GRD-900 Radar Flowmeter

User Manual

V 1.0B

BEIJING GALLOP HIGH & NEW TECH CO., LTD

Statement

Copyright Statement

Update and Modification

- Due to continuous update of the technology, Beijing Gallop may constantly update the functions of the product, and will not notify you of any updated products and functions.
- Beijing Gallop reserves the right to modify any information in the document at any time. The modified content will be added to the new version of the document without prior notice.

Preface

Overview

The document describes the following in detail.

Title	Content
Product Introduction	Introduce the main functions, characteristics, principles and dimensions of the flowmeter
Installation	Introduce the installation angle and detection range of the flowmeter
Parameter Description	Introduce the general settings and principles of each parameter of the flowmeter
Communication Protocols	Introduce the operation method and application of various communication protocols of the flowmeter
Company Information	Introduce contact information of the company

Special Statement

- The product is based on the real object, and the manual is for reference only.
- The manual and procedures will be updated in real time according to the product, please contact the company for the latest product information.
- In case of any unit exception in actual operation, please contact the company for technical solution in time.
- The manual may contain technical inaccuracies, or inconsistencies with product functions and operations, which shall be subject to the company's final interpretation.

1 Product Introduction

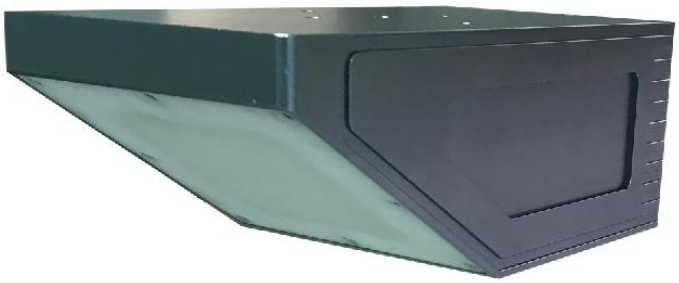

Figure 1-1 Picture of Real Product

1.1 Principle Explanation

The open channel flowmeter is mainly composed of radar current meter and radar water level meter. The current meter is used to acquire the surface velocity of fluid, and get the average velocity of cross-section through the model calculation, and then calculate the cross-section area of flow by combining the water level measured by the water level meter and the cross-section information, and the flow is obtained by using the formula: Flow = Average Flow Velocity × Cross-section Area × Correction Coefficient, wherein the correction coefficient is calculated according to the standard value obtained in the actual measurement environment.

1.2 Operating Parameters

Parameters	Description
Supply Voltage	DC 7 ～ 28V
Current (12V power supply)	About 300mA in normal operation, and less than 1mA in sleep mode.
Operating Temperature	-35° ～ 70°
Waterproof Level	IP68
Transmitting Frequency	24.000 ～ 24.250GHz

Communication Interface	RS-232 / RS-485
Communication Protocols	MODBUS-RTU / Custom Protocol

1.3 Measuring Parameters

Parameter	Description
Velocity Measurement Range	0.15 ～ 15m/s
Velocity Measurement Accuracy	±2%
Velocity Resolution	0.01m/s
Range-finding Scope	0.4 ～ 40m
Range-finding Accuracy	±1cm
Range Resolution	1mm
Antenna Style	Flow Velocity: 14 x 32 ° Water Level: 11 x 11 °
Intervals	1 ～ 5000min

1.4 Appearance Parameters

Parameter	Description
Flowmeter Dimensions (L*W*H)	210×110×100mm
Bracket Dimensions(L*W*H)	100×100×100mm
Weight	Flowmeter and Bracket: 4kg

1.5 Wiring

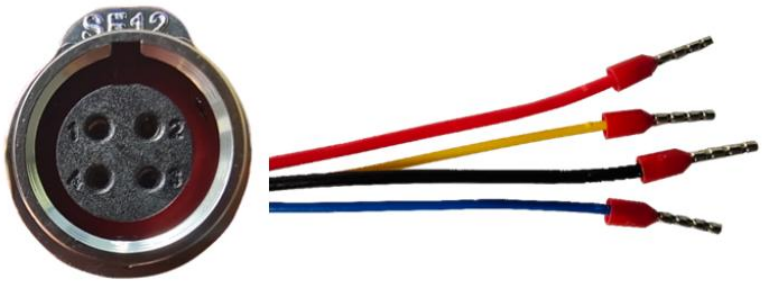

Figure 1-2 Flowmeter Connectors and Leads

	No.	Color	Definition	Note
	1	**Yellow**	RS-485_A	485 Communication Terminal A
	2	**Red**	VIN	Power Input Positive Pole
	3	**Black**	GND	Power Input Negative Pole
	4	**Blue**	RS-485_B	485 Communication Terminal B

Table 1-1 Lead Definition

1.5.1 Communication Interface

1.5.2 External Interface Specification

The flowmeter uses a six-core aviation waterproof connector, as shown in Figure 1-3:

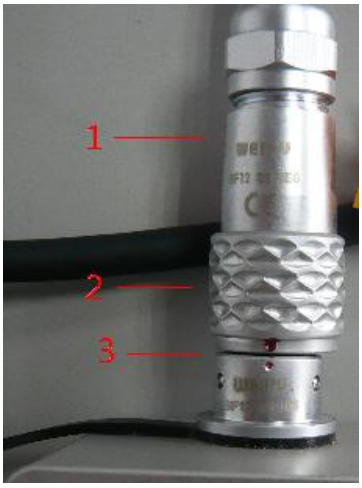

Figure 1-3 Picture of Real Interface

When the aviation plug of the external communication cable is connected to the flowmeter interface, the red dots (as shown by 3 in Figure 1-3) on connector and interface should be aligned. At the same time, it is suggested to hold the plug part marked as 1 and plug it into the interface forcefully. A snap sound indicates that it is plugged in. When unplugging from the flowmeter, hold the part marked as 2 and pull it out.

1.5.3 RS232 / RS485 Interface

The flowmeter integrates two types of interfaces, RS232 and RS485, and the basic settings are as follows:

Table 1-2 Basic Communication Settings

Baud Rate	**1200～256000（Default:9600）**
Check Bit	None
Data Bit	8
Stop Bit	1

2 Environmental Selection

The selection of flow measurement channel section has a direct relationship to the accuracy of flow measurement. In order to obtain better results of flow measurement, the channel section should meet the following conditions as much as possible:

1. There is no huge block stone blocking water, no huge whirlpool, turbulence and other phenomena.

2. It should be straight and stable, with concentrated water flow.

3. The channel section should be hardened, while the flow section should be neat.

4. it should be kept smooth, and prevent floating objects from accumulating.

3 Installation

3.1 Flowmeter Dimensions

The hole site and related dimensions (in mm) of the flowmeter is shown in Figure 3-1, and the angle between the inclined plane and the horizontal plane is 30 degrees.

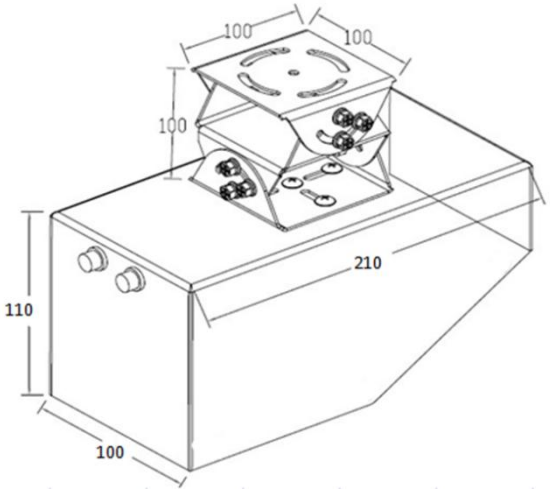

Figure 3-1 Flowmeter Dimensions

3.2 Antenna Beam Range

The flowmeter integrates a radar water level meter and a radar current meter. The antenna beam angle of the radar water level meter is 11×11°, and the radar antenna angle is 14°×32°. When the water level meter illuminates the water surface, the illuminated area is similar to a circle, while the current meter illuminates the water surface, the illuminated area is similar to an elliptical area, as shown in Figure 3-2. An accurate understanding of the illumination range of radar waves is helpful to choose a suitable place for the flowmeter installation, and keep away from some scenes where the flowmeter is easy to be interfered, such as branches swinging with the wind on both sides of the river.

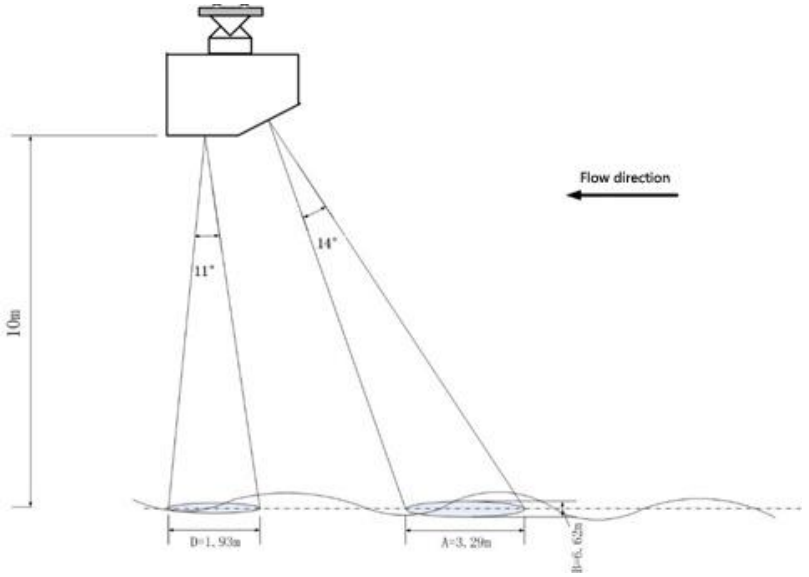

Figure 3-2 Illumination Area of Water Level Meter and Current Meter Antenna with 10m Installation Height

The boundary of the water surface area illuminated by radar is proportional to the installation height. Table 3-1 shows the values of parameter A, B, and D when the installation height is 1m and the wave beam of water level meter and current meter irradiates the water surface (see Figure 3-2 for the meaning of A, B and D). The actual installation height (in meters) multiplied by the following values is the actual corresponding parameters.

Table 3-1 Parameters of the Antenna Beam Illumination Surface

Name	Length (m)
Current Meter A	0.329
Current Meter B	0.662
Diameter of Water Level Meter D	0.192

3.3 Influence of Installation Height on Flow Measurement

Under the same conditions, the higher the installation height, the weaker the echo and the worse the signal quality, especially for the scene with low water velocity, the ripple is small and it is more difficult to detect. At the same time, the radar wave illumination area might be larger, The beam may illuminate to the channel bank and be affected by moving objects on the bank. If the installation is too low, it is not conducive to anti-theft protection, so for the pole installation, the recommended installation height range is 3-4 meters.

3.4 Installation Precautions

1. When installing the flowmeter, the radar of water level meter and the current meter should not be blocked, otherwise the measurement accuracy will be affected.
2. The upper surface of the flowmeter housing should be kept horizontally as much as possible, and the flowmeter should be installed in the middle of the channel.
3. The current meter beam is recommended to be directed towards the incoming water, as shown in Figure 3-2, with a horizontal angle of 0 degrees to the water flow direction.
4. The current meter is only affected by moving objects. When the channel is hardened and free of weeds or trees, even if the beam hits both sides of the channel, it will not affect the flow measurement.

3.5 485 Network Terminal Resistance Configuration

In the practical application of the RS485 bus, when the transmission distance exceeds a certain length, the anti-interference capability of the bus will decline. In such case, it is necessary to connect a 120Ω terminal resistance to both ends of the RS485 bus, so as to ensure the stability of the RS485 bus.

The correct connection of the RS485 communication terminal matching resistance is to connect a 120Ω terminal resistance to the outlet of the device at the head-end of the RS485 bus and the inlet of the end device. The terminal matching resistor is connected in parallel between the positive and negative wires of the RS485 bus. The correct connection of the RS485 communication terminal matching resistance is to connect a 120Ω terminal resistance to the outlet of the device at the head-end of the RS485 bus and the inlet of the end device. The terminal matching resistor is connected in parallel between the positive and negative wires of the RS485 bus. It is shown as below figure:

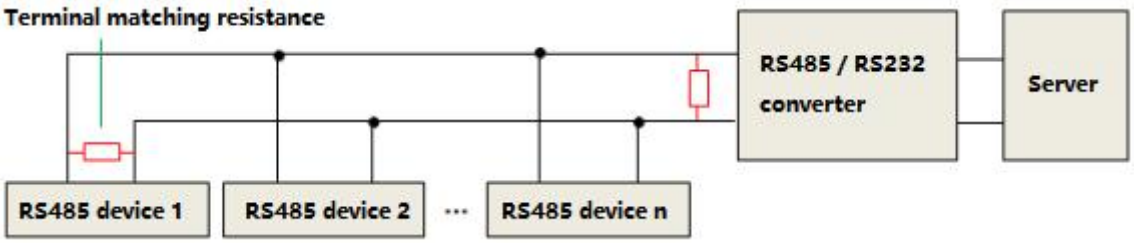

Figure 3-3 Terminal Resistance Configuration Diagram

4 Parameter Description

4.1 Communication Parameters

4.1.1 Flowmeter Communication Interface

The flowmeter communication interface parameters include interface type, baud rate and protocol type.

Interface type sets the communication interface as RS485 or RS232, and default to RS485 interface. To switch the interface type, the parameters need to be modified under the current interface.

The Baud Rate can be set to 1200, 2400, 4800, 9600, 14400, 19200, 38400, 56000, 57600, 115200, 128000 and 256000. The default value is 9600.

Protocol types include custom protocol and MODBUS-RTU protocol.

4.1.2 Sensor Communication Interface

The flowmeter apply water level meter, current meter and other sensors, and its major parameters include baud rate, number of acquisitions, acquisition waiting time and number of failed acquisition.

The Baud Rate can be set to 1200, 2400, 4800, 9600, 14400, 19200, 38400, 56000, 57600, 115200, 128000 and 256000. It defaults to 9600, and no modification is required in general.

The number of acquisitions indicates the number of acquisitions of corresponding sensor data. The more acquisitions, the longer the time.

The acquisition waiting time indicates the time waiting for the sensor to return data when acquiring sensor data. If the data is not returned within the set time, it is considered a failure.

The number of failed acquisitions indicates the number of retries when the sensor data acquisition fails.

4.1.3 Flowmeter Address

The flowmeter is compatible with two protocols: custom protocol and MODBUS-RTU protocol. The custom protocol address is 0-9, a-z, and the MODBUS-RTU protocol is 1-247.

4.2 Operating Parameters

Operating parameters include working mode and interval time.

The working mode of the flowmeter includes continuous working mode and interval working mode. The continuous working mode refers to the continuous measurement after the flowmeter is powered on. The interval working mode refers to the mode in which the flowmeter enters the dormant state after the measurement is completed, and then it will conduct the next measurement after the interval time is up.

Interval time is the time between two measurements under interval working mode.

4.3 Relevant Parameters for Flow Calculation

4.3.1 Cross-section Parameters

Cross-section parameters are mainly used for the calculation of cross-section area, and includes section type and section cross-section dimension 1, cross-section dimension 2 and cross-section dimension 3.

Cross-section types include Trapezoid, Rectangular and Others.

Others indicates some shapes whose areas cannot be directly calculated. When the cross-section type is set to Others, the area corresponding to the water depth can be made into a .txt file according to the actual situation and imported into the flowmeter.

Cross-section dimension 1 is the height of the channel in mm.

Cross-section dimension 2 corresponds to the bottom width of the trapezoidal channel and the width of the rectangular channel, in mm.

Cross-section dimension 3 is the slope coefficient of the trapezoidal channel (multiplied by 1000).

For a trapezoidal cross-section, it is required to set up all these three cross-section dimensions, while for a rectangular cross-section, it is only required to set up Cross-section dimension 1 and 2.

4.3.2 Threshold Parameters

Threshold parameters include Water Level Jump Threshold, Flow Velocity Jump Threshold and other parameters.

Water Level Jump Threshold and Flow Velocity Jump Threshold are mainly used to shield data jumps caused by environmental interference (such as floating objects). When the value exceeds the threshold, the corresponding processing is performed.

The unit of the Water Level Jump Threshold is mm, and the default value is 50.

The unit of the Flow Velocity Jump Threshold is cm/s, and the default value is 30.

4.3.3 Flow Calculation Parameters

Relevant parameters for flow calculation include Number of Water Level Smoothing, Number of Flow Velocity Smoothing, Water Level Air Draft, and Flow Velocity Correction Coefficient.

The Number of Water Level Smoothing and the Number of Flow Velocity Smoothing indicates the number of sliding average filters for water level and flow velocity data. The more the settings are made, the smoother the data will be. However, there may be a lag for fast flow changes. Therefore, the parameter needs to be adjusted according to actual conditions. The default value is 6.

The parameter Water Level Air Draft indicates the distance from the radar surface to the bottom of the channel. The distance measured by the flowmeter is the distance between the radar surface and the water surface, which needs to be converted by the Water Level Air Draft to obtain the water depth data. The unit of the parameter Water Level Air Draft is mm, and the default value is 10000.

The Flow Velocity Correction Coefficient includes K value and B value. Since the model for converting cross-section average velocity to surface velocity inside the flowmeter might be deviated from different environments, it is necessary to correct the flow value or average flow velocity obtained from the field test. The relationship between the measured flow velocity and the corrected flow velocity is:

Corrected Flow Velocity= Measured Flow Velocity * (Correction Factor K/1000) + (Correction Factor B/1000)

4.3.4 Measuring Parameters

Measuring parameters include Accumulated Water Volume, Instantaneous Flow, Water Level, Flow Velocity, Voltage, Water Level Signal Strength, Flow Velocity Signal Strength, Current Meter Inclination Angle and other parameters. The output items of different protocols will be different, see each protocol for details.

The calculation time of measuring parameters is related to the number of data acquired by water level, flow rate and other sensors. The more acquired, the longer the calculation time. The default time is about 30 seconds. For the MODBUS-RTU protocol, if the measurement

time is not over, it will return the last measurement result upon query the measuring parameters.

The Accumulated Water Volume is represented by a 32-bit integer, which is divided into high-order 16 bits and low-order 16 bits for operation. The operations include reading and setting. It is required to read the high-order 16 bits and low-order 16 bits at the same time, and make calculation for the accumulated water volume. The calculation method is as follows:

Accumulated Water Volume = High-order 16 Bits × 65536 + Low-order 16 Bits.

When setting, it is also required to set the high-order 16 bits and the low-order 16 bits at the same time. The calculation method is that the high-order 16 bits are equal to the set cumulative water volume divided by 65535 and rounded. The lower-order 16 bits are equal to the remainder of the cumulative water volume divided by 65536. For example, if the Accumulated Water Volume is set to 70,000 cubic meters, the High-order 16 Bits are equal to 1, and the Low-order 16 Bits are equal to 4464.

The unit of Instantaneous Flow is cubic meter per second, retains 3 decimal places, while the output is an integer, which needs to be divided by 1000.

The water level is the height from the bottom of the channel to the surface of the water (in mm).

The unit of the Flow Velocity is cm/s.

Voltage represents the supply voltage of the flowmeter, with unit in V. The output is an integer, and needs to be divided by 10.

Water Level Signal Strength and Flow Velocity Signal Strength indicate the echo signal strength of the water level meter and current meter. The larger the value, the better the signal quality. The signal strength can help analyze some problems in the testing process.

The inclination angle of the current meter is the angle between the radar surface and the horizontal plane, or the complementary angle between the center line of the radar beam and the horizontal plane. The unit is degree, which is about 30 degrees under normal conditions.

4.3.5 System Parameters and Commands

System parameters include time, date, version number, etc.

System commands include upgrade mode, file transfer mode, cross-section data operation, parameter output, parameter reset, system reset, system time query, measurement query, sensor interface pass-through mode, version number query, etc.

Upgrade Mode: it can be used to upgrade the flowmeter hardware.

File Transfer Mode: it can be used for reading out log files stored in the internal memory card of the flowmeter and writing into .txt files of cross-section area.

Cross-section data operation: it includes loading and output. After the cross-section area file is imported into the flowmeter memory card, a loading operation is required to load the data into the program for operation. The output operation is used to check whether the data is written correctly.

Parameter Output: it is used to view the internal parameters of the flowmeter.

Parameter Reset: used to restore factory settings of parameters.

System Reset: force the program to reset and restart.

System Time Query: including query the current time and the next measurement time.

Measurement Query: when the flowmeter is in sleep mode, this command can be used to measure and return data.

Sensor Interface Pass-through Mode: After entering this mode, you can directly communicate with the internal sensor of the flowmeter through the communication interface, to facilitate the adjustment and debugging of internal sensor parameters.

Version Number Query: it is used to query the version number.

Note: The above commands are not supported under individual protocols.

5 Communication Protocols

5.1 Custom Protocol

Custom protocol uses ASCII code for transmission. When using softwares such as serial port debugging assistant, display and transmission should be set to ASCII code.

5.1.1 Custom Protocol Output

Table 5-1 Custom Protocol Output

Output Content	Description	Number of Bytes

A	Address start identifier	**1**
Address	0-9, a-z	**1**
D	Address end identifier	**1**
Y	Water volume identifier	**1**
Water Volume	Unit: cubic meters	**10**
F	Flow identifier	**1**
Flow	Unit: cubic meter per second (to be divided by 1000)	**5**
L	Water level identifier	**1**
Water Level	Unit: millimeters	**5**
V	Flow velocity identifier	**1**
Flow Velocity	Unit: centimeters per second	**4**
P	Cross-section area identifier	**1**
Cross-section Area	Unit: square meters per second (to be divided by 1000)	**6**
B	Battery identifier	**1**
Battery	Unit: volt (to be divided by 10)	**3**
E	Frame end identifier	**1**
<0x0D><0x0A>	Carriage return and line feed	**2**

Notes:

1. The parameter values are all integers. If there is special instructions of (to be divided by...) in the description, it means that the data must be divided by the corresponding value to match the corresponding unit.

2. The output length is fixed at 54 bytes.

Below is an example:

A0DY0000000100F01005L02001V0068P001003S031R1800B138E

The output indicates: flowmeter address 0, accumulated water volume 100 cubic meters, instantaneous flow 1.005 cubic meter per second (1005 divided by 1000), water level 2.001m, flow velocity 0.68m/s, cross-sectional area 1.003 square meters, battery voltage 13.8 volts.

5.1.2 Custom Protocol Commands

The command format is as follows:

Table 5- 2 Command Format

	Command Header	Device Address	Command No.	Command Parameter	Command Tail
ASCII code	@	A	XXX	XXX	< Enter>
Hexadecimal	0x40	--	--	--	0x0D 0x0A

Notes:

1. The command header, command number, and command parameters must be separated by spaces.

2. The command tail is the Enter key, which is converted into hexadecimal as 0x0D 0x0A, that is, <CR><LF>. Some serial port tools will be converted into <0x0A>, which needs to be checked.

3. The device address range is 0-9, a-z (lowercase letters). The command numbers are 100～142, 200～212.

The command number and its corresponding parameter settings are as follows:

Table 5-3 Correspondence between Command Numbers and Parameters

Command No.	Command Description	Parameter Range	Parameter Description	Default Value
100	Device Address Setting or Query	0-9, a-z		0
101	Flowmeter Interface Type	1-2	1:RS485 2:RS232	1
102	Flowmeter Interface Baud Rate	48, 96, 144, 192, 384, 560, 576, 1152, 1280	The baud rate is the corresponding parameter value multiplied by 100	96
103	Reserved	--	--	--
104	Baud Rate of Flow Velocity Interface	Same as Command No. 102	Same as Command No. 102	96
105	Reserved	--	--	
106	Baud Rate of Water Level Interface	Same as Command No. 102	Same as Command No. 102	96
110	Working Mode	1-2	1: Continuous working 2: Interval working	1
111	Intervals	1-5000	Unit: min	1
112	Protocal Type	1-3	1: Custom Protocol 2: MODBUS-RTU	1

			Protocol 3: Data Transmission Protocol for Water Resources Monitoring Management System	
113	Water Level Air Draft	0-40000	Unit: mm	10000
114	Correction Factor K of Average Flow Velocity	1-5000	Multiply the coefficient value by 1000 to round off	1000
115	Correction Factor B of Average Flow Velocity	-5000-5000	Multiply the coefficient value by 1000 to round off (unit: m/s)	0
116	Reserved	--	--	
117	Reserved	--	--	
118	Acquisition Number of Flow Velocity	1-10		5
119	Failed Acquisition Number of Flow Velocity	1-10		3
120	Acquisition Waiting Time of Flow Velocity	1-100	Unit: second	8
121	Water Level Acquisition Number	1-10		5
122	Failed Acquisition Number of Water Level	1-10		3
123	Acquisition Waiting Time of Water Level	1-100	Unit: second	10
130	Cross-section Type	1-3	1: Trapezoid 2: Rectangle 3: Others	1
131	Cross-section Dimension 1	0-40000	Unit: mm	1000
132	Cross-section Dimension 2	0-20000	Unit: mm	1000
133	Cross-section Dimension 3	0-10000		1000
135	Water Level Jump Threshold	0-5000	Unit: mm	50
136	Flow Velocity Jump Threshold	0-500	Unit: cm/s	30
137	Reserved	--	--	
138	Water Level Smoothing Number	0-50		6
139	Flow Velocity Smoothing Number	0-50		6
140	Accumulated Water Volume High-order Bits	0-65535	Unit: cubic meters	0
141	Accumulated Water Volume Low-order Bits	0-65535	Unit: cubic meters	0
142	Reserved	--	--	
200	Upgrade Mode	0-2	0: Exit Upgrade Mode	

			1: GPRS Upgrade Mode 2: Serial Port Upgrade Mode	
201	Version Query	1		
202	Parameter Output	100-142	Query the parameter command No. correspondingly	
203	Factory Parameter Reset	0		
204	Date Setting	Year, Month, Date, 0	4 parameters, and the fourth parameter is fixed to 0	
205	Time Setting	Hour, Minute, Second, 0	4 parameters, and the fourth parameter is fixed to 0	
206	System Time Query	1-2	1: Current Time Query 2: Next Measurement Time Query	
207	Measurement Query	1		
208	Cross-section Data Operation	1-2	1: Cross-section Data Output 2: Cross-section Data Loading	
209	System Reset	1		
210	Reserved	--	--	
211	File Transfer Mode	1		
212	Sensor Interface Pass-through Mode	1-3	1: Water Level Interface 2: Flow Velocity Interface	

The parameter output format is as follows:

	Command Header	Command No.	Parameter Header	Parameter	Parameter Tail	Command Tail
ASCII code	C	XXX	P	XXX	A	< Enter>
Hexadecimal	0x43	--	0x50		0x41	0x0D 0x0A

Description for the parameter output format:

Command No. is the query parameter command No..

For example, C101P1A<Enter> indicates that the parameter value of Command No. 101 is 1.

When querying multiple parameters consecutively, the parameters will have multiple sets of output, such as C101P1A<Enter> C102P96A<Enter>...

Detailed Explanation of Commands:

100	Address Setting	Command Format	@ A 100 PARA<Enter>	
		Response	Y/N(Success: Y, Failure: N)	
		Parameter Description	A is the current device address (0 ~ 9, a ~ z). PARA is the set address with a value range of 0 to 35.	
		Example	@ 0 100 8<Enter>	Change address 0 to 8.
	Address Query	Command Format	@ ? 100 0<Enter>	
		Response	Address (0-9, a-z)	
		Parameter Description	--	
		Example	@ ? 100 0<Enter>	Query current address.
101	Flowmeter Interface Type	Command Format	@ A 101 PARA<Enter>	
		Response	Y/N(Success: Y, Failure: N)	
		Parameter Description	A is the current device address (0 ~ 9, a ~ z). PARA is the interface type, the value range is 1-2, 1: RS485, 2: RS232, defaults to 1:485	
		Example	@ 0 101 1<Enter>	Enable the 485 interface.
102	Flowmeter Interface Baud Rate	Command Format	@ A 102 PARA<Enter>	
		Response	Y/N(Success: Y, Failure: N)	
		Parameter Description	A is the current device address (0 ~ 9, a ~ z). PARA is the set baud rate divided by 100, the value is 48, 96, 144, 192, 384, 560, 576, 1152, 1280, and the default value is 96.	
		Example	@ 0 102 96<Enter>	Set the baud rate to 9600.
104	Baud Rate of Flow Velocity Interface	Command Format	@ A 104 PARA<Enter>	
		Response	Y/N(Success: Y, Failure: N)	
		Parameter Description	Same as Command 102, with default value of 96.	
		Example	@ 0 104 96<Enter>	Set the baud rate to 9600.
106	Baud Rate of Water Level Interface	Command Format	@ A 106 PARA<Enter>	
		Response	Y/N(Success: Y, Failure: N)	
		Parameter Description	Same as Command 102, with default value of 96.	

		Example	@ 0 106 96<Enter>	Set the baud rate to 9600.
110	Working Mode	Command Format	@ A 110 PARA<Enter>	
		Response	Y/N(Success: Y, Failure: N)	
		Parameter Description	A is the current device address (0 ~ 9, a ~ z). PARA is the set Working Mode, and the value range is 1-2, 1: Continuous Working, 2: Interval Working, and the default value is 1: Continuous Working.	
		Example	@ 0 110 2<Enter>	Set the Working Mode to Interval Working.
111	Intervals	Command Format	@ A 111 PARA<Enter>	
		Response	Y/N(Success: Y, Failure: N)	
		Parameter Description	A is the current device address (0 ~ 9, a ~ z). PARA is the set interval, the value range is 1-5000 in min., and the default value is 1.	
		Example	@ 0 111 5<Enter>	Set the intervals to 5 min.
112	Protocal Type	Command Format	@ A 112 PARA<Enter>	
		Response	Y/N(Success: Y, Failure: N)	
		Parameter Description	A is the current device address (0 ~ 9, a ~ z). PARA is the set protocol type, the value range is 1-3, 1: Custom Protocol, 2: MODBUS-RTU Protocol, 3: Data Transmission Protocol for Water Rresources Monitoring Management System	
		Example	@ 0 112 2<Enter>	Set the protocal type to MODBUS-RTU Protocol.
113	Water Level Air Draft	Command Format	@ A 113 PARA<Enter>	
		Response	Y/N(Success: Y, Failure: N)	
		Parameter Description	A is the current device address (0 ~ 9, a ~ z). PARA is the set water level air draft, the value range is 1-40000 in mm., the default value is 10000.	
		Example	@ 0 113 5000<Enter>	Set the Water Level Air Draft to 5.0m.
114	Correction Factor K of Average Flow Velocity	Command Format	@ A 114 PARA<Enter>	
		Response	Y/N(Success: Y, Failure: N)	
		Parameter Description	A is the current device address (0 ~ 9, a ~ z). PARA is the correction factor K times 1000, the value range is 1-5000, and the default value is 1000.	

		Example	@ 0 114 9813<Enter>	Set the correction factor K to 0.9813.
115	Correction Factor B of Average Flow Velocity	Command Format	@ A 115 PARA<Enter>	
		Response	Y/N(Success: Y, Failure: N)	
		Parameter Description	A is the current device address (0 ~ 9, a ~ z). PARA is the correction factor B times 1000, and the value range is -5000 -5000. Defaults to 0.	
		Example	@ 0 115 200<Enter>	Set the correction factor B to 0.2m/s.
118	Acquisition Number of Flow Velocity	Command Format	@ A 118 PARA<Enter>	
		Response	Y/N(Success: Y, Failure: N)	
		Parameter Description	A is the current device address (0 ~ 9, a ~ z). PARA is the set acquisition number of flow velocity, with a value range of 1 to 10. Defaults to 5.	
		Example	@ 0 118 5<Enter>	Set the Acquisition Number of Flow Velocity to 5 times.
119	Failed Acquisition Number of Flow Velocity	Command Format	@ A 119 PARA<Enter>	
		Response	Y/N(Success: Y, Failure: N)	
		Parameter Description	A is the current device address (0 ~ 9, a ~ z). PARA is the set Failed Acquisition Number of Flow Velocity, with a value range of 1 to 10. The default value is 3.	
		Example	@ 0 119 3<Enter>	Set the Failed Acquisition Number of Flow Velocity to 3 times.
120	Acquisition Waiting Time of Flow Velocity	Command Format	@ A 120 PARA<Enter>	
		Response	Y/N(Success: Y, Failure: N)	
		Parameter Description	A is the current device address (0 ~ 9, a ~ z). PARA is the set Acquisition Waiting Time of Flow Velocity, with a value range of 1 to 100 in cm/s. Defauls to 8.	
		Example	@ 0 120 10<Enter>	Set the waiting time to 10 seconds.
121	Water Level Acquisition Number	Command Format	@ A 121 PARA<Enter>	
		Response	Y/N(Success: Y, Failure: N)	
		Parameter Description	A is the current device address (0 ~ 9, a ~ z). PARA is the set Water Level Acquisition Number, with a value range of 1 to 10. Defaults to 5.	
		Example	@ 0 121 5<Enter>	Set the Water Level Acquisition Number to 5 times.

122	Failed Acquisition Number of Water Level	Command Format	@ A 122 PARA<Enter>	
		Response	Y/N(Success: Y, Failure: N)	
		Parameter Description	A is the current device address (0 ~ 9, a ~ z). PARA is the set Failed Acquisition Number of Water Level, with a value range of 1 to 10. The default value is 3.	
		Example	@ 0 122 3<Enter>	Set the Failed Acquisition Number of Water Level to 3 times.
123	Acquisition Waiting Time of Water Level	Command Format	@ A 123 PARA<Enter>	
		Response	Y/N(Success: Y, Failure: N)	
		Parameter Description	A is the current device address (0 ~ 9, a ~ z). PARA is the set Acquisition Waiting Time of Water Level, with a value range of 1 to 100 in cm/s. The default value is 10.	
		Example	@ 0 123 10<Enter>	Set the waiting time to 10 seconds.
130	Cross-section Type	Command Format	@ A 130 PARA<Enter>	
		Response	Y/N(Success: Y, Failure: N)	
		Parameter Description	A is the current device address (0 ~ 9, a ~ z). PARA is the set Section Type, and the value range is 1-3, 1: Trapezoid, 2: Rectangle, 3: Others. The default value is 1.	
		Example	@ 0 130 1<Enter>	Set the Section Type to Trapezoid.
131	Cross-section dimension 1	Command Format	@ A 131 PARA<Enter>	
		Response	Y/N(Success: Y, Failure: N)	
		Parameter Description	A is the current device address (0 ~ 9, a ~ z). PARA is the set Cross-section Dimension 1, which is the height of the trapezoid or rectangle, the value range is 0～40,000 in mm. The default value is 1000.	
		Example	@ 0 131 1000<Enter>	Set Cross-section Dimension 1 (height of the trapezoid or rectangle) to 1.0m.
132	Cross-section dimension 2	Command Format	@ A 132 PARA<回车>	
		Response	Y/N(Success: Y, Failure: N)	
		Parameter Description	A is the current device address (0 ~ 9, a ~ z). PARA is the set Cross-section Dimension 2, which is the bottom width of the trapezoid or the width of the rectangle, the value range is 0～20,000 in mm. The default value is 1000.	
		Example	@ 0 132 1000<Enter>	Set Cross-section Dimension 2 (bottom width of the trapezoid or

				width of the rectangle) to 1.0m.
133	Cross-section dimension 3	Command Format	@ A 133 PARA<Enter>	
		Response	Y/N(Success: Y, Failure: N)	
		Parameter Description	A is the current device address (0 ~ 9, a ~ z). PARA is theCross-section Dimension 3, which is the slope coefficient of trapezoid multiplied by 1000, the value range is 0-10,000, defaults to 1000.	
		Example	@ 0 133 1000<Enter>	Set the Cross-section dimension 3 (slope coefficient of trapezoid) to 1.
135	Water Level Jump Threshold	Command Format	@ A 135 PARA<Enter>	
		Response	Y/N(Success: Y, Failure: N)	
		Parameter Description	A is the current device address (0 ~ 9, a ~ z). PARA is the set Water Level Jump Threshold, with a value range of 0 to 5000 in mm. Defaults to 50.	
		Example	@ 0 135 50<Enter>	Set the Water Level Jump Threshold to 50mm.
136	Flow Velocity Jump Threshold	Command Format	@ A 136 PARA<Enter>	
		Response	Y/N(Success: Y, Failure: N)	
		Parameter Description	A is the current device address (0 ~ 9, a ~ z). PARA is the set Flow Velocity Jump Threshold, with a value range of 0 to 500 in cm/s. Defaults to 30.	
		Example	@ 0 136 30<Enter>	Set the Flow Velocity Jump Threshold to 30cm/s.
138	Water Level Smoothing Number	Command Format	@ A 138 PARA<Enter>	
		Response	Y/N(Success: Y, Failure: N)	
		Parameter Description	A is the current device address (0 ~ 9, a ~ z). PARA is the set Water Level Smoothing Number, with a value range of 0 to 50. The default value is 6.	
		Example	@ 0 138 6<Enter>	Set the Water Level Smoothing Number to 6.
139	Flow Velocity Smoothing Number	Command Format	@ A 139 PARA<Enter>	
		Response	Y/N(Success: Y, Failure: N)	
		Parameter Description	A is the current device address (0 ~ 9, a ~ z). PARA is the set Flow Velocity Smoothing Number, with a value	

			range of 0 to 50. The default value is 6.	
		Example	@ 0 139 6<Enter>	Set the Flow Velocity Smoothing Number to 6.
140	Accumulated Water Volume High-order Bits	Command Format	@ A 140 PARA<Enter>	
		Response	Y/N(Success: Y, Failure: N)	
		Parameter Description	A is the current device address (0 ~ 9, a ~ z). PARA is the set Accumulated Water Volume High-order Bits, the value range is 0-65535, with unit in cubic meters.	
		Example	@ 0 140 0<Enter>	Set the Accumulated Water Volume High-order Bits to 0.
141	Accumulated Water Volume Low-order Bits	Command Format	@ A 141 PARA<Enter>	
		Response	Y/N(Success: Y, Failure: N)	
		Parameter Description	A is the current device address (0 ~ 9, a ~ z). PARA is the set Accumulated Water Volume Low-order Bits, the value range is 0-65535, with unit in cubic meters.	
		Example	@ 0 141 50<Enter>	Set the Accumulated Water Volume Low-order Bits to 50 cubic meters.
200	Upgrade Mode	Command Format	@ A 200 PARA<Enter>	
		Response	Y/N(Success: Y, Failure: N)	
		Parameter Description	A is the current device address (0 ~ 9, a ~ z). PARA is the set Upgrade Mode, the value range is 0-2, 0: Exit Upgrade Mode 1: GPRS Upgrade Mode 2: Serial Port Upgrade Mode.	
		Example	@ 0 200 1<Enter>	Enter the GPRS Upgrade Mode.
201	Version Query	Command Format	@ A 201 1<Enter>	
		Response	C201P<EDITON>A<Enter>	
		Parameter Description	<EDITON> indicates the output version number	
		Example	C201P116A< Enter>	The software version number is 1.1.6
202	Parameter Query (single parameter)	Command Format	@ A 202 PARA<Enter>	
		Response	C<CMD>P<PARA>A<Enter>	
		Parameter	A is the current device address (0 ~ 9, a ~ z).	

		Description	PARA is the command number corresponding to the query parameter, and the value range is 100-141.	
		Example	@ 0 202 101<Enter> Response: C101P1A< Enter>	Upon query, the Flowmeter Interface Type Parameter is 1.
202	Parameter Query (multiple parameters)	Command Format	@ A 202 CMDST CMDEND 0 0< Enter>	
		Response	C< CMDST >P<PARA>A< Enter>…C< CMDEND>P<PARA>A< Enter>	
		Parameter Description	A is the current device address (0 ~ 9, a ~ z). CMDST is the start command number of the query parameter, CMDEND is the end command number of the query parameter, and its value range is 100-141. The response will be output sequentially from CMDST to CMDEND.	
		Example	@ 0 202 101 102 0 0<Enter> Response: C101P1A< Enter> C102P96A< Enter>	Upon query, the parameter of the flowmeter interface type is 1, and the baud rate of the flowmeter interface is 9600.
203	Factory Parameter Reset	Command Format	@ A 203 0<Enter>	
		Response	Y/N(Success: Y, Failure: N)	
		Parameter Description		
		Example	@ 0 203 0<Enter>	Reset the factory parameter.
204	Date Setting	Command Format	@ A 204 YEAR MON DAY 0<Enter>	
		Response	(Success) CT: YYYY-MM-DD HH:MM:SS<Enter>/(Failure)N	
		Parameter Description	YYYY: Year, MM: Month, DD: Day.	
		Example	@ 0 204 2018 2 26 0<Enter> Response: CT: 2018-02-26 14:30:29<Enter>	Set the date as February 26, 2018
205	Time Setting	Command Format	@ A 205 HOUR MIN SEC 0< Enter >	
		Response	(Success) CT: YYYY-MM-DD HH:MM:SS<Enter> (Failure) N	
		Parameter Description	HH: Hour, MM: Minute; SS: Second.	
		Example	@ 0 205 14 25 20 0<Enter> Response: CT: 2018-02-26 2:25:20 PM<Enter>	Set the time to 14:25:20

206	System Time Query	Command Format	@ A 206 PARA<Enter>	
		Response	(Success) CT: YYYY-MM-DD HH:MM:SS<Enter> MT: YYYY-MM-DD HH:MM:SS<Enter> (Failure) N	
		Parameter Description	A is the current device address (0 ~ 9, a ~ z). PARA is to query time type, with the value range of 1-2, 1: query current time, 2: query next measurement time under interval mode. When PARA is 1, it returns CT, and when para is 2, it returns MT.	
		Example	@ 0 206 1<Enter> Response: CT: 2018-02-26 2:25:20 PM<Enter>	Current time is 14:25:20, February 26, 2018.
207	Measurement Query	Command Format	@ A 207 1<Enter>	
		Response	Measurement Data Output	
		Parameter Description	--	
		Example	@ 0 207 1<Enter>	
208	Cross-section Data Operation	Command Format	@ A 208 PARA<Enter>	
		Response	(Success) PARA = 1 output cross-section data. PARA= 2 Y/N(Success: Y, Failure: N) (Failure) N	
		Parameter Description	A is the current device address (0 ~ 9, a ~ z). PARA is Operation Type, the value range is 1-2, 1: Cross-section Data Output and 2: Cross-section Data Loading.	
		Example	@ 0 208 1<Enter>	Output cross-section data.
209	System Reset	Command Format	@ A 209 1<Enter>	
		Response	Reset /N(Failure: N)	
		Parameter Description		
		Example	@ 0 209 1<Enter>	Force the flowmeter to restart.
211	File Transfer Mode	Command Format	@ A 211 1<Enter>	
		Response	Enter the File Transfer Mode/N(Failure: N)	
		Parameter Description		
		Example	@ 0 211 1<Enter>	Enter the File Transfer Mode.

212	Sensor Interface Pass-through Mode	Command Format	@ A 212 PARA<Enter>	
		Response	Y/N(Success: Y, Failure: N)	
		Parameter Description	A is the current instrument address (0 ~ 9, a ~ z). PARA is to set the Sensor Interface Type for Pass-through Mode, the value range is 1-3, 1: Water Level Interface 2: Flow Velocity Interface	
		Example	@ 0 212 1<Enter>	Water Level Interface enters into Pass-through Mode

5.2 MODBUS Protocol

5.2.1 RTU Frame Structure

In RTU mode, new information always starts with a silent time of at least 3.5 characters, followed by the transmission of the first domain: Address Domain. The information of the entire frame must be transmitted in a continuous data stream. If there is an interval of more than 1.5 characters before the end of the information, an error occurs.

Start	Device Address	Function Code	Data	CRC Check	End
T1-T2-T3-T4	8Bit	8Bit	Several 8Bits	16Bit	T1-T2-T3-T4

1. Address Domain: The effective address range of the slave (target address) is 1～247. It supports broadcast sending and receiving address 0xFF and broadcast receive-only address 0xFE. When using the broadcast address, make sure that only one sensor is connected, otherwise it will cause data error or hardware damage.
2. Function Domain: the effective code is 1～255. The radar flowmeter supports 0x03, 0x06 and 0x10 function codes.
3. Data Field: it is composed of multiple groups of data - with two hexadecimal numbers in one group and ranged between 00 and FF.
4. CRC Check: After the CRC is generated, the low-order byte comes before high-order byte.

5. T1, T2, T3, and T4 represent the transmission time length of each byte, which is the total transmission delay time of four bytes.

5.2.2 Variable Status Table of Radar Flowmeter Register

[Base address: 1000(0x03E8)] U16: Unsigned 16-bit Integer S16: Signed 16-bit Integer

Address	Variable	Parameter Description	Format	Type	Register Address (HEX)
0	Water Volume High-order 16 Bits	m^3	U16	R+	03 E8
1	Water Volume Low-order 16 Bits	m^3	U16	R+	03 E9
2	Flow	m^3/s (to be divided by 1000)	U16	R	03 EA
3	Water Level	mm	U16	R	03 EB
4	Flow Velocity	cm/s	U16	R	03 EC
7	Supply Voltage	V (to be divided by 10)	U16	R	03 EF
8	Water Level Signal Strength	None	U16	R	03 F0
9	Flow Velocity Signal Strength	None	U16	R	03 F1
10	Current Meter Angle	degree	U16	R	03 F2
11	Software Version	None	U16	R	03 F3
12	Address	Value range: 1- 247	U16	R+	03 F4
13	Flowmeter Interface Type	Value range: 1- 2, 1: RS485, 2: RS232	U16	R+	03 F5
14	Flowmeter Interface Baud Rate	48, 96, 144, 192, 384, 560, 576, 1152, 1280, and the baud rate is the corresponding parameter value multiplied by 100	U16	R+	03 F6
15	Reserved	--	U16	R+	03 F7
16	Baud Rate of Flow Velocity Interface	Same as Address 14	U16	R+	03 F8
17	Reserved	--	U16	R+	03 F9
18	Baud Rate of Water Level Interface	Same as Address 14	U16	R+	03 FA
19	Reserved	--	U16	R+	03 FB
21	Reserved	--	U16	R+	03 FD
22	Working Mode	Value range: 1- 2, 1: Continuous Working, 2: Interval Working	U16	R+	03 FE
23	Intervals	Value range: 1- 5000 in min	U16	R+	03 FF

24	Protocal Type	Value range is 1-3, 1: Custom Protocol, 2: MODBUS-RTU Protocol, 3: Data Transmission Protocol for Water Rresources Monitoring Management System	U16	R+	04 00
25	Water Level Air Draft	Value range: 0- 40000 in mm	U16	R+	04 01
26	Correction Factor B of Average Flow Velocity	Value range: 1- 5000, and the coefficient value needs to be multiplied by 1000 and rounded down U16	U16	R+	04 02
27	Correction Factor B of Average Flow Velocity	Value range: -5000-5000, and the coefficient value needs to be multiplied by 1000 and rounded down, with the unit in m/s	S16	R+	04 03
28	Reserved	--	U16	R+	04 04
29	Reserved	--	U16	R+	04 05
30	Acquisition Number of Flow Velocity	Value range: 1- 10	U16	R+	04 06
31	Failed Acquisition Number of Flow Velocity	Value range: 1- 10	U16	R+	04 07
32	Acquisition Waiting Time of Flow Velocity	Value range: 1- 100 in s	U16	R+	04 08
33	Water Level Acquisition Number	Value range: 1- 10	U16	R+	04 09
34	Failed Acquisition Number of Water Level	Value range: 1- 10	U16	R+	04 0A
35	Acquisition Waiting Time of Water Level	Value range: 1- 100 in s	U16	R+	04 0B
42	Cross-section Type	Value range: 1- 3, 1: Trapezoid, 2: Rectangle, 3: Others	U16	R+	04 12
43	Cross-section dimension 1	Value range: 0- 40000 in mm	U16	R+	04 13
44	Cross-section dimension 2	Value range: 0- 20000 in mm	U16	R+	04 14
45	Cross-section dimension 3	0-10000	U16	R+	04 15
47	Water Level Jump Threshold	Value range: 0- 5000 in mm	U16	R+	04 17
48	Flow Velocity Jump Threshold	Value range: 0- 500 cm/s	U16	R+	04 18
49	Reserved	--	U16	R+	04 19

50	Water Level Smoothing Number	0-50	U16	R+	04 1A
51	Flow Velocity Smoothing Number	0-50	U16	R+	04 1B
52	Upgrade Mode	Value range is 0-2, 0: Exit Upgrade Mode , 1: GPRS Upgrade Mode , 2: Serial Port Upgrade Mode	U16	W	04 1C
53	Factory Parameter Reset	The value is 0	U16	W	04 1D
54	System Reset	The value is 1	U16	W	04 1E
55	Reserved	--	U16	W	04 1F
56	File Transfer Mode	The value is 1	U16	W	04 20
57	Sensor Interface Pass-through Mode	Value range: 1- 3, 1: Water Level Interface, 2: Flow Velocity Interface	U16	W	04 21
58	Reserved	无	U16	R+	04 22

5.2.3 MODBUS-RTU Command Details (Command and Response are all in Hexadecimal Format)

0x03 Function Code (Support broadcast sending and receiving address 0xFF)）			
Command Format: Device Address (1 byte) + 03 + Start Address (2 bytes) + Number of Read Registers (2 bytes) + CRC Check (low-order bits comes before high-order bits) Response Format: Device Address (1 byte) + 03 + Total Number of Bytes of Read Data (1 bytes) + Data Content (2× Total Number of Data) + CRC (low-order bits comes before high-order bits)			
0	Water Volume High-order 16 Bits	Command	01 03 03 E8 00 01 04 7A
		Response	01 03 02 00 00 B8 44
		Parameter Description	Water Volume High 16 Bits is 0.
1	Water Volume Low-order 16 Bits	Command	01 03 03 E9 00 01 55 BA
		Response	01 03 02 00 32 39 91
		Parameter Description	Water Volume Low 16 Bits is 50 cubic meters.
2	Flow	Command	01 03 03 EA 00 01 A5 BA
		Response	01 03 02 03 F3 F8 F1
		Parameter Description	Instantaneous Flow is 1.011 cubic meter per second.
3	Water Level	Command	01 03 03 EB 00 01 F4 7A
		Response	01 03 02 04 28 BA 9A
		Parameter Description	Water level is 1.064m.

4	Flow velocity	Command	01 03 03 EC 00 01 45 BB
		Response	01 03 02 00 48 B8 72
		Parameter Description	Flow velocity is 0.72m/s
7	Supply Voltage	Command	01 03 03 EF 00 01 B5 BB
		Response	01 03 02 00 7F F9 A4
		Parameter Description	Supply voltage is 12.7V.
8	Water Level Signal Strength	Command	01 03 03 F0 00 01 84 7D
		Response	01 03 02 00 58 B9 BE
		Parameter Description	Water Level Signal Strength is 88.
9	Flow Velocity Signal Strength	Command	01 03 03 F1 00 01 D5 BD
		Response	01 03 02 00 63 F8 6D
		Parameter Description	Flow Velocity Signal Strength is 99.
10	Current Meter Angle	Command	01 03 03 F2 00 01 25 BD
		Response	01 03 02 00 1E 38 4C
		Parameter Description	Current meter angle is 30 degree.
11	Software Version	Command	01 03 03 F3 00 01 74 7D
		Response	01 03 02 01 05 79 D7
		Parameter Description	Software version is 1.05
12	Address	Command	FF 03 03 F4 00 01 D0 62
		Response	01 03 02 00 01 79 84
		Parameter Description	Query address is 01.
13	Flowmeter Interface Type	Command	01 03 03 F5 00 01 94 7C
		Response	01 03 02 00 01 79 84
		Parameter Description	The flowmeter interface type is 1, RS485.
14	Flowmeter Interface Baud Rate	Command	01 03 03 F6 00 01 64 7C
		Response	01 03 02 00 60 B8 6C
		Parameter Description	The baud rate is 9600.
16	Baud Rate of Flow Velocity Interface	Command	01 03 03 F8 00 01 05 BF
		Response	01 03 02 00 60 B8 6C
		Parameter Description	The baud rate is 9600.
18	Baud Rate of Water Level Interface	Command	01 03 03 FA 00 01 A4 7F
		Response	01 03 02 00 60 B8 6C
		Parameter Description	The baud rate is 9600.
22	Working Mode	Command	01 03 03 FE 00 01 E5 BE
		Response	01 03 02 00 01 79 84

		Parameter Description	Working mode is 1: Continuous working.
23	Intervals	Command	01 03 03 FF 00 01 B4 7E
		Response	01 03 02 00 01 79 84
		Parameter Description	The intervals is 1 min.
24	Protocal Type	Command	01 03 04 00 00 01 85 3A
		Response	01 03 02 00 02 39 85
		Parameter Description	Protocal type is 2: MODBUS-RTU Protocol.
25	Water Level Air Draft	Command	01 03 04 01 00 01 D4 FA
		Response	01 03 02 27 10 A2 78
		Parameter Description	Water level air draft is 10.000m.
26	Correction Factor K of Average Flow Velocity	Command	01 03 04 02 00 01 24 FA
		Response	01 03 02 03 E8 B8 FA
		Parameter Description	The correction factor K is 1.
27	Correction Factor B of Average Flow Velocity	Command	01 03 04 03 00 01 75 3A
		Response	01 03 02 00 00 B8 44
		Parameter Description	The correction factor B is 0.
30	Acquisition Number of Flow Velocity	Command	01 03 04 06 00 01 65 3B
		Response	01 03 02 00 05 78 47
		Parameter Description	The acquisition number is 5 times
31	Failed Acquisition Number of Flow Velocity	Command	01 03 04 07 00 01 34 FB
		Response	01 03 02 00 03 F8 45
		Parameter Description	The number of failures is 3 times.
32	Acquisition Waiting Time of Flow Velocity	Command	01 03 04 08 00 01 04 F8
		Response	01 03 02 00 08 B9 82
		Parameter Description	The acquisition waiting time is 8 seconds.
33	Water Level Acquisition Number	Command	01 03 04 09 00 01 55 38
		Response	01 03 02 00 05 78 47
		Parameter Description	The acquisition number is 5 times
34	Failed Acquisition Number of Water Level	Command	01 03 04 0A 00 01 A5 38
		Response	01 03 02 00 03 F8 45
		Parameter Description	The number of failures is 3 times.
35	Acquisition Waiting Time of Water Level	Command	01 03 04 0B 00 01 F4 F8
		Response	01 03 02 00 0A 38 43
		Parameter Description	The acquisition waiting time is 10 seconds.

42	Cross-section Type	Command	01 03 04 12 00 01 25 3F
		Response	01 03 02 00 01 79 84
		Parameter Description	Cross-section type is 1: Trapezoid.
43	Cross-section Dimension 1	Command	01 03 04 13 00 01 74 FF
		Response	01 03 02 03 E8 B8 FA
		Parameter Description	Cross-section Dimension 1 is 1000mm.
44	Cross-section Dimension 2	Command	01 03 04 14 00 01 C5 3E
		Response	01 03 02 03 E8 B8 FA
		Parameter Description	Cross-section Dimension 2 is 1000mm.
45	Cross-section dimension 3	Command	01 03 04 15 00 01 94 FE
		Response	01 03 02 03 E8 B8 FA
		Parameter Description	Cross-section Dimension 3 is 1000.
47	Water Level Jump Threshold	Command	01 03 04 17 00 01 35 3E
		Response	01 03 02 00 32 39 91
		Parameter Description	The water level jump threshold is 50cm.
48	Flow Velocity Jump Threshold	Command	01 03 04 18 00 01 05 3D
		Response	01 03 02 00 1E 38 4C
		Parameter Description	The flow velocity jump threshold is 30cm/s.
50	Water Level Smoothing Number	Command	01 03 04 1A 00 01 A4 FD
		Response	01 03 02 00 06 38 46
		Parameter Description	The smoothing number is 6.
51	Flow Velocity Smoothing Number	Command	01 03 04 1B 00 01 F5 3D
		Response	01 03 02 00 06 38 46
		Parameter Description	The smoothing number is 6.
52	Upgrade Mode	Command	01 03 04 1C 00 01 44 FC
		Response	01 03 02 00 00 B8 44
		Parameter Description	Normal working mode.
Read multiple registers simultaneously			
Example 1: Query measureing parameters: Water Volume, Water Level, Flow Velocity, Wind Speed, Wind Direction, Supply Voltage, Water Level Signal Strength, Flow Velocity Signal Strength, Flowmeter Angle.			
Command	01 03 03 E8 00 0B 84 7D		
Response	01 03 16 00 00 00 32 03 F3 04 28 00 48 00 38 99 84 00 7F 00 58 00 63 00 1E 96 25		
Example 2: Query parameters: Flowmeter Interface Type, Flowmeter Interface Baud Rate, Baud Rate of Flow Velocity Interface, Baud Rate of Water Level Interface, Wind Velocity and Direction Interface Baud Rate, Working Mode.			
Command	01 03 03 F5 00 0B 14 7B		
Response	01 03 16 00 01 00 60 00 64 00 60 00 64 00 60 00 64 00 60 00 64 00 01 00 01 4E 64		

0x06 Function Code (Support broadcast sending and receiving address 0Xff and broadcast receive-only address 0xFE)				
Command Format: Device Address (1 byte) + 06 + Start Address (2 bytes) + Preset Value (2 bytes, high-order bits comes before low-order bits) + CRC Check (low-order bits comes before high-order bits) Response: Device Address (1 byte) + 06 + Start Address (2 bytes) + Preset Value (2 bytes, high-order bits comes before low-order bits) + CRC Check (low-order bits comes before high-order bits)				
0	Water Volume High-order 16 Bits	Command	01 06 03 E8 00 00 09 BA	0<= Preset Value <= 65535
		Response	01 06 03 E8 00 00 09 BA	
		Description	Set Water Volume High-order 16 Bits to 0.	
1	Water Volume Low-order 16 Bits	Command	01 06 03 E9 00 00 A8 7A	0<= Preset Value <= 65535
		Response	01 06 03 E9 00 00 58 7A	
		Description	Set Water Volume Low-order 16 Bits to 0.	
12	Address	Command	01 06 03 F4 00 05 08 7F	1<= Preset Value <= 247
		Response	05 06 03 F4 00 05 09 FB	
		Description	Set address to 5.	
13	Flowmeter Interface Type	Command	01 06 03 F5 00 01 58 7C	1：RS485 2：RS232
		Response	01 06 03 F5 00 01 58 7C	
		Description	Set the flowmeter interface type to 01, RS485 interface.	
14	Flowmeter Interface Baud Rate	Command	01 06 03 F6 5E 60 21 F3	48, 96, 144, 192, 384, 560, 576, 1152, 1280
		Response	01 06 03 F6 00 60 69 94	
		Description	Set Flowmeter Interface Baud Rate to 9600.	
16	Baud Rate of Flow Velocity Interface	Command	01 06 03 F8 00 60 08 57	48, 96, 144, 192, 384, 560, 576, 1152, 1280
		Response	01 06 03 F8 00 60 08 57	
		Description	Set Flow Velocity Interface Baud Rate to 9600.	
18	Baud Rate of Water Level Interface	Command	01 06 03 FA 00 60 A9 97	48, 96, 144, 192, 384, 560, 576, 1152, 1280
		Response	01 06 03 FA 00 60 A9 97	
		Description	Set Water Level Interface Interface Baud Rate to 9600.	
22	Working Mode	Command	01 06 03 FE 00 01 29 BE	1: Continuous working mode 2: Interval working mode
		Response	01 06 03 FE 00 01 29 BE	
		Description	Set working mode to 1: Continuous working mode	
23	Intervals	Command	01 06 03 FF 00 05 79 BD	1<= Preset Value <= 5000
		Response	01 06 03 FF 00 05 79 BD	
		Description	Set the intervals to 5 min.	
24	Protocal Type	Command	01 06 04 00 00 01 49 3A	1: Custom Protocol 2: MODBUS-RTU Protocol 3: Data Transmission
		Response	01 06 04 00 00 01 49 3A	
		Description	Set the Protocol to 1: Custom Protocol.	

				Protocol for Water Resources Monitoring Management System
25	Water Level Air Draft	Command	01 06 04 01 13 88 D4 6C	0<= Preset Value <= 40000
		Response	01 06 04 01 13 88 D4 6C	
		Description	Set water level air draft to 5.0m.	
26	Correction Factor K of Average Flow Velocity	Command	01 06 04 02 01 F4 08 68	1<= Preset Value <= 5000
		Response	01 06 04 02 03 E8 29 84	
		Description	Set the value of correction factor K to 1 (1000/1000).	
27	Correction Factor B of Average Flow Velocity	Command	01 06 04 03 FF 9C 39 63	-5000<= Preset Value <= 5000
		Response	01 06 04 03 FF 9C 39 63	
		Description	Set the value of correction factor B to -0.1m/s (-100/100).	
30	Acquisition Number of Flow Velocity	Command	01 06 04 06 00 05 A8 F8	1<= Preset Value <= 10
		Response	01 06 04 06 00 05 A8 F8	
		Description	Set the acquisition number to 5	
31	Failed Acquisition Number of Flow Velocity	Command	01 06 04 07 00 03 79 3A	1<= Preset Value <= 10
		Response	01 06 04 07 00 03 79 3A	
		Description	Set the failed acquisition number to 3.	
32	Acquisition Waiting Time of Flow Velocity	Command	01 06 04 08 00 0A 89 3F	1<= Preset Value <= 100
		Response	01 06 04 08 00 0A 89 3F	
		Description	Set the acquisition waiting time to 10 seconds.	
33	Water Level Acquisition Number	Command	01 06 04 09 00 05 98 FB	1<= Preset Value <= 10
		Response	01 06 04 09 00 05 98 FB	
		Description	Set the acquisition number to 5	
34	Failed Acquisition Number of Water Level Command	Command	01 06 04 0A 00 03 E8 F9	1<= Preset Value <= 10
		Response	01 06 04 0A 00 03 E8 F9	
		Description	Set the failed acquisition number to 3.	
35	Acquisition Waiting Time of Water Level	Command	01 06 04 0B 00 0A 79 3F	1<= Preset Value <= 100
		Response	01 06 04 0B 00 0A 79 3F	
		Description	Set the acquisition waiting time to 10 seconds.	
		Command	01 06 04 0E 00 05 29 3A	
		Response	Set the acquisition waiting time to 5 seconds.	
42	Cross-section Type	Description	01 06 04 12 00 01 E9 3F	1: Trapezoid 2: Rectangle 3: Others
		Command	01 06 04 12 00 01 E9 3F	
		Response	Set the Section Type to trapezoid.	
43	Cross-section dimension 1	Description	01 06 04 13 03 E8 79 81	0<= Preset Value <= 40000
		Command	01 06 04 13 03 E8 79 81	
		Response	Set the Cross-section Dimension 1 to 1000mm.	
44	Cross-section dimension 2	Description	01 06 04 14 03 E8 C8 40	0<= Preset Value <= 20000
		Command	01 06 04 14 03 E8 C8 40	

		Response	Set the Cross-section Dimension 2 to 1000mm.	
45	Cross-section dimension 3	Description	01 06 04 15 03 E8 99 80	0<= Preset Value <= 10000
		Command	01 06 04 15 03 E8 99 80	
		Response	Set the Cross-section Dimension 3 to 1000.	
47	Water Level Jump Threshold	Description	01 06 04 17 00 32 B9 2B	0<= Preset Value <= 5000
		Command	01 06 04 17 00 32 B9 2B	
		Response	Set the water level jump threshold to 50mm.	
48	Flow Velocity Jump Threshold	Description	01 06 04 18 00 1E 88 F5	0<= Preset Value <= 500
		Command	01 06 04 18 00 1E 88 F5	
		Response	Set the flow velocity jump threshold to 30cm/s.	
50	Water Level Smoothing Number	Description	01 06 04 1A 00 06 29 3F	0<= Preset Value <= 50
		Command	01 06 04 1A 00 06 29 3F	
		Response	Set the Water Level Smoothing Number to 6.	
51	Flow Velocity Smoothing Number	Description	01 06 04 1B 00 06 78 FF	0<= Preset Value <= 50
		Command	01 06 04 1B 00 06 78 FF	
		Response	Set the Flow Velocity Smoothing Number to 6.	
52	Upgrade Mode	Description	01 06 04 1C 00 00 49 3C	0: Exit Upgrade Mode 1: GPRS Upgrade Mode 2: Serial Port Upgrade Mode
		Command	01 06 04 1C 00 00 49 3C	
		Response	Exit Upgrade Mode.	
53	Factory Parameter Reset	Description	01 06 04 1D 00 00 18 FC	Preset Value = 0
		Command	01 06 04 1D 00 00 18 FC	
		Response	Restore the factory parameter.	
54	System Reset	Description	01 06 04 1E 00 01 29 3C	Preset Value = 1
		Command	---	
		Response	System reset and restart	
56	File Transfer Mode	Description	01 06 04 20 00 01 48 F0	Preset Value = 1
		Command	---	
		Response	Enter the file transfer mode.	
57	Sensor Interface Pass-through Mode	Description	01 06 04 21 00 01 19 30	1: Water Level Interface 2: Flow Velocity Interface
		Command	--	
		Response	Enter the Water Level Interface Pass-through Mode.	
Broadcast Mode: Broadcast sending and receiving address 0xFF				
For example: set the address of an device with unknown address				
Command	FF 06 03 F4 00 0A 08 7F			
Response	0A 06 03 F4 00 0A 5D A5			
Broadcast Mode: Broadcast sending-only address 0xFE				
For example: set the flowmeter working mode.				

Command	FE 06 03 FE 00 01 3D B1
0x83 Function Code (Exception Response)	
Response format: Device Address (1 byte) + 83 + Exception Code (1 byte) + CRC Check (low-order bytes comes before high-order bytes)	
Response	Description
01 83 01 80 F0	Function code error
01 83 02 C0 F1	Register Address Error
01 83 03 01 31	Register Number or Value Error
01 83 04 40 F3	CRC Check Error

6 Technical Parameters

Flow measurement system

Measurement principle	Planar Microstrip Array Antenna CW + FMCW
Operating mode	Manual, automatic, telemetry
Applicable environment	24 hours, rainy
Operating temperature	-30~80℃
Operating Voltage	7~28VDC；
Working current	12VDC input, working mode: ≤120mA standby mode: <1mA

Protection class	IP68
Lightning protection level	6KV
physical dimension	235.4×100×104（mm）
weight	Less than 1.5kg

Radar Velocity meter

Radar frequency	24GHz
Maximum range	40m
Velocity measurement range	0.03~20m/s
Velocity measurement accuracy	±0.01m/s；±1%FS
Antenna angle	12°
Measurement direction	Automatic identification of water flow direction, built-in vertical angle correction

Radar water level meter

Radar frequency	60GHz
Measuring range	0.2-40m
measurement accuracy	±1mm、
Antenna angle	12°

Data transmission system

Digital transmission method	RS485 / RS232, 4 ~ 20mA, LoRa (wireless option), NB-IoT (wireless option), 4G RTU (wireless option)

7 Company Information

If you have any questions or suggestions to the product, please contact us through the following ways, we are glad to be at your service!