User's Manual of

PH/ORP Meter

Chapter 1 Overview

PH-501 economical online pH/ORP meter is one of the intelligent online chemical analyzers developed by our company. It has strong environmental adaptability, clear display, simple operation and excellent test performance, making it highly cost-effective and can accurately measure the pH/ORP value and temperature of the solution. It can be widely used in continuous monitoring of pH value in solutions such as thermal power, chemical fertilizer, metallurgy, environmental protection, pharmaceuticals, biochemistry, food and tap water. It is also a precise ORP meter when equipped with an ORP redox electrode.

Features:

◆ High intelligence: PH-501 online pH/ORP meter adopts high-precision AD conversion and single-chip microprocessor technology, and can complete multiple functions such as pH/ORP value measurement, temperature measurement, and automatic temperature compensation.

◆ Time display: The online pH/ORP meter has a built-in clock chip that can display the current time.

◆ Data storage: The instrument's built-in memory chip can save the past three days' historical data, making it easy for users to search.

◆ Flushing relay: The instrument is equipped with a flushing relay, which can be used to regularly clean the pH/ORP electrode by installing a solenoid valve.

◆ 25℃ conversion: Pure water and ultrapure water with ammonia are converted to 25℃ reference temperature , which enables the display of PH/OPR value at 25℃, which is particularly suitable for

- Measuring various water qualities in power plants.
- Strong anti-interference ability: Using the latest devices, the impedance is as high as 10^{12} Ω; the current output adopts photoelectric coupling isolation technology, which has strong anti-interference ability and can achieve remote transmission. It has good electromagnetic compatibility.
- Simultaneous display of multiple parameters: time, PH/OPR value or mV value, temperature, and output current value are displayed on the LCD screen at the same time. It uses a high-brightness 128*64 LCD display module, which is eye-catching and has a long viewing distance.
- RS485 communication interface: MODBUS RTU communication protocol can be easily connected to a computer for monitoring and communication.
- Industrial control watchdog: ensures that the instrument does not crash.

Chapter 2 Technical Indicators

Technical Parameters	Technical indicators
Implementation Standards	JB/T 6203-92 "Industrial PH/OPR Meter";
pH measurement range	0 ~ 14.00pH (maximum -2-16PH); Graduation value: 0.01pH;
pH measurement accuracy	±0.02pH;
ORP measurement range	-1999 ~ +1999mV; Graduation value: 1mV;
ORP Measurement Accuracy	±1mV;
Temperature measurement range	0 ~ 99.9℃ (maximum -10 ~ 120℃); Graduation value: 0.1℃
Temperature measurement accuracy	±0.5℃;

Automatic temperature compensation range	0 ~ 99.9℃, 25℃ as the reference;
Electronic unit repeatability error	±0.02pH;
stability	±0.02pH/24h;
Input Impedance	≥10 ^{12} Ω;
Galvanic isolation output	4 ~ 20mA;
Output current error	≤±1%FS;
High and low alarm relay	AC220V, 3A;
Data Storage	72 points, three days of data.
RS485 communication interface	MODBUS RTU protocol; non-isolated (standard), isolated (optional);
Power supply	AC220V ± 22V, 50 ± 1Hz; DC24V ± 2.4V optional (specify when ordering);
Protection level	IP54;
Dimensions	96 (length) × 96 (width) × 110 (depth) mm;
Opening size	92×92 mm;
Instrument weight	Transmitter: 0.8kg;
Working conditions	Ambient temperature: 0 ~ 60 ℃ Relative humidity: <85%;
Electrode wire length	Standard configuration: 5 meters; can be equipped with three-composite or two-composite electrodes.

Chapter 3 Electrode Maintenance

The quality of PH/OPR meter depends largely on the maintenance of electrodes. Electrodes should be cleaned frequently to ensure that they are not contaminated or blocked; electrodes should be calibrated at regular intervals; during water outages, electrodes should be immersed in the measured liquid, otherwise their life will be shortened; cable connectors must be kept clean and not exposed to moisture or water. If there is indeed a problem with the instrument, please do not repair it yourself, please contact us.

1. Activation: If the electrode is stored in a dry environment, it must be soaked for 24 hours before use to activate it; otherwise large errors will occur in calibration and measurement.

2. Cleaning: If the electrode is found to be contaminated or blocked, which affects the measurement accuracy, you can use a soft brush to gently brush the electrode head, and then clean it with clean water. The cleaning methods for various contaminations are as follows:

Inorganic metal oxides	Less than 1mol/dilute acid cleaning
Organic oils and fats	Clean with dilute detergent (weak acid)
Resin polymer	Alcohol cleaning
Protein hemoglobin	Acid enzyme solution cleaning
Pigment substances	Clean with dilute bleach

3. Regeneration: When the electrode response becomes slow and almost inactive, soak it in a mixture of 10% HNO$_3$ and NH$_4$F (50g/l) to regenerate it. Generally, it takes less than 10 seconds.

When leaving the factory, the electrode has a protective cap containing a sponge soaked in KCl solution to keep the sensitive membrane moist. When the electrode is not in use, rinse it with water and insert it back into the protective cap with 3 mol/L KCl solution, or soak the electrode in KCl solution.

Chapter 4 Instrument Installation

PH-501 economical online PH /ORP meter consists of two parts: transmitter and pH electrode or ORP electrode.

1. Instrument size

The instrument can be installed in a monitoring room far away from the site, or installed on site together with the PH/OPR electrode. The required wiring is led out from the terminal at the back of the transmitter.

The appearance of the transmitter is shown in the figure:


Instrument dimensions: 96 * 96 * 110 mm
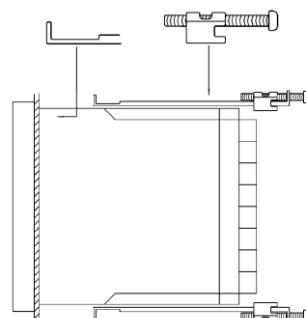
Install the fixed bracket
opening size: 92 * 92 mm

Please note during installation:

1. The closer the distance between the meter and the measuring pool, the better. Generally, it should not exceed 10 meters. It is best to fix the secondary meter at the best sight line. The surface should be kept clean and dry to avoid direct splashing of water drops, and it must be well grounded.

2. The connecting cable between the electrode and the instrument should not be laid in parallel with the power line at a close distance to avoid adverse effects on the signal.

2. Electrode size
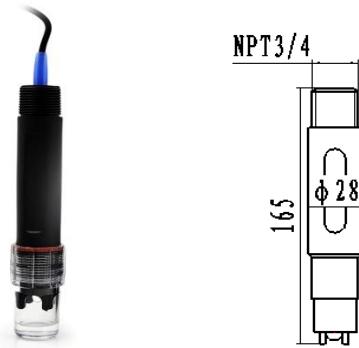
Electrode size as below (remove the transparent protective cap at the bottom of the electrode when using)
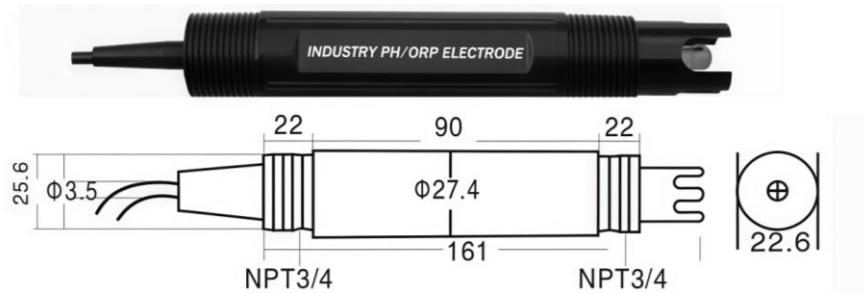

3. Electrode Installation

1. Immersion installation: The lead wire of the PH/OPR electrode is inserted into the stainless steel tube, and the 3/4 thread on the top of the PH/OPR electrode is connected to the 3/4 thread of the stainless steel with raw tape . **Make sure that the top of the**

electrode and the electrode wire are not exposed to water.

2. Side wall installation: The manufacturer provides a 316L stainless steel sheath with a bevel. The PH/OPR electrode can be screwed into the sheath.

3. Pipeline installation: Connect the PH/OPR electrode to the pipeline through the 3/4 thread.
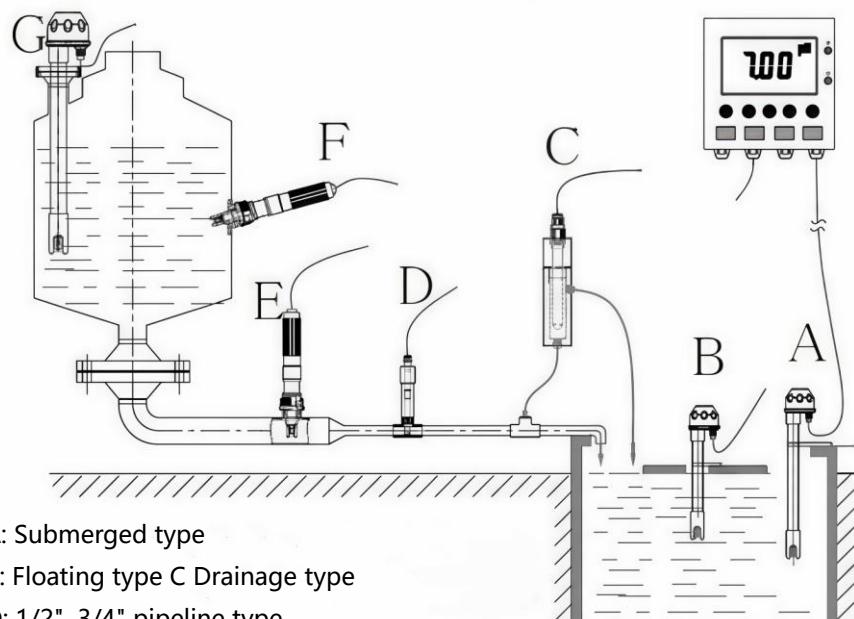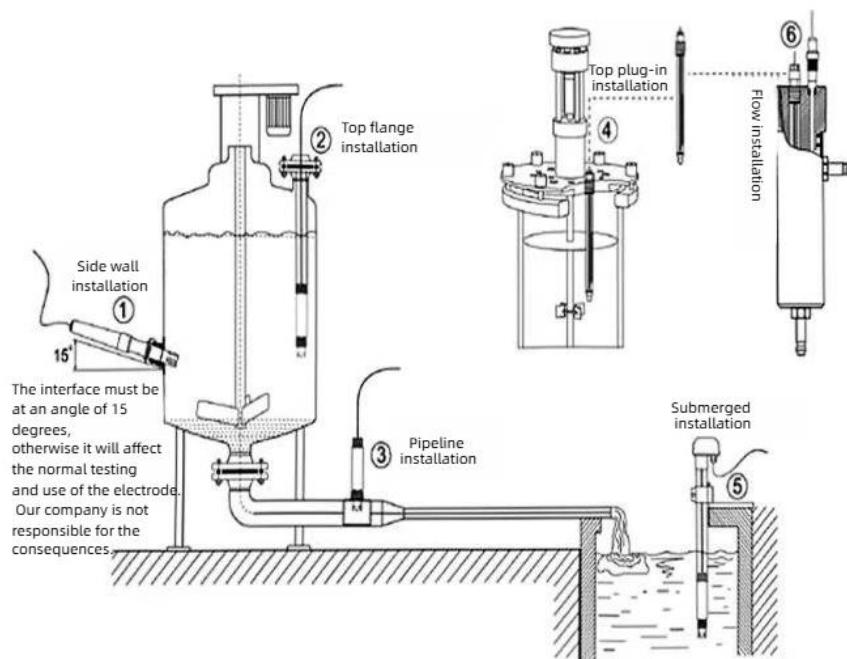
A: Submerged type

B: Floating type C Drainage type

D: 1/2", 3/4" pipeline type

E: 1" pipeline type F: Side plug-in type

G Top plug-in type

4. Instrument wiring

The pins of the PH/OPR transmitter terminal block are defined as follows:

0V	24V	HO	H	HC	LO	L	LC
NC	REF	TEMP	TEMP	+	-	B	A

(INPUT)

Lc: low point alarm normally closed terminal

L: low point alarm contact

Lo: Low point alarm normally open terminal

Hc: High point alarm normally closed terminal

H: high point alarm contact

Ho: High point alarm normally open terminal

24V: Connect to 220V live wire; if 24V power supply is selected, connect to 24 positive pole

0V -: Connect to 220V neutral line; if 24V power supply is selected, connect to 24 negative pole

A: connect to 485 communication

B: connect to 485 communication

-: negative end of 4-20mA output

+: 4-20mA output positive terminal

TEMP: one of the temperature terminals connected to the PH/OPR electrode

TEMP: one of the temperature terminals connected to the PH/OPR electrode

REF: Connect to the reference terminal of the PH/OPR electrode

Measurement: The middle stainless steel terminal is connected to the measurement terminal of the PH/OPR electrode

Note: If you choose DC24V power supply, the 7th pin is DC24V positive, and the 8th pin is DC24V negative; the other pins remain unchanged. The two wires for temperature compensation are not in order.

Chapter 5 Instrument Use

1. Display and function keys

The PH-501 online PH/OPR meter uses a 128*64 large-screen LCD to display time, PH/OPR value or mV number, temperature value, and 4-20mA current output value. It is eye-catching and has a long visible distance to meet the different usage habits of users.
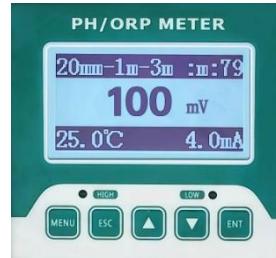
PH measurement mode interface ORP measurement mode interface

Interface display description:

The first line: displays the current time;

The second line: displays the measured PH or ORP value;

The third line: displays the current measured temperature value and the output 4-20mA current value;

Function button description:

Press the "MENU" button to enter the menu interface. Please enter the correct password before entering. The default password is 0000.

Press the "ESC" key to return to the measurement state.

Press the " ▲ " key to scroll up to view parameter items or increase data.

Press " ▼ " Key to scroll down to view parameter items or decrease data.

Press the "ENT" key to store the modified parameter value.

2. Menu Structure

By pressing the M ENU key on the transmitter of the online PH/OPR meter and entering the correct password, you can enter the menu interface. The menu is a single-level menu. The functions and related parameters are shown in the table.

Number	Menu Items	Setting parameters	scope	Initial Value
1	High alarm setting	Set the high alarm relay to open the PH value	-20.00 ~ 20.00PH	1 4.00 PH
2	Low alarm setting	Set the low alarm relay to open the pH value	-20.00 ~ 20.00 PH	0.00 PH
3	4mA Setting	Set the 4mA output current to the corresponding pH value	-20.00 ~ 20.00 PH	0.00 PH
4	20mA Setting	Set the 20mA output current to the corresponding pH value	-20.00 ~ 20.00 PH	1 4.00 PH
5	Hysteresis setting	Set high and low alarm hysteresis values	0.00 ~ 1.00 PH	0.00 PH
6	Time settings	Set current time		Current time
7	Temperature correction	Corrected temperature value	-99.9 ~ +99.9 ℃	0.00

		Enter password	0000-9999	9999
8	Potential value correction	Coefficient Correction	0.900% ~ 1.100%	1.000%
		Offset	-99mV - +99mV	0mV
9	Filter coefficient	Set the filter coefficient value (the larger the value, the more stable it is)	0~ 5	0
10	Two-point calibration	pH meter calibration		
1 1	Already PH calibrated	Correction of pH offset	-20.00 ~ 20.00PH	0.00 PH
1 2	Manual temperature compensation	Temperature compensation value of two composite electrodes	0.0 ~ +99.9 ℃	25.0℃
1 3	Password Settings	Set a password to enter the menu	0000-9999	0000
1 4	Communication Settings	Set the instrument number	0-255	001
		Baud rate		9600
1 5	Factory settings	Restore factory settings	Password: 9999	
16	Current correction	Corrected 4-20mA current output offset	-9.99 ~ +9.99mA	0.00mA
1 7	Historical data	Record data for the past three days (1 point/h)		
1 8	Flushing relay	PH flushing relay switch and interval time		
19	Measurement Mode	Set to display pH or ORP value		pH

20	Contact Us			

Online pH/ORP meter is installed, the operator can calibrate the PH/OPR meter through the 10th or 11th menu and it will work normally : **It is recommended to use the default factory settings for other menus. It is best not to correct them by yourself. Please make corresponding settings according to the actual situation under the guidance of professionals.**

Chapter 6 PH/OPR calibration

When using the instrument for the first time, since the PH/OPR electrode is relatively dry, it may affect the instrument's measurement. Therefore, it is recommended that you immerse the electrode sensor in the electrode soaking solution for 2 hours.

1. Preparation method of electrode immersion solution:

1. Weigh 223.65 g of potassium chloride reagent and dissolve it in one liter of distilled or deionized water.

2. Prepare pH 4.00 standard buffer (refer to the section on preparing standard buffer).

3. Mix potassium chloride solution and pH 4.00 standard buffer solution in a 1:1 ratio.

If you are unable to prepare the electrode soaking solution, you can temporarily use tap water instead. Note: Do not use distilled water or pure water to soak the electrode, otherwise the response speed of the electrode sensor will become very slow.

2. Precautions before PH/OPR calibration:

When the electrode is used for the first time, it must be calibrated with two-point standard solution, and then calibrated at regular intervals. If you want to ensure the measurement accuracy of the instrument, you must also use two-point standard solution calibration.

1. Check that the electrode sensor is clean and that no contaminants are attached to the sensitive bulb or reference core. Confirm that the standard buffer is fresh, accurate, and free of any contamination.

2. The sensitive bulb of the PH/OPR electrode sensor is very thin. Please be careful not to bump it during calibration.

3. When the electrode is taken out of one solution and placed in another solution, it is necessary to wash it in distilled water and absorb the water droplets on the electrode with filter paper.

4. Do not wipe the electrode sensor, otherwise the electrode will be charged with static electricity and affect the calibration accuracy.

Standard buffer preparation method:

1. Take out the pH 4.00 standard buffer reagent, cut open the seal, and pour it into a 250ml volumetric flask.

2. Add 250 mL of distilled water to the volumetric flask and stir the solution until all the reagents in the flask are dissolved.

The preparation method of different types of bagged standard buffer reagents is the

same. After the preparation is completed, you should have a pH4.00/6.86/9.18 standard buffer set.

Storage of standard buffer:

1. The prepared standard buffer solution must be stored in a sealed container and should be kept away from direct sunlight.

2. It is recommended that you store the prepared calibration solution at an ambient temperature of 5°C.

3. If flocs appear in the standard buffer, do not use it again, otherwise the calibration accuracy will be affected.

3. Calibration

The online PH/OPR meter has two calibration methods: **two-point standard solution calibration** and **known pH calibration.**

Two-point calibration:

◆ Press the menu to enter item 10: two-point calibration interface:

9. filter set
＊ 10. two points
11. ph offset
12. hm temp

select point:
＊ 6.86 and 4.00
6.86 and 9.18
4.00 and 9.18

the pH range that the user needs to test . This table has three ranges to choose from: **"6.86 and 4.00** ", " **6.86 and 9.18** ", and **"4.00 and 9.18** ".

◆ Select one of the ranges to enter the next interface, for example, select " **4.00 and 6.86**

". Press the "ENT" key, and the instrument will first display the first screen in the figure below (the mV number in the figure is for reference only).

Place 6.86:	Place 4.00:
+ 10.0mV	**+ 176.0mV**
exit　　　　enter	exit　　　　enter

◆ After cleaning the electrode, first put it into the 6.86 standard solution and wait for the value to stabilize, which usually takes a few minutes. After it stabilizes, press the "ENT" key and the instrument will enter the next "Put it into 4.00 standard solutions" interface. Take the electrode out of the 6.86 standard solutions, clean it, and then put it into the 4.00 standard solutions. Also wait for the value to stabilize, which usually takes a few minutes. After it stabilizes, press the "ENT" key. The instrument will automatically calculate E0 and S and display the following interface, and the calibration is completed.

> **calibration succeed!**
> E0=0. 00
> S=59.16
> 　　　　enter

◆ If the measured mV value has a large deviation during calibration, the instrument will display the following interface after pressing the ENT key.

> **calibration error!**
> 1. Standard solution correct?
> 2. Reclean the electrode。
> 3. Replace with a new electrode。

4. Calibration with known PH/OPR

During the instrument measurement process, if the measured value is found to have a slight deviation, it can be corrected through the known PH/OPR calibration in item 11.
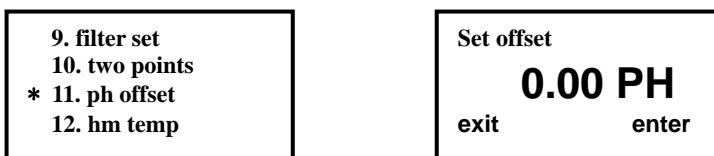
```
┌─────────────────────┐   ┌─────────────────────┐
│    9. filter set    │   │ Set offset          │
│   10. two points    │   │      0.00 PH        │
│ ∗ 11. ph offset     │   │                     │
│   12. hm temp       │   │ exit         enter  │
└─────────────────────┘   └─────────────────────┘
```

If the instrument measured value is smaller than the actual value, press the ▲ key to increase the corresponding PH offset; if the instrument measured value is larger than the actual value, press the ▼ key to reduce the corresponding PH offset.

Chapter 7 ORP Calibration

If the online OPR meter is equipped with an ORP electrode, it can measure the redox potential of the solution. The function can be switched through "Item 19: Measurement Mode" in the menu, as shown in the figure below.

```
┌─────────────────────┐   ┌─────────────────────┐
│   17. data rom      │   │ select mode：        │
│   18. auto flush    │   │    1. PH mode       │
│ ∗ 19. display       │   │ ∗ 2. ORPmode        │
│                     │   │ exit         enter  │
└─────────────────────┘   └─────────────────────┘
```
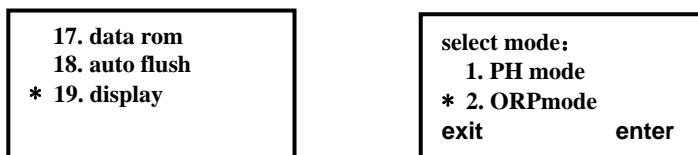
ORP value calibration:

If the ORP value is found to deviate from the actual value during the measurement process, it can be corrected through "Menu 8: Potential Value Correction " .

```
┌─────────────────────┐   ┌─────────────────────┐
│    5. buffer set    │   │ Set offset：         │
│    6. time set      │   │   +   0.0mV         │
│    7. temp set      │   │                     │
│ ∗ 8. mv set         │   │ exit         enter  │
└─────────────────────┘   └─────────────────────┘
```

If the instrument measured value is smaller than the actual value, press the ▲ key to increase the corresponding mV offset; if the instrument measured value is larger than the actual value, press the ▼ key to reduce the corresponding mV offset.

Chapter 8 High and Low Alarms and Hysteresis

1. High and low alarm settings

The instrument is equipped with two sets of high and low alarm relays as standard, each set has two sets of contacts, normally open and normally closed, for users to make various combination control settings.

```
＊ 1. high relay            1. high relay
   2. low relay          ＊ 2. low relay
   3. 4mA set              3. 4mA set
   4. 20mA set             4. 20mAset
```

```
Low relay：                High relay：
   14.00PH                  0.00PH
exit         enter       exit         enter
```
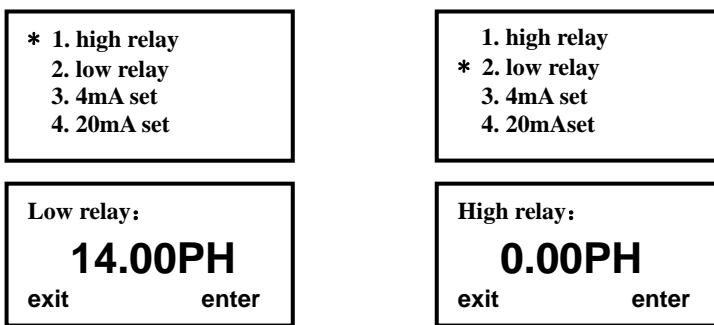
2. Hysteresis setting

The contacts of the instrument alarm relay are used by the user to connect the corresponding control appliances (such as solenoid valves, etc.) to form a control system. In order to avoid the relay contacts from shaking near the alarm point, the secondary meter adopts the method of hysteresis cancellation.

When the preset alarm upper (lower) limit is reached, the relay is immediately closed and the pH value flashes on the screen to alarm. However, when the pH value drops (rises) back to the alarm upper (lower) limit , the alarm will not be canceled immediately. It will not be canceled until it continues to drop (rise) by a Δ pH value, i.e. , the hysteresis value (generally Δ pH is set to 0.05 pH).

The alarm hysteresis is set as follows:

```
┌─────────────────────┐     ┌─────────────────────┐
│ ＊ 5. buffer set     │     │  Buffer offset：     │
│    6. time set       │     │                      │
│    7. temp se        │     │    0.00PH            │
│    8.  mv set        │     │  exit        enter   │
└─────────────────────┘     └─────────────────────┘
```
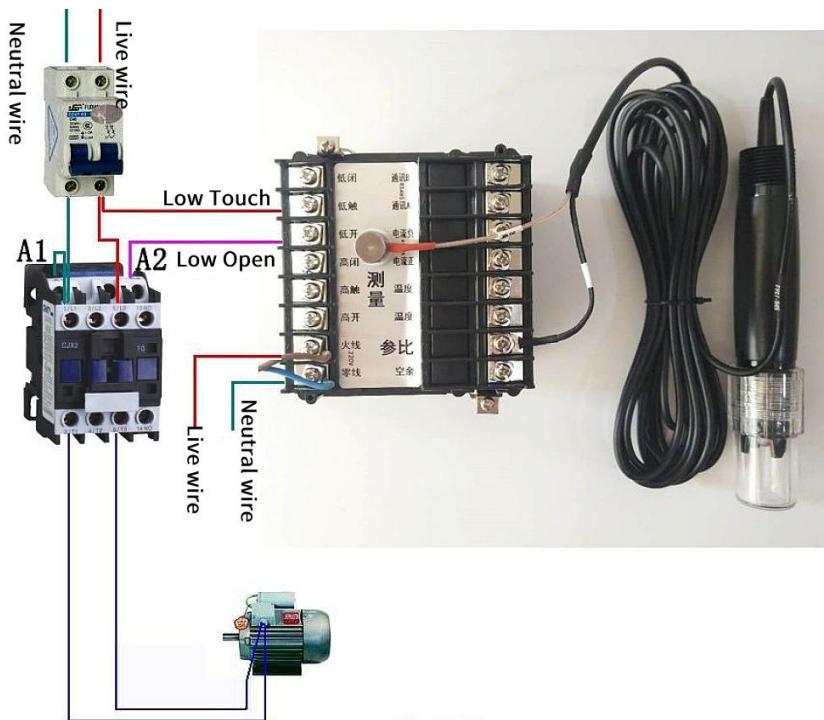

Connection method of alkali pump

1. When adding alkali, use the two terminals of low touch and low open.

2. The instrument setting method is as follows:

For example: add alkali when the pH value is lower than 6.00,

and stop adding alkali when it rises to 8.00.

Set as follows:

The first menu: set the high alarm to 14.00PH

(Not used, the high alarm is to control the acid addition, so it is set to the default value,)

The second menu: set the low alarm to 6.00PH

The fifth menu: set the low point in the hysteresis menu to 2.00PH

(The hysteresis is the hysteresis, 8.00-6.00=2.00PH, the high point in the hysteresis is not used, set to the default value 0.00PH.)
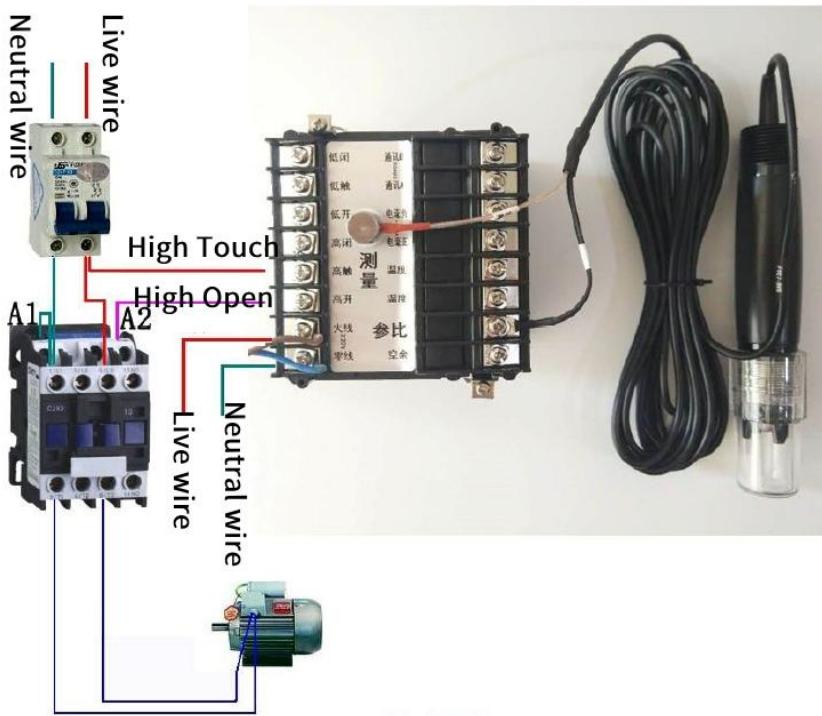
How to connect the acid pump

1. When adding acid, use the high touch and high open terminals.

2. The instrument setting method is as follows:

For example: add acid when the pH value is higher than 9.00,

and stop adding acid when it drops to 7.00.

Set as follows:

The first menu: set the high alarm to 9.00PH

The second menu: set the low alarm to 0.00PH

(The low alarm is not used to control the addition of alkali, so it is set to the default value of 0.00)

The fifth menu: set the high point in the hysteresis menu to 2.00PH,

and the low point in the hysteresis menu to 0.00PH

(The hysteresis is the hysteresis, 9.00-7.00=2.00PH, the low point in the hysteresis

is not used, so it is set to the default value of 0.00PH.)

Chapter 9 Precautions and Maintenance

◆ The secondary meter generally does not require daily maintenance. When an obvious fault occurs, please do not open it and repair it yourself, but contact us as soon as possible!

◆ After starting the power supply, the instrument should have a display. If there is no display or the display is abnormal, turn off the power supply immediately and check whether the power supply is normal and whether the fuse is intact.

◆ The cable connector must be kept clean and free from moisture or water, otherwise the measurement will be inaccurate.

◆ The electrodes should be cleaned frequently to ensure they are not contaminated.

◆ The electrodes should be calibrated at regular intervals.

◆ During water outage, make sure the electrode is immersed in the measured liquid, otherwise its life will be shortened. The quality of pH meter depends largely on the maintenance of the electrode.

PH/ORP meter MODBUS communication protocol
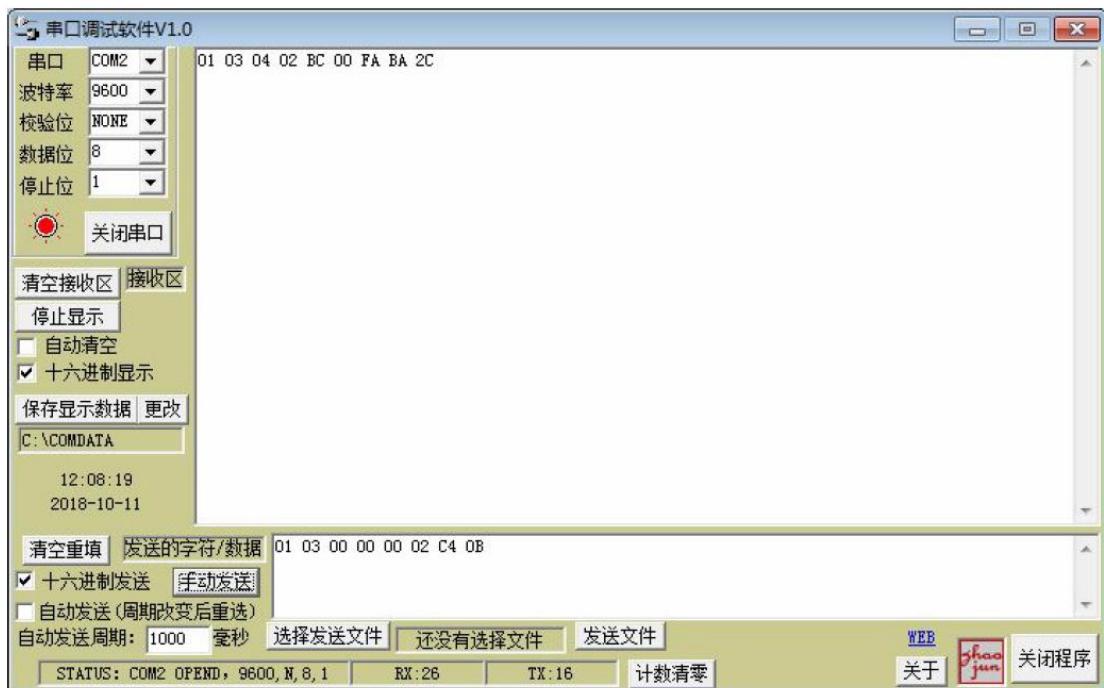
Wiring method: PH controller communication A is connected to the A terminal of 485 to USB; PH controller communication B is connected to the B terminal of 485 to USB.

Serial port debugging assistant communication parameter settings: 9600, N, 8, 1; the PH instrument address number in the above figure is 01;

Please set the data sent according to the above figure 01 03 00 00 0002 C4 0B to test whether the communication is normal

MODSCAN32 communication parameter setting: Please set as shown in the figure;

ADDRESS is 001; length

The number of data is 2;

40001 represents the PH value amplified 100 times;

40002 represents the temperature value amplified 10 times;

1.Command format for batch reading of pH value and temperature value registers

Master station request command format:

Definition	Address	Function Code	First register address		Number of data		CRC check code	
Data	Address	0X03	0X0000		0X0002		CRC-16/MODBUS	
	0-255		Hi	Lo	Hi	Lo	Hi	Lo
Bytes	1 byte	1 byte	2 bytes		2 bytes		2 bytes	

For example, data: 01 03 00 00 00 02 C4 0B

Address: 01 represents the instrument number of the communication setting in instrument menu 14

The slave station responds in the following format:

Definition	Address	Function Code	Number of data		PH data		Temperature Data		CRC check code	
Data	Address	0X03	0X0002		0X0000		0X0000		CRC-16/MODBUS	
	0-255		Hi	Lo	Hi	Lo	Hi	Lo	Hi	Lo
Bytes	1 byte	1 byte	2 bytes		2 bytes		2 bytes		2 bytes	

For example, data: 01 03 04 02 BC 00 FA BA 2C

Definition	Address	Function Code	First register address		Number of data		CRC check code	
Data	Address	0X03	0X0001		0X0001		CRC-16/MODBUS	
	0-255		Hi	Lo	Hi	Lo	Hi	Lo
Bytes	1 byte	1 byte	2 bytes		2 bytes		2 bytes	

Explanation: Instrument address 01; Function code 03; Number of data bytes 4; Read the contents of two register addresses in succession.

The PH value is 7.00 (0X02BC is 700 in decimal); The temperature value is 25.0 (0X00FA is 250 in decimal); The lower 8 bits of the check code are 03, and the upper 8 bits are F1;

2. Command format for reading only one pH value register address

Master station request command format:

Definition	Address	Function Code	First register address		Number of data		CRC check code	
Data	Address	0X03	0X0000		0X0001		CRC-16	
	0-255		Hi	Lo	Hi	Lo	Hi	Lo
Bytes	1 byte	1 byte	2 bytes		2 bytes		2 bytes	

For example, sending data: 01 03 00 00 00 01 84 0A

Address: 01 represents the instrument number in the communication setting in instrument menu 14

The slave station responds in the following format:

Definition	Address	Function Code	Number of data		PH data		CRC check code	
Data	Address	0X03	0X0001		0X0000		CRC-16/MODBUS	
	0-255		Hi	Lo	Hi	Lo	Hi	Lo
Bytes	1 byte	1 byte	2 bytes		2 bytes		2 bytes	

For example, the data received is: 01 03 02 02 BC B8 95

Explanation: Instrument address 01; Function code 03; Number of data bytes 2; Read only the content of 1 register address (ph).

The PH value is 7.00 (0X02BC is 700 in decimal); The lower 8 bits of the check code are B8, and the upper 8 bits are 95;

2. Command format for reading only one temperature register address

Master request command format:

For example, sending data: 01 03 00 01 00 01 D5 CA

Address: 01 represents the instrument number of the communication setting in instrument menu 14

Slave station response return format:

Definition	Address	Function Code	Number of data		Temperature data		CRC check code	
Data	Address	0X03	0X0001		0X0001		CRC-16/MODBUS	
	0-255		Hi	Lo	Hi	Lo	Hi	Lo
Bytes	1 byte	1 byte	2 bytes		2 bytes		2 bytes	

For example, the data received is: 01 03 02 00 FA 38 07

Explanation: Instrument address 01; Function code 03; Number of data bytes 2; Read only the content of 1 register address (temperature).

The temperature value is 25.0 (0X00FA is 250 in decimal); The lower 8 bits of the check code are 38, and the upper 8 bits are 07;

A register contains 2 bytes