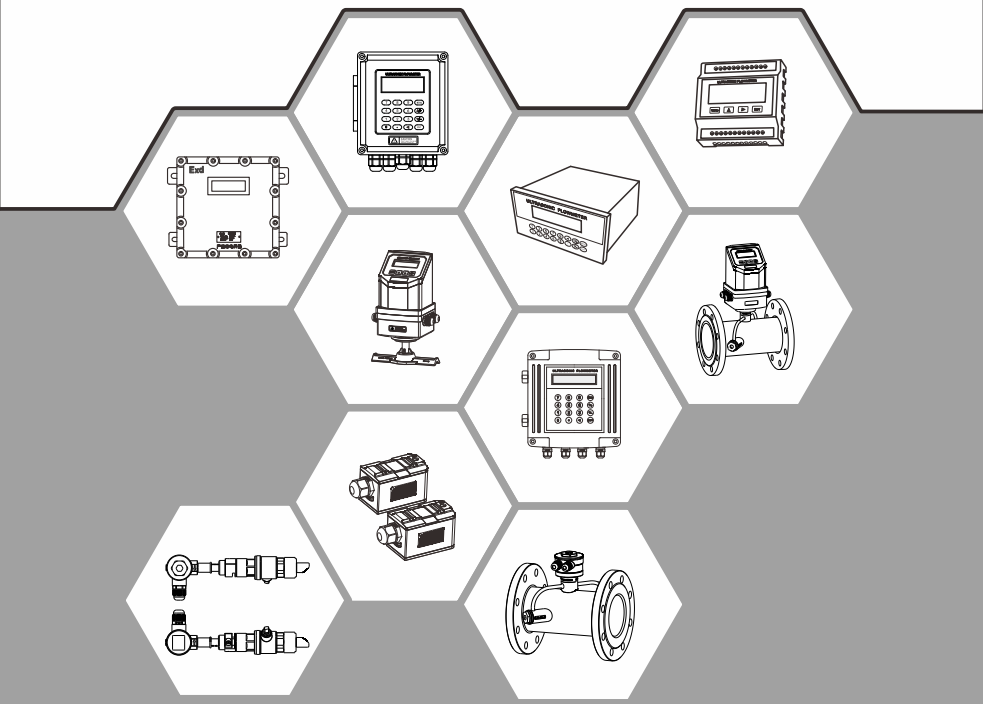
Ultrasonic Flow/Heat Meter

User Manual



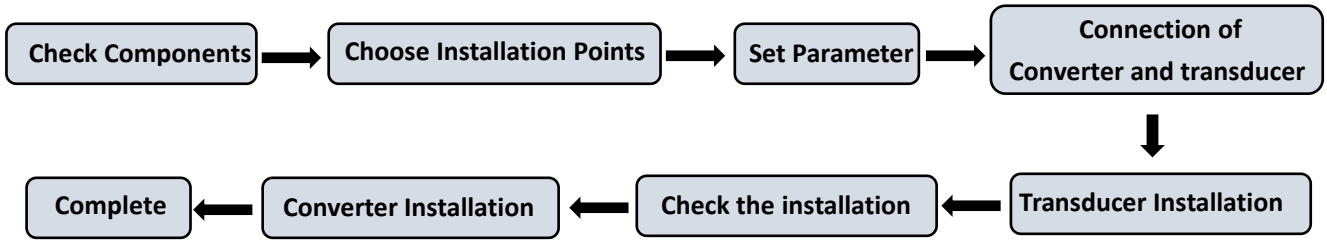
MC CE ISO9001

Contents

Welcome to use the new generation ultrasonic flow meter made of our patented technology.
TUF-2000 Series Ultrasonic Flow/Heat Meters utilize the transit-time principle to measure the velocity of relatively clean liquids in full pipes.

The purpose of this guide is to provide installation procedures and basic operating instructions for TUF-2000 Series Ultrasonic Flow/Heat Meters.

Installation Procedure



1. Products Categories

1.1 Composition of Ultrasonic flow meter

Ultrasonic Flow meter = Converter + Transducer
Ultrasonic Heat meter = Converter + Transducer + Temperature transducer

1.2 Types of Converters

Type Name	Split Type			Integrated Type	Modular Type
	Wall-Mounted Type	Panel-Mounted Type	Explosion-Proof Type		
Picture					

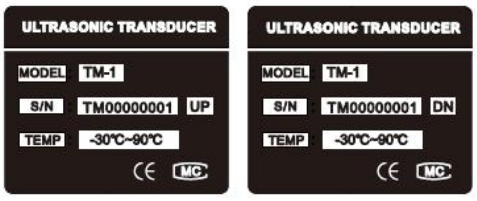
1.3 Types of Flow/Temperature Transducers

Flow Transducer	Picture	Model	Measuring range	Temperature
Clamp on		TS-2(small)	DN15-100	-30~90℃
		TM-1(medium)	DN50-700	
		TL-1(large)	DN300-6000	
High temp Clamp on		TS-2-HT(small)	DN15-100	-30~160℃
		TM-1-HT(medium)	DN50-700	
Insertion		TC-1(standard)	DN50-6000	-30~160℃
		TC-2(extended)		
		TP-1(parallel)	DN200-6000	
Segmented pipe section		Standard pipe section type	DN15-1000	-30~160℃

Temperature Transducer	Picture	Model	Measuring range	Temperature	Installation requirements
Clamp on		CT-1	≥DN50	-40~160℃	No need for interruption
Insertion		TCT-1	≥DN50	-40~160℃	Need to stop the flow
Insertion under pressure		PCT-1	≥DN50	-40~160℃	No need for interruption
Insertion small sizes		SCT-1	≤DN50	-40~160℃	Need to stop the flow

2. Check Components

1. Please check you have all the components in the order.
2. All codes on the converter and transducers should be matched. They are used in sets.



Transducer Codes

Transducer Codes on Converter

3. Measurement Composition Chart

3.1 Split Ultrasonic Flowmeter Measurement Composition Diagram

		
Clamp-on type	Plug-in type	Pipe segment type

Note: The assembly diagram in panel form and explosion-proof type is the same as the one shown above

.3.2 Integrated Ultrasonic Flowmeter Measurement Composition Diagram

		
Clamp-on type	Plug-in type	Pipe segment type

3.3 Ultrasonic Flow Module Measurement Composition Diagram

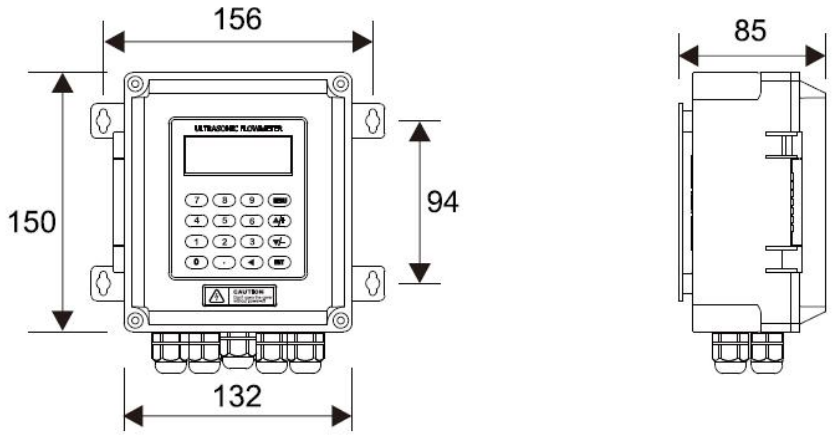
		
Clamp-on type	Plug-in type	Pipe segment type

★ Temperature can be measured by connecting PT100 temperature transducer on both supply and return pipes.

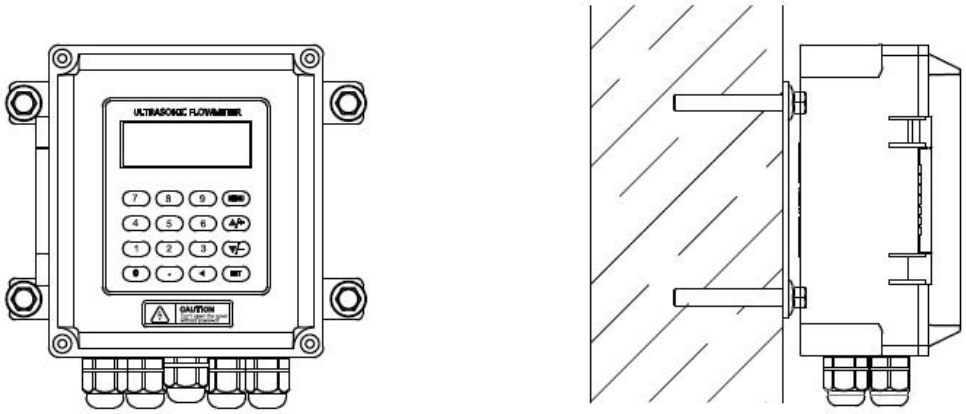
4. Converter Installation and Wiring Diagram

4.1 Installation and wiring diagram for a split-type main unit

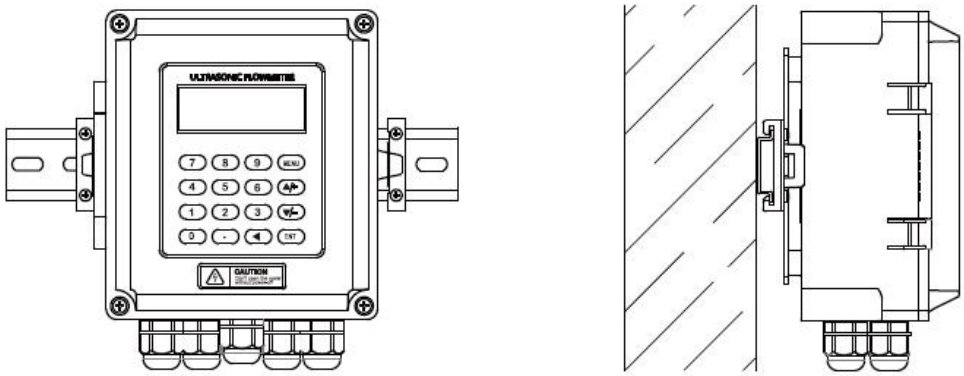
- **Wall-mounted Type I main unit installation instructions**



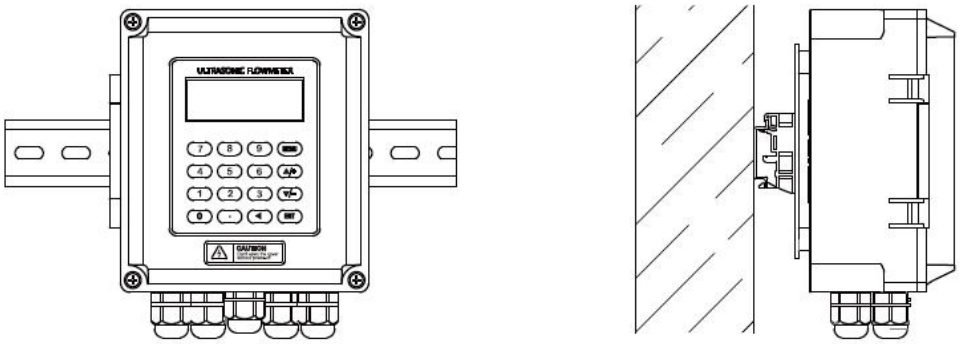
- Wall mounting: Fix the converter with 4 Φ6 expansion bolts or normal nails.



- Use rail fixing clips for rail mounting.

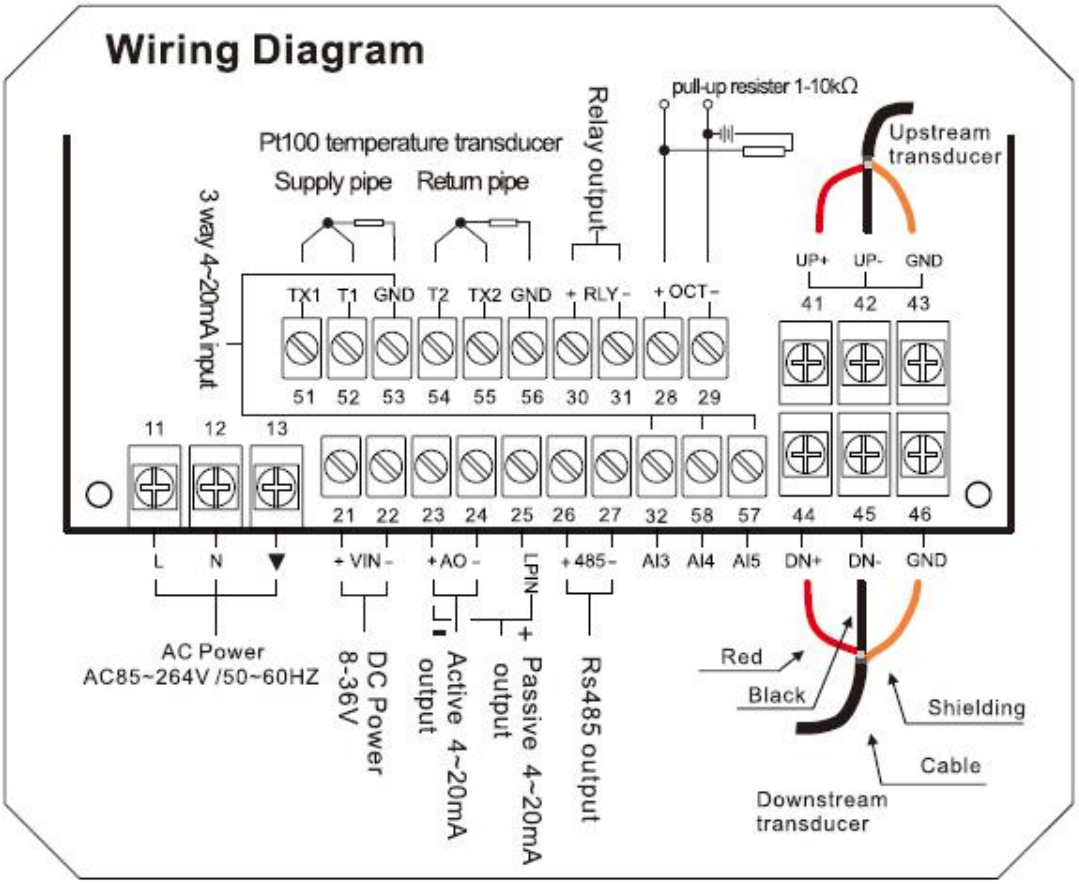


- DIN-rail mounting by using PCB bracket

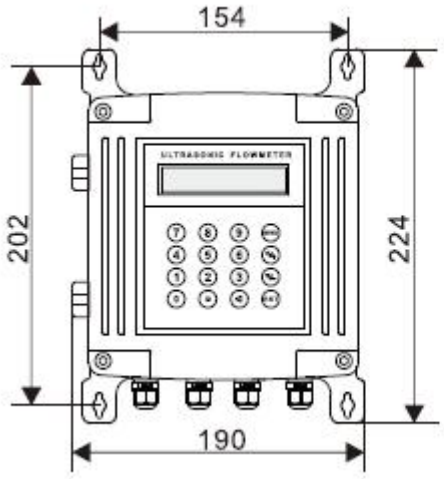


★ The wall-mounted host can be installed on the wall, in a distribution box or in an explosion-proof box using guide rail installation.

- Wall-mounted Type I host wiring diagram

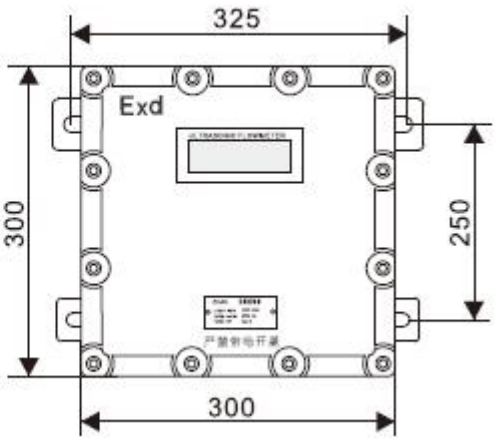


- **Installation Instructions for Wall-mounted Type II Host and Explosion-proof Host**



Thickness: 75mm

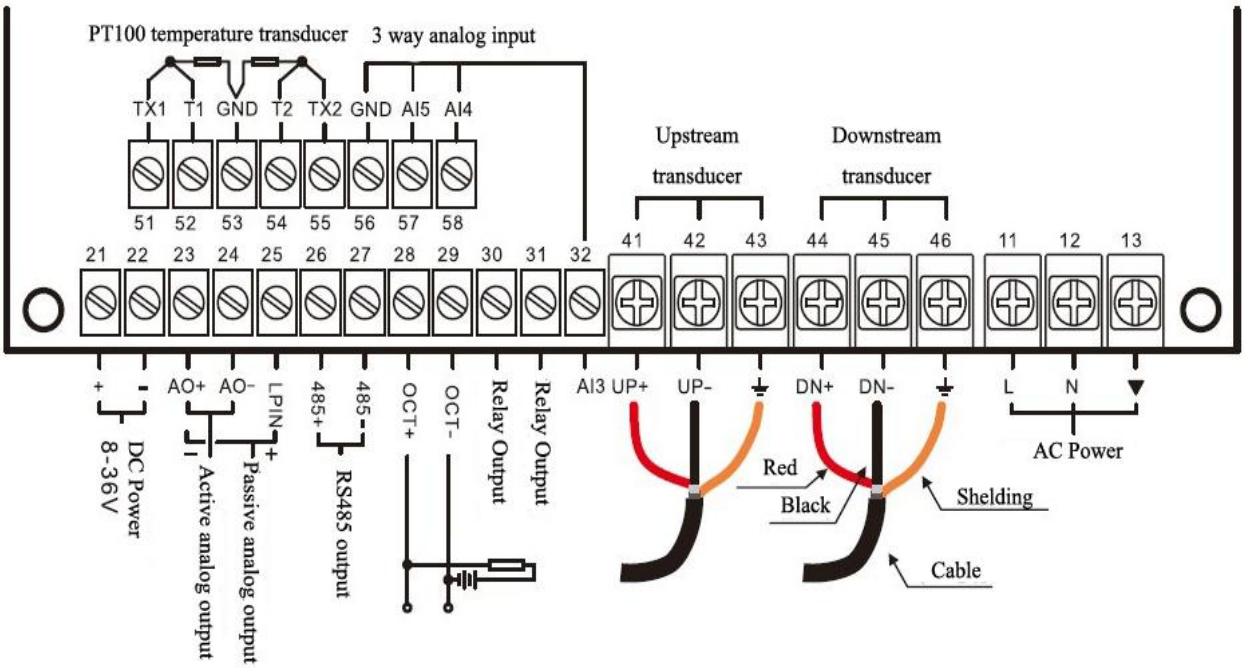
Wall mounting: Fix the converter with 4 Φ6 expansion bolts.



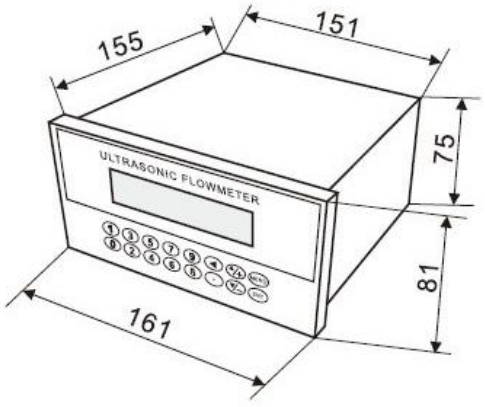
Thickness: 165mm

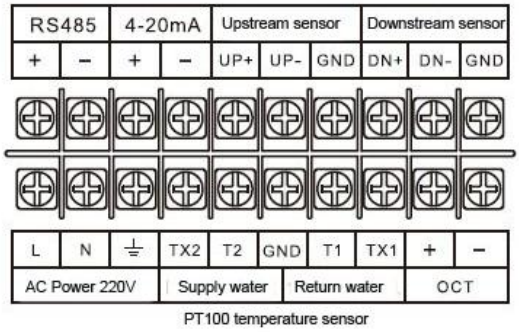
Explosion-proof grade: DⅡBT5
Fix the converter with 4 Φ8 expansion bolts.

- Wiring diagram of wall-mounted II host and explosion-proof host



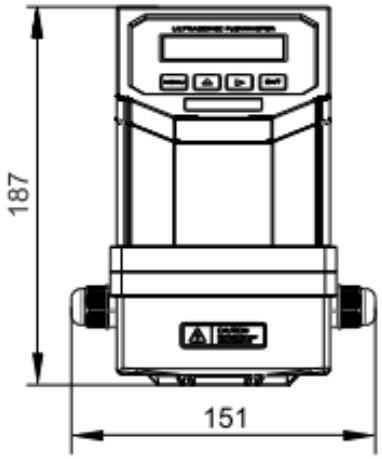
- **Panel installation and wiring diagram**





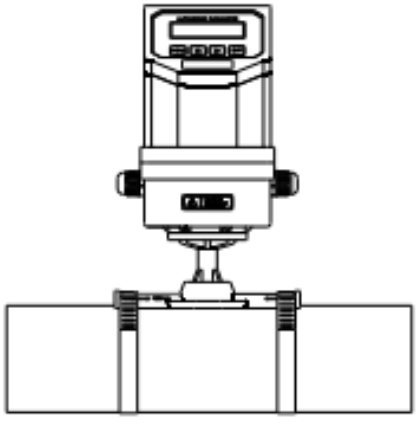
- Used for Panel Mounting
  Hole size : 152 × 76mm

4.2 Installation, wiring diagram and waterproofing of integrated host

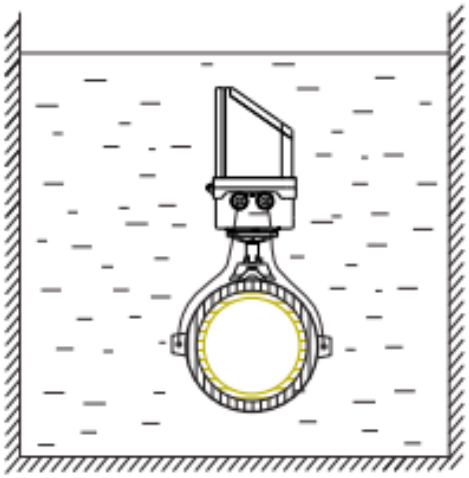


Thickness 117mm

The main unit is usually installed on the pipe. The protection level of the main unit is IP68 and it can be immersed in water 2mm.

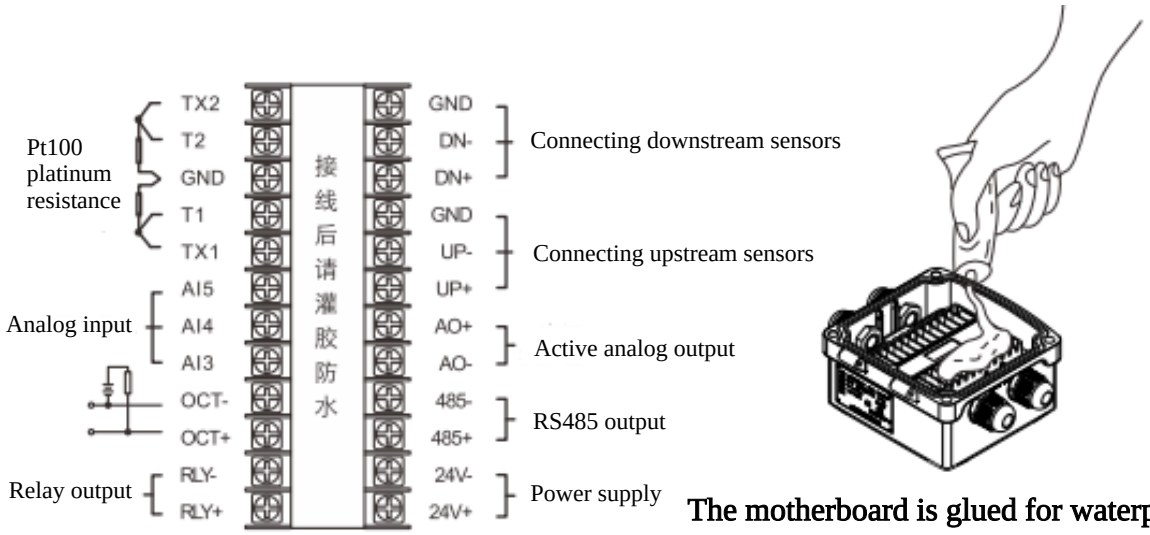


Installed in pipelines



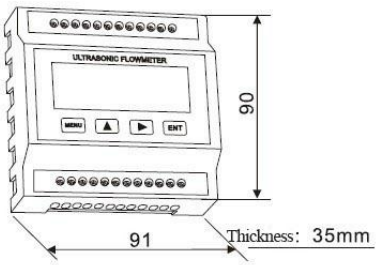
Installed underwater

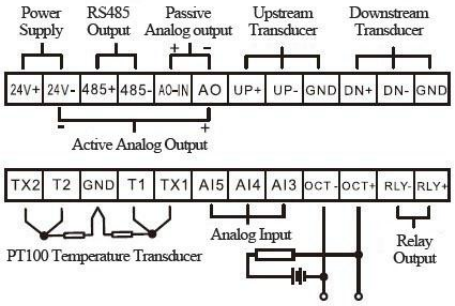
- Integrated host wiring diagram

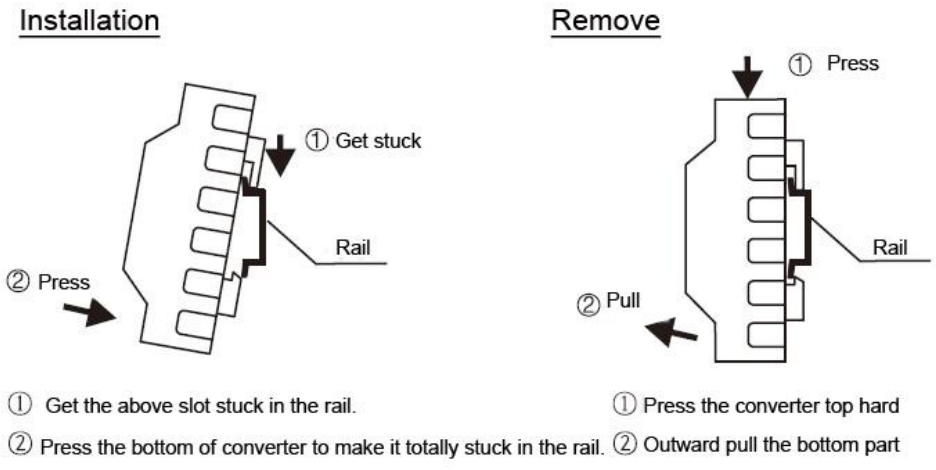


After opening the cover and wiring, please fill the terminal slots with the included silicone to make the motherboard waterproof.

4.3 Module_installation_and_wiring_diagram



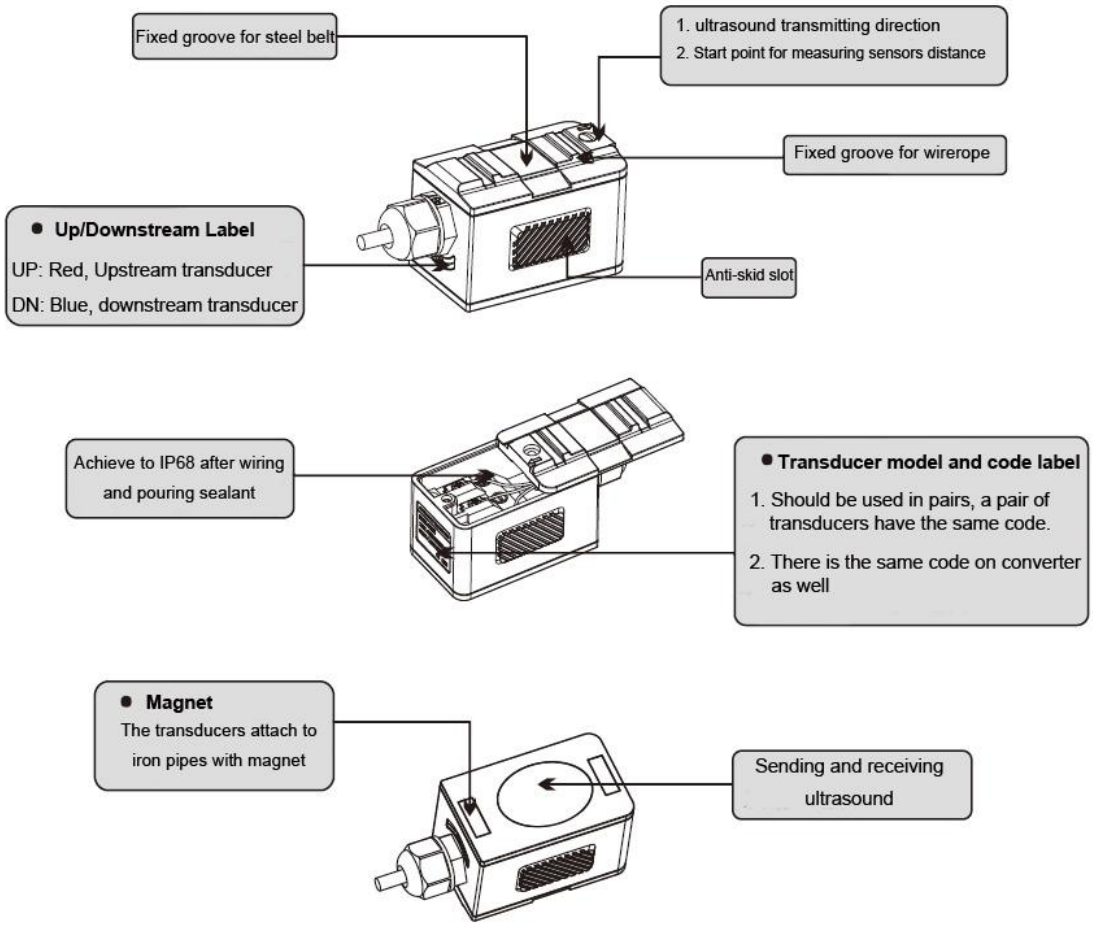




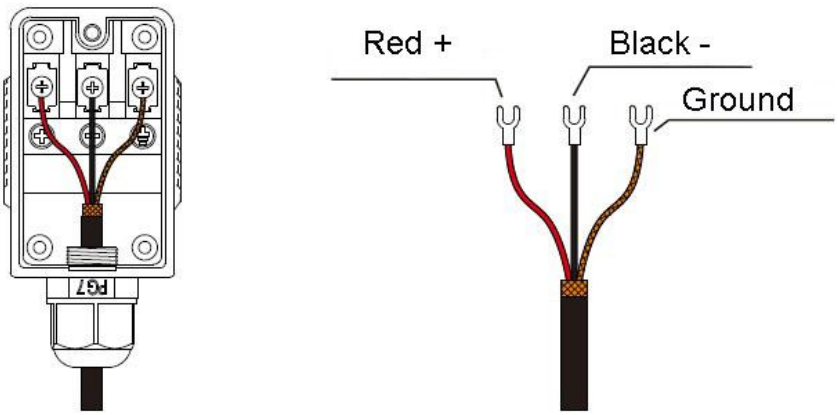
5. Transducer Introduction and Wiring Diagram

5.1 Clamp on type transducer

- Introduction

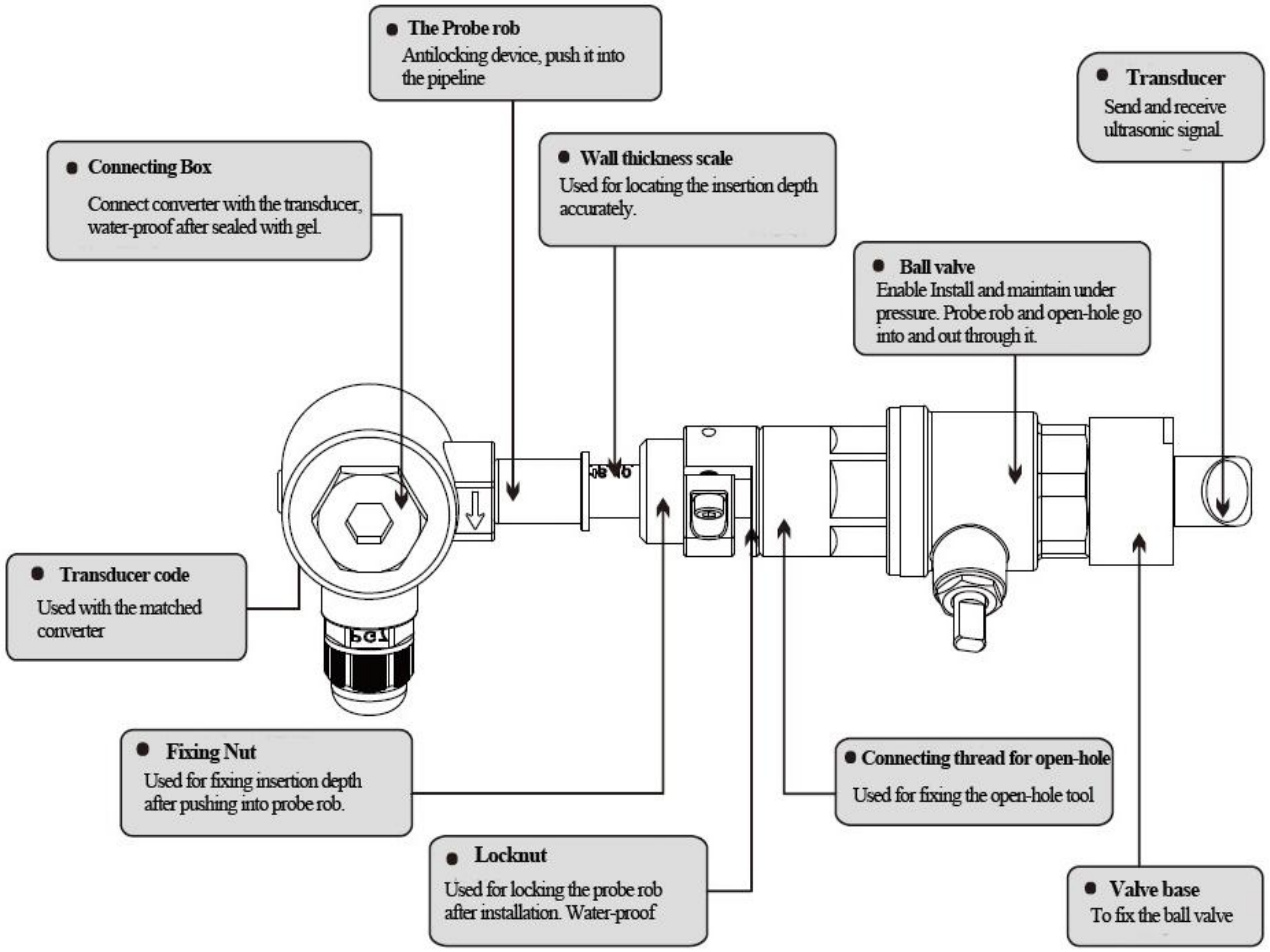


- Wiring Diagram

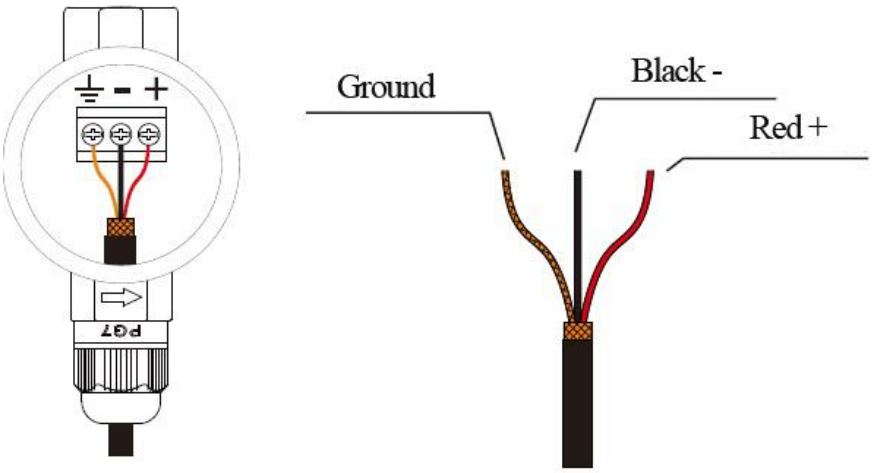


5.2 Insertion type transducer

- Introduction

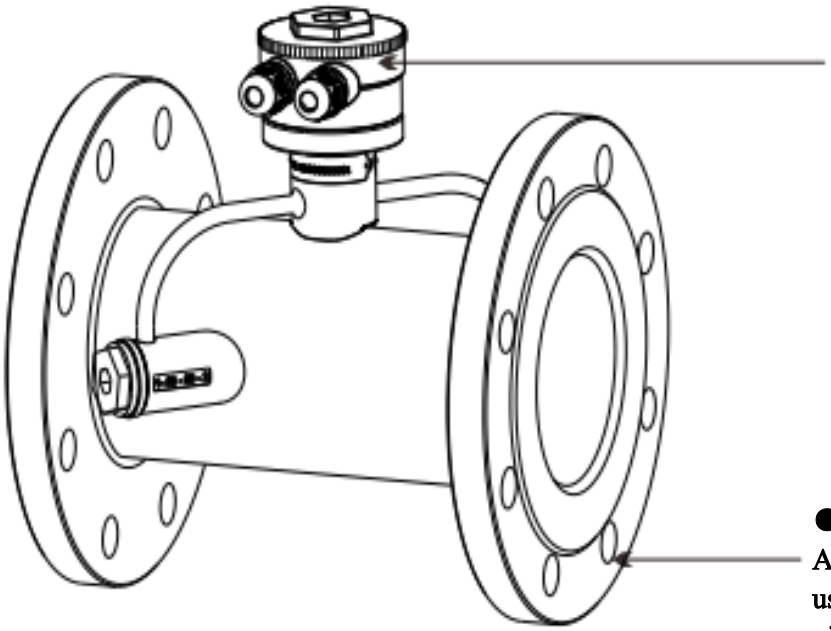


- Wiring Diagram



5.3 Pipe Segment Sensors

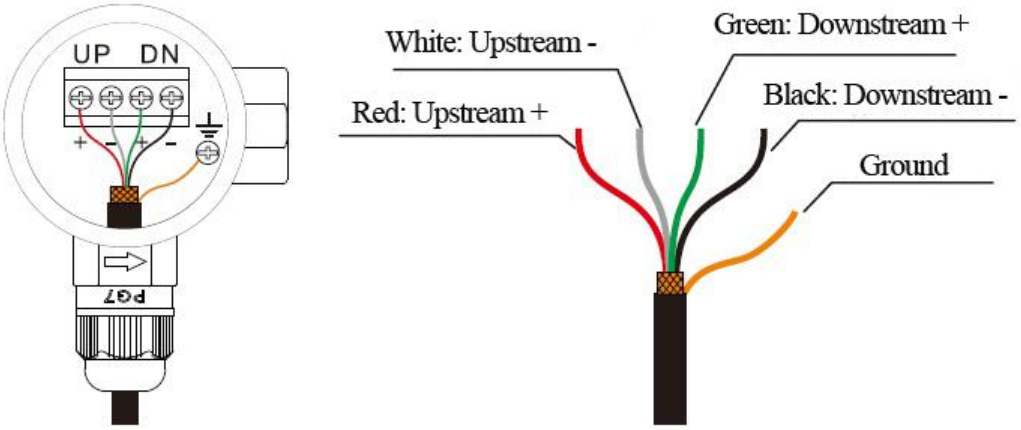
- Introduction



●Junction box
Connects the host and the sensor, and is sealed with silicone after wiring to prevent water damage.

●Flange
After selecting the installation point, use the matching flange to connect the pipe segment sensor to the pipeline.

- Wiring Diagram

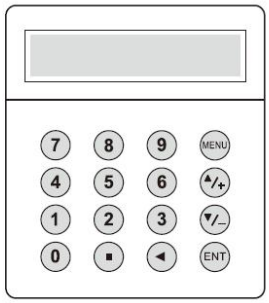


6. Display and Operation

6.1 Display and keyboard

Display is 2×20 characters LCD with backlight, available to set backlight time and contrast.

- 16-key Keyboard



Separated Mounting

[0] - [9] and [.] are used for inputting numbers or menu numbers.

[◄] is used for back left or delete the left character.

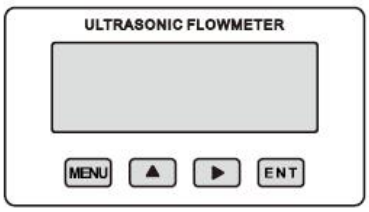
[▲/+] and [▼/-] are used for entering into the last and next menu. Also can be used as ± sign when inputting numbers.

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

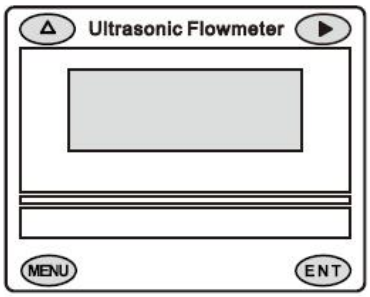
[ENT] is the Enter key, also known as the Confirm key, used to confirm entered numbers or selections. Another function is to enter the "Edit" state before entering a parameter.

>>For detailed operation, see "Quickly Setting Measurement Parameters " on page 16.

- 4-key Keyboard



Modular Keyboard



Integrated 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 sub menu.

6.2 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 [MENU] [3] [5]

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

6.3 Menu Details

Flow/ accumulation display	00	Displays instantaneous flow rate/net cumulative amount. Display units are adjustable in the M30-M32 windows.
	01	Displays instantaneous flow rate/instantaneous flow velocity. Display units are adjustable in the M30-M32 windows.
	02	Displays instantaneous flow rate/positive cumulative amount. Display units are adjustable in the M30-M32 windows.
	03	Displays instantaneous flow rate/negative cumulative amount. Display units are adjustable in the M30-M32 windows.
	04	Displays date and time/instantaneous flow rate.
	05	Displays heat flow rate/total heat. Display units are adjustable in the M84 and M88 windows.
	06	Displays temperature inputs T1 and T2.
	07	Displays analog inputs AI3 and AI4.
	08	Displays system error codes.
	09	Displays today's net cumulative flow rate.
Initial Setup	10	Enter the pipe circumference.
	11	Enter the pipe outer diameter (values range from 0 to 18,000).
	12	Enter the pipe wall thickness.
	13	Enter the pipe inner diameter.
	14	Select the pipe material type.
	15	Enter the pipe sound velocity.
	16	Select the lining material type.
	17	Enter the lining material thickness.
	18	Enter the lining thickness.
	19	Enter the absolute inner wall roughness.
	20	Select the fluid type.
	21	Enter the fluid sound velocity.
	22	Enter the fluid viscosity.
	23	Select the sensor type, over 20 different types are available.
	24	Select the sensor mounting method.
	25	Display the sensor mounting spacing.
	26	Parameter storage and configuration.
	27	Access installation parameters at the installation point.
	28	Set the "Keep last data when signal degrades." Select "Yes" to display the last correct measurement when the ultrasonic signal degrades.
	29	Enter the signal strength when the pipe is empty. For example, entering 65 means that when the signal strength drops to 65, the flowmeter will assume there is no fluid in the pipe and the displayed flow value will be reset to 0.
Flow unit setting	30	Select the English and Metric units.
	31	Select the instantaneous flow unit.
	32	Select the cumulative flow unit.
	33	Select the totalizer multiplier. The multiplier increases the totalizer range and is typically set to x1.
	34	Net totalizer on/off.
	35	Positive totalizer on/off.
	36	Negative totalizer on/off.
	37	Restore factory settings and reset totalizers.
	38	Manual totalizer (for calibration): displays manual totalizer, totalizer time, and instantaneous flow.
	39	Select the user interface language. Four languages are available (Chinese, English, Italian, and Turkish) for international users.

Select Settings	40	Damping coefficient.
	41	Enter the low flow rate cutoff value.
	42	Set the static zero point.
	43	Clear the zero point setting and manually set zero point, and restore the original value.
	44	Manually set the zero offset value.
	45	Instrument coefficient and correction coefficient.
	46	Enter the network identification address code (instrument communication address).
	47	Password protection operation: Once the instrument is password-protected, the menu can only be browsed but not modified.
	48	Linearity curve correction data input. Up to 11 segments of the curve are available for user correction of instrument nonlinearity.
	49	Network communication tester: In this window, you can view data sent by the host computer to diagnose communication problems.
Timing output	50	Set the scheduled data output options. Choose the output content for scheduled printing, with over 20 options available.
	51	Set the scheduled output time.
	52	Control the print data flow. By default, print data is sent to a thermal printer connected to the internal bus. Print data can also be output to an external serial port (RS485).
AI5 Settings	53	Displays analog input AI5 (TDS16 version displays battery voltage in this window)
Input and output settings	54	OCT cumulative pulse output pulse width setting, range: 6 milliseconds to 1000 milliseconds.
	55	Current loop output mode selection
	56	Corresponding values for current loop 4mA or 0mA output
	57	Corresponding values for current loop 20mA output.
	58	Current loop output calibration. Used to verify that the current loop is functioning properly.
	59	Current loop output value.
	60	Date and time settings. The date and time of the new generation ultrasonic flowmeter is implemented by the CPU, which can cause time delays during software upgrades. It is recommended to adjust the date and time to display correctly after the software upgrade.
	61	Software version number and electronic serial number.
	62	Setting serial port parameters
	63	Communication protocol selection (including compatible protocol selection) has two options: MODBUS-RTU for binary MODBUS-RTU protocol, and MODBUS-ASCII + original protocol for ASCII code. This allows simultaneous support of multiple protocols, including MODBUS-ASC11, the original version 7 protocol, Meter-BUSx protocol, and various communication protocols of Huizhong Instruments.
	64	Analog input AI3 corresponding value range — By inputting the value range, the flow meter will convert the current signal into a value range that suits the user's needs, thereby displaying the physical parameter value corresponding to the corresponding analog input.
	65	Analog input A14 corresponding value range
	66	Analog input A15 corresponding value range
	67	By inputting the value range, the flow meter will convert the current signal into a value range that suits the user's needs, thereby displaying the physical parameter value corresponding to the corresponding analog input.
	68	Set the frequency output signal range. The frequency signal output represents the instantaneous flow rate through the signal frequency. The default setting is 0-1000Hz, with a maximum range of 0-999Hz. The frequency signal is output through a dedicated frequency output unit.
	69	Set the frequency signal output lower limit flow
	70	Display backlight control
	71	Display contrast control
	72	Working timer, records the instrument's operating time in seconds. Can be reset
	73	Set the lower flow rate limit for alarm #1 — By setting the upper and lower limits of the alarm, a range can be determined. When the measured flow exceeds this window, an alarm signal will be output. The alarm signal can be output to the external
	74	Set the upper flow rate limit for alarm #1
	75	Set the lower flow rate limit for alarm #2
	76	Set the upper flow rate limit for alarm #2
	77	Buzzer settings
	78	Open collector (OCT) output settings
	79	Relay (or OCT2) output settings
	80	Batch controller control signal selection
	81	Flow rate controller

Calorie measurement	82	Daily, monthly, and annual totalizers: View accumulated flow and heat for each day, month, and year.
	83	Automatic current replenishment switch. Off by default. Please note that this function may not be enabled under certain conditions.
	84	Select the heat unit: Gigajoules, kilocalories, kilowatt-hours, or British Thermal Units (BTU).
	85	Select the temperature signal source. If you choose to input the temperature signal through A13 or AI4, a temperature transmitter capable of outputting a 4-20 mA current signal is required.
	86	For heat capacity, the GB-CJ128 enthalpy difference method is used by default. The temperature difference method can also be used.
	87	Heat accumulator switch.
	88	Heat accumulation multiplier.
	89	Displays the current temperature difference and sets the temperature difference sensitivity.
	8·	Select whether to install the heat meter on the supply or return pipe.
Diagnosis	90	Displays signal strength and signal quality
	91	Display signal transmission time ratio
	92	Displays the calculated fluid sound velocity
	93	Display total transfer time/time difference
	94	Displays the Reynolds number and its pipe coefficient
	95	Display positive and negative heat accumulation and start the cycle display function
Additional Window	+0	Displays power-on and power-off times and flow rate
	+1	Displays total flowmeter operating hours
	+2	Displays the time of the last power outage
	+3	Displays the flow rate during the last power outage
	+4	Displays total power-on times
	+5	Scientific calculator
	+6	Fluid sound velocity threshold setting
	+7	Net cumulative flow rate for this month
	+8	Net cumulative flow rate for this year
	+9	Faulty operating time (including power outages)
Hardware Adjustment Window	.2	Static zero point storage
	.5	Q value threshold setting
	.8	Daily and monthly maximum instantaneous flow rate
	.9	Serial port test window with CMM command output
	-0	Circuit hardware parameter adjustment entry (enter password to access the following window)
	-1	4-20 mA current loop calibration
	-2	A13 analog input 4 mA input calibration
	-3	AI3 analog input 20 mA input calibration
	-4	AI4 analog input 4 mA input calibration
	-5	A14 analog input 20 mA input calibration
	-6	A15 analog input 4 mA input calibration
	-7	A15 analog input 20 mA input calibration
	-8	Platin resistance thermometer zero setting at low temperatures (<40°C)
	-9	Platin resistance thermometer zero setting at high temperatures (>55°C)
	-A	Platin resistance thermometer standard 50°C calibration
	-B	Platin resistance thermometer standard 84.5°C calibration

6.4 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 Menu29. Please complete one by one.

>>> Following parameters need to be inputted before measurement:

1. Outer diameter unit: mm
2. Pipe thickness unit: mm
3. Pipe material
4. Lining parameters: thickness and sound velocity (If have lining)
5. Liquid type
6. Transducer type
7. Transducer mounting type

>> Above parameters setup generally follow the steps below:

1.Press keys [MENU] [1] [1] to enter M11 window to input the pipe outer diameter, and then press
[ENT] key.
2.Press key [▼/-] to enter M12 window to input the pipe outer diameter and then press [ENT] key.
3.Press key [▼/-] to enter M14 window, and press [ENT] key to enter the option selection mode. Use keys [▲/+] and [▼/-] to select the pipe material, and then press [ENT] key.
4.Press key [▼/-] to enter M16 window, press [ENT] key to enter the option selection mode. Use keys [▲/+] and [▼/-] to select the liner material, and then press ENT key. Select "No Liner", if there is no liner.
5.Press key [▼/-] to enter M20 window, press [ENT] key to enter the option selection mode. Use keys [▲/+] and [▼/-] to select the proper liquid, and then press [ENT] key.
6.Press key [▼/-] to enter M23 window, press [ENT] key to enter the option selection mode. Use keys [▲/+] and [▼/-] to select the proper transducer type, and then press [ENT] key.
7.Press key [▼/-] to enter M24 window, press [ENT] key to enter the option selection mode. Use keys [▲/+] and [▼/-] to select the proper transducer mounting method, and then press [ENT] key.
8.Press key [▼/-] to enter M25 window and get the transducer installation distance.
9.Press [MENU] [2] [6] to store the parameters setup.

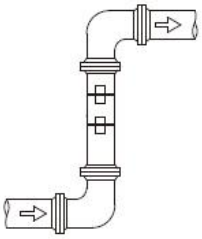
7. Transducers Installation

7.1 Choose installation points

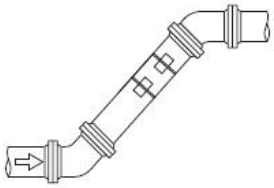
Proper installation point is a key for transducer installation. Following factors must be considered: Full filled pipeline, shaking, steady flow, scaling, temperature, pressure, EMI, instrument well.

>> Full filled pipeline

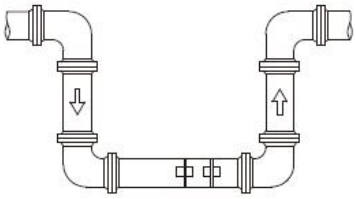
Following situations can be full filled of liquid:



Vertical upward



Obliquely upward



Lowest point

>> Shaking

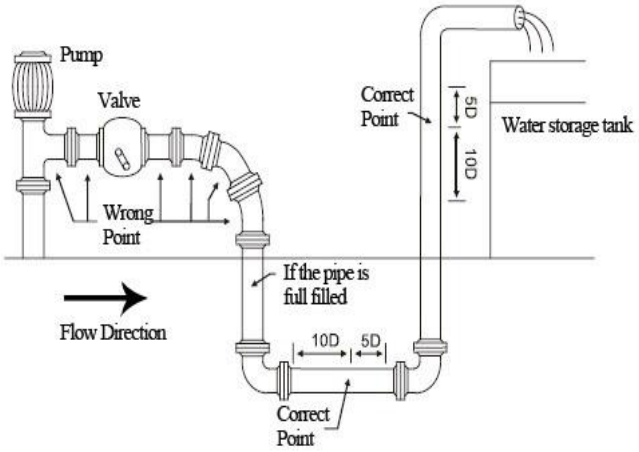
There cannot be obvious shaking on the installation point, otherwise it needs to be tightened.

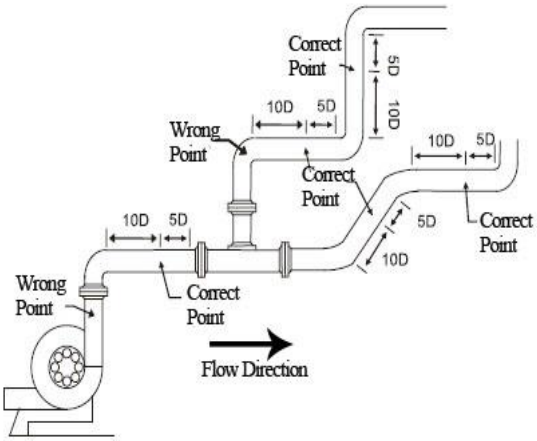
>>Steady flow

Steady flow is helpful for ensuring measurement accuracy.

Standard requests for steady flow are:

1. The pipe should be far away from pump outlet and half-open valve.
   10D to upstream and 50D to downstream. (D means outer diameter)
2. 30D 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. Please try to avoid choosing the installation point with inside scaling.

>>Temperature

The liquid temperature on installation point should be in the working range of transducers. Please try to choose the point with lower temperature. Avoid to choose points like the outlet of boiler water and heat exchanger. Return water pipe would be better.

Temperature range of standard clamp on and insertion transducers: -30 ~ 90℃

Temperature range of high temperature clamp on and insertion transducers: -30 ~ 160℃

>>Pressure

The maximum pressure for standard insertion and inline transducer is **1.6MPa**

Out of this range need customized.

>>EMI (electromagnetic interference)

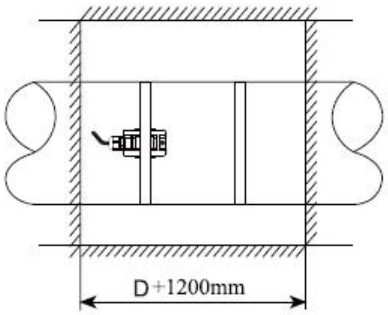
The ultrasonic flow meter, transducer and signal cable can be easily interfered by interference sources such as frequency changer, radio station, microwave station, GSM base station and high-tension cable. Please try to avoid these interference sources when choosing installation points.

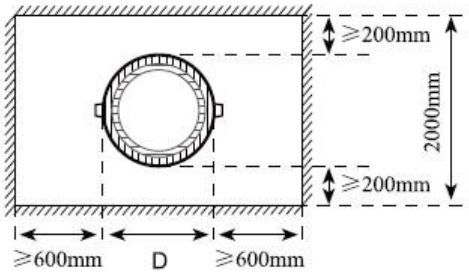
The shield layer of flow meter, transducer and signal cable should be connected to earth.

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

7.2 Clamp on transducer Installation

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

1) Installation procedure

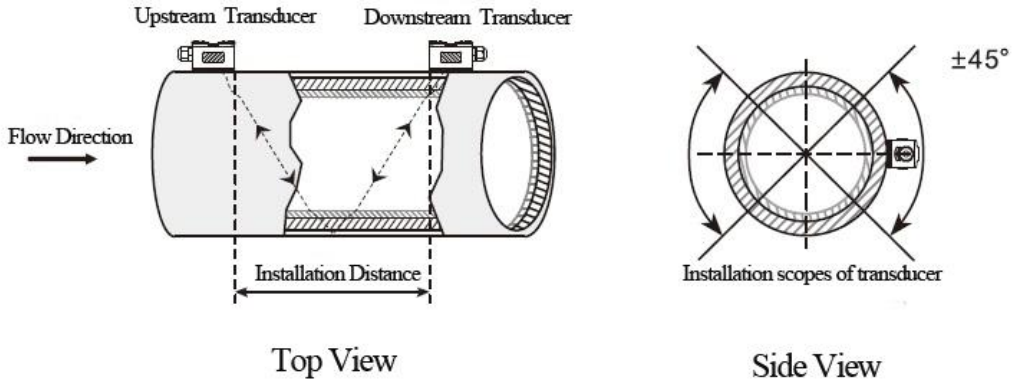
Select an installation method → Input the measuring parameters → Clean pipe surface → Install transducers → Check the installation

2) Select an installation method

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

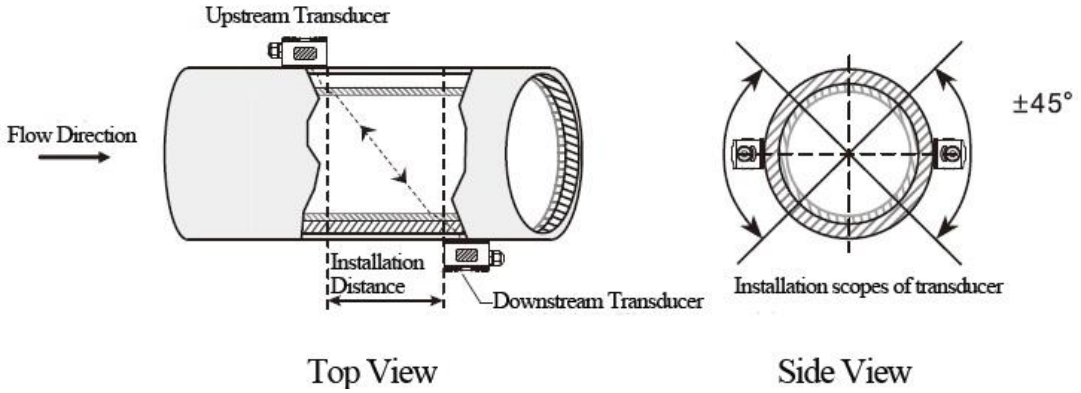
>> V method

V method should be priority selected for pipe sizes DN15 - DN200. Let the pair of transducers horizontal alignment, the central line in parallel with the pipeline axis.



>> Z method

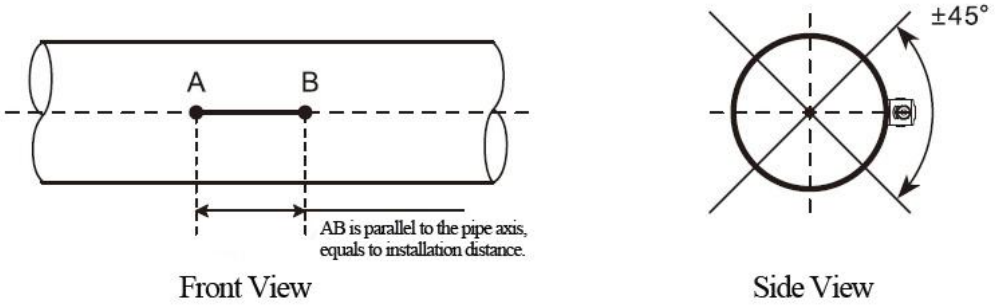
Z method should be priority selected for pipe sizes DN200 - DN6000. Also can be used when V method doesn't work well. Make sure the vertical distance of two transducers equals to the installation distance, and the two transducers are on the same axis surface.



3) Positioning installation points

>> V method

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

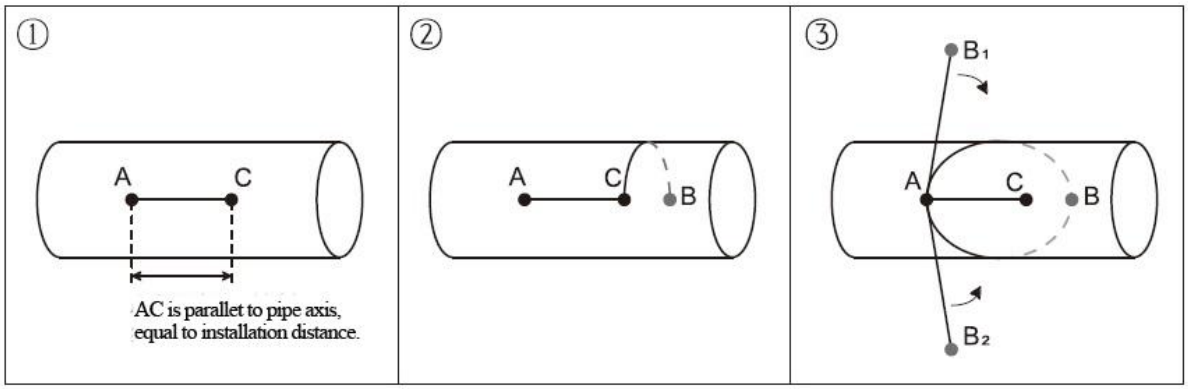


>> Z method

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

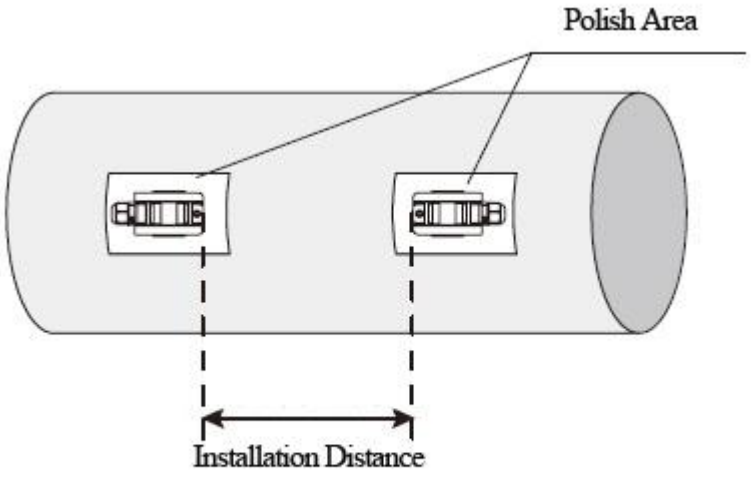
② Perpendicular to the pipe axis, opposite to point C, get Point B.

③ Check. Measure the length between A and B from both sides of the pipe, get AB_1 and AB_2. If $AB_1 = AB_2$, 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.



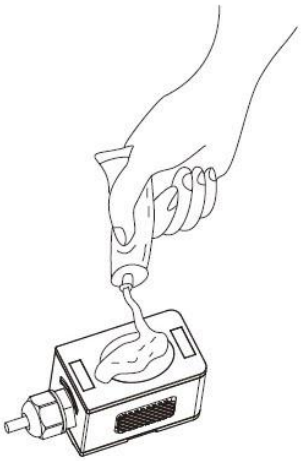
4) Clean the surface of installation points

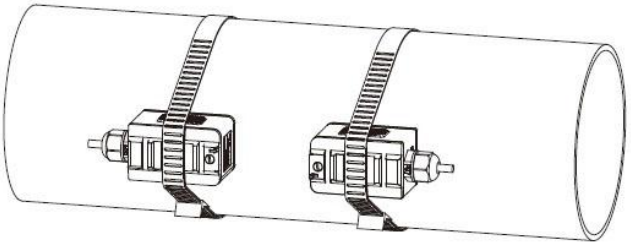
Paint, rust and anticorrosive coating on installation points need to be cleaned. It's good to use a polishing machine to get the metal luster.
As shown below:



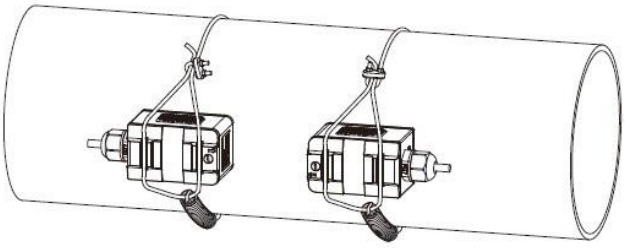
5) Install transducers

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.





Steel belt DN15-500



Steel rope > DN500

6) Check Installation

Please see details in Chapter 7.5

7.3 Insertion type transducer installation

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

1) **Installation procedure**

Select an installation method → Input the measuring parameters → Positioning installation points → Fix ball valve base → Open hole under pressure → Install transducers → Check the installation

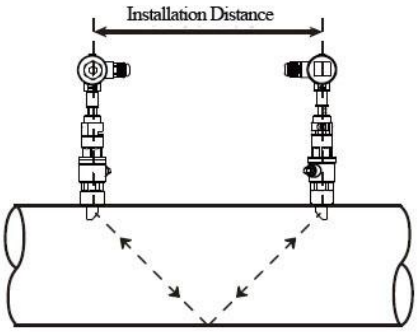
2) **Select installation method and positioning installation points**

Insertion type transducers are suitable for pipe sizes > 50mm.

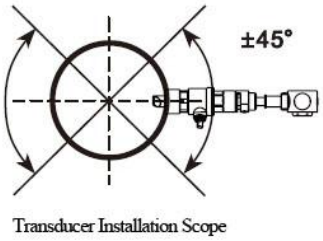
Two different installation methods: V method and Z method. Generally use Z method, only use V method for lack of space.

>> 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.



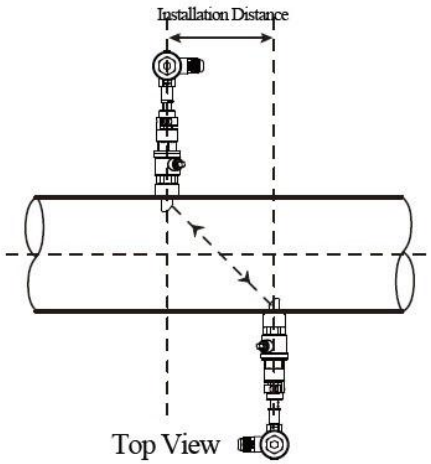
Top View



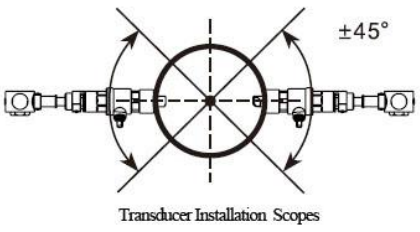
Side View

>> 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.



Top View



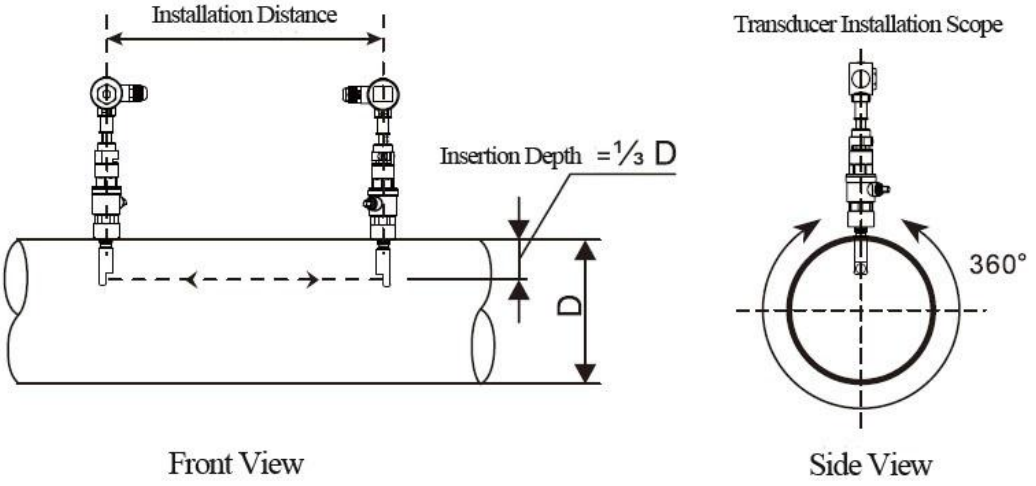
Side View

>> 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 ≥ 300)

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

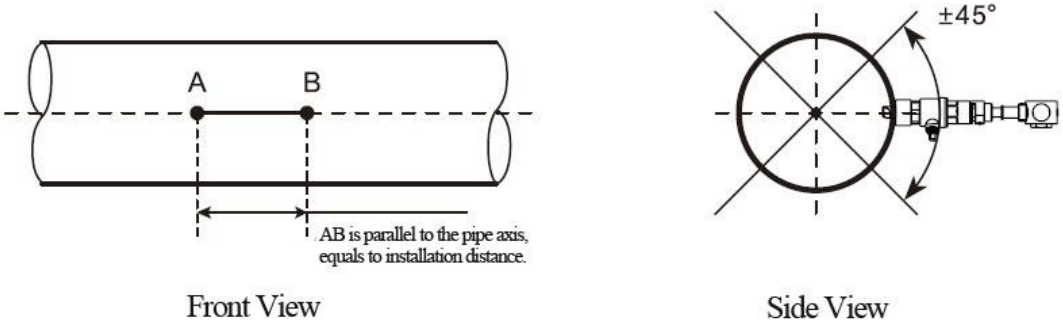
- Installation distance = Vertical distance of two transducers along the pipe axis direction
- Make sure two transducers are in the same horizontal line,
  Insertion depth = 1/3 inner diameter
- Users can set the distance between transducers by themselves. Recommend 300~500mm



3) Positioning installation points

>> V method

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



>> Z method

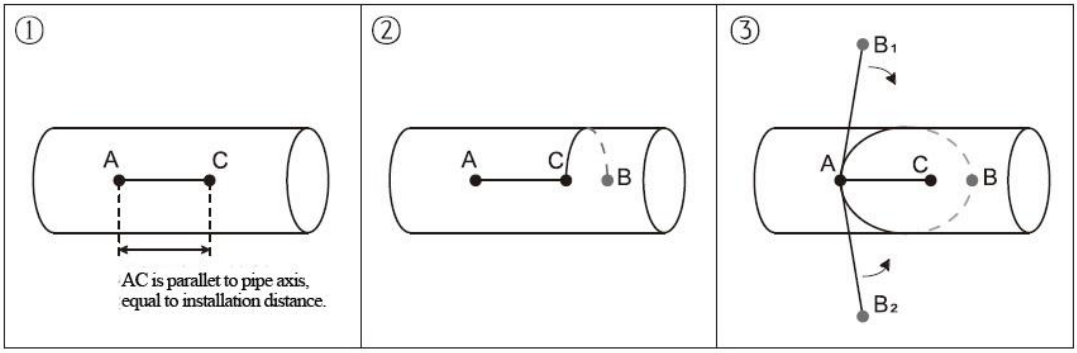
① Firstly according to the installation distance shown in converter, positioning two points A, C on the same side of pipeline. AC is parallel to pipe axis.

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

③ Check. Measure the length between A and B from both sides of the pipe, get AB_1 and AB_2. If

$AB_1 = AB_2$, 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.



4) 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:

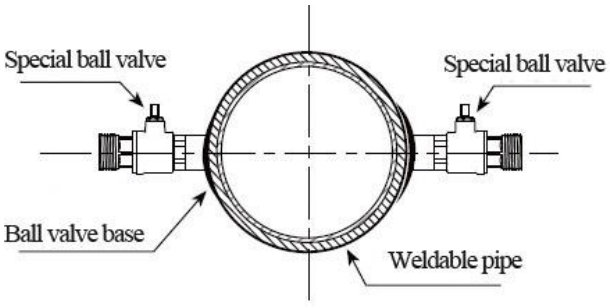
- Please take the PTFE sealing gasket out from the base before welding.
- Please clean the pipe surface around welding point before welding. Pay attention that there should not be any air hole during welding, which can avoid leaking. Welding strength must be ensured.
- Do not sputter welding slag on the base thread.
- Non-deformation of base during welding.

After welding, tighten ball valve into the base.

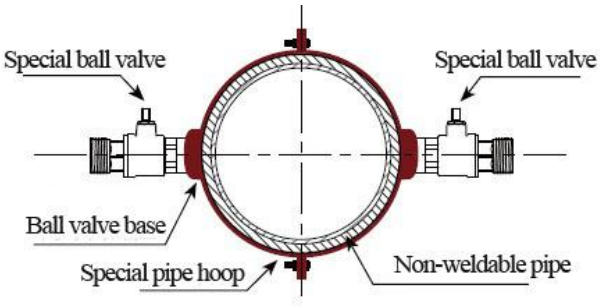
>> Pipe hoop Fix

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 Fix

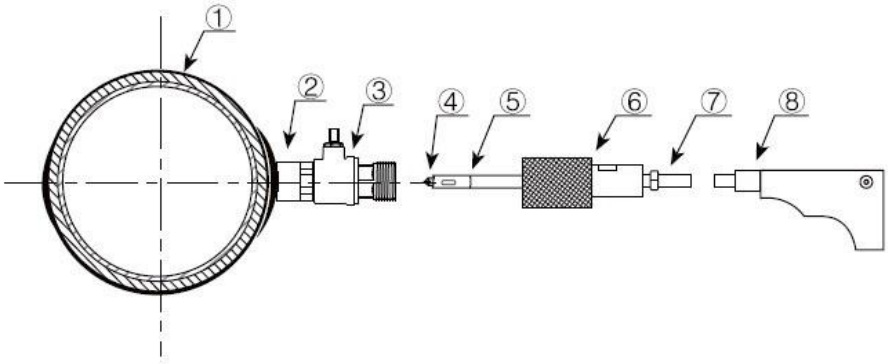


Pipe hoop Fix

5) Open hole

After finishing the installation of ball valve and base, insert the open-hole tool into ball valve and lock it. Then open the ball valve, start drilling, from slow to fast. Close ball valve after drilling.

See more details in the video of insertion transducer installation.



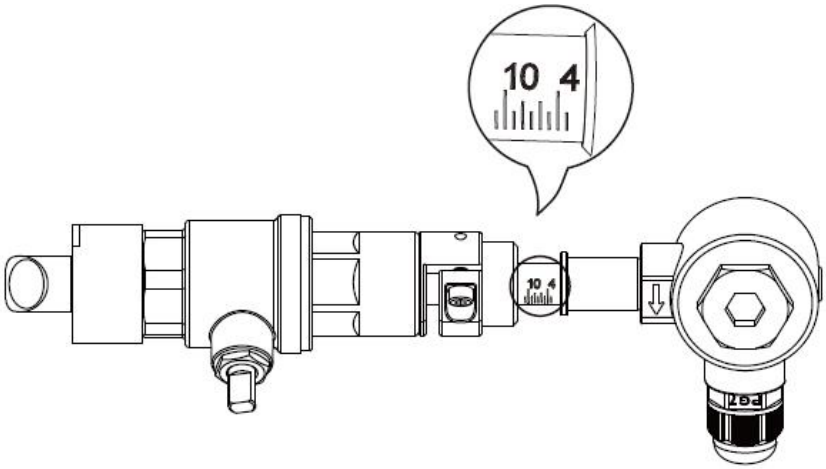
① Pipeline
② Ball valve base
③ Special ball valve
④ Drill
⑤ Super hole cutter
⑥ Seal cover
⑦ Drill rod
⑧ Electric hand drill

6) Install transducer and adjustment

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

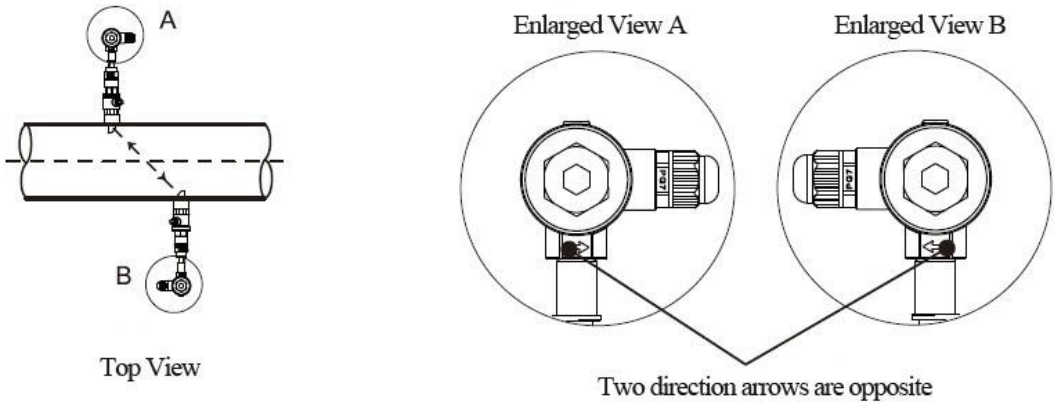
>> Insertion depth adjustment

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



>> Transmit direction

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.



>>Operation steps

- Tighten the locknut into ball valve, adjust the insertion depth scale.
- Open 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.
- Install downstream transducer in the same way. Adjust the transmit direction to get the best signal strength and watching Menu91, 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.

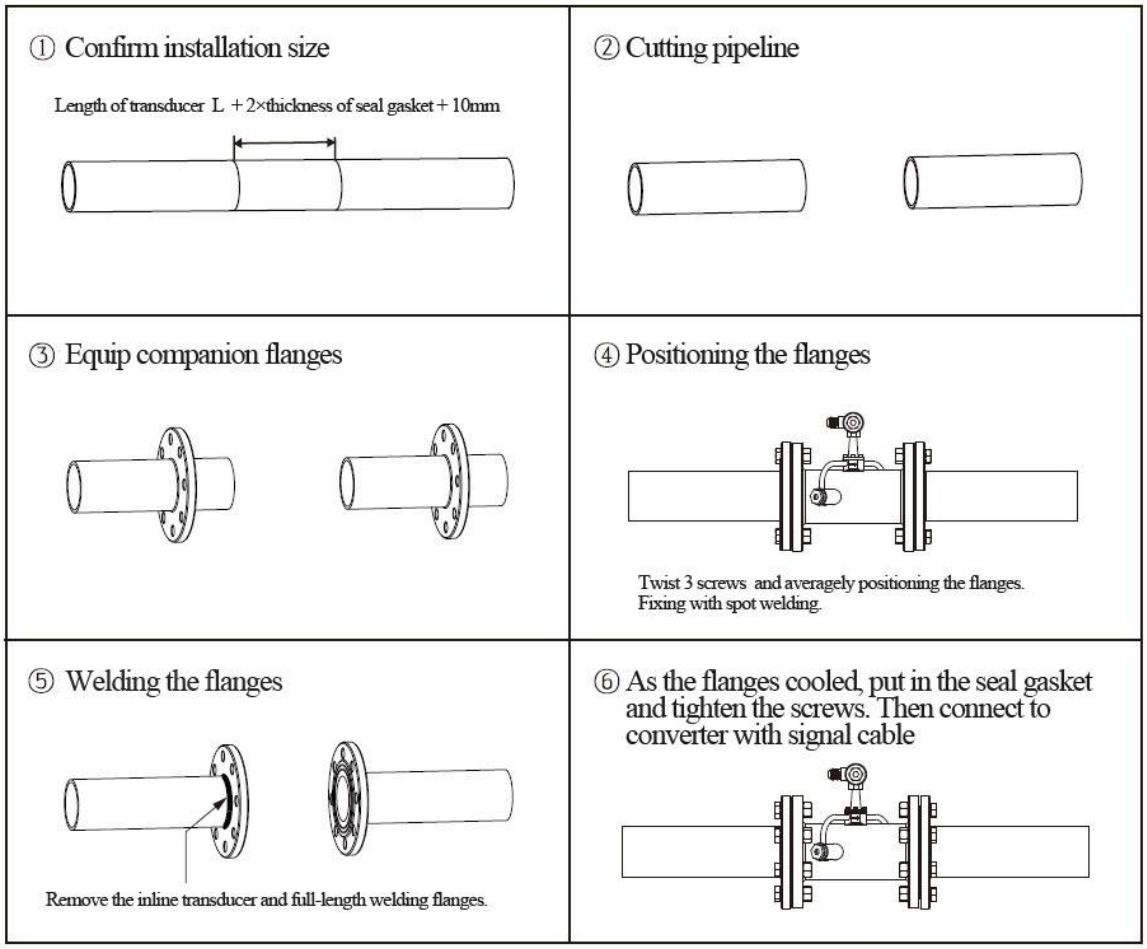
7) Check installation

Please see details in Chapter 7.5

7.4 In-line type transducer installation

After choosing the installation point, install the transducer in the pipeline with companion flanges. Then connect the transducer to converter with special signal cable. Installation is complete.

1) Installation method



2) Check installation

Please see details in Chapter 7.5

7.5 Check Installation

The flow meter includes the detection ability. M90 is used for checking signal strength and quality. M91 is used for checking the ratio of measured and theoretical transmission time (transmission time ratio).

1) Check signal strength and quality

M90 is used for checking the signal strength and signal quality(Q value) of upstream and downstream transducers.

Signal strength is represented by numbers 00.0 ~ 99.9, 00.0 means no signal and 99.0 means maximum signal. Generally, the flow meter can work properly when signal strength is > 60.0

Signal quality (Q value) is represented by numbers 00 ~ 99. 00 means signal is worst and 99 means signal is best. The flow meter can work properly when Q > 60.

During the installation, please adjust the transducer to make the signal strength and signal quality the larger the better. This will ensure the flow meter long term stable operation and lead to accurate measurement.

Signal strength and Q value	Installation Judgement
< 60	Can not work
60~75	Bad
75~80	Good
>80	Excellent

2) Check transmission time ratio

M91 is used for displaying transmission time ratio. It is a percentage ratio between theoretical transmission time and measured transmission time. It shows the relation between setting parameters and actual transducer installation distance. This ratio should be between 97% ~ 103%.
If not in the range of 97%~103%, it means that the parameters and transducer installation distance are inconsistent. Please check separately.

8. Finish Installation

1) Commonly used menus. M00 or M02 is for meter reading. M30~M33 is for unit selection. M40 is for selecting damping factor, generally 5~10 sec. M60 is for correcting time and date. M26 is for curing parameters.

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.

9.Communication Interface and Protocol

The ultrasonic flowmeter/heat meter has an isolated RS485 interface that supports multiple common communication protocols, including MODBUS, M-BUS, Fuji Extended Protocol, and other domestic manufacturers' protocols.

The default MODBUS protocol is MODBUS-ASCI. For MODBUS-RTU, select " MODBUS-RTU Only" in the M63 menu. The following is a table of commonly used MODBUS protocol addresses:

Register	Length	Register Name	Data Type	Illustrate
0001-0002	2	Instantaneous flow rate	REAL4	Unit: cubic meters per hour
0003-0004	2	Instantaneous heat flow rate	REAL4	Unit: GJ per hour
0005-0006	2	Fluid velocity	REAL4	Unit: meters per second
0007-0008	2	Measured fluid sound velocity	REAL4	Unit: meters per second
0009-0010	2	Positive cumulative flow rate	LONG	The unit is controlled by M32
0011-0012	2	Positive cumulative flow rate decimal	REAL4	It can also be called FLOAT
0013-0014	2	Negative cumulative flow rate	LONG	
0015-0016	2	Negative cumulative flow rate decimal	REAL4	
0017-0018	2	Positive cumulative heat amount	LONG	The unit is under the control of M84.
0019-0020	2	Positive cumulative heat amount decimal	REAL4	
0021-0022	2	Negative cumulative heat amount	LONG	
0023-0024	2	Negative cumulative heat amount decimal	REAL4	
0025-0026	2	Net cumulative flow rate	LONG	
0027-0028	2	Net cumulative flow rate decimal	REAL4	
0029-0030	2	Net cumulative heat amount	LONG	
0031-0032	2	Net cumulative heat amount decimal	REAL4	
0033-0034	2	Temperature 1/Supply water temperature	REAL4	Unit: °C
0035-0036	2	Temperature 2/Return water temperature	REAL4	Unit: °C

The FUJI Extended Protocol is an extension of the Japanese FUJI ultrasonic flow meter protocol. Its sent and received commands are in character format, making program writing and debugging easier. The FUJI Extended Protocol also supports keyboard emulation for virtual keyboard operations.

The compatible protocol is compatible with water meter protocols and other domestic manufacturers' protocols. To facilitate integration of ultrasonic flow meters/heat meters with data acquisition systems developed using international communication protocols, eight compatible communication protocols are currently supported. To use a compatible communication protocol, users simply select the "MODBUSASCI" option in the M63 and then select any protocol. Ultrasonic flow meters/heat meters can also function as simple RTU devices. MODBUS or PROFIBUS interfaces can be used to control the current loop and OCT outputs, thereby controlling other devices. Three 4-20mA analog inputs (AI3, AI4, and AI5) can be used to collect pressure, liquid level, and temperature signals. Our ultrasonic flowmeters/heat meters can be easily connected to a PROFIBUS network using a MODBUS-PROFIBUS converter.

Using a GPRS communication module, flowmeter data can be read and sent to the internetv ia the RS-485 bus, enabling remote data transmission.

Data transmission uses a command-response method: the host computer issues a command, and the flowmeter responds accordingly.

Flow data collection can be performed using our company's developed general/dedicated flow/heat data monitoring system. This system leverages the unique software and hardware design of ultrasonic flowmeters/heat meters, offering low investment, simplicity, and reliability. If you need a detailed description of the communication protocol, please contact us or visit our website to download the communication protocol manual.

10.FAQ

1. How to Identify the Direction of Fluid Flow in a Pipeline

After the sensor and wiring are properly installed, a positive instantaneous flow value indicates that the flow is flowing in the forward direction, from the upstream probe to the downstream probe. A negative instantaneous flow value indicates that the flow is flowing in the reverse direction.

2. How to Use Zero Cutoff to Prevent Invalid Accumulation

The data in window 41 is called the low flow cutoff value. The system treats flow rates with an absolute value below this value as "0." Setting this parameter prevents false accumulation caused by measurement errors when the actual flow rate is "0." Typically, this parameter is set to 0.03 m/s. When the flow rate exceeds the low flow cutoff value, the low flow cutoff value has no effect on the measurement results and does not affect them.

3. How to Set the Zero Point

If the pipe is filled with still water and the instantaneous flow displayed by the flowmeter is not zero, use the M42 menu to perform a zero adjustment. Do not perform any operations during the zeroing process. After zeroing, use the M.2 menu to store the zero point. 4. How to Modify the Instrument Coefficient (Scale Factor) for Calibration

When a flowmeter has been running for an extended period of time, it may introduce flowmeter errors. This can be corrected by modifying the coefficient (scale factor). This is done by entering the ratio of the actual value to the measured value in window M45. The instrument coefficient must be entered based on the actual calibration results.

5. How to Use the 4-20mA Current Loop Output

Ultrasonic flowmeters/heat meters feature a current loop output with an accuracy better than 0.1% and can be configured in various output modes, including 4-20mA and 0-20mA. This is selected in window M55.

Enter the flow rate represented by 4mA in window M56 and the flow rate represented by 20mA in window M57. If flow direction is a consideration, a 0-4-20mA output mode can be selected. When the flow direction is negative, the output current is in the 0-4mA range; when the flow direction is positive, the output current is in the 4-20mA range. The output mode is selected in window M55. Window M58 can be used to force the current loop to output a specific value to verify accuracy. For wiring diagrams, see "Host Installation and Wiring Diagram" on page 4.

6. How to Output Accumulation Pulses

Ultrasonic flowmeters/heat meters generate an accumulation pulse for each unit of flow.

Accumulation pulses can only be output via a hardware OCT or relay. Therefore, the hardware OCT or relay settings must be configured accordingly (see windows M78 and M79). For example, to use a relay to output positive cumulative pulses, with each pulse representing 0.1 m^3 of flow, you can configure the following settings:

① In window M32, select the cumulative flow unit: "Cubic meter (m^3)"

② In window M33, select the multiplication factor: "2 x 0.1"

③ In window M79, select "9. Positive cumulative pulse output"

Note: The cumulative pulse size must be appropriately selected. If it is too large, the output cycle will be too long; if it is too small, the relay will operate too frequently, shortening its service life. If it is too fast, pulse loss errors may occur. A rate of 1 to 60 pulses/minute is recommended.

7. How to Use the OCT Output

The ultrasonic flowmeter/heat meter's OCT output is an electrically isolated open-collector output capable of operating at 60V DC and 100mA. The activation conditions can be set by setting M78. For wiring diagrams, see "Host Installation and Wiring Diagrams" on page 4.

8. How to Use the Relay Output

The ultrasonic flowmeter/heat meter's relay output operates at 125V AC and 28V DC and 1A. The activation conditions can be set by setting M78. For wiring diagrams, see "Host Installation and Wiring Diagrams" on page 4.

9. How to Use the Quantitative (Batch) Controller

The flowmeter/heat meter has a built-in batch controller for quantitative flow control. Inputs are controlled using the keyboard or the rising or falling edge of an analog input signal. Outputs can be controlled using the OCT or relays. When using the analog input as the control signal, a current signal greater than 2mA at the analog input indicates a "1" state, and 0mA indicates a "0" state.

Use window M80 to select the control input signal. Use window M78 (OCT output) or M79 (appliance output) and select option 8, "As dosing device output," to generate an output signal on the OCT or relay output.

Enter the dosing value in window M81. Once the dosing value is entered, the batch controller is activated.

Calibration results are temporarily stored in the main unit's built-in power-failure-protected RAM. Option "1" in menu M26 can be used to store them in the internal flash memory for permanent storage. This ensures that calibration results are not lost even if the backup battery is removed.

10. How to Enter Linearity Linearity Input Data

Ultrasonic flowmeters/heat meters can perform multi-point linearization correction for flow nonlinearity, with up to 11 segments of linearity correction. This function is disabled at the factory. It can be enabled by entering menu M48 with the password: 1111.

To correct for flows outside the flow range without causing sudden changes in the correction coefficient, we add two flow points, 0 m³/h and 100,000 m³/h, to the already measured coefficient points. The coefficient for 0 m³/h is the coefficient for the lowest measured flow point, and the coefficient for 100,000 m³/h is the coefficient for the highest measured flow point. These flow points are then entered into M48 in ascending order.

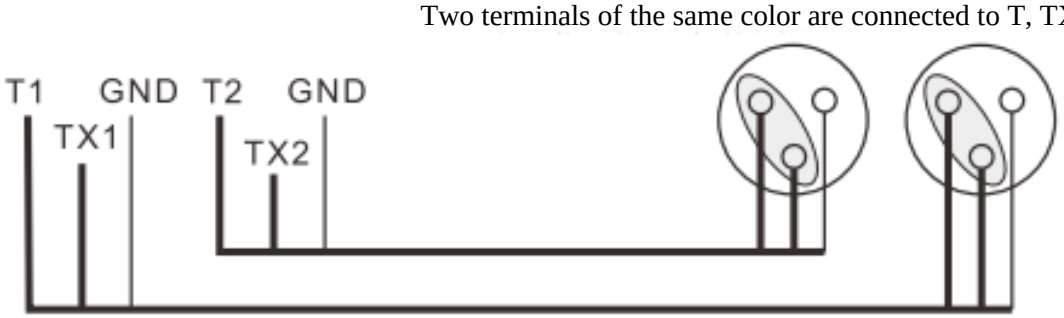
To disable the broken line correction function, simply enter "0" for the broken line point number in menu M48.

The following table shows an example of a 5-point broken line correction:

Standard device flow rate (m³/h)	Standard device flow rate (m³/h)	Correction factor (standard/indicated value)
0	0	1
1.02	0.998	1.02
5.11	5.505	0.93
10.34	10.85	0.95
20.45	19.78	1.03
50.56	51.23	0.99
100000	100000	1

11. How to Measure Heat

Connecting an ultrasonic flowmeter to a 3-wire PT100 can achieve heat measurement. The wiring instructions are as follows.



12. How to Use the SD Card Memory

The external SD card memory supports massive storage of measurement parameters and results.

Supported SD cards range from 512MB to 4GB. (Some SD cards with certain chips may not be supported, so we recommend purchasing SD cards from our company.) For the SD card memory to function properly, the following settings must be made:

①Use the M50 menu to select the content you wish to store.

②Use the M51 menu to select the start time, storage interval, and number of storages. Entering **:**:** for the start time indicates the current time. Entering 9999 for the number of storages indicates an unlimited storage duration.

③In the M52 menu, select "Send flowmeter data to the internal serial bus."

11.Fault Analysis

Ultrasonic flowmeters/heat meters are designed with comprehensive self-diagnostic features. Detected problems are displayed in chronological order as codes in the upper right corner of the LCD display. The M08 menu displays all existing faults in sequence.

Ultrasonic flowmeters/heat meters typically perform hardware fault checks upon power-up, and some hardware faults can be detected during normal operation. Displayed errors are divided into two categories: One category is circuit hardware error information. Possible problems and solutions are shown in Table 1. If a problem is detected during the power-on self-test, "*F" will appear in the upper left corner of the display after entering the measurement state. Re-power on, review the displayed information, and take specific measures according to the table below. If the problem persists, contact the company.

The other category is measurement-related error information, detailed in Table 2.

Problems and solutions are listed in the following two tables.

Table 1: Hardware Power-On Self-Test Information and Causes and Solutions

LCD Display Information	Reason	Solution
Program ROM checksum error	System ROM is illegal or faulty	Contact the manufacturer
Data memory read/write error	Memory parameter data is incorrect	Re-power the device / Contact the manufacturer
System data memory error	Error in system storage data area	Re-power the device / Contact the manufacturer
Measurement circuit hardware error	Fatal error in sub-CPU circuitry	Re-power the device / Contact the manufacturer
Frequency error (check the oscillator)	System clock is incorrect	Re-power the device / Contact the manufacturer
Date and time error	System date and time are incorrect	Reset the date and time
Display failure, garbled display, malfunction, or other unusual phenomena	Cable connection of the connection panel is not properly made	Check if the cables of the connection panel are properly connected. This condition does not affect normal metering.
Keys unresponsive	Contact of the connector is faulty	Same as above

Table 2: Causes and Solutions for Error Codes During Operation

Code	M08 Menu Corresponding Display	Reason	Solution
*R	System operating normally.	System normal	
*J	Measurement circuit hardware error.	Hardware failure	Contact the company.
*I	No received signal detected.	No signal received	Place the sensor close to the pipe and apply sufficient coupling agent.
		Poor contact between sensor and pipe or insufficient coupling agent	Ensure the pipe surface is clean and free of rust, paint, and corrosion eyes.
		Improper sensor installation	Check that the initial parameters are set correctly.
		Excessive scale on inner wall	Remove scale or replace the test point.
		Replaced lining	Wait until the lining is cured and saturated before testing again.
*H	Received signal strength is low, poor quality.	Low signal Poor quality	Solution: Same as above.
*E	Current loop current is greater than 20 mA (does not affect normal measurement; ignore if current output is not used).	4-20mA current loop output overflow exceeds 100% Incorrect current loop output setting	Recheck the settings or confirm whether the actual flow rate is too high.
*Q	Frequency output is higher than the set value (does not affect normal measurement; ignore if frequency output is not used).	Frequency output overflow 120% Incorrect frequency output setting or actual flow rate too high	Recheck the frequency output settings (see the M66-M69 window instructions) or confirm whether the actual flow rate is too high.
*F	See Table 1.	Problem detected during power-on self-test Permanent hardware failure	Recycle the power and observe the display information. Follow the previous table for correct handling.
*G	Gain adjustment in progress > S1 Gain adjustment in progress > S2 Gain adjustment in progress > S3 Gain adjustment in progress > S4	If the machine stops at S1 or S2 or switches only between S1 and S2, the received signal is too low or the waveform is poor.	
*K	Pipeline empty, M29 menu settings	No fluid in the pipe or incorrect setting.	If there is fluid in the pipe, enter a value of 0 in the M29 menu.

Appendix Common Parameters

1. Common liquid sound velocity and viscosity

Liquid	Sound Speed (m/s)	Viscosity		Liquid	Sound Speed (m/s)	Viscosity
Water 20°C	1482	1.0		Glycerin	1923	1180
Water 50°C	1543	0.55		Gasoline	1250	0.80
Water 75°C	1554	0.39		66# Gasoline	1171	
Water 100°C	1543	0.29		80# Gasoline	1139	
Water 125°C	1511	0.25		0# Diesel	1385	
Water 150°C	1466	0.21		Benzene	1330	
Water 175°C	1401	0.18		Ethylbenzene	1340	
Water 200°C	1333	0.15		Toluene	1170	0.69
Water 225°C	1249	0.14		Carbon tetrachloride	938	
Water 250°C	1156	0.12		Kerosene	1420	2.3
Acetone	1190			Petroleum	1290	
Methanol	1121			Pine oil	1280	
Ethanol	1168			Trichloroethylene	1050	0.82
Alcohol	1440	1.5		Dagang jet fuel	1298	
Ethyl ketone	1310			Daqing 0# jet fuel	1290	
Acetaldehyde	1180			Peanut oil	1472	
Ethylene glycol	1620			Castor oil	1502	
Aniline	1659	1.762		Ethyl ether	1006	0.336
n-octane	1192			O-xylene	1360	
Chloroform	1001	1.383		Chlorobenzene	1289	
Glycerol	1923	1188.5		Acetic acid	1159	1.162
Methyl acetate	1181	0.411		Ethyl acetate	1164	
Diformic acid	1389			Heavy water	1388	1.129
Carbon disulfide	1158	0.29		Bromoform	931	
n-Propanol	1225			N-pentane	1032	0.366
n-Ethane	1083	0.489		Light oil	1324	
Transformer oil	1425			Spindle lubricant	1342	15.7
Petroleum	1295			Gasoline	1250	0.4-0.5

2. Sound velocity of common materials Speed of sound unit: m/s

Tube Material	Sound Velocity (m/s)
Steel	3206
Iron	3230
Cast Iron	2460
Lead	2170
ABS	2286
Aluminum	3048
Brass	2270
Cast Iron	2460
Bronze	2270
Fiberglass	3430
Glass	3276
Polyethylene	1950
Acrylic	2644
PVC	2540
Mortar	2500

Lining Material	Sound Velocity (m/s)
Teflon	1225
Ductile iron	3000
Stainless steel	3206
Vinyl chloride	2640
Titanium	3150
Cement	4190
Asphalt	2540
Enamel	2540
Glass	5970
Plastics	2280
Polyethylene	1600
PTFE	1450
FRP	2505
Rubber	1600
Epoxy-asphalt	2505

Please contact the company for inquiries regarding the sound velocity of other liquids and materials