

# **Suspended Solids (Sludge Concentration) Sensor**

## **Operation Manual**



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## Chapter 1 Product Specifications

Specifications	Details
Size	Diameter 60mm* Length 256mm
Weight	1.65 KG
repeatability	±2%
resolution ratio	0.01~1 mg/L, It depends on different range
Main Materials	Main Body:SUS316L (Ordinary Version), Upper and Lower Cover: POM Cable: PUR
Waterproof Rate	IP68/NEMA6P
Measurement Range	0.01-20000 mg/L、 0.01-45000 mg/L 、 0.01-120000 mg/L
Indication Resolution	Less than ± 5% of the measured value (depending on sludge homogeneity)
Pressure Range	≤0.4Mpa
Flow velocity	≤2.5m/s、 8.2ft/s
Environment Temperature	0~45℃ (not freeze)
Calibration	Sample Calibration, Slope Calibration
Cable Length	Standard 10-Meter Cable, Max Length: 100 Meters
Power Supply	12 VDC
communication protocol	MODBUS RS485

### External Dimension:

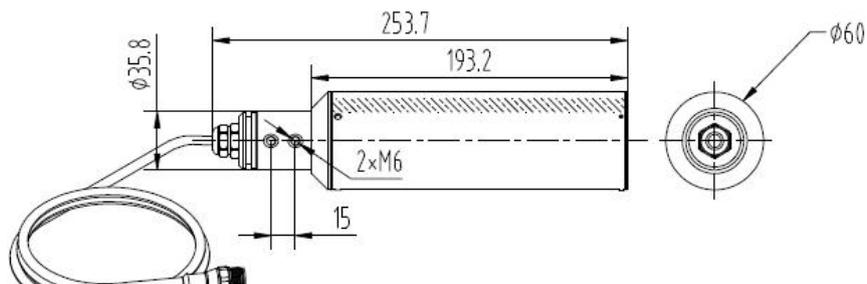


Table 1 Specifications of Suspended Solids (Sludge Concentration) Sensor

## Chapter 2 Product Overview

### 2.1 Product Information

SS(Sludge Concentration )sensor is based on the method of combination of infrared absorption scattered light. Infrared light which the photosource sends out scattered by suspended particles in the sample. And finally converted to electrical signals by photoelectric detector and getting the suspended solids concentration of the sample after treatment by analog and digital signals.

The product is widely used in sewage plant, water plant, water station, surface water, farming, industry and other fields.

### 2.2 Safety Information

Please read this manual completely before opening the package, installing or using. Otherwise it may cause personal injury to the operator, or cause damage to equipment.

#### Warning labels

Please read all labels and signs on the instrument, and comply with the security label instructions, otherwise it may cause personal injury or equipment damage.



When this symbol appears in the instrument, please refer to the operation or safety information in the reference manual.



While this symbol indicates an electric shock or risk of death from electric shock.

**Please read this manual completely. Pay particular attention to some notes or warnings, etc. To ensure that the protective measures provided by the equipment are not destroyed.**

## Chapter 3 Installation

### 3.1 Installation of Sensors

#### 3.1.1 Quick Dismantling pool side fixed installation

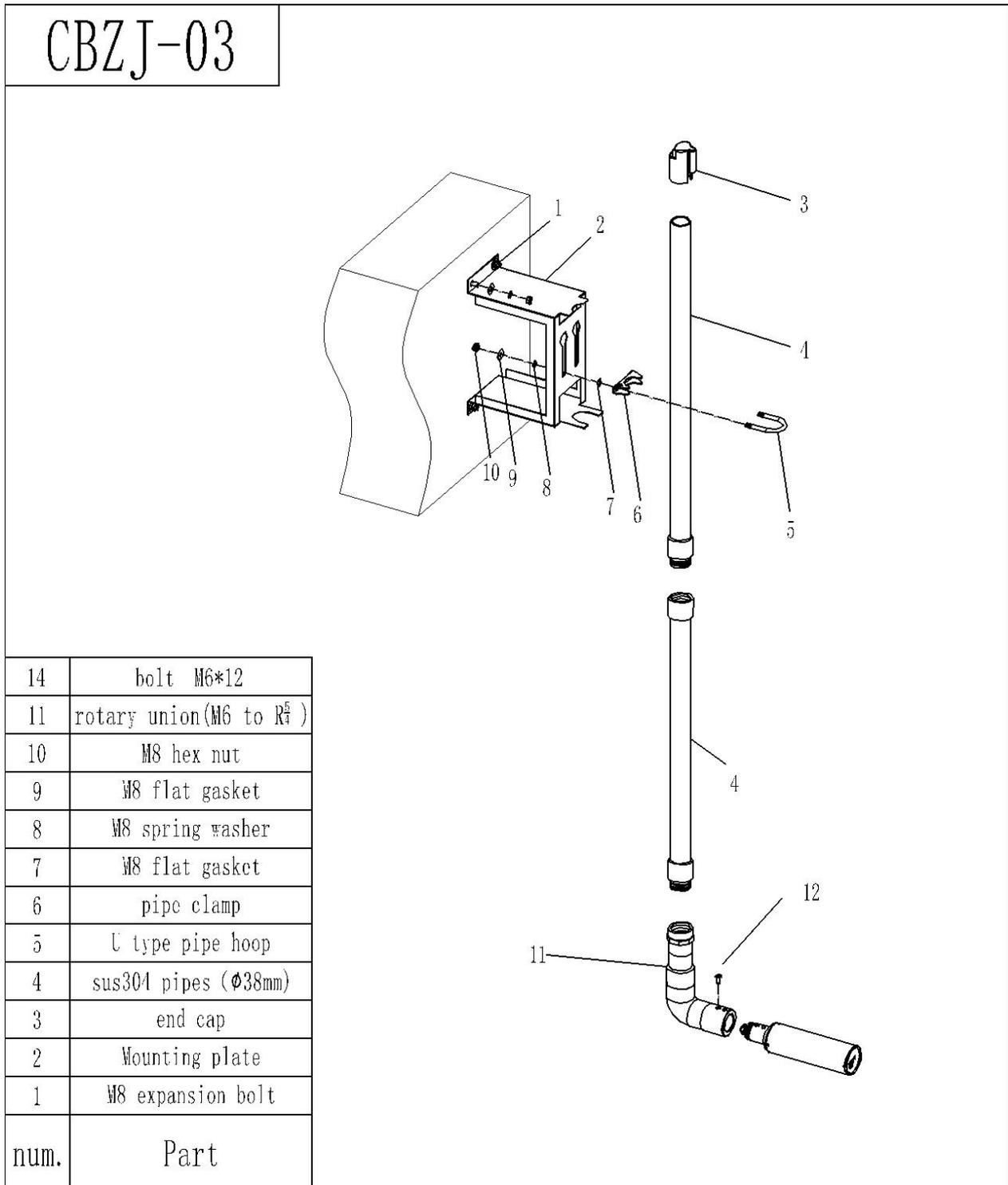


Figure 1 Quick Dismantling pool side installation sketch map

### 3.1.2 Classic pool side fixed installation

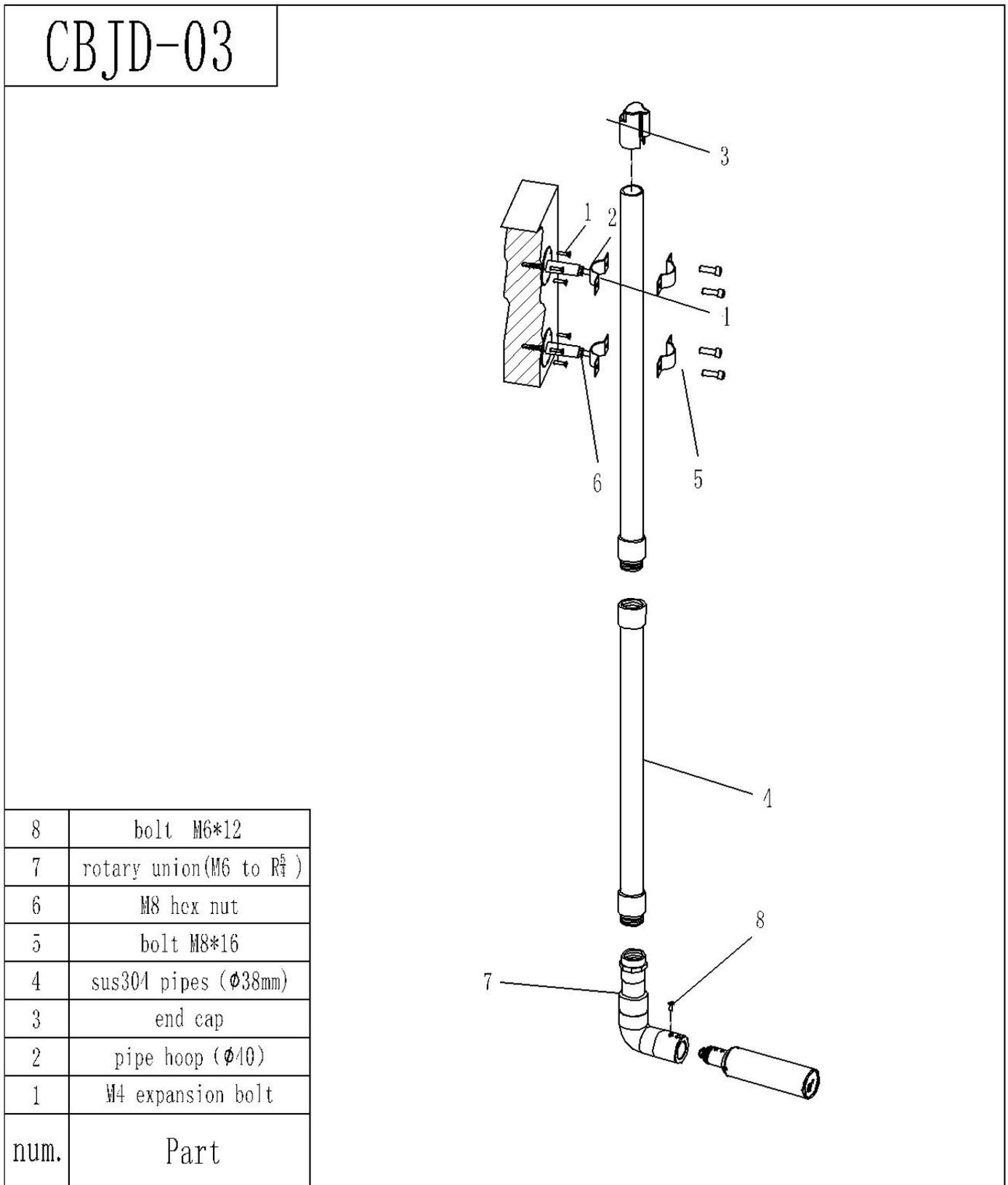


Figure 2 Classic pool side fixed installation sketch map

### 3.1.3 Railing fixed installation

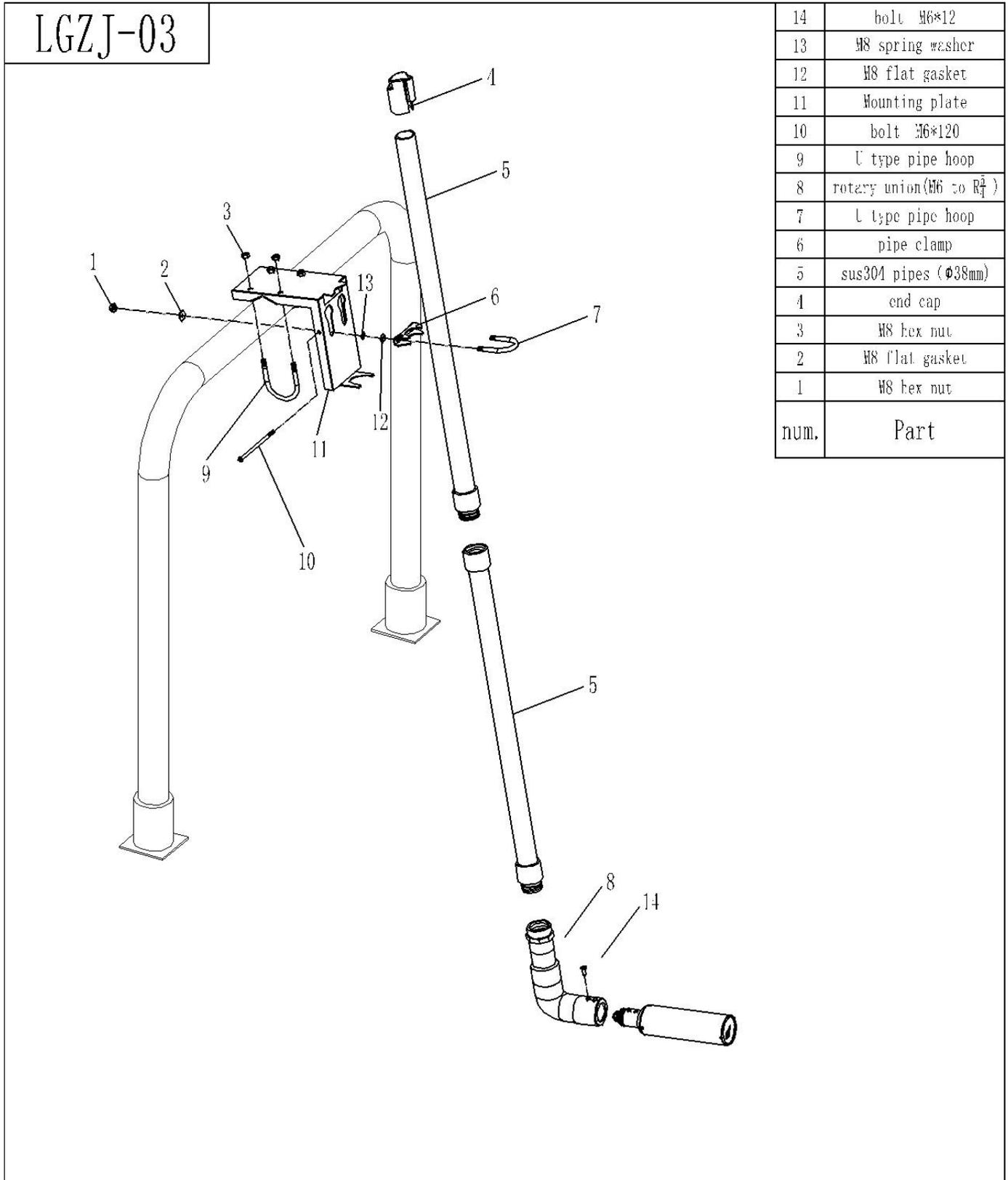


Figure 3 Railing fixed installation sketch map

## 3.2 Connection of Sensor

The sensor should be correctly connected by the following definition of wire core:

Serial No.	1	2	3	4	5
Sensor Cable	Brown	Black	Blue	White	Yellow+Green
Signal	+12VDC	AGND	RS485 A	RS485 B	Ground lead

# Chapter 4 Interface and Operation

## 4.1 User Interface

The sensor is connected to the computer using RS485 to USB, and then use Modbus Poll to connect

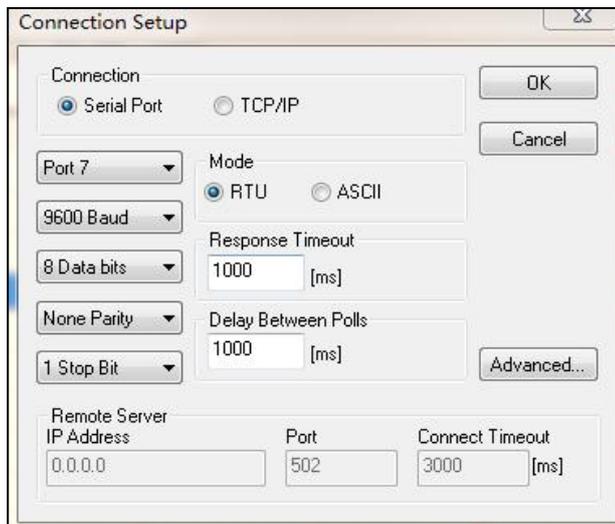
**Note: Modbus Poll software is a general software that can be downloaded online.**

## 4.2 Parameter Setting

1. Click "Setup" on the menu bar, select "Read / Write Definition", and then click "OK" according to the parameters shown below.

**Note:** The default initial Slave ID is 1, and after the slave address is changed, the new address will be used for communication and the slave address for the next time connection is also the most recently changed address.

2. Click "Connection" on the menu bar, select the first line in the drop-down menu "Connection setup", set it as shown below, and click "OK".



**Note:** Port7 means USB representing the COM port on the computer.

**Note:** If the sensor has been connected as described, and "No Connection" appears on the software "Display status", it means that the connection is failed; remove and replace the USB port or check the USB to RS485 converter, repeat the above procedure until the sensor connection is successful.

## Chapter 5 Calibration of Sensor

There are 3 kinds of calibration methods for the sensor, but only one type is valid. Which calibration mode is used depends on the actual needs of the site. For the selection method, see the communication protocol.

The specific calibration can be carried out according to the following steps.

Note: Curve calibration is used as the base calibration and coexists with the other three calibration modes.

### 5.1 Factor calibration

Factor calibration of suspended solids (sludge concentration) requires the use of suspended solids standards solution. **The specific steps are as follows:**

If there is a large deviation between the measured value and the standard value, the slope of calibration curve needs factor correction.

1. Connect the sensor to the Modbus software;
2. Set the relevant parameters and wipe the sensor;
3. Slowly immerse the sensor into the suspended solids (sludge concentration) standard solution;
4. Wait for the value to be stable and record the stable value;
5. Calculate the correction factor. The correction factor equals to the standard solution value divided by the value measured in the fourth step. (Factor = standard solution value / stable value)
6. Enter the calculated correction factor in the corresponding register to complete the calibration.

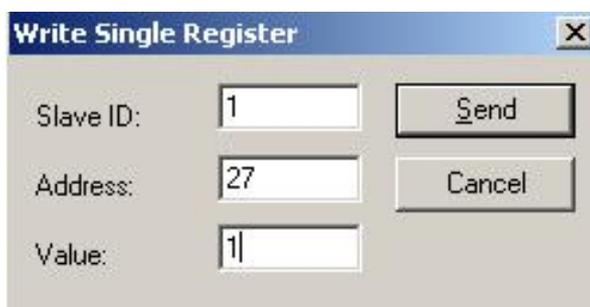
**Note:**

1. **During the process of calibration, make sure the lens of probe is 15cm far from the bottom of calibration cup,**
2. **No bubbles in front of the lens, meanwhile,**
3. **It is recommended to keep the correction cup away from the light.**

## 5.2 Two-point calibration

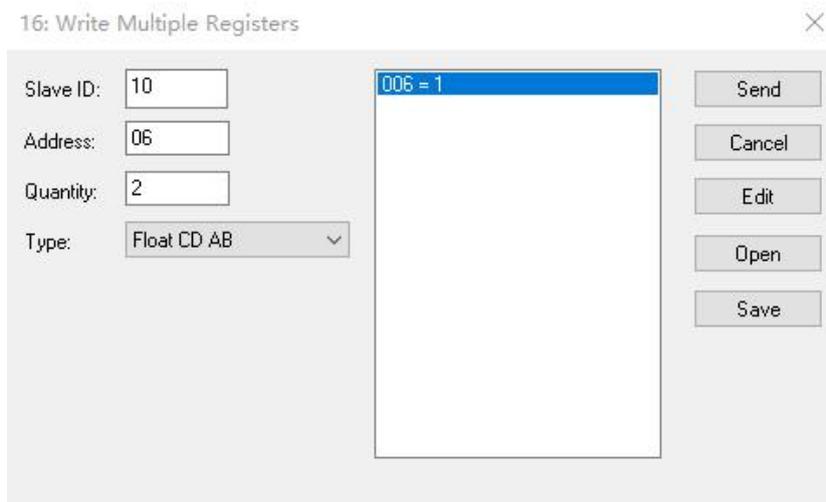
Two-point calibration of suspended solids (sludge concentration) requires the use of suspended solids standards solution. **The specific steps are as follows:**

1. Connect the sensor to the Modbus software;
2. Prepare the two suspension standards required for two-point calibration and wipe the sensor clean;
3. Select “06” in the menu bar to enter “27” for Address and “1” for Value, and then click “Send”, as shown below;



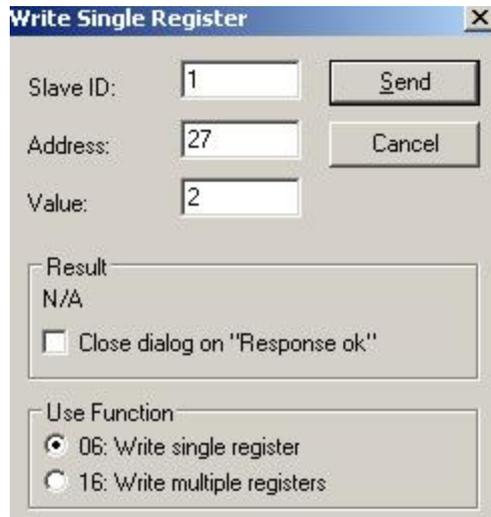
4. Select “16” in the menu bar to enter “06” for Address, “2” for Quantity, and change to “Float CD AB” for “Type”. Double-click the value that pops up on the right to enter “1” for “Value”. Click "OK",

then click "Send" as shown below;



5. Slowly immerse the sensor into the first suspension standard solution, record the first standard value and measurement value, clean and wipe clean. Slowly immerse the sensor into the second suspension standard solution. record the second standard value and measurement value,

6. Select "06" in the menu bar to enter "27" for Address and "2" for Value, and then click "Send", as shown below;



7. Select "06" in the menu bar to enter "28" for Address and "1" for Value in the dialog, and then click "Send", as shown below;



8. Select "16" in the menu bar to enter "20" for Address, "2" for Quantity, and "Float CD AB" for

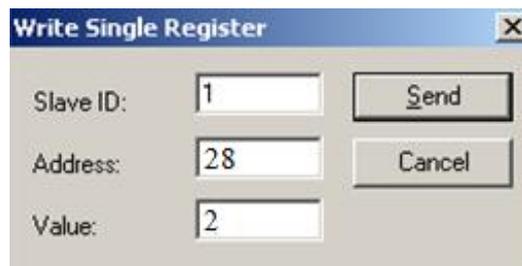
Type. Double-click the value that pops up on the right to enter Value as "1st. Standard value", click "OK", then click "Send", as shown below;



9. Select "16" in the menu bar to enter "22" for Address, "2" for Quantity, and "Float CD AB" for Type. Double-click the value that pops up on the right to enter Value as "1st. Standard measurement value", click "OK", then click "Send", as shown below, clean and wipe the sensor;

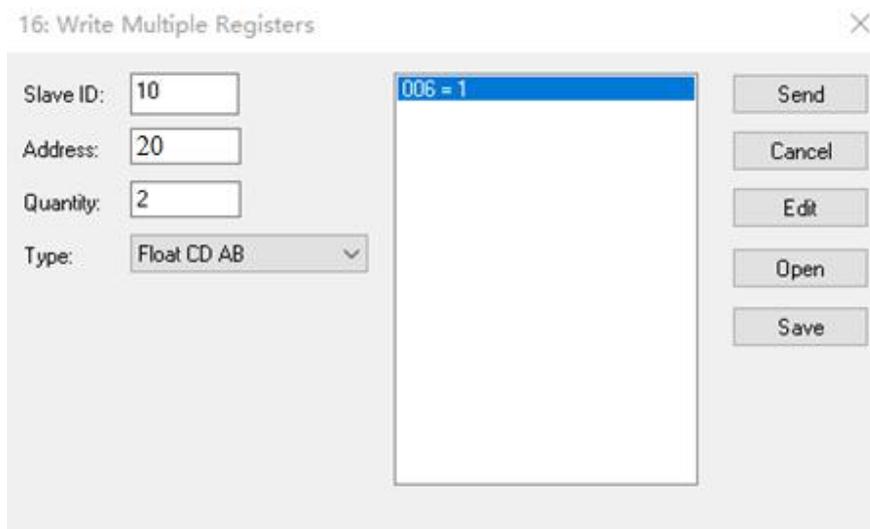


10. Select "06" in the menu bar to enter "28" for Address and "2" for Value, and then click "Send", as shown below;

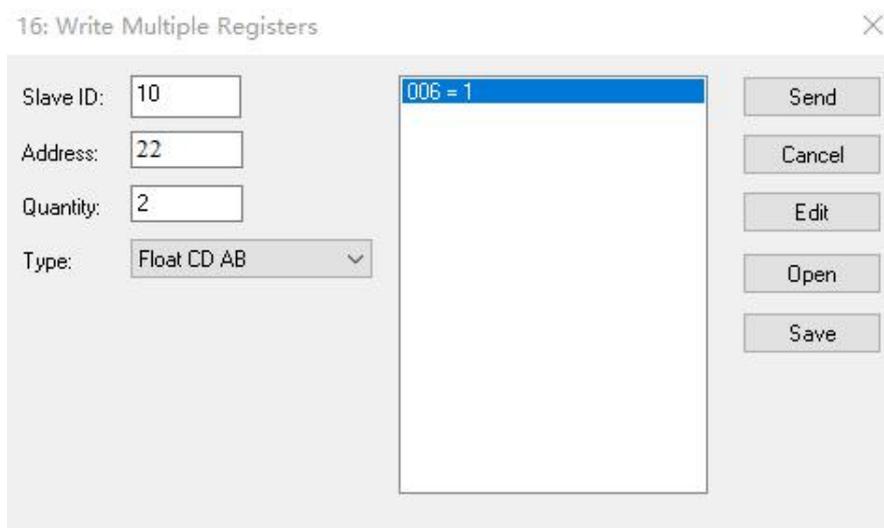


11. Select "16" in the menu bar to enter "20" for Address in the dialog box, "2" for Quantity, and

“Float CD AB” for Type. Double-click the value that pops up on the right to enter “Value 2 Standard value”, click "OK", then click "Send", as shown below;



12. Select “16” in the menu bar to enter “22” for Address, “2” for Quantity, and “Float CD AB” for Type. Double-click the value that pops up on the right to enter “Value 2”. “Standard measurement value”, click “OK”, then click “Send”, as shown below,



13. After the calibration is complete, remove the sensor and clean it.

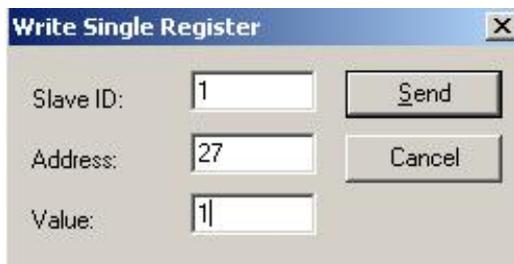
### 5.3 Four-point calibration

Four-point calibration of suspended solids (sludge concentration) requires the use of suspended solids standards solution. **The specific steps are as follows:**

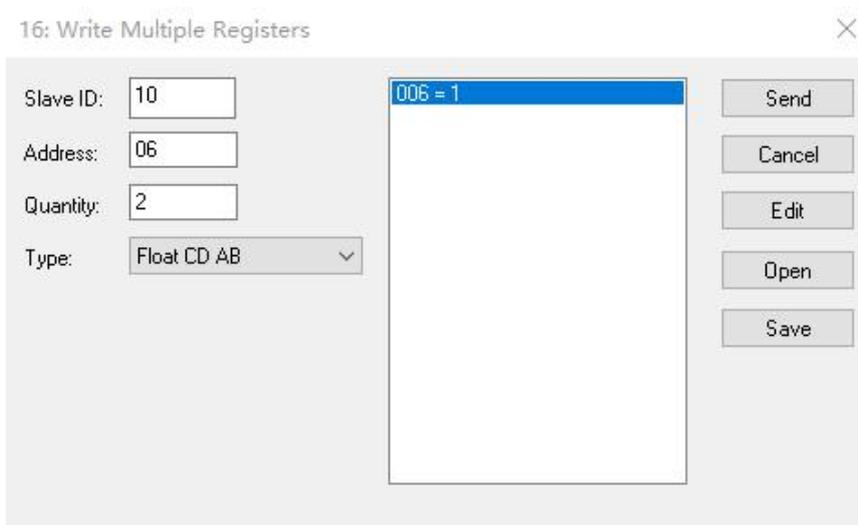
1. Connect the sensor to the Modbus software;
2. Prepare the four suspension standards required for four-point calibration and wipe the sensor

clean;

3. Select “06” in the menu bar to enter “27” for Address and “1” for Value, and then click “Send”, as shown below;



4. Select “16” in the menu bar to enter “06” for Address, “2” for Quantity, and change to “Float CD AB” for “Type”. Double-click the value that pops up on the right to enter “1” for “Value”. Click "OK", then click "Send" as shown below;

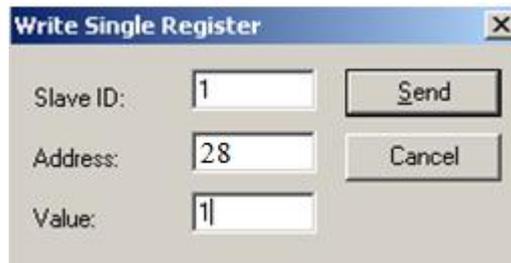


5. Slowly immerse the sensor into the first suspension standard solution, record the first standard value and measurement value, clean and wipe clean. Slowly immerse the sensor into the second suspension standard solution. record the second standard value and measurement value, clean and wipe clean; slowly immerse the sensor into the third suspension standard solution, record the third standard value and measured value of the standard solution, cleaned and wiped clean; slowly immerse the sensor into the 4th suspension standard solution, record the 4th standard value and measurement value, clean and wipe clean;

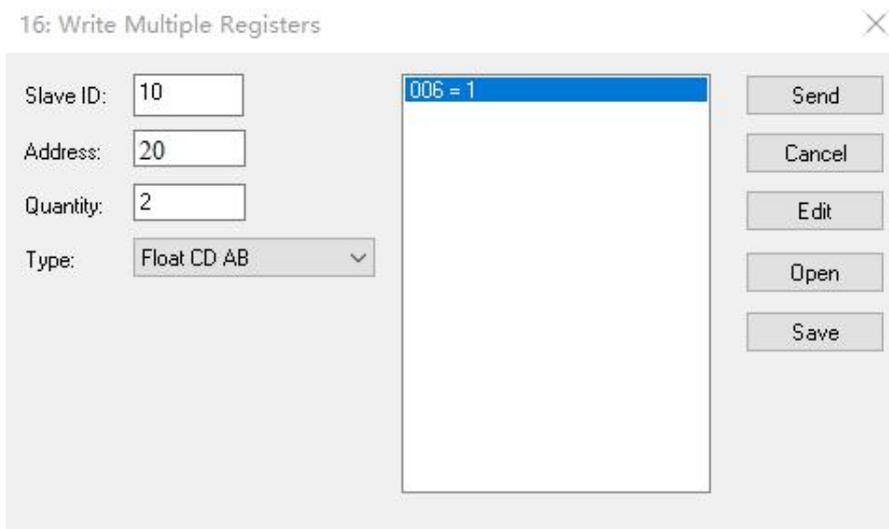
6. Select “06” in the menu bar to enter “27” for Address and “3” for Value, and then click “Send”, as shown below;



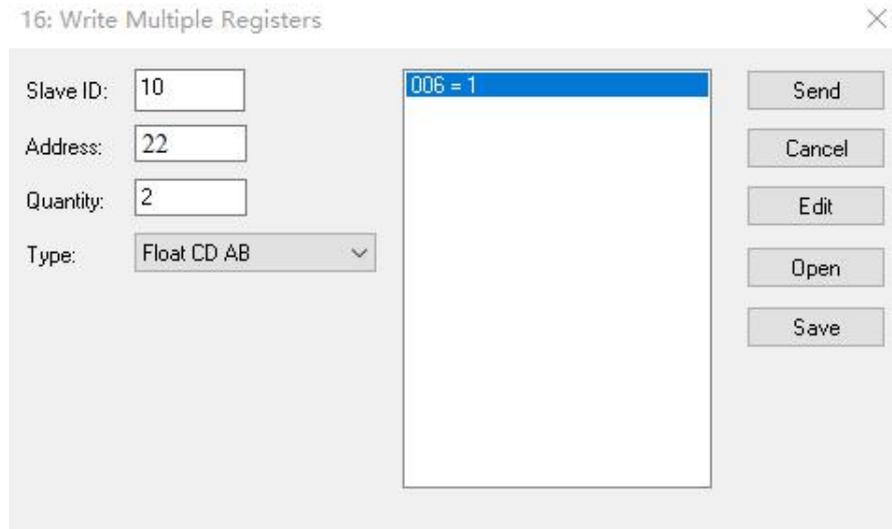
7. Select “06” in the menu bar to enter “28” for Address and “1” for Value in the dialog, and then click “Send”, as shown below;



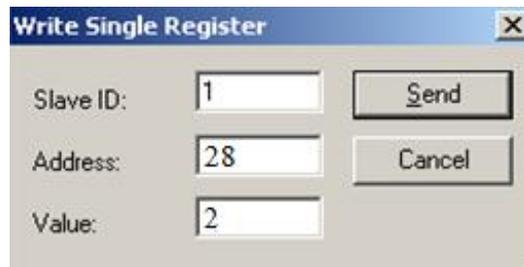
8. Select “16” in the menu bar to enter “20” for Address, “2” for Quantity, and “Float CD AB” for Type. Double-click the value that pops up on the right to enter Value as “1st. Standard value”, click "OK", then click "Send", as shown below;



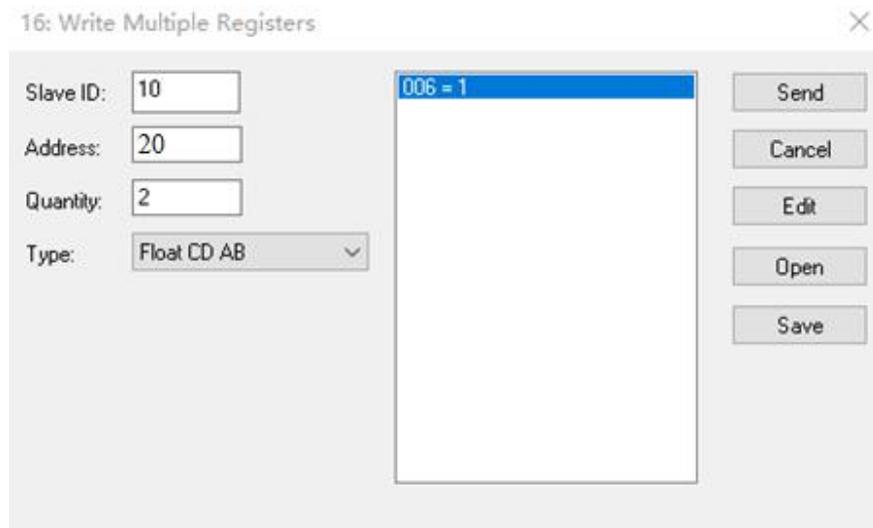
9. Select “16” in the menu bar to enter “22” for Address, “2” for Quantity, and “Float CD AB” for Type. Double-click the value that pops up on the right to enter Value as “1st. “Standard measurement value”, click “OK”, then click “Send”, as shown below, clean and wipe the sensor;



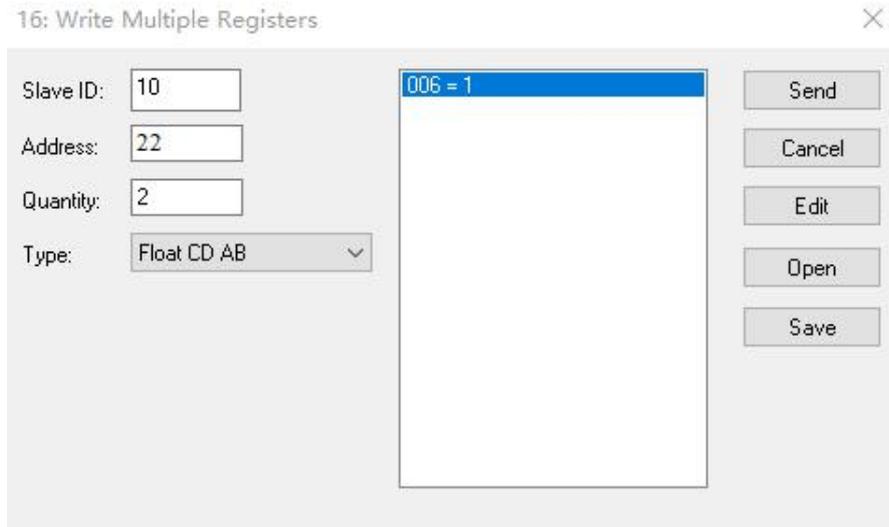
10. Select “06” in the menu bar to enter “28” for Address and “2” for Value, and then click “Send”, as shown below;



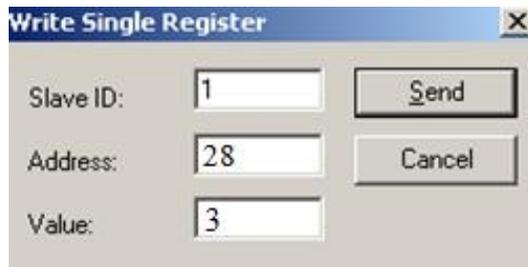
11. Select “16” in the menu bar to enter “20” for Address in the dialog box, “2” for Quantity, and “Float CD AB” for Type. Double-click the value that pops up on the right to enter “Value 2 Standard value”, click "OK", then click "Send", as shown below;



12. Select “16” in the menu bar to enter “22” for Address, “2” for Quantity, and “Float CD AB” for Type. Double-click the value that pops up on the right to enter “Value 2”. “Standard measurement value”, click “OK”, then click “Send”, as shown below, clean and wipe the sensor;



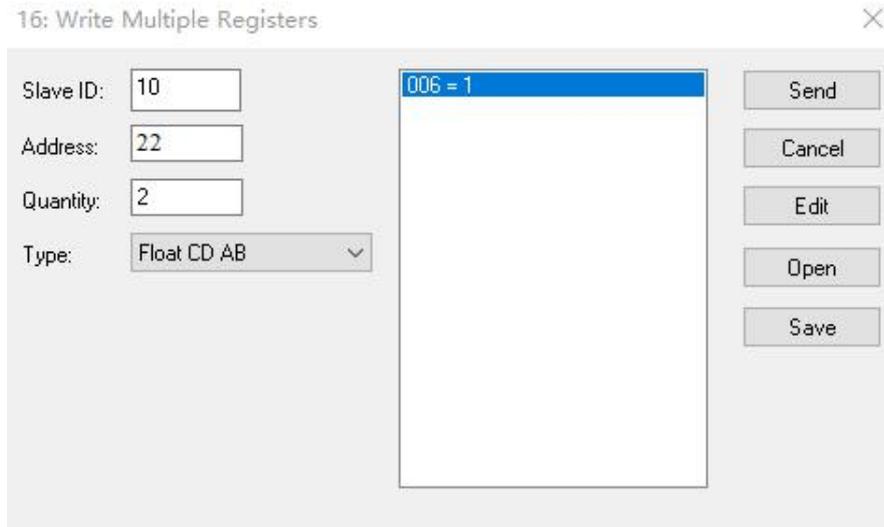
13. Select "06" in the menu bar to enter "28" for Address, "3" for Value, and then click "Send", as shown below.



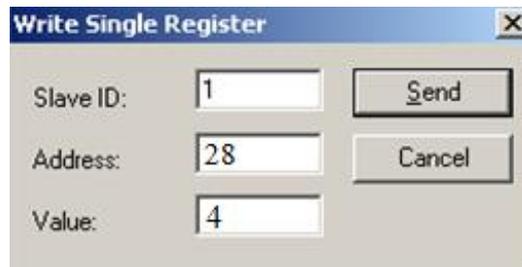
14. Select "16" in the menu bar to enter "20" for Address, "2" for Quantity, and "Float CD AB" for Type. Double-click the value that pops up on the right to enter "Value 3". "Standard value", click "OK", then click "Send", as shown below;



15. Select "16" in the menu bar to enter "22" for Address, "3" for Quantity, and "Float CD AB" for Type. Double-click the value that pops up on the right to enter "Value 3". "Standard measurement value", click "OK", then click "Send", as shown below, clean and wipe the sensor;



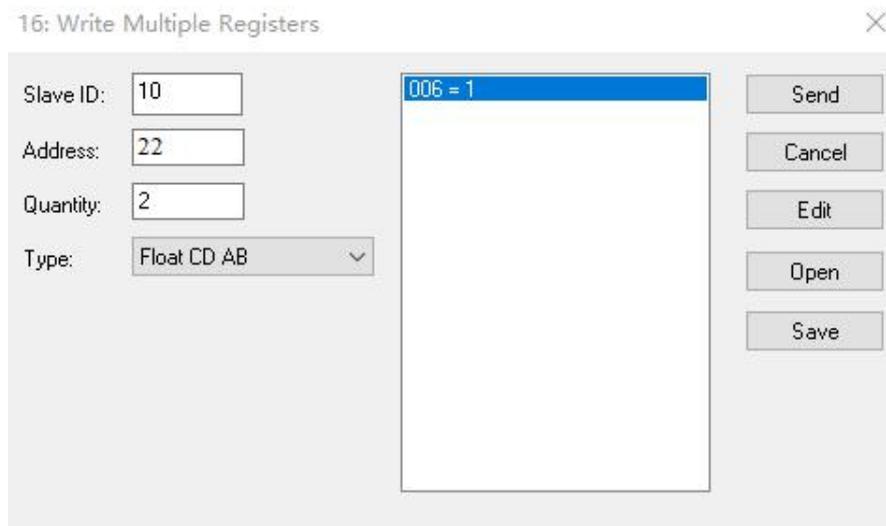
16. Select "06" in the menu bar to enter "28" for Address, "4" for Value, and then click "Send", as shown below.



17. Select "16" in the menu bar to enter "20" for Address, "4" for Quantity, and "Float CD AB" for Type. Double-click the value that pops up on the right to enter "Value 4". "Standard measurement value", click "OK", then click "Send", as shown below, clean and wipe the sensor;



18. Select "16" in the menu bar to enter "22" for Address, "4" for Quantity, and "Float CD AB" for Type. Double-click the value that pops up on the right to enter "Value 4". "Standard measurement value", click "OK", then click "Send", as shown below, clean and wipe the sensor;



19. After the calibration is complete, remove the sensor and clean it.

## 5.4 Curve calibration

Suspension (sludge concentration) calibration requires the use of turbidity standards solution. **The specific steps are as follows:**

If you enter the curve calibration, you must perform the calibration action until step 6, otherwise the sensor will be in the calibration mode all the time. If the normal measurement cannot be performed, you can choose to restart after power failure or perform step 7.

1. Connect the sensor to the Modbus software;
2. After setting the parameters according to Section 4.2, select the second column and the last column and right click and select “Format” , click “Float CD AB” and wipe the sensor;
3. Select “16”, then enter “06” for Address in the dialog box, “2” for Quantity, and change type into “Float CD AB” . Double-click the up on the right to enter “1” for the value. Click "OK", then "Send" as shown below;



Select “06” ,enter “13” for Address and “1” for Value ,click “Send” as shown below;

Tx = 71: Err = 1: ID = 10: F = 03: SR = 1000ms

	Alias	00000	Alias	00010	Alias	00020
0		1.36362		0		
1		--		60		
2		0		1		
3		--		1		
4		1		0		
5		--		0		
6		0		9600		
7		--		10		
8		0		221		
9		--		1373		

Write Single Register

Slave ID:

Address:

Value:

Result: N/A

Close dialog on "Response ok"

Use Function

06: Write single register

16: Write multiple registers

Select “16” ,enter “04” for Address and “2” for Quantity, and change type into “Float CD AB” . Double-click the up on the right to enter “1” for the value, click “ OK", then click "Send" to start calibration.

1. Enter calibration mode, select “06” ,enter “59” for Address in the dialog box, enter “66” for Value, and click “Send” ;
2. Change the Value to "1" and place the sensor in distilled water. After a while, click "Send";
3. Then change the Value to "2", wait for the value in the red box below the figure to be less than 17 and stabilize for a period of time, click "Send" to close the dialog box;

## Suspended Solids (Sludge Concentration) Sensor Operation Manual

Tx = 352: Err = 1: ID = 10: F = 03: SR = 1000ms

	Alias	00000	Alias	00010	Alias	00020
0		0		0		287.055
1		--		60		
2		0		1		9.05689
3		--		1		
4		1		0		0
5		--		0		--
6		0		9600		0
7		--		10		--
8		0		221		0
9		--		1373		--

Write Single Register ✕

Slave ID:  Send

Address:  Cancel

Value:

Result  
Response ok  
 Close dialog on "Response ok"

Use Function  
 06: Write single register  
 16: Write multiple registers

4. Select “16”, enter “30” for Address, and “2” for Quantity. Change the Type to “Float CD AB” and double-click the value popped on the right to enter the value into the “known label”. Liquid value (500-1000NTU)", click "OK", then click "Send";

5. Select “06”, enter “59” and “3” for value. Put the sensor into the standard solution. After a period of time, wait until the value and input in the red box below the value is close and stable, click "Send", then change the Value to "4", click "Send", the calibration is completed;

Tx = 273: Err = 1: ID = 10: F = 03: SR = 1000ms

	Alias	00000	Alias
0		698.771	
1		--	
2		0	
3		--	
4		1	
5		--	
6		0	
7		--	
8		0	
9		--	

Write Single Register ✕

Slave ID:  Send

Address:  Cancel

Value:

Result  
Response ok  
 Close dialog on "Response ok"

Use Function  
 06: Write single register  
 16: Write multiple registers

6. After the calibration is completed, select “06”. Enter the “13” and “2” for value, and click “Send” .

7. If the customer wants to quit the calibration during the calibration or for other reasons, send the following command Address to enter "59" and Value to enter "33".

**Note: If the calibration of Method 4 is inaccurate, it is recommended to use Method 1 to calibrate again.**

## Chapter 6 Communication Protocol

The sensor is equipped with MODBUS RS485 communication function, please refer to this manual section 3.2 to check the communication wiring . The default baud rate is 9600, the specific MODBUS RTU table is shown in the following table.

MODBUS-RTU	
<b>Baud Rate</b>	4800/9600/19200/38400
<b>Data Bits</b>	8 bit
<b>Parity Check</b>	no
<b>Stop Bit</b>	1bit

Register Name	Address Location	Read/Write	Data Type	Length	Descriptions
Suspended solids/sludge concentration	13	RW	Int	2	It should be 2, otherwise, it should be changed to 2.
Suspended solids /sludge concentration Value	2	OR	Float	2	0-Range
Suspended solids/sludge concentration Factor	6	RW	Float	2	0.1-10
Brushing Time	11	OR	Int	1	
Manual Brushing Order	20	W	Int	1	Send 66
Automatic Brushing Order	21	W	Int	1	Sending Intervals (1、 5、 15、 30、 60 (1h)、 240 (4h)、 720 (12h)、 1440 (1D)、 4320 (3D)、 10080 (7D) unit: min)
Response Time	12	RW	Int	1	1-60s

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Probe Humidity	14	OR	Int	1	It is recommended to be less than 10 (Greater than 10 indicates that the sensor may have been flooded)
Probe Baud Rate	16	RW	Int	1	0 stands for 4800 1 stands for 9600 2 stands for 19200 3 stands for 38400
Probe Slave Address	17	RW	Int	1	1-254
Serial No. 1	18	OR	Int	1	First 4 numbers of Serial No.
Serial No. 2	19	OR	Int	1	Last 4 numbers of Serial No.
<b>Calibration Mode</b>					
<b>Factor Calibration (use of suspended solids standards solution)</b>					
Step 1	27	W	Int	1	Send 1 (1 stands for the sensor enable factor correction mode)
<b>Two-point Calibration (use of suspended solids standards solution)</b>					
Step 1	27	W	Int	1	Send 2(2 stands for the sensor enable two-point calibration mode)
the First Point Calibration					
Step 1	28	W	Int	1	Send 1(1 stands for the First Point)
Step 2 Set Target Value	20	W	Float	2	Send Target Value
Step 3 Set Actual Value	22	W	Float	2	Send
the Second Point Calibration					
Step 1	28	W	Int	1	Send 2(2 stands for the Second Point)
Step 2 Set Target Value	20	W	Float	2	Send Target Value

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Step 3 Set Actual Value	22	W	Float	2	Send
<b>Four-point Calibration (use of suspended solids standards solution)</b>					
Step 1	27	W	Int	1	Send 3(3 stands for the sensor enable four-point calibration mode)
the First Point Calibration					
Step 1	28	W	Int	1	Send 1(1 stands for the First Point)
Step 2 Set Target Value	20	W	Float	2	Send Target Value
Step 3 Set Actual Value	22	W	Float	2	Send
the Second Point Calibration					
Step 1	28	W	Int	1	Send 2(2 stands for the Second Point)
Step 2 Set Target Value	20	W	Float	2	Send Target Value
Step 3 Set Actual Value	22	W	Float	2	Send
the Third Point Calibration					
Step 1	28	W	Int	1	Send 3(3 stands for the Third Point)
Step 2 Set Target Value	20	W	Float	2	Send Target Value
Step 3 Set Actual Value	22	W	Float	2	Send
the Fourth Point Calibration					
Step 1	28	W	Int	1	Send 4(4 stands for the Fourth Point)
Step 2 Set Target Value	20	W	Float	2	Send Target Value
Step 3 Set Actual Value	22	W	Float	2	Send
<b>Curve Calibration (use of turbidity standards solution)</b>					

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Step 1	13	W	Int	1	Send 1 (1 means switch sensor status, ready for calibration)
Step 2	59	W	Int	1	Send 66 (66 means enter calibration mode)
Step 3	59	W	Int	1	Send 1 (1 means ready to calibrate 0 points)
Step 4	59	W	Int	1	Send 2 (2 means calibration 0 point)
Step 5	30	W	Float	2	Write the 2nd point standard value (500-1000NTU)
Step 6	59	W	Int	1	Send 3 (3 means ready to calibrate point 2)
Step 7	59	W	Int	1	Send 4 (4 means calibration point 2)
Step 8	13	W	Int	2	Send 2 (2 means switch sensor status, enter normal measurement)
Step 9	59	W	Int	1	Send 33 (33 to exit calibration mode)

## Chapter 7 Maintenance

In order to obtain the best measurement results, it is very necessary to maintain the sensor regularly. Maintenance mainly includes cleaning, inspecting damage of the sensor, and periodic calibration. You can also view the sensor's status during maintenance and inspection.

## 7.1 Sensor Cleaning

Both the two lenses on the sensor need to be cleaned and maintained regularly to ensure the accuracy of the measurement on the basis of actual use. Wash with clean water, then wipe with a cleanser and rag to remove stubborn stains.

## 7.2 Inspection on the Damage of Sensor

Check the appearance of the sensor to see whether there is damage, if it's damaged, please contact to the after-sales service center in time for replacement to prevent malfunction of sensor caused by water due to the damage.

## 7.3 Sensor Blade Replacement

It is recommended that the blade of the sensor should be replaced quarterly with a new rubber one, the specific steps are as follows:



- 1.The position of the blade is shown on the left picture;
- 2.Remove the screws on the blade with the corresponding screwdriver;
- 3.Remove the blade, take out the rubber sheet inside, and replace it with a new one;
- 4.Finally put the blade back, and fasten the screw and blade with a screwdriver.

## Chapter 8 Special Description

The optional self-cleaning brush is motor-driven. In order to avoid the internal motor gear, please don't move the brush with hand. The warranty doesn't include the malfunction/damage caused by manually moving of the brush.