TOTAL PRESSURE SOLUTIONS

Chemical Oxygen Demand (COD) Analyzer

Preface

- Thank you for purchasing our product.
- This manual is about the product functions, wiring methods, setting methods, operating methods, troubleshooting methods, etc.
- Prior to operation, please read this manual thoroughly to ensure proper use and to prevent potential losses.
- After reading, please keep this manual in an accessible place for future reference during operation.

Note

- The contents of this manual are subject to change without notice due to real-time factors such as function upgrading.
- We strive to ensure the accuracy of the manual. Nevertheless, if you identify any errors or inaccuracies, please contact us.
- Unauthorized reprinting or copying of this manual is strictly prohibited.

Version

U-SUP-MDE20-COD-EN1

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.
- Prior to 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 in 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 applications 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 regularly 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 components, or unpredictable damage caused directly or indirectly by improper operation of the user.

No.	Items	Quantity	Note
1	Chemical oxygen demand (COD) analyzer	1	
2	Power cord	1	Double-ended， 3-core
3	Accessories kit	1	Fuses, screws, etc.
4	User manual	1	
5	Test report	1	
6	Certificate	1	

After opening the box, please confirm the scope of delivery before starting the operation. If you find that the model and quantity are incorrect or there is physical damage to the product's appearance, please contact us.

Contents

1 Introduction

1.1 Overview

The Chemical Oxygen Demand (COD) Online Water Quality Analyzer (hereinafter referred to as the COD analyzer) is a new-generation water quality monitoring instrument developed by our company. It is widely applicable to the monitoring of COD levels in various water bodies, including environmental discharge outlets, municipal wastewater, industrial effluents, and water used in industrial processes.

1.2 Measuring Principle

Chemical Oxygen Demand (COD) refers to the oxidant amount consumed when a water sample is treated with potassium dichromate under strong acidic and heated conditions. It is expressed in milligrams of oxygen per liter (mg/L). COD is a key indicator used to comprehensively assess the degree of water pollution. As one of the most important parameters in water quality monitoring, COD plays a crucial role in the implementation of total pollutant discharge control. It is also an important and relatively accessible parameter in the study of river and industrial wastewater, as well as in evaluating the performance of sewage treatment plants.

COD reflects the total amount of oxidizable substances in water, primarily organic compounds, but also including certain inorganic reducing agents such as nitrites, ferrous ions, sulfides, and more. Organic contamination is common in water samples. These organic pollutants are decomposed through microbial oxidation, consuming large amounts of dissolved oxygen, which leads to black, foul-smelling water, the death of aquatic life, ecological imbalance, and deterioration of the human living environment. Therefore, timely monitoring of COD concentration in water is essential for water quality assessment and pollution control.

Details:

In the measurement process, a specific amount of potassium dichromate ($K_2Cr_2O_7$) and the catalyst silver sulfate (Ag_2SO_4) are added to the water sample. Under high-temperature and high-pressure sealed conditions, part of the potassium dichromate is reduced by oxidizable substances in the sample, converting Cr^{6+} into green Cr^{3+}. The degree of color change is proportional to the concentration of oxidizable substances in the sample. The analyzer detects this color change and converts it into a corresponding COD value.

1.3 Features

- **Highly Integrated Structure:** the all-in-one digestion module and integrated plunger pump design help to reduce component wear, enhance stability, and extend the service life of the equipment.
- **Standardized Quick Connection**: Modular components with plug-and-play capability simplify installation and maintenance, significantly reducing operation and maintenance costs.
- **Strict Compliance with National and Industry Standards:** Fully conforms to GB/HJ 828 “Water Quality—Determination of Chemical Oxygen Demand—Dichromate Method” and HJ 377 “Technical Specifications and Test Procedures for Water Quality Online Automatic Monitoring Equipment of Chemical Oxygen Demand (CODCr)”, ensuring the accuracy and validity of monitoring data.
- **Intelligent Anti-fouling Compensation Algorithm:** Based on the water sample onsite, the system features an automatic anti-fouling mode to deliver reliable and accurate monitoring results.
- **Innovative Reagent Mixing Technology:** Ensures thorough reaction between the water sample and reagents, improving measurement accuracy.
- **Industry-Specific Customization:** Optimized reagent formulations and detection sequences tailored for various industries such as chemical manufacturing, municipal wastewater, and electroplating, ensuring broad applicability.
- **Fully Automated Intelligent Monitoring:** Supports automatic calibration, cleaning, and sample injection. In case of unexpected interruptions, the system can resume operation automatically, ensuring continuous monitoring.
- **Reagent Shortage Detection and Alarm:** Automatically detects insufficient water or reagent supply to prevent reagent-free measurements.
- **Flexible Measurement Modes:** Supports both real-time online monitoring and batch sampling to meet the needs of different application scenarios.
- **Seamless Data Integration:** Monitoring data is automatically stored and uploaded in real time to regulatory platforms, supporting efficient decision-making.

2 Technical Parameters

Table 1 Product specifications

Measurement Performance	
Measured variables	COD
Measuring range	(0~200) mg/L; (0~500) mg/L; (0~2000) mg/L; Note: The range can be switched online
Indication error	20% range: ±10.0% 50% range: ±8.0% 80% range: ±5.0%
Repeatability	≤5.0 %
Low-level drift in 24h	±5mg/L
High-level drift in 24h	≤5.0%
Limit of quantitation(LOQ)	≤15mg/L (indication error ±30%)
Memory effect	80%→20%: ±5mg/L 20%→80%: ±5mg/L
Interference of voltage	±5.0%
Interference of chloridion	±10.0%
Interference of environmental temperature	±5.0%
Comparison test with the actual water sample	COD<50mg/L: ≤5mg/L COD≥50mg/L: ≤10%
Minimum period between maintenance operations	≥168h/time
Data availability	≥90.0%
Conformity	≥90.0%
Output	

Current output	(4~20)mA output
Communication	RS232, RS485, RJ45 interface
Electrical specifications	
Power supply	(220±22) VAC, (50±0.5) Hz
Power consumption	≤100W
Insulation resistance	≥20MΩ
Dielectric strength	The power inlet and chassis of the analyzer can withstand a 50Hz, 1.5kV AC(rms) test voltage for 1 minute with a current limit of 5 mA, without flashover or breakdown.
Leakage current	≤5mA
Process conditions	
Water sample temperature	(0~50)℃
Environmental conditions	
Ambient temperature	(5~40)℃
Relative humidity	≤90% (no condensation)
Construction	
Dimensions	315mm×239.5mm×500mm (D×W×H)
Weight	20kg
Material	Cold rolled sheet (SPCC)
Fixing method	Mount on a flat, level, and stable surface.

Table 2 Function

No.	Project	Content
1	Measurement mode	Online mode, maintenance mode, remote control mode
2	Continuous running time	⩾720h/time
3	Automatic calibration	Calibration interval can be set from 1 to 999 hours, at any desired time
4	Automatic cleaning	Automatic cleaning after each measurement; periodic cleaning can be performed according to the complexity of the on-site water sample
5	Range switching	Realize online switching of different ranges according to the measured value.
6	Liquid level detection	Detects sample and reagent levels; alerts for insufficient liquid
7	Online fitting	Selectable fitting method based on application requirements
8	User interface	Full color touchscreen, with resolution 1024×600
9	Data storage	Continuously store data for more than 5 years
10	Communication	RS232/RS485/ RJ45/CAN, etc.
11	USB upgrade	Upgrade via USB flash drive
12	Other features	Reagent shortage warning, system logs, and fault alarms.

3 Structure and Dimensions

3.1 Dimensions

Unit：mm

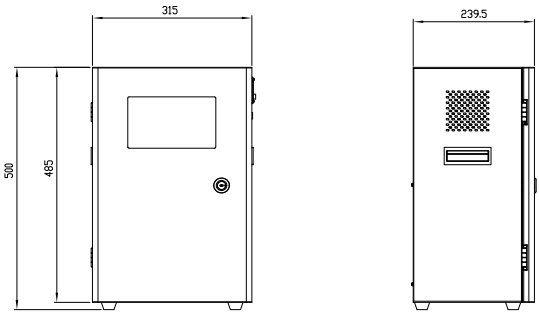
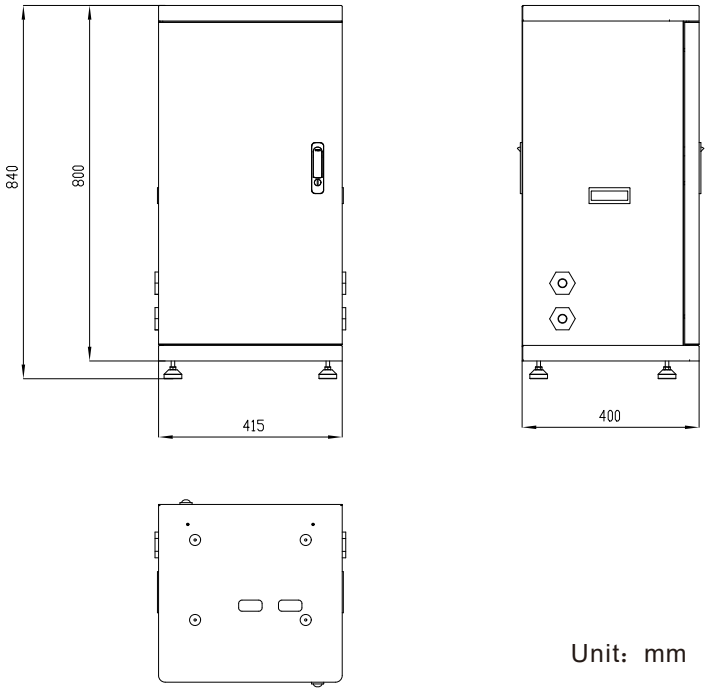


Fig.1 Dimensions (unit: mm)



Unit：mm

Fig.2 Pre-treatment System Dimensions (Optional)

3.2 Structure

The internal structure of the COD analyzer is shown as below:

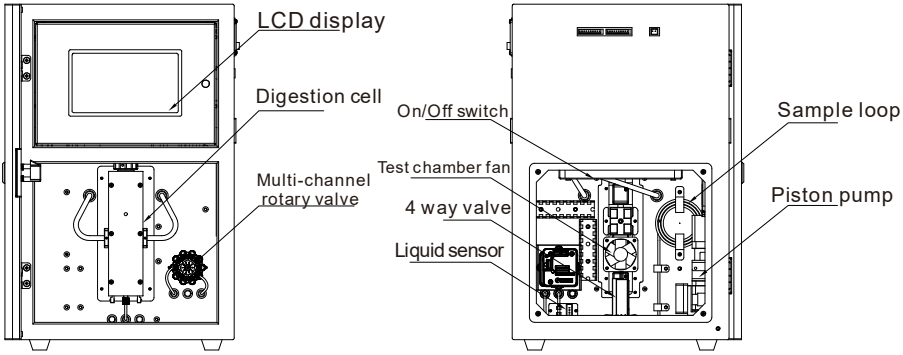


Fig.3 The diagram of the analyzer's internal structure

If pre-treatment system is included in the order, its internal structure is shown below:

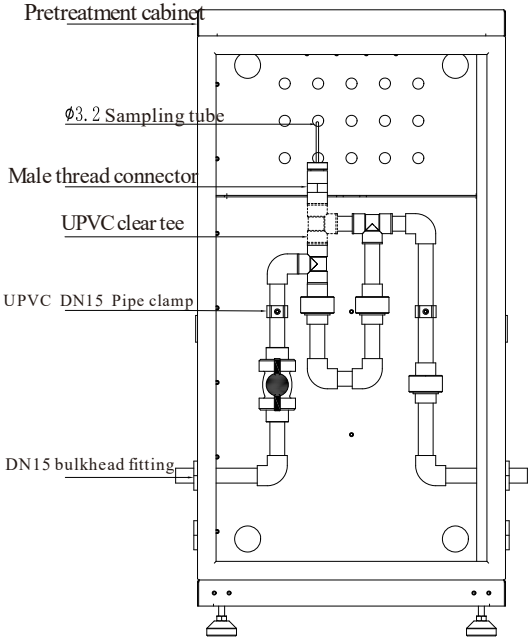


Fig.4 The diagram of the analyzer pretreatment system internal structure

4 Installation

4.1 Incoming and Checking

Upon receiving the delivery, users shall first inspect the condition of the packaging. The packaging box should be intact with clear labeling. If any visible damage to the packaging is found, please promptly contact the logistics department for investigation and clarification. Contact our company at the same time. If no damage or other issues are detected, proceed to unbox the product and verify the completeness of its components.

4.2 Installation Site

This instrument is designed for indoor operation only; therefore, it should be installed on a flat, dry, well-ventilated indoor surface where temperature can be effectively controlled. To ensure measurement accuracy and enhance the operational stability of the analyzer, the installation site should meet the following requirements:

(1) To minimize the water sampling time of the sampling pump, the installation site should be as close as possible to the wastewater discharge channel.

(2) At least 0.5 meters of clearance on all sides of the analyzer should be left for routine maintenance.

(3) If possible, position the analyzer near the water pretreatment device to minimize the sampling tube length and avoid bends or folds.

(4) Maintain the ambient temperature of the installation area within the range of (5–40)℃.

(5) Keep the installation site dry and out of direct sunlight.

(6) Avoid locations subject to frequent ground vibrations, such as areas near large motors, stamping machines, or roads frequently used by heavy-duty trucks. To test for vibration, place a cup filled with water on the ground and observe the water surface. Visible ripples in the cup indicate that vibration could affect measurement accuracy.

4.3 Device Fixing

Place the device vertically on a flat surface. If a pretreatment system is equipped,

position the device on top of the pretreatment system as shown in the figure below. **Note:** the device must be installed vertically; otherwise, the sensor measurement accuracy may be affected, and the internal structure may even become contaminated.

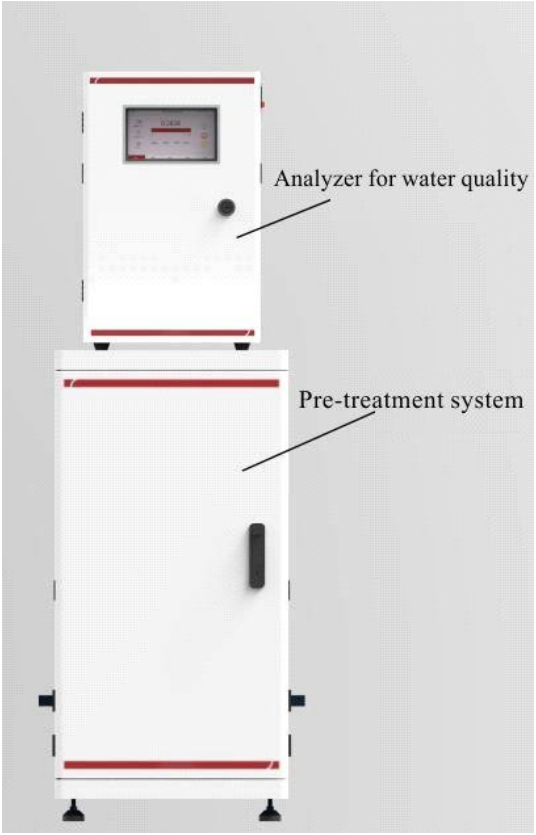


Fig.5 Pre-treatment system installation

4.4 Tubing Connection

(1) First, prepare purified water and pour it into the pure water container. Next, unpack the reagents with appropriate protective measures during the process. Then, modify the caps of the reagent bottles, the purified water containerm, and the reagent effluent container as shown in the diagram below.

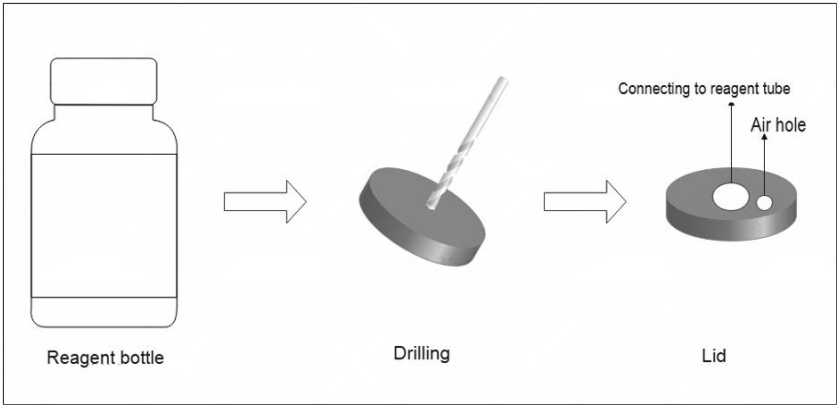


Fig.6 Diagram of reagent opening

(2) Insert the reagent tube into the reagent bottle as shown below. When inserting, the tube should reach near the bottom of the bottle but must not be in complete contact with the bottom surface.

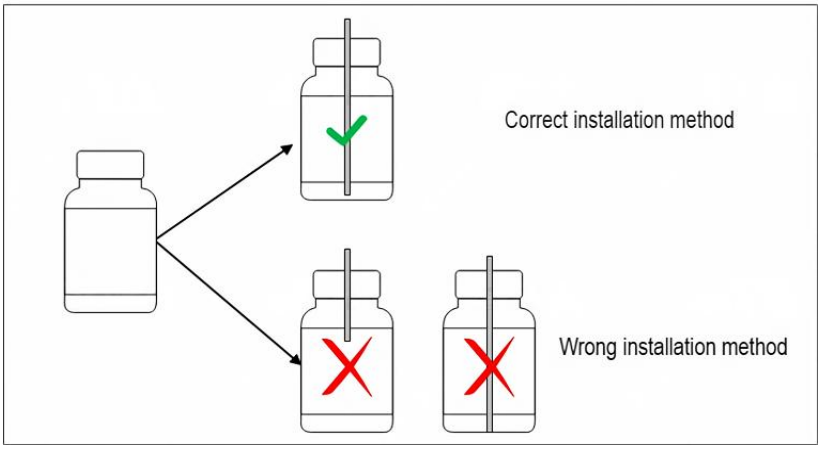
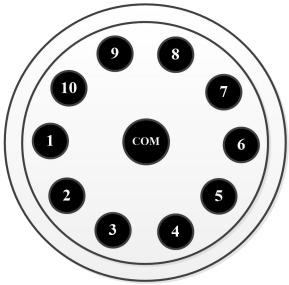


Fig.7 Reagent tube diagram

(3) Internal Tubing and Reagent Connection Instructions:

Place the pure water container, reagent bottles, and wastewater container in their designated positions. Then connect the reagent guide tubes from the multi-port valve to the reagent bottles according to the diagram below.

Table 3 Reagent arrangement table

Multi-port valve connection diagram	Port No.	Reagents	Notes
	P1	-	
	P2	Waste liquid of analysis	
	P3	Cleaning water	
	P4	Calibration solution	
	P5	Water sample	
	P6	-	
	P7	Cleaning solution R7	Optional
	P8	Reagent R8	
	P9	Reagent R9	
	P10	Air	
	COM	-	

Note: Insert tubing No. 2 and No. 3 into the reagent effluent container cap to a depth of 3–8 cm. Do not insert it too deeply.

4.5 Power Connection

(1) Power Supply:

Voltage: (220±22) VAC; Frequency: (50±0.5) Hz

(2) Ensure the electrical environment is equipped with a voltage stabilizer and proper grounding. Use a test pen to check whether the socket, instrument cabinet, and other grounding terminals are properly grounded.

(3) Lightning protection measures should be in place to prevent damage from lightning strikes to the instrument.

(4) It is recommended to use a UPS (Uninterruptible Power Supply) to ensure that the instrument can continue operating for 2–4 hours in the event of an unexpected power outage.

After completing the checks, take the power cable from the packaging and connect it to the analyzer's power inlet.

5 Electrical Connection

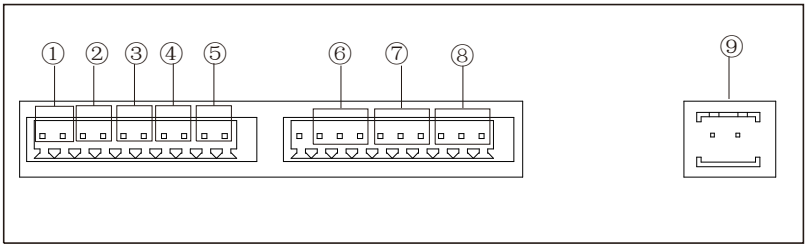


Fig.8 Diagram of the back panel interface

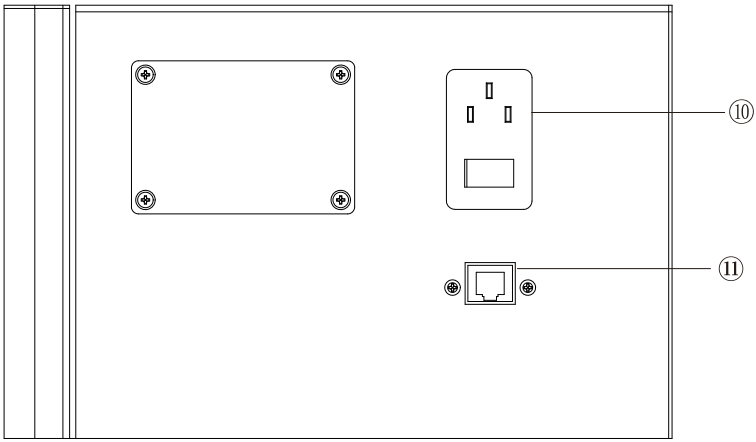


Fig.9 Diagram of the ports on the analyzer's right side

Table 4 Interface description

No.	Interface	Specification and description
1	Reserved port	/
2	Analog output	Used to output analog signals with external instruments
3	24V input	24VDC power input
4	24V output	Supply power to sensors and low-voltage displays
5	CAN interface	CAN interface
6	Mainboard RS232	Mainboard RS232 output interface
7	Screen RS232	Screen RS232 output interface
8	Screen RS485	Screen RS485 output interface
9	24V output	Supply power to sensors and low-voltage displays
10	Power inlet	Pure copper, national standard-compliant three-core 1 mm^2 power cord, which is the main power cord of the instrument
11	Network cable interface	Standard RJ45 network interface, wired access to the Internet or VPN network communication

6 Operation

6.1 Start-up

After connecting to the power supply, please turn on the power switch on the right side of the analyzer. The system will start 3 seconds after the analyzer is powered on and enter the main interface.

6.2 Main Page

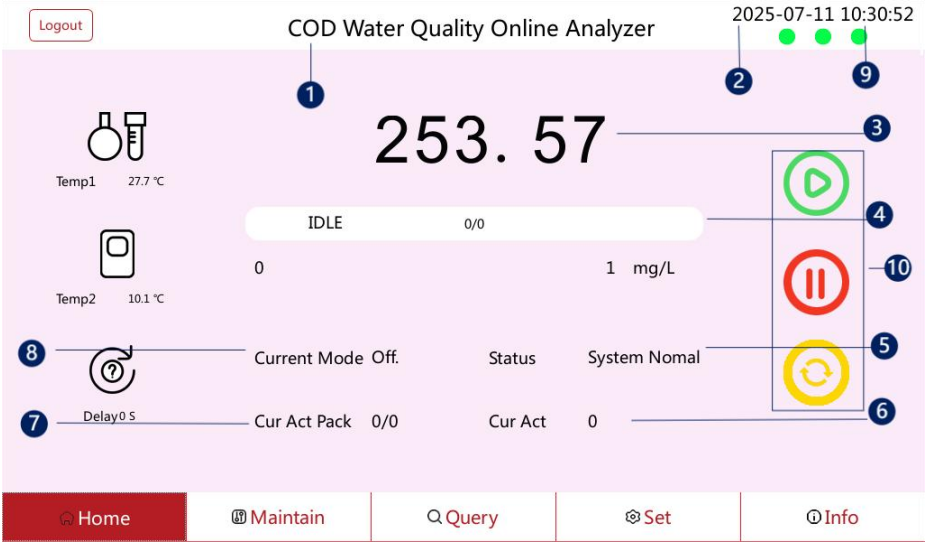


Fig.10 Main page

Table 5 Main page description

No.	Content
1	The measured parameter
2	System time
3	Measurement value
4	Measurement status bar
5	Status
6	Current action

No.	Content
7	Current action pack
8	Current mode
9	From left to right, there are three indicator lights: **Light 1**: Green: Idle; Yellow: plans waiting to be executed; Red: Running: **Light 2**: Green: no heating; Yellow: constant temperature; Red: heating; **Light 3**: Green: normal; Yellow: maintenance reminder; Red: system failure
10	Control icons: from top to bottom, they are start measurement, stop measurement, and reset

6.3 System Permission

The analyzer provides users with three levels of management authority, namely general user, maintainer, and administrator.

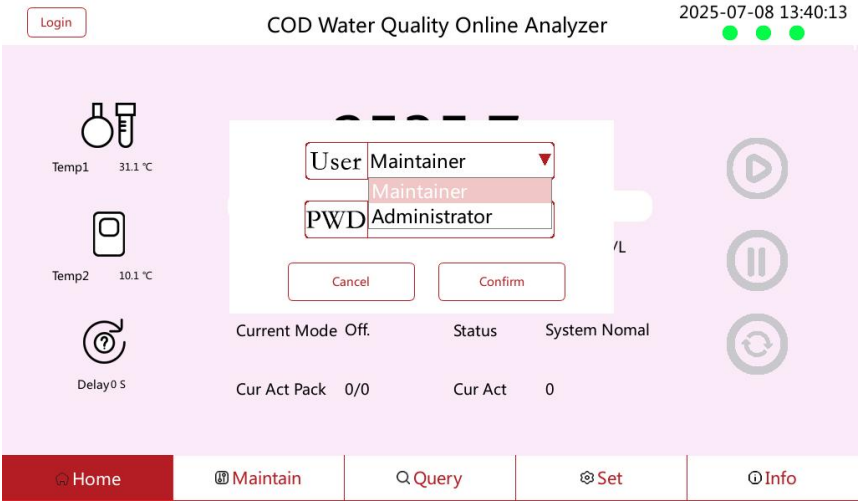


Fig.11 Login interface

- **Level 1 Access (General Users):**

Users can access and operate functions on the query page without logging in from the system home screen.

- **Level 2 Access (Maintainer):**

From the system home screen, users can click the [**Login**] button in the upper left corner and enter the password (default: 1234) to gain Level 2 access. This level allows operation of functions on the Maintenance, Query, and Settings pages. Click "Logout" in the upper left corner to return to Level 1 access.

- **Level 3 Access (Administrator):**

From the system home screen, users can click the [**Login**] button in the upper left corner and enter the password (default: 0722) to gain Level 3 access. This level allows full access to all functions on the Maintenance, Query, Settings, and Software Upgrade pages. Click [**Logout**] in the upper left corner to return to Level 1 access.

Table 6 Permission list

Software Features	General User	Maintainer	Administrator
Log in	Automatic login	Maintainer settings	Administrator settings
Run/Stop		★	★
Query	★	★	★
Maintenance		★	★
Setup		★	★
Software upgrade			★

6.4 Menu Description

Table 7 Menu List

First level menu	Secondary menu	Description
Home	/	You can view measurement data, instrument status, manual measurement, stop, reset and other operations.
Maintain	Monitor	It can monitor the status of equipment components, temperature control, etc. in real time, and can control the relay switch.
	Reagent	Display reagent remaining amount, effective days, and reagent replacement
	Oper	Manually perform special operations and routine processes, such as manual measurements, reagent introduction, cleaning, and all atomic operations
	Meas	Measurement plan settings
	Calib	Calibration scheme settings
Query	Meas	View historical measurement data
	Calib	View calibration records
	Log	Query instrument operation records
	Export	Data export
Set	Comm.	Setting communication parameters
	System	Setting the system date and time
	Meas	Range setting, liquid detection, digestion setting and turbidity supplement setting
	Others	Procurement settings and pre-processing
Info	/	Check the instrument version information and software upgrade operation

6.5 Data Inquiry

Query functions include access to historical measurement data, calibration records, and operation logs, with features such as data lookup, curve viewing, and data export.

6.5.1. Measurement Data Query

On the "Meas" interface, users can view historical measurement data. Navigation through pages is available via the [**Prev**] (Previous Page) and [**Next**] (Page) buttons. Users can also search for data records by selecting a specific date and time, which enables direct access without scrolling through every entry.

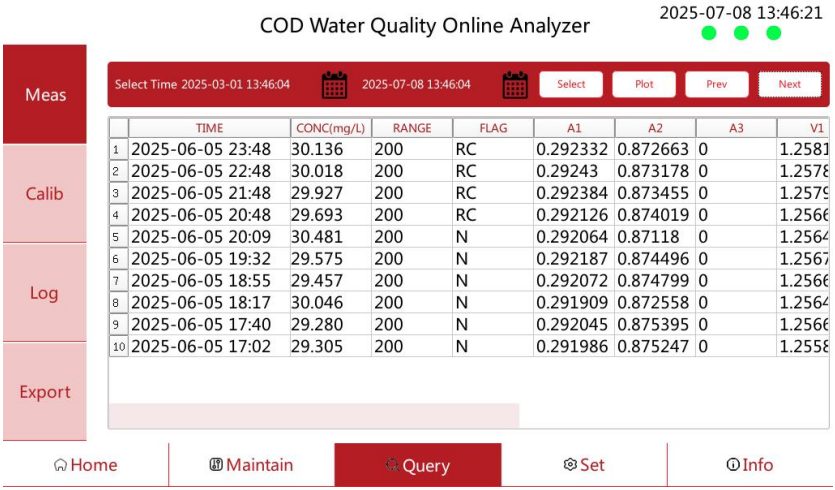


Fig.12 Data query interface

After data query is done, click [**Plot**], the analyzer will display the data in the form of curve.

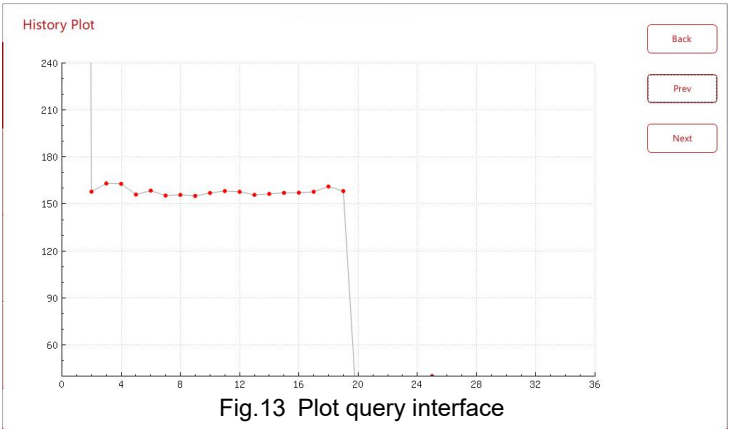
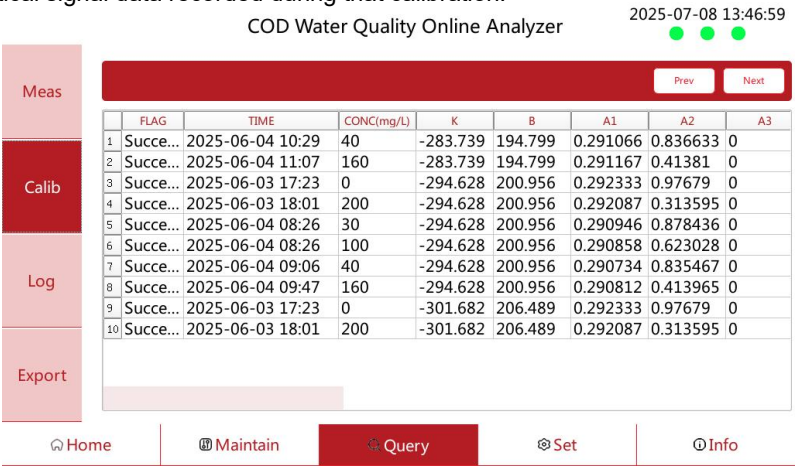


Fig.13 Plot query interface

On the plot viewing page, users can visually observe the trend of test data over a period of time through the curve, allowing them to gain an overall understanding of the changes in pollutant emissions for the selected indicator at the monitoring point.

6.5.2. Calibration Record Query

The "Calib" interface stores and displays historical records of both online and manual calibrations. The main "Calib" page shows details such as the calibration time, concentration, and calibration coefficient. By selecting a specific calibration record and sliding the action bar at the bottom to the right, users can view the optical signal data recorded during that calibration.



	FLAG	TIME	CONC(mg/L)	K	B	A1	A2	A3
1	Succe...	2025-06-04 10:29	40	-283.739	194.799	0.291066	0.836633	0
2	Succe...	2025-06-04 11:07	160	-283.739	194.799	0.291167	0.41381	0
3	Succe...	2025-06-03 17:23	0	-294.628	200.956	0.292333	0.97679	0
4	Succe...	2025-06-03 18:01	200	-294.628	200.956	0.292087	0.313595	0
5	Succe...	2025-06-04 08:26	30	-294.628	200.956	0.290946	0.878436	0
6	Succe...	2025-06-04 08:26	100	-294.628	200.956	0.290858	0.623028	0
7	Succe...	2025-06-04 09:06	40	-294.628	200.956	0.290734	0.835467	0
8	Succe...	2025-06-04 09:47	160	-294.628	200.956	0.290812	0.413965	0
9	Succe...	2025-06-03 17:23	0	-301.682	206.489	0.292333	0.97679	0
10	Succe...	2025-06-03 18:01	200	-301.682	206.489	0.292087	0.313595	0

Fig.14 Calibration record interface

6.5.3. Log Query

"Log" interface provides all the operation records of the instrument, including [**Alarm**], [**Run**] and [**Oper**] record. Select the corresponding option box to query the record.

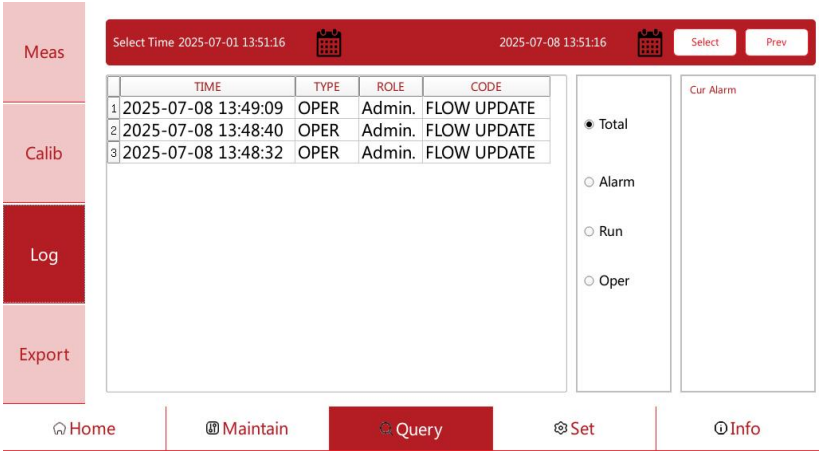


Fig.15 Alarm log

(1) "Alarm" Log Query

On the right side of the interface, the "Current Alarm" section displays unresolved alarm messages. The "Alarm Log" records faults detected during instrument operation, including the time of occurrence, alarm type, and alarm content, helping users identify the cause of the fault.

(2) "Run" Log Query

The "Run" Log records all process operations performed by the instrument during its operation.

(3) "Oper"(Operation) Log Query

The **"Oper"(Operation) Log** records all operations performed during instrument operation, such as measurement mode, ON/OFF switch, power-on, and power-off events. The "Role" column displays the type of operators.

6.5.4. Data Export

For the convenience of data collection and processing, the analyzer provides a data export function. First, insert a USB flash drive into the USB port at the back of

the screen, then click the [**Next Step**] button.

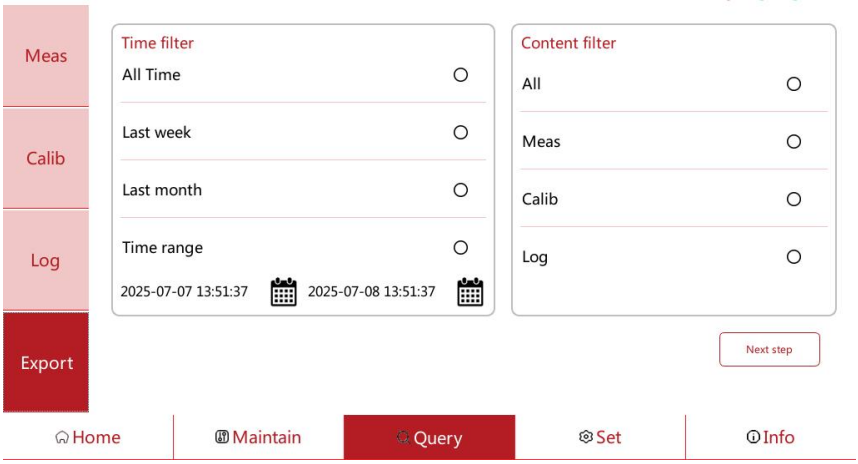


Fig.16 Data export

The analyzer will prompt that the data has been exported successfully. Wait for approximately 30 seconds to complete data transfer.

Note: Removing the USB drive too quickly may result in data loss.

6.6 Online Monitoring Plan

Before operating the instrument online, users must first configure the online monitoring plan.

6.6.1. Range Setting

Path: Set → Meas → Range

Permission Level: Administrator

The instrument provides three measurement ranges: Range 1, Range 2, and Range 3. Users can determine the optimal range for online measurement based on the actual concentration range of the on-site wastewater.

The selection criterion is: the chosen range should be 2 to 3 times the local COD discharge limit for water samples.

The extremely high or low selected range may affect the measurement accuracy.

Users can view the currently selected measurement range on the home page of the software controlling the analyzer.

Click "Set → Meas", and select or confirm the current range in the "Range" dialog box. Set the calibration solution concentration for the current range on the right-hand side under [**Standard ConC**].

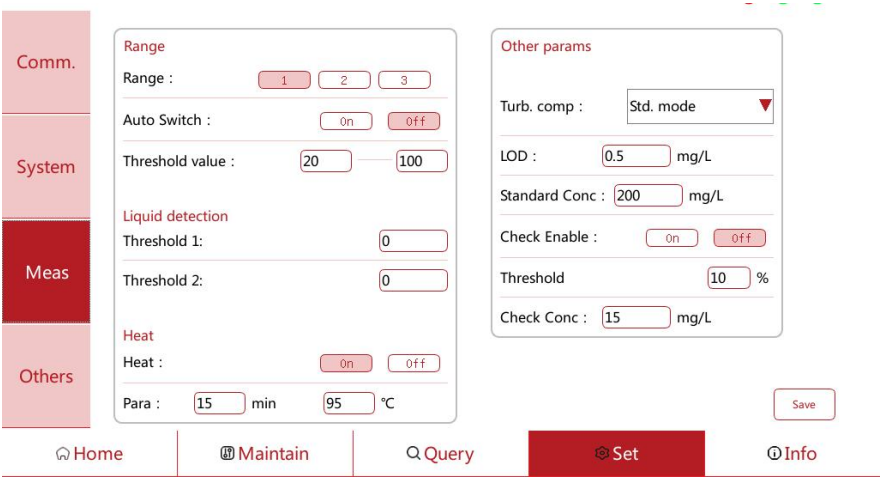


Fig.17 “Set-Meas” interface

Note: when changing the calibration solution of the measuring range, please ensure the consistency between the standard measuring range and the standard concentration which was set in [**Standard ConC**] on the right.

6.6.2. Calibration Setting

Path: Maintain → Calib

Permission Level: Maintainer/ Administrator

Click the [**Add**] button to add new calibration operators (Note: Calibration tasks are usually preconfigured before the instrument leaves the factory, so adding a new one is generally unnecessary).

Click the [**Change**] button to modify the current calibration task, including calibration time, concentration, cycle, etc.

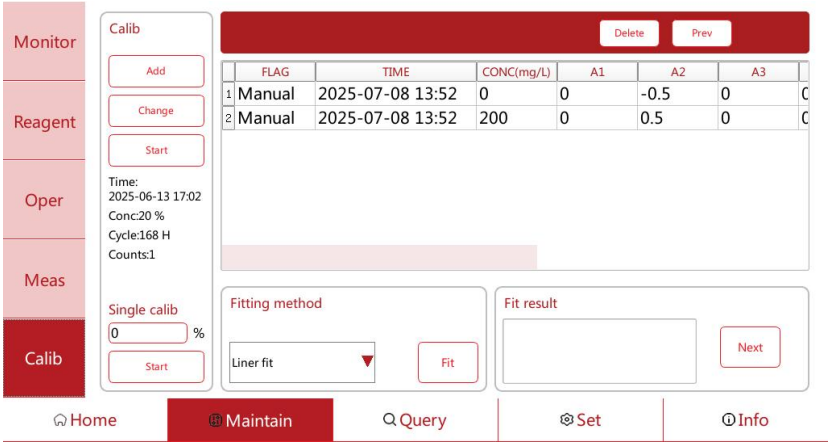


Fig.18 “Maintain-Calib” interface

6.6.3. Measurement Setting

Path: Maintain → Meas

Permission Level: Maintainer/ Administrator

Click the [**Add**] button or select a row and click the [**Change**] button to configure the measurement process.

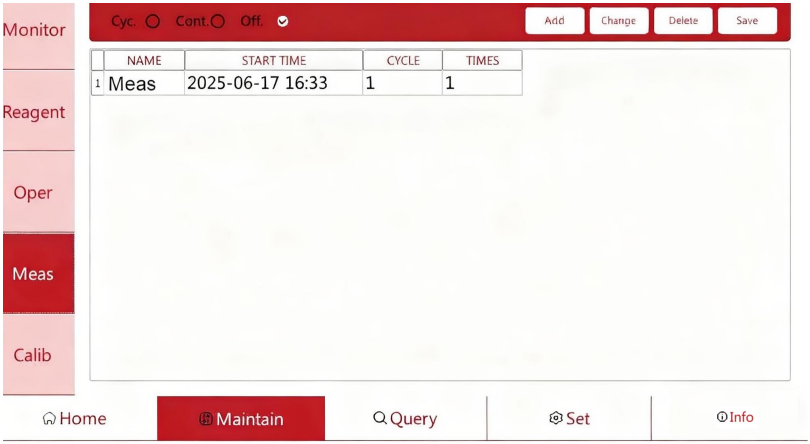


Fig.19 “Maintain-Meas” interface

6.6.4. Monitoring Mode Setting

The monitoring mode is primarily used to select the execution mode during the measurement process, as well as to manage parameters such as execution time,

cycle, and number of repetitions.

There are three monitoring modes: **Cycle (Cyc.)**, **Continuous (Cont.)**, and **Offline (Off.)** Mode.

You can select the desired mode by checking one of the three circles on the left. A confirmation dialog will appear after selecting a mode.

- **Cycle** Mode: The instrument performs measurement tasks at fixed intervals. This mode is used for routine monitoring.
- **Continuous** Mode: The instrument executes measurement processes continuously without interruption. This mode is mainly used for emergency monitoring.
- **Offline** Mode: The instrument is in an offline state. After completing the current process or action, it remains idle unless a manual command is issued. This mode is mainly used for routine maintenance. In offline mode, manual execution of action pack, single-point calibration, reset, cleaning, and other processes is supported.

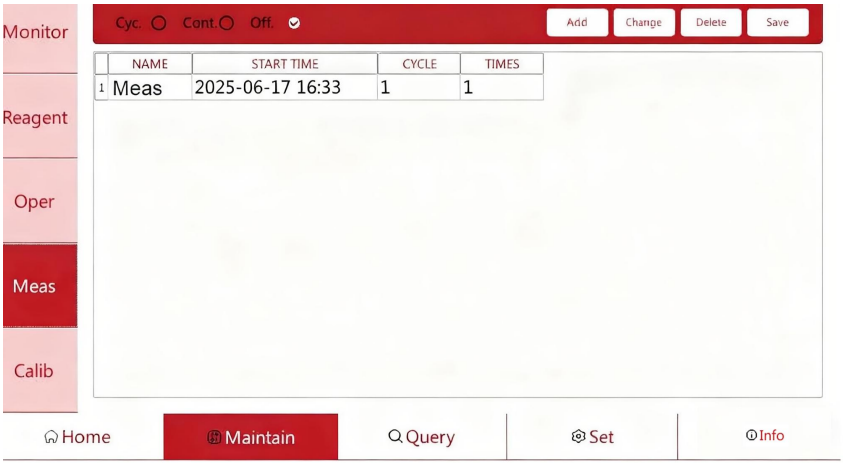


Fig.20 Setting measurement mode interface

After all settings are completed, you must click the confirm button to save the configuration. Otherwise, the settings will not be saved properly.

6.6.5. Switching Monitoring Modes

Method 1:

Users can switch between online and offline modes by clicking the [**Current Mode**] button on the main page.

- When the instrument is running, clicking [**Current Mode**] and selecting "Offline" will set the instrument to offline mode after the current process starts.
- When the instrument is offline, clicking [**Current Mode**] and selecting "Continuous" will start continuous measurement.
- Selecting "Periodic" mode from [**Current Mode**] will enable periodic measurements.

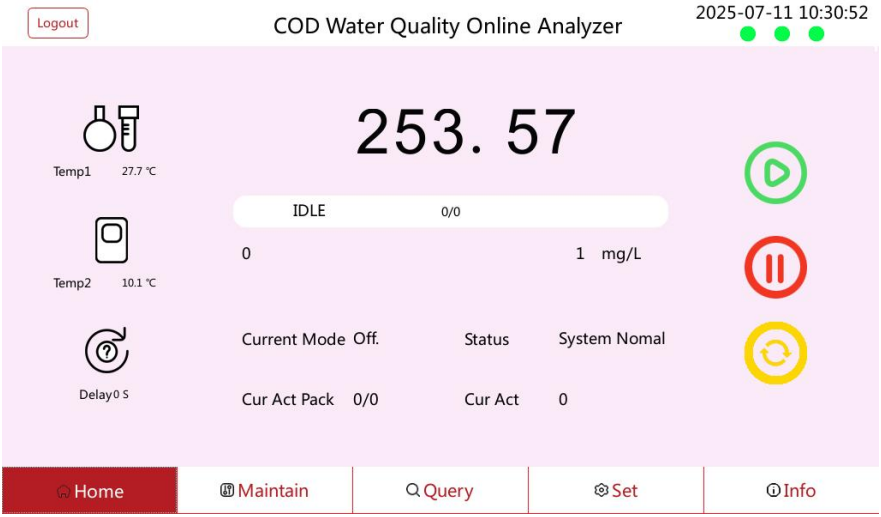


Fig.21 Click on the current mode

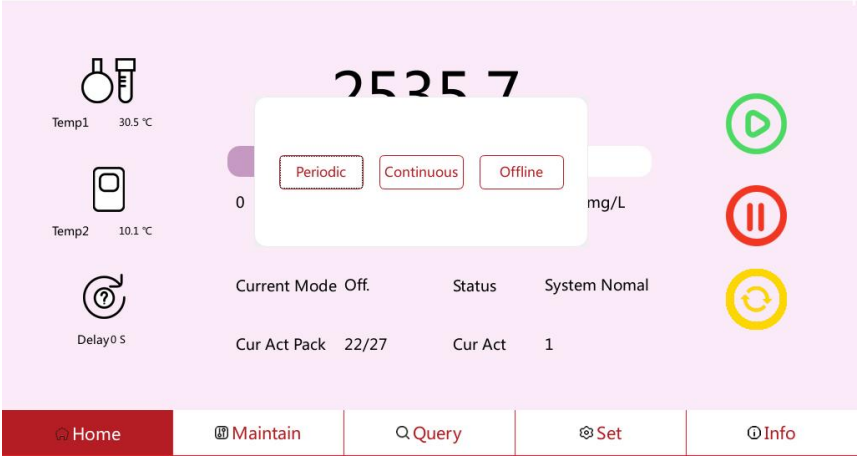


Fig.22 Switch measurement mode

Method 2: You can also switch the measurement mode through the "Maintain-meas" interface, as shown below.

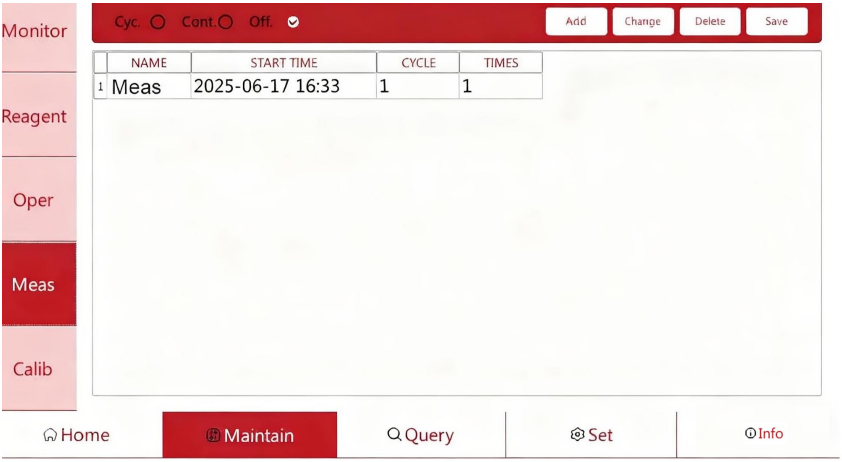


Fig.23 Modifying mode in the "Maintain-meas" interface

7 Maintenance

7.1 Stop or Emergency Stop

During commissioning, if the user wishes to interrupt a process or measurement task that is currently running, they can click the **[Stop]** button on the Home interface.

The analyzer will immediately terminate the ongoing process and cancel any scheduled tasks.

In case of an emergency, the **[Stop]** button can be used. If there is no time to react, the user may directly cut off the instrument's power supply to stop its operation immediately.

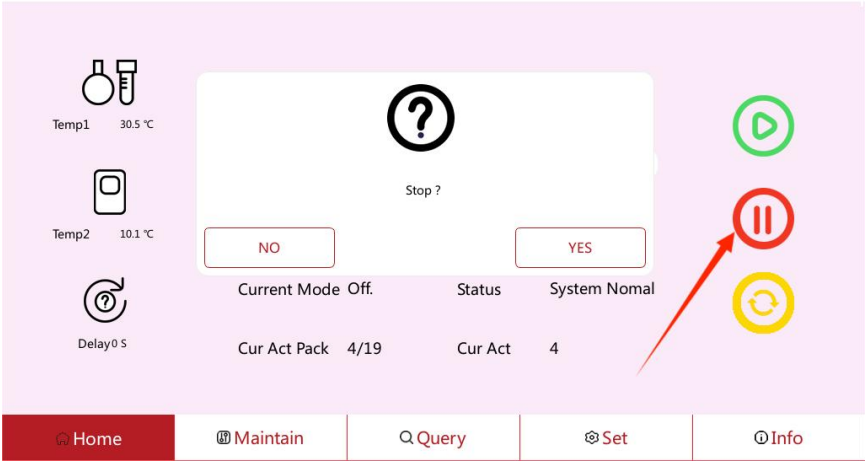


Fig.24 Stopping setting

7.2 Power-off Restart Settings

When the instrument experiences a sudden power-off and restarts, it will automatically handle the following scenarios:

- If the analyzer was in "Running" state before the power-off, it will execute a reset process after restarting.
- If the analyzer was in "Waiting" state before the power-off, it will resume waiting after restarting.

- If the power-off lasts too long and exceeds the calibration interval, the instrument will immediately start the calibration process, and the cycle measurement will be postponed accordingly.
- If the power-off occurs before calibration and the duration is less than 12 hours, the next calibration time remains unchanged. If the duration exceeds 12 hours, the next calibration will start at the first "Start Time" after the interval period.

7.3 Device Monitoring

Path: Maintain → Monitor

Permission Level: Maintainer/Administrator

The monitoring interface provides real-time monitoring of device components, temperature control, and allows relay switch control.

- The "**Core Parameters**" dialog box allows real-time monitoring of multi-valve numbers, pump volume, enclosure and detection chamber temperatures, main and reference light path voltages, and the status of the liquid detector.
- The "**Device Control**" dialog box enables control of digital switches, including fans in the detection chamber and enclosure, solenoid valves, light sources, etc., helping users quickly identify issues and simplifying maintenance.

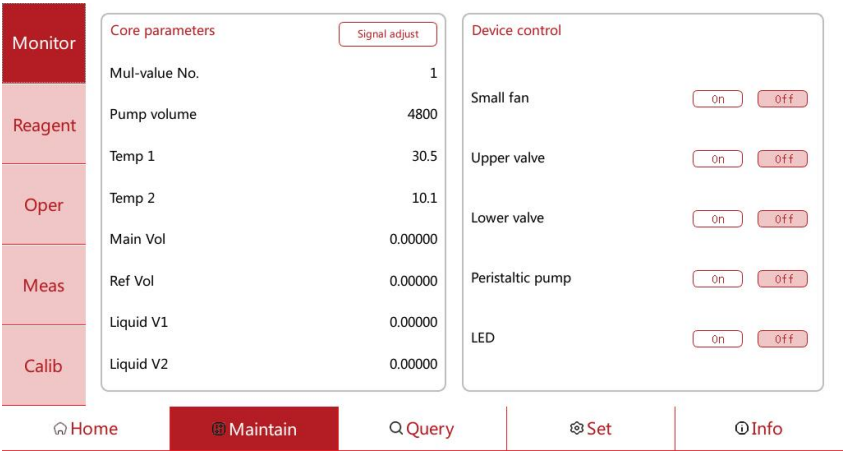


Fig.25 Monitoring interface

7.4 Signal Adjustment

After maintenance, the instrument must perform signal adjustment before executing normal calibration and measurement processes. This ensures that the voltages of the main and reference optical paths are within a reasonable range, thereby guaranteeing the reliability of measurement results.

Path: Maintain → Monitor

Permission Level: Maintainer/Administrator

Click the [**Signal Adjust**] button to enter the signal adjustment interface, as shown below.

In this interface, you can set signal adjustment limits and check adjustment results. In general, the lower limit is 0.8V, and the upper limit is 2.2V. After setting the limits, click the **[Adjust]** button to perform the adjustment. Alternatively, you can select the signal adjustment process from the manual operation interface.

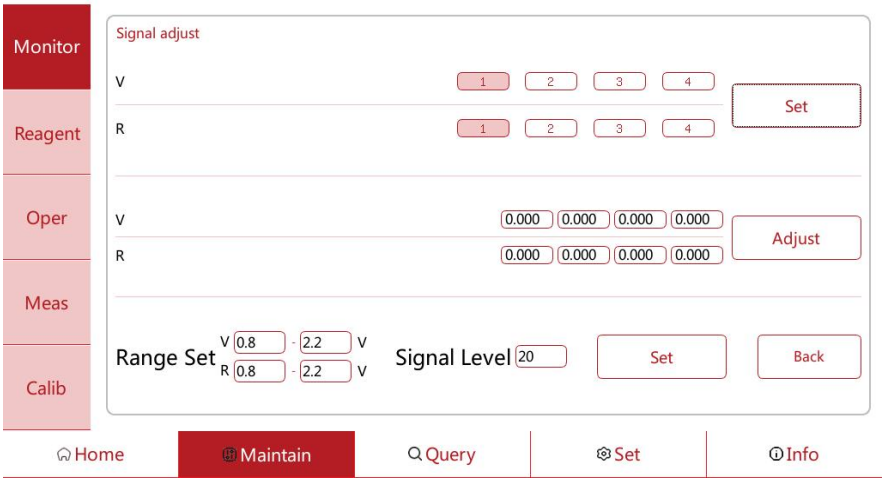


Fig.26 Signal adjustment interface

7.5 Reagent Maintenance

7.5.1. Safety Tips

	Note: Reagent bottles being replaced may still contain a small amount of reagent. Do not mix it with new reagents. Instead, pour it into the reaction effluent container or hand it over to O&M personnel for centralized disposal. During testing, the instrument discharges two types of liquids: **Waste liquid of analysis,** which is highly toxic and strongly corrosive. It must be collected and treated in a centralized manner and must not be discharged randomly. **Cleaning wastewater**, which is used to rinse out the analyzer and does not contain toxic or corrosive substances.
	Note: When replacing reagents or effluent containers, operators must wear disposable gloves, long pants or lab coats, and protective face shields if needed.

7.5.2. Reagent Maintenance

The reagent total volume, expired data, and alarm counts of the residual volume are preset at the factory, but users may adjust them as required to meet actual needs. Path: maintain→reagent; Permission level: maintainer/administrator.

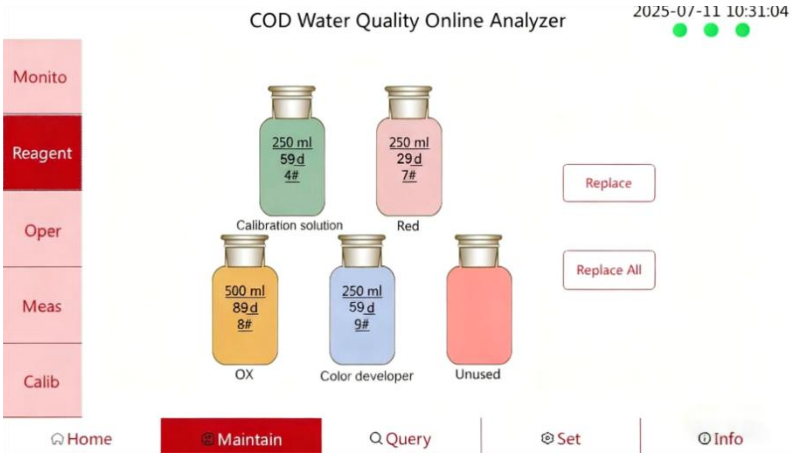


Fig.27 “Maintain-reagent” interface

When replacing reagents, select the reagent bottle icon corresponding to the reagent name and click the [**Replace**] button. The reagent volume will be reset to its nominal volume. Clicking the [**Replace All**] button will reset the volume of all reagents to their respective nominal volumes.

Reagents should be replaced or refilled regularly in accordance with the shelf life and consumption requirements specified in Chapter 8. When the reagents in the bottle are used up, unscrew the reagent tube together with the bottle cap, then replace it with a new bottle filled with fresh reagent and secure the cap. After that, ensure that the reagent tube is fully immersed at the bottom of the bottle.

7.6 Cleaning and Maintenance

Path: Maintain → Oper (Operation)

Permission level: Maintainer/Administrator

After accessing the interface, select [**Chamber wash**] and [**Pipe flushing**], and the corresponding task will be performed.

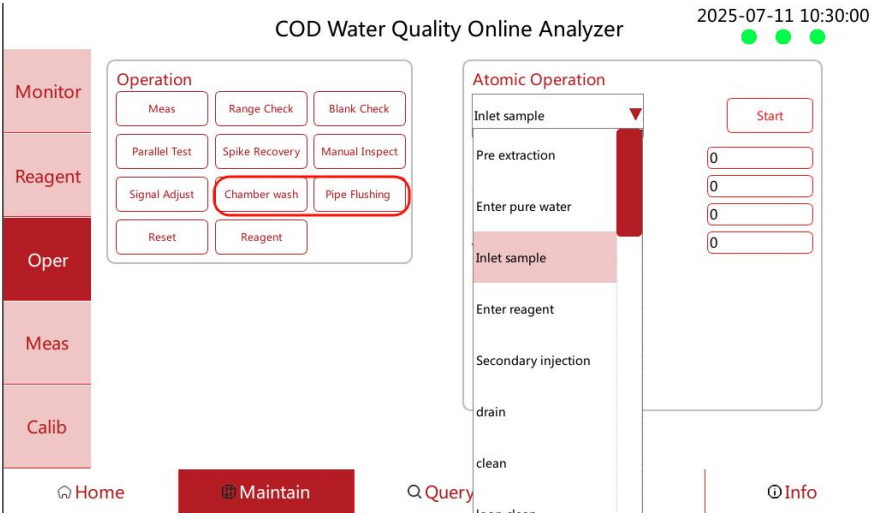


Fig.28 Cleaning and maintenance interface

Cleaning is generally divided into pipe flushing performed before delivery and chamber wash after the instrument has been in operation for some time.

(1) Pipe Flushing:

When the instrument is in standby mode, this process can be run to draw pure water through all pipelines and the digestion tank for cleaning. Once cleaning is complete, all liquid in the pipelines and the digestion tank will be drained.

(2) Chamber Wash:

When the instrument is in standby mode, this process draws cleaning solution through the pipelines and the digestion tank for cleaning. After the process is complete, the instrument will return to standby mode.

7.6.1. Pipe Flushing

The analyzer would be subjected to various factory tests to verify its analytical performance. Once all parameters meet the specified standards, the cleaning process is initiated. When this cleaning process stops, an additional 1–2 rounds of factory cleaning are performed to flush all pipelines and drain any remaining liquid inside.

7.6.2. Chamber Wash

The analyzer supports scheduled cleaning. After a period of operation, untimely cleaning may compromise measurement accuracy. In cases where the water sample is particularly dirty—especially if it contains oil or sludge—the pipelines and digestion tank may become progressively contaminated. Solutions include:

(1) Using a proper pretreatment system to effectively remove oil and sludge from the water which fundamentally resolves the problem and ensures the instrument's longevity and stability.

(2) Cleaning the reaction unit with diluted sulfuric acid or hydrochloric acid. For extremely poor water quality, tubing between the multi-channel selection valve and reaction unit can become heavily soiled. In such cases, it is recommended to use a specially formulated cleaning solution provided by the manufacturer.

(3) If the tubing turns black, loosen the joint under the reaction unit cover, remove one end of the tubing, and clean it with a dedicated brush (available via customer service).

(4) Directly replacing the pipelines is also an option—especially after long-term use, as the pipelines may become aged and dirty. Regular maintenance should include replacing them with new ones.

(5) If the reaction unit becomes dirty or blackened, first draw a certain amount of diluted hydrochloric acid into the digestion tank for cleaning. If this proves ineffective, rinse the reaction unit with distilled water and drain it. Then, open the instrument's front door, unscrew the digestion module's upper knob, remove the reaction unit at a slight angle, and clean it thoroughly with a test tube brush (professional service by our after-sales team is recommended).

In online monitoring setups, the instrument can be configured with cleaning intervals to enable automatic cleaning. Alternatively, users may initiate manual cleaning via the “Maintain → Oper” interface by clicking [**Chamber Wash**].

7.7 Manual Operation

7.7.1. Manual Measurement

Manual measurement allows for a one-time measurement within the current range. The result is calculated using the calibration coefficient for the current range and recorded in the historical data. It is important to note that manual measurement or other procedures must be executed in offline mode.

Manual measurement can be initiated via the (Measurement) button on the Home screen (see Figure 29) or manually executed from the [**Meas**] button in the “Maintain” interface (see Figure 30).

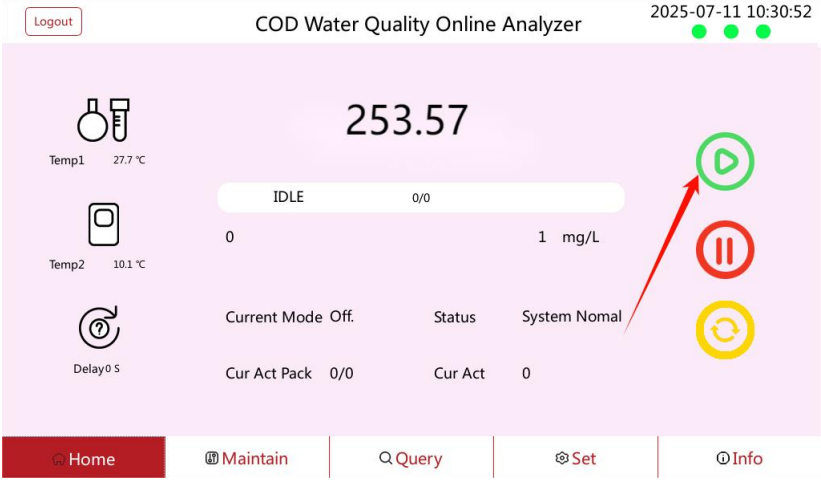


Fig.29 Manual measurement on the home page

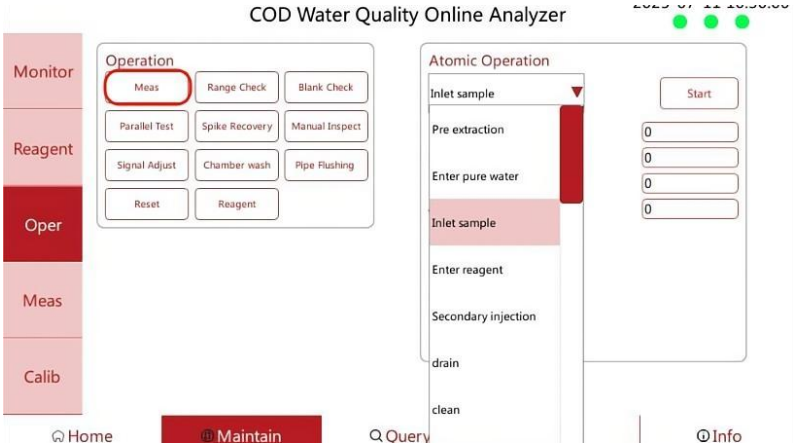


Fig.30 Manual measurement of the “Maintain” interface

7.7.2. Manual Calibration

Path: Maintain → Calib (calibration)

Permission level: Maintainer / Administrator

- **Manual Calibration Interface**

The figure below shows the storage area for calibration results. It primarily stores the results from the most recent calibration, located in area ① of the interface.

This interface allows manual curve fitting of calibration results. To do so, select a calibration record from area ①, choose a fitting method, and click the [**Fit**] button to perform curve fitting. The final fitting results will be stored in area ②, which mainly displays the correlation coefficients and parameters of the fitted curve. These parameters will serve as the final calibration coefficients.

After clicking [**Fit**], a dialog box will appear confirming whether to save the fitted parameters. If "Yes" is selected, the fitted parameters will be saved to the calibration record interface. If "No" is selected, the manually fitted result will not be saved.

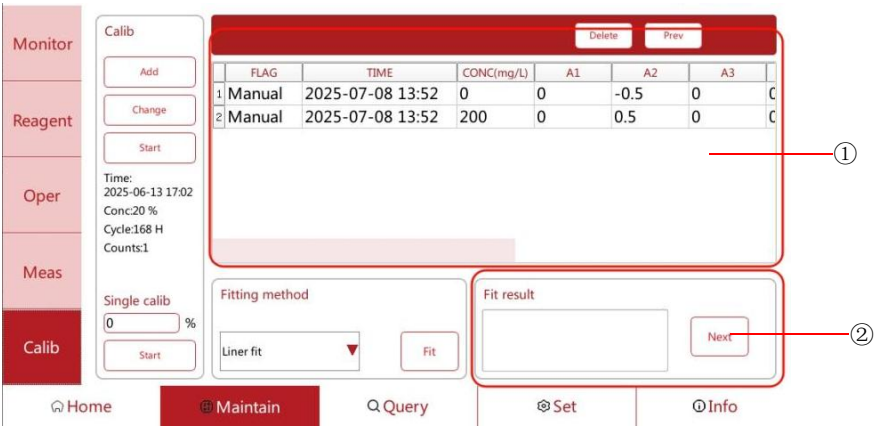


Fig.31 “Maintain-calib” interface

- **Manual Calibration Setting**

After obtaining maintenance access, go to “Maintain→Calib”, as shown in Figure 31. In this interface, you can [**Add**], [**Change**], or [**Start**] a calibration process.

When performing single-point calibration, one set of calibration parameters is saved. While editing the single calibration parameter, the concentration percentage and number of measurements for the calibration point need to be edited, as the blank and standard solution volumes are considered external inputs. The concentration percentage can be set to any value between 0% and 100%, with 0% and 100% typically used for standard calibration. Once the calibration information is configured, click the [**Start**] button to activate the manual calibration process.

- **Calibration Frequency**

To ensure the reliability and accuracy of online monitoring results, the instrument should undergo regular automatic or manual calibration during operation. Calibration must be performed again after instrument acceptance, testing of low-concentration COD samples, audit testing, reagent replacement, maintenance, or relocation. Do not reuse calibration coefficients from several days ago, as this may result in significant errors in COD measurements.

Note: According to the technical specification HJ/T 355 “Technical specifications for the operation and assessment of wastewater online monitoring system”, the system must automatically perform zero-point and span correction every 48 hours.

Our recommended calibration interval is once every 168 hours.

7.7.3. Manual Operation Procedure

Path: Maintain → Oper (operation)

Permission level: Maintainer / Administrator

Manual operations include process-level operations, operations in the “atomic operation” dialog box, and manual self-checks in case of system faults.

In the “Maintain → Oper” interface, select the desired process in the “Atomic Operation” dialog box, then click [**Start**]. The instrument will execute the corresponding process. Processes that can be manually executed include measurement, check, reset, wash, and more.

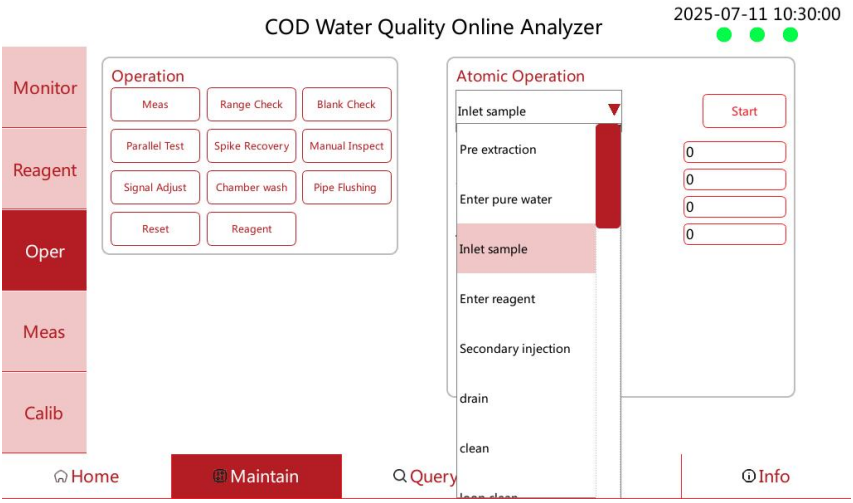


Fig.32 Process procedure

In the “Maintain → Oper” interface, under the “Atomic Operation” dialog box, select the atomic operation to be performed manually, set the relevant parameters, and click the [**Start**] button. The instrument will then execute the selected atomic operation. All available atomic operations can be performed manually from the “Atomic Operation” dialog box. These operations can be useful for maintenance and troubleshooting, allowing users to conveniently identify and resolve instrument issues.

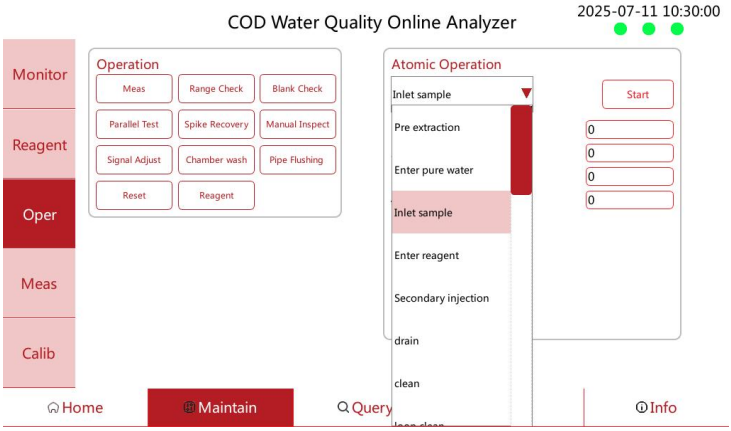


Fig.33 Atomic operations

7.8 Analyzer Information

In the “Info” page, users can view instrument information, including instrument name, software version, and sequence control settings.

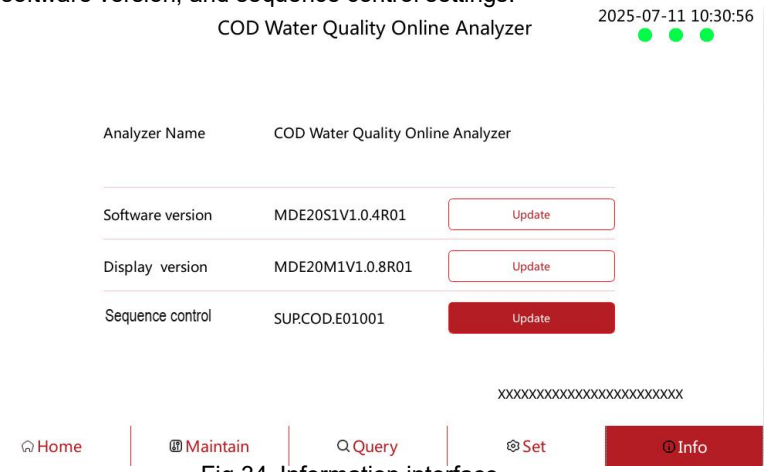


Fig.34 Information interface

7.9 Software Upgrade and Maintenance

With the appropriate user permissions, the interface, software, and timing control system of the instrument can be upgraded via a USB flash drive. To avoid file corruption, ensure that the USB drive is safely removed after the upgrade is completed.

8 Reagent Preparation

- After the instrument has been installed and debugged, reagents must be prepared before calibration.
- As some of the reagents are highly toxic, for safety reasons, all chemical reagents must be prepared by professsionals.
- For reagent uploading, please place the reagents in the designated positions on the reagent rack inside the instrument cabinet. For detailed instructions, refer to 4.4 Tubing Connection.
- Proprietary reagent formulations are available upon request.

9 Maintenance

9.1 Maintenance Cycle

For the best measurement performance, regular maintenance and care for the Analyzer are required.

Table 8 Maintenance cycle

No.	Maintenance project	Maintenance methods	Maintenance cycle			
			One week	Half of a month	Quarter	Year
1	Analyzer's appearance cleanup	Manual Cleanup	★			
2	Reagent maintenance	Manual Cleanup		★		
3	Cleaning and replacement of reagent pipelines	Manual Cleanup				★
4	Cleaning and maintenance of the digestion cell	Manual Cleanup			★	
5	Reagent effluent disposal	Manual Cleanup		★		

9.2 Analyzer's Appearance Cleanup

The outer surface of the instrument should be wiped down regularly. It is recommended to use disposable wipes for cleaning the reagent tubes and reagent bottles in front of the instrument. Be sure to wear disposable gloves and other necessary protective equipment during the cleaning process, as some of the reagents are highly corrosive.

9.3 Reagent Maintenance

For details on reagent maintenance, refer to Chapter 8.

9.4 Cleaning and Replacement of Reagent Tubing

For cleaning and maintenance procedures, refer to Chapter 7.

9.5 Cleaning and Maintenance of the Digestion Cell

For cleaning and maintenance procedures, refer to Chapter 7.

9.6 Disposal of Analytical Wastewater

The waste liquid of analysis generated by the water quality analyzer is highly acidic and toxic. It should be collected and stored in dedicated high-density polyethylene (HDPE) containers and disposed of in accordance with the methods specified by the local environmental protection authority.

The wastewater must be handled by a certified third-party organization authorized to dispose of chemical waste. Do not attempt to dispose of it yourself.

Danger: The wastewater is extremely toxic and highly corrosive. As strong acids are added during disposal, strict safety measures are essential. To minimize the risk of splashing, disposal must be carried out in a well-ventilated area. Operators must wear appropriate protective gear, including workwear, gas masks, chemical splash goggles, rubber gloves, and rubber boots.

10 Fault Analysis and Troubleshooting

10.1 Electrical Failure

Table 9 Electrical Fault Analysis and Troubleshooting

Troubles	Possible causes	Troubleshooting
The touchscreen is not lighting up	Loose or disconnected power cable on the mainboard	Reconnect the power cable
	Loose or disconnected ribbon cable on the mainboard	Reconnect the cable
	Mainboard malfunction	Contact Us
	Touchscreen malfunction	Contact Us
Touchscreen unresponsive	Touch pen failure	Replace the touch pen
	Mainboard crash	Restart the instrument
	Loose or disconnected control ribbon cable on the mainboard	Reconnect the ribbon cable to the motherboard
	Damaged communication cable on the touchscreen	Replace the communication line.
	Touchscreen malfunction	Contact Us
Internal communication failure	Loose or disconnected power cable on the mainboard	Reinsert the power cable
	Incorrect alignment of the ribbon cable connector on the main control board	Realign and reconnect properly.
	Incorrect alignment of the ribbon cable connector on the system board	Realign and reconnect properly
	DIP switch set incorrectly	Adjust the DIP switch settings
	Main control board malfunction	Contact Us
Abnormal temperature display	Loose or disconnected temperature sensor interface on the main control board	Reconnect the temperature sensor
	Damaged temperature sensor	Contact Us

10.2 Digestion Troubles

Table 10 Digestion troubles and troubleshooting

Troubles	Possible causes	Troubleshooting
Heating failure	The heating wire connector is loose or falls off	Reconnect the heating wire
	The Pt100 connector is loose or falls off	Reconnect the plugin
	Main control board failure	Contact Us
Cooling failure	The fan and mainboard connector are loose or fall off	Reconnect the plugin
	Main control board failure	Contact Us

10.3 Fluid Path Troubles

Table 11 Fluid circuit fault analysis and troubleshooting

Troubles	Possible causes	Troubleshooting
Selector valve alarm indicates optocoupler error or other selector valve failure	Selector valve failure	Contact Us
The selector valve alarm code shows parameter error or communication frame error	The communication line is loose or disconnected.	Reconnect the communication cable
	Selector valve failure	Contact Us
Plunger pump stalled	Pipeline blockage	Cleaning pipeline
	Plunger pump failure	Contact Us
Plunger pump alarm shows optocoupler error or other faults	Plunger pump failure	Contact Us
Plunger pump alarm	The volume of liquid	Re-upload the

Troubles	Possible causes	Troubleshooting
indicates overflow	collected exceeds 5 ml	sequence file
Upper and lower solenoid valves switch failure.	The white joint between the solenoid valve and the hard conduit is not tightened	Tighten the joint
	The counter-pressure ring in the connector between the solenoid valve and the rigid conduit is not flush with the conduit	Trim the end of the rigid tubing flush with the ferrule with the tubing cutter, then re-tighten the fitting.
During digestion, the oil bubbles in the digestion cell keep flowing upwards.	Solenoid valve failure	Contact Us
Failure to aspirate/dispense liquid properly from the valve port	The white interface of the valve port is not fixed firmly	Replacing connector
	The ferrule in the connector is not flush with the tube	Trim the end of the rigid tubing flush with the ferrule with the tubing cutter, then re-tighten the fitting.
	The liquid storage ring may be leaking air or blocked	Clean or replace the reservoir ring

Table 12 Troubleshooting the faults of the accuracy measurement

Troubles	Possible causes	Troubleshooting
Unstable readings for quality control samples; the indication error exceeds 10%.	Range error	Change to a suitable range and measure again
	Non-standard reagents	Replace the appropriate reagent and re-measure
Unstable readings for actual water samples; indication error exceeds 10%.	Visible suspended solids in the water sample	After the water sample settles, take the supernatant for measurement. If the result stabilizes, consider adding a filter to the sampling tube.
The measured value is stable, but the result differs from the true value by more than 10%.	Range error	Change to a suitable range and measure again
	Non-standard reagents	Replace the appropriate reagent and re-measure
Occasional high readings, with manual measurement of retained samples yielding similar results.	Malfunction in the sampling pretreatment system	Clean or rectify the pre-treatment device
Occasional high readings, with manual measurement of retained samples yielding significantly lower results.	Malfunctions in the sampling, heating, or digestion, and others processes.	Refer to the corresponding "Troubleshooting" procedures and take corrective actions.

11 Warranty and After-Sales Service

Our company guarantees that any product quality issues arising during the warranty period will be covered under our unconditional "Three Guarantees" policy, which includes free repair, replacement, or return. All non-customized products are eligible for return or exchange within 7 days (excluding products damaged due to misuse). For customized products, the warranty terms specified in the contract shall apply.

Disclaimer

The following situations are not covered under the "Three Guarantees" policy, even during the warranty period:

(1) Product malfunctions caused by improper use by the customer.

(2) Product malfunctions resulting from unauthorized disassembly, repair, or modification by the customer.

Appendix A Communication Protocol

A.1 Communication Setting

Communication interface: RS485/RS232/TCP.

Communication mode: two-way asynchronous, master/slave mode. The communication terminal (such as data acquisition instrument, IPCs) that receives instrument information on site is the master, and the instrument is the slave.

Port settings: Baud rate: 115200/57600/38400/19200/9600

Data bits: 8

Stop bits: 1

Parity: None

Note: The shortest reading interval is 200ms

A.2 Communication Protocol

The communication protocol between the online monitoring instrument and the data acquisition device adopts the Modbus RTU standard, with communication data defined through Modbus registers.

A.2.1 Message Frame Structure

Table 13 Modbus Message Frame Table

Item	Type	Length (bytes)	Description
Device address	BYTE	1	Corresponding to the device address in the instrument, used to distinguish different online monitoring instruments hanging on the same 485 bus. The value range is 1 ~247
Function code	BYTE	1	Function code definition, see Table 16
Data	BYTE[n]	N	Variable length data, with different function codes and response modes
CRC	WORD	2	Modbus CRC16 check result

A.2.2 Function Code

Table 14 Function code

Code	Function	Data Types	Remark
0x03	Read	Integer, float, character	Read single register
0x10	Write	Integer, float, character	Write multiple registers

A.2.3 Data Type

Table 15 Data type definition table

Data	Description and requirements
BYTE	Unsigned single-byte integer (byte, 8 bits)
WORD	Unsigned 2-byte integer (word, 16 bits)
DWORD	Unsigned 4-byte integer (double word, 32 bits)
FLOAT	4-byte floating point number (byte, 32 bits) IEEE 754 standard
DOUBLE	8-byte floating point number (byte, 64 bits)
BYTE[n]	N bytes
STRING	GBK encoding uses a 0 terminator. If there is no data, a 0 terminator is placed.
CHAR[n]	N characters, ASCII
DATE	Date type 6 bytes Year (BYTE) - Month (BYTE) - Day (BYTE) - Hour (BYTE) - Minute (BYTE) - Second (BYTE) Among them: year=byte+2000, month: 1-12, day: 1-31, hour : 0-23, minute: 0-59, second: 0-59 Numerical format: BCD code

Data byte order definition: 1 - 0 - 3 - 2

The protocol uses big-endian mode to transfer WORD, DWORD, FLOAT, and DOUBLE. For DWORD, FLOAT, and DOUBLE, the word order is arranged in little-endian mode.

A.3 Register Definition

Table 16

Areas	Starting address offset	Ending address offset	Register quantity	Description
Measurement data	0x1000	0x10 7F	128	Measurement data area
Status warning	0x1080	0x109F	32	Working status, alarm, fault, etc.
Key parameter	0x10A0	0x10FE	95	Key parameters, feedback status
Control command	0x1200		1+n	Control command 1 + command parameter n

Considering that some instruments integrate multiple monitoring parameters (e.g., total phosphorus and total nitrogen, or total phosphorus and ammonia nitrogen), a separate Modbus address can be assigned to each parameter for differentiation. This way, the register addresses in the measurement data area for each parameter remain the same, eliminating the need to account for channel offset issues and avoiding restrictions imposed by channel limitations.

A.3.1 Measurement Data Area

Table 17 D efinition of registers in the measurement data area

Register Offset	Data Types	Register Description	R/W	Note
0x1000~0x1001	DWORD	Factor coding	R	01018: COD 01019: IMN 21001: TN 21011:TP 21003: NH3N
0x1002	WORD	Measurement unit	R	mg/L
0x1003~0x1004	FLOAT	Reference value of the standard sample	R	
0x1005~0x1007	DATE	Data time of the standard sample	R	

Register Offset	Data Types	Register Description	R/W	Note
0x1008~0x1009	FLOAT	Measured value of the water sample	R	
0x10 0A~0x100F	CHAR[12]	Data identifier of the water sample	R	See Table 20
0x1010 ~0x1012	DATE	Data time of the standard sample	R	
0x1013~0x1014	FLOAT	Measured value of the standard sample	R	
0x1015~0x101A	CHAR[12]	Data identifier of the standard sample	R	
0x101B~0x101D	DATE	Blank data time	R	
0x101E~0x101F	FLOAT	Blank measured value	R	
0x1020~0x1025	CHAR[12]	Blank data identifier	R	
0x1026~0x1028	DATE	Data time of zero point check	R	
0x1029~0x102A	FLOAT	Measured value of the zero point check	R	
0x102B~0x1030	CHAR[12]	Data identifier of zero point check	R	
0x1031~0x1033	DATE	Data time of span check	R	
0x1034~0x1035	FLOAT	Measured value of span check	R	
0x1036~0x103B	CHAR[12]	Data identifier of span check	R	
0x103C~0x103E	DATE	Data time of spike recovery	R	
0x10 3F~0x1040	FLOAT	Measured value of spiked recovery	R	
0x1041~0x1046	CHAR[12]	Data identifier of spiked recovery	R	

Register Offset	Data Types	Register Description	R/W	Note
0x1047~0x1049	DATE	Data time of duplicate sample	R	
0x104A~0x104B	FLOAT	Measured value of the duplicate sample	R	
0x104C~0x1051	CHAR[12]	Duplicate sample data identifier	R	
0x1052~0x107F			R	Reserve

Table 18 Data Identification Table

Logo	Identity Definition	Description
N	Normal	The measurement data is normal and valid
bt	Blank Test	Blank test, manual, and automatic
sc	Check test of standard sample	Standard sample test verification, manual and automatic
ps	Duplicate sample test	Duplicate sample testing was performed during the acquisition of automatic monitoring data
dz	24-hour zero drift	automatically tests zero drift every 24 hours
ds	24-hour range drift	The instrument automatically tests the range drift every 24 hours
ra	Spike recovery test	Instrument internal spike recovery test
ac	Actual water sample comparison	Comparison of actual water samples inside the instrument
en	Zero point verification	Internal zero point check of the instrument
mh	Span Verification	Internal span check of the instrument

A.3.2 Status Alarm Area

Table 19 Status alarm area register definition

Register Offset	Data	Register Description	R/W	Note
0x1080	DATE	System time	R	Instrument system time
0x1081				
0x1082				
0x1083	WORD	Working status	R	See Table 22
0x1084	WORD	Measurement Mode	R	1 Continuous mode 2-cycle mode 3 Fixed-point mode 4 Controlled Mode 5. Manual Mode
0x1085	WORD	Alarm code	R	See Table 23
0x1086	WORD	Fault Codes	R	1 Motor failure 2 Temperature fault 3 Communication failure 4 Titration fault
0x1087	WORD	Log Code	R	Return 0
0x1088	WORD	Software Version	R	
0x1089	WORD	Measurement interval	R	minute
0x108A	WORD	Zero check interval	R	minute
0x108B	WORD	Span Check Interval	R	minute
0x108C	WORD	Standard sample check interval	R	minute
0x108D	FLOAT	Real-time temperature of digestion cell	R	Extension, unit : ℃
0x108E				
0x108F	FLOAT	Real-time temperature of mixing cell	R	Extension, unit : ℃
0x1090				
0x1091-0x109F			R	Reserve

Table 20 Working status table

Encoding	Description	Note
1	Start measurement	none
2	Standard sample check	none
3	Zero point check	none
4	Span check	none
5	Blank check	none
6	Parallel test	none
7	Spike recovery	none
8	Blank calibration	none
9	Standard calibration	none
10	Initialization (cleaning)	none
19	Calibration	
...	Expandable	

Table 21 Alarm code

Alarm code	describe	Scope of application
0	Reagent shortage alarm	General
1	Water shortage alarm	General
2	Distilled water shortage alarm	General
3	Standard solution shortage alarm	General
4	Leakage alarm	Extensions
5	Calibration abnormality alarm	Extensions
7	Heating abnormality	General
8	Low reagent warning	Extensions
9	Upper-limit alarm	General
10	Lower limit alarm	General
11	Other abnormalities inside the instrument	General
12	Titration abnormality alarm	General (titration only)

Alarm code	describe	Scope of application
13	Electrode abnormality alarm	General (only for ORP potentiometric titration)
14	Range switching alarm	Extensions
15	Parameter setting alarm	Extensions
16	Abnormal pH electrode potential	Extension (five parameters)
17	Conductivity electrode abnormality	Extension (five parameters)
18	Abnormal turbidity and light intensity	Extension (five parameters)
19	Dissolved oxygen electrode abnormality	Extension (electrochemical probe method only)
20	Abnormal dissolved oxygen light intensity	Extension (unique to fluorescence method)
Expandable		

A.3.3 Key Parameter Area

Table 22 Key parameter area register definition

Register Offset	Data	Register Description	R/W	Note
0x10A 0	WORD	Measurement accuracy	R	invalid
0x10A1	WORD	Digestion temperature	R	Unit: Celsius
0x10A2	WORD	Digestion time	R	Unit: Minutes
0x10A3	FLOAT	Lower limit of range	R	
0x10A4			R	
0x10A5	FLOAT	Upper limit of range	R	
0x10A6			R	
0x10A7	FLOAT	Curve slope k	R	
0x10A8			R	
0x10A9	FLOAT	Curve intercept b	R	
0x10AA			R	

Register Offset	Data	Register Description	R/W	Note
0x10AB	DATE	Calibration date	R	
0x10AC			R	
0x10AD			R	
0x10AE	FLOAT	Standard solution 1 concentration	R	
0x10AF			R	
0x10B0	FLOAT	Standard Solution 1 Measuring process values	R	
0x10B1			R	
0x10B2	FLOAT	Standard solution 2 concentration	R	
0x10B3			R	
0x10B4	FLOAT	Standard Solution 2 Measuring process values	R	
0x10B5			R	
0x10B6	FLOAT	Standard solution 3 concentrations	R	
0x10B7			R	
0x10B8	FLOAT	Standard Solution 3 Measuring process values	R	
0x10B9			R	
0x10BA	FLOAT	Standard Solution 4	R	
0x10BB			R	
0x10BC	FLOAT	Standard Solution 4 Measuring process values	R	
0x10BD			R	
0x10BE	FLOAT	Standard Solution 5	R	
0x10BF			R	
0x10C0	FLOAT	Standard Solution 5 Measuring process values	R	
0x10C1			R	
0x10C2	FLOAT	Linear Correlation Coefficient (R or R^2)	R	R or R^2
0x10C3			R	

Register Offset	Data	Register Description	R/W	Note
0x10C4	DWORD	Reagent Residue	R	
0x10C5			R	
0x10C6	FLOAT	Measuring process values	R	
0x10C7			R	
0x10C8	Date	Blank calibration time	R	
0x10C9			R	
0x10CA			R	
0x10CB	Date	Standard sample calibration time	R	
0x10CC			R	
0x10CD			R	
0x10CE	FLOAT	Detection limit	R	Set initial value
0x10CF			R	
0x10D0	FLOAT	Calibration factor	R	1
0x10D1				
0x10D2-0x10D7		Original serial number		Fill 0
0x10D8	FLOAT	Quadratic polynomial coefficients	R	Extension (0 for the equation of a line)
0x10D9				
0x10DA	FLOAT	Blank calibration process value	R	Extended (blank process value when calibrating the curve)
0x10DB				
0x10DC	FLOAT	Blank calibration process value	R	Extended (Blank process value for blank calibration)
0x10DD				
0x10DE	FLOAT	Standard calibration reference value	R	Extensions
0x10DF				
0x10E0	FLOAT	Standard calibration process value	R	Extensions
0x10E1				
0x10E2	WORD	Color rendering	R	Return 0

Register Offset	Data	Register Description	R/W	Note
		temperature		
0x10E3	WORD	Color development time	R	
0x10E4~0x10EF	WORD[12]	Device serial number	R	24-character MN number
0x10F0	FLOAT	Measurement accuracy	R	For example: 0.0001
0X10F1				
…	Expandable			

A.3.4 Control Command Area

Table 23 Control command area register definition

Register Offset	Data	Register Description	R/W	Note
0x1200	WORD	Control command code	W	
0x1201	BYTE[n]	Control command parameters	W	When the control command code is a time calibration command, this field is a 6-byte DATE

Table 24 Controlling command definition

Encoding	Items	Number of parameters	Parameter Description	Remark
1	Start measurement	none		Execution success/failure
2	Standard sample check	none		
3	Zero point check	none		
4	Span check	none		
5	Blank check	none		
6	Parallel test	none		
7	Spike recovery	none		

Encoding	Items	Number of parameters	Parameter Description	Remark
8	Blank calibration	none		
9	Standard calibration	none		
10	Initialization (cleaning)	none		
11	Stop test	none		
13	Time calibration	3 registers	DATE type: Data format BCD code	For example: 2017-01-01 00:00:00 is represented as 170101000000
32	Start measurement-Range 1	none		Execution success/failure
33	Start measurement-Range 2	none		
34	Start measurement-Range 3	none		
35	Start the test chamber cleaning	none		

A.4 Communication Example

A.4.1 Error Response Message

Table 25 Error response message example table

Error Code	Error Type	Sample Message
0x01	Illegal function	01 83 01 80 f0
0x02	Illegal data address	01 83 02 c0 f1
0x03	Illegal data value	01 83 03 01 31
0x04	Slave device failure	01 83 04 40 f3
0x06	Slave device is busy	01 83 06 c1 32

Note: the 0x83 here is the error function code, which is obtained by inverting the highest bit of the request message function code byte. For example, the error

function code of 0x03 is 0x83.

A.4.2 Data Reading Message

Request message: 01 03 10 00 00 10 40 C6

Response message: 01 03 20 52 0B 00 00 00 01 00 00 3F 00 17 01 01 00 00 00 1E B8 3E 85 4E 00 00 00 00 00 00 00 00 00 00 00 78 89

Parsing process:

01 indicates the device address

03 indicates function code

52 0B 00 00 indicates factor code 21003 : Ammonia nitrogen

00 01 indicates unit: mg/L

00 00 3F 00 means standard reference concentration: 0.5

17 01 01 00 00 00 indicates the data time 2017-01-01 00:00:00

1E B8 3E 85 means the water sample test result is 0.26

4E 00 00 00 00 00 00 00 00 00 00 00 indicates identification N

If the identifier is T, the identifier packet is: 54 00 00 00 00 00 00 00 00 00 00 00

If the identifier is Ir, the identifier package is: 6C 72 00 00 00 00 00 00 00 00 00 00

A.4.3 Control Messages

Table 26 Control message example table

Operation	Example message
Start measurement	Request message: 01 10 12 00 00 01 02 00 01 55 91 Response message: 01 10 12 00 00 01 04 B1
Zero point check	Request message: 01 10 12 00 00 01 02 00 03 D4 50 Response message: 01 10 12 00 00 01 04 B1
Span check	Request message: 01 10 12 00 00 01 02 00 04 95 92 Response message: 01 10 12 00 00 01 04 B1
Time calibration	Request message: 01 10 12 00 00 04 08 00 0D17 01 01 00 00 00 6C 73 Response message: 01 10 12 00 00 04 C4 B2 17 01 01 00 00 00 means the setting time is 2017-01-01 00:00:00