Water Quality

On-line Total Phosphorous Analyzer

User Manual

Instructions

User Guide

Thank you very much for choosing to use our company's On-line Total Phosphorous Analyzer (hereinafter referred to as: TP analyzer). Before using this product, please read this manual carefully. This manual covers various important information and data for the use of the product. Users must strictly abide by its regulations to ensure the normal operation of the instrument. At the same time, relevant information can help users use the product correctly and obtain accurate analysis results.

Overview

This manual gives a detailed description of the installation, commissioning, operation and maintenance of the instrument, as well as the measurement principle, instrument composition and performance characteristics of the instrument.

This manual guides the user to install and operate the instrument correctly, and to carry out preventive maintenance on the instrument to ensure the continuous and reliable operation of the analyzer.

The products introduced in this manual have been strictly inspected before leaving the factory to ensure that the products are of first-class quality. At the same time, in order to ensure its safe and high-quality operation and obtain correct analysis results, the user must strictly follow the operation method described in this manual.

This instruction manual provides detailed information on the correct use of the instrument. It provides an accurate reference for use by technicians who have received special training or knowledge related to the operation control of the instrument. Before operating the instrument, make sure to correctly understand the safety information and warning information mentioned in this manual, and apply them to the actual operation.

Due to various reasons, it is impossible for this manual to describe all the details of the product. If users need to learn more about relevant information or solve problems not covered in this manual, please contact us.

Standards to be Followed

“Water quality--Determination of total phosphorus-Ammonium Molybdate Spectrophotometric Method” (GB 11893)

“The Technical Requirement for Water Quality Automatic Monitoring analyzer of Total Phosphorous” (HJ 103)

"Technical Regulations on Communication Protocol for Surface Water Automatic Monitoring Instruments (Trial)"

Cautions and Warnings

Safety standards are put in the first place for development, manufacture, testing and filing of the product described in this manual. Therefore, if you follow the guidance in this manual during assembly, approval, operation and maintenance, property damage and personal injury during the normal use due to improper operation can be avoided.

To ensure the personal safety and avoid property damage during the operation and maintenance of this analyzer, please pay attention to relevant cautions and warnings in this manual. These cautions and warnings are crucial (highlighted in the text and having proper icons) since they provide proper suggestions on avoiding improper operation.

The information is displayed with certain icons and has corresponding explanations. Interpretation of icons used in this manual is shown in the following table.

Icon	Meaning
	Tip - it indicates the general information to be reminded to the users during the operation of the product, or the part in this manual required general attention.
	Caution - it indicates the important information to be noticed during the operation of the product or the part in this manual required special attention.
	Warning - it indicates that if the safety measures are not properly followed during the operation of the product, the instrument will result in error or even will cause major personal injury and death or property damage accident.

Supply and Shipping

The specific shipping requirements shall be in accordance with the corresponding clauses in the order contract.

When unpacking, please carefully read the corresponding information on the packaging materials to ensure that the unpacked goods are complete and undamaged. Please try to keep the outer packaging of the product for use when returning the meter or parts.

Warranty and Repair

The specific warranty and maintenance requirements are in accordance with the corresponding clauses in the order contract.

During the warranty period and within the scope of the warranty, free maintenance services will be provided, mainly including product maintenance within the warranty period, spare parts maintenance and replacement, technical support and regular on-site services.

If the warranty period is exceeded or the following failures occur during the warranty period, they are all out-of-warranty repairs, and no free warranty service will be provided. The failures include but are not limited to:

- Due to improper use (water ingress, corrosion, fire, strong current in series, failure to ground as required, etc.);
- Damage caused by force majeure (earthquake, lightning strike, flood, volcano, etc.);
- Unauthorized changes inside the product;
- Failure to follow the user manual and training regulations, causing damage to the product.
- Regarding the products developed and manufactured by the company, the company strictly abides by relevant national regulations in terms of disposal of waste products.

Statement

This instruction manual does not bear any legal responsibility for the user, please refer to the corresponding contract for all legal terms.

Warning

1. The maintenance of this instrument may be dangerous. Please be sure to observe the following items: wear laboratory work clothes, protective goggles/masks, and rubber gloves.
2. The instrument cannot be used as substitute reagents such as water or beverages, otherwise the temperature of the glass container used for digestion will be too high, which may melt or burst.
3. Please handle reagents, toxic waste water, and cleaning waste water in strict accordance with the waste liquid treatment and recycling regulations of the local ecological and environmental authorities or other relevant departments. Untreated dumping of reagents, toxic waste water, and cleaning waste water will pollute the environment.

Contents

1 Overview

1.1 Measuring Principle

Use potassium persulfate to digest the sample at high temperature, and all the phosphorus contained in the sample is oxidized into orthophosphate. In acidic media, orthophosphate reacts with ammonium molybdate to generate phosphomolybdate heteropoly acid in the presence of antimony salt, which is immediately reduced by ascorbic acid to generate a blue compound, and the instrument can calculate the concentration of TP in the sample through spectrophotometric conversion.

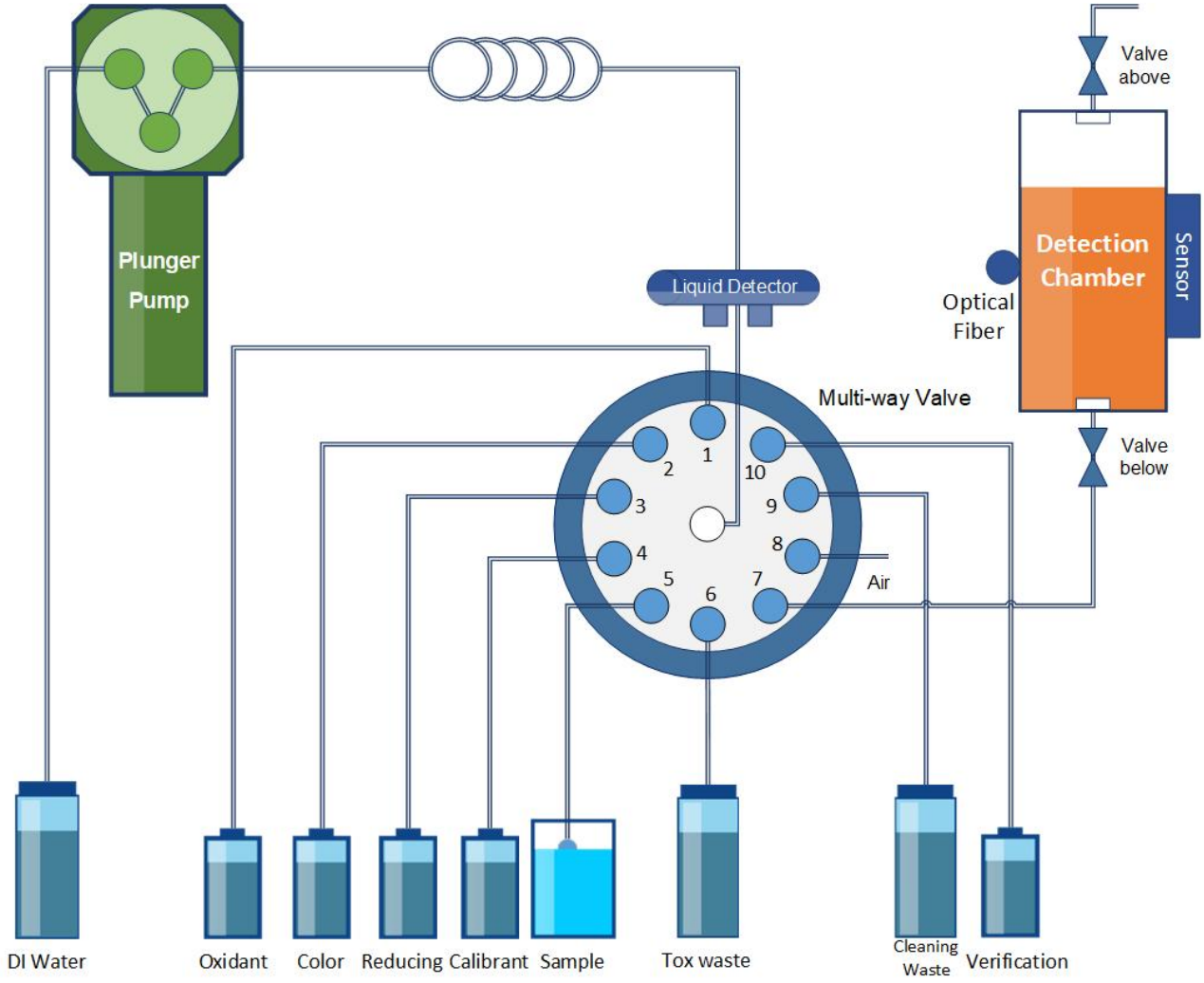


Fig 1-1 Work flow diagram

1.2 Features

- Small reagent consumption: The total reagent consumption for a single measurement is less than 3mL, and the maintenance cost is low.
- Separation of toxic waste water and cleaning waste water: Both the amount of toxic waste water and cleaning waste water in a single measurement is less than 15mL.
- Plunger pump quantitative: No contact with reagents, samples, toxic waste water and cleaning waste water, reliable and durable.
- Double optical path detection: Real-time calculation of absorbance, eliminating the interference of the external environment on the optical system.
- Lack of liquid detection and alarm: Automatically identify insufficient sample and reagents supply to avoid no reagent measurement.
- Automatic compensation of turbidity: Automatic compensation based on the turbidity of sample to reduce interference to measurement.
- Automatic range switching: Automatically switch to high-range to measure through dilution if the detection result exceeds the range.
- Key parameter upload: Based on the protocol requirements, key parameters are automatically uploaded to assist in judgment.
- Friendly human-computer interaction: 7-inch color touch screen, the application program is based on the Linux system.
- Support IPv4 network: Compatible with IPv6 network and meet the communication requirements of TCP/IP protocol.
- Support USB and TF card: program upgrade, data export, and data storage can be expanded.

1.3 Technical Parameters

Parameters	**Details**
Measuring range	(0～0.5 / 2 / 5 / 10 / 20) mg/L
Error	50% Range: ±5%
Repeatability	≤3%
Zero drift	±5%
Range drift	±5%
Minimum Maintenance Period	≥168 h/time
Digital communication	RS232、RS485、RJ45
Analog communication	(4~20)mA input; (4~20)mA output
Power requirements	(220±22)VAC；(50±1)Hz
Ambient temperature	(5~40)℃
Size	300mm×420mm×240mm (W×H×D)
Weight	＜15 Kg

1.4 Product Appearance

The appearance of the instrument (excluding the pretreatment system) is shown in Figure 1-2.

Fig 1-2 Appearance of the instrument

1.5 Applications

- Industrial enterprise waste water automatic monitoring
- Automatic monitoring of waste water in medical units
- Automatic monitoring of water in and out of the sewage treatment plant in the park
- Automatic monitoring of water in and out of urban sewage treatment plants
- Automatic monitoring of inflow and outflow of rural sewage treatment stations
- Automatic monitoring of sewage river and canal water quality
- Automatic monitoring of ship waste water
- Automatic monitoring of waste water in laboratories and automatic monitoring stations
- Watershed and river water quality automatic monitoring
- Automatic monitoring of urban water quality in small watersheds and inland rivers
- Automatic monitoring of water quality in surface drinking water sources
- Automatic monitoring of groundwater quality
- Automatic monitoring of water quality in coastal waters
- Automatic monitoring of drinking water

- Automatic monitoring of urban water supply quality
- Automatic monitoring of water quality in rural water supply

2 Installation

2.1 Unpacking the Instrument

The instrument has been tested and verified before leaving the factory. When receiving the goods, carefully check whether the instrument is damaged during transportation. When unpacking, check the original packing box, and do not throw away the spare parts of the equipment together with the packing materials.

If any damage is found during unpacking, please contact us in time.

2.2 Environmental Requirements

The working environment should be equipped with air-conditioning to keep the constant temperature at (5~40) ℃ and humidity (45~85)% RH.

The instrument should be placed flat and level without vibration. The ground of the instrument should be higher than the ground of the sampling port by more than 300 mm, and ensure that there is no protrusion or depression in the middle of the pipeline, and there is no strong electromagnetic field interference and corrosive gas near the instrument.

2.3 Space Requirements

The size of the instrument is width * height * depth = 300mm * 420mm * 240mm. It is required to leave a reasonable space on the left, right, front and back of the instrument according to the structure, flow path and electrical design of the integrated system during installation for easy maintenance.

2.4 Power Requirements

The power supply used by the instrument is: voltage: (220±22) VAC, current: 10 A; frequency: (50±1) Hz; power: <150 W. The instrument should be well grounded. For areas with unstable voltage, it is recommended to use an AC power regulator with matching power to protect the instrument.

Warning:

If the instrument is not grounded as required, the instrument may be damaged due to lightning strikes, static electricity, etc.

3 Instrument Operation

3.1 System Mode

During the operation of the instrument, it can be divided into two modes according to different operating conditions: working mode and failure mode.

1. Working mode

In the working mode, the instrument may be in two working states, normal and alarm.

- **Normal working state**

The instrument measures normally without any alarm information.

- **Alarm working state**

The system currently has alarms (such as reminders for insufficient reagents, alarms for samples exceeding the standard, alarms for exceeding the upper limit of measurement, etc.), but they have not had a major impact on the instrument. In this state, the instrument is still running normally, but there may be some errors in the measurement results. (For specific alarm information and solutions, please refer to "4 Instrument Maintenance" in this manual)

2. Malfunction mode

The system enters a fault mode when it detects some fault that could permanently damage the analyzer. In this mode, the system will stop most of the system functions and enter the protection state, and the display will display the corresponding alarm information. (For specific alarm information and solutions, please refer to "4 Instrument Maintenance" in this manual)

3.2 System Authority

The controller provides users with three levels of management authority, which are general authority, maintenance authority and administrator authority.

Level-1 authority (ordinary authority): Users can operate related functions on the data page under the system home page.

Level-2 authority (maintenance authority): The user clicks "login" on the system homepage, enters the password (initial password: 1111), and logs in to the second level authority to operate the related functions of the four pages of control, parameter, maintenance and data. Click "Maintainer" to exit the current authority and go to the level-1 authority.

Level-3 authority (administrator authority): The user clicks "login" on the system home page, enters the password (initial password: 9999), and logs in to the third-level authority, and can operate control, parameter, maintenance, data, and all five pages of the system related functions. Click "Administrator" to exit the current authority and go to the level-1 authority.

3.3 Home

The Home is the interface after the instrument is turned on and initialized and enters the normal working state. It is mainly used to display the measurement information of the instrument, as shown in Figure 3-1, 3-2, and 3-3. After booting, the screen enters the first-level normal authority, click Login, then enter the password, you will get the corresponding authority.

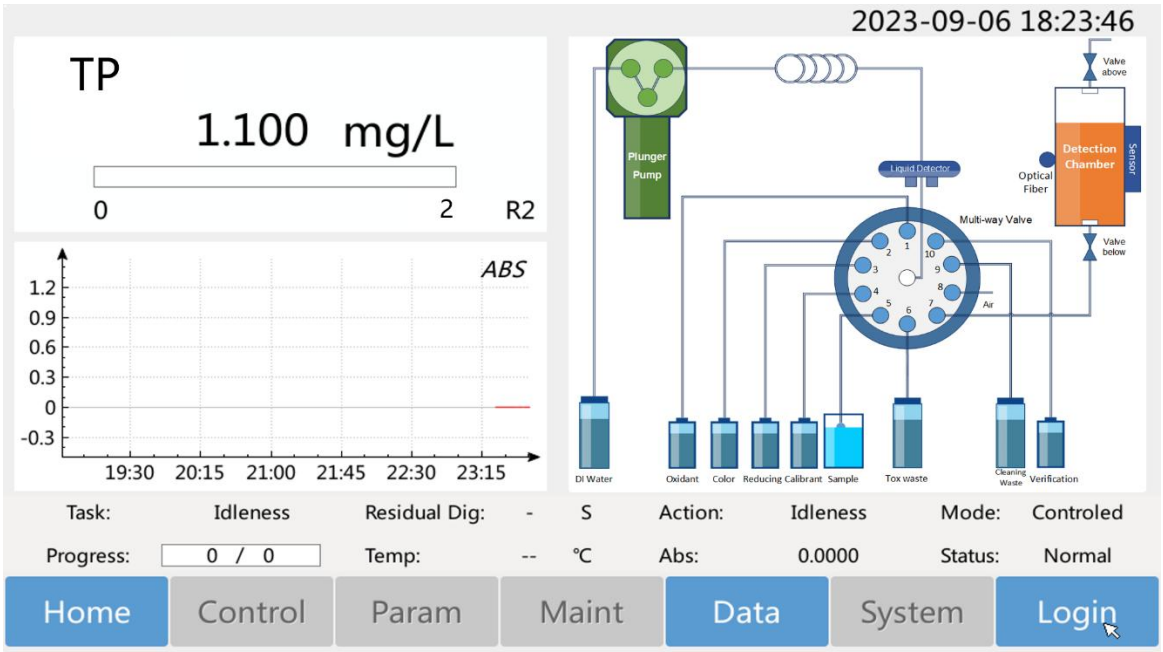


Fig 3-1 Home (level-1 authority)

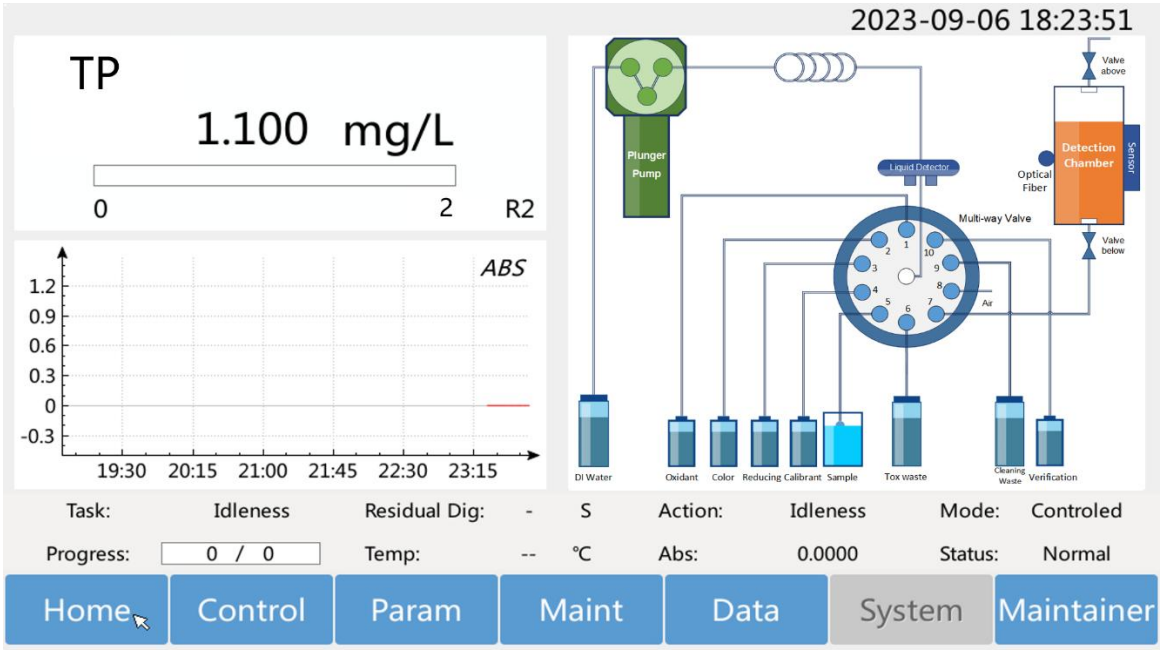


Fig 3-2 Home (Level-2 authority)

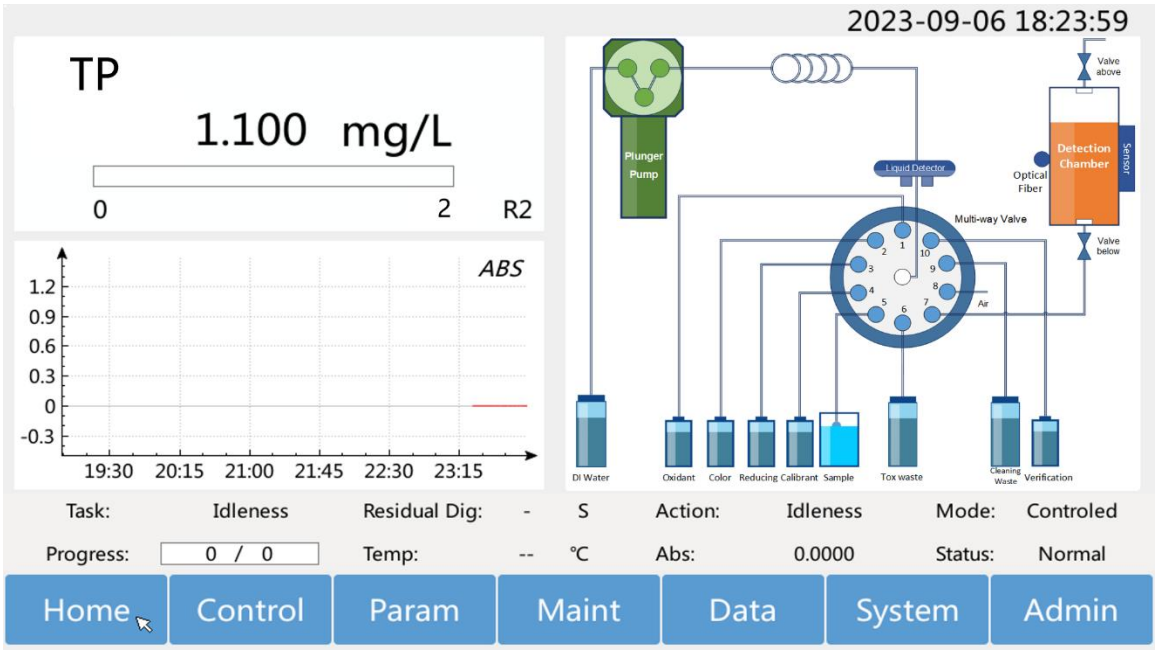


Fig 3-3 Home (level-3 authority)

3.4 Control

Control functions include: measurement, calibration, verification, and instrument online.

3.4.1 Online State

- It is enabled by default. To disable it, click , switch to .
- When turned on, the instrument is online, and the data can be uploaded to the upper information

software or platform normally.

- When turned off, the instrument is offline and does not actively upload data. When the upper information software or platform request data, the instrument does not respond.
- This setting does not need to save, it will be executed immediately.

3.4.2 Measure

In any interface, click the "Control" button in the menu bar at the bottom of the screen to enter the “Measure” interface. Measurement commands include: single mode, continuous mode, cycle mode and fixed time mode. Please insert the sample pipe into the sample to be tested according to the work flow diagram, and then start the measurement.

1. Single mode

- Click Execute to start a single measurement.

2. Continuous mode

- The start time and the times of measurement can be set; when the times of measurement is reached, it will stop automatically.
- After the setting is completed, click the save button, and the continuous measurement will be automatically executed immediately.

3. Cycle mode

- The start time, end time, and measurement interval can be set; the end time can be set to the future, such as 2222.
- After the setting is completed, click the save button, and the cycle measurement will be executed immediately.

4. Fixed-time mode

- The start time, end time, and fixed time point can be set; the end time can be set to the future, such as 2222.
- Click the "Setup" button after "Time Point" to set a daily fixed time point to measure. By default, it is executed on a daily basis.
- Click the save button, and the fixed-time measurement command will be executed immediately.

5. close

- Selecting close means that the local periodic tasks (continuous measurement, cycle measurement and fixed-time measurement) will not be executed, but single measurement and external trigger measurement can still be performed.
- If the measurement is triggered externally (by data logger, industrial computer, etc.), it must be set to close, otherwise it will cause confusion between the local tasks and the external trigger tasks.

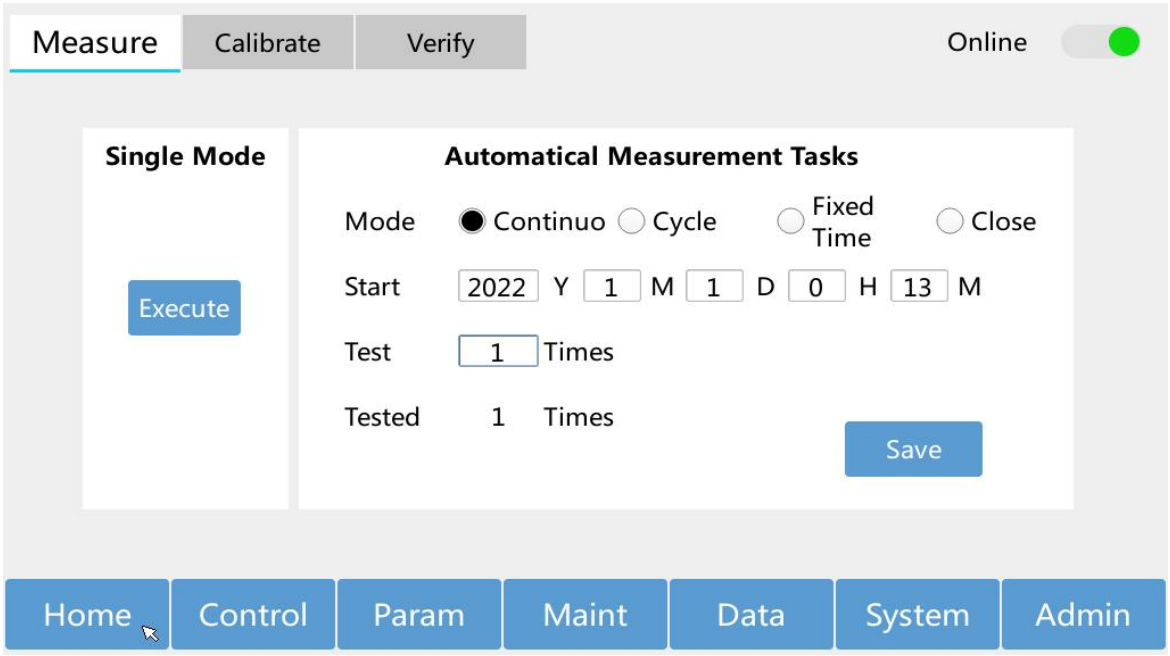


Fig 3-4 Continuous measurement interface

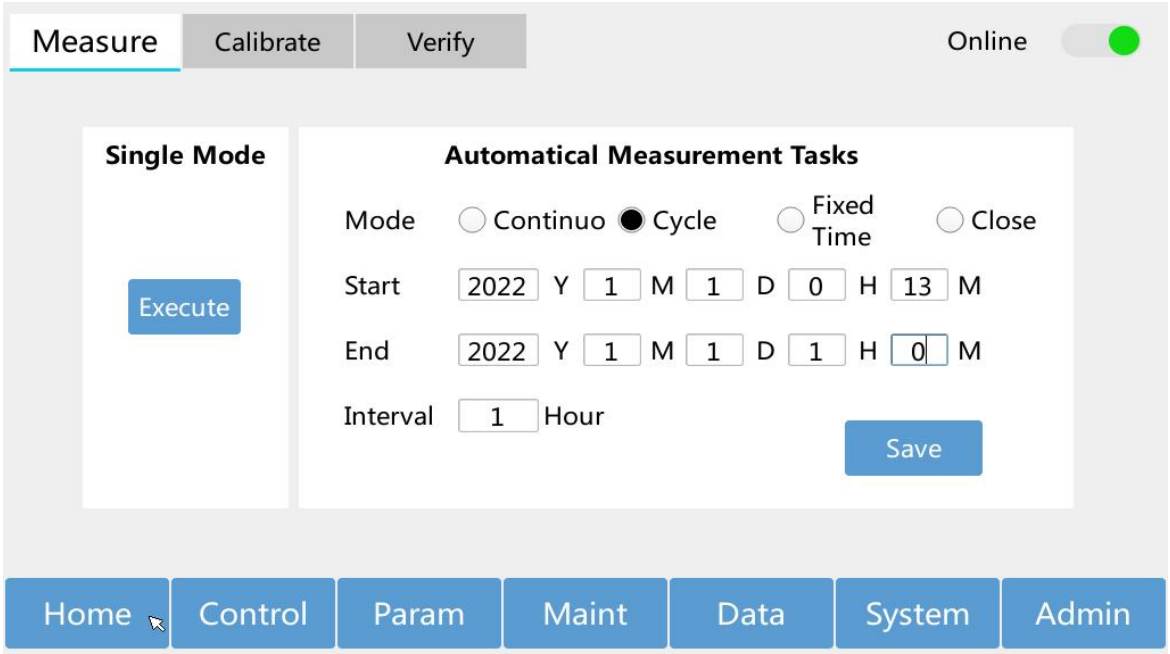


Fig 3-5 Cycle measurement interface

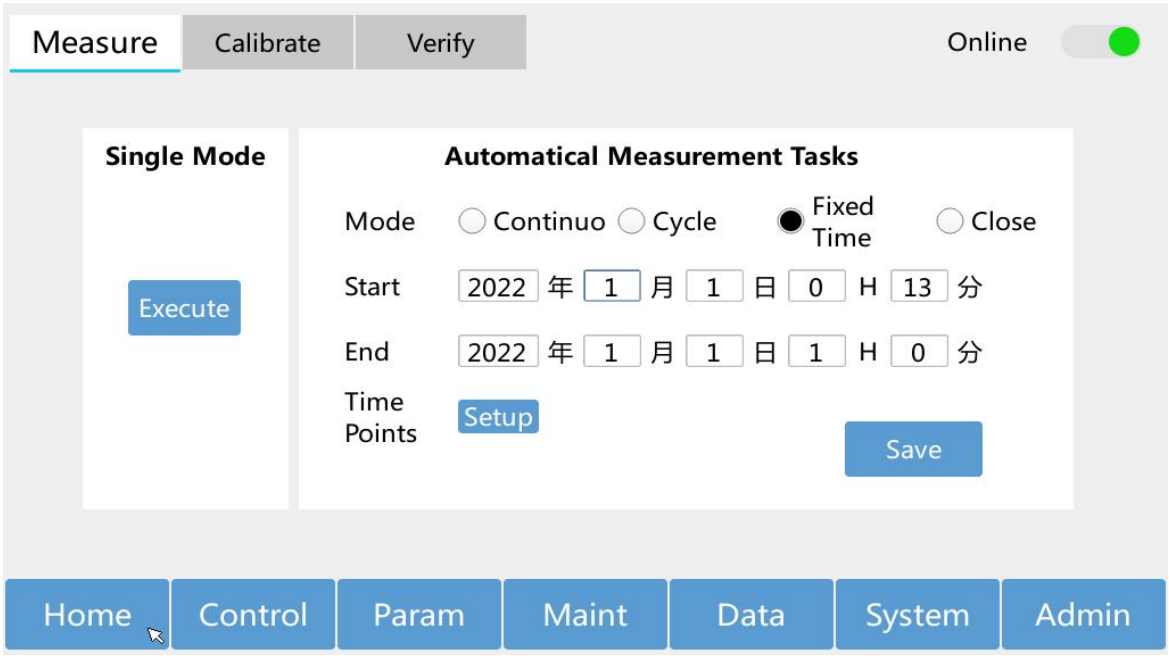


Fig 3-6 Fixed-time measurement interface

3.4.3 Calibrate

In any interface, click the "Control" button on the bottom menu bar of the screen to enter the measure interface, and then click the "Calibrate" button on the top menu bar to enter the “Calibrate” interface. Calibration commands include: single mode and cycle mode. Please insert the calibrant pipe into the calibration solution of current range concentration according to the work flow diagram, and then start the calibration.

Calibration adopts two-point calibration, point 1 (zero calibration) uses DI water (the pipe is connected to the plunger pump according to the work flow diagram), and point 2 (range calibration) uses the full-scale concentration calibration solution (connected to the No. 4 channel of the multi-way valve according to the work flow diagram). Whether the calibration is qualified or not will be judged automatically by the instrument, if not qualified, the last calibration curve will continue to be used. For the specific calibration qualified range, please refer to the historical calibration data and curve data of the factory test of the instrument.

1、Single mode

Click execute to start a single calibration.

2、Cycle mode

- It is off by default, to enable it, click， switch to。If the instrument calibration is triggered externally (by data logger, industrial computer, etc.), it must be set to close, otherwise it will cause confusion between the local tasks and the external trigger tasks.
- Start time, end time, and calibration interval can be set; the end time can be set to the future, such as 2222.

- After the setting is completed, click the save button, and the cycle calibration will be executed immediately.

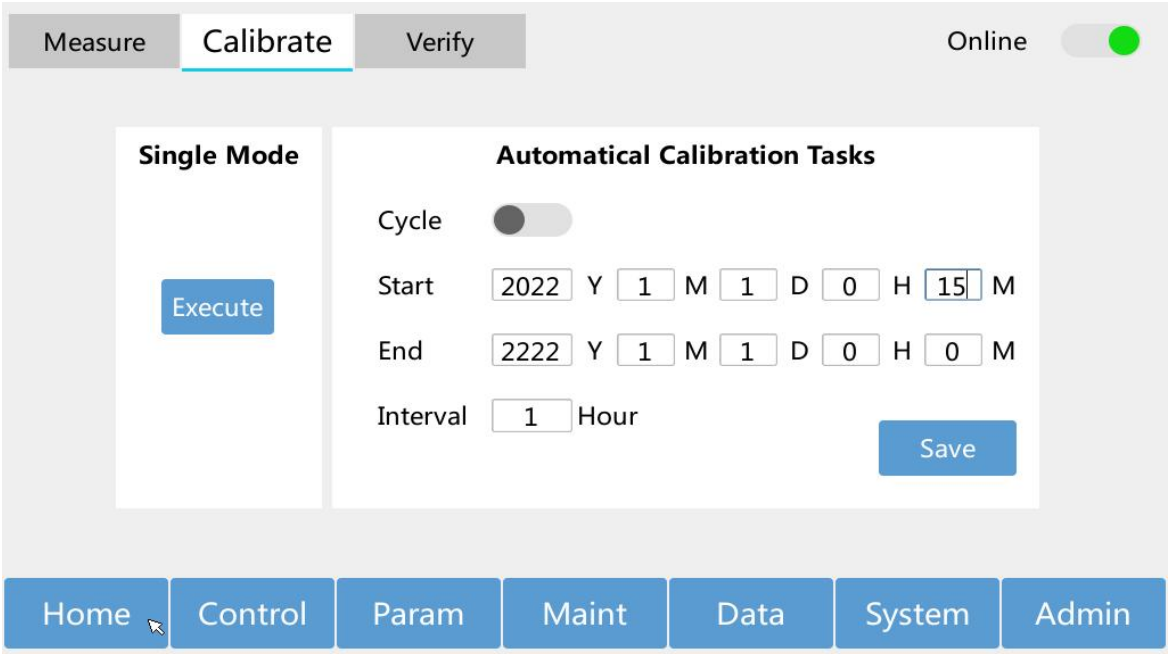


Fig 3-7 Calibration Interface

3.4.4 Verify

In any interface, click the "Control" button in the menu bar at the bottom of the screen to enter the measure interface, and then click the "Verify" button in the top menu bar to enter the “Verify” interface. The “Verify” is the test performed by the instrument base on the standard solution. Verification commands include: single mode and cycle mode. Please insert the verification pipe into the standard solution according to the work flow diagram, and then start the verification.

1、Standard solution concentration setting

- The concentration of the standard solution used for verification can be set, and the verification results and errors will be uploaded to the management platform according to the protocol.

2、Single mode

- Click Execute to start a single verification.

3、Cycle mode

- It is off by default, to enable it, click， switch to。If the instrument verification is triggered externally (by data logger, industrial computer, etc.), it must be set to close, otherwise it will cause confusion between the local tasks and the external trigger tasks.
- Start time, end time, and calibration interval can be set; the end time can be set to the future, such as 2222.
- Calibration linkage can be set to automatically calibrate after the verification error exceeds 10%.
- After the setting is completed, click the save button, and the cycle calibration will be executed

immediately.

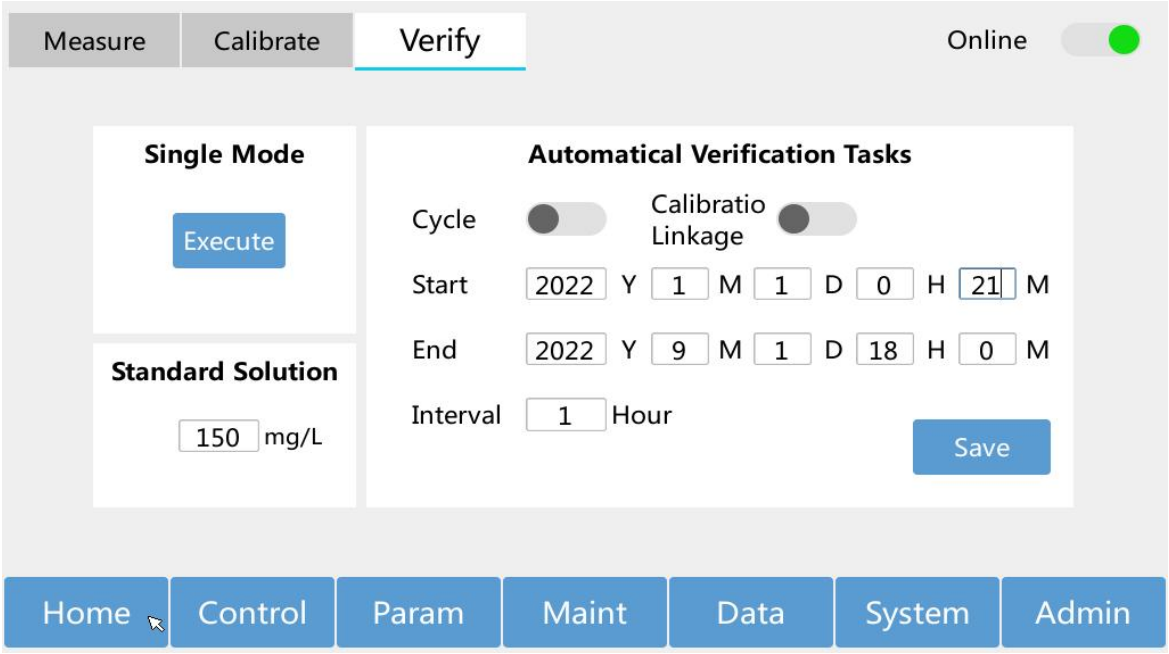


Fig 3-8 Verification interface

3.5 Parameters

The parameter of the instrument include: measurement parameters, digital parameters, analog parameters, and TCP/IP parameters.

3.5.1 Measurement Parameters

In any interface, click the "Param" button on the bottom menu bar of the screen, and then click the "Measure" button on the top menu bar to enter the measurement parameter interface. Measurement parameters include: pretreatment parameters, digestion parameters, alarm after exceeding, range setting parameters, range switching, Alarm for reagent, and reagent parameters.

1. pretreatment

Time: the waiting time for pretreatment system to supply sample, in seconds. When the timer ends, the instrument will start to measure.

2. Digestion

- Temperature: the digestion temperature of sample. To ensure the safety of the system, the temperature is not allowed to exceed 175℃.
- Time: the digestion time of sample, in seconds.

3. Alarm after exceeding

Alarm for exceeding the standard limit can be set according to the needs, and can be set as the discharge limit of the sewage discharge, or the water quality standards of river and lake, so as to monitor

whether the concentration of pollutant to be measured exceeds the standard.

4. Range setting

Range: pull down to select the required range.

5. Range switching

- It is off by default, to enable it, click， switch to。
- Upper threshold: It is the percentage higher than the current range. When the measured value is higher than the value corresponding to the upper threshold, the instrument will automatically switch to the upper range and re-measure. (For example, in the range of 0-200 mg/L, the upper threshold is set to 120%, then when the measured value is higher than 240 mg/L, the instrument will automatically switch to the high range and re-measure.)
- Lower threshold: It is the percentage lower than the current range. When the measured value is lower than the value corresponding to the upper threshold, the instrument will automatically switch to the lower range and re-measure. (For example, in the range of 0-500 mg/L, the lower threshold is set to 20%, then when the measured value is lower than 100 mg/L, the instrument will automatically switch to the low range and re-measure.)
- When the automatic range switching is enabled, the data will not be uploaded after the first measurement that exceeds the threshold, and the second measurement will be started by switching the range directly, and only the second measured value will be uploaded.

6、Alarm for reagent

- Limit: The default limit is 10%, and can be set. When the residue of reagent is less than 10% of the total amount, the instrument will get an alarm of " Low residual reagent ", but it can continue to run.
- When the residual reagent reaches 0%, or is close to 0% but not enough for a single measurement, the “Lack of reagent” alarm is displayed, the instrument enters a malfunction state, and the reagents needs to be replaced, and update reagent residue, clear the malfunction on the maintenance interface.
- You can also turn off the switch after “Reagent(mL)”, click ， switch to , and then the residual amount will not be counted. Even if the residual reagent reaches 0%, no alarm will be generated and the instrument will continue to measure.

7. Reagent parameters

Total: The total amount of every **reagent** can be set according to the reagent bottle size.

Residue: After replacing new reagents, the reagent residue needs to be updated manually, or click “Reagent refill”.

8. Reagent refill

After clicking, the reagent residue will automatically return to the total amount.

9. After all parameters are set, click the save button to save the settings.

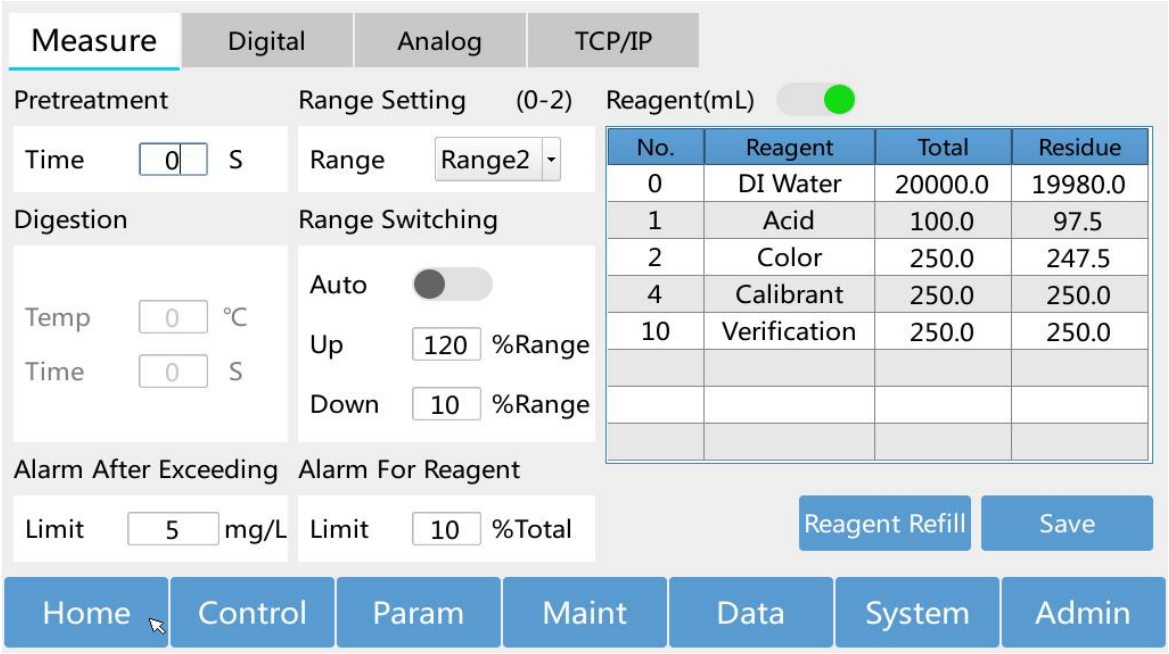


Fig 3-9 Measurement parameter interface

3.5.2 Digital Parameters

In any interface, click the "Param" button on the bottom menu bar of the screen, and then click the "Digital" button on the top menu bar to enter the digital parameter interface. Digital parameter includes: COM setting (RS232, RS485), switch setting.

1、COM settings

- Pull down to select RS232 port and baud rate.
- Pull down to select RS485 port, baud rate, and local address.
- Pull down to select native protocol.

2、Switch setting

- Output channel: pull down to select.
- Output method: pull down to select, including level output and pulse output.
- Output event: pull down to select, including pretreatment and alarm.
- Input channel: pull down to select.
- Input event: pull down to select, including start measurement and disable.

3、After all parameters are set, click the save button to save the settings.

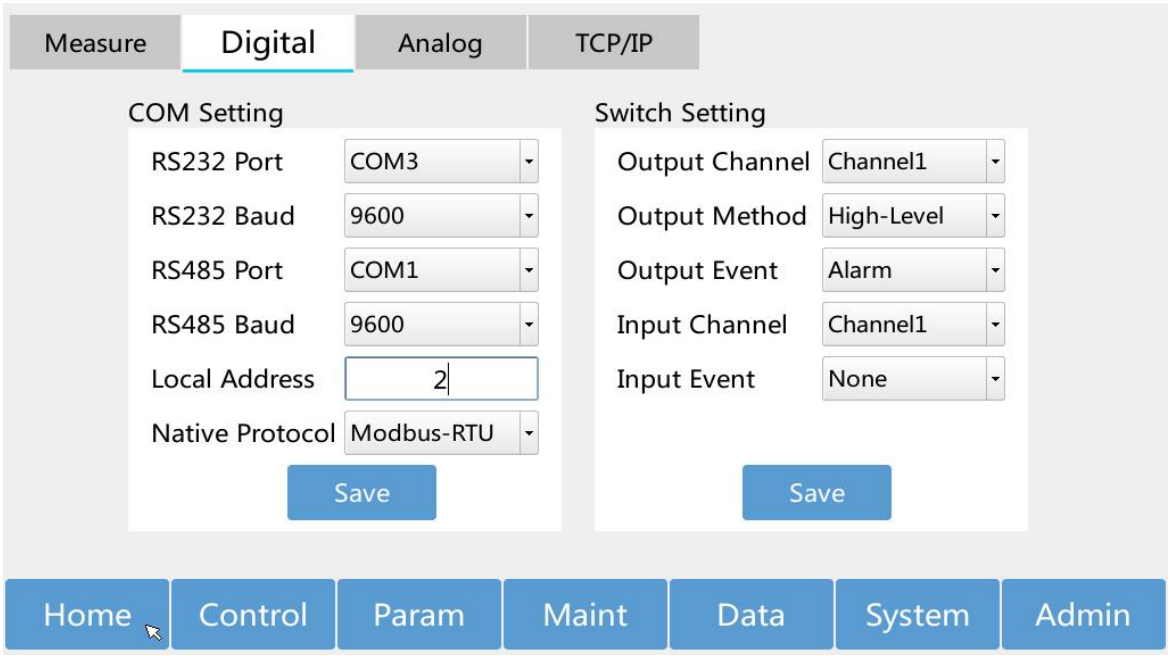


Fig 3-10 Digital parameter interface

3.5.3 Analog Parameters

In any interface, click the "Param" button in the bottom menu bar of the screen, and then click the "Analog" button in the top menu bar to enter the analog parameter interface. Analog parameters include: 4-20 mA input parameters, 4-20mA output parameters.

1、Input parameters

- It is off by default, to enable it, click， switch to。
- 4 mA and 20 mA values can be set, and correspond to the measuring range. The unit is mg/L.
- Display the input value. The unit is mA.

2、Output parameters

- It is off by default, to enable it, click， switch to。
- 4 mA and 20 mA values can be set, and correspond to the measuring range. The unit is mg/L.
- Display the output value. The unit is mA.

3、After all parameters are set, click the save button to save the settings.

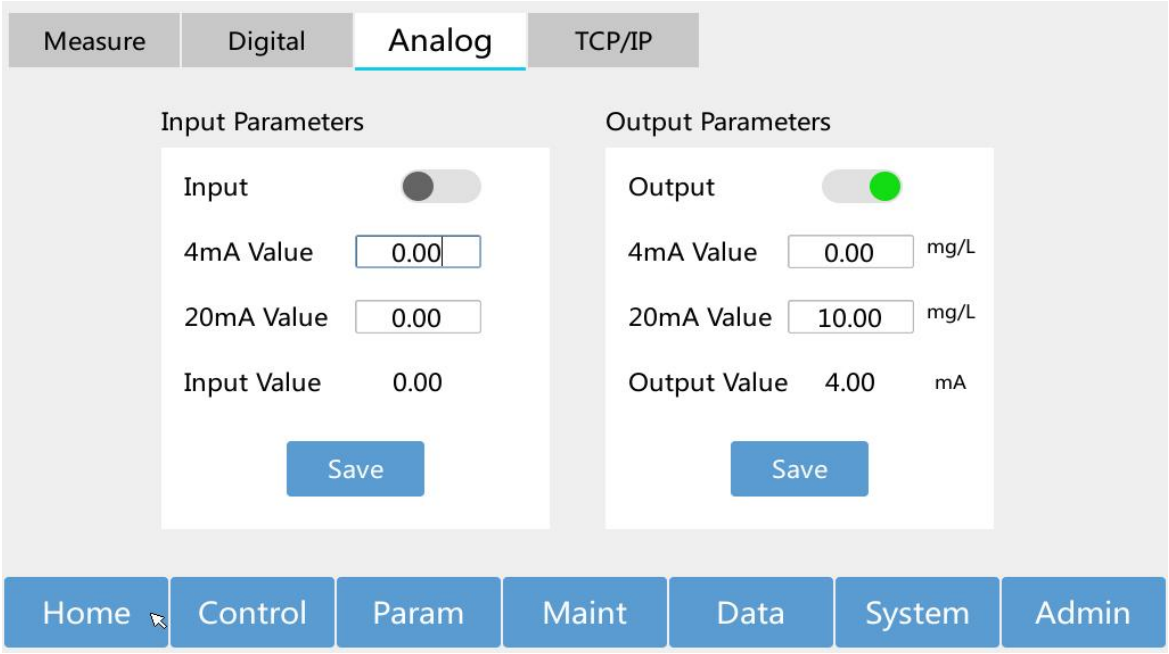


Fig 3-11 Analog parameter interface

3.5.4 TCP/IP Parameters

In any interface, click the "Param" button on the bottom menu bar of the screen, and then click the "TCP/IP" button on the top menu bar to enter the TCP/IP parameter interface.

1、TCP/IP

- Local IP, subnet mask, gateway, server IP and port can be set.
- Local protocol can be selected.

2、After all parameters are set, click the save button to save the settings.

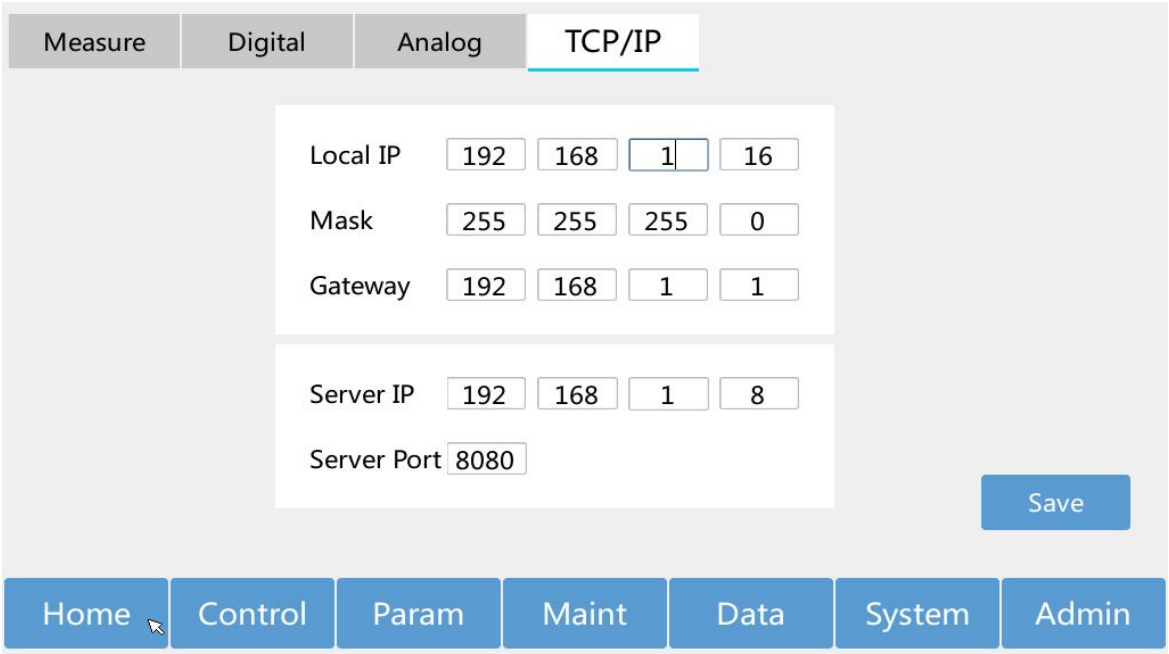


Fig 3-12 TCP/IP parameter interface

3.6 Maint

The maintenance functions of the instrument include: instrument maintenance and device control.

3.6.1 Instrument Maintenance

In any interface, click the "Maint" button in the menu bar at the bottom of the screen, and then click the "Maintain" button in the top menu bar to enter the instrument maintenance interface. Instrument maintenance includes: reset, stop, clean, evacuate pipe, import reagent, adjust signal, clear malfunction, and maintain automatically.

1. Reset

- Click "Reset" to execute the process, it will drain the liquid in the flow system and clean with water.
- This function has the second highest priority and can terminate other process commands.

2. Stop

- Click "Stop" to immediately stop the current action and make the instrument standby. If it stops during the measurement, it is recommended to perform reset later, otherwise it will affect the next measurement.
- This function has the highest priority and can terminate all the other process commands.

3. Clean

- Click "Clean" to execute the process to clean the entire flow system with water automatically.

4. Evacuate pipe

- Click " Evacuate pipe " to execute the process to empty the pipe connected to the plunger pump and multi-way valve.
- When performing this operation, please place the DI water pipe in DI water in advance, and place other reagent pipes in waste container to avoid contamination of the reagents in the reagent bottle.

5. Import reagent

- Click "Import reagent " to execute the process and pre-import each reagent.
- This operation needs to be performed after the instrument is replaced with new reagents.

6. Adjust signal

- Click " Adjust signal " to execute the process to adjust the signal amplification gain of the photoelectric sensor.
- This page displays the signal voltage level and adjustment time of the detection signal and reference signal. The present signal parameter and the last signal parameter can be switched.
- The signal current can be adjusted according to the light intensity, and the adjustment range is 4-20

mA.

7. Clear malfunction

- In the malfunction state of system, the instrument cannot operate normally. After the maintenance completes the instrument maintenance and restore the instrument to normal, if the system indicator light is still red, or the home interface displays a system alarm, they need to click "Clear malfunction" to eliminate malfunction state.
- The malfunction state can also be cleared by restarting the instrument.

8. Maintain automatically

- After clicking " Maintain automatically", the instrument will automatically perform " Import reagent" → "Clean" → "Adjust signal" → "Calibrate" in order to achieve one-click automatic maintenance.

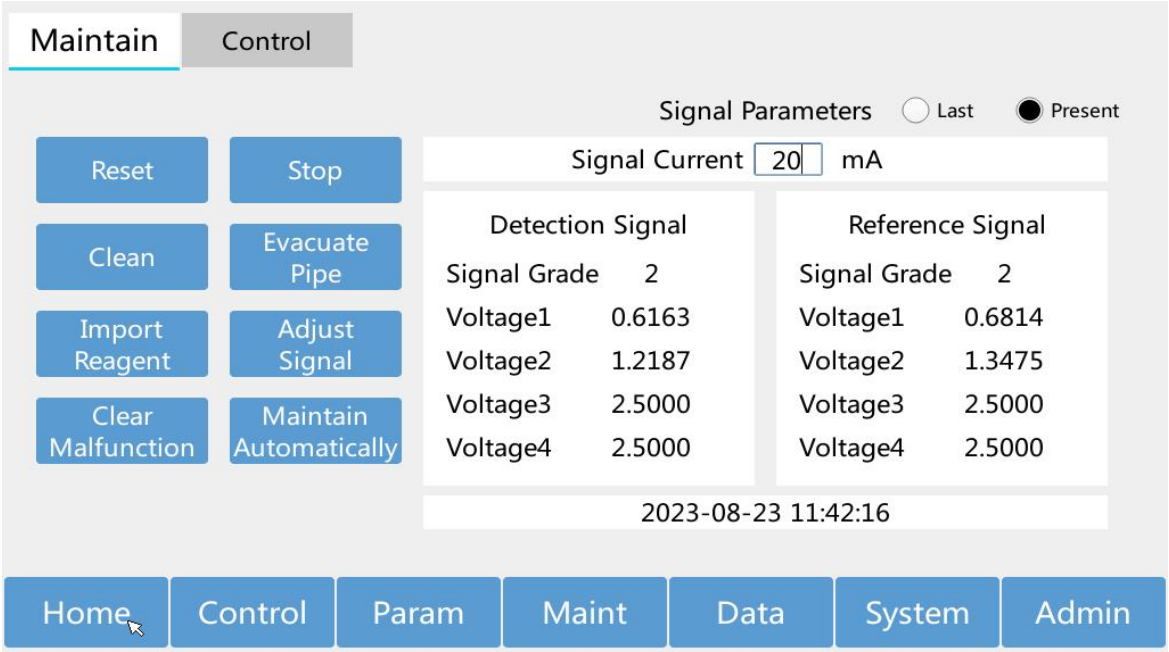


Fig 3-13 Instrument maintenance interface

3.6.2 Device Control

In any interface, click the "Maint" button on the bottom menu bar of the screen, and then click the "Control" button on the top menu bar to enter the device control interface. Device control includes: multi-way valve control, plunger pump control, liquid detection control, switch output control, and other parts control. When entering this page, all devices display the current status; when exiting this page, if there is a device control operation, it will prompt whether to perform reset. If you are not sure whether your operation will interfere with the next measurement, click OK to perform reset.

1. Multi-way valve control

The multi-way valve position 1-10 can be selected individually.

2. Plunger pump control

- Pump valve: It is a three-way valve connected to DI water and liquid storage ring.
- Pump action: liquid suction or drain can be selected.

3. Liquid detection

You can choose to turn on or off:

- Liquid: Detect whether reagents and samples have been pumped.
- Leakage: Detect any liquid leaks.

4. Switch output

You can choose to turn on or off the switching value output channel 1 and channel 2.

5. Other parts control

The valve above, valve below, waste valve, fan, peristaltic pump, heater and light can be controlled.

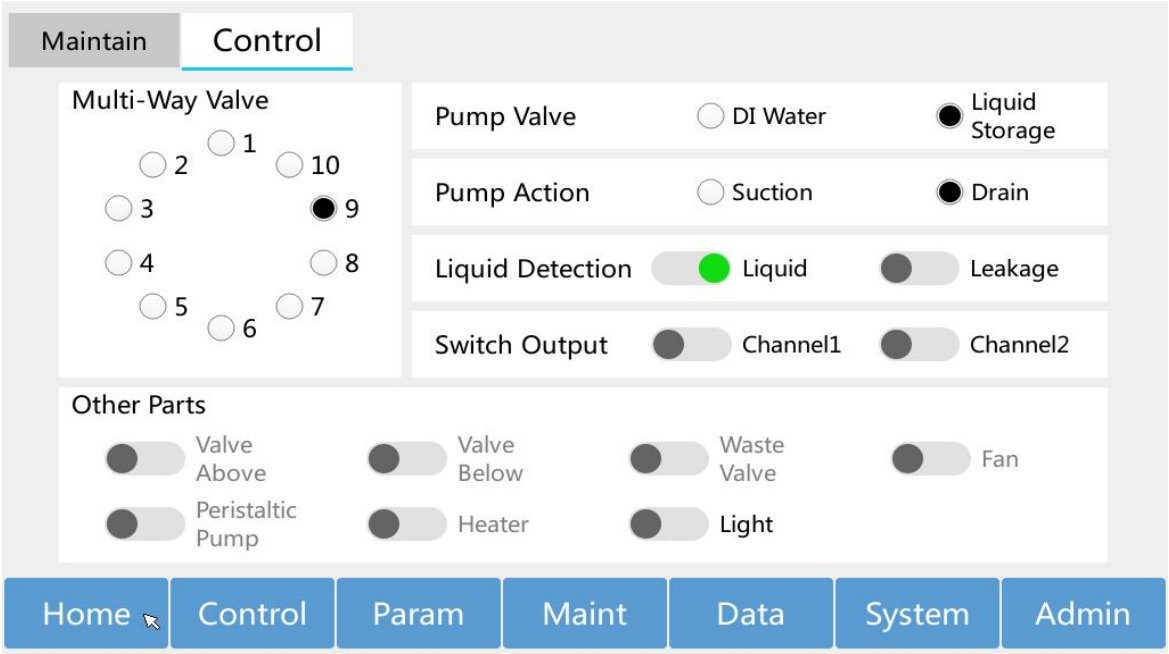


Fig 3-14 Device Control Interface

3.7 Data

The data includes: measurement data, calibration data, standard curve, alarm record, operation log.

3.7.1 Measurement Data

In any interface, click the "Data" button on the bottom menu bar of the screen, and then click the "Measurement" button on the top menu bar to enter the historical measurement data query interface. The measurement data and standard sample verification data are displayed on this page. When you need to view the standard sample verification data, click the drop-down box after the query time period, select verification, and then click Query to filter out all the standard sample verification data.

All the measurement data can be exported, first create the iWaterX-HistoryData folder in the root directory of the U disk (FAT32 format), insert the U disk at the back of the instrument control screen, and click "Data output" to export the data to the iWaterX-HistoryData folder in U disk.

Data identification description:

- N: Automatic measurement data
- M: Manual measurement data (maintenance data)
- D: Measurement data in malfunction state

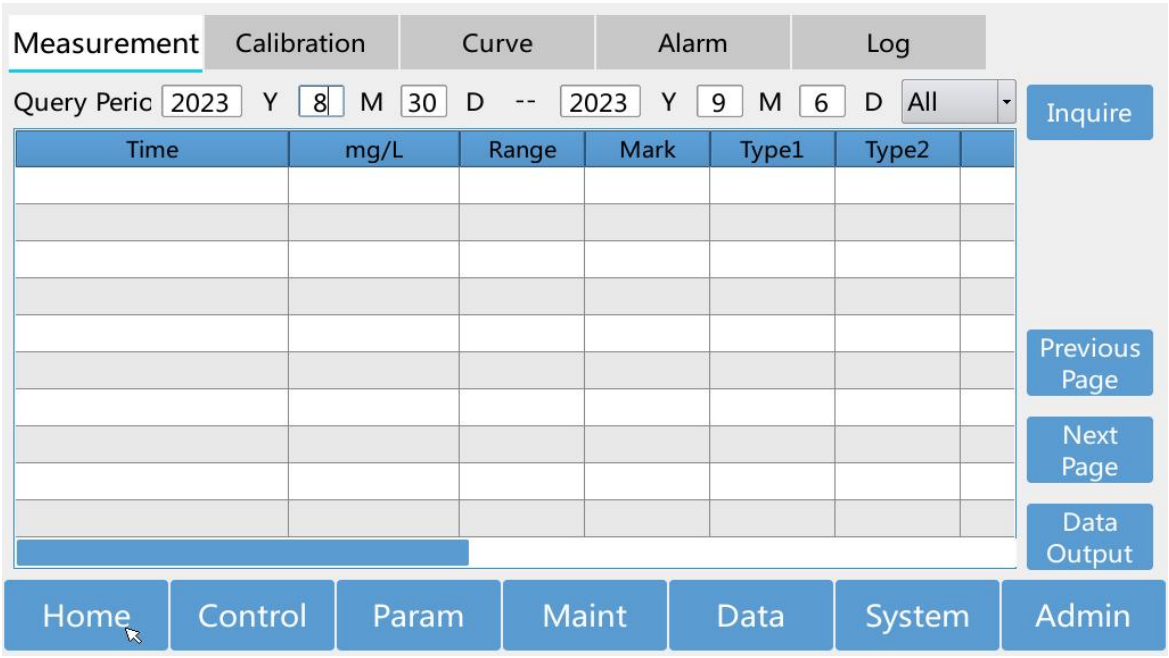


Fig 3-15 Measurement data interface

3.7.2 Calibration Data

In any interface, click the "Data" button on the bottom menu bar of the screen, and then click the "Calibration" button on the top menu bar to enter the calibration data query interface. Calibration data can be exported. You need to create the iWaterX-HistoryData folder in the root directory of the U disk (FAT32 format). After inserting the U disk at the back of the instrument control screen, click " Data output" to export the data to the iWaterX-HistoryData folder in U disk.

Data identification description:

- C: Calibration data
- D: Calibration data in malfunction state

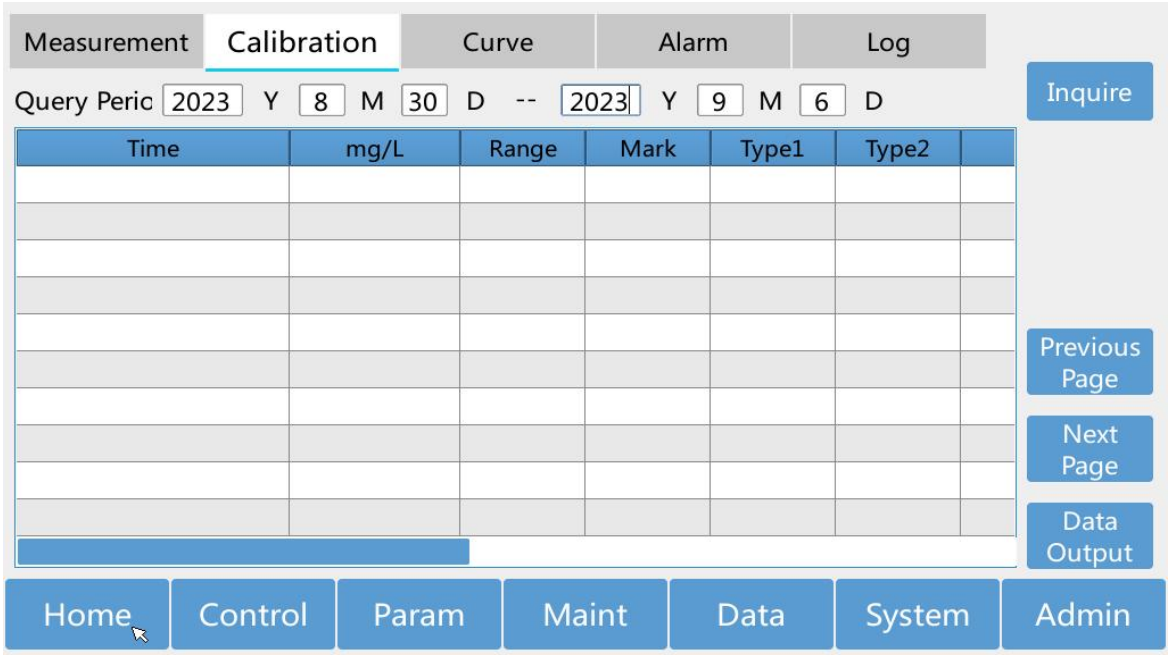


Fig 3-16 Calibration Data Interface

3.7.3 Standard Curve

In any interface, click the "Data" button on the bottom menu bar of the screen, and then click the "Curve" button on the top menu bar to enter the standard curve query interface.

In each standard curve, y is the measured value, and x is the absorbance A, $y = k_0 + k_1 x$. Select a standard curve and click "Details" to view the zero calibration and range calibration information corresponding to this standard curve. The standard curve data can be exported. It is necessary to create the iWaterX-HistoryData folder in the root directory of the U disk (FAT32 format). After inserting the U disk at the back of the instrument control screen, click "Data output" to export the data to the iWaterX-HistoryData folder in U disk.

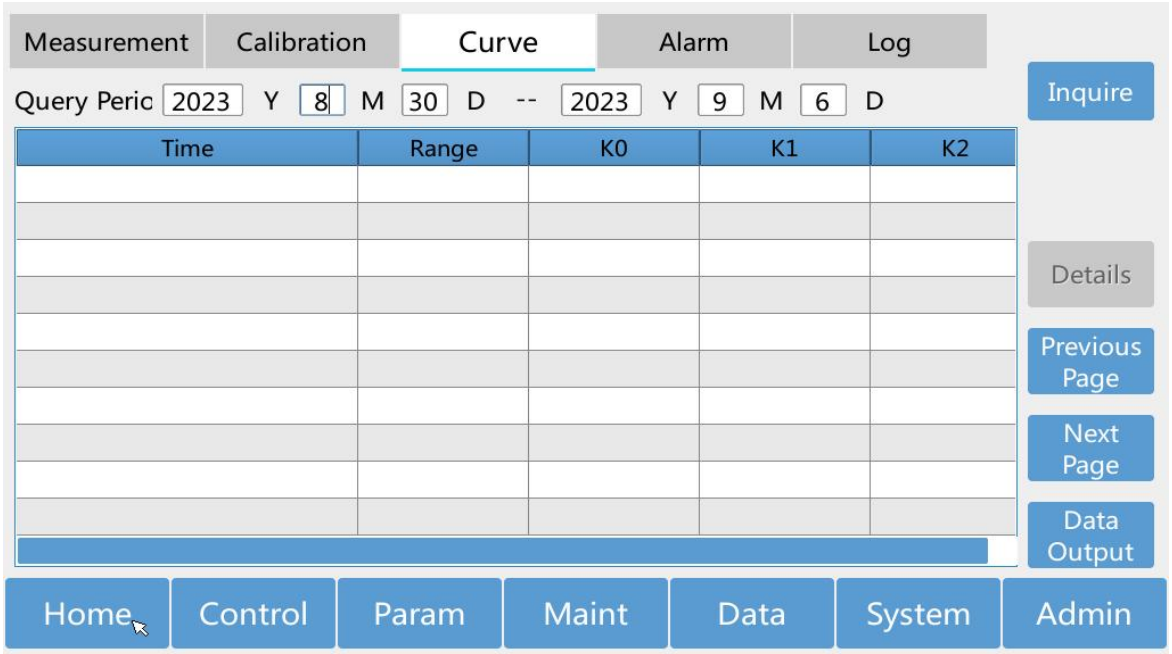


Fig 3-17 Standard Curve Interface

3.7.4 Alarm Record

In any interface, click the "Data" button on the bottom menu bar of the screen, and then click the "Alarm" button on the top menu bar to enter the alarm record query interface. The alarm log can be exported. You need to create the iWaterX-HistoryData folder in the root directory of the U disk (FAT32 format). After inserting the U disk at the back of the instrument control screen, click "Data output" to export the data to the iWaterX-HistoryData folder in U disk.

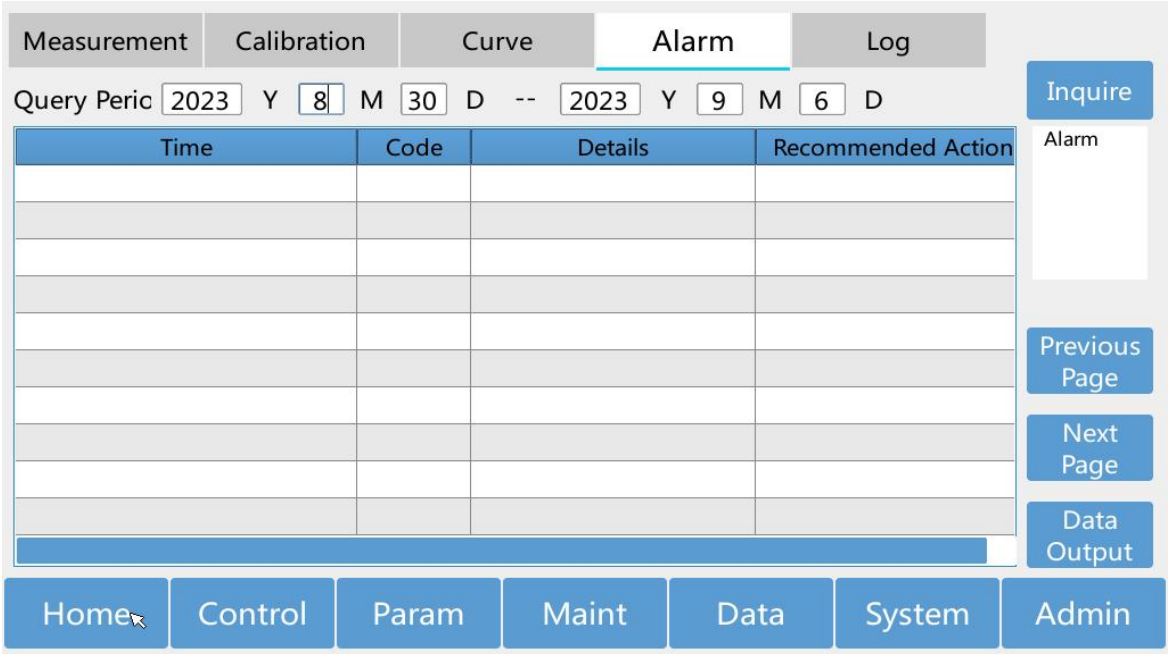


Fig 3-18 Alarm record interface

3.7.5 Operation Log

In any interface, click the "Data" button on the bottom menu bar of the screen, and then click the "Log" button on the top menu bar to enter the operation log query interface. The operation log can be exported. You need to create the iWaterX-HistoryData folder in the root directory of the U disk (FAT32 format). After inserting the U disk at the back of the instrument control screen, click "Data output" to export the data to the iWaterX-HistoryData folder in U disk.

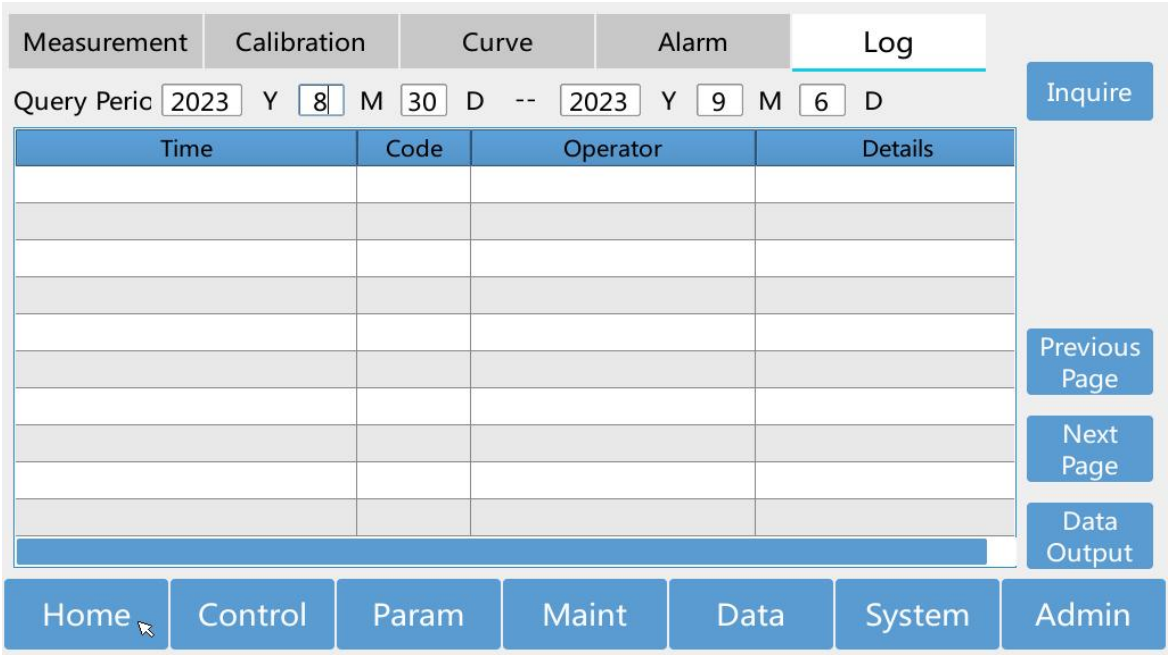


Fig 3-19 Operation log interface

3.8 System

The system setting include: system management, system upgrade, advanced parameters, and auxiliary calibration.

3.8.1 System Management

In any interface, click the "System" button on the bottom menu bar of the screen, and then click the "Management" button on the top menu bar to enter the system management interface.

1. Time setting

After setting the time, click "Save", it will prompt that the save is successful, and the current time will be refreshed synchronously.

2. Password management

- Pull down to select to modify the maintenance password or administrator password.
- Enter the old password to confirm your identity, then enter the new password, and repeat the new password. If the new passwords entered twice are inconsistent, it will prompt you to re-enter the new password.
- After clicking "Save", it will prompt that the save is successful.

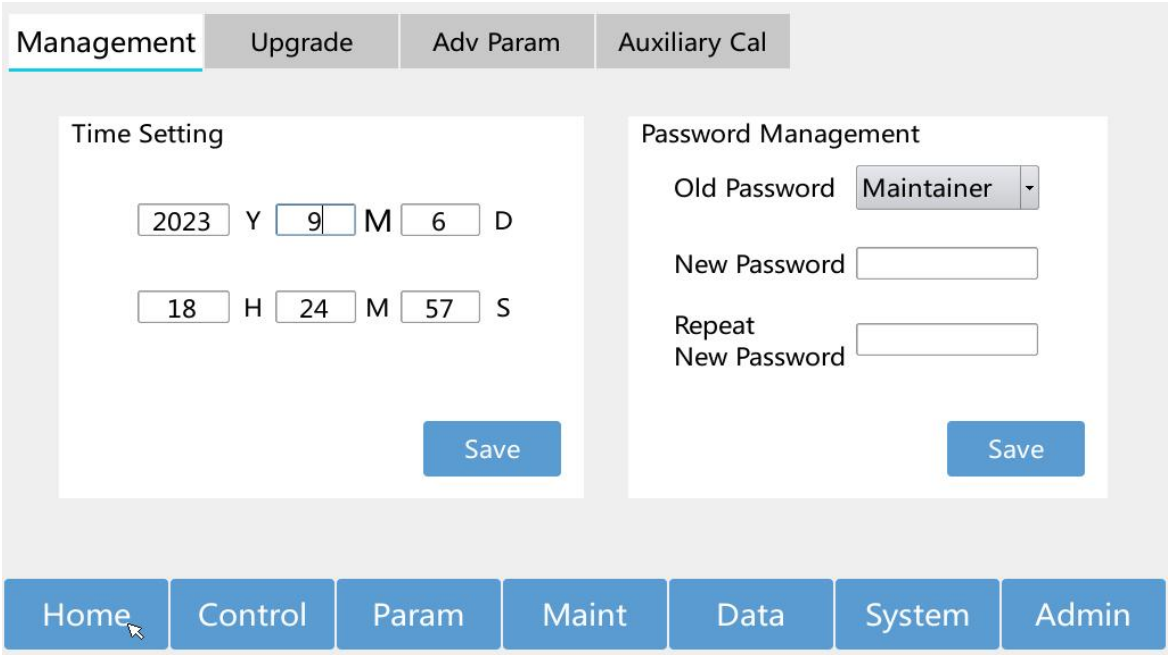


Fig 3-20 System management interface

3.8.2 System Upgrade

In any interface, click the "System" button on the bottom menu bar of the screen to enter the system management interface, and then click the "Upgrade" button on the top menu bar to enter the system upgrade interface. Upgrade commands include: motherboard software upgrade, interface software upgrade, flow program upgrade, and config parameter upgrade.

1. Motherboard software upgrade

- Create “iWaterX-Main” folder under the root directory of the U disk (FAT32 format), and put the motherboard software into this folder.
- Insert the U disk into the USB socket on the back of the instrument control screen.
- In the motherboard software upgrade box, click upgrade, select the upgrade file in the prompt box, click upgrade and wait for the upgrade to succeed.

2. Interface software upgrade

- Create an “iWaterX-HMI” folder under the root directory of the U disk (FAT32 format), and put the interface software into this folder.
- Insert the U disk into the USB socket on the back of the instrument control screen.
- In the software upgrade box on the screen, click upgrade, select the upgrade file in the prompt box, click upgrade and wait for the upgrade to succeed.

3. Flow program upgrade

- Create “iWaterX-Flow” folder under the root directory of the U disk (FAT32 format), then create a “TP” folder under the “iWaterX-Flow” folder, and put the flow program into this folder.
- Insert the U disk into the USB socket on the back of the instrument control screen.
- In the flow program upgrade box, click upgrade, select the upgrade file in the prompt box, click upgrade or one-click upgrade and wait for the upgrade to succeed.

4. Configuration parameter upgrade

- Create “iWaterX-Config” folder under the root directory of the U disk (FAT32 format), and put the config file into this folder.
- Insert the U disk into the USB socket on the back of the instrument control screen.
- In the config parameter upgrade box, click upgrade, and select the upgrade file in the prompt box, click upgrade and wait for the upgrade to succeed.

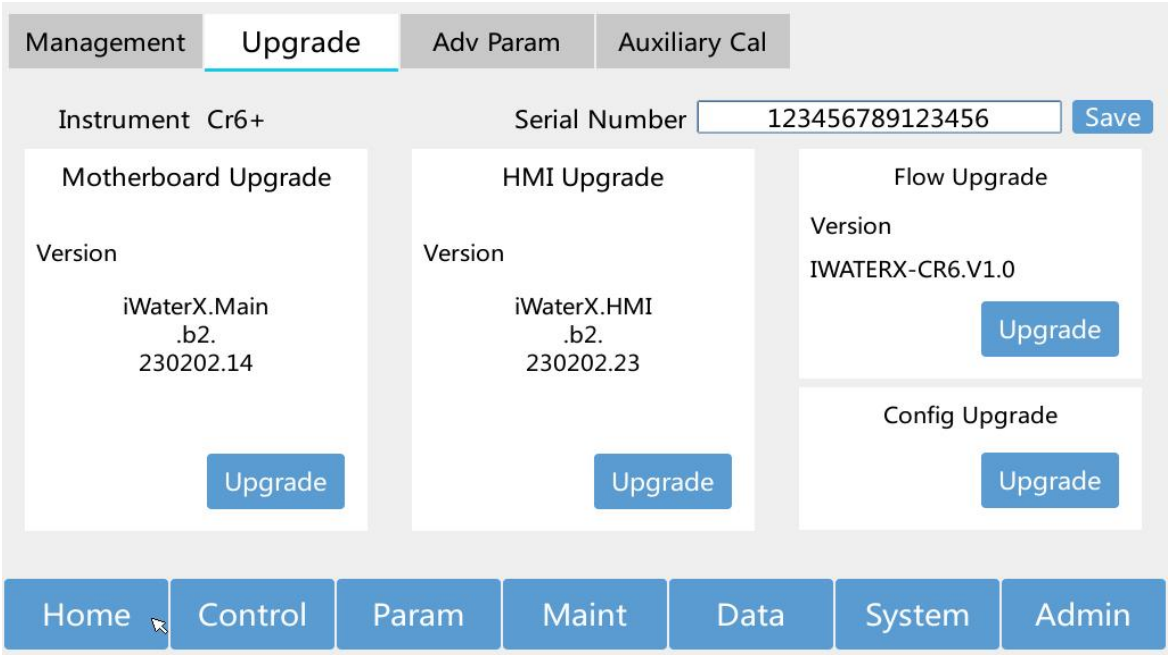


Fig 3-21 System upgrade interface

3.8.3 Advanced Parameters

In any interface, click the "System" button on the bottom menu bar of the screen, and then click the "Adv Param" button on the top menu bar to enter the advanced parameter interface. Advanced parameters include: turbidity subtraction, integral coefficient, standard curve correction factor and detection limit.

1. Turbidity deduction

- It is off by default, to enable it, click , switch to .
- The turbidity deduction coefficient can be set. After it is turned on, the turbidity interference of sample measurement can be deducted.

- After clicking "Save", it will prompt that the save is successful.

2. Integral coefficient

- It is only effective for xenon lamp detection (ultraviolet method for total nitrogen, nitrate nitrogen, etc.), and this function is turned off for LED light.

3. Standard curve correction factor

- Can correct the standard curve under different ranges.
- After the correction factor are set, the measured value = original measured value * slope correction factor + intercept correction factor. The default slope correction factor is 1, and the intercept correction factor is 0, then the measured value = the original measured value.
- After clicking "Save", it will prompt that the save is successful.

4. Detection limit

- It is off by default, to enable it, click , switch to 。
- After the detection limit is turned on, when the measured value is lower than the detection limit or is a negative value, the display is the detection limit, and the actual measured value will no longer be displayed.

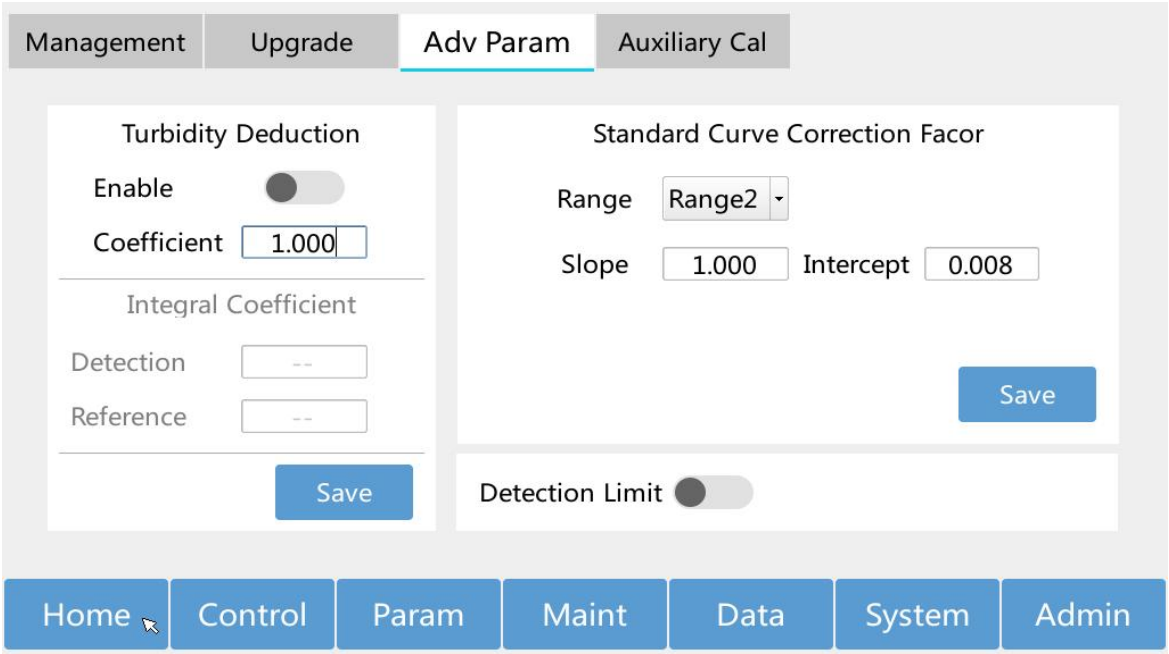


Fig 3-22 Advanced parameter interface

3.8.4 Auxiliary Calibration

In any interface, click the "System" button on the bottom menu bar of the screen, and then click the "Auxiliary Cal" button on the top menu bar to enter the auxiliary calibration interface.

Single-point calibration can choose zero calibration and range calibration (middle calibration only used for three-point calibration instrument). After the single-point calibration is completed, the

absorbance value of the corresponding calibration point of the last calibration is automatically replaced, and the calibration curve is re-fitted. Single-point calibration does not support cycle calibration, only can operate manually.

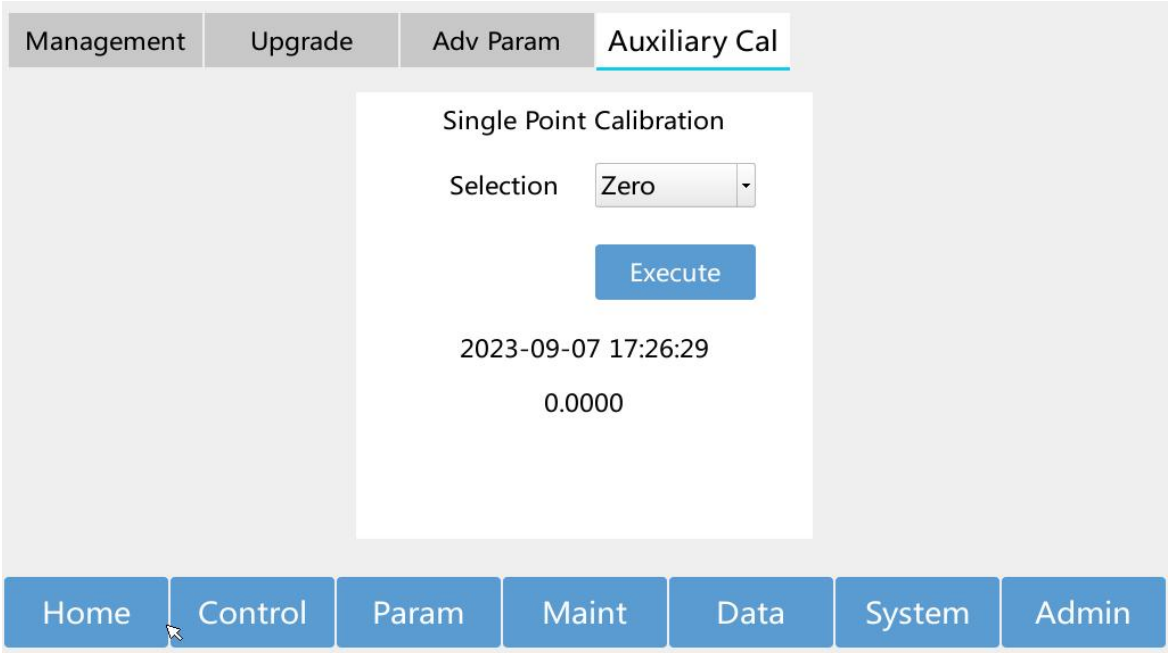


Fig 3-23 Auxiliary calibration interface

4 Instrument Maintenance

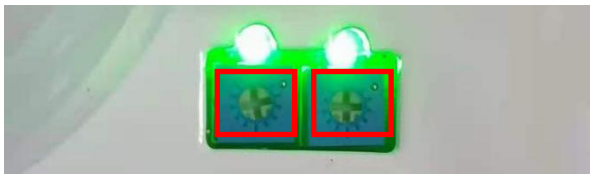
4.1 Operations for First Run

After the install the instrument, for the initial operation, please perform the following operations in sequence:

1. According to the work flow diagram of the instrument, insert each regent pipe into the corresponding reagent bottle, DI water container, waste container.

2. Turn on the instrument.

3. Directly execute " Maintain Automatically" in Maint page, or execute " Import reagent " → "Clean" → "Adjust signal" → "Calibrate".

Caution:
1. Check whether the liquid detector drifts due to transportation vibration and other reasons: the light is on when there is water in the pipe, and the light is off when there is no water. Adjustment method: When there is water, adjust the variable resistor with a small Phillips screwdriver to make the indicator light just brighten, and then turn it 90 degrees in the direction of the light. 
2. For reagent bottles, DI water container, waste container, please be sure to open an extra hole on the bottle cap to ensure that the air communicates with the outside world. Otherwise, negative pressure or positive pressure will be generated inside, which will affect the normal measurement.
3. The end of the waste pipes can be inserted into the bottle cap of the waste container. Do not insert too deep, otherwise it will affect the discharge of waste, and affect the normal measurement.

4.2 Reagent Preparation

The preparation method of each reagent is shown in the table below.

Reagent	Preparation method
Oxidant	**Chemicals:** Potassium persulfate (CAS: 7727-21-1); AR.

Reagent	Preparation method
	Preparation: Accurately weigh (20±0.1) g of potassium persulfate, place it in a beaker, then slowly add DI water, stir, until completely dissolved, transfer to a 500 mL volumetric flask, dilute to the mark with DI water, and shake well. The concentration of this solution is 40 g/L. **Storage:** Use plastic reagent bottles to store. The validity period is 6 months. Do not refrigerate at low temperatures, as potassium persulfate is easy to crystallize and precipitate; do not store at high temperatures, as potassium persulfate is easy to decompose. **Caution:** Potassium persulfate will decompose above 50°C, causing the oxidant to lose its oxidizing property. If it is to be heated and dissolved, the water bath temperature needs to be controlled below 40°C.
Color	**Chemicals:** Sulfuric acid (CAS: 7664-93-9), ammonium molybdate (CAS: 12054-85-2), potassium antimony tartrate (CAS: 28300-74-5); AR. **Preparation:** Accurately measure 75 mL of sulfuric acid, add it to 125 mL of DI water with constant stirring, and cool to room temperature. Accurately weigh (6.5±0.05) g of ammonium molybdate, add it to the cooled sulfuric acid solution, and stir until completely dissolved. Then accurately weigh (0.175±0.005) g of potassium antimony tartrate, add it to the above solution, and stir until completely dissolved. Transfer to a 250 mL volumetric flask, dilute to the mark with DI water, and shake well. **Storage:** Use glass or plastic reagent bottle to store. The validity period is 3 months. Low temperature storage can extend the shelf life. **Caution:** Pour sulfuric acid into the water slowly. If the order is wrong, the temperature of the solution will rise sharply, water and acid will splash out, and the experimenter may be burned.
Reducing	**Chemicals:** Ascorbic acid (CAS: 50-81-7); AR. **Preparation:** Accurately weigh (10±0.1) g of ascorbic acid and dissolve it into 100 mL of DI water. The concentration of this solution is 100 g/L. **Storage:** Use black/brown reagent bottles to protect from light. The validity period is 2 months. Low temperature storage can extend the shelf life.
Phosphorous 500 mg/L	**Chemicals:** Potassium dihydrogen phosphate (CAS: 7778-77-0), sulfuric acid (CAS: 7664-93-9); AR. **Preparation:** Accurately weigh (2.197 ± 0.001) g of potassium dihydrogen phosphate and dissolve it in DI water. Move it into a 1000 mL volumetric flask, add about 800 mL of DI water, add 2.5 mL of sulfuric acid, dilute with DI water to the mark, and shake well. Store at 4°C. The phosphorus concentration of this solution is 500 mg/L. **Storage:** Use glass or plastic reagent bottles to store at low temperature. The

Reagent	Preparation method
	validity period is 3 months.
Phosphorous 50 mg/L	**Preparation:** Use a pipette to accurately draw 25 mL of 500 mg/L phosphorus standard stock solution into a 250 mL volumetric flask, add about 200 mL of DI water, add 0.5 mL of sulfuric acid, dilute with DI water to the mark, and shake well. The phosphorus concentration of this solution is 50 mg/L. **Storage:** Use glass or plastic reagent bottles to store. The validity period is 2 months. Low temperature storage can extend the shelf life.
Phosphorous 0.5 mg/L	**Preparation:** Use a pipette to accurately draw 2.5 mL of 50 mg/L phosphorus standard solution into a 250 mL volumetric flask, add about 200 mL of DI water, add 0.5 mL of sulfuric acid, dilute with DI water to the mark, and shake well. The phosphorus concentration of this solution is 0.5 mg/L. **Storage:** Use glass or plastic reagent bottles to store. The validity period is 2 months. Low temperature storage can extend the shelf life.
Phosphorous 2 mg/L	**Preparation:** Use a pipette to accurately draw 10 mL of 50 mg/L phosphorus standard solution into a 250 mL volumetric flask, add about 200 mL of DI water, add 0.5 mL of sulfuric acid, dilute with DI water to the mark, and shake well. The phosphorus concentration of this solution is 2 mg/L. **Storage:** Use glass or plastic reagent bottles to store. The validity period is 2 months. Low temperature storage can extend the shelf life.
Phosphorous 5 mg/L	**Preparation:** Use a pipette to accurately draw 25 mL of 50 mg/L phosphorus standard solution into a 250 mL volumetric flask, add about 200 mL of DI water, add 0.5 mL of sulfuric acid, dilute with DI water to the mark, and shake well. The phosphorus concentration of this solution is 5 mg/L. **Storage:** Use glass or plastic reagent bottles to store. The validity period is 2 months. Low temperature storage can extend the shelf life.
Phosphorous 10 mg/L	**Preparation:** Use a pipette to accurately draw 5 mL of 500 mg/L phosphorus standard stock solution into a 250 mL volumetric flask, add about 200 mL of DI water, add 0.5 mL of sulfuric acid, dilute with DI water to the mark, and shake well. The phosphorus concentration of this solution is 10 mg/L. **Storage:** Use glass or plastic reagent bottles to store. The validity period is 2 months. Low temperature storage can extend the shelf life.
Phosphorous 20 mg/L	**Preparation:** Use a pipette to accurately draw 10 mL of 500 mg/L phosphorus standard stock solution into a 250 mL volumetric flask, add about 200 mL of DI water, add 0.5 mL of sulfuric acid, dilute with DI water to the mark, and shake well. The phosphorus concentration of this solution is 20 mg/L. **Storage:** Use glass or plastic reagent bottles to store. The validity period is 2 months. Low temperature storage can extend the shelf life.

4.3 Reagent Consumption

Reagent consumption (L/month) (calculated based on measurement once every 2 hours):：

Reagent	DI Water	Oxidant	Color	Reducing
consumption	7.5	0.41	0.21	0.11

Note: The reagent consumption is the same for all ranges. The larger the range, the greater the DI water consumption.

4.4 Waste Water Treatment

The toxic waste water produced by total phosphorus measurement is a strongly acidic liquid containing heavy metal ions such as molybdenum and antimony; the cleaning waste water is mainly the second and third colorless neutral cleaning water. Toxic waste water and cleaning waste water can be collected and stored in special high-density polyethylene plastic barrels, and then handed over to qualified hazardous waste disposal units for disposal.

4.5 Alarm Code Table

Users can look up the alarm codes in the table below to find out the specific reasons and solutions.

Code	Description	State	Solutions
1	Sample exceeds the standard	system alarm	None (the measured value exceeds the set emission standard or environmental standard)
2	Range switching	system alarm	None (automatic range switching)
3	Over range	system alarm	Switch to the appropriate range
4	Over the upper limit	system alarm	Switch to the appropriate range
5	Over the lower limit	system alarm	1. Re-execute Zero calibration. 2. Check whether there are interfering substances in the sample.
6	Low detection signal	system alarm	Replace the light and adjust signal.
7	High detection signal	system alarm	1. Lower the signal current and adjust signal. 2. Replace the light and adjust signal.
8	Low reference signal	system alarm	Replace the light and adjust signal.

Code	Description	State	Solutions
9	High reference signal	system alarm	1. Lower the signal current and adjust signal. 2. Replace the light and adjust signal.
10	High detection signal during measurement	system alarm	Adjust signal.
11	Low detection signal during measurement	system alarm	Adjust signal.
12	Low residual reagent	system alarm	1. Check the residual reagent. 2. Replace new reagent and update reagent residue.
13	Abnormal Absorbance at zero calibration	system alarm	1. Check whether there is reagent in the pipe and whether the reagent is invalid. 2. Check whether the signal is normal. 3. Check for reagent and water leaks.
14	Abnormal Absorbance at range calibration	system alarm	1. Check whether there is reagent in the pipe and whether the reagent is invalid. 2. Check whether the signal is normal. 3. Check for reagent and water leaks.
15	Abnormal absorbance at middle calibration	system alarm	1. Check whether there is reagent in the pipe and whether the reagent is invalid. 2. Check whether the signal is normal. 3. Check for reagent and water leaks.
16	Abnormal difference in absorbance between zero and range calibration	system alarm	1. Check whether there is reagent in the pipe and whether the reagent is invalid. 2. Check whether the signal is normal. 3. Check for reagent and water leaks.
17	Abnormal liquid detection in DI water pipe	system alarm	1. Check the liquid detector and adjust the variable resistor. 2. Replace the liquid detector.
18	Abnormal liquid detection in No. 1 pipe	system alarm	1. Check the liquid detector and adjust the variable resistor. 2. Replace the liquid detector.
19	Abnormal liquid detection in No. 2 pipe	system alarm	1. Check the liquid detector and adjust the variable resistor. 2. Replace the liquid detector.
20	Abnormal liquid detection in No. 3 pipe	system alarm	1. Check the liquid detector and adjust the variable resistor. 2. Replace the liquid detector.
21	Abnormal liquid detection in No. 4 pipe	system alarm	1. Check the liquid detector and adjust the variable resistor. 2. Replace the liquid detector.
22	Abnormal liquid detection in No. 5 pipe	system alarm	1. Check the liquid detector and adjust the variable resistor. 2. Replace the liquid detector.

Code	Description	State	Solutions
23	Abnormal liquid detection in No. 6 pipe	system alarm	1. Check the liquid detector and adjust the variable resistor. 2. Replace the liquid detector.
24	Abnormal liquid detection in No. 7 pipe	system alarm	1. Check the liquid detector and adjust the variable resistor. 2. Replace the liquid detector.
25	Abnormal liquid detection in No. 8 pipe	system alarm	1. Check the liquid detector and adjust the variable resistor. 2. Replace the liquid detector.
26	Abnormal liquid detection in No. 9 pipe	system alarm	1. Check the liquid detector and adjust the variable resistor. 2. Replace the liquid detector.
27	Abnormal liquid detection in No. 10 pipe	system alarm	1. Check the liquid detector and adjust the variable resistor. 2. Replace the liquid detector.
28	Leakage	system alarm	1. Check for leakage. 2. Check for false report.
29	Abnormal measurement	system alarm	Check sample or calibration data.
30	Timeout waiting for input signal 1	system alarm	Check sample supply.
31	Timeout waiting for input signal 2	system alarm	Check sample supply.
129	Malfunction	system malfunction	Analyse comprehensively.
130	Abnormal motherboard ADC	system malfunction	Replace the motherboard.
131	Abnormal motherboard DAC	system malfunction	Replace the motherboard.
132	Abnormal motherboard EEPROM	system malfunction	Replace the motherboard.
133	Abnormal mainboard FLASH	system malfunction	Replace the motherboard.
134	Abnormal motherboard WDT	system malfunction	Replace the motherboard.
135	Abnormal mainboard PWM output	system malfunction	Replace the motherboard.
136	Abnormal motherboard RTC	system malfunction	Replace the motherboard.

Code	Description	State	Solutions
137	Abnormal temperature of PT100	system malfunction	1. Check the PT100 wiring and the temperature of the reaction unit in standby mode. 2. Replace the glass container.
138	Abnormal communication of plunger pump	system malfunction	1. Check the plunger pump signal line and restart the instrument. 2. Replace the plunger pump.
139	Plunger pump down failure	system malfunction	1. Check the plunger pump signal line, power cord, and restart the instrument. 2. Replace the plunger pump.
140	Plunger pump down overflow	system malfunction	1. Check the plunger pump signal line, power cord, and restart the instrument. 2. Remove the plunger pump, use a flat-head screwdriver to tighten the screw at the bottom of the plunger pump, screw the piston up manually, and reset with power on. 3. Replace the plunger pump.
141	Wrong steps of plunger pump down	system malfunction	1. Check the plunger pump signal line, power cord, and restart the instrument. 2. Replace the plunger pump.
142	Plunger pump up failure	system malfunction	1. Check the plunger pump signal line, power cord, and restart the instrument. 2. Replace the plunger pump.
143	Piston pump up overflow	system malfunction	1. Check the plunger pump signal line, power cord, and restart the instrument. 2. Remove the plunger pump, use a flat-head screwdriver to tighten the screw at the bottom of the plunger pump, screw the piston up manually, and reset with power on. 3. Replace the plunger pump.
144	Wrong steps of plunger pump up	system malfunction	1. Check the plunger pump signal line, power cord, and restart the instrument. 2. Replace the plunger pump.
145	Plunger pump empty failure	system malfunction	1. Check the plunger pump signal line, power cord, and restart the instrument. 2. Replace the plunger pump.
146	Plunger pump busy and timeout	system malfunction	1. Check the plunger pump signal line, power cord, and restart the instrument. 2. Replace the plunger pump.
147	Plunger pump stalled	system malfunction	1. Check the plunger pump signal line, power cord, and restart the instrument. 2. Replace the plunger pump.
148	Abnormal communication of	system malfunction	1. Check the multi-way valve signal line and power cord, and restart the instrument.

Code	Description	State	Solutions
	multi-way valve		2. Replace the multi-way valve.
149	Multi-way valve fails to rotate	system malfunction	1. Check the multi-way valve signal line and power cord, and restart the instrument. 2. Replace the multi-way valve.
150	Multi-way valve fails to reset	system malfunction	1. Check the multi-way valve signal line and power cord, and restart the instrument. 2. Replace the multi-way valve.
151	Abnormal optocoupler of multi-way valve	system malfunction	1. Check the multi-way valve signal line and power cord, and restart the instrument. 2. Replace the multi-way valve.
152	Abnormal temperature of reaction unit	system malfunction	1. Check the PT100 wiring and the temperature of the reaction unit in standby mode. 2. Check the heater connection. 3. Replace the glass container.
153	Reactor heating timeout	system malfunction	1. Check whether the ambient temperature is too low. 2. Check the PT100 wiring and the temperature of the reaction unit in standby mode. 3. Check the heater connection. 4. Replace the glass container.
154	Reactor cooling timeout	system malfunction	1. Check whether the ambient temperature is too high. 2. Check the PT100 wiring and the temperature of the reaction unit in standby mode. 3. Replace the glass container.
155	Invalid flow	system alarm	Upgrade flow program.
156	Illegal flow step	system alarm	Upgrade flow program.
157	Flow fails to execute	system alarm	Upgrade flow program.
158	DI water not detected	system malfunction	1. Check the DI water in the central public pipeline of the multi-way valve. 2. Add DI water, import reagent, and manually modify reagent residue or execute reagent refill. 3. Check the liquid detector and adjust the variable resistor. 4. Replace the liquid detector.

Code	Description	State	Solutions
159	Reagent No. 1 not detected	system malfunction	1. Check the reagent in the No. 1 pipe of the multi-way valve. 2. Add reagents, import reagent, and manually modify reagent residue or execute reagent refill. 3. Check the liquid detector and adjust the variable resistor. 4. Replace the liquid detector.
160	Reagent No. 2 not detected	system malfunction	1. Check the reagent in the No. 2 pipe of the multi-way valve. 2. Add reagents, import reagent, and manually modify reagent residue or execute reagent refill. 3. Check the liquid detector and adjust the variable resistor. 4. Replace the liquid detector.
161	Reagent No. 3 not detected	system malfunction	1. Check the reagent in the No. 3 pipe of the multi-way valve. 2. Add reagents, import reagent, and manually modify reagent residue or execute reagent refill. 3. Check the liquid detector and adjust the variable resistor. 4. Replace the liquid detector.
162	Reagent No. 4 not detected	system malfunction	1. Check the reagent in the No. 4 pipeline of the multi-way valve. 2. Add reagents, import reagent, and manually modify reagent residue or execute reagent refill. 3. Check the liquid detector and adjust the variable resistor. 4. Replace the liquid detector.
163	Reagent No. 5 not detected	system malfunction	1. Check whether sample collection is normal. 2. Check the liquid detector and adjust the variable resistor. 3. Replace the liquid detector.
164	Reagent No. 6 was not detected	system malfunction	1. Check the reagent in the No. 6 pipe of the multi-way valve. 2. Add reagents, import reagent, and manually modify reagent residue or execute reagent refill. 3. Check the liquid detector and adjust the variable resistor. 4. Replace the liquid detector.
165	Reagent No. 7 was not detected	system malfunction	1. Check the reagent in the No. 7 pipe of the multi-way valve. 2. Add reagents, import reagent, and manually modify reagent residue or execute reagent refill. 3. Check the liquid detector and adjust the variable

Code	Description	State	Solutions
			resistor. 4. Replace the liquid detector.
166	Reagent No. 8 was not detected	system malfunction	1. Check the reagent in the No. 8 pipe of the multi-way valve. 2. Add reagents, import reagent, and manually modify reagent residue or execute reagent refill. 3. Check the liquid detector and adjust the variable resistor. 4. Replace the liquid detector.
167	Reagent No. 9 was not detected	system malfunction	1. Check the reagent in the No. 9 pipe of the multi-way valve. 2. Add reagents, import reagent, and manually modify reagent residue or execute reagent refill. 3. Check the liquid detector and adjust the variable resistor. 4. Replace the liquid detector.
168	Reagent No. 10 not detected	system malfunction	1. Check the reagent in the No. 10 pipe of the multi-way valve. 2. Add reagents, import reagent, and manually modify reagent residue or execute reagent refill. 3. Check the liquid detector and adjust the variable resistor. 4. Replace the liquid detector.
169	Reagent exhausted	system malfunction	Replace reagents, import reagent, and manually modifying reagent residue.
170	Flow start failed	system malfunction	Upgrade flow program.
171	Abnormal titration	system malfunction	1. Check whether there is reagent in the pipe and whether the reagent is invalid. 2. Check whether the signal is normal. 3. Check for liquid and water leaks.
172	Abnormal motherboard communication	system malfunction	1. Check the communication cable between the motherboard and the screen. 2. Replace the motherboard.
173	Plunger pump action timeout	system malfunction	Check plunger pump.
174	Plunger pump position error	system malfunction	Check plunger pump.
175	Plunger pump failed to read position	system malfunction	Check plunger pump.

Code	Description	State	Solutions
176	Plunger pump failed to write position	system malfunction	Check plunger pump.
177	Plunger pump failed to write direction	system malfunction	Check plunger pump.
178	Plunger pump failed to write step	system malfunction	Check plunger pump.
179	Plunger pump failed to clear emergency stop flag	system malfunction	Check plunger pump.
180	Plunger pump does not match	system malfunction	Check plunger pump.
181	Plunger pump failed to write back to zero	system malfunction	Check plunger pump.
182	Multi-way valve does not match	system malfunction	Check multi-way valve.

4.6 Inspection and Maintenance

The instrument has a high level of automation and intelligence, and just needs less maintenance. The suggested items for maintenance inspection are shown in the table below:

TP analyzer inspection list			
Time		**Maintainer**	
Place		**Instrument**	**TP**
Check item	**Check content**		**Result**
1.Circuit	1) Whether the operation and display of the screen is normal.		
	2) Whether the motherboard is running normally, and the indicator light on the motherboard shows is normal.		
	3) Whether the internal and external communication is normal (the data light is flashing, there is no alarm prompt).		
2.Plunger pump	1) Whether the plunger pump is working normally.		
	2) Whether the plunger pump is clean (no visible impurities or obvious discoloration).		
	3) Whether the three-way valve of the plunger pump is well sealed (no liquid leakage).		

3.Multi-way valve	1) Whether the valve position switching of the multi-way valve is normal.	
	2) Whether the valve head is leaking, and whether there is liquid backflow in the connecting pipe of the valve head.	
	3) Whether the pipe joints are loose.	
4.Reaction unit	1) Whether the glass container is intact and well sealed.	
	2) Whether there are no any impurities in the glass container.	
	3) Whether the heater and its casing are normal.	
5.Flow and reagents	1) Whether the pipe joints are loose.	
	2) Whether impurities and air bubbles are mixed in the pipe.	
	3) Whether the reagent pipe is connected correctly, and the pipe is inserted below the liquid level.	
	4) Whether the reagent is sufficient and within the validity period.	

Caution:

1. In order to avoid crystallization of residual substances in the pipe of the instrument or other dirt deposits in the pipe and multi-way valve, resulting in pipe blockage and increased static friction of the valve head, which will cause failure when the instrument is started next time. When the instrument stops running exceeding 48 hours, you must operate “Clean” and “Evacuate pipe”.
2. In order to ensure the accurate measurement of the instrument, according to the water sample quality, it is necessary to clean the flow of the instrument from time to time. In addition, if the water sample quality is poor and the turbidity is high, the instrument pipe may be blocked, so it is necessary to replace the PTFE pipe and other spare parts from time to time.
3. Monitoring stations without air conditioners or other temperature control equipment should stop running or take temperature control method in case of cold weather or high temperature to avoid damaging the instrument.