

KWL803 Radar Level Sensor



Semi-PTFE Version



ABS Version



304 Version

Table of contents

1.Introduction	1
1.1 Product Overview	1
1.2 Detection principle	1
2.Feature	1
3. Technical Specifications	2
3.1 Model Selection	2
4.Dimension	3
5.Wiring Instructions	4
5.1 [RS485 version] Wiring instructions	4
5.2 [RS232 version] Wiring instructions	4
5.3 [TTL version] Wiring instructions	4
5.4 [4-20mA Three-wire version] Wiring instructions	4
5.5 [4-20mA Two-wire version] Wiring instructions	5
5.6 [RJ45 version] Wiring instructions	5
5.7 [RS485+ High/Low Level] Wiring instructions	5
6.Installation instructions	6
6.1 Test installation requirements	6
6.2 Radar level sensor installation example	7
6.2.1 How to calculate liquid level?	7
6.2.2 Installation example	8
7. MODBUS-RTU communication protocol	10
7.1 MODBUS protocol	10
7.2 Query data instruction: Function Code 0x04	12
7.2.1 Query measurement results - level (i.e. installation height - air height)	12
7.2.2 Query measurement results - air height	12
7.3 Query configuration information instruction: Function Code 0x03	13
7.3.1 Broadcast query slave address	13
7.3.2 Query the baud rate of the communication interface	13
7.3.3 Query version information	14
7.3.4 Query calibration parameters	14
7.3.5 Query automatic push cycle	14
7.3.6 Query blind area	15
7.3.7 Query range	15
7.3.8 Check the depth at installation	16
7.3.9 Check installation height	16
7.4 Set instruction: Function Code 0x10	16
7.4.1 Set the slave address	16
7.4.2 Set baud rate of communication interface	17
7.4.3 Setting calibration parameters	17
7.4.4 Set automatic push cycle	18
7.4.5 Set the water depth at the time of installation	18

7.4.6 Set the installation height	18
7.5 Text protocol	19
7.5.1 Communication protocol hardware interface parameters	19
7.5.2 Description of communication protocol commands	19
7.5.2.1.Read the real spatio-temporal height	19
7.5.2.2.Read the real-time level	20
7.5.2.3.Water depth at installation	20
7.5.2.4.Height of installation	20
7.5.2.5.Read the version number	21
7.5.2.6.Read range	21
7.5.2.7.Read blind area	21
7.5.2.8.Software reset (reboot)	21
7.5.2.9.Factory data reset	21
7.5.2.10.Frequency of acquisition	21
7.5.2.11.Baud rate	22
7.5.2.12.Calibration parameters	22
7.5.2.13Automatic push cycle	22
7.5.2.14Automatic Push Protocol Type	23
7.5.2.15.Reference Installation Height	23
7.5.2.16.Reference Liquid Level	24

Modify the Record

Date	Version	Modify the content
20240421	V0.1	This paper mainly introduces the operation manual of RS485 version for split-type radar level sensor..
20240705	V0.2	Based on the V1.0 version, the RJ45,RS232,TTL model description and wiring description of the split radar liquid level sensor are added.
20251226	V0.3	Dimension Modification
20260320	V0.4	(1) Added 4-20mA analog output version (two-wire/three-wire) (2) Added RS485 + high/low level composite output version (3) Expanded to 7 wiring methods, applicable to more scenarios (4) Optimized document structure and chapter numbering (5) Clarified measurement range: 4-20m (6) MODBUS-RTU Protocol Optimization: ➤ Improved the protocol description in Chapter 7, and added features 7.5.2.14-7.5.2.16; ➤ Optimized the chapter structure for the query function in sections 7.3.2-7.3.9; ➤ Added detailed steps and practical instructions for protocol operation;

1.Introduction

1.1 Product Overview

The 80G radar level gauge supports RS485/RS-232/RJ45/4-20MA applications. The maximum range is 40m, and the minimum blind zone is 5cm. Due to its higher operating frequency and shorter wavelength, it is particularly suitable for solid-state applications. Its lens-based electromagnetic wave transmission and reception method offers unique advantages in high-dust and harsh temperature environments (+75°C). The instrument features a threaded mounting system for easy and convenient installation.

1.2 Detection principle

Radar level sensor is based on the principle of time domain reflection (TDR). The electromagnetic pulse propagates along the cable or probe with the speed of light. When it meets the surface of the measured medium, part of the pulse of the radar level meter is reflected to form an echo return to the pulse transmitter along the same path, and the distance between the transmitter and the surface of the measured medium is in direct proportion as the propagation time of the pulse, hence the height of the level is calculated.

2.Feature

The main advantages are as follows:

- Based on the domestic COMS millimeter wave RF chip, it realizes a more compact RF architecture, higher signal-to-noise ratio, and smaller blind area.
- 5GHz working bandwidth enables the product to have higher measurement resolution and measurement accuracy.
- The narrowest $\pm 2.75^\circ$ antenna beam angle makes the influence of interference in the installation environment on the instrument smaller and the installation more convenient.
- Shorter wavelength, better emission characteristics on solid surfaces, so there is no need to use a special universal flange for aiming.
- The performance meets the national standard DB50/T 826-2017 General technical requirements for level gauges, and the core components adopt a fully sealed IP68 waterproof design.

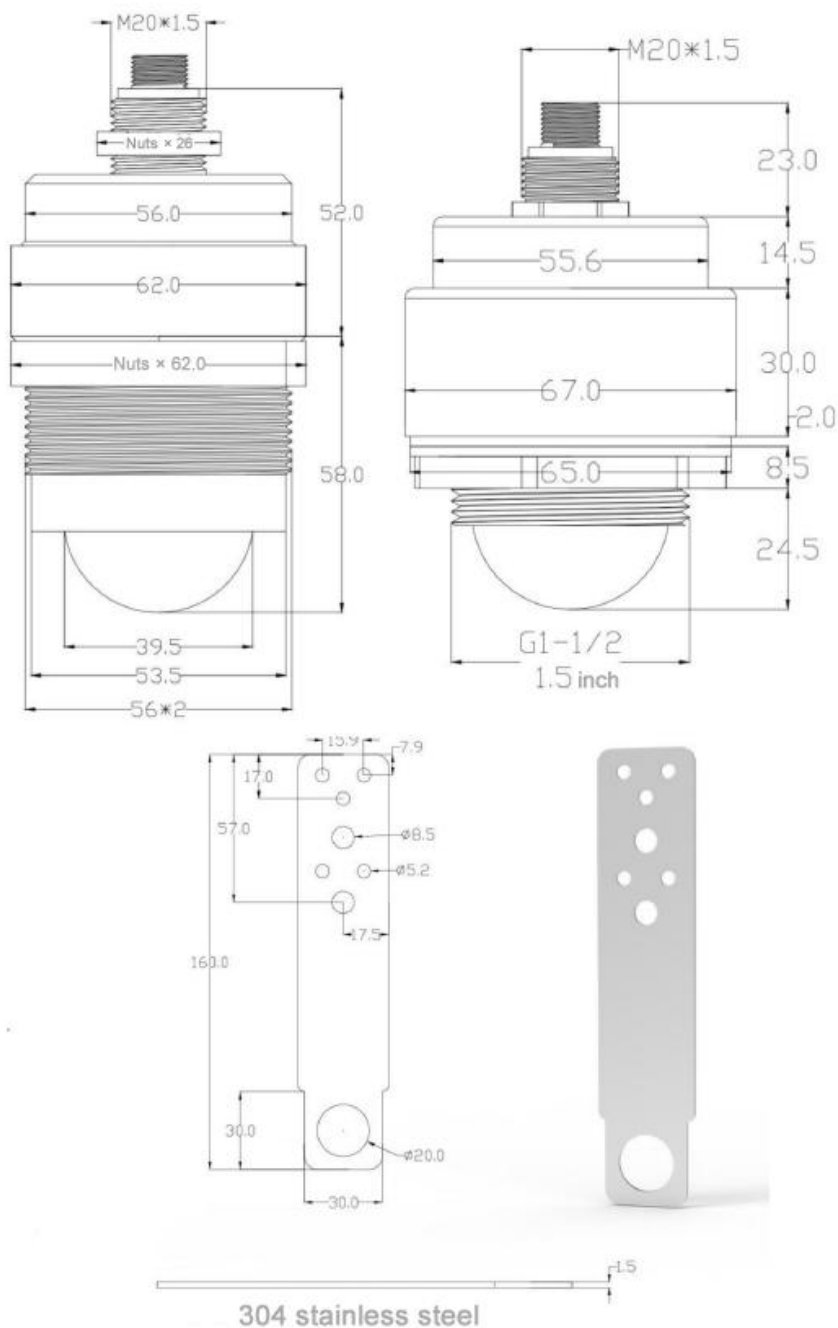
3. Technical Specifications

Model	KWL803					
Communication	RS485	RS232	RJ45	4-20mA Three-wire	4-20mA Two-wire	TTL
Average Current	18mA/12V				3.4mA/24V	10mA/3.3V
Acquisition frequency	200ms/Configurable				1500ms	200ms/Configurable
Pulse current	100mA/10ms				40mA/24V	400mA/10ms
Voltage range	9-24V				24V	3-3.3V
Transmission Frequency	80 GHz					
Measurement Accuracy	±2mm					
Measuring Range	0.05m-40m					
Resolution	1mm					
Beam Angle	±2.75°					
Debugging Method	Host computer					
Communication Protocol	Modbus/Text protocol					
Protection Rating	IP68					
Operating Humidity	0-95%					
Operating Temperature	-40℃~75℃					
Appearance Material	Black ABS, Stainless steel, PTFE					
Cable Length	5 meters [RJ45 cable 0.5 meters]					

3.1 Model Selection

KWL803	A	ABS casing	
	B	Stainless steel 304 casing	
	C	Semi-PTFE casing	
		20mA2	2 wire 4-20mA Output
		20mA3	3 wire 4-20mA Output
		485	RS485
		232	RS232
		45	RJ45
		TTL	TTL
KWL803	A	20mA2	Example: KWL803-A-20mA2

4.Dimension



5. Wiring Instructions

5.1 [RS485 version] Wiring instructions

In serial communication UART applications, there are 4 wiring heads, namely DC/GND/485-A/485-B.



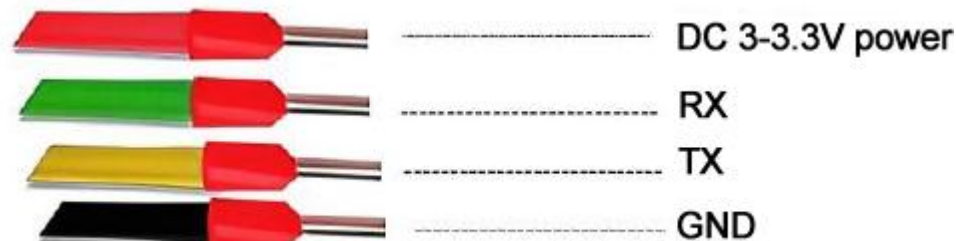
5.2 [RS232 version] Wiring instructions

In serial communication UART applications, there are 4 wiring heads, namely DC/GND/TX/RX.

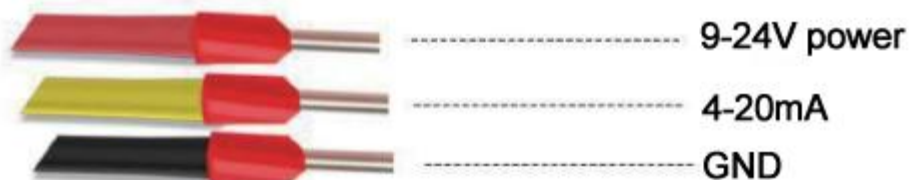


5.3 [TTL version] Wiring instructions

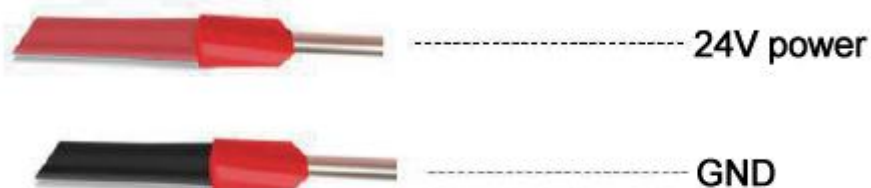
In serial communication UART applications, there are 4 wiring heads, namely DC/GND/TX/RX.



5.4 [4-20mA Three-wire version] Wiring instructions



5.5 [4-20mA Two-wire version] Wiring instructions



5.6 [RJ45 version] Wiring instructions

In serial communication UART applications, there are 4 wiring heads, namely DC/GND/TX/RX.



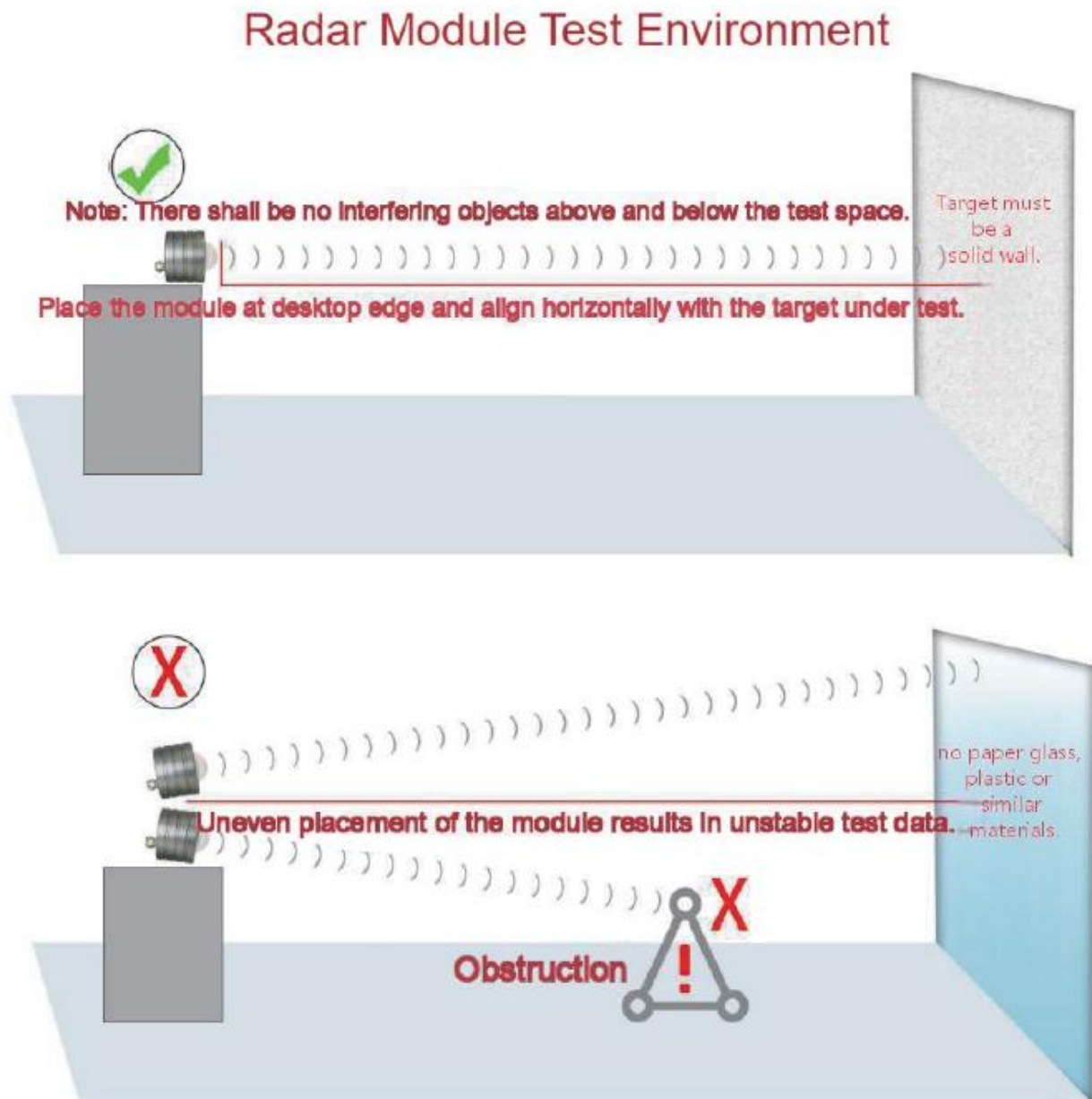
5.7 [RS485+ High/Low Level] Wiring instructions

Red wire	VCC (9-24V power)		VCC (9-24V power)
Black wire	GND		GND
Yellow wire	485-A		485-A
Green wire	485-B		485-B
White wire	Digital Output:12/24V		Digital Output:12/24V
Brown wire	Digital Output: GND		Digital Output: GND

6. Installation instructions

6.1 Test installation requirements

(1) **Sensor installation requirements during testing:** The sensor must be installed horizontally and fixedly; do not hold or suspend the sensor during testing.



(2) **Requirements for the object being tested:** It is recommended that the dielectric constant of the object be greater than 2.5, such as a wall or water surface. Paper, glass, or similar materials cannot be used. The surface of the object being tested must be level, flat, and without any protruding parts.

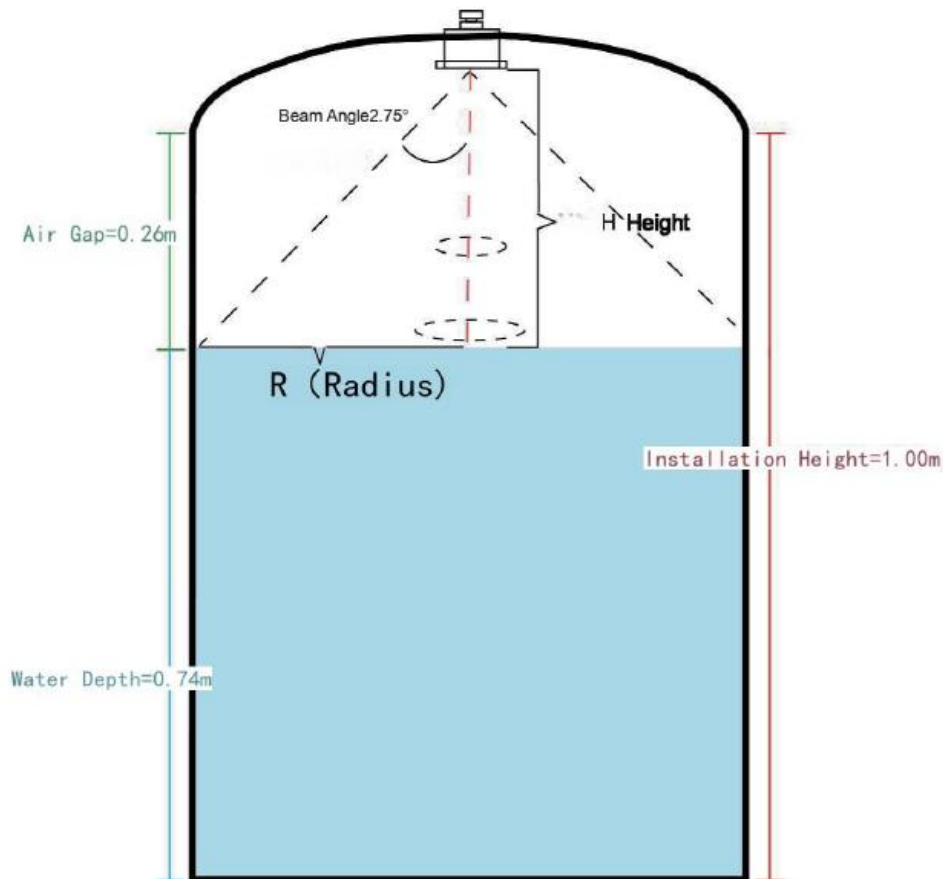
6.2 Radar level sensor installation example

6.2.1 How to calculate liquid level?

Air gap: SensorBottom of probeDistance to liquid surface.

Liquid level: Depth of liquid level.

Installation height: Distance from the bottom of the sensor probe to the bottom of the liquid.



Calculation Formula for Measuring Height:

$$H = R (\text{Radius}) / \tan (\text{Beam Angle Calculation})$$

$$\text{Example: } H = R / \tan 2.75^\circ$$

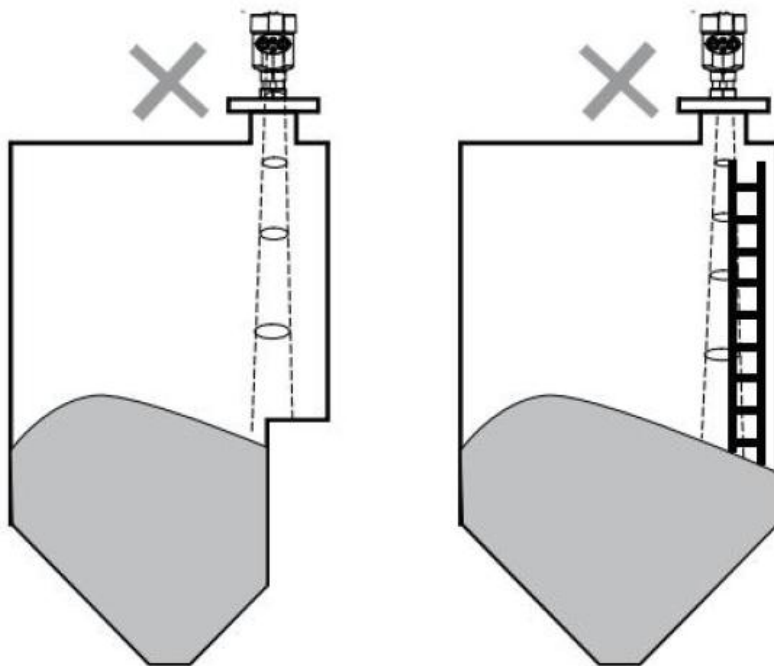
6.2.2 Installation example

Two points to note during installation:

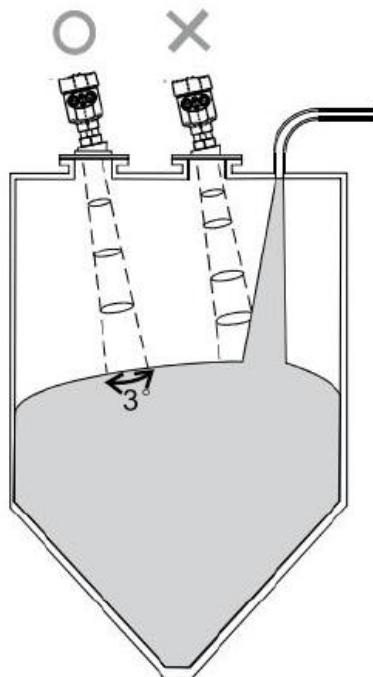
- (1) Align with the target material level and try to ensure vertical incidence to the material level;
- (2) Avoid false echoes.

Refer to the following points for typical working conditions.

- Ensure that there are no obstructions in the beam range, such as ladders or steps.

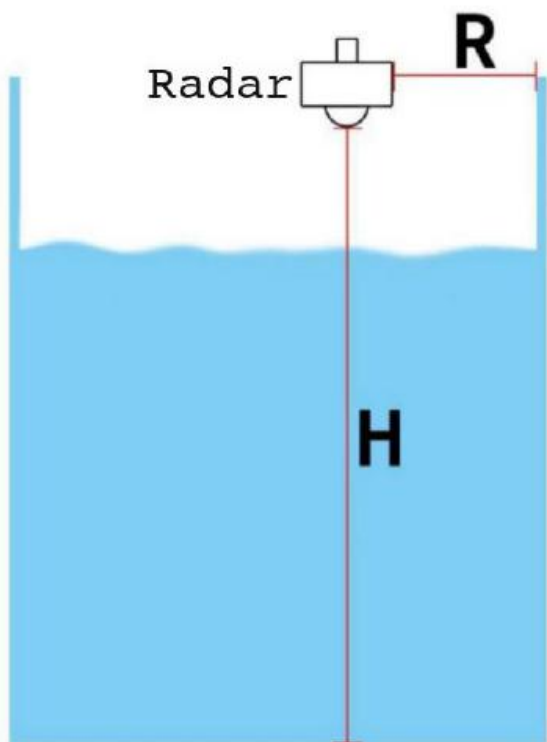


- The instrument installation should ensure that the antenna beam avoids the feed inlet.



- The instrument installation should be at least 6cm away from the container wall, otherwise it is likely to produce incorrect readings.
- For conical containers, ensure that the beam is directed directly to the bottom of the container (or the surface of the material); otherwise, measurements taken at the bottom of the container may be inaccurate.

This table is a reference data table for instrument installation:



Measurement Distance (H)	Distance from Wall (R)	For mirror-finished metals with smooth inner walls (such as 304 stainless steel), the distance from the wall can be reduced by 50%.
1m	0.06m	0.03m
2m	0.11m	0.06m
3m	0.16m	0.08m
4m	0.21m	0.11m
5m	0.27m	0.14m
10m	0.53m	0.24m
15m	0.79m	0.4m
20m	1.1m	0.55m
25m	1.34m	0.67m
30m	1.56m	0.78m

7. MODBUS-RTU communication protocol

7.1 MODBUS protocol

1. Communication protocol hardware interface parameters

The sensor uses serial port communication, and the default parameters are as follows :

Communication Parameters	Serial Port Level	Baud Rate	Parity Check	Data Length	Stop Bit
Serial Port	TTL	9600	None	8	1

Timeout between frames 250ms.

2. Communication protocol format

The radar level sensor communicates externally using the Modbus RTU communication protocol. Each complete data frame includes: address field, Function Code, data, and checksum. The checksum is the CRC16 check data of the data frame, with the low byte preceding the high byte. The default factory address for the sensor is 0x7F.

Request command format and radar reply data format are described as follows:

(1) Query parameter format: **Function Code 0x03**

Request:

Device Address	Function Code	Register Address	Number of Registers	C R C
1 Byte	1 Byte	2 Bytes	2 Bytes	2 Bytes

Reply:

Device Address	Function Code	Data Length	Register Value	C R C
1 Byte	1 Byte	1 Byte	2N Bytes	2 Bytes

N: numbers of registers

(2) Query parameter format: **Function Code 0x04**

Request:

Device Address	Function Code	Register Address	Number of Registers	C R C
1 Byte	1 Byte	2 Bytes	2 Bytes	2 Bytes

Reply:

Device Address	Function Code	Data Length	Register Value	C R C
1 Byte	1 Byte	1 Byte	2N Bytes	2 Bytes

N: numbers of registers

(3) Set parameter format: **Function Code 0x10**

Request:

Device Address	Function Code	Register Address	Number of Registers	Data Length	Register Value	C R C
1 Byte	1 Byte	2 Bytes	2 Bytes	1 Byte	2N Bytes	2 Bytes

Reply:

Device Address	Function Code	Register Address	Number of Registers	C R C
1 Byte	1 Byte	2 Bytes	2N Bytes	2 Bytes

N: numbers of registers

3. Register Address Summary Table

Parameter Default					
Parameter	Register Address	PLC Or Group Status Address	Support Function Code	Type Of Data	Illustrate
Slave Address	0x2001	48194	0x03,0x10	int16	int16 for 2 bytes integer (AB); int32 for 4 byte integer, high 16 in front (ABCD);
Baud Rate	0x2002	48195	0x03,0x10	int32	
Version Information	0x2004	48197	0x03	int32	
Set Up Calibration	0x2052	48275	0x03,0x10	int16	
Automatic Push Cycle	0x2053	48276	0x03,0x10	int16	
Blind Spot	0x2044	48261	0x03	float(little 16)	float(little 16) is 4 byte float, low 16th place first (CDAB);
Measuring Range	0x2046	48263	0x03	float(little 16)	
Set Current Depth	0x2048	48265	0x03,0x10	float(little 16)	
Set Up Installation High	0x204A	48267	0x03,0x10	float(little 16)	
Level	0x0A0B	32572	0x04	float(little 16)	
Empty Height	0x0A0F	32576	0x04	float(little 16)	int16 for 2 bytes integer (AB);
	0x0000	0x4001	0x03	int16	
	0x0001	0x4002	0x03	int16	

Note: The Register Address and data type of some parameters can be modified by the host computer software. After modifying the Register Address or data type, the corresponding Modbus operation instructions will also change accordingly, such as: The default instruction to read the empty height is 0x 7F 04 0A 0F 00 02 48 0E. If the register of the empty height is modified to 00 01, the instruction to read the empty height is changed to 0x 7F 04 00 01 00 02 2A 15.

4. Communication protocol command description

Note:

- The default Device Address is 0x7F;
- The float type data in the data adopts IEEE754 binary floating point arithmetic standard, the low 16 bits in the first (CDAB);
- In this protocol, the Register Address corresponding to each parameter is the default address. If the address of the register is modified by the host computer, the Register Address in the Modbus operation instruction should be changed accordingly;
- In this protocol, the data definition (data type/unit) of each parameter is parsed according to the default

configuration. If the data definition (data type/unit) is modified through the host computer, the data reading and parsing should be modified accordingly; For example, when the host computer converts the data type from floating-point to integer, special attention must be paid to changing the unit to centimeters or millimeters. Assuming the current real-time data is 1.23 meters, with the data type being floating-point and the unit being meters, Modbus will read 1.23 meters. If the data type is changed to integer, but the unit is still set to meters, Modbus will read 1 meter. If the unit is set to centimeters, it will read 123 centimeters.

7.2 Query data instruction: Function Code 0x04

7.2.1 Query measurement results - level (i.e. installation height - air height)

Request command:

Device Address	Function Code	Register Address	Number of Registers	CRC
0x7F	0x04	0x0A 0B	0x00 02	0x09 CF

Reply data:

Device Address	Function Code	Length of Data	Data	CRC
0x7F	0x04	0x04	0x00 00 41 30	0x09 CF

Data definition: The default data type is float(little16) data, the default unit is meters (m), the data length is 4 bytes, and the lowest 16 bits are in the first.

Error code:

- ① When the sensor echo energy is insufficient, the output result is -0.001 meters;
- ② When the sensor is in the dead zone, the output result is -0.002 meters;
- ③ When the measurement result exceeds the range, the output result is -0.003 meters;
- ④ When the installation height is not set, the liquid level cannot be calculated, and the output result is -0.004 meters;

Note: When reading the sensor's real-time data, the read data must be judged to determine if it contains an error code. Error codes are not meaningful and are only used to identify abnormal conditions.

Example 1:

Request: 7F 04 0A 0B 00 02 09 CF

Reply: 7F 04 04 00 00 41 30 55 C7

The data part 0x 00 00 41 30 is converted to floating point data, that is, 11.00 m.

Example 2:

Request: 7F 04 0A 0B 00 02 09 CF

Reply: 7F 04 04 9B A5 BB 44 28 47

The data 0x 9B A5 BB 44 is converted to floating-point data, i.e., -0.003m, indicating that the range is exceeded.

7.2.2 Query measurement results - air height

Request command:

Device Address	Function Code	Register Address	Number of Registers	CRC
0x7F	0x04	0x0A 0F	0x00 02	0x48 0E

Reply data:

Device Address	Function Code	Length of Data	Data	CRC
0x7F	0x04	0x04	0x31 13 40 10	0xAA B6

Data definition: The default data type is float(little16) data, the default unit is meters (m), the data length is 4 bytes, and the lowest 16 bits are in the first.

Error code:

- ① When the sensor echo energy is insufficient, the output result is 0.001 meters;
- ② When the sensor is in the dead zone, the output result is 0.002 meters;
- ③ When the measurement result exceeds the range, the output result is 0.003 meters;

Note: When reading real-time sensor data, the read data must be judged to determine if it contains an error code. Error codes are not meaningful and are only used to identify abnormal states.

Example 1:

Request: 7F 04 0A 0F 00 02 48 0E

Reply: 7F 04 04 31 13 40 10 AA B6

The data part 0x 31 13 40 10 is converted to floating point data, that is, 2.253 m.

Example 2:

Request: 7F 04 0A 0F 00 02 48 0E

Reply: 7F 04 04 12 6E 3A 83 52 27

The data 0x12 6E 3A 83 is converted to floating-point data, i.e., 0.001m, indicating that the sensor echo energy is insufficient.

7.3 Query configuration information instruction: Function Code 0x03

7.3.1 Broadcast query slave address

Request command:

Device Address	Function Code	Register Address	Number of Registers	CRC
0x00(broadcast)	0x03	0x20 01	0x00 01	0xDF DB

Reply data:

Device Address	Function Code	Length of Data	Data	CRC
0x7F	0x03	0x02	0x00 7F	0xD1 AE

Data definition: The data type is int16 data, and the data length is 2 Bytes.

Examples:

Request: 00 03 20 01 00 01 DF DB

Reply: 7F 03 02 00 7F D1 AE

The data part 0x 00 7F is converted to integer data, which is 127 or 0x7F.

7.3.2 Query the baud rate of the communication interface

Note: Baud rate only supports: 4800,9600,19200,38400,115200

Request command:

Device Address	Function Code	Register Address	Number of Registers	CRC
0x7F	0x03	0x20 02	0x00 02	0x64 15

Reply data:

Device Address	Function Code	Length of Data	Data	CRC
0x7F	0x03	0x04	0x00 00 25 80	0x7F 04

Data definition: The data type is int32(big) data, and the data length is 4 bytes.

Examples:

Request: 7F 03 20 02 00 02 64 15

Reply: 7F 03 04 00 00 25 80 7F 04

The data part 0x 00 00 25 80 is converted to integer data, which is 9600.

7.3.3 Query version information

Request command:

Device Address	Function Code	Register Address	Number of Registers	CRC
0x7F	0x03	0x20 04	0x00 02	0x84 14

Reply data:

Device Address	Function Code	Length of Data	Data	CRC
0x7F	0x03	0x04	0x20 23 09 08	0x99 A8

Data definition: The data type is int32 data, and the data length is 4 bytes. Version numbers were coded in BCD format.

Examples:

Request: 7F 03 20 04 00 02 84 14

Reply: 7F 03 04 20 23 09 08 99 A8

The data part is 0x 20230908, and the data is encoded in BCD format, namely the version number is 20230908.

7.3.4 Query calibration parameters

Request command:

Device Address	Function Code	Register Address	Number of Registers	CRC
0x7F	0x03	0x20 52	0x00 01	0x24 05

Reply data:

Device Address	Function Code	Length of Data	Data	CRC
0x7F	0x03	0x02	0x00 10	0x91 82

Data definition: The data type is int16 data, the unit is millimeter (mm), and the data length is 2 Bytes.

Examples:

Request: 7F 03 20 52 00 01 24 05

Reply: 7F 03 02 00 10 91 82

The data part 0x 00 10 is converted to integer data, that is, 16 mm.

7.3.5 Query automatic push cycle

Note: When the automatic push period is ≥ 300 ms, the sensor will automatically push data. When the installation height is not set (level cannot be calculated), push the air height data; When the mounting height is set, push the level data.

Request command:

Device Address	Function Code	Register Address	Number of Registers	CRC
0x7F	0x03	0x20 53	0x00 01	0x75 C5

Reply data:

Device Address	Function Code	Length of Data	Data	CRC
0x7F	0x03	0x02	0x03 E8	0x90 F0

Data definition: The data type is int16 data, the unit is milliseconds (ms), and the data length is 2 Bytes.

Examples:

Request: 7F 03 20 53 00 01 75 C5

Reply: 7F 03 02 03 E8 90 F0

Where the data part 0x 03 E8 is converted to integer data, that is, 1000 ms.

7.3.6 Query blind area

Request command:

Device Address	Function Code	Register Address	Number of Registers	CRC
0x7F	0x03	0x20 44	0x00 02	0x85 C0

Reply data:

Device Address	Function Code	Length of Data	Data	CRC
0x7F	0x03	0x04	0x6D B7 3E AB	0x99 61

Data definition: The default data type is float(little16) data, the default unit is meters (m), and the data length is 4 bytes.

Examples:

Request: 7F 03 20 44 00 02 85 C0

Reply: 7F 03 04 6D B7 3E AB

The data part 0x 6D B7 3E AB was converted to floating-point type data, that is, 0.334 m.

7.3.7 Query range

Request command:

Device Address	Function Code	Register Address	Number of Registers	CRC
0x7F	0x03	0x20 46	0x00 02	0x24 00

Reply data:

Device Address	Function Code	Length of Data	Data	CRC
0x7F	0x03	0x04	0x00 00 42 20	0x55 4C

Data definition: The default data type is float(little16) data, the default unit is meters (m), and the data length is 4 bytes.

Examples:

Request: 7F 03 20 46 00 02 24 00

Reply: 7F 03 04 00 00 42 20 55 4C

The data part 0x 00 00 42 20 is converted to floating point data, that is, 40.0m.

7.3.8 Check the depth at installation

Note: The water depth at the time of installation is used to calculate the installation height. Installation height = water depth at installation + real time height at installation. When setting the water depth at the time of installation, the installation height is automatically calculated and saved to the configuration.

Request command:

Device Address	Function Code	Register Address	Number of Registers	CRC
0x7F	0x03	0x20 48	0x00 02	0x45 C3

Reply data:

Device Address	Function Code	Length of Data	Data	CRC
0x7F	0x03	0x04	0x47 AE 40 B1	0xE0 D5

Data definition: The default data type is float(little16) data, the default unit is meters (m), and the data length is 4 bytes.

Examples:

Request: 7F 03 20 48 00 02 45 C3

Reply: 7F 03 04 47 AE 40 B1 E0 D5

The data part 0x 47 AE 40 B1 was converted to floating point data, that is, 5.54 m.

7.3.9 Check installation height

Note: Set the mounting height, which is used to calculate the level. Real-time level = installation height - real time height. At the same time, installation height = water depth at installation + height at installation time. Therefore, when setting the installation height, the water depth during installation will be automatically calculated and saved to the configuration.

Request command:

Device Address	Function Code	Register Address	Number of Registers	CRC
0x7F	0x03	0x20 4A	0x00 02	0xE4 03

Reply data:

Device Address	Function Code	Length of Data	Data	CRC
0x7F	0x03	0x04	0x8A 64 41 2A	0xBE 7C

Data definition: The default data type is float(little16) data, the default unit is meters (m), and the data length is 4 bytes.

Examples:

Request: 7F 03 20 4A 00 02 E4 03

Reply: 7F 03 04 8A 64 41 2A BE 7C

The data part 0x 8A 64 41 2A is converted to floating point data, that is, 10.65m.

7.4 Set instruction: Function Code 0x10

7.4.1 Set the slave address

Request command:

Device Address	Function Code	Register Address	Number of Registers	Length of Data	Data	CRC
0x7F	0x10	0x20 01	0x00 01	0x02	0x00 01	0x6E 21

Reply data:

Device Address	Function Code	Register Address	Number of Registers	CRC
0x7F	0x10	0x20 01	0x00 01	0x51 D7

Data definition: The data type is int16 data, and the data length is 2 Bytes.

Examples:

Request: 7F 10 20 01 00 01 02 00 01 6E 21

The data part 0x 00 01 is converted to integer data, that is, 1 or 0x01.

Reply: 7F 10 20 01 00 01 51 D7

7.4.2 Set baud rate of communication interface

Note: Baud rate only supports: 4800,9600,19200,38400,115200

Request command:

Device Address	Function Code	Register Address	Number of Registers	Length of Data	Data	CRC
0x7F	0x10	0x20 02	0x00 02	0x04	0x00 01 C2 00	0x75 3E

Reply data:

Device Address	Function Code	Register Address	Number of Registers	CRC
0x7F	0x10	0x20 02	0x00 02	0xE1 D6

Data definition: The data type is int32 data, and the data length is 4 bytes.

Examples:

Request: 7F 10 20 02 00 02 04 00 01 C2 00 75 3E

The data part 0x 00 01 C2 00 is converted to integer data, which is 115200.

Reply: 7F 10 20 02 00 02 E1 D6

7.4.3 Setting calibration parameters

Request command:

Device Address	Function Code	Register Address	Number of Registers	Length of Data	Data	CRC
0x7F	0x10	0x20 52	0x00 01	0x02	0x00 01	0xA2 4E

Reply data:

Device Address	Function Code	Register Address	Number of Registers	CRC
0x7F	0x10	0x20 52	0x00 01	0xA1 C6

Data definition: The data type is int16 data, the unit is millimeter (mm), and the data length is 2 Bytes.

Examples:

Request: 7F 10 20 52 00 01 02 00 10 A2 4E

The data part 0x 00 10 is converted to integer data, that is, 16 mm.

Reply: 7F 10 20 52 00 01 A1 C6

7.4.4 Set automatic push cycle

Note: When the automatic push period is $\geq 300\text{ms}$, the sensor will automatically push data. When the installation height is not set (level cannot be calculated), push the air height data; When the mounting height is set, push the level data.

Request command:

Device Address	Function Code	Register Address	Number of Registers	Length of Data	Data	CRC
0x7F	0x10	0x20 53	0x00 01	0x02	0x03 E8	0xA2 ED

Reply data:

Device Address	Function Code	Register Address	Number of Registers	CRC
0x7F	0x10	0x20 53	0x00 01	0xF0 06

Data definition: The data type is int16 data, the unit is milliseconds (ms), and the data length is 2 Bytes.

Examples:

Request: 7F 10 20 53 00 01 02 03 E8 A2 ED

Where the data part 0x 03 E8 is converted to integer data, that is, 1000 ms.

Reply: 7F 10 20 53 00 01 F0 06

7.4.5 Set the water depth at the time of installation

Note: The water depth at the time of installation is used to calculate the installation height. Installation height = water depth at installation + real time height at installation. When setting the water depth at the time of installation, the installation height is automatically calculated and saved to the configuration.

Request command:

Device Address	Function Code	Register Address	Number of Registers	Length of Data	Data	CRC
0x7F	0x10	0x20 48	0x00 02	0x04	0x47 AE 40 B1	0x75 30

Reply data:

Device Address	Function Code	Register Address	Number of Registers	CRC
0x7F	0x10	0x20 48	0x00 02	0xC0 00

Data definition: The default data type is float(little16) data, the default unit is meters (m), and the data length is 4 bytes.

Examples:

Request: 7F 10 20 48 00 02 04 47 AE 40 B1 75 30

The data part 0x 47 AE 40 B1 was converted to floating point data, that is, 5.54 m.

Reply: 7F 10 20 48 00 02 C0 00

7.4.6 Set the installation height

Note: The installation height is the distance from the sensor to the 0 object level. If the current water depth is 2 meters and the air height is 4 meters, the installation height is 6 meters. Set the mounting height, which is used to calculate the level. Real-time level = installation height - real time height. At the same time, installation height = water depth at installation + height at installation time. Therefore, when setting the installation height, the water depth during installation will be automatically calculated and

saved to the configuration.

Request command:

Device Address	Function Code	Register Address	Number of Registers	Length of Data	Data	CRC
0x7F	0x10	0x20 4A	0x00 02	0x04	0x8A 64 41 2A	0xAA 40

Reply data:

Device Address	Function Code	Register Address	Number of Registers	CRC
0x7F	0x10	0x20 4A	0x00 02	0x61 C0

Data definition: The default data type is float(little16) data, the default unit is meters (m), and the data length is 4 bytes.

Note: Setting the mounting height to 0 will clear the mounting height/water depth configuration at installation.

Examples:

Request: 7F 10 20 4A 00 02 04 8A 64 41 2A AA 40

The data part 0x 8A 64 41 2A is converted to floating point data, that is, 10.65m.

Reply: 7F 10 20 4A 00 02 61 C0

7.5 Text protocol

7.5.1 Communication protocol hardware interface parameters

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

Communication parameters	Serial port level	Baud rate	Parity check	Length of Data	Stop position
Serial port	TTL	9600	None	8	1

The timeout time was 250ms for each frame interval.

7.5.2 Description of communication protocol commands

Note: "\n" represents a newline, corresponding to the hexadecimal number 0x0A. After the setup command configuration is successful, the configuration will be saved in Flash, and no reconfiguration is needed to restart the power outage.

The command error response is as follows:

Command error response	Description
This AT cmd is error\n	Instruction error
This AT cmd is no exist\n	Instruction does not exist
This AT cmd is exist,but not allow to operate\n	Instructions exist but are not allowed to operate
This AT cmd is exist,but value is error\n	Incoming parameter error

7.5.2.1.Read the real spatio-temporal height

Unit: Meter (m)

	Instruction	Description
Send	AT+REALAIRHEIGHT\n	Read the real spacetime height
Reply	REALAIRHEIGHT=2.212m\n	The current real spacetime height is 2.212 meters

Reply	REALAIRHEIGHT=OutOfRange\n	Out of range
Reply	REALAIRHEIGHT=InBlindZone\n	The sensor is in the blind area
Reply	REALAIRHEIGHT=LackEnergy\n	The echo energy is insufficient

7.5.2.2.Read the real-time level

Unit: Meter (m)

The calculation method of the level is: installation height - air height

	Instruction	Description
Send	AT+REALWATERDEPTH\n	Read real-time level
Reply	REALWATERDEPTH=7.789m	The current real-time level is 7.789 meters
Reply	REALWATERDEPTH=OutOfRange\n	Out of range
Reply	REALWATERDEPTH=InBlindZone\n	The sensor is in the blind area
Reply	REALWATERDEPTH=LackEnergy\n	The echo energy is insufficient
Reply	REALWATERDEPTH=No Set InstallHeight\n	The installation height is not set

7.5.2.3.Water depth at installation

Unit: Meter (m)

Note: Setting the water depth during installation is used to calculate the installation height (installation height = water depth during installation + empty height during installation). The installation height is then used to calculate the liquid level data (real-time liquid level = installation height - real-time empty height). When setting the water depth during installation, the installation height is automatically calculated and saved to the configuration. When the sensor is in an abnormal state (such as a blind zone), the installation height cannot be calculated, and setting the water depth during installation will be invalid.

Read the water depth at installation:

	Instruction	Description
Send	AT+INSTALLWATERDEPTH\n	Read the water depth at installation
Reply	INSTALLWATERDEPTH=4.60m\n	Water depth at installation is 4.60 meters

Set the water depth at the time of installation:

	Instruction	Description
Send	AT+INSTALLWATERDEPTH=4.6\n	Water depth is set to 4.6 m during installation
Reply	AT+INSTALLWATERDEPTH=4.6\n OK\n	Operation successful

7.5.2.4.Height of installation

Unit: Meter (m)

Note: Set the mounting height, which is used to calculate the level. Real-time level = installation height - real time height. At the same time, installation height = water depth at installation + height at installation time. Therefore, when setting the installation height, the water depth during installation will be automatically calculated and saved to the configuration. When the sensor is in an abnormal state (such as a blind zone), the installation height can also be set. In this case, the water depth parameter at the time of installation cannot be calculated and recorded. The default value is 0, but it does not affect the calculation of the liquid level.

Read mounting height:

	Instruction	Description
Send	AT+INSTALLHEIGHT\n	Read mounting height
Reply	INSTALLHEIGHT=9.72m\n	Water depth at installation is 9.72 meters

Set mounting height:

	Instruction	Description
Send	AT+INSTALLHEIGHT=9.72\n	Set the installation height to 9.72 m
Reply	AT+INSTALLHEIGHT=9.72\n OK\n	Operation successful

Note: Setting the mounting height to 0 will clear the configuration for mounting height and water depth at installation.

7.5.2.5.Read the version number

	Instruction	Description
Send	AT+VERSION\n	Read version number
Reply	VERSION=20230908\n	The version number is 20230908

7.5.2.6.Read range

Unit: Meter (m)

	Instruction	Description
Send	AT+RANGE\n	Read range
Reply	RANGE=40.00m\n	The range is 40 meters

7.5.2.7.Read blind area

Unit: Meter (m)

	Instruction	Description
Send	AT+BLINDZONE\n	Read blind area
Reply	BLINDZONE=0.335m\n	The blind zone is 0.335 meters

7.5.2.8.Software reset (reboot)

	Instruction	Description
Send	AT+BOOT\n	Software reset
Reply	AT+BOOT\n OK\n	Operation successful

7.5.2.9.Factory data reset

	Instruction	Description
Send	AT+DEFAULT\n	Factory data reset
Reply	AT+DEFAULT\n OK\n	Operation successful

7.5.2.10.Frequency of acquisition

Unit: milliseconds (ms)

Note: The default acquisition frequency is 200ms, and the acquisition frequency can only be adjusted to 160ms at the earliest. (If the acquisition frequency jumps too fast, the speed of responding to the reply instructions will be slow, and the sending instructions may be incomplete, resulting in no response. In this case, the instruction can be sent again.)

Read acquisition frequency:

	Instruction	Description
Send	AT+COLLECTFREQ\n	Read acquisition frequency
Reply	COLLECTFREQ=200\n	The acquisition frequency is 200 ms/cycle

Set collection frequency:

	Instruction	Description
Send	AT+COLLECTFREQ=500\n	Set the acquisition frequency to 500 ms/cycle
Reply	AT+COLLECTFREQ=500\n OK\n	Operation successful

7.5.2.11.Baud rate

Read baud rate:

	Instruction	Description
Send	AT+BAUDRATE\n	Read baud rate
Reply	BAUDRATE=9600\n	The baud rate is 9600

Set baud rate

	Instruction	Description
Send	AT+BAUDRATE=115200\n	Set the baud rate to 115200
Reply	AT+BAUDRATE=115200\n OK\n	Operation successful

7.5.2.12.Calibration parameters

Unit: Millimeter (mm)

Real spatio-temporal height = sampling value -calibration parameter. Therefore, when the real space-time height is larger than a fixed value, it can be calibrated by adjusting the quasi-parameters.

Read calibration parameters:

	Instruction	Description
Send	AT+CALIBRATION\n	Read calibration parameters
Reply	CALIBRATION=16mm\n	The calibration parameter is 16mm

Setting calibration parameters:

	Instruction	Description
Send	AT+CALIBRATION=30\n	Set the calibration parameter to 30 mm
Reply	AT+CALIBRATION=30\n OK\n	Operation successful

7.5.2.13Automatic push cycle

Unit: milliseconds (ms)

Note: When the automatic push period is ≥ 300 ms, the sensor will automatically report the real-time data. Among them, when the installation height (or water depth during installation) is set, the real-time

data reported automatically is the real-time level; If the installation height is not set (or the water depth during installation), the real-time data reported automatically is the real time height.

Read the automatic push cycle:

	Instruction	Description
Send	AT+AUTOOUTDATA CYCLE\n	Read the automatic push cycle
Reply	AUTOOUTDATA CYCLE=100\n	Automatic push cycle is 100 ms (less than 200 ms, no automatic push data)

Set the automatic push cycle:

	Instruction	Description
Send	AT+AUTOOUTDATA CYCLE=200\n	Set the automatic push period to 200 ms
Reply	AT+AUTOOUTDATA CYCLE=200\n OK\n	Operation successful

7.5.2.14. Automatic Push Protocol Type

Note: The sensor will automatically push data when the automatic push period is ≥ 160 ms. Otherwise, it will not push data automatically. Specifically, when an installation height (or water depth at installation) is set, the automatically reported real-time data is the real-time liquid level; if no installation height (or water depth at installation) is set, the automatically reported real-time data is the real-time air level.

There are two types of push protocols: 0—Modbus, 1—Text protocol.

Read the automatic push protocol type:

	Instruction	Description
Send	AT+PROTOCOLTYPE\n	Read the automatic push protocol type
Reply	PROTOCOLTYPE=0\n	Automatic push protocol type is 0—Modbus

Set the automatic push protocol type to text protocol:

	Instruction	Description
Send	AT+PROTOCOLTYPE=1\n	Set the automatic push protocol type to text protocol.
Reply	AT+PROTOCOLTYPE=1\n OK\n	Operation successful

7.5.2.15. Reference Installation Height

Unit: Meters (m)

Note: Setting a reference installation height is for convenient calculation of negative liquid level values (Reference Liquid Level = Reference Installation Height - Real-time Air Level).

Read Reference Installation Height:

	Instruction	Description
Send	AT+REFINSTALLHEIGHT\n	Read reference installation height
Reply	REFINSTALLHEIGHT=0m	No reference installation height set
Reply	REFINSTALLHEIGHT=1.00m	Reference installation height is 1m

Set installation height:

	Instruction	Description
Send	AT+REFINSTALLHEIGHT=1\n	Set the reference installation height to 1 meter
Reply	AT+REFINSTALLHEIGHT=1\n OK\n	Operation successful

7.5.2.16.Reference Liquid Level

Unit: meters (m)

Reference liquid level is calculated as: Reference installation height - Real-time air height = Reference liquid level.

Read the reference liquid level:

	Instruction	Description
Send	AT+REALREFWATERDEPTH\n	Read reference installation height
Reply	REALREFWATERDEPTH=0.200m	No reference installation height set
Reply	REALREFWATERDEPTH=No Set InstallHeight	Reference installation height is 1m