FOUR E'S SCIENTIFIC

Operating Instructions

Optima96

Gradient PCR



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1.Declaration of Conformity

We declare under our sole responsibility that this product corresponds to the

directives

2014/35/EU

2006/42/EC

2014/30/EU and 2011/65/EU

and is manufactured in accordance with the following standards

EN 61010-1

EN 61010-2-010

EN 61010-2-051

EN 61326-1

EN ISO 12100

Meanings of Precaution Marks

Signs & symbols	Explanation
	Consult Operating Instructions for use
	Keep dry
	Keep away from sunlight
	Fragile. Handle with care
	Storage Temperature limits
	Storage humidity limits
	Storage atmospheric limits
	Maximum stack limit
	Attention! See instructions for use.
	Can be recycled

2. Safety Instructions

/// General information

Please read through this operating instruction carefully before using the instrument and follow the safety instructions.

• Please keep the instructions in a place where users can readily access it.

• Only trained people can operate this device.

• Please comply with safety regulations, physical safety and accident prevention regulations.

• Operate the instrument under technically sound conditions.

Beware of burn injury caused by hot metal parts!

• Do not touch the hot surface without protective gloves.

• The surface of the instrument may be at a high temperature while in operation.

• Allow the metal parts to cool down before continuing to use the instrument.

• Do not move the machine until it is cooled down.

/// Installations

Instrument protection

• The power switch of the instrument can be turned off directly and safely at any time. If it cannot be turned off readily due to accessibility issues, please install an easy-to-use emergency power switch in the working area.

• When placing the instrument, be careful not to injure your fingers.

• Only trained repairmen can repair the instrument.

• Do not cover the instrument during operation. Otherwise, it will overheat.

• Prevent the instrument and accessories from pressure and collision.

• Keep heating block modules clean and free of any foreign objects.

• Keep proper distances between instruments

• Place the instrument on a broad table which is flat, stable, clean, non-slip, dry and fireproof.

• Do not block the ventilation slot on the back of the instrument.

• Before you start, please ensure that the container and the lid are properly installed to the main machine.

• Keep the instrument at proper distances

- At least 100 mm between instruments.
- At least 200 mm away from surrounding walls
- There should be adequate space above the device to open the heated lid.

/// Operation

Danger

• Do not use the instrument in an explosive environment. It's not explosion-proof.

• When operating with substances capable of forming explosive mixtures, please take appropriate safety measures, for instance, working under the fume hood.

• To avoid physical injury and property damage, please follow relevant safety instructions and take precautions when handling hazardous materials.

Warning

• This instrument is only intended for use with materials that will not react dangerously to the energy generated during operation, or other external sources of energy.

• Only use this device to heat material whose flash point is higher than 170°C. (EN 61010-2-010)

• When handling hazardous substances or mixtures of toxic substances or substances contaminated by pathogenic microorganisms, users shall take appropriate protective measures, abide by the State's regulations, laboratory biosafety

standards and Material Safety Data Sheets.

• For bacteria or biomaterials rated hazardous level II or higher, please comply with the Laboratory Biosafety Manual promulgated by the World Health Organization (WHO).

Caution

• Avoid hand injury during operation.

• The heating blocks and the heated lid will be extremely hot after use, and touching them can cause burn injury.

• Be careful with residual heat after the instrument is turned off.

• Don't open the lid until it's completely cooled down.

Attention

• Only operate the instrument on a flat table and do not move it while in operation.

• Do not use glass tubes or fragile reaction tubes, as there is breakage risk.

• Only use sealed reaction tubes or PCR tubes.

• The reaction tube must be sealed while in operation. If there is any material leakage, please turn off the instrument immediately, cut off the power and then clean the instrument.

• The foot of the instrument must be clean and free of damage.

Danger caused by electrostatic discharge

• Electrostatic discharge generated between the medium and the instrument can lead to electrostatic hazards such as explosion.

/// Power supply / Power-off

• The input voltage must be consistent with the voltage marked on the instrument.

• To completely disconnect the device from AC mains, please unplug the power supply cord.

• Only use the original power cord to connect the instrument.

• Power socket must be grounded.

/// Requirements of Operators / Users

- Only trained people can operate this machine.
- Please comply with safety regulations, physical safety, and accident prevention regulations.
- Wear appropriate protective equipment based on the type of medium when operating the instrument.
- Inform users of the possible dangers of contact with or inhalation of media such as toxic liquids, gases, mist, steam, dust, biological or microbial materials.
- This instrument is only intended for use with materials that will not react dangerously to the energy generated during operation, or other external sources of energy.
- The input voltage must be consistent with the voltage marked on the instrument.
- Power socket must be grounded.
- Power socket should be easy to use.
- Place the instrument on a flat, stable, clean, non-slip, dry and fire-proof table.
- Do not block the ventilation hole of the instrument. The distance between ventilation hole and the nearest object should be at least 20 cm.
- Do not block the air vent of the heat dissipation system to ensure that the heat dissipation system functions properly.
- Keep monitoring the instrument while in operation.
- Please use the device in well ventilated area (or a fume hood).
- Please refer to the operating instructions for the optional accessories.
- Please check the equipment and accessories before each use and ensure that they are not damaged. Do not use if they are damaged.

/// Maintenance

- Clean the surface of the instrument with a soft cloth or a neutral laboratory cleaner if necessary.
- Open the heated lid. Wipe with a soft cloth or a neutral laboratory cleaner if necessary.
- Check PCR wells for any remaining PCR tube fragments. Clean with cotton swabs dipped in anhydrous alcohol.
- Only specially trained professionals can open the instrument for repair. Please unplug the instrument before you open it. Some parts of the instrument can still hold a charge even after disconnecting power.
- Please only use the original spare parts provided by the manufacturer.

3. Correct Use

/// Application

Gradient PCR, derived from common PCR, is a type of PCR with gradient function. It's applied in molecular biology, medicine, food industry, forensic science, biotechnology, environmental science, microbiology, clinical diagnosis, epidemiology, genetics, genetic testing, gene cloning, gene expression, etc., used for a variety of pathogen detection and gene analysis featuring polymerase chain reaction (PCR)

/// Fields of Application

Laboratories or a laboratory-like indoor environment in pharmaceutical industry, universities, commercial, or industrial fields.

Ideal for molecular breeding, NGS library amplification, gene cloning, vector construction, and forensic identification.

We can't guarantee your safety, if

- you have used optional accessories not provided or recommended by the manufacturer.
- the instrument is operated incorrectly or in violation of the manufacturer's operating instructions.

• the instrument or circuit board has been illegally modified by a third party.

• the working voltage is inconsistent with that indicated on the instrument.

4. Unpacking

Inspection

• Remove the package and check the instrument carefully.

• Contact the distributor or shipping company if there is any damage.

Notes:

In case of any apparent damage to the device, do not connect the power cord.

Contents of package

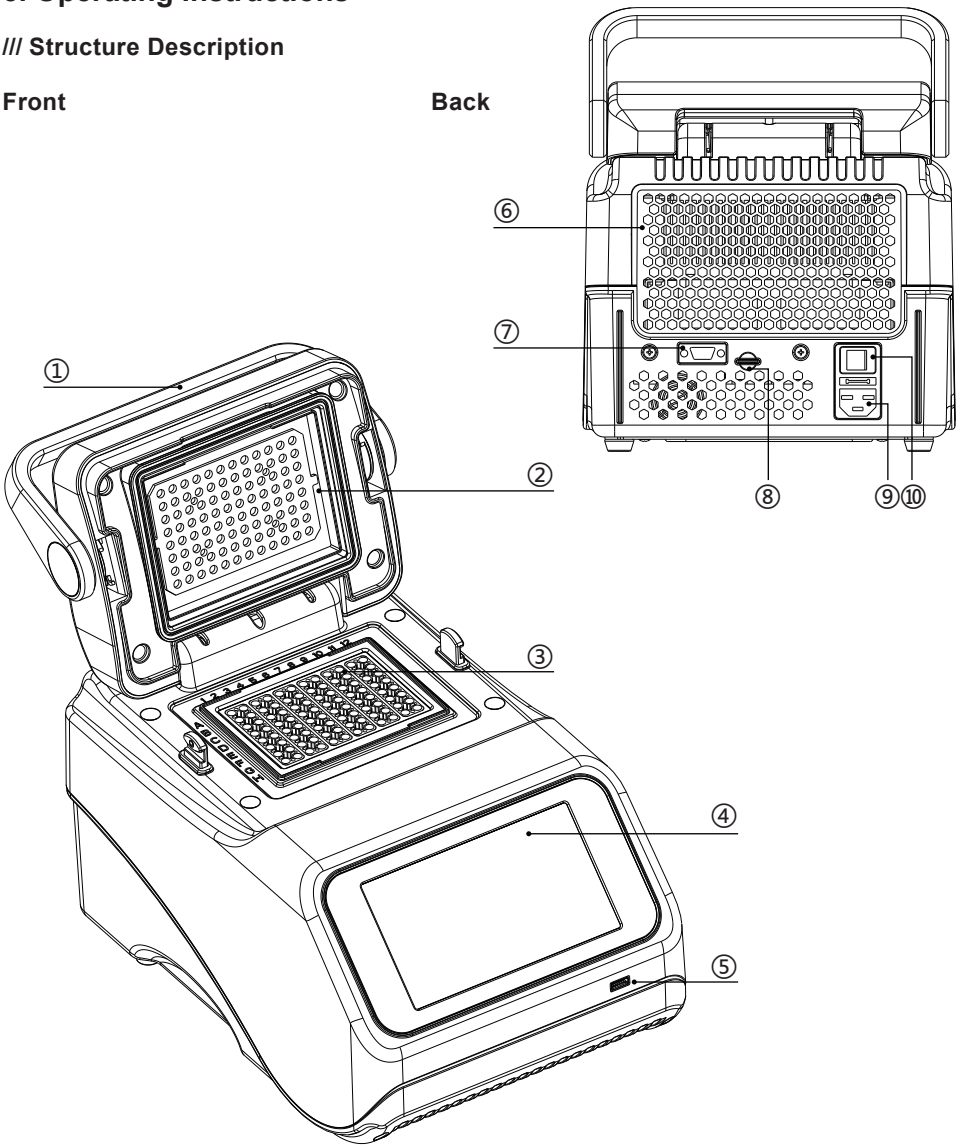
Item	QTY
Main Unit	1 PC
Power cord	1 PC
Operating instructions	1 PC
USB drive	1 PC

5. Operating Instructions

/// Structure Description

Front

Back



① Handle of heated lid

② Heated lid modules

③ Heating blocks

④ Touch screen

⑤ USB port

⑥ rear air vent

⑦ RS-232 Port

⑧ SD card port

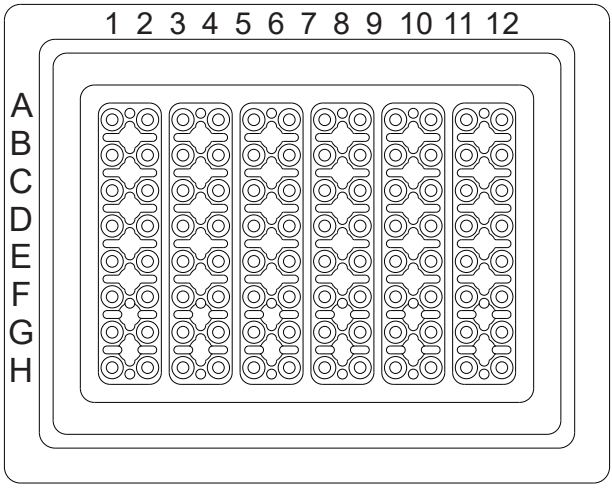
⑨ Power port

⑩ Power switch

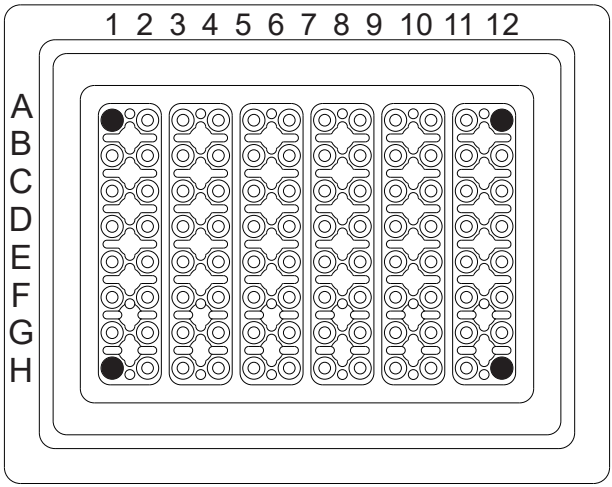
/// PCR tube loading

Note: Please load PCR tubes as instructed below to ensure the temperature accuracy. Make sure there are no foreign objects in the heating blocks before loading. If any, please use a cotton swab with a small amount of alcohol (75% v/v) for cleaning.

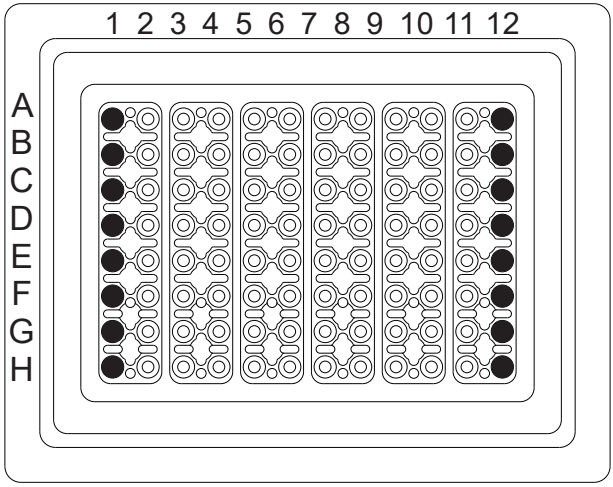
1) Loading 96-well plates: When loading 96-well plates on to the block, ensure the PCR plate is placed corresponding to the alphanumeric codes: so that well A1 is at the upper left corner (as shown below):



2) Loading Single PCR tubes: When loading single PCR tubes, firstly place empty PCR tubes in the four corners as indicated below, so that the heated lid can stay balanced when it's closed. This is to avoid uneven heating of PCR tubes caused by unbalanced heated lid.



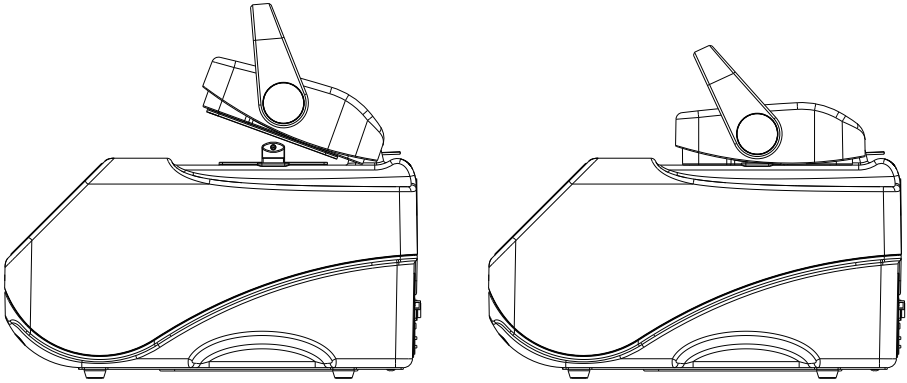
3）Loading 8-strip PCR tubes: When loading PCR strips, firstly place empty strips on the left and right sides as indicated below, so that the heated lid can stay balanced when it's closed. This is to avoid uneven heating of PCR tubes caused by unbalanced heated lid.



/// Close the heated lid

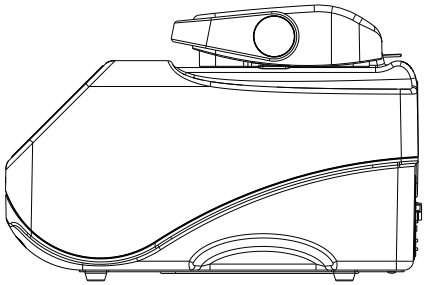
Notes: Before closing the heated lid, please make sure the PCR tubes are firmly in position and mind your hands to avoid pinching risk while closing the lid.

Step 1: Close the lid after loading the PCR plate / strips / tubes.



Step 2: After closing the lid, pull the metal handle to a horizontal position to lock the heating lid.

Attention: When the handle is moved to the horizontal position, a mechanical sound indicates that the lid is locked in place.



6. Powering-on & Running

/// Powering-on

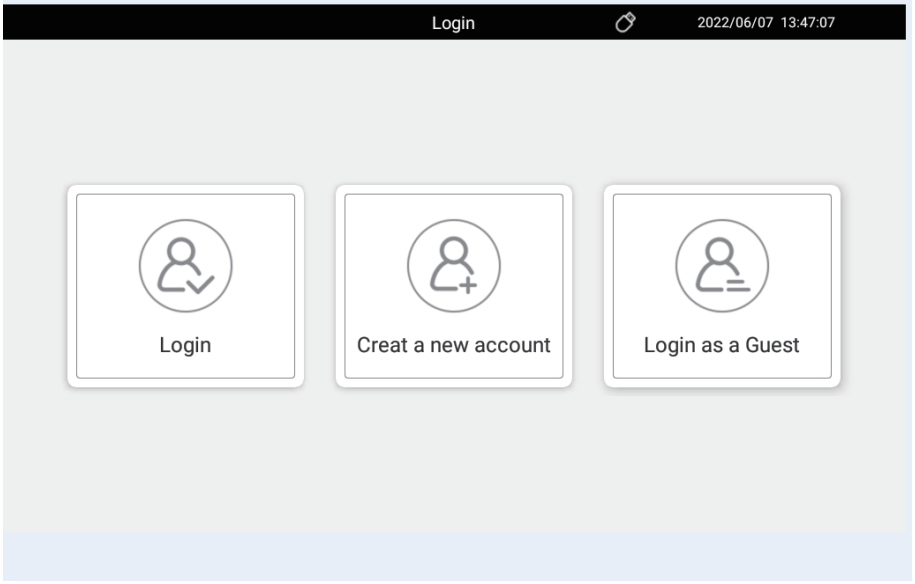
After turning on the power switch on the back of the instrument, the screen will light up, showing the interface is initializing and instrument is self-testing.



Once self-testing is complete, the home screen will be shown.

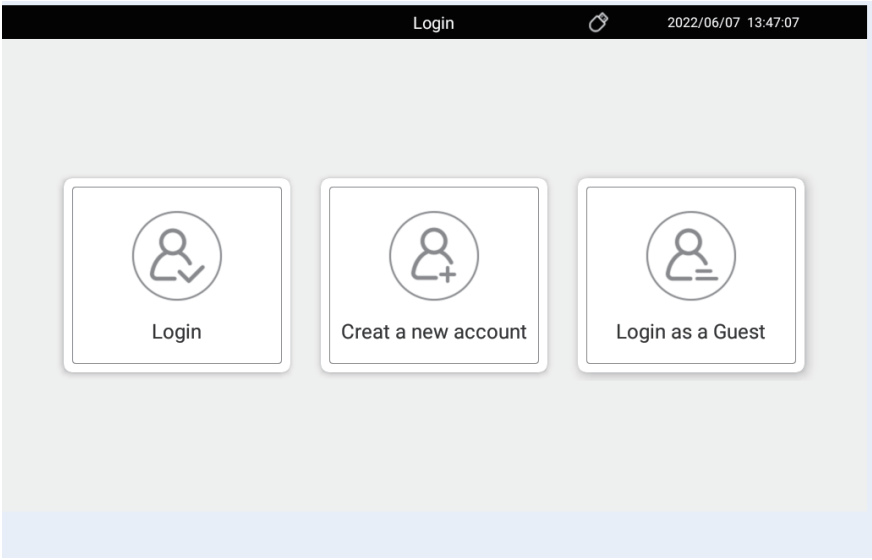


If you have registered an account before, you will see the ‘login’ page first. The home screen opens after you log on to the system.



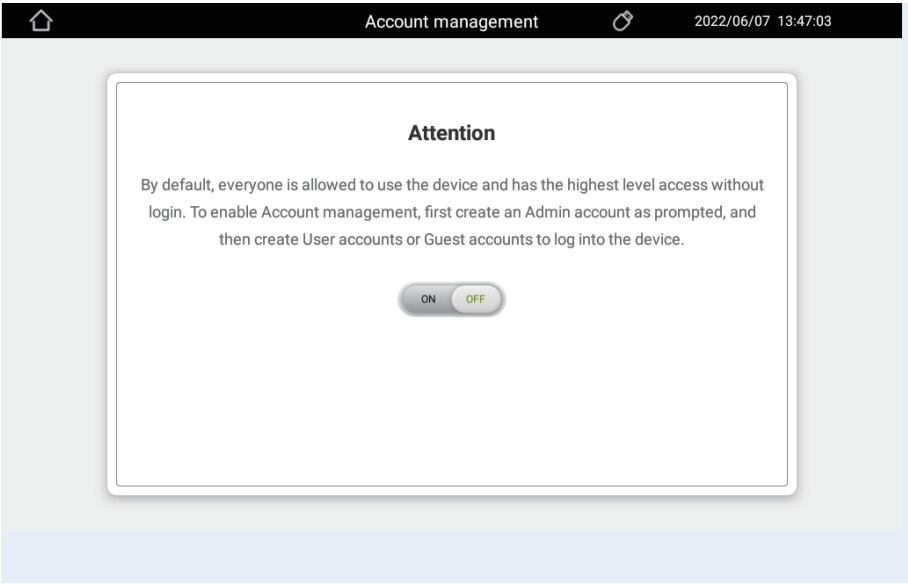
/// Login

Touch ‘Login’ button on the home screen and enter the ‘login’ page.



1. Here you can log in using an existing user account, create a new account or log in as a guest. Different accounts can be assigned different access level.

If no accounts are created or if you happen to disable ‘Account Management’, on clicking the ‘login’ button you will see the following screen indicating that by default any one can use the device and edit the settings.



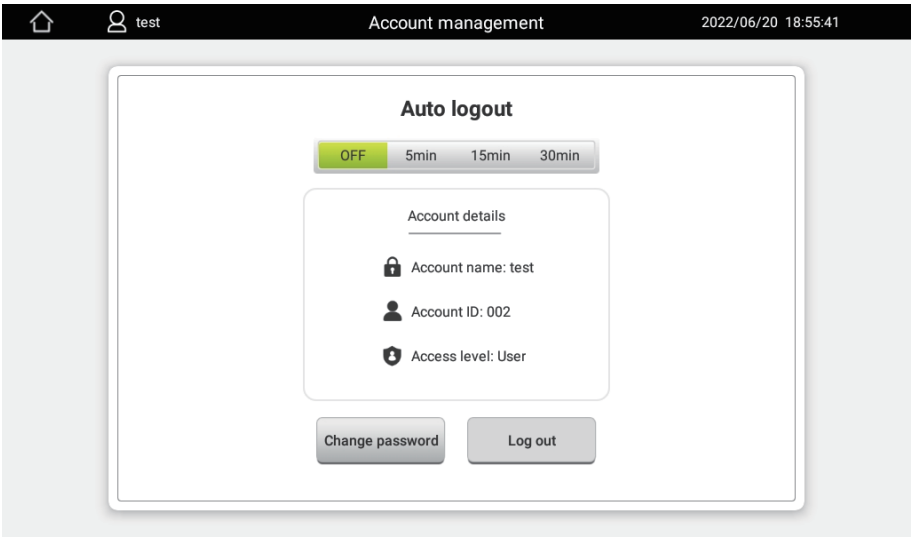
2. There are three types of user accounts:

1) Admin account: Admin account is created when launching the device for the first time. Admin account can upgrade device software, and also restore factory settings etc.

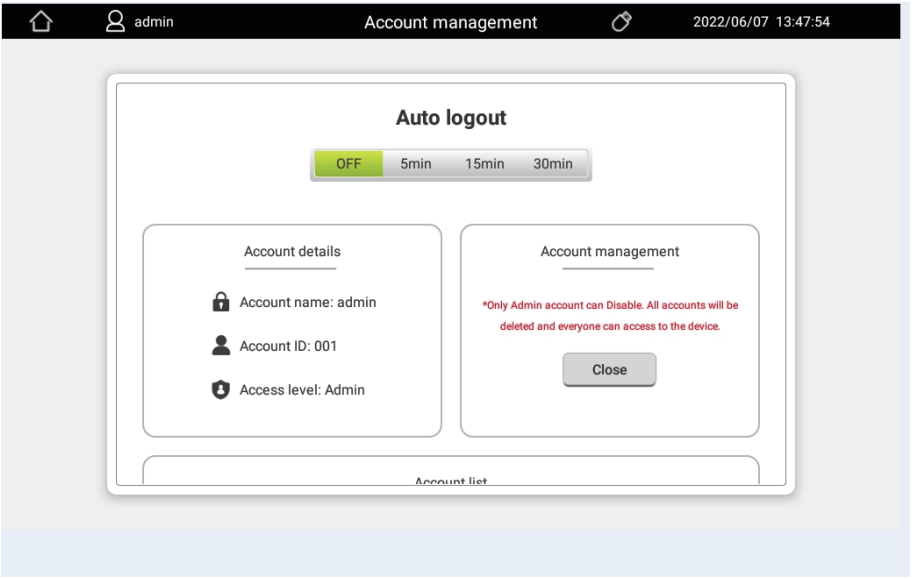
2) User account: Individual user accounts can be created as needed. Program data will be protected individually.

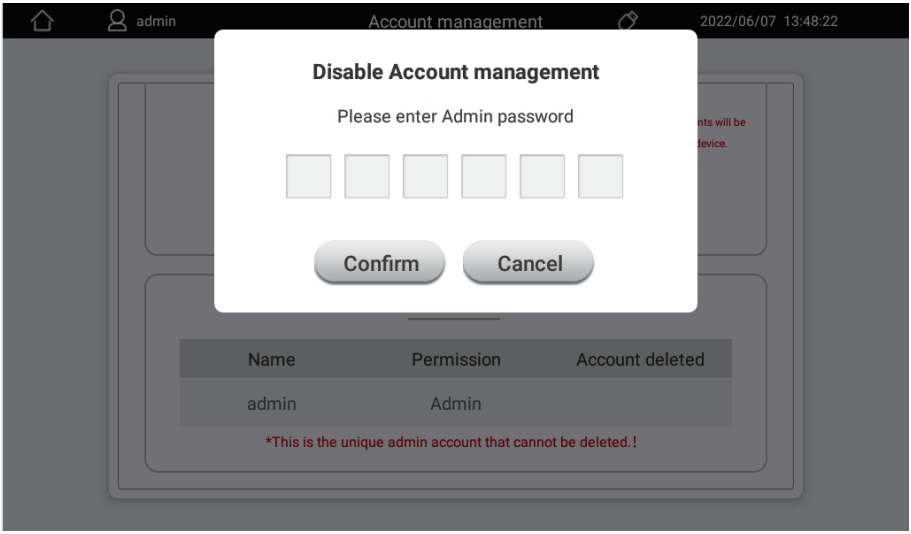
3) Guest account: For quick log in without password. Programs can be saved on USB drive only.

3. Touch the icon on the top left of the screen to check current account information, set auto logout function, or change the password (see below).



Account Management Function: Only the Admin account can enable or disable this function. If disabled, by default any one can use the device and edit the settings.



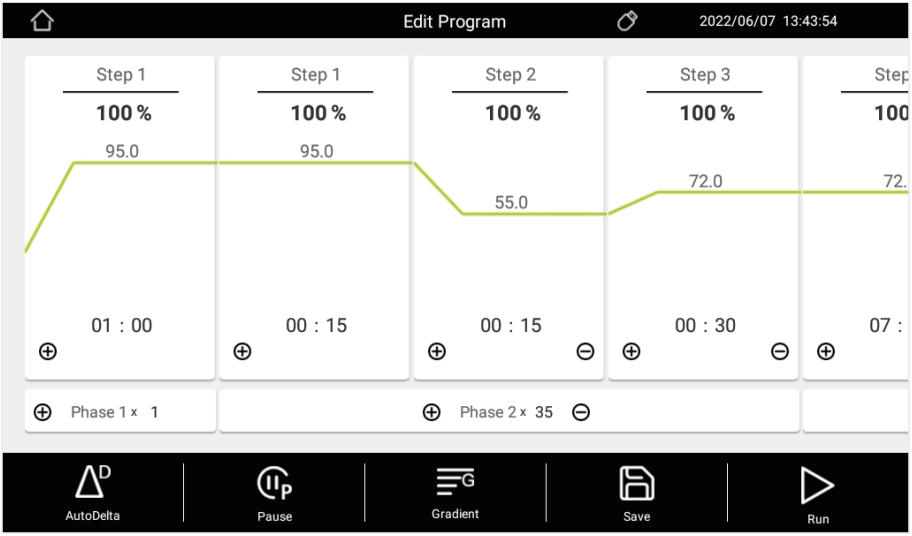


4. Touch the ⌂ icon on the top left of the screen to go back to the Home screen at any time.

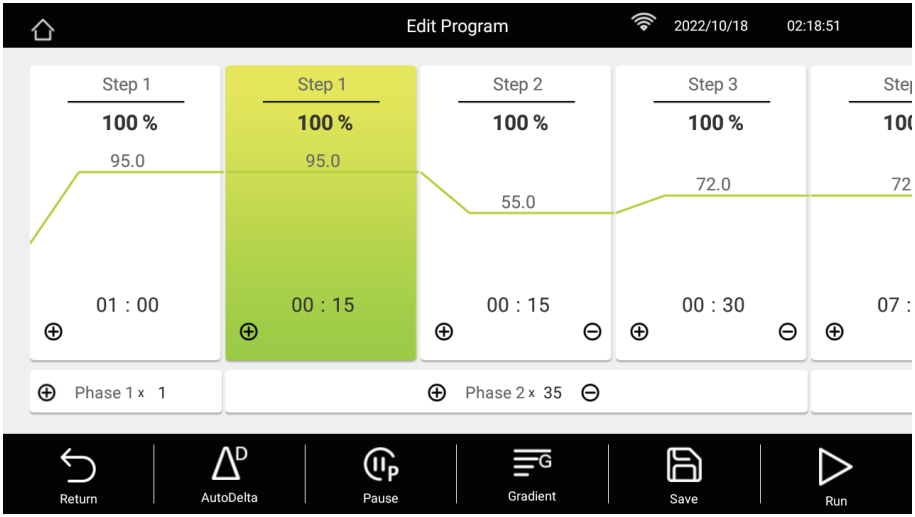
/// New

1. Touch ‘New’ button and enter the ‘Edit program’ page.

Here the default program is displayed and you can edit parameters of the program as needed.



1) Editing ramp rate: You can edit the rate at which the instrument ramps to the temperature for the step. The default ramp rate is 100%, and can be edited to any value between 1 to 100%. Touch to select the box 100% in the STEP field, enter a value between 1-100% and touch ‘confirm’. The resolution is 1%. For example (refer picture below), the ramp rate in Step 1 of Phase 2 has been set to be 50%.



2) Editing temperature: Touch any temperature field to select it, then edit the temperature as desired. For example, touch to select the box 55.0 on the curve, enter a value between 4-99.9℃ and touch ‘confirm”. The resolution is 0.1℃. The curve shape will vary with the change in value. For example (refer picture below), the temperature below in Step 2 of Phase 2 has been set to be 58.5℃.



3) Editing time: Touch any time field to select it, then edit the time as desired. For example, touch to select the box 00:15, enter a value between 00:00-59:59 in the format ‘mm: ss’ and touch ‘Confirm’. For example (refer picture below), the time in Step 2 of Phase 2 has been set to be 00:50.

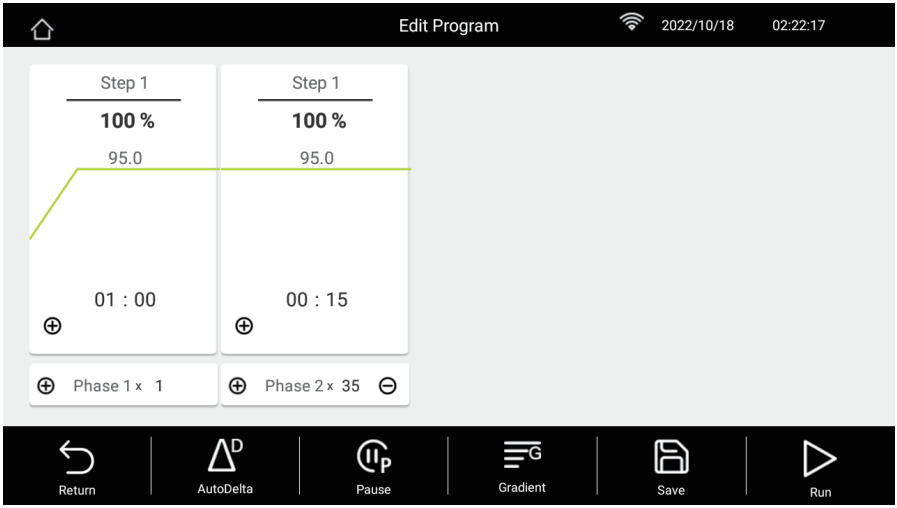


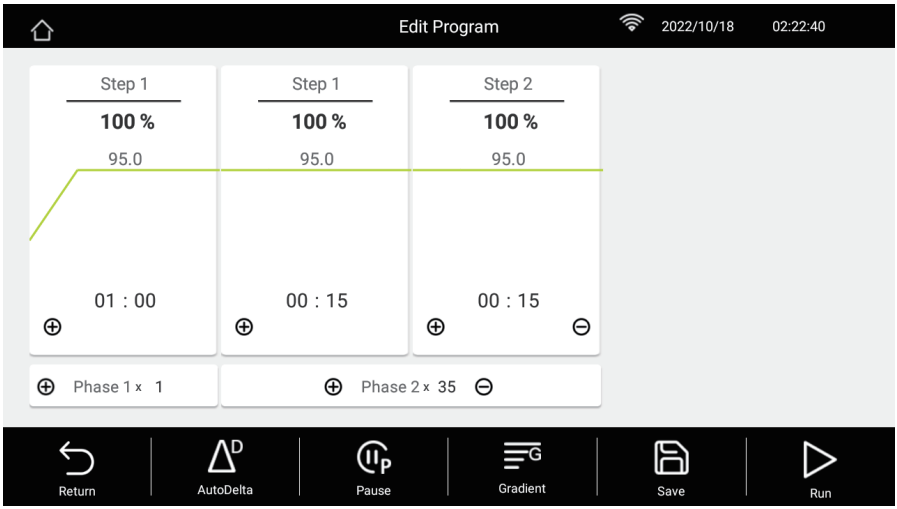
4) Editing STEP

a. Adding a step: Touch the icon ⊕ in Step field. Touch once to add a new STEP with the same parameters to the right side of the selected step. The ‘number’ of the newly added step will be equal to the selected step ‘number’+1. The newly-added step has the same ‘ramp rate’, ‘temperature’ and ‘time’ as the last STEP. See the newly added Step 2 in Phase 2 (refer picture below) as an example.

b. Deleting a step: Touch the icon ⊖ on a selected Step field to delete that step.

The step 2 (refer picture below) is deleted on clicking ⊖ in that step.





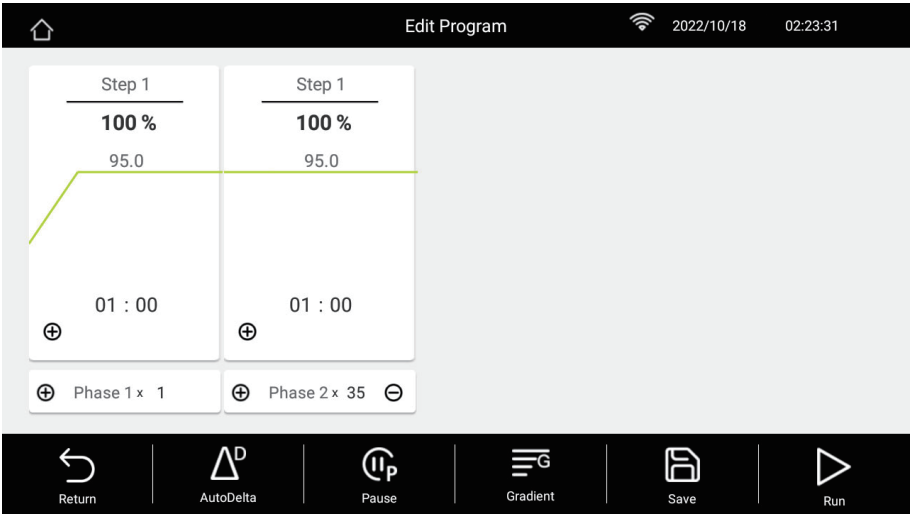
5) Editing Phase.

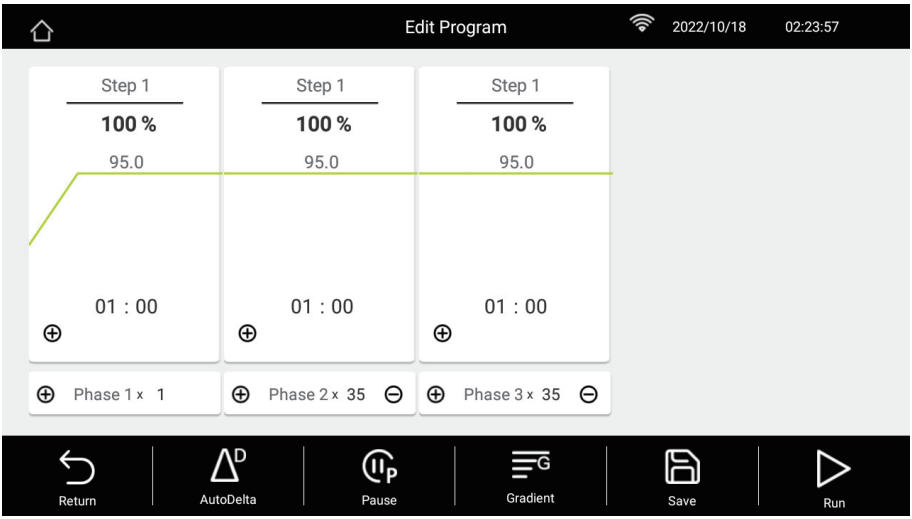
a. Adding a Phase: Touch the icon ⊕ in Phase field.

Touch once to add a new Phase with the same parameters to the right side of the selected Phase. The ‘number’ of the newly added phase will be equal to the selected phase ‘number’ +1. All the step parameters of last phase will be copied in the newly-added Phase. See the Phase 3 (in picture below) added on the right side of Phase 2, as an example.

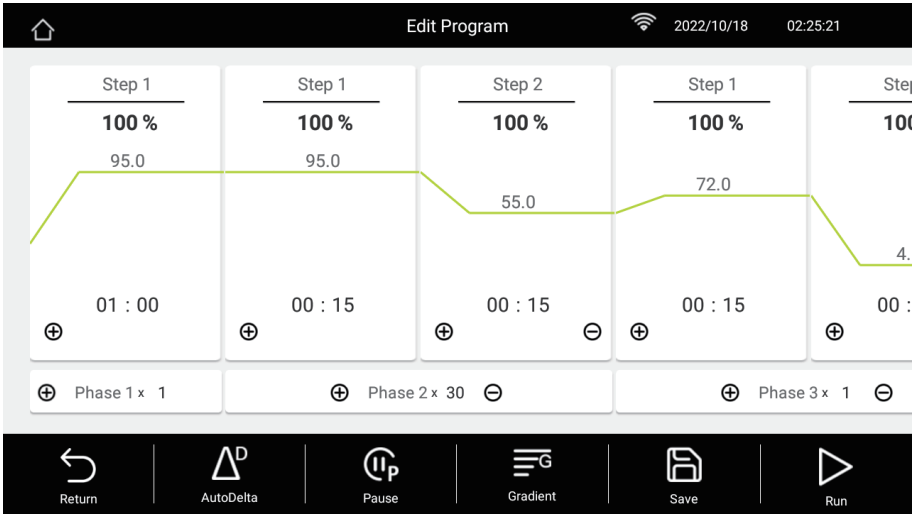
b. Deleting a Phase: Touch the icon ⊖ in Phase field. Touch once to delete the Phase.

Example: Phase 3 (refer picture below) is deleted on clicking ⊖ in that step.

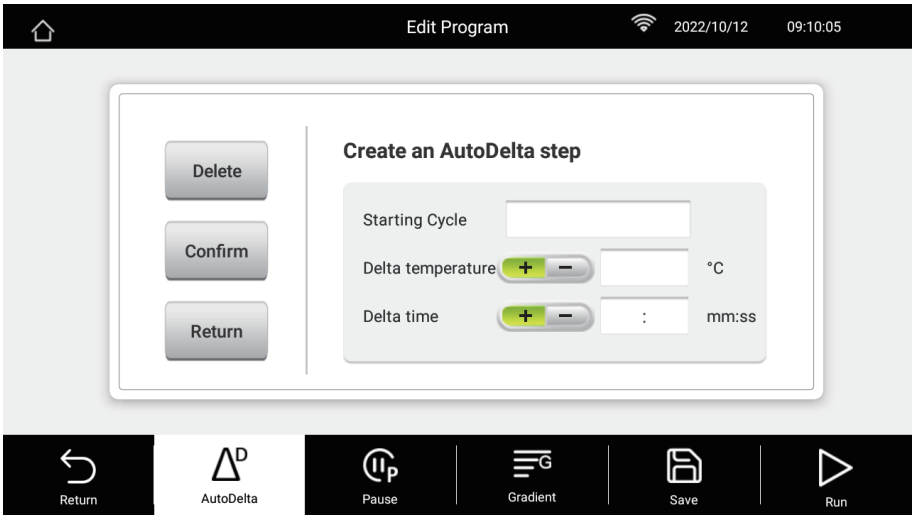




6) Editing Cycling Phase: For a cycling, edit the number of cycles as needed. Touch to select cycles box Phase 2 x 35 , enter a value between 1-100 and touch ‘Confirm’. The format is ‘x N’ (N should be an integer). N indicates the number of cycles the Step of the Phase will perform. Once N cycles are completed, it goes to the next Phase automatically. As an example, the number of cycles in Phase 2 below is set to be x 30.



2. Creating an AutoDelta step



AutoDelta steps are allowed only in cycling phases. An AutoDelta step allows you to increase or decrease the temperature and/or change the duration of the cycle during a cycling phrase.

Step 1: Open a program template and enter the ‘Edit Program’ page. Select the Step as required.

Step 2: Touch "AutoDelta" from the bottom menu to enter the settings page (see the picture).

Starting Cycle:

Touch the input box to enter starting cycle (the cycle at which the AutoDelta begins).

Delta temperature:

Turn on the temperature increase function:  When The ‘+’ button turns green, it indicates the temperature increase function is on.

Turn on the temperature decrease function:  When The ‘-’ button turns green, it indicates the temperature decrease function is on.

Attention:

a. You can only enter a number between 0.1-94 in the input box for Delta temperature. Symbols are not allowed.

b. The value for ‘temperature decrease’ in the step cannot be lower than 21°C.

Delta time:

Turn on the time increase function:  When The ‘+’ button turns green, it indicates the time increase function is on.

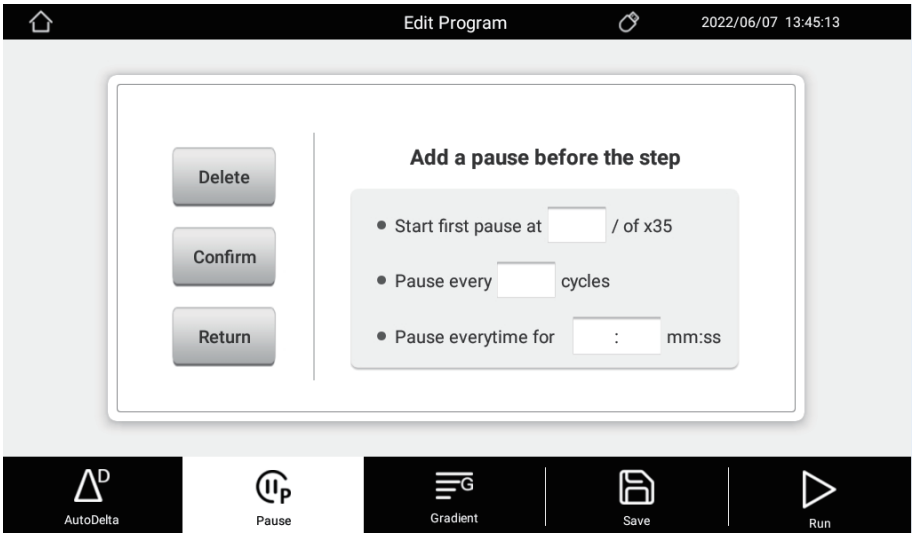
Turn on the time decrease function:  When The ‘-’ button turns green, it indicates the time decrease function is on.

Attention.

You can only enter a number between 1-59 in the input box for Delta time. Symbols are not allowed.

b. When the setting is done, touch "Confirm" and go to the Run page automatically. The set step column will be marked with a "D" symbol.

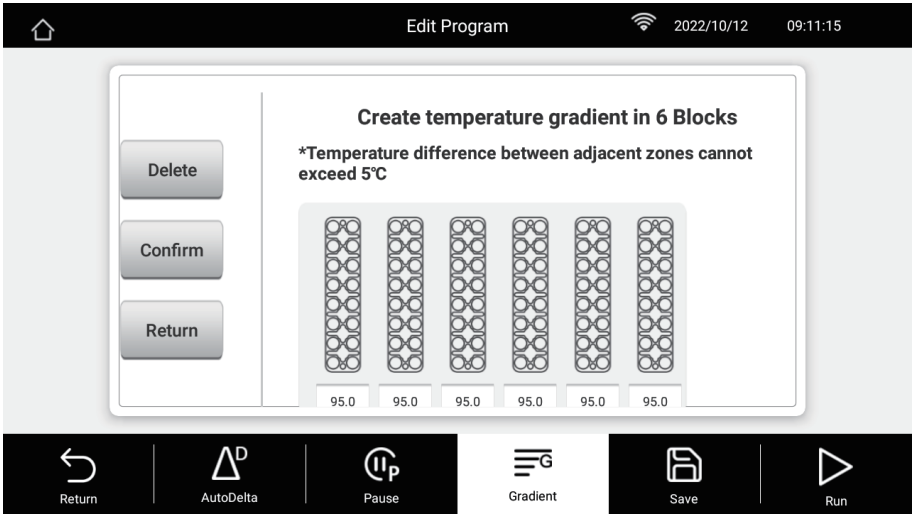
3. Adding a Pause



Touch a step in a cycling phase to select it and touch "Pause" button to enter the Settings page (see above). Pause can be set before any step. First enter the first cycle in which the run will pause, then frequency of the pause, and duration of the pause (in mm:ss).

Touch "Confirm" and the set step will be marked with a "P" symbol.

4. Creating a Gradient step



Gradient function can be used to provide up to six different temperature zones for the 96 wells. In a Gradient step you can set different temperatures for different blocks. This feature is useful for quickly optimizing new run methods.

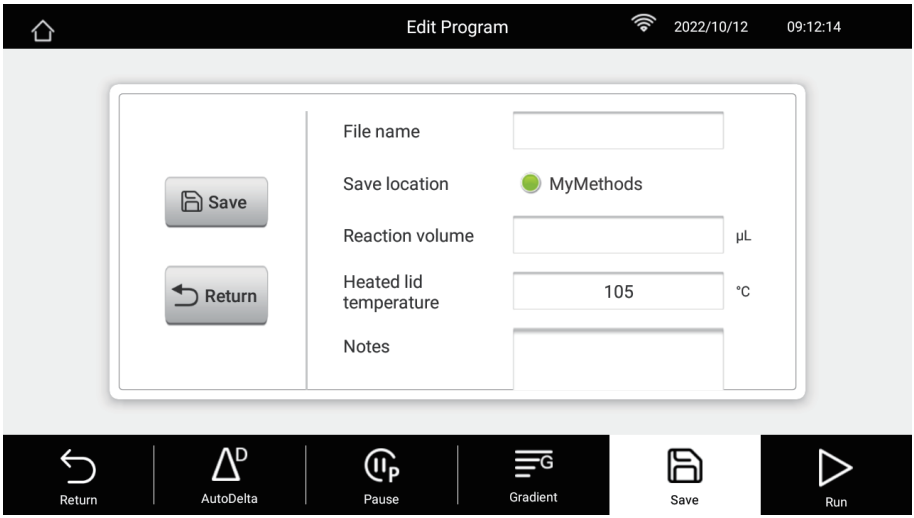
Touch the column of a step to select it, and then touch "Gradient" button to enter the settings page (see above).

Enter the desired temperature for each block. Temperatures difference between adjacent blocks should be less than 5°C. The maximum temperature that can be set is 99.9 °C.

Touch ‘Confirm’ button, and the set step will be marked with a "G" symbol. Meanwhile, the temperature curve will also display the set minimum and maximum temperatures.

5. Save

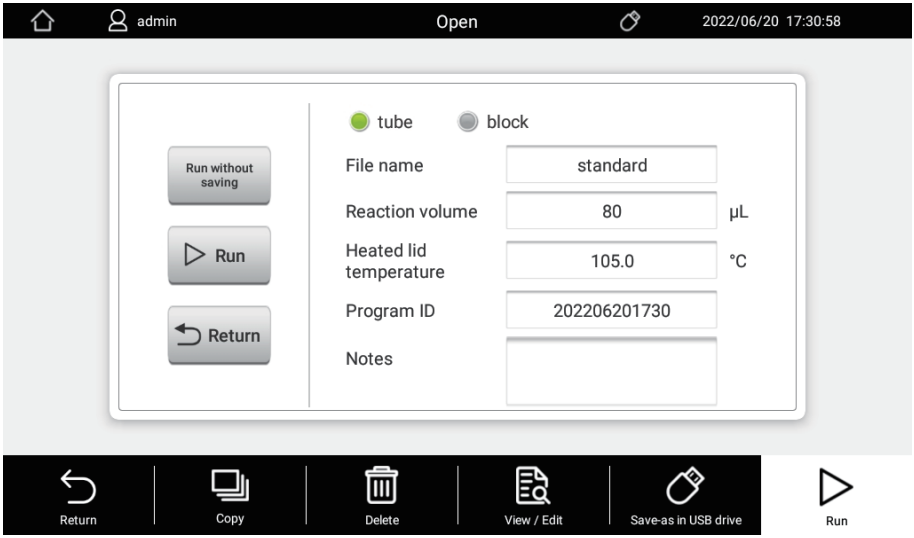
Touch "Save" button to enter the "Save" page (as shown below) and save the current Settings. Here you can also edit ‘file name’, ‘reaction volume’, ‘heated lid temperature’ and ‘notes’.



6. Run

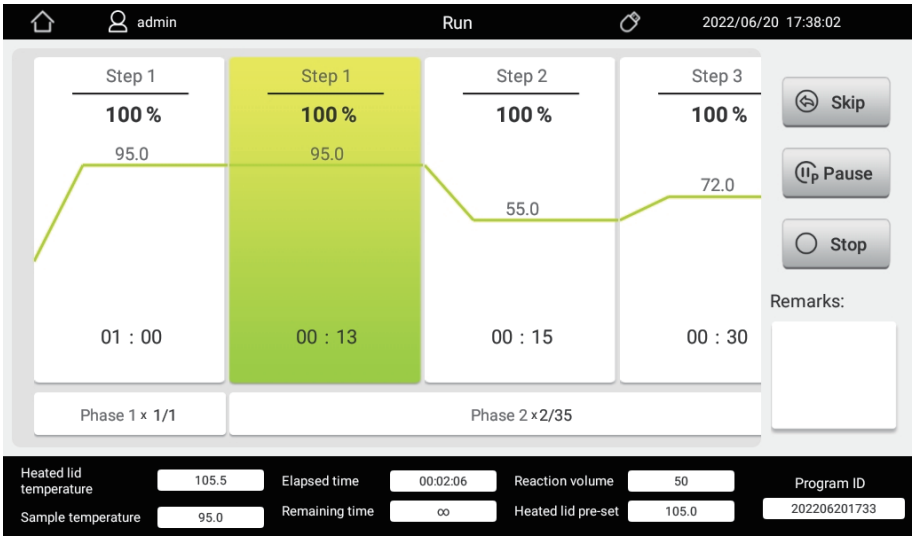
1) After a program is created or an existing program is opened, touch "Run" button to start the program. If changes hasn't been saved, go to the "Save" page first to save the program changes (see below).

After editing ‘file name’, ‘reaction volume’, ‘heated lid temperature’ and ‘notes’ as needed, touch ‘run’ button, or directly touch ‘Run without saving’ button to start the program.

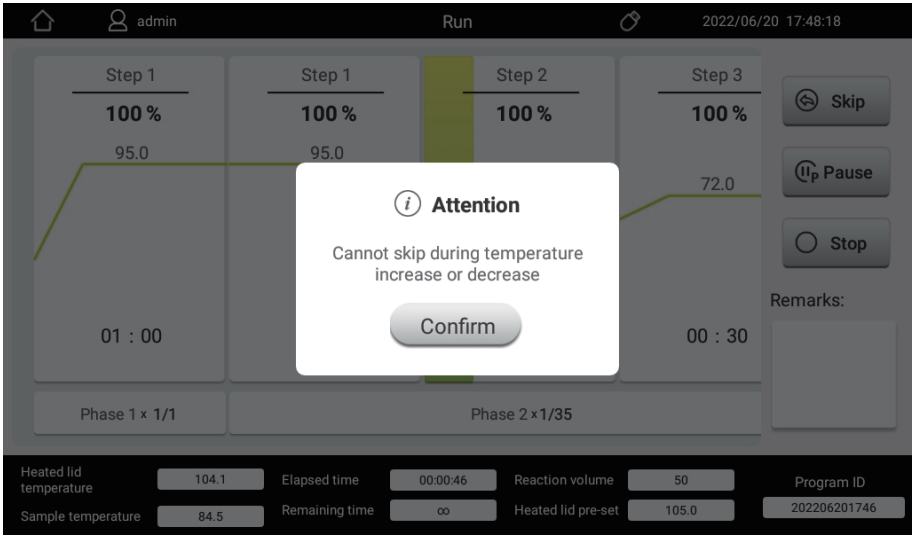


2) In the ‘Run’ page, the current running program Step will be highlighted.

You can also see the heated lid temperature, sample temperature, elapsed time, remaining time, reaction volume and heated lid pre-set temperature.



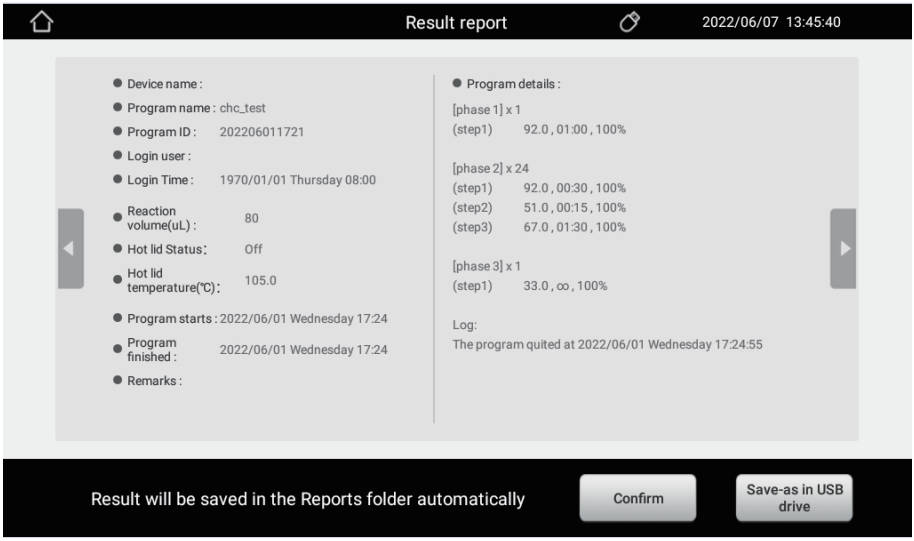
3) You can skip the current step by touching the ‘Skip’ button. However, if the temperature is rising or falling, there will be a pop-up saying, ‘Cannot skip during temperature increase or decrease’.



4) Pause the current program by touching ‘Pause’ button and continue run by touching ‘Resume’ button.

5) Stop the current program by touching ‘Stop’ button. There will be a pop-up confirming ‘Are you sure you want to stop the program?’. Touch ‘confirm’ button to stop the program, or touch ‘Cancel’ button to continue the program.

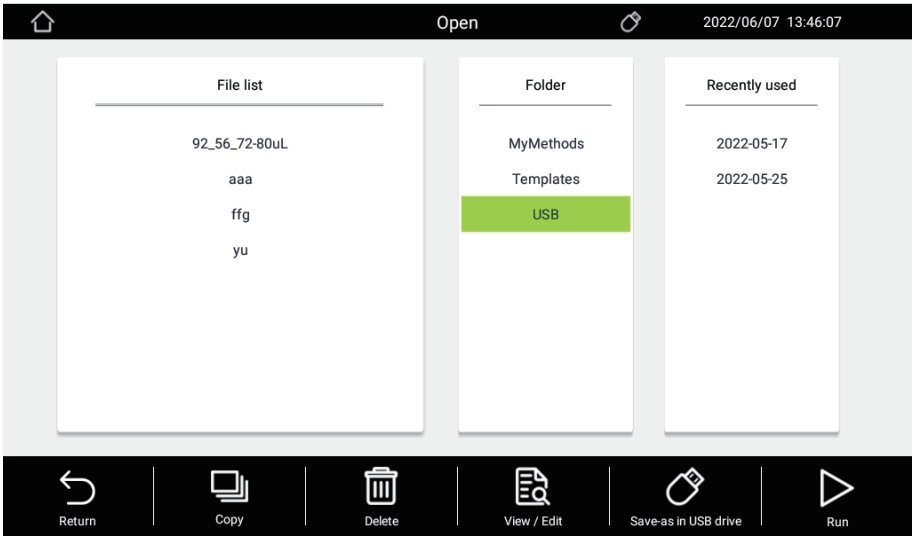
6) After completion of the program, the result report page will open automatically as follows.



Notes: If the above operation can be performed properly, that means there is no problem with the instrument. Otherwise, the instrument may be damaged in shipment. In this case, please contact manufacturer or supplier for technical support.

/// Open

Touch ‘Open’ button on the home screen to go to the ‘Open’ page.



1. A run method is a set of instructions that specifies the heating and cooling parameters.

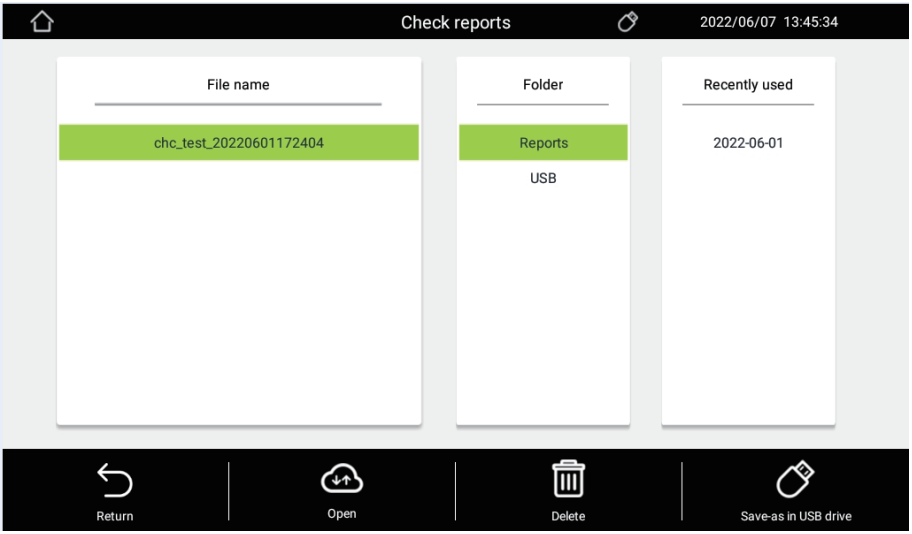
2. The instrument is preset with 11 template programs saved in the ‘Templates’ folder. You can directly choose, edit and save any one of them without altering the template files.

3. Previously saved methods/programs can be found under ‘MyMethods’. You can choose copy, delete, view, edit any saved program, or save it in USB drive.

4. Programs previously saved on USB drive can also be opened by selecting the USB folder.

/// Report

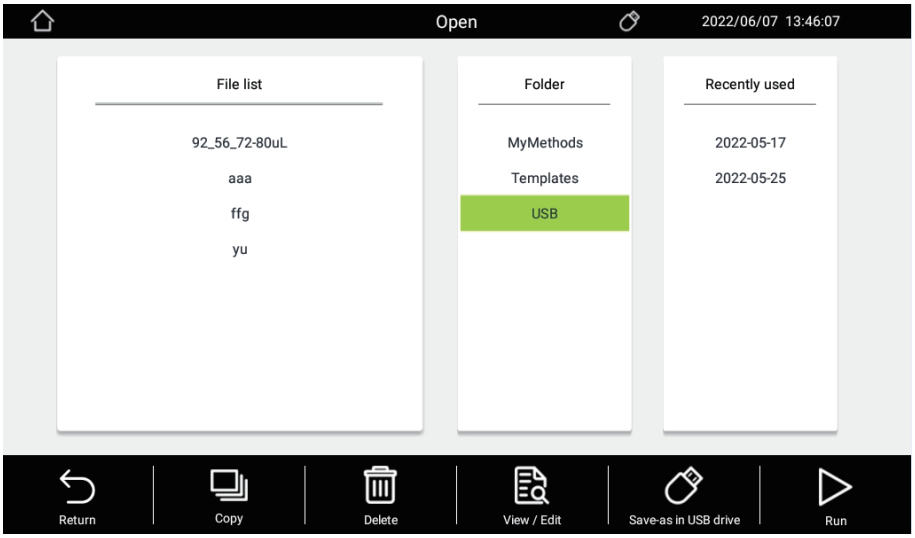
Touch ‘Report’ button on the home screen to go to ‘Check reports’ page.



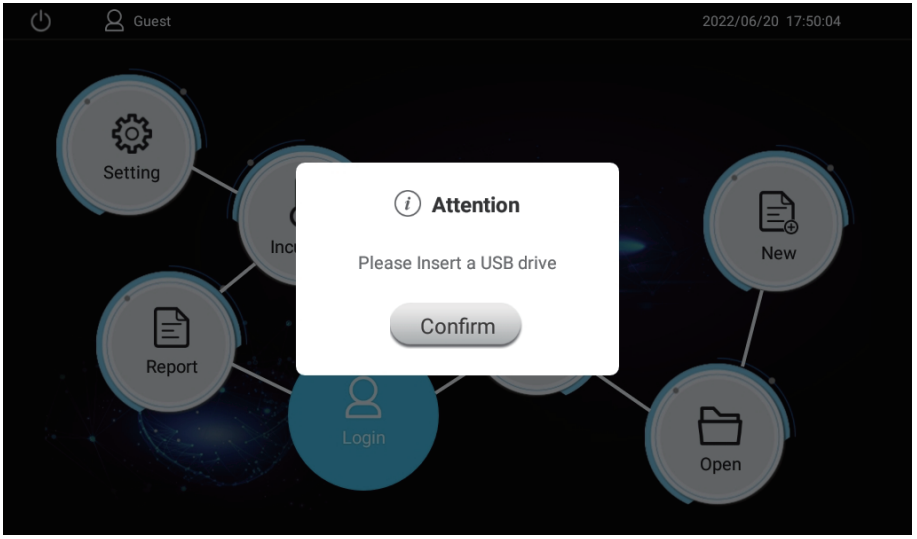
Here you can check or delete the reports of run programs or save them in a USB drive.

/// USB Port

Touching ‘USB’ button on the home screen, you can view the programs saved in the USB drive.

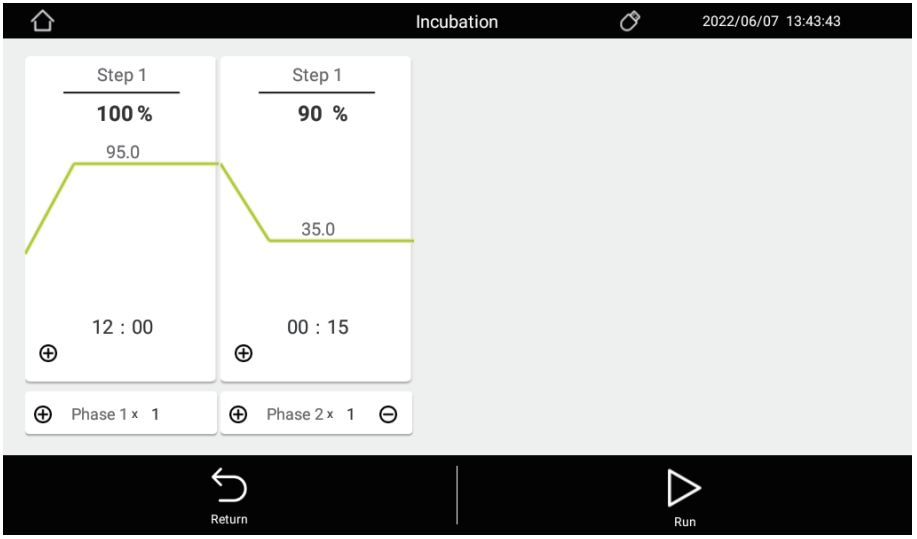


If no USB drive is inserted, there will be a pop-up as below.



/// Incubation

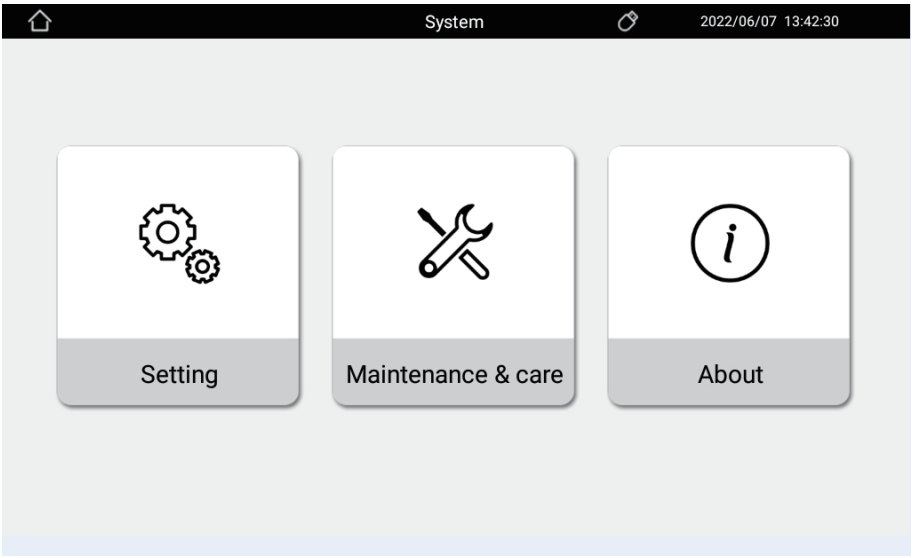
Touch ‘Incubation’ button in the home screen and enter the ‘Incubation’ page.



You can perform the incubation function for a long time using the function, for example, incubate overnight at 4℃.

/// System

Touch ‘System’ button on the home screen to go to the ‘System’ page.

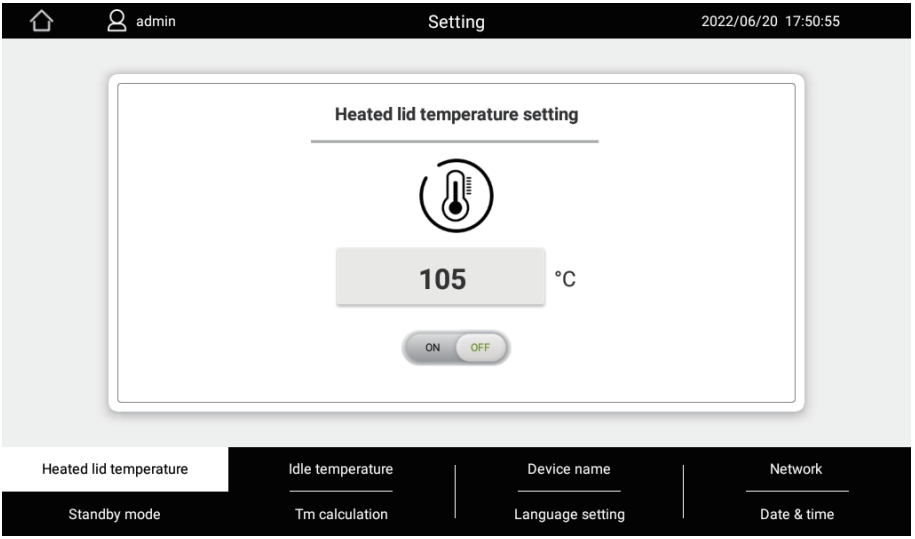


Touch ‘Setting’ button to enter the following page.

1) Heated lid temperature setting:

Turn the button ‘ON’ ON OFF and enter the desired lid temperature in the box (Accuracy is 0.1°C).

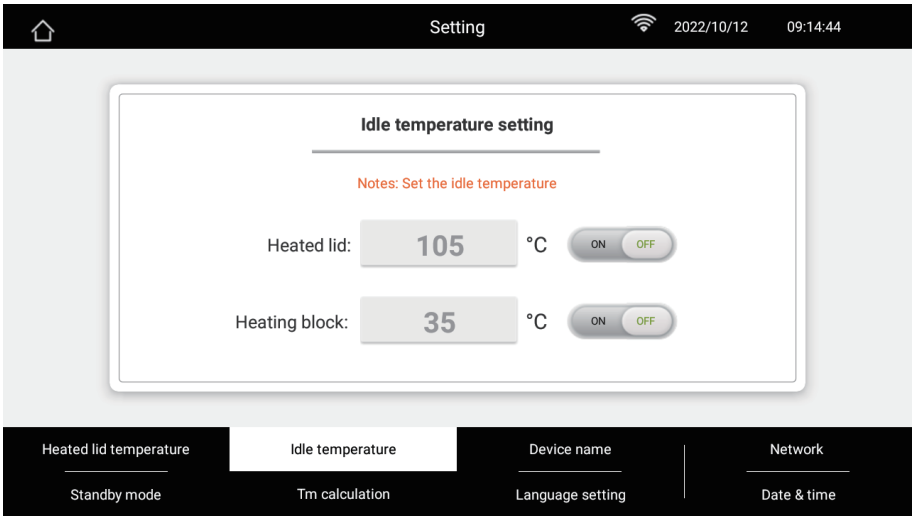
Maximum temperature is 115°C. Turn the button ‘OFF’ ON OFF if no lid heating is required.



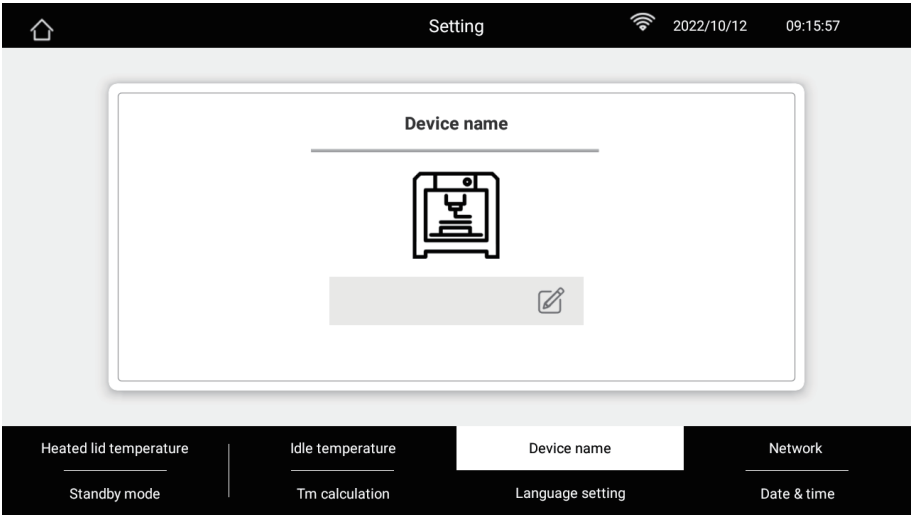
2) Idle temperature setting: Use this setting to set temperature when device is idling.

Heated lid temperature setting: Turn the button ‘ON’  and enter the desired lid temperature in the box (Accuracy is 0.1°C). Maximum temperature is 115°C. Turn the button ‘OFF’  if no lid heating is required when the machine is idling.

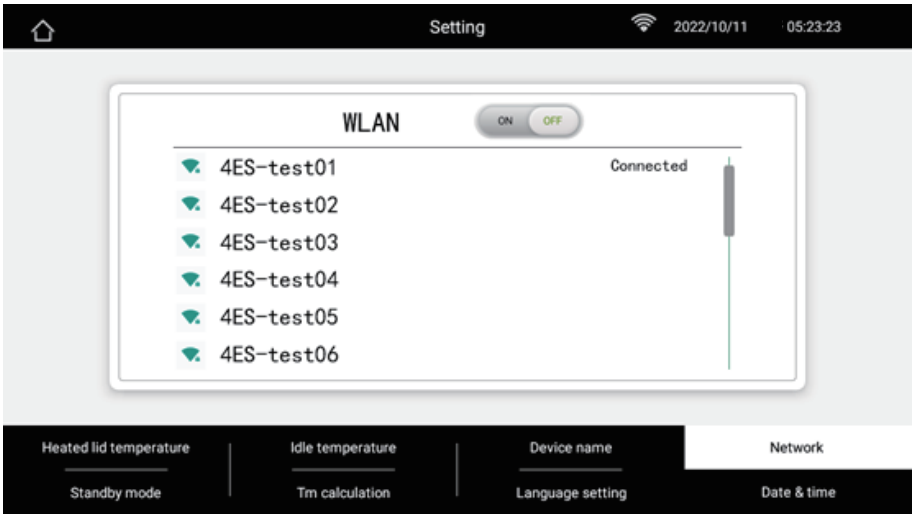
Heating block setting: Turn the button ‘ON’  and enterand enter the desired block temperature in the box (Accuracy is 0.1°C). Maximum temperature is 100°C. Turn the button ‘OFF’  if it is not needed to keep the blocks heated while the machine is idling



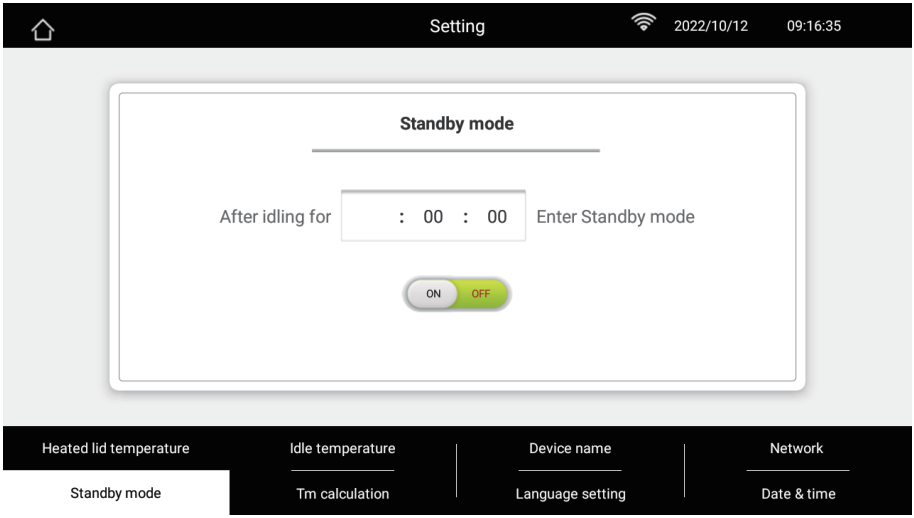
3) Device name setting: Click the input box and enter the name.



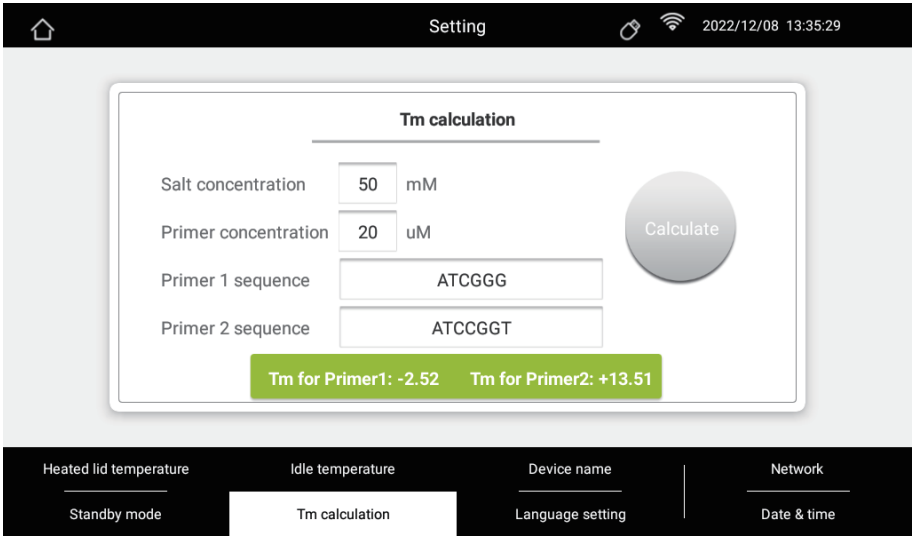
4) Network setting: Turn the button to ‘ON’  to enable WiFi. From the list choose the right one for connection. Turn the button to ‘OFF’  if no need for network.



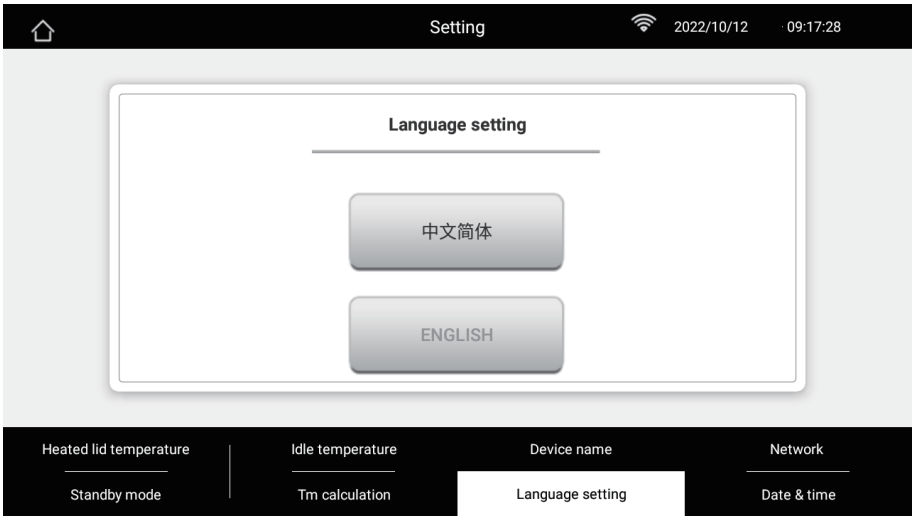
5) Standby mode setting: Turn the button to ‘ON’  and enter the standby time. Turn the button to ‘OFF’  to disable the standby mode.



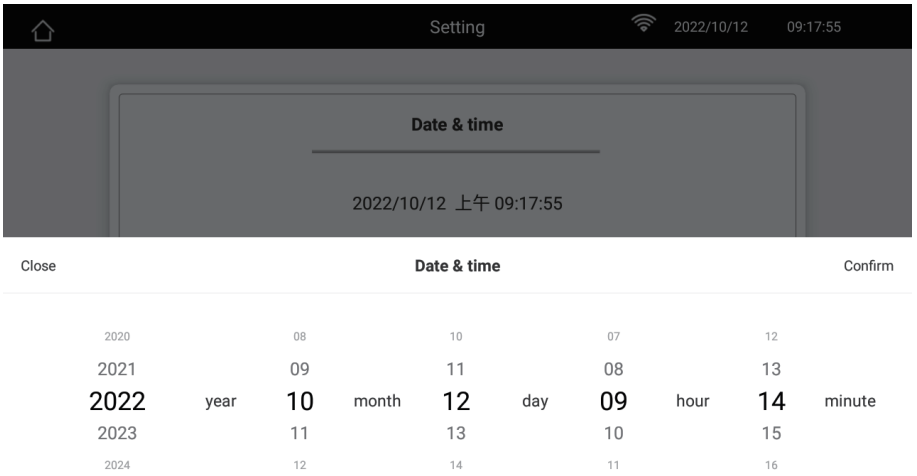
6) Tm calculation: Enter Salt concentration / Primer concentration / Primer 1 sequence / PRIMER 2 sequence, and touch ‘Calculate’ for the results of Primer 1 and Primer 2.



7) Language setting: Click to switch language between Chinese and English as needed.

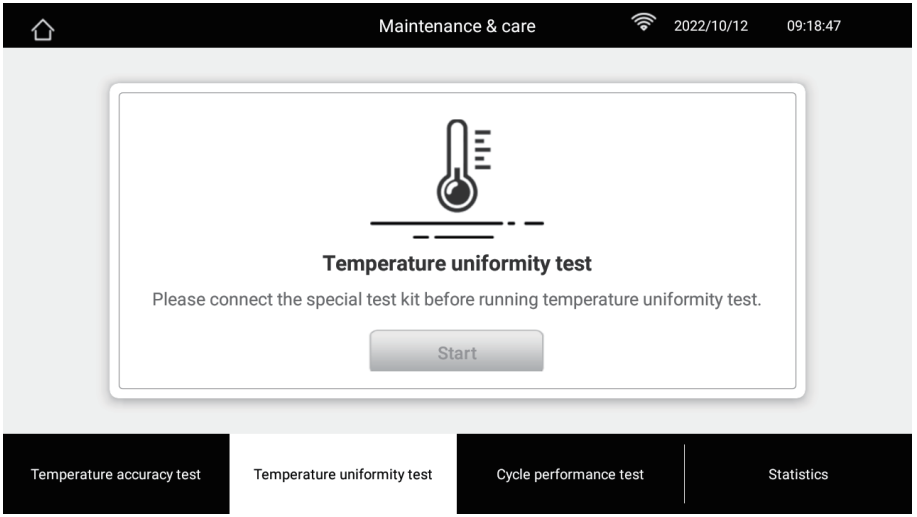


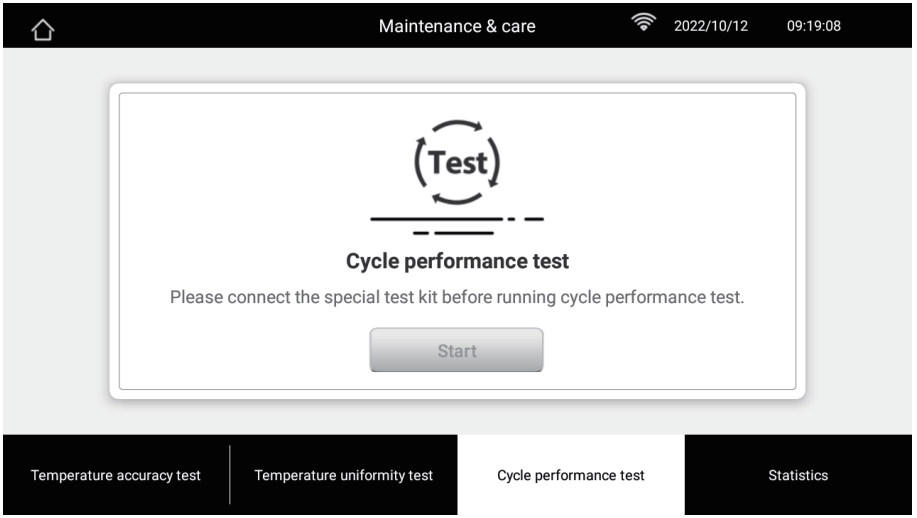
8) Time setting: Touch ‘Change’ and slide to set the date and time as required. Touch ‘Confirm’ to save the setting, or touch ‘Close’ to cancel the setting.

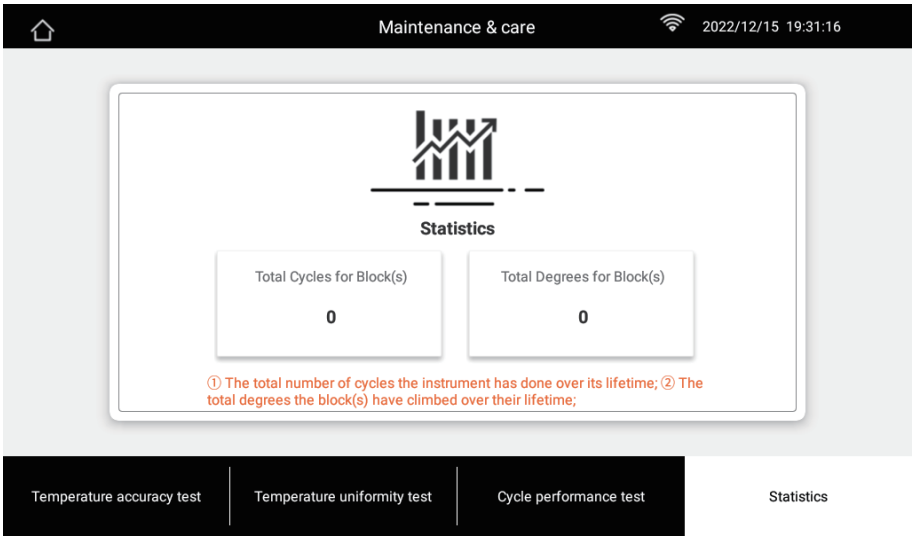


2. Touch ‘Maintenance & Care’ button and enter the following page.

When temperature calibration kit (required additionally) is connected, you can run tests for temperature accuracy & uniformity, and run cycle performance test.

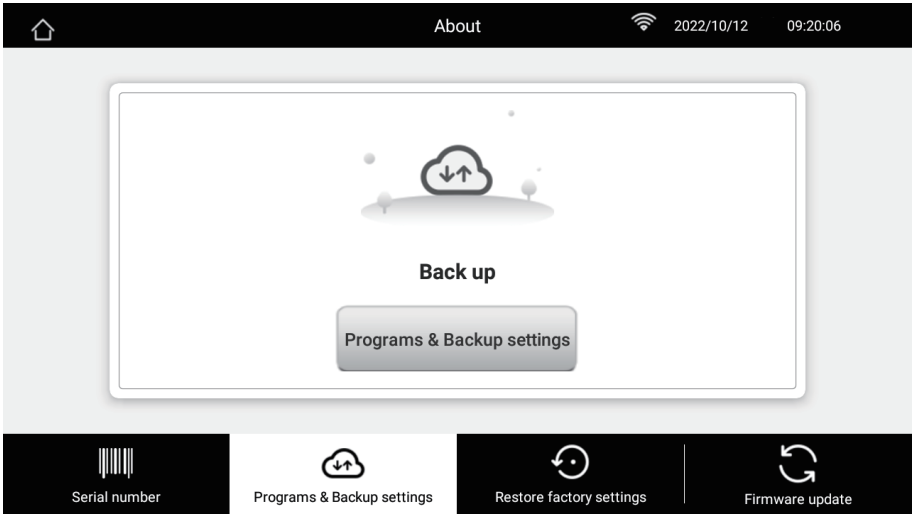



Maintenance & care
2022/10/12
09:19:08
Test
Cycle performance test
Please connect the special test kit before running cycle performance test.
Start
Temperature accuracy test
Temperature uniformity test
Cycle performance test
Statistics

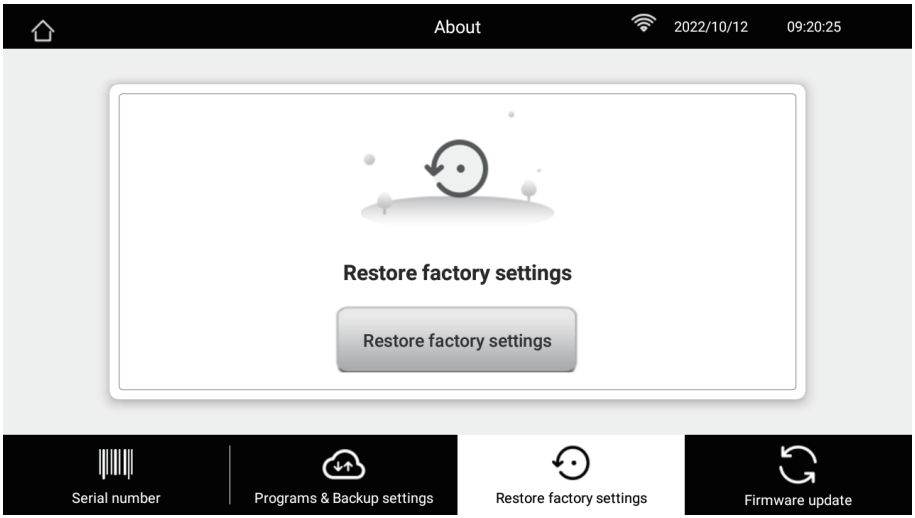

Maintenance & care
2022/12/15 19:31:16
Statistics
Total Cycles for Block(s)
0
Total Degrees for Block(s)
0
① The total number of cycles the instrument has done over its lifetime; ② The total degrees the block(s) have climbed over their lifetime;
Temperature accuracy test
Temperature uniformity test
Cycle performance test
Statistics

3. About

1) Backup: Backup Programs to external USB drive.



2) Restore Factory Settings: Only Admin can restore device to Factory Settings.



3) Firmware Update: Insert a USB device with the updated software first, touch "Firmware Update" to upgrade Firmware and touch “UI Upgrade” to update UI. Only Admin can perform firmware update

Attention:

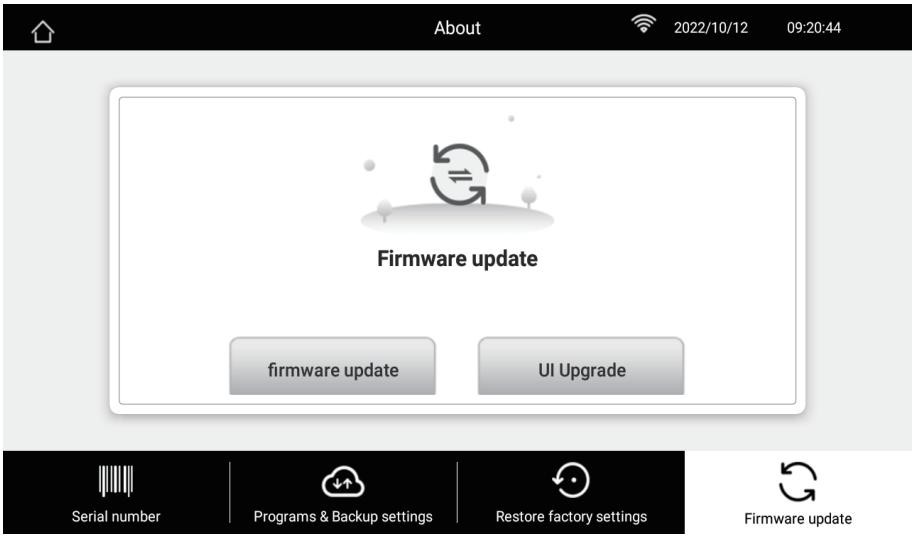
a. USB drive must be formatted to FAT32 first, and then copy two files "xxx.apk", xxx.bin to USB drive.

b. This upgrade will clear the user data created before, including stored programs and running history. Remember to back up data in advance.

Firmware update: Upgrade the program running algorithm.

UI software update: Update the UI interface in software operating system.

System will reboot automatically after upgrade.



7. Troubleshooting

1. The instrument cannot work after start-up.
   - Check if the power cord is connected properly.
   - Check if DC power plug is disconnected or loose.
2. Self-testing failure
   - Turn off the power switch and re-start the device.

8.Error Codes

Error code	Error Description	Error description
E1	Malfunction of TEC block No. 1	E1 pop-up+sound alert
E2	Malfunction of TEC block No. 2	E2 pop-up+sound alert
E3	Malfunction of TEC block No. 3	E3 pop-up+sound alert
E4	Malfunction of TEC block No. 4	E4 pop-up+sound alert
E5	Malfunction of TEC block No. 5	E5 pop-up+sound alert
E6	Malfunction of TEC block No. 6	E6 pop-up+sound alert
E7	Failure in heated lid	E7 pop-up+sound alert
E8	Radiator malfunction	E8 pop-up+sound alert
E9	Malfunction of temperature sensor of TEC block No. 1	E9 pop-up+sound alert
E10	Malfunction of temperature sensor of TEC block No. 2	E10 pop-up+sound alert
E11	Malfunction of temperature sensor of TEC block No. 3	E11 pop-up+sound alert
E12	Malfunction of temperature sensor of TEC block No. 4	E12 pop-up+sound alert
E13	Malfunction of temperature sensor of TEC block No. 5	E13 pop-up+sound alert
E14	Malfunction of temperature sensor of TEC block No. 6	E14 pop-up+sound alert
E15	Malfunction of temperature sensor of heated lid	E15 pop-up+sound alert
E16	Malfunction of temperature sensor of radiator	E16 pop-up+sound alert
E17	Communication failure or others	E17 pop-up+sound alert

If you still cannot trouble shoot the problems, please contact supplier or manufacturer.

9. Cleaning & Maintenance

No special maintenance is needed for this device.

Cleaning

- Disconnect the power supply before cleaning the instrument.
- When cleaning, only use cleaning solution recommended by us, such as aqueous solution with active agent and isopropyl alcohol.
- Wear protective gloves when cleaning the device.
- Do not immerse device in the cleaning solution.
- When cleaning, do not let moisture penetrate the instrument.
- Please confirm with us before cleaning with other methods to avoid damage to the instrument.

Maintenance

Before sending back your instrument for service, please clean it and ensure there is no hazardous material remaining inside the instrument.

For repair service, please pack the device with the original packaging and send it back. Use proper packaging if original packaging is no longer available.

10. Technical Specifications

Item name	Specifications
Input voltage [V] / Frequency [Hz]	AC 100 V-240V, 50/60Hz
Max input power [W]	750W
Display	7-inch LCD touch screen
Compatible consumables	96X0.2mL PCR tubes, 8X12 PCR strips and 96-well plate
Heating block temperature range [°C]	4°C~100°C
Heated lid temperature range [°C]	30°C~115°C
Accuracy of temperature display [°C]	±0.1°C
Accuracy of temperature control [°C]	±0.25°C (35 °C – 99.9°C)
Max temperature ramp rate [°C/s]	5°C/s
Max cooling rate [°C/s]	4°C/s
Temperature uniformity [°C]	< 0.5℃(20s after reaching 95°C)
Gradient temperature range [°C]	30-99°C
Gradient temperature difference [°C]	1-25°C (max. 5°C between adjacent blocks)
Material of heating blocks	Aluminum alloy
Communication port	USB & RS232
Program Storage Capacity	1000
Protection grade [DIN EN60529]	IP42
Power loss protection (PLP)	Included
Permissible ambient temperature [°C]	5-40°C
Permissible ambient humidity [%]	80%
Dimensions（W*D*H）[mm]	365*243*244mm
Weight [kg]	9KG

11. Warranty

This instrument is warranted to be free from defects in materials and workmanship under normal use and service, for a period of 12 months from the date of dispatch. The warranty is extended only to the original purchaser.

It shall not apply to any product or parts which have been damaged on account of improper installation, improper connections, misuse, accident, or abnormal conditions of operation. For claims under the warranty, please contact your local supplier or the manufacturer.

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