BH-485-NH

Ammonia Nitrogen Sensor

User Manual

Shanghai BOQU Instrument Co.,Ltd

Table of Contents

Chapter 1 Product Overview

1.1 Product Information

The ammonia nitrogen concentration was measured by an ion selective electrode method. The ammonium ion selective electrode directly detects the ammonium ion in the water environment to determine the concentration of ammonia nitrogen. Use a pH electrode as a reference electrode for better stability. The concentration of ammonia nitrogen in the measurement process is easily interfered by potassium ions, so potassium ion compensation is required.

The ammonia nitrogen probe is an integrated sensor that is composed of ammonium ion selective electrode, potassium ion (optional), pH electrode and temperature electrode. These parameters can mutually correct and compensate the measured value of ammonia nitrogen, and meanwhile achieve the measurement for multiple parameters.

It is widely used to measure the value of ammonia nitrogen in the nitrification treatment and aeration tanks of the sewage treatment plants, industrial engineering as well as river water. The technical parameters are shown in Table 1.

Specification	**Details**
Measurement Range	NH4N：0.1-1000 mg/L K+：0.5-1000 mg/L （Optional） pH：5-10 Temperature：0-40℃
Resolution	NH4N：0.01 mg/l K+：0.01 mg/l（Optional） Temperature：0.1℃ pH：0.01
Measurement Accuracy	NH4N：±5 % of the measured value or ± 0.2 mg/L, take the greater one. K+：±5 % of the measured value or ±0.2 mg/L （Optional） Temperature：±0.1℃ pH：±0.1 pH

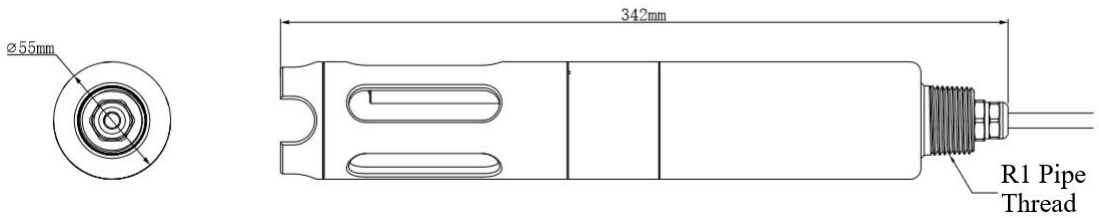
Response Time	≤2 minutes
Minimum Detection Limit	0.2mg/L
Communication Protocol	MODBUS RS485
Storage Temperature	-15 to 50℃ (Non-frozen)
Working Temperature	0 to 45℃(Non-frozen)
Size	55mm×340mm（Diameter*Length）
Weight	<1KG；
Level of Protection	IP68/NEMA6P；
Length of Cable	Standard 10-meter long cable, which can be extended to 100 meters
Outer Dimension： 	

Table 1 Technical specification of Ammonia Nitrogen Probe

Note: Product specifications are subject to change without notice.

1.2 Safety Information

Please read this manual thoroughly before unpacking, setting up or operating the instrument.

Pay special attention to all hazard and warning statements. In the event of mishandling, it may cause serious injury to the operator or damage to the equipment.

This equipment must be used and installed only in accordance with the detailed instructions in this manual.

1.2.1 Use of Danger Information

For all the hazards occurred, this manual will use signal specific term (Danger, Caution, Note) that correspond to the degree of danger.

Danger

Refers to a potentially or imminently dangerous state that, if not prevented, could be life-threatening or cause serious injury.

Caution

Refers to a potentially dangerous state that may cause mild or moderate injury.

Important Note: Information that requires special emphasis.

Tip: Information in the text that supplements the points

1.2.2 Warning and Prevention Labels

Please read all the labels and identifiers attached to the instrument carefully, otherwise it may cause personal injury or damage to the instrument.

	If the label is marked on the instrument, refer to the instrument manual for operation and/or safety information.
	If the label is marked on the product, it indicates that there is a fuse or current limiting device.
	If the label is marked on the product, it indicates that the device is susceptible to static electricity leakage and protective measures should be taken to prevent damage.
	If the label is marked on the product, it indicates the location of the ground wire.

1.3 Pressure Limit

The maximum pressure for the immersion of the probe is less than or equal to 10 meters. When the pressure for the underwater probe is greater than 10 meters, it will be mechanically damaged and deformed.

1.4 Temperature Limit

The storage temperature for the probe should be non-frozen, ranging from 0 to 45 ° C, while its working temperature should be non-frozen ranging from 0 to 40 ° C; Otherwise, exposing the probe outside of the above temperature range may result in mechanical damage and electric failure.

To prevent the probe from freezing, please store the probe in a place where it will not freeze.

1.5 Minimum Requirement for the Depth

In order to prevent the sun exposure sensor, the sensor body must be completely submerged by water when in use.

Chapter 2 Introduction to the Probe

The ammonia nitrogen probe is composed of four sensors: temperature, pH, ammonia nitrogen, and potassium ion (optional), which can be used to monitor the wide range of physical, biological and chemical properties of natural waters.

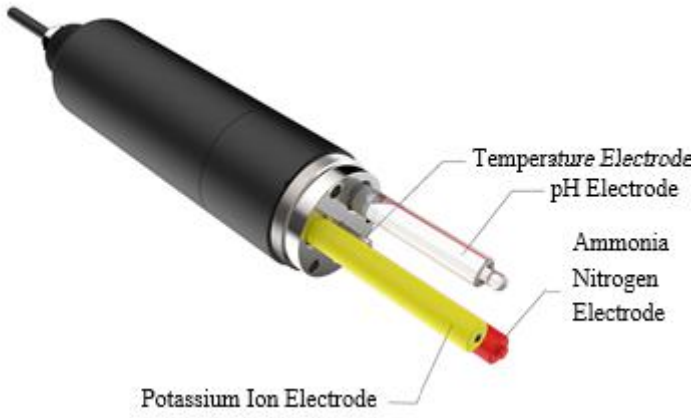


Figure 1 Structure Diagram of Ammonia Nitrogen Probe

2.1 Temperature Sensor

Principle：

Temperature is a measurement of the amount of heat existing in a certain body of water, and it is considered to be a very important single parameter, for it affects the other parameters of the water quality and controls the metabolism of aquatic animals and plants.

The temperature sensor uses the thermistor to measure the temperature of the water. The resistance value of the thermistor changes with temperature, and the measured resistance value can be converted into a temperature value using a corresponding calculation formula. This formula has been programmed into the host software, and users can directly view the real-time Celsius temperature through the software. The temperature sensor is shown in Figure 2.

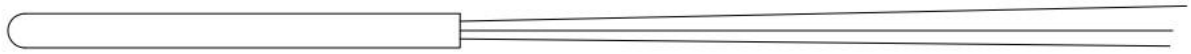


Figure 2 Temperature Sensor

Technical Specification of the Temperature Sensor	
Principle	Thermistor Method
Range	0~40 °C
Resolution	0.1 °C
Accaccuracy	± 0.1 °C

2.2 pH Sensor

Principle：

pH describes the pH value and basic properties of a water body. It is acidic when pH<7.0, neutral when pH=7.0, and alkaline when pH>7.0.

The pH sensor measures the pH value of the water in the glass electrode method. It is composed of two parts, including a glass bubble with a glass film that selectively responds to H+, inside of which it is filled with a 0.1 mol/L HCl internal reference solution, and an internal reference electrode Ag- AgCl. When the electrode is immersed in the solution, the difference between the stable electric potential of the reference electrode and the electric potential generated by the glass bubble is proportional to the H+ concentration in the solution.

The pH sensor measures data with stability, reliable performance and easy installation. Its appearance is

shown in Figure 3.

Important Tip1: When using a new pH electrode, the electrode should be immersed in distilled water for a period of time, usually 24 hours or more, in order to form a good hydration layer. There should be no air bubbles between the bulbs of the inner electrodes of the glass electrodes, and if there are bubbles, the bubbles can escape easily.

Important Tip 2: Provided the pH is used in high sulfur ion environments, which is easy damaged and with short life time.

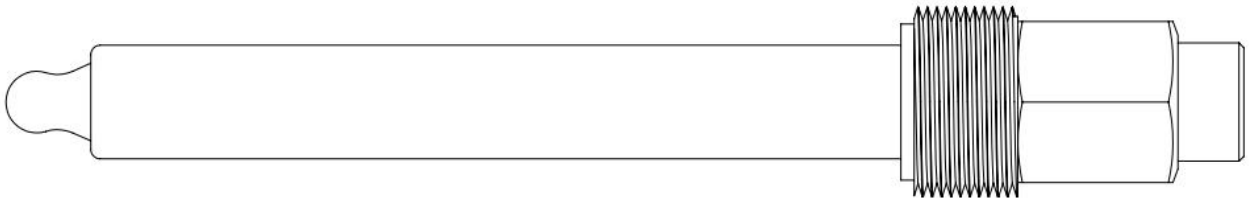


Figure 3 pH Sensor

Technical Specification of pH Sensor	
Principle	Glass Electrode Method
Range	5-10 pH
Resolution	0.01 pH
Accuracy	±0.1 pH

2.3 Ammonia Nitrogen Sensor

The NH4 ion selective electrode is a grid film electrode， the material of which mainly uses a special organic ion exchange membrane that dissolves in the organic solution and penetrates with the PVC mesh. The fields it is widely used include: drinking water, fertilizer, and refrigerant. To use the electrode requires the reference electrode, it has good repeatability and faster response time, but its accuracy is no better than the colorimetric method. The outer appearance of the ammonia nitrogen sensor is shown in Figure 4.

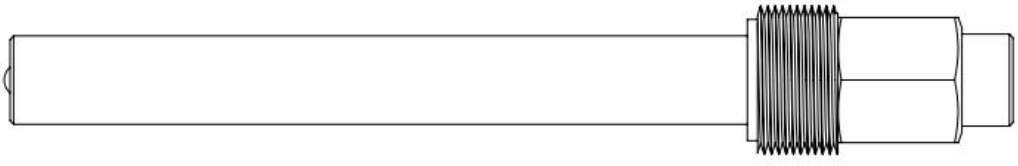


Figure 4 Ammonia Nitrogen Sensor

Technical Specification of Ammonia Nitrogen Sensor	
Principle	Ion Selective Electrode Method
Range	0.1~1000mg/L
Resolution	0.01 mg/L
Accuracy	±5 % of the measured value or ± 0.2 mg/L, take the greater one.

Important Tip: Ammonia nitrogen must be set to no compensation if potassium ions are not purchased and installed.

2.4 Potassium Ion Sensor

The K+ selective electrode is a grid film electrode，the material of which mainly uses a special organic ion exchange membrane. It dissolves in the organic solution and interpenetrates with the PVC mesh, as the potassium ions are similar to ammonium ions in such properties (for example, size and electric charge), and some potassium ions can also penetrate the ion selective membrane of the ammonium ion selective sensor. As a result, the presence of potassium in the sample will result in getting a higher value of the concentration of ammonium measured by the ammonium ion selective sensor. Therefore, with measuring potassium, the effect of potassium can be compensated for in the ammonium concentration measurement. The appearance of the potassium ion sensor is shown in Figure 5.

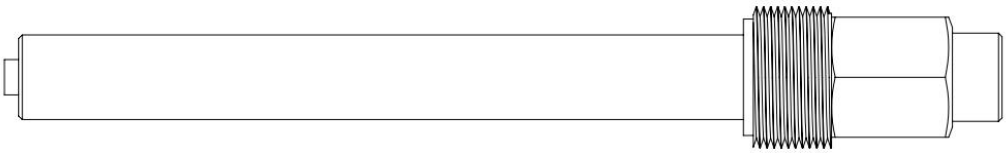


Figure 5 Potassium Ion Sensor

Technical Specification of Potassium Ion Sensor	
Principle	Ion Selective Electrode Method
Range	0.5~1000mg/L（Optional）
Resolution	0.01 mg/L（Optional）
Accuracy	±5 % or ±0.2 mg/L (Optional)

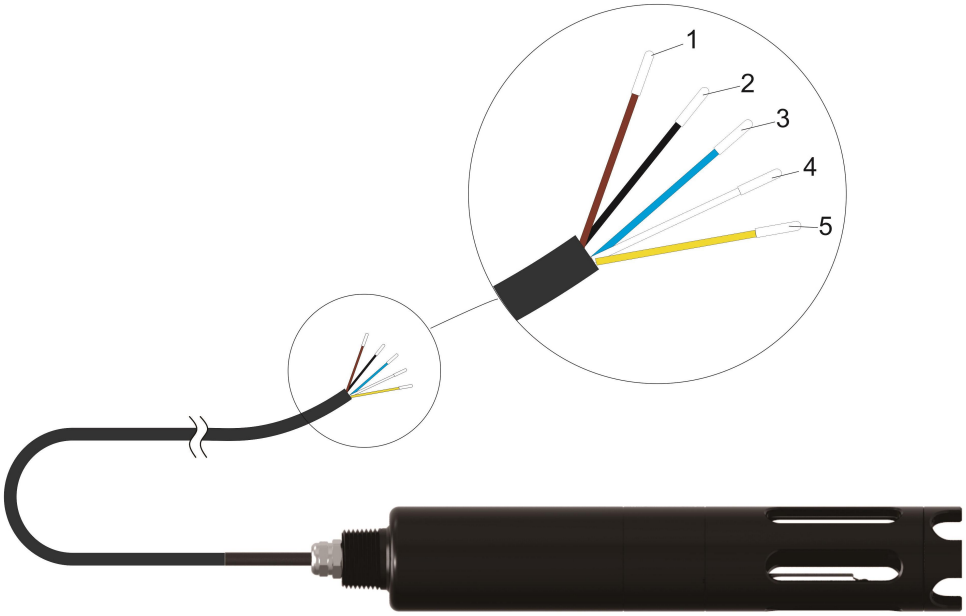
Chapter 3 Installation

3.1Sensor connection

3.1.1 Specific steps for instrument connection

Remove the protective caps before powering the instrument, and then connect the cable core correctly according to the core definition table.

Important Tip: *The power supply of this product is 12VDC. It is not allowed to connect directly to 220VAC or 24VDC power supply. Otherwise, the sensor will be over-pressed and damaged. If there is no suitable power supply at the site, you can use the 220VAC to 12VDC power adapter that is equipped with the instrument and then connect the instrument.*



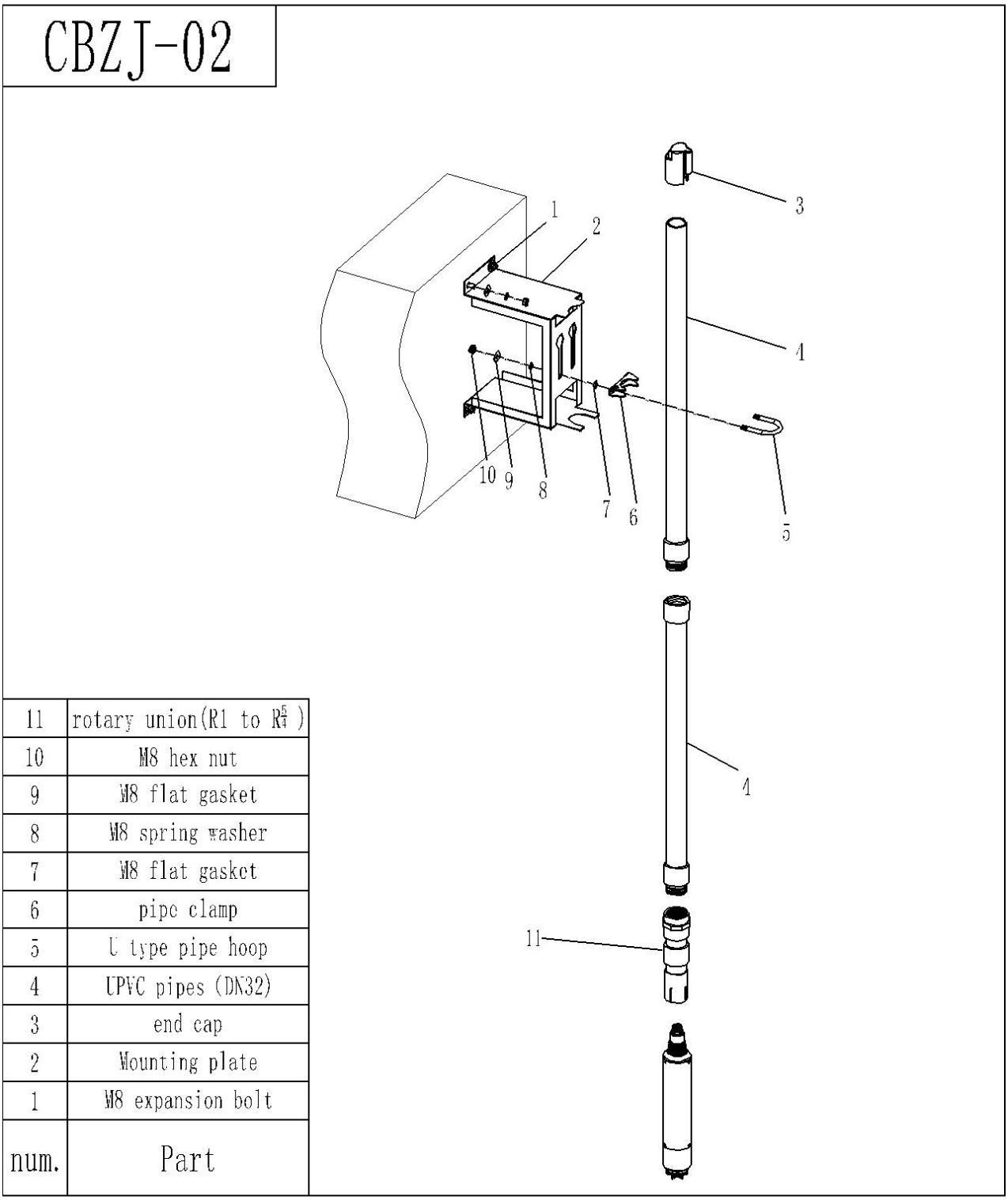
Core Definition Table:

Core No.	1	2	3	4	5
Sensor Wire	**Brown**	**Black**	**Blue**	**White**	**Yellow**
Signal	+12VDC	AGND	RS485 A	RS485 B	CHGND

Connection with software: The ammonia nitrogen sensor has standard MODBUS protocol and RS-485 interface, which can be directly connected to the host computer software to realize real-time online monitoring and data transmission of the instrument.

3.2 Installation of Sensors

3.2.1 Quick Dismantling pool side fixed installation

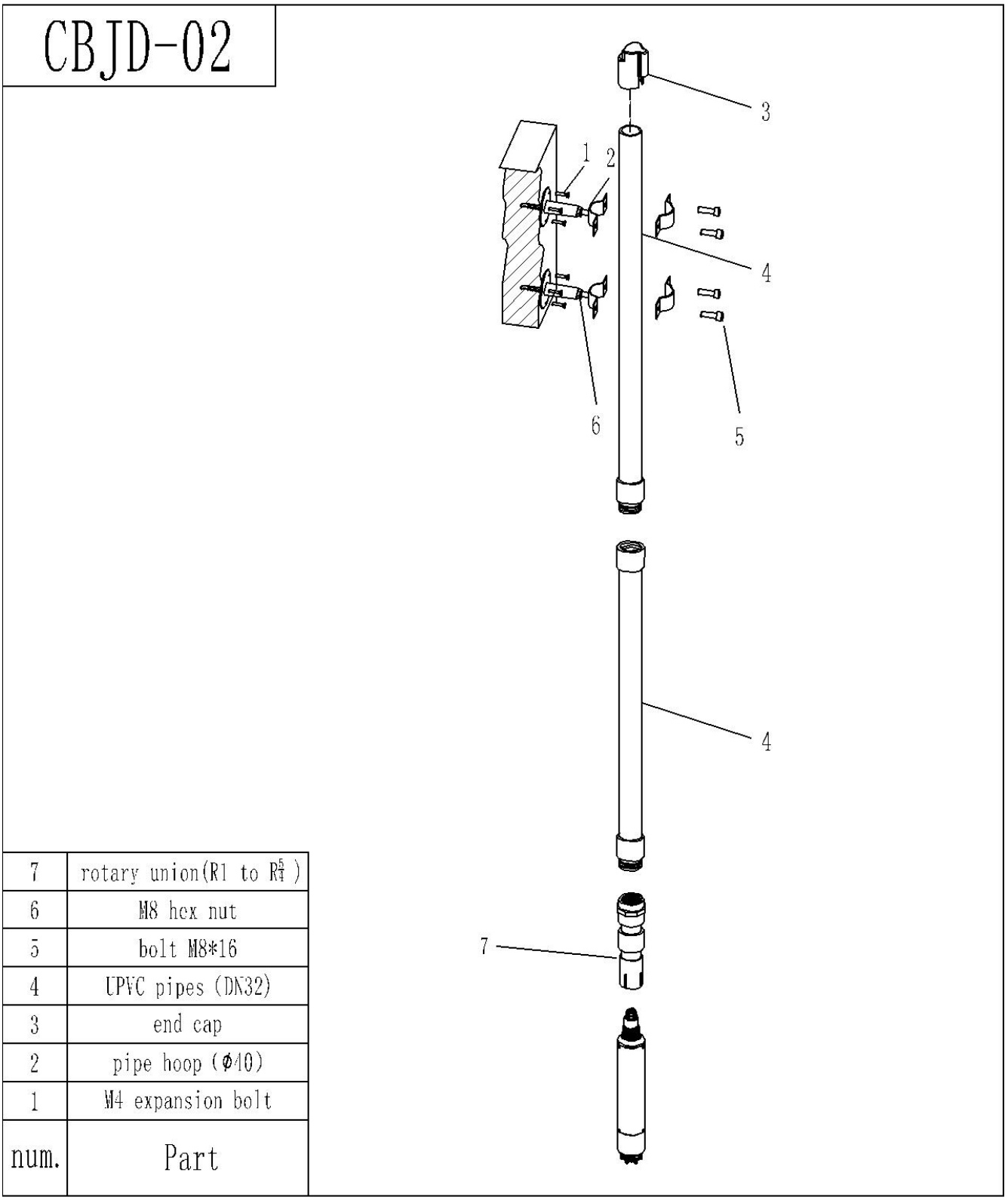


num.	Part
11	rotary union(R1 to R$\frac{5}{4}$)
10	M8 hex nut
9	M8 flat gasket
8	M8 spring washer
7	M8 flat gasket
6	pipe clamp
5	U type pipe hoop
4	UPVC pipes (DN32)
3	end cap
2	Mounting plate
1	M8 expansion bolt

Figure 6 Quick Dismantling pool side installation sketch map

Note: The number 4 mounting tube DN32 indicates that the tube inner diameter is 32mm.

3.2.2 Classic pool side fixed installation

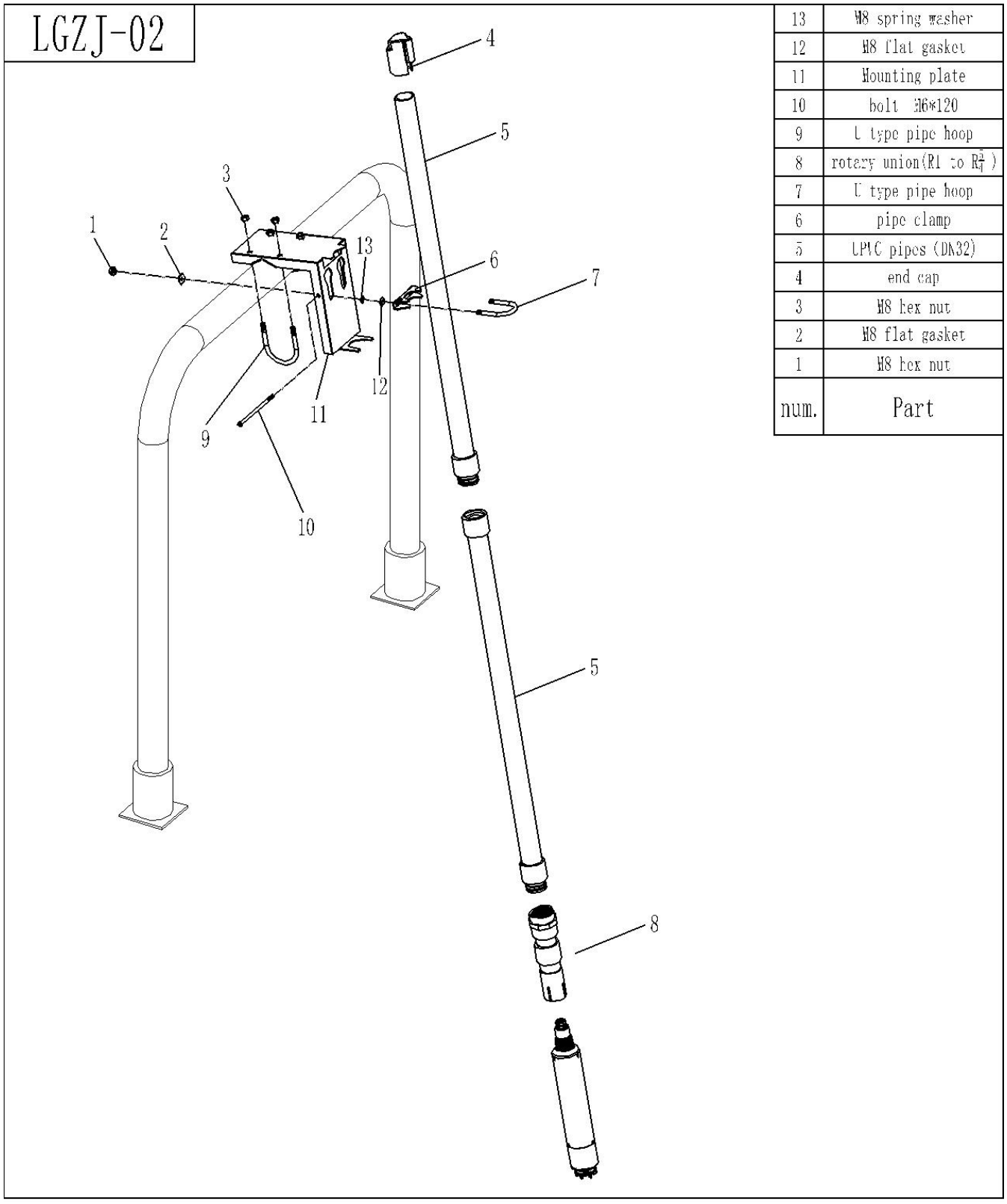


num.	Part
7	rotary union(R1 to R$\frac{5}{4}$)
6	M8 hex nut
5	bolt M8*16
4	UPVC pipes (DN32)
3	end cap
2	pipe hoop (ϕ40)
1	M4 expansion bolt

Figure 7 Classic pool side fixed installation sketch map

Note: The number 4 mounting tube DN32 indicates that the tube inner diameter is 32mm.

3.2.3 Railing fixed installation



num.	Part
13	M8 spring washer
12	M8 flat gasket
11	Mounting plate
10	bolt M6*120
9	L type pipe hoop
8	rotary union(R1 to $R\frac{3}{4}$)
7	U type pipe hoop
6	pipe clamp
5	UPVC pipes (DN32)
4	end cap
3	M8 hex nut
2	M8 flat gasket
1	M8 hex nut

Figure 8 Railing fixed installation sketch map

Note: The number 5 mounting tube DN32 indicates that the tube inner diameter is 32mm.

Note: Avoid the following places when installing the sensor:

1. Where the sunlight directly shines and in the vicinity of the heat appliance.

2. Where the environment temperature exceeds 60 °C during operation.

3. In the vicinity of the electromagnetic source.

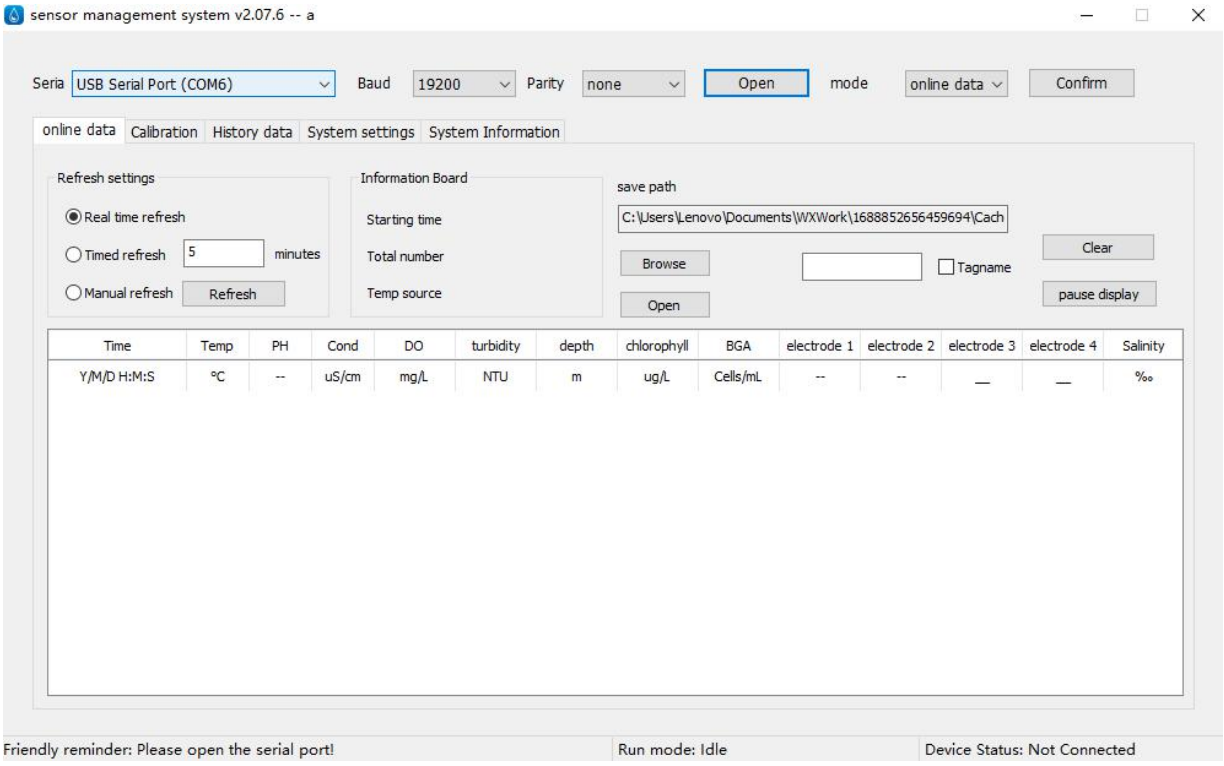
4. Where the mechanical vibration is strong.

5. Where the temperature changes greatly and is likely to dew.

Chapter 4 Software Installation and Use

4.1 Software Installation

Insert the U disk into the computer, open the U disk, double-click the file in the U disk, and install according to the steps. Start the software and the application displays as shown below. Electrode one and electrode two are ion selective electrodes (electrode one is ammonia nitrogen and electrode two is potassium ion).



Tip: *Installing software and shortcuts in advance can give you greater efficiency.*

4.2 Software use

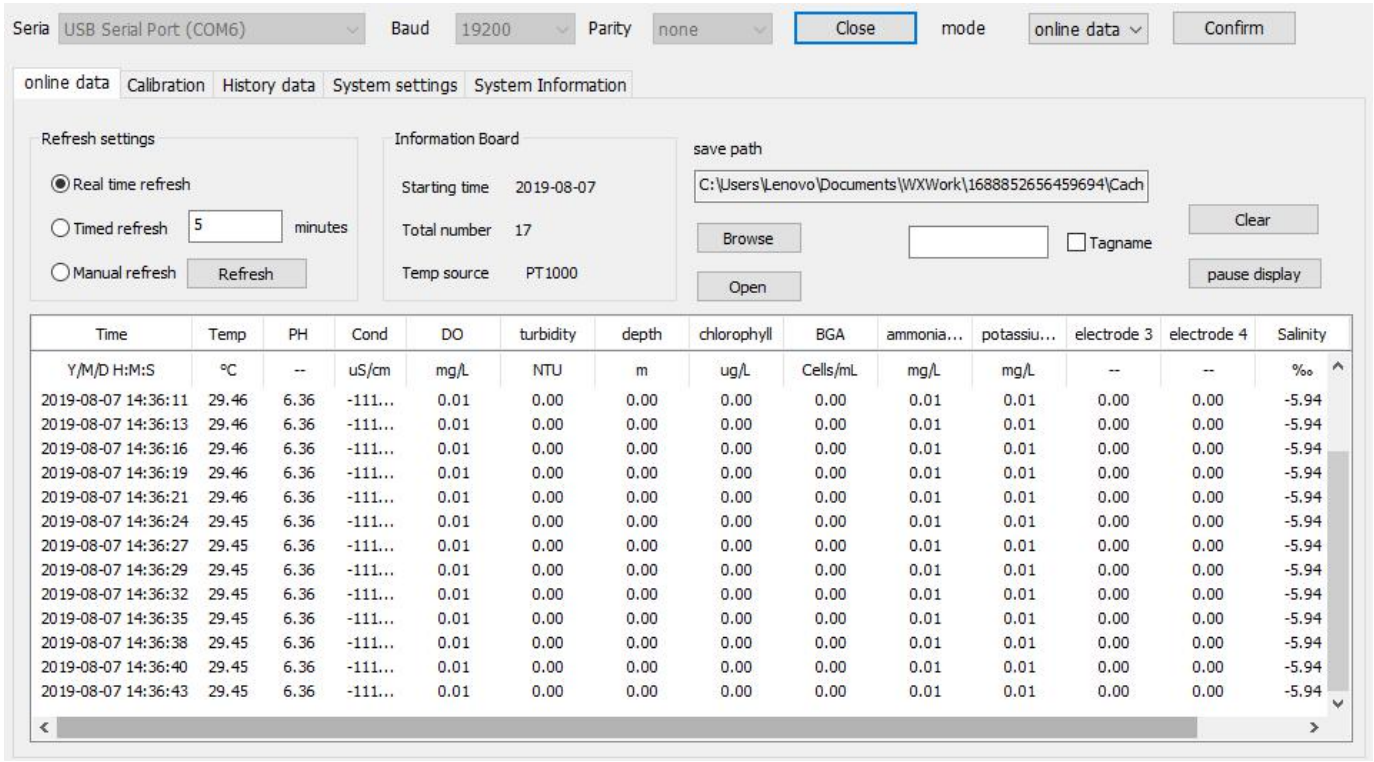
Connect the instrument well. Before measuring the data, run the software first. The serial port will automatically identify the connected serial port. If it is not recognized, please click the serial port to drop the small box and select the port number corresponding to USB. Select the baud rate and finally click Open.

Tip: *If the sensor has been connected as described, and the software prompt has not been connected, remove and replace the USB port or check the USB to RS485 converter, repeat the above operation until the sensor connection is successful.*

4.2.1 Online data

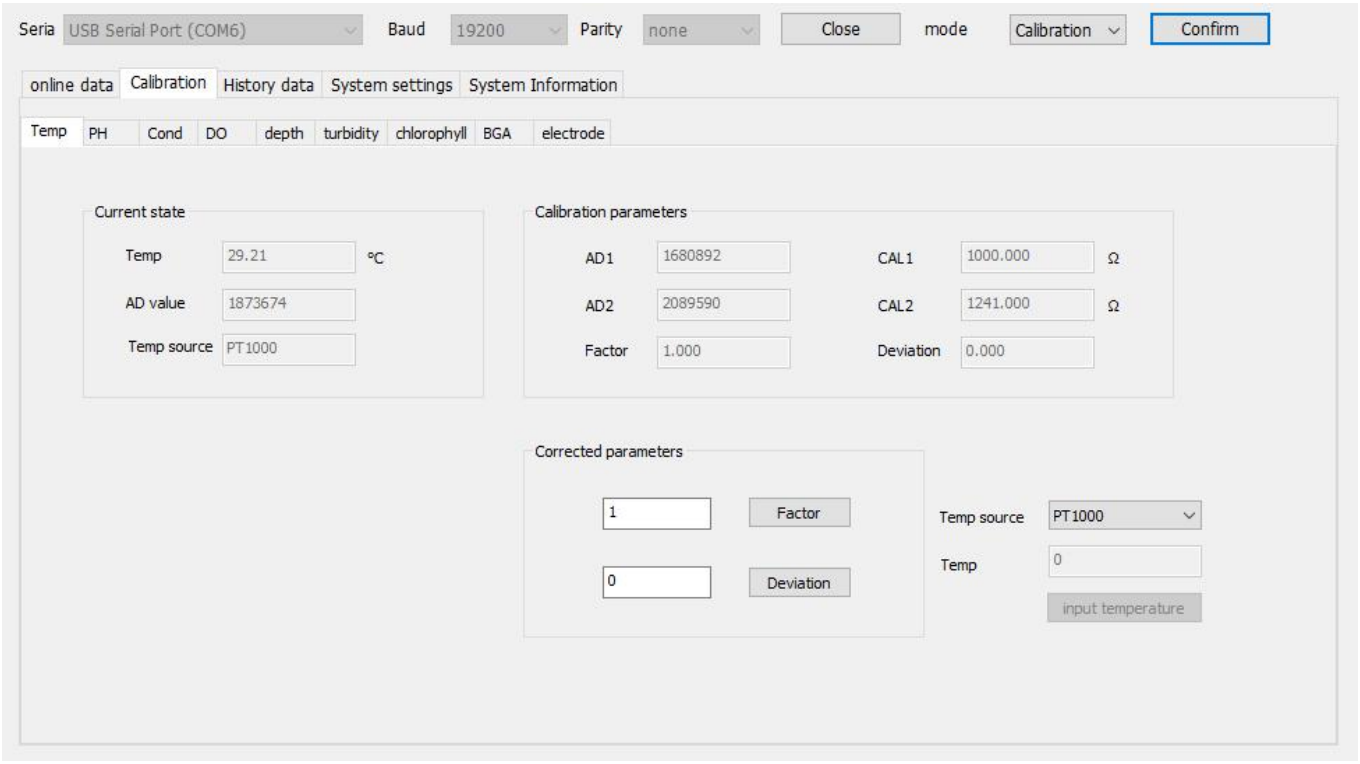
When using online data measurement, first click on the online data and then set the save path, refresh settings, tagname, etc. Then click on the mode setting at the top right of the software and select “Online Data”. Click “Confirm” to monitor the online data in real time. If you select “Auto switch” directly, you do not need to re-select the operating mode when changing the menu bar.

The "starting time", "total number" and "temperature source" of the meter can be viewed in the information board, as shown in the figure below.



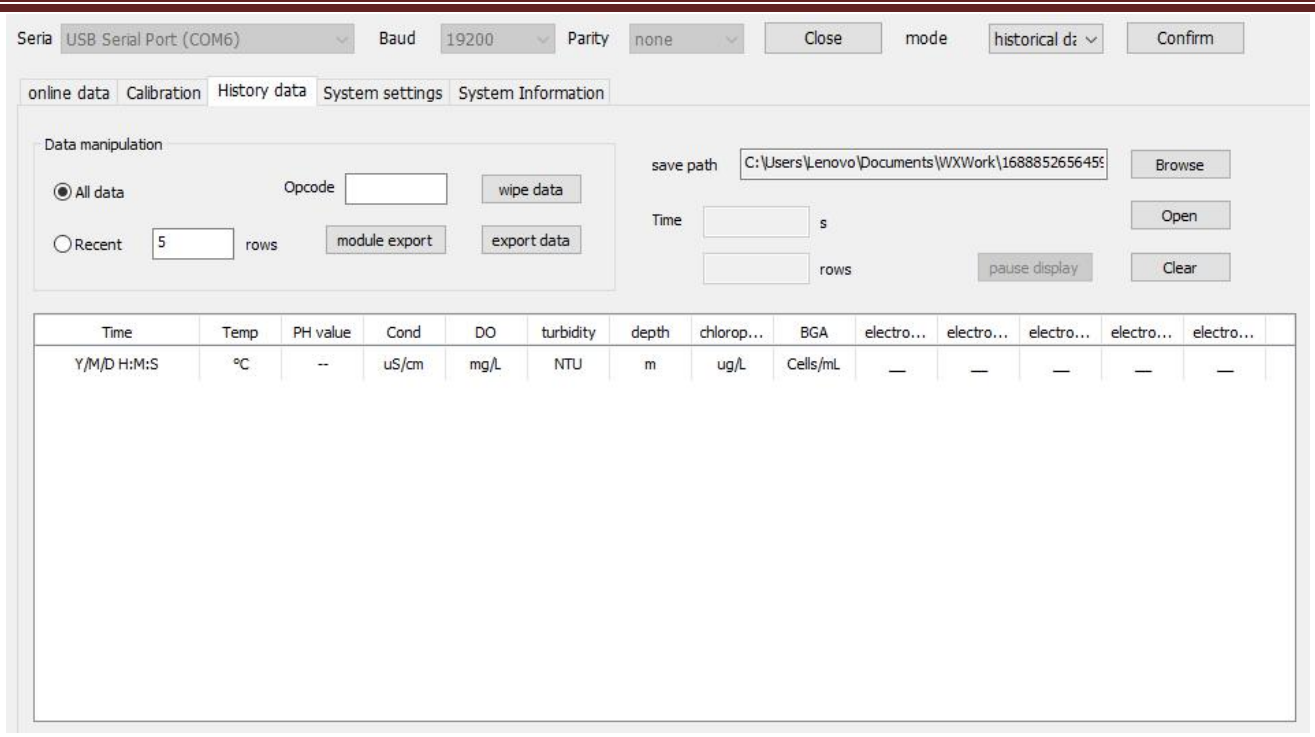
4.2.2 Calibration

Calibration of this module will be specified in the following (Chapter 5 Sensor Calibration) and will not be described in detail here. First select the operation mode in the upper right corner as calibration, then click OK, and select the parameter to be calibrated from the calibration menu to calibrate. If you select “auto switch” directly, you do not need to re-select the operation mode when changing the menu bar. The interface is shown below.



4.2.3 Historical data

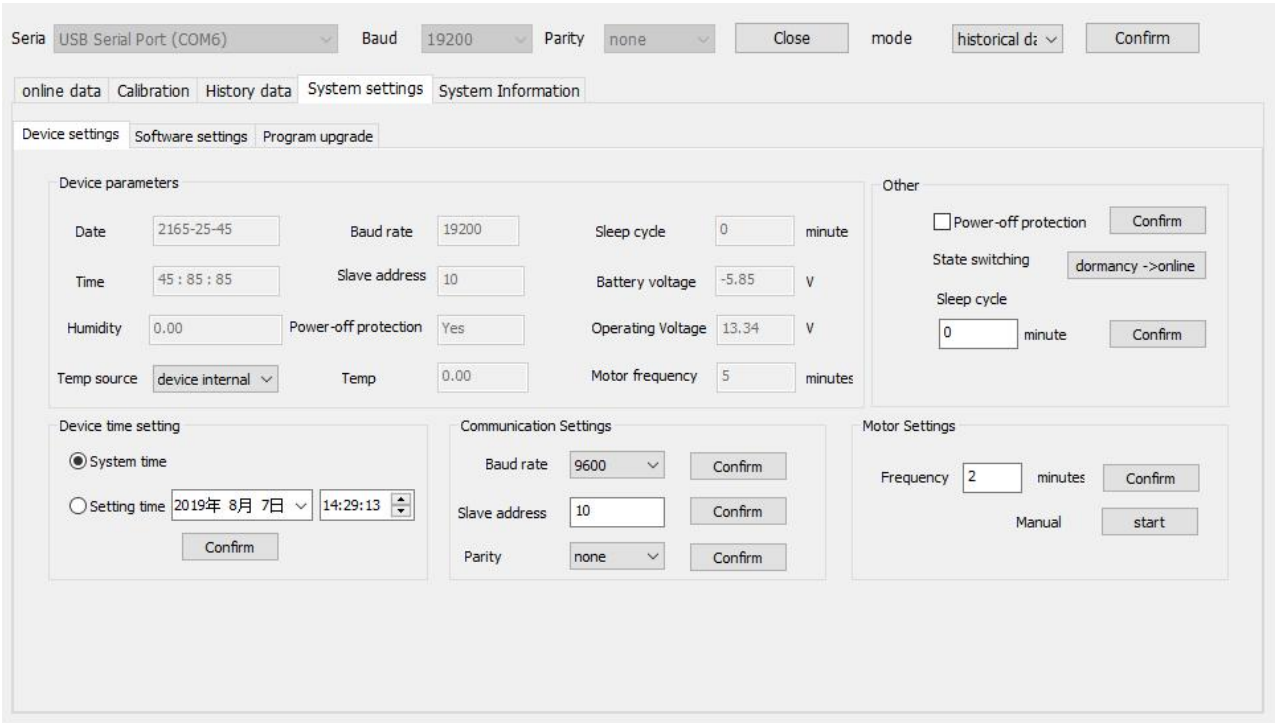
The software has the function of storing historical data. Before viewing historical data, you must first set the running mode to historical data, and then click OK to view the required data in the historical data menu. If you select "Auto switch" directly, you do not need to re-select the operating mode when changing the menu bar. The interface is shown below.



4.2.4 System Settings

4.2.4.1 Device Settings

In the device settings, you can view the current device parameters, as well as set the date, time, humidity, baud rate, slave address, power-off protection, temperature, sleep cycle, battery voltage, operating voltage, motor frequency ect. As shown below.



System time: When the system time is selected, clicking OK will automatically update the computer's

system time to the sensor;

Setting time: When the computer time is not accurate, you can select the setting time. After manually setting the current time and clicking OK, the manually set time will be updated to the sensor.

Communication settings

Baud rate: 4800, 9600, 19200, 38400, 115200. When a baud rate is selected and clicked, the PC will disconnect and need to use the new baud rate to connect.

Slave address: The address is shaped data, the range can be set from 1~255. If the slave address is changed, the PC will not drop the line and reconnect wirelessly.

Motor settings

The ammonia nitrogen sensor does not have a hanging brush function, so there is no need to set it.

Other

Power-off protection: Generally, the setting is set to Yes; after the power-off protection is selected, the sensor will remain in the previous operating state when it is powered off and then re-powered

(For example:

1. Before the power is off, it is online, then power on again. It is still in the online running state;

2. It is the timing acquisition state before the power is cut off, then the power-on is still the timing acquisition state, but it will automatically wait until the next acquisition is started after the acquisition;

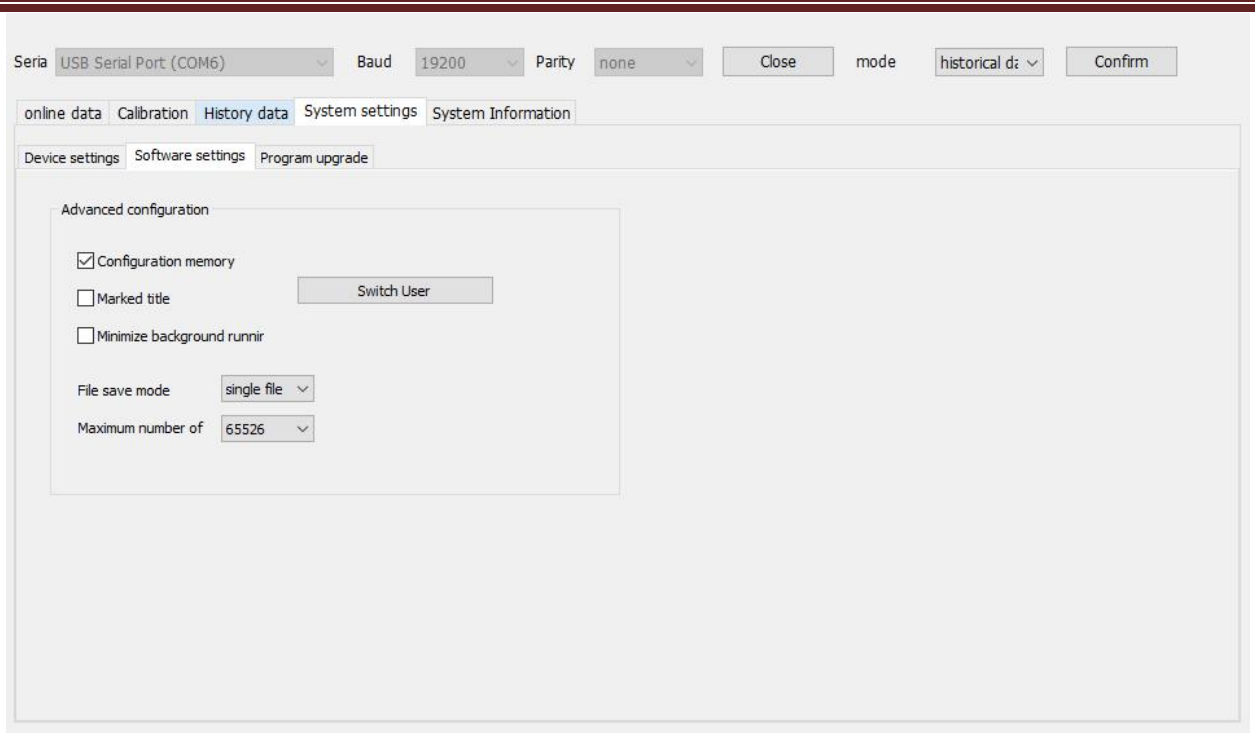
3. The manual shutdown before the power failure state, then power-on is still off, unless the power-on switch is manually triggered ;).

Sleep cycle: It is the timing acquisition operation mode. It is necessary to set the timed acquisition mode to input an integer of more than 5 in the input box, the unit is minute; when set to 0, it means not to enter the timed acquisition mode, ie. On-line real-time acquisition mode; when setting >5, the filled data represents Automatic start, acquisition complete shutdown, to the next automatic start, a full cycle time (for example: fill in 60, indicating a complete cycle is 60 minutes, including "start acquisition time 2~3 minutes, standby time = sleep cycle - When starting the acquisition = 57~58 minutes")

Status switching: This is a shortcut button. This button can quickly set the sleep period of the timing acquisition mode to 0, and quickly switch to online mode.

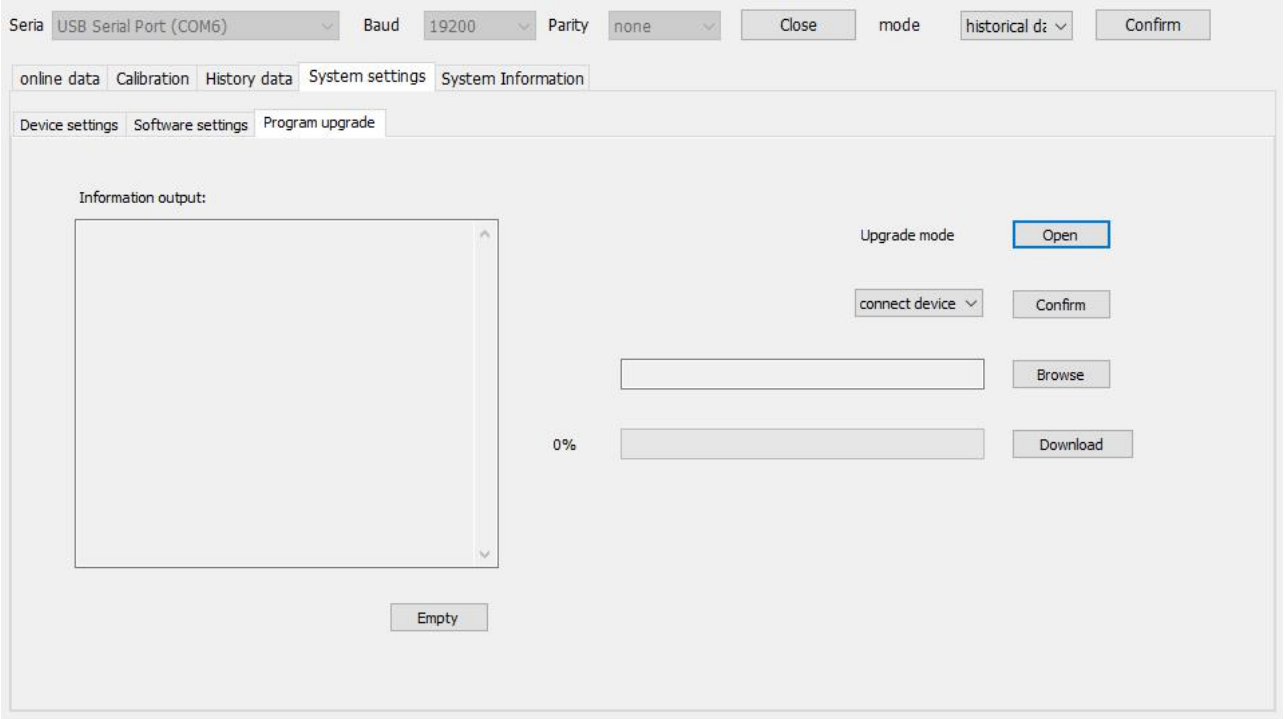
4.2.4.2 Software Settings

In software settings, can set "Advanced Settings" as shown in the figure below.



4.2.4.3 Program upgrade

Used to upgrade the program, non-professionals do not operate, the interface is shown below.



4.2.5 System Information

From the system information, you can view "Controller Version", "Power Control Version", "Dissolved Oxygen ", "Turbine Version", "chlorophyll Version" Software version, "chlorophyll version", "BGA

Version", "SN" and "Bluetooth", the interface is shown below.

Chapter 5 Calibration of Sensors

The probe is calibrated at the factory and is selectively calibrated depending on the situation on the site. There is a need to calibrate the sensor when the following situation occurs:

1. When the measured value of the parameter is inconsistent with the known calibration standard value.

2. When dirt appears or could be seen obviously.

3. When the components are replaced.

Some system components are susceptible to time, use, and environment. To ensure the accuracy of the instrument, it is recommended to perform routine testing under the standard conditions for the system.

5.1 Probe Settings

1. Ion electrode should not be placed in high-purity or deionized water. Otherwise, the electrolyte will get lost, thus shortening its service life. It should not be placed for a long time.

2. When the temperature changes suddenly or severely, it will take a long time for the ion electrode to

stabilize and temperature to become normal.

3. If the ammonia nitrogen concentration is very low, the potassium ion concentration is higher, and the difference between the two is necessary to compensate potassium ions.

4. If the probe is exposed to air for more than 30 minutes, then the electrode must be repolarized.

5. It is recommended that the standard solution for calibration should be prepared over 2L.

5.2 Basic Process of Calibration

1. Rinse the used probe with clean tap water.

2. Rinse the calibration container thoroughly with water first and then rinse with a small amount of standard solution for calibration.

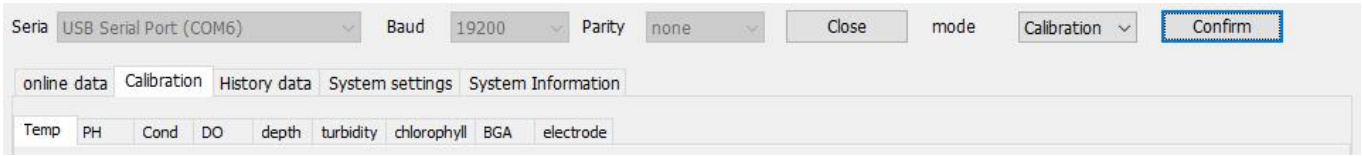
3. Pour off the rinsed standard solution and refill the calibration container with the unused standard solution to ensure the sensor is submerged.

Important Tip: When changing the calibration solution, rinse the calibration container with distilled water. Please avoid cross-contamination between different standard solutions.

4. Place the clean and dry probe in the calibration container. It is recommended to use one calibration container for calibration only and the other hollow calibration container for on-site measurement. By this way, it will greatly guarantee the accuracy of the calibration and cleanliness during the process.

5. Connect the instrument to the computer correctly (the connection method is the same as the instrument connection of 3.2), start the software program, change the mode setting to calibration, and then click OK.

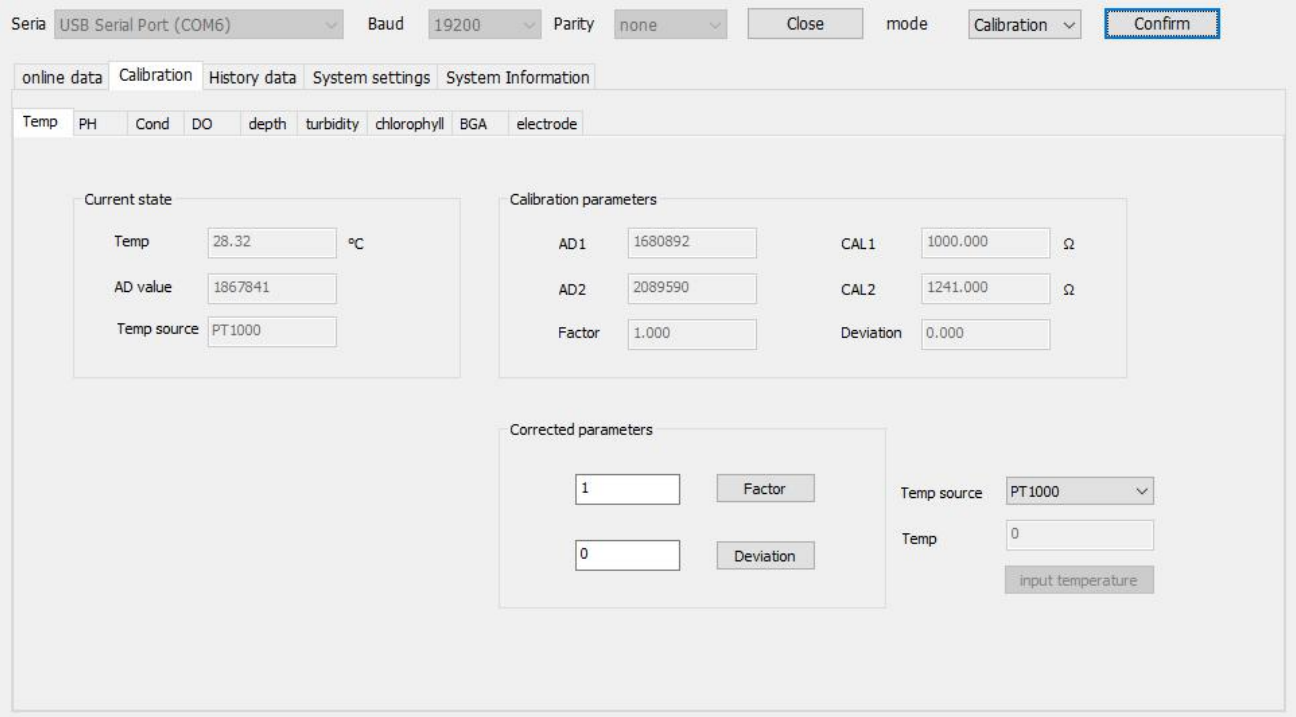
6. Then find the sensor to be calibrated from the calibration menu and calibrate according to different calibration methods. The specific sensor calibration method will be introduced later in this chapter. The calibrated menu bar (temperature, pH, and electrode can be calibrated) is shown below.



Tip: *The calibration of each sensor follows the basic steps above. Please keep the sensor clean and dry before calibrating.*

5.3 Temperature sensor calibration

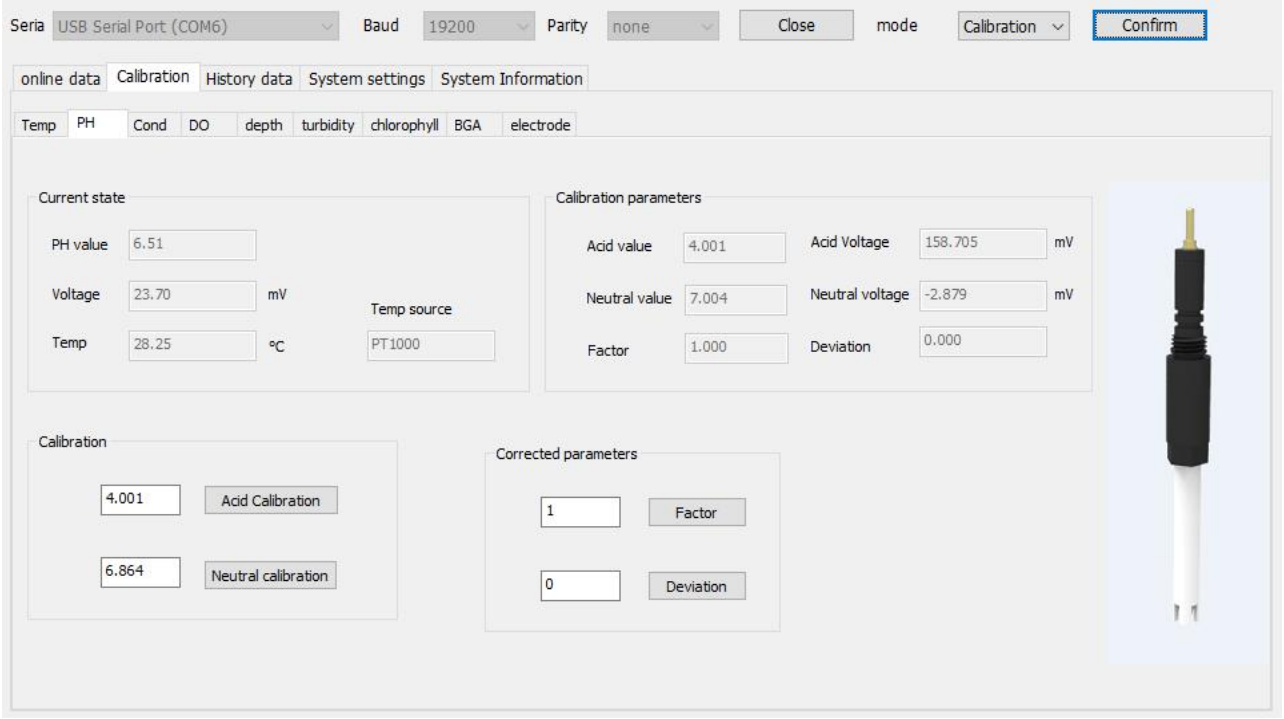
From the Calibration menu, select the “Temperature” option to enter the temperature calibration procedure as shown below.



The temperature sensor is calibrated at the factory and does not need to be calibrated again. However, you can directly enter the values in the “Correction Parameters” box and click “Factor” and “Deviation” to calibrate the factors and deviation values.

5.4 pH sensor calibration

From the Calibration menu, select the “pH” option to enter the pH calibration procedure, as shown in the figure below, and then you are ready to start calibration.



Before the test, remove the protective soaking bottle or rubber sleeve with the soaking liquid on the sensor, immerse the sensor in distilled water, then remove it and gently absorb the water. Be careful not to break the glass bulb and keep the sensor clean and dry. The pH sensor uses a 2-point calibration method.

The specific calibration steps are:

1. First point (neutral point): Pour the correct amount of pH=6.864 buffer/standard solution into a clean, dry or pre-rinsed calibration container. Carefully immerse the probe at the end of the main unit in the solution. Make sure the glass bulb is immersed in the solution at least 1 cm. When the pH electrode voltage data in the software interface is stable, enter the “6.864” buffer/standard solution value in the “Calibration” box and click “Neutral Calibration”.

2. Second point (acidic point): Rinse the probe with water and wipe it clean. Pour the correct amount of pH=4.001 buffer/standard solution into a clean, dry or pre-rinsed calibration container. Carefully immerse the probe at the end of the main unit in the solution. Make sure the glass bulb is immersed in the solution at least 1 cm. When the pH electrode voltage data in the software interface is stable, enter “4.001” buffer/standard solution value in the “Calibration” box and click “Acid Calibration”.

3. After the calibration is complete, rinse the sensor and calibration container with water and dry to ensure the following use.

Tip: *Be sure to calibrate the neutral point and then calibrate the acid point. The order cannot be reversed.*

4. In order to ensure the accuracy of the calibration, we will provide a buffer/standard solution with pH=9.18. After the above calibration is completed, the calibration accuracy can be verified by detecting the pH of the buffer. The specific steps are: change the mode setting. For “on-line date”, place the probe in a calibration container containing the correct amount of buffer/standard solution at pH=9.18, place the glass bubble into the solution at least 1 cm, leave it for at least one minute, and then click on the confirmation on the side of the mode setting. , watch online data. If the data is found to be significantly different from 9.18, it needs to be recalibrated until there is no deviation.

5. You can also directly enter the value in the “Correction Parameters” box and click “factor” and “deviation” to calibrate the factor and deviation value.

5.5 Ammonia Nitrogen Sensor Calibration

From the Select menu in the calibration menu, go to the “Electrode” calibration program and display the following interface. Select “Electrode 1” in the current state “Electrode” to start calibration.

The Ammonia Nitrogen sensor is calibrated with Ammonia Nitrogen standard solution for two to five point calibration. The factory requires 4-point calibration. The customer can base on the situation on the site to calibrate with two- to four- point calibration method. The calibration points and current calibration points can be selected in the calibration box.

1. Generally, two-point calibration can be selected when measuring water below 50mg/L: 1mg/L and 10mg/L

2. Generally, the following calibration methods can be selected when measuring water over 50mg/L:

1）Two-point Calibration: 1mg/L or 10mg/L (or 25mg/L or 100mg/L)

2）Three-point Calibration: 1mg/L、5mg/L (or 10mg/L or 25mg/L)、100mg/L (or 200mg/L)

3）Four-point Calibration: 1mg/L、25mg/L、200mg/L、500mg/L or 1000mg/L

4）Five-point Calibration: 1mg/L、25mg/L、200mg/L、500mg/L and 1000mg/L

3. But when the water condition is stable, the two-point calibration can be performed according to the concentration range of the water body, and it can achieve a result with better accuracy.

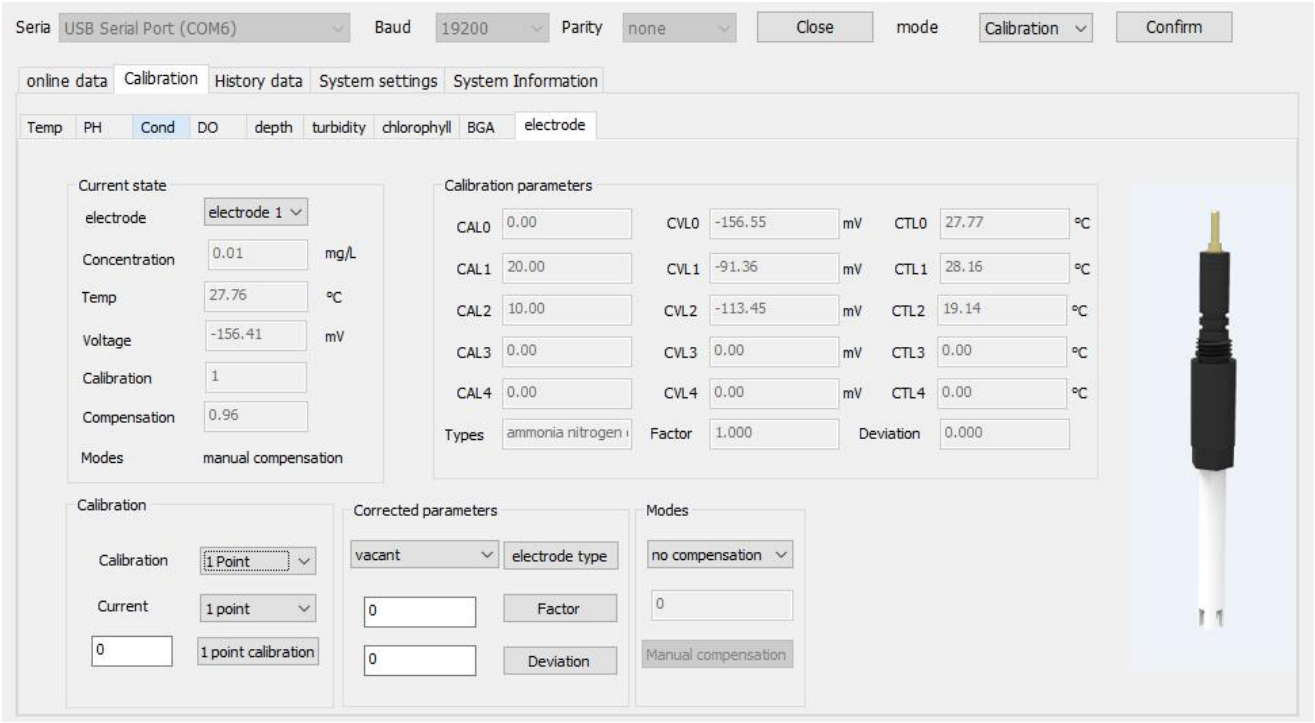
For example, when the concentration range of the measured water is generally between 0.5 and 2, then 1 mg / L and 5 mg / L can be selected;

When the concentration range of the measured water is generally between 5 and 10, then 5 mg / L and 10

mg / L can be selected;

When the concentration range of the measured water is generally between 20 and 30, then 10 mg / L and 50 mg / L can be selected;

When selecting the calibration point, please note that when the measured value is high, select a higher value of the calibration point which is close to the measured value, and the lower point should generally be no more than 10mg/L.



The specific calibration steps are as follows:

The following is an example of two-point calibration when measuring water below 50mg/L:

Pour the standard solution from point 1 (generally recommended 1 mg/L) into a clean, dry or pre-rinsed calibration container. Carefully immerse the probe at the end of the main unit in the solution. Please ensure that the front end of the Ammonia Nitrogen sensor is immersed in the solution at least 2 cm and enter the standard value. After the value in the software interface is stable, click “1 point Calibration”. Rinse and dry the sensor and calibration container with water after completion.

Pour the standard solution at point 2 (generally recommended 10 mg/L) into a clean, dry or pre-rinsed calibration container. Carefully immerse the probe at the end of the main unit in the solution. Please ensure that the front end of the Ammonia Nitrogen sensor is immersed in the solution at least 2 cm and enter the standard value. When the value in the software interface is stable, click “2 point Calibration”. Rinse and dry the sensor and calibration container with water after completion.

You can directly select the input value in the correction parameter box and click “factor” and “deviation” to calibrate the factor and deviation value.

On the premise of selecting potassium ions，in the frame, you can also choose the compensation mode “no compensation”, “manual compensation”, “auto compensation”. According to the water source selection measured by the buyer, when the potassium ion concentration in the water is stable, manual compensation is selected, and the potassium ion concentration can be directly input. When the potassium ion concentration is unstable and changes frequently, select automatic compensation. (But need with the K+ sensor, which is optional sensor).

5.6 Potassium Ion Sensor Calibration

From the Select menu in the calibration menu, go to the “Electrode” calibration program and display the following interface. Select “Electrode 2” in the current state “Electrode” to start calibration.

The Potassium Ion sensor is calibrated with ammonia Potassium Ion solution for two to five point calibration. The factory requires 4-point calibration. The customer can base on the situation on the site to calibrate with two to four point calibration method. The calibration points and current calibration points can be selected in the calibration box.

1. Generally, two-point calibration can be selected when measuring water below 50mg/L: 1mg/L and 10mg/L

2. Generally, the following calibration methods can be selected when measuring water over 50mg/L:

1）Two-point Calibration: 1mg/L or 10mg/L (or 25mg/L or 100mg/L)

2）Three-point Calibration: 1mg/L、5mg/L (or 10mg/L or 25mg/L)、100mg/L (or 200mg/L)

3）Four-point Calibration: 1mg/L、25mg/L、200mg/L、500mg/L or 1000mg/L

4）Five-point Calibration: 1mg/L、25mg/L、200mg/L、500mg/L and 1000mg/L

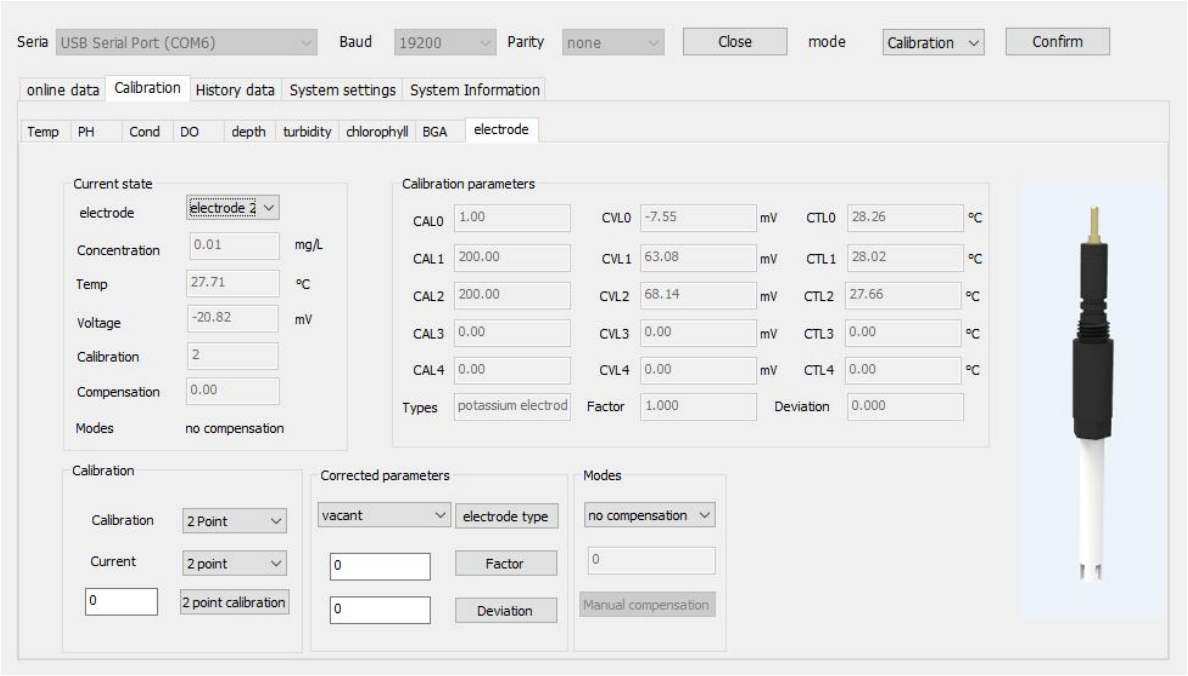
3. But when the water condition is stable, the two-point calibration can be performed according to the concentration range of the water body, and it can achieve a result with better accuracy.

For example, when the concentration range of the measured water is generally between 0.5 and 2, then 1 mg / L and 5 mg / L can be selected;

When the concentration range of the measured water is generally between 5 and 10, then 5 mg / L and 10 mg / L can be selected;

When the concentration range of the measured water is generally between 20 and 30, then 10 mg / L and 50 mg / L can be selected;

When selecting the calibration point, please note that when the measured value is high, select a higher value of the calibration point which is close to the measured value, and the lower point should generally be no more than 10mg/L.



The specific calibration procedures are as follows:

The following is an example of two-point calibration when measuring water below 50mg/L:

Pour the standard solution from point 1 (generally recommended 1 mg/L) into a clean, dry or pre-rinsed calibration container. Carefully immerse the probe at the end of the main unit in the solution. Please ensure that the front end of the Potassium Ion sensor is immersed in the solution at least 2 cm and enter the standard value. After the value in the software interface is stable, click “1 Point Calibration”. Rinse and dry the sensor and calibration container with water after completion.

Pour the standard solution at point 2 (generally recommended 10 mg/L) into a clean, dry or pre-rinsed calibration container. Carefully immerse the probe at the end of the main unit in the solution. Please ensure that the front end of the Potassium Ion sensor is immersed in the solution at least 2 cm and enter the standard value. When the value in the software interface is stable, click “2 Point Calibrate”. Rinse and dry the sensor and calibration container with water after completion.

You can directly select the input value in the correction parameter box and click “factor” and “deviation” to calibrate the factor and deviation value.

Chapter 6 Maintenance

Danger: Only the professionals can undertake the maintenance tasks described in this chapter of the manual.

To ensure continuous and reliable operation of the water quality monitoring system, we recommend a thorough and standardized maintenance process over time. In order to determine the appropriate maintenance intervals required on a site, the equipment and sensors should be periodically observed to compare the results before and after calibration as well as the response time of the sensors.

A contaminated, worn or damaged sensor will not deliver an reliable reading. It is recommended to maintain the sensor before calibration.

In order to get the best measurement results, regular maintenance is required, which mainly includes cleaning of sensors.

6.1 Sensor Maintenance

1. It requires regular maintenance, and on-site inspection every week, during the process of which, cleaning is recommended. It should be calibrated once a month, and replace the electrolyte every three months and the diaphragm every half a year.

2. It is not allowed to touch the electrode tip by hand, or clean with alcohol. It can only be rinsed with water or gently wiped with a soft tissue or a clean cloth.

3. It can not be placed upside down during the measurement. Otherwise, it must be shaken normally vertical downwards.

4. The depth should not exceed 10M, otherwise, it may cause damage or abnormal probe.

5. The replacement interval of the electrode cap (F plasma needs to be polished) is about half a year, the replacement interval of the electrolyte is about 3-6 months, and its storage time is about 2 years.

6. Do not measure the electrode under strong light

7. If the ion exchange membrane of the electrode has been severely contaminated, it must be replaced without regard to the maintenance cycle.

6.1.1 Temperature Sensor Maintenance

Use soap or alcohol to remove grease, oil or microbes and rinse the tip of the sensor with water. Do not use any object to poke the sensor, otherwise, its film will rupture.

6.1.2 pH Sensor Maintenance

pH sensor requires frequent maintenance to remove contaminants from the sensing components, these contaminants can reduce the sensor response time. Remove the sensor from the main unit before cleaning.

If the pH sensor is covered by deposits or micro-organisms, then clean the glass with a very clean, soft, wet, and non-scratched cloth or cotton ball with enough soap and then brush with 0.01 mol/L HCL or NaOH solution. (Those insoluble deposits such as calcium and magnesium can be dissolved in EDTA disodium solution) and then rinse with water, get dried and then be calibrated with the aid of instrument.

If there is oil on the electrode, it can be rubbed with cotton soaked with CCl4 or acetone. Then, immerse it in a 0.1 mol/L HCI solution for 12 hours for cleaning, and then repeatedly rinse with distilled water and get dried, and then be calibrated with the aid of instrument. Try to void long-term storage under a dry environment, usually it should be placed in a protective cover with 3.0 mol / L potassium chloride solution; before and after the maintenance of the electrode, the maintenance of the pH electrode pH, observe whether the internal electrolyte/gel is exhausted. If the electrolyte/gel is not visible, please replace the electrode in time; before and after the maintenance of the pH electrode, check whether there is a non-eliminable air bubble on the inner end of the salt bridge (the side is bright and bubble-like). If there is air bubble, it will affect the pH and reference work. Please replace it in time.

The pH electrode is recommended to be replaced once a year (the service life of the pH electrode is only about 1 year)

Important Tip: *Avoid using anhydrous ethanol or dehydrating detergent to deal with the electrode.*

6.1.3 Ammonia Nitrogen Sensor Maintenance

If the electrode leaves the water for about 15 minutes, it is recommended to re-discharge the electrode in water for 1 hour. If the electrode cap is contaminated, the user needs to clean the cap according to the maintenance cycle. Be careful not to touch the membrane cap with your hands. Use a

clean cloth or water to clean it. For ion electrodes using PVC ion exchange membranes, it is usually necessary to replace the membrane head (or depends on the use of the electrode) for half a year.

Figure 9 Diagram of Ammonia Nitrogen Electrode

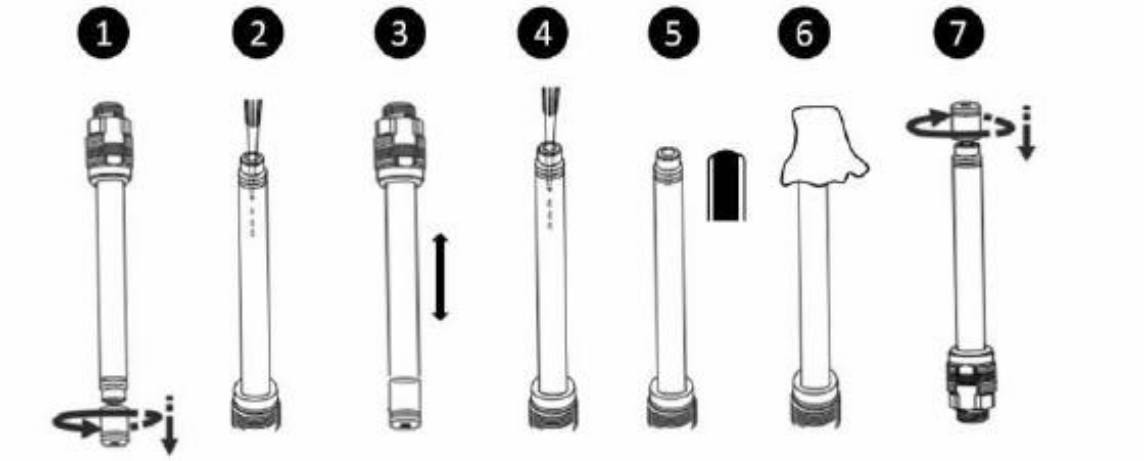


Figure 10 Diagram of Replacing Electrolyte

Procedures of Replacing Electrolyte

1. Unscrew the electrode cap of the ion electrode: pour out the remaining electrolyte in the electrode body;

2. Use a pipette to put a small amount of electrolyte into the electrode body: (If the electrode is used for a long time, it is suggested to put a small amount of deionized water in the electrode body first and clean it according to procedure 3, and later add a small amount of electrolyte)

3. Slightly shake the electrode up and down to clean it. After cleaning, pour off the electrolyte.

4. Re-use the pipette to place the electrolyte into the electrode body until the electrolyte forms a

bulge (capillary action)

5. Form a raised electrolyte: It is forbidden to add electrolyte in the membrane cap. The residual water must be shaken off from the used membrane cap.

6. Dry the spilled electrolyte

7. Tighten the membrane. Then slowly rotate the electrode with the head facing down. This process is able to remove the bubbles from the head: then vertically shake the electrode downwards. In this process, it should ensure that the electrode head is facing down, and the force can not be too strong, otherwise the electrode cap will be damaged.

6.1.4 Potassium Ion Sensor Maintenance

If the electrode leaves the water for about 15 minutes, it is recommended to re-discharge the electrode in water for 1 hour. If the electrode cap is contaminated, the user needs to clean the cap according to the maintenance cycle. Be careful not to touch the membrane cap with your hands. Use a clean cloth or water to clean it. For ion electrodes using PVC ion exchange membranes, it is usually necessary to replace the membrane head (or depends on the use of the electrode) for half a year.

If there is potassium ion in the original configuration, it needs to be restarted after canceling the potassium ion electrode.

The replacement of the potassium ion electrode electrolyte is the same as that of the ammonia nitrogen electrode. For details, please refer to section 5.1.3.

6.2 Storage of Sensor

The storage temperature in the dry environment should be 10 ° C ~ 30 ° C.

Electrodes, membranes, and electrolytes should be stored in the dark. If it is new, the shelf life is two years, if its used electrode, it should be rinsed before being stored.

6.2.1 Short Term Storage

Short term refers to the intermittent period (days, weeks, fortnight, etc.) in which the host is in normal use.

Short-term storage users should keep the sensor moist, but do not immerse it in water (immersion in

water can cause the sensor to drift). The users should place it in a humid saturated air environment (100% humidity). Inject approximately 1 cm of water into the bottom of the calibration container (Note: Do not immerse the sensor), then insert the sensor-equipped main unit into the calibration container and tighten to prevent evaporation of the water.

6.2.2 Long Term Storage

Long-term refers to the state of being unused for a long time.

1) For the long-term storage of pH sensor, remove it from the main unit, clean it, and then immerse it in a protective cover with 3.0 mol/L potassium chloride solution, pay attention to make sure its tightly closed.

2) The other sensors being removed from the main unit should be cleaned, and it is recommended that the device be stored in a shipping container or in a plastic container with electric shock prevention in an environment that is not frozen and dry. The empty end left by the sensor on the main unit should be sealed with a port protection plug.

6.3 Maintenance of Cable

When operating in the field, please make sure that any non-waterproof cables (ie any cables other than waterproof underwater cables) should not be placed near water. Keep the joints dry at any time.

Use a silicone grease to properly lubricate the sealing surfaces of all underwater joints.

Keep all cables clean and dry, and being stored (tidy and coiled) in a large plastic container.

The coil diameter of the cable must more than 6 inches, otherwise the cable will be damaged.

Do not knot the cable or use a clip to mark a certain depth.

Any cable should be protected from wear, unnecessary tension, repeated or severe bending (such as railings) during use.

6.4 Inspection on the Damage of Sensor

Check the appearance of the sensor to see if it is damaged. If there is any damage, contact the after-sales service center for replacement to prevent any fault caused by the damaged sensor in the water.

Chapter 7 Communication Protocol

A. The sensor probe has Modbus RS485 function, communicates in RTU mode, and the default baud rate is 9600. It can communicate with the host computer (PC/digital instrument, etc.) with RS485 communication function. The specific MODBUS-RTU table is shown in the table below.

MODBUS-RTU	
Baud rate	9600/4800/19200/38400/115200
Data bit	8 digits
Parity	no
Stop bit	1 digit
Slave address	1-254 (default 10)

B、Adopt MODBUS standard communication protocol. The specific agreement content is shown in the table below.

Address	**Name**	**Data**	**Operate**	**Remarks**
0	Temp. Value	float	read	03 command
2	pH Value	float	read	03 command
16	Ammonia Nitrogen	float	read	03 command
18	Potassium ion value	float	read	03 command
35	Equipment serial number SN1	unsigned	read	03 command
36	Equipment serial number SN2	unsigned	read	03 command
37	Equipment serial number SN3	unsigned	read	03 command
70	Year	float	read/write	03 command /16 command
72	Month	float	read/write	03 command /16 command
74	Day	float	read/write	03 command /16 command
76	Hour	float	read/write	03 command /16 command
78	Minute	float	read/write	03 command /16 command
80	Second	float	read/write	03 command /16 command

420	Temp. source	float	Read/write	03 command /16 command
422	Manual temp. compensation value	float	Read/write	03 command /16 command
900	pH acid point calibration	float	write	16 command
902	pH neutral point calibration	float	write	16 command
1500	pH deviation value	float	read/write	03 command /16 command
1510	Temp. deviation value	float	read/write	03 command /16 command
1600	PH factor	float	read/write	03 command /16 command
1610	Temp. factor	float	read/write	03 command /16 command
1800	Data manipulation standard level	unsigned	read/write	0 - idle,
1801	Customer data backup and	unsigned	write	06 command
1802	Factory data backup and recovery	unsigned	write	06 command
2200	Ammonia nitrogen electrode	float	read	03 command
2202	Ammonia nitrogen factor	float	read/write	03 command /16 command
2204	Ammonia nitrogen deviation	float	read/write	03 command /16 command
2208	Ammonia nitrogen calibration	UINT16	read/write	Supports 03, 16 commands,
2210	Ammonia nitrogen compensation	UINT16	read/write	Electrode 1 compensation
2212	Ammonia nitrogen manual	float	read/write	This value is valid when
2234	Ammonia nitrogen first point	float	write	Electrode Calibration

Address 2234 Calibration Step Description:

1. First set the number of calibration points of the electrode with 16 commands. The max. support is 5 points, and the min. support is single point.

2. Select the calibration standard solution, the electrode to be calibrated is immersed in the standard solution, wait for the electrode voltage value to be stable, and input the standard value to the standard calibration register of the point to be calibrated. Then the calibration is completed.

3. The calibration parameters of the calibration points can be read by the standard value of each point, the calibration voltage of the standard solution, and the calibration temperature of the standard solution.

4. Calibration of other points and calibration of other ion electrodes, and so on.

2236	Ammonia nitrogen 1st point standard value	float	read	03 command
2238	Ammonia nitrogen 1st point standard calibration voltage	float	read	03 command
2240	Ammonia nitrogen 1st point standard calibration temp.	float	read	03 command
2242	Ammonia nitrogen 2nd point calibration	float	write	16 command
2244	Ammonia nitrogen 2nd point standard value	float	read	03 command
2246	Ammonia nitrogen 2nd point standard calibration voltage	float	read	03 command
2248	Ammonia nitrogen 2nd point standard calibration temp.	float	read	03 command
2250	Ammonia nitrogen 3rd point calibration	float	write	16 command
2252	Ammonia nitrogen 3rd point standard value	float	read	03 command
2254	Ammonia nitrogen 3rd point standard calibration voltage	float	read	03 command

2256	Ammonia nitrogen 3rd point standard calibration temp.	float	read	03 command
2258	Ammonia nitrogen 4th point calibration	float	write	16 command
2260	Ammonia nitrogen 4th point standard value	float	read	03 command
2262	Ammonia nitrogen 4th point standard calibration voltage	float	read	03 command
2264	Ammonia nitrogen 4th point standard calibration temp.	float	read	03 command
2266	Ammonia nitrogen 5th point calibration	float	write	16 command
2268	Ammonia nitrogen 5th point standard value	float	read	03 command
2270	Ammonia nitrogen 5th point standard calibration voltage	float	read	03 command
2272	Ammonia nitrogen 5th point standard calibration temp.	float	read	03 command
2300	Potassium ion electrode voltage	float	read	03 command
2302	Potassium ion factor	float	read/write	03 command/16 command

2304	Potassium ion deviation	float	read/write	03 command/16 command
2308	Potassium ion calibration points	UINT16	read/write	Support 03, 06 command, the written values 1, 2, 3, 4, 5 represent single point calibration to 5 point calibration
2334	Potassium ion first point calibration	float	write	16 命令
2336	Potassium ion 1st point standard value	float	read	03 command
2338	Potassium ion 1st point standard calibration voltage	float	read	03 command
2340	Potassium ion 1st point standard calibration temp.	float	read	03 command
2342	Potassium ion 2nd point calibration	float	write	16 command
2344	Potassium ion 2nd point standard value	float	read	03 command
2346	Potassium ion 2nd point standard calibration voltage	float	read	03 command
2348	Potassium ion 2nd point standard calibration temp.	float	read	03 command
2350	Potassium ion 3rd point calibration	float	write	16 command

2352	Potassium ion 3rd point standard value	float	read	03 command
2354	Potassium ion 3rd point standard calibration voltage	float	read	03 command
2356	Potassium ion 3rd point standard calibration temp.	float	read	03 command
2358	Potassium ion 4th point calibration	float	write	16 command
2360	Potassium ion 4th point standard value	float	read	03 command
2362	Potassium ion 4th point standard calibration voltage	float	read	03 command
2364	Potassium ion 4th point standard calibration temp.	float	read	03 command
2366	Potassium ion 5th point calibration	float	write	16 command
2368	Potassium ion 5th point standard value	float	read	03 command
2370	Potassium ion 5th point standard calibration voltage	float	read	03 command
2372	Potassium ion 5th point standard calibration temp.	float	read	03 command
0x270D	Slave address	unsigned	read/write	03 command /06 command

0xF209	Slave baud rate	UINT16	read/write	Slave baud rate set range 4800、9600、19200、38400、115200，Use the integer 1, 2, 3, 4, 5 to represent the corresponding baud rate Support 03, 06 commands
0xF20A	Parity	UINT16	read/write	0 means no parity; 1 means ODD odd parity, 2 means EVEN even parity Support 03, 06 commands

Chapter 8 Errors and Warnings

If errors and warnings occur, the readings on the measurement screen will flash and there will be a "Fault" appearing at the bottom. The common faults and warnings are shown as follows:

1）ERR3 Error

When the ERR3 alarm occurs, it refers to the current loop is out of range and the actual output is greater than 20mA. The readings on the screen will flash continuously and "ERR3" will be displayed below the reading. When this warning occurs, please contact the technical support or after-sales service department.

2）Sensor Loss Warning

When the probe is not connected to the transmitter, "Not Connected" will be displayed on the screen; when the connection between the probe and the transmitter is weak, the alarm of the sensor loss will appear, and the screen will flash continuously on the next line. The word "Fault" will be displayed. When the above situation occurs, the steps below are suggested to follow:

① Disconnect the transmitter power supply and reconnect the sensor to ensure the connection is correct.

② Connect the power supply and observe the measurement interface. If the connection is

successful, the measurement data will appear. If the connection fails, “Not Connected” will appear on the measurement interface.

Chapter 9 Problems and Solutions

Phenomenon	Possibility	Exclusion Method
The value is constant during the test or fluctuates within the full range	It might be caused by abnormal electrode (poor contact, damage, etc.)	Reassemble the electrode or replace a new electrode
The value cannot be stabilized during the test and fluctuates greatly during a certain period of time.	It might be caused by abnormal pH reference electrode (poor contact, damage, etc.)	Reinstall or replace the pH electrode
	There are air bubbles at the front end of the electrode membrane	Shake the entire sensor vertically downwards with a little bit of strength, so that the bubbles move to the end without affecting the test.
	There might be bubbles affecting the measurement at the front end of the electrode	Shake the electrode in water to remove air bubbles
The test is inaccurate after using for a period of time	The tip of the membrane might get contaminated	Rinse the membrane tip with distilled water or tap water (do not rinse with high pressure spray head), then wipe with non-woven fabric/dust-free cloth.
	The electrolyte needs to be supplemented/replaced	Please replace the supplementary electrolyte according to the specifications.

	There might be bubbles affecting the measurement at the front end of the electrode	Shake the electrode in water to remove air bubbles
The test is inaccurate after being transported	It might be caused by abnormal electrode (poor contact, damage, etc.)	Reassemble the electrode or replace a new electrode
	It might be caused by abnormal pH reference electrode (poor contact, damage, etc.)	Reinstall or replace the pH electrode
	There are air bubbles at the front end of the electrode membrane	Shake the entire sensor vertically downwards with a little bit of strength, so that the bubbles move to the end without affecting the test.
	There might be bubbles affecting the measurement at the front end of the electrode	Shake the electrode in water to remove air bubbles