MANUAL
RADAR WATER LEVEL SENSOR

YANTAI RWLS

1.Product Introduction

1.1. Feature

The radar water level gauge series products refer to frequency modulated continuous wave (FMCW) radar products that operate at 76-81GHz. The maximum quantity of the product can reach 65m, with a blind spot of 10cm. Due to its higher operating frequency, larger bandwidth, and higher measurement accuracy. The product provides a bracket fixing method without the need for on-site wiring, making installation convenient and simple.

The main advantages of the radar level gauge series are as follows:
Millimeter wave RF chips achieve a more compact RF architecture, higher signal-to-noise ratio, and smaller blind spots.
The 5GHz working bandwidth enables the product to have higher measurement resolution and accuracy.
The narrowest 8 ° antenna beam angle minimizes the impact of interference in the installation environment on the instrument, making installation more convenient.
Integrated lens design with compact volume.
Low power operation, with a lifespan greater than 3 years.
Support Bluetooth debugging for mobile phones, facilitating on-site personnel maintenance work (later version support)

Features：
※ Integrated lens design with compact volume.
※ UV resistant material.
※ Work with data logger
※ Low consumption can work with solar energy
※ According for WMO NO:168
Application
※ Streams and rivers,Tidal zones,Reservoirs and lakes.
※ Environmental protection sewage, water resources monitoring
※ Surface waters prone to flooding

2. Technical data

measuring range	0. 1 m ~65m
measurement accuracy	±1mm
Resolution	1mm
Beam angle	6°
Power supply range	9~28 VDC
Communication method	RS485
working temperature	-40~75℃
Shell material	Stainless steel/PP
Antenna type	Lens antenna
Recommended cables	0.5mm ^{2}
Protection level	IP67
Installation method	Bracket/Thread
Cable entry	PG9

3. size

80

80

Ø8

10

5

5

120

Ø49

35

80

80

Ø8

30

Ø12

10

10

5

120

Ø60

35
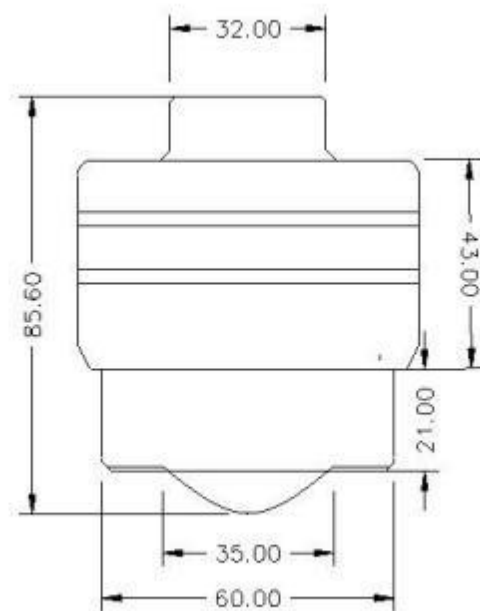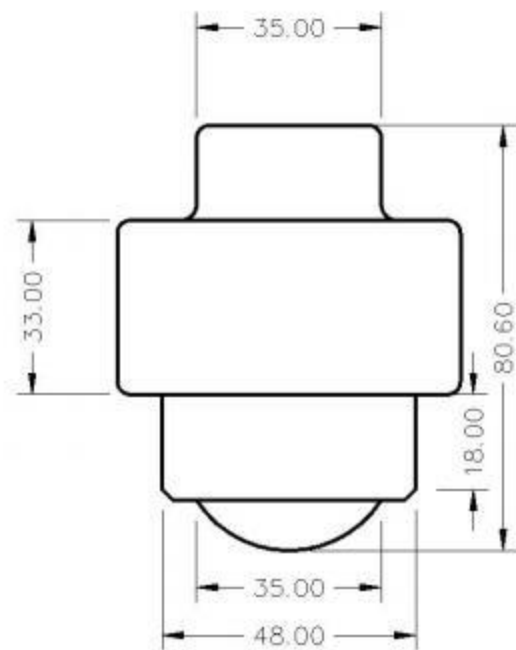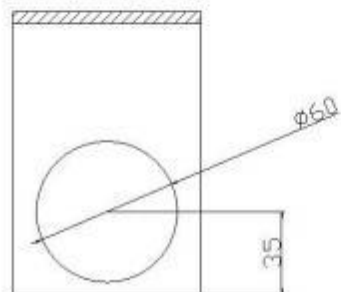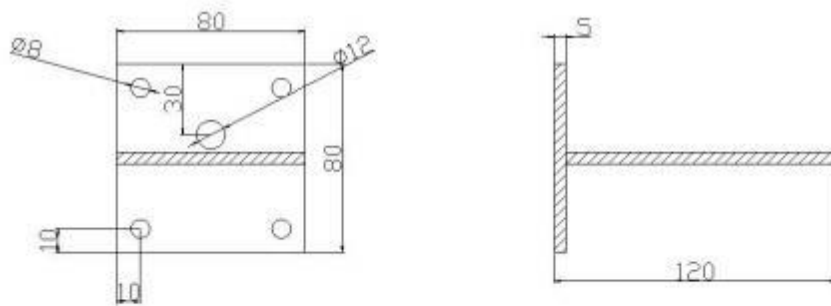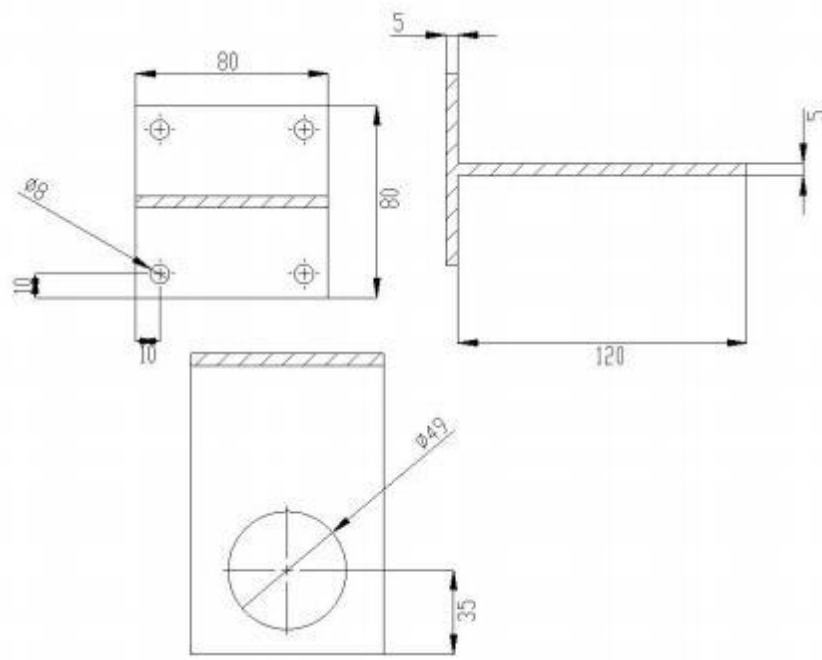
4. installation

Two points to pay attention to during installation: (1) Ensure that the instrument is perpendicular to the water surface; (2) Avoid emitting beams that illuminate interfering objects and generate false echoes. Please refer to the following points for typical operating conditions.
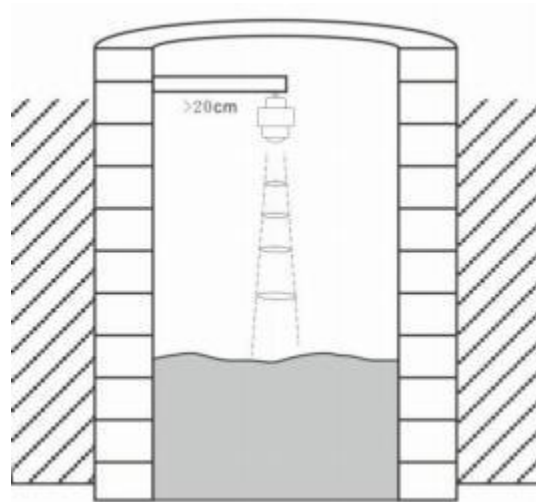
Ensure that the water level gauge is installed perpendicular to the water surface, and tilting will weaken the signal amplitude and affect normal ranging.
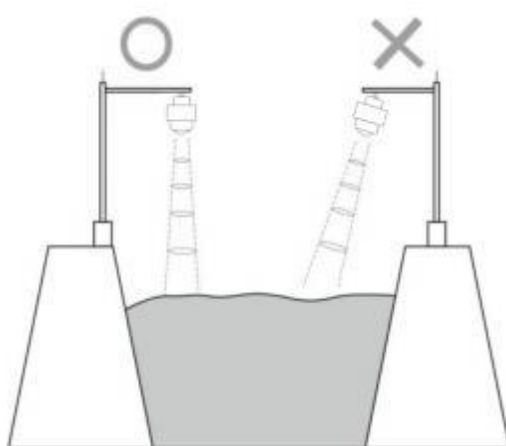
Ensure that there are no interfering objects within the beam range, such as the riverbank and shore
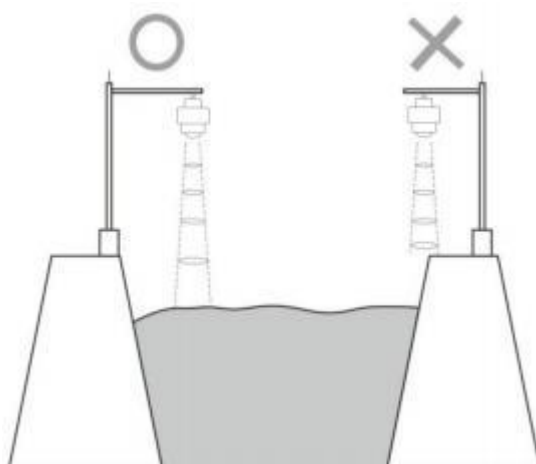
The installation of the instrument should be at least 20cm away from the side wall, and the installation of the underground pipe network should be as close as possible to the center of the well, otherwise the well wall is easy to produce interference signals, affecting the measurement and judgment

>20cm

5. Wiring

5.1

No.	color	备注
1	green	RS485A
2	yellow	RS485B
3	red	Power input positive pole
4	blue	Power input negative pole

When the user uses RS485 transmission, the liquid level gauge leads out 4 wires through a waterproof joint and connects the user's product according to the wire sequence in the figure. The length of the end wires in the figure can be customized according to user needs. Serial port parameters: RS458, baud rate - 9600, data bit -8, stop bit -1, check bit - none. Note that the power supply voltage of the equipment is within the range of 9V-28V, and it is recommended to use 12V power supply。

5.2   Upper computer communication

communication line
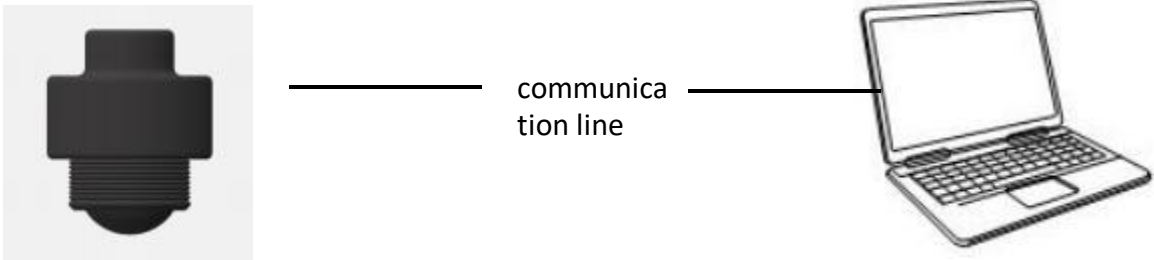
Firstly, connect the device correctly according to the above interface definition, and note that the power supply range of the device is 9V~28V

Step 2, connect the device to the computer using a 485 to serial cable

Step 3: Connect the 12V power supply, turn on the upper computer, and perform equipment adjustment

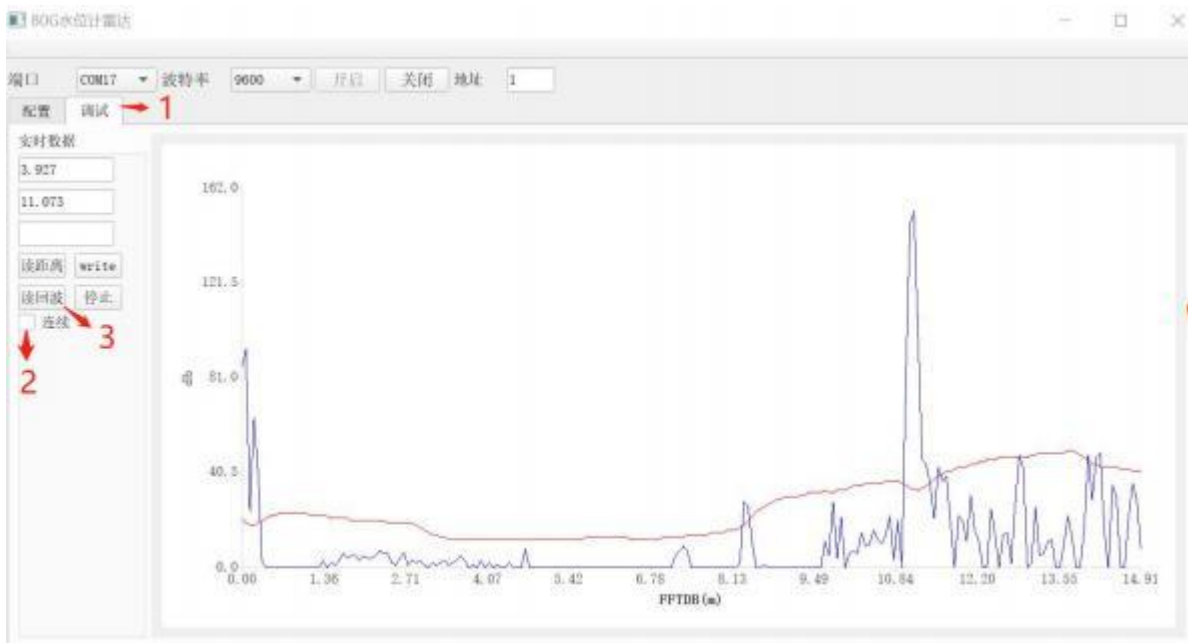## 6.3 PC Upper Computer Interface Description

6.3.1 Function Introduction
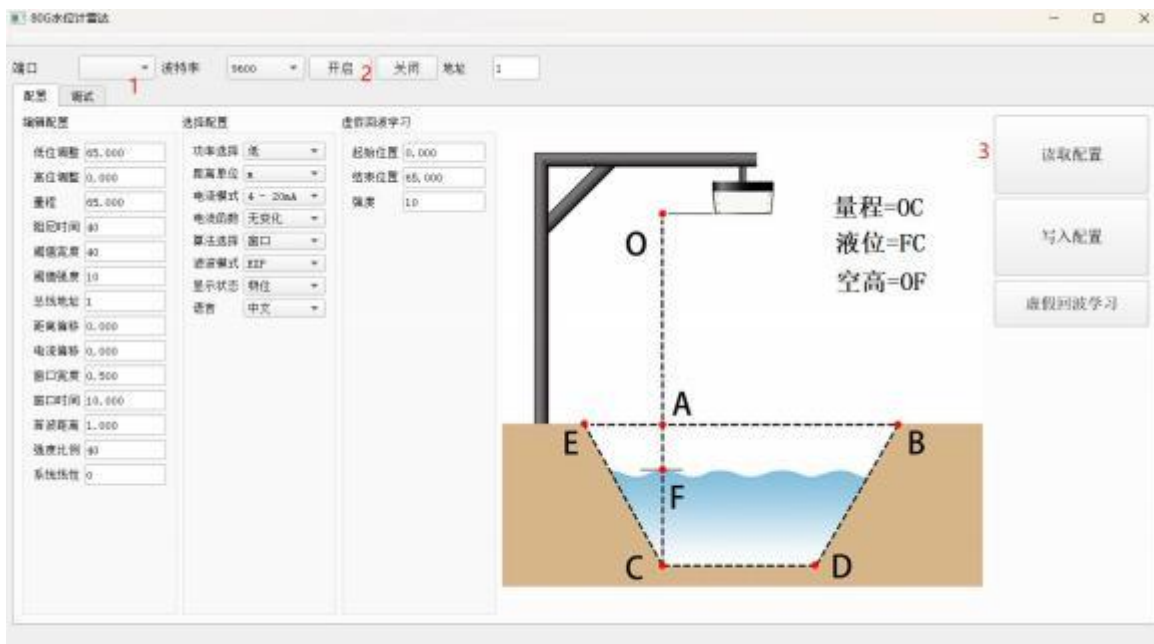
Configure the serial port parameters of the upper computer

Configure the serial port parameters in the order shown in the figure, with a baud rate of 9600. After successful connection, double-click "Read Configuration" to set and read the parameters。

6.3.2 Echo Profile

6.3.3 【Low adjustment】

【Low adjustment】That is, the low adjustment point. See the figure below for the specific definition.
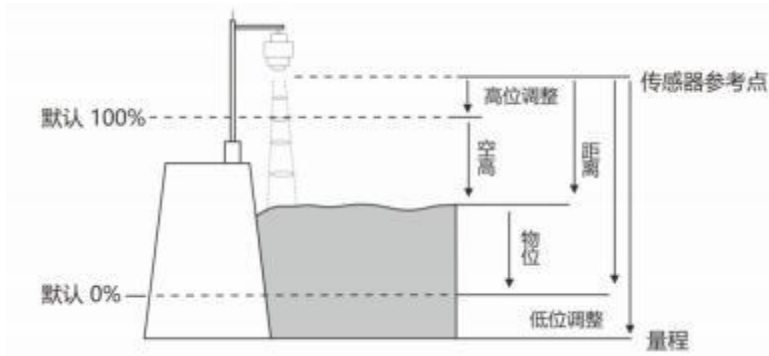
parameter name	Low adjustment
Parameter range (division)	0.1~Range
Default value (division)	sixty-five
Associated configuration	If the set low adjustment<high adjustment+0.1, then low adjustment=(high adjustment+0.1);
Special matters	The low adjustment point is independent of the range and only affects the calculation of the material level

6.3.4 【High level adjustment】

【High level adjustment】Refers to the high adjustment point, as shown in the figure for specific meanings

Parameter Name	High level adjustment
Parameter range (m)	0~(low adjustment -0.1)
Default value (m)	0
Associated Configuration	If the set high adjustment>(low adjustment -0.1), then high adjustment=(low adjustment -0.1);
Special matters	High level adjustment is not related to blind spot setting, but only affects the calculation of air height

6.3.5 【Range setting】

In order to obtain the correct measurement results, it is necessary to set the range range of the instrument, and the specific meaning is shown in the table below。

Parameter Name	range
Parameter range (m)	1-65
Default value (m)	fifteen
Associated Configuration	If the range is set to<(blind zone+0.1m), the range is automatically set to (blind zone+0.1m).
Option Meaning	When processing the algorithm, echoes outside the range will be ignored. Setting the range reasonably can avoid multiple reflection interference and possible interference signals outside the range.
Special matters	This range does not refer to the remote measurement limit of the instrument, but is only used to limit the algorithm area. Please refer to the technical specifications section for instrument measurement limits.

Note: The blind spot and range determine the specific range of algorithm application, which can be reasonably set to avoid interference and false echoes, achieving fast and stable measurement.

6.3.6 【Blind spot adjustment】

Please refer to the table below for specific meanings。

| Parameter Name	Blind spot
Parameter range (m)	0 ~ (low adjustment -0.1)
Default value (m)	0
Associated Configuration	If the blind zone set is>(range -0.1), then the blind zone=(range -0.1).
Option Meaning	When processing the algorithm, echoes within the blind area will be ignored, and this option can be used to avoid interference signals at the near end.
Special matters	This blind spot does not refer to the near end measurement limit of the instrument, but is only used to limit the algorithm area. Please refer to the technical specifications section for instrument measurement limits.

6.3.7 【Distance offset】

【Distance offset】The reference point used to correct the sensor. The default reference point of the instrument is adjusted to the position shown in point a in the following figure at the factory. If you want to adjust the reference point downwards to point b, enter h1 in the settings。
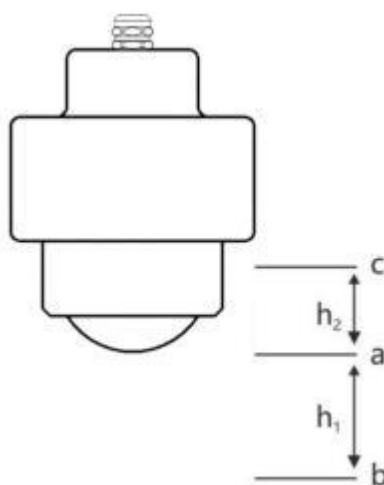
7. nomenclature

Beam Angle: Beamwidth bounded by 3dB below the maximum value. Series beam angle 6°, as shown in Figure 7-1。
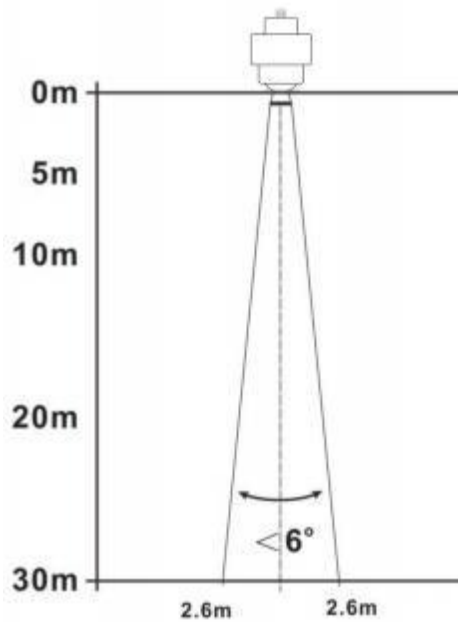
7-1图 仪表的雷达波束空间几何形状示意图

Distance resolution: Distance resolution refers to the distance between two objects that are close together. The level radar can distinguish two objects instead of one object and measure their respective distances. If the distance interval between two objects is less than the distance resolution of the level radar, then the radar can only measure one distance value, which is not equal to the distance value of any one of the objects, but the combination of the distance values of the two objects. The frequency modulation bandwidth of the product is B=5GHz, and the minimum distance resolution=speed of light/working bandwidth/2≈ 3cm.

Measurement accuracy: If there is only one object and the object moves a small distance, whether the level radar can identify the distance change. The metric that tells how far a single object has moved is called accuracy. The intermediate frequency signal is analyzed by its own algorithm, and the measurement accuracy is 0.5mm. Blind zone: (1) Refers to the measurement limit of the near end of the instrument. The instrument cannot measure in the blind zone.

Echo: The reflected signal received by the radar.

Transmission cone: The extension of the antenna beam angle.

False Echo: Any echo that is not produced by the desired target. Generally speaking, false echoes are generated by obstructions in the vessel. Multiple echoes: Multiple reflection echoes that appear at the target echo distance, possibly 2 or 3 times.

Measuring range: (1) Refers to the farthest measurement limit of the instrument (2) Special, refers to the farthest distance set artificially. Beyond this distance, the instrument does not consider it when processing data.

Repeatability: The degree of deviation in multiple measurements of the same variable under the same circumstances.

Threshold curve: a time-varying curve that serves as a threshold beyond which echoes are considered valid.

1. Communication protocol hardware interface parameters

The water level gauge adopts serial communication, and the default parameters are as follows：

communication parameters	Serial port level	BAUD/bps	Parity	Data length/bit	stop bit/bit
Serial port	485 USB	9600	none	8	1

The timeout time between each frame interval is 50ms。

2.Communication protocol format

The water level gauge adopts ModbusRTU communication protocol for external communication, with each complete data frame packet

Including: address field, function code, data, and verification. The number of CRC16 checksums that are verified as data frames

According to statistics, low bytes come first and high bytes come last. The factory default address of the water level gauge radar is 1.

The request command format and radar response data format are explained as follows:

（1）Query parameter format: Function code 0x03

Request：

Device Address	function code	start address	Number of Registers	CRC
（1 byte）	（1 byte）	（2 byte）	（2 byte）	（2 byte）

Reply：

Device Address	function code	data length	Register value	CRC
（1 byte）	（1 byte）	（1 byte）	（2xN byte）	（2 byte）

N: Number of Registers

(2) Set parameter format: Function code 0x10

Request：

Device Address	function code	start address	Number of Registers	data length	Register value	CRC
（1 byte）	（1 byte）	（2 byte）	（2byteN）	（1 byte）	（2N byte）	（2 byte）

Reply：

Device Address	function code	start address	Number of Registers	CRC
（1 byte）	（1 byte）	（2 byte）	（2 byte）	（2 byte）

3、 Communication protocol commands clearly stated

Offset Address	Command name	数据格式	单位
0	low adjustment	0-65000	mm
1	High adjustment	0-65000	mm
2	Measuring range	0-65000	mm
3	Damping time	0-100	None
4	threshold width	10-200	None
5	threshold intensity	0-200	Db
6	bus address	1-32	none
7	distance offset	-10000-10000	mm
8	Current offset	-10000-10000	mA/1000
9	window width	0-35000	mm
10	window time	0-65000	ms
11	first wave distance	0-35000	ms
12	intensity ratio	10-90	percentage
13	Material selection	0-liquid, 1-solid	
14	distance unit	0-m, 1-cm, 2-mm	
15	current mode	0- (4-20mA),1- (20-4mA)	
16	Current simulation	Default 0	
17	current function	0-no change, 1-22mA, 2-3.6mA	
18	Algorithm selection	0-window, 1-first wave, 2-intensity	Water level gauge selection 2
19	filter mode	0-EXP, 1-KEF	
20	Display state	0-material level, 1-empty height	
21	language	0-Chinese, 1-English	

Note: Each parameter occupies a register address, and the data is in U16 or I16 format.

For example：

The read low bit adjustment command is as follows：：

Device address	Function code	Starting address s	Number of registers	CRC
0x01	0x03	0x2000	1	（2 字节）

Write low bit adjustment command as follows：

Device address	Function code	Starting address s	Number of registers	Data length	Register value	CRC
0x01	0x10	0x2000	（2 byte N）	（1 byte）	（2N byte）	（2 byte）

CRC code calculation rules:

The reserved 16-bit register is hexadecimal FFFF (that is, all 1). Call this register bit CRC odd register;

Number one

An 8-bit data is XORed with the position of the 16-bit CRC register, and the result is placed in the CRC register:

Check if the lowest bit is 0, if so. Then shift the contents of the register one bit to the right (toward the lower bit) and fill the high bit with;

If it is 1, shift the contents of the register to the right by one bit (toward the lower bit), fill the high bit with times, so that the entire 8-bit data is processed:

Repeat steps 2 to 4 to process the next 8-bit data;

The finally obtained CRC odd register is the CRC code. When putting the CRC result into the information frame, swap the high bits with the low bits first. 。

Communication protocol example：

Host sends data：

Station number	Function code	Starting address	Number of reading points	Check code	Meaning
01	03	0000	0001	840A	Read the empty height in cm
01	03	0001	0001	D5CA	Read the empty height in mm
01	03	0002	0001	25CA	Read the liquid level height in cm
01	03	0003	0001	740A	Read the liquid level height in mm

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