Pneumatic Water Gauge Sensor

User Manual

RD-RWG-01

1.Description

The pressure transmitter uses a high-performance pressure-sensitive chip that combines advanced circuit processing and temperature compensation techniques to convert pressure into a linear current or voltage signal. The product is small in size, easy to install, and is insulated by a stainless steel case. It is suitable for measuring gases such as gas and liquid compatible with the material of the contact part. It can be used to measure gauge pressure, negative pressure and absolute pressure.

2.Application

This product is widely used in water plants, oil refineries, sewage treatment plants, building materials, light industry, machinery and other industrial fields to achieve the measurement of liquid, gas and steam pressure.

3.Features

➢ Reverse polarity and current limit protection

➢ Laser resistance temperature compensation

➢ Programmable adjustment

➢ Anti-vibration, anti-shock, anti-radio frequency electromagnetic interference

➢ Strong overload and anti-interference ability, economical and practical

4.Main Technique

➢ Measuring range:0~10meters (-0.1~0~60Mpa)

➢ Measuring accuracy:0.2%

➢ Output signal: RS485

➢ Overload capability: ＜1.5 times the range

➢ Temperature drift：0.03% FS/℃

➢ Power supply：12-36VDC typical 24V

➢ Medium temperature：-20~75℃

➢ Ambient temperature：-30~80℃

➢ Measuring medium: gas or liquid that does not corrode stainless steel

5.Electrical wiring diagram
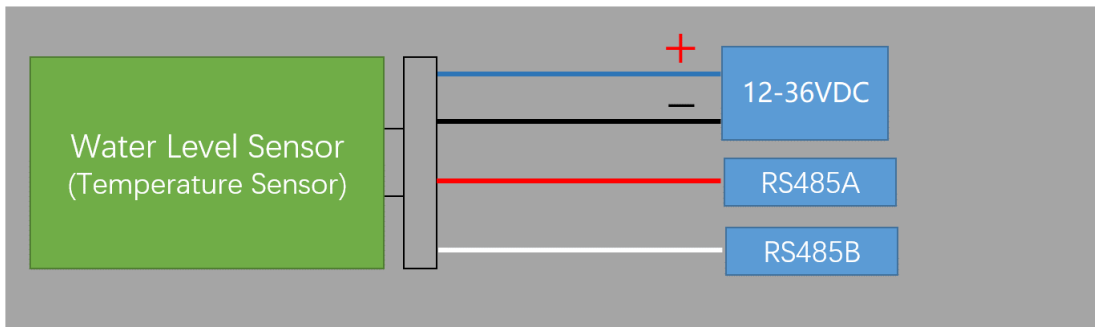
6.MODBUS Communication Protocol

1. Overview

This protocol complies with the MODBUS communication protocol and adopts the subset RTU method in the MODBUS protocol. RS485 half-duplex working mode.

2. Serial data format

Serial port settings: no parity, 8 bits of data, 1 stop bit.

Example: 9600, N, 8, 1 Meaning: 9600bps, no parity, 8 data bits, 1 stop.

The serial port baud rate supported by this transmitter is:

1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200

Polynomial of CRC check: 0xA001.

The data in the data communication process is all processed according to the double-byte signed integer data. If the data identifies the floating point number, the write needs to read the decimal point to determine the size of the data.

3. Communication format

(1). Read water level

First , Read output value

Address	Function code	Data start address (H)	Data start address (L)	Number of data (H)	Number of data (L)	CRC16 (L)	CRC16 (H)
0X01	0X03	0X00	0X04	0X00	0X01	0XC5	0XCB

Data returned:

Address	Function Code	Data length	Return data High byte (H)	Return data Low byte (L)	CRC16(L)	CRC16(H)
0X01	0X03	0X02	0X00	0X0A	0X38	0X43

Second need read decimal

Send instruction:

Address	Function code	Data start address (H)	Data start address (L)	Number of data (H)	Number of data (L)	CRC16 (L)	CRC16 (H)
0X01	0X03	0X00	0X03	0X00	0X01	0X74	0X0A

Return:

Address	Function Code	Data length	Return data High byte (H)	Return data Low byte (L)	CRC16(L)	CRC16(H)
0X01	0X03	0X02	0X00	0X03	0XF8	0X45

0003 means three decimal

So the water level is 000A(Hexadecimal)=10 (Decimal)/1000 =0.01 meter.

(2) Modify the sensor address, modify the address from 01 to 02

A. Send read command format:

Original address	Function code	Reserved 1	Reserved 2	Reserved 3	new address	CRC16 low	CRC16 high
0X01	0X06	0X00	0X00	0X00	0X02	0X08	0X0B

If success, it will return : 01 06 00 00 00 02 08 0B

Please pay attention that, when change the address, need make the save for the new address:

For example, after change the address as 02, need send the instruction:

Changed address	Function code	Reserved 1	Reserved 2	Reserved 3	Reserved 4	CRC16 low	CRC16 high
0X02	0X06	0X00	0X0F	0X00	0X00	0XB9	0XFA

If save success, it will return : 02 06 00 0F 00 00 B9 FA

(3). Error and abnormal command response return data format:

Address	Function code	Exception code	CRC16 Low byte (L)	CRC16 High byte (H)
0x01	0x80 + function code	0x01：(Illegal function) 0x02：(Illegal data address) 0x03：(Illegal data)		

(4). Function code and data address list

Read data function code: 0x03 (corresponding to the data address list)					
Function code	Data start address	Number of data	Data bytes	Data range	Instruction meaning
0x03	0x0000	1	2	1-255	Read slave address
0x03	0x0001	1	2	0-1200 1-2400 2-4800 3-9600 4-19200 5-38400 6-57600 7-115200	Read baud rate
0x03	0x0002	1	2	0- Mpa 1- Kpa 2- Pa 3- Bar 4- Mbar 5- kg/cm^2 6- psi 7- mh^{2}o 8- mmh^{2}o	Primary variable unit
0x03	0x0003	1	2	0-#### 1-###.# 2-##.## 3-#.###	The decimal point represents 0-3 decimal points respectively
0x03	0x0004	1	2	-32768-32767	Measurement output value
0x03	0x0005	1	2	-32768-32767	Transmitter range zero point
0x03	0x0006	1	2	-32768-32767	Transmitter range full point
0x03	0x000c	1	2	-32768-32767	Zero offset value, the factory is generally 0
Write data function code: 0x06 (corresponding to the data address list)					
Function code	Data start address	Number of data	Data byte	Data range	Instruction meaning
0x06	0x0000	No	2	1-255	Rewrite slave address
0x06	0x0001	No	2	0-1200 1-2400 2-4800	Modify the baud rate

				3-9600	
				4-19200	
				5-38400	
				6-57600	
				7-115200	
0x06	0x000c	No	2	-32768-32767	Zero offset value. Primary variable output value = calibration measurement value + zero offset value
Save and restore factory command list					
Function code	Data start address	Number of data	Data byte	data range	Instruction meaning
0x06	0x000F	No	2	0-　　0- Save to user area 1-　　1- Save to the factory area	
0X06	0x0010	No	2	1- Return to factory parameters	

4. Examples of commonly used commands: (example data are hexadecimal, transmitter address is 1)

(1). Read the main variable data:

A. Send command: 01 03 00 04 00 01 C5 CB

B. Return data: 01 03 02 00 0A 38 43 (0x000A is the value of the main variable read)

(2). Read the number of decimal places:

A. Send command: 01 03 00 03 00 01 74 0A

B. Return data: 01 03 02 00 03 F8 45 (0x0003 is the number of decimal places)

(3). Read the transmitter address:

A. Send command: 01 03 00 00 00 01 84 0A

B. Return data: 01 03 02 00 01 79 84 (0x0001 is to read the transmitter address)

(4). Read the baud rate of the transmitter:

A. Send command: 01 03 00 01 00 01 D5 CA

B. Return data: 01 03 02 00 03 F8 45 (0x0003 is to read the baud rate of the transmitter, and the data

description list shows that the baud rate is 9600)

(5). Modify the transmitter address: (the original address of the transmitter is 0x01, modified to 0x02)

A. Send command: 01 06 00 00 00 02 08 0B

B. Return data: 01 06 00 00 00 02 08 0B (0x0002 is the modified transmitter address)

(6). Modify the baud rate of the transmitter: (the original baud rate of the transmitter is 9600, modified to

4800)

A. Send command: 01 06 00 01 00 02 59 CB

B. Return data: 01 06 00 01 00 02 59 CB (0x0002 is to modify the baud rate of the transmitter, the baud

rate is 4800 through the data description list)

Note: Send the save to user area command after modifying the command, otherwise the modified data

will be lost because it is not saved after the transmitter is powered off.

(7) The save to user area command is as follows: the save command code after the address is changed

from 1 to 2

A. Send command: 02 06 00 0F 00 00 B9 C9

B. Return data: 02 06 00 0F 00 00 B9 C9 (0x000F is the saving function code, 0x0000 means saving to

the user area)

5. Matters needing attention:

(1). When the baud rate is modified, the transmitter will reply to the modified data with the baud rate sent

by the host. After the reply, the baud rate of the transmitter will become the modified target value.

(2). When modifying the address, the data is also returned to the address before the modification, and

the transmitter address will be automatically modified after the reply.

(3). Save and reply factory commands will return the original value, indicating that the transmitter has

accepted the command from the host.

(4). When restoring factory data, pay attention to that the parameters saved by the factory may be inconsistent with those saved by the user, so the address, baud rate, and calibration data may be inconsistent, so you must search for the transmitter again after restoring the factory parameters.

(5). There are only 3 data that the user allows to modify, which are address, baud rate, and zero offset value.

(6). General users are not allowed to modify the calibration data of the transmitter. If you need to calibrate and modify, please contact our company to obtain the transmitter calibration software. Sending the command to modify the calibration data by the user will cause the transmitter to output an abnormal code. If you need to modify the calibration data, please use our company's calibration software.

(7). This protocol stipulates that the data is communicated with plastic data. For example, the main variable data is 6.000MPa, three decimal places, and the read data is 6000. Then you must perform calculations based on the position of the decimal point to get 6.000. For example, if the decimal point is 3, it means 6000/10 (3), which is 6000 divided by 10 to the third power, and the data is 6.000.

7.Precautions

1.When the baud rate is modified, the transmitter will reply to the modified data with the baud rate sent by the host. After the reply, the baud rate of the transmitter will become the modified target value.

2. When modifying the address, the data is also returned to the address before the modification, and the transmitter address will be automatically modified after the reply.

3. Save and reply factory commands will return the original value, indicating that the transmitter has accepted the command from the host.

4. When restoring factory data, pay attention to the fact that the parameters saved by the factory may be inconsistent with those saved by the user, so the address, baud rate and calibration data may be

inconsistent, so you must search for the transmitter again after restoring the factory parameters.

5. There are only 3 data that the user allows to modify, which are address, address, baud rate, and zero

offset value.

6. General users are not allowed to modify the calibration data of the transmitter. If you need to calibrate

and modify, please contact our company to obtain the transmitter calibration software. Sending the

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Ultrasonic Level Sensor
User Manual
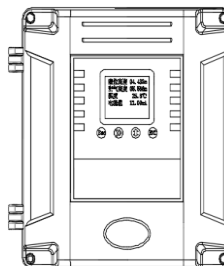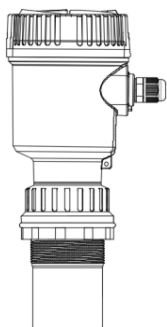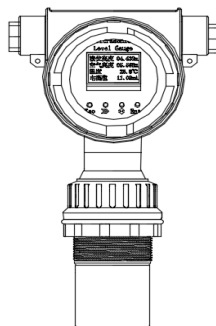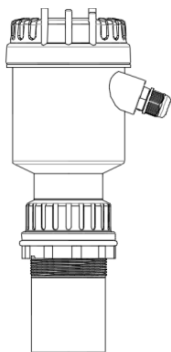
1. Overview

Thank you for choosing our ultrasonic level sensor!
The instrument contains a number of patented technologies, with safety, sanitary, high precision, long life, stable and reliable, easy installation and maintenance, etc., suitable for acid, alkali, salt, anti-corrosion, high temperature and other fields.

The instrument can be connected to the display meter or various DCS,PLC systems through 4~20mA or RS485(Modbus protocol or other customized protocols),   provide real-time liquid level data for industrial automation.

This instrument has the following features:

patented acoustic wave intelligent technology software can carry out intelligent echo analysis without any debugging and other special steps, this technology has the function of dynamic thinking and dynamic analysis.

Our company has the acoustic intelligent patent technology, so that the accuracy of the instrument is greatly improved, the liquid level accuracy can reach 0.3%, can resist all kinds of interference waves.

This instrument is a non-contact instrument, no direct contact with the liquid, so the failure rate is low. The instrument can be installed in a variety of ways, and the user can calibrate the instrument through this manual.

All the input and output lines of the instrument have the protection function of lightning protection and short circuit protection.

2. Technical Indicators

Measuring range: 0 ~ 15m

Blind area: 0.35m/10m; 0.5 m / 15 m

Range accuracy: 0.25%-0.5% (standard conditions)

Range resolution: 1mm

Pressure: Below 4 bar

Instrument display: with LCD display showing level & distance

Analog output: 4 ~ 20mA

Digital output: RS485, Modbus protocol or custom protocol

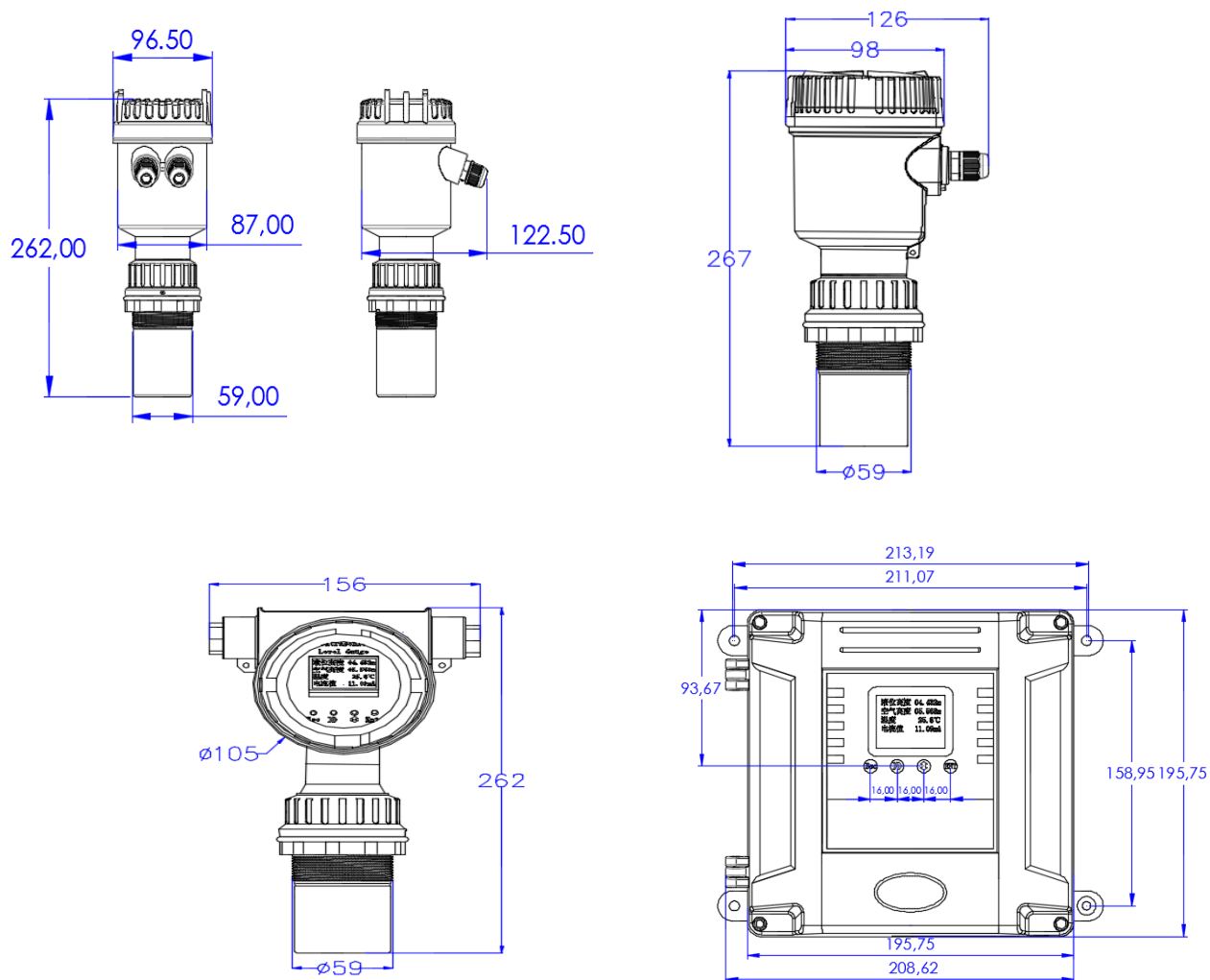Power supply voltage: DC24V/AC220V, built-in lightning protection device

Ambient temperature: -20℃ ~ +60℃

Protection class: IP65

3. Instrument Installation

3.1 Overall dimensions of the instrument

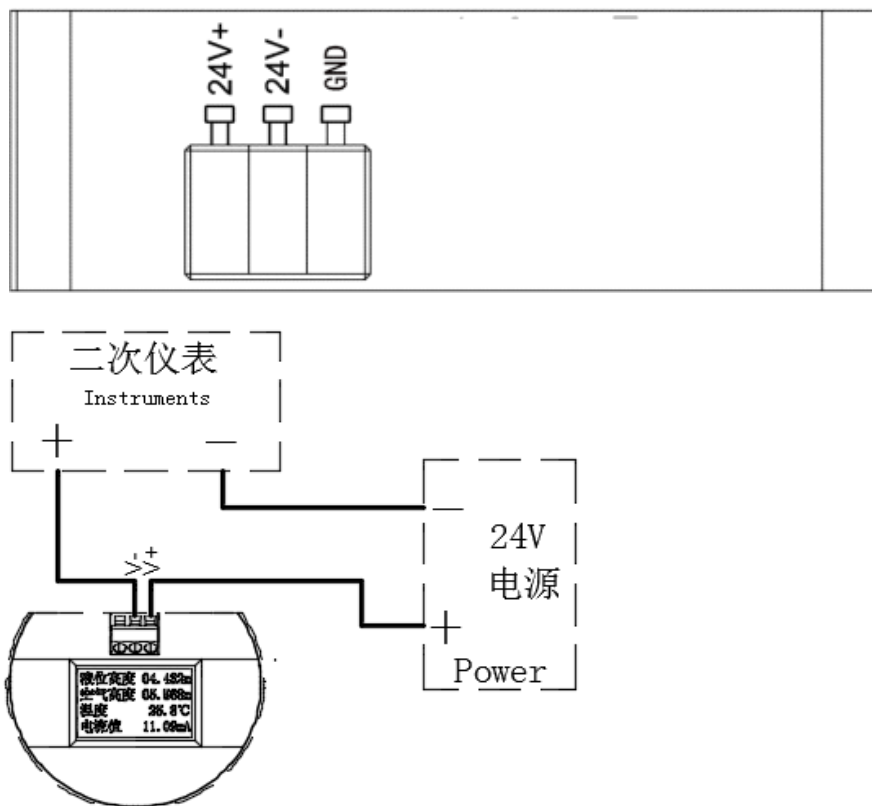Thread of Probe:10m M60*2/G2.0, 15m M78*2

Installation:

In the open area, use bracket; closed area, use thread or flange.

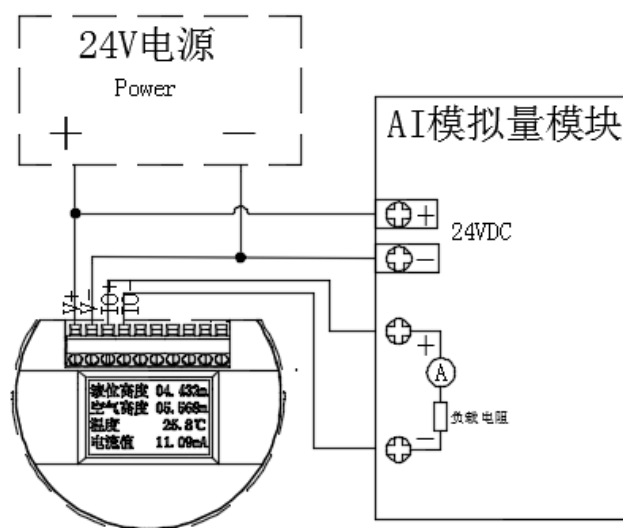Please keep perpendicular between probe and surface of liquid.
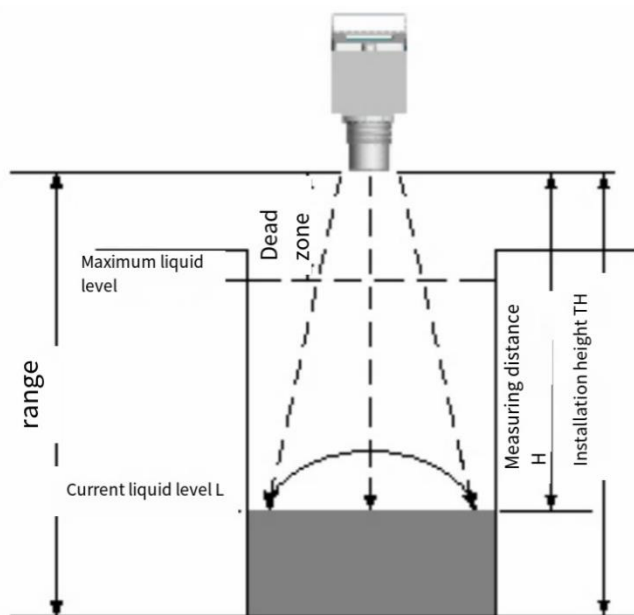
3.2 Wiring：

Two-Wire System

Four-Wire System

1	2	3	4	5	6	7	8	9	10
✕	✕	✕	✕	✕	✕	✕	✕	✕	✕
RL2	CM2	RL1	CM1	B+	A-	IO-	IO+	V-	V+
↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
Relay2	COM2	Relay1	COM1	485 Output		Current Output		24V DC	

Please specify 220VAC or DC24V , output signal when placing order; ; The two relays are respectively: dry contact one is the first circuit, dry contact two is the second circuit.

3.3 Param

As shown above figure, the probe of the instrument sends a wave to the liquid level and reflects it back to the probe. After the probe receives the wave, the time from sending to receiving the wave is calculated, and the measuring

distance H is obtained. The installation height of the instrument "TH" minus the measuring distance H will get the current liquid level "L".

Measuring range should set a little greater than installation height "TH".

Instrument blind area refers to the area where the instrument can not be measured near the probe, the maximum liquid level and the probe distance should be greater than the blind area, for example, the blind area is 0.3m, then the liquid level and the probe distance must be greater than 0.3m.

The probe wave is a diffusion process, that is, there is a Beam Angle, pay attention to the installation to avoid obstacles, otherwise there maybe unwanted wave affect measuring results.

3.4 Instrument Installation Rules

1.The distance from the probe launching surface to the lowest liquid level should be less than the range of the optional instrument.

2.The distance from the probe launching surface to the highest liquid level should be greater than the blind area of the optional instrument.

3.The transmitting surface of the probe should be parallel to the liquid surface.

4.The installation position should try to avoid inlet and outlet etc where medium may fluctuating.

5.If the wall of the pool or tank is not smooth, the installation position of the instrument should be more than 0.3m away from the wall of the pool or tank.

6. If the distance from the probe to the highest liquid level is less than the blind area, it is necessary to install an extension tube, the extension tube diameter is greater than 120mm, the length is 0.35m ~ 0.50m, the vertical installation, the inner wall is smooth, the hole on the tank should be greater than the inner diameter of the extension tube. Or pass the pipe to the bottom of the tank, the diameter of the pipe is greater than 80mm, and the hole at the bottom of the pipe is left to keep the liquid level in the extended pipe equal to that in the tank.

3.5 Installation Precautions

1.The instrument is installed outdoors. It is recommended to install a sun visor to extend the service life of the instrument..

2. Protection tube of wire and cable should be sealed right and avoid water ingression.

3. Although the instrument itself has a lightning protection device, when the instrument is used in lightning frequently area, it is recommended to extra special lightning protection device at the inlet and outlet end of the instrument.

4. If the instrument is used in a particularly hot and cold place, that is, when the ambient temperature may exceed the working requirements of the instrument, it is recommended to equip with protection.

4. Instrument Debugging

4.1 keypad description

【ESC】Button：Press【ESC】back to previous menu.

【》】Button：Press【》】to move to right option or up option.

【↕】Button：Press【↕】to get a value from 0 to 9 circularly or move to down option

【Enter】Button：Press【Enter】access to menu or Press【Enter】to save the setting.

4.2 Parameter setting

4.2.1

For 2-wire instrument's parameters, set "Measuring Range" and "20mA" only. There is no need to set other menus. If you want to set them, please contact the manufacturer, otherwise the data maybe distorted, resulting in abnormal data.

4-wire instrument's parameter setting "Measuring Range" and "20mA Height", relay setting and communication setting are explained separately, other menus do not need to be set, if you want to set, please contact the manufacturer, otherwise the data maybe distorted, resulting in abnormal data.

4.2.2   20mA Height

Press【Enter】,【↕】to get 1000 which is the password;

Press【Enter】and get to User Setup;

Press【Enter】once, 【↕】button twice, to get to Current setup;

Press 【↕】move to 20mA Height;

Press【Enter】and Use 【》】【↕】set to right value.

4.2.3 Measuring Range（TH）

Press【Enter】,【↕】to get 1000 which is the password;

Press【Enter】and get to User Setup;

Press【Enter】and get to Measuring Range;

Press【Enter】and Use 【》】【↕】set to right value.

4.2.4 Modbus Communication（Local address and baud rate Settings）

You can reset the address and baud rate of the local device as required. Do not set or plug the serial cable when the instrument interacts with the upper computer (heat engine state)! It is best to restart the instrument after setting up! (The host computer needs to make corresponding changes to the parameter changes of the instrument)

RS485(Modbus format) Example Command line (hexadecimal) :

01 03 00 00 00 03 05 CB

Command definition (in sequence) :

01 is the instrument address (can be changed according to the actual address, the factory default is 01);

03 for the execution of the read command (function code), the user does not need to modify it;

00 00 00 03 indicates the high and low bits of the start address of the register to be read and the high and low bits of the length of the register. The user does not need to modify this part ;

05 CB is the 16-bit CRC check code before the low byte (this instrument supports the low-byte CRC check in the first 16 bits);

RS485(Modbus protocol format) received data format (hexadecimal, letters represent example data,not real data) :

01 03 06 aa aa bb bb cc cc xx xx

Data format interpretation (in sequence) :

01 is the address of the instrument (it will be changed according to the actual address, the factory default is 01);

03 indicates the read command (function code);

06 is the length of the data read (the meter reads the liquid level, distance and

temperature at one time);

"aa aa "data indicates the liquid level data (16-bit unsigned integer data is divided into two 8-bit unsigned integer data, with the high byte first), and the unit is mm after decimal conversion.

"bb bb" data is distance data (16-bit unsigned shaping data is split into two 8-bit unsigned integer data, with the high byte in front), and the unit is mm after decimal conversion.

"cc cc" data is temperature (16-bit signed integer data is split into two 8-bit unsigned integer data, high byte before, pay attention to the temperature bit has a signed number, after conversion need to be calculated according to signed integer data!) After the decimal number is converted, the data needs to be divided by 10 to obtain the actual temperature, the unit is Celsius;

"xx xx "is the CRC check code after verification (this instrument supports low bytes in the first 16 bits of CRC check);

4.2.5 Relay Setting (4-wire ultrasonic)

Press【Enter】, 【↕】 to get 1000 which is the password;

Press【Enter】and get to User Setup;

Press【Enter】once and 【↕】 four times and get to relay

Press【Enter】and Relay one or Relay two setting;

Pressure 【Enter】and Use 【》】【↕】set to ideal condition.

Four symbols "&", "|", "N", and "∧" can be selected.

Meaning of symbols:

< : less than symbol

> : greater than symbol

& : and, indicates that both conditions must be met.

| : or, one of the two conditions can be met.

N: Only the former condition is functioned, and the latter condition is not functioned.

∧ : The former condition is the relay closed (generally used to switch on pump), and the latter condition is the relay Open (generally used to switch off pump), Mainly used for drainage and water inlet control.

4.3.1（**DispMode**）

Default text display currently, new feature is developing.

4.3.2 Language

This instrument supports English and Chinese, you can select the language through this setting.

4.4 Warranty Policy:

The warranty period of our products is twelve months from the date of receipt of goods.

The following conditions are not covered by the free warranty:

1)The product or its parts are out of the free warranty period.

2)Hardware failure caused by the use of the environment does not meet the requirements of the product.

3)Failure or damage caused by wrong power supply or foreign objects ingress the device.

4)Faults caused by failure to operate according to the instructions and precautions written in the operating manual.

5)Faults caused by irresistible natural factors such as lightning, water fire, etc. Failure or damage caused by unauthorized dismantling and repair or unauthorized modification or abuse.

Radar Water Level Gauges
Product specification

RD-300s Series

Alibaba website: https://hondetec.en.alibaba.com/

Acknowledgement

First of all, I would like to express my heartfelt thanks to you for choosing our products!

RD-300s Series Radar Water Level Gauge is a kind of equipment using microwave radar technology, which can realize accurate, quick and non-contact measurement of water level. The instrument is small, light and easy to install, and can realize non-contact measurement of river water level, open channel, reservoir and sewage pipe network.

RD-300s series radar water level gauge adopts 80G frequency modulated continuous wave (FMCW) technology, which has high measurement accuracy, low power consumption, small size, light weight, strong anti-environmental interference ability, good reliability, availability and maintainability.

In particular, we recommend that you read this manual before using the RD-300s Series Radar Water Level Gauge, so that you will have a better understanding of how to use this advanced water level measuring instrument. This manual describes in detail the use, maintenance and precautions of RD-300s series radar water level gauges.

Alibaba website: https://hondetec.en.alibaba.com/

Instructions for RD-300s Series

✧ **Matters needing attention and restrictions on use**

Note: The design and manufacture of our products are safe and reliable. Please use them correctly (according to the text instructions shown) and fully comply with the following precautions, so as not to cause harm to the instrument and human body.

Legend:

⚠Note: Attention/Warning

Matters needing attention in the process of transportation, use and maintenance must be carefully read.

Matters needing attention are as follows:

✧ **Operating environment and matters needing attention in electricity consumption**

- Warning: Do not use this instrument in places where flammable and explosive gases are or may be present.

- Caution: Do not touch the water surface or put the instrument into the water.

- Caution: Do not place the instrument at extreme temperatures and avoid static electricity.

✧ **Instrument operation**

- Caution: No matter in the use, storage or transport of the instrument, should be taken and placed carefully, do not fall damage.

- Note: The installation and setting of this radar water level gauge can only be operated by professional technicians.

- Note: Please do not disassemble the radar water level gauge or make any changes to it, otherwise there will be no warranty.

- Note: If the instrument breaks down, please hand it over to our company for after-sales maintenance, please do not disassemble and assemble without permission!

✧ RS232 Interface, RS485 Interface

⚠Warning: System equipment or computer equipment connected to RS232 interface or RS485 must comply with BS EN 60950/IEC 950 standard.

✧ **Instrument components**

⚠Warning: This instrument is not equipped with internal spare parts, and it is not allowed to disassemble the instrument parts without authorization.

✧ **Hazardous substance management**

⚠Discarded RD-300s should be treated as discarded electronic/electrical products in accordance with the Hazardous Substances Management Regulations.

⚠Warning: Do not throw used instruments into classified waste or municipal garbage.

✧ **Use restriction regulations**

The design of RD-300s series meets the requirements of

routine and safety.

    ◇ **Declaration**

        The design of RD-300s series meets and complies with the requirements of low voltage index.

DIRECTORY

Alibaba website: https://hondetec.en.alibaba.com/

1 Product introduction

1.1 Product Profile

RD-300s series radar water level gauge is independently developed by our company. It adopts FMCW technology and takes 80G mm radar wave as carrier signal. The product has high measurement accuracy, low power consumption, small size and light weight; The measurement process is not affected by environmental factors such as temperature, air pressure, sediment, dust, river pollutants, floating objects on the water surface, air, etc., and has good wind-proof and anti-shake ability; The optimized algorithm makes the measurement results more accurate and stable.

This product has three standard physical circuit interfaces: RS485/RS232/wireless, 4-20mA; The equipment adopts standard Modbus-RTU protocol. In order to meet the individual needs of customers, the company also provides custom agreements.

1.2 Instrument characteristics

➢ Product specification: 89x90, hole spacing 44 (unit: mm)

➢ You can use basic building facilities such as bridges or auxiliary facilities such as cantilever construction;

➢ Measuring range: 0-20m

➢ Wide power supply range of 7-32VDC, solar power supply can also meet the demand;

➢ 12V power supply, the current in sleep mode is less than

1mA;;

➢ Non-contact measurement, not affected by ambient temperature and humidity, and not corroded by water;

➢ Multiple working modes: cycle, hibernation and automatic.

1.3 Basic measurement principles

RD-300s radar water level gauge adopts FMCW modulation mode and triangular wave as modulation signal. The working process is as follows: Firstly, a voltage modulation circuit generates a triangular wave voltage and inputs it to a VCO (Voltage Controlled Oscillator) to generate electromagnetic waves with varying frequencies, The frequency of electromagnetic wave changes according to the law of modulation voltage, The electromagnetic wave emitted by the antenna generates an echo after being reflected by the measured object, Electromagnetic waves are emitted from the beginning to the target, The radar transmission frequency has changed during the time period when it is reflected by the target and then returned to the antenna, The radar antenna couples the echo signal with the transmitted signal to obtain a difference frequency signal, The distance and velocity information of the target is contained in the frequency of the difference frequency signal, Because the difference frequency signal is very weak, it needs to be processed by preamplifier and filter circuit of radar sensor to send the signal to ADC (analog-to-digital converter) of MCU. MCU analyzes the waveform collected by ADC through FFT algorithm to get the difference frequency, and finally calculates the distance from the measured

target to radar water level gauge through deduced formula.
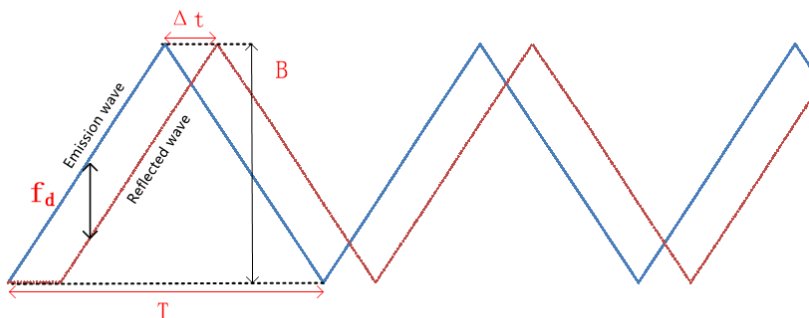
The above picture shows the relationship between frequency and time of FMCW radar transmission and echo signals

When the source of radar wave is relatively stationary with the target, the bandwidth of radar transmission frequency is B, the time of radar wave from transmission to return to radar antenna is Δt, the frequency of triangular wave is f, and the frequency of difference frequency signal is fd. The derivation is as follows: (S: range from radar plate to target, T: period of triangular wave)

$$\Delta t = \frac{2S}{c_0}$$

$$T = \frac{1}{2f}$$

$$S = \frac{f_d C_0}{4fB}$$

In the above formula, C0 is the speed of light, F is the frequency

of modulated triangular wave, B is the radar sweep bandwidth, and FD is the difference frequency signal obtained by MCU analysis, so the only FD can calculate the corresponding distance between radar plate and target.

1.4 Technical Specifications

1.4. 1 Equipment characteristics

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

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

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

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

5. Waterproof grade IP68, which effectively avoids damp of internal devices;

6. Low power consumption, solar power supply, convenient installation and maintenance-free;

1.4. 2 Electrical characteristics

1. 7-32V power supply, wide power supply voltage facilitates the selectivity of power supply mode;

2. The working current and standby current are low, and solar energy can be used for power supply, which is convenient for installation and maintenance-free;

3. Lightning protection circuit can protect against lightning by 6KV, and can effectively protect equipment from lightning strikes in thunderstorm days;

4. Support RS485, RS232, 4-20mA and other communication modes.

1.4. 3 Pin configuration

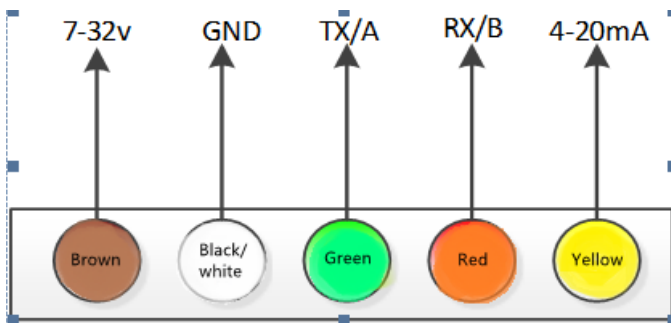| Pin	Color	Description
1	Brown	7-32V DC Power Supply
2, 6	Black, white	GND
3	Green	TXD_A (232_TX/485_A)
4	Red	RXD_B (232_RX/485_B)
5	Yellow	IOUT (4-20mA positive, reserved)

2 Serial port connection description

2.1 Wiring

As shown in the following figure, brown line is the positive input of power supply, black/white line is GND line, TX (green/A) is RS232 output interface or RS485 positive electrode of radar water level gauge, RX (red/B) is RS232 input interface or RS485 negative electrode of water level gauge, and the maximum transmission distance of RS232 communication interface is about 15m; The maximum transmission distance of RS485 interface is about 1.5 km, and the yellow line is the positive electrode of 4-20mA (reserved).

Connecting line color and signal contrast diagram

2.2 Settings

Communication format

Communication interface: RS485

Baud rate: Settable (default 9600)

Check bit: NONE

Alibaba website: https://hondetec.en.alibaba.com/

Data bit: 8bit

Stop bit: 1

2.3 Wired Mode Description

RD-300s series radar water level gauges are compatible with standard MODBUS-RTU communication protocol, and our company can also provide customized communication protocol for users.

RD-300s series radar water level gauge has two working modes: normal working and regular 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 timing sleep mode. After the measurement is completed, the device sleeps according to the set sleep time (minutes), and the sleep time continues to measure.

2.3. 1 Working normally

The radar water level gauge is in a continuous working state, continuously sampling and measuring, and its power consumption is relatively high. It returns the latest measurement result, and has fast response and good real-time performance.

2.3. 2 Sleep regularly

The radar water level gauge is switched between sleep and non-sleep at regular intervals. Timing sampling measurement, after sampling, go to sleep. When the user queries the water level gauge, immediately return the latest measurement value, which consumes

relatively low power and can detect the water level for a period of time.

3 Product Installation

3.1 Instrument structure

Appearance of instrument:

RD-300s Series Appearance Structure Drawing

Alibaba website: https://hondetec.en.alibaba.com/

3.2 Appearance Dimensions of Instruments
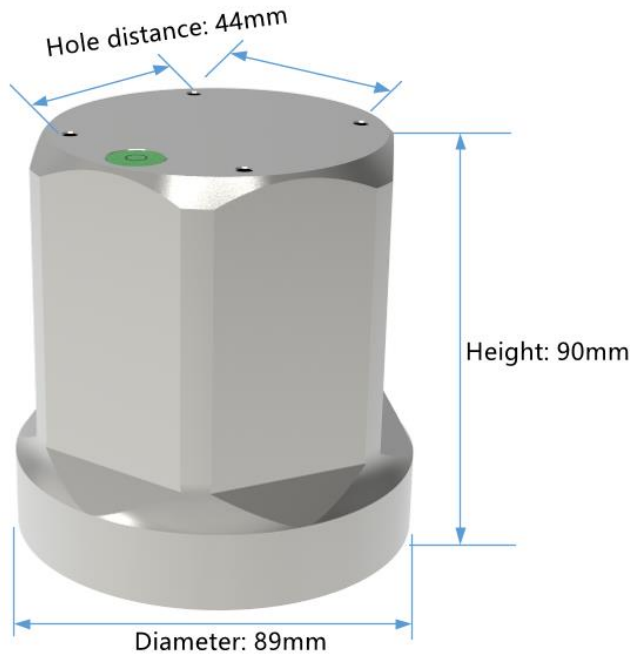
As shown above, the external dimension without antenna is 89x90, and the hole spacing is 44 (unit: mm)

3.3 Plug Installation

As shown in the following figure, when the cable is inserted into the instrument, hold the position of the cable ④, insert the red dot ② of the cable plug in alignment with the red dot ① of the instrument interface, and plug it in when you hear a snap. When unplugging, hold the position ③ in the cable with your hand and pull it out.
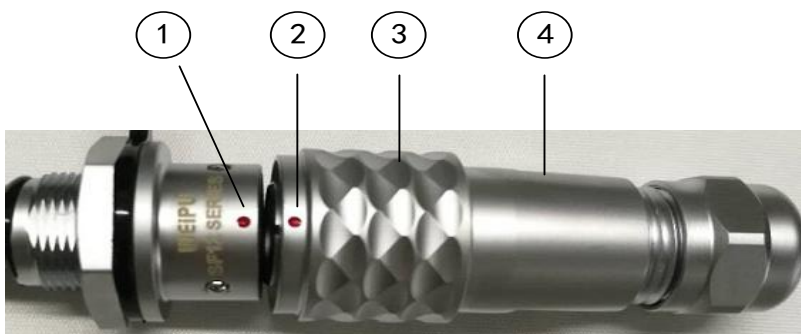
3.4 Site Installation

3.4. 1 Wishbone Installation Method

The installation direction is shown above. Two clamps fix the bracket and instrument on the cross bar (cross bar diameter range: 40mm-85mm), and keep the upper surface of the instrument level with the river during installation.

3.4. 2 Installation method of Bachel groove
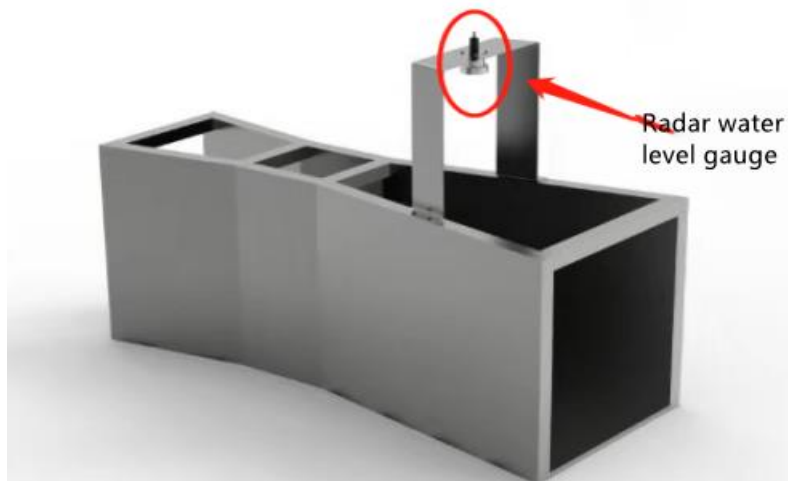
As shown in the above figure, the radar water level gauge is installed on the Bachel groove. On the bracket of the Bachel groove, the corresponding hole position can be reserved according to the fixed position of the radar water level gauge. Please contact our company if you need this installation method.

3.4. 3 Selection of measuring points

When choosing the installation site, it is necessary to ensure that the radar wave covers the water surface, avoid the influence of floating objects, vortices and aquatic plants, and avoid the error of measurement caused by the radar wave covering the ground due to riverbed siltation and main trough swing in low water period. The coverage area is approximately circular as shown in the following figure;
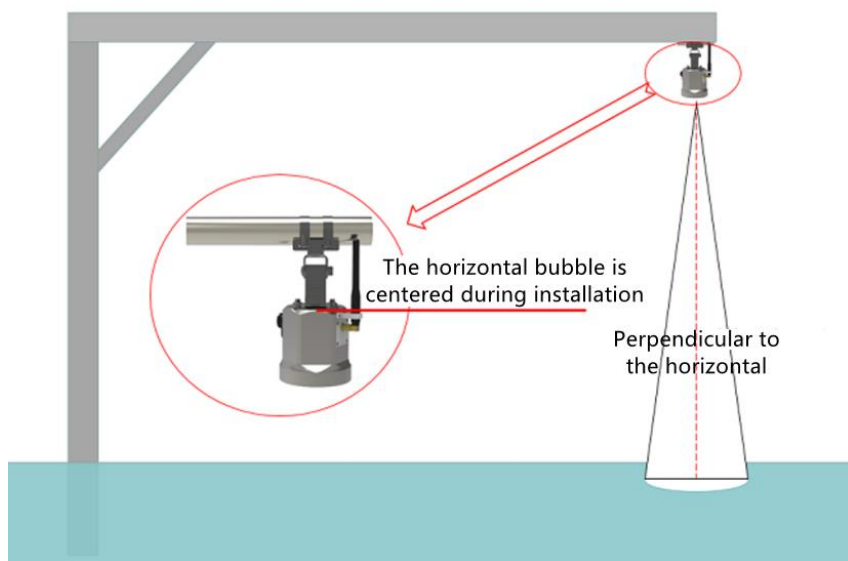

The horizontal bubble is centered during installation

Perpendicular to the horizontal

Schematic diagram of radar water level gauge installation

This product is an algorithm upgrade product, which can be used in depth measurement of narrow pipes or wells.

After the installation is completed, it is necessary to ensure that the radar detection plane of the water level gauge is parallel to the

horizontal plane. When installing, it is best to use reference tools (for example, the bubbles in the level gauge on the radar water level gauge should be adjusted to the center during installation), and ensure that the installation height of the radar water level gauge is within the measuring range;

The selection of installation points should follow the following main principles:

1) The canal is straight, the canal foundation is fixed, and the section is regular and stable, which is convenient for equipment installation;

2) The water flow is smooth and uniform, and is not affected by vortex, gate opening and closing and backwater of canal system buildings;

3) Avoid installing in the position where there is water level drop and water surface churning;

4) There should be no buildings, trees or weeds that affect the water flow near the section, and they will not be affected by the discharge when downstream of the building.

4 Serial communication protocol

Our company provides four communication modes for RD-300s series: RS232, RS485, wireless transmission (optional), 4-20mA (reserved), and the default communication mode of equipment is RS485.

Communication protocols include standard Modbus-RTU and ASCLL (Personalized Customization).

4.1 Modbus-RTU communication protocol

The communication mode of Modbus protocol is single master station/multiple slave stations. Only the master station can issue queries (queries). The slave station executes the processing of the query request and replies the response information.

4.1. 1 Modbus-RTU transport mode

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

Frame description:

Device address	Function code	Data	CRC
			2 bytes
1 byte	1 byte	0 ~ 252 bytes	
			Low CRC High CRC

Message frames are distinguished by idle intervals with a duration of at least 3.5 characters, which is called T3.5. This module adopts standard T3.5 as idle interval distinction. The schematic diagram of RTU frame transmission idle interval distinction is as follows
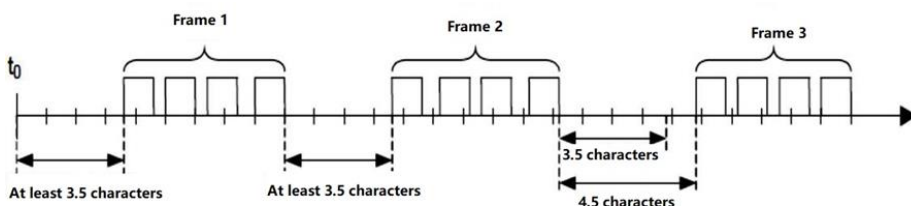
If the idle interval between two characters is greater than 1.5 character time, the message frame is considered incomplete and should be discarded by the receiving node. This idle time is called T1.5, and this module adopts the standard T1.5 time. Schematic diagram of abnormal frame idle interval determined by RTU frame transmission is as follows
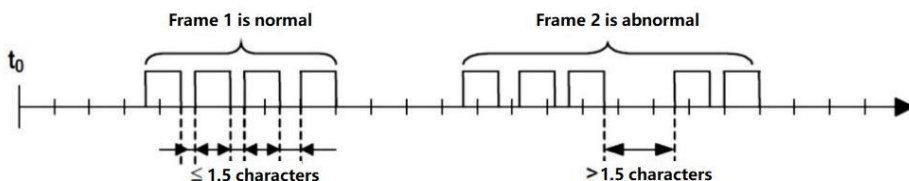
4.1. 2 Modbus-RTU data model

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	Read-only	I/O systems provide this type of data
Hold register	16-bit word	Read and write	Changing this type of data through an application

4.1. 3 Modbus-RTU Common Function Codes

	Function code name	Function code
16-bit access	Read input register	0x04
	Read hold register	0x03
	Write a single hold register	0x06
	Write multiple hold registers	0x10

4.1. 3.1 Read Hold Register (0x03)

Read and hold the current value of register 0x0007 baud rate.

Request message (hexadecimal)

Slave address	Function code	Register address	Number of registers	CRC check value
80	0x03	00 07	00 01	2B DA

Response message (hexadecimal)

Slave address	Function code	Number of bytes	Register value	CRC check value
80	0x03	02	00 01	Slightly

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

The current baud rate value is 1 (9600bps).

4.1. 3.2 Read Input Register (0x04)

Read the value of the input voltage in the input register 0x0005.

Request message

Slave address	Function code	Register address	Number of registers	CRC check value
80	0x04	00 05	00 01	3F DA

Response message (hexadecimal)

Slave address	Function code	Number of bytes	Register value	CRC check value
80	0x04	02	00 78	Slightly

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

The current input voltage value is 0x0078 (you need to convert 0x0078 to decimal 120, and then reduce it ten times, that is, 120/10=12V).

4.1. 3.3 Writing a single hold register (0x06)

Set the baud rate of Register 0x0007 in slave address 0x80 to 0x01 (9600bps).

Request message (hexadecimal)

Slave address	Function code	Register address	Register value	CRC check value
80	0x06	00 07	00 01	E7 DA

Response message (hexadecimal)

Slave address	Function code	Register address	Register value	CRC check value
80	0x06	00 07	00 01	E7 DA

4.1. 3.4 Write multiple hold registers (0x10)

Set the slave address to 0x80, keep register 0x0005, set the filtering times of water level gauge, keep the distance from water level gauge to the bottom of canal in register 0x0006 to 0x64 (need to convert 0x64 into decimal 100, and then reduce it by 100 times, that is, 100/100=1. 0 m), and keep register 0x0007 to set serial baud rate.

Request message (hexadecimal)

Slave address	Function code	Start address	Number of registers	Number of bytes	Register value	CRC check value
80	0x10	00 05	00 03	06	00 05 00 64 00 01	47 CF

Response message (hexadecimal)

Slave address	Function code	Start address	Number of registers	CRC check value
80	0x10	00 05	00 03	Slightly

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

4.1. 4 Cyclic Redundancy Check (CRC)

CRC is one of the most commonly used error check codes in the field of data communication. Its characteristic is that the length of information field and check field can be arbitrarily selected (CRC-16 check code agreed by standard modbus is used).

Use of CRC-16 check code:

According to Modbus protocol, the message transmission form of conventional RS485 communication is as follows:

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

CRC check is the check value of the previous data content, which is a 16-bit data. When sending, the lower 8 bits are in front and the higher 8 bits are last.

The receiver uses the same calculation method to calculate the check code of the information field, and compares the received actual check code. If it is equal, the information is correct, and if it is not equal, the information is wrong.

CRC-16 check code calculation method:

* pucFrame is the first address of the data to be verified, and usLen is the length of the data to be verified. The return value is the verification result.

USHORT usMBCRC16 (UCHAR * pucFrame, USHORT usLen)

{

```
UCHAR uCCRCHi = 0xFF;
UCHAR uCCRCLO = 0xFF;
Int iIndex;
While (usLen--)
{
IIndex = UCCCLO ^ * (pucFrame + +);
UCCRCLO = (UCHAR) (UCCRCHI ^ ACCRCHI [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 auCCCLO [] = {
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

};

4.1. 5 Communication Anomaly Response

When the master station device sends a request to the slave station device, the master station wants a normal response. The query from the master station may lead to one of the following four events:

If the slave device receives a communication error-free request and can process the query normally, the slave device will return a normal response.

If the slave station does not receive the request due to a communication error, the response cannot be returned. The master program will be treated as timeout.

If the slave station receives the request but detects a communication error (parity, CRC …), the master station program will be treated as timeout if it cannot return.

If the slave device receives a request without a communication error, but cannot process the request (for example, if a request is made to read a nonexistent input register), the slave will return an exception response informing the client of the cause of the error.

The abnormal response message has two different fields from the normal response message:

Function code field: In the normal response, the function code of the original request is assigned from the function code field standing in the response. All function codes have an MSB of 0 (their values are all lower than hexadecimal 80). In the exception response, the slave station sets the MSB of the function code to 1. This causes the function code value in the abnormal response to be 80 hexadecimal higher than the function code

Value in the normal response.

Exception co	Exception name	Describe
01	Illegal function code	Function code unrecognized, not within 0x00 ~ 0x0F
02	Illegal data address	Data address beyond definition
03	Illegal data value	Values outside of register storage
04	Slave equipment	Generate non-retrievable errors

Slave address	Function code	Exception code	CRC check value
80	0x86	01	D3 88

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

In the exception response, the exception code is returned from the standing data field. This explains the cause of the exception. The abnormal response message of all supported function codes is the function code plus 0x80.

All abnormal function codes are 0x83, 0x84, 0x86, 0x88, 0x90 and 0x97.

The abnormal response message corresponding to function code 0x06 is as follows:

4.1. 6 Terminal resistance

In the process of network construction, if the network terminates the embedded connection with other Modbus devices, it is necessary to access a terminal matching resistor of 120 ohms at the end of the network.
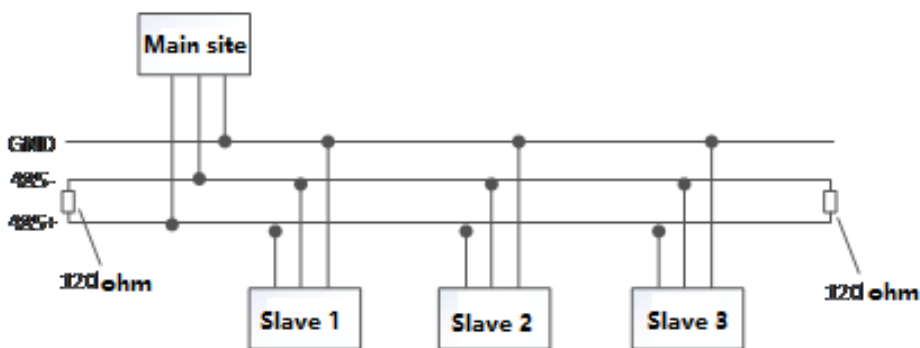
5. Equipment debugging

5.1 Device Address

The device address can be set from 1 to 200 by setting the value of the hold register address 0x0008. The factory default slave address is 0x80. Slave address is automatically saved after successful setting (it can be set by professional debugging software of our company, please refer to Appendix A for details).

Example of setting the current device address (for example, 0x80) to 0x01

Request message sent (hexadecimal)

Slave address	Function code	Register address	Register value	CRC check value
80	0x06	00 08	00 01	D7 D9

Response message (hexadecimal)

Slave address	Function code	Register address	Register value	CRC check value
80	0x06	00 08	00 01	D7 D9

When the device address is forgotten, the device address can be specified as 0xFF, and the real address of the device can be obtained by querying the register address 0x0008 through Modbus Protocol 03 function code. Using this method to query the device address, only one device can be connected to the Modbus bus.

Example of querying equipment address

Request message sent (hexadecimal)

Slave address	Function code	Register address	Register value	CRC check value
FF	0x03	00 08	00 01	10 16

Response message (hexadecimal)

Slave address	Function code	Number of bytes	Register value	CRC check value
80	0x03	02	00 80	Slightly

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

The register value 0x0080 in the response message is the real device address of the device.

5.2 Noise Threshold

The noise threshold is used to set the signal extraction threshold. If the signal strength of the equipment (obtained through the input register) is lower than the set value, it is considered that noise will not be picked up. This item usually does not need to be adjusted, but can be done according to the factory default. When the installation distance is long, the signal is weak, so it needs to be adjusted according to the field signal strength. The threshold value of water level gauge should not be less than 200. The register for setting the water level gauge noise threshold is 0x0004.

Example of setting the noise threshold of water level gauge to 500

The request message sent (the response message is the same as

the request message)

Slave address	Function code	Register address	Register value	CRC check value
80	0x06	00 04	01 F4	D6 0D

5.3 Filtering times

The larger the filtering times, the smaller the numerical fluctuation, the more stable the measurement results and the weaker the real-time performance. Normal default will do. Set the register of filtering times of water level gauge to 0x0005.

Example of setting the filtering times of water level gauge to 5

The request message sent (the response message is the same as the request message, both in hexadecimal)

Slave address	Function code	Register address	Register value	CRC check value
80	0x06	00 05	00 05	47 D9

5.4 Measuring Time

A stable value will be measured in about 10s, and the intermittent power supply mode suggests that the power supply time should be longer than or equal to 15s.

5.5 Measurement results

The measurement results are stored in both the hold register and the input register, and can be read through the Modbus protocol

0x03 or 0x04 function code (0x04 function code is recommended to read the input register). Read the relevant registers through a debug assistant (such as MODBUS debug assistant), and note that the read value is hexadecimal, so it needs to be converted to decimal for convenience of calculation.

For example, we have installed a radar water level gauge at the site, and set the equipment address of the radar water level gauge, the distance from the water level gauge to the bottom of the sink, the filtering times of the water level gauge, etc., and the radar water level gauge also works normally. At the scene, if we want to know the installed radar water level gauge, how many meters is the water level measured at the scene? Then we use the 0x03 or 0x04 function code to read the data value from the 0x0001 register. Assuming that we read the data value of 0x7B (hexadecimal), and the conversion of 0x7B to decimal is 123, the actual water level needs to be reduced by 1000 times (0.123 m).

It should be noted here that the values stored in the register are all enlarged values (the column of "Description" in the following table describes that the values stored in the register are enlarged), so the extracted values should be reduced by the corresponding multiple. (Note: The waiting time for each query command is 100ms)

Function	Register address	Unit	Description
Water level	0x0001	M	It has been magnified 1000 times
Air height	0x0002	M	It has been magnified 1000 times
Water level signal intensity	0x0003	/	/
Noise threshold of water level gauge	0x0004	/	/
Filtering times of water level gauge	0x0005	/	/
Distance from water level gauge to bottom of flume	0x0006	M	It has been magnified 100 times
Serial port baud rate	0x0007	/	/

Read through 0x04 function code and input register address as follows

Function	Register address	Unit	Description
Water level	0x0001	M	It has been magnified 1000 times
Air height	0x0002	M	It has been magnified 1000 times
Water level signal intensity	0x0003	M	It has been magnified 1000 times
Fault information	0x0004	/	Reserved
Input voltage	0x0005	/v	It has been magnified 10 times
Version number	0x0006	/	/

In order to deal with the decimal part, the water level and empty

height are enlarged, and the value needs to be reduced. For example, if the read water level is 1000, the real water level is 1m.

Example of reading a single input register through 0x04 function code (reading water level)

Request message sent (hexadecimal)

Slave address	Function code	Start address	Number of registers	CRC check value
80	0x04	00 01	00 01	7E 1B

Response message (hexadecimal)

Slave address	Function code	Number of data bytes	Register value	CRC check value
80	04	02	0B B0	Slightly

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

0x04 function code can read several continuous registers, and all measurement results can be read through 0x04 function code for example

Request message sent (hexadecimal)

Slave address	Function code	Start address	Number of registers	CRC check value
80	04	00 01	00 09	7F DD

Response message (hexadecimal)

Slave address	80
Function code	04
Number of data bytes	1A
Water level	00 7B
Air height	00 7B
Water level signal intensity	07 D0
Noise threshold of water level gauge	01 F4
Filtering times of water level gauge	00 05
Distance from water level gauge to bottom of flume	00 64
Fault information	00 00
Input voltage	00 78
CRC check value	Slightly

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

6 Register List

Maintain register list

Address Hexadecimal	Name	Describe	Data range	Default value	Read-write status
01	Water level	Unit: m Magnify the water level by 1000 times	0 ~ 65535	0	Read-only
02	Air height	Unit: m Amplify the empty height value by 1000 times	0 ~ 65535	0	Read-only
03	Water level signal intensity	Current signal strength of water level	0 ~ 65535	0	Read-only
04	Noise threshold of water level gauge	Noise threshold of water level gauge	0 ~ 65535	500	Read and write
05	Filtering times of water level gauge	Set the filtering times of water level gauge	0 ~ 65535	5	Read and write
06	Distance from water level gauge to bottom of flume	Unit: m Support decimal and write after magnification of 100 times	0 ~ 65535	0	Read and write
07	Serial port baud rate	0x01: 9600 0x02: 19200 0x03: 56000 0x04: 115200	1 ~ 4	1	Read and write
08	Device address	Set/read device address	1 ~ 200	0x80	Read and write
09	Dormancy time	Unit: Minutes Dormancy time after measurement in a single measurement cycle	0 ~ 65535	0	Read and write
0A	Fault information	Reserved	-	-	-

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0B	Input voltage	Unit: V Input voltage value after 10 times amplification	0 ~ 65535	0	Read-only
0C	Software version number	Software version number High 8 bits plus low 8 bits combination For example, the version number corresponding to 0x0102 is V1.2	0 ~ 65535	0	Read-only
0D	Restore factory settings	0x01: Restore factory default settings	0 ~ 1	0	Read and write

Input register list

Address Hexadecimal	Name	Describe	Data range	Default value
01	Water level	Unit: m Magnify the water level by 1000 times	0 ~ 65535	0
02	Air height	Unit: m Amplify the empty height value by 1000 times	0 ~ 65535	0
03	Water level signal intensity	Current signal strength of water level	0 ~ 65535	0
04	Fault information	Reserved	-	-
05	Input voltage	Unit: V Input voltage value after 10 times amplification	0 ~ 65535	0
06	Software version number	Software version number High 8 bits plus low 8 bits combination For example, the version number corresponding to 0x0102 is V1.2	0 ~ 65535	0

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7 Technical parameters

Water level measurement	
Measuring range	0.2-20m
Measurement accuracy	± 2mm
Resolution	1mm
Radar antenna	Planar microstrip array antenna
Dormancy time	0-18h, settable
Radar frequency	80GHz
Radio wave emission angle	8 °

Other parameters	
Power supply range	7-32V DC
Digital interface	RS232\ RS485\ 433MHz (Optional)
Analog output	4-20mA
12V power supply energy consumption	Operating mode, ≤ 26mA Low power (sleep) mode, ≤ 1mA
Shell material	Aluminum alloy shell
Protection level	IP68
Operating temperature	-40 ℃-85 ℃
Storage temperature	-40 ℃-85 ℃
Lightning protection	Lightning protection level 6KV
Dimensions (mm)	89 x 90 (mm)

8 Warranty

The supplier guarantees that the RD-300s series instruments have no defects in terms of performance and quality when they are sold. For problems that occur during use, the instruments that are abnormal under the correct use conditions can be repaired or replaced according to different situations.

Before the instrument needs to be repaired, please contact the supplier first; the returned product must be well packaged to ensure that the instrument is not damaged due to transportation.

8.1 Warranty period

The free warranty period enjoyed by users is one year (calculated from the date of purchase). For instruments beyond the warranty period, the company will provide paid repairs.

8.2 Warranty scope

During the warranty period, the company only repairs products that fail under correct usage conditions for free.

Failures caused by the following conditions are not covered by the warranty:

-overdue warranty;

-Failure to comply with the requirements of the product instruction manual, use, maintenance and cause damage;

-Damage caused by disassembly by a repairer not authorized by the company (dismantling and repairing privately);

-Other non-quality causes such as natural disasters, mechanical damage, etc.

9 Failure analysis

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

A: 1) Check whether the power supply voltage is within 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) Whether the device is in low power consumption mode, in low power consumption mode, the host computer needs to send instructions to wake up and transmit.

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

A: 1) Confirm whether the radar transmitter probe is vertically aligned with the measurement target;

2) Whether the measurement distance is within the reasonable range of the probe test;

3. Q: Why does the measured value jump frequently and drastically?

A: 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 emission wave is perpendicular to the horizontal plane

4. Q: Why is the measured value stable for a long time without any fluctuations?

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

2) Check whether the measurement is inaccurate due to the low water period or the swing of the main tank causing the radar wave to cover the ground.

5. Q: The RD-Lite radar wave water level measurement system software cannot be connected to the water level gauge.

A: 1) The water level gauge adopts the RS-485 interface by default, check whether the RS-485 receiver is used for receiving;

2) Check whether the serial port number of the device is correct;

3) The default device address of the water level gauge is 0x80, and whether the device address is set to 0x80;

4) Whether the water level gauge is normally powered;

5) Whether to click to start measurement.

Appendix A RD-Lite radar wave water level measurement system manual

1. Software Installation

Open the installation package and install the software

Alibaba website: https://hondetec.en.alibaba.com/
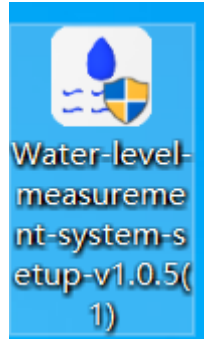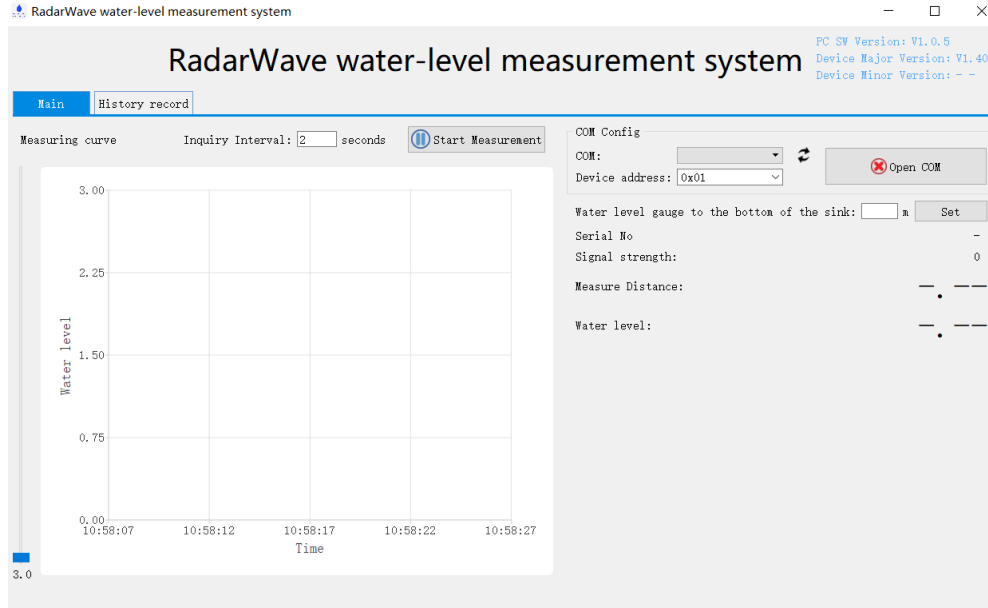
2. Main Menu

Figure 4 Main menu interface

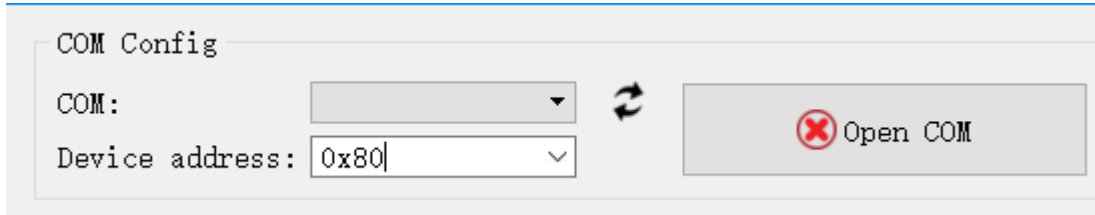Alibaba website: https://hondetec.en.alibaba.com/

3. Serial port settings

Figure 5 Serial port selection

Select the device serial port number, device address (the default device address is: 80 (HEX)) and connection method, click to open the serial port.

4. Water level gauge setting

Figure 6 Device menu

The water level gauge setting can set the internal registers of the water level gauge. For the specific register description, please refer to the water level gauge manual. After modifying the parameters, click the write button on the right to write, and there will be a prompt in the lower left corner of the software if the write is successful.

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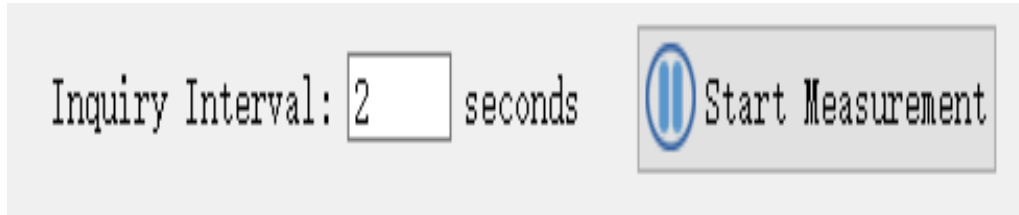
5. Start measuring

Figure 7 Measuring button

The measurement can be performed after opening the serial port, and the installation height needs to be set before starting the measurement. The query interval on the left side of the measurement is the interval time for the software to obtain data from the instrument. The query interval should be an integer greater than 0. Click the start measurement button to start the measurement.
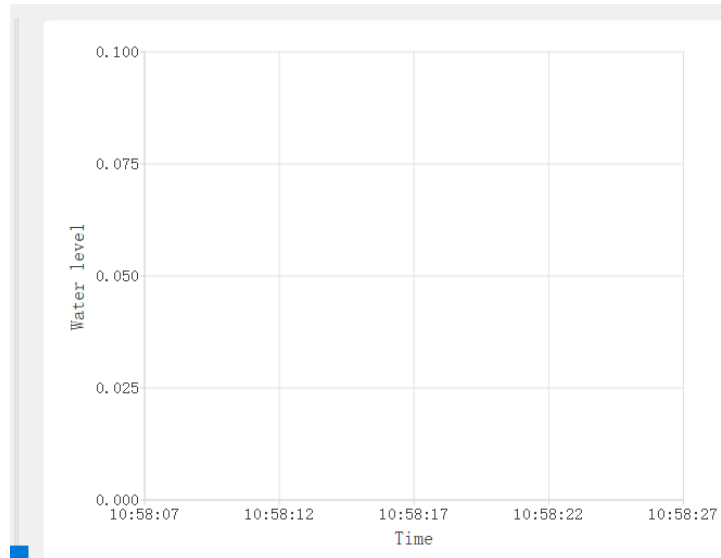
6. Water level curve

Figure 8 Water level curve

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The abscissa of the water level curve is the current system time, and the ordinate is the current water level. Each point on the curve represents a water level value. Place the mouse on the curve point to view the detailed information of each point.
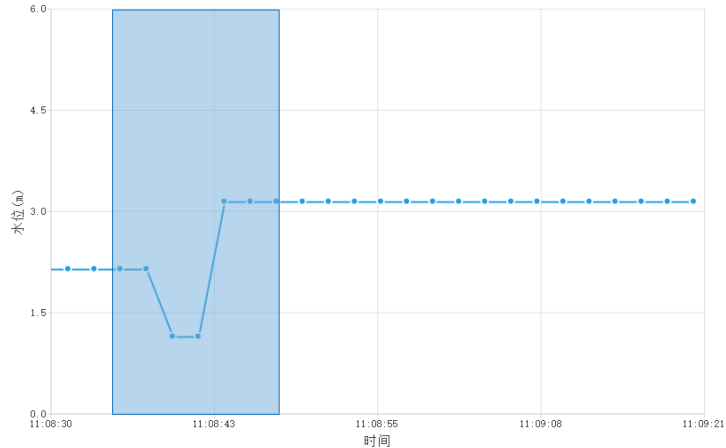

Figure 9 Curve detail view

Click the right mouse button to reduce the abscissa of the curve, and select a certain area with the left mouse button to enlarge the currently selected area.
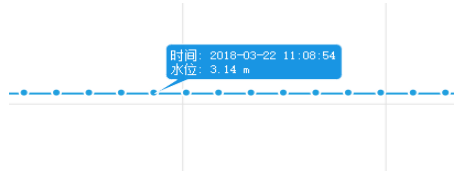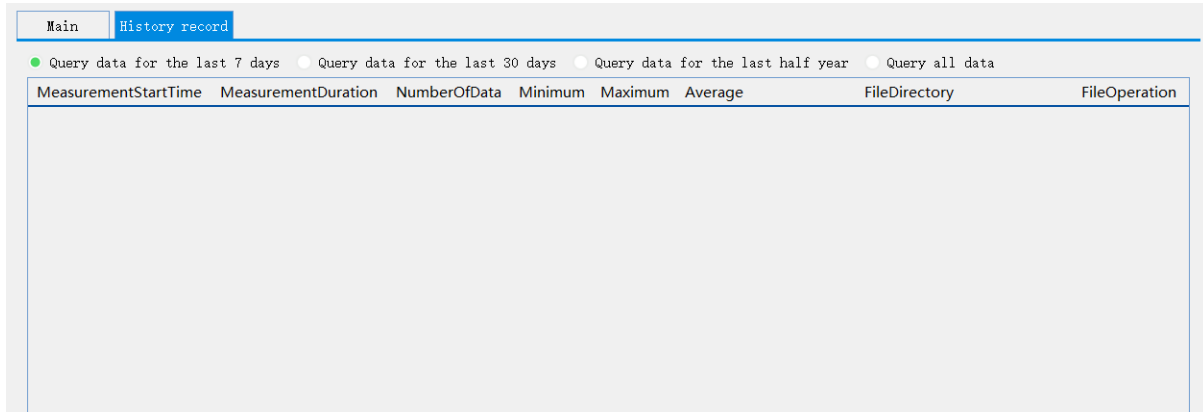
Figure 10: Curve zoom

7.History

Attached Figure 13 History Record Interface

List of historical data

The historical data interface lists the historical measurement records in detail. The main interface will generate a measurement record every time the measurement is started and then closed. The measurement data of the last 7 days is displayed by default. You can select the data to be queried by selecting the radio button above.

Click the button on the right of each row to delete a row of measurement data.

1. Detailed information

Click the row in the list to view the detailed information of the current measurement.
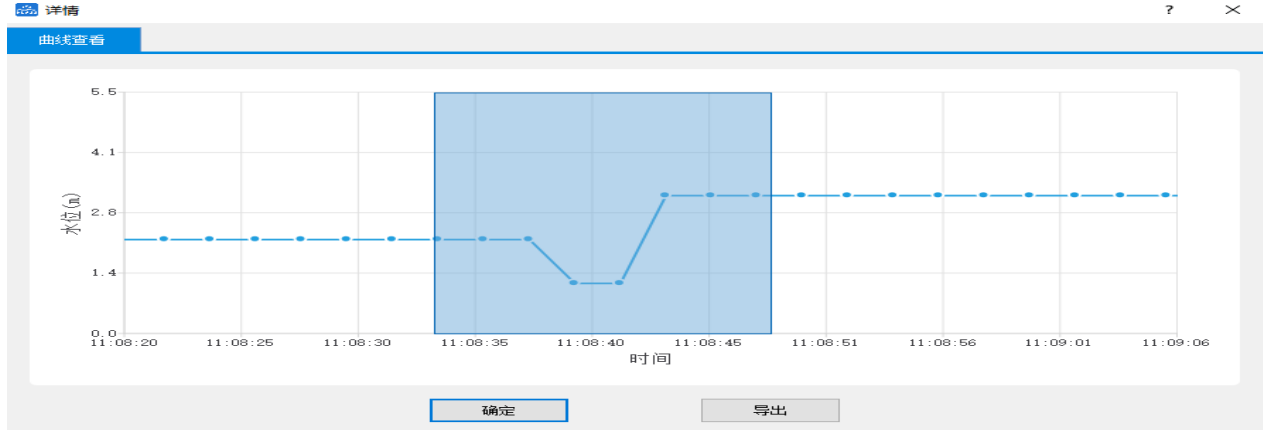

Figure 15 List interface details

Place the mouse on the curve point to view the detailed information of each point, click the right mouse button to reduce the horizontal coordinate of the curve, and select a certain area with the left mouse button to enlarge the currently selected area.
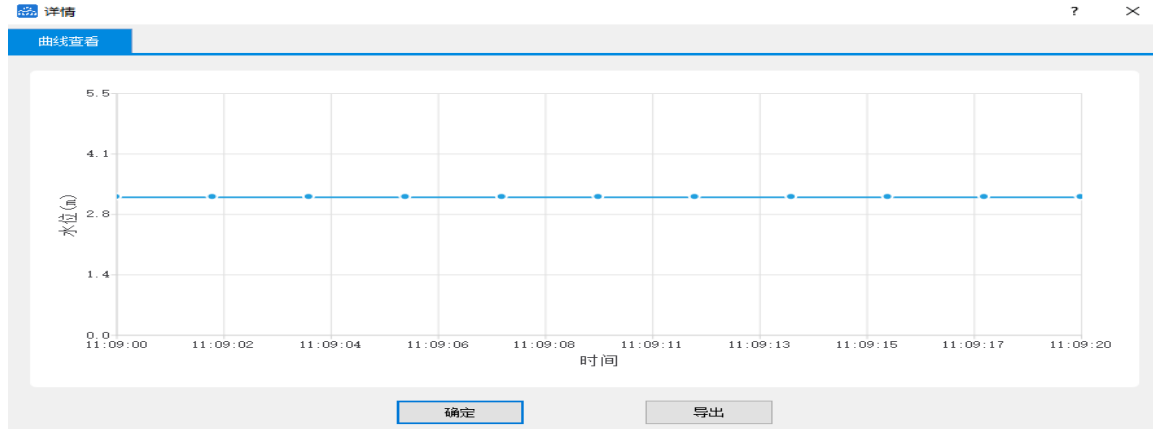

Figure 16 Zoom in details of waveform data

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Click the export button below to export the detailed data of the curve to Excel, click export and select the destination folder, and select the save type to choose to save as .xml or .xls file format.

Figure 17 Data export and save

Appendix B

Table 4 System component table

	Product name	Specification Quantity Remarks	Specification Quantity Remarks	Specification Quantity Remarks
1	Radar water level gauge		1	
2	Cable with plug		1	
3	Mounting brackets, screws, clamps		1	
4	Product Manual		1	
5	Warranty card, certificate of conformity		1	

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Radar Water Level Gauge

Product specification

RD-306

Acknowledgement

First of all, I would like to express my heartfelt thanks to you for choosing our products!

RD-306 is a non-contact integrated radar water level gauge/open channel flowmeter designed by our company with high precision, low power consumption and high integration. This product integrates power supply battery, high-precision radar level gauge, RTU data transmission unit, Bluetooth parameter adjustment, temperature measurement and other functional units, and can be used for liquid level and flow measurement in various industries. Its discharge measurement principle is based on the water level-discharge relationship of standard weir channel or calibration curve, By accurately measuring the liquid level, the instantaneous flow rate and cumulative flow rate of the output section are converted. The liquid level measurement adopts high-precision pulse coherent radar (PCR) technology, which has higher measurement accuracy, lower power consumption and ultra-small volume compared with the traditional pulse radar liquid level gauge. At the same time, because 60G submillimeter radar wave is used as carrier signal, it has the characteristics of non-contact, high precision, small volume and energy saving, which makes it free from corrosion, temperature gradient, air pressure, water vapor on water surface, bubbles in water and sediment during measurement. The optimized algorithm makes the measurement result more accurate.

In particular, we recommend that you read this manual before using the RD-306 Integrated Radar Water Level Gauge/Open Channel Flowmeter, so that you will have a better understanding of how to use this advanced measuring instrument. This manual details the use, maintenance and precautions of RD-306 integrated radar water level gauge/open channel flowmeter.

Instructions for use

✧ **Matters needing attention and restrictions on use**

Note: Please use our products correctly (according to the text shown) and fully observe the following precautions, so as not to cause harm to the instrument and human body.

Legend:

⚠Note: Attention/Warning

Matters needing attention in the process of transportation, use and maintenance must be carefully read.

Matters needing attention are as follows:

✧ **Operating environment and matters needing attention in electricity consumption**

⚠ Warning: Do not use this instrument in places where flammable and explosive gases are or may be present.

⚠ Caution: Do not touch the water surface or put the instrument into the water.

⚠ Caution: Do not place the instrument at extreme temperatures and avoid static electricity.

✧ **Instrument operation**

⚠ Caution: No matter in the use, storage or transport of the instrument, should be taken and placed carefully, do not fall damage.

⚠ Note: The installation and setting of this integrated radar water level gauge/open channel flowmeter can only be installed and operated by professional technicians.

⚠ NOTE: Please do not disassemble or alter the integrated radar water level gauge/open channel flowmeter, otherwise there will be no warranty.

⚠ Note: If the instrument breaks down, please hand it over to our company for after-sales maintenance, please do not disassemble and assemble without permission!

✧ **Instrument components**

⚠Warning: This instrument is not equipped with internal spare parts, and it is not allowed to disassemble the instrument parts without authorization.

✧ **Hazardous substance management**

⚠To discard RD-306, please comply with the Hazardous Substances Management Regulations and treat it as waste electronic/electrical products.

⚠Warning: Do not throw used instruments into classified waste or municipal garbage.

✧ **Use restriction regulations**

The design of RD-306 meets the requirements of routine and safety.

✧ **Declaration**

The design of RD-306 meets and complies with the requirements of low voltage index.

1 product introduction

1.1 Product Profile

RD-306 integrated radar water level gauge/open channel flowmeter is independently developed by our company. It adopts FMCW technology and takes 60G mm radar wave as carrier signal. The product has high measurement accuracy, low power consumption, small size and light weight; The measurement process is not affected by environmental factors such as temperature, air pressure, sediment, dust, river pollutants, floating objects on the water surface, air, etc., and has good wind-proof and anti-shake ability; The optimized algorithm makes the measurement results more accurate and stable.

RD-306 has built-in integrated RTU acquisition and uploading function and built-in Bluetooth function, which can set device parameters and view device measurement results through mobile APP.

1.2 Instrument characteristics

1. Product specification: φ 154 × 171. 4 (mm), weight 1.3 kg, which can be used for basic building facilities such as bridges or auxiliary facilities such as cantilever construction;

2. Sampling non-contact mode, the sensor does not contact with the measured fluid and does not interfere with the fluid flow pattern;

3. Millimeter-level high-precision measurement of liquid level and ultra-low blind area;

4. The measuring range is 0.2-3m/0.2-7m;

5. Built-in battery, ultra-low power sleep mode, 3 ~ 7 years working hours;

6. Remote parameter adjustment, configuration and upgrade can be debugged and maintained remotely without going to the site;

7. Bluetooth connection, on-site adjustable maintenance through mobile APP;

8. Small size, compact structure, compact and simple installation;

9. IP68 fully waterproof design, immersed in water will not be damaged;

10. Non-contact measurement, not affected by ambient temperature and humidity, and not corroded by water;

11. Multiple working modes: cycle, sleep, automatic;

12. The test data can be stored in excel type and can be downloaded by APP.

1.3 Basic measurement principles

RD-306 integrated radar water level gauge/open channel flowmeter adopts FMCW modulation mode and takes triangular wave as modulation signal. The working process is as follows: Firstly, a voltage modulation circuit generates a triangular wave voltage and inputs it to a VCO (Voltage Controlled Oscillator) to generate electromagnetic waves with varying frequencies. The frequency of electromagnetic wave changes according to the law of modulation voltage. The electromagnetic wave emitted by the antenna generates an echo after being reflected by the measured object. Electromagnetic waves are emitted from the beginning to the target. The radar transmission frequency has changed during the time period when it is reflected by

the target and then returned to the antenna. The radar antenna couples the echo signal with the transmitted signal to obtain a difference frequency signal. The distance and velocity information of the target are contained in the frequency of the difference frequency signal. Because the difference frequency signal is very weak, it needs to be processed by the preamplifier and filter circuit of radar sensor to send the signal to ADC (analog-to-digital converter) of MCU. MCU analyzes the waveform collected by ADC through FFT algorithm to get the difference frequency, and finally calculates the distance from the measured target to the sensor through the derived formula.

When the source of radar wave is relatively stationary with the target, the bandwidth of radar transmission frequency is B, the time of radar wave from transmission to return to radar antenna is Δt, the frequency of triangular wave is f, and the frequency of difference frequency signal is fd. The derivation is as follows: (S: range from radar plate to target, T: period of triangular wave)

$$\Delta t = \frac{2S}{c_0}$$

$$T = \frac{1}{2f}$$

$$S = \frac{f_d C_0}{4fB}$$

In the above formula, C_0 is the speed of light, F is the frequency of modulated triangular wave, B is the radar sweep bandwidth, and FD is the difference frequency signal obtained by MCU analysis, so the only FD can calculate the corresponding distance between radar plate and target.

1.4 Technical Specifications

1.4. 1 Equipment characteristics

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

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

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

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

5. Waterproof grade IP68, which effectively avoids damp of internal devices.

1.4. 2 Electrical characteristics

1. Built-in battery, ultra-low power sleep mode, 3 ~ 7 years working time;

2. The working current and standby current are low, and solar energy can be used for power supply, which is convenient for installation and maintenance-free;

3. Lightning protection circuit can protect against lightning by 6KV, and can effectively protect equipment from lightning strikes in thunderstorm days;

4. The test accuracy is high and the data is stable, which effectively ensures the accuracy of the test;
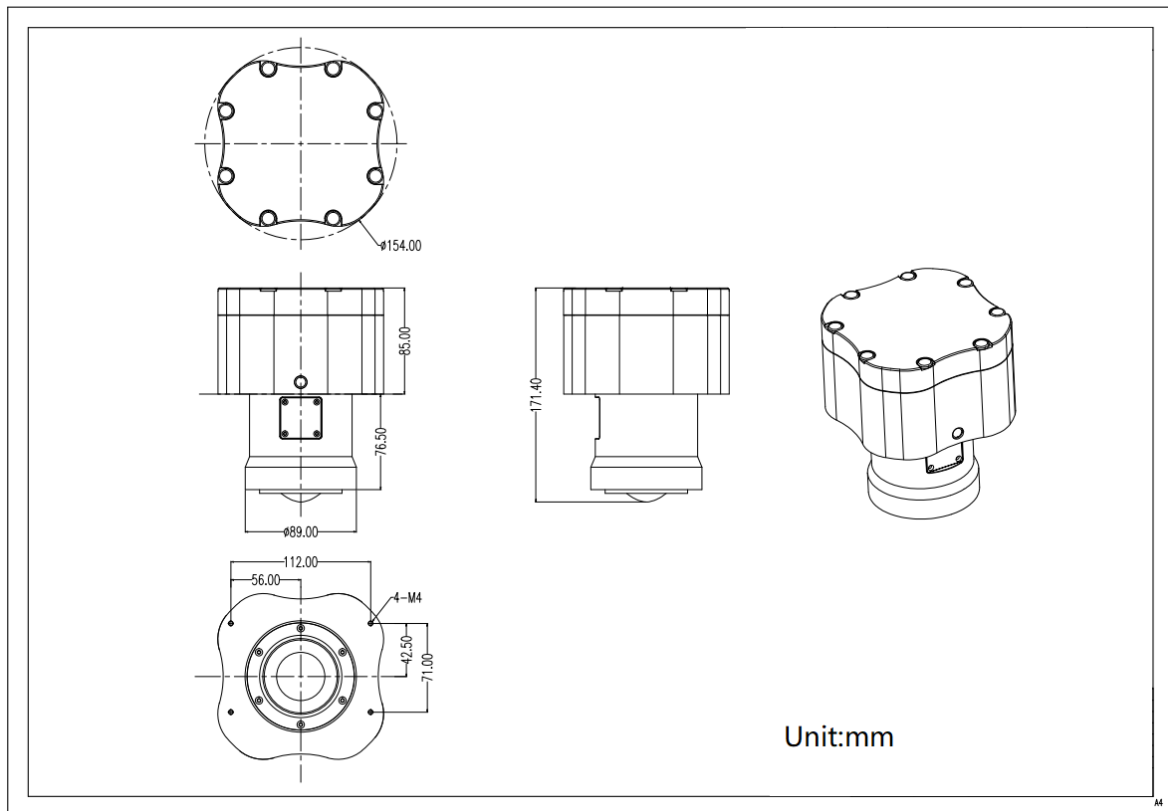
2 Product Installation

2.1 Instrument structure

Appearance of instrument:

RD-306 Integrated Radar Water Level Gauge

2.2 Appearance Dimensions of Instrument

2.3 Selection of measuring points

When choosing the installation site, it is necessary to ensure that the radar wave covers the water surface, avoid the influence of floating objects, vortices and aquatic plants, and avoid the error of radar wave covering the ground due to riverbed siltation and main trough swing in low water period, and the coverage area is approximately circular.

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

Installation height (M)	Water level gauge coverage diameter range (M)
0.2	0.028
0.5	0.07
1	0.14
2	0.28
3	0.42
5	0.7
7	0.98

After installation, it is necessary to ensure that the radar detection plane of water level gauge/open channel flowmeter is parallel to the horizontal plane. It is best to use reference tools when installing, and ensure that the installation height of integrated radar water level gauge/open channel flowmeter is within

the measuring range;

The selection of installation points should follow the following main principles:

1. The canal is straight, the canal foundation is fixed, and the section is regular and stable, which is convenient for equipment installation;

2. The water flow is smooth and uniform, and is not affected by vortex, gate opening and closing and backwater of canal system buildings;

3. The measuring section is perpendicular to the water flow direction;

4. There should be no buildings, trees or weeds that affect the water flow near the section, and they will not be affected by the discharge when downstream of the building.

3. Technical parameters

Parameter	
Measuring range	0.2 ~ 3m/0.2 ~ 7m
Measurement accuracy	± 2mm
Resolution	0.1 mm
Radar antenna	Pulse coherent radar
Radar frequency	60GHz
Radio wave emission angle	8 °
Battery specification	Built-in lithium battery
Upload cycle	0-24 hours, settable
Working hours	3-7 years (related to reporting cycle)
Wireless communication module	
Wireless configuration	Bluetooth (above standard 4.0)
Transmit/receive power sensitivity	+ 8dBm/-95dBm at 0.1% BER
Shell material	Black PC (UV-resistant)
Dimensions (mm)	φ 154 × 171.4 (mm)
Protection level	IP68
Operating temperature	-35 ℃-70 ℃
Storage temperature	-40 ℃-85 ℃
Lightning protection	Lightning protection level 6KV
Data download	APP Download