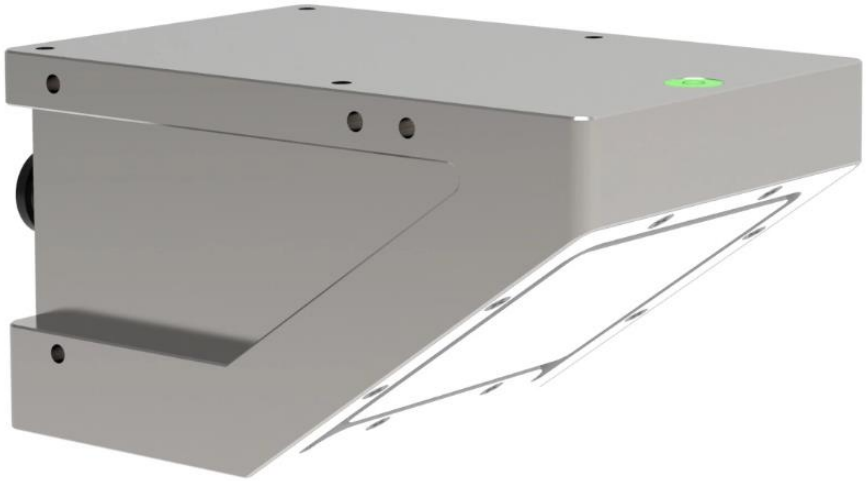
3 in 1 Radar water flowrate water level water flow sensor



Type Model: RD- 600s

CATALOGUE

1. PRODUCT INTRODUCE 2

2. INSTALLATION AND COMMISSIONING 5

3 WORK MODE DESCRIPTION 10

4. TECHNICAL PARAMETER 11

5. APPLICATION SCENARIOS AND SOLUTIONS 12

6. MODBUS COMMUNICATIONS PROTOCOL 14

7. REGISTER LIST.....34

8. SYSTEM CONFIGURATION SOFTWARE (ONLY FOR RD600S) 40

APPENDIX A FREQUENTLY ASKED QUESTIONS 46

APPENDIX B SHIPPING LIST 48

1. PRODUCT INTRODUCE

1.1 Product brief Introduce

The RD-600s radar flowmeter was independently developed by our company. It is a non-contact and integrated flow monitoring device that can continuously measure flow rate, water level and flow. It uses radar planar microwave technology to measure the velocity and level of water in a non-contact manner. According to the built-in software algorithm, the instantaneous cross-sectional flow and cumulative flow are calculated and output. At the same time, the flow rate and water level can be output, and the telemetry platform can be easily connected, and the measurement information can be viewed on the cloud platform. Support digital (RS485, RS232) or analog (4-20mA) transmission of measurement results, using standard Modbus-RTU protocol. Support 4G technology to realize wireless data transmission. This product can be used for non-contact flow measurement in open channels, rivers, irrigation channels, underground drainage pipeline networks, flood control warnings, etc .; this product has the characteristics of low power consumption, small size, high reliability, simple operation, convenient maintenance, etc .; measurement process It is not affected by environmental factors such as temperature, air pressure, sediment, dust, river pollutants, floating objects on the surface, and air.

1.2 Measuring principle

The RD-600s radar flowmeter uses planar microwave technology, uses the Doppler radar principle to measure the surface velocity of water flow, and uses the built-in microstrip radar technology to measure the water level. According to the velocity-area method, the water level is measured to convert the cross-sectional area, and then the average velocity is converted from the surface velocity combined with the cross-sectional parameters. The empirical formulas for the velocity distribution of the open channel cross section such as circular, rectangular and trapezoidal are established, and the hydraulic model algorithm is used to obtain Flow rate is a non-contact flow measuring instrument that accurately measures the flow rate without changing the boundary conditions of channels, rivers, pipes, etc.

1.2.1 Flow rate measurement principle

The radar velocity meter uses the principle of Doppler radar velocity measurement. When measuring the speed of the water surface, the radar velocity sensor emits microwaves to the water surface, and the microwaves will be absorbed and reflected after encountering the water surface. A part of the reflected

wave is received by the probe of the flow meter, and then converted into an electrical signal, which is processed by the measurement circuit and the Doppler frequency shift is measured, and then the flow rate of the water body can be calculated by the signal processing algorithm such as FFT according to the above principle.

1.2.2 Principle of water level measurement

The radar water level probe adopts pulse coherent radar (PCR) technology. The microstrip planar antenna emits very narrow microwave pulses. When it encounters the surface of the material to be measured, part of its energy is reflected back and received by the same antenna. The time interval between the transmitted pulse and the received pulse is proportional to the distance between the antenna and the surface of the measured medium. Due to the extremely high propagation speed of electromagnetic waves, the time interval between the transmitted pulse and the received pulse is very small. Compared with the traditional radar pulse water level gauge, the 60G radar water level gauge uses a special modulation and demodulation technology. Through the pulse coherence method, it can be accurate Identify the time interval and phase difference between the transmitted pulse and the received pulse, which greatly improves the measurement accuracy. At the same time, the own software's wave cancellation algorithm is used to ensure the measurement accuracy and also have good result stability.

1.2.3 Flow measurement principle

The average flow velocity can be obtained and converted through the radar flow rate probe, and the water depth can be obtained and converted through the radar water level probe. The cross-sectional flow is equal to the (average flow rate) × (water flow cross-sectional area) × (bank coefficient). In the open channel of the irrigation area, the common open channel cross-section types are rectangular, trapezoidal or U-shaped; the commonly used slopes are dry and branch canal longitudinal slopes; the two commonly used roughness rates are concrete canal walls and masonry canal walls. For these common open channels, the bottom slope and roughness are determined. In the flow velocity distribution of the cross section, the flow velocity has a strong symmetry, and the straight section of the irrigation section and the downstream are longer, and the cross section is symmetrical. The distribution is characterized by good symmetry. The velocity field distribution is modified according to the cross-sectional form, bottom (longitudinal) slope, and roughness; the turbulence mathematical model used is mainly the RNG

(renormalization group) κ-ε model, which has high calculation accuracy, good numerical stability, and calculated data volume Moderate.

1.3 Specifications

1.3.1 Features

1. Small size, high reliability, simple operation and convenient maintenance;

2. Not affected by environmental factors such as temperature, sediment, dust, river pollutants, floating objects on the water surface, and air pressure;

3. Used for non-contact flow measurement in open channels, rivers, irrigation canals, underground drainage pipe networks, flood control and other occasions;

4. Non-contact measurement method, convenient measurement, no pollution to the environment;

5. With rain mode to prevent interference caused by rain;

6. The waterproof grade is IP68, which can effectively prevent the internal components from getting damp;

7. Low power consumption, solar power can be used, easy installation and maintenance-free;

8. Ultra-low power consumption sleep mode, 12V power supply current is less than 30uA. (RD-600s-R).

1.3.2 Electrical characteristics

1. 3.5-4.35V power supply;

2. The working current and standby current are low, it can be powered by solar energy, which is convenient for installation and maintenance-free;

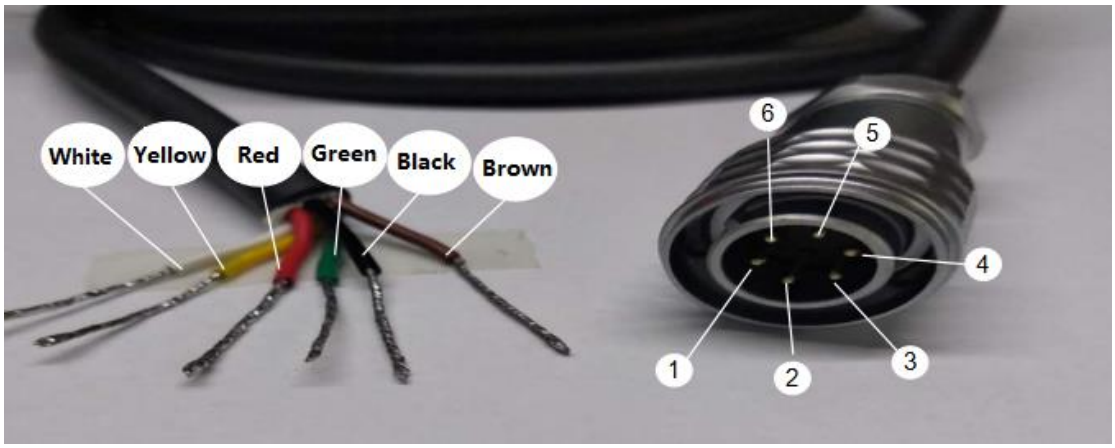
3. Lightning protection circuit, 6KV lightning protection. Thunderstorm days can effectively protect equipment against lightning strikes;

4. High test accuracy and stable data. Effectively guarantee the accuracy of the test;

5. Support RS485, RS232, 4-20MA and other wired communication methods;

6. Support 4G wireless communication.

1.3.3 Pin configuration

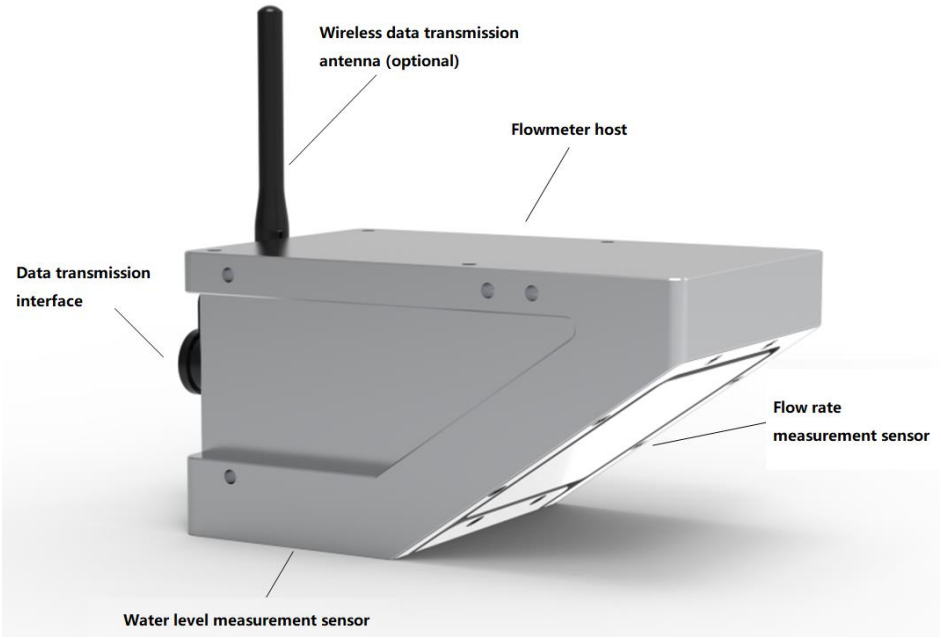


Pins	Colour	Instruction
1	Brown	7-32V / 5.5-32V (optional) DC power supply
2、6	Black ,White	GND
3	Green	TXD_A（232_TX/485_A+）
4	Red	RXD_B（232_RX/485_B-）
5	Yellow	IOUT（4-20mA positive electrode，Set aside）

2. INSTALLATION AND COMMISSIONING

2.1 Installation Notes

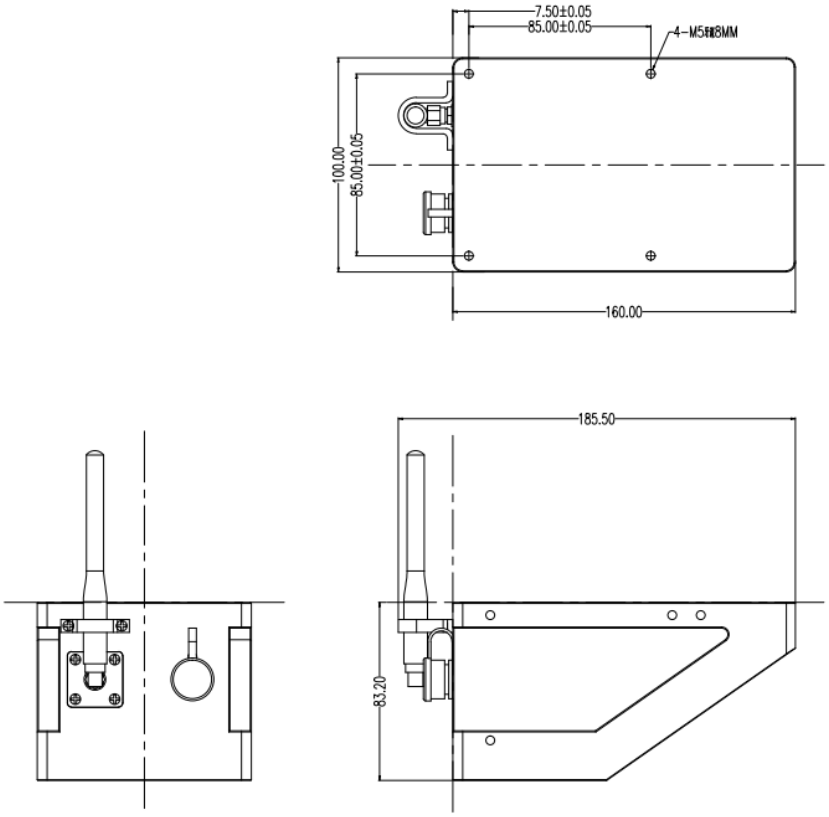
2.1.1 Instrument structure



As shown in the figure above, the flowmeter host consists of a flow velocity measurement sensor, a water level measurement sensor, a data transmission interface, and a wireless data transmission antenna (optional).

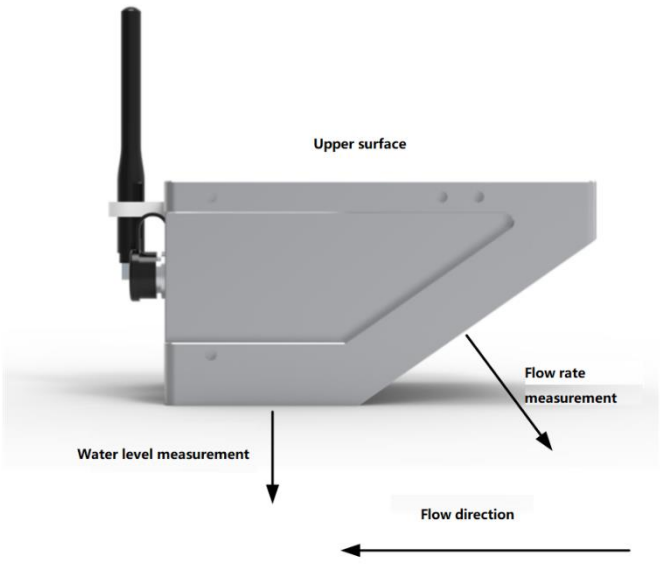
2.1.2 Appearance size

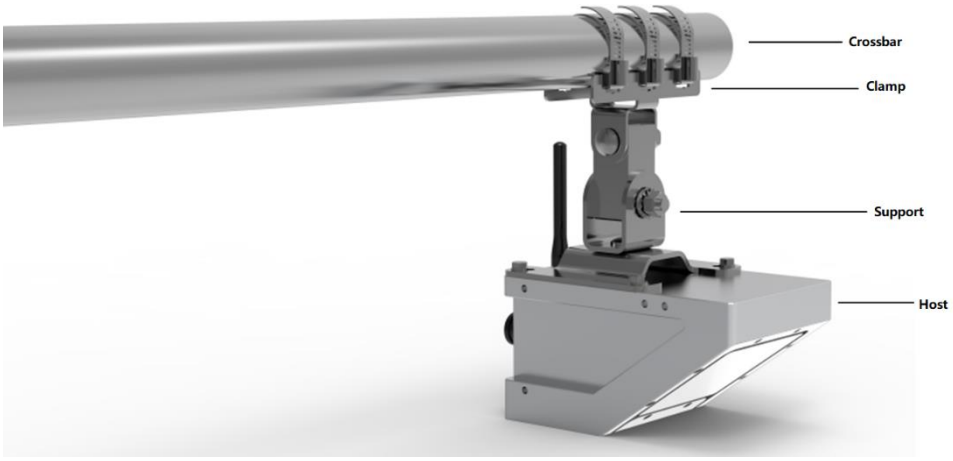
The appearance size without antenna is 160 × 100 × 83.2 (unit: mm)



2.1.3 On-site installation

2.1.3.1 Instrument installation method and direction

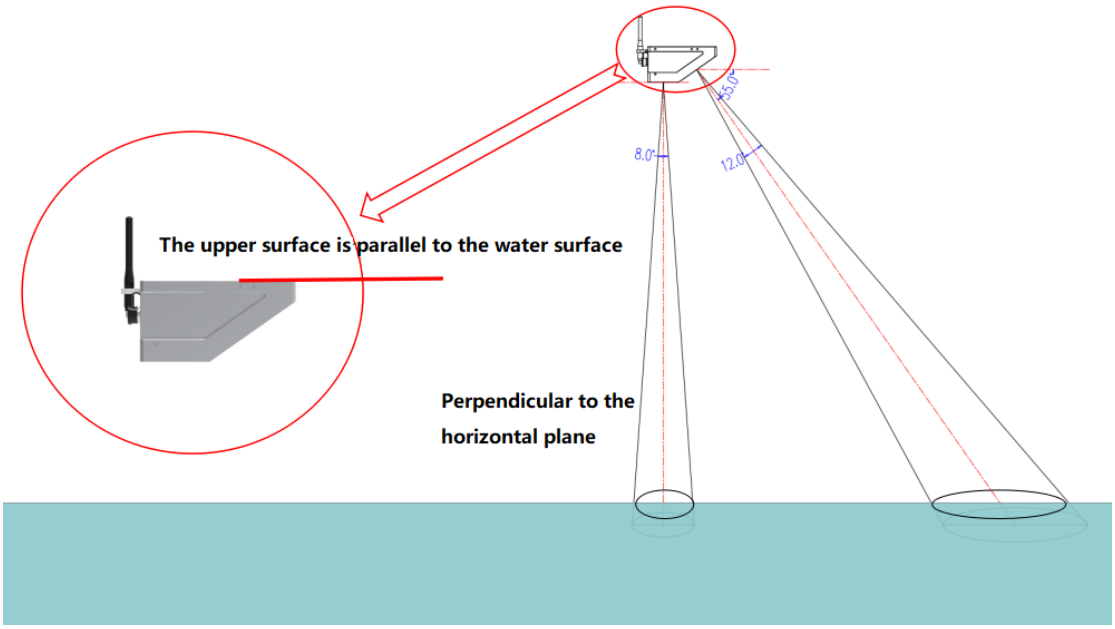




The installation direction is as shown in the figure above. The three clamps fix the bracket and the instrument on the crossbar (crossbar diameter range: 40mm-85mm). Keep the upper surface of the instrument and the river surface level during installation. The installation direction is recommended: the flow direction is facing the measurement direction of the flow rate.

2.1.3.2 Measuring point selection

When choosing the installation site, ensure that the radar wave covers the water surface to avoid the influence of floating objects, eddies and aquatic plants. It is also necessary to avoid the sedimentation of the river bed during the low water period and the swing of the main trough. The launch angle of the radar water level gauge is 8 °, and the coverage is approximately circular; the launch angle of the radar velocity meter is 12 °, and the coverage is approximately elliptical as shown in the figure below;



The relationship between the diameter and distance of the circle is shown in the following table:

Installation height (m)	Flowmeter covers diameter range (m)	Water level gauge covers diameter range (m)
0.2	0.073	0.028
0.5	0.168	0.07
1	0.325	0.14
2	0.64	0.28
3	0.955	0.42
5	1.585	0.7
7	2.215	0.98

2. The selection of channel measurement points should follow the following main principles:

1) The channel is straight, the channel base is fixed, and the section rule is stable, which is convenient for equipment installation;

2) The water flow is smooth and even, and is not affected by the vortex, gate opening and closing, and the water in the canal system;

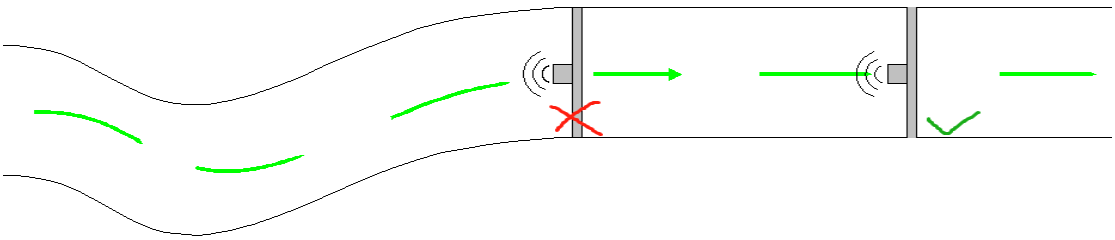
3) The measurement section is perpendicular to the direction of water flow;

4) There should be no buildings, trees or weeds affecting the water flow near the cross-section, and it will not be affected by the discharge when the building is downstream;

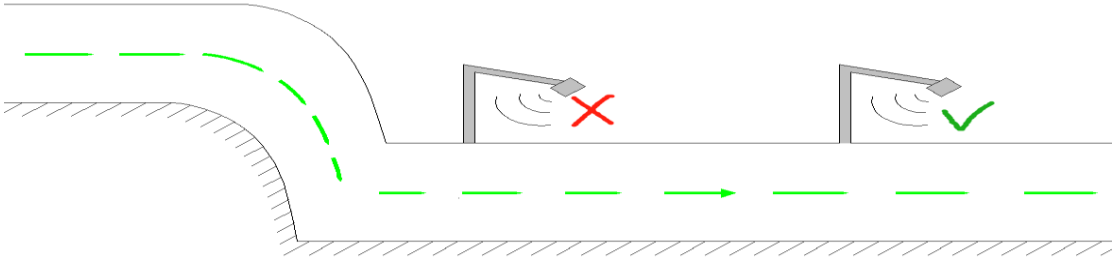
5) It should not be located in the place where the siltation is serious and there are many water plants or debris.

3. For non-contact measuring equipment such as radar flowmeters, the installation points should avoid the following positions

1) Avoid changing the direction of the river or channel flow, try to ensure that the flow direction is parallel to the installation direction of the radar flowmeter



2) Avoid the direction of the flow probe of the radar gauge directly facing the water flow with large drop



3) Avoid installing above the sluice gate and above the underflow reservoir. The typical feature of this scenario is the lower water level, but the undercurrent under the water surface cannot cause a stable flow rate on the surface, so it is not suitable for the installation point.

4) Avoid installation points located at culvert exits, mountain pass air ducts, etc. where wind easily rises. Wind has a certain influence on low flow rate measurement.

2.1.3.3 Installation Precautions

1. When the instrument is installed, keep the upper surface and the river surface level;

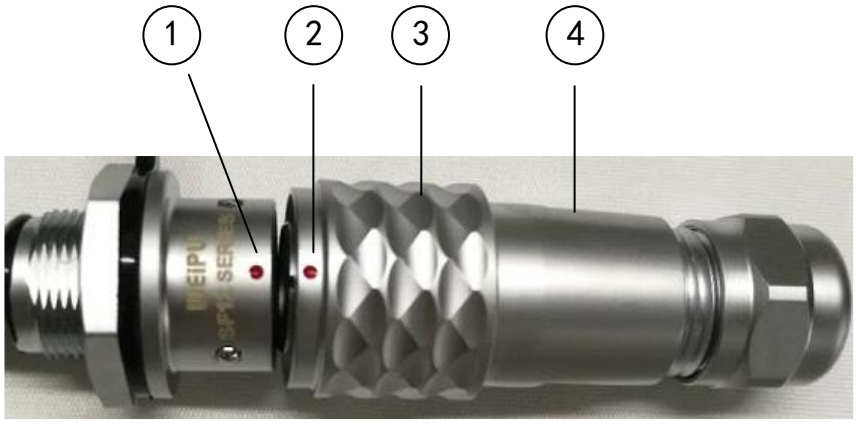
2. Do not install the instrument in the corner;

3. The instrument should not be installed at high or low drop;

4. Do not install the instrument on the vortexed water surface.

2.1.4 Interface installation

As shown in the figure below, when the cable is inserted into the instrument, hold the position of the cable ④, the red dot ② of the cable plug is aligned with the red dot ① of the instrument interface, and insert it when you hear a snap. When unplugging, you can pull it out by holding the position of ③ in the cable.



3 WORK MODE DESCRIPTION

For the wire type, RD-600s / RD-600s-R radar flowmeter is compatible with the standard MODBUS-RTU communication protocol, our company can also provide customized communication protocol for users).

For the wireless type, The RD-600s radar flow meter supports 4G wireless communication function. The data measured by the RD-600s radar flow meter can be reported to the central station server by setting the station address, communication port, and central station IP.

RD-600s / RD-600s-R radar flowmeter has two working modes: normal operation and timed sleep. When the sleep time register is set to 0, the device is in normal working mode, and when it is greater than 0, it enters the timer sleep mode. After the measurement is completed, the device sleeps according to the set sleep time (minutes), and the sleep time is up to continue measurement.

3.1 Normal work

The radar flowmeter is in continuous working state, continuous sampling measurement, relatively high power consumption, returning to the last measurement result, fast response and good real-time performance.

3.2 Sleep mode

After setting the sleep time of the device, the flowmeter will measure the latest flow rate, water level and other data before entering the sleep mode and save it. When the set sleep time is reached, it will exit the sleep mode and the flowmeter will be automatically awakened. The flowmeter after waking up will measure the most recent flow after waking up in the shortest time (note that the accumulated flow at this time is the most recent flow after waking up After the product of the measured flow rate and the sleep time, add the cumulative flow before sleep).

Because there may also be unpredictable flow changes during the dormant period, which will cause the flow rate of the water flow during the dormant period to be unstable, causing the accumulated flow counted during the dormant period to be different from the actual accumulated flow. In order to ensure the accuracy of the accumulated flow, it is recommended that the sleep time should not be set too long or it is better not to let the flowmeter enter the sleep or power-down mode. (Note: Sleep time can be set)

4. TECHNICAL PARAMETER

Item	Index
Flow measurement system	
Measuring principle	Planar microstrip array antenna CW + PCR
Operating mode	Manual, automatic, telemetry
Applicable environment	24 hours, rainy day
Operating temperature	-30~80℃
Operating Voltage	7-32V / 5.5-32V (optional) DC power supply
Working current	12VDC input, working mode: ≤28mA standby mode: <1mA
Protection level	IP68
Lightning protection level	6KV
Physical dimension	160*100*80（mm）
Weight	< 1KG
Radar speed sensor	
Radar power	100mW
Transmission power	< 10mW
Radar frequency	24GHz
Maximum range	40m
Speed range	0.03m/s~20m/s (related to water flow)
Speed measurement accuracy	±0.01m/s ;±1%FS
Radar current meter beam angle	12°
Measuring direction	Automatic recognition of water flow direction, built-in vertical angle correction vertical angle correction
Radar water level gauge	
Radar frequency	60GHz
Radar Ranging range	0.2~7.0m
Radar Ranging accuracy	±2mm
Antenna angle	8°
Data transmission system	
Data transmission type	RS485/ RS232,4~20Ma,4G RTU, LORA/LORAWAN

5. APPLICATION SCENARIOS AND SOLUTIONS

Water treatment plant (sewage treatment plant, pumping station) sewage treatment non-full pipe monitoring system:

1. Sewage treatment system

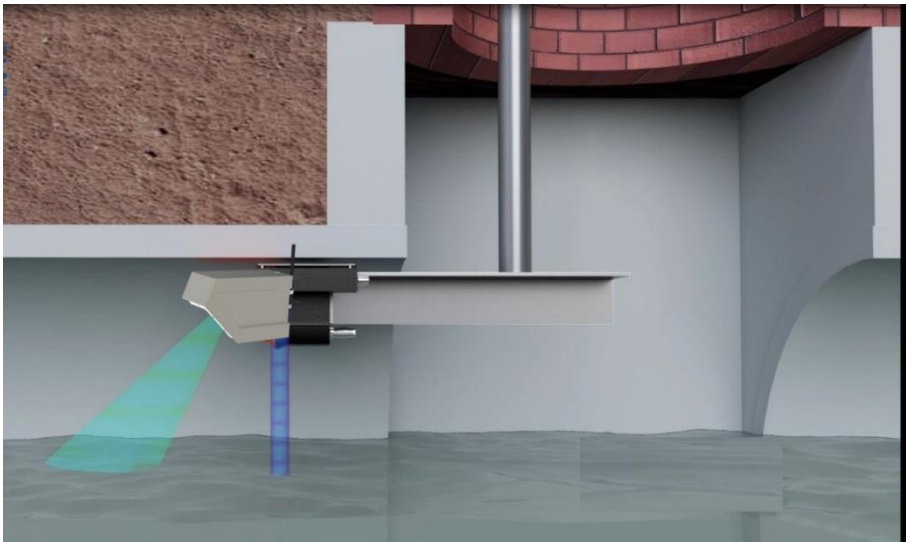
The sewage treatment system is an indispensable part of the urban development process. In order to meet the requirements of real-time monitoring, a comprehensive scientific and intelligent comprehensive sewage treatment management system is essential. A new generation of 24QP radar flow monitoring system, the device uses non-contact measurement, is not subject to sewage corrosion, greatly reducing maintenance costs. The water level, flow rate and flow are measured in real time and transmitted to the monitoring center through the RTU, which is convenient for real-time understanding of the operation status of the underground pipe network.

2. Urban drainage network traffic monitoring Solution

Solution composition

The system consists of a radar flowmeter, a pressure water level gauge (mainly for monitoring the water level in the well during the full-tube state), RTU, wireless communication equipment, disposable lithium batteries, and mounting brackets. The radar flow monitoring station is mainly responsible for data acquisition and transmission.



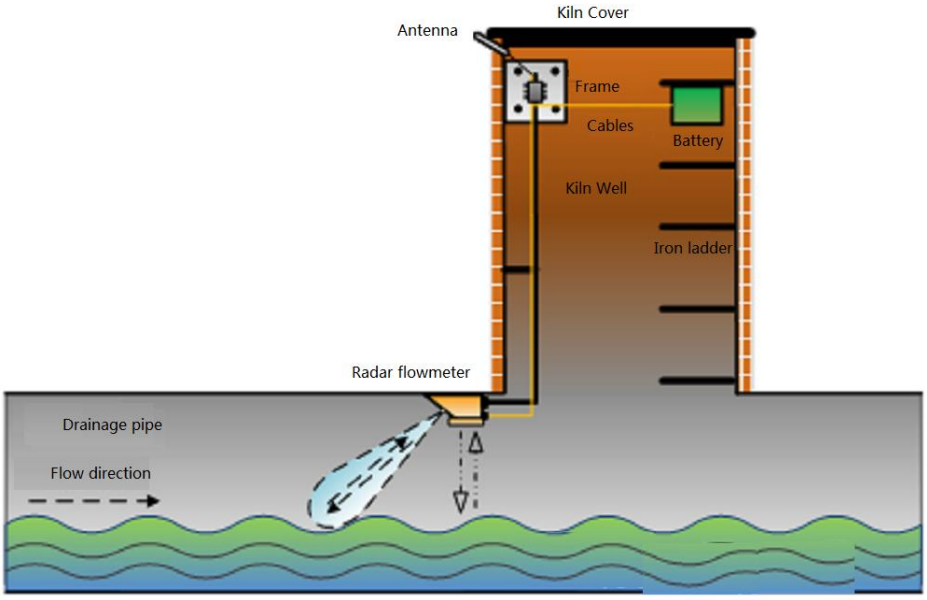


(1)System structure

The radar flow monitoring station mainly has two working conditions: full pipe and non-full pipe. The working modes under the two working conditions are as follows:

When the drainage pipe is in the non-full pipe state, the radar flowmeter works to monitor the flow velocity, flow direction, water level and flow data inside the sewage pipe in real time;

When the drainage pipe is in the full pipe state, the radar flowmeter is in a flooded state, stops working, the pressure water level gauge starts to work, and the water level data in the well is monitored and monitored in real time.



(2) Achieve function

Monitor water level, flow rate and flow information in urban drainage pipes

Realizing inward warning and forecast

Real-time control of the overall operation of the pipe network

Comprehensive data information, changing the management of rough judgments



6. MODBUS COMMUNICATIONS PROTOCOL

6.1 Modbus-RTU protocol

The communication method of Modbus protocol is single master station / multiple slave stations. Only the master station can issue inquiries (inquiries). The slave station performs the processing required by the query and replies to the response message.

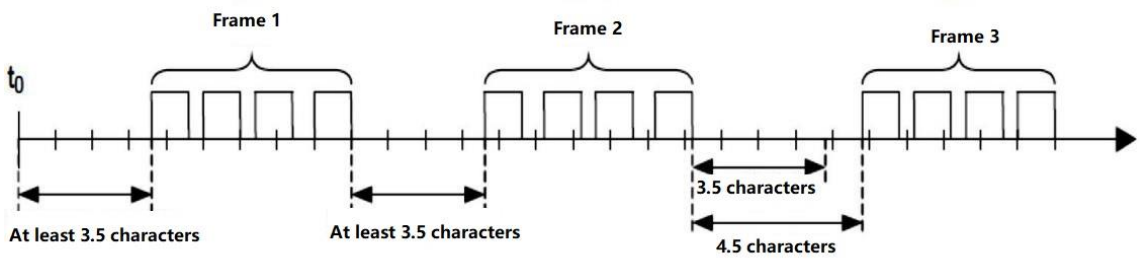
6.1.1 Modbus-RTU transmission mode

When the device uses RTU (Remote Terminal Unit) mode to communicate on the Modbus serial link, each 8-bit byte in the message contains two 4-digit hexadecimal characters. The main advantage of this mode is higher data density and higher throughput than ASCII mode at the same baud rate. Each message must be transmitted in a continuous stream of characters.

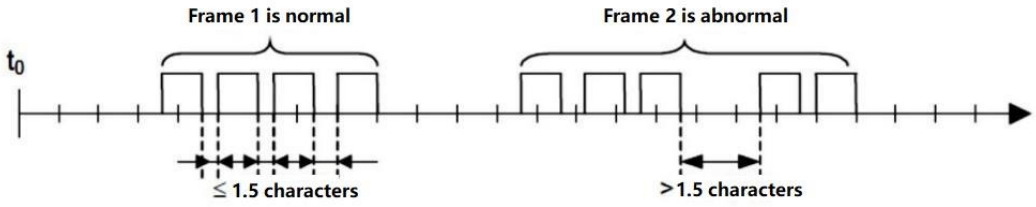
Frame description:

Device Address	Function code	Data	CRC
1 byte	1 byte	0 ~ 252 bytes	2bytes CRClow CRChigh

The message frame is distinguished by an idle interval of at least 3.5 character time, called t3.5. This module uses standard t3.5 as the idle interval. The schematic diagram of the RTU frame transmission idle interval is as follows



If the idle interval between two characters is greater than 1.5 character times, the message frame is considered incomplete and should be discarded by the receiving node. This idle time is called t1.5, and this module uses the standard t1.5 time. RTU frame transmission determines abnormal frame idle interval as follows.



6.1.2 Modbus-RTU data model

Modbus is based on a series of data models with different characteristics. The two basic models used by the device are as follows:

Register type	Object type	Access type	Content
Input register	16- Bit word	Only read	I/O system provides this type of data
Holding register	16- Bit word	Read&Write	Change this type of data through the application

6.1.3 Common Modbus-RTU function codes

Function code name	Function code
Read input register	**0x04**
Read holding register	**0x03**
Write a single holding register	**0x06**
Write multiple holding registers	**0x10**

6.1.3.1 Read holding register (0x03)

Read the current value of the holding register 0x001B baud rate.

Request message

Slave address	Function code	Register address	Number of registers	CRC check value
80	03	00 1B	00 01	EA 1C

Response message

Slave address	Function code	Bytes	Register value	CRC check value
80	03	02	00 01	45 9A

The current baud rate value is 1 (9600bps)

6.1.3.2 Read input register (0x04)

Read input register 0x000D value of input voltage

Request message

Slave address	Function code	Register address	Number of registers	CRC check value
80	04	00 0D	00 01	BE 18

Response message

Slave address	Function code	Bytes	Register value	CRC check value
80	04	02	00 78	85 0C

The current input voltage value is 0x0078 (0x0078 / 10 = 12V).

6.1.3.3 Write a single holding register (0x06)

Set the slave register 0x80 to keep register 0x001B and the baud rate is 0x01 (9600bps).

Request message

Slave address	Function code	Register address	Register value	CRC check value
80	06	00 1B	00 01	26 1C

Response message

Slave address	Function code	Register address	Register value	CRC check value
80	06	00 1B	00 01	26 1C

6.1.3.4 Write multiple holding registers (0x10)

Set the slave register address 0x80 to hold register 0x000F. The shape of the channel is 0x01 (circular), the distance from the holding register 0x0010 to the bottom of the channel is 0x64 (1.0m), and the radius of the holding register 0x0011 circular channel is 0x64 (1.0m).

Request message

Slave address	Function code	starting address	Number of registers	Bytes	Register value	CRC check value
80	10	00 0F	00 03	06	00 01 00 64 00 64	56 04

Response message

Slave address	Function code	starting address	Number of registers	CRC check value
80	10	00 0F	00 03	AE 1A

6.1.4 Cyclic Redundancy Check (CRC)

CRC is the most commonly used error check code in the field of data communication. Its feature is that the length of the information field and the check field can be arbitrarily selected (using the standard CRC-16 check code agreed by the standard modbus). Use of CRC-16 check code: According to the Modbus protocol, the information transmission form of conventional 485 communication is as follows:

Address	Function code	Data information	CRC check value
1byte	1byte	N byte	2byte

The CRC check is the check value of the data content of the previous paragraphs. It is a 16-bit data. When sending, the lower 8 bits are first and the upper 8 bits are last. The receiver uses the same calculation method to calculate the check code of the information field, and compares the actual check code received. If they are equal, the information is correct, and if they are not equal, the information is wrong.

CRC-16 check code calculation method:* puc Frame is the first address of the data to be checked, and us Len is the length of the data to be checked. The return value is the verification result. USHORT usMBCRC16 (UCHAR * puc Frame, USHORT usLen)

```
{
        UCHAR ucCRCHi = 0xFF;
        UCHAR ucCRCLo = 0xFF;
        int iIndex;
        while( usLen-- )
       {
            iIndex = ucCRCLo ^ *( pucFrame++ );
           ucCRCLo = ( UCHAR )( ucCRCHi ^ aucCRCHi[iIndex] );
           ucCRCHi = aucCRCLo[iIndex];
      }
        return ( USHORT )( ucCRCHi << 8 | ucCRCLo );
}
```

```
static const UCHAR aucCRCHi[] = {
    0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x01, 0xC0, 0x80, 0x41,
    0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x00, 0xC1, 0x81, 0x40,
    0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x01, 0xC0, 0x80, 0x41,
    0x00, 0xC1, 0x81, 0x40, 0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41,
    0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x01, 0xC0, 0x80, 0x41,
    0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x00, 0xC1, 0x81, 0x40,
    0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x00, 0xC1, 0x81, 0x40,
    0x01, 0xC0, 0x80, 0x41, 0x01, 0xC0, 0x80, 0x41, 0x00, 0xC1, 0x81, 0x40,
    0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x01, 0xC0, 0x80, 0x41,
    0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x00, 0xC1, 0x81, 0x40,
    0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x01, 0xC0, 0x80, 0x41,
    0x00, 0xC1, 0x81, 0x40, 0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41,
    0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x01, 0xC0, 0x80, 0x41,
    0x00, 0xC1, 0x81, 0x40, 0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41,
    0x01, 0xC0, 0x80, 0x41, 0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41,
    0x00, 0xC1, 0x81, 0x40, 0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41,
    0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x01, 0xC0, 0x80, 0x41,
    0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x00, 0xC1, 0x81, 0x40,
    0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x01, 0xC0, 0x80, 0x41,
    0x00, 0xC1, 0x81, 0x40, 0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41,
    0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x01, 0xC0, 0x80, 0x41,
    0x00, 0xC1, 0x81, 0x40
};
static const UCHAR aucCRCLo[] = {
    0x00, 0xC0, 0xC1, 0x01, 0xC3, 0x03, 0x02, 0xC2, 0xC6, 0x06, 0x07, 0xC7,
0x05, 0xC5, 0xC4, 0x04, 0xCC, 0x0C, 0x0D, 0xCD, 0x0F, 0xCF, 0xCE, 0x0E,
    0x0A, 0xCA, 0xCB, 0x0B, 0xC9, 0x09, 0x08, 0xC8, 0xD8, 0x18, 0x19, 0xD9,
    0x1B, 0xDB, 0xDA, 0x1A, 0x1E, 0xDE, 0xDF, 0x1F, 0xDD, 0x1D, 0x1C, 0xDC,
```

```
    0x14, 0xD4, 0xD5, 0x15, 0xD7, 0x17, 0x16, 0xD6, 0xD2, 0x12, 0x13, 0xD3,
    0x11, 0xD1, 0xD0, 0x10, 0xF0, 0x30, 0x31, 0xF1, 0x33, 0xF3, 0xF2, 0x32,
    0x36, 0xF6, 0xF7, 0x37, 0xF5, 0x35, 0x34, 0xF4, 0x3C, 0xFC, 0xFD, 0x3D,
    0xFF, 0x3F, 0x3E, 0xFE, 0xFA, 0x3A, 0x3B, 0xFB, 0x39, 0xF9, 0xF8, 0x38,
    0x28, 0xE8, 0xE9, 0x29, 0xEB, 0x2B, 0x2A, 0xEA, 0xEE, 0x2E, 0x2F, 0xEF,
    0x2D, 0xED, 0xEC, 0x2C, 0xE4, 0x24, 0x25, 0xE5, 0x27, 0xE7, 0xE6, 0x26,
    0x22, 0xE2, 0xE3, 0x23, 0xE1, 0x21, 0x20, 0xE0, 0xA0, 0x60, 0x61, 0xA1,
    0x63, 0xA3, 0xA2, 0x62, 0x66, 0xA6, 0xA7, 0x67, 0xA5, 0x65, 0x64, 0xA4,
    0x6C, 0xAC, 0xAD, 0x6D, 0xAF, 0x6F, 0x6E, 0xAE, 0xAA, 0x6A, 0x6B, 0xAB,
    0x69, 0xA9, 0xA8, 0x68, 0x78, 0xB8, 0xB9, 0x79, 0xBB, 0x7B, 0x7A, 0xBA,
    0xBE, 0x7E, 0x7F, 0xBF, 0x7D, 0xBD, 0xBC, 0x7C, 0xB4, 0x74, 0x75, 0xB5,
    0x77, 0xB7, 0xB6, 0x76, 0x72, 0xB2, 0xB3, 0x73, 0xB1, 0x71, 0x70, 0xB0,
    0x50, 0x90, 0x91, 0x51, 0x93, 0x53, 0x52, 0x92, 0x96, 0x56, 0x57, 0x97,
    0x55, 0x95, 0x94, 0x54, 0x9C, 0x5C, 0x5D, 0x9D, 0x5F, 0x9F, 0x9E, 0x5E,
    0x5A, 0x9A, 0x9B, 0x5B, 0x99, 0x59, 0x58, 0x98, 0x88, 0x48, 0x49, 0x89,
    0x4B, 0x8B, 0x8A, 0x4A, 0x4E, 0x8E, 0x8F, 0x4F, 0x8D, 0x4D, 0x4C, 0x8C,
    0x44, 0x84, 0x85, 0x45, 0x87, 0x47, 0x46, 0x86, 0x82, 0x42, 0x43, 0x83,
    0x41, 0x81, 0x80, 0x40
};
```

6.1.5 Communication abnormal response

When the master station device sends a request to the slave station device, the master station expects a normal response. The inquiry from the master station may cause one of the following four events:

---- If the slave device receives a request without communication error and can process the query normally, then the slave device will return a normal response.

---- If the slave station does not receive the request due to a communication error, it cannot return a response. The master program will be processed according to the timeout.

---- If the slave station receives the request, but detects a communication error (parity, CRC ...), then it cannot return a response. The master program will handle the timeout.

---- If the slave device receives a request without communication error, but cannot process the request (for example, if the request reads an input register that does not exist), then the slave will return an abnormal response to notify the client of the error the reason. The abnormal response message has two different fields from the normal response message:

Function code field: In the normal response, the slave station assigns the function code of the original request to the function code field of the response. All function codes MSB are 0 (their values are lower than 80 hexadecimal). In the abnormal response, the slave station sets the MSB of the function code to 1. This makes the function code value in the abnormal response higher than the function code value in the normal response by 80 hexadecimal.

By setting the function code MSB, the application of the master station can recognize the abnormal response, and can detect the data field of the abnormal code. Data field: In a normal response, the slave can return data or statistics (any information requested in the request) in the data field.

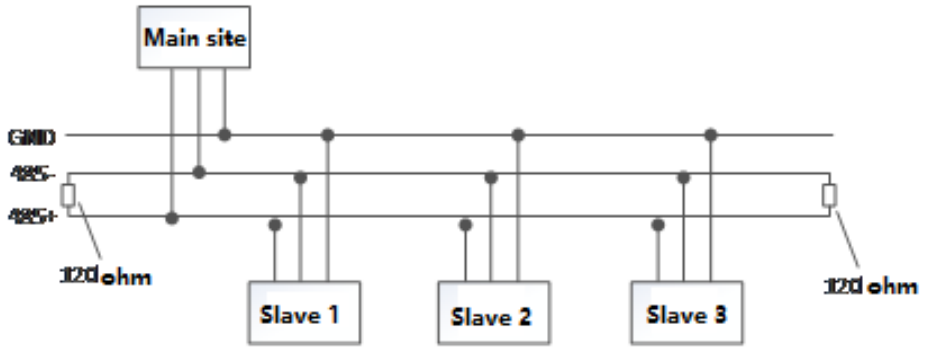
In the exception response, the slave returns the exception code in the data field. This explains the cause of the exception. The exception response message of all supported function codes is the function code plus 0x80.All abnormal function codes are 0x83, 0x84, 0x86, 0x88, 0x90, 0x97.The corresponding abnormal response message of function code 0x06 is as follows:

Slave address	Function code	Exception code	CRC check value
80	86	01	3D 88

Exception code	Exception name	Description
01	Illegal function code	The function code cannot be recognized and is not within 0x00 ~ 0x0F
02	Illegal data address	Data address exceeds definition
03	Illegal data value	Values other than register storage
04	Slave failure	Produces an unrecoverable error

6.1.6 Terminating resistor

In the process of network construction, if the network is terminated and connected to other Modbus devices, it is necessary to connect a 120 ohm terminal matching resistor at the end of the network (for RTUs that have integrated matching resistors, you can not connect them).



6.2 Equipment commissioning

6.2.1. Device address

The device address can be set by setting the value of the holding register address 0x001C, and the range can be set from 1 to 200. The factory default slave address is 0x80. After the slave address is set successfully, it will be saved automatically. (It can be set through our company's professional debugging software, please refer to Chapter 7 for details)

1. Example for setting the device address to 0x01

Request message sent

Slave address	Function code	Register address	Number of registe	CRC check
80	06	00 1C	00 01	97 DD

Response message

Slave address	Function code	Register address	Register value	CRC check
80	06	00 1C	00 01	97 DD

When you forget the device address, you can specify the device address as 0xFF, and query the register address 0x001C through the Modbus protocol 03 function code to obtain the real address of the device.

Note: When using this method to query the device address, only one device can be connected to the 485 bus.

2. Example of querying device address

Request message sent

Slave address	Function code	Register address	Number of register	CRC check
FF	03	00 1C	00 01	50 12

Response message

Slave address	Function code	Register address	Register value	CRC check
80	03	02	00 80	85 FA

Note: The CRC check value will change with the change of the register value in the response message The register value 0x0080 in the response message is the real device address of the device.

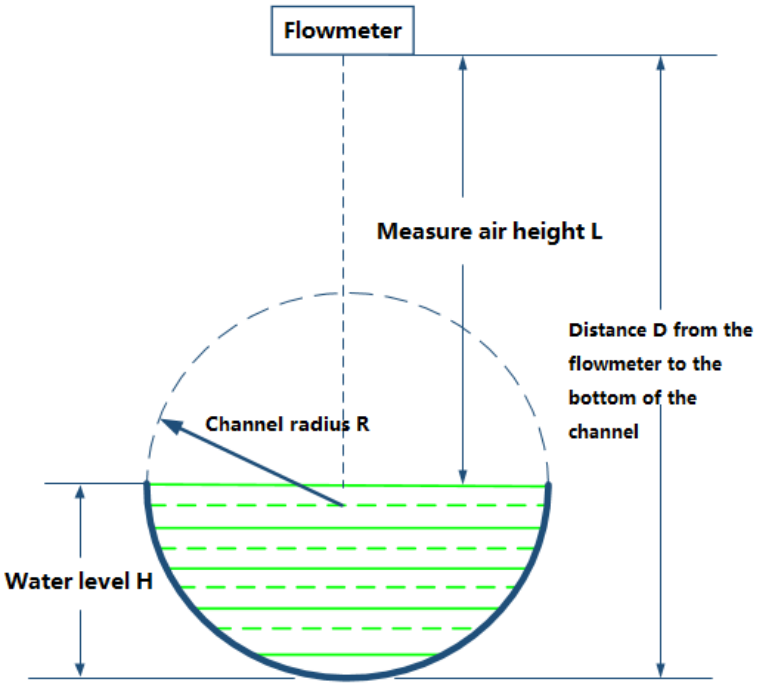
6.2.2 Channel shape

The device supports three basic types of water channel shapes, which are circular, trapezoidal and U-shaped. Rectangular and triangular water channels can be obtained by adjusting the length of the bottom side and the top side of the trapezoid. Drain parameters support Modbus protocol 0x06 and 0x10 function code setting, support 0x03 function code reading. Set the register of the channel shape to 0x000F, the value is as follows

Register value	Description
0x01	Round
0x02	Trapezoid
0x03	U type

6.2.2.1 Circular water channel

The parameters that need to be set for a circular channel are the channel shape, the distance from the flowmeter to the bottom of the channel, and the radius of the circular channel. The distance from the flowmeter to the bottom of the channel and the radius of the circular channel need to be written after magnifying the actual value by 100 times. For example, the actual value is 1.23 The value written in m is 123. Note that you need to convert the decimal value into hexadecimal and then enter it (123 corresponds to hexadecimal 7B).



The address of the holding register corresponding to the parameters of the circular channel

Description	Register address	Number of registers
Channel shape	0x000F	1
Distance from flowmeter to bottom of drain	0x0010	1
Radius of circular channel	0x0011	1

1. Examples of setting parameters for circular channels

Set the shape of the water channel to a circle, and send the request message (the response message is the same as the request message)

Slave address	Function code	Register address	Number of registers	CRC check
80	06	00 0F	00 01	66 18

Set the distance from the flowmeter to the bottom of the drain to 1.0m in decimal (100 times magnification is 100, which is equal to 0x64 in hexadecimal), and send the request message (the response message is the same as the request message)

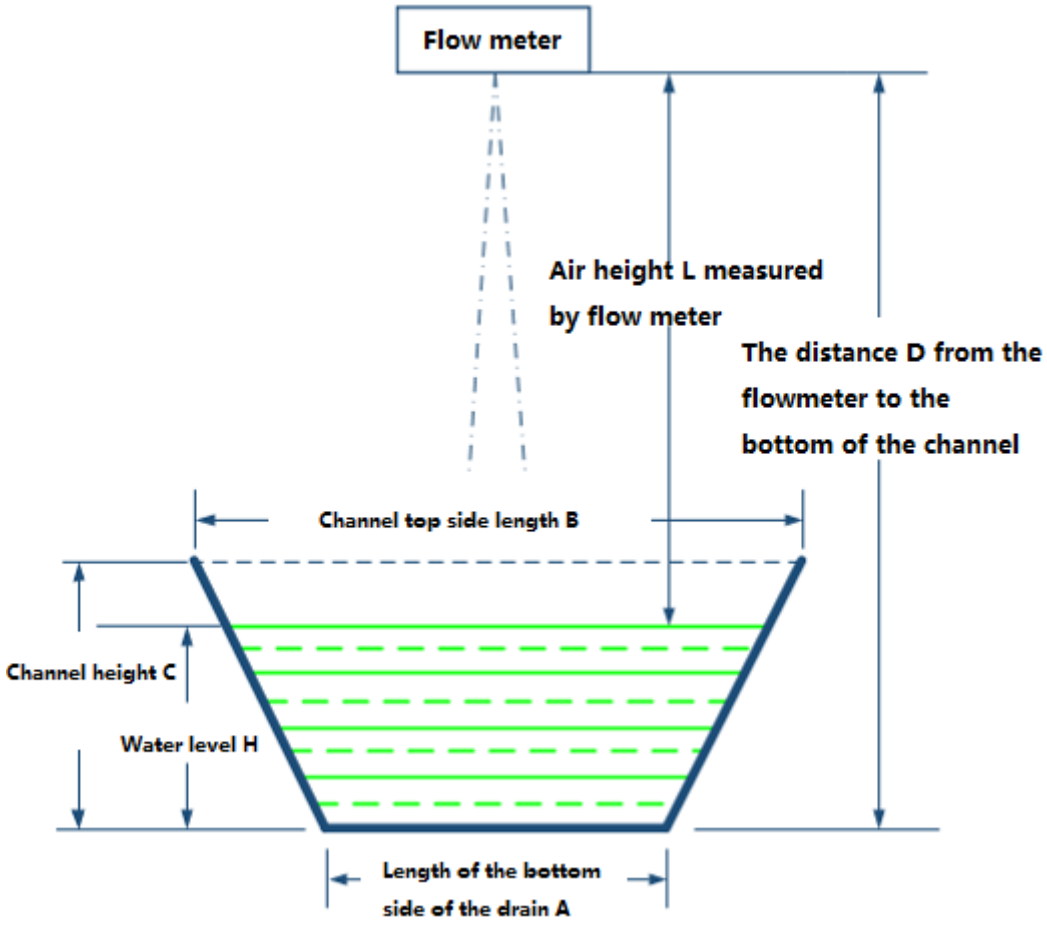
Slave address	Function code	Register address	Register value	CRC check
80	06	00 10	00 64	97 F5

Set the radius of the circular channel to 1.0m, and send the request message (the response message is the same as the request message)

Slave address	Function code	Register address	Register value	CRC check
80	06	00 11	00 64	C6 35

6.2.2.2 Trapezoidal Channel

The parameters that need to be set for a trapezoidal channel include the shape of the channel, the distance from the flow meter to the bottom of the channel, the length of the bottom side of the trapezoidal channel, the length of the top side of the trapezoidal channel, and the height of the trapezoidal channel. The distance from the flowmeter to the bottom of the channel, the length of the bottom side of the trapezoidal channel, the length of the top side of the trapezoidal channel, and the height of the trapezoidal channel need to be written in after magnifying the actual value by 100 times. If the actual value is 1.23m, the written value is 123. The decimal value is converted into hexadecimal and then imported (123 corresponds to hexadecimal 7B).



The address of the holding register corresponding to the trapezoidal channel parameter

Description	Register address	Number of registers
Channel shape	0x000F	1
Distance from flow meter to bottom of channel	0x0010	1
Bottom side length of trapezoidal channel	0x0012	1
Top side length of trapezoidal channel	0x0013	1
Trapezoidal channel height	0x0014	1

1. Examples for setting trapezoidal channel parameters

Set the shape of the water channel to trapezoid, and send the request message (the response message is the same as the request message)

Slave address	Function code	Register address	Register value	CRC check
80	06	00 0F	00 02	26 19

Set the distance from the flowmeter to the bottom of the drain to 1.0m in decimal (100 times magnification is 100, which is equal to 0x64 in hexadecimal), and send the request message (the response message is the same as the request message)

Slave address	Function code	Register address	Register value	CRC check
80	06	00 10	00 64	97 F5

Set the bottom side length of the trapezoidal channel to 1.0m, and send the request message (the response message is the same as the request message)

Slave address	Function code	Register address	Register value	CRC check
80	06	00 12	00 64	36 35

Set the top side length of the trapezoidal channel to 1.0m, and send the request message (the response message is the same as the request message)

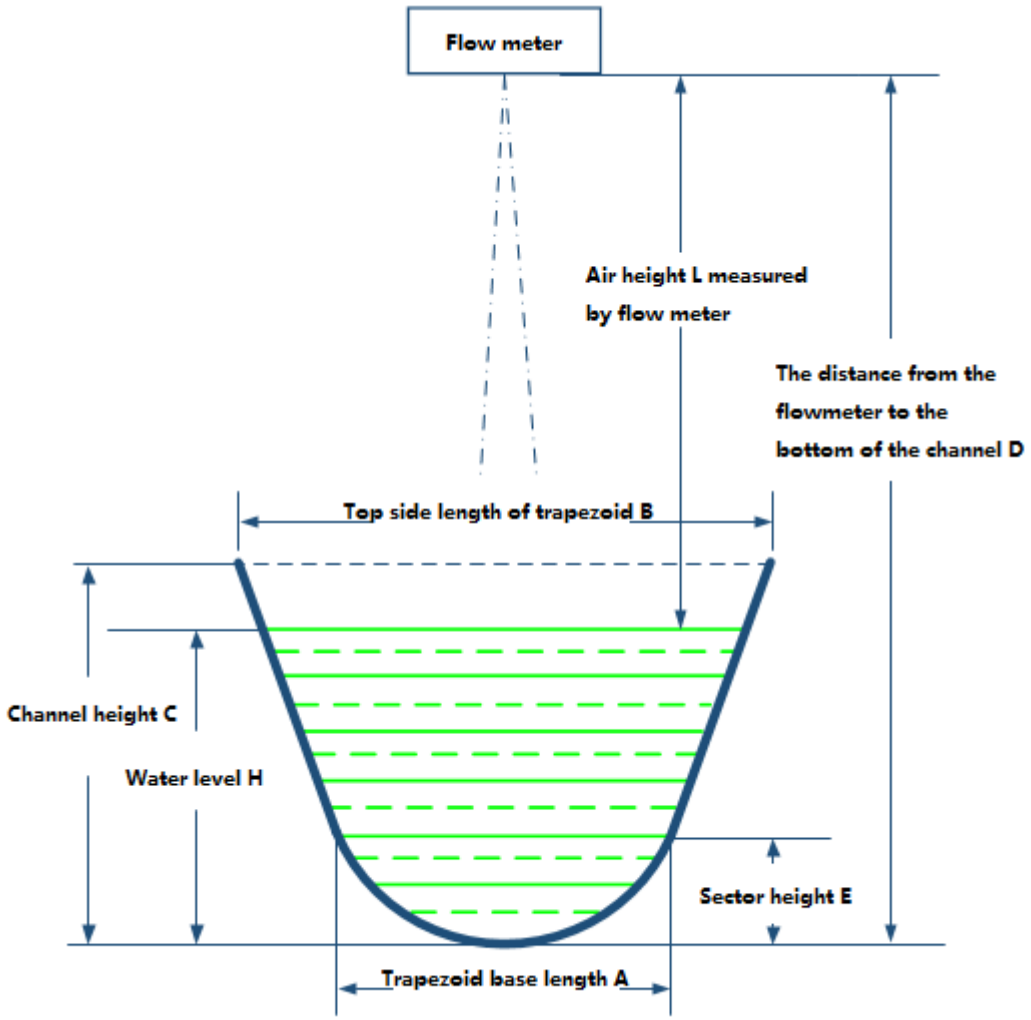
Slave address	Function code	Register address	Register value	CRC check
80	06	00 13	00 64	67 F5

Set the height of the trapezoidal channel to 1.0m, and send the request message (the response message is the same as the request message)

Slave address	Function code	Register address	Register value	CRC check
80	06	00 14	00 64	D6 34

6.2.2.3 U-shaped channel

The parameters that need to be set for the U-shaped channel are the channel shape, the distance from the flowmeter to the bottom of the channel, the height of the fan, the length of the bottom side of the trapezoid, the length of the top side of the trapezoid, and the height of the channel. The distance from the flowmeter to the bottom of the channel, the height of the sector, the length of the bottom side of the trapezoid part, the length of the top side of the trapezoid part and the height of the channel need to be written after magnifying the actual value by 100 times. If the actual value is 1.23m, the written value is 123. Note that you need to convert the decimal value into hexadecimal and then enter it (123 corresponds to hexadecimal 7B).



The address of the holding register corresponding to the U-shaped channel parameter

Description	Register address	Number of registers
Channel shape	0x000F	1
Distance from flow meter to bottom of drain	0x0010	1
Sector height	0x0011	1
Bottom side length of trapezoid	0x0012	1
Top side length of trapezoid part	0x0013	1
Channel height	0x0014	1

Example of setting U-shaped channel parameters

Set the shape of the water channel to U-shape, and send the request message (the response message is the same as the request message)

Slave address	Function code	Register address	Register value	CRC check
80	06	00 0F	00 03	E7 D9

Set the distance from the flowmeter to the bottom of the drain to 1.0m in decimal (100 times magnification is 100, which is equal to 0x64 in hexadecimal), and send the request message (the response message is the same as the request message)

Slave address	Function code	Register address	Register value	CRC check
80	06	00 10	00 64	97 F5

Set the height of the sector to 1.0m, and send the request message (the response message is the same as the request message)

Slave address	Function code	Register address	Register value	CRC check
80	06	00 11	00 64	C6 35

Set the bottom side length of the trapezoid to 1.0m, and send the request message (the response message is the same as the request message)

Slave address	Function code	Register address	Register value	CRC check
80	06	00 12	00 64	36 35

Set the top side length of the trapezoid part to 1.0m, and send the request message (the response message is the same as the request message)

Slave address	Function code	Register address	Register value	CRC check
80	06	00 13	00 64	67 F5

Set the height of the trapezoid part to 1.0m, and send the request message (the response message is the same as the request message)

Slave address	Function code	Register address	Register value	CRC check
80	06	00 14	00 64	D6 34

6.2.3 River type

Different river types correspond to different built-in filtering schemes. If you are uncertain, use the default setting for this setting. Set the river type register to 0x0016, and the values are as follows

Register value	Description
0x01	Straight type
0x02	Normal type
0x03	Turbulence type
0x04	Tilt type
0x05	Splash type

Example of setting river type

Request message sent (the response message is the same as the request message)

Slave address	Function code	Register address	Register value	CRC check
80	06	00 16	00 01	B7 DF

6.2.4 Noise threshold

The noise threshold is used to set the signal extraction threshold. If the signal strength of the device (obtained through the input register) is lower than the set value, it is considered that noise is not picked up. This item usually does not need to be adjusted, just follow the factory default. When the installation distance is long and the flow rate is low, the signal is weak and needs to be adjusted according to the field signal strength. The flow rate radar sensor threshold is generally not less than 400. The register for setting the noise threshold of the flow velocity radar sensor is 0x000B.

Take the example of setting the noise threshold of the velocity radar sensor to 1000

Request message sent (the response message is the same as the request message)

Slave address	Function code	Register address	Register value	CRC check
80	06	00 0B	03 E8	E6 A7

6.2.5 Radar wave direction of velocity radar sensor

The radar wave direction of the velocity radar sensor in the radar flowmeter has downstream, reverse and bidirectional (automatic). The radar wave of the velocity radar sensor is consistent with the flow direction of the river as downstream (the relative velocity measurement direction is the water flow away), and the downstream velocity radar sensor is set to collect only downstream velocity. The direction of the radar wave and the river is reverse flow (the relative flow velocity measurement direction is the oncoming water flow). When set to reverse flow, the velocity radar sensor only collects the reverse flow velocity. When set to bidirectional, the flow velocity radar sensor automatically recognizes the direction of the flow velocity and collects the flow velocity of the upstream and backward flow. It is recommended to install in countercurrent (factory default), and the countercurrent has anti-rain function. The register for setting the radar wave direction of the velocity radar sensor is 0x0018, and the value is as follows:

Register value	Description
0x01	Downstream
0x02	Countercurrent
0x03	Two-way (automatic)

Example of setting the radar wave direction of a velocity radar sensor

Request message sent (the response message is the same as the request message)

Slave address	Function code	Register address	Register value	CRC check
80	06	00 18	00 02	96 1D

6.2.6 Filtering times

The larger the number of filtering, the smaller the numerical fluctuation, and the more stable the measurement result, but the real-time performance is weakened. The normal default is fine. The register for setting the filter times of the flow meter is 0x000D, and the register for setting the filter times of the water level radar sensor is 0x000E.

Set the filter times of the flow velocity radar sensor to 20

Request message sent (the response message is the same as the request message)

Slave address	Function code	Register address	Register value	CRC check
80	06	00 0D	00 14	06 17

Example of setting the filter times of the water level radar sensor to 5

Request message sent (the response message is the same as the request message)

Slave address	Function code	Register address	Register value	CRC check
80	06	00 0E	00 05	36 1B

6.2.7 Measuring time

1. High signal strength: a stable value will be measured in about 30s.

2. The signal strength is relatively weak: Although the measurement result takes a long time (2min) at this time, the measurement performance of the low flow rate is high at this time, and the obtained result is also stable.

6.2.8 Measurement results

The measurement result is saved in the holding register and the input register, and can be read through Modbus protocol 0x03 or 0x04 function code (it is recommended to use 0x04 function code to read the input register). Read the relevant registers through the debugging assistant (such as MODBUS debugging assistant). Please note that the value read out is hexadecimal, so in order to facilitate the calculation, it needs to be converted to decimal. For example: the flow rate to be queried now is 0x7B, the value read from the 0x0001 register is 0x7B, and 0x7B is converted to decimal, which is 123. At this time, the actual flow rate needs to be reduced by 1000 times (0.123m/s). It should be noted here that the values stored in the registers are all amplified values (the "Description" column in the table below means that the values stored in the registers are amplified), so the extracted values To reduce the corresponding multiple. (Note: The waiting time for each query command is 100ms)

Read through the 0x03 function code, the holding register address is as follows (hexadecimal)

Description	Register address	Unit	Description
Velocity of flow	0x0001	m/s	1000 times magnified
Water level	0x0002	m	1000 times magnified
Air height	0x0003	m	1000 times magnified
Instantaneous flow	0x0004	m^3/s	1000 times magnified
Cumulative flow (high 16 bits)	0x0005	m^3	1000 times enlarged after merged
Cumulative flow (middle 16 digits)	0x0006		
Cumulative flow (lower 16 bits)	0x0007		
Flow rate signal strength	0x0008	/	/
Water level signal strength	0x0009	/	/
Flow direction	0x000A	/	Reverse is 0 Forward is 1
Accident details	0x0021	/	
Vertical angle	0x0022	°	100 times enlarged
Input voltage	0x0023	V	Magnified 10 times

Read through function code 0x04, input register address as shown in the table below

Description	Register address	Unit	Description
Velocity of flow	0x0001	m/s	1000 times magnified
Water level	0x0002	m	1000 times magnified
Air height	0x0003	m	1000 times magnified
Instantaneous flow	0x0004	m^3/s	1000 times magnified
Cumulative flow (high 16 bits)	0x0005	m^3	1000 times enlarged after merged
Cumulative flow (middle 16 digits)	0x0006		
Cumulative flow (lower 16 bits)	0x0007		
Flow rate signal strength	0x0008	/	/
Water level signal strength	0x0009	/	/
Flow direction	0x000A	/	Reverse is 0 Forward is 1

Accident details	0x0021	/	
Vertical angle	0x0022	°	100 times enlarged
Input voltage	0x0023	V	Magnified 10 times
Software version number	0x000E		Combination of high 8 bits plus low 8 bits
Large instantaneous flow (high 16 bits)	0x000F	m^3/s	1000 times magnified
Large instantaneous flow (lower 16 bits)	0x0010	m^3/s	1000 times magnified

Note: In order to process the decimal part, the flow rate, water level, air height, etc. are all enlarged. After reading the value, it needs to be reduced. For example, if the read flow rate is 1000, the real flow rate is 1m/s.

The instantaneous flow of input register address 0x04 only supports the storage of small flow, the range is 0-65.535 m^3/s, if the instantaneous flow value is large, you can read registers 0x0F and 0x10, and the storage range is 0- 4294967.296 m^3/s. When the instantaneous flow value is less than 65.535 m^3/s, the value of 0x04 and 0x10 registers are equal.

Example of reading a single input register through 0x04 function code (read flow rate)

Request message sent

Slave address	Function code	Register address	Number of registers	CRC check
80	04	00 01	00 01	7E 1B

Response message

Slave address	Function code	Data bytes	Register value	CRC check
80	04	02	00 7B	C5 0D

Note: The CRC check value will change with the change of the register value in the response message

0x04 function code can read multiple consecutive registers, through 0x04 function code to read all the measurement results example

Request message sent

Slave address	Function code	Register address	Number of registers	CRC check
80	04	00 01	00 10	BE 17

Response message

Slave address	80
Function code	04
Data bytes	20
Velocity of flow	01 CD
Water level	04 01
Air height	08 75
Small instantaneous flow	8F 34
Cumulative flow (high 16 bits)	00 08
Cumulative flow (middle 16 digits)	94 4B
Cumulative flow (lower 16 bits)	EB 6A
Flow rate signal strength	02 F7
Water level signal strength (reserved)	00 00
Flow direction	00 01
Accident details	02 97
Vertical angle	14 96
Input voltage	00 76
Software version number	02 04
Large instantaneous flow (high 16 bits)	00 00
Large instantaneous flow (lower 16 bits)	8F 34
CRC check value	12 34

Note: The CRC check value in the response message will change due to the change of the actual measured value.

7. REGISTER LIST

7.1 Keep register list

Address Hex	Name	Description	Data range	Defaults	Read and write status
1	Velocity of flow	Unit: m/s Flow rate value magnified 1000 times	0~65535	0	Read only
2	Water level	Unit: m Water level value magnified 1000 times	0~65535	0	Read only
3	Air height	Unit: m Altitude value magnified 1000 times	0~65535	0	Read only
4	Small instantaneous flow	Unit: m^3/s Instantaneous flow rate magnified 1000 times	0~65535	0	Read only
5	Cumulative flow (high 16 bits)	Unit: m^3 Accumulated flow magnified 1000 times	0~65535	0	Read only
6	Cumulative flow (middle 16 digits)		0~65535	0	Read only
7	Cumulative flow (lower 16 bits)		0~65535	0	Read only
8	Signal strength of velocity radar sensor	Current signal strength of the velocity radar sensor	0~65535	0	Read only
9	Water level radar sensor signal strength	Current signal strength of water level radar sensor	0~65535	0	Read only
A	Flow direction	0x00: Reverse 0x01: Forward	0~1	0	Read only
B	Velocity radar sensor noise threshold	Set/query the noise threshold of the velocity radar sensor	0~65535	800	Read and write
C	Water level radar sensor noise threshold	Set/query noise threshold of water level radar sensor	0~65535	500	Read and write
D	Flow rate filter times	Set/query flow rate filtering times	1~30	20	Read and

					write
Address Hex	Name	Description	Data range	Defaults	Read and write status
E	Filter times of water level	Set/query water level filtering times	1~30	5	Read and write
F	Channel shape	0x01: round 0x02: trapezoid 0x03: U type	1~3	0	Read and write
10	Distance from flow meter to bottom of drain	Unit: m Support decimal, write after magnification 100 times	0~65535	0	Read and write
11	Radius of circular channel/ U-shaped channel fan height	Unit: m Support decimal, write after magnification 100 times	0~65535	0	Read and write
12	Length of bottom side of trapezoidal channel/ The bottom side of the trapezoidal part of U-shaped channel	Unit: m Support decimal, write after magnification 100 times	0~65535	0	Read and write
13	Length of top side of trapezoidal channel/ Top side length of trapezoidal part of U-shaped channel	Unit: m Support decimal, write after magnification 100 times	0~65535	0	Read and write
14	Trapezoidal channel height/ U-shaped channel total height	Unit: m Support decimal, write after magnification 100 times	0~65535	0	Read and write
15	Shore factor	Instantaneous flow rate coefficient, default 1.0 Support decimal, write after magnification 100 times	0~65535	100	Read and write

16	River type	0x01: straight type 0x02: normal type 0x03: Turbulence 0x04: Tilt type 0x05: splash type	1~5	2	Read and write
17	Speed radar sensor gear	0x01: 1st gear 0x02: 2nd gear 0x03: 3rd gear	1~3	2	Read and write
18	Velocity radar sensor radar wave direction	0x01: forward 0x02: reverse 0x03: Two-way (automatic)	1~3	2	Read and write
19	Maximum flow rate	0x00: no limit Support decimal, write after magnification 100 times	0~65535	0	Read and write
1A	Clear accumulated flow	0x01: clear	0~1	0	Read and write
1B	Serial port baud rate	0x01: 9600 0x02: 19200 0x03: 56000 0x04: 115200	1~4	1	Read and write
1C	Device address	Set/read device address	1~200	0x80	Read and write
1D	Manual acquisition of vertical angle	The device automatically obtains the angle every 20s 0x01: Get it manually once	0~1	0	Read and write
1E	Horizontal angle	Unit: ° Manually enter the horizontal angle, decimals are not supported	0~60	0	Read and write

1F	Rainy day mode	0x01: open 0x02: Close	1~2	1	Read and write
Address Hex	Name	Description	Data range	Defaults	Read and write status
20	Sleep time	Unit: minutes Sleep time after a single measurement period is measured	0~65535	0	Read and write
21	Accident details	Fault information statistics	-	-	-
22	Vertical angle	Unit: ° Vertical angle value after magnification 100 times	0~65535	0	Read only
23	Input voltage	Unit: V Input voltage value after magnification 10 times	0~65535	0	Read only
24	Software version number	Software version number Combination of high 8 bits plus low 8 bits For example, the version number corresponding to 0x0102 is V1.2	0~65535	0	Read only
25	Reset	0x01: Restore factory default settings	0~1	0	Read and write
2C	Still water height setting	The water level is less than this value, the flow output is 0 Support decimal, write after magnification 100 times	0~65535	0	Read and write
2D	Maximum fluctuation limit	Reserved			
2E	4-20mA output selection	0x01: empty height 0x02: water level	1~2	1	Read and write

Note: The register address 0x2C can set the static water height. When the static water height is set, when the measured water level is less than the static water height, the flow output is zero, which can avoid the dead water in the channel due to the influence of wind, resulting in flow output and error This type of situation occurs when it becomes larger (do not confuse the still water height with the installation height).

Input register list

7.2 Input register list

Address Hex	Name	Description	Data range	Defaults
1	Velocity of flow	Unit: m/s Flow rate value magnified 1000 times	0~65535	0
2	Water level	Unit: m Water level value magnified 1000 times	0~65535	0
3	Air height	Unit: m Altitude value magnified 1000 times	0~65535	0
4	Small instantaneous flow	Unit: m^3/s Instantaneous flow rate magnified 1000 times	0~65535	0
5	Cumulative flow (high 16 bits)	Unit: m^3 Accumulated flow magnified 1000 times	0~65535	0
6	Cumulative flow (middle 16 digits)		0~65535	0
7	Cumulative flow (lower 16 bits)		0~65535	0
8	Signal strength of velocity radar sensor	Current signal strength of the velocity radar sensor	0~65535	0
9	Water level radar sensor signal strength	Current signal strength of water level radar sensor	0~65535	0
A	Flow direction	0x00: reverse 0x01: forward	0~1	0

B	Accident details	Statistics failure information	-	-
C	Vertical angle	Unit: ° Vertical angle value after magnification 100 times	0~65535	0
D	Input voltage	Unit: V Input voltage value after magnification 10 times	0~65535	0
E	Software version number	Software version number Combination of high 8 bits plus low 8 bits For example, the version number corresponding to 0x0102 is V1.2	0~65535	0
F	Large instantaneous flow (high 16 bits)	Unit: m³/s Instantaneous flow rate magnified 1000 times	0~65535	0
10	Large instantaneous flow (lower 16 bits)		0~65535	0
11	Reserved	Reserved	-	-
12	Reserved	Reserved	-	-
13	Accumulated overflow times	Used to count cumulative traffic overflow times	0~65535	1
14	Temperature	Unit: °C Temperature value after magnification 100 times	0~65535	0

Note: The instantaneous flow of register address 0x04 only supports the storage of small flow, the range is 0-65.535 m³/s, if the instantaneous flow value is large, you can read registers 0x0F and 0x10, and the storage range is 0- 4294967.296 m³/s. When the instantaneous flow value is less than 65.535 m³/s, the value of 0x04 and 0x10 registers are equal.

The register address 0x13 is used to store the cumulative flow overflow times, that is, when the value in the cumulative flow register reaches a certain fixed value (such as 20000000000), the value in the register address 0x13 will increase by one. Here we must remember Live, when calculating the cumulative flow, don't forget to read the register address 0x13 (the default value is 1). If the value in this

register is greater than 1, we remember to add (N – 1) 20000000000, where N It is the value stored in the register address 0x13.

8. SYSTEM CONFIGURATION SOFTWARE (ONLY FOR RD600S)

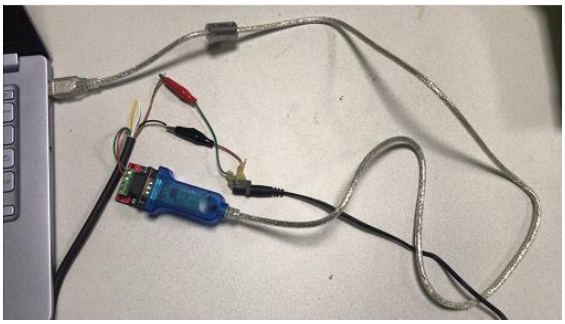
In addition to the data acquisition and transmission through the data acquisition terminal or the serial port assistant, the radar flowmeter can also be used for communication debugging through the PC debugging software equipped by the company. The visualization software can facilitate the user to quickly set the parameters of the flowmeter and read the data, assist the customer to quickly understand the function and performance of the product, and provide a simple and fast intuitive means for system joint adjustment and on-site debugging. The following describes how to use the software.

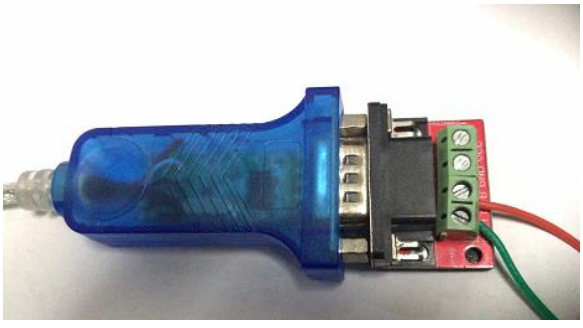
8.1 Installation preparation

1. Prepare a computer with Windows 7 and above operating system;

2. The RS485 communication interface of the radar flowmeter needs to communicate with the PC, and a set of RS485 to USB converter is required (if RS232 interface is required, a corresponding converter is required), and the RS485 interface is connected, as shown in the following figure:





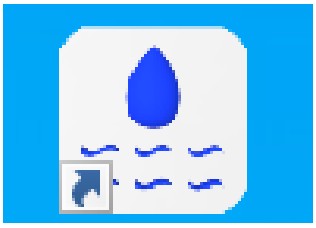


For specific connection methods, please refer to 1.3.3 Pin configuration above.

①Install the driver of RS485 to USB converter;

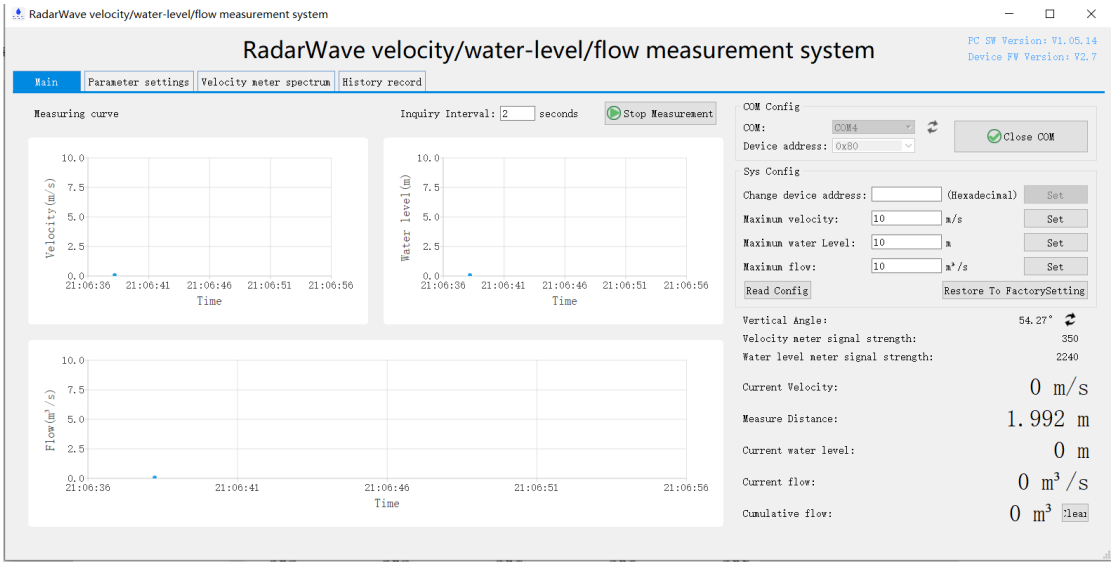
② Install the application software RD-Lite600S-Vx.x.x-Setup.exe on the client PC;

③After the installation is successful, double-click the application icon on the desktop (as shown in the figure below) to run and enter the main interface.



(Note: we will send the free RS485 to USB convertor and the matched driver and the system configuration software)

8.2 Software main interface



The main interface of the software can display the current water level value, flow velocity value, instantaneous flow, accumulated flow and other information, and display it in a curve.

① Click behind the serial port  to refresh the serial port list and find the serial port corresponding to the radar flowmeter;

② The device address refers to the address selection on the label of the radar flowmeter (default 0x80H, hexadecimal), click "open serial port" to realize the connection between the device and the PC, and the device software version information will be read at the same time and displayed on the upper right angle;

③ The query interval can set the frequency of data refresh, the unit is second, if it is set to 2, it means that the measurement result is refreshed every 2 seconds, click start measurement to start the flowmeter and enter the working state;

④ If you need to modify the address, you can write and modify it in the modify address column (range 1~C8H, corresponding to decimal 1~200);

⑤ The maximum flow rate, maximum water level, and maximum flow are used to set the ordinate amplitude of the coordinate view, which is convenient for viewing the curve;

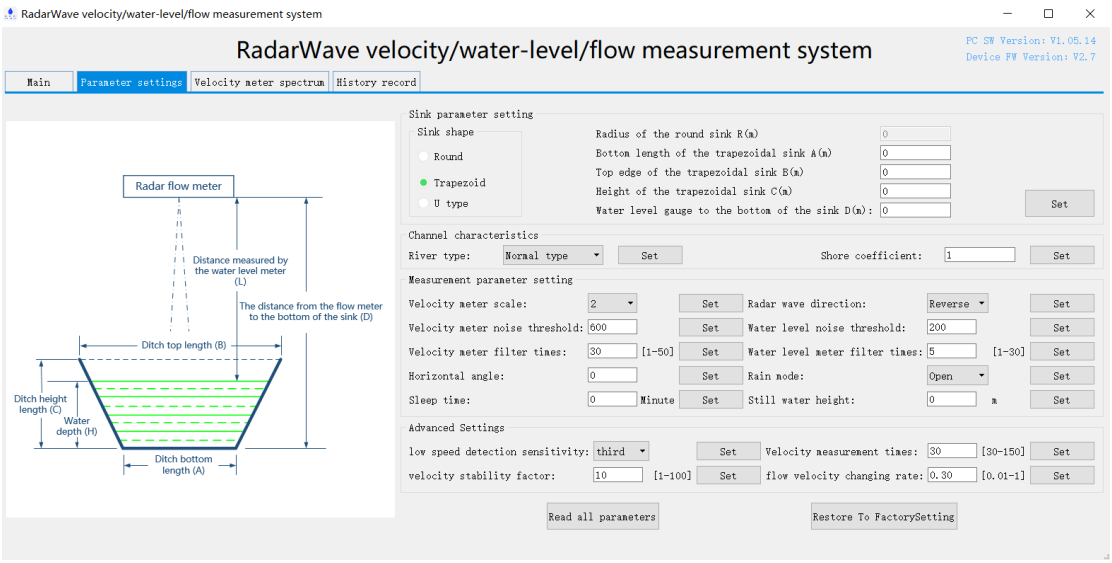
⑥ The vertical angle is used to display the angle between the current radar flow meter beam emission direction and the water flow direction in real time. After the radar flowmeter is installed horizontally, the angle is about 55°±1°;

⑦ Signal strength of flow meter and water level meter (reserved), respectively indicate the current flow meter and water level meter echo signal strength, the larger the signal, the stronger the signal; for the flow meter signal, when the distance to the water surface is too far or the water surface is relatively calm, The echo signal becomes weak. If it is lower than the noise threshold described later, the measurement effect will be reduced. You need to reduce the noise threshold setting or lower the flowmeter to be closer to the water surface; it is recommended to observe the signal strength through the debugging software during on-site installation. Evaluate the signal quality of the installation point, and ensure that the set noise threshold is lower than the signal strength of the site under high probability. The default value has considered most application scenarios, and the setting needs to be modified only when the signal is too weak;

⑧The lower right corner displays the current measurement results numerically, and at the same time updates according to the set query time period, the home page view will have 3 coordinates displayed on the corresponding measurement parameter curve;

8.3 System parameter setting interface

Click "Parameter Setting" to enter the following interface to set related parameters;



Parameter setting interface

① Select the corresponding option according to the shape of the water channel, pay attention to the rectangle, the triangular water channel is a special rectangle, set its length according to the sign shown, and click "write parameter" after setting;

② The distance from the water level radar sensor to the bottom of the tank minus the air height is the water level to be measured;

③ River types correspond to different algorithm processing, here you can select the default "normal";

④ Choose the corresponding value of the shore coefficient according to different materials, the default value is 1, if you don't confirm, just follow the default parameters;

⑤ Flow rate measurement gear, corresponding to different measurement ranges:

1——Used for ultra-low speed precise measurement (less than 0.1m/s, reserved);

2——0.03~10m/s conventional flow velocity measurement (system default value);

3——0.1~20m/s wide range velocity measurement, accuracy is slightly lower than 2.

⑥ The radar wave direction of the flow velocity radar sensor is divided into automatic, downstream, and upstream. It is used to set different flow velocity directions. Oncoming is upstream. It is recommended to install upstream (default), with rain resistance; if you choose automatic or downstream , The rain-resistant mode is invalid;

⑦ The noise threshold of the flow rate radar sensor is used to set the signal extraction threshold. If the signal strength (available in real time on the main interface) is lower than the set value, it is considered to be noise and not picked up; this parameter usually does not need to be adjusted, and the default value is That's it; only when the installation distance is long and the flow rate is low, the signal is weak, and it needs to be adjusted according to the field signal strength. The threshold setting of the flow rate radar sensor should not be less than 400;

⑧ The number of filtering times corresponds to the wave-eliminating effect, the larger the wave-eliminating effect is, the more stable the measurement result is, but the real-time performance will be weakened, and the default is normal;

⑨ The horizontal angle setting is used for the angle that needs to be corrected when the flowmeter is installed on the bank, not directly above the river, and has a certain angle with the flow direction of the river; although this installation is not recommended, the device still provides a correction option, the default Is 0°;

⑩ The rain mode has certain requirements for the installation direction of the device, and the river needs to face the flowmeter. If you need to measure downstream or bidirectional flow, the rain mode will fail; the device defaults to the rain mode;

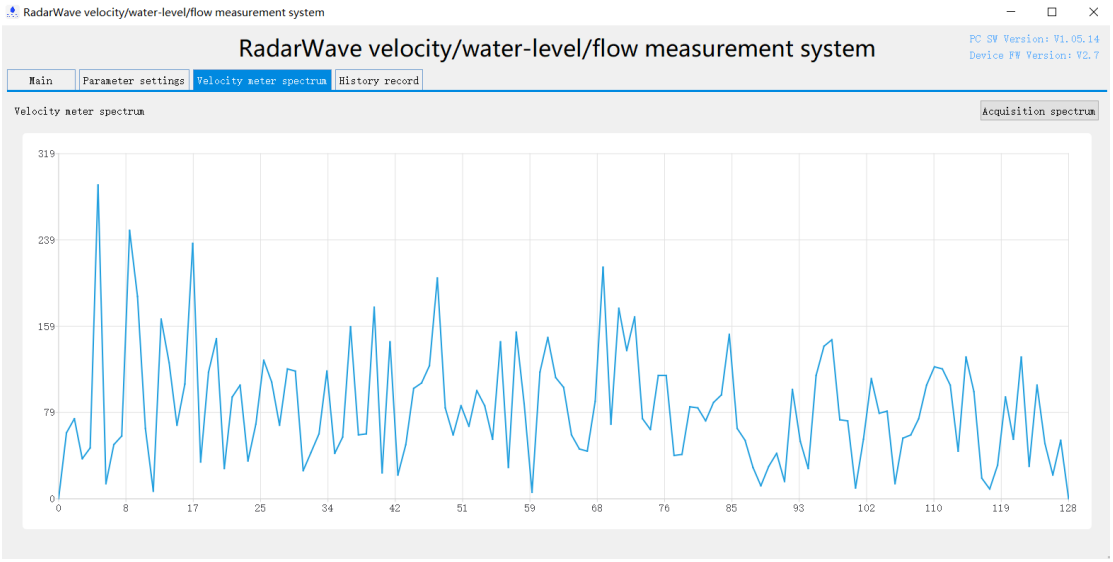
⑪ Sleep time is to set the time for the flow meter to enter the low-power sleep mode, and stop measurement during this period. Measure and accumulate the flow again after the sleep time is automatically awakened. It is generally used in low-power application environments and the unit is minutes; after reaching the sleep set time, it automatically enters the working mode, and enters the sleep state again after measuring a valid result;

⑫ Click "Read all settings" to get the currently set parameters;

⑬ Click "Restore Factory Settings" to restore the default parameters.

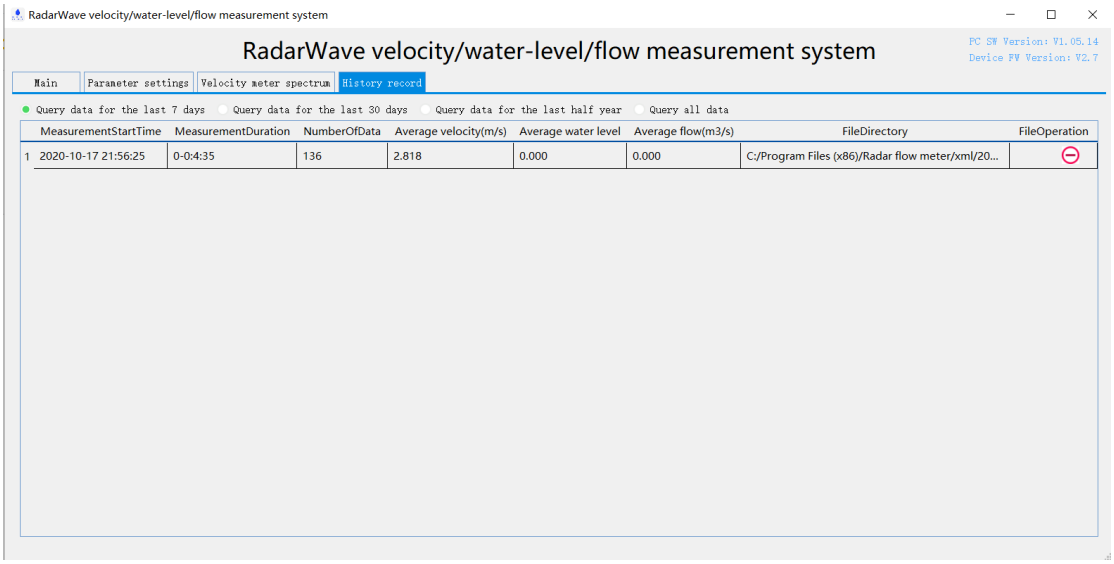
⑭ Set the still water height and click "write" to set the still water height.

8.4 Velocity meter spectrum



Click Get Spectrum, you can view the signal quality of the velocity radar sensor for on-site debugging.

8.5 History record



Click the history menu to see the history data list, click the list to see the curve data of this measurement, and click export to export and save the curve data as an Excel or xml file.

APPENDIX A FREQUENTLY ASKED QUESTIONS

1. Question: Why does the host computer not receive any data?

answer:

1) Check whether the power supply voltage is 7~32VDC, and re-power on after confirmation;

2) Check whether the communication mode, serial port number, and baud rate are correct;

3) Check whether the communication protocol is operated according to the instructions, and check whether the instructions are correct;

4) Try to change a USB to 485 communication line to test again

2. Question: Why is the measured value always zero?

answer:

1) Confirm whether the radar transmitter probe is aimed at the measurement target;

2) Whether the measuring distance is within the reasonable range of the probe test.

3. Question: Why does the measured value jump frequently and greatly?

answer:

1) Check whether the power supply voltage is too low;

2) Whether there are obstacles in the measurement range;

3) Whether the probe is installed firmly and whether the radar flowmeter is installed parallel to the horizontal plane;

4) Check if there is a vortex.

4. Question: Why is the measured value not updated?

answer:

1) Check whether the water surface freezes due to seasonal reasons;

2) Check whether the measurement is inaccurate due to radar waves covering the ground due to low water period or main tank swing.

5. Question: Used to measure water surface flow when flooding occurs. The water flow is very fast, the water is turbulent, the water surface is rough, and there are many debris and floating objects. Can the radar flowmeter be used to obtain accurate measurement results in this case?

Answer: Yes. The turbulent water current and the floating objects on the water surface can provide a good return signal for the radar speed probe. Please note that in this case, the radar speed probe will read multiple speeds in different directions. The radar speed probe will measure these speeds and get the average speed.

6. Question: The roughness of the water surface is good, and the water surface has ripples, but the reading of the radar speed probe is still high and/or far below my expectations.

Answer: Make sure not to be too far away from the water surface when measuring. The exact distance is sometimes difficult to determine because the measurement result is a function of the amount of signal returned to the radar speed probe. The returned signal is directly related to the distance of the radar speed probe from the water surface and the roughness of the water surface. The closer the radar speed probe is to the surface of the water, the better the measurement effect is even when the water velocity is low. Regularly observe whether the cross arm or other fixing mechanism where the flowmeter is installed is tilted or loosened due to external forces (such as strong wind).

7. Question: I am measuring the water flow velocity which is lower than 0.60m/s visually, but the reading is higher than expected.

Answer: Check the influence of wind on the water surface. Wind may affect the measurement of low-speed water flow (such as water flow below 0.50m/s). If possible, measure in two directions, one direction is the direction of the water flow toward the radar speed probe, and the other is the direction of the water flow away from the radar speed probe. Try to point the radar speed probe to the same place for measurement.

8. Q: Why did the database not receive any data? (RD-600s-R)

A: 1) Check whether the power supply voltage is 7-32VDC, and re-power on after confirmation;

2) Check whether the SIM card is inserted and make sure that the SIM can access the Internet normally;

3) Check whether the SIM card is not inserted properly;

4) Check whether the server-side receiving program is normally installed and configured correctly;

5) Check whether the device RTU upload server and port number are configured correctly.

APPENDIX B SHIPPING LIST

Number	Name	Specification model	Quantity	Note
1	Radar flowmeter	RD-600s / RD-600s-R	1	/
2	Cable with plug	Six-core cable	1	Standard 10 meters
3	Operating instructions	PDF electronic file	1	/
4	Mounting brackets, screws, clamps	Stainless steel + aluminum alloy	1	/
5	Certificate of conformity	RD-600s	1	/