

76-81GHz FM Radar Level Transmitter

User Manual



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1. Product Introduction

1.1. Characteristics

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 fixing method for the bracket, without the need for on-site wiring, making installation convenient and simple.

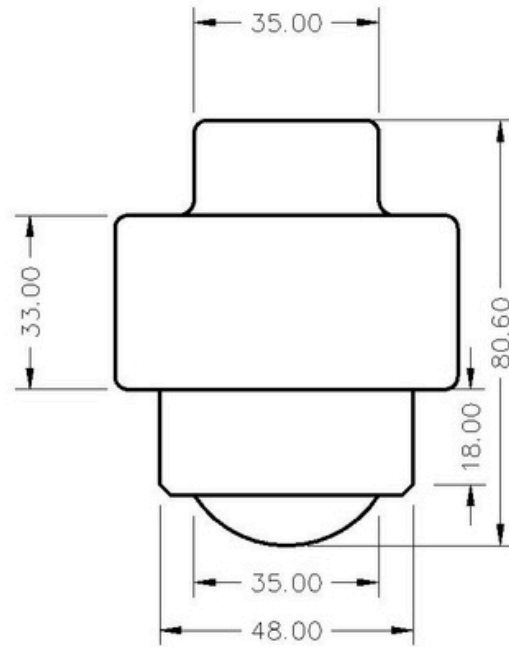
The main advantages of the radar level gauge series are as follows:

- 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 and long service life.
Support Bluetooth debugging for mobile phones, facilitating on-site personnel maintenance work (later version support)

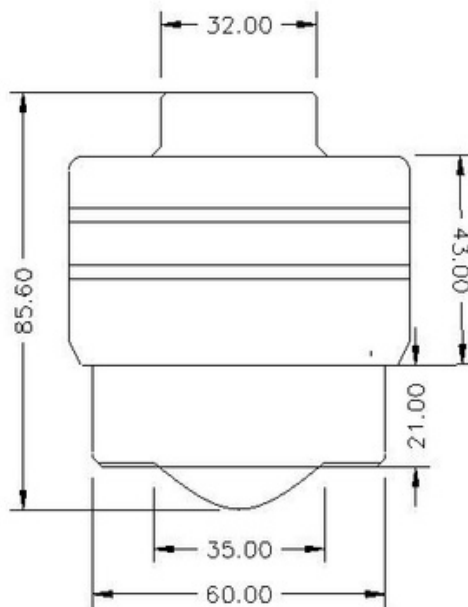
1. Technical specifications

Measuring range	0.1 m ~65m
Measurement accuracy	±1mm
Beam angle	6°
Power supply range	12-24VDC
Communication method	RS485
Working temperature	-30~75°C
Shell material	SS /PP
Antenna type	lens antenna
Recommended cables	0.5mm ²
Protection level	IP67
Installation method	Bracket/Thread
Cable entry	PG9

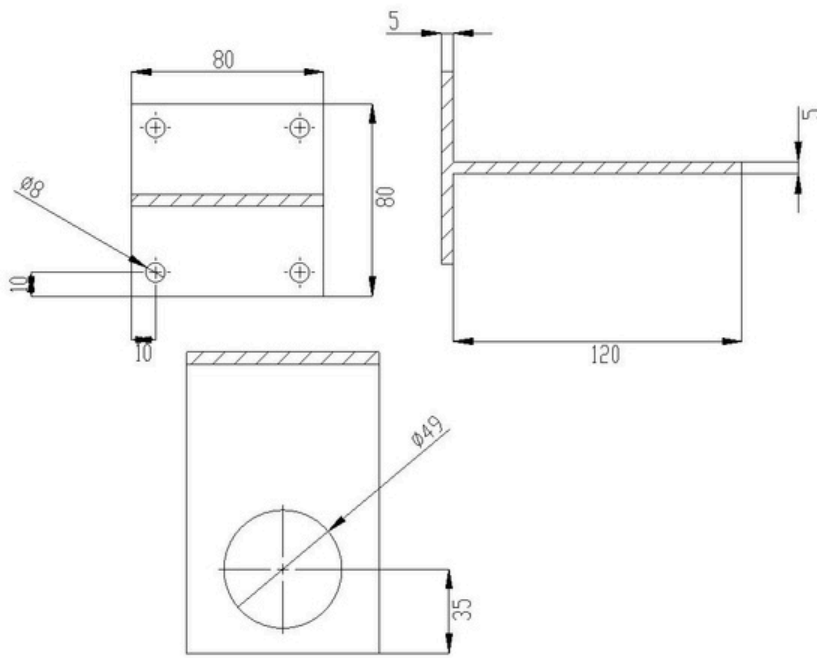
1. Structural dimension diagram



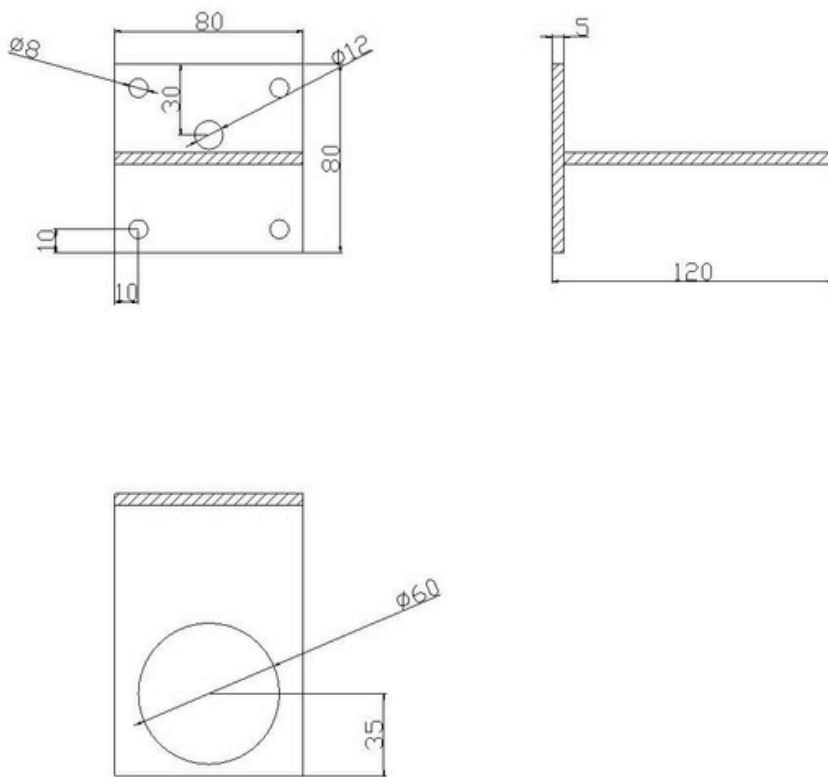
3-1 Schematic diagram of a 1.5 inch PP water level gauge



3-2 Schematic diagram of a 2-inch stainless steel water level gauge



3-2 Schematic diagram of a 1.5-inch T-shaped bracket

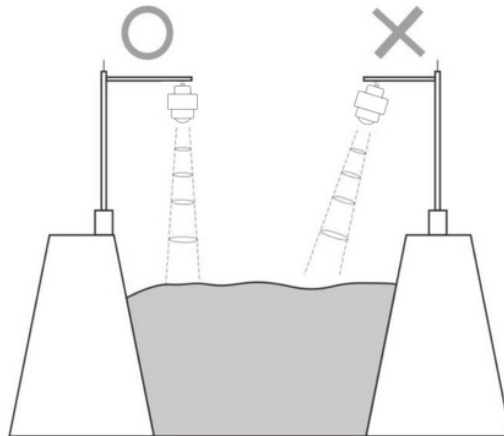


3-3 Schematic diagram of 2-inch T-shaped bracket

1. Installation

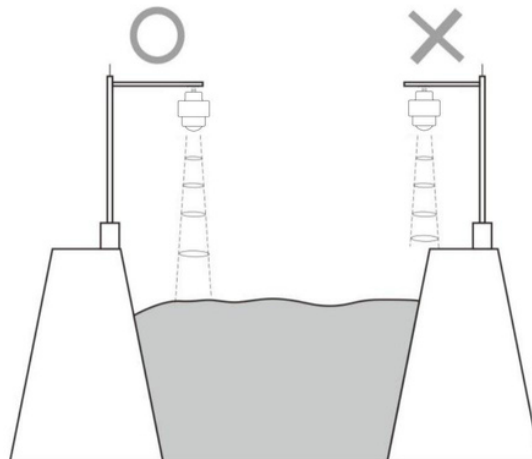
Two points to pay attention to during installation: (1) Ensure that the instrument is perpendicular to the water surface; (2) Avoid emitting beams that illuminate interfering objects and generate false echoes. Please refer to the following points for typical operating conditions.

Ensure that the water level gauge is installed perpendicular to the water surface, and tilting will weaken the signal amplitude and affect normal ranging.



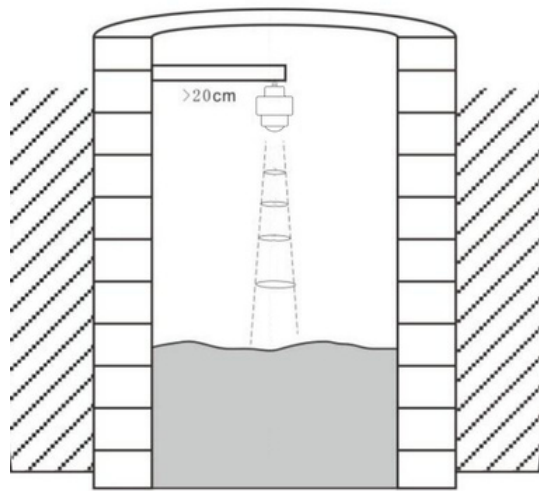
4-1 Schematic diagram of instrument installation location

Ensure that there are no interfering objects within the beam range, such as the riverbank and shore



4-2 Schematic diagram of instrument installation location


The instrument installation should be at least 20cm away from the side wall, and the underground pipeline network should be installed as close as possible to the center of the drainage well, otherwise the well wall may generate interference signals that affect measurement judgment



4-3 Install at least 20cm away from the container wall

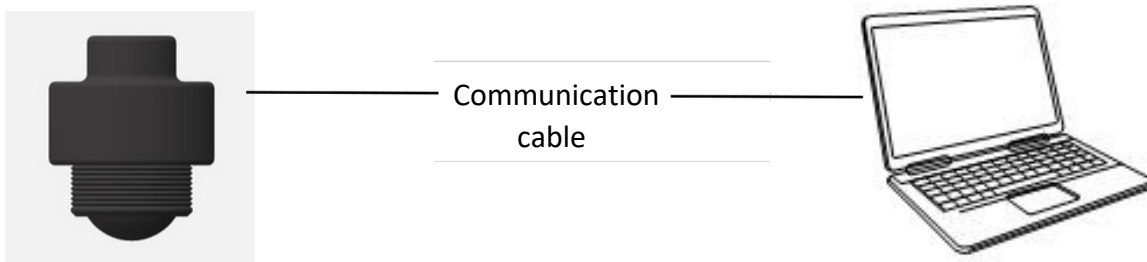
1. Wire Connection

5.1 Application Scenarios

	NO.	Color	Note
	1	Green	RS485A
	2	Green	RS485B
	3	Yellow	Power input +
	4	Red	Power input -
		Blue	

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: RS485, 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 12V-24V, and it is recommended to use 12V power supply.

5.1 Upper computer communication



Firstly, connect the device correctly according to the above interface definition, and note that the power supply range of the device is 12V~24V

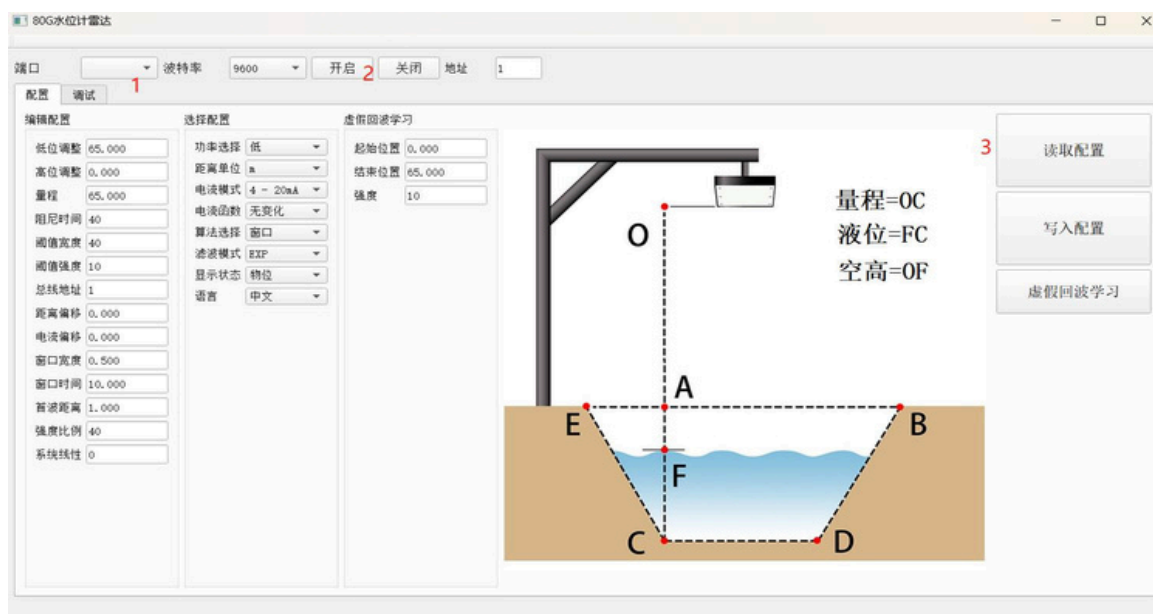
Step 2, connect the device to the computer using a 485 to serial cable

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

6. Water level gauge operation

6.3 PC Upper computer interface description(English software to be updated)

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.

6.3.1 【 Range adjustment】

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)	15
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, and can be reasonably set to avoid interference and false echoes, achieving fast and stable measurement.

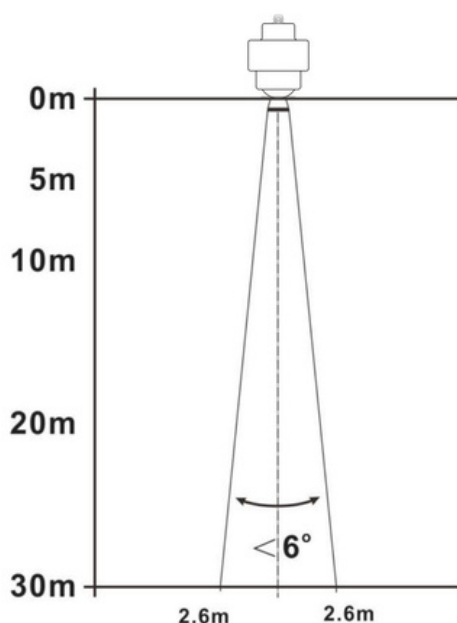
6.3.2 【Dead zone adjustment】

Specific meaning is shown in the table below

Parameter Name	Dead zone
Parameter range (m)	0~ (Range -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.

7 .Glossary

Beam angle: The beam width bounded by 3dB lower than the maximum value. The beam angle of the series is 6°, as shown in Figure 7-1.



7-1 Schematic diagram of the radar beam space geometry of the instrument

Distance resolution: Distance resolution refers to how far apart two objects are from each other, and the level radar can distinguish between two objects rather than one object and measure their respective distances. If the distance 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 rather the combination of the distance values of the two objects. The frequency modulation bandwidth of the product is $B=5\text{GHz}$, and the minimum distance resolution is equal to the speed of light/working bandwidth/2 $\approx 3\text{cm}$.

Measurement accuracy: If there is only one object and it has moved a small distance, can the level radar recognize distance changes. The indicator for distinguishing the distance traveled by a single object is called accuracy. The intermediate frequency signal is analyzed using its own algorithm, with a measurement accuracy of 0.5mm.

Dead zone:Refers to the measurement limit of the near end of the instrument, which cannot be measured by the instrument within the blind zone

echo: The reflected signal received by the radar.

Emission cone: Extension of antenna beam angle.

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

multiple echo: Multiple reflection echoes that occur at the target echo distance may be 2 or 3 times.

Range: (1) Refers to the farthest measurement limit of the instrument (2) Special, refers to the artificially set farthest distance beyond which the instrument does not consider when processing data.

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

Threshold curve: A curve that changes over time serves as a threshold, and echoes exceeding it are considered valid.

80G FM Radar Water Level Transmitter Modbus Details

1、 Communication protocol hardware interface parameters

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

Communication parameter	Serialport level	BAUD/bps	Paritycheck	Length/bit	stop bit/bit
Serialport	485USB	9600	(none)	8	1

Time out per frame interval 50ms。

2、 Communication protocol format

The water level meter adopts ModbusRTU communication protocol for external communication, and each complete data frame includes: address domain, function code, data, and verification. The CRC16 checksum data which is verified as a data frame, has low bytes before and high bytes after.

The factory default address : 1.

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

(1) Query parameter format: function code 0x03

Request:

Device Address	Functioncode	Start address	Numberof Registers	CRC
(1byte)	(1byte)	(2byte)	(2byte)	(2byte)

Reply:

Device Address	Function code	Data Length	Register value	CRC
(1 byte)	(1 byte)	(1 byte)	(2xN byte)	(2 byte)

N: NumberofRegisters

(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)	(2 byteN)	(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 Command Description

OffsetAddress	CommandName	Dataformat	UNIT
0 1 2 3 4 5 6 7	Lowadjustment	0-65000 0-65000 0-100 10-	mm
8 9 10 11 12	Highleveladjustment	200 0-200 1-32 -10000-	mm
13 14 15 16 17	Range	10000 -10000-10000 0-	none none
	Dampingtime	35000 0-65000 0-35000	Db
	Thresholdwidth	10-90 0-liquid, 1-solid 0-	none
	Thresholdstrength	m , 1-cm , 2-mm 0-(4-	mm
	Busaddress	20mA),1-(20-4mA)	mA/1000
	Distanceoffset	Default0	mm
	Currentoffset	0-no	ms
	Windowwidth	change ,1-22mA,2-3.6mA	ms
	Windowtime		percentage
	Firstwavedistance		
	Strengthratio		
	Materialselection		
	Distanceunit		
	Currentmode		
	Currentsimulation		
	Currentfunction		
18	Algorithmselection	0-window ,1-First wave,2-strength	level meter selection2
19	Filteringmode	0-EXP, 1-KEF	
20	DisplayStatus	0-waterlevel, 1-airdistance	
21	Language	0-Chinese, 1-English	

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

Example :

The command to adjust the read low adjustment is as follows:

Device Address	Function code	Start address	Numberof Registers	CRC
0x01	0x03	0x2000	1	(2byte)

Write the low adjustment command as follows:

Device Address	Function code	Start address	Number of Registers	Data Length	Register value	CRC
0x01	0x10	0x2000	(2 byte N)	(1 byte)	(2N byte)	(2 byte)

Calculation rules for CRC codes :

1. Reserve 16 bit registers as hexadecimal FFFF (i.e. all are 1). Call this register bit CRC odd memory;
2. Distinguish the position of the first 8-bit data from the 16-bit CRC register, and place the result in the CRC register;
3. Check if the lowest position is 0, if so. Move the contents of the register to the right one bit (towards the low bit) to fill in the high bit;
4. If it is 1, shift the contents of the register to the right one bit (towards the low bit), fill in the high bit, and then perform XOR with the CRC odd memory and polynomial A001 (1010 0000 0000 0001);

Repeat step 3 until it is moved 8 times to the right, so that the entire 8-bit data has been processed:

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

The resulting CRC odd memory is the CRC code. When placing the CRC results in the information frame, the high bits are swapped and the low bits are placed first.

Communication Protocol Example :

Host sends data :

Device Address	Function code	Start address	Readpoints	CheckCode	Significance
01	03	0000	0001	840A	Readairdistance, unit:cm
01	03	0001	0001	D5CA	Readairdistance, unit:mm
01	03	0002	0001	25CA	Readwaterlevel value, unit:cm
01	03	0003	0001	740A	Readwaterlevel value, unit:mm