User Manual

pH Controller

U-HP-CDM-EN1

Preface

Thank you for purchasing 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.
- This product is forbidden to use in explosion-proof occasions.

Version

U-HP-CDM-EN1

Safety Precautions

In order to use this product safely, be sure to follow the safety precautions described.

About this manual

- Please submit this manual to the operator for reading.
- Please read the operation manual carefully before applying the instrument. On the precondition of full understanding.
- This manual only describes the functions of the product. The company does not guarantee that the product will be suitable for a particular use by the user.

Precautions for protection, safety and modification of this product

- Please read the operation manual carefully before putting into operation to avoid unnecessary losses due to wrong operation. Ensure the safe use of the product and it's control function, and understand the correct application methods.. If the instrument is operated in other ways not described in the manual, the protections that the instrument give may be destroyed, and the failures and accidents incurred due to violation of precautions shall not be borne by our company.
- When installing lightning protection devices for this product and its control system, or designing and installing separate safety protection circuits for this product and its control system, it needs to be implemented by other devices.
- If you need to replace parts of the product, please use the model specifications specified by the company.
- This product is not intended for use in systems that are directly related to personal safety.Such as nuclear power equipment, equipment using radioactivity, railway systems, aviation equipment, marine equipment, aviation equipment and medical equipment.If applied, it is the responsibility of the user to use additional equipment or systems to ensure personal safety.

- Do not modify this product.
- The following safety signs are used in this manual:

Hazard, if not taken with appropriate precautions, will result in serious personal injury, product damage or major property damage.

Warning:Pay special attention to the important information linked to product or particular part in the operation manual.

- Confirm if the supply voltage is in consistent with the rated voltage before operation.
- Don’t use the instrument in a flammable and combustible or steam area.
- To prevent from electric shock, operation mistake, a good grounding protection must be made.
- Thunder prevention engineering facilities must be well managed: the shared grounding network shall be grounded at is-electric level, shielded, wires shall be located rationally, SPD surge protector shall be applied properly.
- Some inner parts may carry high voltage. Do not open the square panel in the front except our company personnel or maintenance personnel acknowledged by our company, to avoid electric shock.
- Cut off electric powers before making any checks, to avoid electric shock.
- Check the condition of the terminal screws regularly. If it is loose, please tighten it before use.
- It is not allowed to disassemble, process, modify or repair the product without authorization, otherwise it may cause abnormal operation, electric shock or fire accident.
- Wipe the product with a dry cotton cloth. Do not use alcohol, benzine or other organic solvents. Prevent all kinds of liquid from splashing on the product. If the product falls into the water, please cut off the power

immediately, otherwise there will be leakage, electric shock or even a fire accident.

- Please check the grounding protection status regularly. Do not operate if you think that the protection measures such as grounding protection and fuses are not perfect.
- 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, otherwise the product's protective device may be damaged.

- Don’t use the instrument if it is found damaged or deformed at opening of package.
- Prevent dust, wire end, iron fines or other objects from entering the instrument during installation, otherwise, it will cause abnormal movement or failure.
- During operation, to modify configuration, signal output, startup, stop, operation safety shall be fully considered. Operation mistakes may lead to failure and even destruction of the instrument and controlled equipment.
- Each part of the instrument has a certain lifetime, which must be maintained and repaired on a regular basis for long-time use.
- The product shall be scrapped as industrial wastes, to prevent environment pollution.
- When not using this product, be sure to turn off the power switch.
- 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 the terms outside the scope of this product warranty.
- This company is not responsible for damage to the instrument or 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

The MDC-PH Controller 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

- 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.
- NB IoT 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 500,000 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	≥$10^{12}\Omega$
Temperature types	NTC10K，Pt1000，Pt100
Temperature range	(-10~130)℃
Accuracy	pH：±0.02pH Antimony：±0.2pH ORP：±2mV NTC10K：(-10~60)℃, accuracy ±0.3℃ (60~130)℃, accuracy±2℃ Pt1000：accuracy±0.3℃ Pt100：accuracy±0.3℃
Resolution	pH/Antimony：0.01pH； ORP：1mV
Repeatability	0.02pH
Temperature compensation	Manual compensation; Automatic compensation: 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

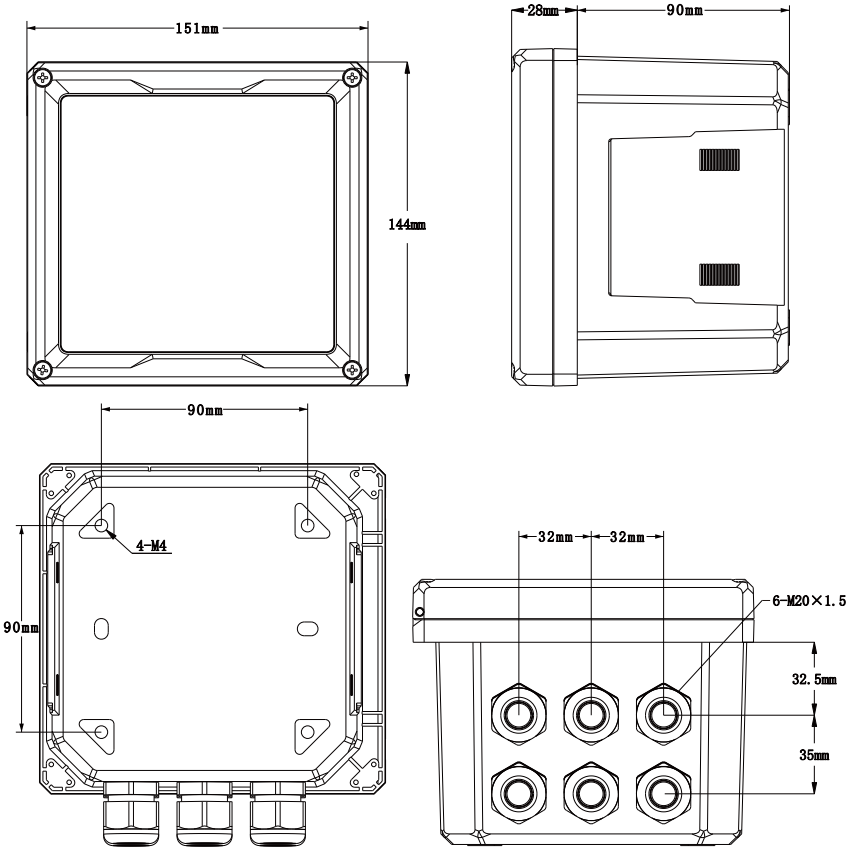


Fig.1 Product dimensions

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 temperature 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.

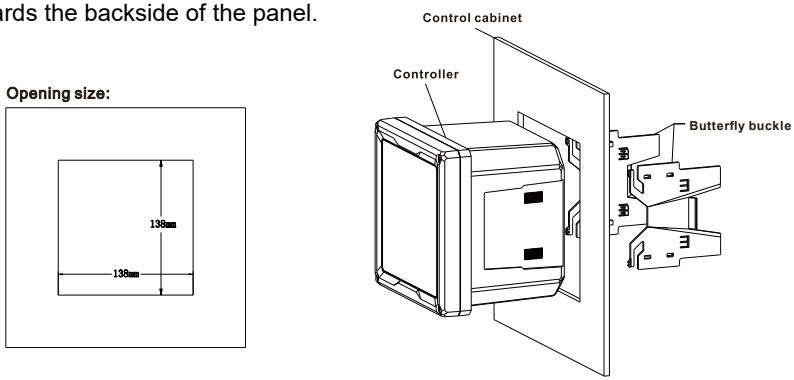


Fig.2 Panel cutout dimensions and installation method

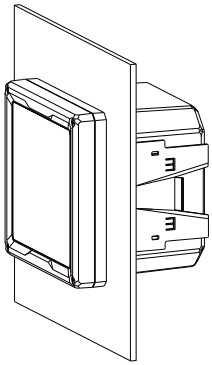


Fig.3 Panel mounting schematic

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.

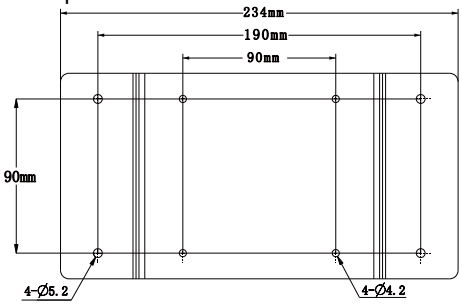


Fig.4 Dimensions of wall mounting plate

(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.

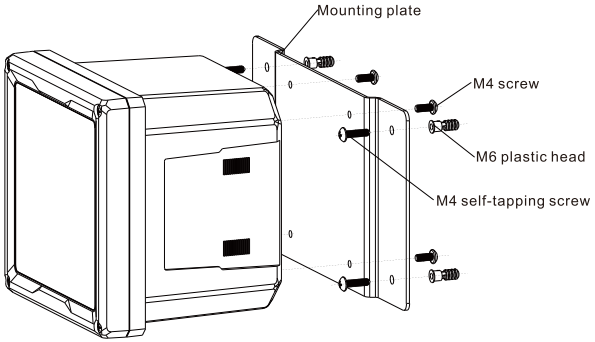


Fig.5 Wall mounting method

3.4 Sensor installation

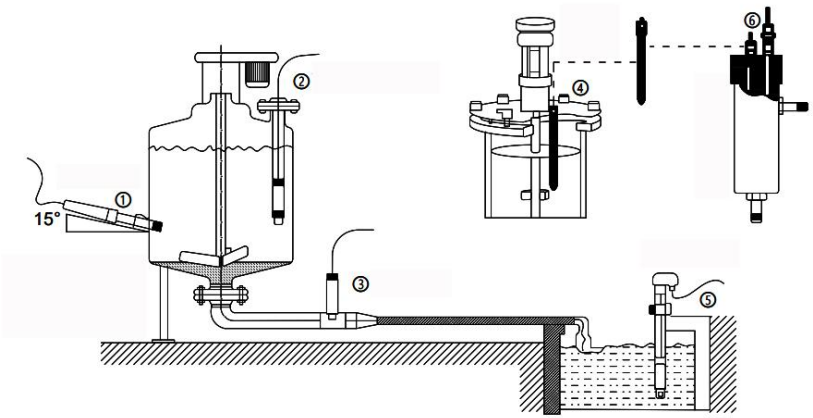


Fig.6 Schematic diagram of common installation method

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.

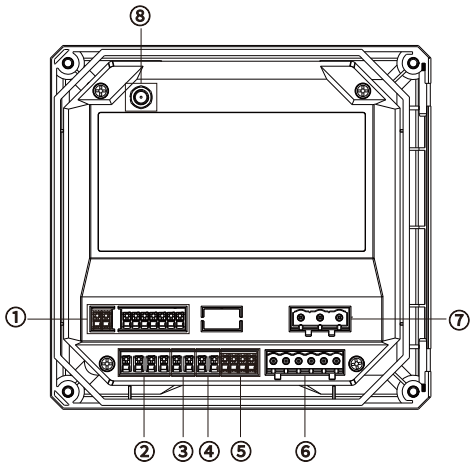


Fig.7 Internal wiring schematic

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.			

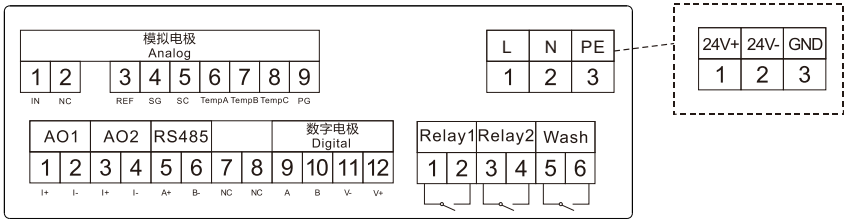


Fig.8 Terminal definitions (single channel)

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.

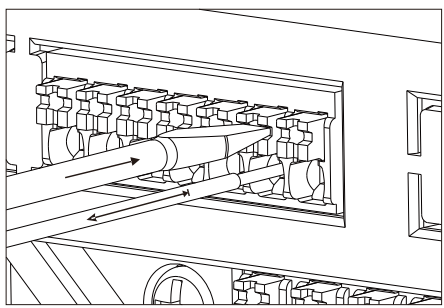


Fig.9 Spring terminal connection method

（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 to 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.

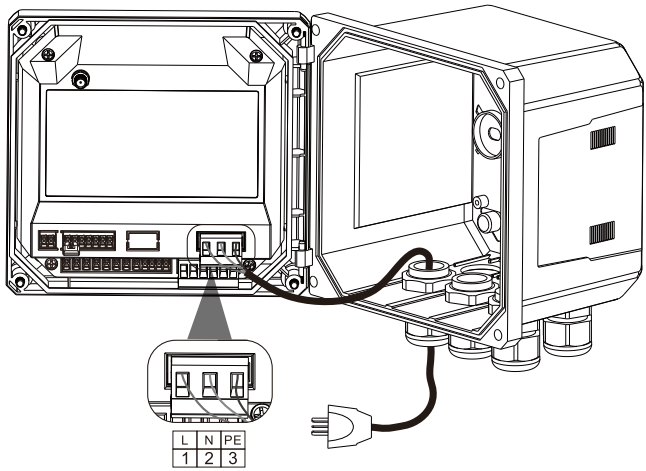


Fig.10 Power wiring schematic

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.

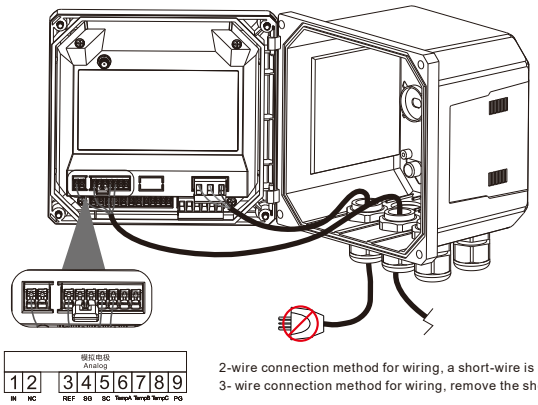


Fig.11 Analog sensor connection schematic

Table 3 Analog sensor wiring instructions

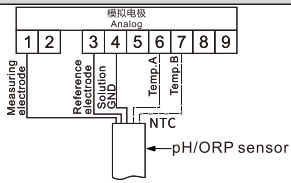
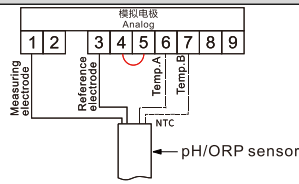
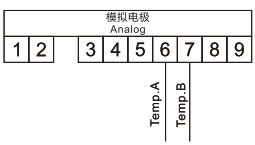
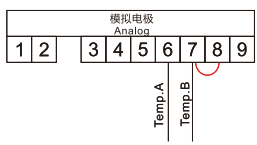
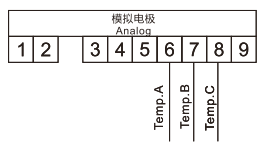
3-wire: Sensor with SG	2-wire: Sensor without SG
	
pH/ORP sensor with SG directly connects to terminal 4	pH/ORP sensor without SG need to short terminals 4 and 5 (the controller comes with a short-wire, or users can use a wire to connect them)

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

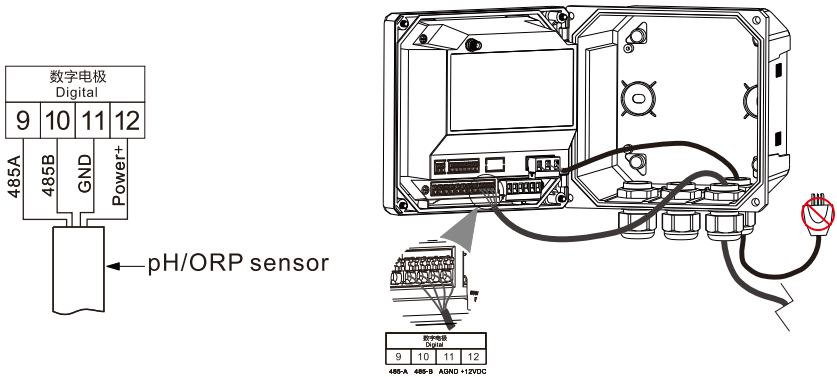


Fig.12 Digital sensor wiring schematic

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 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.

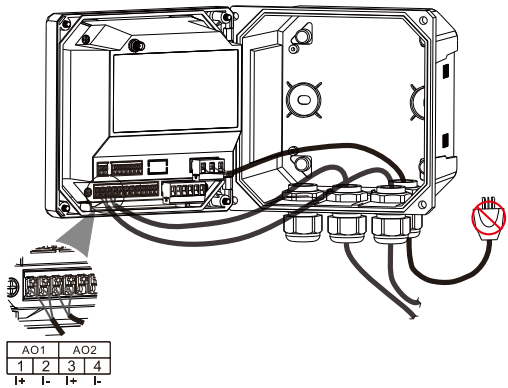


Fig.13 Analog output wiring schematic

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

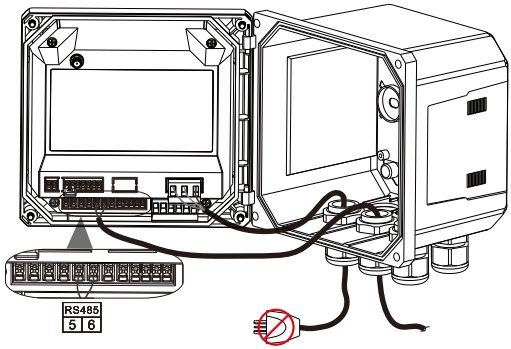


Fig.14 Communication output wiring schematic

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.

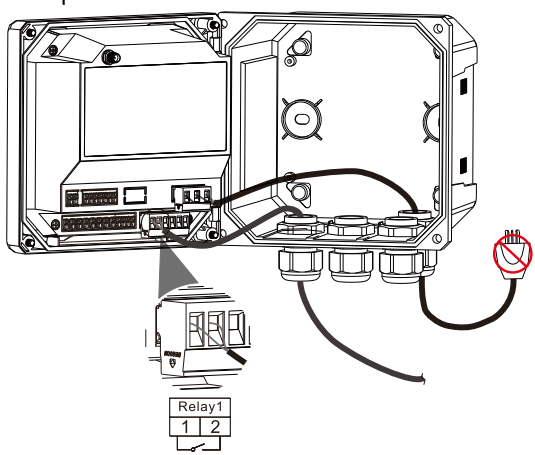


Fig.15 Relay wiring schematic

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.

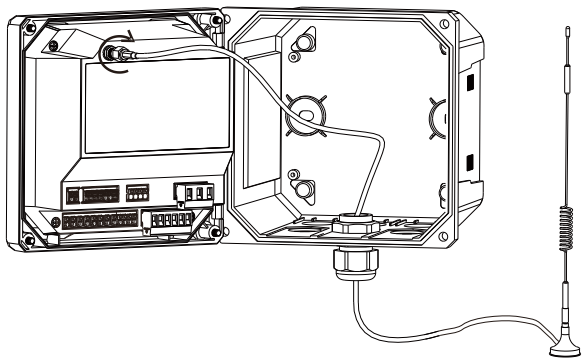


Fig.16 Wireless communication wiring schematic

- 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 IP66 rating. Hydrate the O-rings before assembly.

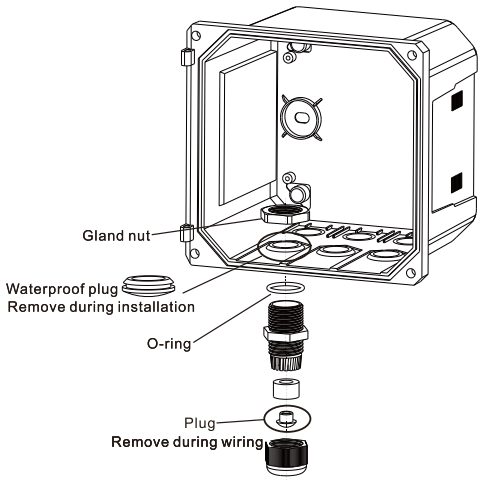


Fig.17 Cable gland installation

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 (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

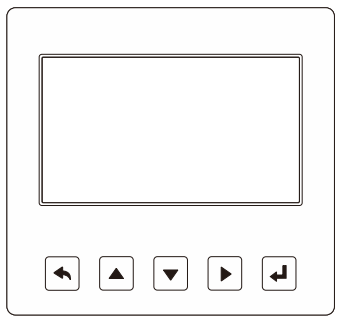
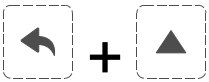
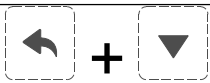


Fig.18 Button display

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

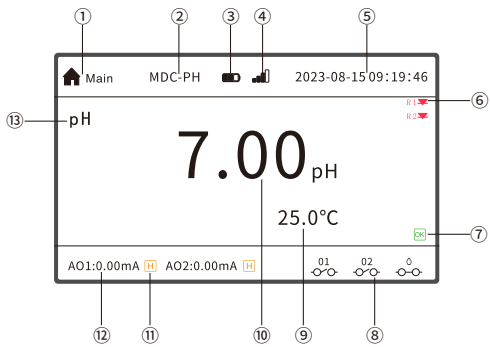
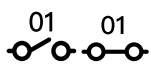
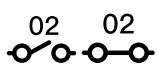


Fig.19 Main measurement interface

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 Maintain.

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 NB-IoT wireless signal strength. The icon flashes during communication (optional NB module).
5	System Time	/	/
6	Alarms	R1 R2	01/02 Relay high alarm
		R1 R2	01/02 Relay low alarm
7	Controller Status (Normal/Fault)	OK 	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	/	/

No.	Content	Icon	Description
	Values		
11	Output Hold/Current Simulation	H	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."

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.

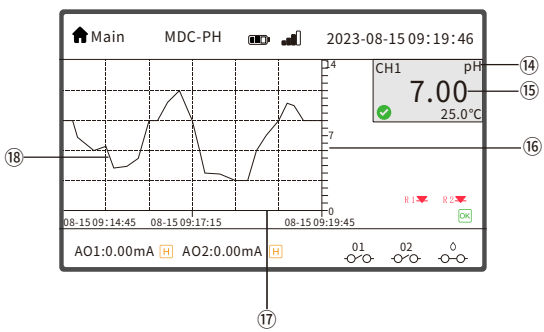


Fig.20 Curve interface

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, does not back-track when switching interfaces.

5.3.3 Alarm information interface

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

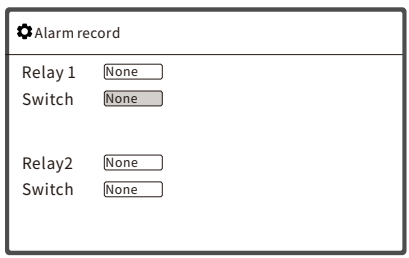


Fig.21 Alarm information interface

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

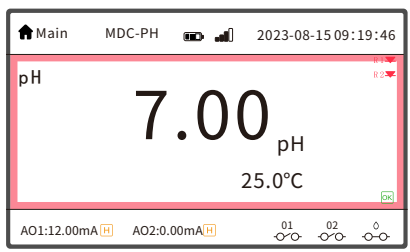


Fig.22 Alarm interface

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 "----".

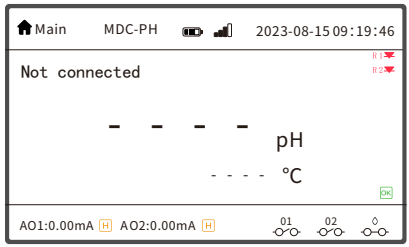


Fig.23 Sensor not connected or disconnected

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 "****".

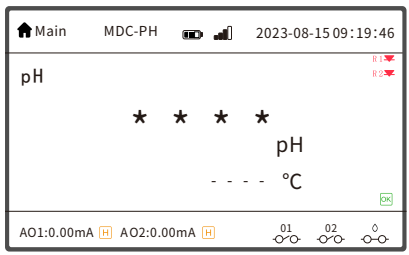


Fig.24 Measurement data out of range

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.

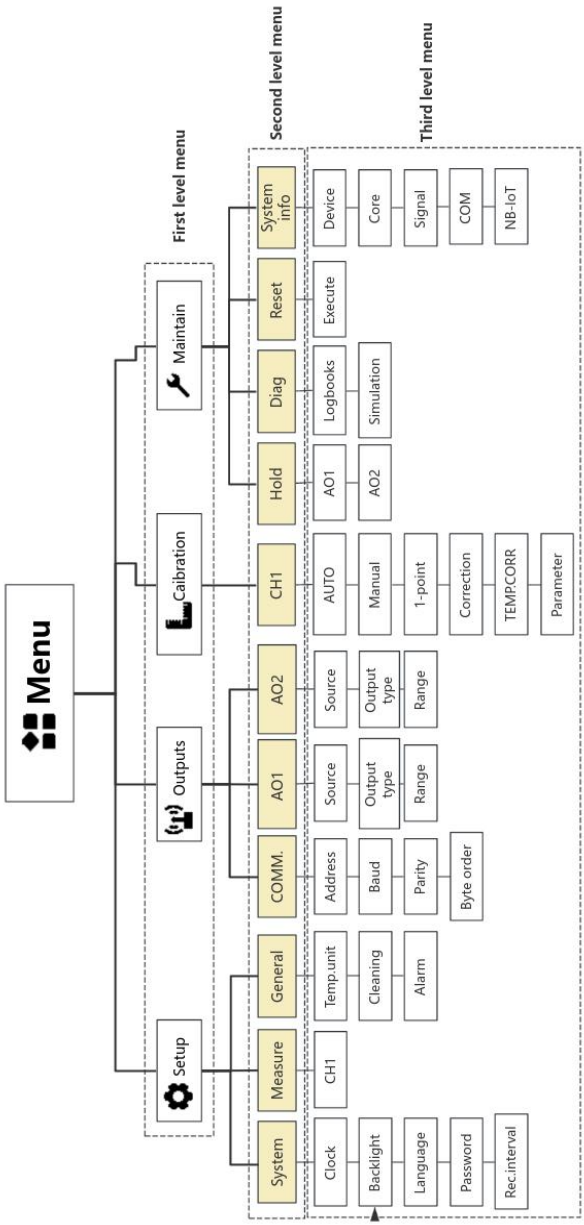


Fig.25 Menu tree

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

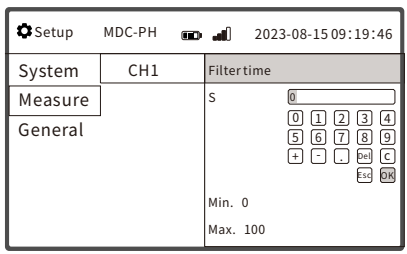


Fig.26 Setting values

5.4.3 Changes taking effect

If the MDC controller prompts a "**Do you want to ave 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.

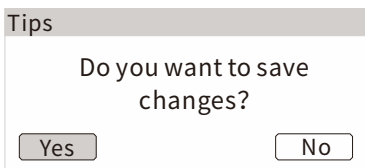


Fig.27 Save changes

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 ave 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".

`

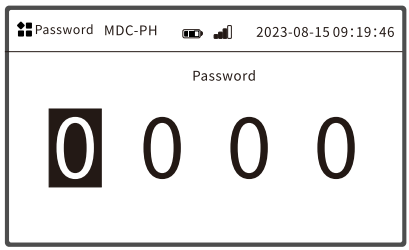


Fig.28 Enter password

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.

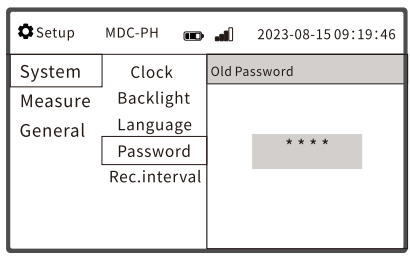


Fig.29 Password setting

5.6 Configuration settings

5.6.1 System Settings

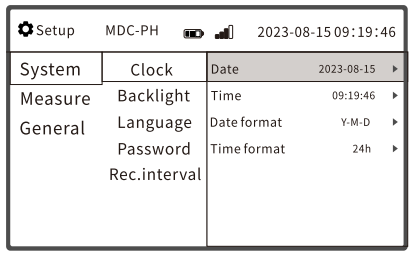


Fig.30 System settings menu

(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.

5.6.2 Measure settings

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

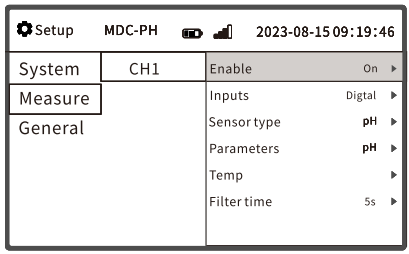


Fig.31 Measure settings menu

(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 sensor, 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, 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 0s ~ 100s 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.

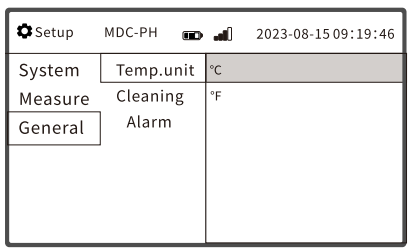


Fig.32 General settings menu

(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.
- Several conditions can interrupt the cleaning feature: power loss or reboot of the controller; enabling of output-hold function; 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.

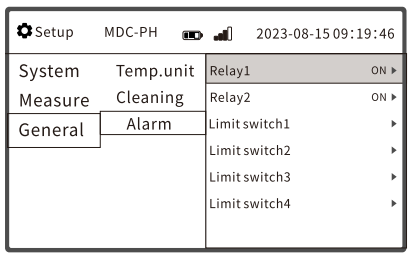


Fig.33 Alarm settings menu

- **Relay**

Relay 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.

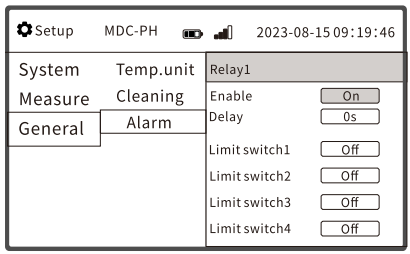


Fig.34 Alarm delay settings

- **Limit switches**

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

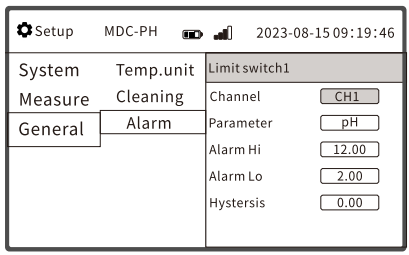
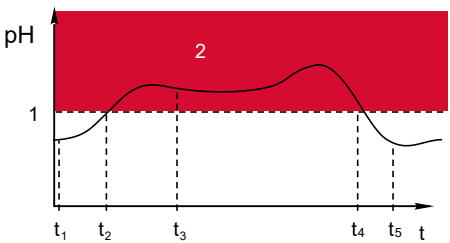


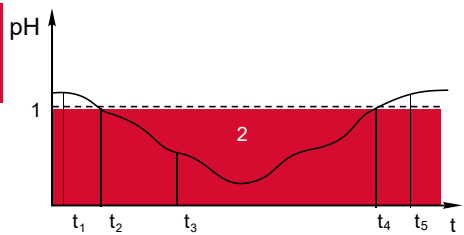
Fig.35 Limit switch settings

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 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.

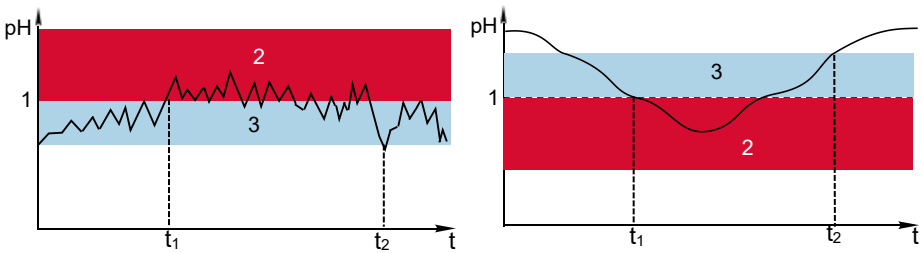
When the measured value (pH) increases and exceeds the set threshold, the relay activates (limit), especially if it surpasses the alarm delay time.

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.

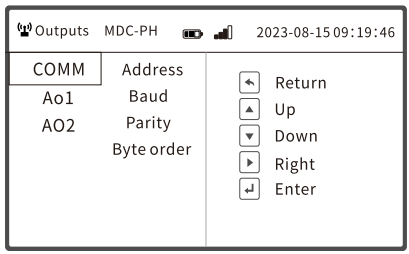


Fig.36 Communication settings

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.

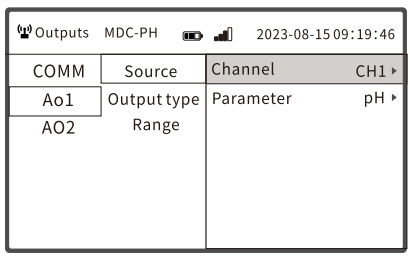


Fig.37 Analog output settings

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 MDC 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 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 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**

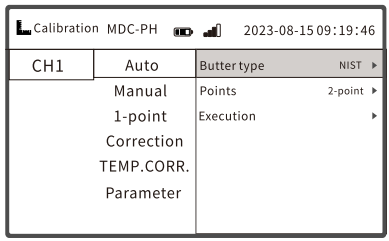


Fig.38 Auto-Calibration settings

（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.

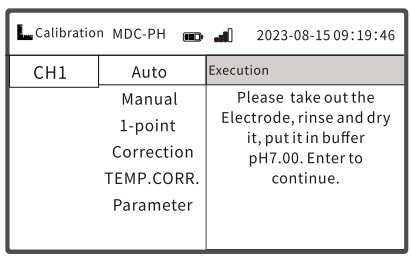


Fig.39 Execute calibration

- **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".

Electrode Health Prompt: Excelente rendimiento del electrodo ； Sensor condition qualified ,need to schedule maintain; Sensor condition 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.

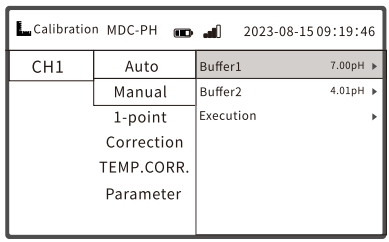


Fig.40 Manual calibration

- **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.

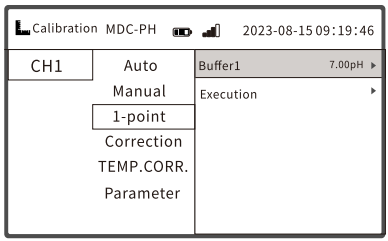


Fig.41 1-point calibration

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 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.

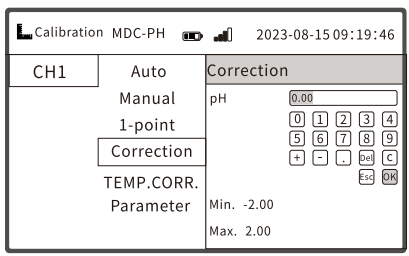


Fig.42 Signal correction

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.

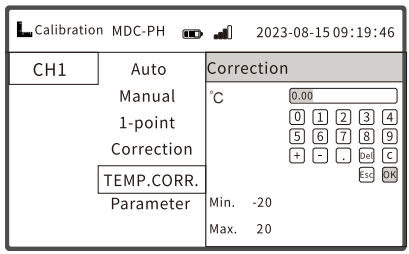


Fig.43 Temperature correction

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".

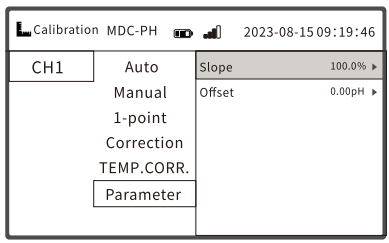


Fig.44 Calibration parameter setting

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

For ORP analog sensors, the MDC controller provides options for 2-point calibration, 1-point calibration, signal correction, and temperature correction (if a temperature electrode is available). For industrial ORP sensors, 1e-point calibration generally meets the measurement requirements.

The default values for ORP standard buffer solutions are 86mV and 256mV. Users can also adjust to other standard solution values.

Preparation and values of ORP standard buffer solution:

For the 256mV standard buffer: Pour approximately 250ml of pH 4.00 standard

buffer solution into a small beaker. Add 10.2g of hydroquinone reagent and stir until saturation to prepare a 256mV standard buffer.

For the 86mV standard buffer: Pour approximately 250ml of pH 6.86 standard buffer solution into a small beaker. Add 10.2g of hydroquinone reagent and stir until saturation to produce an 86mV standard buffer solution.

Note: Once prepared, the ORP standard buffer solution should not be used for an extended period, as it may lose its effectiveness. It's generally recommended to use it only on the same day of preparation.

6.3.1 2-point calibration

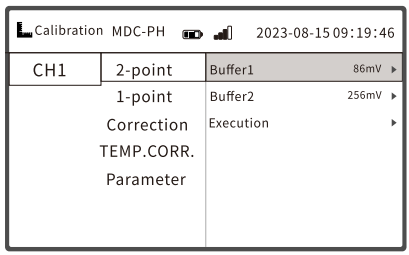


Fig.45 2-point calibration

- **Calibration Steps**

Step 1: After selecting "**Execution**", follow the instructions to remove the electrode, rinse, dry, and then immerse it in Buffer Solution 1 (the current measurement value of this buffer will be displayed at the bottom of the interface).

Step 2: Once stabilized, press < ↵ > to proceed to the second point calibration.

Step 3: Follow the instructions to remove the electrode, rinse, dry, and then immerse it in Buffer Solution 2.

Step 4: After stabilization, press the ↵. The controller will display "In calibration", followed by the results of this calibration.

Note:

(1) During the calibration process, you can press "↩" at any time to exit the calibration.

(2) If the calibration is successful, the slope and zero point of this calibration will be displayed. Press the <↩> and a prompt will appear asking, "Save ". Clicking "Yes" will save the calibration results in both the Calibration Parameters

and Calibration Log. Clicking "Back" will decline the current calibration results.

(3) If the calibration fails, a message "Failed, XXXX" will be displayed. This calibration result will not be saved. Press the <↵> to return to the calibration menu.

Slope and Zero Point Limits: If the slope value is not between 80% to 120% or the zero point drift is not within the range of -200mV to 200mV, an error message will be displayed. Refer to Chapter 9 "Error Messages and Troubleshooting".

6.3.2 1-point calibration

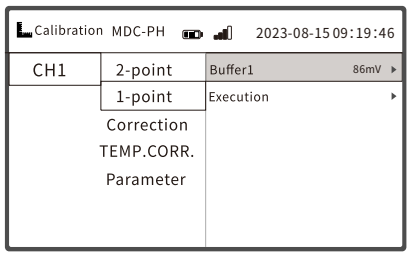


Fig.46 1-point calibration

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.

6.3.3 Signal correction

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

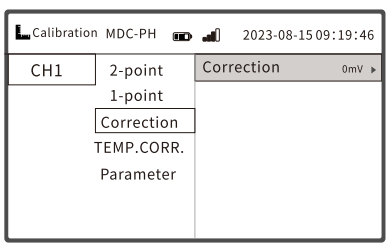


Fig.47 Signal correction

6.3.4 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.

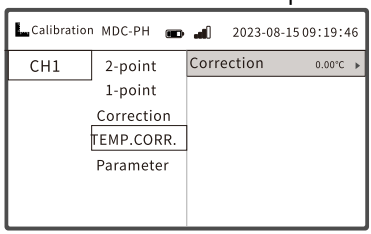


Fig.48 Temperature correction

6.3.5 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".

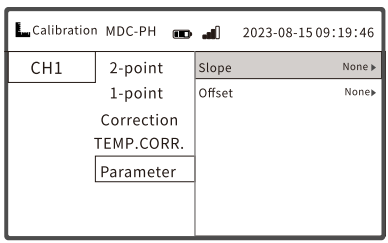


Fig.49 Calibration parameter setting

6.4 Digital pH calibration

For digital pH sensors, the MDC controller offers automatic calibration, 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 MDC 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 MDC maintain 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).

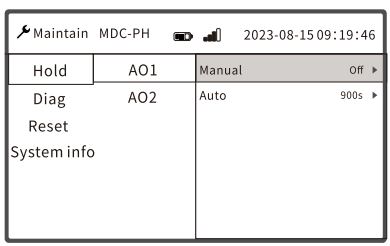


Fig.50 Output hold interface

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.

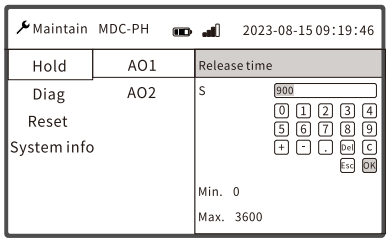


Fig.51 Setting the hold release time

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.

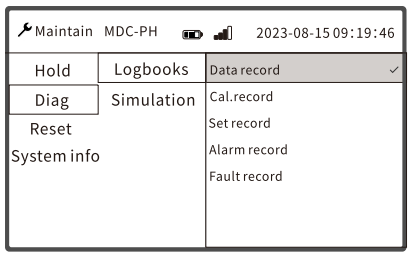


Fig.52 Diagnostics interface

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.

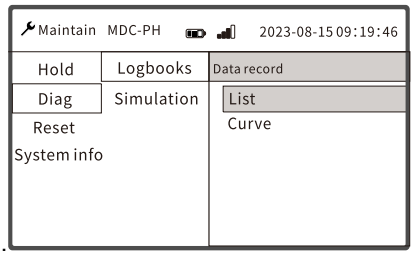


Fig.53 Data record

(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

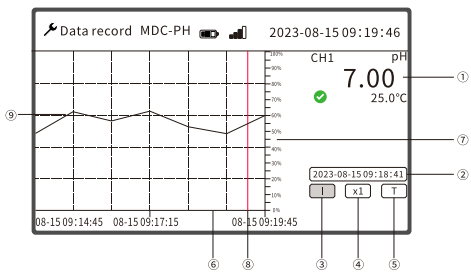


Fig.54 Data record Interface

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).

No.	Description
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.

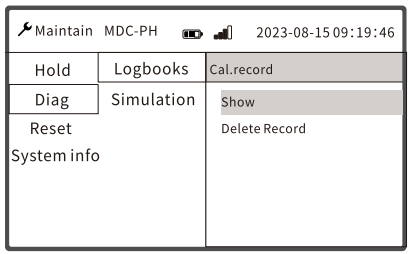


Fig.55 Logbooks Interface

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.

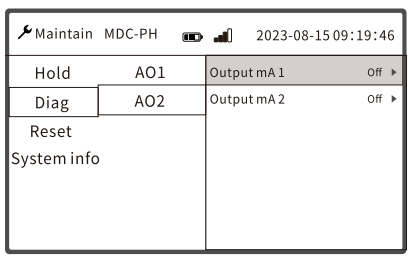


Fig.56 Simulation interface

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.

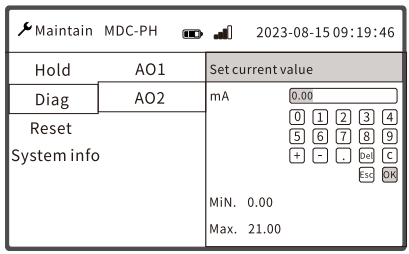


Fig.57 Output current setting

7.3 Reset

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

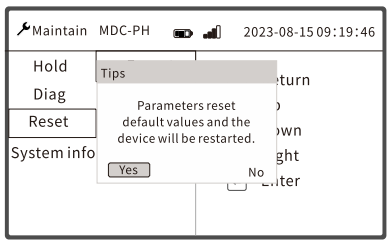


Fig.58 Factory reset

Default values:

(1) Port type: If the channel supports an analog port, the port type will be switched to the analog port.

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

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

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

(5) 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.

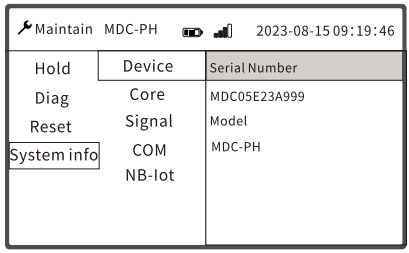


Fig.59 System information

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 upper range limit
102	Analog output 2 current exceeds lower range limit
103	Analog output 2 current exceeds 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 limit.	Buffer solution contaminated or expired.	Use a new buffer solution.
	Sensor aged.	Activate the sensor.
	Glass bulb contaminated.	Clean the sensor.
	Calibration procedure error.	Recalibrate.

Issues	Possible causes	Solutions
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 sensor with 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.
	Sensor or cable 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.
	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

Issues	Possible causes	Solutions
	Output port malfunction.	Check the output signal through menu : **Maintain/Diag/Simulation**
Sensor not recognized.	Sensor wiring incorrect.	Check the sensor wiring, 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.
Interface displays 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

To achieve the best 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 damages. 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 damages. 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 damages. 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 damages 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 0.1mol 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.

10 Communication protocol

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

10.1 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 Data 1	Measurement Type & Unit	1	uint16_t	RO	High byte: Represents the measurement parameter type (See Table 18) Low byte: Represents unit type (See Table 19)
0x2007		Reserved (for alignment)	1	uint16_t	RO	
0x2008		Measurement Value	2	float	RO	0x7FFFffff （+NAN） indicates an invalid value

Register Address	Register Name		Number of Registers	Data Type	RS485 Access	Description
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
0x200E		Reserved	2	float	RO	
0x2010		Reserved	2	float	RO	
0x2012		Reserved	2	float	RO	
0x2014 ~0x2022	Measurement Data 2, same as the description in "Measurement Data 1"					

10.2 Configuration data

10.2.1 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	Number of Registers	Data Type	RS485 Access	Description
0x1100	Device Address	1	uint16_t	RW	[1, 247], default factory setting is 1
0x1101	Baud Rate	1	uint16_t	RW	Baud rate selection: 1:2400 9:4800 2:9600(Default) 4:19200

Register Address	Register Name	Number of Registers	Data Type	RS485 Access	Description
					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

10.2.2 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	Number of Registers	Data Type	RS485 Access	Description
System Clock					
0x4602	System Date	2	uint32_t	RW	BCD format, representing year, month, day sequentially. For example, 0x20230705 represents July 5th, 2023. Note: If time is set backward, data records between the old and new times will be lost.

Register Address	Register Name	Number of Registers	Data Type	RS485 Access	Description
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 backward, 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

10.3 Measurement Parameter Types

Table 18 Measurement Parameter Types Table

Parameter Type	Parameter Name	Parameter Type
0	None	0x10
0x01	pH	0x11
0x02	ORP	0x12

10.4 Unit Conversion Table

Table 19 Unit Conversion Table

Unit	ID	Unit	ID
℃	0x00	℉	0x01
mV	0x02	pH	0x03

10.5 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 D

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