pH/ORP Controller

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Preface

Thank you for purchasing the pH/ORP controller. Please read this manual carefully before operating and using it correctly to avoid unnecessary losses caused by wrong operation.

Note

- Modification of this manual's contents will not be notified as a result of some factors, such as function upgrading.
- We try our best to guarantee that the manual content is accurate. If you find something wrong or incorrect, please contact us.
- Please use this product in accordance with its explosion-proof characteristics and comply with national and regional laws and regulations.

Version

U-SUP-MDC-pH-EN3

Safety Precautions

For the safe operation of this product, please strictly follow the outlined safety precautions.

About this manual

- Please ensure the instrument operators have a careful reading of this manual.
- Before the operation, please study this manual in detail to ensure a thorough comprehension of the device's functionality.
- This manual only describes the product's functions. The responsibility for the device's suitability for any special or personalized purpose lies solely with the operator.

Precautions for product protection, safety, and modification

- For your safety and the normal operation of the product and its controlling systems, the guidelines and precautions specified in this manual are supposed to be fully observed. Operating the instrument in ways not specified in this manual may compromise its protective features. Our company shall not be liable for any malfunctions or accidents resulting from non-compliance with the precautions described.
- When equipping the product and its controlling systems with lightning protection or separate safety protection circuits, it needs to be implemented by other devices.
- If you need to replace components or fittings of the product, please use the model specified by the company.
- This product is not designed for use in systems directly related to personal safety, such as nuclear power facilities, radioactive equipment, railway systems, aviation equipment, marine equipment, and medical equipment. If applied, it is the user's responsibility to implement additional equipment or systems to ensure personal safety.
- Do not modify this product.
- The following safety symbols are used in this manual:

Hazard: Failure to take appropriate precautions may result in serious personal injury, product damage, or major property loss.

Warning: Pay special attention to critical information related to the product or specific sections of this user manual.

- Confirm whether the supply voltage is consistent with the rated voltage before operation.
- Do not use the instrument in a flammable and combustible or steam area.
- To prevent electric shock and operation errors, ensure proper grounding protection is in place.
- Thunder prevention engineering facilities must be well managed: the shared grounding network shall be grounded at the correct electric level, shielded, with wires properly routed, and an SPD surge protector applied as needed.
- Some internal components may carry high voltage. To avoid the risk of electric shock, do not open the front square panel unless it is being handled by trained personnel or maintenance staff authorized by our company.
- To avoid electric shock, disconnect the power before performing any checks.
- Check the condition of the terminal screws regularly. If loose, please tighten them before use.
- Unauthorized disassembly, modification, or repair of the product is not allowed, as it may lead to malfunctions, electric shock, or fire hazards.
- Wipe the product with a dry cotton cloth. Do not use alcohol, benzine, or other organic solvents, and avoid exposing the product to any liquids. If the product falls into the water, please cut off the power immediately to prevent leakage, electric shock, or fire hazards.

- Please check the grounding protection regularly. Do not operate the product if you think that the protection, such as grounding protection and fuses, is inadequate.
- Ventilation holes on the product housing must be kept clear to avoid malfunctions due to high temperatures, abnormal operation, shortened life, and fire.
- Please strictly follow the instructions in this manual; failure to do so may damage the product's protective devices.

- Do not use the instrument if it is found damaged or deformed upon opening the package.
- Prevent dust, wire ends, iron fines, or other objects from entering the instrument during installation, as this may cause abnormal operation or failure.
- During operation, to modify the configuration, signal output, startup, stop, and operation safety shall be fully considered. Improper operation may lead to failure and even destruction of the instrument and control equipment.
- Each part of the instrument has a certain service life, which must be maintained and repaired on a regular basis for long-term use.
- If the product comes to the end of its service life, it should be disposed of as industrial waste as a way of environmental protection.
- Disconnect the instrument when it is not in use.
- If you find smoke from the product, smell odor, abnormal noise, etc., please turn off the power switch immediately and contact the company in time.

Disclaimer

- The company does not make any guarantees for terms beyond the scope of this product warranty.
- This company is not responsible for damage to the instrument, loss of parts, or unpredictable damage caused directly or indirectly by improper operation of the user.

No.	Name	Quantity	Note
1	pH/ORP Controller	1	
2	Manual	1	
3	Certificate	1	

After opening the box, please confirm the package contents before starting the operation.If you find that the model and quantity are incorrect or there is physical damage in appearance, please contact us.

Contents

1 Introduction

1.1 Introduction

This product is a smart, online pH/ORP transmitter. Its multi-mode channel functionality allows for the connection of both analog and digital sensors. Continuous monitoring data can be transmitted to a DCS system via output connections for remote tracking and recording. Alternatively, communication with computers is possible through an RS485 interface using the Modbus-RTU protocol, enabling computer-based monitoring and recording. This controller is widely used across various industries, including thermal power, chemical fertilizers, metallurgy, environmental protection, pharmaceuticals, biochemistry, food, wastewater treatment, semiconductors, and tap water.

1.2 Features

- The hybrid mode in single-channel controllers (analog + digital) makes maintenance more economical in the later stage.
- IP66 ingress protection, suitable for more complex working conditions.
- The wireless communication function is optional, and the mobile app can view data in real-time.
- Automatic recognition of digital sensors.
- 4.3-inch full-view color display, quick toggle between digital display and real-time curve modes, making it easier for users to view data fluctuations.
- Capacity for 1, 000,000 data records.
- Optically isolated (0/4~20) mA transmission output, offering strong anti-interference capabilities, high-precision output circuit design, with an accuracy of 0.1%, and executed according to the international technical standard of NAMUR NE43.
- Optically isolated RS485 communication.
- The design of power and signal grounds has improved the product's anti-interference ability.
- Manual temperature and various automatic temperature compensation features.

- High and low alarm functions; adjustable hysteresis and hysteresis time settings.
- Support for 4 languages: Chinese, English, Spanish, and Korean.
- Panel and wall mounting methods are optional, and installation methods are flexible.

1.3 Technical parameters

Table 1 Technical parameters

Analog sensor input	
Measured variables	pH / ORP / Antimony
Measuring ranges	pH/Antimony: (-2.00 ~ 16.00) pH ORP: (-2000 ~ 2000) mV
Input impedance	≥10^{12}Ω
Temperature types	NTC10K，Pt1000，Pt100
Temperature range	(-10~130)℃
Accuracy	pH: ±0.02pH Antimony: ±0.2pH ORP: ±2mV NTC10K: (-10~60)℃, ±0.3℃ (60~130)℃, ±2℃ Pt1000: ±0.3℃ Pt100: ±0.3℃
Resolution	pH/Antimony: 0.01pH； ORP: 1mV
Repeatability	0.02pH
Temperature compensation	Compensation mode: Manual / Automatic Compensation curve: Linear, Acid, Base, Pure
Digital sensor input	
Measured variables	pH/ORP
Measuring ranges	pH: (0.00 ~ 14.00) pH ORP: (-2000 ~ 2000) mV

	Note: For the actual measurement range, refer to the technical specifications of the connected sensors.
Output	
Current output	Isolated, 2-channel (0/4~20) mA configurable to corresponding measurement ranges, load capacity 750Ω, output accuracy ±0.1%FS, compliant with NAMUR NE 43 standards.
Communication output	Isolated, RS485 interface, Modbus-RTU communication protocol.
Alarm output	3-channel SPST (2 alarms + 1 cleaning), NO/NC type, capacity 250VAC, 5A.
Alarm relay delay	0~9999 seconds, adjustable.
Electrical specifications	
Power supply	AC: (85~265)V，50/60Hz DC: (21.6~26.4) V
Power consumption	≤28W
Cable entries	M20*1.5 cable gland
Cable specification	Spring terminals: suitable for AWG16~AWG24(0.2mm^2~1.5mm^2)cables； Plug-in terminals: suitable for AWG12~AWG28(1mm^2~2.5mm^2)cables；
Environment	
Operating environment	Temperature: (0 ~ 60)℃ Relative Humidity: 10 %~85%(non-condensing)
Storage environment	Temperature: (-15~65)℃ Relative Humidity: 5%~95%(non-condensing) Altitude: <2000m
Ingress protection	IP66
Flame Retardancy	UL94V-0

2 Structure and dimensions

Controller dimensions: 151mm*144mm*118mm.

Weight: 0.8kg

Material: PC+ABS

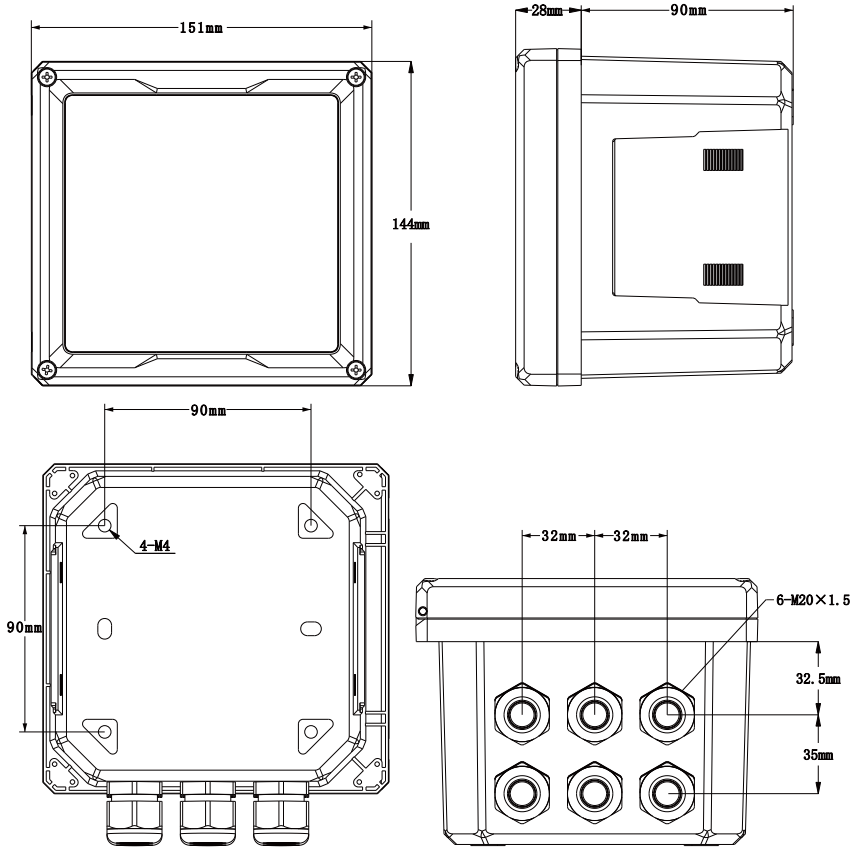


Fig.1 Product dimensions

3 Installation

3.1 Arrival inspection

After the product arrives, users should first check the packaging quality of the product, and the packaging box should be intact, undamaged, and clearly marked. If there is obvious damage to the packaging, the storage and transportation department should be contacted in a timely manner to investigate the problem and responsibility, and our company should be notified. If there are no damages or other issues with the packaging, the product can be unpacked and checked for completeness.

3.2 Installation conditions

Please read the instruction of installation location and method of instrument as described during installation.

Notes for installation

- The installation method of this product is panel mounting or wall mounting.
- Please install it indoors, avoiding wind, rain and direct sunlight.
- In order to prevent the internal temperature of this product from rising, please install it in a well-ventilated place.
- When installing this product, please do not tilt it to the left and right; try to install it horizontally (it can be tilted back <30 °).

The following places shall be avoided during the installation

- With ambient temperature over 60℃ degrees in operation.
- With humidity over 85% in operation.
- Nearby electromagnetic source.
- In strong mechanical vibration.
- With varying temperatures and dew condensation.
- With oil smoke, steam, humidity, dust, and corrosive gases.

3.3 Controller installation

3.3.1 Panel mounting

Installation steps:

(1) Cut an opening in the panel (opening size 138mm*138mm). Make sure the area around the panel cutout is clean and free of burrs.

(2) Place the controller into the panel cutout, ensuring a tight fit between the panel and the controller.

(3) Position two butterfly brackets on either side of the controller as shown in Fig.2.

(4) To secure the controller tightly in the opening, push both mounting brackets towards the backside of the panel.

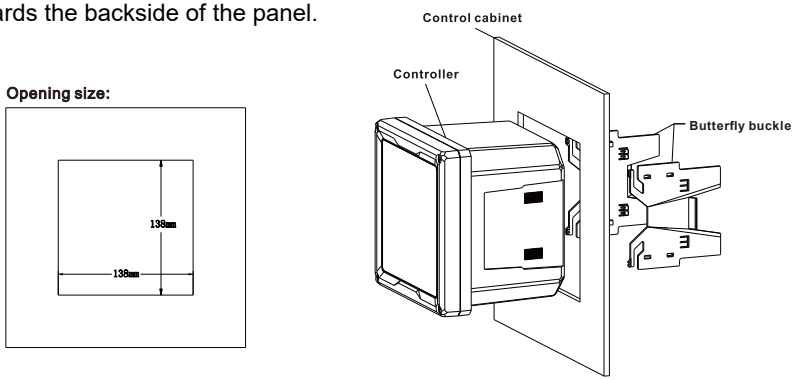


Fig.2 Panel cutout dimensions and installation method

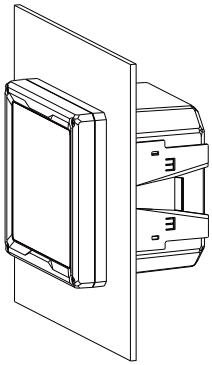


Fig.3 Panel mounting schematic

3.3.2 Wall mounting

Note: The maximum screw-in depth for the enclosure's mounting holes is 6mm. Do not exceed this limit.

Installation steps:

(1) Attach the mounting backplate to the enclosure. Do not exceed the maximum screw-in depth.

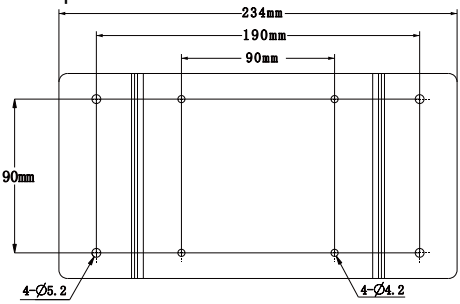


Fig.4 Dimensions of the wall mounting plate

(2) Install the mounting plate along with the enclosure onto the wall.

(3) Use M4 self-tapping screws and M6 plastic heads to secure it to the wall.

(4) Ensure the controller is securely mounted in a horizontal position and that there is sufficient clearance around it for future maintenance and servicing.

(5) Adjust the orientation of the controller so that the cable gland faces downward.

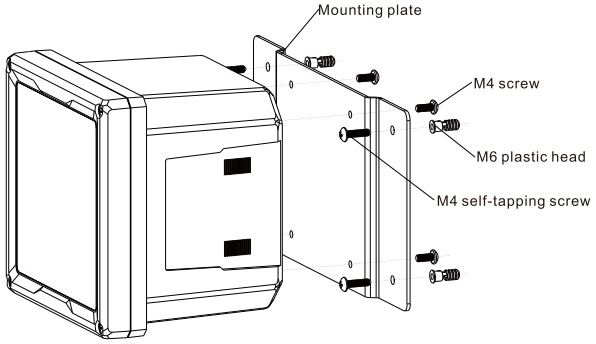


Fig.5 Wall mounting method

3.4 Sensor installation

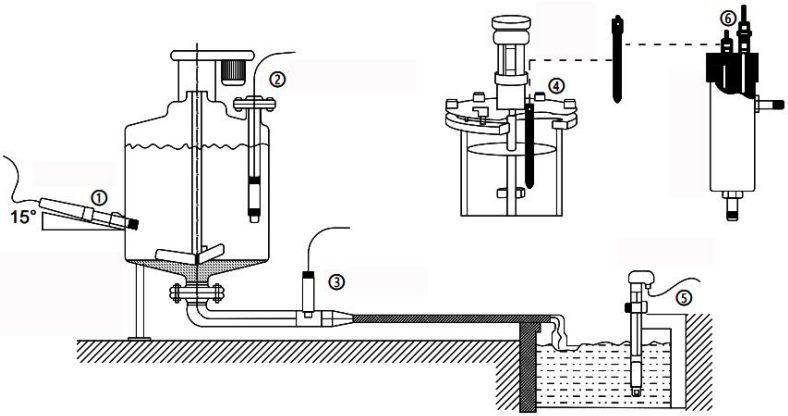


Fig.6 Schematic diagram of the common installation method

①Side wall installation ②Flange mounted at the top ③Pipe installation
④Top installation ⑤Submersible installation ⑥Flow-through installation
The interface must be in 15°oblique angle, or it will affect the normal test and use of the electrode.We won't be responsible for any results due to this.

4 Electrical connections

4.1 Terminal blocks

The following diagram illustrates the internal wiring of the controller. Please connect according to the wiring instructions.

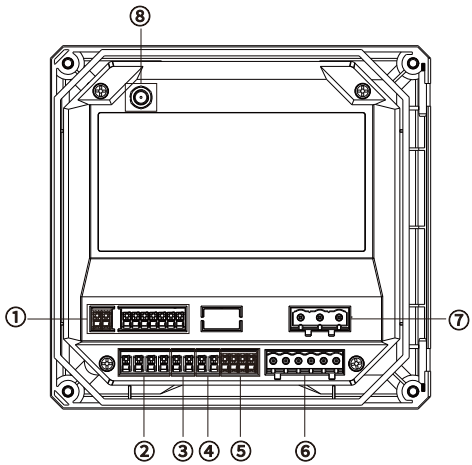


Fig.7 Internal wiring schematic

Table 2 Terminal definitions

No.	Definition	No.	Definition
①	Analog sensor terminal	⑤	Digital sensor terminal
②	2-channel (0/4~20) mA signal output terminal	⑥	Relay terminal
③	Communication module Terminal	⑦	AC or DC power terminal
④	Undefined	⑧	Wireless module antenna port (Optional)
①, ②, ③, ④, and ⑤ are spring terminals; ⑥ and ⑦ are plug-in terminals.			

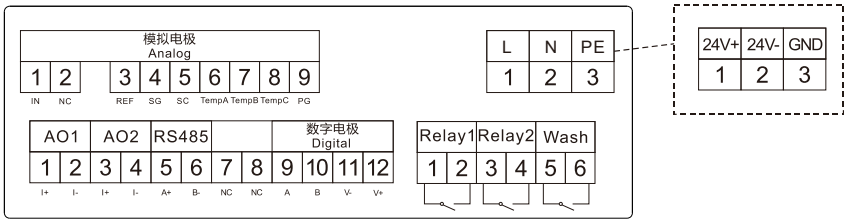


Fig.8 Terminal definitions (single channel)

4.2 Spring terminal connection

4.2.1 Safety tips

⚠Warning	
	Risk of fatal electric shock. Always disconnect the device's power before making any electrical connections.
	Risk of fatal electric shock. To maintain the enclosure's IP protection rating, use only conduit fittings and cable glands that are at least rated IP66 when connecting cables to the device.

4.2.2 Connection instructions

The signal port connection terminals use spring terminals, suitable for wires ranging from AWG16~AWG24 ($0.2mm^2$~$1.5mm^2$). The connection method is shown below.

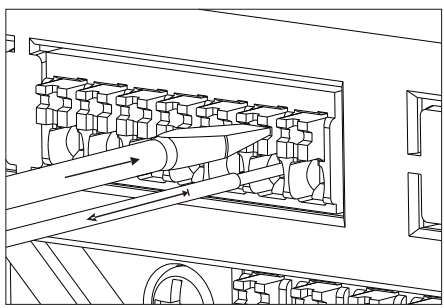


Fig.9 Spring terminal connection method

（1）Use a screwdriver to depress the wire clip (to open the terminal block).

（2）Insert the cable until it reaches the stop block.

（3）Remove the screwdriver (to close the terminal block).

Note: After connecting, ensure each cable end is securely fixed in place. If

the cable end is not correctly installed in the stop block, the terminal cable end is especially prone to loosening.

4.3 Connecting to power

4.3.1 Safety tips

⚠Warning	
	Risk of fatal electric shock. Always disconnect the device's power before making any electrical connections.
	Risk of fatal electric shock. If this device is used outdoors or in potentially damp locations, it must be connected to its power source through a high-voltage protection device.
	Risk of fatal electric shock. Wiring applications for both (85-265) VAC and 24 VDC require a grounding (PE) wire. Due to electromagnetic interference, not connecting a well-grounded wire could result in fatal electric shock and poor device performance. Always connect a well-grounded wire to the controller terminal.
⚠ Danger	
	Risk of fatal electric shock. Do not connect an AC power source to the 24VDC model.

4.3.2 Wiring instructions

Note: Install the device in a location where it is convenient to turn off the device switch and operate it.

The controller is available in models with either (85~265)V AC or 24VDC power supply options. Please follow the relevant wiring instructions for the model you have purchased.

For controllers powered by 24V DC, the DC current must be stabilized within the specified 24VDC±10% voltage limits. The DC power source must also provide adequate surge and line transient protection.

Users must prepare a grounding cable (minimum 1.0mm^2), connect it to the power supply PE (GND), and ensure effective grounding.

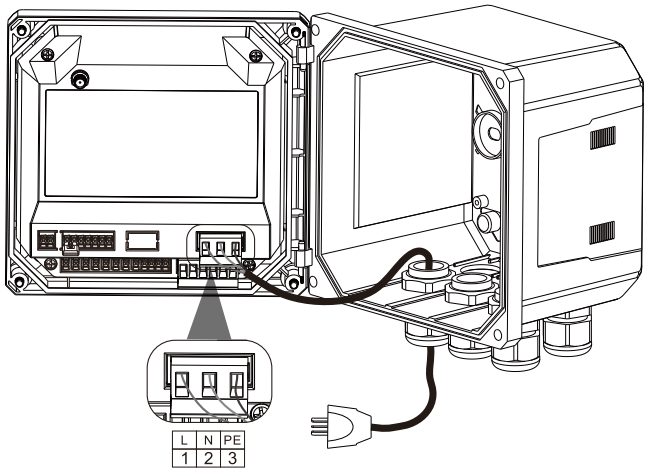


Fig.10 Power wiring schematic

4.4 Analog sensor wiring

4.4.1 Safety tips

⚠Warning	
	If the sensor lacks a solution grounding cable (SG) or shielded cable, terminals 4 and 5 must be shorted together using a jumper. Otherwise, measurement data may fluctuate significantly.

4.4.2 Wiring instruction

Note:

- If possible, use shielded cables and connect the shielding end to terminal 4 (SG) to enhance the device's anti-interference capabilities. If the cable has no shielding layer, then it is not necessary to make a connection.
- When the controller's power is not grounded, users can connect signal grounding terminal 9 (PG) to the earth.

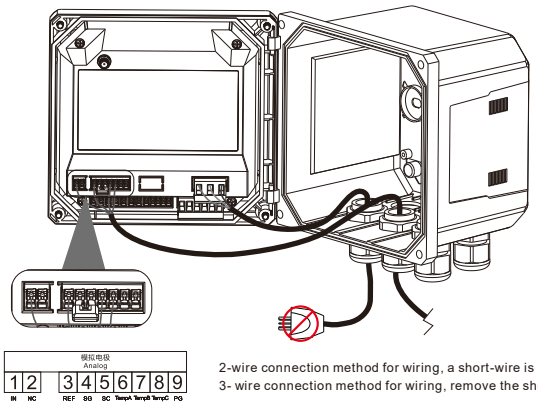


Fig.11 Analog sensor connection schematic

Table 3 Analog sensor wiring instructions

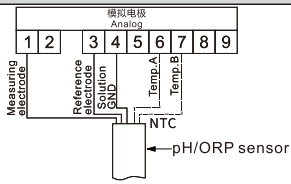
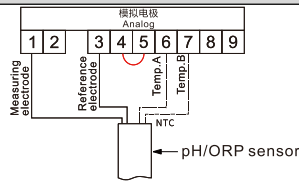
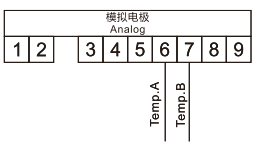
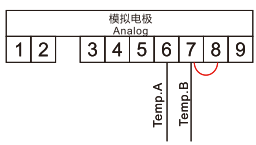
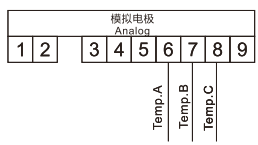
3-wire: Sensor with SG	2-wire: Sensor without SG
	
pH/ORP sensor with SG directly connects to terminal 4	pH/ORP sensor without SG needs to short terminals 4 and 5 (the controller comes with a short-wire, or users can use a wire to connect them)

Table 4 Temperature electrode wiring

NTC TEMP.electrode	2-wire TEMP.electrode (Pt1000、Pt100)	2-wire TEMP.electrode (Pt1000、Pt100)
		
	2-wire TEMP.electrodes need to short terminals 7 and 8 (the controller comes with a short-wire, or users can use a wire to connect them)	

4.5 Digital sensor wiring

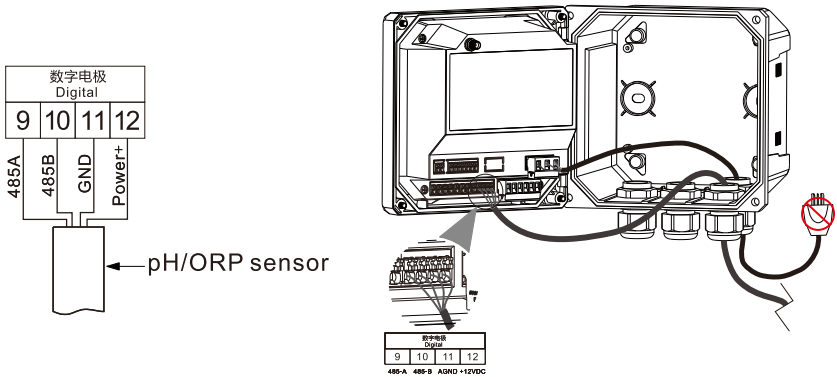


Fig.12 Digital sensor wiring schematic

When connecting a digital sensor to the controller for the first time, navigate to the "Settings/Measurement Settings/Channel 1" menu. Then, under "Input Signal," change "Analog Electrode" to "Digital Electrode" (the factory default is an analog signal). The controller will automatically scan for devices. If a new device is detected, the controller will execute the installation process, requiring no further action from the user. If the controller displays "Search Failed" or the main interface shows "Not Connected," it means the controller did not find the electrode or the electrode connection is incorrect. Please check the electrode wiring. The controller will continue to search automatically, requiring no additional user intervention.

4.6 Analog output wiring

4.6.1 Safety tips

⚠Warning	
	There is a risk of fatal electric shock. Always disconnect the power source from the device before making any electrical connections.
	To maintain the IP protection level of the enclosure, use only conduit fittings and cable glands with an IP66 protection level or higher to connect the cables to the device.

4.6.2 Wiring instruction

The device is equipped with two independent analog outputs (AO1 and AO2). These outputs are commonly used for analog signals with a maximum load of 750Ω.

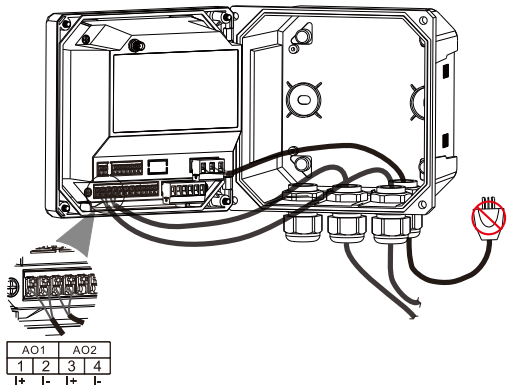


Fig.13 Analog output wiring schematic

4.7 Communication output wiring

4.7.1 Safety tips

⚠Warning	
	There is a risk of fatal electric shock. Always disconnect the power source from the device before making any electrical connections.
	To maintain the IP protection level of the enclosure, use only conduit fittings and cable glands with an IP66 protection level or higher to connect the cables to the device.

4.7.2 Wiring instruction

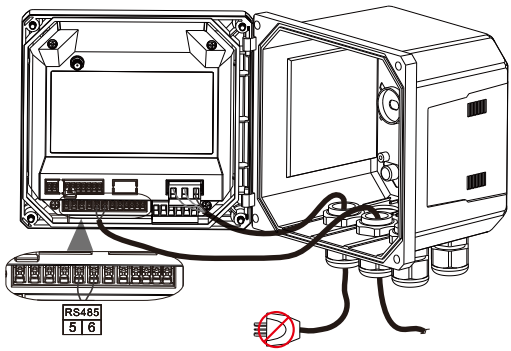


Fig.14 Communication output wiring schematic

4.8 Alarm and relay wiring

The controller is equipped with three unpowered, single-pole relays with a maximum resistive rating of 250VAC, 50/60Hz, 5A. For AC-powered controllers, the relay contacts have a maximum resistive rating of 250VAC, 5A, while for DC-powered controllers, the maximum resistive rating is 30VDC, 5A. The relays have no rated inductive load.

4.8.1 Safety tips

⚠Warning	
	Risk of fatal electric shock. Always disconnect the power source from the device before making any electrical connections.
	Risk of fire. The relay contacts are rated for 5A and are not fusible. Any external load connected to the relay must be equipped with a current-limiting device to restrict current to below 5A.
	Risk of fire. Do not bundle common relay connections or power connections inside the device on a daily basis.

For controllers powered by (85-265) VAC:

⚠Warning	
	Risk of electric shock. AC-powered controllers are designed to connect relays to AC power circuits.

Do not connect AC voltage exceeding 265V in the wiring compartment.

For controllers powered by 24VDC:

⚠Warning	
	Risk of electric shock. Controllers with an operating voltage of 24V are designed to connect relays to low-voltage circuits (e.g., voltage below 16V-RMS, 22.6V-PEAK, or peak 35VDC).

4.8.2 Wiring instruction

Relay terminals can accept AWG12~AWG28(1.0mm2~2.5mm2) wires (specific application depends on load conditions). Wires smaller than AWG28 are not recommended.

The relay is of SPST type; after activating an alarm or other statuses, the "Normally Open" (NO) and relay contacts will complete the circuit. The relay contacts will open the circuit when the alarm or other statuses are cleared, or when the controller's power is disconnected.

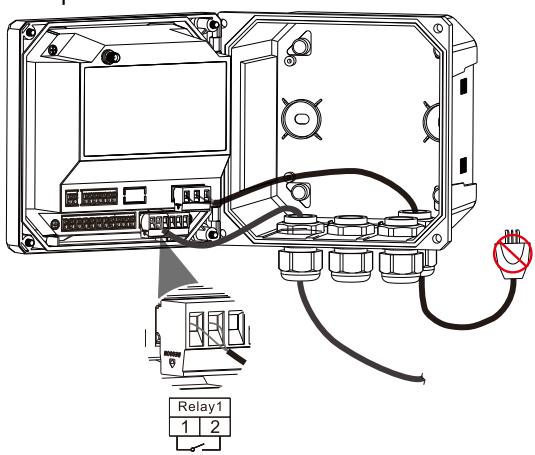


Fig.15 Relay wiring schematic

4.9 Wireless communication wiring (Optional)

4.9.1 Safety tips

⚠Warning	
	Risk of fatal electric shock. Always disconnect the power source from the device before making any electrical connections.
	Risk of lightning strike. When installing the controller outdoors, position the antenna where lightning protection is provided, or use a high-voltage shock protection device.
	Risk of fatal electric shock. To maintain the IP protection level of the enclosure, use only conduit fittings and cable glands with an IP66 protection level or higher to connect the cables to the device.

4.9.2 Wiring Instructions

Note: Do not place it inside a shielded cabinet.

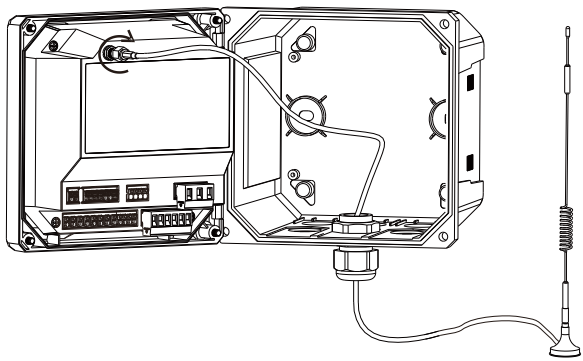


Fig.16 Wireless communication wiring schematic

- The antenna base comes with a magnetic suction feature, allowing it to adhere to metal devices.
- Position the antenna facing upwards to maximize the signal reception area.
- Since the antenna cable is relatively thin, for protection purposes, it is recommended to thread it through the same cable gland as other cables and secure it with a waterproof connector.

4.10 Cable gland installation

Note: Cable glands must be correctly installed to meet the IP66 rating. Hydrate the O-rings before assembly.

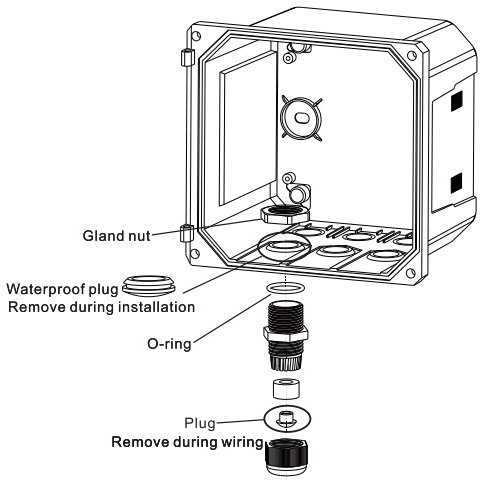


Fig.17 Cable gland installation

4.11 Post-Connection checks

Table 5 Post-Connection checks

Check Item	Result
Is the cable or instrument undamaged (visual inspection)?	☐
Does the cable meet the specifications?	☐
Is the cable completely free from external forces?	☐
Is the terminal allocation correct?	☐
Does the supply voltage match the voltage specified on the nameplate?	☐
Are all cable glands installed, tightly fastened, and sealed?	☐
Are all housings installed and tightly secured?	☐
After power-up, does the display show values?	☐

5 Operation

5.1 Startup

Once the controller is connected to the power circuit, it starts up as soon as the circuit is energized. After initialization, the controller will automatically scan for devices (the factory setting is set to analog signals). If no sensor is detected, check if the sensor end is functioning properly. If you're connecting a digital sensor, go to **Setup/Measure/CH1/Inputs**, and change from analog signal to digital signal. The controller will then automatically search for the sensor.

5.2 Button display

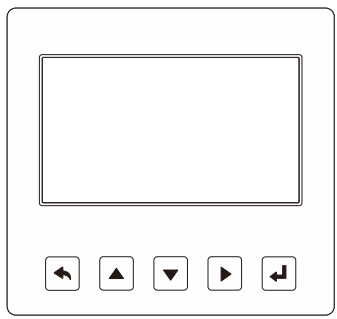
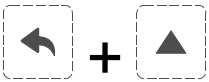
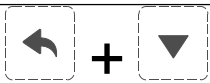


Fig.18 Button display

Table 6 Button definitions

Icon	Button Name	Function Description
	Return	In "Main Measurement Interface," view related alarm status. In "Menu Interface," navigate back to the upper level between related layers.
	Up	In "Menu Interface," select relevant menu items. In settings, modify relevant values.
	Down	In "Menu Interface," select relevant menu items. In settings, modify relevant values.

Icon	Button Name	Function Description
	Right	Cycle through the digits of parameters. In "Measurement Interface," toggle display mode between numerical display and real-time curve.
	Enter	Hold down for 3 seconds under "Measurement Interface" to enter the main menu. In "Menu Interface," confirm changes.
	Return + Up	Press both simultaneously to initiate wireless communication (optional communication module).
	Return + Down	Press both simultaneously to search for digital electrodes.

5.3 Interface description

5.3.1 Main measurement interface

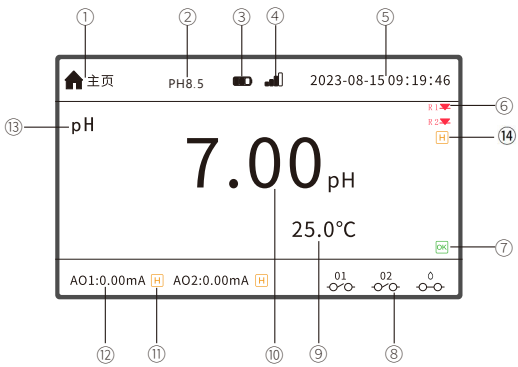
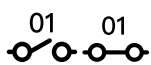
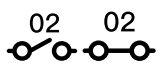


Fig.19 Main measurement interface

Table 7 Main measurement interface description

No.	Content	Icon	Description
1	Symbols Displayed		Icons will display based on the current page. Six icons represent the Home, Menu, Setup, Outputs, Calibration, and Maintenance.

No.	Content	Icon	Description
2	Controller Model	/	Current model of the controller.
3	Mainboard Battery Level		Displays the charge level of the built-in button cell battery.
4	Wireless Signal Strength		Displays the wireless signal strength. The icon flashes during communication (optional wireless module).
5	System Time	/	/
6	Alarms		01/02 Relay high alarm
			01/02 Relay low alarm
7	Controller Status (Normal/Fault)		If the controller experiences a performance fault, < OK > disappears, and a warning symbol appears. Users can go into the Maintenance Menu > Diagnostics > Logs > Fault Records to view specific issues. Alarms won't change the controller status under this state.
8	Relay Status		01 Relay on or off (normally defaults to open)
			02 Relay on or off (normally defaults to open)
			Cleaning Relay on or off (normally defaults to open)
9	Temperature Measurement	/	/
10	Main Measurement Values	/	/

No.	Content	Icon	Description
11	Output Hold/Current Simulation		Output Hold: When the user activates this feature, a hold icon appears next to the current output on the main display screen.
			Current Output Simulation: When this feature is activated, a simulation icon will appear next to the current output on the main display. Note: Simulation cannot be used while in hold status.
12	Analog Output	AO1，AO2	2 analog outputs
13	Sensor Name	/	Current sensor name. If a digital signal input fails to identify a sensor, it displays "Not Connected."
14	Measurement value hold		This function freezes the current measured value. After activation, the **Hold** indicator appears at the upper right of the measured value on the main display.

5.3.2 Curve interface

In the Main Measurement Interface, press the <▶> to switch to the curve display. The graph displays the measurement values for each active channel, making it convenient for monitoring measurement trends.

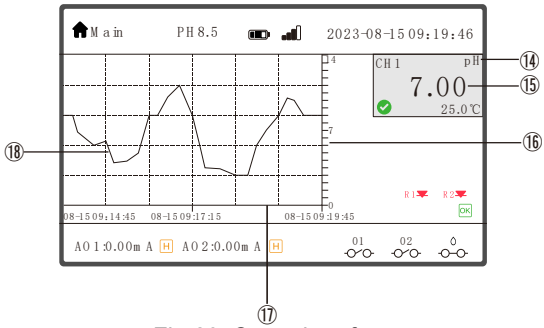


Fig.20 Curve interface

Table 8 Curve interface description

No.	Description
14	Measurement Parameter Name
15	Real-Time Measurement Data
16	Y-Axis: Measurement Value Axis, auto-adjusts within the range
17	X-Axis: Time Axis (recording interval * 300)
18	Trend: Real-time measurement values; It does not back-track when switching interfaces.

5.3.3 Alarm information interface

In the Measurement Interface, press <> to view the alarm information.

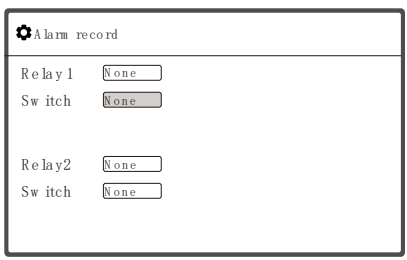


Fig.21 Alarm information interface

In case of alarm, a flashing red alarm box will appear on the controller's measurement interface.

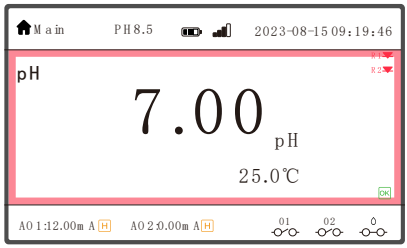


Fig.22 Alarm interface

5.3.4 Sensor not connected or disconnected

If the controller fails to recognize a digital sensor or if the digital sensor is disconnected, the parameter name on the main interface will display "Not Connected," and the measurement data will change to "----".

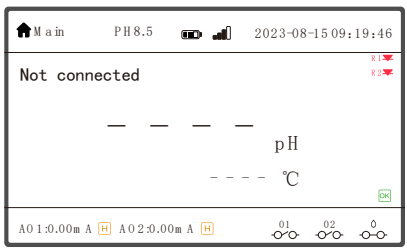


Fig.23 Sensor not connected or disconnected

5.3.5 Measurement data out of range

If the sensor measurement parameters exceed the upper or lower limits of the measurement range, the measurement data will display as "****".

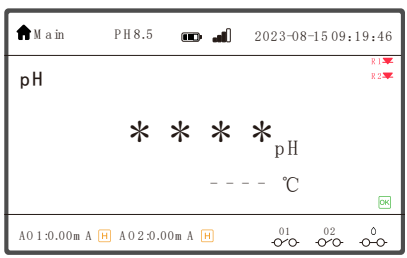


Fig.24 Measurement data out of range

5.3.6 Menu

Hold down <↵> for 3 seconds and enter the password (default password is

"0000") to access the menu interface. The menu is as shown in the following figure.

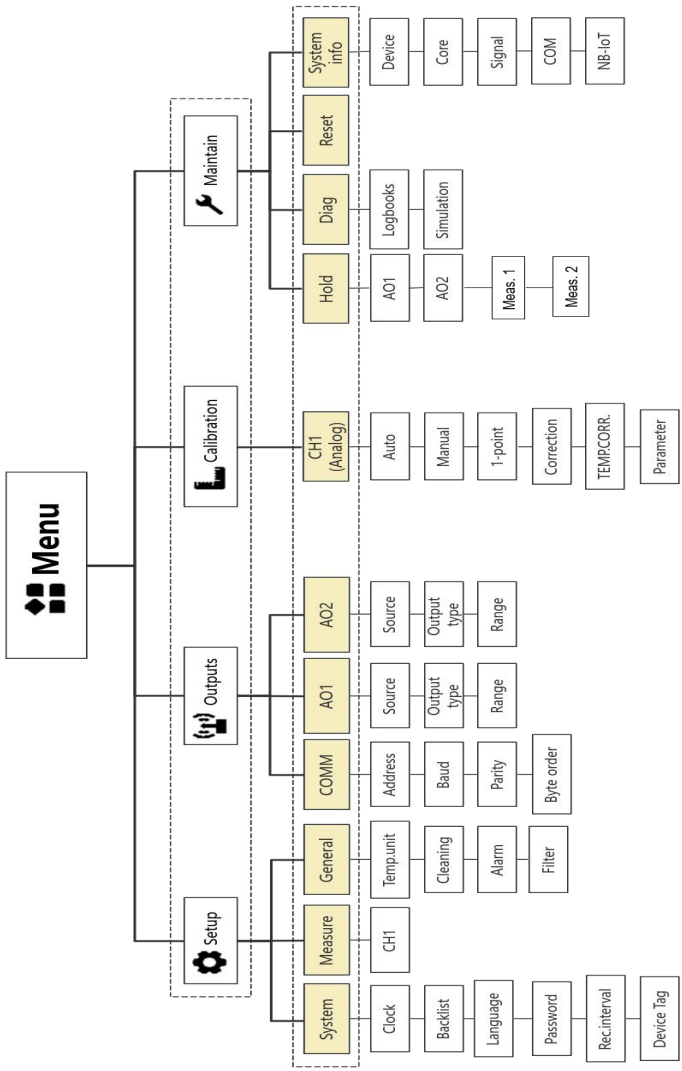


Fig.25 Menu tree

5.4 Operational instructions

5.4.1 Selection List

Some menus require choosing a parameter/data. In such cases, the controller will provide a list of options. Access the parameter selection interface by pressing <↵> and select the required parameter/data.

For example: Menu→Setup→Measure→CH1→Temp→TEMP.Sensor.

5.4.2 Numerical Values

(1) Values can be changed.

(2) The maximum and minimum limits of the variable are displayed at the bottom of the screen.

(3) Set the value within the specified range.

For example: Menu → Setups → Measure → CH1 → Filter time

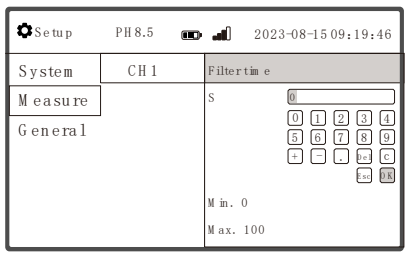


Fig.26 Setting values

5.4.3 Changes taking effect

If the controller prompts a "**Do you want to have changes?**" dialog box, the following options are available. Selecting "**Yes**" will save the changes made, while selecting "**No**" will return you to continue with the settings.

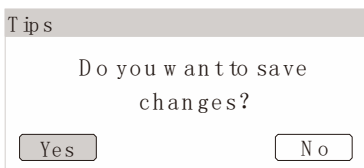


Fig.27 Save changes

After completing most menu settings, you'll need to go back to the secondary menu. At this point, the controller will prompt, "**Do you want to have changes?**" The changes will only take effect after pressing "**Yes**".

For some specific menu parameters, the changes will take immediate effect, such as **backlight status, backlight brightness, clock, inputs, sensor type, hold output, etc**. For these settings, the system will not prompt to save and will automatically save the changes.

5.5 Password

To access the controller's menu, a security password is required. The default password is "0000".

Fig.28 Enter password

Users can navigate to **Setup** → **Password** to customize and change the password. It is important to keep the updated password secure. In case of loss or forgetting the password, please contact our company for assistance.

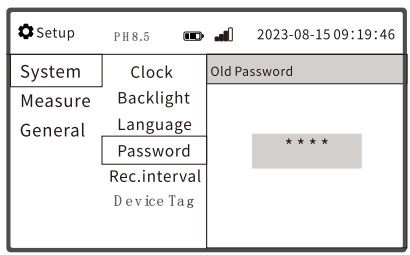


Fig.29 Password setting

5.6 Configuration settings

5.6.1 System Settings

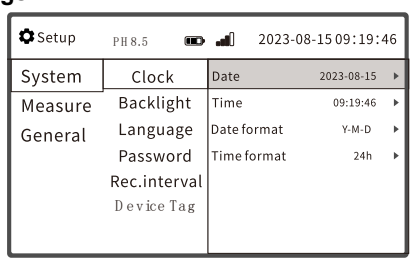


Fig.30 System settings menu

(1) Clock settings

If needed, adjust the time and format.

(2) Backlight settings

Adjust the screen backlight and brightness according to the work environment. Options include **Auto/On/Off.** If set to **Auto**, the backlight will turn off automatically after 30 seconds of inactivity and will turn back on upon pressing any button. If set to **On**, the backlight will not turn off automatically.

Brightness levels range from 1 to 5, with 5 being 100% brightness.

(3) Language settings

The default language for the controller is Chinese. English, Korean, and Spanish are also available.

(4) Password settings

Please refer to Chapter 5.5 "Security Password" for details.

(5) Recording interval

The default interval is 1 s. Real-time measurement curves and historical data are sampled or recorded based on this interval. The interval can be set to: 1s, 2s, 5s, 10s, 15s, 30s, 1min, 2min, 5min, 10min, 15min, 30min, 1h.

(6) Device Tag

Customize the device name.

5.6.2 Measure settings

The single-channel products cannot be turned off and are enabled by default.

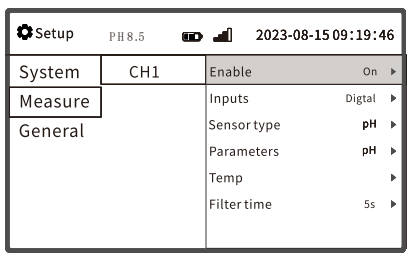


Fig.31 Measure settings menu

(1) Inputs

Set to analog or digital sensor. The controller defaults to analog input; if a digital sensor is connected, switch from analog to digital. After making this change, the controller will automatically scan for sensor types. If no match is found, the

controller will display "Search Failed". Please refer to Chapter 4.5 "Digital Sensor Wiring" for details.

(2)Sensor type

For analog sensors, users can manually select between pH, ORP, or Sb; no need to choose for digital sensors.

(3) Parameters

Set the main parameters for sensor measurements. For pH/Sb, the parameters can be set to pH or mV; For ORP, the parameter can be set to mV.

(4) Temperature

Users can set the temperature compensation mode, type of temperature sensor (only supported for analog sensors), and the compensation curve type (only for analog sensors).

Temperature compensation is for pH only. ORP generally does not have temperature compensation.

Compensation modes include Auto and Manual. In Auto, users can choose the type of temperature electrode and compensation curve; in Manual, users can only set the temperature, and the default is 25°C.

Temperature sensors supported: NTC10K, Pt1000, Pt100.

Compensation curve types: Linear, Pure, Acid, Base.

Linear: Use only when the sample has a good linear temperature coefficient; the default value is 0.1984mV/°C.

Pure: Compensates according to the ultra-pure water curve (corresponding to pH 7.0 at 25°C).

Acid: Compensates according to the sulfate curve (4.84mg/l corresponds to pH 4.0 at 25°C).

Base: Compensates according to the ammonia/ammonium curve (0.272mg/l ammonia + 20μg/l ammonium corresponds to pH 9.0 at 25°C).

(5) Filter time

In environments with significant electromagnetic interference, the filter time can be set to 0s ~ 100s to enhance measurement stability.

5.6.3 General settings

This menu allows users to configure the controller's temperature unit and relays. Of the three relays, two are designated as alarm relays and one as a cleaning

relay. Settings can be adjusted according to user requirements.

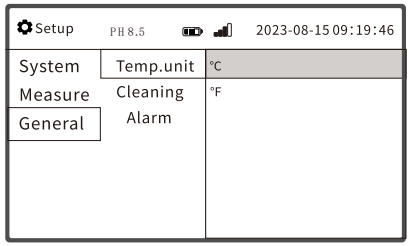


Fig.32 General settings menu

(1) Temperature unit

Options for Celsius (℃) or Fahrenheit (℉) are available, with ℃ being the default.

(2) Cleaning

- Manual enabling or disabling of the cleaning function is possible, and the indicator <> on the measurement interface will provide appropriate cues.
- Cleaning duration can be set between 1 and 900 seconds.
- Cleaning intervals can be set between 1 second and 7 days.
- Automatic Hold can be enabled or disabled.
- The output channel can be set to AO1 or AO2.
- Measurement Hold can be enabled or disabled.
- Measurement Hold Time is adjustable from 0 to 240 seconds.
- Several conditions can interrupt the cleaning feature: power loss or reboot of the controller; manual disabling by the user; or controller malfunctions.

⚠Warning	
	Failing to cease cleaning operations during calibration or maintenance poses the risk of personnel injury due to exposure to media or cleaning solutions.

If a cleaning system is connected, it should be turned off before removing the sensor from the media.

If checking the cleaning function is necessary and the system cannot be turned off, appropriate safety measures, such as protective clothing, goggles, and gloves, must be taken.

(3) Alarm settings

The alarm settings can be configured for relay status, limit switch conditions, and

delay functions.

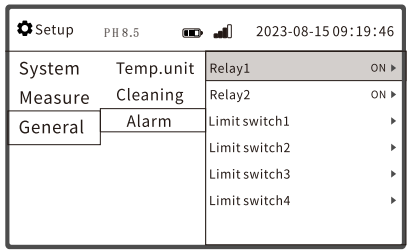


Fig.33 Alarm settings menu

- **Relay**

Relays can be turned on or off, and each relay can control up to four limit switches.

- **Alarm delay**

Alarm Delay only displays errors persisting beyond the set delay time, omitting brief or transitional errors. Delay time can be set between 0 and 9999 seconds.

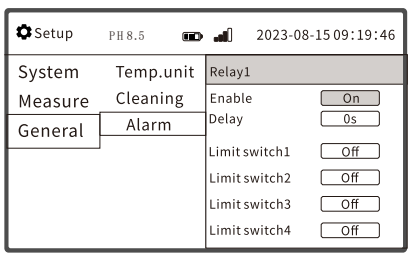


Fig.34 Alarm delay settings

- **Limit switches**

The function of the limit switch is to set the data source, alarm threshold, and hysteresis values.

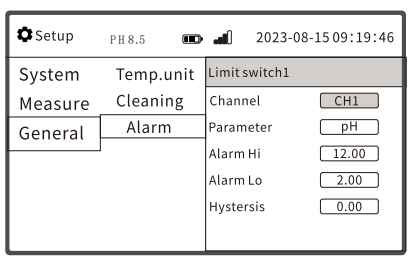
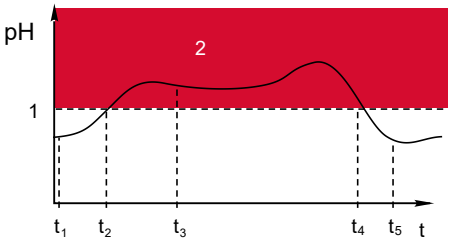


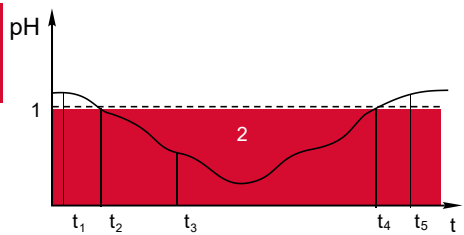
Fig.35 Limit switch settings

Parameter: Depend on the data source: pH, mV, temperature.

Alarm high/low: The range depends on the scale; for example, the pH alarm threshold can range from -2pH to 16pH



Exceeding high alarm value (without hysteresis and delay)



Exceeding the low alarm value (without hysteresis and delay)

In the graph:

1. Alarm value 2. Alarm range

t_1, t_3, t_5, the relay remains inactive .t_2,t_4, the alarm is triggered.

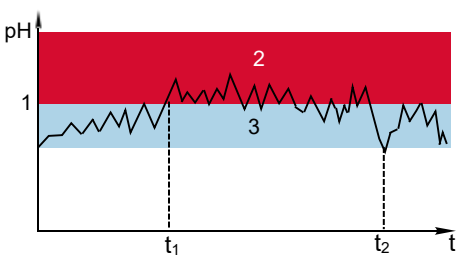
When the measured value (pH) increases and exceeds the set threshold, the relay activates (limit), especially if it surpasses the alarm delay time.

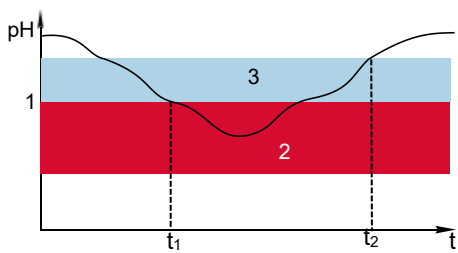
If the measured value decreases and falls below the close value, the relay triggers to close (limit minus hysteresis).

Hysteresis Value: This is added or subtracted from the set limit. The relay will only release when the measured value is entirely below or above the value after the hysteresis is applied. For instance, if a high set value is fixed at 100, and the measured value exceeds this, the relay is activated. If the hysteresis is 10, then the measured value must drop to 90 for the relay to release.

Values of (low alarm point + hysteresis) and (high alarm point - hysteresis) must be within the range.

Hysteresis Range: 0 to (high alarm value - low alarm value) / 2.





The graph on the left shows the hysteresis effect for a high alarm, while the one on

the right illustrates the hysteresis effect for a low alarm.

In the graph:

1: High alarm value

2: Alarm range

3: Hysteresis range

t_1: Trigger the alarm； t_2: Clean the alarm.

5.7 Output settings

Under this menu, settings related to RS485 communication and analog output can be adjusted.

5.7.1 Communication settings

Users can configure the RS485 communication address, baud rate, transmission format, and byte order.

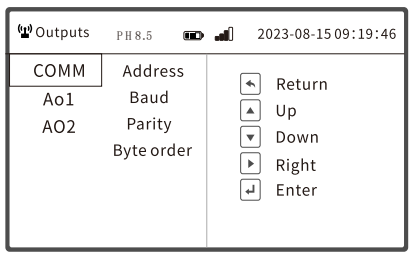


Fig.36 Communication settings

Address: Range from 1 to 247.

Baud: Options include 2400, 4800, 9600 (default), 19200, 57600, 115200.

Parity: The first digit represents the number of data bits, the second digit denotes parity, and the third digit indicates the stop bit.

Byte order: Choices are 1-0-3-2, 0-1-2-3, 2-3-0-1, and 3-2-0-1.

5.7.2 Analog output

Users can configure the signal source, output type, and range.

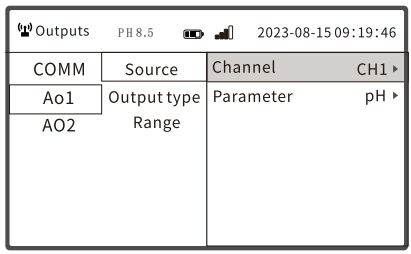


Fig.37 Analog output settings

Source: Users can select from input channels and sensor parameters. For instance, for pH, users can choose to output based on the pH parameter or the temperature parameter.

Output type: Either (4~20)mA or (0~20)mA. The current output complies with the NAMUR NE43 standard, with a linear range of 3.8mA to 20.5mA or (0~20.5)mA. If values exceed the range, the current value is capped at the upper or lower range limit and outputs a fault message (E100 or E101).

Range: Users can define the desired measurement range. By default, the controller is set to its maximum range.

6 Calibration

6.1 Analog pH Calibration

For the pH analog sensor, the controller offers auto-calibration, manual calibration, single-point calibration, signal correction, and temperature correction. It also comes pre-stored with two sets of buffer solutions (GBT27501/NIST), and there's an option to manually input the buffer solution. The pH value of the buffer solution is measured at 25°C. If you wish to use the auto-detection of buffer solutions for calibration, you need one of the two sets of buffer solutions (please refer to Appendix B for the relationship between buffer solutions and temperature). Before using auto-calibration, select the correct buffer solution set. The pre-stored buffer sets are: GBT27501 (4.00/6.86/9.18) and NIST (4.01/7.00/10.01).

In the automatic temperature compensation mode, the temperature sensor must be immersed in the buffer solution, which will systematically compensate for the sensor's temperature based on the Nernst system.

In manual temperature compensation mode, during calibration, the system will automatically search for the corresponding buffer value based on the user-set temperature. Thus, try to keep the buffer solution temperature close to the set temperature to minimize calibration errors.

For precise calibration of the pH electrode, it's recommended to use two-point calibration, where one of the pH levels should be close to the sample water's pH value. For zero-point calibration, use the pH7.00/pH6.86 buffer solution (at 25°C). For calibrating the electrode's slope, use the pH4.01/pH4.00 buffer solution (at 25°C) or the pH10.01/pH9.18 buffer solution (at 25°C).

6.1.1 Calibration

- **Calibration settings**

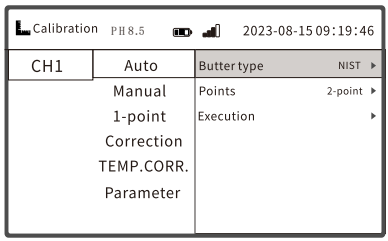


Fig.38 Auto-Calibration settings

（1） In auto-calibration mode, users need to select the standard solution group type (GBT/NIST) and confirm the buffer values at different temperatures.

（2） Choose the calibration method: 2-point calibration or 3-point calibration. Generally, two-point calibration is sufficient to meet requirements.

（3） Execute the calibration.

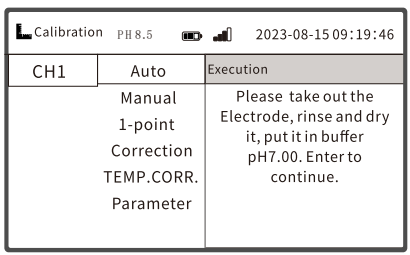


Fig.39 Execute calibration

- **2-point calibration steps:**

Step 1: After selecting "**Execution**", follow the prompts to remove the electrode, rinse and wipe it dry, then place the electrode into the pH6.86 (or pH7.00) buffer solution. Press <↵> to start the first point calibration.

Step 2: The interface will display "In calibration and current calibration value". The analyzer will automatically recognize the value of the standard solution from the selected calibration buffer series.

Step 3: Once the reading stabilizes, the analyzer will automatically decide (or you can manually confirm) and proceed to the second point calibration.

Step 4: Follow the prompts to remove the electrode, rinse, and wipe it before

placing it into buffer solution 2. Press <↵> to start the second point calibration (Note: Buffer solution 2 is chosen based on the measurement medium property to be either acidic or alkaline).

Step 5: After the reading stabilizes, the analyzer will automatically determine the calibration result.

Note:

During the calibration process, you can press "↩" at any time to exit without saving the current calibration result.

If calibration is successful, it will prompt the electrode's health status, display the slope and zero point of this calibration. Pressing <↩> will prompt "**Save** ". Click **"Yes"** to record the calibration result in calibration parameters and calibration log; click **"No"** to reject this calibration.

Slope and zero point limit: If the slope value isn't within 80%-120% or the zero point drift isn't in the -1pH~1pH range, an error message will be displayed. Refer to Chapter 8 "Error Messages".

Sensor health prompt: Excellent sensor performance; sensor condition qualified. Need to schedule maintenance; Sensor condition is bad. Suggestion maintenance.

If calibration fails, it will display "**Failed, XXXX**", and this calibration result won't be recorded. Press <↵> to return to the calibration menu.

- **3-point calibration steps:**

The steps for three-point calibration are similar to "2-point calibration". The first point should be neutral, and it's advised to calibrate in the order of acidic first, then alkaline, for more accurate results.

6.1.2 Manual calibration

When users don't have standard buffer solutions (GBT/NIST) for the calibration type in use, they can use this menu to manually input values of other types of buffer solutions (values maintained at a constant temperature). Users only need to input this value once.

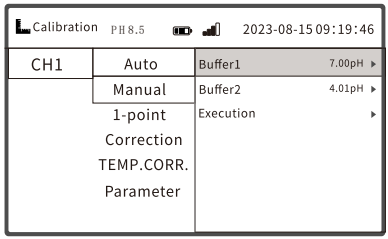


Fig.40 Manual calibration

- **Manual calibration steps:**

Step 1: After selecting "**Execution**", follow the prompts to remove the electrode, rinse, and wipe it dry, then place it into buffer solution 1 (the current value of the buffer solution will be displayed at the bottom of the interface).

Step 2: Wait for the value to stabilize and press <↵> to proceed to the second point calibration.

Step 3: Follow the prompts to remove the electrode, rinse, and wipe it dry, then place it into buffer solution 2.

Step 4: Wait for the value to stabilize and press <↵>. The analyzer will display the calibration result, and the result determination is the same as "Auto-Calibration".

6.1.3 1-point calibration

⚠Warning	
	Only perform this operation when there is zero-point drift.

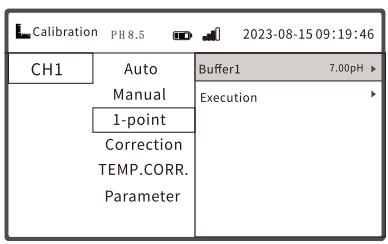


Fig.41 1-point calibration

Users use a single buffer solution, a solution of known concentration, or directly measure with sample water (the value of which has been measured in the

laboratory) for single-point calibration. Each time they perform a single-point calibration, users need to input the buffer solution value or the sample water value. After calibration, the zero-point value will be displayed.

6.1.4 Signal correction

You can set the pH offset. Effective range for pH offset: -2.00pH to 2.00pH.

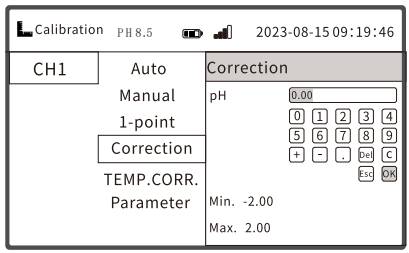


Fig.42 Signal correction

6.1.5 Temperature correction

This menu allows you to set the temperature offset. Effective range for temperature offset: -20.0°C to 20.0°C.

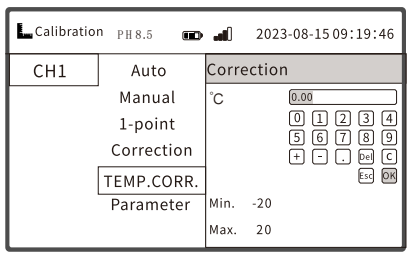


Fig.43 Temperature correction

6.1.6 Calibration parameter

The calibration parameters display the slope and zero-point data from the most recent successful calibration. If no calibration has been performed, it will display "None".

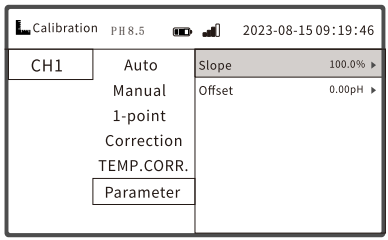


Fig.44 Calibration parameter setting

6.2 Analog antimony calibration

Change the sensor type to "Sb". The calibration method follows the procedures described in Section 6.1 "pH Calibration."

6.3 Analog ORP calibration

6.3.1 1-point calibration

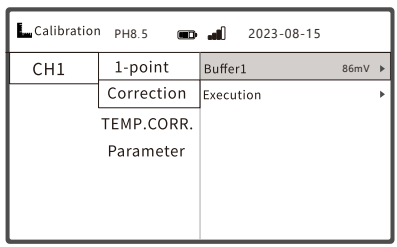


Fig.45 1-point calibration

For 1-point calibration, users utilize one buffer solution, a solution of known concentration, or directly measure a sample (where the value of the sample has been determined in the laboratory). Each time a single-point calibration is conducted, users need to input the buffer solution value or sample value. Upon completing the calibration, the zero-point value is displayed. Click "**Yes**" to save the parameters, or "**No**" to discard the calibration parameters for this session.

6.3.2 Signal correction

Adjustments can be made for ORP offset. Effective range for ORP offset: -200mV to 200mV.

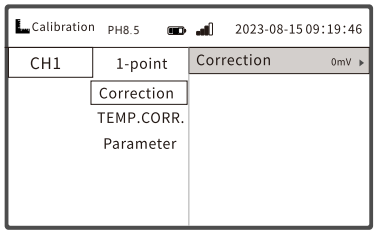


Fig.46 Signal correction

6.3.3 Temperature correction

If the ORP sensor comes with a temperature probe, users can opt for automatic temperature compensation and make temperature corrections, similar to section 6.1.5 "pH Temperature correction". Standard ORP sensors use manual temperature compensation and don't have the temperature correction feature.

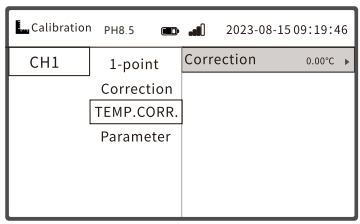


Fig.47 Temperature correction

6.3.4 Calibration parameter

You can view the slope and zero-point data from the most recent successful calibration. If no calibration has been performed, it displays "None".

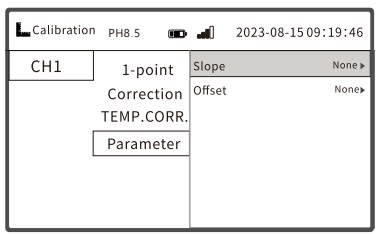


Fig.48 Calibration parameter setting

6.4 Digital pH calibration

For digital pH sensors, the controller offers automatic calibration and signal

correction, and has two preset buffer solution sets (GBT27501/NIST). The calibration method is the same as "Section 6.1 Analog pH Calibration".

6.5 Digital ORP calibration

For digital ORP sensors, the controller offers two-point calibration and signal correction. The calibration method is the same as "Section 6.3 Analog ORP Calibration".

7 Maintain menu

The maintenance menu offers Output Hold, Diagnostics, Reset, and System Information. When maintenance work is required on the analyzer, users can select the relevant function based on their needs.

7.1 Output hold

"Hold" is the process of setting the output to a known state during debugging. The output will be a fixed value or the last value. During calibration or other maintenance tasks, it's up to the user to decide whether to activate the hold function. Powering off and restarting won't affect the hold state.

Users can set the hold for both analog outputs of the analyzer. Before replacing the electrode or maintaining the instrument, activating this function will keep the output current constant. The controller can continue to display the measurement value in real-time, but the relay state cannot be modified, preventing inadvertent triggering of alarm chains. Once the hold output is activated, an "H" symbol will appear next to the respective analog output channel on the main interface. This interrupts all ongoing sensor cleaning programs. However, during hold mode, manual sensor cleaning can still be initiated (by toggling the cleaning settings on or off).

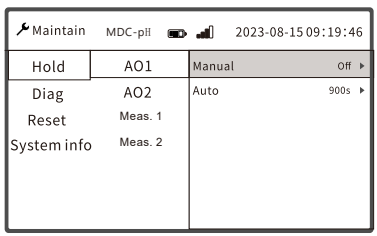


Fig.49 Output hold interface

There are two modes for Output Hold: Manual and Automatic.

In Automatic mode, you can set the release time for the hold. Once the set time is reached, the controller will automatically exit hold mode and return to normal output status. The range for setting the release time is 0s to 3600s, with a default setting of 900s. If you wish to cancel hold mode while in automatic hold mode, you can do so by turning on manual hold and then turning it off, thus canceling the current controller's automatic hold status.

To activate automatic hold mode: Enter the automatic mode menu, set the release time, and press "**OK**". The controller will then immediately activate the hold function, ensuring that the output current remains unchanged.

Note:

This function can be enabled only when "**Hold**" in the [Cleaning Settings] menu and the Simulation function in the "**Maintain**" menu are both disabled.

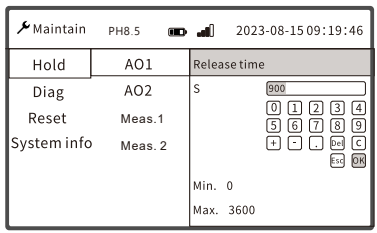


Fig.50 Setting the hold release time

The Simulated Measurement Hold function supports two modes: Manual and Automatic.

In Automatic mode, a hold-release time can be configured. When the preset time is reached, the controller automatically exits the hold mode. The release time is adjustable from 0 to 3600 s, with a default value of 900 s. If it is necessary to cancel the hold state while in Automatic mode, the current automatic hold can be cleared by enabling Manual Hold and then disabling it again.

The Simulated Measurement Hold function is mutually exclusive with the Measurement Hold function in the Cleaning Settings menu and can take effect only when Measurement Hold is disabled.

7.2 Diagnostics

This section provides the option to view log events and current simulation functions. All logs are arranged in chronological order and contain event-related information.

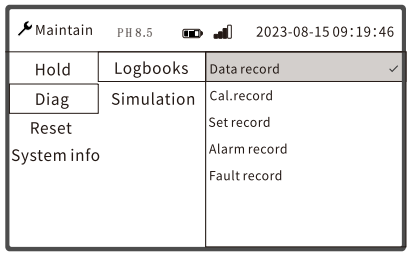


Fig.51 Diagnostics interface

7.2.1 Logbooks

Table 9 Log records

Log Type	Display	Max. Record Count	Delectable
Data record	All Measurement Data	500000	No
Cal. record	Calibration Events	100	Yes
Set record	Setting Events	100	Yes
Alarm record	Alarm Events	120	Yes
Fault record	Fault Events	120	Yes

- **Data record**

  Display Modes: List and curve.

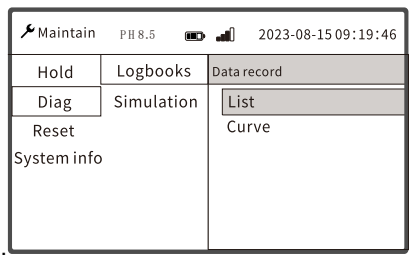


Fig.52 Data record

(1) List

Users can scroll through the list using the "Up" and "Down" keys. They can also search for data records by selecting a specific date and time, avoiding the need to scroll through all the information.

(2) Curve

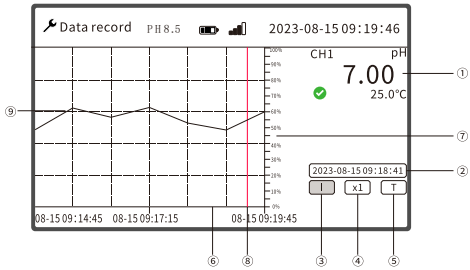


Fig.53 Data record Interface

Table 10 Explanation of data records

No.	Description
1	Measurement data, changes with the cursor.
2	Measurement time, changes with the cursor.
3	Cursor function, press the "Confirm" key to select.
4	Zoom function, after selecting "Confirm", adjust using the "Up" and "Down" keys. Zoom ratios: x1, x2, x4, x8.
5	Time selection, press "Confirm" to input a time to view.
6	X-axis: Time axis (record interval * 300, the record interval can be changed in system settings).
7	Y-axis: Displayed as a percentage of the range.
8	Data cursor axis, displayed after selecting the cursor function. Use the "Up" and "Down" keys to move the cursor and view data.
9	Data curve.

- **Logbooks**

Four types of logs can be queried, displayed, or deleted. Records can be viewed by scrolling through the list using the "Up" and "Down" keys. All records of a particular event type can be deleted.

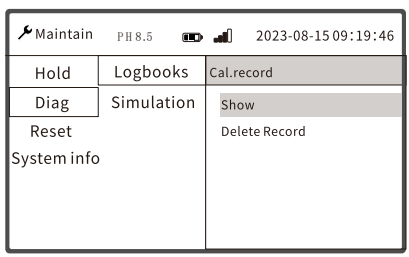


Fig.54 Logbooks Interface

7.2.2 Simulation

When testing, simulate the output current values of the two analog channels separately. This can be used to check whether the analyzer's output current is normal and consistent with the loop current.

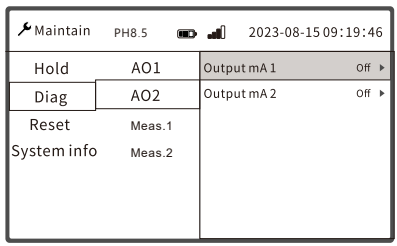


Fig.55 Simulation interface

To enable simulation: After entering the simulation function menu, input the desired simulation current value and press "OK" to start the current simulation. <> will be displayed next to the simulated output channel on the main interface. Selecting "Off" will turn off the simulation. The simulation function is ineffective when in output maintenance mode.

Note: This function can only be enabled when the "Hold" under the Cleaning setting menu and under the Maintain menu are disabled.

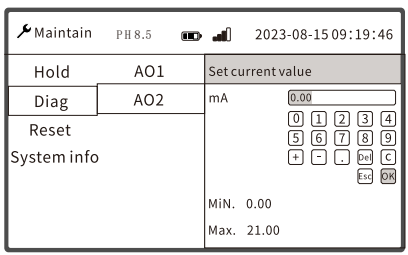


Fig.56 Output current setting

7.3 Reset

This operation will reset the controller parameters to their default values and erase all programmed values.

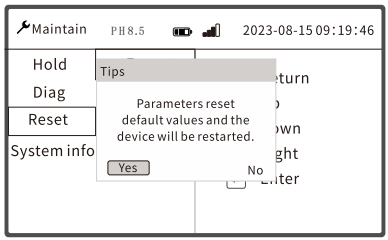


Fig.57 Factory reset

Default values:

(1) Restore all configuration data under the "Analog Output 1/2" interface.

(2) Restore all configuration data under the "Alarm Settings" interface.

(3) Restore all configuration data under the "Communication" interface.

7.4 System information

View device hardware, software information, NB-IoT communication status, and other related details.

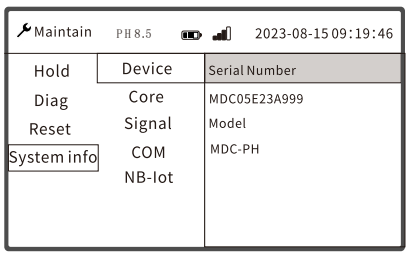


Fig.58 System information

8 Troubleshooting and resolution

8.1 Displayed error messages on the instrument

Table 11 Error messages

Category	Message Content	Solution
pH/ORP	Failed, measurement ultralimit.	Refer to Section 8.3 "Troubleshooting and Resolution"
	Failed, coefficient ultralimit.	
	Failed, communication failed	

8.2 Error codes

Table 12 Error Codes

Error Code	Error Content
100	Analog output 1 current exceeds lower range limit
101	Analog output 1 current exceeds the upper range limit
102	Analog output 2 current exceeds the lower range limit
103	Analog output 2 current exceeds the upper range limit
201	Real-time clock time anomaly
202	Real-time clock battery voltage low
204	F-RAM access failed
205	External Flash access failed

8.3 Common troubleshooting

The table below lists potential problems with the instrument and their solutions. If your issue is not listed or the solution provided doesn't address your concern, please contact us.

Table 13 Troubleshooting and Resolution

Issues	Possible causes	Solutions
Measurement value (zero point) exceeded the limit.	Buffer solution contaminated or expired.	Use a new buffer solution.
	Sensor aged.	Activate the sensor.
	Glass bulb contaminated.	Clean the sensor.

Issues	Possible causes	Solutions
	Calibration procedure error.	Recalibrate.
Slope exceeded limit or slow response.	Buffer solution contaminated or expired.	Use a new buffer solution.
	Glass bulb contaminated.	Clean the sensor.
	Reference sensor blocked.	Clean the sensor.
	Sensor malfunction.	Check sensor operation.
	Sensor aged.	Activate the electrode.
Reading out of range.	Controller malfunction.	Connect a pH signal generator in place of the probe to check the controller.
	Electrode failure.	Check the sensor with a buffer solution.
	Sensor connection incorrect.	Check sensor cable connections.
	Air bubbles inside the sensor glass bulb.	Remove the sensor, gently shake, and reinstall.
Reading unstable.	Controller malfunction.	Connect a pH signal generator in place of the probe to check the controller.
	The sensor or cable is too close to high electromagnetic noise equipment.	Use shielded cables or stay away from high electromagnetic noise equipment.
	Solution not grounded.	Properly connect the sensor.
	Air bubbles inside the sensor glass bulb.	Remove the electrode, gently shake, and reinstall.
	External bubbles adhering to the bulb.	Remove and reinsert the electrode.

Issues	Possible causes	Solutions
	Sample pipeline leaking, air entering the line.	Check pipeline sealing.
Slow drift.	Bulb contamination.	Clean the sensor.
	Reference electrode blocked.	Clean the sensor.
	sensor aged.	Activate the sensor.
No current output.	Output not configured.	Check the current output configuration
	Output port malfunction.	Check the output signal through the menu : **Maintain/Diag/Simulation**
Sensor not recognized.	Sensor wiring incorrect.	Check the sensor wiring and ensure proper connection.
	Input signal setting error.	Confirm if the current sensor is analog or digital, check if the **Setup/Measure/Inputs** set correctly.
	Digital sensor terminal box wiring error.	If a digital sensor is connected to a controller with a digital terminal box, user-provided terminal box, digital extension cable, or user-provided extension cable, please check if the wiring inside the terminal box or extension cable is correct.
The interface displays a red border flashing.	Triggered alarm.	The set value is in an alarm state, refer to Section 5.6.3 "Alarm Settings".

9 Maintenance and care

For optimal measurement results, regular maintenance and care of the instrument are necessary. The maintenance and care of the sensor mainly include cleaning the sensor and checking for any damage. During maintenance and inspection, the related status of the sensor can also be observed. The maintenance of the controller mainly involves cleaning and checking its exterior and cables for any damage. As an electronic device, an inappropriate environment may cause damage to the controller.

9.1 Maintenance and care of the controller

Controller Cleaning:

- Ensure the controller cover is securely closed and wipe the exterior with a clean, damp cloth.

Controller Inspection:

- Periodically check if the instrument is functioning properly. Regularly inspect the panel, terminals, switches, and buttons for dirt or grime, and clean or blow them off as needed.

9.2 Maintenance and care of the sensor

Sensor damage inspection:

- Inspect the electrode's exterior for any damage. Ensure that the probe is sealed. If any damages are observed, contact the after-sales service center for a replacement immediately to prevent any malfunctions due to water ingress.

Sensor cleaning:

- If a cleaning system is connected, first turn it off before removing the sensor from the medium.
- If the cleaning function cannot be turned off for inspection, wear protective clothing, safety goggles, protective gloves, or take other safety precautions.
- If the electrode has no mechanical damage or any broken parts, it can be regenerated as per the following instructions:

Table 14 Sensor Cleaning

Sensor contamination	Cleaning method
Salt deposition	Soak the sensor in a 0.1 mol HCl hydrochloric acid solution for 5 minutes to dissolve the deposits, then soak in a 0.1mol NaOH sodium hydroxide solution for another 5 minutes, followed by rinsing with a large amount of deionized water.
Lubricating grease/oil	Clean the sensor bulb with detergent and water, then rinse the sensor's end with deionized water.
Inorganic substances	Soak in a 0.1mol/L EDTA solution for 15 minutes.
Reference electrode salt bridge blockage	Heat a diluted KCL potassium chloride solution to 60~80°C and soak the blocked part of the sensor in the hot solution for 10 minutes. Then, place the sensor in a cool KCL potassium chloride solution to cool it down.
Electrode aging	Soak in a 5% HF solution for 10~20 minutes, immediately rinse with water, then soak in a 0.1mol HCl solution overnight before continuing to use.

If the above methods cannot ensure a return to normal response time, replace the sensor immediately.

Appendix A: Communication protocol

This product provides a standard RS485 serial communication interface and uses the standard Modbus-RTU communication protocol.

A.1 Real-time data

Reading operations use function codes 0x03/0x04.

Table 15 Addresses of measurement input registers

Register Address	Register Name	Number of Registers	Data Type	RS485 Access	Description
0x2004	Sensor access status	1	uint16_t	RO	0: Not accessed 1: Accessed
0x2005	Reserved (for alignment)	1	uint16_t	RO	
0x2006	Measurement Type & Unit	1	uint16_t	RO	High byte: Measurement parameter type: 0x01: pH，0x02: ORP. Low byte: Unit type: 0x02: mV, 0x03: pH For example: 0x03 means that the measurement parameter is pH and the unit is pH
0x2007	Reserved (for alignment)	1	uint16_t	RO	
0x2008	Measurement value	2	float	RO	0x7FFFffff(+NAN) indicates an invalid value
0x200A	Upper limit value	2	float	RO	0x7FFFffff(+NAN) indicates an invalid value
0x200C	Lower limit value	2	float	RO	0x7FFFffff(+NAN) indicates an invalid value

Register Address	Register Name	Number of Registers	Data Type	RS485 Access	Description
0x200E	Reserved	2	float	RO	
0x2010	Reserved	2	float	RO	
0x2012	Reserved	2	float	RO	
0x2014	Temperature Type & Unit	1	uint16_t	RO	High byte: indicates the type of measurement parameter; this register is fixed at 0x26, indicating the measured temperature. Low byte: represents unit type, 0x00: ℃, 0x01:℉
0x2016	Temperature value	2	float	RO	0x7FFFffff (+NAN) indicates an invalid value
0x2018	Temperature upper limit	2	float	RO	0x7FFFffff (+NAN) indicates an invalid value
0x201A	Temperature lower limit	2	float	RO	0x7FFFffff (+NAN) indicates an invalid value
0x201C	Reserved	2	float	RO	
0x201E	Reserved	2	float	RO	
0x2020	Reserved	2	float	RO	

A.2 Configuration data

A.2.1 RS485 communication

For read operations, function codes 0x03/0x04 are used. For write operations, function codes 0x06/0x10 are used.

Table 16 Addresses of RS485 registers

Register Address	Register Name	Registers#	Data type	RW	Description
0x1100	Device address	1	uint16_t	RW	[1- 247], the default factory setting is 1
0x1101	Baud rate	1	uint16_t	RW	Baud rate selection: 1:2400 9:4800 2:9600(Default) 4:19200 6:57600 7:115200
0x1102	Data format	1	uint16_t	RW	Fixed 8-bit data: 1: No parity (1 stop bit) 2: No parity (2 stop bits) 3: Even parity (1 stop bit) 4: Odd parity (1 stop bit) Factory default: 1

A.2.2 Other configuration

For read operations, function codes 0x03/0x04 are used. For write operations, function codes 0x06/0x10 are used.

Table 17 Addresses of other configuration registers

Register address	Register name	Registers #	Data type	RS485 RW	Description
System Clock					
0x4602	System date	2	uint32_t	RW	BCD format, representing year, month, day sequentially. For example, 0x20230705 represents

Register address	Register name	Registers #	Data type	RS485 RW	Description
					July 5th, 2023. Note: If time is set forward, data records between the old and new times will be lost.
0x4604	System time	2	uint32_t	RW	BCD format, the top 3 bytes represent hour, minute, and second, respectively. For example, 0x18400100 represents 18:40:01. Note: If time is set forward, data records between the old and new times will be lost.
RS485 Communication (Additional Configuration)					
0x4606	Byte order for Transmission	1	uint16_t	RW	0: 1-0-3-2 1: 0-1-2-3 2: 2-3-0-1 3: 3-2-1-0 Factory default: 0
0x461E~ 0x462A	SN code	24	String	RO	Device Serial Number (SN) Encoded in ASCII format and padded with 0x00 if the length is insufficient.

A.3 Event log

The event log types include "Online Calibration Records," "Configuration Setting Records," and "Other Fault Records."

The host system can periodically (e.g., 10 seconds) read the latest event record from the device. If the host detects a change between two consecutive valid records, it can determine that a new event has been generated on the device side. The read operation uses function codes 0x03 / 0x04.

Table 18 Event Log

Record type	Register	Register name	Registers#	Data type	RW	Description
Online calibration recorder	0x2602	Timestamp	2	uint32_t	RO	The timestamp is based on January 1, 2000, 00:00:00.
	0x2604	Event code	1	uint16_t	RO	See Table 19 for details Valid range [1000, 1999]
	0x2605	Basic information	1	uint16_t	RO	See Table 19 for details.
	0x2606	Slope	2	float	RO	+NAN(0x7FC00000) indicates an invalid value.
	0x2608	Bias	2	float	RO	+NAN(0x7FC00000) indicates an invalid value.
	0x260A	Zero point error	2	float	RO	+NAN(0x7FC00000) indicates an invalid value.
	0x260C	Units of bias and zero	1	uint16_t	RO	High-byte reserved The low byte represents the unit; see Table 23 for unit type ID details.

Record type	Register	Register name	Registers#	Data type	RW	Description
	0x260D	Reserved	1	uint16_t	RO	
Configuration setup Record	0x260E	Timestamp	2	uint32_t	RO	The timestamp is based on January 1, 2000, 00:00:00.
	0x2610	Event code	1	uint16_t	RO	See Table 20 for details. Valid range [3000, 3999]
	0x2611	Basic information	1	uint16_t	RO	See Table 20 for details.
other fault record	0x2612	Timestamp	2	uint32_t	RO	The timestamp is based on January 1, 2000, 00:00:00.
	0x2614	Event code	1	uint16_t	RO	See Table 21 for details. Valid range [4000, 4999]
	0x2615	Basic information	1	uint16_t	RO	See Table 21 for details.

A.3.1 Online calibration events

Table 19

Specific events	Event Code	Basic Information	Additional Information
Automatic calibration	1000	High byte: Bits 15-13 represent the measurement channel number. 0 = 1, and so on.	Slope (floating-point), bias (floating-point),
Manual calibration	1001		

Specific events	Event Code	Basic Information	Additional Information
Single-point calibration	1002	Bits 12-11 indicate the port type. 0 = analog port; 1 = digital port. Bits 10-8 indicate the health status of the electrodes. 0 = not available 1 = excellent 2 = good 3 = fair 4 = unusable Low byte: Parameter type For details on the ID values of specific parameter types, please refer to Table 23.	zero-point error (floating-point)
Two-point calibration	1003		
Meaningless	1004		
Zero point calibration	1005		
Slope calibration	1006		
Online calibration	1007		
Air calibration	1008		

A.3.2 Configuration setup events

Table 20

Events	Event Code	Basic Information
Clock settings	3000	Fixed constant 0
Password change	3001	Fixed constant 0
Logging interval	3002	The high byte represents the recording interval value, ranging from 1 to 64. The low byte represents the unit of the recording interval: 0 represents seconds, 1 represents minutes, 2 represents hours, and 3 represents days.
Measurement settings	3003	The high byte contains Bits 7-4, which represent the measurement channel number (0 for channel 1, and so on);

Events	Event Code	Basic Information
		Bit 3 represents the channel's strobe status (0 for channel off, 1 for channel on). Bits 2-0 represent the port type (0 for analog port, 1 for digital port), and the low byte represents the parameter type. (see Table 23 for specific parameter type ID values).
Temperature settings	3004	Bits 15-13 indicate the measurement channel number, with 0 representing channel 1 and so on; Bit 12 indicates the temperature compensation mode, with 0 indicating automatic and 1 indicating manual. Bits 11-10 indicate the temperature electrode type in "automatic temperature compensation mode"; 0 indicates NTC10K; 1 indicates PT1000; 2 indicates PT100; 3 indicates NTC30K; Bits 9-0 indicate the temperature value in "manual temperature compensation mode", in units of 0.1℃ (maximum up to 102.3℃).
Reserved	3005	
Cleaning function	3006	The high byte is reserved. The low byte indicates whether the function is on or off, with 0 indicating that the function is off (disabled) and 1 indicating that the function is on (enabled).
Limit alarm (relay)	3007	High byte bits 7-4; Alarm ID number (0 for alarm 1, and so on); bits 3-0: alarm master enable (0= disabled, 1=enabled); Low byte: limit switch selection status

Events	Event Code	Basic Information
		bits 7-0: switches 8-1. Bit x = 0: not selected; bit x=1: selected
Limit switch	3008	High byte bits 7-4: switch ID(0= switch 1, and so on) bits 3-0: signal source channel (0=channel 1, and so on) Low byte: parameter type (see table 23)
Communicating with the host computer	3009	High byte: communication address Low byte: Bits 7-4 indicate the baud rate: 1 for 2400; 2 for 9600; 3 for 14400; 4 for 19200; 5 for 38400; 6 for 57600; 7 for 115200; 8 for 1200; 9 for 4800. Bits 3-2 indicate the transmission format: 0 for no parity (1 stop bit); 1 for no parity (2 stop bits); 2 for odd parity; 3 for even parity. Bits 1-0 indicate the byte order: 0 for "1-0-3-2"; 1 for "0-1-2-3"; 2 for "2-3-0-1"; 3 for "3-2-1-0".
Analog output	3010	The high byte, where Bits 7-5: the analog output channel number (0=analog output channel 1), and so on; Bits 4-3: the analog output range type (0 indicates 4~20mA; 1 indicates 0~20mA); Bits 2-0: the measurement input channel number (0= measurement input channel 1), and so on. Low byte: the parameter type; see Table 23 for the specific parameter type ID values.
Full machine restored to factory settings	3011	Fixed constant: 0

Events	Event Code	Basic Information
Signal Correction	3012	High byte: Bits 7-4: the measurement channel number, with 0 representing channel 1, and so on. Bits 3-0 are reserved for the low byte to represent the parameter type. See Table 23 for the ID values of specific parameter types.
Temperature correction	3013	Same as above
Administrator settings	3014	Meaningless
Filter coefficients	3015	High byte: measurement channel (0= channel 1, and so on); Low byte: coefficient value.
Electrode configuration parameters	3016	High byte: Bits 7-4: measurement channel, with 0 indicating channel 1, and so on. Bit 3: the channel selection status, with 0 indicating channel off and 1 indicating channel on. Bits 2-0: the port type, with 0 indicating an analog port and 1 indicating a digital port. The low byte represents the electrode type; see Table 23 for specific parameter type ID values.
Electrode factory reset	3017	Same as above

A.3.3 Fault events

Events	Event Code	Basic Information
System restart	4000	High byte: reserved, Low byte: restart cause Bit 0=1: power reset, Bit 1=1: brown-out reset, Bit 2=1: external pin reset, Bit 3=1: window watchdog reset, Bit 4=1: independent watchdog reset, Bit 5=1: software reset.
RTC exception	4001	High byte: Reserved; Low byte: RTC fault type 0: time invalid (power loss occurred, re-synchronization required) 1: time format error 2: communication failure with RTC device.
RTC backup voltage low	4002	High byte: Reserved; Low byte: voltage status at event occurrence 1: Low voltage 2: power loss
External Flash access error	4003	**High Byte: Access type** 0 for erase; 1 for read; 2 for write. **Low byte: partition ID number:** 0 for self-test area; 1: APP firmware upgrade related information; 2: APP firmware (BOOT); 3: GUI boot screen; 4: GUI fonts and images; 5: "calibration" event logs; 6: "limit alarm" event logs; 7: "configuration settings" event logs; 8: "fault/abnormal" event logs; 9: the main data record index; 10: the backup data record index; 11: the data record area.

Events	Event Code	Basic Information
FRAM access error	4004	The **high byte** indicates the access mode: 0 for read, 1 for write. The **low byte** indicates the partition ID: 0 for the self-test area, 1: first power-on flag, 2: production configuration data, 3: user configuration data. 4: event log management information; 5: calibration event log; 6: limit alarm event log; 7: configuration setting event log; 8: fault/abnormal event log; 9: measurement data management unit; 10: measurement data log index area; 11: measurement data log area.
System reset	4005	**High byte**: thread/task ID; **low byte**: reset reason: 0: factory reset, 1: firmware upgrade, 2: window watchdog reset, 3: HardFault.
Analog output overrange (high)	4006	**High byte** Bits 7-4 represent the analog output channel number (0 for analog output channel 1), and Bits 3-0 represent the measurement input channel number (0 for measurement input channel 1), and so on. **Low byte**: parameter type; see Table 23 for the specific parameter type ID values.
Analog output overrange (low)	4007	Same as above

Events	Event Code	Basic Information
Measurement overrange (high)	4008	**High byte:** bits 3-0: input channel (0=channel 1 and so on) **Low byte:** parameter type (0 represents measurement input channel 1), and so on. See Table 23 for the specific parameter type ID values.
Measurement overrange (low)	4009	Same as above
Electrode communication error	4010	**High byte:** bits 3-0: input channel (0=channel 1 and so on) **Low byte:** port type (1 represents an analog port; 0 represents a digital port).

A.4 System information

Read operations use function codes 0x03 / 0x04.

Table 21 System Information

Register	Register name	Register number	Data type	RW	Description
0x 1300	SN code	10	string	RO	ASCII code format, padded with 0x00 if necessary.
0x 130A	MN code	12	string	RO	ASCII code format, padded with 0x00 if necessary.
0x5002	SN code	10	string	RO	ASCII code format, padded with 0x00 if necessary.
0x500C	Selection Name	10	string	RO	ASCII code format, padded with 0x00 if necessary.
0x5016	MN code	12	string	RO	ASCII code format, padded with 0x00 if necessary.

A.5 Measurement parameters type

Table 23

Type	Name	Type	Name	Type	Name
0	none	0x10	Nitrate nitrogen (NO_3-N)	0x20	Mercury ions (Hg^{2+})
0x01	pH	0x11	Ultraviolet nitrate	0x21	Lead ions (Pb^{2+})
0x02	ORP	0x12	Chlorine dioxide (ClO_2)	0x22	Sulfide ions S^{2-}
0x03	Dissolved oxygen concentration	0x13	Sodium ion Na^+	0x23	Lg (ion concentration) (Nernst equation, logarithm of concentration)
0x04	Dissolved oxygen saturation	0x14	Potassium ions (K^+)	0x24	
0x05	Salinity	0x15	Ammonium ion $NH4_+$	0x25	
0x06	Atmospheric pressure	0x16	Silver ions Ag^+	0x26	temperature
0x07	Electrical conductivity	0x17	Fluoride ion F-	0x27	resistance value
0x08	Resistivity	0x18	Chloride ions Cl-	0x28	Current value (e.g., dissolved oxygen electrode)
0x09	TDS	0x19	Bromide ion Br^-	0x29	Ultraviolet light path
0x0A	Turbidity	0x1A	Iodide ion I^-	0x2A	Electrode sensitivity
0x0B	MLSS (mixed lime sludge concentration)	0x1B	Nitrate NO_3^-	0x2B	Biochemical oxygen demand (BOD)
0x0C	Residual chlorine	0x1C	Calcium ions (Ca^{2+})	0x2C	Total suspended solids (TSS)
0x0D	Total organic carbon (TOC)	0x1D	Water hardness ($CaCO_3$)	0x2D	Benzene series compound concentration (BTEX)

Type	Name	Type	Name	Type	Name
0x0E	Chemical oxygen demand (COD)	0x1E	Copper ions Cu^{2+}	0x2E	Concentration of 1, 5-disulfonic acid disodium salt dihydrate (NDSA) / Concentration of polycyclic aromatic hydrocarbons (PAH)
0x0F	Ammonia nitrogen (NH4-N)	0x1F	Cadmium ions (Cd^{2+})	0x2F	Solution concentration (conductivity)

A.6 Communication example

Table 24

ID	unit	ID	unit
0x00	℃	0x01	℉
0x02	mV	0x03	p H
0x04	uS/cm	0x05	mS/cm
0x06	ppm	0x07	p pt (part) per thousand)Salinity unit
0x08	mg/L	0x09	g/L
0x0A	ug/L	0x0B	%
0x0C	h P a	0x0D	g/Kg
0x0E	MΩ*cm	0x0F	mmHg
0x10	NTU	0x11	uA
0x12	mA	0x13	A
0x14	mbar	0x15	Ω
0x16	KΩ	0x17	MΩ
0 x18	nA	0 x19	K Pa
0x1A	mol	0 x1 B	M Pa
0 x1C	pX	0x1D	PSI

ID	unit	ID	unit
0x1E	BAR	0x1F	Kgf/cm^2
0x20	m	0x21	cm
0x22	mm	0x2 3	S/cm
0x2 4	Us/m	0x2 5	Ms/m
0x2 6	M Ω *m	0x2 7	K Ω *cm
0x2 8	K Ω *m	0x2 9	Ω *m
0x2 A	PSU	0x2 B	PPb
0x2 C	FTU	0x2D	K (a unit of temperature, Kelvin)

A.7 Communication example

All frame data values are in hexadecimal format, and the byte order for transmission is "1-0-3-2".

Master (Computer) sends: 01 03 20 04 00 0A 8F CC

Slave (Instrument) responds: 01 03 14 00 01 00 00 01 03 00 00 00 00 40 E0 00 00 41 80 00 00 C0 00 89 D5

Response command notes:

01 - Device address

03 - Function code

14 - Indicates the data content length of the response is 20 bytes

0001 - Indicates the electrode's connection status is connected

0000 - Reserved field

0103 - The high byte indicates the parameter type is pH; the low byte indicates the parameter unit is pH

00 00 - Reserved field

00 00 40 E0 - Measurement value is 7.0

00 00 41 80 - Upper range value is 16.0

00 00 C0 00- Lower range value is -2.0

Appendix B: pH calibration buffer solution

Table 25 GBT27501 buffer solution table

Temperature (℃)	pH4.00	pH6.86	pH9.18	Temperature (℃)	pH4.00	pH6.86	pH9.18
0	4.006	6.981	9.458	40	4.029	6.838	9.072
5	3.999	6.949	9.391	45	4.042	6.834	9.042
10	3.996	6.921	9.330	50	4.055	6.833	9.015
15	3.996	6.898	9.276	55	4.070	6.834	8.990
20	3.998	6.879	9.226	60	4.087	6.837	8.968
25	4.003	6.864	9.182	70	4.122	6.847	8.926
30	4.010	6.852	9.142	80	4.161	6.862	8.890
35	4.019	6.844	9.105	90	4.203	6.881	8.856

Table 26 NIST buffer solution table

Temperature (℃)	pH4.01	pH7.00	pH10.01	Temperature (℃)	pH4.01	pH7.00	pH10.01
0	4.01	7.12	10.32	40	4.03	6.97	9.89
5	4.01	7.09	10.25	45	4.04	6.97	9.86
10	4.00	7.06	10.18	50	4.06	6.97	9.83
15	4.00	7.04	10.12	55	4.08	6.97	9.81
20	4.00	7.02	10.06	60	4.10	6.98	9.79
25	4.01	7.00	10.01	70	4.12	6.99	9.76
30	4.01	6.99	9.97	80	4.16	7.00	9.74
35	4.02	6.98	9.93	90	4.20	7.02	9.73

Appendix C: Optional accessories

(1) Built-in network components:

Part Name	quantity
Wireless communication module NB-IoT or 4G	1
150mm SMA adapter cable	1
4G 3-meter suction cup antenna	1

(2) Wall mounting components:

Part Name	quantity
304SS wall panel	1
M4 self-tapping screws + M6 rubber pads	4
304SS three-piece combination screw, M4*8	4