Radar flow meter YSR
Instruction Manual

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1. Product introduction

Radar flowmeter refers to a product that uses radar to measure water flow velocity and water level, and converts water flow through an integral model. It can measure water flow in real time around the clock, and non-contact measurement is not easily affected by the measurement environment. The product provides a bracket fixing method.

The main advantages of the product are as follows:

Non-contact measurement based on mixed-band radar, flow velocity, liquid level, flow output at the same time without interfering with each other, less maintenance, and not affected by sediment, etc.

IP68 waterproof design, internal glue filling, suitable for various outdoor environments and various extreme weather environments

Small and compact appearance, super cost-effective

Integrated anti-reverse connection, lightning protection and over-voltage protection functions

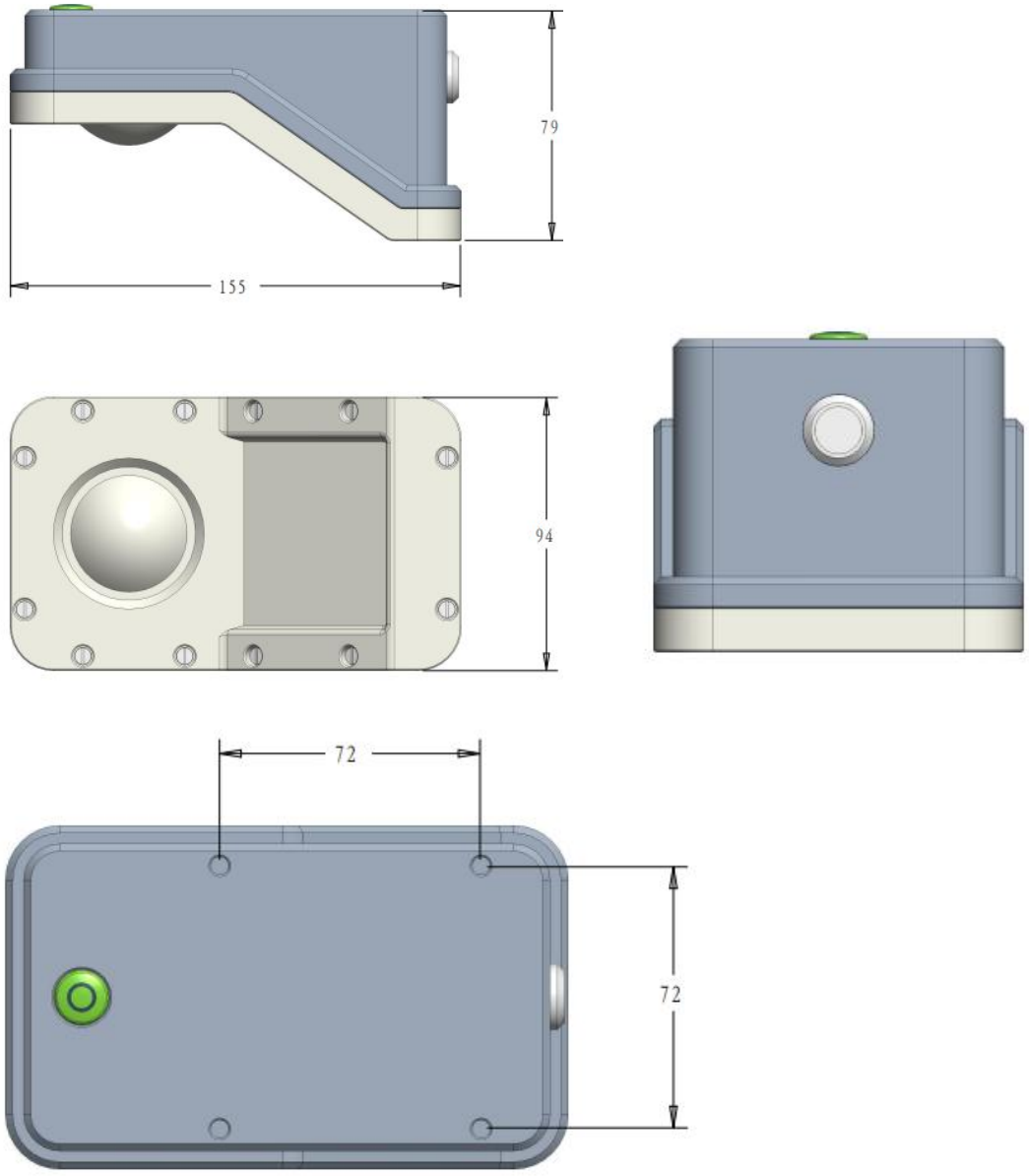
Supports Modbus-RTU protocol for easy access to the system

Supports Bluetooth debugging on mobile phones to facilitate maintenance work by on-site personnel

2. Technical specifications

Speed range	0.01 m/s ~30m/s
Speed measurement accuracy	±0.01m/s(Radar simulator calibration)
Speed measurement pitch angle (automatic compensation)	0°- 80°
Speed measuring antenna beam angle	12°*25°
Ranging blind area	8cm
Maximum ranging range	40m
Ranging accuracy	±1mm
Ranging antenna beam angle	6°
Maximum distance between radar and water surface	30m
Power supply range	9~30VDC
Working current	Working current 25ma@24V
Communication Interface	RS485 (baud rate), Bluetooth (5.2)
Protocol	Modbus（9600/115200）
Operating temperature	-20-70°
shell material	Aluminum alloy ,PBT
Dimensions (mm)	155mm*79mm*94mm
Protection level	IP68
Installation method	Bracket

3. Structural dimensions



The flow meter has a compact structure and comes with horizontal bubbles for installation and adjustment. Integrated surface, internal potting and reinforced sealing, adaptable to various extreme work frames.

4. Installation

The flow meter consists of two parts: flow velocity measurement radar and liquid level measurement radar. Among them, the flow meter calculates the flow speed of the water surface by measuring the Doppler frequency shift of the water flow; the liquid level measurement radar is similar to the flow speed measurement radar, and calculates the distance between the radar and the water surface by calculating the flight time of the electromagnetic wave. The flowmeter estimates the velocity distribution on the river

section based on the measured flow velocity and liquid level, combined with the input actual river characteristics to be measured, and calculates the river flow based on the corresponding empirical model.

Therefore, to accurately measure flow, you need to pay attention to the following points:

4.1 Selection of waters to be measured

(1) There are no major changes in the direction and speed of the water flow in the tested river section, and there are certain undulations in the water surface.

(2) There are no large eddies, turbulence, turbulence and other phenomena, and the river section is straight.

(3) Floating objects: Floating objects will cause certain interference to the radar signal, causing a certain jump in the flow velocity measurement results. After the floating objects leave the radar field of view, the measurement can return to normal.

(4) Rainfall: Rainwater itself is a moving object and will also be measured by radar. The radar has a built-in tracking system to avoid jumps in measurement results. At the same time, for better measurement, it is recommended to lower the installation angle to about 30°.

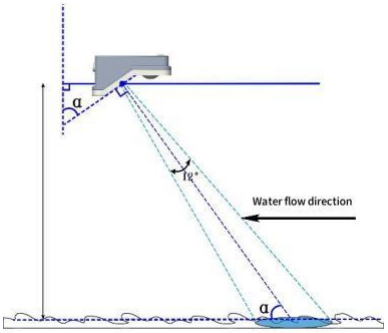
Note: If the water surface to be measured is calm and waveless, the electromagnetic waves emitted by the radar will not be reflected back to the receiver due to specular reflection. As a result, the radar will not be able to receive echo signals and will not be able to give accurate flow velocity results.

4.2 Influence of installation angle

(1) In order to ensure the correct measurement of the liquid level, try to place the flow meter facing the water surface, that is, ensure that the flow meter is installed horizontally (the water surface does not have an excessive slope). If the flow module is installed at an angle, it may affect the radar measurement accuracy and measurement stability. It is recommended that the horizontal inclination angle be controlled within plus or minus 3°.

(2) When the flow meter is placed horizontally, the angle between the flow velocity measurement part and the water surface is approximately , as shown in Figure 4-1.

(3) The angle between the flow velocity module and the water surface determines the stability and reliability of the flow velocity measurement. If the angle is too small, the radar echo is too weak, the radar cannot measure stably, and the measurement results are unreliable; the radar inclination angle is too large, such as 85- Between 90°, the radar cannot detect the Doppler frequency shift of the water flow, and the measurement results will be unreliable. The radar has a built-in gyroscope that automatically compensates for the flow rate based on the time declination, eliminating the need for precise adjustments.



4.3 Influence of installation height

(1) The farther the radar is from the water surface, the weaker the echo received by the radar, and the worse the radar's ability to correctly detect the water flow velocity.

(2) The radar should not be too close to the water surface, as it may be easily submerged by the water flow.

(3) If you want to measure extremely low flow speed (<0.1m/s) or a relatively calm water surface, you need to test at a close distance to increase the energy of the echo received by the radar. It is recommended that the distance from the water surface be 10-30cm.

(4) In order to ensure normal measurement of liquid level, please ensure that the installation height is much greater than the blind zone of the radar and less than the farthest test limit of the radar.

4.4 Impact of radar FOV

The radar's field of view is called FOV. The radar field of view spreads outward in a cone shape. Within the field of view, there should be no interference from other objects with speed other than the water flow to be measured, such as turbines, pedestrians, cars, etc.; or other prominent interference objects.

In this product, the FOV of the flow rate measurement module is approximately 12° × 25°. Thanks to the higher measurement frequency band, the FOV of the liquid level measurement module is approximately (6° × 6°).

Example: FOV range of the flow rate module at a distance of 10m = (2×tan(12/2)×10)*(2×tan(25/2)×10)=2.1m×4.44m

Note: FOV is just a simple measure of radar beam width. It does not mean that objects outside the beam cannot be detected by radar at all. Therefore, when installing radar, be sure to confirm the echo curve and check for clutter other than liquid level and flow rate, such as If there is high clutter, false echo learning needs to be done and shielded.

4.5 Influence of installation position

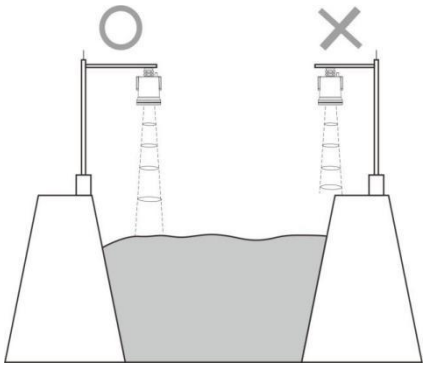
(1) The farther the radar installation location is from the center of the flow, the greater the estimation error of the average river flow velocity.

(2) The closer the radar is installed to the river bank, the more likely it is to be affected by factors such as shore plants and river banks.

(3) It is recommended that the radar installation location be as close to the center of the

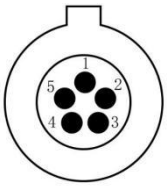
river as possible.

(4) In order to make the liquid level measurement results as reliable as possible, try to avoid interference in the radar beam, such as shore, walls, and protrusions. For installation, it is recommended to confirm the echo curve. If there is unavoidable interference, it can be shielded through false echo learning.



5. Connect

Wiring instructions: When inserting the aviation plug, the red dots on the two parts should be aligned. When you hear a snap, plug it in. Specific wiring instructions reference table

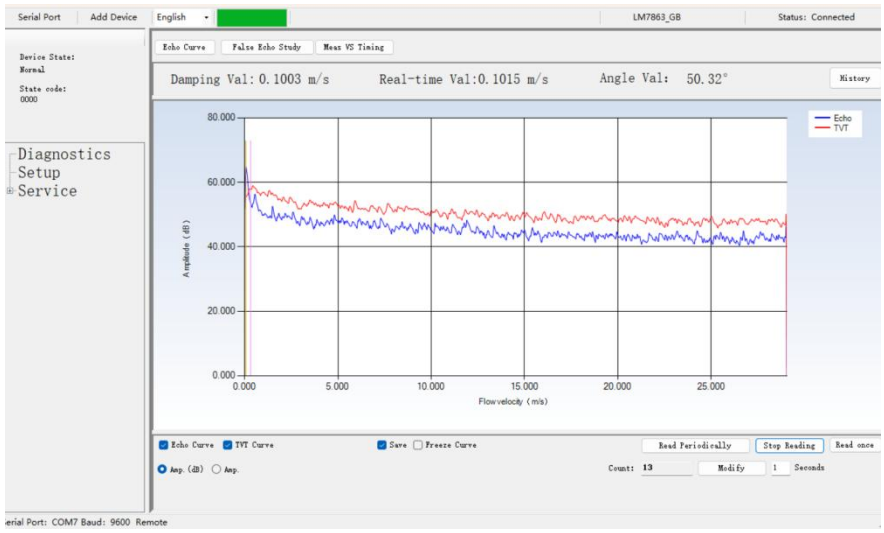


Mother seat

sequence	line	Function	interior color	Internal functions	Note
1	white	485A	white	485A	The baud rate is 9600 and cannot be reversed.
2	black	Negative pole of power supply	black	Negative pole of power supply	-
3	red	Positive pole of power supply	red	Positive pole of power supply	9-30V
4	yellow	485_GND	yellow	485_GND	The baud rate is 9600 and cannot be reversed.
5	green	485B	green	485B	485 common

						ground, connect if necessary

6. Flowmeter operation



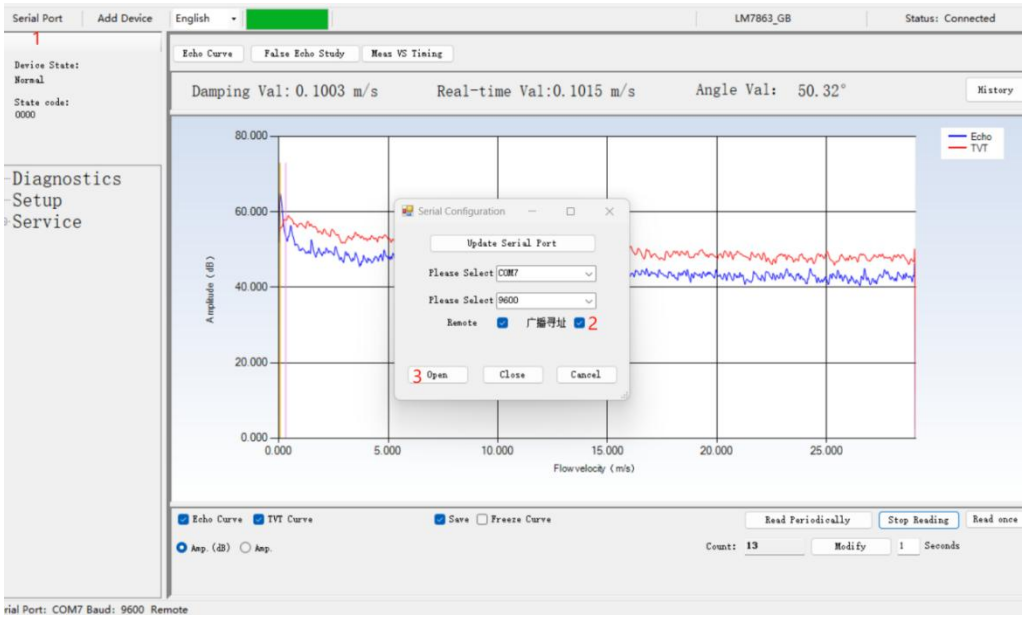
The default measurement period is 1s, with built-in adaptive scene-based algorithm and simple setting options to solve problems encountered on site. These settings can be modified through Bluetooth and 485 interface.

6.1 PC host computer interface description

6.1.1 Connection instructions

On the PC side, click on the serial port configuration in the order shown in the figure, try to select 9600 for the baud rate, click "Open", and the progress bar will scroll to completion, indicating that the connection is successful. After successful connection, you can view waveforms, collect data, set and read parameters.

6.1.2 Echo curve interface



As a host computer, you can request real-time echo data from the flow meter through the request method and display it in detail.

[Echo data] is a real-time radar echo curve.

[TVT curve] is a real-time judgment curve, used as a threshold value to determine effective radar echoes.

[Save] is used to save the echo data in the database and browse it in the [History] interface.

[Measurement-Background] You can save the real-time echo curve as the background of the display area for easy comparison.

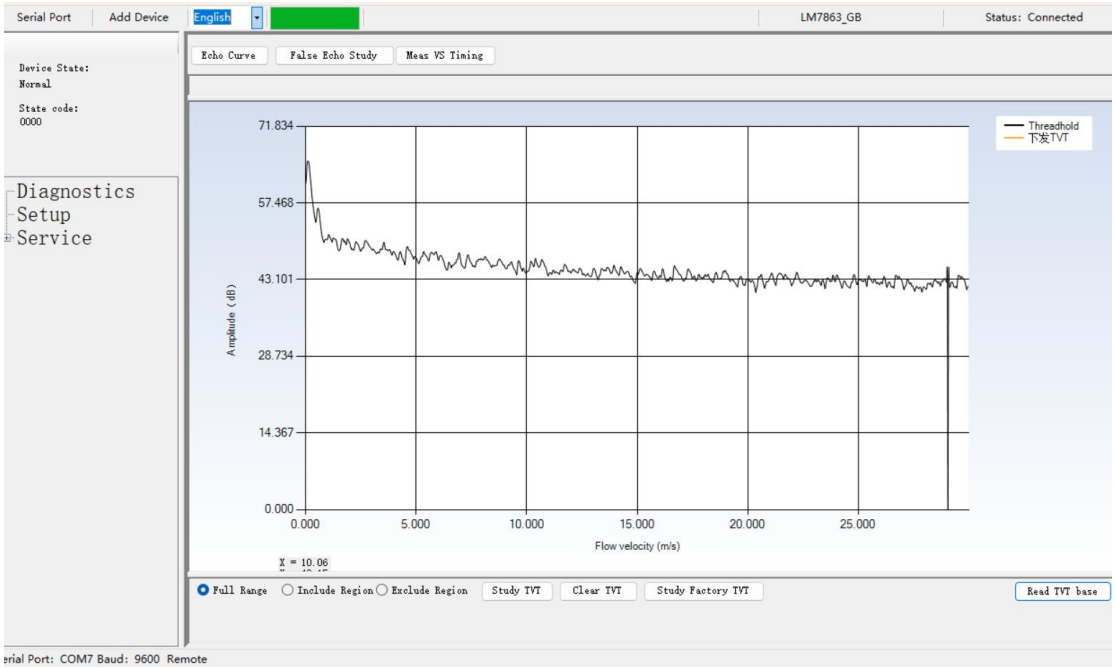
[Data transmission start (period)] Periodically requests the echo curve from the flow meter.

[Modify measurement cycle] determines the frequency requested by the host computer. In addition, regardless of whether the host computer requests it, it will not affect the normal working cycle of the flow meter.

[End of data transmission (cycle)] Stop data request and refresh

[Single upload] Request the echo data of the velocity meter once

6.1.3 False echo learning interface



If you encounter irresistible interference signals during radar measurement, you can try to suppress them through false echo learning. Provides a wealth of false echo suppression methods that customers can flexibly set according to actual conditions.

[TVT benchmark learning] Perform false echo learning based on the set area.

[TVT benchmark clear] Clear previously learned false echoes according to the set area.

[TVT baseline factory learning] This selection is suitable for users to use before the complete machine leaves the factory, and is used to record the baseline noise floor of the radar. By default, full-scale false echo learning is performed.

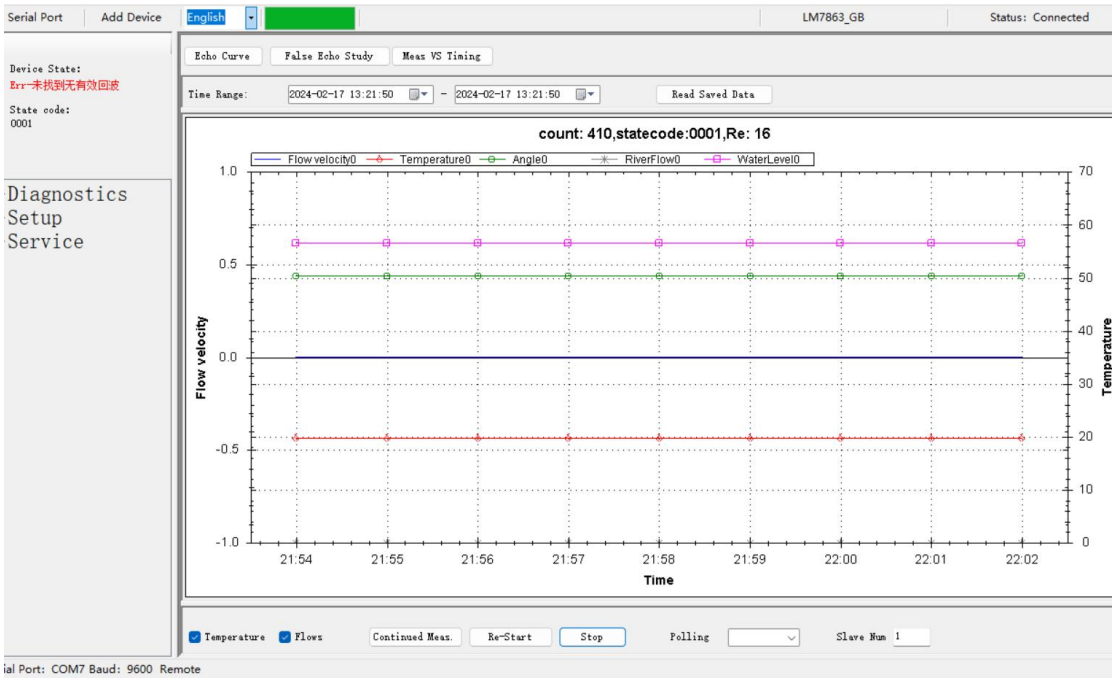
[Full-range learning] Perform full-scale learning. The measurement options cannot be operated on site or against the water flow.

【In-area learning】Learn false echo curves within the set area

【Outside area learning】Learn false echo curve outside the set area

Note: The operations in 6.1.2 and 6.1.3 are only for the flow meter module and liquid level measurement module. Please use the host computer corresponding to our water level meter to view the echo curve and perform factory learning.

6.1.4 Measurement Vs time interface



Configure the host computer serial port parameters

Real-time data collection can be carried out on the PC side, and the host machine will display real-time flow rate, liquid level, flow rate, temperature, inclination and other data in real time.

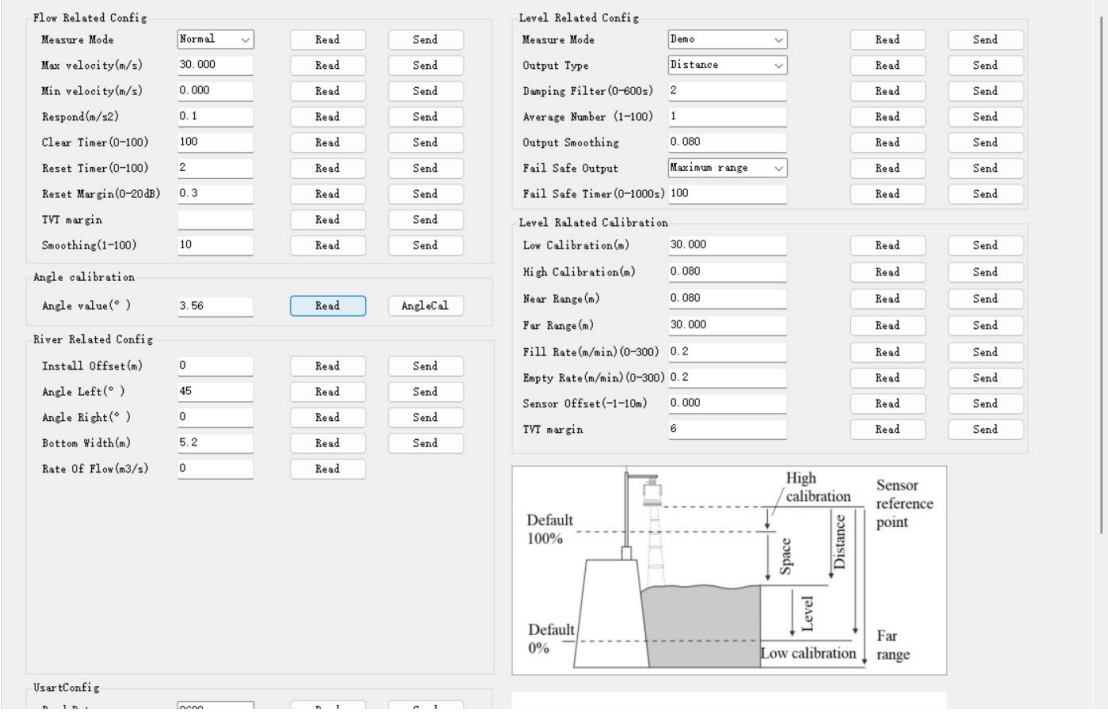
【Continue measurement】Continue the previous measurement

[Restart measurement] Clear the screen display, restart counting and refresh data

[Stop measurement] Stop refreshing data. The flow meter will continue to run after stopping, but the host computer interface will no longer refresh data.

At the same time, the PC side also supports patrol mode, which can simultaneously display real-time data of multiple slave flow meters. By configuring the patrol mode and the number of slave machines, multiple monitoring windows can be generated, so that the working status of multiple radar flow meters can be easily monitored.

6.1.5 Setting interface parameter description



PC setting interface

6.1.5.1. Flow rate parameter setting

[Measurement Mode] Provides two configurations: normal and demonstration; normal mode is used in real scenarios, with built-in scene-based adaptive algorithm, stable output results, and anti-interference; demonstration mode can meet the needs of fast measurement in the field, responsive, but susceptible to interference, it is not recommended for on-site application.

[Minimum flow rate] See the table below for specific meanings.

Blind spot description

parameter name	minimum flow rate
Parameter range (m/s)	0~30
Default value (m/s)	0
Option meaning	The algorithm will ignore velocity signals within the minimum flow velocity during processing, and this can be used to avoid near-end interference signals.

Special matters	This parameter does not refer to the near-end measurement limit of the instrument, but is only used to limit the algorithm area.

[Maximum flow rate] In order to obtain correct measurement results, the measuring range of the instrument needs to be set. For specific meanings, see the table below.

Range description

parameter name	maximum flow rate
Parameter range (m/s)	0~30
Default value (m/s)	30
Option meaning	The algorithm will ignore velocity signals outside the maximum flow rate during processing, and reasonable settings can avoid interference signals outside the range.
Special matters	This parameter does not refer to the remote measurement limit of the instrument, but is only used to limit the algorithm area.

[Inclination] Users can obtain the inclination of the flow meter in real time by reading.
[Inclination Calibration] If the angle deviation is large before leaving the factory, it can also be standardized through angle calibration. Place the flowmeter antenna surface on a horizontal platform and wait for 10 seconds before clicking. (Use this option with caution. If you find that the inclination value is obviously abnormal, please contact our after-sales personnel).

【Tracking speed】

Tracking speed description

parameter name	tracking speed
Parameter range（m/s2）	>0
default value（m/s2）	0.10

Option meaning	Radar's ability to respond to changes in speed measurement results per unit time

【Clear timer】

Clear timer description

parameter name	Clear timer
Parameter range（s）	0~100
default value（s）	10
Option meaning	To judge that the speed signal disappears, the time required for continuous no echo detection is required.

【Reset timer】

Reset timer description

parameter name	reset timer
Parameter range（s）	0~100
default value（s）	5
Option meaning	To judge the occurrence of the speed signal, the time required to continuously detect the echo is required.

【Reset margin】

Reset margin description

parameter name	reset margin
Parameter range（dB）	0~20

default value（dB）	7.5
Option meaning	To judge the occurrence of speed signal, the minimum signal-to-noise ratio needs to be met.

【TVT margin】

TVT balance description

parameter name	TVT margin
Parameter range	>0
default value	8
Option meaning	For a speed signal to be detected, it needs to be at least higher than the TVT reference by a TVT margin value.

【Output average】

Output average description

parameter name	Output average
Parameter range	0~100
default value	100
Option meaning	Average window length for outputting average speed

6.1.5.2. Water level parameter setting

[Measurement mode] Please choose according to actual working conditions. River mode is recommended. If infield testing is performed, demonstration mode is recommended. It responds quickly. If the measuring range is less than 2m, it is recommended to use well or water tank mode.

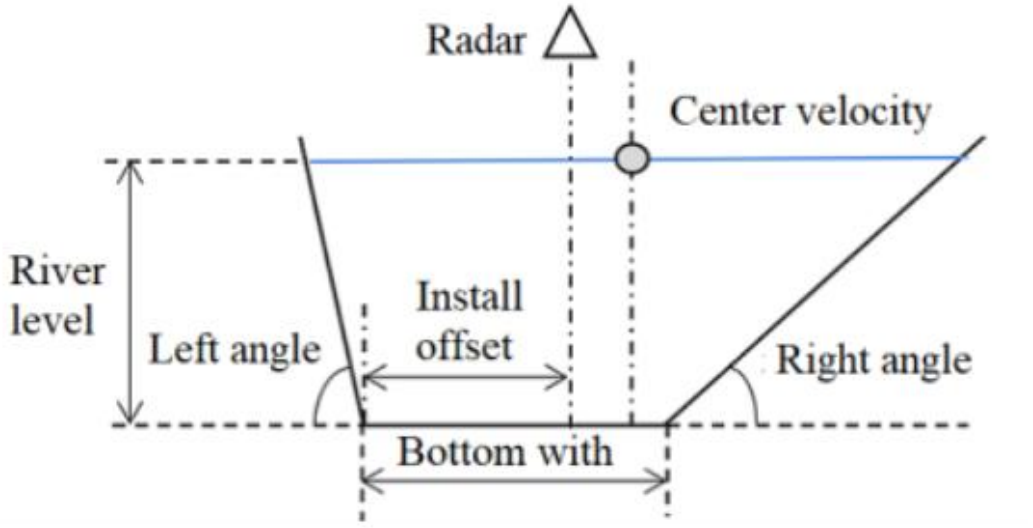
[Output type] The radar determines what kind of water level information to output based on the settings, water level value, altitude value, or distance value from the water surface.

[Low position adjustment] represents the distance between the bottom of the river bed and the radar. Set the low position so that the radar can correctly output water level information.

[High position adjustment] The reference point for empty height calculation. Set according to the output needs. If no high output is required, it does not need to be set.

The above is the setup process for correct water level testing. For other details, please refer to our "76-81GHz Continuous FM Wave Radar Water Level Meter Product Instructions"

6.1.5.3. Flow parameter setting



Schematic diagram of each setting parameter of the flow meter

[Installation offset] See the table below for specific meanings

Installation offset

parameter name	Installation offset
Parameter range（m）	-BL (horizontal length of the left slope) ~ B (width of the river bottom) + BR (horizontal length of the right slope)
default value（m）	B/2
Option meaning	The offset distance between the radar and the bottom of the left bank is recommended to be installed in the center of the river. If it is installed off-center, the radar has a built-in compensation algorithm.

[Left (right) slope angle] See the table below for specific meanings.

Left (right) slope angle

parameter name	Left (right) slope angle

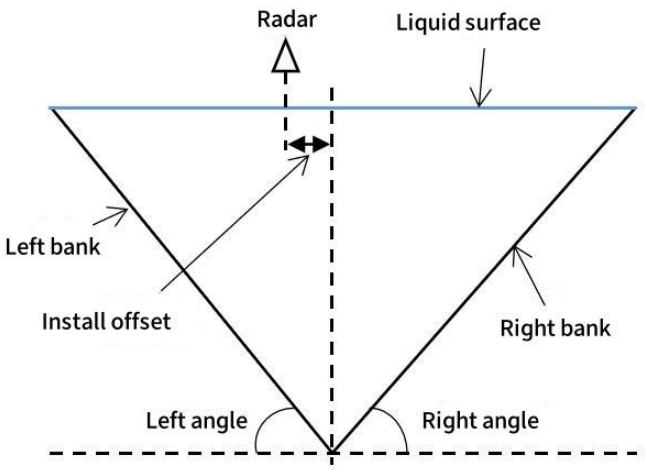
Parameter range (°)	0~90
default value (°)	45
Option meaning	Determine the shape of the river section and enrich the applicable scenarios of the flow meter.

[River bottom width] See the table below for specific meanings.

River channel bottom width

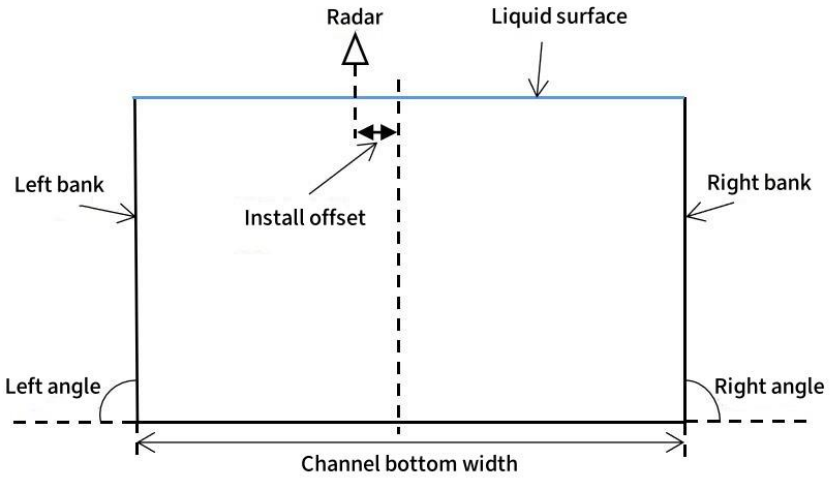
parameter name	River channel bottom width
Parameter range (m)	>=0
default value (m)	none
Option meaning	Determine the shape of the channel cross section.

6.1.6 Common river cross-section configuration methods



Schematic diagram of triangular section setting parameters

[Triangular cross-section] When the river cross-section is triangular, the width of the river bottom needs to be set to 0, and the flowmeter should be placed as close to the center of the river as possible. The section shape can be changed according to the left (right) slope angle. For a symmetrical triangular section, the left (right) slope angles need to be set to equal sizes.



Schematic diagram of setting parameters for rectangular section

[Rectangular cross-section] When the river cross-section is rectangular, the width of the river channel bottom needs to be set to the length of the lower side of the rectangle, the left (right) slope angle should be set to 90°, and the flow meter should be placed as close to the center of the river as possible.

7. Problem diagnosis

(1) Why does the flow rate measurement result jump?

The flow meter measurement results may jump as follows:

a. Check whether the power supply is within the required range

b. Check whether the operating current is normal (less than 45mA@24V)

c. Check whether the water surface at the site is still or the water ripples are very small (if the water surface is indeed calm or the flow rate is extremely low, it is recommended to change the installation location)

d. Whether there are floating objects, aquatic plants, or other moving objects waiting in the irradiated area (false echo transplantation by observing the echo)

e. Whether the water level is too low and the radar directly illuminates the river bed or rocks (it is recommended to change the installation location)

f. Whether the radar installation is stable and the inclination angle is appropriate (it is recommended to install it fixedly and adjust the installation angle to 30°)

g. Whether the data jump is related to specific weather (it is recommended to adjust the installation angle value to 30°)

(2) Why does the liquid level measurement result jump?

a. Whether to choose the appropriate measurement mode. For ordinary rivers and open channels, it is recommended to use the river mode; if the test range is small, such as within 2m, it is recommended to choose the well mode.

b. Under the premise that the mode is correct, if the measurement result jumps in the direction of rising water level, depending on the actual situation, it may be that the radar has measured other interference signals inside the beam angle, such as shore, terrace, wall protrusions, etc. , at this time it is recommended to adjust the installation angle to

avoid the direction of interference, or adjust the installation position; if the measurement result jumps to within 0.5m of the radar, it may be due to poor factory learning. It is recommended to set the blind zone according to the on-site application, such as 0.3m, or conduct 0-1m area learning for shielding (make sure the water surface is far greater than 1m from the radar, such as 2m away before you can do the above operation).
c. When testing in areas such as manholes and sewers, false echo shielding must be done. This type of area is usually narrow and long, and the lack of uneven walls can easily cause strong reflected signals. It is recommended to use Bluetooth to confirm the echo curve, confirm the interference position and signal position, and perform corresponding false echo shielding
d. Just after power-on, the water level information needs stabilization time, which varies according to the damping and smoothing coefficients. If the power is frequently cut off in the application, be sure to wait until the data is stable before reading.

(3) The flow meter cannot communicate

a. Check the wiring, confirm that the connection is connected, and check whether the line sequence is correctly connected according to the instructions in Section 5.1.
b. Check the power supply voltage with a multimeter and also check the power supply voltage on the power supply line to ensure it is between 9-30V
c. Confirm the working current and ensure that the current is XXmA@24v when there is no data interaction.
d. Whether the serial port number and serial port baud rate are set correctly.
e. Check whether the modbus address is consistent with expectations.