

PH3500 pH/ORP Controller / Transmitter

Operating Manual



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15、 pH buffer corresponding temperature value

温度 (°C)	pH4.01	pH6.86	pH9.18	pH4.00	pH7.00	pH10.01
0	4.01	6.98	9.47	4.01	7.12	10.32
5	4.01	6.95	9.38	4.00	7.09	10.25
10	4.00	6.92	9.32	4.00	7.06	10.18
15	4.00	6.90	9.27	4.00	7.04	10.12
20	4.00	6.88	9.22	4.00	7.02	10.06
25	4.01	6.86	9.18	4.00	7.00	10.01
30	4.01	6.85	9.14	4.01	6.99	9.97
35	4.02	6.84	9.10	4.02	6.98	9.93
40	4.03	6.84	9.07	4.03	6.97	9.89
45	4.04	6.83	9.04	4.04	6.97	9.86
50	4.06	6.83	9.01	4.06	6.97	9.83
55	4.08	6.83	8.99	4.07	6.97	9.81
60	4.10	6.84	8.96	4.09	6.98	9.79
70	4.12	6.85	8.92	4.12	6.99	9.76
80	4.16	6.86	8.89	4.16	7.00	9.74
90	4.20	6.88	8.85	4.20	7.02	9.73

14.3、 Storage

Keep the sensitive membrane moist at all times, store the electrode in the protective cap with 3M KCL solution, and prohibit the use of deionized water, distilled water, pure water, etc. to store the electrode. The electrode is not used for a long time, it is recommended to place it in a dry and dark place.

14.4、 Electrode aging

The pH electrode will age as the number of uses increases. As a result, the electrode response is slow and the slope gradually becomes smaller. In addition, wrong storage methods and specific media will shorten the life of the electrode. We do not provide warranty for electrode failure or mechanical damage caused by the test medium.

14.5、 Cleaning

If the electrode is unresponsive or slightly contaminated after use, the measuring part of the electrode can be cleaned according to the following methods:

Pollutants	Detergent
Inorganic metal oxide	Less than 1mol/L dilute acid
Organic fats and oils	Dilute detergent (weak alkaline)
Resin polymer substance	Alcohol, ether, acetone
Protein precipitate	5% pepsin+0.1mol/L HCL solution
Pigment substances	Dilute bleach, hydrogen peroxide

1、 User reminder

Thank you for your support to our company. Please read the instruction manual carefully before use to help you use our products correctly.

2、 Product inspection

Open the package carefully and check whether the instrument is damaged and the accessories are complete. If any abnormality is found, please contact the dealer or our company immediately.

Under any circumstance, do not disassemble the meter by yourself. If there is such behavior, our company will no longer be responsible for the warranty.

3、 Introduction

- 128*64 dot matrix LCD display, switchable between Chinese and English, IP65 protection level, reliable operation in any climate
- Concise menu design, simple and convenient operation, graphical prompt, beautiful and clear interface
- Digital filter is adjustable, and the hardware anti-interference ability is enhanced, which makes the measurement more stable and adapts to the complex industrial environment
- Power supply 85~260VAC, DC 18~36VDC can also be customized
- RS-485 digital interface, MODBUS - RTU communication protocol, read-write duplex communication, which can realize complete remote control of the instrument
- Two measurement functions: PH measurement or ORP (Redox) measurement
- With antimony electrode function, it can be used in hydrofluoric acid environment

4、 Technical Parameters

pH	range	-2.00~16.00 pH
	Resolution	0.01 pH
	Accuracy	±0.01 pH
	Input resistance	≥10 ¹² Ω
ORP	range	-2000~2000 mV
	Resolution	1 mV
	Accuracy	±1 mV
TEMP	range	-10.0~130.0 °C
	Resolution	0.1 °C
	Accuracy	±0.3 °C
	Input type	PT1000
	TEMP compensation	自动/手动
Transmission current	Output type	Two 4~20 mA (Corresponding range can be set)
	Accuracy	±1%FS
	Output load	Less than 500 Ω
Relay control	Function relay	1 (Can be set as cleaning or alarm function)
	Switch relay	2 SPST relays
	load capacity	2.5A 230VAC
data transmission	Transmission interface	1 RS485 Isolation voltage 2500Vrms
	Protocol	MODBUS-RTU (Read and write duplex communication)
Other parameters	Power supply	85~260VAC or 18~36VDC (User can order)
	Operating temperature	0~60°C
	Working humidity	Relative humidity < 90%
	Protection level	IP65
	Installation method	Dial installation
	Dimensions	(H×W×D) 108×108×132 mm
	Hole Size	92.5×92.5 mm (Positive tolerance)

14.2、 calibration

A) Make sure that the standard solution and the sample are at the same temperature. If it is not at the same temperature, it is recommended to use the temperature compensation setting;

B) The pH electrode generally adopts two-point calibration, two standard solutions, according to the commonly used measurement range, choose as follows:

Acid medium: pH4.01 & pH7.00 (USA) ; pH4.01 & pH6.86 (NIST)

Alkaline medium: pH10.01 & pH7.00 (USA) ; pH9.18 & pH6.86 (NIST)

C) Put the electrode into the first standard solution (pH7.00 or pH6.86) and stir gently, and wait for the pH value to stabilize, The first point of operating the instrument calibration;

D) Take out and clean the electrode (the second standard solution can be used to rinse the electrode), put the electrode into the second standard solution and stir gently, wait for the pH value to stabilize, and operate the meter to calibrate the second point;

E) When the second point of the pH meter is calibrated, take out and clean the electrode (using distilled water), and use absorbent paper towels to absorb the water droplets on the electrode's sensitive membrane. After calibration, the pH electrode can be used normally.

The electrode calibration period depends on the frequency of electrode use and the condition of the measuring medium. For measurements with average accuracy, it can be used for several weeks or longer after one calibration.

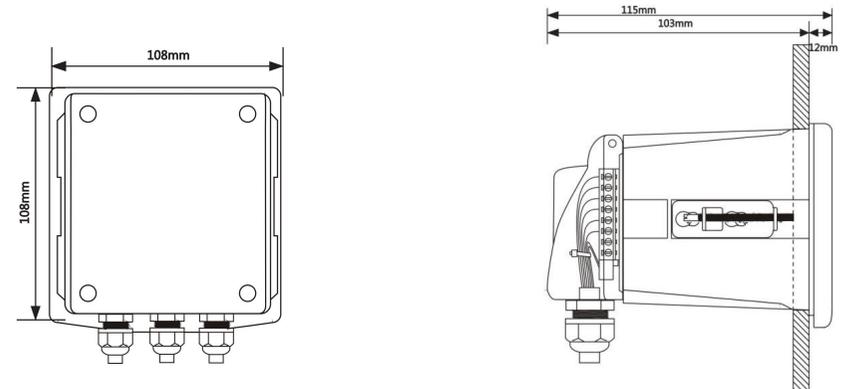
14、 Electrode use and maintenance

14.1、 Ready to work

- A) Before normal use, the electrode should have a good appearance, no damage, cleanliness and no pollution;
- B) Connect the electrodes;
- C) Remove the protective cap at the front of the pH electrode and rinse the electrode with distilled water;
- D) Use absorbent paper towels to absorb the water droplets on the electrode sensitive membrane (Please do not wipe the electrodes with paper towels to avoid electrostatic interference) ;
- E) Soak the pH electrode in a neutral standard solution for about 10 minutes;
- F) Calibrate and measure according to the instrument manual.

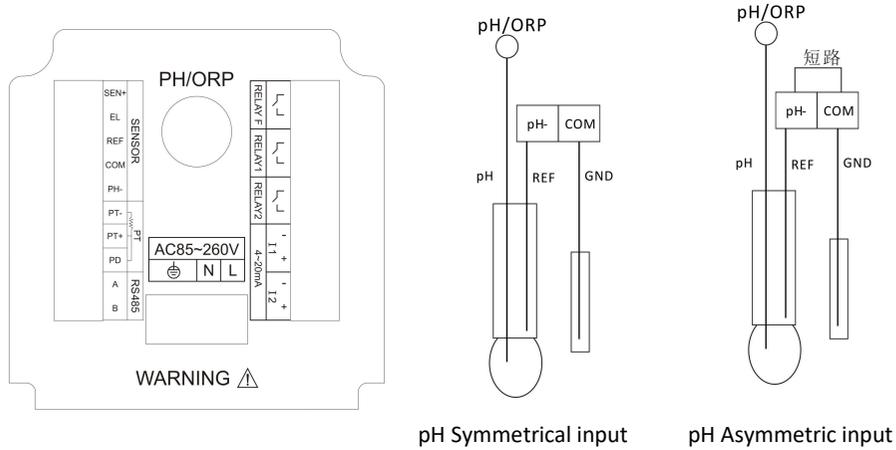
Note : If the electrode sensitive membrane becomes dry, soak the electrode in a neutral standard solution, It is best to soak in 3M KCL solution for 24 hours. During the transportation and storage of the electrode, a small amount of KCL will overflow the electrode protective cap and form white crystals, which can be washed directly with water.

5、 Installation method



1. Installation opening size 92.5×92.5mm (Positive tolerance)
2. It is recommended to use 0.5 to 1 square wire for the power cord, passing through the middle of the waterproof cable harness, and leaving a certain length allowance.

6、Wiring label



Terminals	Function	Terminals	Function
PH/ORP	pH/ORP sensor BNC connector	RELAY F	Function relay (flush/alarm)
SEN+	NC	RELAY1	Relay 1
EL	NC	RELAY2	Relay 2
REF	NC	I1-	4~20mA channel1, -
COM	Asymmetric mode short with PH-	I1+	4~20mA channel1, +
PH-	Symmetrical mode connect with REF sensor, Asymmetric mode short with COM	I2-	4~20mA channel2, -
PT-	PT1000 - (Wiring diagram)	I2+	4~20mA channel2, +
PT+	PT1000 +		GND
PD	PT1000 device	N	Power neutral
A	RS-485 T/R+	L	Power cord
B	RS-485 T/R-		

note: 1、 This wiring diagram uses 220V AC for illustration, If the user customized 24V DC, please pay attention to the power indicator label of the meter。

2、 The conventional electrode wiring method adopts asymmetrical input method, and uses symmetrical input method when encountering strong interference.。

13.10、 Unit code table

unit	Code hexadecimal	Code decimal	unit	Code hexadecimal	Code decimal
mV	0x00	0	ug/L	0x0D	13
nA	0x01	1	mg/L	0x0E	14
uA	0x02	2	g/L	0x0F	15
mA	0x03	3	ppb	0x10	16
Ω	0x04	4	ppm	0x11	17
KΩ	0x05	5	ppt	0x12	18
MΩ	0x06	6	%	0x13	19
uS/cm	0x07	7	mbar	0x14	20
mS/cm	0x08	8	bar	0x15	21
S/cm	0x09	9	mmHg	0x16	22
pH	0x0A	10			
℃	0x0B	11			
℉	0x0C	12			

13.9、Communication parameter setting

The contents of the instrument setting menu can be set through the communication function. They are all located in the holding register group and the control transmission register group. The holding register group is written with the 0x06 function code, and the control transmission register group uses the 0x10 function. Code writing, please refer to the corresponding section.

When setting these parameters, the instrument needs to be in the menu state of the setting mode. Therefore, in the measurement mode, first write the calibration mode code 0x0050 in the working mode register (address 64) to make the meter enter the setting mode.

If the password is not set (the password is 0000), the instrument directly enters the setting menu (the value of the work event register (address 66) is 1)

If the password has been set (the password is not 0000), the meter will display the password data interface (work event register (address 66) value is 0) at this time. The password can be written in the working mode parameter register (address 65), and the password is correct before entering the setting menu.

In the setting menu interface, the following values can be written to the working mode parameter register (address 65) to perform corresponding operations

0x7FFF: The instrument performs a factory reset operation

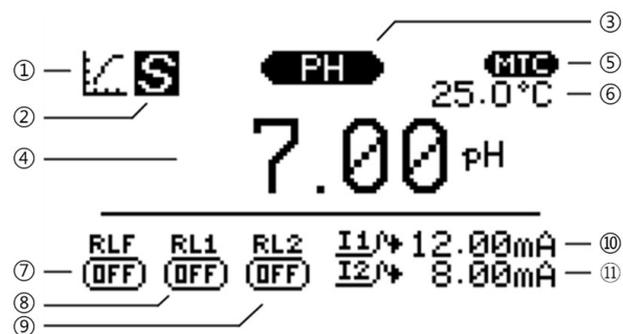
0x7FFE: The meter performs a restart operation

7、Key Description

KEY	Key function description
	In the measurement mode, press this key to enter the browse mode, and you can browse the measurement related values, Continue to press this key in the browse mode to browse until it returns to the measurement mode Press this key in other modes as the return key
	Press this key in measurement mode to enter calibration mode When there is a ▲ symbol in the menu interface, press this key to move up the options When the value is set, this key is the value up key
	Press this key in measurement mode to enter the setting menu When the menu interface has a ▼ symbol, press this key to move down the options When the value is set, this key is the value down key
	In the measurement mode, this key enters the information mode, continue to press this key to view the set parameters and instrument information When the menu interface has a □ symbol, press this key to switch to the next menu When setting the value, this key is the value shift key
	Press this key in browse mode to lock the current browsing interface (to prevent automatic return to measurement when browsing timeout) Press this key in other modes to confirm

8、 Measurement mode

After the meter is started, it enters the measurement mode and displays the main measurement parameters and meter status. The interface is as shown in the figure below.



- ① Work mode indication, measurement mode
- ② The main measurement value stable symbol, the appearance of this symbol indicates that the main measurement value has stabilized.
- ③ The main measurement value type. PH: pH. ORP: oxidation reduction potential.
- ④ Main measurement value display area. If OVER is displayed, the measured value exceeds the upper limit, UNDER indicates that the measured value exceeds the lower limit.
- ⑤ Secondary measurement value type. MTC: Manual temperature compensation. ATC: Automatic temperature compensation.
- ⑥ Secondary measurement value display area. If OVER is displayed, the measured value exceeds the upper limit, UNDER indicates that the measured value exceeds the lower limit.
- ⑦ Function relay status. ON: Closed. OFF: disconnect.
- ⑧ Relay 1 status. ON: Closed. OFF: disconnect.
- ⑨ Relay 2 status. ON: Closed. OFF: disconnect.
- ⑩ Transmission current channel 1 output current value.
- ⑪ Transmission current channel 2 output current value.

③ ORP Buffer code

The ORP buffer code is the value of the buffer, such as the commonly used 86mV buffer, the code is 86 (0x0056), the 256mV buffer, the code is 256 (0x0100).

If the current electrode has not been calibrated, write the buffer code, which is equivalent to selecting the offset calibration.

If the current electrode has been calibrated for offset, write the buffer code, which is equivalent to selecting the slope calibration.

If the current electrode offset and slope have been calibrated, write the buffer code, which is equivalent to selecting the offset calibration. If the calibration is successful, the offset value will be recalculated and the slope will be restored to the default value of 100.0%. If the calibration fails, then Use original calibration data.

Step 3: Read the calibration status register (address 67) to judge the current calibration status, the register value and calibration status are as follows,

0x0000: Successfully calibrated (returned to the calibration menu)

0x0001: Calibrating (you can read the calibration status register later)

0x0002: Wrong buffer (returned to calibration menu)

0x0003: The calibration measurement signal cannot be stable for a long time (180 seconds) (has returned to the calibration menu)

0x0004: The electrode slope or zero offset is out of range (Returned to the calibration menu)

0x0005: Wrong calibration sequence (Returned to the calibration menu)

If the calibration is successful, you can repeat steps 2 and 3 to continue to calibrate other points. Other errors follow the prompts to eliminate errors and recalibrate. If you need to return to the measurement mode, you can write the measurement mode code 0x0010 in the working mode register (address 64). The calibration status, electrode zero offset and slope of the electrode can be checked at the corresponding position in the holding register group at any time.

② pH Buffer code

Acid point 4.00/4 Code is 2 (0x0002)

Neutral point 6.86/7 Code is 4 (0x0004)

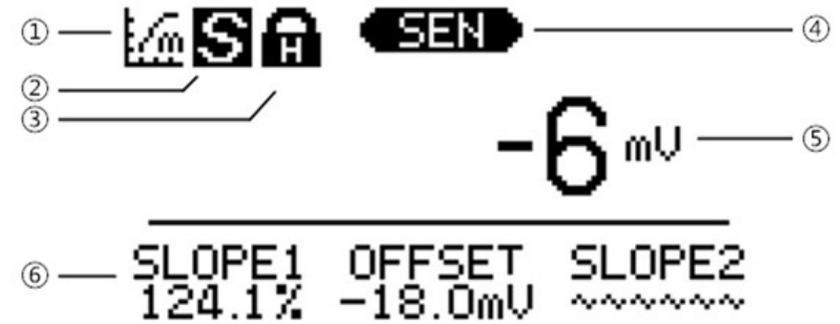
Alkaline point 9.18/10 Code is 8 (0x0008)

It can be seen that the pH buffer code and the calibration status register (address 25) are the same. If the buffer used is calibrated successfully, the corresponding binary bit of the calibration status register (address 25) is set to one.

Calibration needs to follow the rule of mid-point calibration first, and the mid-point calibration is successful, then the acid point or alkali point can be calibrated, otherwise it will prompt that the calibration sequence is wrong.

9、Browse mode

In measurement mode, press the  key to enter browse mode, Display parameters such as electrode signal and calibration status, and automatically return to measurement mode if there is no key operation for 1 minute, For long-term viewing, Can key  to lock the current interface, Press  again to exit the lock. The interface is as shown below.



① Work mode indication, browse mode.

② The measurement stability symbol in the main display area, the appearance of this symbol indicates that the value in the main display area has stabilized.

③ Interface lock symbol, press ENT in browse mode to lock the current interface to prevent automatic return to measurement mode without operation.

④ Measured value type in main display area. SEN: Electrode signal.

⑤ Measured value in main display area. If OVER is displayed, the measured value exceeds the upper limit, UNDER indicates that the measured value exceeds the lower limit.

⑥ Electrode calibration information display area. OFFSET: zero offset. SLOPE: Slope. A numerical value indicates that the corresponding point has been successfully calibrated. The wavy line indicates that the corresponding point is not calibrated or the calibration has failed.

10、 Calibration mode

10.1、 Enter the calibration menu

In measurement mode, press  key to enter the electrode calibration menu,

Press  or  to select the point to be calibrated, Press  key to enter the calibration interface.

The last item in the calibration menu is to clear the calibration data, this option can be used to clear the calibrated information.

If there is no key operation on the calibration menu interface for a long time, the meter will automatically return to the measurement mode.

10.2、 Calibration interface description

The working mode indicator icon of the calibration interface is  , For other icons, please refer to the measurement mode and browse mode icons.

10.3、 pH electrode calibration instructions

- ① Before calibrating the pH electrode, please make sure that the type of buffer used is the same as the meter setting. You can check it in the information mode. If it is different, you can modify it in the setting mode. Please refer to the corresponding chapter.
- ② The pH electrode can be calibrated at most three points, and the uncalibrated electrode must be calibrated to the neutral point first, otherwise the order will be incorrect.
- ③ The neutral point is calibrated successfully, and the meter calculates the electrode zero offset. Expressed by OFFSET, allowable range $\pm 60\text{mV}$.

13.8、 Communication control calibration

① Calibration step description

The user can use the communication function to control the meter and complete the electrode calibration operation. Please read the chapter on calibration mode first to understand the electrode calibration rules. The corresponding key operations will be mentioned in the description. Proceed as follows.

Step 1: In measurement mode, write calibration mode code 0x0060 in the work mode register (address 64), Make the meter enter the calibration mode, at this time

the meter displays the calibration menu. It is equivalent to pressing the  key in the measurement mode.

Step 2: When calibrating the menu interface, put the electrode in the buffer to be calibrated, and write the buffer code in the calibration status register (address 67) to start the calibration, which is equivalent to selecting the calibration item in the menu. You can also write 0x7FFF to clear the calibration information, which is equivalent to selecting the last item in the calibration menu to clear the calibration data.

□ Address 64 : Working mode, the value of this register reflects the current working mode of the instrument. Write the corresponding value of working mode into the register to control the instrument to enter the corresponding mode. The corresponding relationship between the value and the working mode is as follows, and the value is defined in hexadecimal format.

0x0000: Initial state

0x0010: Measurement mode

0x0020: Information model

0x0030: Browse mode

0x0050: Set mode

0x0060: Calibration mode

□ Address 65 : Working mode parameters, used for some operations in instrument control, see specific applications. Generally, keys can be replaced, the corresponding relationship is as follows, and the value is defined in hexadecimal format.

0x0001:  0x0002:  0x0003:  0x0004:  0x0006: 

□ Address 66 : Work event, the value of this register reflects a certain event when the instrument is currently in work mode, and users generally don't need to care about it.

□ Address 67: Calibration status, used for electrode calibration operation, please refer to the communication control calibration chapter.

□ Address 68, 69, 79, 71, 72, 73: The basic information of the instrument, the value is defined in hexadecimal format.

- ④ The second and third points can be calibrated to choose acid point or basic point. If the calibration is successful, the meter calculates the slope of the electrode and the allowable range is $\pm 30\%$. The slope between the neutral point and the acid point is represented by SLOPE1, and the slope between the neutral point and the basic point is represented by SLOPE2.
- ⑤ Repeat calibration for acid point or basic point. If the calibration succeeds, the slope between this point and the neutral point will be recalculated. If it fails, the original slope will be used.
- ⑥ Repeat the neutral point calibration. If the calibration succeeds, all previous calibration information will be cleared and the OFFSET will be recalculated. If it fails, the original calibration data will be used.

10.4、pH electrode calibration process

- ① Enter the calibration menu, the uncalibrated electrode needs to be put into the neutral point (6.86 or 7.00) buffer first, select the neutral point (6.86/7) option in the menu, press the key to enter the calibration interface, and start the calibration. The calibrated electrode can be directly calibrated from the process ④ to the acid point or alkaline point.
- ② The calibration process is fully automatic, waiting for the measured value to stabilize, The meter displays the stable symbol  of the measured value, And calculate the OFFSET, if the result meets the requirements, it will prompt the calibration is successful, otherwise it will prompt the calibration failed. Whether it succeeds or not, it will return to the calibration menu。
- ③ Calibration failed. According to the error message, check whether the electrode performance or buffer is wrong, and re-calibrate after troubleshooting. If the calibration is successful, you can continue to calibrate the acid point or alkaline point according to the subsequent process.If there is no need to continue the calibration, press  key to return to the measurement mode.
- ④ Put the electrode into the acidic point (4.00 or 4.01) or alkaline point (9.18 or 10.01) buffer, select the corresponding buffer option in the menu, Press  key to enter the calibration interface and start calibration.

13.7、Information register group (20 addresses from 0x003C to 0x004F)

The information register contains instrument running status and instrument information, such as version number, serial number, etc., which can be read using function code 0x03. You can also use the function code 0x06 to modify the register value related to the running status of the meter, and control the meter to perform electrode calibration and other operations.

register	Address hexadecimal	Address	name	Types	Attributes	Remarks
Holding register code 0x03 read Code 0x06 write	0x003C~0x003F	60~63	Operating mode	Integer		
	0x0040	64	Operating mode	Integer	R/W	
	0x0041	65	Work event	Integer	R/W	
	0x0042	66	Calibration status	Integer	R	chapter for communication
	0x0043	67	Instrument type	Integer	R/W	0x0001 Means PH
	0x0044	68	Instrument model	Integer	R	
	0x0045	69	Software version	Integer	R	
	0x0046	70	hardware version	Integer	R	
	0x0047	71	serial number	Integer	R	
	0x0048	72	serial number	Integer	R	
	0x0049	73			R	
	0x004A~0x004F	74~79				

register	Address hexadecimal	Address decimal	name	Type	Attributes	Remarks
Control transfer register code 0x03 read Code 0x10write	0x0050	80	4~20mA 1.4mA Corresponding value	Integer	R/W/D	Code 0x10Write together
	0x0051	81	4~20mA 1.20mA Corresponding value	Integer	R/W/D	
	0x0052	82	4~20mA 2.4mA Corresponding value	Integer	R/W/D	Code 0x10Write together
	0x0053	83	4~20mA 2.20mA Corresponding value	Integer	R/W/D	
	0x0054	84	Function relay parameters 1	Integer	R/W/D	Code 0x10Write together
	0x0055	85	Function relay parameters 2	Integer	R/W/D	
	0x0056	86	Relay 1 on value	Integer	R/W/D	Code 0x10Write together
	0x0057	87	Relay 1 off value	Integer	R/W/D	
	0x0058	88	Relay 2 on value	Integer	R/W/D	Code 0x10Write together
	0x0059	89	Relay 2 off value	Integer	R/W/D	
	0x005A~0x0063	90~99				

- ⑤ The calibration process is the same as ②, it is fully automatic calibration, waiting for the measured value to stabilize, if the calibration is acidic point, calculate SLOPE1, and alkaline, calculate SLOPE2. After prompting success or failure, return to the calibration menu. If it fails, follow the prompts to troubleshoot and recalibrate.
- ⑥ After the two points are successfully calibrated, the remaining one can be calibrated from the process ④. No need to continue calibration or all three points have been calibrated, Press  key to return to measurement mode.

Note: While waiting for the measured value to stabilize, if the user press  key,

The meter skips the automatic stability judgment and calculates the calibration result according to the current display value.

10.5、ORP electrode calibration instructions

- ① ORP electrode can be calibrated at most two points, the electrode that is not calibrated must be calibrated offset first, otherwise the sequence error will be prompted.
- ② The offset calibration is successful, and the meter calculates the electrode zero offset. Expressed by OFFSET, the allowable range is $\pm 100\text{mV}$.
- ③ Can continue to calibrate the slope, the meter calculates the slope of the electrode after the calibration is successful, and the allowable range is $\pm 30\%$. Expressed by SLOPE.
- ④ Repeat the calibration slope. If the calibration succeeds, the electrode slope will be recalculated, and if it fails, the original slope will be used.
- ⑤ Repeat the offset calibration. If the calibration succeeds, all previous calibration information will be cleared and the OFFSET will be recalculated. If the calibration fails, the original calibration data will be used.

10.6、ORP electrode calibration process

- ① Enter the calibration menu and put the electrode in the buffer. If the electrode is not calibrated, select the offset option in the menu first, Press  key to enter the buffer value input interface. For electrodes that have been calibrated for offset, the slope can be calibrated directly from process ⑤.
- ② In the buffer value input interface, use the value setting key (  ) to set the current buffer value, After setting, press  to enter the calibration interface and start calibration.
- ③ The calibration process is fully automatic, waiting for the measured value to stabilize, The meter displays the stable symbol  of the measured value, And calculate the OFFSET, if the result meets the requirements, it will prompt the calibration is successful, otherwise it will prompt the calibration failed. Whether it succeeds or not, it will return to the calibration menu.
- ④ Calibration failed. According to the error message, check whether the electrode performance or buffer is wrong, and re-calibrate after troubleshooting. If the calibration is successful, you can continue to calibrate the slope according to the subsequent process. If there is no need to continue calibration, Press  key to return to measurement mode.
- ⑤ The two buffers used for calibration slope and calibration offset must differ by at least 100mV. Put the electrode in the buffer and select the slope option in the menu, Press  key to enter the buffer value input interface.
- ⑥ In the buffer value input interface, use the value setting key (  ) to set the current buffer value, After setting, press  to enter the calibration interface and start calibration.

□ Address 82, 83: 4-20mA channel 2, 4mA and 20mA corresponding value. The minimum interval between the two values is 200. Channel 2 is controlled by the temperature measurement value. The setting range of these two register values is the temperature measurement range, and the value of the register is read or written in the form of 10 times the temperature value, for example, the register value is read 200 means 20.0°C, if you want to write -5.0°C, you need to write the value -50.

□ Address 84, 85: two parameters of function relay. The value of the register is an integer. When the value of parameter 1 is 0, the functional relay is in alarm mode. When the value of parameter 1 is 1 to 1000, the functional relay is in cleaning mode, and the value of parameter 1 is the cleaning interval time, in hours. In the cleaning mode, the value of parameter 2 indicates the cleaning duration, ranging from 1 to 1000, in seconds.

□ Address 86, 87: Relay 1 open value and close value, the minimum interval between the two values is 1. The values of these two registers are the same as 4~20mA channel 1 when reading and writing.

□ Address 88, 89: Relay 2 is the same as Relay 1.

13.6、 Control transmission register (20 addresses from 0x0050 to 0x0063)

The control transmission register is the relay switch value set by the user and the corresponding value of the transmission current, etc., which can be read using the function code 0x03. When the instrument is in the setting menu interface (setting state), the function code 0x10 must be used to write the values of two registers of one device at a time. For example, the closing value and opening value of a relay, or the corresponding value of 4mA and 20mA of a transmitting current channel, of course, they are also continuous in the address. The address list is as follows. In the attribute column, R means readable, W means writable, and D means that the register will be restored to the default value after factory reset. Default refer to 9.6, set the default value list of menu options.

□ Address 80, 81: 4-20mA channel 1, 4mA and 20mA corresponding value. The minimum interval between the two values is 200.

In the pH measurement mode, channel 1 is controlled by the pH measurement value. The value setting range of these two registers is the pH measurement range, and the value of the register is read or written in an integer type of 100 times the pH value. For example, if the register value is 200, it means 2.00pH, and if you want to write 4.00pH, you need to write the value 400.

In the ORP measurement function, channel 1 is controlled by the ORP measurement value. The setting range of the two register values is the ORP measurement range. The value of the register is an integer, with mV as the unit, which can be read or written directly.

⑦ The calibration process is the same as ③. It is fully automatic calibration. Wait for the measured value to stabilize, calculate the SLOPE, and return to the calibration menu after indicating success or failure. If it fails, follow the prompts to eliminate the problem and recalibrate the slope point.

⑧ After successfully calibrating the two points, press  key to return to the measurement mode.

Note: When waiting for the measured value to stabilize, if the user presses  key, the meter will skip the automatic stability judgment and calculate the calibration result according to the current displayed value.

11、 Set mode

11.1、 Enter the settings menu

Press  in measurement mode, If the instrument has not set a password, it will directly enter the setting menu, if the instrument is set with a password, it will enter the password input interface, Use the numeric setting key (  ) to enter the password, Then press  key, If the password is correct, enter the setting menu, otherwise it will prompt that the password is wrong.

11.2、 Setting menu button description

① The setting menu includes three main menus, namely system setting, parameter setting, and running setting. Under the main menu interface,

Press  key to cycle through the three main menus.

Press  key to return to the measurement mode.

Press   key to move the  cursor in the menu.

Press  key to enter the option where the  cursor is.

② After entering the option, press  key to return to the previous level.

If the current interface is an option selection interface, Press   key to move the  cursor to the option, Press  key to confirm options.

If the current interface is a value setting interface, Use the value setting    key to set the value, Press  key to confirm the value.

□ Address 34: Measurement type, that is, the measurement function of the instrument. Setting this register will restore the factory settings and restart the instrument.

- 0: pH mode
- 1: ORP mode

□ Address 35: pH electrode type, setting this register will clear the electrode calibration information.

- 0: glass sensor (Defaults)
- 1: antimony sensor

□ Address 36: pH buffer type, setting this register will clear the electrode calibration information.

- 0: NIST(4.00/6.86/9.18) (Defaults)
- 1: USA(4/7/10)

□ Address 45: digital filter, setting range 1~24, default value 8.

□ Address 46: language, unaffected by restoring the factory operation.

- 0: English
- 1: Simplified Chinese

□ Address 47: Backlight mode.

- 0: Delay off (Defaults)
- 1: always on

□ Address 32~36: Relevance, indicating the current equipment controlled object. The value of the register represents different objects. Refer to the floating-point register address list, where the pH value is object 0, the sensor signal value is object 1, and so on, the temperature value is object 4.

For example, the address 33 register is 4-20mA channel 2 correlation, the register value is 4, then the current value of 4-20mA channel 2 is controlled by the temperature value.

□ Address 31: communication baud rate, the setting range is 0~4, the corresponding relationship between register value and communication baud rate is as follows, and it is not affected by the factory reset operation.

0:1200

1:2400

2:4800

3:9600 (Defaults)

4:19200

□ Address 32: Temperature compensation type. The instrument has two types of temperature compensation, manual and automatic. The automatic temperature compensation method is PT1000, and the corresponding relationship is as follows. After this register is set, it will affect the temperature compensation setting value of the next address 33. If it is set to 0 (manual), the register temperature compensation setting value becomes 250 (25.0°C), if it is set to 2 (Automatic), the register temperature compensation setting value becomes 0 (0.0°C).

0: Manual

2: Automatic PT1000 (Defaults)

□ Address 33: temperature compensation setting value. When the temperature compensation type is manual, this register represents the manual temperature value; when the temperature compensation type is automatic, this register represents the temperature offset value. When setting this register, write it in a ten-fold integer value of the temperature value.

For example, if you want to set a value of 50.0°C, you need to write a value of 500. To set the value to -10.0°C, write the value -100.

The manual temperature value setting range is -10.0~130.0°C, and the temperature offset value setting range is -10.0~10.0°C.

11.3、System setting menu option description

① Language

Menu display language, select Chinese or English.

② Backlight mode

Delay off: there is button operation, the backlight is on, and there is no button operation for one minute after lighting, the backlight is off.

Constantly on: The backlight keeps on all the time.

③ Digital filter

The digital filter adopts the sliding weighted average filter method, and the setting range is 1-24.

The larger the value setting, the more stable the data, but the slower the response, which is suitable for occasions with greater interference.

④ Change password

When the password is set to 0000, there is no password. In the measurement mode, press the SET key to directly enter the setting menu.

The password is set to other values. In the measurement mode, press the SET key to enter the password input interface. Only when the password is entered correctly can you enter the setting menu.

⑤ Restore the factory

Perform the factory reset operation, the meter will clear the calibration information, restore some set parameters to the factory default values, and then restart the meter.

11.4、Parameter setting menu option description

① Temperature compensation

Manual: If the meter is not connected with PT1000 temperature resistance, you can select this option, and continue to set the temperature value according to the prompt of the meter. The setting range is $-10.0^{\circ}\text{C}\sim 130.0^{\circ}\text{C}$.

Auto: If the meter is connected with a PT1000 temperature resistance, this option can be selected. At this time, the meter prompts to set the temperature offset, do not adjust the value first, press the key directly, that is, the offset is set to 0.0°C . In actual use, if you find that the temperature displayed by the meter differs greatly from the temperature of the measured object, for example, the display temperature of the meter is 26.0°C , and the temperature of the measured object measured with a mercury thermometer is 30.0°C . At this time, you can enter the temperature compensation option again and select the automatic option. The meter prompts to set the temperature offset, at this time set the value to $+4.0^{\circ}\text{C}$, and press the key to confirm. Returning to the measurement mode, you can see that the temperature display value becomes 30.0°C , that is, the measured value 26.0°C plus the offset set value 4.0°C . The offset value setting range is $-10.0^{\circ}\text{C}\sim +10.0^{\circ}\text{C}$.

② Measurement type

The measurement type is the function of the instrument, and you can choose pH (acid-base) measurement or ORP (oxidation-reduction potential) measurement. After the selection is confirmed, the meter will restore the factory settings and restart, and run according to the set function.

□ Address 25: Calibration status register, which uses binary bits to indicate the status of the calibration point. The register is a 16-bit integer. The corresponding relationship between the bits and the calibration point is shown in the table below. If the calibration point has been calibrated, the value of the corresponding bit is 1, otherwise it is 0.

16-bit integer	BIT15~BIT4	BIT3	BIT2	BIT1	BIT0
pH mode	NC	9.18 or 10	6.86 or 7	4.00 or 4	NC
ORP mode	NC	NC	NC	SLOPE	OFFSET

□ Address 26, 27: These two registers together constitute electrode bias data (zero offset). Address 26 is an integer value, the high byte of address 27 represents the number of decimal places, and the low byte represents the data unit. The neutral point is successfully calibrated under the pH measurement function, the offset point is successfully calibrated under the ORP measurement function, and the meter calculates the offset data.

For example, the register value of address 26 is 300 and the register value of address 27 is $0x0100$ (one decimal place, unit mV), then the offset data is 30.0mV .

□ Address 28, 29: electrode slope, in the pH measurement function, slope 1 represents the slope calculated after the neutral point and acid point are successfully calibrated, and slope 2 represents the slope between the neutral point and the alkaline point. In ORP measurement function, only slope 1 is available. The slope value defaults to 1 decimal and the unit is percentage.

For example, if the register value is 1001, the slope data is 100.1%

□ Address 30: The address of the local machine during communication, the setting range is $1\sim 247$, and the default value is 1, which is not affected by the factory reset operation.

register	address Hexadecimal	address Decimal	name	type	Attributes	Remarks
Holding register	0x0024	36	pH buffer type	Integer	R/W/D	Refer to ①-4.4
	0x0025~ 0x002C	37~44		Integer		
	0x002D	45	Digital filtering	Integer	R/W/D	Refer to ①-3.3
	0x002E	46	Language	Integer	R/W	Refer to ①-3.1
	0x002F	47	backlight	Integer	R/W/D	Refer to ①-3.2
	0x0030~ 0x0031	48~49		Integer		
	0x0032	50	4~20mA 1 Related	Integer	R	
	0x0033	51	4~20mA 2 Related	Integer	R	
	0x0034	52	Function relay related	Integer	R	
	0x0035	53	Relay 1 related	Integer	R	
0x0036	54	Relay 2 related	Integer	R		
0x0037~ 0x003B	55~59					

③ pH electrode type

This option is an option under the pH function type. If the meter is running under the ORP function, please do not set this option.

Optional glass electrode or antimony electrode, if supporting metal antimony electrode test, you need to choose antimony electrode option.

After selecting and confirming, the meter will clear the previous electrode calibration information.

④ pH buffer type

The type of buffer used during pH electrode calibration. Please do not set this option if the meter is running under the ORP function.

NIST type: acid point 4.00, neutral point 6.86, basic point 9.18.

USA type: acid point 4, neutral point 7, basic point 10.

After selecting and confirming, the meter will clear the previous electrode calibration information.

11.5、 Operation setting menu option description

① Mailing address

Local address during RS485 MODBUS communication. The setting range is 1～247.

② Communication baud rate

RS485 MODBUS communication rate, optional 1200, 2400, 4800, 9600, 19200.

③ Functional relay

The functional relay can be set to alarm mode or cleaning mode.

Alarm mode: suitable for external alarm devices, if any one of relay 1 and relay 2 is closed, the functional relay is closed.

Cleaning mode: suitable for external cleaning equipment, first set the cleaning interval, the setting range is 1 to 1000 hours, and then set the cleaning duration, the setting range is 1 to 1000 seconds.

④ Relay 1 and Relay 2

In the pH measurement function, these two relays are related to the pH measurement value, and in the ORP measurement function, they are related to the ORP measurement value.

The settings of the two relays are the same. After entering the relay option, you need to set an on value and then an off value. The setting range of the two values is the same as the measurement range of the related measurement quantity, and the on value and off value Can't be the same. details as follows:

Under the pH measurement function, the setting range of the two values is -2.00～16.00pH.

Under ORP measurement function, the setting range of two values is -2000～2000mV.

register	address Hexadecimal	address Decimal	name	type	Attributes	Remarks	
Holding register	0x0014～0x0018	20～24					
	0x0019	25	Calibration situation	Integer	R/D	Binary representation	
	0x001A	26	Electrode offset value	Integer	R/D		
	0x001B	27	Offset decimals and units	Integer	R/D		
	code 0X03	0x001C	28	Slope 1	Integer	R/D	One decimal place, unit %
	read	0x001D	29	Slope 2	Integer	R/D	One decimal place, unit %
	code	0x001E	30	ID	Integer	R/W	Refer to 十一.5.1
	0X06	0x001F	31	Baud rate	Integer	R/W	Refer to 十一.5.2
	write	0x0020	32	TEMP compensation type	Integer	R/W/D	Refer to 十一.4.1
		0x0021	33	TEMP setup value	Integer	R/W/D	Refer to 十一.4.1
	0x0022	34	Measurement type	Integer	R/W	Refer to 十一.4.2	
	0x0023	35	pH sensor type	Integer	R/W/D	Refer to 十一.4.3	

13.5、 Holding register group (40 addresses from 0x0014 to 0x003B)

The holding register is the user's set value and electrode calibration information. Use the function code 0x03 to read the register value. When the instrument is in the setting menu interface (setting state), use the function code 0x06 to write the register value. Of course, this register must have a writable attribute to be allowed to write a value. The address list is as follows. In the attribute column, R means readable, W means writable, D means restoring factory operation. This register will be restored to the default value.

⑤ 4~20mA channel

The output current value of 4-20mA channel 1 is related to the pH measurement value under the pH measurement function, and is related to the ORP measurement value under the ORP measurement function.

The output current value of 4-20mA channel 2 is related to the temperature measurement value.

The settings of the two 4-20mA channels are the same. After entering the 4-20mA channel option, you need to set the corresponding value of 4mA first, and then set the corresponding value of 20mA. The setting range of the two values is the same as the measurement range of the related measurement quantity. And the minimum interval between two values is 200 words, as follows:

In the pH measurement function of channel 1, the setting range of the two values is -2.00~16.00pH, and the minimum interval is 2.00pH.

Under the ORP measurement function of channel 1, the setting range of the two values is -2000~2000mV, and the minimum interval is 200mV.

The setting range of channel 2 two values is -10.0 ~ 130.0°C, the minimum interval is 20.0°C.

11.6、Set the default value list of menu options

If the option in the table corresponds to the value of whether it is affected by the factory reset operation is Yes, then the factory reset operation will be executed, and this option will become the default value. Otherwise it won't change.

menu	Options	Defaults	Can be reset
System settings	Language	Chinese	no
	backlight	Delay off	yes
	Digital filter	8	yes
	password	0000 (No password)	no
parameter settings	TEMP compensation	automatic, offset value 0.0℃	yes
	Measurement type	pH	no
	pH sensor type	glass	yes
	pH buffer type	NIST	yes
Run settings	ID	1	no
	Baud rate	9600	no
	Functional relay	flush, interval 1 hour, continued 10 seconds	yes
	Relay 1	On value 4.00pH / 400mV Off value 4.50pH / 450mV	yes
	Relay 2	On value 10.00pH / 1000mV Off value 9.50pH / 950mV	yes
	4~20mA 1	4mA related 0.00pH / -2000mV 20mA related 14.00pH / 2000mV	yes
	4~20mA 2	4mA related -10.0℃ 20mA related 130.0℃	yes

① In the pH measurement function, this register is the pH measurement value, and in the ORP measurement function it is the ORP measurement value, ranging from -2000 to 2000. The pH value decimal and unit register is the decimal and unit of the ORP value, all others are the same.

② When the instrument temperature compensation is set to automatic, this register is the temperature measurement value, if it is set to manual, it is the user set value.

The relay status register uses binary bits to represent the relay status. The register value is a 16-bit integer. The 0th bit, BIT0, represents the status of the functional relay, BIT1 represents the status of the relay 1, and BIT2 represents the status of the relay 2. When the bit value is 1, the relay is turned on, and when it is 0, the relay is turned off.

As shown in the table below.

16-bit integer	BIT15~BIT3	BIT2	BIT1	BIT0
	NC	Relay 2	Relay 1	Function relay

register	address Hexadecimal	address Decimal	Name	Range	Type	Attributes	Remarks
float Integer register Code OX04 Read	0x0000	0	pH value ①	-200~1600	Integer	R	Over 7FFF Under 8000
	0x0001	1	pH Decimals and units		Integer	R	
	0x0002	2	Sensor signal	-2000~2000	Integer	R	Over 7FFF Under 8000
	0x0003	3	Signal Decimals and units		Integer	R	
	0x0004	4			Integer		
	0x0005	5			Integer		
	0x0006	6			Integer		
	0x0007	7			Integer		
	0x0008	8	TEMP value ②	-100~1300	Integer	R	Over 7FFF Under 8000
	0x0009	9	TEMP Decimals and units		Integer	R	
	0x000A	10					
	0x000B	11					
	0x000C	12					
	0x000D	13					
	0x000E	14	Current 1 value	400~2000	Integer	R	Over 2100 Under 370
	0x000F	15	Current Decimals and units		Integer	R	
	0x0010	16	Channel 2mA value	400~2000	Integer	R	Over 2100 Under 370
	0x0011	17	mA Decimals and units		Integer	R	
	0x0012	18	Relay status ③		Integer	R	Binary representation
0x0013	19						

12、 Information model

In the measurement mode, press  key to enter the information mode. In the information mode, you can browse the instrument setting parameter values and instrument information. The upper right of the display interface has the current page and total page number prompt, For example, 1/8, that is the current first page, there are 8 pages in total, and there is a  symbol to prompt you to press  key to turn the page and cycle through the pages.

Press  key to return to the measurement mode. If there is no key operation for a long time, the meter will automatically return to the measurement mode.

13、 letter of agreement

13.1、 Introduction to Communication

The instrument adopts RS485 hardware interface Modbus-RTU communication protocol. The data format is N, 8, 1, that is, no parity, 8 data bits, and 1 stop bit. The factory default local address is 1, the baud rate is 9600. The address can be set in the range of 1~247, the baud rate can be 1200, 2400, 4800, 9600, 19200, and users can set it according to their needs.

13.2、 Data format

The function codes used in communication include 0x03, 0x04, 0x06 and 0x10. Here is only a brief introduction to the data frame format corresponding to the function codes used. If you need to know more, you can query Modbus-RTU related information.

One register occupies two bytes in the data. Floating point numbers are represented by two registers, that is, 4 bytes.

The integer is represented by a register, the high byte is first, the low byte is after, and the negative number is represented by the complement form, that is, 0xFFFF represents -1

① Function codes 0x03 and 0x04, used to read the contents of the register, the instruction format is the same, suitable for different register groups

Host computer command format

Slave address	Code	Starting address of the register	Number of registers N	CRC check
1 byte	1 byte	2 byte	2 byte	2 byte

Response format of lower computer

Slave address	Code	Return the total number of bytes of data N*2	Register data N	CRC check
1 byte	1 byte	1 byte	N*2 byte	2 byte

② Function code 0x06 to modify a register value.

Host computer command format

Slave address	Code	Modify the address of the register	Modify value	CRC check
1 byte	1 byte	2 byte	2 byte	2 byte

Response format of lower computer

Slave address	Code	Modify the address of the register	Modified value	CRC check
1 byte	1 byte	2 byte	2 byte	2 byte

13.4、Floating integer register group (20 addresses from 0x0000 to 0x0013)

The floating integer register is the integer data of the measured value of the instrument and the transmitted current value. Use function code 0x04 to access, the address list is as follows. Property bar R means readable, W means writable.

A measurement value in the table consists of two parts, the value is one part, the decimal and the unit are part.

For example: the address 0x0000 register is the integer form of the pH value, and the address 0x0001 register is the decimal place and unit of the pH value. The high byte value is used to indicate the decimal place, and the low byte value indicates the unit, which can be obtained by querying the unit comparison table. If the read 0x0000 register value is 0x02BC (decimal 700), the 0x0001 register value is 0x020A, where 02 represents 2 decimal places, and 0A represents the unit pH, then the current pH value is 7.00pH.

register	address Hexadecimal	address Decimal	Name	Range	Type	Attributes	Remarks
float Floating point register Code 0X03 Read	0x0000	0	pH value ①	-2.00~16.00	Float data pH	R	Over 16.01
	0x0001	1					Under -2.01
	0x0002	2	Sensor signal	-2000~2000	Float data mV	R	Over 2001
	0x0003	3					Under -2001
	0x0004	4					
	0x0005	5					
	0x0006	6					
	0x0007	7					
	0x0008	8	TEMP value ②	-10.0~130.0	Float data TEMP °C	R	Over 130.1
	0x0009	9					Under -10.1
	0x000A	10					
	0x000B	11					
	0x000C	12					
	0x000D	13					
0x000E	14	4~20mA 1 value	4.00~20.00	Float data mA	R	Over 21.00	
0x000F	15					Under 3.70	
0x0010	16	4~20mA 2 value	4.00~20.00	Float data mA	R	Over 21.00	
0x0011	17					Under 3.70	

③ Function code 0x10 to modify the values of multiple consecutive registers, this instrument can only be used to modify the values of two consecutive registers, and only a few fixed registers can be modified.

The command format of the host computer, here is an example of modifying two registers, N=2 in the following table.

Response format of lower computer

Slave address	Code	Starting address of the register	Number of registers N	Bytes occupied by modified value N*2	First register Modify value	Second register Modify value	CRC check
1 byte	1 byte	2 byte	2 byte	1 byte	2 byte	2 byte	2 byte

Response format of lower computer

Slave address	Code	Register address	Number of registers N	CRC check
1 byte	1 byte	2 byte	2 byte	2 byte

④ Error response, the lower computer receives an error command and will reply in the following format.

Slave address	Code+0x80	error code	CRC check
1 byte	1 byte	1 byte	2 byte

⑤ Error code description:

0x01: Function code error, an unsupported function code was received.

0x02: The register address is wrong, and the register address to be accessed is wrong.

0x03: The number of registers is wrong, and the number of registers to be accessed is out of range.

0x04: The modified value is wrong, and the modified value exceeds the allowable range of the register value.

0x05: check error, CRC check value is wrong.

0x06: Write error, target register does not support write operation.

13.3 、 Floating floating-point register group (20 addresses from 0x0000 to 0x0013)

Floating floating point type register is the floating point type data of the measured value of the instrument and the transmitted current value. Use function code 0x03 to access, the address list is as follows. The property bar R means readable, W means writable.

One data in the table occupies two register addresses. When reading data, you need to read two register addresses at a time to form a floating-point data.

① In the pH measurement function, this register is the pH measurement value, in the ORP measurement function it is the ORP measurement value, the range is -2000~2000, the unit is mV, the upper limit is 2001, the lower limit is -2001.

② When the instrument temperature compensation is set to automatic, this register is the temperature measurement value, if it is set to manual, it is the user set value.