choose wanted, then press “ENT” to confirm.

5.5 How to Select Totalizer Multiplier Factor

Multiplier factor is used for extending the range of totalizer, initial setup→flow unit, choose totalizer multiplier factor.

Method： Press “ECS” then press “ENT” to choose totalizer multiplier factor, then press”ENT” to confirm.

5.6 How to Open/Close Flow Totalizer

Initial Setup→Total Flow Setup to open/close positive totalizer.

Users can choose positive/negative flow according to needs.

5.7 How to Clear Flow Totalizer

Initial Setup→Total Flow Setup to clear totalizer, generally do not use this function except for first installation.

5.8 How to Restore Factory Settings

Press “ESC” then press “ENT” to restore all factory settings. But the calibrated factor, network address and other items will be maintained.

5.9 How to Use Damper to Stabilize Flow Display

Initial Setup→Pipe parameter setup, the factor is bigger the flow display is more stable. But the factor can’t be too big otherwise flow display will delay, generally the range is 10~30 seconds.

This window is in Initial Setup→Pipe parameter setup to input time factor directly, then press “ENT” to confirm.

5.10 How to Use Zero Cut-off to Avoid Invalid Accumulation

Initial Setup→low velocity cut-off value, if velocity value is lower than excision value, system will treat the flow as “0”. When real flow is “0”, to avoid false accumulation, generally set the parameter 0.03m/s. When velocity is bigger than the excision value, excision value is irrelevant with measuring result, have no effect on the measuring result.

5.11 How to Set Zero Point

Each instrument will have a zero point when the flow is 0, but the display value is not 0.This is called Zero Point. Ensure that the pipe is full of liquid and the flow is absolutely stopped. Then run the function in window Initial Setup→Pipe parameter setup→zero point setup, press “ENT” and wait until the counter readings displayed in the bottom right corner of the screen goes to “00”; thus, the zero set is completed and the instrument indicates the results automatically through Window No.01. Repeat zero set calibration if it still needs to be minimized, i.e. the velocity reading is still high.

5.12 How to Use Scale Factor

Scale factor refers to the ratio between “actual value” and “reading value”. The scale factor default is a factory calibration value for each instrument prior to shipment from the factory. In initial setup→flow scale factory setup to input the ratio between “actual value” and “reading value”.Re-calibration or change the Scale factor may be necessary on different pipe lines or different applications in order to obtain better accuracy. Meter scale shall be same with actual calibration result.

5.13 How to Use Data Timing Output Function

The flow meter can set data timing output, including contents, start time, interval, duration. In the window: initial setup→press “NB”.

5.14 4~20mA Output

The flow meter current loop output accuracy is higher than 0.1% and can be programmable, can set different output mode, including 4-20mA and 0-20mA. Select in the window: Output Setup→Current Loop Output.

In window “Current Loop Output” to input flow value corresponding to 4mA and 20mA. For instance, if the flow range in a specific pipe is 0~1000m3/h, just enter 0 and 1000 in “Current Loop output”. If the flow ranges from -1000~0~2000m3/h, without considering flow direction, just enter 1000 and 2000 by selecting 20~4~20mA. If taking flow direction in consideration, using 0~4~20mA output, when the flow direction is negative, current output is in range 0~4mA, when the flow direction is positive, current output is in range 4~20mA. Output mode: enter “-1000” in minimum value, and enter “2000” in maximum value.

5.15 Analog voltage signal output

Parallel a 250Ω resistance on both sides of electric current loop. The 4~20mA voltage can be changed into 1-~5V.

5.16 Frequency Signal Output

Ultrasonic flow meter has frequency signal output function, the high or low frequency output displayed indicates the high or low flow rate reading. Users can reset the frequency output as well as flow rate according to actual requirements.

5.17 Totalizer Pulse Output

Each unit flow of the ultrasonic flowmeter can generate a cumulative pulse output to an external counting device.

Flow resolution is set in window: “Initial Setup→Pulse Output”

Accumulated pulse only can be output by hardware OCT or relay, so users also need to set OCT and relay.

For example: Users want to output accumulated pulse by relay, each pulse means 0.1m³ flow, can set as below

In window “Initial setup→Flow Unit to choose accumulative flow unit “m³”, then choose multiplier factor: “×0.1”; and choose “Positive Pulse Output” in window “ Pulse output”.

Notice: Please select the suitable totalizer output. If the output is too large or too small, it will influence the working life and lose the pulse. Recommended velocity is 1~60 pulse/min.

5.18 Date and Time Setup

Users can set the date and time in window “ System setup→Date and Time setup” to press “ENT”

it ill show‘>’which means can be modified.

5.19 Backlit Setup

Ultrasonic flow meter’s LCD backlit and contrast can be set in window “System setup→Backlit setup” Press “ENT” to confirm.

5.20 How to Use RS232/RS485

Ultrasonic Flow Meter has a RS-232 standard DB9 serial port, and the data rate can be selected between 75 ~ 115200 baud rate.

In window “ Initial Setup→Modbus Output Setup” to set baud rate and check bit.

Using matched RS-232C/RS-485 converting device to connect with 485 BUS easily. This converting device is electric isolated. It’s convenient to be applied in industrial fields.

Refer to “RS232” communication protocol and command.

6. Communication protocols and data storage

6.1 RS485（Modbus-RTU）Communication

1. Menu Settings: Modbus address Settings, baud rate Settings, check Settings and stop bits are set in the Modbus Output window in Output Settings.

The default address is 1, the communication baud rate is 9600, no check, and the stop bit is 1bit.

2. Modbus-RTU Communication protocol

Register introduction

Register address	Size (bytes)	Read/write	Data type	Description
00	4	RO	float	Instantaneous velocity
02	4	RO	float	Instantaneous flow
04	8	RO	double	Net cumulative flow
08	8	RO	double	Positive cumulative flow
12	8	RO	double	Negative cumulative flow
16	4	RO	float	T1(Input) Temperature
18	4	RO	float	T2(output) Temperature
20	4	RO	float	Instantaneous energy
22	8	RO	double	Net accumulated energy
26	8	RO	double	Positive cumulative energy
30	8	RO	double	Negative accumulated energy
34	4	RO	int	Transducer distance (mm)
36	4	RO	float	Channel 1 transmission time ratio
38	4	RO	float	Channel 1 Signal Quality (Q)
40	4	RO		Keep unused

42	4	RO	float	Uplink signal strength in channel 1
44	4	RO	float	Downlink signal strength in channel 1
46	4	RO		Keep unused
48	4	RO		Keep unused
50	4	RO		Keep unused
52	4	RO		Keep unused
54	4	RO		Keep unused

Register address	Size (bytes)	Read/write	Data type	Description
100	4	RO	float	Pipe diameter (mm)
102	4	RO	float	Wall thickness (mm)
104	4	RO	float	Lining thickness (mm)
106	4	RO	Int	Pipeline type
108	4	RO	float	Custom pipe sound speed (m/s)
110	4	RO	Int	Lining type
112	4	RO	float	Custom lining sound speed (m/s)
114	4	RO	Int	Type of liquid to be measured
116	4	RO	float	Custom measured liquid sound velocity (m/s)
118	4	RO	Int	Transducer type
120	4	RO	Int	Customize the transducer Angle
122	4	RO	float	Custom Transducer wedge Sound speed (m/s)
124	4	RO	float	Custom transducer acoustic wedge surface center point to transducer edge distance (mm)
126	4	RO	float	Custom acoustic wave delay time in a single transducer (us)
128	4	RO	Int	Transducer mounting type
130	4	RO	Int	Measure signal minimum signal strength
132	4	RO	Int	Zero type
134	4	RO	float	Custom zero offset
136	4	RO	Unit	Damping coefficient
138	4	RW	Int	Volume of flow unit Set
140	4	RW	Int	Time setting in traffic unit
142	4	RW	Int	Cumulative traffic unit setting
144	4	RW	Int	Cumulative flow multiplier Settings
146		RW	Int	Positive cumulative traffic is

				enabled
148		RW	Int	Negative cumulative flow is enabled
150		RW	float	Low-flow excision
152		RW	float	Flow scaling factor
154		RW	Int	Energy measurement enabled
156		RW	Int	Energy unit
158		RW	Int	Positive cumulative energy enabled
160		RW	Int	Negative cumulative energy enabled
162		RW	Int	Cumulative energy multiplier Settings
164		RW	float	Input temperature calibration
166		RW	float	Output temperature calibration
168		RW	float	Low temperature differential excision
170		WO	Int	Set accumulated traffic clearing
172		WO	Int	Accumulated energy reset setting
174		RO	Int	Measuring channel

Register address	Size (bytes)	Read/write	Data type	Description
200	4	RW	Int	Modbus address
202	4	RW	Int	Baud rate setting
204	4	RW	Int	Check setting
206	4	RW	Int	The relay output was enabled
208	4	RW	Int	Relay output type setting
210	4	RW	Int	Relay output flow unit setting
212	4	RW	Int	Relay output energy unit setting
214	4	RW	Int	Pulse output is enabled
216	4	RW	Int	Pulse output type setting
218	4	RW	Int	Pulse output flow unit setting
220	4	RW	Int	Pulse output energy unit setting
222	4	RW	Int	Current loop output is enabled
224	4	RW	Int	Current loop calibration Settings
226	4	RW	Int	4ma calibration
228	4	RW	Int	20ma calibration
230	4	RW	Int	Current loop test setup
232	4			reserve
234	4	RW	float	Current loop minimum flow setting
236	4	RW	float	Current ring maximum flow setting

238	4	RO	float	Current loop current output
240	4	RW	Int	Log enable
242	4	RW	hhmmss	The log interval is set to the BCD code
244	4	RW	Int	NB enable
246	4	RW	Int	NB Upload type Set
248	4	RW	hhmmss	NB Upload start time BCD code
250	4	RW	hhmmss	NB Upload interval BCD code
252	4	RW	hhmmss	NB Timed upload time 1, BCD code
254	4	RW	hhmmss	NB Timed upload time 2, BCD code
256	4	RW	hhmmss	NB Timed upload time 3, BCD code
258	4	RW	hhmmss	NB Timed upload time 4, BCD code

Register address	Size (bytes)	Read/write	Data type	Description
300	4	RW	yymmdd	Date setting BCD code
302	4	RW	hhmmss	Time setting BCD code
304	4	RW	Int	Backlight brightness Settings
306	4	RW	Int	Language setting
308	4	RO	Int	Relay output type setting
310	4	RO	Int	Accumulated working hours (hours)

Register address	Size (bytes)	Read/write	Data type	Description
400	4	RW	Int	ESN Settings

7. Heat measurement function

7.1 Introduction to Heat Function

The TP4000 ultrasonic flow/BTU meter has an optional heat measurement function, which can automatically calculate the heat of the fluid, and can display instantaneous heat and net accumulated heat. The temperature signal is input through ports T1 and T2.

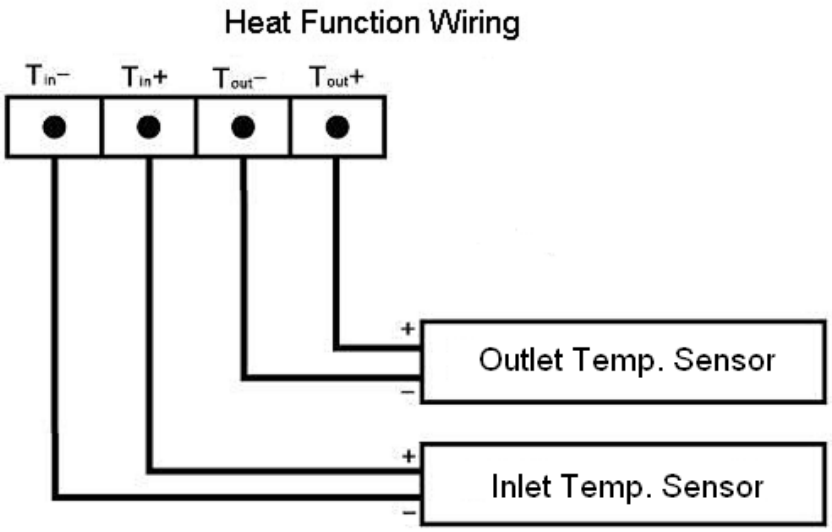
Heat = flow rate x density x (T1 enthalpy -T2 enthalpy). The enthalpy values of T1 and T2 are calculated according to the national standard specific heat value.

Initial setting - Select heat parameter setting Type ENT key to see the following information:

- Heat measurement: On/off
- Thermal measurement unit choice: GJ or KWh.
- Positive cumulative: On/off
- Negative cumulative: On/off
- Accumulator: not clear zero
- Accumulator quantity multiplier factor: 0.001
- Inlet temperature calibration: ℃
- Outlet temperature calibration: ℃
- Low temperature differential excision: 0.5℃

7.2 Heat meter wiring

The fluid temperature is obtained from an external input platinum resistance temperature transducer signal. T1 connects to the inlet water temperature transducer, and T2 connects to the outlet water platinum resistance temperature transducer. Instantaneous heat and net accumulated heat can be displayed through menu M05. The T1 and T2 temperature values are displayed on the menu。



7.3 Range of temperature

The temperature range can be set through Initial Settings - Select Heat parameter Settings. The

temperature corresponding to the platinum resistance value of 1000Ω is 0℃; The platinum resistance value of 1758.56Ω corresponds to the temperature of 200℃; The user needs to output the temperature range of the heat parameter 0-200℃, because the temperature value is calibrated before the factory, so when the user is in use, if the output resistance value of the platinum resistance temperature transducer is 1000Ω, the temperature displayed by the instrument is 0℃; The output resistance value of the platinum resistance temperature transducer is 1758.56Ω, and the temperature displayed by the instrument is 200℃. You can view the current temperature from the menu.

7.4 The temperature transducer installation requirements

Platinum resistance temperature transducers are available as plug-in mounts. When installing platinum resistance temperature transducers, the following points should be noted:

1) The plug-in temperature transducer is generally installed at 5DN downstream of the flow rate transducer.

2) It is conducive to accurate temperature measurement, safe and reliable, convenient maintenance, and does not affect equipment operation and production operations.

3) For the need to measure the fluid temperature in the center of the pipeline, a plug-in temperature transducer is used, and its measuring end should be inserted into the center of the pipeline (vertical installation or inclined installation). If the pipe diameter of the measured body is 200mm, the insertion depth of the temperature transducer should be selected to 100mm.

4) The cable of platinum resistance temperature transducer is provided by the manufacturer, the standard length is 1.5 meters, and 10m is optional.。

7.5 Platinum resistance temperature transducer installation steps

Insertion type

Because the plug-in platinum resistance temperature transducer is directly in contact with the measuring medium, the measurement accuracy is higher than that of the externally clipped platinum resistance temperature transducer.

After deciding where to install the plug-in platinum resistance temperature transducer, you can install the plug-in temperature transducer in two ways.

First, install the plug-in temperature transducer through the ball valve.

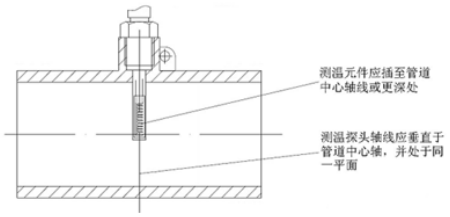
For welded pipes (such as steel, PVC, etc.), only need to weld the ball valve base directly on the outer wall of the pipeline, (before welding, the surface of the pipeline near the welding spot is clean), pay attention to the welding must not include pores, to prevent water leakage, or even fracture.

For pipes that cannot be welded directly (such as cast iron or cement pipes), a customized special hoop (with a rubber pad for sealing) must be used. The ball valve base has been welded to the hoop in advance, and the hoop is directly secured to the pipe under test. Fasten the ball valve base on

the outer wall of the pipeline and be sure to seal it well to prevent water leakage. Wrap the raw material belt around the base of the ball valve and screw on the ball valve.

Connect the sealing sheath of the hole opener with the external thread of the special ball valve, tighten it, open the ball valve, push the drill pipe until it contacts the outer wall of the pipeline, connect the electric drill and the drill pipe and lock it tightly, switch on the power supply, and start drilling. During the drilling process, the electric drill should keep a low speed and do not enter the drill too fast and slowly, so as not to get stuck or even break the drill bit. Pull out the drill pipe until the most front end of the drill bit is back to the ball valve core, close the ball valve, and remove the hole opener (it is best to open the ball valve a little and drain the water to wash the iron scraps for easy installation of the transducer). Insert the plug-in transducer, adjust the insertion depth, and fix it.

Second, directly cut a hole in the pipeline, insert the transducer, and weld the transducer on the pipeline. Note: The temperature element of the temperature transducer should reach the center of the pipe.



The temperature measuring element is inserted into the central axis of the pipe or deeper

Temperature measuring probe axis should be perpendicular to the pipe axis, and in the same plane

8. Error code

Work error code causes and solutions

Code	Corresponding display	Cause	Solutions
*R	System working properly	* System normal	
*J	Measurement circuit hardware error	* Hardware failure	* Contact factory
*I	No received signal detected	* Can't receive signal * The probe is not in tight contact with the pipe Or too little coupling agent * Probe is not properly installed * The inner wall is too dirty * New lining	* Make sure the probe is close to the pipe and use sufficient coupling agent * Ensure that the pipe surface is clean and free of rust, paint, and corrosion. Clean the pipe surface with an iron brush * Check that the initial parameters are set correctly. * Only scaling can be removed or replaced, but in general, the test point can be replaced, possibly another point with less scaling, and the machine may work normally. * Wait until the lining is cured and saturated before testing.

*H	The received signal strength is low	* low signal * same as above	** The same as above.
*H	The received signal quality is poor	* poor signal * same as above	* Corresponding solutions to the problem
*E	Current Loop current greater than 20 mA (Does not affect the normal measurement if the current output is not used, can be ignored.)	* 4-20mA current loop output over 100% * Wrong current loop output setting	* Recheck the Settings or confirm that the actual traffic is too large.
*F	See Table 1	* A fault was found during the power-on self-test * Permanent hardware failure	* Try to power on the device again, observe the information displayed on the monitor, and handle the problem according to the previous table. If the problem persists, contact our company * Contact US
*G	Adjust the gain in progress >S1 Adjust the gain in progress >S2 Adjusting the gain in progress >S3 Adjusting the gain in progress >S4	*These four steps indicate that the machine is making gain adjustments in preparation for normal measurements. * If the machine stops on S1 or S2 or only switches between S1 and S2, the received signal is too low or the waveform is not good.	
*K	Empty pipe, menu Settings	There is no fluid in the pipe or the setting is wrong	If really have the fluid in the pipe, input 0 values in the menu

Note: The presence of error codes *Q,*E does not affect the measurement, but indicates that there is a problem with the current loop and frequency output

Appendix A: Sound velocity and Viscosity of commonly used liquids

Fluid	Liquid sound velocity meter				power viscosity	absolutely viscosity
	20℃					
	Specific gravity	Velocity of sound		Velocity of sound / Temperature℃		
		m/s	ft/s			
Butyl acetate		1270	4163.9			
Ethyl acetate	0.901	1085	3559.7	4.4	0.489	0.441
Acetic acid, methanol	0.934	1211	3973.1		0.407	0.380
Acetate, propyl		1280	4196.7			
acetone	0.79	1174	3851.7	4.5	0.399	0.316
Alcohol	0.79	1207	3960.0	4.0	1.396	1.101
Alcohol, butyl acrylate	0.83	1270	4163.9	3.3	3.239	2.688
phenylethanol	0.83	1180	3868.9	4	1.396	1.159
Alcohol, methyl	0.791	1120	3672.1	2.92	0.695	0.550
Alcohol, propyl		1170	3836.1			
Alcohol, propyl	0.78	1222	4009.2		2.549	1.988
ammonia	0.77	1729	5672.6	6.7	0.292	0.225
aniline	1.02	1639	5377.3	4.0	3.630	3.710
benzene	0.88	1306	4284.8	4.7	0.711	0.625
Benzene, ethyl acetate	0.867	1338	4389.8		0.797	0.691
bromine	2.93	889	2916.7	3.0	0.323	0.946
butane	0.60	1085	3559.7	5.8		
Butyl ester, ethyl ester		1170	3836.1			
Carbon dioxide	1.10	839	2752.6	7.7	0.137	0.151
Carbon tetrachloride	1.60	926	3038.1	2.5	0.607	0.968
chloroxime	1.11	1273	4176.5	3.6	0.722	0.799
chloroform	1.49	979	3211.9	3.4	0.550	0.819
Ethyl ether	0.71	985	3231.6	4.9	0.311	0.222
Diethyl ketone		1310	4295.1			
Diethylene glycol	1.12	1586	5203.4	2.4		
Ethyl alcohol	0.79	1207	3960.0	4.0	1.390	1.097
Ethyl ether	0.71	985	3231.6	4.9	0.311	0.222
Ethylene glycol	1.11	1658	5439.6	2.1	17.208	19.153
Freon r12		774.2	2540			
gasoline	0.7	1250	4098.4			
glycerin	1.26	1904	6246.7	2.2	757.100	953.946

Ethylene glycol	1.11	1658	5439.6	2.1		
isobutanol	0.81	1212	3976.4			
isobutane		1219.8	4002			
isopentane	0.62	980	3215.2	4.8	0.340	0.211
Isopropyl alcohol	0.79	1170	3838.6		2.718	2.134
kerosene	0.81	1324	4343.8	3.6		
linalool		1400	4590.2			
Linseed oil	.925-.939	1770	5803.3			
carbinol	0.79	1076	3530.2	2.92	0.695	0.550
dichloromethane	1.33	1070	3510.5	3.94	0.310	0.411
Ethyl ketone		1210	3967.2			
Engine Oil (SAE 20/30)	.88-.935	1487	4875.4			
octane	0.70	1172	3845.1	4.14	0.730	0.513
Oil, castor beans	0.97	1477	4845.8	3.6	0.670	0.649
Diesel oil	0.80	1250	4101			
Lubricating oil		1530	5019.9			
Olive oil	0.91	1431	4694.9	2.75	100.000	91.200
Peanut oil	0.94	1458	4783.5			
Paraffin oil		1420	4655.7			
pentane	0.626	1020	3346.5		0.363	0.227
petroleum	0.876	1290	4229.5			
N-propyl alcohol	0.78	1222	4009.2			
Refrigerant 11	1.49	828.3	2717.5	3.56		
Refrigerant 12	1.52	774.1	2539.7	4.24		
Refrigerant 14	1.75	875.24	2871.5	6.61		
Refrigerant 21	1.43	891	2923.2	3.97		
Refrigerant 22	1.49	893.9	2932.7	4.79		
Refrigerant 113	1.56	783.7	2571.2	3.44		
Refrigerant 114	1.46	665.3	2182.7	3.73		
Refrigerant 115		656.4	2153.5	4.42		
Refrigerant C318	1.62	574	1883.2	3.88		
Silicon (30 cp)	0.99	990	3248		30.000	29.790
toluene	0.87	1328	4357	4.27	0.644	0.558
Transformer oil		1390	4557.4			
trichloroethylene		1050	3442.6			
1,1, 1-trichloroethane	1.33	985	3231.6		0.902	1.200
turpentine	0.88	1255	4117.5		1.400	1.232
Distilled water	0.996	1498	4914.7	-2.4	1.000	0.996
deuterium	1	1400	4593			
seawater	1.025	1531	5023	-2.4	1.000	1.025
Wood alcohol	0.791	1076	3530.2	2.92	0.695	0.550
xylene	0.868	1343	4406.2		0.749	0.650
o-xylene	0.897	1331.5	4368.4	4.1	0.903	0.810
benzene	1330		4376.8		0.662	

ethylbenzene	1340					
toluene	1170	0.69				
Carbon tetrachloride	938					
kerosene	1420	2.3				
petroleum	1290					
Pine oil	1280					
trichloroethylene	1050	0.82				
Grand Port jet coal	1298					
Daqing 0 # aviation coal	1290					
Peanut oil	1472					
Castor oil	1502					
Carbon dioxide	258.0					
chlorine	205.3					
Ethyl ketone	1310					
acetaldehyde	1180					

Appendix B: Underwater sound velocity meter (1 standard atmosphere)

Unit: Temperature ℃; Sound speed m/s (pressure 1Bar)

Temperature	sound velocity	Temperature	sound velocity	Temperature	sound velocity	Temperature	sound velocity
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

Appendix C: Sound velocity of commonly used materials

Tube material	sound velocity (m/s)
steel	3206
ABS	2286
aluminum	3048
Orichalcum	2270
Cast iron	2460
bronze	2270
Glass fiber reinforced plastic	3430
glass	3276
polythene	1950
PVC	2540

Lining material	sound velocity (m/s)
Teflon	1225
titanium	3150
cement	4190
pitch	2540
enamel	2540
glass	5970
plastic	2280
polythene	1600
Polytetrafluoroethylene	1450

USonic Metering LLC
444 W 52nd St.
New York, NY 10019
United States of America
Tel: +1 774 325 8000
Fax: +1 914 565 4000
E-mail: sales@usonicmetering.com