Manual of
BT7580 Radar Flow Gauge

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1. Introduction

The BT7580 radar flowmeter is a product that utilizes radar technology to measure water flow velocity and water level, and calculates the water flow rate through an integration model. This product can measure water flow in real-time, regardless of the weather conditions, and its non-contact measurement method makes it less susceptible to environmental influences. The product is installed using a bracket, providing convenient installation.

The main advantages of the BT7580 series are as follows

- ✧ Non-contact measurement of flow velocity, liquid level, and flow rate using a hybrid frequency radar, with simultaneous and independent outputs, requiring minimal maintenance and unaffected by sediment and other factors.
- ✧ IP68 waterproof design, suitable for various field environments and extreme weather conditions.
- ✧ Compact and sleek appearance, offering excellent cost-effectiveness.
- ✧ Integrated reverse connection, lightning protection, and overvoltage protection functions.
- ✧ Support for Modbus-RTU protocol, facilitating system integration.
- ✧ Support for Bluetooth debugging via mobile phones, allowing convenient on-site maintenance by field personnel.

2. Specifications

Range（Velocity）	0.05 m/s ~30m/s
Accuracy（Velocity）	±0.01m/s
Pitch Angle （Velocity） (Automatic Compensation)	0°x80°
Antenna Beam Angle	12°x25°
Range	0.08m～60m
Distance Accuracy	±1mm
Distance Antenna Beam Angle	6°
Power Supply	9~30VDC
Operating Current	25 mA @ 24 V in working mode, ≤1 mA @ 12 V in sleep mode
Communication Interface	RS485、Bluetooth for parameter adjustment
Communication Protocol	Modbus（9600/115200）
Operating Temperature	-40-80℃
Housing	Aluminum alloy, PBT
Dimensions（mm）	153mm*94mm*84mm
Protection Level	IP68
Installation Method	Bracket

3. Physical Dimensions

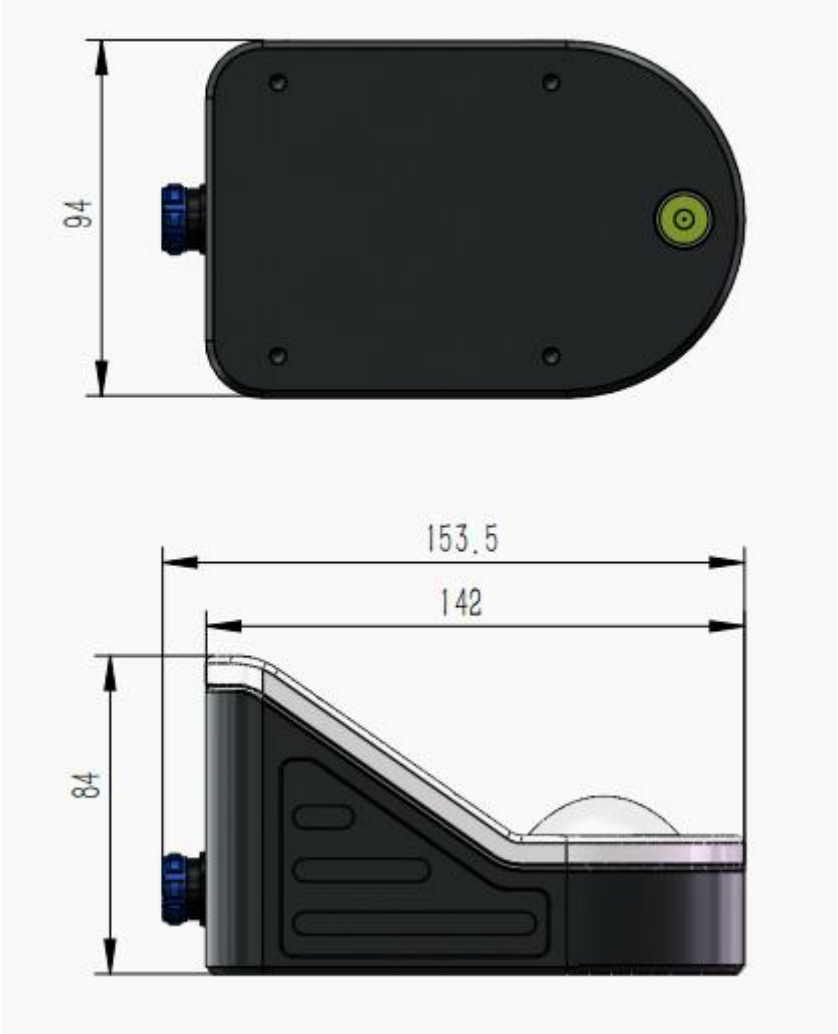


Figure 3-1 Schematic Diagram of Product Structure Dimensions

The BT7580 flowmeter has a compact overall structure with a built-in bubble level for installation adjustment. It features an integrated surface design, ensuring excellent sealing performance. The total weight of the device is 0.8kg, making it suitable for various extreme working conditions.

4.Installation

The flowmeter consists of two parts a velocity measurement radar and a level measurement radar. The velocity meter calculates the flow velocity of the water surface by measuring the Doppler frequency shift of the water flow. The level measurement radar, similar to the velocity measurement radar, calculates the distance from the radar to the water surface by measuring the flight time of electromagnetic waves. The flowmeter estimates the velocity distribution on the river cross-section based on the measured velocity and level, combined with the input parameters of the actual river being measured. It then calculates the river flow rate based on the corresponding empirical model.

To accurately measure the flow rate, the following points should be considered

4.1 Selection of the measurement water area

(1) The water flow direction in the test section should be consistent, and there should be no significant variations in flow velocity. The water surface should have certain wave fluctuations.

(2) There should be no large eddies, turbulence, or turbulent flow phenomena, and the river section should be straight.

(3) Floating objects Floating objects can interfere with the radar signal, causing certain fluctuations in the velocity measurement results. Once the floating objects leave the radar's field of view, the measurements can return to normal.

(4) Rainfall Rainwater itself is a moving object and can also be detected by the radar. The radar has a built-in tracking system to avoid abrupt changes in measurement results. Additionally, for better measurements, it is recommended to adjust the installation angle to around 30°.

Note：

If the water surface is calm and without ripples, the electromagnetic waves emitted by the radar may not reflect back to the receiver due to mirror reflection, resulting in the radar not receiving echo signals and unable to provide accurate velocity results.

4.2 Impact of installation angle

(1) To ensure accurate level measurement, the flowmeter should be placed perpendicular to the water surface, ensuring horizontal installation (no significant slope on the water surface). If the flow module is installed at an incline, it may affect the accuracy and stability of radar measurements. It is recommended to control the horizontal tilt angle within ±3°.

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

(3) The angle between the velocity module and the water surface determines the stability and reliability of velocity measurement. If the angle is too small, the radar echo will be weak, resulting in unstable and unreliable measurements. If the radar tilt angle is too large, such as between 85-90°, the radar cannot detect the Doppler frequency shift of the water flow, leading to unreliable measurements. The radar has

a built-in gyroscope that automatically compensates for the time offset, eliminating the need for precise adjustments.

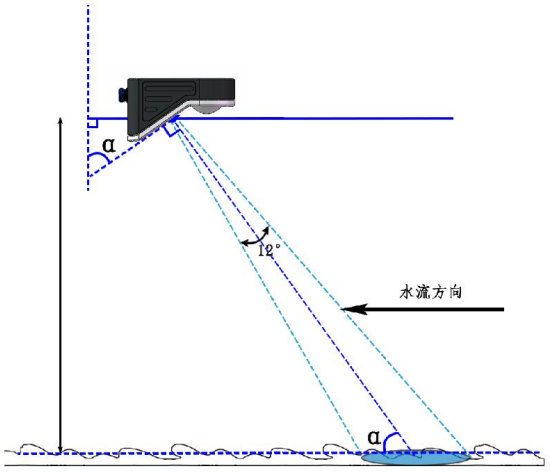


Figure 4-1 Schematic Diagram of Installation Position

4.3 Impact of installation height

(1) The farther the radar is from the water surface, the weaker the received echo signal, resulting in a poorer ability to accurately detect water flow velocity.

(2) The radar should not be too close to the water surface to avoid being submerged by the water flow.

(3) If you want to measure very low flow velocities (<0.1m/s) or relatively calm water surfaces, a close-range measurement is required to increase the energy of the radar's received echo. It is recommended to maintain a distance of 10-30cm from the water surface.

(4) To ensure accurate level measurement, the installation height should be significantly higher than the radar's blind zone and within the maximum testing limit of the radar.

4.4 Impact of radar field of view (FOV)

The field of view of the radar is referred to as the FOV. The radar's field of view spreads outward in a cone shape. Within the FOV, there should be no other moving objects, such as turbines, pedestrians, cars, etc., outside the water flow being measured, or other prominent interferences.

In the BT7580 product, the FOV of the velocity measurement module is approximately 12°×25°, thanks to a higher measurement frequency range, while the FOV of the level measurement module is roughly (6°×6°).

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

Note FOV is a simple measure of the radar beam width, and it does not imply that the radar cannot detect objects beyond the beam. When installing the radar, it is necessary to confirm the echo curve and eliminate interference from clutter that is unrelated to level or velocity. If there is significant clutter, false echo learning and shielding should be performed.

4.5 Impact of installation position

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

(2) The radar installation position closer to the riverbank is more likely to be affected by factors such as water grass and the riverbank itself.

(3) It is recommended to install the radar as close to the center of the river as

possible.

(4) To obtain reliable level measurement results and minimize interference within the radar beam, it is advisable to avoid installation near the riverbank, walls, and protruding objects. Prior to installation, it is suggested to confirm the echo curve. If unavoidable interference exists, false echo learning can be used for shielding.

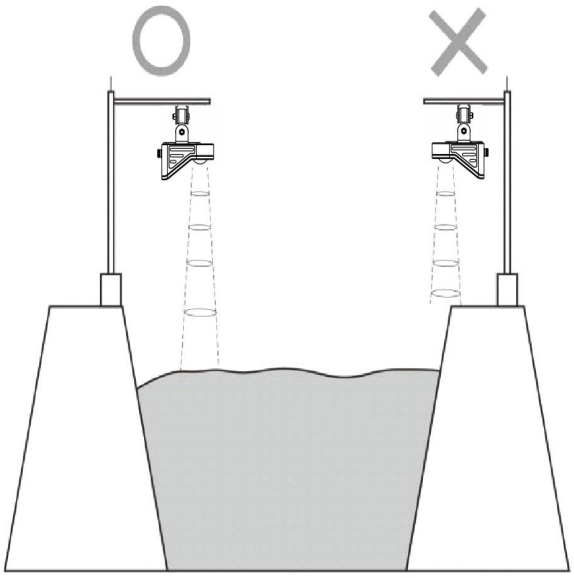


Figure 4-2 Schematic Diagram of Product Installation Position

5.Connection

Wiring Instructions

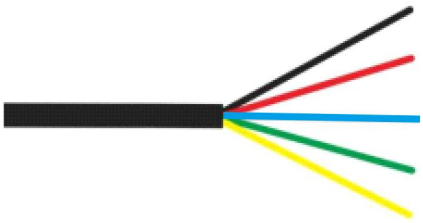
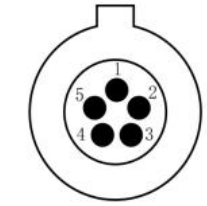


Figure 5-1 Product Wiring Diagram

When inserting the aviation plug, align the white dots on both parts and tighten the nut after insertion. Refer to Table 5-1 for specific wiring instructions.

Table 5-1 Wire Sequence Description

 Mother socket	Sequence	Wire Sequence	Function	Internal Color	Internal Function	Remarks
	1	Red	Positive Power Supply	Red	Positive Power Supply	9-30V
	2	Yellow	Negative Power Supply	Black	Negative Power Supply	-
	3	Blue	485A	White	485A	Baud rate 9600, do not reverse
	4	Green	485B	Green	485B	Baud rate 9600, do not reverse
	5	Black	485_GND	Yellow	485_GND	Common ground for 485, connect when necessary

6. Flowmeter Operation

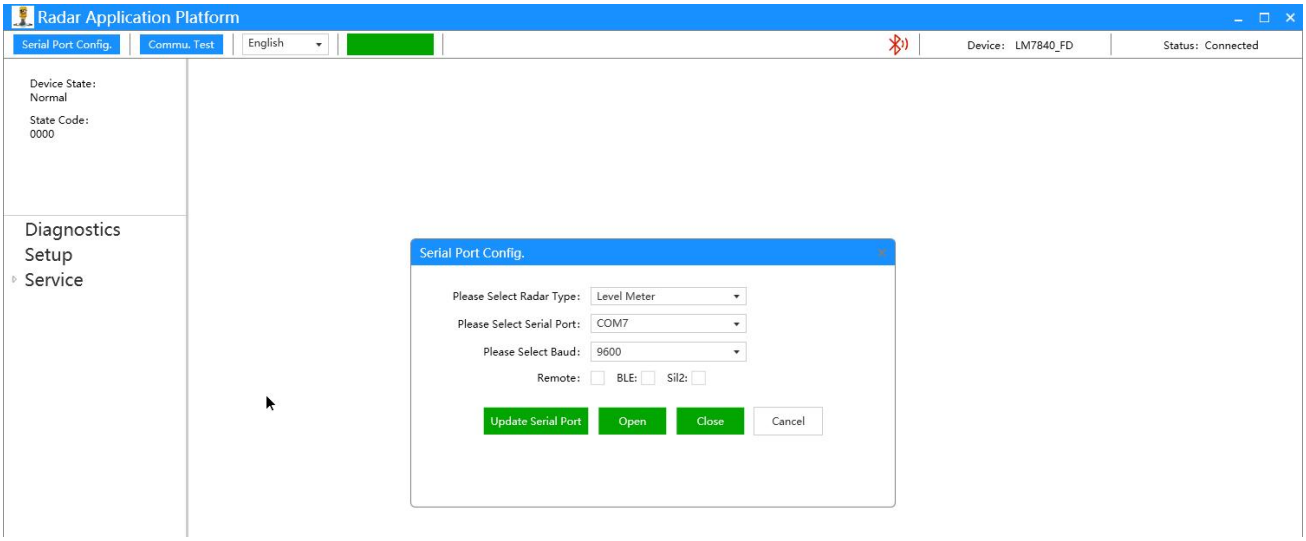
The BT7580 flowmeter has a default measurement cycle of 1 second and is equipped with a built-in adaptive scenario-based algorithm. It also provides simple configuration options to address on-site issues. These settings can be modified using Bluetooth or the 485 interface.

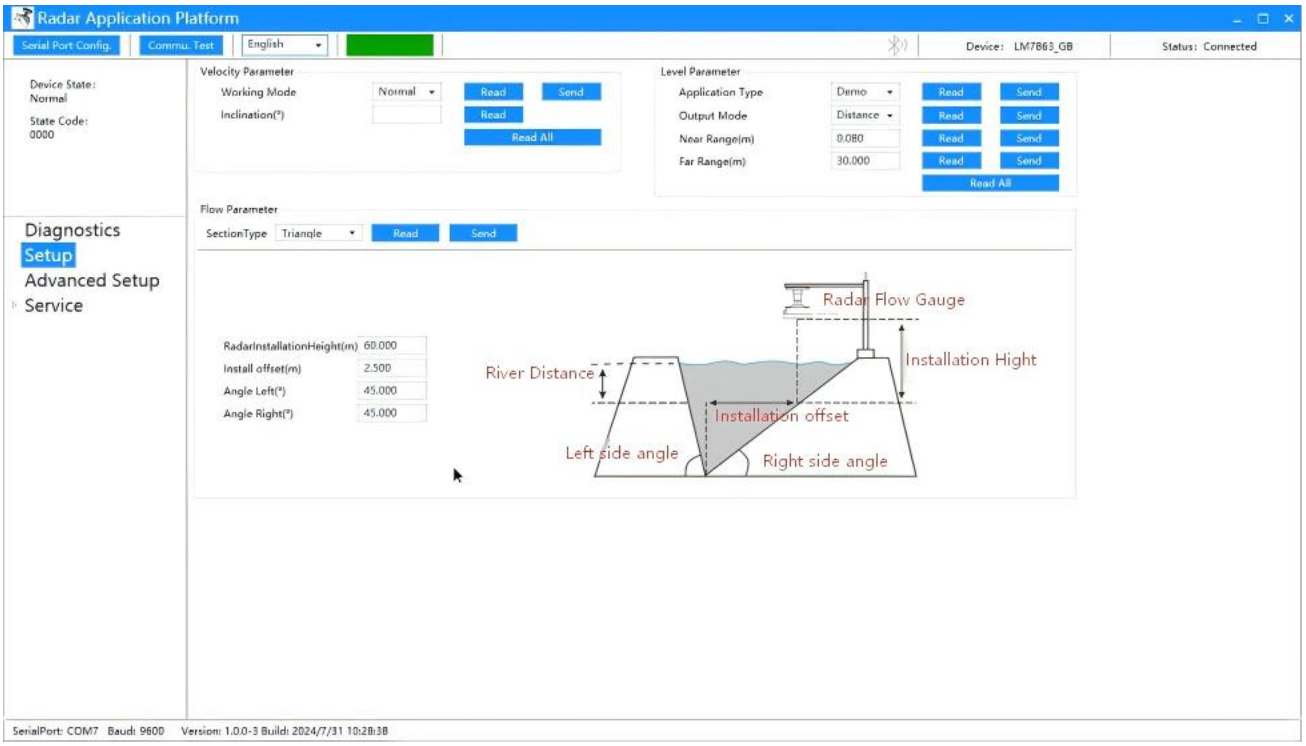
6.1 PC Host Interface Description

6.1.1 Connection Instructions

Figure 6-1 Setting the Flowmeter Baud Rate

（Language can be customized）





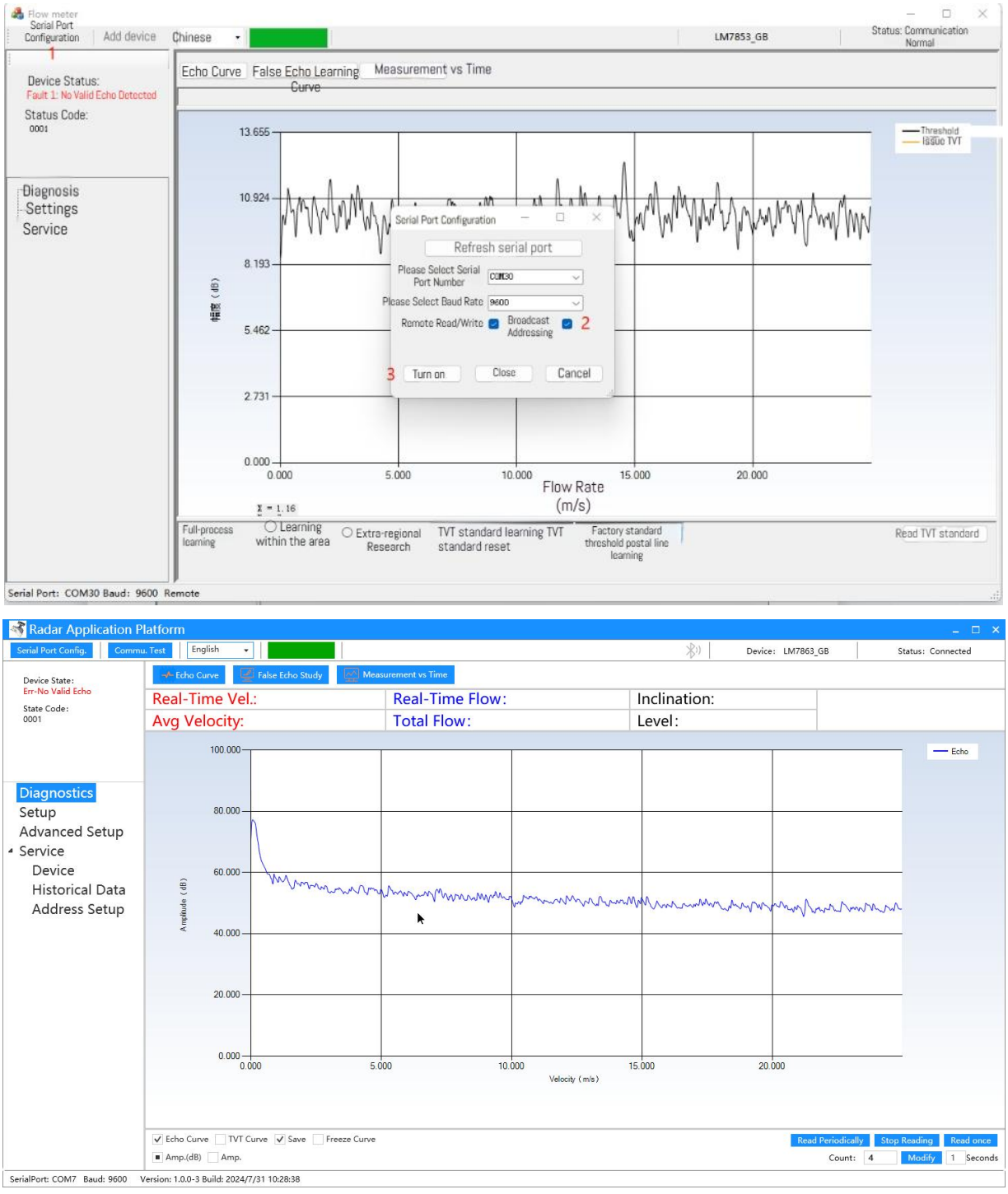


Figure 6-2 Configuring PC Host Serial Port Parameters

On the PC side, follow the sequence shown in the diagram to click on "Serial Port Configuration." Try selecting a baud rate of 9600 and click "Open." Once the progress bar completes scrolling, it indicates a successful connection. After a successful

connection, you can view waveforms, collect data, and configure or read parameters.

6.1.2 Echo Curve Interface

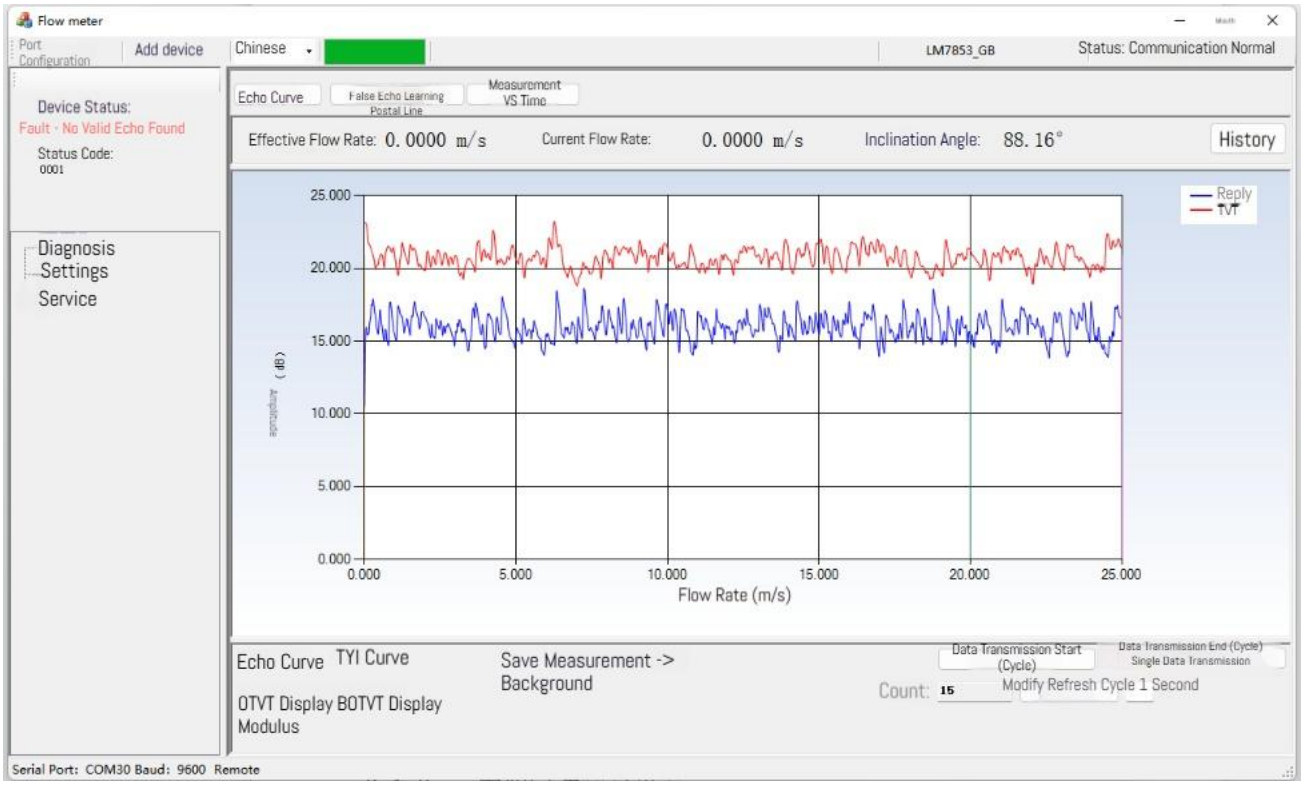


Figure 6-3 Configuring PC Host Serial Port Parameters

As a PC host, you can request real-time echo data from the flowmeter and display it in a detailed manner.

The "Echo Data" represents the real-time radar echo curve.

The "TVT Curve" is the real-time decision curve used as a threshold to determine valid radar echoes.

The "Save" button is used to store the echo data in a database and browse it in the "History" interface.

The "Measure-Background" function allows you to save the real-time echo curve as the background in the display area for easy comparison.

The "Start Data Transmission (Cycle)" button periodically requests echo curves from the flowmeter.

The "Modify Measurement Cycle" determines the frequency of data requests from the PC host. Regardless of whether the host requests data or not, it does not affect the normal working cycle of the flowmeter.

The "Stop Data Transmission (Cycle)" button stops data requests and refreshing.

The "Single Data Transmission" button requests echo data from the flowmeter once.

6.1.3 False Echo Learning Interface

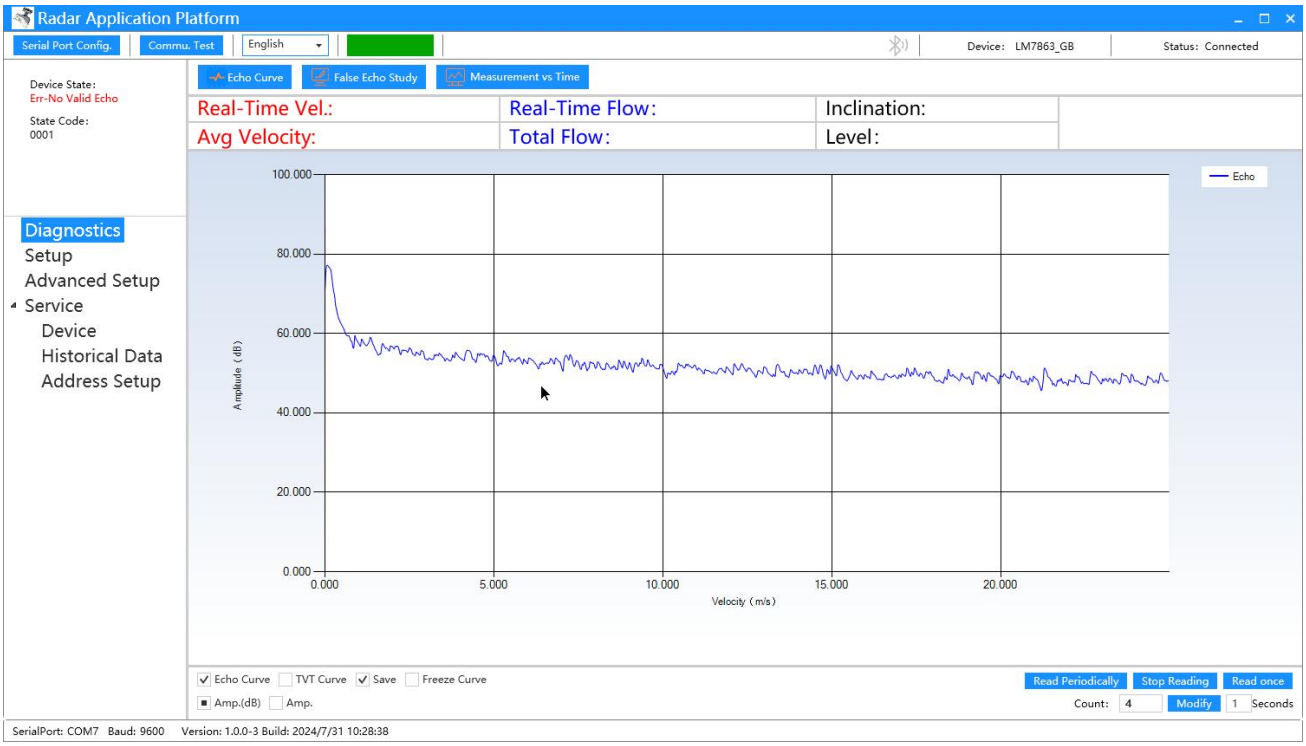


Figure 6-4 Configuring PC Host Serial Port Parameters

During radar measurements, if there are unavoidable interference signals, you can try to suppress them using false echo learning. The BT7580 provides various methods for

false echo suppression, allowing customers to flexibly configure them according to the actual situation.

【TVT Reference Learning】Performs false echo learning based on the set area.

【TVT Reference Clear】Clears previously learned false echo based on the set area.

【TVT Factory Reference Learning】This option is suitable for users to use before the complete assembly of the device to record the baseline noise of the radar. It performs false echo learning across the entire range by default.

【Full-Range Learning】Performs learning across the entire range. It is not suitable for on-site operation and should be performed while facing the water flow.

【Learning within the Area】Performs false echo learning within the set area.

【Learning outside the Area】Performs false echo learning outside the set area.

Note:

The operations described in sections 6.1.2 and 6.1.3 are only applicable to the flowmeter module. For the liquid level measurement module, please use our corresponding PC host software for viewing and factory learning of echo curves.

6.1.4 Measurement vs. Time Interface

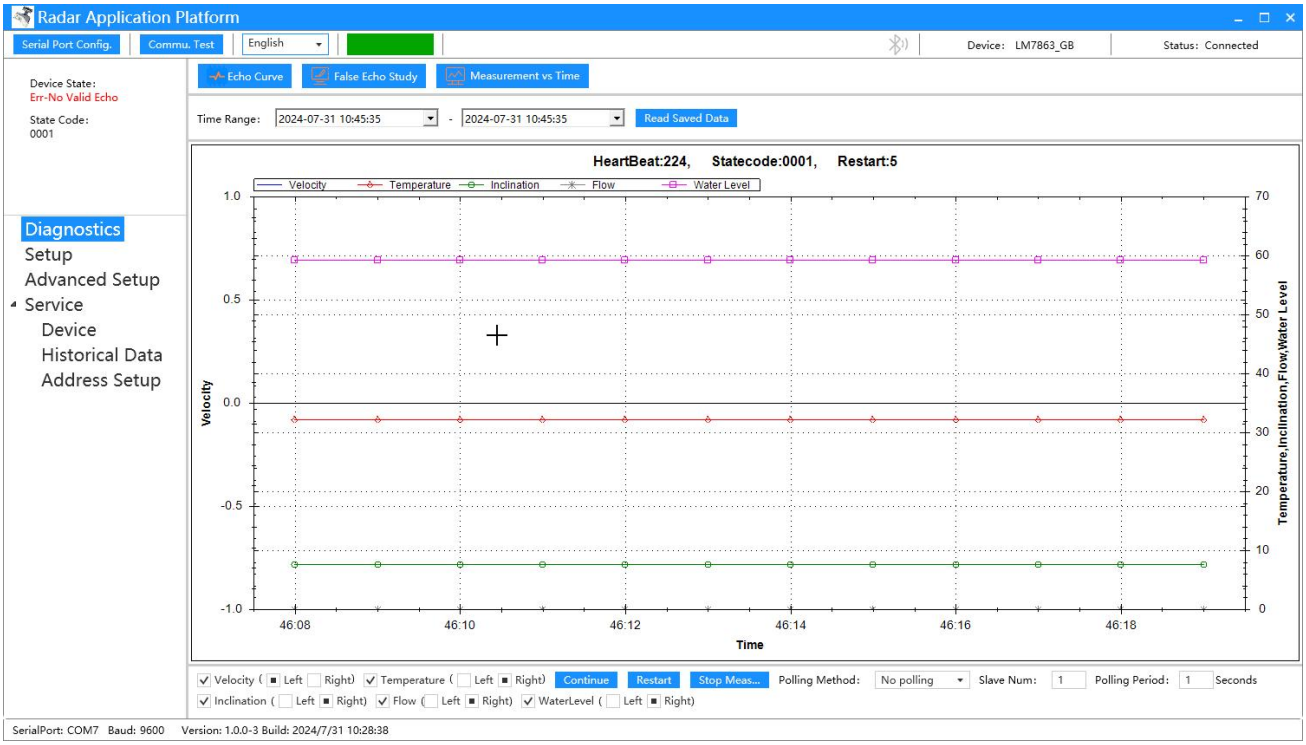


Figure 6-5 Configuring PC Host Serial Port Parameters

On the PC side, you can perform real-time data acquisition, and the PC host will display real-time data such as flow rate, liquid level, flow, temperature, tilt, etc.

【Continue Measurement】 Resumes the previous measurement.

【Restart Measurement】Clears the screen display and restarts the counting and data refresh.

【Stop Measurement】Stops data refresh. After stopping, the flowmeter will continue to operate, but the PC host interface will no longer refresh data.

Additionally, the PC host software supports polling mode, allowing synchronous display of real-time data from multiple slave flowmeters. By configuring the polling mode and the number of slave devices, multiple monitoring windows can be generated, making it easy to monitor the working status of multiple radar flowmeters.

6.1.5 Parameter Explanation in the Settings Interface

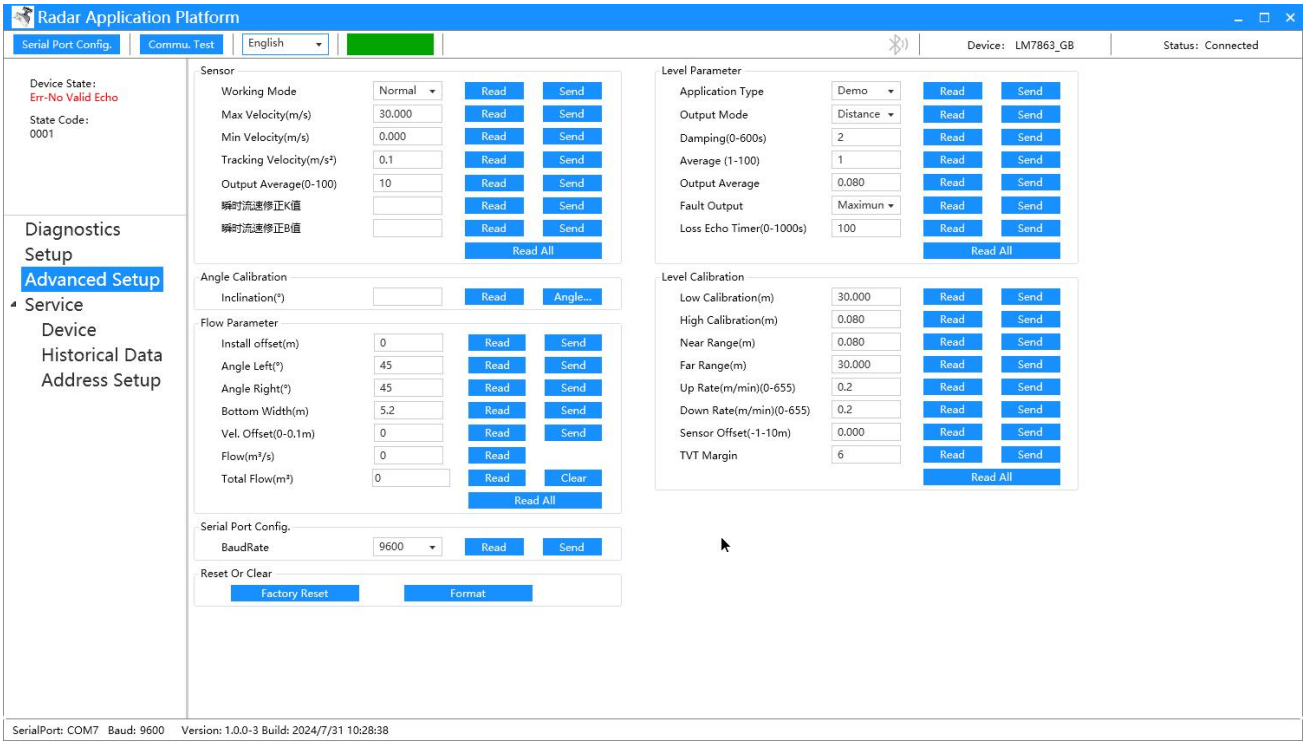


Figure 6-6 PC Host Settings Interface

6.1.5.1 Flow Rate Parameter Settings

【Measurement Mode】

Provides two configurations: Normal and Demo. The Normal mode is used in real-world scenarios and features built-in scenario-based adaptive algorithms for stable and interference-resistant output results. The Demo mode is designed to meet rapid measurement needs within a controlled environment. It is more responsive but susceptible to interference, so it is not recommended for on-site applications.

【Minimum Flow Rate】

Please refer to the table below for specific details.

Table 6-2 Dead Zone Explanation

Parameter Name	Minimum Flow Rate
Parameter Range (m/s)	0~30
Default Value （m/s）	0
Option Significance	When processing algorithms, velocity signals within the range of the minimum flow rate will be ignored. This parameter helps avoid interference signals near the instrument's proximity.
Special Note	To obtain accurate measurement results, it is necessary to set the instrument's measurement range. Please refer to the table below for specific details.

【Maximum Flow Rate】

To obtain accurate measurement results, it is necessary to set the instrument's measurement range. Please refer to the table below for specific details.

Feagure 6-3 Measurement Range Explanation

Parameter Name	Measurement Range Explanation
Parameter Range (m/s)	0~30
Default Value (m/s)	30
Option Significance	When processing algorithms, velocity signals beyond the maximum flow rate will be ignored. By setting a reasonable value, interference signals outside the specified

	range can be avoided.
Special Note	This parameter does not indicate the far-end measurement limit of the instrument but is used to define the algorithm's operating range.

【Tilt】 Users can read the real-time tilt of the flowmeter.

【Tilt Calibration】

If there is a significant angular deviation during factory calibration, the tilt can be calibrated to a standard value. Place the flowmeter's antenna face on a level surface and click the "Calibrate" button after it remains still for 10 seconds. (Note Use this option with caution. If you notice significant anomalies in the tilt values, please contact our after-sales personnel.)

【Tracking Speed】

Table 6-4 Tracking Speed Explanation

Parameter Name	Tracking Speed
Parameter Range (m/s^2）	＞0
Default Value (m/s^2)	0.10
Option Significance	It represents the ability of the radar to respond and measure changes in velocity results within a unit of time.

【Zeroing Timer】

Table 6-5 Zeroing Timer Explanation

Parameter Name	Zeroing Timer
Parameter Range (s)	0~100
Default Value (s)	10
Option Significance	It determines the time required to consider the velocity signal as disappeared. It measures the continuous absence of echo detection.

【Reset Timer】

Table 6-6 Reset Timer Explanation

Parameter Name	Reset Timer
Parameter Range (s)	0~100
Default Value (s)	5
Option Significance	It determines the time required to consider the velocity signal as appeared. It measures the continuous detection of echo.

【Reset Margin】

Table 6-7 Reset Margin Explanation

Parameter Name	Reset Margin

Parameter Range (dB)	0~20
Default Value (dB)	7. 5
Option Significance	It represents the minimum signal-to-noise ratio that must be met for the velocity signal to be considered as appeared.

【TVT Margin】

Table 6-8 TVT Margin Explanation

Parameter Name	TVT Margin Explanation
Parameter Range	>0
Default Value	8
Option Significance	When the velocity signal is detected, it needs to exceed the TVT reference value by at least the TVT margin.

【Output Averaging】

Table 6-9 Output Averaging Explanation

Parameter Name	Output Averaging
Parameter Range	0~100
Default Value	100
Option Significance	It represents the window length for averaging the output average velocity.

6.1.5.2 Water Level Parameter Settings

【Measurement Mode】Please select the appropriate mode based on the actual operating conditions. It is recommended to use the River mode for river applications. For field testing, the Demo mode is recommended as it provides quick response. For applications with a range less than 2m, it is suggested to use the Well or Tank mode.

【Output Type】The radar output will be determined based on this setting, whether it is water level value, air gap value, or distance from the water surface.

【Low-Level Adjustment】Represents the distance from the riverbed to the radar. Setting the correct low-level adjustment is essential for accurate water level measurement.

【High-Level Adjustment】It is the reference point for air gap calculation. Set this parameter based on the desired output. If air gap output is not required, this parameter can be left unset.

The above settings are the basic configuration process for accurate water level measurement. For more detailed information, please refer to our company's "76-81GHz Continuous Wave Radar Water Level Meter User Manual."

6.1.5.3 Flow Rate Parameter Settings

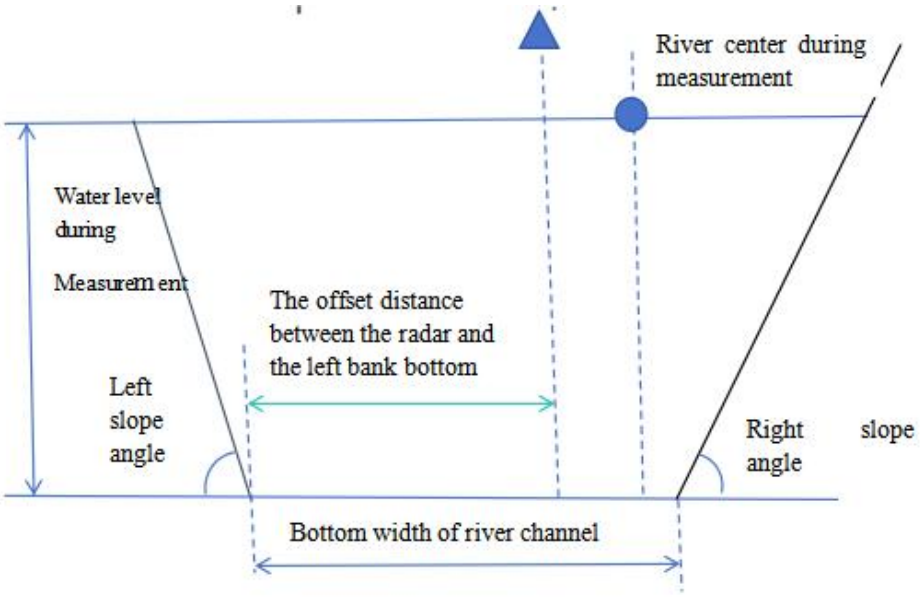


Figure 6-8 Schematic Diagram of Flow Meter Settings Parameters

【Installation Offset】Please refer to the table below for specific details.

Table 6-10 Installation Offset

Parameter Name	Installation Offset
Parameter Range (m)	-BL (horizontal length of left bank slope) to B (riverbed width) + BR (horizontal length of right bank slope)
Default Value (m)	B/2
Option Significance	It represents the distance between the radar and the bottom of the left bank. It is recommended to install the radar in the center of the river. If the installation deviates from the center, the radar has built-in compensation algorithms.

【Left (Right) Bank Slope Angle】Please refer to the table below for specific details.

Table 6-11 Left (Right) Bank Slope Angle

Parameter Name	Left (Right) Bank Slope Angle
Parameter Range (°)	0~90
Default Value (°)	45
Option Significance	It determines the shape of the river cross-section, enriching the applicable scenarios for the flow meter.

【Riverbed Width】 Please refer to the table below for specific details.

Table 6-12 Riverbed Width

Parameter Name	Riverbed Width
Parameter Range (m)	>=0
Default Value (m)	None
Option Significance	It determines the shape of the river cross-section.

6.1.6 Configuration Methods for Common River Cross-Sections

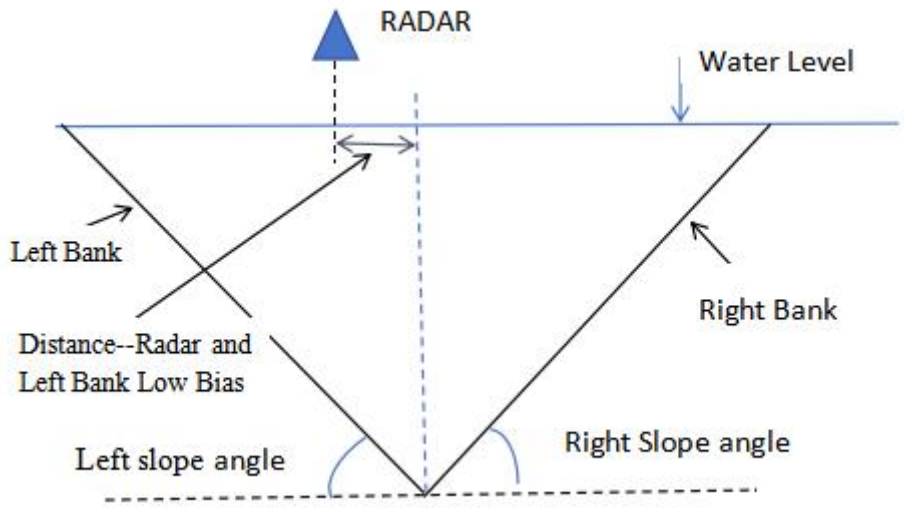


Figure 6-9: Schematic Diagram of Triangular Cross-Section Settings Parameters

【Triangular Cross-Section】

When the river cross-section is triangular, the riverbed width should be set to 0, and the flow meter should be placed as close to the center of the river as possible. The shape of the cross-section can be adjusted by changing the left (right) bank slope angle. For symmetrical triangular cross-sections, the left (right) bank slope angles should be set to equal values.

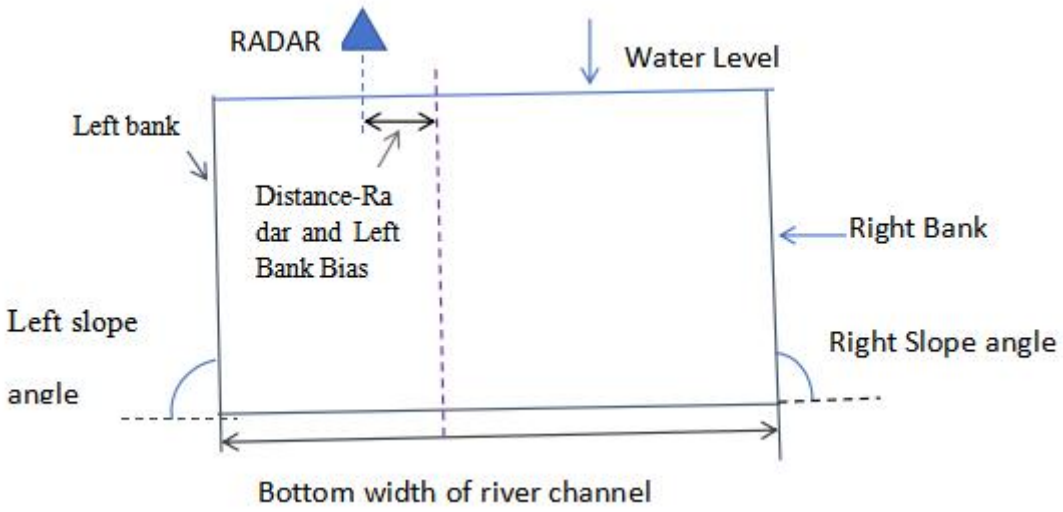


Figure 6-10: Schematic Diagram of Rectangular Cross-Section Settings Parameters

【Rectangular Cross-Section】

When the river cross-section is rectangular, the riverbed width should be set to the length of the bottom side of the rectangle. Set the left (right) bank slope angle to 90°, and place the flow meter as close to the center of the river as possible.

7.Problem Diagnosis

(1) Why is there a sudden change in the flow rate measurement?

There can be several reasons for a sudden change in the flow rate measurement:

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

b. Verify if the operating current is normal (around 25mA @ 24V).

c. Check if the water surface at the site is still or if there are minimal water ripples (if there is significant water disturbance or extremely low flow velocity, consider changing the installation location).

d. Determine if there are floating objects, water grass, or other moving elements that can affect the measurement area (identify false echoes by observing the echoes).

e. Verify if the water level is too low, causing the radar to directly hit the riverbed or rocks (consider changing the installation location).

f. Check if the radar installation is stable and the tilt angle is appropriate (recommend securing the installation and adjusting the installation angle to 30°).

g. Investigate if the data fluctuations are related to specific weather conditions (consider adjusting the installation angle to 30°).

(2) Why is there a sudden change in the liquid level measurement?

a. Confirm if the appropriate measurement mode is selected. For regular rivers or open channels, it is recommended to use the river mode. If the measurement range is small, such as within 2m, consider using the well mode.

b. In the correct mode, if the measurement results suddenly jump in the direction of increasing water level, it may be due to the radar receiving interference signals from within the beam angle, such as shorelines, platforms, protruding walls, etc. In such cases, adjust the installation angle to avoid the interference direction or change the installation location. If the measurement results jump to within a distance of less than 0.5m from the radar, it may be due to incomplete factory learning. It is advisable to set an appropriate blind zone based on the actual application, such as 0.3m, or perform a learning process within the 0-1m range to eliminate interference (ensure that the water surface is more than 1m away from the radar, for example, perform

the above operations at a distance of 2m).

c. When conducting tests in areas such as manholes or sewers, it is essential to shield false echoes. These areas are often narrow, with uneven walls, and can produce strong reflection signals. It is recommended to use Bluetooth to confirm the echo curve, identify the interference and signal positions, and implement corresponding false echo shielding.

d. When the system is just powered on, the water level information requires a certain stabilization time, which varies depending on damping and smoothing coefficients. If power interruptions occur frequently, it is necessary to wait for the data to stabilize before reading.

(3) Why is the flow meter unable to communicate?

a. Check the wiring and ensure that the connections are properly established. Verify the correct wiring sequence according to the instructions in section 5.1.

b. Use a multimeter to check the power supply voltage and ensure that the voltage on the power supply line is between 9-30V.

c. Confirm the operating current. In the absence of data interaction, the current should be approximately 25mA @ 24V.

d. Verify if the serial port number and baud rate are set correctly.

e. Check if the Modbus address matches the expected address.