FRM5000 Radar Water Level Gauge

Operation Manual

V2209

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1. Product introduction

1.1 Features

FRM5000 Radar level gauge series products refer to frequency modulated continuous wave (FMCW) radar products operating at 76-81GHz.The maximum range of the product can reach 65m, and the blind zone is within 10cm.Because of its higher working frequency, larger bandwidth and higher measurement accuracy.The product provides the fixing method of the bracket, without the need for field wiring, making the installation convenient and simple.

The main advantages of radar level gauge series are as follows:

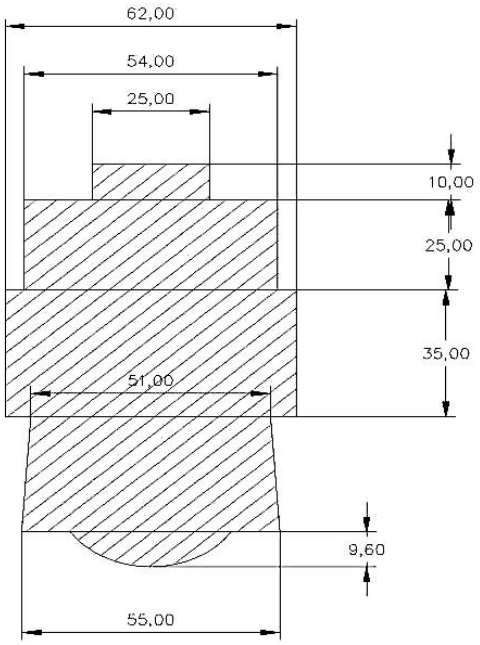
- ✧ Millimeter wave RF chip enables more compact RF architecture, higher signal-to-noise ratio and smaller blind area.
- ✧ 5GHz working bandwidth enables the product to have higher measurement resolution and accuracy.
- ✧ The narrowest antenna beam angle is 6 °, the interference in the installation environment has less impact on the instrument, and the installation is more convenient.
- ✧ Integrated lens design, compact size.
- ✧ Display control and water level gauge adopt separate design, which can be customized.
- ✧ Low power consumption operation, service life more than 3 years.
- ✧ Bluetooth debugging of mobile phones is supported to facilitate the maintenance work of field personnel (supported in subsequent versions).

2. Technical Specifications

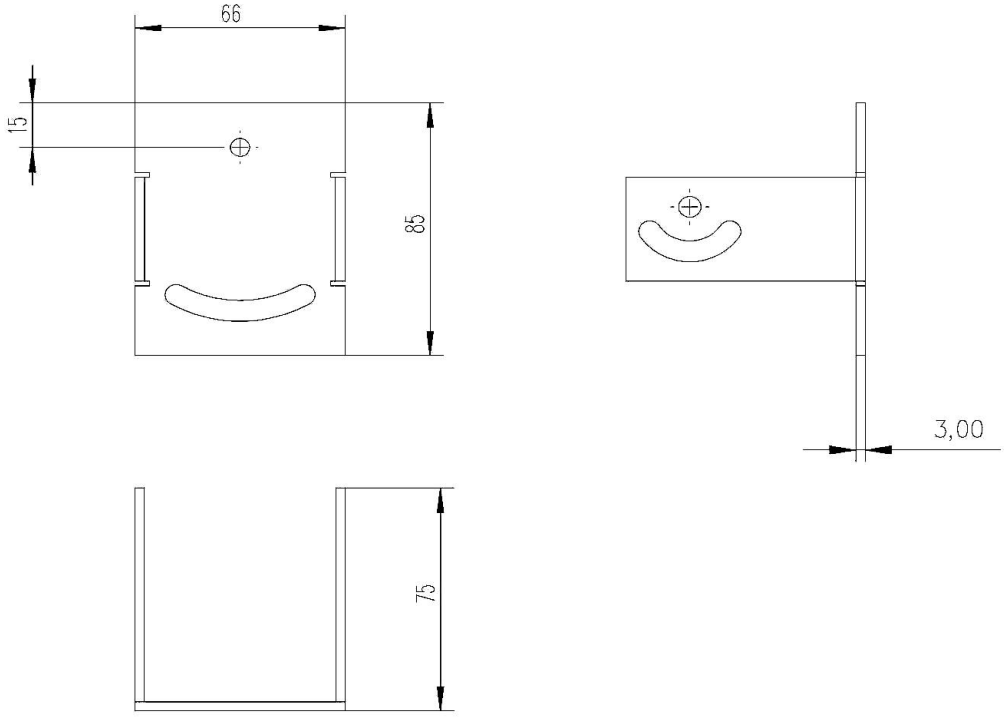
Radar Level Gauge Specifications

Transmit frequency	76GHz~81GHz
Measuring range	0.1 m ~65m
measurement accuracy	±1mm
beam angle	6°
Power supply range	9~28 VDC
Communication method	RS485
Working temperature	-40~85℃
shell material	Stainless steel,PP
Antenna type	lens antenna
Recommended cable	0.35mm²
Protection class	IP67
Installation method	bracket/thread
Cable entry	PG9

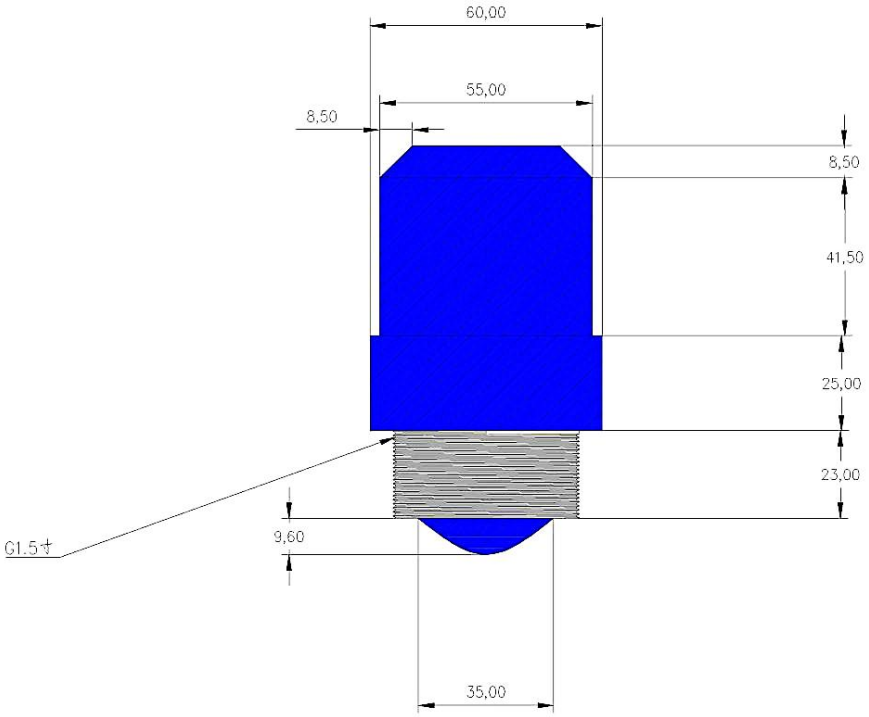
3.Structure size



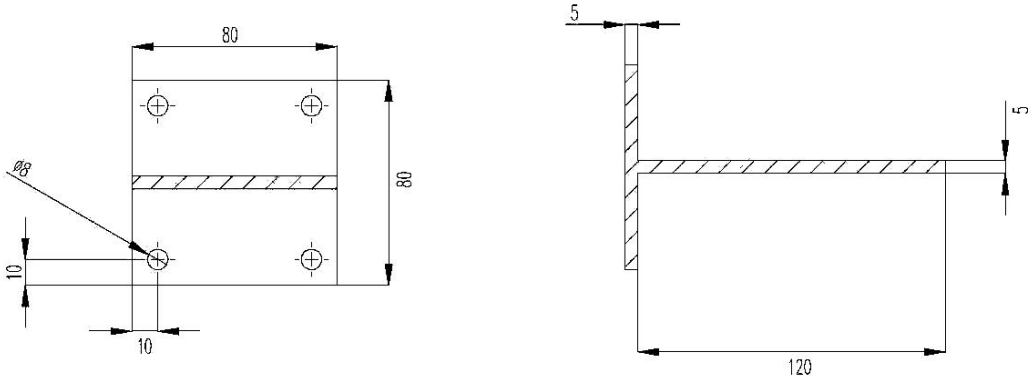
Overall dimension of SS structure

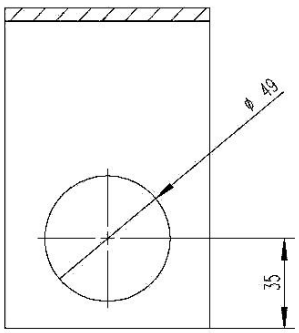


Schematic Diagram of Support Structure Dimensions



PP Structure Dimension Diagram



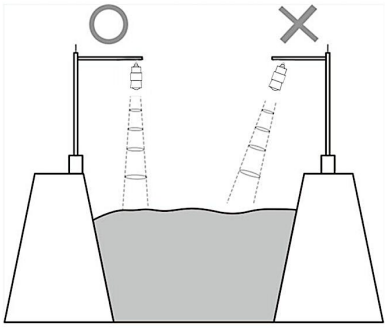


Schematic Diagram of Support Structure Dimensions

4.Installation

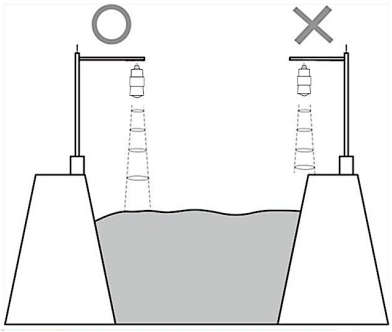
Two points need to be paid attention to during installation: (1) Ensure that the meter is perpendicular to the water surface (2) Avoid the emission beam irradiating the interference object and generating false echoes. See the following points for typical operating conditions.

*Ensure that the water level gauge is installed perpendicular to the water surface. The tilt will weaken the received signal amplitude and affect the normal distance measurement.



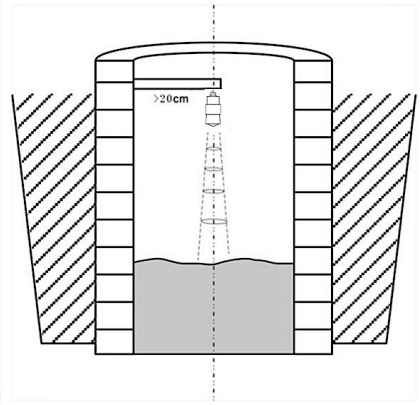
Schematic diagram of instrument installation position

*Ensure that there are no interfering objects within the beam range, such as river banks.



Schematic diagram of instrument installation position

*The instrument should be installed at least 20cm away from the side wall, and the underground pipe network should be installed as close as possible to the center of the water well, otherwise the well wall will easily generate interference signals, which will affect the measurement and judgment.



The installation shall be at least 20cm away from the vessel wall

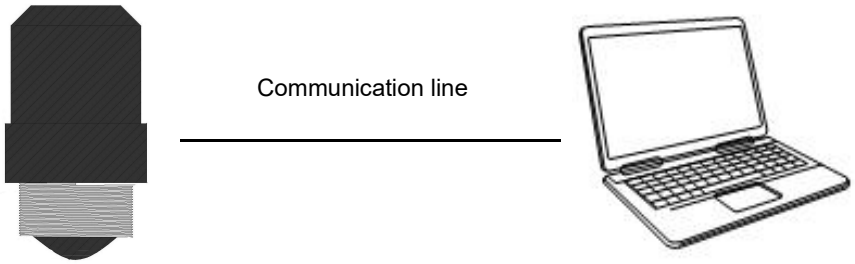
5.Connect

5.1 Application Scenario: 485 transmission

S/N	Colour	Remarks
1	green	RS485A
3	yellow	RS485B
4	red	Power input positive pole
5	black	Power input cathode
6	white	None

Product wiring diagram

When the user uses RS485 transmission, the liquid level gauge leads out 4 wires for wiring through the waterproof joint, and the length of the cable in the figure can be customized according to the user's needs.Serial port parameters: RS458, baud rate -- 9600, data bit -- 8, stop bit -- 1, check bit -- none.Note that the equipment power supply voltage is within the range of 9V - 36V, and 12V power supply is recommended.



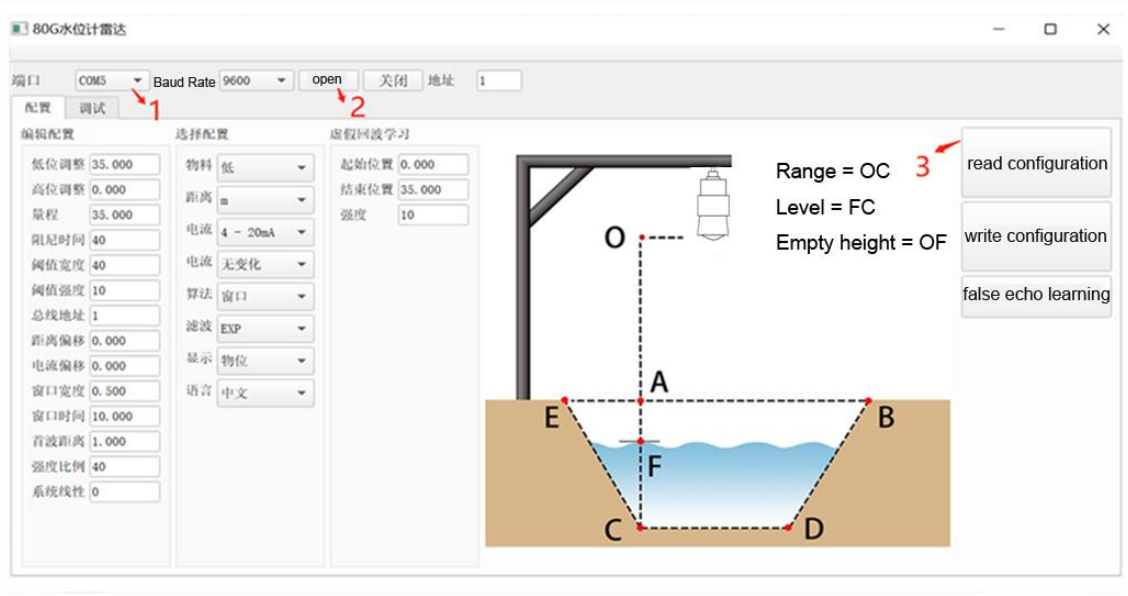
Upper computer connection diagram

Step1: connect the equipment correctly according to the above interface definition. Note that the power supply range of the equipment is 9~36V
Step 2: Connect the device to the computer with 485 serial port cable
Step 3: Connect the power supply 12V, turn on the upper computer, and debug the equipment

6. Level gauge operation

6.1 PC upper computer interface description

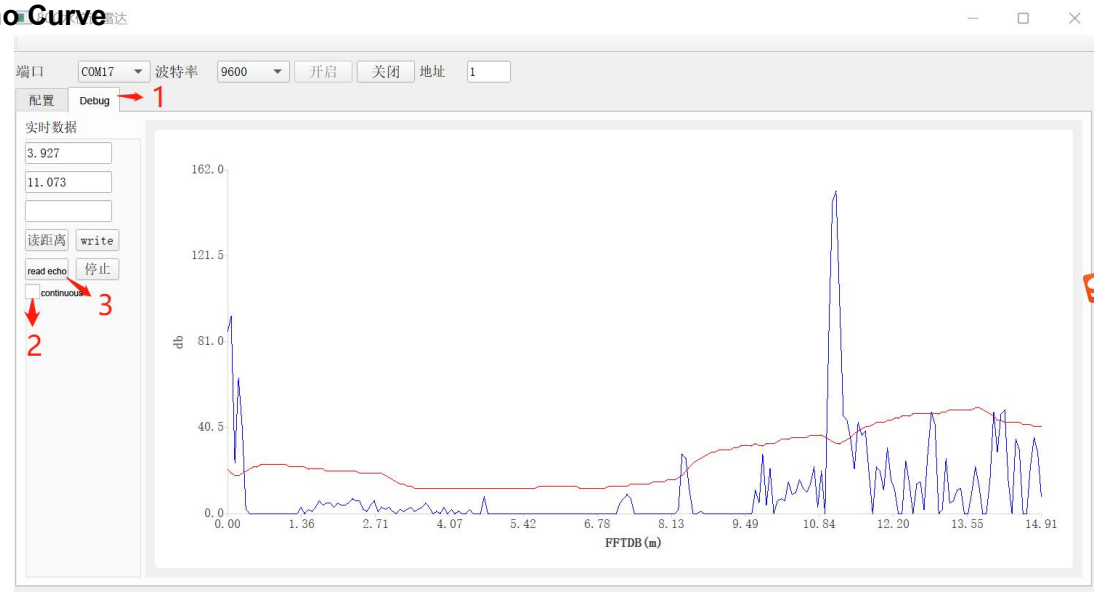
6.1.1 Software settings



Configure serial port parameters of upper computer

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

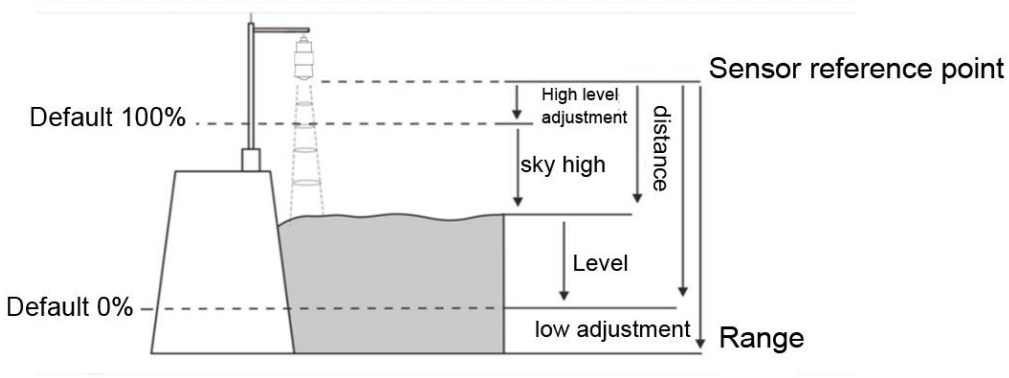
6.1.2 Echo Curve



Upper computer waveform interface

6.1.2.1.【Measurement Type】

[Measurement type] The distance information output form can be selected according to the needs of the site. The core parameter is the test distance from the sensor reference point to the object to be tested. The specific calculation formula of real-time value is given. The high-bit adjustment is 0 by default.

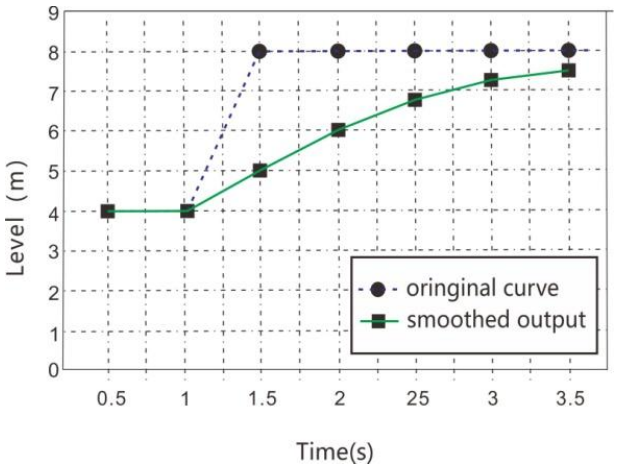


Parameter meaning

Parameter name	show
Defaults	Level
Association configuration	none
Option meaning	Level mode: real-time value = low level adjustment-distance (minimum is 0) Empty height mode:real-time value=distance-height adjustment (minimum is 0)
Special Matters	If distance > low level adjustment, level = 0; If distance < height adjustment, empty height = 0;

6.1.2.2.【Damp filter】

The function of [Damping Time] is to smooth the sudden change in the measurement result, that is, the damping filter. For example, if the damping time is 2 seconds, the position of the measured object changes stepwise at time t, and the measurement output value will change slowly. In the first 2 seconds, 63.2% of the change is completed, and in the 10th second (5 times setting value) to follow to the actual position, as shown in the figure below.



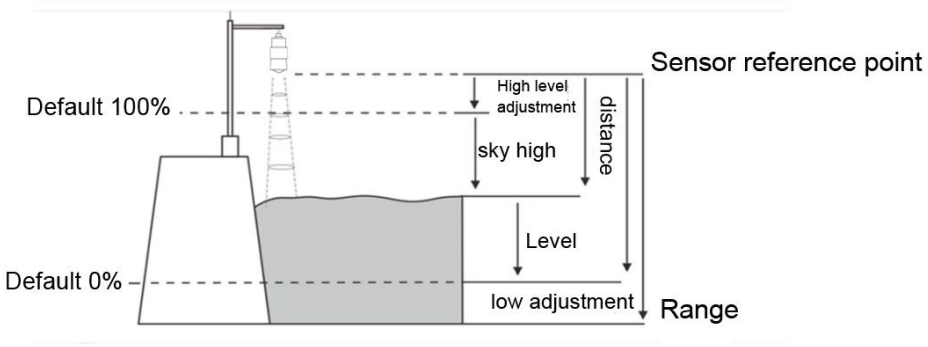
Damping time editing interface and meaning

Damping Time Description

Parameter name	Damping time
Parameter range (S)	0 ~100
Default value(s)	40
Association configuration	none
Option meaning	Damped output to improve signal stability
Special Matters	Due to the short measurement time, this parameter is not used for the time being

6.1.2.3.【Low adjustment】

【Low-level adjustment】is the low-level adjustment point, the specific definition is shown in the figure below.



Low position adjustment editing interface and definition

Low adjustment instructions

Parameter name	low adjustment
Parameter range (m)	0.1~Range
Default (m)	65
Association configuration	If the set low adjustment < high adjustment + 0.1, then low adjustment = (high adjustment + 0.1);
Special Matters	The low-level adjustment point has nothing to do with the range, and only affects the calculation of the material level

6.1.2.4.【High Adjustment】

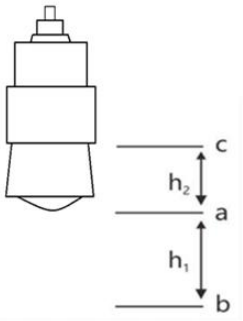
【High level adjustment】It is the high level adjustment point.

High level adjustment instructions

Parameter name	high adjustment
Parameter range (m)	0 ~ (low adjustment -0.1)
Default (m)	0
Association configuration	If the set high adjustment > (low adjustment - 0.1), then high adjustment = (low adjustment - 0.1);
Special Matters	The height adjustment has nothing to do with the blind zone setting, and only affects the calculation of the air height

6.1.2.5.【Distance offset】

【Distance offset】Used to correct the reference point of the sensor. The default reference point of the instrument is adjusted to the position shown at point a in the following figure when it leaves the factory. If you want to adjust the reference point down to point b, enter h1 in the settings.



Distance offset editing interface

Description of distance offset

Parameter name	distance offset
Parameter range (m)	(-Built-in offset)~10m
Default (m)	0
Association configuration	none
Option meaning	Correct the reference point zero of the sensor. The range of the sensor output value is still between [blind zone] ~ [range], and the actual sensor measurement range normalized to the initial reference point is: [distance offset + blind zone] ~ [distance offset + range].
Special Matters	

6.1.2.6.【Range Setting】

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

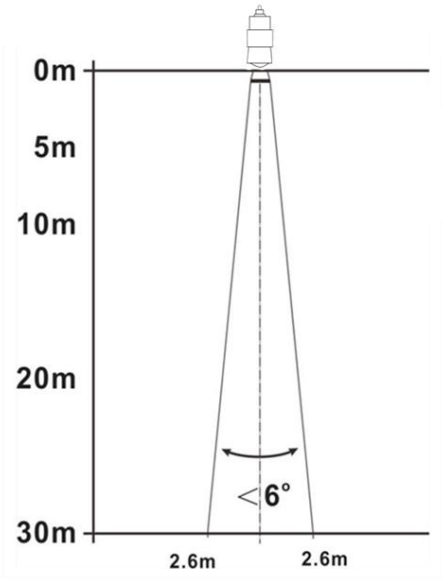
Table 6–10 Range Description

Parameter name	range
Parameter range (m)	1~65
Default (m)	65
Association configuration	If the setting range is <(blind zone+0.1m), the range is automatically set to (blind zone+0.1m).
Option meaning	The algorithm will ignore the echoes outside the range, and 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 meter, but is only used to limit the area of the algorithm. See the Technical Specifications section for meter measurement limits.

Note: Blind zone and range determine the specific range of algorithm application, and can be set reasonably to avoid interference and false echoes, and achieve fast and stable measurement.

7.Appendix B: Glossary of Terms

Beam angle: Beam width bounded by 3dB below the maximum value. Radar level gauge series beam angle 6°



Schematic diagram of the radar beam space geometry of the instrument

Range Resolution: Range resolution refers to how far apart two objects are close together, the level radar can distinguish between two objects instead of one and can measure their respective distances. If the distance between the two objects is smaller than the distance resolution of the level radar, the radar can only measure one distance value, which is not equal to the distance value of any one of the objects, but the sum of the distance values of the two objects. The frequency modulation bandwidth of the radar level gauge is B=5GHz, and the minimum distance resolution=light speed/working bandwidth/2≈3cm.

Measurement accuracy: If there is only one object and this object has moved a small distance, can the level radar recognize the change in distance. The indicator of how far a single object has moved is called accuracy. The intermediate frequency signal of the radar level gauge 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.

Transmit Cone: An extension of the antenna beam angle.

False Echo: Any echo that is not produced by the desired target. Generally, false echoes are generated by obstructions in the container.

Multiple echoes: Multiple reflection echoes appearing at the target echo distance, which may be 2 or 3 times.

Range: (1) Refers to the farthest measurement limit of the instrument (2) Special, refers to the farthest distance set by humans, beyond this distance, the instrument will not consider it when processing data.

Repeatability: The degree to which multiple measurements of the same variable are measured under the same circumstances.

Threshold curve: A curve over time that acts as a threshold beyond which echoes are considered valid.

8.Communication protocol command description

Each command is described in detail as follows:
Setting command: function code 0x10
Read command: function code 0x03
Start address 0x2000

Offset address	Command name	data format	Company
0	Low adjustment	0-65000	mm
1	High level adjustment	0-65000	mm
2	range	0-65000	mm

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

Read the low order adjustment command as follows:

Device address	Function code	Start address	Number of registers	CRC
0x01	0x03	0x2000	(2 bytes)	(2 bytes)

Write the low order adjustment command as follows:

Device address	Function code	Start address	Number of registers	Data length	Register value	CRC
0x01	0x10	0x2000	2 bytes	(2 bytes)	(2N bytes)	(2 bytes)

CRC code calculation rules:
16 bit registers are reserved as hexadecimal FFFF (that is, all are 1).This register bit CRC odd memory;
Put the position of the first 8-bit data and the 16 bit CRC register in different positions or place the result in the CRC register:
Check whether the lowest bit is 0, if so.Move the contents of the register one bit to the right (towards the low bit), and fill the high bit with;
If it is 1, move the contents of the register to the right by one bit (toward the low bit), fill the high bit with, and then CRC odd memory and polynomial A001
(1010 0000 0000 0001);4.3.4 Repeat step 3 until 8 times to the right, so that the entire 8-bit data is processed: repeat steps 2 to 4 to process the next 8-bit data;The final CRC odd memory is CRC code.When CRC results are put into the information frame, the high bit is exchanged, and the low bit is first.
Communication protocol example:
Host sends data:

Station No	Function code	Start address	Reading points	Check code	significance
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 in cm
01	03	0003	0001	740A	Read the liquid level in mm