



YEX-S2-FLO Doppler Ultrasonic Flowmeter User Manual



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I.product description

YEX-S2-FLO Doppler ultrasonic flow meter is a high-precision and wide-range Doppler ultrasonic flow rate flow meter independently developed by our company. The entire equipment is based on the Doppler principle. It has no rotating parts such as propellers and bearings. It uses ultrasonic technology to detect flow velocity. It has no friction and no inertia. The measuring point is in front of the body and does not destroy the flow field. It has high measurement accuracy, wide range and induction. It is sensitive, has linear flow measurement, is not afraid of sediment and floating debris, has intuitive readings, is easy to operate, and is not easily damaged. Products comply with SL/T 186-1997 standards. It is suitable for environments that require continuous and accurate measurement of flow rate and flow rate. It has significant advantages such as convenient installation and maintenance, high reliability, and high precision.

Product implementation standard GB/T 15966-2007 "Basic Parameters and General Technical Conditions of Hydrological Instruments"

Features:

- Wide range: 0.02-5m/s (flow rate, can be expanded)
- Resolution up to 1mm/s (flow rate)
- The data response time is fast, breaking the long time required to obtain the flow rate in the past, and the measurement results are refreshed from time to time.
- Velocity area method flow measurement is suitable for full and non-full pipes, and the cross-section water level relationship can be freely set.
- The built-in high-precision temperature sensor can be used for water temperature measurement and sound velocity compensation.
- Fluid mechanics shell design has little impact on water flow and does not affect measurement accuracy.
- Anti-corrosion shell design, able to work in harsh environments for a long time.
- Can provide instantaneous flow value and cumulative flow value.
- There are no mechanical rotating parts, and there are no problems such as sediment blockage or entanglement of water plants and debris. It is most suitable for measurement in rivers with high

suspended sediment content and many floating objects such as water plants.

- Measurement linearity, factory calibrated and no calibration required for long-term use.
- Equipped with data receiving software, which can read real-time data and accumulate data.

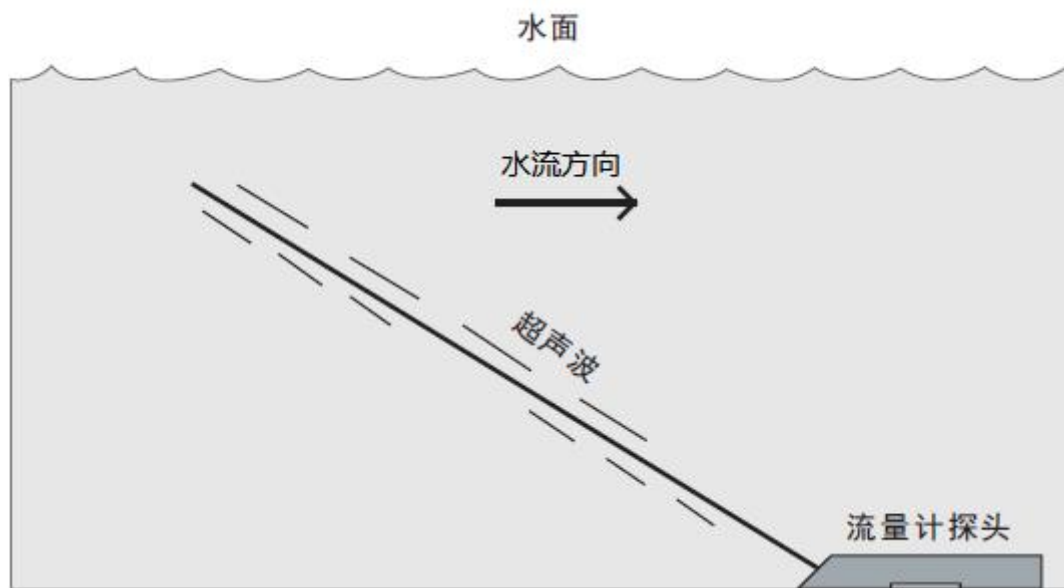
II.working principle

The product includes the following sensors: flow rate sensor, pressure sensor, temperature sensor.

The flow rate sensor is used to measure the speed of fluid flow, the pressure sensor is used to measure water depth, and the temperature sensor is used to measure fluid temperature and sound speed compensation.

Through the measured flow velocity, water level and cross-sectional size, the cross-sectional flow rate can be obtained.

In the ultrasonic Doppler flow measurement method, the ultrasonic transmitter is a fixed sound source, and the solid particles moving with the fluid play the role of "observers" that move relative to the sound source. Of course, it only detects the incident on the solid. The ultrasonic waves reflected on the particles return data. The frequency difference between the emitted sound wave and the received sound wave is the Doppler frequency shift of the sound wave caused by the movement of solid particles in the fluid. Since this frequency difference is proportional to the fluid flow rate, measuring the frequency difference can determine the flow rate. The flow rate of the fluid can then be obtained, so it is suitable for the measurement of dirty water and slurry with high impurity content, such as urban sewage, sludge, etc.



III. Main Specifications

- flow rate:
 - Measuring range: 0.02-5m/s (can be expanded)
 - Accuracy: $\pm 1\% \pm 0.01\text{m/s}$
 - Resolution: 1mm/s
- Water depth:
 - Measuring range: 0m-10m (can be expanded)
 - Accuracy: $\pm 1\text{cm}$
 - Resolution: 1mm
- Traffic:
 - Measuring range: 0.001m³/h-999999999 m³/h
 - Accuracy: $\pm 2\text{-}3\%$ (varies according to cross-section shape)
 - Resolution: 0.001 m³/h
- Temperature:
 - Measuring range: -20°C-65°C
 - Accuracy: $\pm 0.5^\circ\text{C}$,

Resolution: 0.1°C

- Power supply: DC 9V-24V
- Power consumption: ≤1W
- Data refresh frequency: 1Hz
- Signal interface: RS485 (Modbus)
- Storage capacity: 2M (expandable)
- Protection level: IP68
- Operating temperature: -20°C-65°C (no freezing)
- Storage temperature: -10°C-70°C
- Shell material: ABS

IV.Interface Description

The YEX-S2-FLO Doppler ultrasonic flowmeter uses a 4-core cable shield and the colors are as follows:

red●	black●	yellow●	green●
Power+	Power-	RS485-A	RS485-B

Air tube (inside the cable): used to conduct air to the internal pressure sensor.

Precautions:

1. The air conduit is inside the cable. Make sure the cable is placed in a dry and safe location and cannot be placed in water, otherwise the equipment will be damaged.
2. The color and corresponding pins are subject to the actual product, and the design is subject to change without prior notice.
3. Special connection devices are required for cable extension and cannot be connected directly.

V.Equipment composition and details

Doppler ultrasonic flowmeter layout and description of main components are shown in the figure below.

- **Transmitting probe** - The ultrasonic transmitting probe generates short pulse sound waves, with most of the energy concentrated in a narrow wave speed (20 mm in diameter).
- **Receiving probe** - The ultrasonic receiving probe is installed next to the transmitting probe. The receiving probe receives the acoustic signal located at a fixed distance of 10 cm.
- **Temperature sensor** - The temperature sensor is installed inside the Doppler ultrasonic flow meter. Temperature data is used for sound speed compensation and real-time feedback of water temperature.
- **Pressure sensor** - The pressure sensor is installed inside the Doppler ultrasonic flow meter and provides real-time feedback on current water level changes. Water level data and flow velocity data are converted into flow data for easy viewing by users.

Note: The pressure sensor is a precision instrument. Do not use sharp objects to touch the surface of the pressure sensor.

- **Communication cable** - four-core shielded cable, connected to the controller for communication, default length 20m.
- **L-shaped bracket** - helps to fix the Doppler ultrasonic flow meter.
- **Air tube** - used for pressure value comparison of pressure sensors.

Note: The air guide tube cannot be bent. Bending may result in inaccurate pressure sensor values and water damage to the pressure sensor.





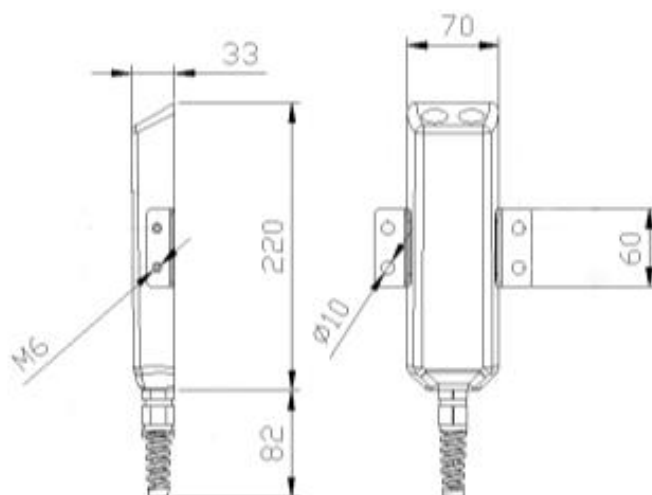
传感器背面

VI. Equipment dimensions and equipment installation

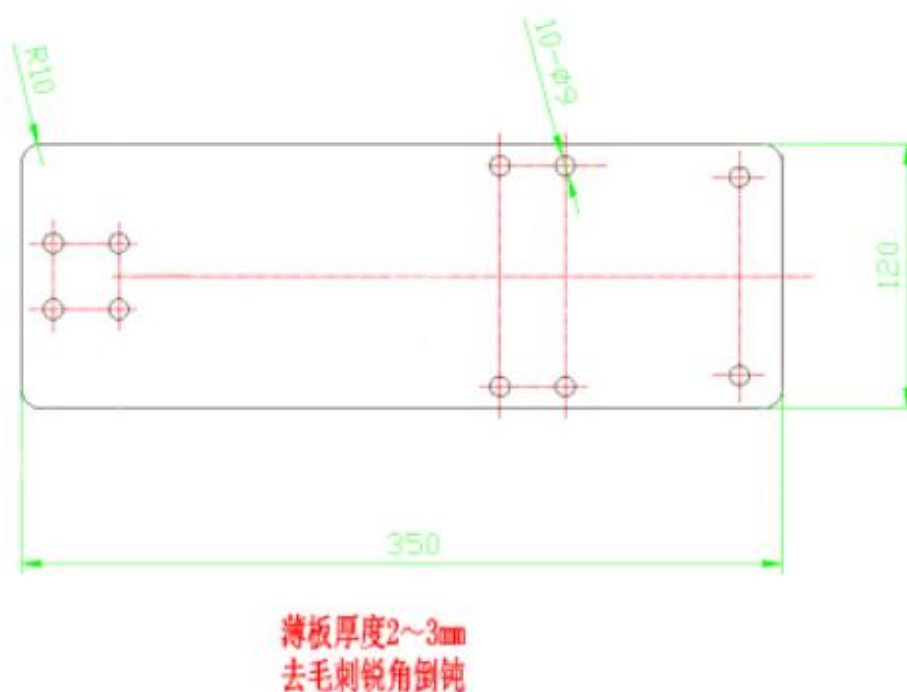
6.1 Installation requirements

The Doppler ultrasonic flowmeter should be installed downstream of the straight section of the channel with a fixed cross-section. The length of the straight section is preferably 15-20 times the hydraulic radius of the channel (the smoother the measurement accuracy of the water flow in the straight section, the higher the accuracy), and this distance There must be no overflow obstructions (such as sluices, weirs, etc.) within the range to ensure a uniform and stable flow pattern at the front end of the probe.

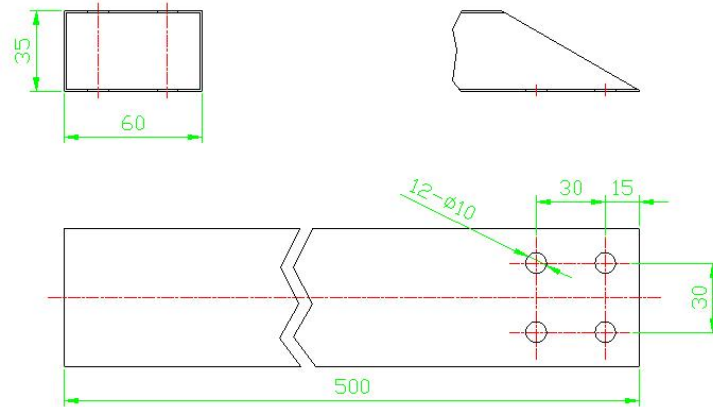
6.2 Equipment and stand dimensions



Doppler Ultrasonic Flowmeter Dimensions



Stainless steel plate size (this bracket is an optional bracket, please use it according to the actual situation)



技术要求:

1. 外观打磨光亮;
2. 去毛刺锐角倒钝;

Square steel size chart (this bracket is an optional bracket, please use it according to the actual situation)

6.3 Device installation

6.3.1 Regular installation

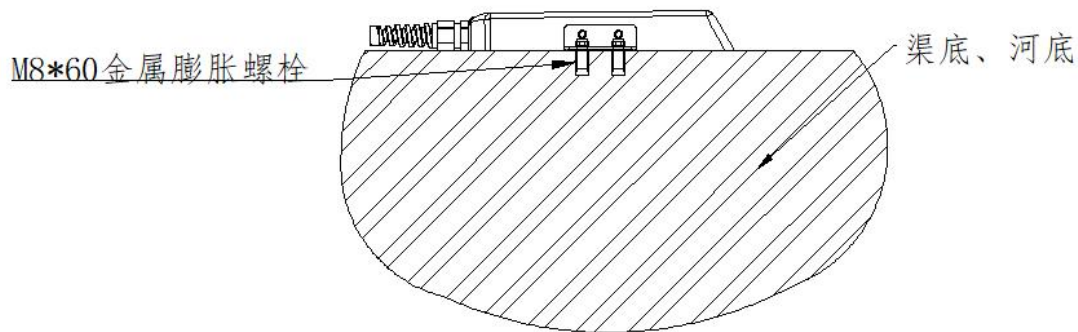
1. Material preparation: 4 M8*60 metal expansion bolts; 1 impact drill, 1 M10 impact drill bit; wire pipe (length depends on the situation); hose (30-40cm); several pipe clamps.

2. Installation environment: The water source needs to be shut off and installed when there is no water. The bottom needs to be a hard foundation (such as a concrete foundation) with low sedimentation content.

3. Installation:

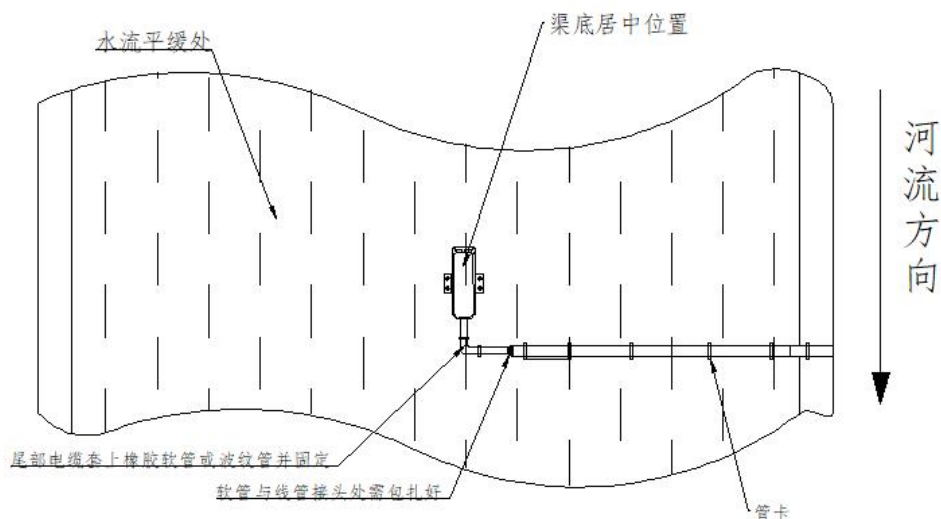
1) Select a positioning point at the flat center of the channel and position it according to the holes on the L-shaped brackets installed on both sides of the Doppler ultrasonic flowmeter.

2) Use the M10 drill bit and impact drill to drill holes at the positioning points. After drilling, use metal expansion bolts to fix the Doppler ultrasonic flow meter on the ground.



Installed to the bottom of the ditch (hard base bottom)

3) Use the prepared hose to cover the tail of the Doppler ultrasonic flowmeter to prevent damage to the tail cable, and then pass the remaining wire through the wire tube to one end of the wiring to protect the cable.



Overall installation at the bottom of the ditch (hard foundation bottom)

6.3.2 Bracket installation

It is divided into inclined plane type and right angle type. It needs to be installed according to the specific situation, but the preparation materials remain basically unchanged.

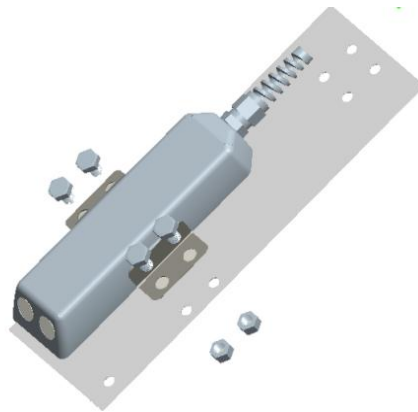
1. Material preparation: M8*4 stainless steel screws with 8 flat washers, spring washers, and nuts; stainless steel plate with size 350*120*2mm (detailed dimensions are in the bracket dimensions); stainless steel square steel with size 60*35mm, thickness 1mm, length Depends on the

site conditions (detailed dimensions are in the bracket dimensions); 2 matching dead wrenches or adjustable wrenches; stainless steel pipe, the length depends on the site conditions; hose (10-30cm), several pipe clamps.

2. Installation environment: There is water for a long time, the water source cannot be turned off, there is no hard foundation at the bottom or there is too much silt.

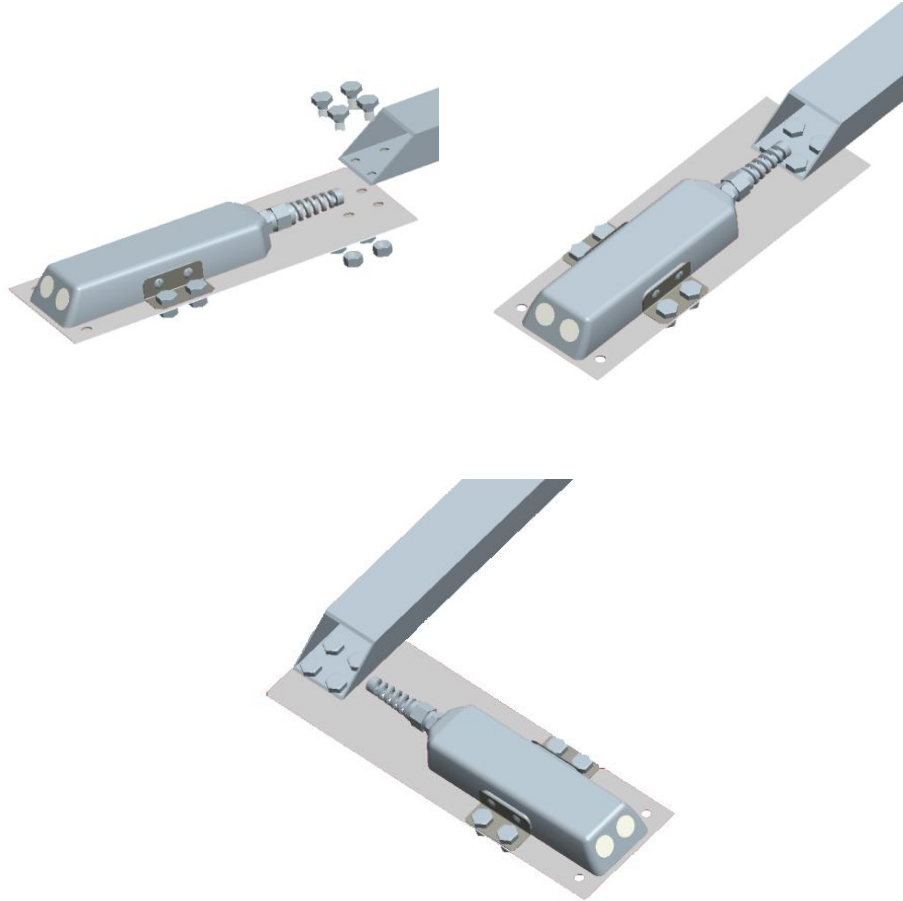
3. Installation:

1) Use 4 M8*4 stainless steel screws to fix the Doppler ultrasonic flowmeter on the stainless steel plate.



Doppler ultrasonic flowmeter fixed on stainless steel plate

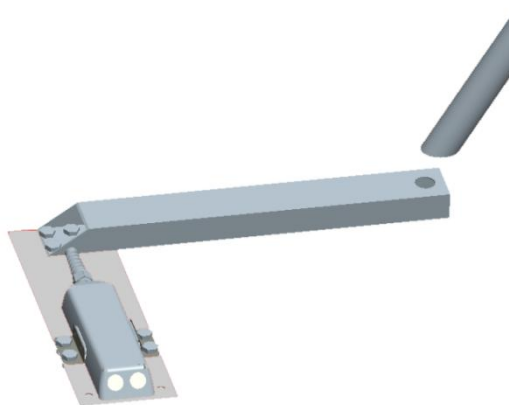
2) Use 4 M8*4 stainless steel screws to connect the installed Doppler ultrasonic flowmeter to the square steel according to the actual situation.



3) The tail cable of the Doppler ultrasonic flowmeter enters the inside of the square steel first. The tail cable needs to be put on a hose, and the cable goes out along the stainless steel pipe.

4) The length of the square steel is cut according to the specific situation, and the installation method is divided into bevel type and right-angle type.

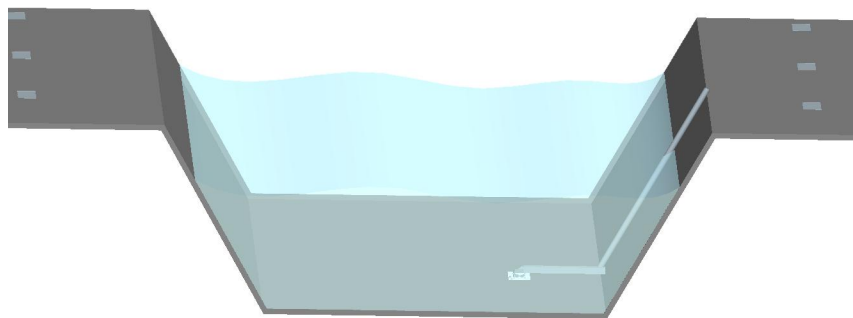
Inclined type:



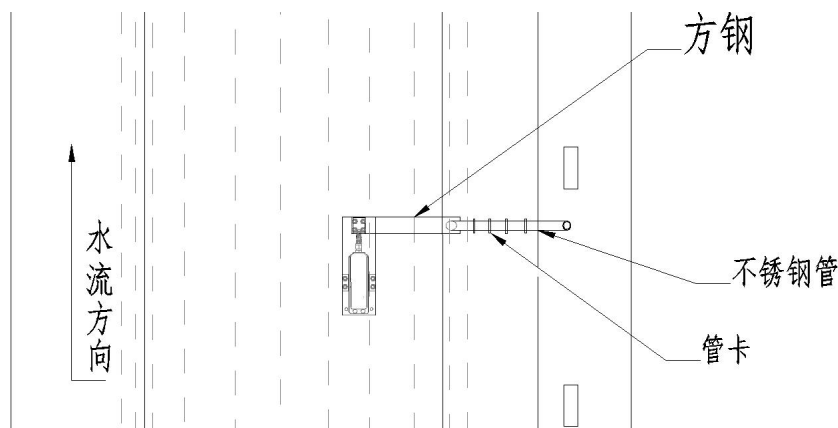
Inclined installation

The unfixed side of the square steel needs to be connected according to the site conditions, whether it is welded or threaded. The angle of the connection should be roughly the same as the slope of the river or canal.

Place the assembled equipment in the river at an angle and try to reach the bottom of the river as far as possible, but not completely placed on the bottom of the river to prevent interference from silt and aquatic plants.



Oblique 3D view

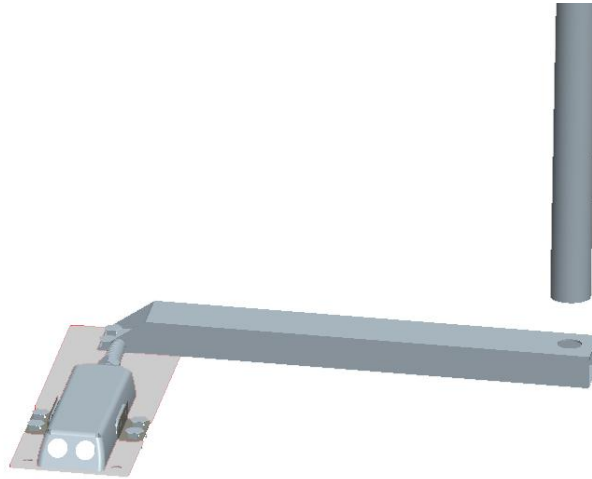


Inclined two-dimensional top view

Note:

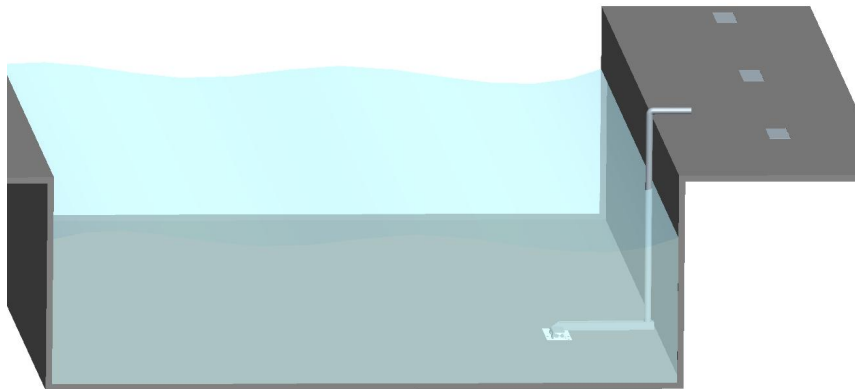
The main fixing position of the inclined plane type is on the pipe clamp. If the water flow in rivers and channels is large, the fixing and component connections need to be strengthened. For example: Weld a steel plate under the stainless steel pipe, and then drill expansion bolts into the steel plate to fix it next to the river or channel.

Right angle type:



Right angle installation

The unfixed side of the square steel needs to be connected according to the site conditions, whether to use welding to connect the stainless steel pipes, or to use threaded connections.

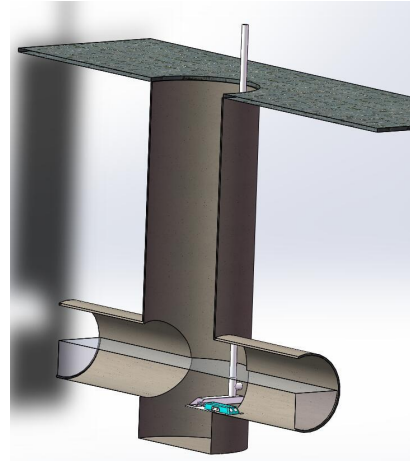
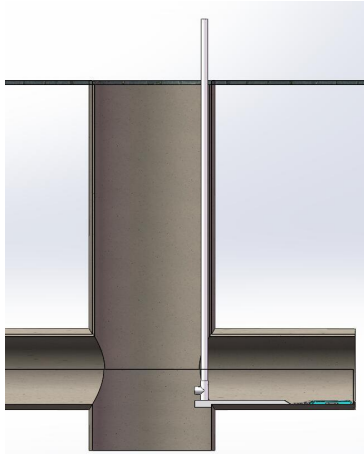


Right angle three-dimensional diagram

The installation and fixing methods are the same as the inclined surface type, and the stainless steel pipe is fixed on the wall.

6.3.3 Underground installation

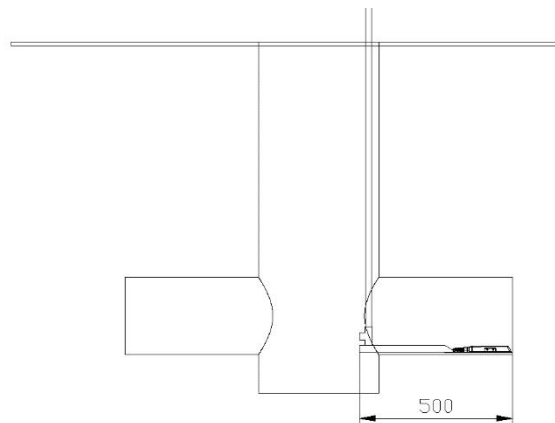
It can be installed underground using the right-angle installation in the bracket:



3D diagram of underground method 1 installation 3D diagram of underground method 2 installation

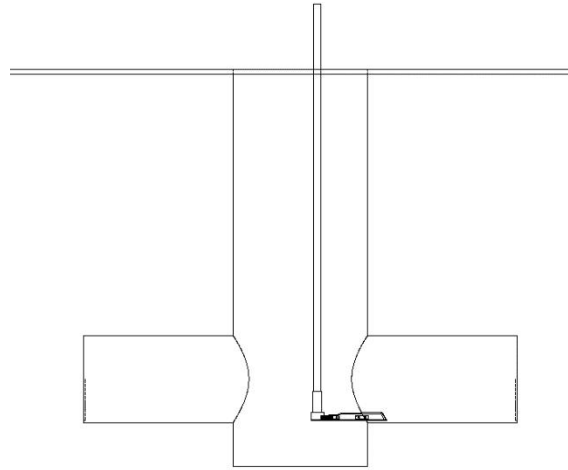
Right-angle underground installation can be fixed on the well wall, but all components must be tightened to prevent the equipment from shaking underwater and causing measurement errors.

Right-angle type underground installation method 1 is suitable for places with smooth and slow water flow and no floating objects, but the overall length of the equipment should not be greater than the diameter of the wellhead, preferably $\leq 500\text{mm}$.

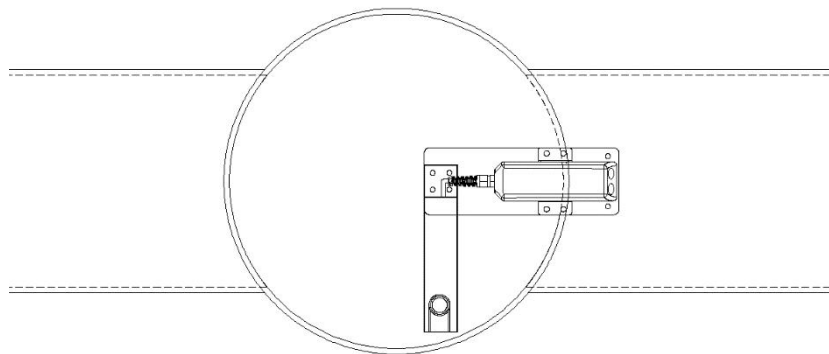


Schematic diagram

Right-angle underground installation method 2 is suitable for fast water flow and many floating objects. The length of the square steel should be similar to the radius of the wellhead.



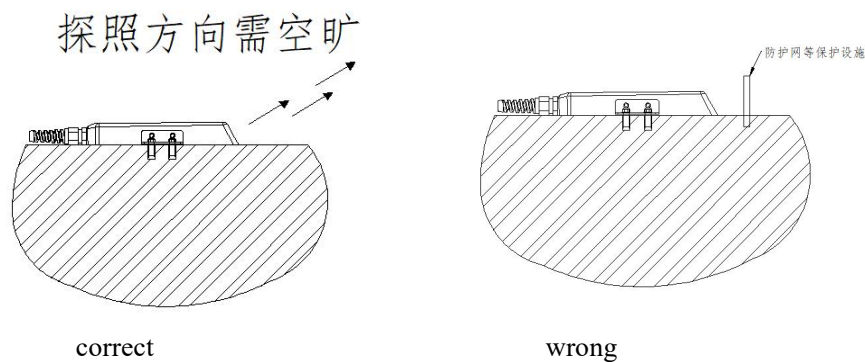
2D diagram of underground method 2 installation

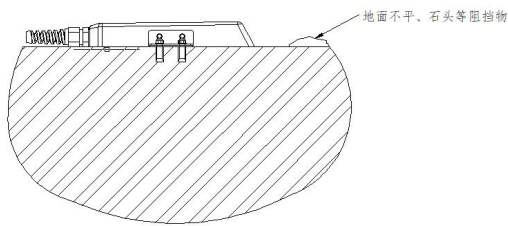


Top view of underground method 2 installation

VII.Installation Precautions

1. The Doppler ultrasonic flowmeter must be installed against the direction of the water flow and kept horizontally in the middle of the fixed cross-section channel. Please refer to the figure below.
2. There should be no obstruction in front of the Doppler ultrasonic flowmeter probe, otherwise it will lead to inaccurate flow measurement.

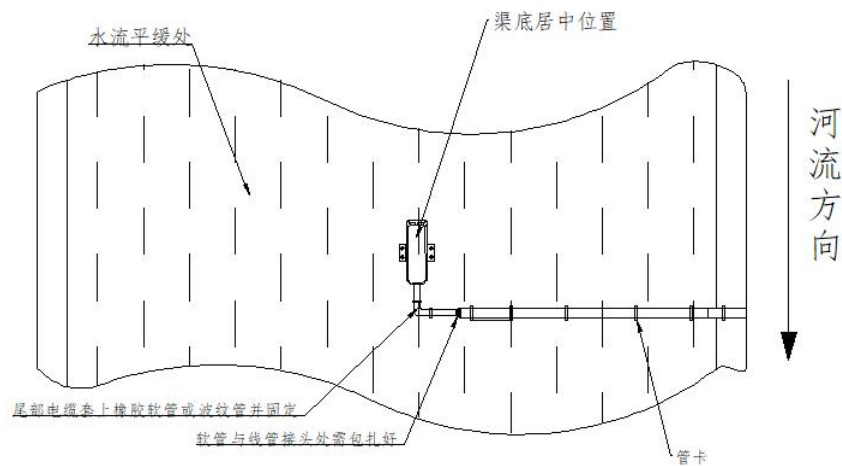




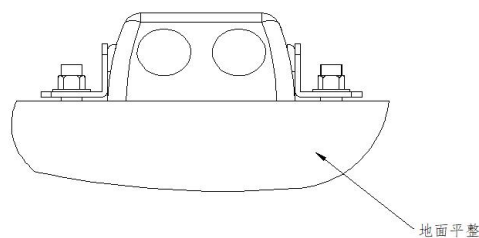
wrong

Note: Protective measures such as protective boards cannot be placed too close to the probe. The minimum distance is 20cm. If there are stones or raised obstacles in front of the probe, they must be removed in time.

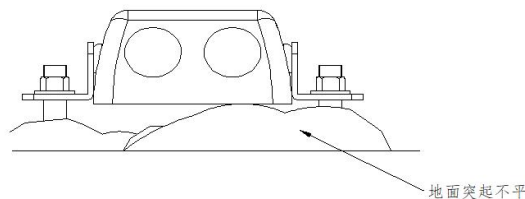
3. The tail cable of the Doppler ultrasonic flowmeter must be covered and fixed with a hose to prevent the cable from being damaged in water.



4. The bottom of the Doppler ultrasonic flowmeter should be level, and there should be no bulges that would cause unstable installation.



correct



wrong

5. Note that the cable contains an air pipe. The end of the cable should be placed in a dry place and cannot be placed in water, which may cause damage to the equipment.

Note: When installing cables, consideration should be given to whether large heavy objects may crush the cables during the flood season, causing the cables to break, water to enter the line, or the cables to break. The cable cannot be bent, as this may cause internal airway obstruction or airway rupture.

6. Before installing the bracket-type installation method, you need to understand the water flow changes in rivers, channels, and underground wells throughout the year. If there is turbulence, the fixed position needs to be strengthened, and each assembly component needs to be tightened to prevent the waterproof equipment from loosening and causing measurement errors. and equipment damage.

7. Regarding the installation method, it is necessary to understand the installation environment in advance and prepare installation materials according to the actual situation to facilitate on-site installation.

VIII.Usage environment

8.1 Use fluid range

1. Doppler ultrasonic flowmeter can be used in most fluids. The more particles and impurities in the fluid, the more accurate the measurement.

2. The fluid in which the Doppler ultrasonic flowmeter is located must be non-acidic and alkaline, because the shell of the Doppler ultrasonic flowmeter is not resistant to acid and alkali. If acidic and alkali substances are accidentally stuck on the shell, please rinse it with clean water in time.

3. If there are very few or almost no particles and impurities in the fluid (for example: pure water), the instrument will be biased or even unable to measure, so please do not install it in such fluids.

8.2 Installation surrounding environment

1. If there are a large number of stones around or there are a large number of rolling stones in the water during flood season, please install isolation protection boards or isolation protection brackets around the equipment.

2. There are aquatic plants or sinking garbage in the water that need to be dealt with in time to avoid measurement errors and equipment failures.

IX.Communication protocol description

1. Communication interface: RS485 interface, baud rate 9600, 1 start bit, 1 stop bit, no parity check, standard Modbus-RTU communication protocol.

2. Register description

Input register (read-only), function code 04H (note: modbus-rtu register is 16 bits in big-endian mode)

Register address	Function	unit	Remark
0	water temperature	degrees celsius	Signed 16-bit, temperature expanded 100 times
1	reserve		
2	flow rate	mm/s	Unsigned 16 bit
3	water level	mm	Unsigned 16 bit

3. Example

Send: 43 04 00 00 00 04 FE EB

43H: Device communication address, the default is 67.

04H: Function code.

00 00H: Reading starting address, 0.

00 04H: Number of read registers, 4.

F8 0FH: Data CRC check

Receiving: 43 04 08 0C 22 01 7F 01 87 00 11 1D E1

43H: Device communication address, the default is 67.

04H: Function code.

08H: Return data length, 8 bytes.

0C 22H: Water temperature 31.06°C.

01 87H: Flow velocity, 0.391m/s.

00 11H: Water level, 0.017m.

A3 11H: Data CRC check.

X.Instrument packing list

Doppler ultrasonic flow meter *1 set

Instruction manual *1 copy

certificate of conformity *1 copy