Ultrasonic flowmeter GTUF-300

GTC Global Co., Ltd.
Tel: 82.53.762.6668 Fax: 82.53.355.7295
E-mail: gtcinfo99@gmail.com
Add.: 121-3, Yutongdanji-ro 8-gil, Buk-gu, Daegu, Korea 41515

Index

1. Overview

1.1 Product introduction

Welcome to the new generation ultrasonic flow (heat) meter developed by our company.
This product is a flow/heat measurement product that uses advanced ultrasonic technology, supporting multi-channel and low power consumption; Among them, multi-channel products support up to 32 channels and open channel measurement (requiring corresponding liquid level gauges).

Low power flow meters can operate for at least 6 years using built-in backup batteries.

The new generation of ultrasonic flow meters can achieve measurement accuracy in every channel; If it is a dual channel flowmeter, the dual channel redundancy greatly improves the accuracy and stability of the flow (heat) meter, overcoming the shortcomings of traditional single channel products that are not suitable for flow field changes, low accuracy, and unstable flow (heat).

The measurement principle is based on signal correlation method, while dual channel products can use two channels to work simultaneously, greatly overcoming the influence of turbulence randomness on measurement, greatly improving the adaptability and measurement accuracy for different working conditions, making small flow (heat) measurement more reliable.

In addition, due to the application of advanced digital signal processing technology, the dead angle of sensor design can be very small, making it difficult to accumulate impurities such as rust and scale. This solves the biggest hidden danger of conventional flow meters being affected by impurities such as iron filings and welding slag, and is particularly suitable for water quality with high impurity content. The dual channel flow (heat) meter uses a high-speed DSP processor to make the measurement system response speed less than 0.1 seconds, which is more than 10 times faster than ordinary flow (heat) meters. It can be used as a quantitative control measurement standard, especially suitable for flow measurement of high viscosity oils, chemical products, and ultrapure water.

It can also be connected to two temperature sensors as a flow (heat) meter.
When more heat function is required, the dual channel flow (heat) meter can also serve as the flow measurement part of the flow (heat) meter, connected to the heat integrator through 4-20mA as the flow measurement part.

1.2 Product features

- The flow measurement adopts time difference correlation method technology, ensuring measurement accuracy and stability.
- Adopting a high-speed DSP processor, with a response speed of 0.1 seconds.
- Advanced digital signal processing technology, measuring without interference from impurities such as iron filings and welding slag.
- Different sensors can be connected to solve the problem of multi bubble application on site.
- Up to 32 channels supported.
- Low power consumption product with built-in battery that can operate for more than 6 years.

1.3 Technical indicators

Technical Indicators	
Measurable liquid	Most single-phase liquids, Less than 5% particles or bubbles
Pipeline materials	Stainless steel, carbon steel, PVC, PPR, cement
Operating ambient temp	-40~ +60˚C
Measured fluid temp	-20~ +150˚C
Explosion Proof level	ExidII BT4
Performance index	
Flow rate range	Nominal accuracy flow rate range 0.1 ~ 7.0m/s
Measurement accuracy	±1%
Sensitivity	0.01m/s
Measurement repeatability	±0.2%
Protection level	IP65
Power supply	External power supply: AC85~265V/ DC7~40V; Low power consumption: DC7 36V/AC85-265V/ built-in backup battery
Electrical interface	Waterproof joint M16 X 1.5
LCD display	128*64 dot matrix LCD screen
Keyboard entry	4 keys/ touch buttons
Input output signal	
Serial communication	RS485, MODBUS RTU protocol
Flow output	Self-powered 4-20mA output

1.4 Safety points

Please read this operating manual to obtain applicable national standards, safety requirements, and accident handling regulations. The installation and operation of measuring instruments can only be carried out by qualified personnel.		
	Pay Attention to	Particular Attention

1.5 Product liability and warranty

The ultrasonic flow (heat) meter we provide is specifically designed for measuring the flow (heat) of liquid fluids.
Regarding the responsibility for equipment suitability and reasonable use, improper installation and operation by the customer may result in loss of warranty.
Other matters shall be handled according to the "sales contract" signed by both parties. If the instrument needs to be repaired, please fill in the information in the form of the warranty card.
Only when you complete this form and send it to us can the convection (heat) meter be tested or repaired.

1.6 Supply terms

At least the following information needs to be provided when ordering: power supply method, sensor type, sensor transmission line degree, and other information.

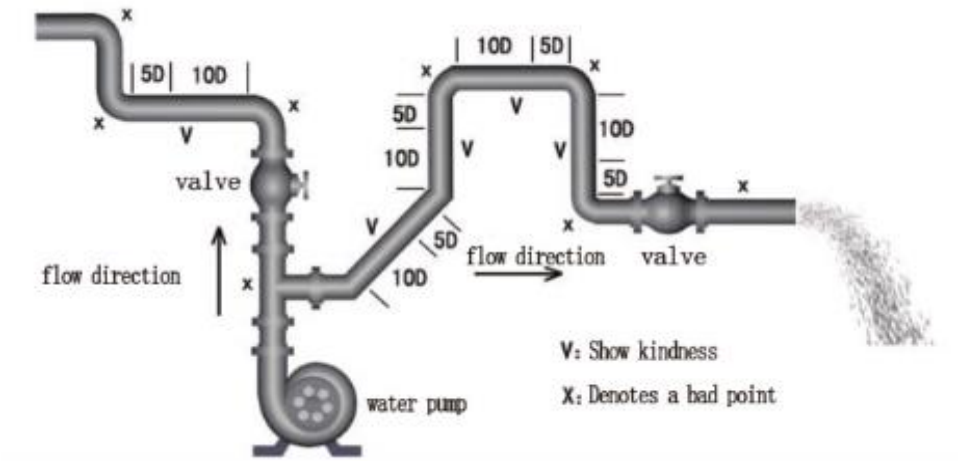
2 Instrumentation

2.1 Installation preparation

Before installing a flow (heat) meter, it is necessary to have a comprehensive understanding of the pipeline location, pipeline parameters, and fluid characteristics of the measurement points.
A plan should be made for power supply, display information, output signal connection, and system maintenance.

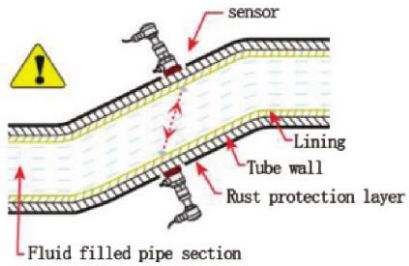
The main principle for selecting the installation location of the flow (heat) meter is that there should be at least 10 times the diameter of a straight pipe upstream of the installation point, and at least 5 times the diameter of a straight pipe downstream. In addition, special attention should be paid to staying as far away as possible from positions such as pumps, valves, and discharge ports that are prone to strong turbulence or bubbles.

Select a position with a full pipe, such as a vertical pipe section (fluid flowing upwards) or a horizontal pipe section.
The following figure indicates some suitable and unsuitable pipeline locations for installation.

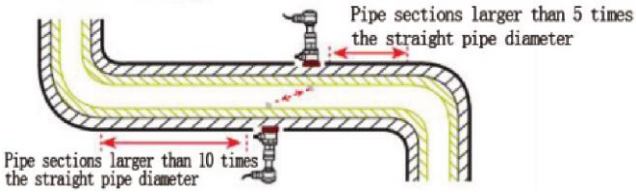


Select flow measurement point: To ensure measurement accuracy and stability, the installation point of the sensor should be selected in a straight pipe section with uniform flow field distribution (the pipeline must be filled with liquid during normal use), and the following principles must be followed:

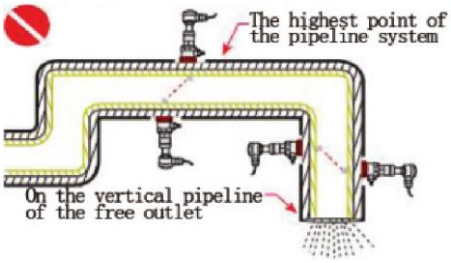
1. Select a position with a full pipe, such as a vertical pipe section (fluid flowing upwards) or a horizontal pipe section.



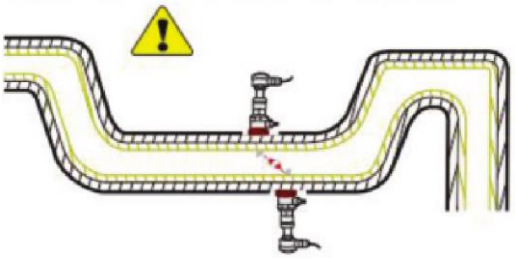
2. The installation point should choose a straight pipe section with an upstream diameter greater than 10 times the straight pipe diameter and a downstream diameter greater than 5 times the straight pipe diameter, without any uniform valves, bends, diameter changes, etc.
The installation point should be fully away from interference sources such as valves, pumps, high-voltage electricity, and frequency converters.



3. Avoid installing on the highest point of the pipeline system or vertical pipelines with free outlets (fluid flowing downwards).



4. For open or partially filled pipes, the flow meter should be installed at the U-shaped pipe section.

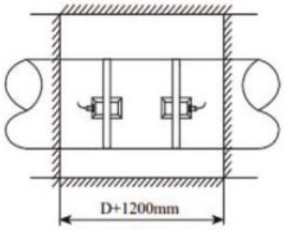


5. Two sensors must be installed in the horizontal direction of the pipeline axis and within ±45° of the horizontal position of the axis to prevent phenomena such as insufficient pipes in the upper part, bubbles, or sedimentation in the lower part from affecting the normal measurement of the sensor.

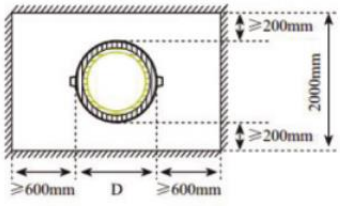
If it is not possible to install the sensor horizontally and symmetrically due to the limitations of the installation location space, the sensor can be installed vertically or at an inclination angle while ensuring that there are no bubbles in the upper part of the pipe.

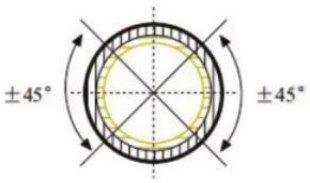
Construction requirements for instrument wells

If the on-site sensor needs to be installed in the instrument well, there must be a certain installation space for people to work upright, that is, the distance between the pipe wall and the wall should be at least 600mm, and the width should be W>(D+600 × 2) mm, cement pipeline W>(D+700 × 2) mm, the axial width of the instrument well L>D+1200mm.
When installing the sensor, avoid flanges, welds, and reducers, and try to install it within ±45° of the horizontal position of the pipeline axis.



D represents the diameter of the measured pipeline.





Note:

★ Please install the sensor within ± 45° of the horizontal position of the pipeline axis.
★ Please ground the main unit housing.
★ The installation position of the sensor should avoid flanges, welds, and reducers.
★ Please leave enough space for people to work upright.

After determining the installation location and obtaining accurate pipeline and fluid information, it is necessary to use the instrument keyboard to input this information to obtain the installation and calculation parameters of the ultrasonic flow meter/heat meter.

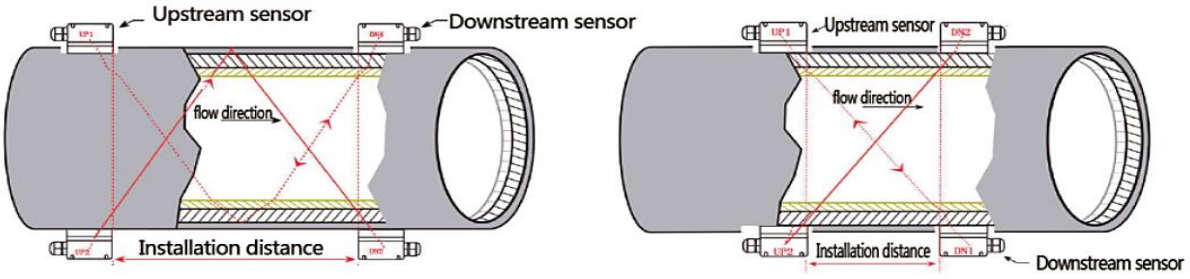
The most important parameter for the external clamp ultrasonic flow meter/heat meter is the installation spacing of the sensor (obtained by inputting pipeline material, pipeline inner diameter, pipe wall thickness, and liquid medium).

Please refer to panel operation for specific operations.

2.2 Classification and layout of flow sensors

Ultrasonic flow (heat) meter sensors are divided into: external clamp type, plug-in type, and pipe section type. Generally speaking, Z-type installation method is recommended for external clamp type or plug-in type, and V-type installation method is not recommended;

Schematic diagram of external clamp Installation

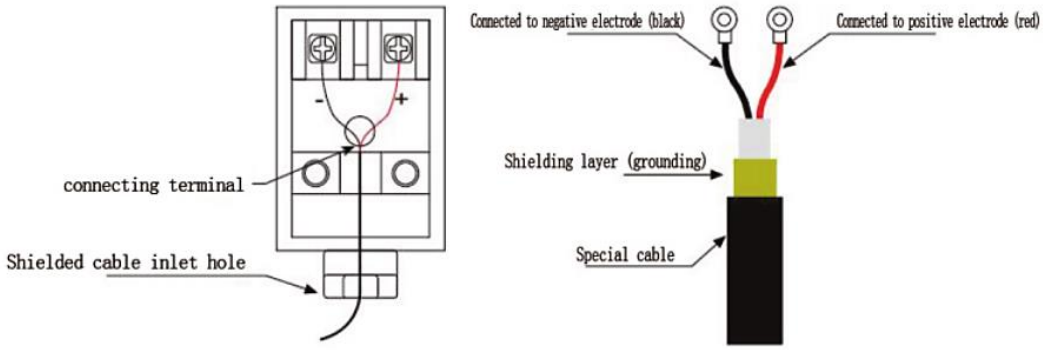


V-method installation of external clamp sensor

Z-method installation of external clamp sensor

Installation steps:

1. The shielded wire of the signal cable for wiring can be suspended and not connected, and should not be short circuited with the positive and negative electrodes (red and black wires);



2. Sealed and waterproof, after connecting the wires, it must be filled with sealant (sealant). After covering the cover, the sensor shielding cable inlet hole must be tightened and locked to prevent water ingress;
3. Install the sensor, use an angle grinder to polish the area where the sensor is to be installed, remove rust, paint, or rust prevention layer, and use a clean cloth dipped in acetone or alcohol to wipe off oil and dust. Then, apply sufficient coupling agent to the pipe wall around the center of the sensor to be installed. Finally, attach the sensor tightly to the pipe wall and bundle it properly.
   The fixture (stainless steel strip) should be fixed to the center part of the sensor to ensure even stress;
   Note that there should be no air bubbles or gravel between the sensor and the pipe wall.

Schematic diagram of plug-in Installation

Installation method for Plug-in Sensors
By using specialized drilling tools, holes can be drilled and installed under pressure without stopping water, allowing the sensor to come into direct contact with the measured medium for flow measurement. In the future, maintenance also does not require stopping water;

There are three standard models available for plug-in sensors to choose from

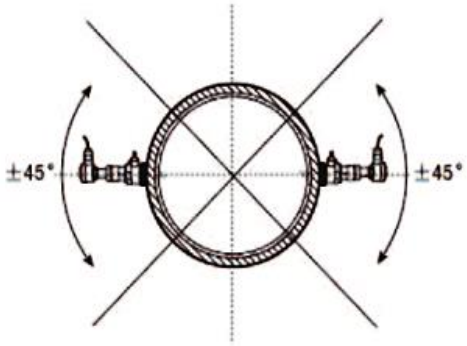
Name	Standard plug-inB	Enhanced plug-inB	Extended plug-in typeB (cement)
Probe type	Insert B-type		
Installation method	Z method (unique)		
Installation distance	Inner diameter -9.113mm		
Applicable pipe diameter	DN80mm and above		
Installation space	≥600mm	≥700mm	
Fluid temperature	-40°C~160°C		
Sensor material	304 stainless steel		

For pipes that cannot be directly welded except for steel and stainless steel, such as cast iron, fiberglass, PVC, cement pipes, etc., special pipe clamps made by the manufacturer must be equipped before installation. If users encounter this type of situation when ordering, please inform the manufacturer of the exact outer diameter of the pipe to be installed to prevent water leakage.

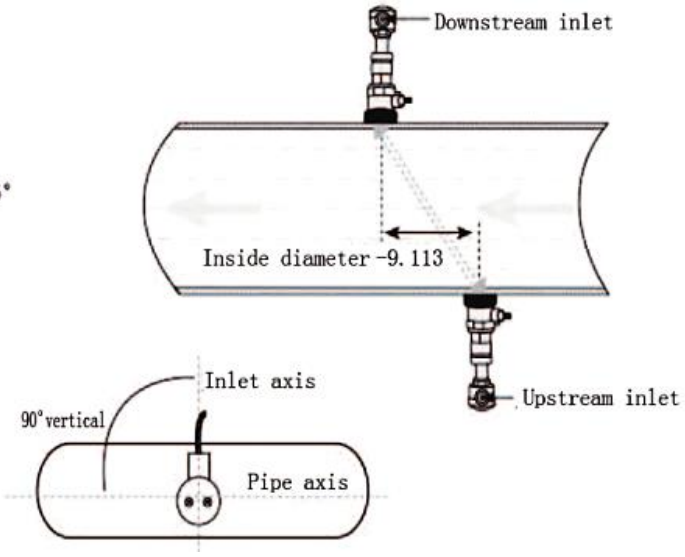
Installation tools: The Company provides specialized drilling tools, 550W electric hand drills (preferably with high-rise speed regulation), wrenches, and other tools.

Installation distance: The distance between the centers of two sensors along the pipe axis direction. The calculation method is to enter the required parameters in the menu, check M25 or "L=inner diameter -9.113mm", and install the sensor according to this data.

Installation method: Z-method, suitable for pipe diameters above DN80mm.



The inlet faces of the two sensors are consistent and the direction indicated is perpendicular to the axis of the pipeline (this ensures that the emission surfaces of the two sensors are relative).

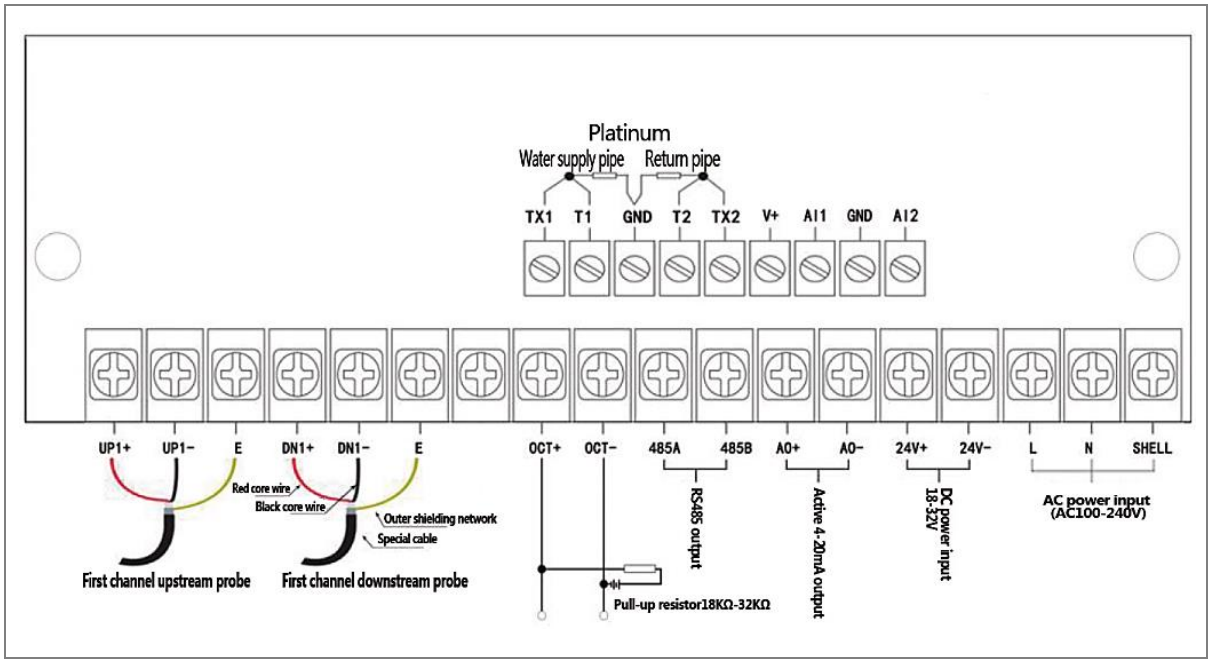


2.3 Split electrical wiring

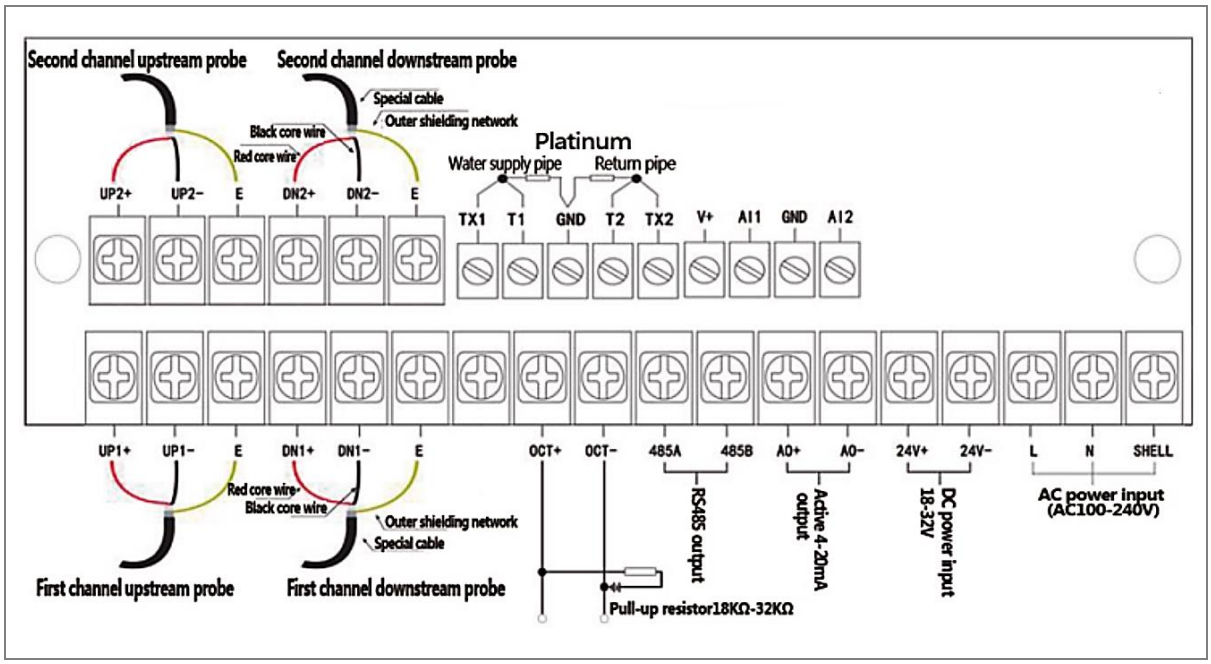
Users should pay special attention to the power supply type of the flow (heat) meter when wiring. To ensure the normal operation of the transmitter, the following aspects should be noted when wiring: ensure that the power connection is consistent with the display specifications on the transmitter label.

The flow (heat) meter can be installed in the designated position as required to start wiring.
Open the back cover of the transmitter and you can see the interface label of the transmitter.
For specific wiring, please refer to the following wiring diagram.
The single channel external power supply product has 2 different types of wiring terminals, and the terminals with the same name have the same function.

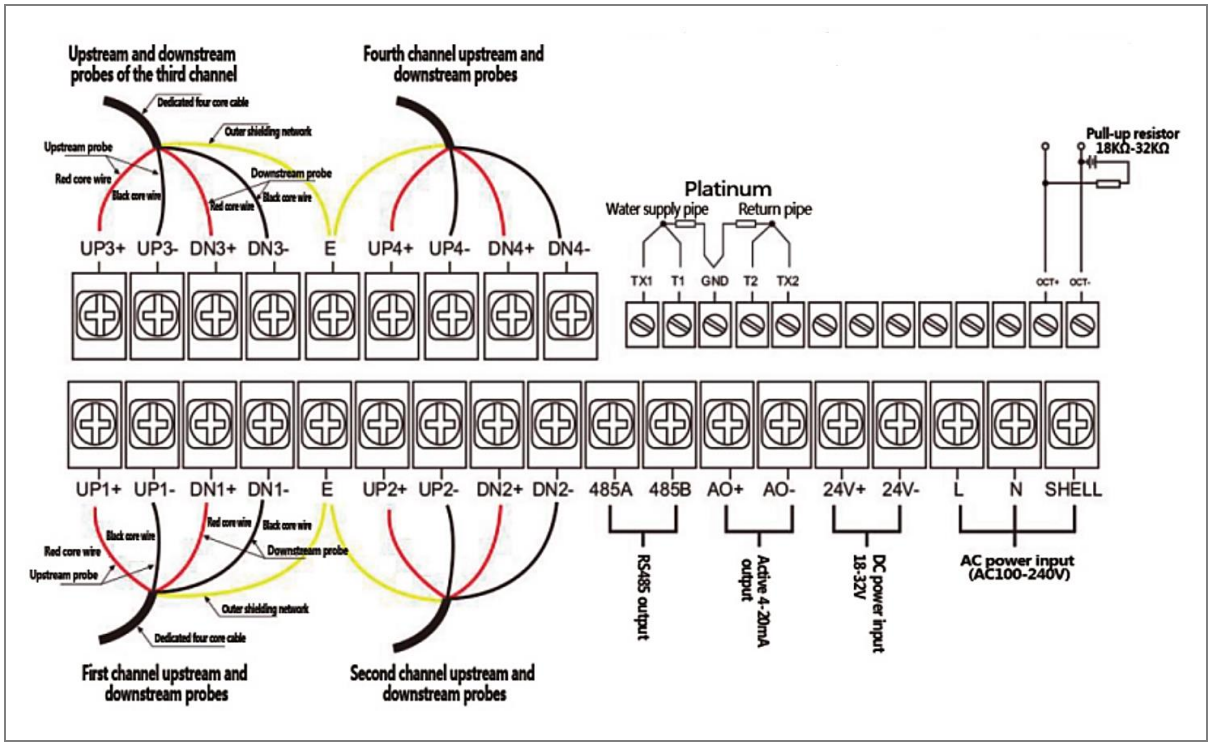
Single channel motherboard wiring diagram terminals:



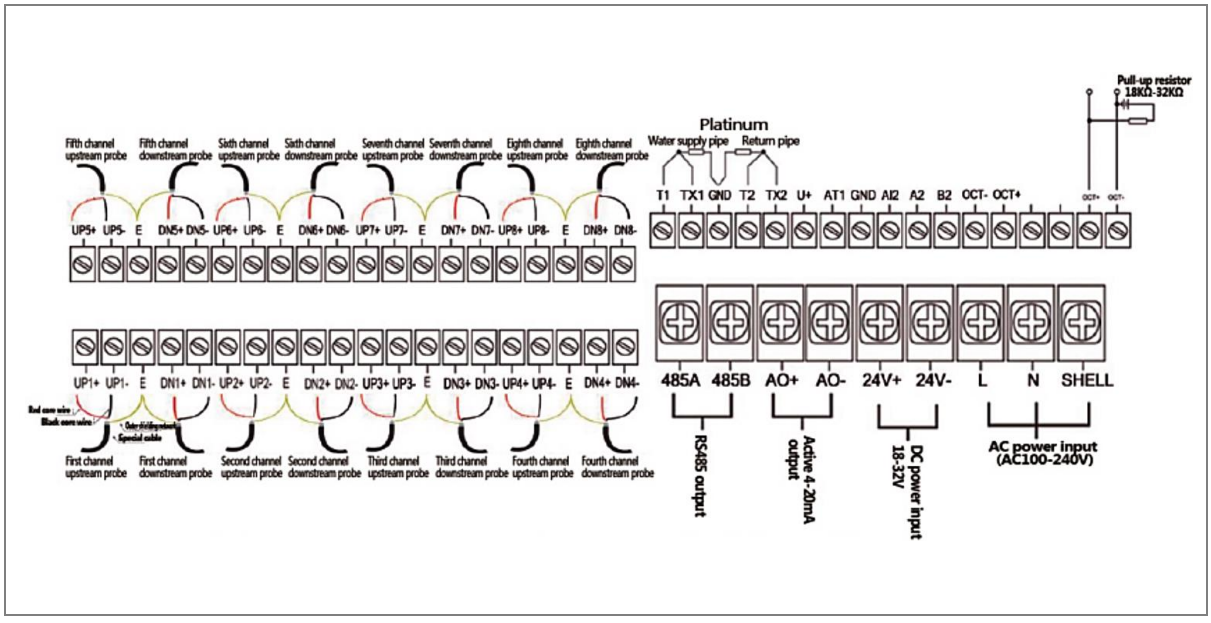
Dual channel motherboard wiring diagram terminals:



Four Channel Motherboard Wiring Diagram Terminals:



Eight-Channel motherboard wiring diagram



3 Panel Operation

The operation panel can be used to check the calculation process, accumulate zeros, change settings, and so on.

3.1 Panel composition

The operation panel consists of a 4-key keyboard, with functions and icons such as:

▼: Menu directory view, scrolling, number change keys

▶: Array shift key, corresponding digits will flicker

M: Mode selection key, exit key, abbreviated as MD key

E: Confirm key (Enter key ENT key), optional. After pressing the confirm key, ">" will appear.
You can use ▼ to input the corresponding data.
Press confirm again, and ">" will disappear, indicating that the input has been made.

3.2 Menu table of contents

Menu operation: Press the MD key and select the corresponding menu.
Press the ENT key to enter the mode selection key.
There are a total of 5 mode menus. Use the ▼ key to select the desired menu, and press the ENT key to enter the corresponding sub items. The details are as follows:

Monitor	Measurement configuration	Output	Calibration	View results	Zero cumulative
Flow display	Sensor selection	Low flow rate cutoff	Instrument coefficient	Signal strength and quality of channel 1	Zero cumulative
Heat display	Installation method	Damping time	Channel 1: Zero	Channel 2 signal strength and quality	
Temperature display	Inner diameter of pipeline	Communication ID	Channel 2: Zero	Instantaneous flow rate	
Pressure display	Pipe wall thickness	Communication parameters			
Time display	Pipeline material	20mA corresponding flow rate			
Local serial number	Pipeline lining	OCT pulse equivalent setting			
Communication parameter display	Fluid type	Heat measurement unit			
	Sensor distance	Metric and English units			
	Signal strength and quality of channel 1	Instantaneous flow unit			
	Channel 2 signal strength and quality	Accumulated traffic unit			
	Signal strength and quality of channel 3	Sound speed transmission and settings			
	Channel 4 signal strength and quality	Instrument type			
	LCD backlight time	Backlight brightness setting			
	Restore parameters	Local password			
		Reboot device			

3.3 Menu analysis

3.3.1 Monitoring

The monitoring screen displays several main measurement results of the flow (heat) meter, and the specific screen is selected using the ▼ key.
The first screen displays the instantaneous flow and total accumulated quantity as shown in Figure 3-3-1, the second screen displays the measured instantaneous heat and accumulated heat as shown in Figure 3-3-2 when it is used as a calorimeter, and the third screen displays the measured supply water temperature and return water temperature as shown in Figure 3-3-3 when it is used as a calorimeter.

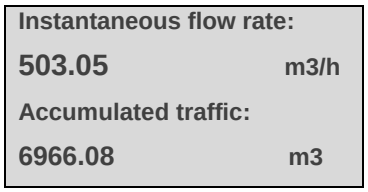


Figure 3-3-1 Flow Screen

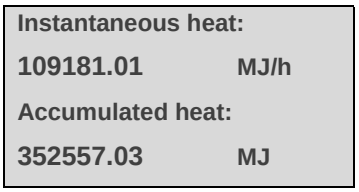


Figure 3-3-2 Heat Screen

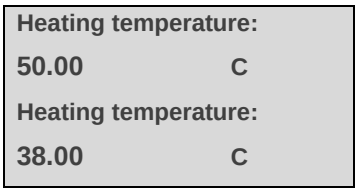


Figure 3-3-2 Temperature Screen

3.3.2 Measurement configuration

The quantity configuration mainly involves setting the most basic information necessary for measurement.
If the input information is not accurate, it is likely to cause the flow (heat) meter to be unable to measure.

The above parameters are used as a pipe section flow (heat) meter and have been set at the factory,
Without the need for customers to set again, changing parameters without authorization will result in various incalculable consequences. However, when used as plug-in and external clamp flow (heat) meters, each parameter needs to be set according to the actual situation.

Inner diameter: The measured inner diameter of the pipeline, in millimeters (mm).

Wall thickness: The measured wall thickness of the pipeline, in millimeters (mm).

Pipeline material: The material of the measured pipeline, commonly used materials such as stainless steel, carbon steel, PVC, and cast iron can be directly selected. Other materials need to refer to the attached table (see the end) or contact the manufacturer to determine the propagation speed of sound waves in the material. The external clamp flow (heat) meter needs to set this parameter, and other flow (heat) meters do not need it.

Installation method: mainly set the layout of the sensor, and the actual installation method of the sensor needs to be consistent with this parameter.

Installation distance: Based on the above settings, the final installation distance of the sensor will be obtained, in millimeters (mm). The actual installation distance between sensors should be consistent with this parameter.

3.3.3 Output

The "Output" menu contains settings for outputting various parameters, as follows:

Damping coefficient: Set the response speed of the instantaneous flow rate, with a maximum value of 200. The larger the value, the more stable the instantaneous flow rate, and the slower the response. The smaller the value, the greater the fluctuation of the instantaneous flow rate, but at the same time, the faster the response.

Low flow rate cutoff: Set the minimum flow rate that the flow (heat) meter can measure, which is usually 0.03m/s when leaving the factory. If the measured value is below this value, it will be treated as zero flow rate.

Communication ID: Set the address number of the flow (heat) meter for Modbus RTU communication, which defaults to 1 at the factory.

Communication parameters: Set the flow (heat) meter RS485 communication rate, check bit, stop bit, etc.

20mA corresponding flow rate: Set the instantaneous flow rate value corresponding to 20mA when outputting 4~20mA.

OCT pulse equivalent: Output a positive cumulative flow meter represented by one pulse, with a maximum output of 10000 pulses per second.
The flow meter will automatically calculate the OCT output frequency based on the device.
The corresponding relationship between OCT pulse equivalent and instantaneous flow calculation is:
instantaneous flow = xxL/pulse * 10000 * 3600/1000, and the maximum output frequency of OCT is 10K.
Assuming the OCT equivalent is 0.1L/pulse, the instantaneous flow range is 0~3600m³/h, and the OCT is 0~10KHz.

3.3.4 Viewing results

Instantaneous flow rate: The measurement result of the flow (heat) meter shows that it is the result of comprehensive calculation of dual channel flow rate.

Accumulated flow rate: The cumulative flow rate in both positive and negative directions of the flow (heat) meter.

Positive accumulation: The cumulative flow rate in the positive direction of the flow (heat) meter.

Negative accumulation: The cumulative flow rate in the negative direction of the flow (heat) meter. When installing, the arrow direction on the flow (heat) meter should be consistent with the actual liquid flow direction. The flow direction opposite to the arrow is negative flow rate, and accumulating negative flow rate is negative accumulation. When leaving the factory, negative flow rate is set to off by default.

Channel 1 signal quality: Channel 1 sensor time transmission ratio T and quality Q

Signal strength of channel 1: upstream and downstream signal strength of channel 1 sensor

Channel 2 signal quality: Channel 2 sensor time transmission ratio T and quality Q

Signal strength of channel 2: upstream and downstream signal strength of channel 2 sensor

Channel 3 signal quality: Channel 3 sensor time transmission ratio T and quality Q

Signal strength of channel 3: upstream and downstream signal strength of channel 3 sensor

Channel 4 signal quality: Channel 4 sensor time transmission ratio T and quality Q

Channel 4 signal strength: Channel 4 sensor upstream and downstream signal strength.

3.3.5 Zero accumulation

Confirm: Press the ENT key to clear all accumulated traffic. Please contact the manufacturer's personnel for the required password.

3.3 Quick input of pipeline parameters and steps

1. Measurement configuration -> Sensor selection -> Select the corresponding sensor
2. Measurement configuration -> Installation method -> Select the corresponding installation method (if it is a plug-in sensor or a pipe section integrated sensor, this item is not available)
3. Measurement configuration -> Pipe inner diameter -> Enter the corresponding inner diameter (if it is a stored pipe section, this item is not available)
4. Measurement configuration -> Pipe inner diameter -> Pipe wall thickness (if it is a pipe section integrated or plug-in sensor, this item is not available)
5. Measurement configuration -> Pipeline material -> Pipeline thickness (if it is a pipe section integrated or plug-in sensor, this item is not available)
6. Measurement configuration -> Sensor installation distance, recommended sensor installation distance, if it is a stored sensor, this item is not available
7. Measurement configuration -> Signal strength and quality of channels 1 and 2
8. Measurement configuration -> Channel 3 and 4 Signal Strength and Quality

4 Communication protocol

This device supports the standard Modbus RTU protocol, and the read flow data is all input registers. Use the 0x04 command to read (the standard Modbus RTU read input register command), and the register address is as follows:

Main address (read by 04 command)	Content	Types Of	Unit	Illustrate
0	Instantaneous flow rate	Float	m3/h	IEE754 floating point, order: CDAB
1				
2	Instantaneous heat	Float	GJ/h	IEE754 floating point, order: CDAB
3				
4	Net cumulative flow integer part	Unsigned 32-bit integer	m3	Order: CDAB Order: CDAB
5				
6	Positive cumulative traffic integer part	Unsigned 32-bit integer	m3	Order: CDAB
7				
8	Negative cumulative traffic integer part	Unsigned 32-bit integer	m3	Order: CDAB
9				
10	Net cumulative heat integer part	Unsigned 32-bit integer	GJ	Order: CDAB
11				
12	Positive cumulative heat integer part	Unsigned 32-bit integer	GJ	Order: CDAB
13				
14	Negative cumulative heat integer part	Unsigned 32-bit integer	GJ	
15				
16	Fractional portion of net cumulative flow	Unsigned 16 bit integer	0.001m3	
17	Fractional part of positive cumulative traffic	Unsigned 16 bit integer	0.001m3	
18	Negative cumulative flow fraction	Unsigned 16 bit integer	0.001m3	
19	Fractional portion of net cumulative heat	Unsigned 16 bit integer	0.001GJ	
20	Fractional part of positive cumulative heat	Unsigned 16 bit integer	0.001GJ	
21	Negative cumulative heat fraction	Unsigned 16 bit integer	0.001GJ	
22	Reserve			
23	Reserve			
24	Instantaneous velocity	float (Floating point)	m/s	IEE754 floating point, order: CDAB
25				
26	gauge height	Unsigned 16 bit integer	mm	This register is not used in the flow meter
27	Battery voltage	Unsigned 16 bit integer	mv	Dedicated for low-power flow meters
28	Hot end temperature	Unsigned 16 bit integer	0.01 degrees	
29	Cold end temperature	Unsigned 16 bit integer	0.01 degrees	
30	Hot end temperature	Unsigned 16 bit integer	0.01 degrees	
31	Cold end temperature	Unsigned 16 bit integer	0.01 degrees	
32	First analog input current value	Unsigned 16 bit integer	uA	
33	Second analog input current value	Unsigned 16 bit integer	uA	
34	Corresponding physical quantity of the first analog input	float (Floating point)		IEE754 floating point, order: CDAB
35				
36	Physical quantity corresponding to the second analog input	float (Floating point)		IEE754 floating point, order: CDAB
37				
65400	Equipment serial number	Uint32 unsigned 32-bit integer		Sequence: CDAB, flow meter serial number is the same as displayed
65401				

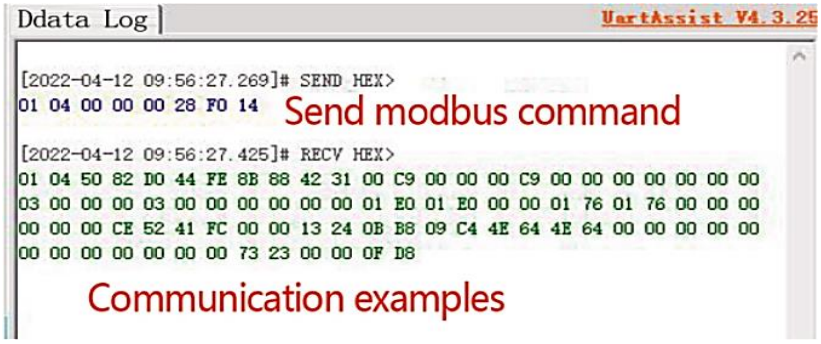
4.1 When using C, what is the storage order of floating point numbers?

The IEEE754 format single precision floating-point form with four bytes of 1.2345678, such as 3F 9E 06 51. The order in the MODBUS data stream is 06 51 3F 9E, and the address 1 data stream should be 01 03 04 06 51 3F 9E 3B 32 (hexadecimal digits).
When using the C language in an X86 computer, the memory is stored in the order of 51 06 9E 3F from low to high.

4.2 How to read

You can use a Modbus RTU command to read the required data, assuming that the flow meter address is 1, Modbus The command sent by the main station is as follows: 01 04 00 00 00 28 F0 14,

The communication data is shown in the following figure:



The instantaneous flow data is: 82 D0 44 FE, and the actual data is arranged in the memory as 44 FE D0 82.
The floating point number (IEE754) is 2036.087890625, so the instantaneous flow is 2036.087890625m^3/h: other data can be extrapolated from this.

The net cumulative integer part is: 00 C9 00 00 00, and the actual data is 00 00 00 C9, which is 201m^3

The net cumulative decimal part is: 01 1E, and the actual data is 011E=481, with a unit of 0.001, representing 0.481m^3

Net Accumulation=Net Accumulated Integer+Net Accumulated Decimal=201+0.481=201.481m^3

5. How to use it

5.1 Determine whether the flow meter is working properly

Check the measurement configuration ->Channel 1 signal strength and quality: it is recommended that Q>80, 97%<T<103%, upstream and downstream are greater than 10mV, and the difference between upstream and downstream is not more than 5%
The viewing method for channel 2 and channel 1 is similar

5.2 How to use zero cut to avoid invalid accumulation

The data of “output ->low flow rate cutoff” is called the low flow rate cutoff value, and the system treats the flow rate with an absolute value below this value as “0”.

This parameter can be set to avoid false accumulation of measurement errors generated by the flow meter when the actual flow rate is “0”. In general, set this parameter to 0.03m/s.
When the flow rate is greater than the flow rate represented by the low flow rate cutoff value, the low flow rate cutoff value is independent of the measurement result and will never affect the measurement result.

5.3 How to use a 4~20mA current loop output

The current loop output accuracy of the flow (heat) meter is better than 0.1%.
The flow value corresponding to 4mA is 0m³/h, and the flow value corresponding to 20mA is adjusted to “output ->20mA corresponding to flow value”; For example, if set to 80m³/h, the corresponding flow meter for outputting 4~20mA is 0~80m3/h.

5.4 How to use RS485 serial port

The flow (heat) meter uses a standard Modbus RTU communication protocol, with device addresses ranging from 1 to 254 that can be set by software.
Its baud rate can be selected between 1200 and 57600, and low-power flow meters can support up to 9600.
Output ->Communication ID: Used to set the Modbus RTU address.
Output ->Communication parameters: used to set serial communication baud rate, parity bit, etc.

5.5 How to use OCT output

This device OCT has intelligent output, which can automatically complete the correspondence between cumulative flow rate, instantaneous flow rate, OCT pulse equivalent, and pulse frequency by inputting OCT equivalent.
The default maximum frequency for OCT output is 10K, and the maximum OCT pulse width is 32ms. The pulse width will decrease as the frequency increases and is automatically calculated.

The relationship between OCT equivalent and instantaneous flow rate is: instantaneous flow rate=xxL/pulse * 10000 * 3600/1000, and the maximum output frequency of OCT is 10K.
Assuming the OCT equivalent is 0.1L pulse, the maximum instantaneous flow rate is 0.1 * 10000 * 3600/1000m³/h=3600m³/h. The instantaneous flow rate range is 0-3600m³/h, and the OCT frequency is 0-10KHz.

6. Water temperature and sound velocity meter

Temperature (°C)	Sound Velocity (m/s)	Temperature (°C)	Sound Velocity (m/s)	Temperature (°C)	Sound Velocity (m/s)
0	1403	**35**	1516.5	**70**	1555.0
5	1427	**40**	1526	**75**	1555.0
10	1447	**45**	1533.5	**80**	1555.0
15	1464	**50**	1541.0	**85**	1552.5
20	1481	**55**	1546.5	**90**	1550.0
25	1494	**60**	1552.0	**95**	1547.0
30	1507	**65**	1553.5	**100**	1543.0

Note: The viscosity of water is 1.13cSt