

# **User's Operating Manual**

## Recirculating Coolers

V2.0

This operating manual has been designed to help you gain an understanding the principles of operating and possibilities of our bath liquid circulation unit. For optimum utilization of all functions, we recommend that you thoroughly study this manual prior to beginning operation.

### **Safety Warnings**

- 1) Take care your unit is operated only by qualified persons.
- 2) Make sure you read and understand all instructions and safety precautions listed in this manual before installing or operating your unit.
- 3) Performance of installation, operation, or maintenance procedures other than those described in this manual may result in a hazardous situation and may void the manufacturer's warranty.
- 4) Transport the unit with care. Sudden jolts or drops may cause damages in the interior of the unit.
- 5) Observe all warning labels.
- 6) Never remove warning labels.
- 7) Never operate damaged or leaking equipment.
- 8) Never operate the unit without bath fluid in the bath.
- 9) Always turn off the unit and disconnect the mains cable from the power supply before performing any service or maintenance procedures, or before moving the unit.
- 10) Always empty the bath before moving the unit.
- 11) Never operate equipment with damaged mains power cables.
- 12) Refer service and repairs to a qualified technician.

Because of upgrade of productions, the contents of the operating manual may have some differences between the newest production you buy, please consult the on-the-spot service people when you operate the unit for the first time. In your afterwards operation, please contact with us in time if there is any question, we will serve you sincerely. In addition, owing to editor's limited level, defections may not be avoided. Those constructive suggestions are welcome.

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## Chapter I System Introduction

The recirculating cooler, also called as chiller, draws heat from bath liquid via the cooling system for instruments or equipments that need to be cooled (Water is a common bath liquid, synthetic bath liquid, such as glycol water is used for lower temperature) to ensure instruments or equipments to work properly under the regular temperature. A close medium circulation is formed between the unit and the instrument depending on the pump's pressure inside the unit, and the temperature sensor detects the medium temperature to realize the control of the cooler.

The recirculating cooler is applied vastly for a variety of laboratory test equipments such as rotary evaporators, X-ray diffractometer, ICP emission spectrometer, ICP-MS, graphite furnace atomic absorption spectrometer, ED-XRF, electron microscope, medical CT, medical physiotherapy unit, production test unit, precision grinder, computer numerical control machine, machining center, laser equipment etc.

This cooler is an integral unit with parts such as condenser, compressor, evaporator and pump inside the same case.

## Chapter II Installation Instruction

The recirculating cooler shall be equipped indoor with good environment. The principles of choosing the location as following:

	Location Principle
1	Firm ground or experiment table in a dust-free and cool environment with good ventilation
2	Far from droplets or steam
3	Far from the location that influx, viscous flow, leak of fuel gas may happen
4	Far from high frequency devices such as high frequency welding machine
5	Far from the location where acidic solutions used frequently
6	Far from the location where special sprayer (sulfide contained) used frequently

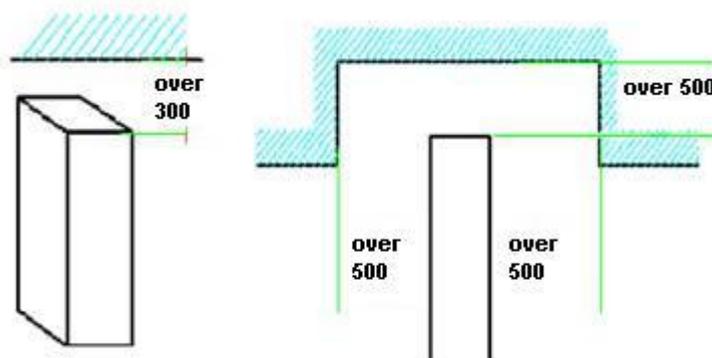
As for convenience and safety of maintenance and installation, space between the indoor unit and obstacles should be ensured.

Ensure the measurements during indoor installation:

- 1) The distance between the bath top and top obstacles shall be at least 300mm;
- 2) The distance between two bath sides and obstacles shall be at least 500mm;
- 3) The distance between bath back and obstacles shall be at least 500mm;
- 4) The distance between bath front and obstacles shall be at least 1000mm;

The following picture shows the space requirements for installation:

(Measurement unit: mm)



Unit installation:

Unpack the unit and check the packing list to ensure accessories to be complete. Please contact with our sales services for solutions when there is a shortage. Move the unit from the wooden packing base to spacious position and check for damages incurred during transit. Push the unit to the installation position after confirmation and ensure it is stable and safe, then install the external circulating loop pipelines.

**Attention**

Please ensure correct collection of the external circulating water loop (That is, the water outlet of the unit should be connected to the water inlet pipe of the instrument needs to be cooled; the return pipe of the instrument should be connected to the water inlet ).

**Please pay attention to joint leakage after injection of the bath liquid. If leakage happens, please deal with it in time.**

## Chapter III User's Guide

### 3.1 Preparations before operation

1. Please clean the water tank and workspace before operation.
2. Make sure the flange bolts of the external flexible hose tightened.
3. Power connection: connect the chiller's power outlet with the single phase power of the workspace (please referring to duty plate of the unit). The requirement of the power supply shall be grounded single phase three wire, whose earth resistance shall not be bigger than 0.1Ω. Electric power supply of single unit shall be at least 10 Ampere.
4. Bath liquid injection: bath liquid should be injected for the first time operation. It will be better the injection volume over the water level switch 10 to 20mm. To avoid blockage and incrustation in pipelines, please use deionized water or dedicated bath liquid. It is necessary for you to clean the water tank and change the bath liquid in water tank regularly to prevent germs.
5. Automatic feed inlet is used to connect with user's bath liquid supply system to realize automatic fluid supplement without supervision. User can voluntarily connect the inlet with bath liquid supply system via standard pipeline. Automatic feed inlet system starts in a low water level state with alarm generated. If user's instrument has already connected with the external bath liquid supply, the automatic fluid supplement process will automatically start. The process will automatically delay 10 seconds to stop after reach the water level.

**Remark 1: Bath liquid shall be injected as soon as the orifice unit starts, which should be slowly injected with funnel diameter no less than 300mm, and stop injection after water level alarm stops.**

**Remark 2: Different temperature range should apply for corresponding bath liquid. Reference as following:**

- Glycol water or alcohol is applied commonly when working temperature is under 5°C.
- Deionized water is applied usually when working temperature is between 5°C and 80°C.
- 15% Glycerin solution is applied commonly when temperature range is

between 80°C and 90°C.

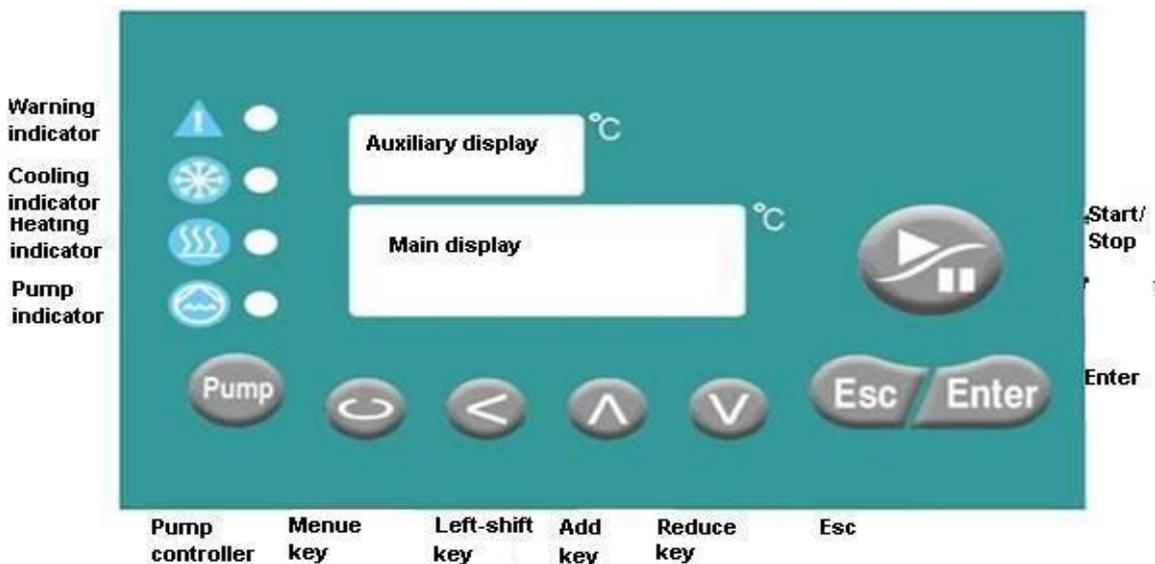
- Silicone oil is applied commonly when temperature range over 90°C.



### Warning

Bath liquid over 35°C should not be directly cooled via cryogenic circulator. That is, the compressor could not start when the temperature of the bath is over 35°C.

## 3.2 Controller Panel



Above is the picture of the unit's controller panel:

There are two 4-digit LED displays. The bigger one is main display, the smaller one is the auxiliary display. The former usually shows real-time temperature, the latter shows target temperature or alarm code and some other related information.

The digital display tube shows and their meanings as following:

0	1	2	3	4	5	6	7	8	9	negative	dot
0	1	2	3	4	5	6	7	8	9	-	.
A	B (b)	C	c	D (d)	E	F	G	H	I	J	K
A	b	C	c	d	E	F	G	H	I	J	K
L	M	N (n)	O (o)	P	Q (q)	R (r)	S	T	t	U	u
L	n	n	o	P	q	r	S	T	t	U	u
V	W	X	Y	Z	centigrade	/	underline				
V	W	X	Y	Z	°	-	-				

There are 8 keys on the controller panel, which are Pump key , Menu key , Left-shift key , Add key , Reduce key , Esc key , Enter key  and Start/Stop key .

There four indicators function as following:

Warning indicator 	Red light flashes	Low water level alarm. No water flow alarm. Protection delay alarm. High temperature and low temperature alarm
Cooling indicator 	Green light	Cooling system working indicator
Heating indicator 	Yellow light	Heating system working indicator (heating function is usually customized by user). Standard unit is not available of the function. This indicator only lights on when heating function is available.
Pump indicator 	Blue light	Water circulation system working indicator

### 3.3 Operation guide

### 3.3.1 Switching on

1. Turn on the leakage protector.
2. Turn on the power switch. Then the unit begins to initializing interface. When initializing finished, the unit enters standby mode with a buzzer beep;
3. Press Start/Stop key. Check the fluctuation of the outlet pressure gauge and the vibration of the pump.

#### Attention



**In case of abnormal noise when pump works, please stop immediately and check; if pump can not start with power on, please cut the power at once and check to remove the faults.**

### 3.3.2 Setting temperature

There are two temperature setting modes: menu set and direct set. Users can set the temperature by operating the Add key  and Reduce key  directly or Menu key  indirectly.

#### 1. Single-point high precision mode:

This mode is to control the water temperature of the bath in a constant value T00 via PID algorithm. The unit under this mode can also work under the Start/Stop economic mode by setting R\_CS and R\_CM parameters (please refer to Part 3.4 for details).

**Remark: In advanced application mode, set 0 as R\_CS parameter, 2 as R\_CM parameter to change to single-point high precision mode. Usually it is not necessary for users to change. It is invalid for start-stop type unit.**

Press Menu key  under working interface, then the auxiliary display shows T00, and the main display shows setting temperature. Press Add key  to add or Reduce key  to reduce the value of the corresponding point. Press Left-shift key  to change the point of the display. After reached the value, please press Enter key  to save the value. The value won't be saved if press Esc key  to return back to the working interface.

## 2. Start/Stop economic mode

This mode controls the start/stop of the compressor by setting two kinds of temperatures (objective control temperature T00 and control precision T01). When the water temperature of the bath is higher than T00+T01, the compressor starts to cooling, and it stops until the temperature lower than T00-T01. This circulation controls the temperature value between T00-T01 and T00+T01. If set T00=20°C and T01=5°C, then the unit will control the temperature between 15°C and 25°C; when the water temperature is higher than 25°C, the compressor starts to cooling, and the auxiliary display shows the objective cooling temperature as 15°C; when the water temperature is lower than 15°C, the compressor stops to cooling, at the same time the auxiliary display shows the temperature upper limit as 25°C.

**Remark: In advanced application mode, it is upper and lower economic control mode to set 0 as R\_CS parameter, 1 as R\_CM parameter. Usually it is not necessary for users to change.**

Press Menu key  under working interface, then the auxiliary display shows T00, and the main display shows setting temperature. After parameters set, press Enter key  to save and press Menu key  enter into temperature control precision setting, now the auxiliary display shows T01(temperature control precision), the main display shows the precision of the temperature difference control, which can be set by Left-shift key , Add key  and Reduce key .

**Remark: Units with Start/Stop economic temperature control mode can not working under single-point high precision temperature control mode by setting R\_CS and R\_CM parameter.**

## 3. Tracking control mode:

In this mode, the water temperature in the bath can be controlled via adding another temperature sensor by configuration of the sensors' port of the unit. This temperature sensor can sense the temperature of the environment or user's equipments. Please refer to Part 3.4 for detailed setting method.

**Remark: Ordinary chillers are not available of tracking temperature control mode function, it is optional for customers.**

### 3.3.3 Start/Stop compressor

Press Start/Stop key  under working interface. The pump operation indicator is on. The auxiliary display shows the compressor protection countdown. After countdown finished, the compressor begin to run, and the auxiliary display shows the target temperature., and the cooling indicator will indicate cooling state according to the computing result of the PID modifier.

Press Start/Stop key  to stop operation during unit operation, and the unit enters into standby mode.

In normal operation state, the auxiliary display on the control panel shows the target temperature, the main display shows the current temperature value of the circulation liquid.

### 3.3.4 Start/Stop pump

The pump indicator is off state when pump does not work. Press Pump key  to start, the pump indicator lights on. During pump is working, pump operation indicator is always on state until the pump stops.

**Remark: In the unit working state, the pump will continue working to provide bath liquid circulation, it is invalid to stop the pump by pressing the Pump key .**

### 3.3.5 PID Adjustment

When medium circulator works under different temperatures, the control parameters are slightly different if cooling power is different. When connecting with different loading units, the control parameters are usually different. PID parameters can be adjusted via circulators for much more precise temperature control.

**Adjustment process:** First set the target temperature then press Start/Stop key . Long press Enter key  until the auxiliary display shows the adjusting objective and adjusting state alternatively. At this moment, users need not do any operation. When adjustment finished, the system will quit automatically and enter into operating state. If users want to quit the adjusting state, long press Esc key , then the unit back to operating state.

**Remark: The adjusting time is different from different unit with different adjusting temperature. Ordinarily it is about 15 to 20 minutes.**

### 3.3.6 Switching off

1. Press Start/Stop key  to stop the compressor, the system enters into standby state, then press Pump key  to turn off then pump.
2. Switch off the power supply of the control panel;
3. Please turn off the electric leakage protection and power supply switch, empty and dry the water tank and pump for long time outage;
4. After long time usage, the pump should be opened to check and change the worn-out parts when water flow and pressure decrease obviously;
5. Please ensure no water in the unit (especially in the pump and plate heat exchanger) when the environment temperature is under 0 °C . Residual water will freeze and do damage to parts such as the pump, heat exchanger and pipes. It is suggestive to use antifreeze as circulating medium for long time operation and outage in low temperature environment.

### 3.4 Advanced application mode

Long press Menu key  over 3 seconds into advanced application mode. The main LED digital display shows four flashing slashes prompting for code, press Add key  and Reduce key  to input data, press Left-shift key  to move the input location, press Enter key  to enter into parameter set mode after finished inputting code. Different parameter set interface can be loaded with inputting different code.

Take setting operation model base as an example in the following text (The other parameter database setting method is similar, please refer to Appendix I for details).

- 1) Input code 0022 to enter into operation model base. The first interface: the auxiliary display shows R\_AM, which is the code for automatic start with power on; the main display shows setting parameter, 0 stands for automatic start, 1 for manual start, 2 for remote control switch, 3 for remote communication control. Press Add key  and Reduce key  to change set value, press Left-shift key  to change the current location, press Enter key  to save current setting value and enter into next

parameter set process, press Esc  to quit current set and back to the work interface, press Menu key  to quit without saving setting value and enter into next parameter set interface.

**Remark: Start automatic control, cooling temperature control mode will process automatically with power on; stop automatic control, cooling temperature control mode can realize by pressing Start/Stop key .**

- 2) The second interface: the auxiliary display shows R\_CM, the temperature control mode code; the main display shows optional parameters of the temperature control mode, 1 stands for upper and lower limit, 2 stands for single point high precision temperature control; the set method is ditto.
- 3) The third interface: the auxiliary display shows R\_CS, the main display show temperature control setting parameter, 0 stands for set mode, 1 stands for tracking mode. Press Menu key  to enter into next interface, use Add key  and Reduce key  to change the parameters.
- 4) The fourth interface: the auxiliary display shows R\_MS, the main display shows the parameter option of the main sensor port, 1 stands for sensor port one, 2 for sensor port two and 3 for sensor port three; the set method is ditto.
- 5) The fifth interface: the auxiliary display shows R\_SS, the main display shows the port option of the auxiliary sensor; the alternation method is ditto.
- 6) The sixth interface: the auxiliary display shows R-LO, the main display shows keyboard lock options. If choose YES, in three minutes under work state, at the bottom right of the main display, the decimal point begins to flash, when the keyboard locks; long press Esc  to quit lock state; Choose NO to disable the function.
- 7) The seventh interface: the auxiliary display shows R\_RS, the main display shows NO or YES, this parameter can restore factory default setting; the set method is ditto.
- 8) The eighth interface: the auxiliary display shows R\_VE, the main display shows the software version number.
- 9) The ninth interface: the auxiliary display and the main display both show \_END, which means the end of parameter set.

### 3.5 Common alarms

#### ■ Start-up delay alarm: E\_DL

The unit will not enter into cooling state until the delay protection time is full after power on. It is three minutes start-up delay time. In power-on state, when the period between two times of the compressor starts to operate is longer than start-up delay protection time, the compressor starts to cool as soon as the unit starts. The start-up delay alarm functions when pressing compressor Start/Stop key before start-up delay protection time fulfils in power-on state. At this moment, the main display shows E\_DL, alarm indicator flashes and no alarm sound; when start-up delay protection time is full, the compressor starts automatically with alarm lifted.

■ **Low water level alarm: E\_LW**

When the water level is lower than the evaporator, the water level alarm functions with buzzer beeps, at the same time the water inlet valve opens automatically, the user's external water circulation begins to import water. In standby state, the compressor won't start when press the compressor Start/Stop key, it will return to normal after water fulfilled. In work state, low water level alarm functions for water level shortage, it can be lifted by adding water or pressing Compressor Start/Stop key to stop the compressor. When water level alarm functions with buzzer beeps, and the auxiliary display shows E\_LW.

**Remark: To protect cooling unit, please switch off it before check.**

■ **Low water flow alarm: E\_LF**

In working state, when the water flow amount is lower than the valve (not all the units available of flow valve, it is optional for customers), the water flow alarm functions with buzzer beeps and the auxiliary display shows E-LF. At this moment, please check whether the pump starts or not. If pump not started, the alarm can be lifted by starting the pump; if it is not the reason, which indicates that there is a failure in the pump or water circuit is blocked, please check the water system. At this moment please press Start/Stop key of the compressor to stop it to lift the alarm and check.

**Remark: To protect cooling unit, please switch off it before check.**

■ **Over temperature limit alarm: E\_H1**

In work state, when the water temperature is higher than the setting high temperature limit, the over temperature limit alarm functions with buzzer beeps, the auxiliary display shows E\_H1. At this moment, the alarm can be lifted either by waiting for the automatic temperature control system of the unit to cool, or just pressing Start/Stop key of the compressor to stop it. After

it, you can check the system.

**Remark 1: To protect cooling unit, please switch off it before check.**

**Remark 2: The compressor can not be started when the temperature of the circulation liquid is higher than the temperature of compressor protection.**

■ **Under temperature limit alarm: E\_L1**

In work state, when the water temperature is lower than the setting low temperature, the under temperature limit alarm will function with buzzer beeps, and the auxiliary display shows E\_L1. At this moment, the alarm can be lifted either by waiting for the automatic temperature control system of the unit to heat up, or just pressing Start/Stop key of the compressor to stop. After it, you can check the system.

**Remark: More details about alarms information please refer to Appendix II.**

### 3.6 Hardware Port (Optional)

The hardware port provides normally open contact signal of the relay to user's instrument, whose load capacity is 0.3A/125VAC or 0.3A/110VDC or 1A/30VDC. In which water level alarm signal, water flow alarm signal and temperature alarm signal can be output. This port on the back of the unit output signals via 12-pin or 7 pin aviation plug.

**The definition of the 12 pins of the aviation plug:**

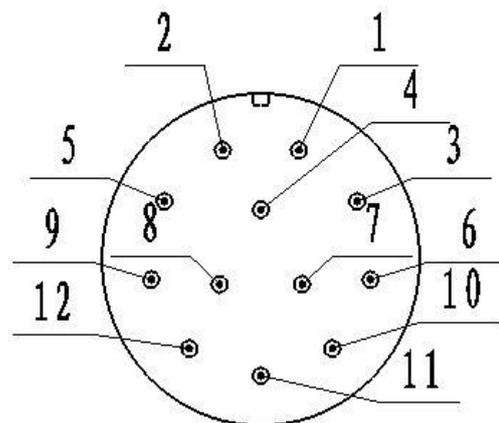
**Pin 1 & 2: water flow signal output, which function with normal water flow and disconnect with abnormal water flow.**

**Pin 3 & 4: water level signal output, which function with normal water level and disconnect with abnormal water level.**

**Pin 5 & 6: temperature signal output 1, it is customized.**

**Pin 7 & 8: temperature signal output 2, it is customized.**

**Pin 9: control input (+) port for receiving of contact signals or level signals (15mA/the resistance provided by the client side). Start the unit with high level or when connected, stop the unit with low level or when**



disconnected.

Pin 10: control input (-) port.

Pin 11 & 12: reservation.

## Chapter IV Trouble Shooting Guide

- **Phenomenon:** the unit starts with the power supply switch indicator not on and pump not working for the first time operation;  
**Possible reason and solution:**  
**Reason:** air break switch on the power supply incoming end is OFF state.  
**Solution:** turn ON the air break switch.
- **Phenomenon:** The pump can not work or work properly with the Pump indicator on but buzzer beeps.  
**Possible reason and solution:**  
**Reason:** it is difficult to start the pump because of a lot of air or dirt in the pump or long time outage causing the lubrication decrease of the rotor.  
**Solution:** Cut off the power supply, open the cover board of the unit and pull out the rubber gasket, rotate the rotor for a while by a straight screwdriver, then the pump can be restarted properly.  
**Attention:** Different unit may apply for different pump type, the method above may be not always applicable.
- **Phenomenon:** water level alarm indicator flashes and buzzer beeps.  
**Possible reason and solution:**
  - a) **Reason:** water shortage in the water tank, low water level.  
**Solution:** add water until water level above the fluid level switch.
  - b) **Reason:** fluid level switch short or damage.  
**Solution:** change the fluid level switch.
- **Phenomenon:** water flow alarm indicator flashes with buzzer beeps  
**Possible reason and solution:**
  - a) **Reason:** the pump is not started;  
**Solution:** press Pump key  to start;
  - b) **Reason:** water circuit leaks;  
**Solution:** check the water circuit;
  - c) **Reason:** pump damage;

**Solution:** change the pump.

## Appendix I Parameter Database

Temperature set menu: no code, directly press Menu key to enter;

Item	Parameter	Meaning	Option or Range	Initial data
Objective temperature	T_00	Setting the target temperature (Start/Stop type, PID)	C_SL ~C_SH	20
Temperature deviation	T_01	Setting control precision (Start/Stop type)	0.01 ~ 9.99	5
Tracking temperature	T_11	Setting deviation temperature (tracking mode)	-99.9~99.9	-2

Operation mode database: code: 0022, long press Menu key to enter with code;

Item	Parameter	Meaning	Option or Range	Initial data
Control mode	R_AM	Automatic start with power on	0 — automatic start	1
			1—manual start	
			2—remote switch control	
			3 — remote communication control	
Temperature control mode	R_CM	Temperature control mode option	1 — Start/Stop type	1
			2—PID	
Temperature control set	R_CS	Temperature control set option	0—set mode	0
			1—tracking mode	
Main sensor	R_MS	Main temperature	1—sensor port 1	1

Item	Parameter	Meaning	Option or Range	Initial data
option		sensor port option	2—sensor port 2 3—sensor port 3	
Auxiliary sensor option	R_SS	Auxiliary sensor port option	0—no 1—sensor port 1 2—sensor port 2 3—sensor port 3	0
Enable keyboard lock	R-LO	keyboard lock options	Yes-Enable No-Disable	No
Recover factory default	R_RS	Recover factory default	YES—yes No—no	No
Version display	R_VE	Version display	N.NN	2.00
End	_END	Parameter set end signal	-----	-----

Alarm parameter database: code: 0055. Long press Menu key to enter with code;

Item	Parameter	Meaning	Option or Range	Initial Data
High temperature alarm 1	E_H1	The first point of the user defined high temperature alarm	C_PL+1 ~ C_PH	C_PH
High temperature alarm 2	E_H2	The second point of the user defined high temperature alarm	E_H1+1 ~ C_PH	C_PH
Low temperature alarm 1	E_L1	The first point of the user defined low temperature alarm	C_PL ~ C_PH-1	C_PL
Low temperature alarm 2	E_L2	The second point of the user defined low temperature alarm	C_PL~E_L1	C_PL
Water level enable	E_LW	Set water level switch to enable	0—No alarm 1—alarm	1
Water flow enable	E_LF	Set water level switch to enable	0—No alarm 1—alarm	0
Sensor port 1	E_S1	Sensor fault alarm in input port 1	0—No alarm	1

Item	Parameter	Meaning	Option or Range	Initial Data
			1—alarm	
Sensor port 2	E_S2	Sensor fault alarm in input port 2	0—No alarm 1—alarm	0
Sensor port 3	E_S3	Sensor fault alarm in input port 3	0—No alarm 1—alarm	0
Warning port 1	E_O1	Alarm output port 1 configuration (output port 5)	0—No alarm 1 — E_H1 alarm 2 — E_H2 alarm 3 — E_L1 alarm 4 — E_L2 alarm 5 — E_S1 alarm 6 — E_ S2 alarm 7 — E_ S3 alarm 8 — E_CE alarm 9 — E_ PL alarm 10 — E_PH alarm 11 — E_CH alarm	0
Warning port 2	E_O2	Alarm output port 2configuration (output port 6)	0—No alarm 1 — E_H1 alarm	0

Item	Parameter	Meaning	Option or Range	Initial Data
			2 — E_H2 alarm 3 — E_L1 alarm 4 — E_L2 alarm 5 — E_S1 alarm 6 — E_ S2 alarm 7 — E_ S3 alarm 8 — E_CE alarm 9 — E_ PL alarm 10 — E_PH alarm 11 — E_CH alarm	
End	_END	Parameter set end signal	-----	--- -

## Appendix II Warning Information

Item	Alarm lamp and buzzer	Auxiliary display	Main display	Solution
High temperature alarm 1	2S flash	E_H1	Current temperature	No, quit when the temperature lower than E_H1, back to original work mode
High temperature	1S flash	E_H2	Current	No, quit when the

Item	Alarm lamp and buzzer	Auxiliary display	Main display	Solution
alarm 2			temperature	temperature lower than E_H2, back to original work mode
Low temperature alarm 1	2S flash	E_L1	Current temperature	No, quit when the temperature higher than E_L1, back to original work mode
Low temperature alarm 2	1S flash	E_L2	Current temperature	No, quit when the temperature higher than E_L2, back to original work mode
Water level alarm	2S flash	E_LW	Current temperature	Stop heating/cooling, quit at normal water level and back to original work mode
Water flow alarm	1S flash	E_LF	Current temperature	Stop heating/cooling, quit at normal water level and back to original work mode
Sensor 1 break	1S flash	E_S1	999	Stop heating/cooling, quit at normal water level and back to original work mode
Sensor 1 short	1S flash	E_S1	-999	Stop heating/cooling, quit at normal water level and back to original work mode
Sensor 2 break	1S flash	E_S2	999	Stop heating/cooling, quit at normal water level and back to original work mode
Sensor 2 short	1S flash	E_S2	-999	Stop heating/cooling, quit at normal water level and back to original work mode
Sensor 3 break	1S flash	E_S3	999	Stop heating/cooling, quit at normal water level and back to original work mode
Sensor 3 short	1S flash	E_S3	-999	Stop heating/cooling, quit at normal water level and back

<b>Item</b>	<b>Alarm lamp and buzzer</b>	<b>Auxiliary display</b>	<b>Main display</b>	<b>Solution</b>
				to original work mode
Delay	2S flash	E_dL	Countdown	No, quit with countdown
Communication	2S flash	E_CE	Current temperature	No, quit with countdown
Under lower limit of the unit temperature	0.5S flash	E_PL	Current temperature	Stop cooling, no quit (restart the unit)
Over upper limit of the unit temperature	0.5S flash	E_PH	Current temperature	Stop heating, no quit (restart the unit)
Over upper limit of the cooling temperature	0.5S flash	E_CH	Current temperature	Stop cooling, quit at normal temperature, back to original work mode

**That's the end of the manual. Thank you! Have a nice day!**