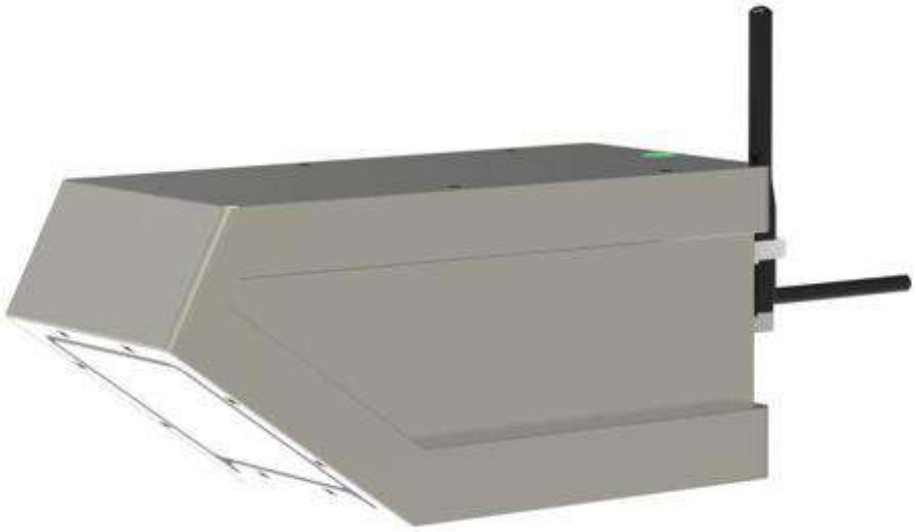
RADAR FLOW METER

USER MANUAL



STARITING POINT

Thank you for purchasing our non-contact open channel radar flow meter.

The radar flow meter uses radar technology to provide precise contactless measurement of surface flow velocity and precise distance (level) measurement from the sensor to the water surface. All contactless radar technology enables quick and simple sensor installation above the water surface, and requires minimum maintenance. Due to the modulation and detection process in the sensor very precise measurements can be achieved and sensor is not affected by the air temperature, humidity or other parameters of the environment.

The radar flow meter is able to detect water surface velocity to 20 m/s with precision of 0,01 m/s and distance can be measured to 40 m with precision of 0.008 m. Integrated with the technology of precision narrowband array signal processing, floating point arithmetic processing, flow velocity direction recognition, rain noise removal, and automatically cosine-corrected according to the measured mounting tilt angle.

Although we are certain that you are more than capable of connecting the radar flow meter to your system, we have created this user manual to assist you in setting up and using the flow meter device.

CONTENT

1Product Profile

1.1 Product Description

The radar flow meter uses radar technology to provide precise contactless measurement of surface flow velocity and precise distance (level) measurement from the sensor to the water surface. It also can calculate the instantaneous cross-sectional flow rate and total flow rate through the built-in calculation software. And the measuring data (flow velocity, level, flow rate) can be checked on the Cloud Platform. Data transmission can use the way of digit (RS485/RS232) and Analog(4-20mA), and the way of wireless transmission(4G, NB-IoT, LoRa) is available if the customer need.
The radar flow meter can be used for non-contact flow measurement in open channels, rivers, irrigation canals, underground drainage pipe networks, flood control and early warning. and sensor is not affected by the air temperature, humidity or other parameters of the environment. The product has the characteristics of low power consumption, small size, high reliability, simple operation and less maintenance, and the measurement process is not affected by environmental factors such as temperature, air pressure, sediment, dust, river pollutants, floating objects on the water surface, etc.

1.2Measuring Principle

The radar flow meter uses planar microwave technology, uses the Doppler radar principle to measure the flow velocity, and uses the built-in narrowband radar technology to measure the water level. According to the velocity-area method, the water level will be measured first, and converted to calculate the cross-sectional area, then the average velocity is converted from the surface flow velocity and the cross-sectional parameters. The flow rate comes from the empirical formula for the velocity distribution of the open channel cross-section such as round, rectangular, and trapezoidal is established combined with the hydraulic model algorithm. It is a non-contact flow measuring instrument that accurately measures the flow without changing the boundary conditions of channels, rivers, pipelines, etc.

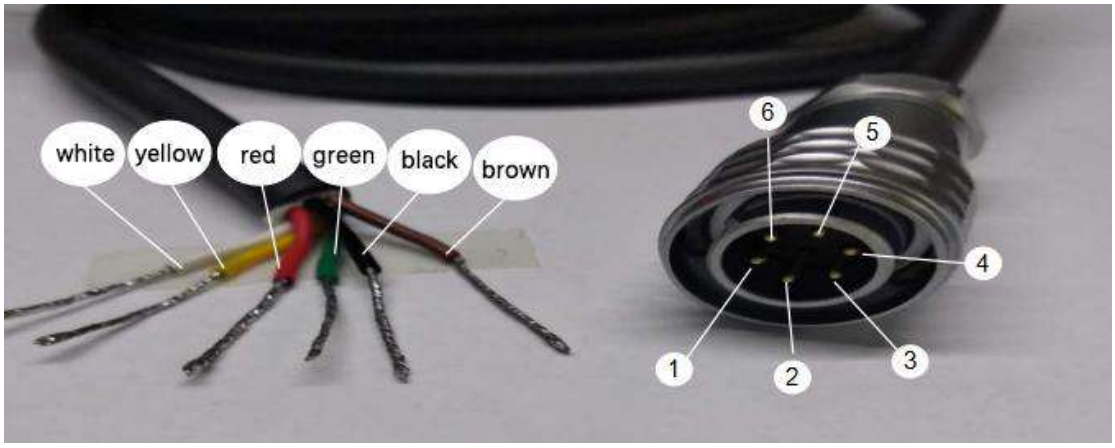
1.3Characteristics

1.Contactless flow measurement, no pollution to the environment
2.Compact, low-power design, easy installation, less maintenance
3.IP68 aluminum casing
4.Wide input voltage range, suitable for solar applications
5.Supports variety of communication interfaces (RS485, RS232, 4-20MA outputs)
6.Wireless communication modes available for selection (4G,NB-IOT,Lora)
7.Automatic mounting angle compensation (cosine correction)
8.Rain mode, avoiding raining interfere
9.Lightning protection circuit, effectively protect the device from lightning strikes

1.4Specifications

PERFORMS	PARAMETERS
Principle	Planar microstrip array antenna CW+FMCW
Operation Mode	Manual, Automatic, Telemetry
Ambient	-30~80 ℃
Voltage	7-32VDC, 5.5-32VDC(optional)
Current	12VDC, operating mode<150mA, Standby mode<1mA
Protective level	IP68
Lightning protection level	6KV
Dimension	235.4×100×103.7（mm）
Wight	1.5KGs
Radar Flow Velocity Sensor	
Radar Power	50mW
Radar Frequency	24GHz
Max Range	40m
Flow Range	0.03-20m/S
Accuracy	0.01m/s; ±1%FS
Antenna Ange	12 °
Radar Level Gauge	
Radar Power	100mW
Radar Frequency	24GHz
Range	0.2-40m
Accuracy	±6mm, ±9mm,
Antenna Ange	12 °
Data Transmission	
Interface	RS232/RS485,4~20mA,433MHz wireless optional, such as LoRa, NB-IoT, 4G RTU

2Cable Pin-Out



Pin No.	Wire color		Pin Name	Pin Description
1	Brown		5.5-32V DC	power supply
2	Black		GND	ground
3	Green		TXD_A	232_TX/485_A+
4	Red		RXD_B	232_RX/485_B+
5	Yellow		IOUT	4-20mA+
6	white		GND	ground

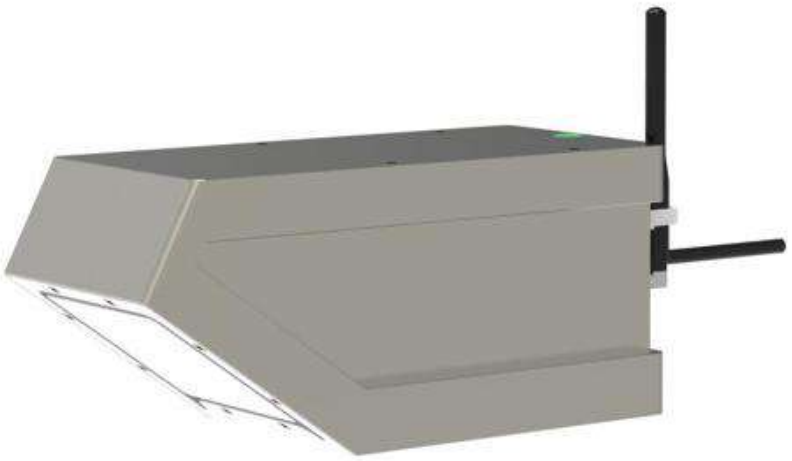
2.1Set-up

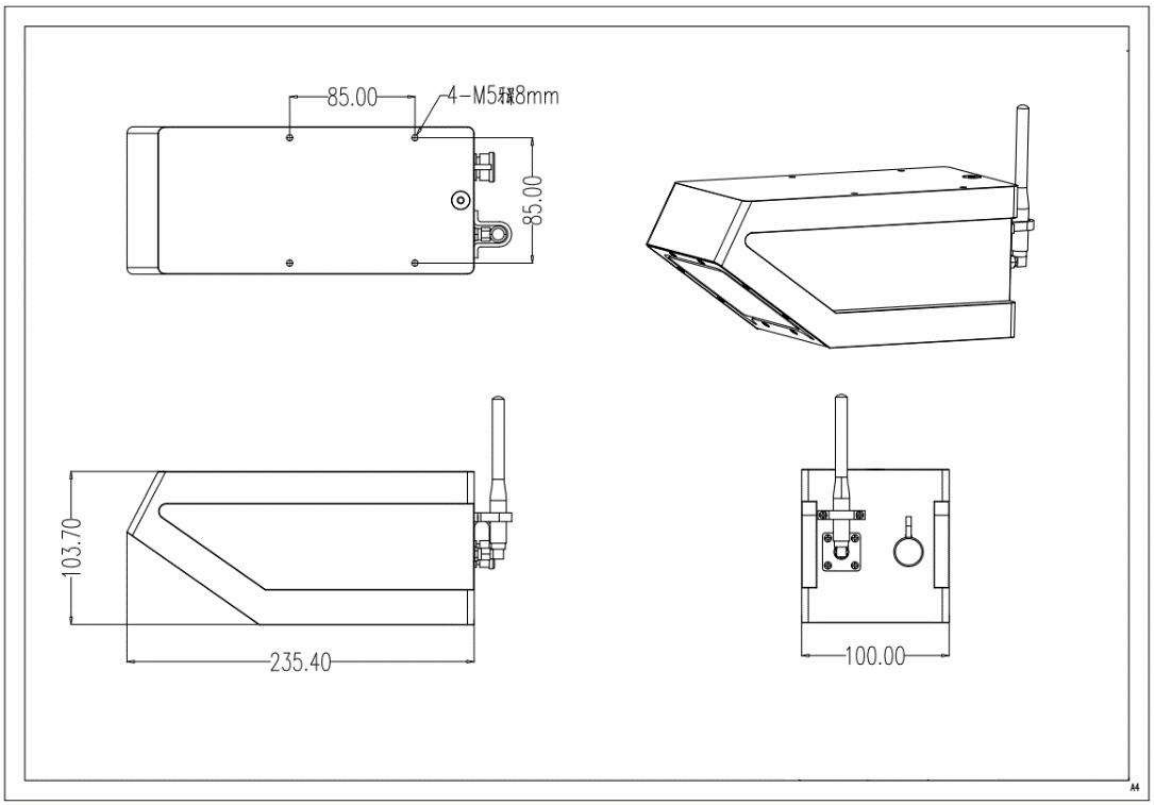
Communication mode
Communication Port:RS485
Baud rate：9600（default）
parity：NONE
Data bit：8
Stop bit：1
Most common communication protocol used with RS-485 interface is Modbus RTU but other protocols are also available if the customer need.

3Installation

3.1Instrument structure and Dimensions

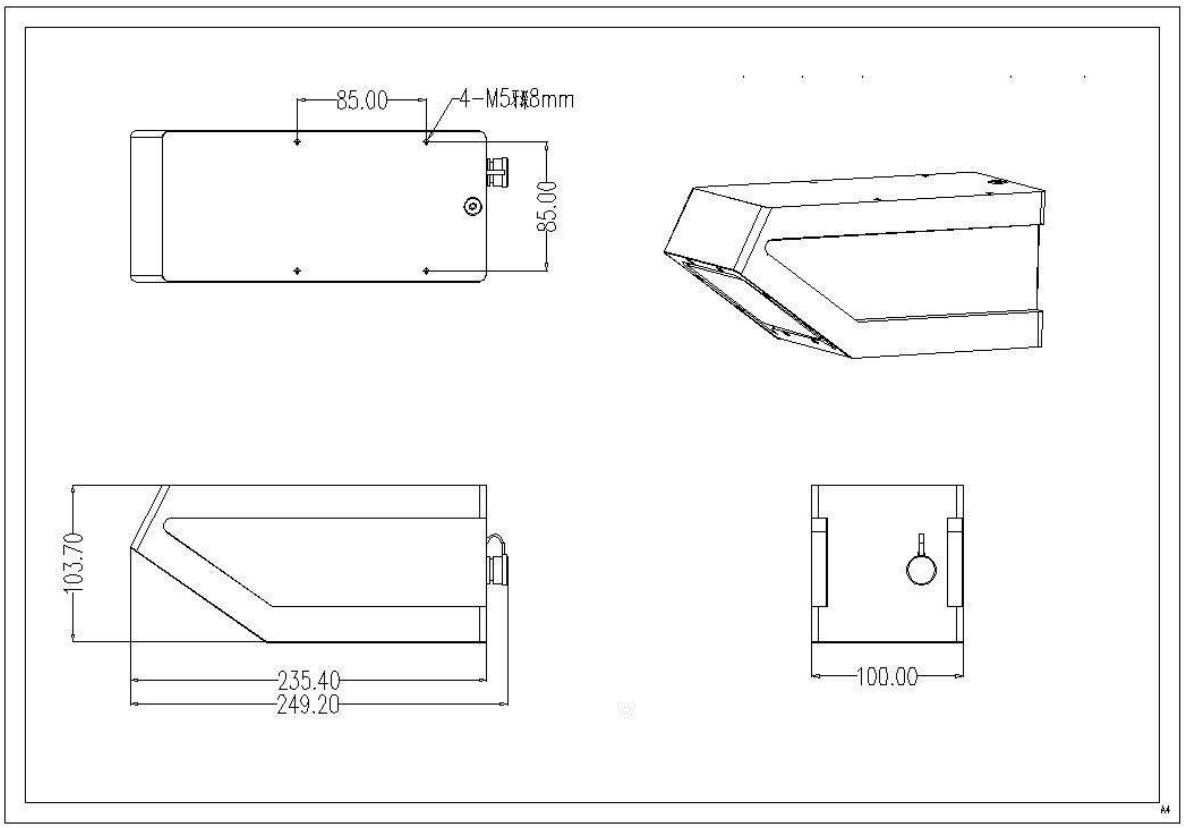
3.1.1 Wireless Remote Transmission Type





Dimensions: 235.4×100×103.7（Unit：mm）

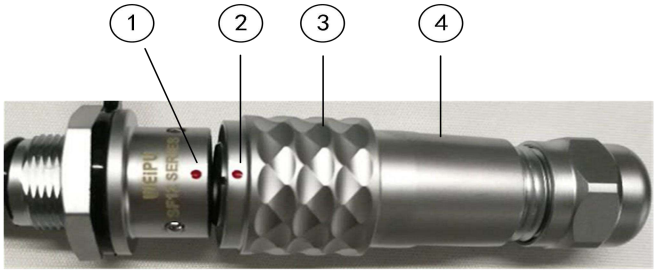
3.1.2 Standard Type



Dimensions: 235.4×100×103.7（Unit：mm）

3.2Plug installation

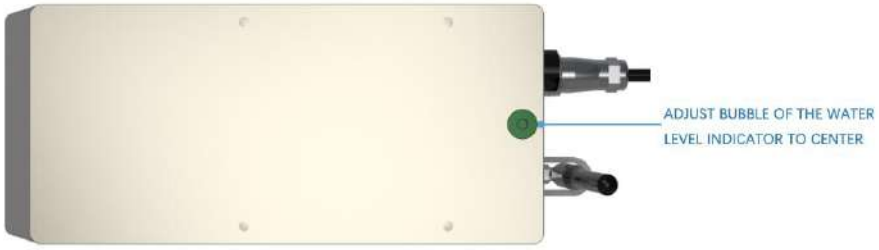
As shown in the figure below, when the cable is inserted into the instrument, hold the position of the cable ④, and insert the cable plug with the red dot ② aligned with the red dot ① of the instrument interface, and plug it in when you hear a pop. When unplugging, hold the position ③ of the cable in your hand and pull it out to unplug it.



The wireless transmission's antenna interface is SMA (internal threaded & inner needle). When using it, you only need to align the antenna interface with the SMA-K (or female seat), press and tighten it. In order to ensure the best communication, the angle of the antenna should be as perpendicular to the ground, and it is better to keep the antenna periphery away from obstacles.

3.3Mouting and Location Selection

3.3.1Instument mounting method and direction



3 hoops fix the holder and the radar flow meter onto the supporting bar (diameter range of the supporting bar: 40mm-85mm).

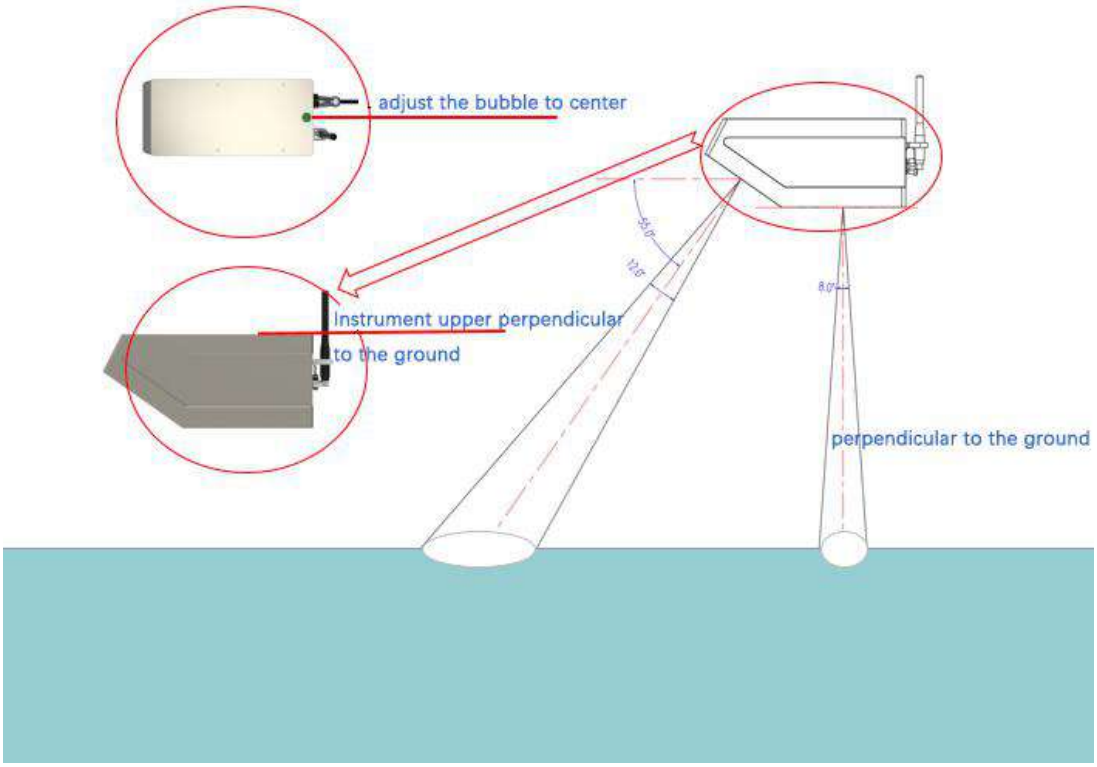
The instrument upper surface should be oriented in parallel with the water flow direction.
(note: the bubble of the leveler is adjusted to the center).

The instrument is pointed upstream, so that the water flows towards the instrument.

3.3.2Location Selecting

The height of the instrument above the water surface and the inclination determine area on the surface that is covered by the radar beam.This measurement area should be clear of any obstacles. The structure holding the instrument (pole, bridge fence, etc.) must be solid and without vibrations. There should be no vegetation, floating objects,turbulent flow between the radar and the measurement area because it could affect measurement accuracy.

The launch angle of the radar level sensor is 12°, and the coverage is approximately circular. the launch angle of the radar velocity sensor is 12°, and the coverage is approximately oval, as shown in the figure below;



Relationship for diameter and length shown the followings

Height (m)	Velocity sensor covers Dia range（m）	Level sensor covers Dia range（m）
5	1.994	1.051
10	3.977	2.102
15	5.960	3.153
20	7.943	4.204
25	9.925	5.255
30	11.994	6.036
35	13.891	7.357
40	15.874	8.408

Location selecting for channel should follow below rules.

1. The channel is straight, and channel base is sturdy, the section is steady and stable, which is convenient for equipment installation.

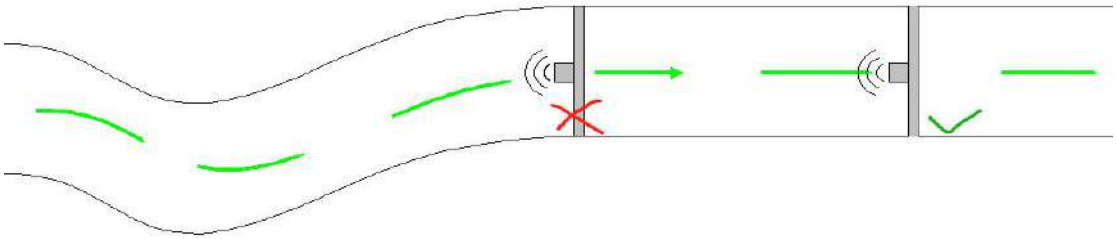
2. The water flows smoothly and evenly, and is not affected by whirlpools, overflow dike opening and closing,

and backwater at channel constrictions.

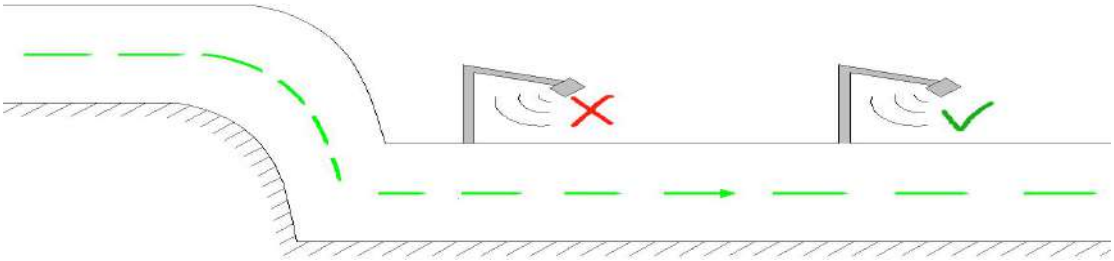
3. There should be no buildings, trees or weeds that affect the flow of water near the section.
4. It is not suitable to be located in a place with serious siltation and a lot of aquatic plants or debris

Avoid the following installation points,

1. Avoid the point where the direction of water flow in rivers or channels changes



2. Avoid the sensor directly faces to the water flows with large drop



3. Avoid installing above the overflow dike and reservoir with turbulence.
4. Avoid the points at culvert exits and other locations where wind is easy to generate.

4Communication Protol

4.1 Data interface

Serial RS-485 interface is used for connecting multiple flow meters to a single data logger. RS-485 interface uses a different protocol then the protocol used over RS- 232 interface, in order to allow multiple flow meters connected on a single RS-485 bus.
The main difference from the protocol used over RS-232 interface is that the flow measurements are not reported automatically, but are instead reported only after being requested by the master device.
Default communication parameters are: Bit rate: 9600 bps, data bits: 8, stop bits: 1, parity: none

4.2Modbus-RTU protocol

When configured in Modbus operation mode, the unit responds to Modbus requests.
over RS-485 data line. The baud rate id configured through the PC application, and default Bitrate: 9600 bps, data bits: 8, stop bits: 1, parity: none.
Modbus registers that are accessed by Modbus protocol are 16-bit (2-byte) registers. Any number of registers can be read or written over Modbus.
Modbus is a request-response protocol where a master device sends out requests, and slave devices (such as our radar flow meter) responds. The request and response format, with example is given in tables 3-6.
In each request, the master can either ask the slave to retrieve value of one or more registers, or the master can set the value of one or more registers. Each register holds one 16-bit value.

The request and response format, with example is given in following 4 tables.

*Master request format

Name	Address	Fun.	Data start address		Count of registers		CRC16	
Length	1 byte	1 byte	2 bytes (H,L)		2 bytes (H,L)		2 bytes (L,H)	
Example	0X01	0X03	0X00	0X00	0X00	0X01	0X84	0X0A

*Request example

Name	Content	Detail
Address	0X01	Slave address(Sensor id)
Function	0X03	Read slave info
Data start address	0X00	The address of the first register to read (HIGH)
	0X00	The address of the first register to read (LOW) – Sensor ID registers
Count of registers	0X00	High
	0X01	Low (read only 1 register)
CRC16	0X84	CRC Low
	0X0A	CRC High

*Slave (sensor) response format

Name	Address	Fun.	Byte count	Data		CRC16	
Length	1 byte	1 byte	1 byte	2 bytes (H,L)		2 bytes (L,H)	
Example	0X01	0X03	0X02	0X00	0X01	0X79	0X84

*Response example

Name	Content	Detail
Address	0X01	Slave address(Sensor id)
Function	0X03	Read slave info
Data length	0X02	Data length is 2 bytes
Data	0X00	Data high byte
	0X01	Data low byte, means ID is 1
CRC16	0X79	CRC Low
	0X84	CRC High

4.3Device Configuration

4.3.1Device address

The device address can be set by changing the holding register address 0x001C, and the range can be set from 1 to 200. The factory default slave address is 0x80. After the slave address is set successfully, it will be saved automatically.

Example for setting the device address to 0x01

*Request example

Slave address	Function	Register address	Data	CRC
80	06	00 1C	00 01	97 DD

*Response example

Slave address	Function	Register address	Data	CRC
80	06	00 1C	00 01	97 DD

When you forget the device address, you can specify the device address as 0xFF, and query the register address 0x001C through the Modbus protocol 03 function code to obtain the real address of the device.

Note: When using this method to query the device address, only one device can be connected to the 485 bus.

Example of querying device address

*Request example

Slave address	Function	Register address	Data	CRC
FF	03	00 1C	00 01	50 12

*Response example

Slave address	Function	Byte count	Data	CRC
80	03	02	00 80	85 FA

0x0080 in the response message is the real device address of the device.

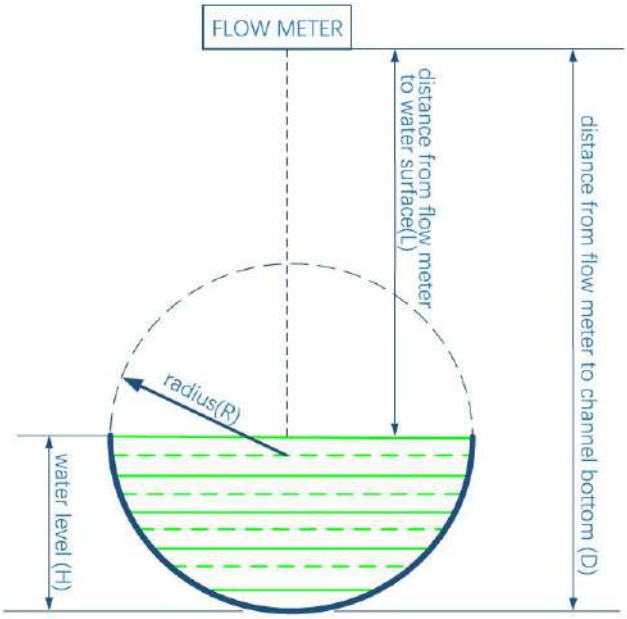
4.3.2Channel shapes

The device supports three basic types of water channel shapes, which are round, trapezoidal and U-shaped. Rectangular and triangular water channels can be obtained by adjusting the length of the bottom side and the length of the top side of the trapezoid. channel parameters are set by 0x06 and 0x10 function code, read by 0x03 function code. Set the register of the channel shape by 0x000F, the data is as follows

Data	Description
0x01	round
0x02	trapezoidal
0x03	U-shaped

4.3.2.1Round Channel

The parameters that need to be set for a round channel are the channel shape, the distance from the radar flow meter to the channel bottom(D), and the radius of the round channel(R). The value D and R need to be written after magnifying the actual value by 100 times. For example, the actual value is 1.23 The value written in m is 123. Note that you need to convert the decimal value into hexadecimal and then enter it (123 corresponds to hexadecimal 7B).



Register address to the round channel parameters

Parameters	Register address	Register count
channel shape	0x000F	1
distance from the radar flow meter to the channel bottom(D)	0x0010	1
radius of the round channel(R)	0x0011	1

Example for setting parameters for the round channel

Set the parameter-channel shape as round, request as followings (response same as the request)

Slaver address	Function	Register Address	Data	CRC
80	06	00 0F	00 01	66 18

Set the parameter-distance from the radar flow meter to the channel bottom, example as Decimal 1.0m (Magnified 100 times as 100， equal to hexadecimal 0x64). Request as followings (response same as the request)

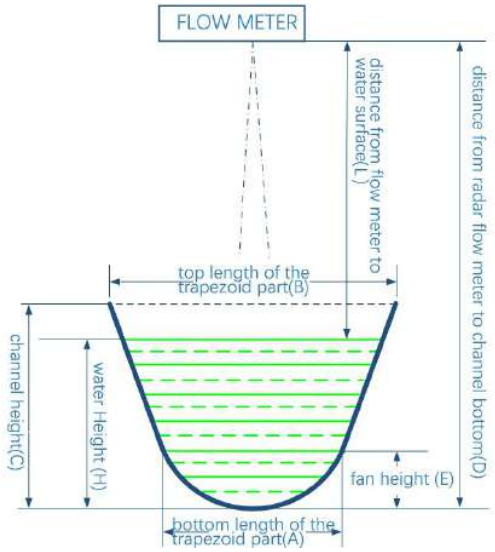
Slaver address	Function	Register Address	Data	CRC
80	06	00 10	00 64	97 F5

Set the parameter-radius of the round channel, example as Decimal 1.0m. Request as followings (response same as the request)

Slaver address	Function	Register Address	Data	CRC
80	06	00 11	00 64	C6 35

4.3.2.2Trapezoidal Channel

The parameters that need to be set for a trapezoidal channel are the channel shape, the distance from the radar flow meter to the channel bottom(D), the trapezoidal channel bottom length(A), the trapezoidal channel top length(B), and the height of the trapezoidal channel(C). The value D, A, B and C need to be written after magnifying the actual value by 100 times. If the actual value is 1.23m, the written value is 123. The decimal value should be converted into hexadecimal (123 corresponds to hexadecimal 7B).



Register address to the trapezoidal channel parameters

Parameters	Register address	Register count
channel shape	0x000F	1
distance from the radar flow meter to the channel bottom(D)	0x0010	1
trapezoidal channel bottom length(A)	0x0012	1
trapezoidal channel top length(B)	0x0013	1
trapezoidal channel height(C)	0x0014	1

Example for setting parameters for the trapezoidal channel

Set the parameter-channel shape as trapezoidal, request as followings (response same as the request)

Slaver address	Function	Register Address	Data	CRC
80	06	00 0F	00 02	26 19

Set the parameter-distance from the radar flow meter to the channel bottom, example as Decimal 1.0m (Magnified 100 times as 100， equal to hexadecimal 0x64). Request as followings (response same as the request)

Slaver address	Function	Register Address	Data	CRC
80	06	00 10	00 64	97 F5

Set the parameter-trapezoidal channel bottom length as 1.0m, request as followings (response same as the request)

Slaver address	Function	Register Address	Data	CRC
80	06	00 12	00 64	36 35

Set the parameter-trapezoidal channel top length as 1.0m, request as followings (response same as the request)

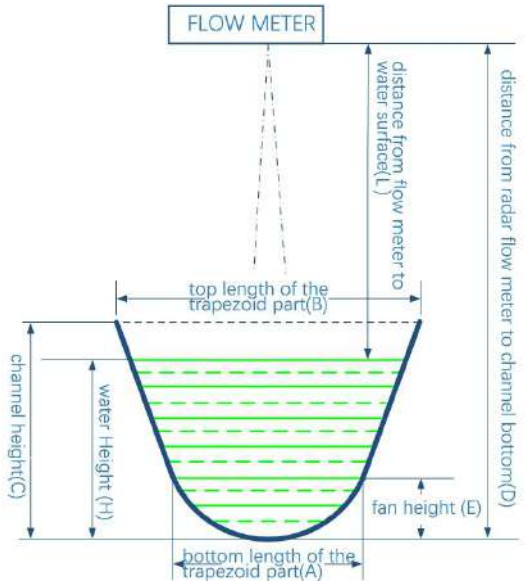
Slaver address	Function	Register Address	Data	CRC
80	06	00 13	00 64	67 F5

Set the parameter-trapezoidal channel height as 1.0m, request as followings (response same as the request)

Slaver address	Function	Register Address	Data	CRC
80	06	00 14	00 64	D6 34

4.3.2.3U-shaped Channel

The parameters that need to be set for the U-shaped channel are the channel shape, the distance from the radar flow meter to the channel bottom(D), the fan height(E), the bottom length of the trapezoid part(A), the top length of the trapezoid part(B), and the channel height(C). The value D, E, A, B and C need to be written after magnifying the actual value by 100 times. If the actual value is 1.23m, the written value is 123. Note You need to convert the decimal value into hexadecimal. (123 corresponds to hexadecimal 7B).



Register address to the U-shaped channel parameters

Parameters	Register address	Register count
channel shape	0x000F	1
distance from the radar flow meter to the channel bottom(D)	0x0010	1
fan height(E)	0x0011	1
bottom length of the trapezoid part(A)	0x0012	1

top length of the trapezoid part(B)	0x0013	1
channel height(C)	0x0014	1

Example for setting parameters for the U-shaped channel

Set the parameter-channel shape as U-shaped, request as followings (response same as the request)

Slaver address	Function	Register Address	Data	CRC
80	06	00 0F	00 03	E7 D9

Set the parameter-distance from the radar flow meter to the channel bottom, example as Decimal 1.0m (Magnified 100 times as 100， equal to hexadecimal 0x64). Request as followings (response same as the request)

Slaver address	Function	Register Address	Data	CRC
80	06	00 10	00 64	97 F5

Set the parameter-the fan height as 1.0m, request as followings (response same as the request)

Slaver address	Function	Register Address	Data	CRC
80	06	00 11	00 64	C6 35

Set the parameter-the bottom length of the trapezoid part as 1.0m, request as followings (response same as the request)

Slaver address	Function	Register Address	Data	CRC
80	06	00 12	00 64	36 35

Set the parameter-the top length of the trapezoid part as 1.0m, request as followings (response same as the request)

Slaver address	Function	Register Address	Data	CRC
80	06	00 13	00 64	67 F5

Set the parameter-the channel height as 1.0m, request as followings (response same as the request)

Slaver address	Function	Register Address	Data	CRC
80	06	00 14	00 64	D6 34

4.2.3River Type

Different river types correspond to different built-in filtering schemes. Use the default setting for this setting if uncertain. Set the river type register data for the river type is 0x0016,as shown in the table below.

Data	Types
0x01	Straight
0x02	Normal
0x03	Turbulence
0x04	Tilt

0x05	Splash

Set the parameter-river types, request as followings (response same as the request)

Slaver address	Function	Register Address	Data	CRC
80	06	00 16	00 01	B7 DF

4.3.4Noise Threshold

The noise threshold is used to set the signal extraction limit. If the signal strength of the device (obtained through the input register) is lower than the set value, it is considered that noise is not picked up. This item usually does not need to be adjusted, just follow the factory default. When the installation distance is long and the flow rate is low, the signal is weak and needs to be adjusted according to the field signal strength. The threshold should be set generally not less than 400.

The register for setting the noise threshold of the flow meter is 0x000B.

Set the threshold example as 1000, request as followings (response same as the request)

Slaver address	Function	Register Address	Data	CRC
80	06	00 0B	03 E8	E6 A7

4.3.5Radar Wave Direction

The radar wave direction of the flow meter is including forward, backward and bidirectional. The radar wave of the device is consistent with the river flow direction as forward, the flow meter just only collect the forward flow velocity when it was set as forward mode. The radar wave direction is reverse to the flow direction as backward. When set to backward mode, the flow meter only collects the backward flow velocity. When set to bidirectional mode, the flow meter automatically recognizes the flow direction and collects the flow velocity of forward and downward. It is recommended to set the backward mode (factory default), as it with anti-raining function. The register for setting the radar wave direction is 0x0018, and the value is as follows:

Data	Modes
0x01	forward
0x02	backward
0x03	bidirectional

Set the radar wave direction example as backward, request as followings (response same as the request)

Slaver address	Function	Register Address	Data	CRC
80	06	00 18	00 02	96 1D

4.3.6Filter Times

The larger the number of filtering, the smaller the numerical fluctuation, and the more stable the measurement result, but the real-time performance is weakened. The normal default is fine.

The register for setting the filter times of the velocity sensor is 0x000D, and the register for setting the filter times of the level sensor is 0x000E.

Set the filter times of velocity sensor example as 20, request as followings (response same as the request)

Slaver address	Function	Register Address	Data	CRC

80	06	00 0D	00 14	06 17

Set the filter times of level sensor example as 5, request as followings (response same as the request)

Slaver address	Function	Register Address	Data	CRC
80	06	00 0E	00 05	36 1B

4.3.7Measuring Time

1. High signal strength: a stable value will be measured in about 30s.
2. Relatively weak signal strength: Although the measurement result takes a long time (2min) at this time, the measurement performance is high for low flow rates, and the obtained results are also stable.

4.3.8Measuring Result

The measurement result is saved in the holding register and the input register, and can be read through Modbus protocol 0x03 or 0x04 function code (it is recommended to use the 0x04 function code to read the input register). Read the relevant registers through the debugging assistant (such as the MODBUS debugging assistant). Please note that the value read out at this time is in hexadecimal, so in order to facilitate the calculation, it needs to be converted to decimal. For example: the flow rate to be queried now is 0x7B, and the value read from the 0x0001 register is 0x7B, which converted to decimal is 123. At this time, the actual flow rate needs to be reduced by 1000 times (0.123m/s). It should be noted here that the values stored in the registers are all amplified values (details please check the "Description" column in the table below), so the values need to reduce the corresponding multiple. (Note: The waiting time for each query command is 100ms)

Holding register address please check in below table, which can be read by 0x03 function code.

Functions	Register address	Unit	Description
Velocity	0x0001	m/s	Magnified 1000 times
Level	0x0002	m	Magnified 1000 times
Height from radar flow meter to water surface	0x0003	m	Magnified 1000 times
Instantaneous Flow rate	0x0004	m^3/s	Magnified 1000 times
calculated flow rate (Hexadecimal-high part)	0x0005	m^3	Magnified 1000 times after merge
calculated flow rate (Hexadecimal-Middle part)	0x0006		
calculated flow rate (Hexadecimal-Low part)	0x0007		
Signal strength for velocity	0x0008	/	/
Signal strength for level(Reserved)	0x0009	/	/
Radar wave direction	0x000A	/	Backward:0 Forward:1
Fault information	0x0021	/	Reserved
Vertical angle	0x0022	°	Magnified 100 times
Input voltage	0x0023	V	Magnified 10 times

Input register address please check in below table, which can be read by 0x04 function code.

Functions	Register address	Unit	Description
Velocity	0x0001	m/s	Magnified 1000 times
Level	0x0002	m	Magnified 1000 times
Distance from radar flow meter to water surface	0x0003	m	Magnified 1000 times
Instantaneous Flow rate	0x0004	m^3/s	Magnified 1000 times
calculated flow rate (Hexadecimal-high part)	0x0005	m^3	Magnified 1000 times after merge
calculated flow rate (Hexadecimal-Middle part)	0x0006		
calculated flow rate (Hexadecimal-Low part)	0x0007		
Signal strength for velocity	0x0008	/	/
Signal strength for level(Reserved)	0x0009	/	/
Radar wave direction	0x000A	/	Backward:0 Forward:1
Fault information	0x000B	/	Reserved
Vertical angle	0x000C	°	Magnified 100 times
Input voltage	0x000D	V	Magnified 10 times

Note: In order to process the decimal part, the reading all magnified multiple for the velocity, level and height. After reading the value, it needs to be reduced. For example, if the reading for velocity is 1000, the real value is 1m/s.

Reading the single input register by 0x04 function code(Example as reading the velocity)
Request:

Slaver address	Function	Register Address	Register Count	CRC
80	04	00 01	00 01	7E 1B

Response:

Slaver address	Function	Data byte No.	Data	CRC
80	04	02	00 7B	C5 0D

Reading multiple consequent register by 0x04 function code. (Example as reading all measuring results)

Request:

Slaver address	Function	Data start Address	Register count	CRC
80	04	00 01	00 0D	7E 1E

Response:

Slaver address	80
Function	04
Data byte No.	1A
Velocity	00 7B
Level	00 7B
distance from radar flow meter to water surface	00 7B
Instantaneous Flow rate	00 7B
calculated flow rate(Hexadecimal-high part)	00 00
calculated flow rate(Hexadecimal-Middle part)	00 12
calculated flow rate(Hexadecimal-Low part)	34 56
Signal strength for velocity	07 D0
Signal strength for level	00 00
Radar wave direction	00 00
Fault information	00 00
Vertical angle	13 88
Input voltage	00 78
CRC	5E 4B

Note: The CRC in response is variable according to the real measuring value.

5Table for Register

5.1 Holding Register table

Address Hexadecimal	Function	Description	Range	Default	Read/Write
1	Velocity	Unit: m/s Magnified 1000 times	0~65535	0	Read
2	Level	Unit: m Magnified 1000 times	0~65535	0	Read
3	Distance from radar flow meter to water surface	Unit: m Magnified 1000 times	0~65535	0	Read
4	Instantaneous Flow rate	Unit: m^3/s Magnified 1000 times	0~65535	0	Read
5	calculated flow rate(Hexadecimal-high part)	Unit: m^3 Magnified 1000 times	0~65535	0	Read

6	calculated flow rate(Hexadecimal-Middle part)		0~65535	0	Read
7	calculated flow rate(Hexadecimal-Low part)		0~65535	0	Read
8	Signal strength for velocity	Signal strength for present velocity sensor	0~65535	0	Read
9	Signal strength for level	Signal strength for present level sensor	0~65535	0	Read
A	Radar wave direction	0x00: Backward 0x01: Forward	0~1	0	Read
B	Noise threshold for Velocity sensor	Set/check the noise threshold for velocity sensor	0~65535	800	Read&Write
C	Noise threshold for Level sensor(Reserved)	Set/check the noise threshold for level sensor	0~65535	500	Read&Write
D	Filter Times for Velocity	Set/check the filter times for Velocity	1~30	20	Read&Write
E	Filter Times for Level	Set/check the filter times for Level	1~30	5	Read&Write
F	Channel Shape	0x00: Round 0x01: Trapezoidal 0x02: U-Shaped	0~2	0	Read&Write
10	distance from the radar flow meter to the channel bottom	Unit: m Decimals is allowed, write after Magnified 100 times	0~65535	0	Read&Write
11	radius of the round channel/Fan height of U-shaped channel	Unit: m Decimals is allowed, write after Magnified 100 times	0~65535	0	Read&Write
12	trapezoidal channel bottom length/bottom length of the trapezoid part for U shaped channel	Unit: m Decimals is allowed, write after Magnified 100 times	0~65535	0	Read&Write
13	trapezoidal channel top length/top length of the trapezoid part for U shaped channel	Unit: m Decimals is allowed, write after Magnified 100 times	0~65535	0	Read&Write
14	trapezoidal channel height/ U-shaped channel height	Unit: m Decimals is allowed, write after Magnified 100 times	0~65535	0	Read&Write
15	Shore Coefficient	Default: 1.0 Decimals is allowed, write after Magnified 100 times	0~65535	100	Read&Write

16	River Types	0x01: Straight 0x02: Normal 0x03: Turbulence 0x04: Tilt 0x05: Splash	1~5	2	Read&Write
17	Velocity meter scale	0x01: 1 0x02: 2 0x03: 3	1~3	2	Read&Write
18	Radar wave direction	0x01: Forward 0x02: Backward 0x03: Bidirection	1~3	2	Read&Write
19	Max. Flow	0x00: Unlimited Decimals is allowed, write after Magnified 100 times	0~65535	0	Read&Write
1A	Clear calculated flow	0x01: clear	0~1	0	Read&Write
1B	Baud rate	0x01: 9600 0x02: 19200 0x03: 56000 0x04: 115200	1~4	1	Read&Write
1C	Device address	Set/read the device address	1~200	0x80	Read&Write
1D	Manual acquisition of vertical angle	The device automatically obtains the angle every 20s 0x01: acquisition it once manually	0~1	0	Read&Write
1E	Horizontal angle	Unit: ° Manually input the horizontal angle, decimals is not allowed	0~60	0	Read&Write
1F	Rain mode	0x01: Open 0x02: Close	1~2	1	Read&Write
20	Sleep Time	Unit: Minute Sleep time after finishing a single measurement period	0~65535	0	Read&Write
21	Fault information	Reserved	-	-	-
22	Vertical angle	Unit: ° Vertical angle after magnification 100 times	0~65535	0	Read
23	Input voltage	Unit: V Input voltage after magnification 10 times	0~65535	0	Read

24	Software version	Software version Combination of high 8 bits plus low 8 bits 0x0102 correspond to V1.2	0~65535	0	Read
25	Reset	0x01: Reset to factory fault	0~1	0	Read&Write
2C	Still water height	If the water level is less than this value, the flow output is 0 Decimals is allowed, write after Magnified 100 times	0~65535	0	Read&Write
2D	Maximum fluctuation limit	Reserved			
2E	4-20mA output	0x01: Height from radar flow meter to water surface 0x02: water level	1~2	1	Read&Write

5.2 Write Register Table

Address Hexadecimal	Function	Description	Range	Default
1	Velocity	Unit: m/s Magnified 1000 times	0~65535	0
2	Level	Unit: m Magnified 1000 times	0~65535	0
3	Distance from radar flow meter to water surface	Unit: m Magnified 1000 times	0~65535	0
4	Instantaneous Flow rate	Unit: m^3/s Magnified 1000 times	0~65535	0
5	calculated flow rate(Hexadecimal-high part)	Unit: m^3 Magnified 1000 times	0~65535	0
6	calculated flow rate(Hexadecimal-Middle part)		0~65535	0
7	calculated flow rate(Hexadecimal-Low part)		0~65535	0
8	Signal strength for velocity	Signal strength for present velocity sensor	0~65535	0
9	Signal strength for level(Reserved)	Signal strength for present level sensor	0~65535	0

A	Radar wave direction	0x00: backward 0x01: Forward	0~1	0
B	Fault information	Reserved	-	-
C	Vertical angle	Unit: ° Vertical angle after magnification 100 times	0~65535	0
D	Input voltage	Unit: V Input voltage after magnification 10 times	0~65535	0
E	Software version	Software version Combination of high 8 bits plus low 8 bits 0x0102 correspond to V1.2	0~65535	0
F	large Instantaneous Flow rate(Hexadecimal-high part)	Unit: m^3 Magnified 1000 times	0~65535	0
10	large Instantaneous Flow rate(Hexadecimal-low part)		0~65535	0

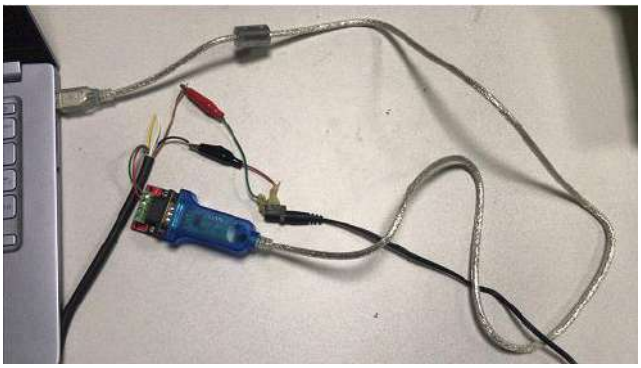
Note: Register address 0x04 for the instantaneous flow is only for small flow, the range is 0-65.535 m^3/s. if the instantaneous flow is large, which can be read by registers 0x0F and 0x10, and the flow range is 0-4294967.296 m^3/s. When the instantaneous flow rate value is less than 65.535 m^3/s, the register 0x04 and 0x10 are equal.

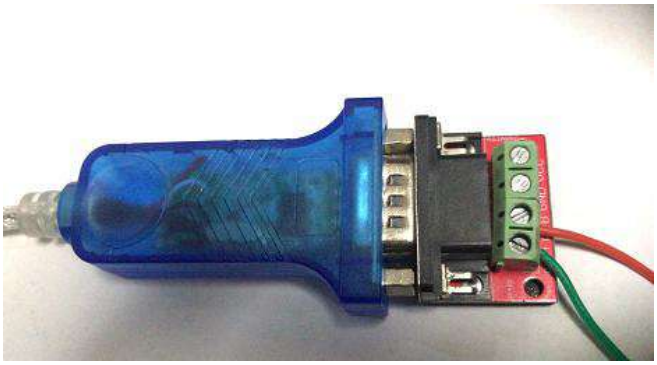
6 Software for Measurement System(Velocity/Level/Flow)

The radar flow meter also can be communication debugged by the Software for measurement system.The visualization software can facilitate the user to quickly set the parameters and read the measuring results, and provide a simple and fast intuitive way for system joint adjustment and on-site debugging.

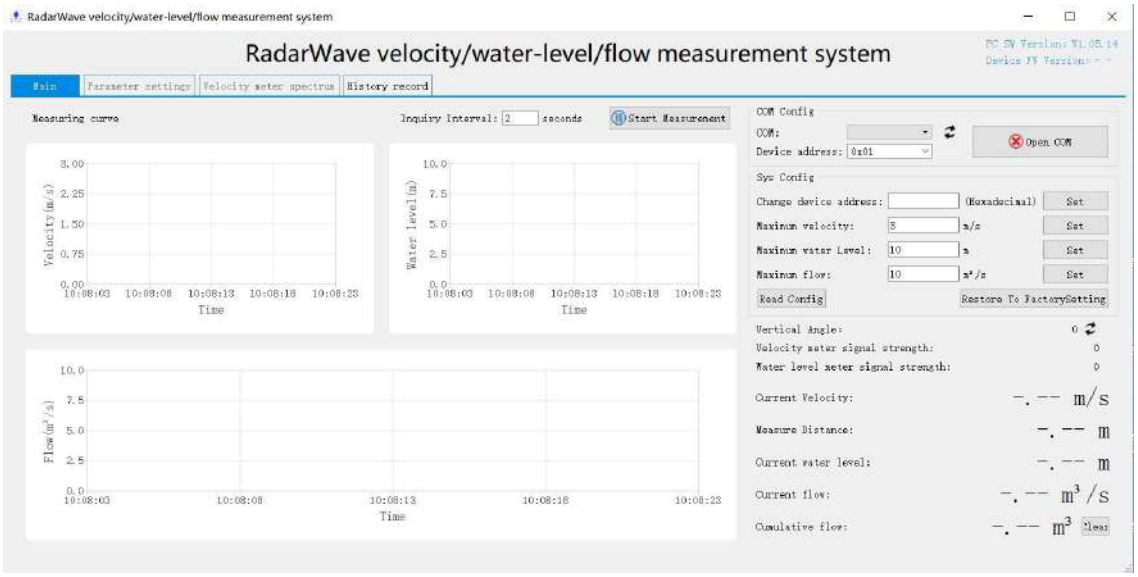
6.1 Preparation for Installation

1. PC or Laptop with Windows 7 & above system.
2. RS485/232-USB converter.
3. Install RS485-USB drive.
4. Install the software onto PC/Laptop.





6.2 Software Main Window

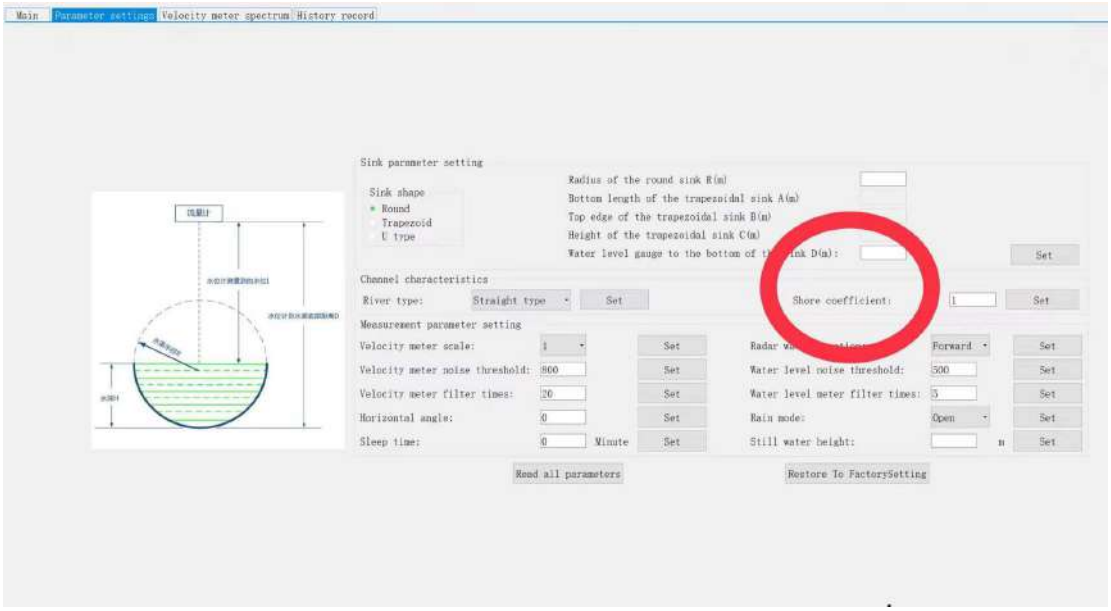


The software main window display the current water level, flow velocity, instantaneous flow, cumulative flow and other information, and it also display the reading by graph.

1.Click to refresh the serial port list and find the radar flow meter's serial port.

2.Check the radar flow meter's address on label(default:0x80H,Hexadecimal), click the button Open COM, that will establish a data link between your PC and the radar flow meter. After the data link is established, active device parameters will be displayed on upper right corner.
3.The inquiry interval can set the refresh frequency, the unit is second, if it is set to 2, it means that the measurement result is refreshed every 2 seconds, click start measurement to ask the flow meter start working.
4.If you need to modify the address, you can write and modify it in change device address (range 1~C8H, corresponding to decimal 1~200).
5.The maximum velocity, maximum water level, and maximum flow are used to set the ordinate amplitude of the coordinate view, which is convenient for viewing the curve.
6.The vertical angle is used to display the angle between the current radar flow meter beam emission direction and the water flow direction in real time. After the radar flow meter is installed horizontally, the angle is about 55°±1°;
7.The velocity meter signal strength and the water level meter signal strength respectively indicate the strength of the echo signal. The larger the signal, the stronger the signal.
For the velocity meter signal, when the distance to the water surface is too far or the water surface is relatively still, the echo signal becomes weak. If it is lower than the noise threshold, the measurement accuracy will be reduced. It is necessary to reduce the noise threshold or lower the position of the flow meter make it closer to the water surface. when installing on-site, it is recommended to observe the signal strength through debugging software to evaluate the signal quality of the installation point, and ensure that the noise threshold is lower than the on-site signal strength in a high probability.
The default value has considered for most applications, and the setting needs to be modified only when the signal is too weak;
8.The measurement results displayed on lower right corner by numerical. 3 graphs are respectively means of velocity, water level and flow.

6.3 Window for Parameter Settings



1.Select the corresponding option according to the channel shape. The rectangle and triangular channel is a special trapezoid, set its length according to the signs shown.
2.The distance from the flow meter to the bottom of the sink minus the distance from the flow meter to the water surface is the water level to be measured.

3.The river type corresponds to different algorithm processing, here you can select the default "normal".

4.The shore factor selects the corresponding value according to different materials, the default is 1, if you don't confirm it, just follow the default parameters.

5.Velocity meter scale, corresponding to different measurement ranges

1——For precise measurement at ultra-low speed（<0.1m/s，reserved）.

2——0.03~10m/s, common flow measurement（default）.

3——0.1~20m/s, wide flow measurement,the accuracy is slightly lower than 2.

6.Radar wave direction is including the forward, backward, and bi-direction. The fault is backward, which with rain mode function.

7.Velocity meter noise threshold, this parameter usually does not need to be adjusted, just follow the default. The noise threshold is used to set the signal extraction limit. If the signal strength of the device (obtained through the input register) is lower than the set value, it is considered that noise is not picked up. When the installation distance is long and the flow rate is low, the signal is weak and needs to be adjusted according to the field signal strength, which should be set generally not less than 400.

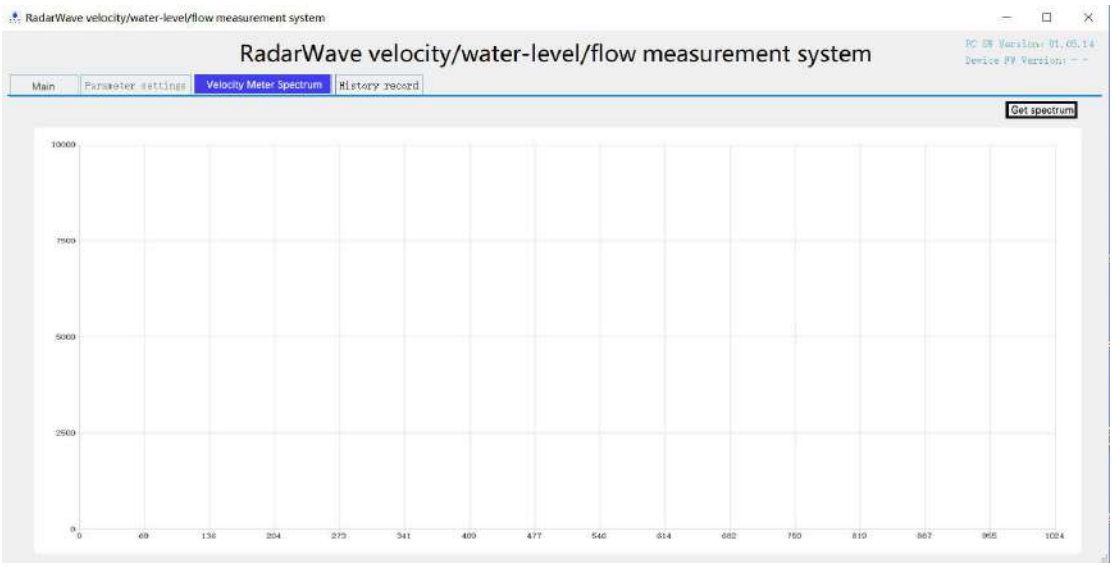
8.The filter times, which just follow the default setting.The larger the number of filtering, the smaller the numerical fluctuation, and the more stable the measurement result, but the real-time performance is weakened.

9.The horizontal angle setting is used for correcting the angle when the flow meter is installed on the shore and cannot be directly above the river, and has a certain angle with the flow direction. Although this installation is not recommended, the device still provides a correction option, the default is 0°.

10. Rain mode-only effective on the radar wave direction as backward. The device default setting the rain mode.

11.Sleep time is to set the flow meter to enter the low-power sleep mode, during which time it stops measuring. Measure and accumulate the flow again after the sleep time is automatically awakened, generally used in low-power application environments, the unit is minutes; when the sleep setting time is reached, it automatically enters the working mode, and after measuring a valid result, it enters the sleep state again

6.4 Velocity Meter Spectrum



Click the button get spectrum, you can view the signal quality of the flow meter for debugging on-site.

6.5 History Record

History record can be checked and convert to Excel and Xml format.

7Warranty and Service

7.1Warranty

The products are warranted to be free from defects in materials and workmanship for a period of one year from the date of shipment to the original purchaser. The supplier obligation should be limited to restoring the meter to normal operation or replacing the meter under correct usage, and shall be conditioned upon receiving written notice of any alleged defect within 10 days after its discovery. It will determine if the return of the meter is necessary. If it is , the user should be responsible for the one-way shipping fee from the customer to the supplier.

The supplier is not liable to any defects or damage attributable to Improper usage and installation,out-of-spec operating conditions, disassemble and repair without authorized, and other failure of non-quality caused by natural disasters, mechanical damage, etc. Besides, fuses and batteries are not part of this warranty.

7.2 Service

For operational problems, please contact the technical support department by telephone, fax, email or internet. In most cases, problems could be solved immediately.

For any hardware failure of the device, we recommend our customers to send back the device for service. Please contact the technical support department with the model number and serial number of the unit before sending the unit back to us.

Take notice that the cost for repairing can only be determined after receipt and inspection of the device. A quotation will be sent to the customer before proceeding with the service.

7.3Important Notice for Product Return

Before returning the instrument for warranty repair or service, please read the following carefully:

1. If the return item has been exposed to nuclear or other radioactive environment, or has been in contact with hazardous material which could pose any danger to our personnel, the unit cannot be serviced.
2. If the return item has been exposed to or in contact with dangerous materials, but has been certified as hazard-free device by a recognized organization, you are required to supply the certification for the service.
3. If the return item does not have a Return Material Authorization associated, it will be sent back without any service conducted.

8Q&As

1.Q:Why the host computer does not receive any data?

A:(1)Check whether the voltage is within 7~32VDC, and re-power on after confirmation;

(2)Check whether the communication mode, serial port number, and baud rate are correct;

(3)Check whether the communication protocol is operated according to the instructions, and check whether the command are correct;

(4)Try to change a USB to 485 converter to test again

2.Q:Why the measured data is always zero?

A:(1)Confirm whether the radar transmitter sensor is aimed at the measurement target;

(2)Whether the measurement distance is within the reasonable range of the sensor.

3.Q:Why the measured value frequently jumps sharply?

A:(1)Check whether the voltage is too low

(2)Whether there are obstacles within the measurement range

(3)Whether the sensor is installed firmly and whether the radar flow meter is installed parallel to the horizontal plane;

(4)Check if there is a flow vortex.

4.Q:Why is the measured value not updated?

A:(1)Check whether the water surface freezes due to seasonal reasons;

(2)Check whether the measurement is inaccurate due to the low water period or the swing of the main tank causing the radar wave to cover the ground.

5.Q:During the flood, the water flow is very fast and turbulent, the water surface is rough with many debris and floating objects. The measurement results be obtained is accurate in this case?

A: Yes, the measurement results is accurate during flood. The turbulent water flow and floating objects on the water surface, that provide a good return signal for the radar velocity sensor. Please note that in this case, the radar velocity sensor will read multiple velocity in different directions, and then measure out the average velocity.

6.Q:The water surface has good roughness and with ripples, but the reading of the radar velocity sensor is still higher or lower than my expectations?

A: Make sure not to get too far from the water surface when measuring.Regularly observe whether the supporting bar or other fixing mechanism where the flow meter is installed is tilted or loosened due to external forces (such as strong wind).

9Packing List

Product Name	Qty	Remark
Radar Flow Meter	1	
Cable with Plug	1	10m
Rod antenna	1	Just For Wireless type
Mounting brackets	1	
Hoop	3	
Fastening kit	1	
User Manual	1	
Certificate of Conformity	1	