BIOBASE

Laboratory Refrigerator
BPR-5V628/968/650
Service Manual

BIOBASE GROUP

Content

1. Working Principle

Laboratory refrigerators are mainly composed of four parts: refrigeration system, electrical control system, sound and light alarm system, and backup power system. There is a temperature controller on the upper part of the refrigerator, which displays information such as temperature, working status, and alarm prompts. The USB module is used to export temperature recording data.

1.1 Refrigeration principle

Laboratory refrigerators are used to store blood and its products in a closed refrigeration system. The compressor sucks in the low-pressure gas refrigerant from the low-pressure end of the evaporator, compresses it into high-temperature and high-pressure gas, and sends it to the condenser for condensation into high-pressure liquid. It flows through a dry filter to remove moisture and impurities, and then through capillary throttling, the liquid enters the evaporator. At this point, due to the sudden drop in pressure, the liquid rapidly boils, vaporizes, and absorbs heat, thereby reducing the temperature inside the cabinet. The evaporated low-pressure gaseous refrigerant is then sucked back by the compressor. Repeat this cycle repeatedly.

1.2 Electrical control principle

The temperature inside the cabinet is controlled by a thermostat. When the temperature inside the cabinet is higher than the set value, the compressor runs and begins cooling; When the temperature inside the cabinet drops to the set value, the compressor stops working, and then the temperature inside the cabinet slowly rises. The above process will be repeated, and so on.
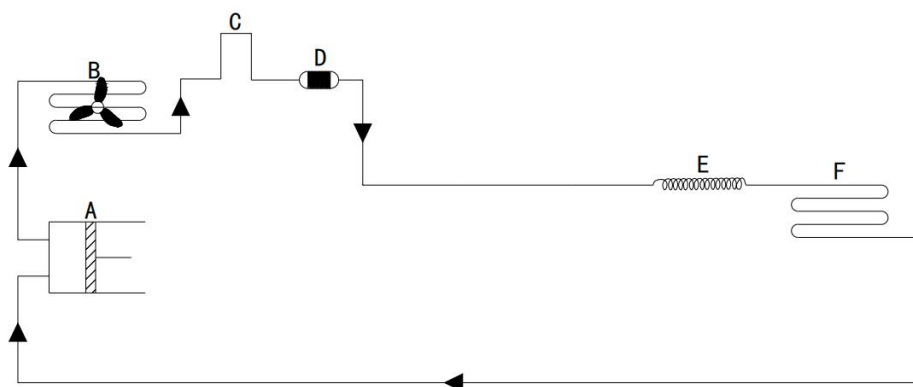
A-Compressor   B-Condenser   C-Anti leakage pipe   D-Dry filter
E-Capillary   F-Evaporator

1.3 Sound and light alarm function

(1) Overtemperature alarm
When the temperature inside the refrigerator exceeds 8 ℃ and falls below 2 ℃, a buzzer will sound an alarm and an over temperature alarm will be triggered. The buzzer sound alarm can be cancelled through the operation button on the surface sticker, and the over temperature alarm indicator light will remain on.
(2) Door open alarm
If the door is opened for more than 60 seconds, the buzzer will sound an alarm and the door will open an alarm. The buzzer sound alarm can be cancelled by pressing the button on the surface, and

the door opening alarm indicator light will remain on.

(3) Power outage alarm

When the backup battery is not connected, the battery status indicator light will turn on. When the refrigerator is powered off, it will sound a buzzer alarm and a power off alarm. The buzzer alarm can be cancelled by pressing the button on the surface, and the power off alarm indicator light will flash.

1.4 Circuit schematic diagram
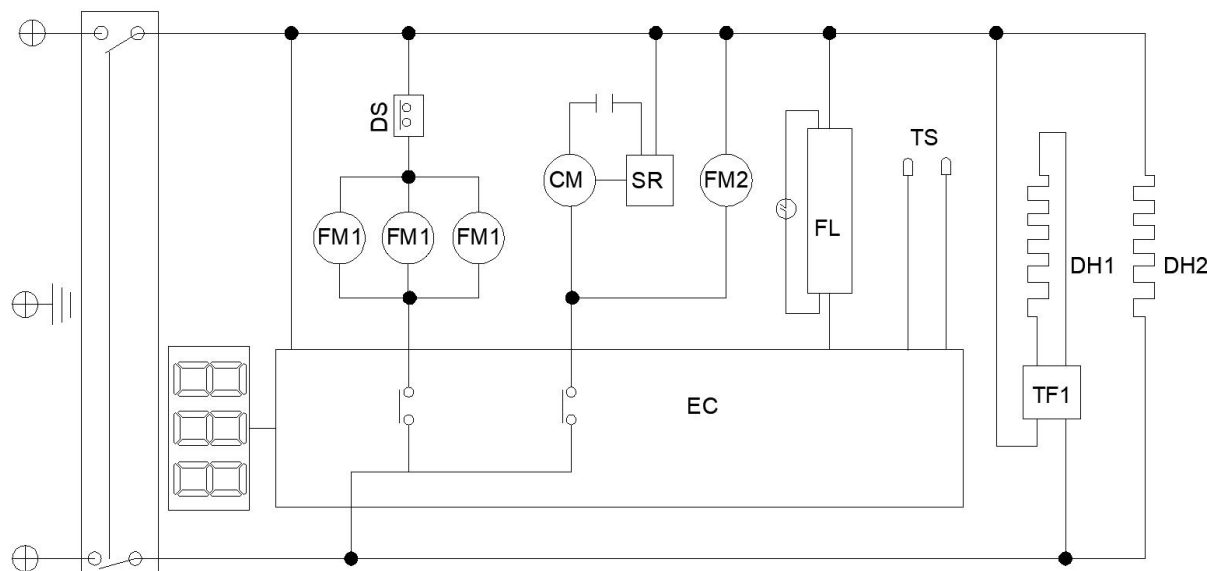
FL=Light   FM1=Evaporator fan   FM2=Condenser fan   CM=Compressor

SR=Start relay   EC=Control board   DS=Door switch   TS=Temperature probe

TF1=Transformer   DH1=Glass door heating wire   DH2=Center beam heating wire

1.5 Button function
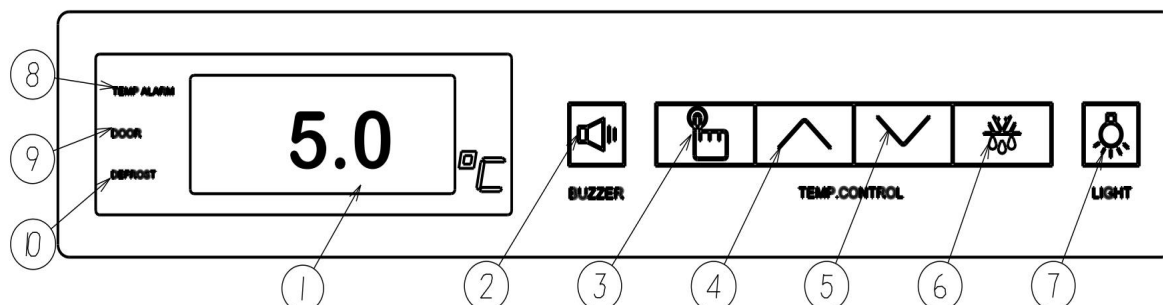
① Temperature display inside the cabinet ② Mute button ③ Set button ④ Up button ⑤ Down button ⑥ Forced defrost button ⑦ Light on key ⑧ High temperature alarm ⑨ Door open alarm ⑩ Defrost status

Note: The forced defrost button function is not applicable to this model of product.

① Temperature display inside the cabinet: Based on the cabinet temperature display sensor sampling, the temperature inside the cabinet is displayed.

② Mute button: When the refrigerator buzzer alarms (including cabinet temperature over temperature alarm, door opening alarm, sensor failure alarm, etc.), press the mute button to stop the buzzer from sounding. (Pressing the mute button only turns off the buzzer for this abnormal state alarm. If the fault is resolved, the next abnormal buzzer will need to continue sounding.)

In the power-off state, press and hold the mute button for 5 seconds to disconnect the backup power connection, and the controller will not work.

③ Setting button: In normal mode, pressing the setting key for more than 3 seconds will display the set temperature value. If it exceeds 5 seconds, the parameter menu can be accessed. (Password required to enter the settings menu)

④ Up button: In parameter setting mode, you can move to the next parameter or increase the parameter value. When setting the set temperature, increase the set temperature value.

⑤ Down button: When working normally, pressing this button for 3 seconds will flash and display the control temperature for 5 seconds. In parameter setting mode, move to the previous parameter or decrease the parameter value. When setting the set temperature, reduce the set temperature.

⑥ Forced defrost button: When PT is not 0, press the forced defrost button for 5 seconds, the controller will print the current temperature, and the digital display will show P.

⑦ Light on button: During normal operation, press the light on key to turn on or off the lights inside the cabinet.

⑧ High temperature alarm: If the cabinet temperature display sensor exceeds the set alarm temperature and an over temperature alarm is triggered, the over temperature alarm indicator light will remain on.

⑨ Door open alarm: If the door switch is not closed within the set time, the door open alarm indicator light will remain on.

⑩ Defrost status: When the refrigerator is defrosted, the defrost status indicator light is on.

1.6 Parameter setting method

When the refrigerator is powered on, the display screen shows the current temperature inside the cabinet. If you need to readjust the set temperature, for example, if the original set temperature was 2 °C and now needs to be adjusted to 5 °C, please follow the steps below:

Serial No.	Keys Operation	Display
1		Displays the inside temperature
2	Press the Set key 🔒 for 3 seconds	Displays that the initial set value is 2 ℃ and twinkles
3	Press the Up-regulation key ⌃	Figure increases
4	Press the Set key 🔒 for 3 seconds	Saves the user settings and displays the inside temperature

Notes: When working normally,simultaneously press the down-regulation key and Defrost key for 5 seconds, enter the page of setting time parameter value, the default page displays t (min).The corresponding parameters of H (hour), D (day), M (month), and Y (year) were displayed respectively after press the up-regulation key.Select the parameters that needed to be adjusted, press the set key

and the digital tube flickers, adjust the parameters by pressing the up-regulation key or down-regulation key, then press the set key to save the current parameter value. In the process, if the down-regulation key and Defrost key are pressed at the same time, the temperature display interface is restored.

1.7 Parameter categories and descriptions

1.7.1 Temperature sensor calibration
The temperature measured by the temperature sensor can be calibrated and stabilized using the parameters given in the table below.

Parameter	Description	Minimum value	Maximum value	Unit	Default value
/0	Sensor measurement stability	1	15	-	4
/1	Offset of cabinet temperature display sensor	-8.0	8.0	^{o}C	0.0
/2	Offset of cabinet temperature control sensor	-8.0	8.0	^{o}C	0.0

Parameter description:
/0 Sensor measurement stability
This parameter defines the coefficient of temperature measurement stability. Smaller values accelerate the sensor's response time and make it more sensitive to interference. Larger values slow down the sensor's response time, but are insensitive to interference, meaning they have relatively stable values.
/1 cabinet temperature display sensor offset
This parameter is used to calibrate the temperature measurement of the cabinet display sensor. The symbol of the numerical value indicates whether the temperature of the cabinet temperature display sensor is plus (positive) or minus (negative) the offset.
/2 cabinet temperature control sensor offset
This parameter is used to calibrate the measured temperature of the cabinet temperature control sensor. The symbol of the numerical value represents the temperature of the cabinet temperature control sensor plus (positive) or minus (negative) offset.
1.7.2 Temperature control parameters
Control the start and stop of the compressor based on the actual measured temperature and parameter settings of the cabinet temperature control sensor.

Parameter	Description	Minimum value	Maximum value	Unit	Default value
St	Setting temperature	r1	r2	^{o}C	5.0
r1	Setting temperature minimum value	-45.0	r2	^{o}C	2.0
r2	Setting temperature maximum value	r1	90.0	^{o}C	8.0
rd	Temperature difference lower limit	0.1	10.0	^{o}C	1.0
ru	Temperature difference upper limit	0.1	10.0	^{o}C	0.5

Parameter description:

St set temperature

User set working temperature

r1 sets the minimum temperature value

Minimum allowable set operating temperature (St)

r2 sets the maximum temperature value

Maximum allowable set operating temperature

rd, ru temperature difference

When the temperature of the cabinet temperature control sensor is less than or equal to St rd, the compressor stops working; When the temperature of the cabinet temperature control sensor is greater than or equal to St+ru, the compressor starts working.

Attention: When the cabinet temperature control sensor fails, the cabinet temperature display sensor will replace the cabinet temperature control sensor to control the compressor on/off; When both the cabinet temperature control sensor and the cabinet temperature display sensor fail, the controller can control the compressor on/off according to the set proportional cycle or memory proportional control (refer to parameter C2).

1.7.3 Compressor Protection

This parameter is designed to protect the normal operation of the cabinet and the compressor.

Parameter	Description	Minimum value	Maximum value	Unit	Default value
c0	Delay of compressor after power on	0	100	Min	3
c1	Minimum downtime	0	100	Min	0
c2	When both the cabinet temperature control sensor and the cabinet temperature display sensor fail, the compressor operates in a different mode	0	1	-	0
c4	Control the working time of the compressor when the sensor fails	0	99	Min	30
c5	Compressor shutdown time in case of sensor malfunction	1	99	Min	15

Delay of C0 compressor and fan after power on

When the instrument is powered on, the compressor and fan do not start immediately and require a delay of at least c0 (unit: Min) to start.

C1 minimum downtime

It takes at least c1 (unit: Min) to start the compressor from stop to restart.

When both the C2 cabinet temperature control sensor and the cabinet temperature display sensor fail, the compressor operates in mode

The controller records the start-up and shutdown time of the compressor within 24 hours during normal operation. When both the cabinet temperature control sensor and the cabinet temperature display sensor fail, if c2=0, the compressor will run according to the compressor start stop record

stored in the controller; If c2=1, the compressor startup time is c4 and the shutdown time is c5

When both the C4 cabinet temperature control sensor and the cabinet temperature display sensor fail, the compressor's working time

When both the cabinet temperature control sensor and the cabinet temperature display sensor fail, the compressor should be turned on in conjunction with c2 and c5.

When both the C5 cabinet temperature control sensor and cabinet temperature display sensor fail, the compressor will shut down for a certain period of time

When both the cabinet temperature control sensor and the cabinet temperature display sensor fail, the compressor shutdown time should be used in conjunction with c2 and c4.

1.7.4 Defrosting

This section is related to defrosting parameters.

Parameter	Description	Minimum value	Maximum value	Unit	Default value
d0	Defrost mode	0	1	-	0
d1	Defrosting cycle	1	199	Hour	8
dp	Maximum defrosting time	0	199	Min	10

d0 defrost mode

d0=0, disable defrosting function

d0=1 cycle defrost, defrost cycle determined by parameter d1

d1

Defrost cycle, which refers to the interval between two defrosts.

dp defrosting maximum time

The maximum time required for defrosting is when defrosting will end.

1.7.5 Alarm

To prevent misjudgment of faults and ensure the normal operation of the controller, alarm parameters are set in the controller to prompt the user when a fault occurs.

Parameter	Description	Minimum value	Maximum value	Unit	Default value
AL	Cabinet temperature display sensor low temperature alarm temperature	-20.0	50.0	oC	2.0
AH	Cabinet temperature display sensor high temperature alarm temperature	-20.0	50.0	oC	8.0
Ad	Cabinet temperature display sensor alarm delay	0	99	Min	1
AS	Alarm delay after power on	0	199	Min	30
AO	Door opening alarm delay	0	250	S	60

AL low temperature alarm temperature

Low temperature alarm temperature: When the temperature inside the cabinet (cabinet temperature display sensor) is lower than or equal to AL, if the alarm delay (see parameter Ad) is met, the buzzer will sound.

AH high temperature alarm temperature

High temperature alarm temperature: When the temperature inside the cabinet is higher than or equal to AH, if the alarm delay (see parameter Ad) is met, the buzzer will sound.

Ad alarm delay

Alarm delay. When the temperature reaches the alarm temperature, it does not immediately sound an alarm. It takes Ad time to sound the alarm. If during the delay period, the alarm condition is lifted, the alarm delay is cancelled, and the counter clears to 0.

If Ad=0 is set, an alarm will be triggered immediately.

Alarm delay after AS power on

After the instrument is powered on, the temperature inside the cabinet (cabinet temperature display sensor) alarm will also be shielded. After a time of AS, it will be determined whether the alarm has been triggered.

AO door open alarm delay

When the door is opened but not closed, the door opening alarm sign on the control panel flashes and the buzzer sounds.

1.7.6 Evaporator Fan Management

To ensure the normal operation of the evaporator fan, set this parameter for evaporator fan management. It needs to be associated with the door switch. When the door is opened, the evaporator fan stops running.

F0	Fan control category		0	1	-	0

Under normal circumstances, the evaporator fan can be managed as follows:

a、 The fan keeps running

b、 Synchronized control with compressor

Parameter description:

F0 fan control type

F0=0, the fan runs continuously

F0=1 fan and compressor synchronous control

Under normal circumstances, the fan operates according to the mode set above.

1.7.7 Other parameters

Parameter	Description	Minimum value	Maximum value	Unit	Default value
H3	Software version number	-	-	-	-
H4	Model selection	0	1	-	0

Parameter description:

H3 software version number

This parameter allows you to view the software version number, which cannot be set and is a system built-in data.

H4 model selection

Corresponding to different models, the internal default parameters will be different. By modifying H4 and pressing the setting key to confirm, all parameters will be changed to the corresponding

default values according to the different models.

1.7.8 Printing Parameters

Parameter	Description	Minimum value	Maximum value	Unit	Default value
PT	Printing and storage interval time	0	999	Min	30

To maintain the temperature inside the cabinet, it is necessary to turn on the printer every Pt time (in minutes) to print the current time and temperature.

Under normal conditions, press the forced defrost button for 5 seconds, and the controller will print the current temperature while the digital display shows P.

PT is 0, no printing, press the forced defrost button to turn on forced defrost.

1.8 Alarm code

Alarm code	Fault description
E0	Cabinet temperature display sensor malfunction (display)
E1	Cabinet temperature control sensor malfunction (control)
Lo and temperature alternate display	Cabinet temperature display sensor low temperature alarm
Hi and temperature alternate display	Cabinet temperature display sensor high temperature alarm
DF and temperature alternate display	The controller is defrosting
Pd	Controller power outage
Up	Importing data to USB drive
End	The data import is complete, and the USB drive needs to be unplugged

When the controller displays the above alarm code, please check the corresponding equipment or components according to the corresponding code, or check whether the controller's parameter settings are appropriate.

1.9 Parameter List

Parameter	Description	Minimum value	Maximum value	Unit	Default value
/0	Sensor measurement stability	1	15	-	4
/1	Cabinet temperature control sensor offset	-8.0	8.0	oC	0.0
/2	Cabinet temperature display sensor offset	-8.0	8.0	oC	0.0

St	setting temperature	r1	r2	oC	5.0
r1	Set the minimum temperature	-45.0	r2	oC	3.0
r2	Set the maximum temperature	r1	90.0	oC	7.0
rd	lower limit of temperature difference	0.1	10.0	oC	0.5
ru	Upper limit of temperature difference	0.1	10.0	oC	0.5
c0	Compressor，the delay time after fan power on	0	100	Min	4
c1	Minimum downtime	0	100	Min	0
c2	When the temperature control sensor and the cabinet temperature display sensor fail, Operation mode of compressor	0	1	-	0
c4	When the control sensor fails the compressor working time	0	99	Min	6
c5	Compressor downtime when controlling sensor failure	1	99	Min	3
d0	Defrost mode	0	1	-	0
d1	Defrosting cycle	1	199	Hour	8
dp	Maximum time to defrost	0	199	Min	10
AL	The cabinet temperature shows the temperature of low temperature alarm of the sensor	-45.0	90.0	oC	2.0
AH	The temperature of high temperature alarm of the sensor is displayed	-45.0	90.0	oC	8.0
Ad	Cabinet temperature display sensor alarm delay	0	99	Min	2
AS	Alarm delay after power	0	199	Min	70
AO	Door open alarm delay	0	250	S	60
F0	Fan control type	0	1	-	0
F1	Forced shutdown temperature of compressor	0.0	3.0	oC	1.5
H3	Software version number	-	-	-	-
H4	Model selection	0	1	-	0
PT	Printing and storage interval time	0	999	Min	30

2. Fault and Maintenance

Fault 1. Refrigeration system leakage problem

The leakage of the refrigeration system is mainly caused by the impact and vibration during the operation of the machine, resulting in leakage of the connection of the pipeline or even cracks in the pipeline, which often occurs in the welding places such as the capillary tube and the evaporator.

The processing methods and steps when handling such faults are as follows:

First fill a small amount of refrigerant, then hold 10kg of nitrogen gas, use the leak detector to check the leaks of each connecting pipe, and alarm. If there is a leak, repair welding is required until the leak is eliminated.sonnel for live operation to avoid danger due to improper operation.

Fault 2. Compressor failure

Treatment method for handling such failures: compressor motor burned out, compressor replaced; compressor starter failure, replacement of starter; compressor liquid blow, refrigerant charged with too much liquid refrigerant sucked into the compressor, causing damage to the suction valve , replace the compressor.

(1) The compressor does not run

Cause analysis: Power supply is off; thermostat is out of regulation.

The processing methods and steps when handling such faults are as follows: check the power supply; check each component.

(2) The compressor does not start

Cause analysis: power failure, low voltage, circuit failure; poor starter contact; temperature controller failure.

The methods and steps for handling such faults are as follows: check the line; repair or replace the starter; repair or replace the thermostat.

(3) The compressor does not stop

Cause analysis: The control system is out of order or the working condition is not good; the compressor suction and exhaust valves leak.

The methods and steps for handling such faults are as follows: overhaul the control system, adjust pressure and temperature parameters, and repair or replace the compressor.

Fault 3. Ice blockage in the refrigeration system

The problem of ice blockage in the refrigeration system can cause a series of chain reactions, ultimately leading to the system not functioning properly. This phenomenon often occurs at the capillary tube welding site.

When dealing with such faults, the handling method is to check the capillary part of the refrigeration system and the filtration system, fill the pipeline with nitrogen for cleaning, and replace the filter.

Fault 4. The refrigeration system cannot start

The ambient temperature is too high, and the overheat protector of the compressor is activated, causing the compressor to fail to start.

The compressor power supply system has malfunctioned, including relay and starter faults, as well as circuit breakers that prevent power supply, resulting in the refrigeration system being unable to start.

Fault 5: The refrigeration system stops working during operation

The methods and steps for handling such faults are as follows:

(1) Check if the instrument suddenly loses power;

(2) Check if there is any malfunction in the electrical circuit;

(3) Check if the compressor is dissipating heat properly, which may cause high pressure (high temperature) and result in the suspension of the refrigeration system operation.

Fault 6: The monitor does not light up

The methods and steps for handling such faults are as follows:

(1) Power off and check if there are any issues with the power supply, and if the power cord plug is securely plugged in;

(2) Digital tube power supply failure, check if the power supply line is normal and if the power supply voltage is normal;

(3) Confirm if the digital tube is damaged;

(4) After confirming that there are no issues with the above items, please replace the control board with a new one.

Fault 7: The film surface sticker cannot be operated

The methods and steps for handling such faults are as follows:

(1) Confirm whether the connection between the button surface sticker and the control board is loose;

(2) Check if the button sticker is damaged. If it is damaged, replace it with a new button sticker;

(3) After confirming that there are no issues with the above items, please replace the control board with a new one.
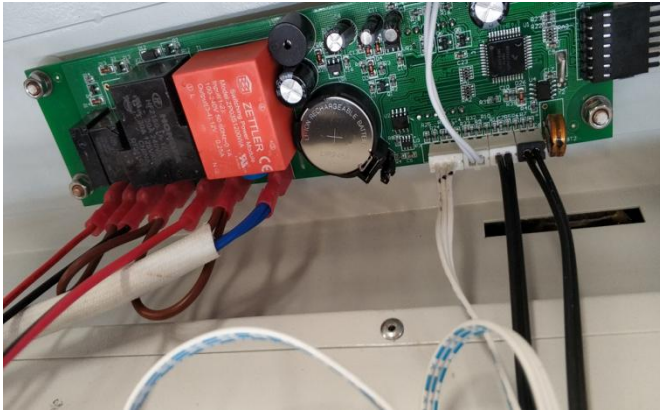
Fault 8: USB malfunction

The methods and steps for handling such faults are as follows:

(1) Check if the wiring harness connection between the USB module and the storage module is loose or incorrectly connected;

(2) Confirm if the USB module is damaged. If it is damaged, replace it with a new USB module;

(3) After confirming that there are no issues with the above items, please replace the thermostat with a new one.
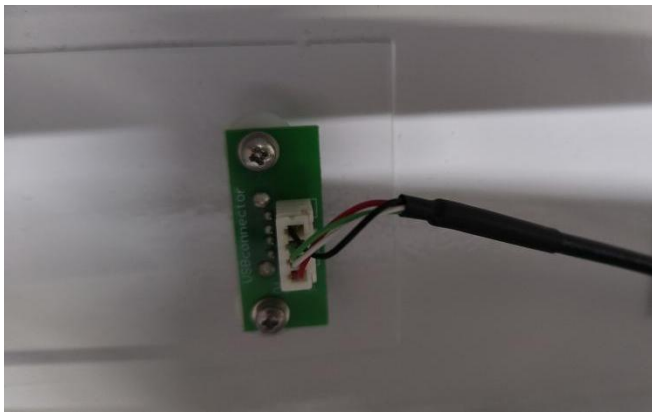

Fault 9: Other faults

If any other component has a problem, check and replace the damaged component. If the electrical connection wire is loose, fix the loose joint properly.

When dealing with most faults, it is necessary to remove the outer cabinet top plate. After removing the screws on the outer cabinet top plate, the electrical components inside the control room can be repaired. The disassembly method is shown in the following figure:
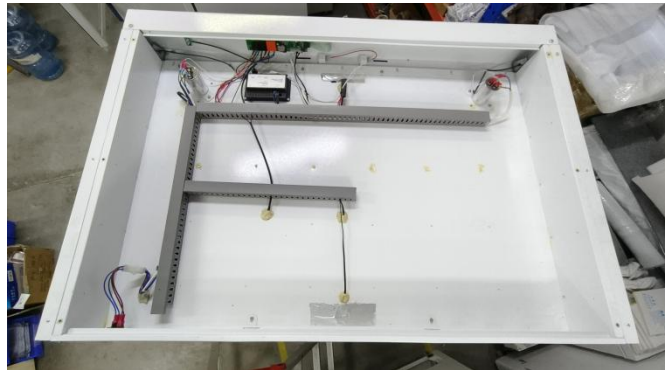
Unplug the wiring harness connected to the upper cover, remove the two screws on the top of the upper cover and the three screws inside the electrical control cabin to remove the upper cover; Remove the control board and USB mounting screws to replace the control board and USB module; The door switch can be directly removed.
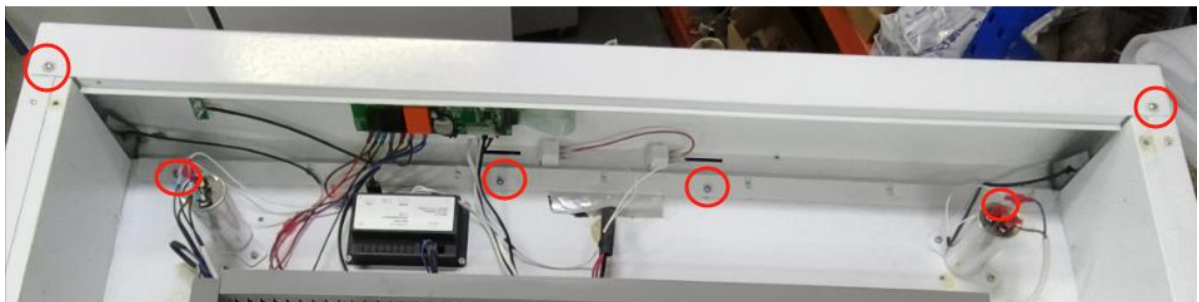
Fault 10: Overtemperature alarm fault

Overtemperature alarm: When the temperature inside the cabinet exceeds 8 ℃ and falls below 2 ℃, a buzzer will sound and an overtemperature alarm will be triggered. The buzzer sound can be cancelled through the operation button on the surface sticker, and the overtemperature alarm indicator light will remain on.

If the temperature inside the cabinet is within the upper and lower temperature range and an alarm occurs, or if the temperature exceeds the upper limit but is lower than the lower limit and no alarm occurs, please adjust the temperature controller parameters according to the instructions.

Analysis of the causes of overheating alarm:

(1) Too many times the door is opened, or too many items are placed in the cabinet at once;

(2) The evaporator fan is malfunctioning and unable to operate;

(3) The compressor is not working

(4) The ambient temperature is too high.

The methods and steps for handling such faults are as follows:

(1) Ensure that the ambient temperature is not too high and place the machine in a well ventilated area;

(2) Suggest not opening the door too frequently, not placing too many items in the cabinet at once, and not exceeding the load line;

(3) Check if the evaporator fan and compressor are working.

Fault 11: Door opening alarm fault

Door opening alarm: If the door is opened for more than 60 seconds, a buzzer will sound and a door

opening alarm will be triggered. The buzzer sound can be cancelled by pressing the button on the surface, and the door opening alarm indicator light will remain on.

If the door opening alarm occurs before 60 seconds, please adjust the temperature controller parameters according to the instructions.

Fault 12: Power outage alarm fault

Power outage alarm: When the backup battery is not connected, the battery status indicator light will turn on. When the refrigerator is powered off, it will sound a buzzer alarm and a power off alarm. The buzzer alarm can be cancelled by pressing the button on the surface, and the power off alarm indicator light will flash.

Analysis of the cause of power outage alarm: battery shortage.

Fault 13: Temperature does not decrease

Fault cause analysis:
(1) The doors inside and outside the cabinet are not tightly closed;
(2) The frost on the air cooler is too thick;
(3) Low compressor efficiency;
(4) Filter clogging;
(5) Refrigerant leakage in the system.
The methods and steps for handling this fault are as follows:
(1) Adjust the gap of the cabinet door;
(2) Defrosting or defrosting;
(3) Compressor maintenance or replacement;
(4) Replace the filter;
(5) Add refrigerant.

Fault 14: Sudden stop during operation

Fault cause analysis:
(1) The motor overheats and the thermal relay activates to cut off power.
(2) Compressor overheat protection.
The methods and steps for handling this fault are as follows:
Check the operation of the condenser fan and whether the condenser is dirty.

Fault 15: Big noise

Fault cause analysis:
(1) Loose machine base;
(2) Compressor hydraulic impact;
(3) Compressor parts are worn out.
The methods and steps for handling this fault are as follows:
a.   Tighten the compressor base;
b.   Replace the compressor.
(4) The noise of the evaporator fan is loud. Observe the noise situation when opening and closing the door. If the noise disappears when opening the door, it indicates that the evaporator fan is noisy and needs to be replaced.

(5) The regular occurrence of noise is caused by the operation of the compressor, and it is necessary to check whether the copper pipe is hitting the wall, etc;

(6) The noise keeps appearing and stops when the door is opened. It is caused by the operation of the evaporator fan. It is necessary to check for loose screws, etc. If not, open the door and press the door switch to check for any abnormal noise from the evaporator axial flow fan. Confirm whether there is wire grinding or fan shaft failure, and replace the evaporator fan if necessary;

(7) The noise level is generally around 55 decibels, with a maximum not exceeding 65 decibels. The noise can be measured by a noise meter;

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