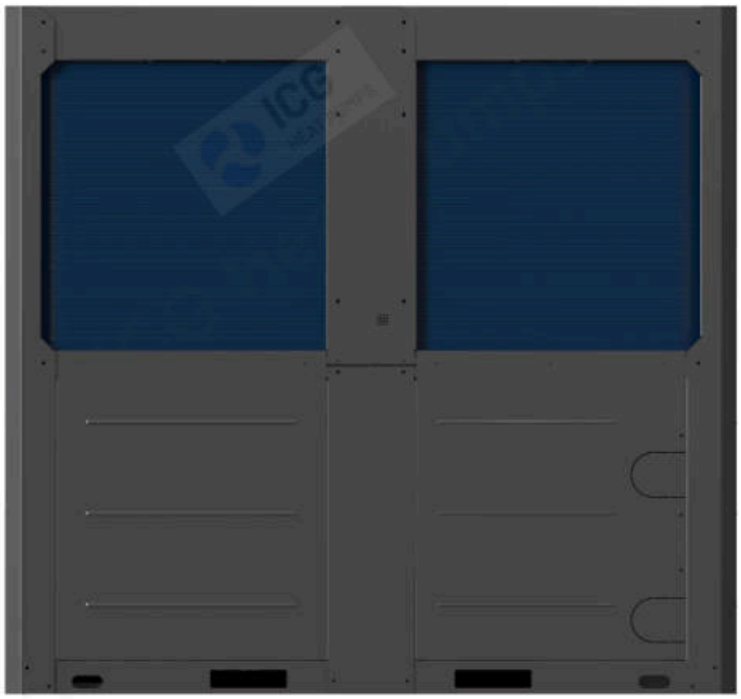
Midea

R290

Midea Building Technologies Division

# Service Manual

## Mars Large Series



## All DC Inverter

MHS-SVC50-RN7TL-B MHS-SVC50(M)-RN7TL-B

MHS-SVC60-RN7TL-B MHS-SVC60(M)-RN7TL-B

MHS-SVC70-RN7TL-B MHS-SVC70(M)-RN7TL-B

# CONTENTS

# Part 1

# General Information

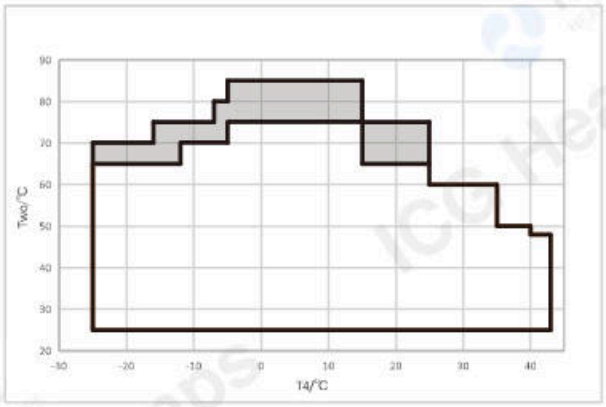
## 1 Unit Capacities and External Appearance

| Model | MHS-SVC50-RN7TL-B<br>MHS-SVC50(M)-RN7TL-B | MHS-SVC60-RN7TL-B<br>MHS-SVC60(M)-RN7TL-B | MHS-SVC70-RN7TL-B<br>MHS-SVC70(M)-RN7TL-B |
|---|---|---|---|
| Power supply | 380-415V/3N/50Hz | | |
| Appearance |  | | |

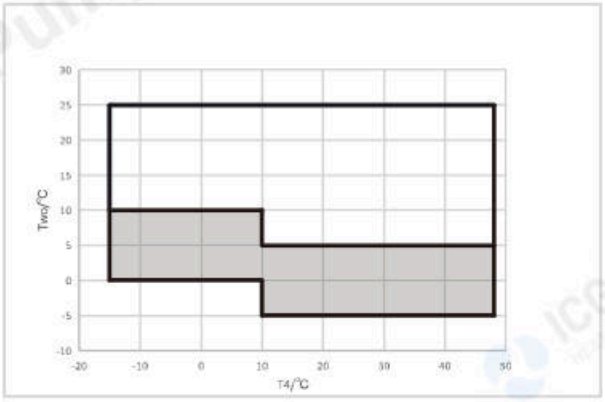
## 2 Water outlet temperature range

### Runing range

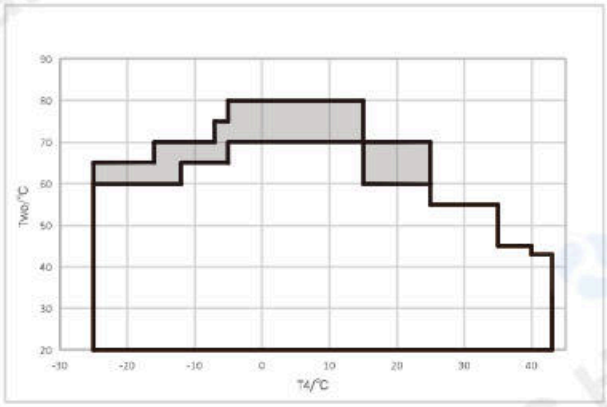
HEATING




COOLING




DHW




Notes:

1) Cooling

If the equipment runs within the temperature range of the shaded area, an antifreeze system must be used instead of a water system, and the antifreeze (especially ethylene glycol solution) must meet both the following requirements:

① The concentration is greater than or equal to 30%;

② The freezing point of the antifreeze is 5.5°C lower than the lowest temperature at the usage location. Otherwise, the water-side pipes and heat exchangers may freeze.

When the Tsafe is set to -5°C in the service menu of the wired controller, the equipment will enter the low-temperature water discharge cooling mode to obtain water discharge below 5°C.

When switching from the antifreeze system to the water system, Tsafe must be set to 5°C to prevent the water-side pipes and heat exchangers from freezing.

2) Heating

If the equipment runs within the temperature range in the shaded area, the DIP switch S1-2 needs to be set to ON.

If the equipment runs within the temperature range of the shaded area, a variable frequency water pump must be matched, and the minimum water flow rate of the water pump shall be able to be as low as 1.8 m3 per hour.

3) Anti-freezing protection for plate heat exchangers

The heat exchanger shall be completely drained and cleaned with antifreeze. Otherwise, other antifreeze measures shall be taken.

When designing the entire system, the following protection methods must be taken into account:

① Continuous circulation of water flow inside pipes and heat exchangers;

② Add an appropriate amount of antifreeze to the water circuits, or provide additional insulation and heating for exposed pipes (both inside and outside the unit).

③ If the unit doesn't work in winter, the heat exchanger shall be drained and cleaned.

It is the responsibility of the installer or local maintenance personnel to ensure that the above anti-freezing methods are taken; failure to follow the above instructions may result in damage to the unit.

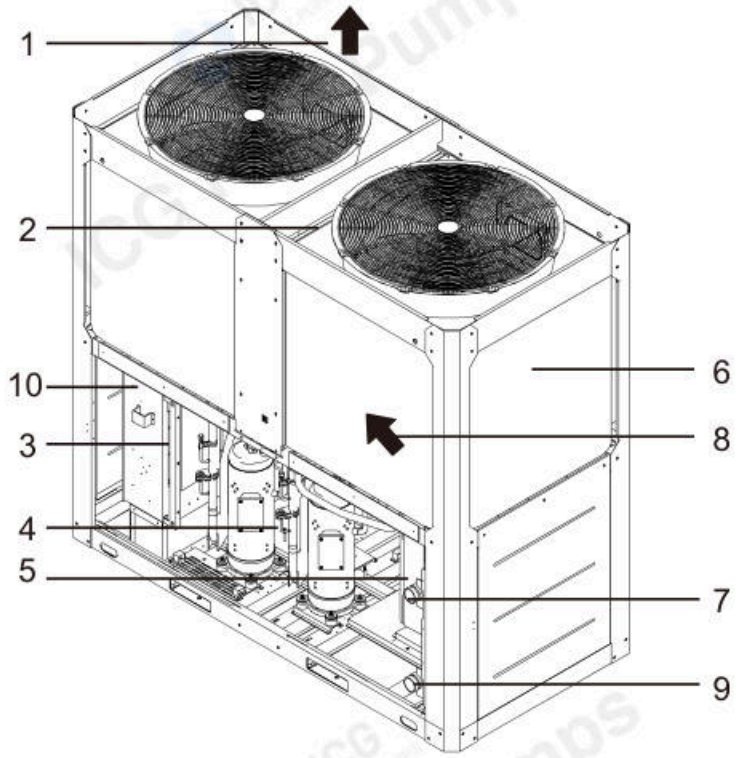
# Part 2

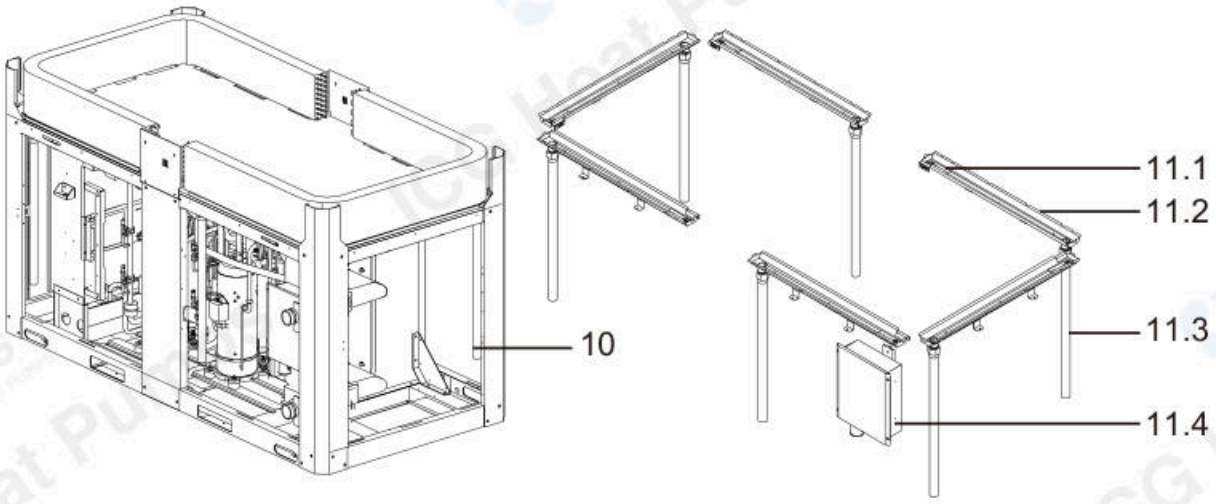
# Component Layout and Refrigerant Circuits

# 1 Layout of Functional Components

## 1.1 Main parts of the unit

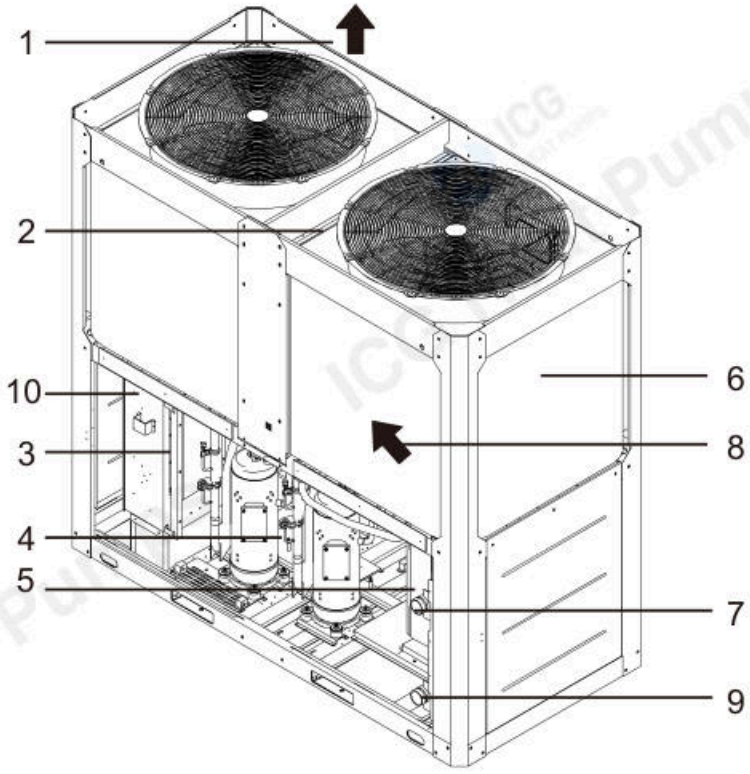
**MHS-SVC50-RN7TL-B / MHS-SVC60-RN7TL-B /MHS-SVC70-RN7TL-B**

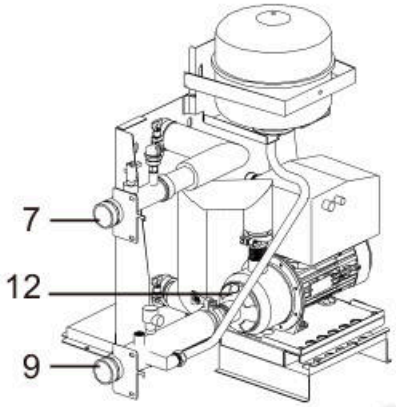


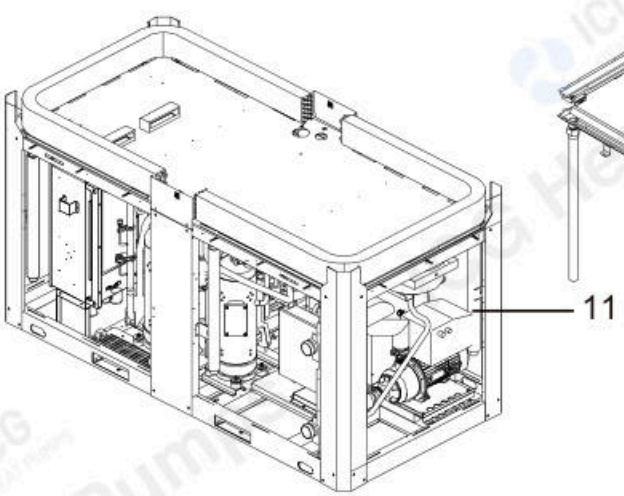



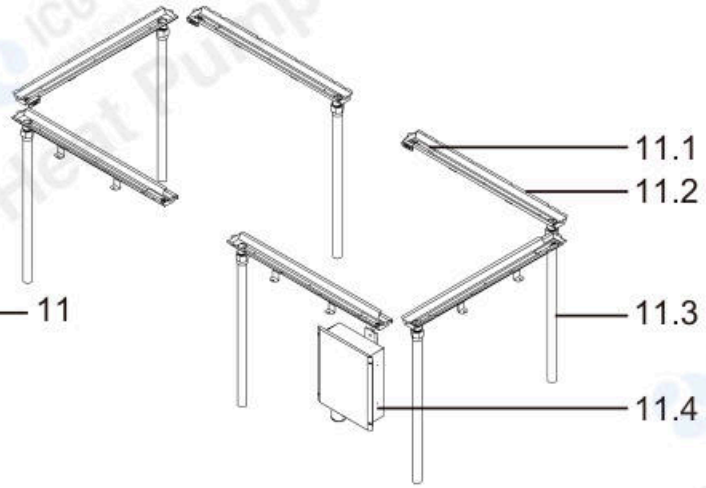

| NO. | NAME | NO. | NAME |
|---|---|---|---|
| 1 | Air outlet | 9 | Water inlet |
| 2 | Top cover | 10 | Wire controller (It can be placed indoors) |
| 3 | Electric control box | 11 | Centralized drainage selectionpiece (Optional) |
| 4 | Compressor | 11.1 | heater band (Optional) |
| 5 | Plate heat exchanger | 11.2 | defrosting pan (Optional) |
| 6 | Heat exchanger | 11.3 | drain-pipe (Optional) |
| 7 | Water outlet | 11.4 | Tropical junction box (Optional) |
| 8 | Air inlet | | |

**MHS-SVC50(M)-RN7TL-B / MHS-SVC60(M)-RN7TL-B / MHS-SVC70(M)-RN7TL-B**




| NO. | NAME | NO. | NAME |
|---|---|---|---|
| 1 | Air outlet | 9 | Water inlet |
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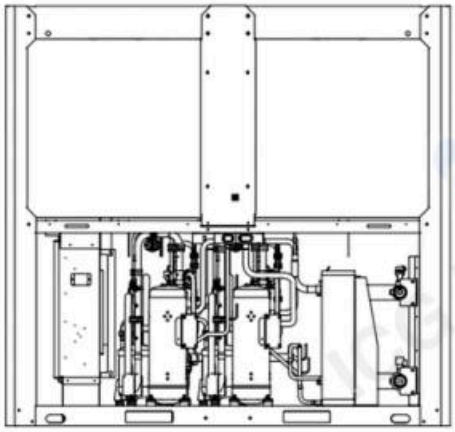
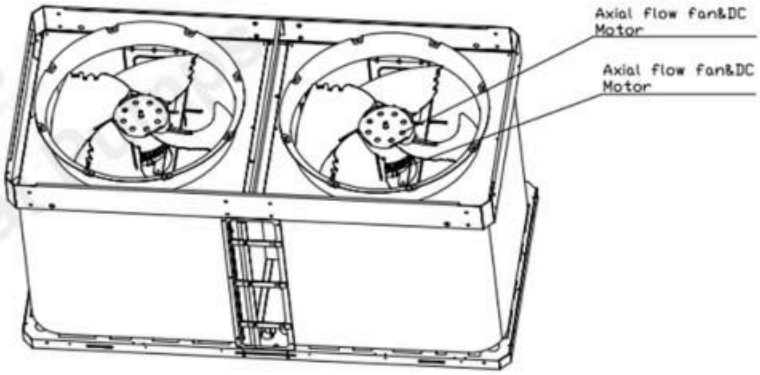
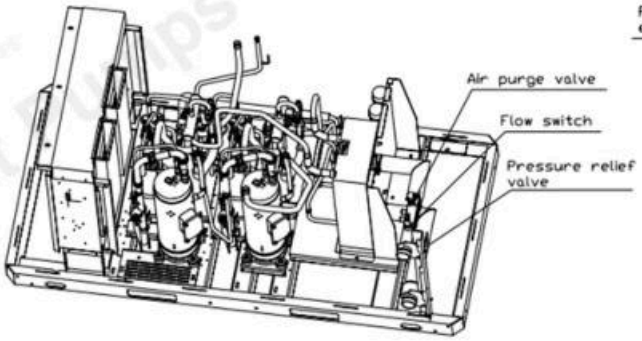
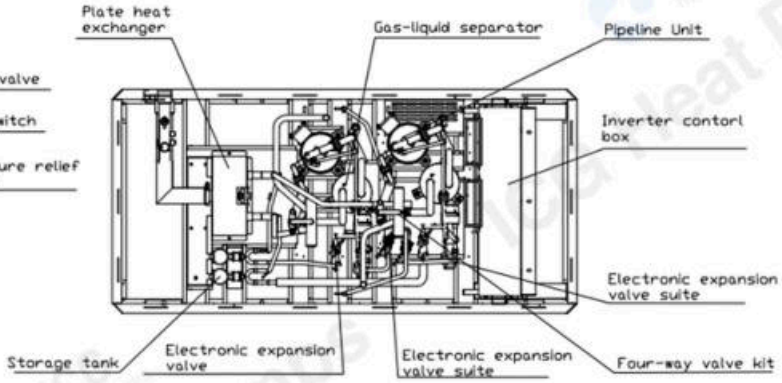
| 4 | Compressor | 11.1 | heater band (Optional) |
| 5 | Plate heat exchanger | 11.2 | defrosting pan (Optional) |
| 6 | Heat exchanger | 11.3 | drain-pipe (Optional) |
| 7 | Water outlet | 11.4 | Tropical junction box (Optional) |
| 8 | Air inlet | 12 | Pump |

## 1.2 Internal structure



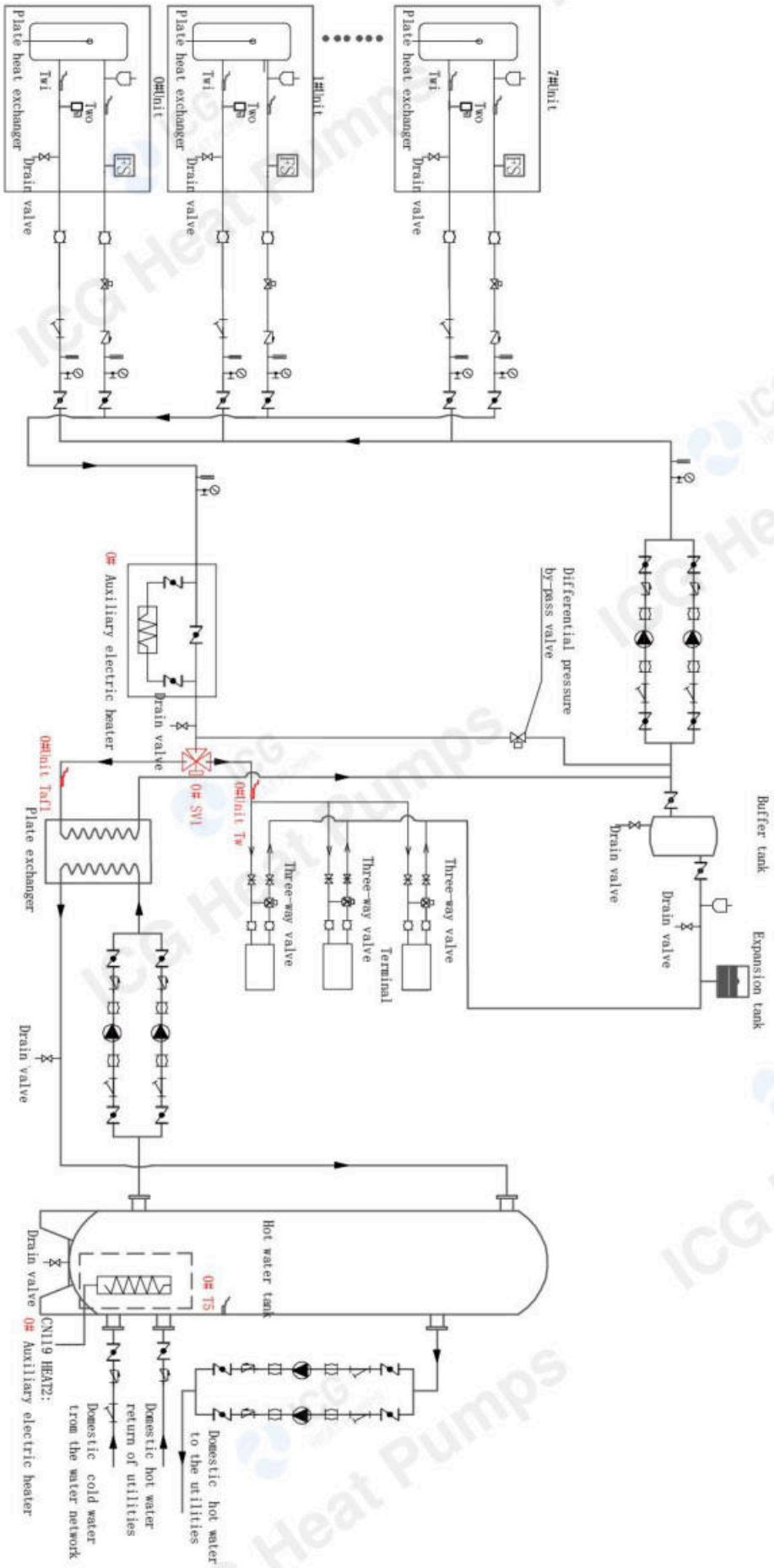


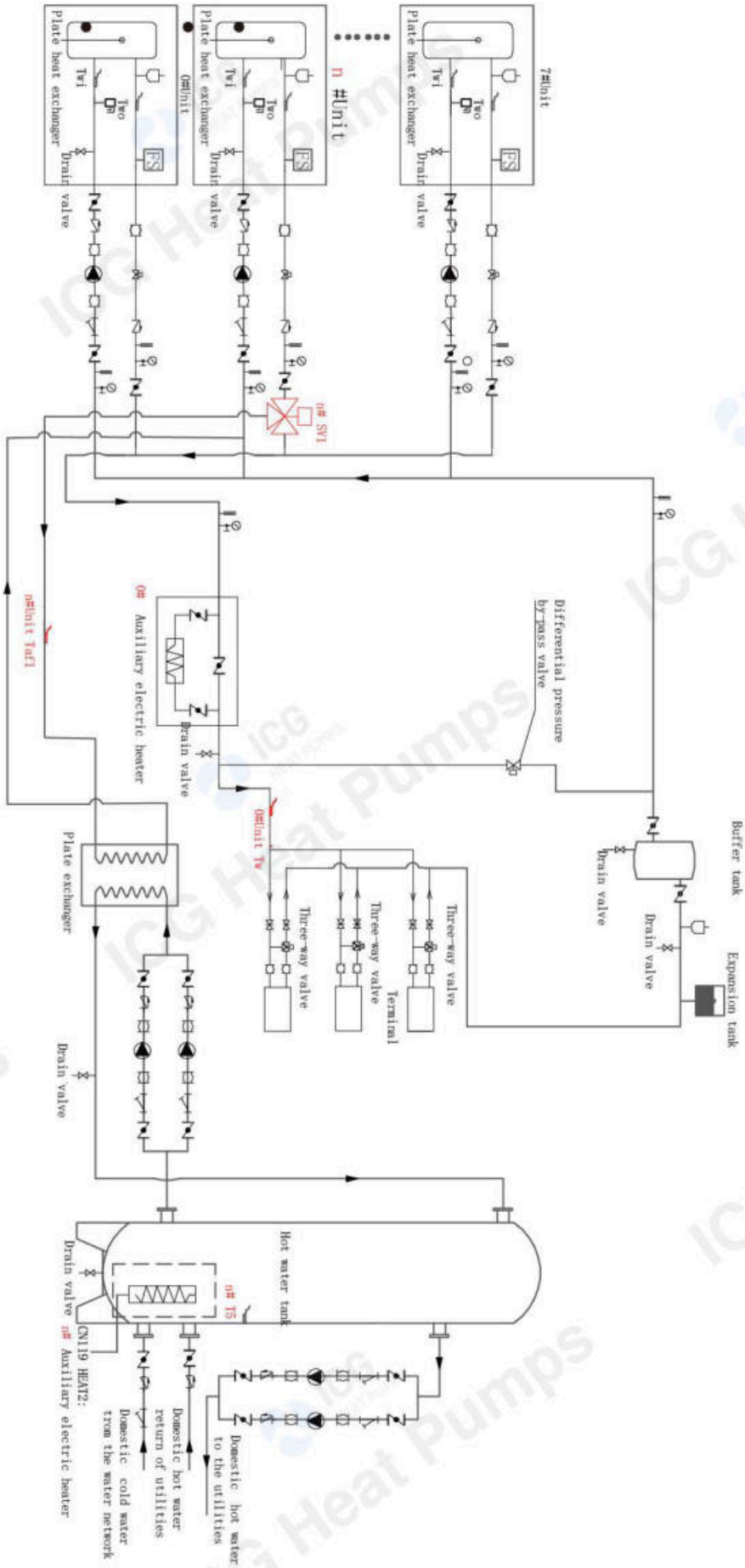
# 2 Piping and Refrigerant Flow Diagrams

## 2.1 Air conditioning and hot water mode



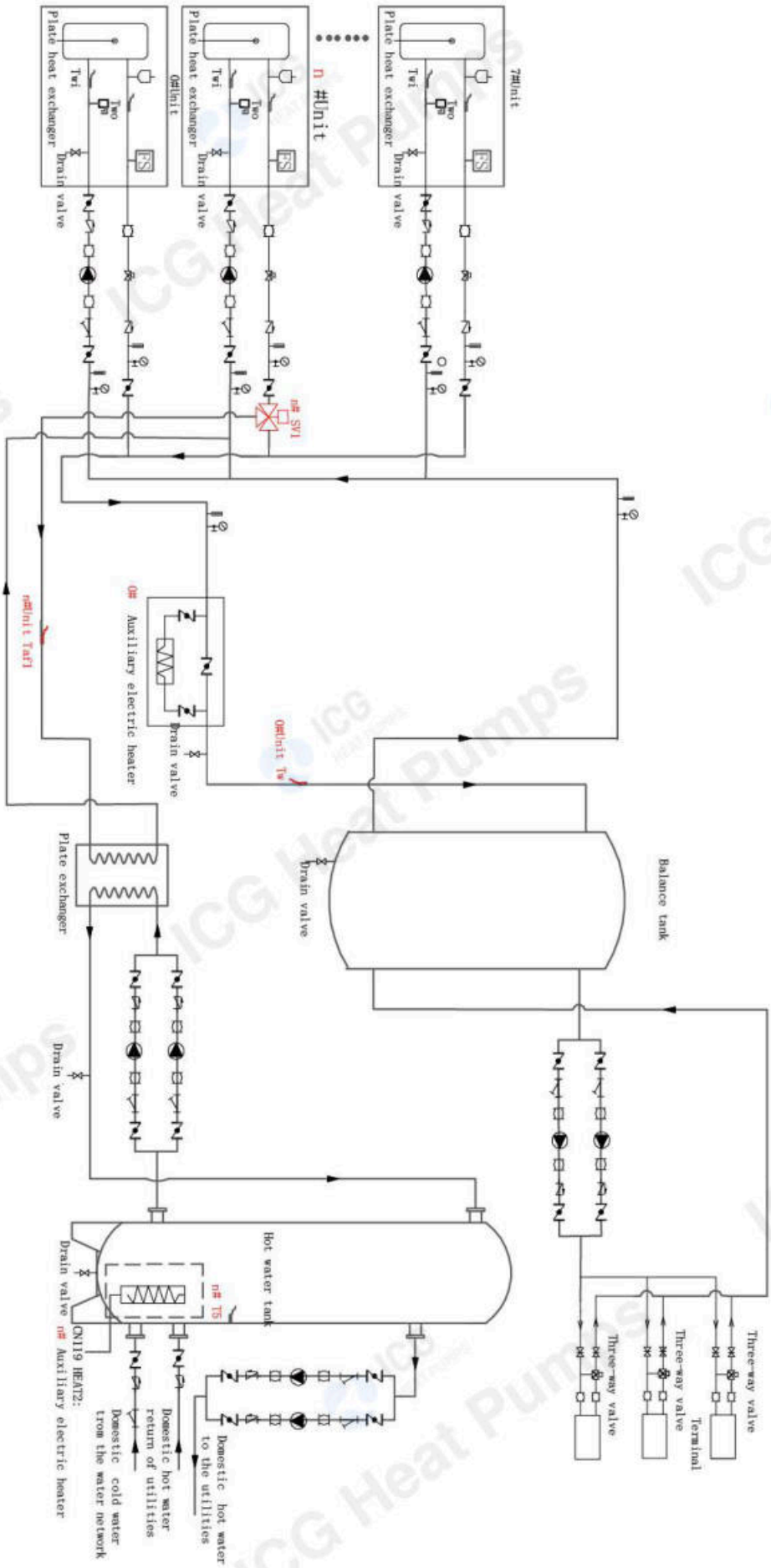

Primary pump system with buffer tank (S1-3 OFF)

## 2.2 Cooling and hot water mode are operated simultaneously



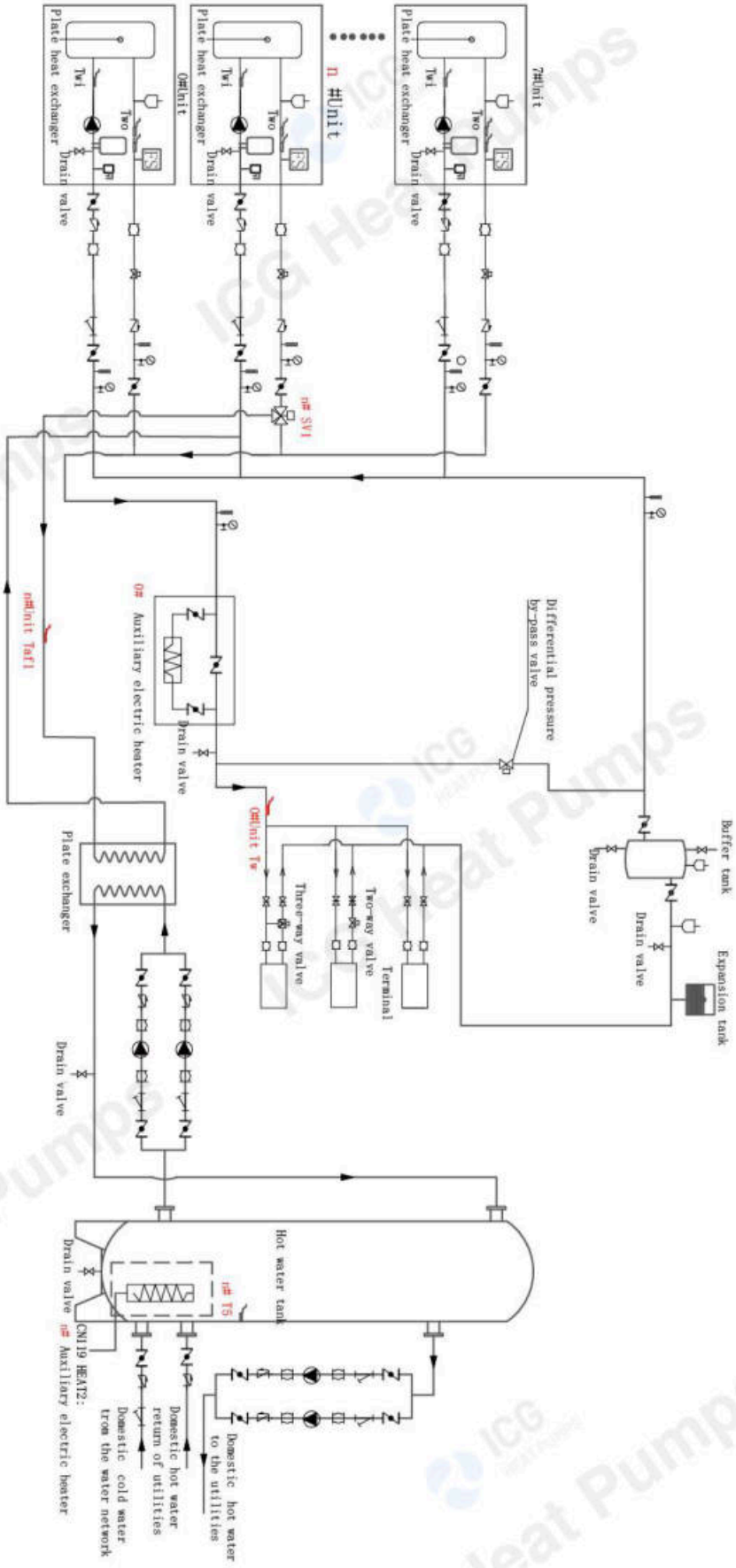

Primary pump system with buffer tank (S1-3 ON)

## 2.3 Cooling and hot water mode are operated simultaneously



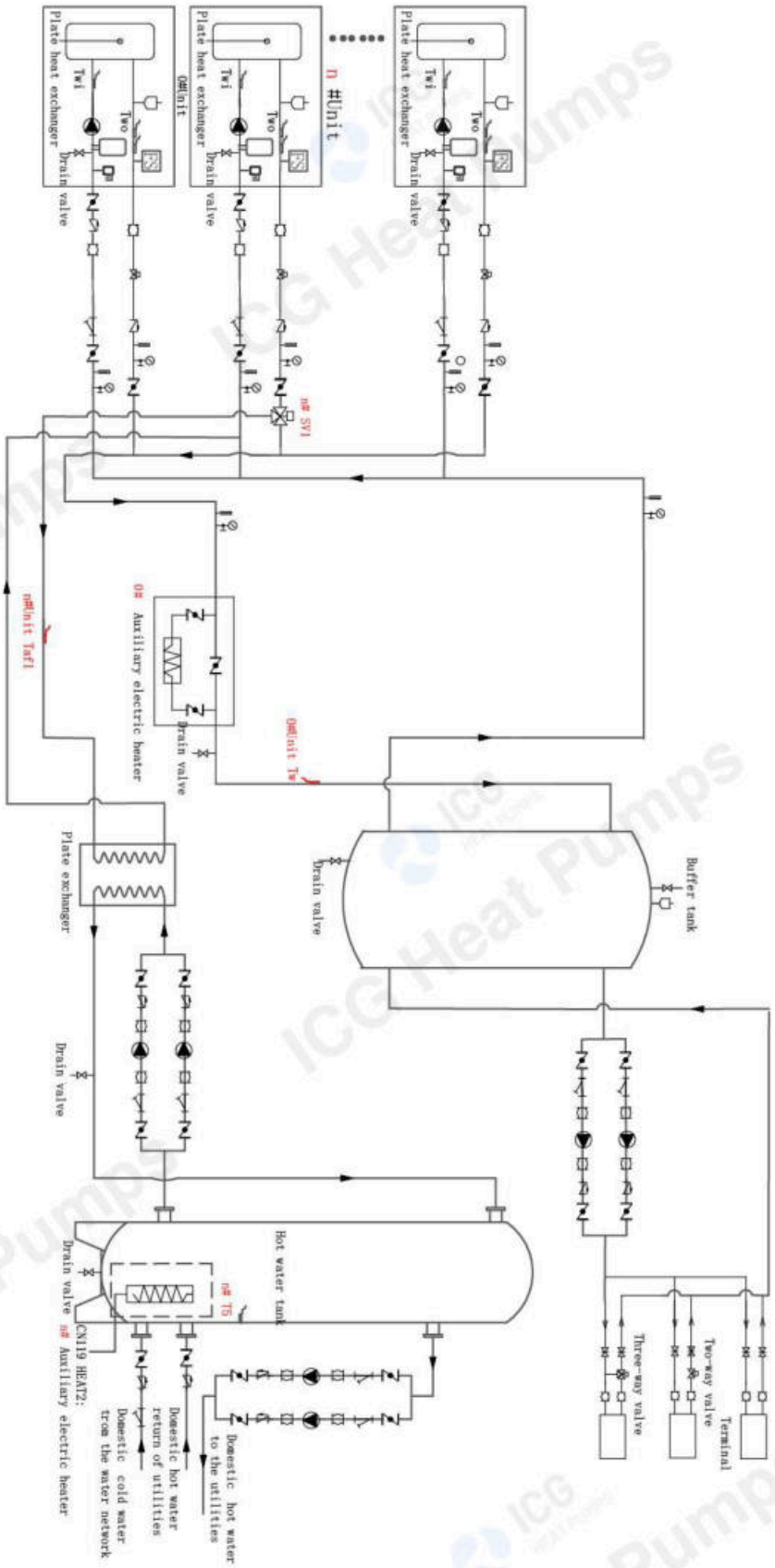

Secondary pump system with buffer tank (S1-3 ON)

## 2.4 Cooling and hot water mode are operated simultaneously (unit with inverter pump)




Primary pump system with buffer tank S1-3 ON

## 2.5 Cooling and hot water mode are operated simultaneously (unit with inverter pump)




Secondary pump system with buffer tank S1-3 ON

| Legend | | | | | |
|---|---|---|---|---|---|
| No. | Symbol | Description | No. | Symbol | Description |
| 1 | COM | Compressor | 9 | EXVB | Electronic Expansion Valve |
| 2 | ST1-A/ST1-B | Four-way valve | 10 | / | Liquid receiver |
| 3 | FAN A/B | DC fan | 11 | H-SW | High-pressure switch |
| 4 | / | Economizer | 12 | H-YL | High-pressure sensor |
| 5 | / | Plate heat exchanger | 13 | L-YL | Low-pressure sensor |
| 6 | / | Gas-liquid separator | 14 | W-SW | Water flow switch |
| 7 | EXVA | Electronic Expansion Valve | 15 | / | Safety valve |
| 8 | EXVC | Electronic Expansion Valve | | | |

## 2.6 Key components

| No. | component | function | specifications | |
|---|---|---|---|---|
| 1 | DC inverter compressor | Circulation power for heat pump systems | DKDA110DGB-SA1S | 2 |
| 2 | Compressor heating tape | Heating the oil pool at the bottom of the compressor | DJRD-520A-2400-50W-VHR | 2 |
| 3 | Discharge temperature Tp1 | Measurement of compressor discharge temperature | CGQ-WD/PQ3950-L4000-XAP2-G3700 | 2 |
| 4 | Discharge temperature switch | Protection of the system from exceeding the safe temperature range | PQWKQ-115/75-3100-AMP | 2 |
| 5 | High pressure switch | Protection of the system from exceeding the safe pressure range | YK-3.5/2.6-C-3000(UL) | 2 |
| 6 | Four-way valve | For switching refrigerant flow direction for refrigeration and heating | STFTJ-35-W-N1-220V-L3500-VHR, minimum 0.1MPa reversing differential pressure | 2 |
| 7 | DC Fan | Provide forced heat transfer power | ZKSN-920-10-2L-3, maximum speed 830r/min | 2 |
| | wind turbine | Exhaust | ZL-750*210*20-4 | 2 |
| 8 | Air side heat exchanger | Place of heat exchange with refrigerant | Number of rows/ row | 3 |
| | | | Pipe spacing/mm | 21 |
| | | | Row spacing/mm | 19.4 |
| | | | Fin spacing/mm | 1.5 |
| | | | Copper tube specification/mm | 7 |
| | | | D×H/mm | 2395×798 |
| | | | Number of condensers | 2 |
| | | | Number of flow paths (inlet×outlet) | 19×19 |
| | | | Number of U-tubes in a row | 19 |
| 9 | Outdoor coil temperature T3 | Detecting fin type heat exchanger temperature | CGQ-WD/GW4100-L3300-XHB2R | 2 |
| 10 | Total heat exchanger outlet temperature $T_z$ | Hot water side panel for refrigerant outlet | CGQ-WD/GW4100-L3300-XAP2 | 2 |
| 11 | Electronic expansion valve front and rear filters | Prevents impurities from entering the electronic expansion valve | GLQ-64B 80 mesh | 4 |
| 12 | Electronic expansion valve EXVA | Throttling effect during cooling and heating operation | D32MISZ-1R 3.2mm | 2 |

| | | | | |
|---|---|---|---|---|
| 13 | EXVA parallel connection check valves | Bypass function in refrigeration | DXF-41A | 2 |
| 14 | Electronic expansion valve EXVB | Throttling effect during cooling and heating operation | UKV-H40DU14 4.0mm | 2 |
| 15 | EXVB parallel connection check valves | Bypass function during heating | DXF-41A | 2 |
| 16 | Liquid storage tank | Storage of excess refrigerant | ZYT-9.52×64×V1.1A 1.1L | 2 |
| 17 | Plate exchange heating tape | Heating for plate heat exchanger | DJRD-200X80D-4200-25W-VHR | 2 |
| 18 | Water-side anti-freezing temperature Taf1/2 | Taf1: Water tank anti-freezing temperature | Taf1：WD/SWD3970-L10000-AMP2(RSG) | customizable |
| | | Taf2: Plate exchange anti-freezing temperature | Taf2：CGQ-WD/SWD3970-L3200-AMP2 | 1 |
| 19.1 | Pressure sensors | Detecting high pressure | CGQ-YL-4.6MPa-L3000-L | 2 |
| 19.2 | Pressure sensors | Detecting low pressure | CGQ-YL-2.0M-L-3000 | 2 |
| 20 | Gas-liquid separator | Storage of excess refrigerant | QYFLQ-22×22×2.1×127×V7.2，7.2L，Pipe diameter 22, oil return hole 2.1 | 2 |
| 21 | Return gas temperature Th | / | CGQ-WD/GW4100-L3300-XAP2 | 2 |
| 22 | Outdoor ambient temperature T4 | Detection of outdoor ambient temperature | CGQ-WD/SW4100-L2600-XHB2B | 1 |
| 23 | Inlet water temperature Twi | / | CGQ-WD/GW3970-L4500-AMP2-P4420 | 1 |
| 24 | Water-side safety valve | Pressure relief when water-side pressure is too high | AQF-06B-G1/2 | 1 |
| 25 | Discharge valve | Discharge of water-side air | PQF-03 | 1 |
| 26 | Outlet temperature Two | / | CGQ-WD/SWD3970-L3200-AMP2 | 1 |
| 27 | Water flow switch | Protection in case of low water flow | SLKG-65-68-4000 | 1 |
| 28 | Total outlet temperature Tw | / | CGQ-WD/GW3970-L4500-AMP2-P4420 | 1 |
| 29 | Plate heat exchanger | Heat exchange between water and refrigerant | HBL133-54D-V | 1 |
| 30 | Target flow electric heating belt | Water-side anti-freezing heating | DJRD-200X80D-4200-25W-VHR | 1 |
| 31 | High and low pressure pin valve | For refrigerant charging | / | 4 |
| 32 | Tank temperature T5 | Detecting the hot water temperature in the tank | WD/SWD3970-L10000-AMP2(RSG) | 1 |
| 33 | Wired Controller | / | KJRM-120H3/BMWK0-E | 1 |
| 34 | Economizer | Heat exchanger for gas injection | C12L-EZ-20 | 2 |
| 35 | Injection electronic expansion valve EXVC | Throttling effect during jet enthalpy increase | D16MISZ-1R 1.6mm | 2 |
| 36 | Auxiliary entry temperature sensor T6A | / | CGQ-WD/GW4100-L2500-XHP4-P2250-2 | 2 |
| 37 | Auxiliary out temperature sensor T6B | / | CGQ-WD/GW4100-L2500-XHP4-P2250-2 | 2 |

**Compressor:**

The refrigerant is compressed which also raise its temperature. The refrigerant enters the compressor as a low-pressure, low-temperature gas and exits the compressor as a high-pressure, high-temperature gas.

**Fan:**

Ventilates the air side heat exchanger.

**Air side heat exchanger:**

Heat is transferred from the refrigerant into the surrounding air by first passing through the tube coils where the heat is transferred to the fins via conduction. It then dissipates into the air forced through the heat exchanger.

**Plate heat exchanger:**

Facilitates transfer of heat between two fluids. This type of exchange offers a significant advantage over conventional heat exchangers as fluids are exposed to a much larger surface area which better facilitates the transfer of heat while greatly accelerating temperature increase.

**4-way valve:**

To better control refrigerant flow, Mars series features an upgraded 4-way valve default position which remains closed in heating mode (no electrical signal) and open in cooling mode. When closed, the air-side heat exchanger functions as an evaporator and water side heat exchanger functions as a condenser; when open, the air side heat exchanger functions as a condenser and water side heat exchanger function as an evaporator.

**Electronic expansion valve (EXV):**

Controls refrigerant flow and reduces refrigerant pressure as necessary.

**High and low pressure switches:**

Regulate refrigerant system pressure. When the refrigerant system pressure rises above the upper limit or falls below the lower limit, the high or low pressure switches turn off, stopping the compressor.

**Discharge temperature switch:**

Protects the compressor from abnormally high temperatures and transient spikes in temperature.

**High pressure sensor:**

Measures compressor discharge side pressure of refrigerant.

**Low pressure sensor:**

Measures compressor suction side pressure of refrigerant.

**Discharge valve:**

Automatically removes air from the water circuit.

**Water flow switch:**

Detects water flow rate to protect the compressor and water pump in the event of insufficient water flow.

**Crankcase heater:**

Prevents refrigerant from mixing with compressor oil when the compressors are stopped.

**Water side heat exchanger electric heater:**

Protects the water side heat exchanger from ice formation.

**Water flow switch electric heater:**

Protects the water from ice formation.

**Pin valve (high and low pressure side):**

Charges or discharges refrigerant.

**Wired Controller:**

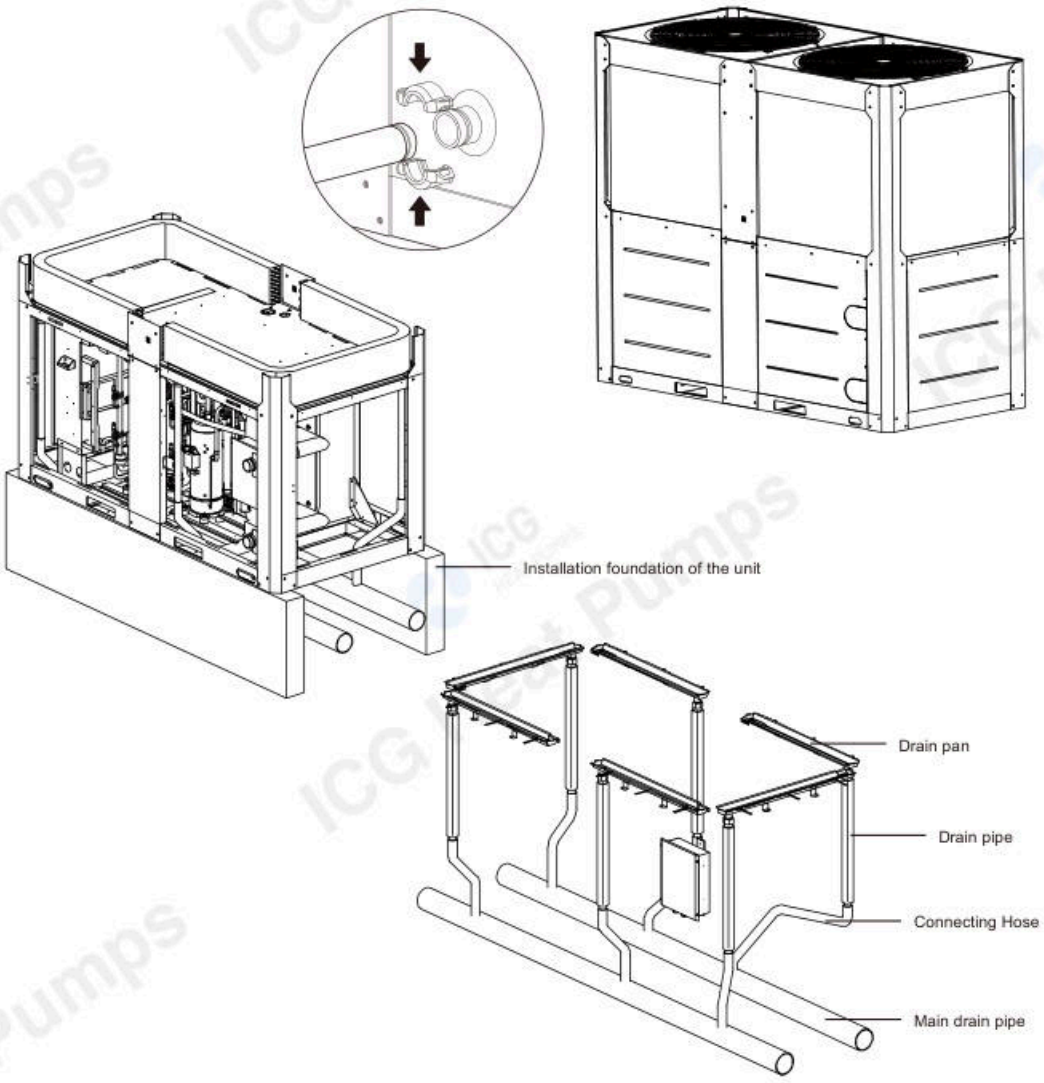
Control and query the operation status of the unit.

## 2.7 **Water pipe connection**

The unit is equipped with interfaces for connecting the heat pump to the water circuit of the system. The operation must be carried out by authorized technical personnel and all current relevant national regulations must be observed.

The installation and connection methods of the inlet and outlet pipes are as shown in the following diagrams. The unit is clamped. The specifications and parameters of the water pipes and threads are detailed in the table below.

| Model | Pipe connection methods | Specifications of water pipe |
|---|---|---|
| 50/60/70kW | Hoop connection | DN50 |



# Part 3

# Control and Field settings

# 1 Control Functions

## 1.1 Standby control

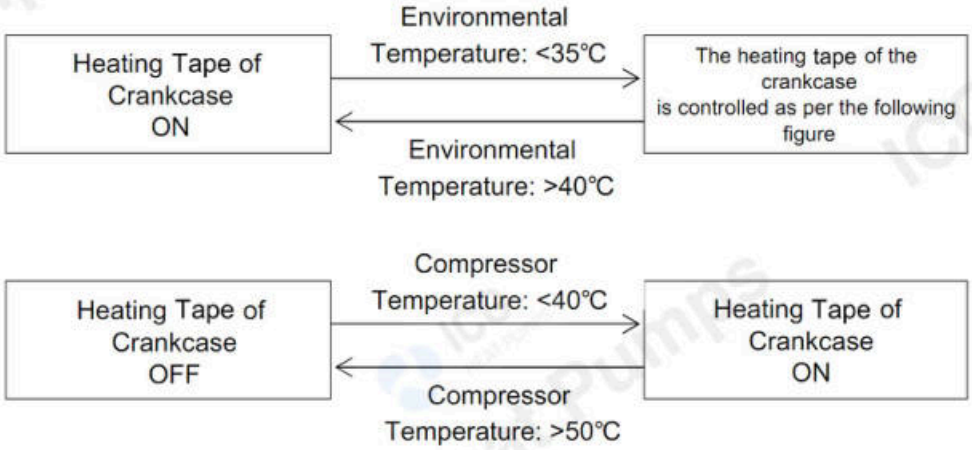
### 1.1.1 Control of first start and restart after shutdown

In order to prevent frequent start and stop of the compressor and balance the pressure inside the cooling system, the compressor shall be forcibly stopped for 7 min (except for special controls such as defrosting) before restart.

### 1.1.2 Control of heating tape of crankcase

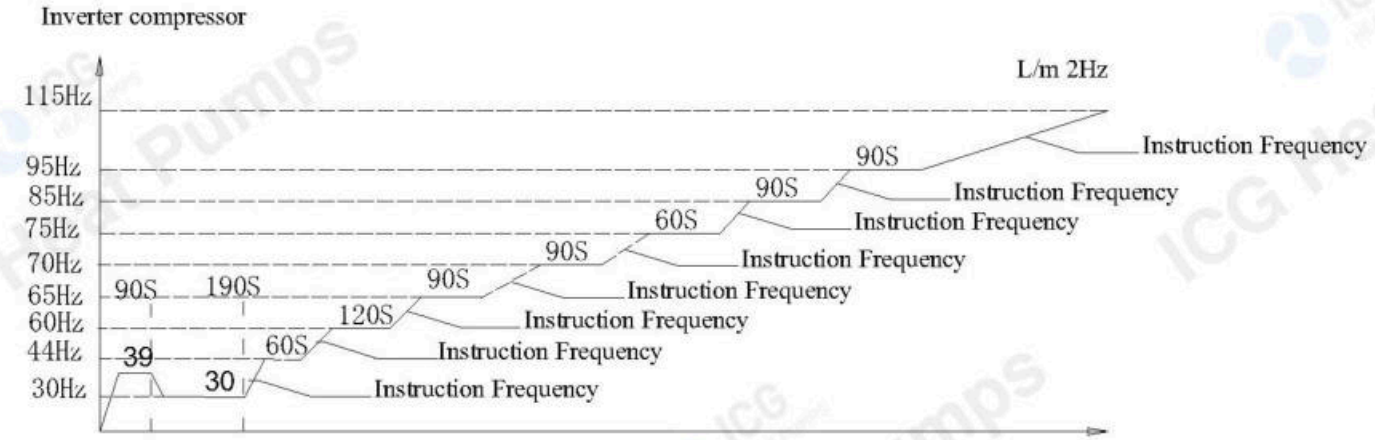
In order to prevent the refrigerant from dissolving in the cooling oil of the compressor during shutdown, this mode is used to control the heating tape of the crankcase.

For the outdoor unit, the working mode of the heating tape of the crankshaft shall be determined as per the outdoor environmental temperature firstly, based on the compressor temperature after entering the temperature judgment control state of the compressor.




## 1.2 Start Control

### 1.2.1 Cooling start frequency-raising control

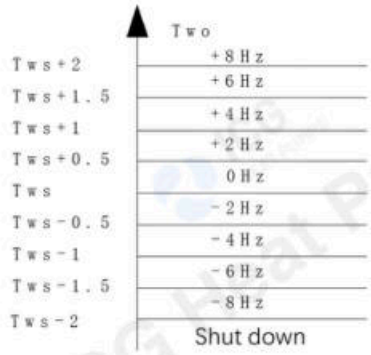


### 1.2.2 Cooling start control

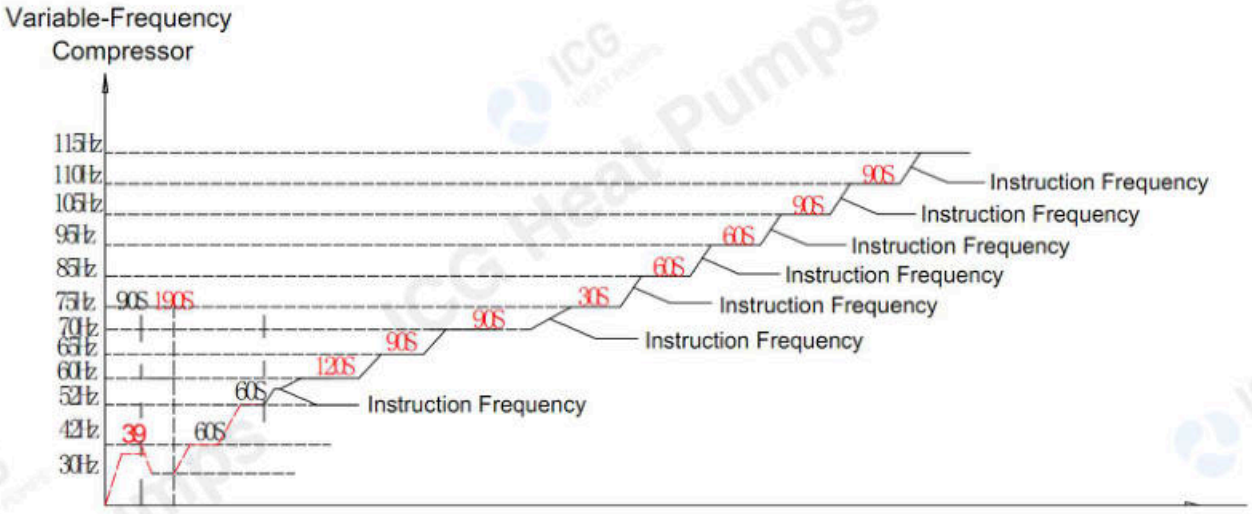
| Component Name | Electrical Symbol | 50/60/70 | Functions of Functional Components |
|---|---|---|---|
| Water pump | PUMP | ● | Non-standard component: After the water pump started for 1 minute and 45 s, the water flow switch is continuously detected. If the water flow switch is not closed, and the operation of the pump is stopped, a water flow fault is displayed. The compressor can be started after the water flow becomes normal. |
| Variable-frequency compressor | BP1 | ● | Control of water outlet temperature. The operating frequency is increased or reduced by 1 Hz/s, and the implementation is carried out as per the start platform. |
| Variable-frequency fan | FAN1 | ● | The fan is started 60 s before the compressor, which is controlled as per the exhaust pressure of the outdoor unit after the fan operates for 120 s at the initial target air speed. |
| Electronic expansion valve | EXV-A | ● | The opening is fixed at 480P. |
| Electronic expansion valve | EXV-B | ● | The opening is between 0 and 480P, which is controlled as per the superheat of the return air. |
| Electronic expansion valve | EXV-C | ● | Enhanced vapor injection EXV, with an opening of 0-480P, which is control based on the inlet and outlet temperature difference of the economy. |
| Four-way valve | ST1 | ● | Power-on |

Cooling Single Unit Capacity Output Control

When the compressor operating frequency (running at the initial frequency if not limited, or at the limited frequency if the limited frequency is lower than the initial frequency) remains stable for 5 minutes [Tim_Fqc_Stable] without any changes, the following adjustments will be made: increase the frequency once every 60 seconds [Tim_Fqc_Ups], and decrease the frequency once every 60 seconds [Tim_Fqc_Downs].



### 1.2.3 Heating start frequency-raising control



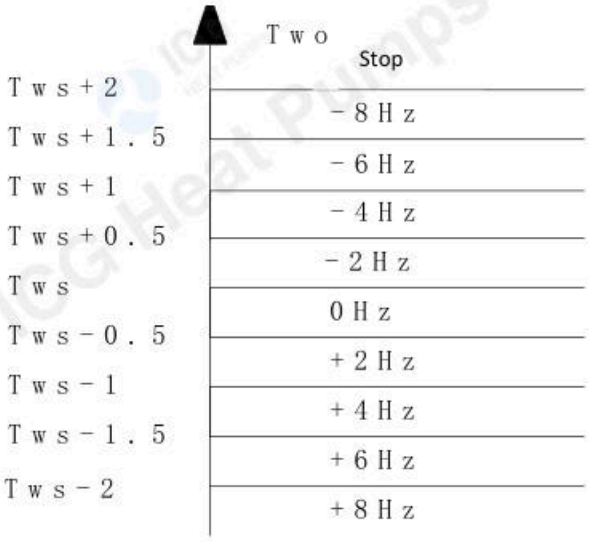

### 1.2.4 Heating/water heating start control

| Component Name | Electrical Symbol | 50/60/70 | Functions of Functional Components |
|---|---|---|---|
| Water pump | PUMP | ● | Non-standard components: After the water pump is started for 1 minute and 45 s, the water flow switch is continuously detected. If the water flow switch is not closed, and the operation of the pump is stopped, a water flow fault is displayed. The compressor can be started after the water flow becomes normal. |
| Variable-frequency compressor | BP1 | ● | Control of water outlet temperature. The operating frequency is increased or reduced by 1 Hz/s, and the implementation is carried out as per the start platform. |
| Variable-frequency fan | FAN1 | ● | The fan is started 60 s before the compressor, which is controlled as per the evaporation pressure after the fan operates for 360 s at the initial target air speed. |
| Electronic expansion valve | EXV-A | ● | The opening is between 0 and 480P, which is controlled as per the superheat of the exhaust air. |
| Electronic expansion valve | EXV-B | ● | The opening is fixed at 480P. |
| Electronic expansion valve | EXV-C | ● | Enhanced vapor injection EXV, with an opening of 0-480P, which is control based on the inlet and outlet temperature difference of the economy. |
| Four-way valve | ST1 | ● | Power-off, and power-on during defrosting |
| Switching of three-way electromagnetic valve for heating/water heating | SV1 | ● | The valve is opened in the water heating mode. |

Single Unit Capacity Output Control

When the compressor operating frequency (running at the initial frequency if not limited, or at the limited frequency if the limited frequency is lower than the initial frequency) remains stable for 5 minutes [Tim_Fqc_Stable] without any changes,

the following adjustments will be made: increase the frequency once every 60 seconds [Tim_Fqc_Up], and decrease the frequency once every 60 seconds [Tim_Fqc_Down].




## 1.3 Normal operation control

### 1.3.1 Cooling operation control

| Component Name | Electrical Symbol | 50/60/70 | Functions of Functional Components |
|---|---|---|---|
| Water pump | PUMP | ● | Opening |
| Variable-frequency compressor | BP1 | ● | Control of water outlet temperature. The operating frequency is increased or reduced by 1 Hz/s. |
| Variable-frequency fan | FAN1 | ● | The fan is controlled as per the exhaust pressure of the outdoor unit, and is adjusted every 60 s from 0 to 32 positions. |
| Electronic expansion valve | EXV-A | ● | The opening is fixed at 480P |
| Electronic expansion valve | EXV-B | ● | The opening is between 0 and 480P, which is controlled as per the superheat of the return air. |
| Electronic expansion valve | EXV-C | ● | Enhanced vapor injection EXV, with an opening of 0-480P, which is control based on the inlet and outlet temperature difference of the economy. |
| Four-way valve | ST1 | ● | Power-on |

### 1.3.2 Heating operation control

| Component Name | Electrical Symbol | 50/60/70 | Functions of Functional Components |
|---|---|---|---|
| Water pump | PUMP | ● | Opening |
| Variable-frequency compressor | BP1 | ● | Control of water outlet temperature The operating frequency is increased or reduced by 1 Hz/s, and the implementation is carried out as per the start platform. |
| Variable-frequency fan | FAN1 | ● | The fan is adjusted as per the evaporation pressure Pe during |

| | | | |
|---|---|---|---|
| | | | operation. |
| Electronic expansion valve | EXV-A | ● | The opening is between 0 and 480P, which is controlled as per the superheat of the exhaust air. |
| Electronic expansion valve | EXV-B | ● | The opening is fixed at 480P. |
| Electronic expansion valve | EXV-C | ● | Enhanced vapor injection EXV, with an opening of 0-480P, which is control based on the inlet and outlet temperature difference of the economy. |
| Four-way valve | ST1 | ● | Power-off, and power-on during defrosting |
| Switching of three-way electromagnetic valve for heating/water heating | SV1 | ● | The valve is opened in the water heating mode. |

## 1.4 Shutdown control

### 1.4.1 Fault shutdown

In order to protect the compressor, in case of any abnormal conditions, the system will shut down (the compressor/fan will stop).

### 1.4.2 Shutdown

After the unit is shut down through the Wired Controller, the compressor fan stops running, the four-way valve is in the OFF state after shutdown, and the electronic expansion valve EXV is in standby state. The standby opening of the AB valve is 320P, and the standby opening of the C valve is 0P.

### 1.4.3 Temperature reaching shutdown

The system will shut down after the outlet temperature reaches the set temperature.

## 1.5 Defrosting control

To prevent poor heat exchange due to frosting of the heat exchanger (i.e. evaporator) of the outdoor unit during heating operation, defrosting is carried out through these control procedures to restore the heating capacity.

Defrosting entry conditions: The parameters of the outdoor unit for defrosting entering and exiting include outdoor environmental temperature, temperature of the outdoor heat exchanger, inlet water temperature, operating time of the outdoor unit, and defrosting time of the outdoor unit.

| Component Name | Electrical Symbol | 50/60/70 | Functions of Functional Components |
|---|---|---|---|
| Water pump | PUMP | ● | To be opened. |
| Variable-frequency compressor | BP1 | ● | Defrosting instruction frequency operation |
| Variable-frequency fan | FAN1 | ● | Closing |
| Electronic expansion valve | EXV-A | ● | With a maximum opening of 480P |
| Electronic expansion valve | EXV-B | ● | With a maximum opening of 480P |
| Electronic expansion valve | EXV-C | ● | With a fixed opening of 96P |
| Four-way valve | ST1 | ● | Power-on |

## 1.6 Tachometer of fan

| Position | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Fan 1 | 0 | 150 | 190 | 230 | 270 | 330 | 150 | 170 | 190 | 210 | 230 | 250 |
| Fan 2 | 0 | 0 | 0 | 0 | 0 | 0 | 150 | 170 | 190 | 210 | 230 | 250 |
| Position | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 |
| Fan 1 | 270 | 290 | 310 | 330 | 350 | 370 | 400 | 430 | 450 | 470 | 510 | 550 |
| Fan 2 | 270 | 290 | 310 | 330 | 350 | 370 | 400 | 430 | 450 | 470 | 510 | 550 |
| Position | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | | | |
| Fan 1 | 580 | 610 | 640 | 680 | 710 | 750 | 780 | 800 | 830 | | | |
| Fan 2 | 580 | 610 | 640 | 680 | 710 | 750 | 780 | 800 | 830 | | | |

Notes: Efficiency is not increased at Positions 1-5, and the highest speed is achieved at Position 32 for this model

Maximum air speed control

| Fan Mode | | 50/60/70 | Achieving Conditions | Contents | Remarks |
|---|---|---|---|---|---|
| Silent Mode Selection | Standard mode | 32 | This mode is set through the Wired Controller (factory default) | | |
| | Night silent mode 1 | 24 | The night silent mode is set through the Wired Controller, which is entered after several hours when T4 detected by the master unit is lower than the maximum temperature recorded. The mode will exit forcedly when the minimum T3 is greater than or equal to 40℃. The mode can be entered when the minimum T3 is less than or equal to 35℃. | 6/10h | The "standard mode + silent mode" can be achieved thorough time combination. |
| | Night silent mode 2 | | | 6/12h | |
| | Night silent mode 3 | | | 8/10h | |
| | Night silent mode 4 | | | 8/12h | |
| | Silent mode | | This mode is set through the Wired Controller | Max≤Power_Silence_Max 50/60/70 kW: 70 Hz | |
| | Super-silent mode | 22 | This mode is set through the Wired Controller | Max≤Power_Silence_Max 50/60/70 kW: 60 Hz | |

## 1.7 Variable-frequency water pump control

| Input | |
|---|---|
| Control Logic Input | Remarks: |
| Machine address | The machine containing the address 0# is the master unit, and the machine without the address 0# is the slave unit. |
| Selection of variable-frequency water pump control | In case of S1-4=OFF, the control is of single variable frequency pump for the unit (by default)<br>In case of S1-4=ON, the control is of parallel connection of variable frequency pump and fixed frequency pump for the unit |
| Single pump/multiple pump | In case of S1-3=OFF, single-pump control (one main water pump is for each system, controlled through the master unit)<br>In case of S1-3=ON, multiple-pump control (one water pump is for each outdoor unit, controlled respectively) |
| Opening signal of main water pump | CN123 on the expansion board is a passive port for controlling the constant-speed water pump. |
| Ratio_pum | Manual frequency control of the variable frequency water pump, set through the wired controller |
| Min ratio | The minimum value in the adjustment range of the variable-frequency water pump is set through the wired controller, and 25% for main control by default |
| Max ratio | The maximum value in the adjustment range of the variable-frequency water pump is set through the wired controller, and 100% for main control by default |
| Output | |
| Control logic output | Remarks: |
| Start and output duty cycle of variable-frequency water pump | 0-100% corresponds to the main control output voltage range 0-10V. The water pump is started as the minimum set value, and the increase/decrease output rate is 1%/0.5s. |

Notes:

① When receiving the opening signal of the main water pump, the variable frequency water pump outputs as per the following control;

② The adjustment range of the variable-frequency water pump: 25%-100% [min ratio-max ratio]. The range can be adjusted through the Wired Controller. The main control adjustment range is 5%. The default value is 25%-100%. The range 0-100% corresponds to the main control output voltage 0-10V.

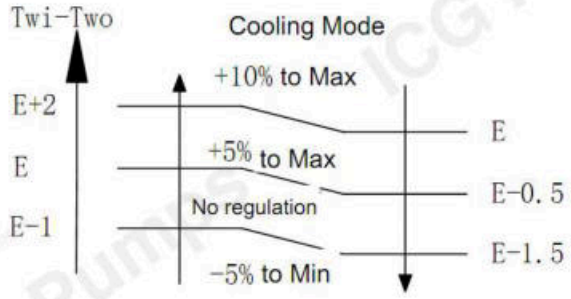
③ Notes for Input and output of the control logic

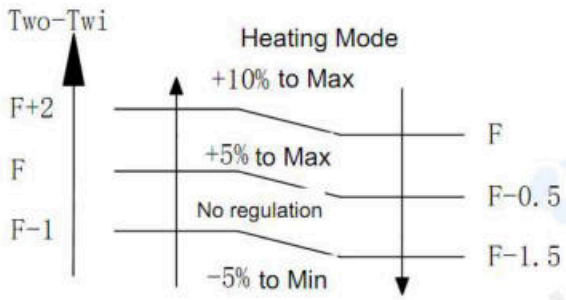
### 1.7.1 Temperature difference control of variable frequency water pump

1) Control of target water temperature difference

| Twi | ＜15℃ | 15≤Twi＜18℃ | 18≤Twi＜25℃ | ≥25℃ | |
|---|---|---|---|---|---|
| E | 5.5 | 5.5 | 6.5 | 8.5 | |
| Initial output of single variable-frequency pump | Variable-frequency water pump: max ratio | Variable-frequency water pump: max ratio | Variable-frequency water pump: max ratio | Variable-frequency water pump: min (70%, max ratio) | |
| Initial output of variable-frequency + fixed frequency pump | Variable-frequency water pump: max ratio Fixed-frequency water pump: on | Variable-frequency water pump: max ratio Fixed-frequency water pump: on | Variable-frequency water pump: max ratio Fixed-frequency water pump: on | Variable-frequency water pump: max ratio Fixed-frequency water pump: off | |
| Twi | ＜35℃ | 35≤Twi＜47℃ | 47≤Twi＜55℃ | 55≤Twi＜62℃ | ≥62℃ |
| F | 5.5 | 7.5 | 9.5 | 11.5 | 14.5 |
| Initial output of single variable-frequency pump | Variable-frequency water pump: max ratio | Variable-frequency water pump: max ratio | Variable-frequency water pump: MIN (60%, max ratio) | Variable-frequency water pump: MIN (60%, max ratio) | Variable-frequency water pump: MIN (60%, max ratio) |
| Initial output of variable-frequency + fixed frequency pump | Variable-frequency water pump: max ratio Fixed-frequency water pump: on | Variable-frequency water pump: max ratio Fixed-frequency water pump: on | Variable-frequency water pump: max ratio Fixed-frequency water pump: off | Variable-frequency water pump: max ratio Fixed-frequency water pump: off | Variable-frequency water pump: max ratio Fixed-frequency water pump: off |

2) Temperature difference control of variable frequency water pump output




## 1.8 Control of Four-Way Valve STF

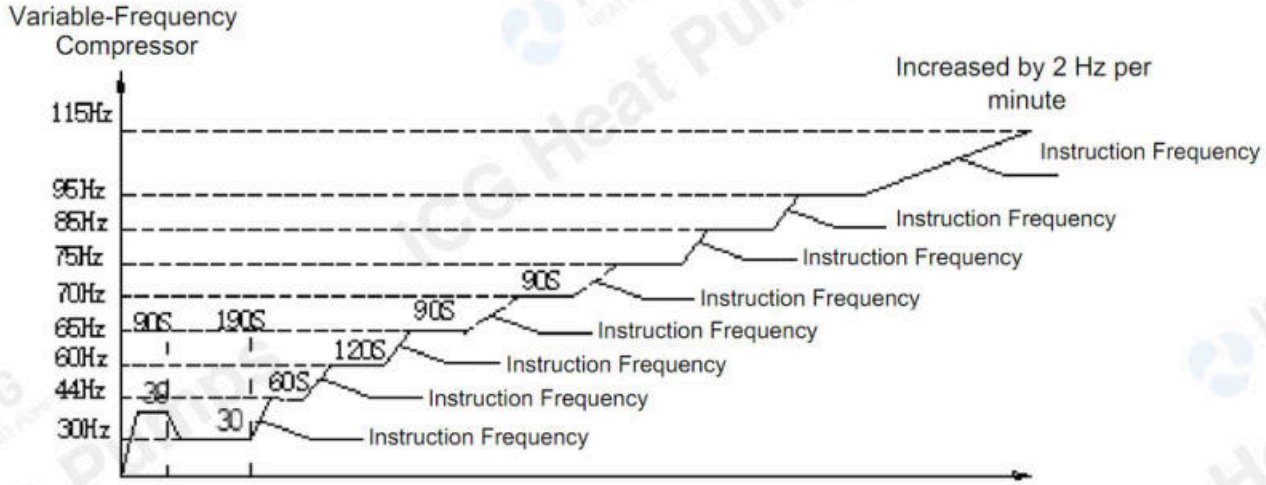
Power-on is not required in heating, which is carried out when defrosting is entered. Power-off will occur when defrosting exits;

The valve is constantly powered on during cooling operation

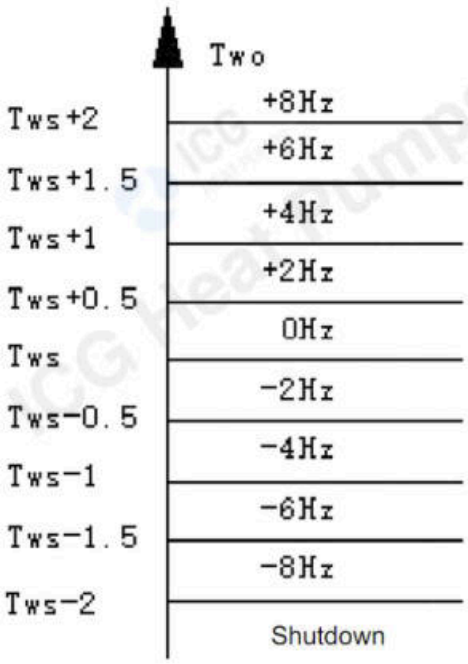
## 1.9 Control of Compressors

The control logic of the compressors includes "forced platform operation control + water temperature energy demand judgment and frequency increase + multiple frequency limiting controls".

The cooling forced platform is shown as follows



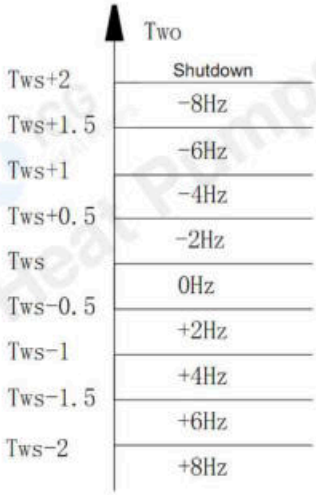

The cooling water temperature energy demand frequency increase or decrease is shown as follows




If the target frequency is higher than the corresponding forced platform during the energy demand frequency increase, it is necessary to run on the forced platform for a certain period of time; in case of various frequency limits, priority shall be given to frequency limiting

The control of the heating mode is similar to that for the cooling mode, with slight differences in the platforms

The water heating temperature energy demand frequency increase or decrease are shown as follows



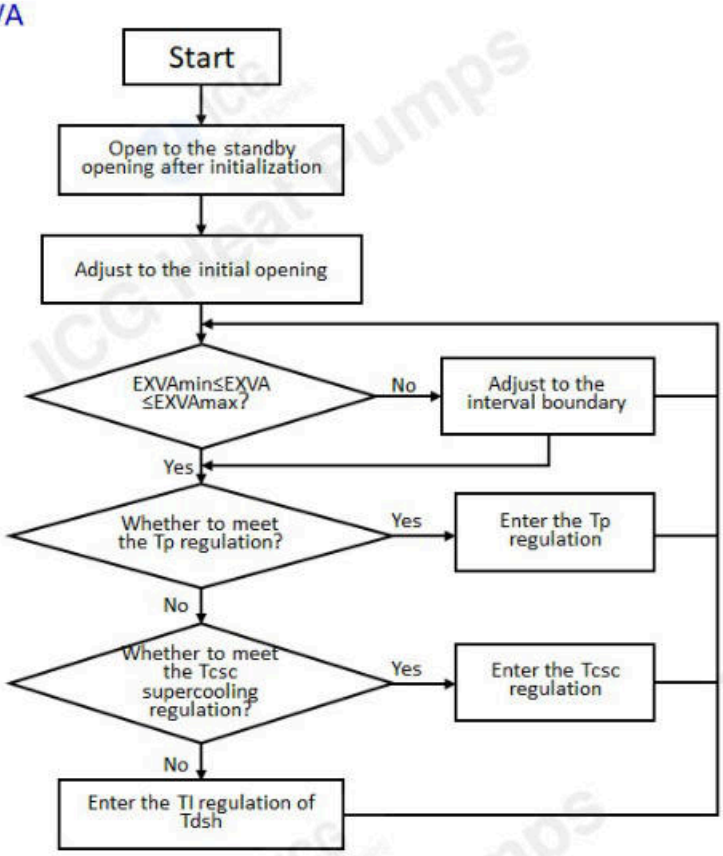

## 1.10 Control of Electronic Expansion Valves

### 1.10.1 Control of EXVA

EXVA remains at 480P during cooling

The overall framework for control during heating operation is shown in the following figure:

Control of EXVA




Different values will be distinguished for the initial opening based on the environmental temperature and water temperature:

Similarly, for the minimum and maximum opening of EXVA, different values will also be distinguished based on the environmental temperature and water temperature:

Tp regulation is a control that forces the EXVA to be turned on or off when the exhaust temperature Tp is high, to avoid protection due to high exhaust temperature;

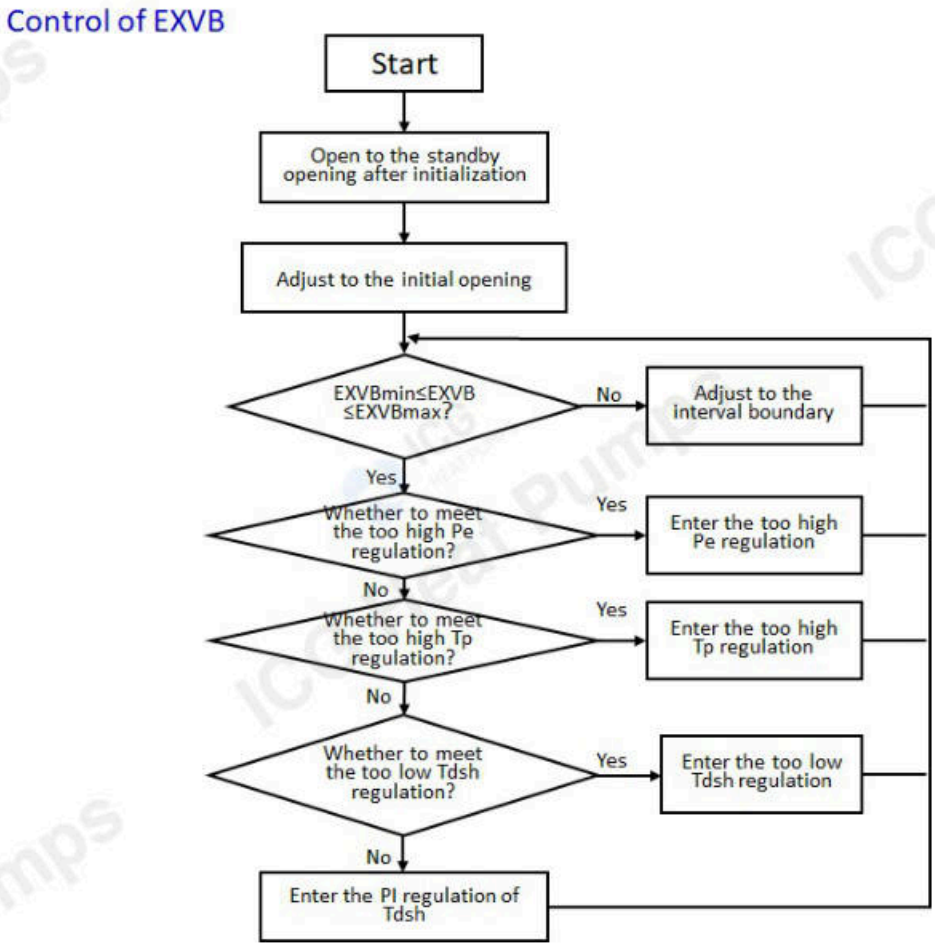
Tcsc supercooling (condensation temperature -- plate heat exchanger tube temperature) control is a basic control, aimed at ensuring that EXVA is not turned off too small and ensuring the energy efficiency of the unit; different control target values are also distinguished based on the environmental temperature and water temperature frequency;

Tdsh exhaust superheat exhaust temperature -- condensation temperature) control is a basic control, aimed at ensuring that the liquid refrigerant does not enter the compressor too much and dilute the lubricating oil, avoiding poor lubrication and compressor wear. Different control target values are distinguished based on the environmental temperature and water temperature frequency.

### 1.10.2 **Control of EXVB**

EXVB remains at 480P during heating

The overall framework for control during cooling operation is shown in the following figure:




The setting method for initial opening and maximum minimum opening is similar to that for EXVA;

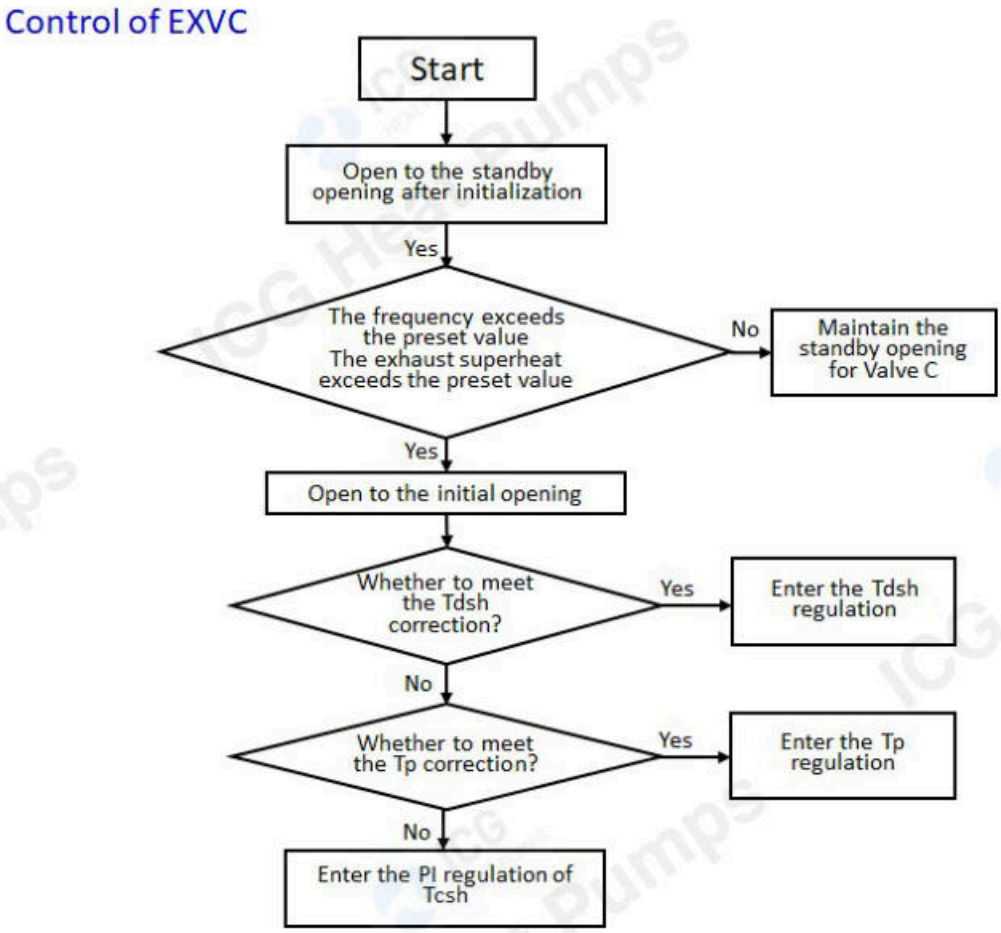
Through adjustment of the too high evaporation pressure of Pe, it is ensured that the operating low pressure does not exceed the operating range of the compressor; if the low pressure exceeds the preset value, EXVB will be turned off;

If the exhaust temperature Tp exceeds the preset value, EXVB will open up to prevent the exhaust temperature from being too high for protection;

Tdsh exhaust superheat regulation is a basic regulation, aimed at ensuring the reliability of the compressor. When Tdsh is less than the preset value, EXVB is turned off to ensure that liquid refrigerant does not enter the compressor too much and dilute the lubricating oil, avoiding poor lubrication and compressor wear.

The regulation of the return air superheat (return air temperature -- evaporation temperature) is to ensure the energy efficiency of the unit during free operation; different control target values are distinguished based on the environmental temperature and water temperature frequency; when Tssh is less than the preset value, EXVB will turn down.

1.10.3 **Control of EXVC**




EXVC is an injection valve that may open for both cooling and heating. The standby opening is set to 0. After the compressor frequency is detected, and the conditions such as exhaust superheat etc. are met, EXVC will open to the initial opening, and then corrected as per the connection of Tdsh, Tp and Tcsh;

The purpose of correction of the Tdsh exhaust superheat is to reduce the injection volume when the EXVC is turned on too much, the injection volume is too high, and Tdsh is small;

Tp correction is to control EXVC regulation when the exhaust temperature is high, in order to avoid protection from high exhaust temperature;

For regulation of the auxiliary circuit superheat (T6B-T6A) of Tcsh, the flow rate, that is, the injection amount, of the auxiliary circuit is adjusted through the regulation of the temperature difference between the inlet and outlet of the auxiliary circuit refrigerant in the economizer, so as to achieve a good state of the capacity and energy efficiency of the unit.

## 1.11 Cooling Control & Heating Control

### 1.11.1 Cooling Control:

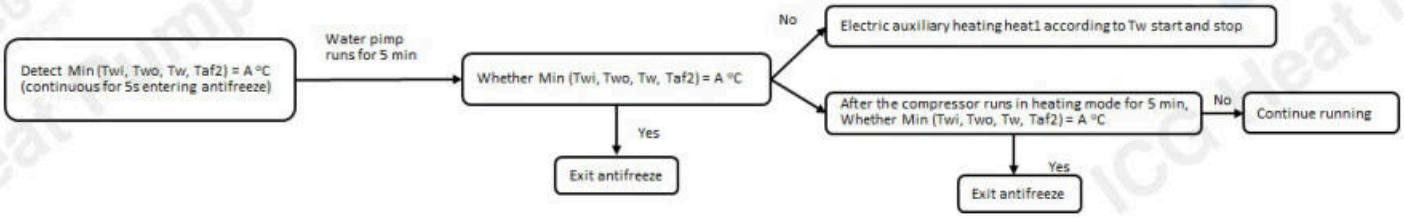
1. The initial air speed position is determined based on the environmental temperature
2. The rotating speed is controlled through the high-pressure pressure Pc during operation. If Pc is too high, the air speed will increase; if Pc is too low, the air speed will be reduced

### 1.11.2 Heating Control:

3. The initial air speed position is determined based on the environmental temperature
4. The rotating speed is controlled through the low-pressure pressure Pe during operation. If Pe is too high, the air speed will be reduced; if Pe is too low, the air speed will increase

## 1.12 Key Function Control Logic

### 1.12.1 Anti-freezing operation Control

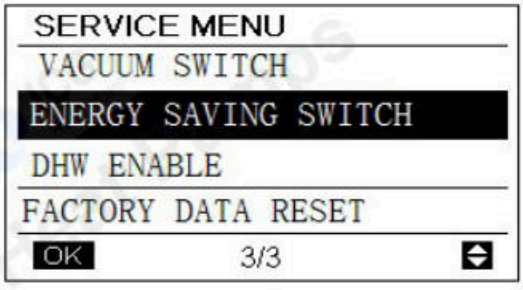


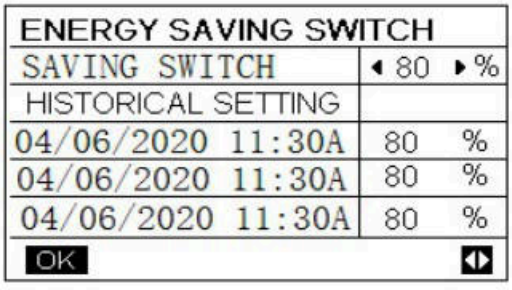

Water Pump Operation + Heat Pump Operation + Electric Auxiliary Heating Operation

It is important to note that when the wired controller is set to the low water outlet mode (antifreeze mode), considering the reliability of the unit and the user's usage conditions, the unit does not check the conditions for entering antifreeze mode when it is shut down or in cooling standby mode. Therefore, the manual clearly specifies the antifreeze concentration requirements.

### 1.12.2 Energy Saving Mode

By setting the energy saving switch ratio through the wired controller, the maximum current during the unit's free operation can be determined. The wired controller offers seven options: 100%, 90%, 80%, 70%, 60%, 50%, and 40%. The smaller the ratio setting, the lower the maximum current limit during operation.




### 1.12.3 Remote Function Control

When using the remote switch function, you first need to set the S1-1 dip switch on the mainboard at address 0# to ON (default is OFF, controlled by the wired controller).

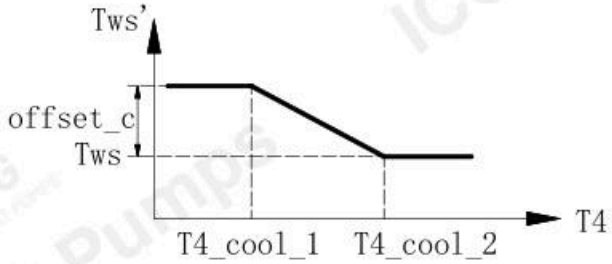
When S1-1 is set to ON for remote control:
The system's power on/off is controlled by the ON/OFF port. Short-circuiting the ON/OFF port turns the system on, while disconnecting the ON/OFF port turns the system off.
The cooling/heating mode is controlled by the H/C port. Disconnecting the H/C port sets the system to cooling mode, with an internal default set temperature of 7°C and an internal default hysteresis (δ) of 2°C. Short-circuiting the H/C port sets

the system to heating mode, with an internal default set temperature of 45°C and an internal default hysteresis (δ) of 2°C. If a wired controller is also connected, the set temperature, hysteresis, and other parameters can be adjusted through the wired controller.

### 1.12.4 Temperature Compensation Control

Cooling Mode

When the user enables this function on the wired controller, the parameters T4_cool_1, T4_cool_2, and offset_c are set. The machine updates the target water temperature every 5 minutes based on the detected T4 temperature. The target water temperature is adjusted as shown in the diagram below:




When T4<T4_cool_1: Tws'=Tws+offset_c

When T4_cool_1≤T4≤T4_cool_2:

$$Tws' = Tws + offset\_c - \frac{offset\_c}{T4\_cool\_2 - T4\_cool\_1} \cdot (T4 - T4\_cool\_1)$$

When T4>T4_cool_2: Tws'=Tws

Note: When the set temperature is lower than the minimum outlet water temperature limit, the system operates at the minimum outlet water temperature.

The same principle applies to the heating mode.

# 2 Faults and Protection Functions

## 2.1 Main Board Detection

a) When the fault EEPROM is read/the model is mismatched, the fault code E0 is displayed

b) For the phase loss and phase sequence error fault, the code E1 is displayed

The three phases of power supply A, B and C shall exist simultaneously and have a phase angle difference of 120° in sequence. If the conditions are not met, a phase sequence or Phase Loss fault will occur and the fault code will be displayed. After the power supply restores, the fault is resolved.

c) For the communication fault, the code E2 is displayed

If the fault occurs between the slave module units (or between the slave and the master), the slave unit where a communication fault occurs and its subsequent slave units will shut down, and the communication fault E2 will be displayed, while the master and slave units before it will not be affected. The number of the units detected on the Wired Controller decreases. EC will be displayed for the wired controller, and at the same time, the indicator light of the Wired Controller will flash.

When a communication fault is detected between the main board and the expansion board, 2E2 will be displayed for the main board.

Two main boards are provided for such series of unties -- host and slave boards, which are connected through communication lines. When the communication between the main board and the slave board is unavailable for two minutes, the system controlled through the salve boards will shut down, and the fault code 3E2 will be displayed for the salve board.

d) For the fault of the power phase sequence protector, the code E8 is displayed

For the external power phase sequence protector, the protection port is output, and the main control board is continuously detected.

e) EC is reduced in the slave module.

f) For the mismatch fault of the driver model, the code H9 is displayed

Two main boards are arranged for one unit of this series, when the code of the compressor/fan detected through the main board does not match the currently dialed model, the fault 1H9 is displayed for the main board, for example, if the driver program of R32 70 kW is used, the refrigerant code of the main board is dialed to R290.

g) For the water flow switch fault, the code E9 is displayed

This protection is to prevent poor heat exchange of the water side heat exchanger and abnormal operation of the system due to low water flow rate. Adjustment will be made after the water pump operates for 1 minute and 45 s, and when the water flow rate is lower than the protection value of the water flow switch, the E9 protection will be triggered. If the water flow switch is damaged, the E9 protection will be also caused.

## 2.2 Temperature sensor

a) For the main outlet temperature sensor fault (which is only detected through the host, rather than the slaves), the code E3 is displayed

b) For the return water temperature sensor fault of the unit, the code EF is displayed; the main system of the unit must be connected, except for the slave systems. If it is connected incorrectly, this fault will be reported

c) For the outlet temperature sensor fault of the unit, the code E4 is displayed; the main system of the unit must be connected, except for the slave systems. If it is connected incorrectly, this fault will be reported

d) For the fault of the condenser tube temperature sensor T3A, the code 1E5 is displayed

e) For the fault of the environmental temperature sensor T4, the code E7 is displayed; the main system of the unit must be connected, except for the slave systems. If it is connected incorrectly, this fault will be reported

f) For the fault of the water tank temperature sensor T5, the code E6 is displayed

g) Tz is the refrigerant outlet of the water heating side plate, and for the sensor fault, the code EU is displayed

h) For the fault of the low-temperature antifreeze temperature sensor Taf2 of the cooling evaporator, the code 2Eb is displayed; the main system of the unit must be connected, except for the slave systems. If it is

connected incorrectly, this fault will be reported

i) For the fault of the anti-freezing temperature sensor Taf1 of the water tank pipeline, the code 1Eb is displayed; the main system of the unit must be connected, except for the slave systems. If it is connected incorrectly, this fault will be reported

j) For the fault of the refrigerant exchange temperature sensor T6A/T6B of the vapor injection board, the code 1EE/2EE is displayed

k) For the fault of the exhaust temperature sensor Tp1, the code Ed is displayed

l) For the fault of the return air temperature sensor Th, the code Fd is displayed

## 2.3 Backup operation plan

### 2.3.1 Environmental temperature sensor fault E7

Single unit: In case of a host (0# unit), after the fault E7 occurs to T4, the heat pump cannot be started for the unit.
Multiple units in parallel: After the fault E7 occurs to the unit T4, the value T4 of the system is used to replace the value T4 of the faulty unit, and the faulty unit can still be started and operates. When other faults or protections occur to the faulty unit, it can still be started and operate unless the shutdown of the unit is locked due to other faults or protections. When the fault occurs to T4 of all the units, the fault E7 is reported.

## 2.4 Driver module

a) For the communication fault of the IPM module, the code 1F0 is displayed

b) For the voltage fault of the busbar (PTC) (＜300V or ＞800V), the code 1F6 is displayed for the system.
Notes: The voltage fault of the busbar (PTC) is detected through the PCB main board in the electrical assembly workshop or 30 s after power-on in the electronic control box detection mode. The detection starts 60 s after power-on by default, and the detection time for busbar voltage fault (PTC) is 10 s.

## 2.5 System protection

a) For the too high exhaust temperature protection and too high exhaust pressure protection of the system, the protection code is P0, and the detection is carried out through the main board;
Under normal circumstances, the exhaust switch is normally closed, and it is disconnected when the exhaust exceeds the protection value. (If within 60 min, protection occurs for 3 times, it cannot be restored unless the power is cut off).
For the discrimination of the detection value of the high-pressure pressure sensor, please refer to the pressure frequency limiting instructions in the compressor control for the model R290 50/60/70 Kw.

b) For the x high-voltage switch disconnection protection of the system, the protection code is 1P0, and for the compressor module fault, the protection code is 1bH, which are feedback through the module board;
① 1P0: Under normal circumstances, the high-voltage switch is normally closed, but it is disconnected when the high-voltage exceeds the protection value.
② 1bH: For the relay adhesion fault or 908 self-check failure fault of the compressor module board, the driver chip sends a fault signal to the main controller, and the code 1bH is displayed. At the same time, the red light of the module board turns on for long, the green light flashes for three times, and the fault cycle lasts for 60 s.

c) For the low-pressure protection of the system, the protection code is P1
The system is not provided with the low-pressure switch, and the low-pressure pressure is detected through a low-pressure pressure sensor. When the pressure is lower than the protection value of 0.03 MPa for 5 s, the low-pressure protection is triggered. If the pressure is higher than 0.10 MPa for 5 s, it is restored; in case of low pressure protection, the compressor of the corresponding system is stopped (if within 60 min, protection occurs for 3 times, it cannot be restored unless the power is cut off).

d) Current protection of compressor

The protection code is P4. The current is not detected during the first 10 s after the compressor is started. When the current of the compressor is detected to exceed the set protection value, all the compressors in the system will shut down. (If within 60 min, protection occurs for 3 times, it cannot be restored unless the power is cut off). The AC current protection is 1P4, and the busbar current protection is 2P4.

e) When the heating environment temperature is too high and T4 is detected to be higher than 65℃, the fault code PH is displayed

f) When the voltage is too high or too low, and the voltage is detected to be higher than 156V or lower than 101V, the fault code H5 is displayed

g) When the module temperature is too high, and the module temperature exceeds 100℃, the fault code PL is displayed (if within 60 min, protection occurs for 3 times, it cannot be restored unless the power is cut off). The code C7 is reported for PL when protection occurs for 3 times

i) When the cooling environment temperature T4 is too high, and T4 is detected to be higher than 65℃, the fault code P3 is displayed

j) When high temperature protection occurs for the condenser, and T3 is detected to be height than 64℃ during cooling operation, the protection code P7 is displayed. If it is below 55℃, the code is eliminated, the unit can be turned on normally

k) Exhaust temperature sensor failure alarm: EP

After the entire unit operates for 10 min, detection and judgment begin. If the cooling/heating/water heating Pc is greater than or equal to 3.5 MPa, and the exhaust Tpmax is less than 15℃, lasting for 2 min, it can be judged as an exhaust temperature sensor failure fault, the corresponding system is stopped, and the exhaust temperature sensor failure fault EP is reported. If the above conditions are not met, the fault will automatically recover, and the unit will be restored upon recovery of the fault.

### 2.5.1 Pressure sensor fault HC, Fb

1) For standby detection, in the standby or shutdown mode (3 min after the compressor stops),
   1.1) If the low pressure detection value Pe is less than 0.02 MPa, and Pc is greater than or equal to 0.1 MPa, Fb is reported. If the above conditions are not met, the fault will automatically recover after 30 s.
   1.2) The reference temperature sensor method for short-circuit treatment is used to determine AD, and if it meets the following:
      1.2.1) In case of short circuit when AD is greater than or equal to 253, HC is reported;
      1.2.2) In case of open circuit when AD is less than 4, HC is reported;
      If the above judgment conditions for the AD value are not met, the fault will automatically recover after 30 s.
2) The operation process detection is carried out 15 min after the cooling/heating/ water heating compressor is started (no detection is required in the defrosting process).
   2.1) If the pressure Pc of the high-pressure pressure sensor is detected to be less than 0.3 MPa and lasts for 5 s, the pressure sensor fault HC will be output. After shutdown, if Pc is detected to be greater than or equal to 0.3 MPa, the fault can be restored after 30 s;
   2.2) If the pressure Pc of the high-pressure pressure sensor is detected to be greater than 2.0 MPa and lasts for 5 s, the low-pressure pressure sensor fault Fb will be output. After protection shutdown, the fault can be automatically restored after 30 s;

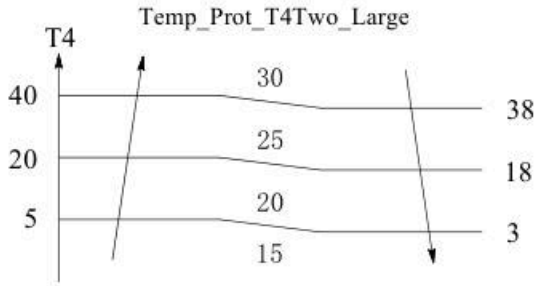
m) Insufficient exhaust superheat protection F2

5 min after the unit is started, the exhaust superheat Tdsh of the compressor is detected (when defrosting or compressor stopping occurs to the unit, the correction is exited, and then timing correction is carried out after defrosting is completed or the compressor is restarted); when Tdsh is less than or equal to 0℃ and lasts for 20 min, or Tdsh is less than or equal to 5℃ and lasts for 60 min, the protection F2 is reported for the unit. After the

insufficient exhaust superheat protection F2 occurs, it will recover for at least 20 min, and after the F2 protection occurs for the second time, it will recover for at least 40 min (if the F2 protection occurs successively, the waiting time of the outdoor unit accumulates for 20 min for each occurrence, and the longest waiting time is 120 min). Until the continuous operation time exceeds 60 min without F2 protection, the shutdown waiting time limit will be automatically eliminated.

n) Low refrigerant protection of the system

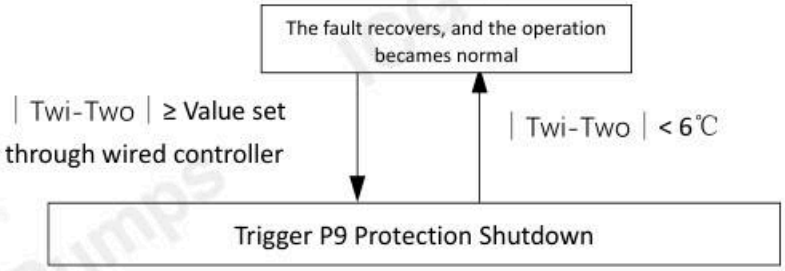
1) When Min(T4,Two)-Tc is detected to be greater than or equal to Temp_Prot_T4Two_Large in the unit in the standby or shutdown mode (3 minutes after the compressor is stopped), it is judged that the refrigerant system of the unit is insufficient, and P1 protection is reported, without locking. When Min(T4,Two)-Tc is less than Temp_Prot_T4Two_Large-5, the protection is released. [The refrigerant leakage is adjusted during standby to prevent compressor damage caused due to start with insufficient refrigerant]




2) When Tdsh of the compressor of the unit during operation is greater than or equal to 75℃ and lasts for 30 min, the P1 shutdown shall be reported for the unit. The low refrigerant judgment is carried out. If the low refrigerant protection is not triggered, the P1 protection will be released, and the operation will be restarted as needed.

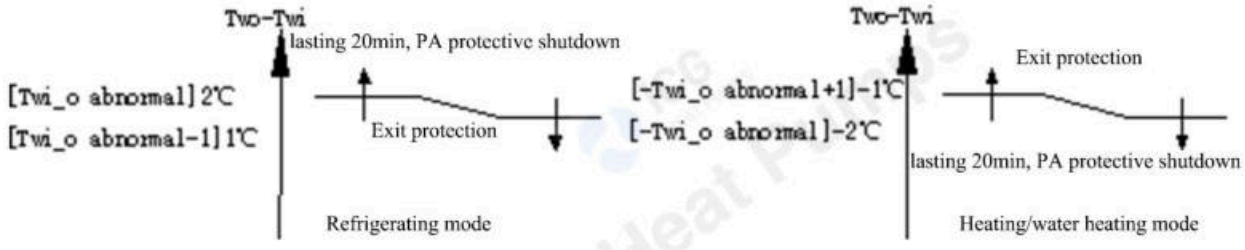
o) Excessive inlet and water outlet temperature difference protection P9

When the filter is dirty or blocked or the water flow rate is low, the difference in inlet and water outlet temperature increases, and when it exceeds the set protection value, P9 protection is triggered. This set value can be changed through the Wired Controller.




p) Abnormal inlet and water outlet temperature difference protection PA

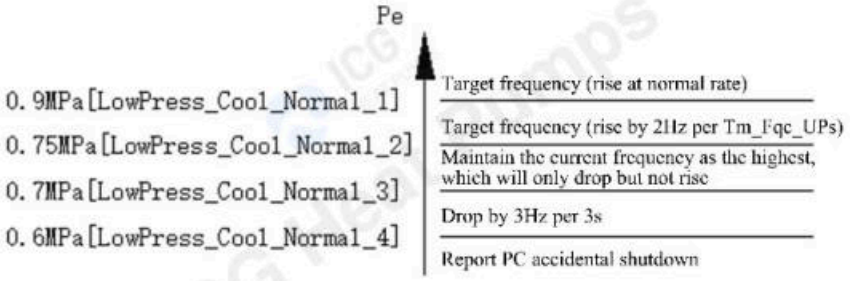
After the compressor is started, the abnormal inlet and water outlet temperature difference protection PA is detected



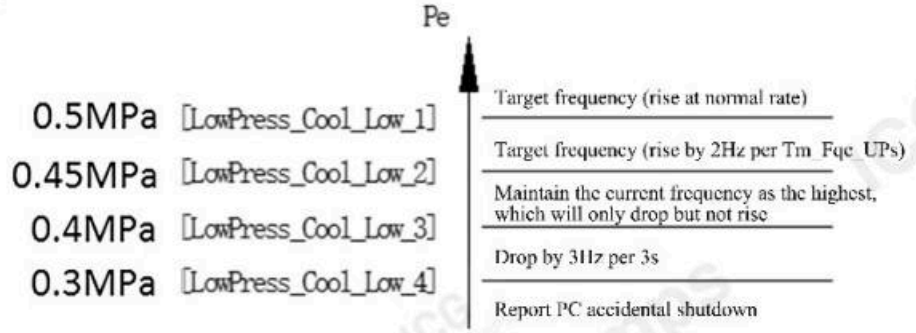

q) Too low evaporator pressure protection pc during cooling

During the conventional water outlet cooling operation, the following principles shall be followed for frequency limiting:

After the cooling compressor is started, the low pressure frequency limiting and protection shall be carried out as per the following figure.




During the low water outlet cooling operation, the following principles shall be followed for frequency limiting:
After the cooling compressor is started, the low pressure frequency limiting and protection shall be carried out as per the following figure.




r) Low temperature antifreeze protection PE for cooling evaporator

The code for low temperature protection of the cooling evaporator is PE, the low temperature protection for Taf2 is ineffective in the standby mode.

1. Conventional cooling: In the cooling mode, if Taf2 is less than or equal to 3℃ and lasts for 3 s, the shutdown procedures shall be implemented, until Taf2 is greater than 10℃, and the shutdown time is greater than 3 min. When protection occurs to the host, only the host is stopped; when protection occurs to the slave, only the slave is stopped.
2. Saltwater type: In the cooling mode, if Taf2 is less than or equal to -10℃ and lasts for 3 s, the shutdown procedures shall be implemented, until Taf2 is greater than -2℃, and the shutdown time is greater than 7 min.

# 3 Spot Checking Instructions & Operating Parameters

## 3.1 Spot Checking Instructions

List of spot checking (Spot checking can continue if there is no fault)

The display instructions for the spot checking sequence are as follows:

| Serial Number | | Inspection Content |
|---|---|---|
| 0 | | Standby: Main unit address (left 88) + Online units (right 88),<br>Power on: Display frequency<br>Defrost: dFdF (alternately displayed with current operating frequency) |
| 1 | 0.xx | Host address |
| 2 | 1.xx | Outdoor unit matching (e.g.R290 model: display 70/60/50) |
| 3 | 2.xx | Online units (effective host) |
| 4 | 3.xx | T4 capacity correction (reserved display "1") |
| 5 | 4.xx | Operating mode (8 shutdown, 1 cooling, 2 heating, 4 hot water) |
| 6 | 5.xx | Fan speed (0-35) |
| 7 | 6.xx | Fan speed (reserved display "0") |
| 8 | 7.xx | T3 (min) |
| 9 | 8.xx | T4 |
| 10 | 9.xx | Outlet water temperature of T5 water tank |
| 11 | 10.xx | Taf1 |
| 12 | 11.xx | Taf2 |
| 13 | 12.xx | Tw total outlet water temperature of the unit |
| 14 | 13.xx | Twi unit inlet water temperature |
| 15 | 14.xx | Two unit outlet water temperature |
| 16 | 15.xx | Tz total cooling outlet temperature (for heating water side plate exchange refrigerant outlet temperature) |
| 17 | 16.xx | THeatR heat recovery sensor temperature (reserved display "--") |
| 18 | 17.xx | Exhaust temperature 1 |
| 19 | 18.xx | Exhaust temperature 2 (reserved display "--") |
| 20 | 19.xx | Radiator temperature 1 |
| 21 | 20.xx | Radiator temperature 2 (reserved display "--") |
| 22 | 21.xx | Exhaust superheat Tdsh |
| 23 | 22.xx | Compressor A current |
| 24 | 23.xx | Compressor B current (reserved display "--") |
| 25 | 24.xx | -- |
| 26 | 25.xx | Electronic expansion valve A opening degree (percentage, maximum value is 100%) |
| 27 | 26.xx | Electronic expansion valve B opening degree (percentage, maximum value is 100%) |
| 28 | 27.xx | Electronic expansion valve C opening degree (percentage, maximum value is 100%) |
| 29 | 28.xx | High pressure (heating mode) (cooling and heating effective) |
| 30 | L.xx | Low pressure (display with decimal places - displayed during cooling or standby) (cooling and heating effective) |
| 31 | 30.xx | Refrigerant superheat Tssh |
| 32 | 31.xx | Discharge air temperature |

| | | |
|---|---|---|
| 33 | 32.xx | First digital tube on the right: mute selection (0: night mute 1: mute 2: super mute 3: no mute (default))<br>Second digital tube on the right: mute time selection (0-3) value depends on the line controller parameters |
| 34 | 33.xx | Static pressure selection (default 0 static pressure) |
| 35 | 34.xx | DC voltage A (actual value * 10) |
| 36 | 35.xx | DC voltage B (reserved display "--") |
| 37 | 36.xx | Frequency limit number (reserved) (0: no frequency limit; 1: T4 frequency limit; 2: Tp exhaust frequency limit; 3: Tz total cooling frequency limit (refrigeration high pressure frequency limit); 4: Tf module temperature frequency limit; 5: Two outlet water frequency limit 6: pressure frequency limit; 7: current frequency limit; 8: voltage frequency limit |
| 38 | 37.xx | Defrosting process status (first digit: T4 selection scheme; second digit: interval in the scheme; the third and fourth digits together indicate the defrosting timing) |
| 39 | 38.xx | E fault: 1 for fault, 0 for no fault (reserved for 90kw) |
| 40 | 39.xx | Defrosting scheme |
| 41 | 40.xx | Initial frequency |
| 42 | 41.xx | Tc (saturated temperature corresponding to high pressure) point inspection value +30 |
| 43 | 42.xx | Te (saturated temperature corresponding to low pressure) point inspection value +30 |
| 44 | 43.xx | T6a |
| 45 | 44.xx | T6b |
| 46 | 45.xx | Main control software version number |
| 47 | 46.xx | Expansion board software version number |
| 48 | 47.xx | Last first fault |
| 49 | 48.xx | Last second fault |
| 50 | 49.xx | Last third fault |
| 51 | 50.xx | Last fourth fault |
| 52 | 51.xx | Last fifth fault |
| 53 | 52.xx | Last sixth fault |
| 54 | 53.xx | ---- |

Note: Need to perform spot check operation on the online controller.

* If the displayed value is below -9, the preceding digit is not shown. For example, if the value is -15, the main board will display.-15. If the displayed value exceeds 100, the hundreds digit is not shown. For example, if the 18th value is 115, the main board will display 18.15.

## 3.2 Normal Operating Parameters of Refrigerant System

Under the following conditions, the operating parameters given below should be observed:

- If the outdoor ambient temperature is high, the system is being run in normal cooling mode with the following settings: temperature 5°C.
- If the outdoor ambient temperature is low, the system is being run in heating mode with the following settings: temperature 75°C.
- The system has been running normally for more than 30 minutes.

| Outdoor ambient temperature | °C | < 10 | 10 to 25 | 25 to 35 | 35 to 48 |
|---|---|---|---|---|---|
| Outlet water temperature | °C | 10 | 7 | 7 | 7 |
| Average discharge temperature | °C | 35-80 | 45-100 | 55-105 | 60-105 |
| Average discharge superheat | °C | 15-30 | 15-35 | 15-35 | 15-35 |
| Discharge pressure | MPa | 0.8-1.6 | 1.0-1.8 | 1.1-2.0 | 1.2-2.3 |
| Average suction superheat | °C | 2-4 | 2-6 | 2-6 | 2-8 |
| Suction pressure | MPa | 0.7-1.3 | 0.7-1.0 | 0.7-1.3 | 0.7-1.4 |
| Average suction temperature | °C | 1-30 | 3-30 | 3-35 | 5-40 |
| T3 | °C | 5-50 | 20-50 | 30-55 | 35-65 |
| Tz/7 | °C | / | / | / | / |
| Taf | °C | 8-20 | 5-25 | 5-25 | 5-25 |
| T6A/B | °C | / | 5-30 | 8-30 | 10-40 |
| Twi | °C | 10-25 | 10-30 | 10-30 | 10-30 |
| Two | °C | 8-20 | 5-25 | 5-25 | 5-25 |
| Tw | °C | 8-20 | 5-25 | 5-25 | 5-25 |

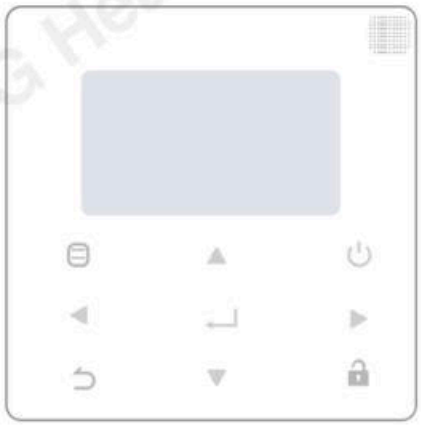
*Outdoor unit in heating mode operating parameters*

| Outdoor ambient temperature | °C | < -12 | -12 to -5 | -5to 15 | 15 to 25 | > 25 |
|---|---|---|---|---|---|---|
| Average discharge temperature | °C | 30-110 | 35-105 | 35-105 | 35-105 | 45-100 |
| Average discharge superheat | °C | 20-40 | 20-40 | 15-35 | 15-35 | 15-30 |
| Discharge pressure | MPa | 0.7-3.2 | 1.0-3.2 | 1.1-3.2 | 1.2-3.2 | 1.3-3.2 |
| Average suction superheat | °C | 0-4 | 0-4 | 0-4 | 1-6 | 2-8 |
| Suction pressure | MPa | 0.05-0.2 | 0.12-0.28 | 0.18-0.6 | 0.4-0.80 | 0.55-0.85 |
| Average suction temperature | °C | -25 to -10 | -22 to -5 | -15 to 10 | 0 to 22 | 5 to 25 |
| T3 | °C | -25 to -15 | -22 to -7 | -12 to 8 | 0 to 22 | 5 to 25 |
| Tz/7 | °C | 20 to 60 | 20 to 65 | 20 to 70 | 20 to 60 | 20 to 55 |
| Taf | °C | 25-65 | 25-70 | 25-75 | 25-65 | 25-60 |
| T6A/B | °C | -15-60 | -10-65 | 0-70 | 10-60 | 20-55 |
| Twi | °C | 22-63 | 22-68 | 21-72 | 20-60 | 20-52 |
| Two | °C | 25-65 | 25-70 | 25-75 | 25-65 | 25-60 |
| Tw | °C | 25-65 | 25-70 | 25-75 | 25-65 | 25-60 |

## 4 Installation and Field Setting

During installation, the unit's settings and parameters should be configured by the installer to suit the installation configuration, climate conditions and end-user preferences. The relevant settings are accessible and programmable through the SERVICE and PROJECT menu on the wired controller's user interface.

KJRM-120H3/BMWKO-E



| Icon | Function |
|---|---|
| | Enter the menu structure from the home page |
| | Navigate the cursor on the display/navigate in the menu structure/ adjust the settings |
| | Turn on or off the space operation mode |
| | Come back to the up level |
| | Long press for unlocking /locking the controller |
| | Go to the next step when programming a schedule in the menu structure / confirm a selection/enter a submenu in the menu structure |

## 4.1 Service menu

### 4.1.1 Structure

**For SERVICE Menu**

1. STATE QUERY
2. CLEAR HSITORY ERRORS
3. SETTING ADDRESS
4. HEAT CONTROL
5. TEMPERATURE COMPENSATION
6. PUMP CONTROL
7. MANUAL DEFROST
8. LOW OUTLET WATER CONTROL
9. VACUMM SWITCH
10. ENERGY SAVING SWITCH
11. DHW ENABLE
12. FACTORY DATA RESET

**1. STATE QUERY**

**2. CLEAR HISTORY ERRORS**
CLEAR UNIT HISTORY ERRORS
CLEAR ALL HISTORY ERRORS
CLEAR LOCK ERRORR
CLEAR RUN TIME

**3. SETTING ADDRESS**
CONTROLLER ADDRESS
CONTROL ENABEL
MODBUS ENABLE
MODBUS ADDRESS

**4. HEAT CONTROL**
HEAT1
HEAT2
FORCED HEAT2 OPEN

**5. TEMPERATURE COMPENSATION**
COOL MODE ENABLE
T4_COOL_1
T4_COOL_2
OFFSET-C
HEAT MODE ENABLE
T4_HEAT_1
T4_HEAT_2

**6. PUMP CONTROL**
FORCED PUMP OPEN
INV PUMP SETTING
PUMP ON/OFF TIME

**7. MANUAL DEFROST**

**8. LOW OUTLETWATER CONTROL**

**9. VACUUM SWITCH**

**10. ENERGY SAVING SWITCH**

**11. DHW ENABLE**

**12. FACTORY DATA RESET**

### 4.1.2 Service Menu

**MENU > Service Menu**

Service Menu allows installers to input the system configuration and set the system parameters. Enter the password, using ◄ ► to navigate between digits and using ▼ ▲ to adjust the numerical values, and then press ↵. The password is 234.

| SERVICE MENU |
|---|
| PLEASE INPUT THE PASSWORD |
| 0 0 0 |
| OK |

The following pages will be displayed after putting the password.

| SERVICE MENU |
|---|
| STATE QUERY |
| CLEAR HISTORY ERRORS |
| SETTING ADDRESS |
| HEAT CONTROL |
| OK 1/3 |

| SERVICE MENU |
|---|
| TMEPERATURE COMPENSATION |
| PUMP CONTROL |
| MANUAL DEFROST |
| LOW OUTLET WATER CONTROL |
| OK 2/3 |

| SERVICE MENU |
|---|
| VACUUM SWITCH |
| ENERGY SAVING SWITCH |
| DHW ENABLE |
| FACTORY DATA RESET |
| OK 3/3 |

### 4.1.3 State query

**MENU > Service Menu > State query**

| SERVICE MENU |
|---|
| STATE QUERY |
| CLEAR HISTORY ERRORS |
| SETTING ADDRESS |
| HEAT CONTROL |
| OK 1/3 |

**STATE QUERY** allows installers to check the operation parameters. Press ◄ ► to select the address of units.

| STATE QUERY | |
|---|---|
| SELECT ADDRESS | ◄ 07 ► # |
| ODU MODEL | 130 kW |
| COMP FREQUENCE | 50 Hz |
| COMP1 CURRENT | 20 A |
| COMP2 CURRENT | 20 A |
| BACK | |

| STATE QUERY | |
|---|---|
| H-P PRESSURE | 3.83 MPa |
| L-P PRESSURE | 1.00 MPa |
| TP1 DISCHARGE TEMP | 30 ℃ |
| TP2 DISCHARGE TEMP | 30 ℃ |
| TH SUCTION TEMP | -20 ℃ |
| OK 2/9 | |

| STATE QUERY | |
|---|---|
| TZ TEMP | -20℃ |
| T3 TEMP | -20℃ |
| T4 TEMP | -20℃ |
| T6A TEMP | 40℃ |
| T6B TEMP | 40℃ |
| BACK 3/9 | |

| STATE QUERY | |
|---|---|
| TFIN1 TEMP | 60 ℃ |
| TFIN2 TEMP | 60 ℃ |
| TDSH | 30 ℃ |
| TSSH | 15 ℃ |
| TCSH | 15 ℃ |
| BACK 4/9 | |

| STATE QUERY | |
|---|---|
| FAN1 SPEED | 850 RPM |
| FAN2 SPEED | 850 RPM |
| FAN3 SPEED | 850 RPM |
| EXV A | 1800 P |
| EXV B | 1800 P |
| BACK 5/9 | |

| STATE QUERY | |
|---|---|
| EXV C | 1800P |
| Twi TEMP | 30℃ |
| Two TEMP | 30℃ |
| Tw TEMP | 30℃ |
| TAF1 TEMP | 30℃ |
| BACK 6/9 | |

| STATE QUERY | |
|---|---|
| TAF2 TEMP | 30 ℃ |
| T5 TEMP | 30 ℃ |
| COMP TIME1 | 120 MIN |
| COMP TIME2 | 120 MIN |
| COMP TIME3 | 120 MIN |
| BACK | 7/9 |

| STATE QUERY | |
|---|---|
| COMP TIME | 65535 H |
| FIX PUMP TIME | 65535 H |
| INV PUMP TIME | 65535 H |
| ODU SOFTWARE | V45 |
| HMI SOFTWARE | V45 |
| BACK | 8/9 |

| STATE QUERY |
|---|
| DEFROSTING STATE |
| 00 01 02 03 04 05 06 07 |
| 08 09 10 11 12 13 14 15 |
| E2 SOFTWARE V45 |
| END |
| OK 9/9 |

Note:

1. Tz plate heat exchanger outlet temperature
   T3 lowest temperature of condenser tube
   T4 ambient temperature
   T6A, T6B EVI plate heat exchanger refrigerant temperature
   Tfin1, Tfin2 inverter module temperature
   TDSH Discharge superheat temperature
   TSSH Suction superheat temperature
   TCSH Injection superheat temperature
   Twi Unit water inlet temperature
   Two Unit water outlet temperature
   Tw Total water outlet temperature
   Taf1 DHW water pipe antifreeze temperature
   Taf2 Water side antifreeze temperature
   T5 Water tank temperature
2. For ODU SOFWARE and HMI SOFTWARE, the version number will vary with product iterations.

### 4.1.4 Clear history errors

**MENU > Service Menu > Clear history errors**

| SERVICE MENU |
|---|
| STATE QUERY |
| CLEAR HISTORY ERROR |
| SETTING ADDRESS |
| HEAT CONTROL |
| OK 1/3 |

| CLEAR HISTORY ERRORS |
|---|
| CLEAR UNIT HISTORY ERRORS |
| CLEAR ALL HISTORY ERRORS |
| CLEAR LOCK ERROR |
| CLEAR RUN TIME |
| OK |

**CLEAR HISTORY ERRORS** is used to clear the history error codes and component operation time.

| CLEAR UNIT HIS ERRS | |
|---|---|
| SELECT ADDRESS | ◂ 07 ▸ |
| DO YOU WANT TO CLEAR? | ◂ YES ▸ |
| OK | |

| CLEAR ALL HIS ERRS | |
|---|---|
| DO YOU WANT TO CLEAR? | ◂ YES ▸ |
| OK | |

| CLEAR LOCK ERR | |
|---|---|
| DO YOU WANT TO CLEAR? | ◂ YES ▸ |
| OK | |

| CLEAR RUN TIME | |
|---|---|
| SELECT ADDRESS | ◂ 07 ▸ |
| CLEAR COMP TIME? | ◂ NO ▸ |
| CLEAR FIX PUMP TIME? | ◂ NO ▸ |
| CLEAR INV PUMP TIME? | ◂ NO ▸ |
| OK | |

### 4.1.5 Setting address

**MENU > Service Menu > Setting address**

| SERVICE MENU |
|---|
| STATE QUERY |
| CLEAR HISTORY ERROR |
| SETTING ADDRESS |
| HEAT CONTROL |
| OK 1/3 |

**SETTING ADDRESS** is used to set whether the unit can be controlled by wired controller and through MDOBUS. SETTING ADDRESS can also enter by combining buttons pressing, ► for 3s.

| | |
|---|---|
| CONTROLLER ADDRESS | ◄ 10 ►# |
| CONTROL ENABEL | ◄ NO ► |
| MODBUS ENABLE | ◄ NO ► |
| MODBUS ADDRESS | ◄ 10 ►# |
| OK | |

**CONTROLLER ADDRESS** selects the unit address then we can check the parameters about this unit.

If CONTROL ENABLE sets as YES, it means the controller can set all the parameters; if CONTROL ENABLE sets as NO, it means the controller can only display the parameters.

If the chiller system access to MODBUS system, MODBUS ENABLE should be set as YES. Please note that in this case, **COMTROL ENABLE** should be also set as YES, otherwise the units cannot be controlled.

**MODBUS ADDRESS** set the controller address if the Modbus system is available.

### 4.1.6 Heat control

**MENU > Service Menu > Heat control**

| SERVICE MENU |
|---|
| STATE QUERY |
| CLEAR HISTORY ERROR |
| SETTING ADDRESS |
| HEAT CONTROL |
| OK 1/3 |

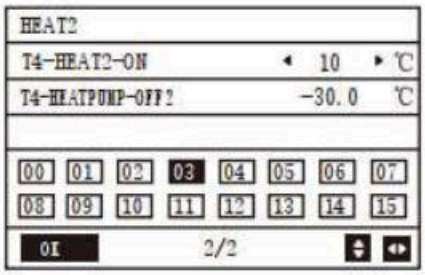
| HEAT CONTROL |
|---|
| HEAT1 |
| HEAT2 |
| FORCED HEAT2 OPEN |
| OK |

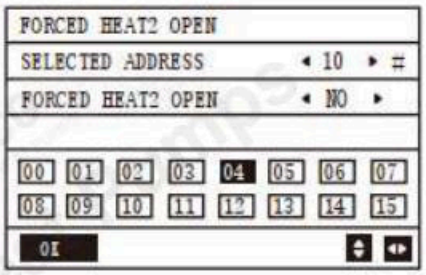
**HEAT1** means pipe electric heating in heating mode.

**HEAT2** means tank electric heating in DHW mode.

| HEAT1 | |
|---|---|
| HEAT1 ENABLE | ◄ NO ► |
| TEMP-AUXHEAT1-ON | ◄ 07 ►℃ |
| TW.HEAT1-ON | ◄ 25 ►℃ |
| TW.HEAT1-OFF | ◄ 45 ►℃ |
| OK 1/2 | |

| HEAT2 | |
|---|---|
| ALL HEAT2 DISABLE | ◄ YES ► |
| SELECT ADDRESS | ◄ 10 ►# |
| HEAT2-ENABLE | ◄ NO ► |
| T-HEAT2-DELAY | ◄ 190 ►MIN |
| DT5-HEAT2-OFF | ◄ 10 ►℃ |
| OK 1/2 | |




**TEMP-AUXHEAT1-ON** sets the ambient temperature below which the pipe heater (field supplied) turns on.

When the leaving water temperature does not reach TW. HEAT1-ON, the pipe electric heater (field supplied) turns on automatically.

When the leaving water temperature reaches TW. HEAT1-OFF, the pipe electric heater (field supplied) turns off automatically.

If the system is installed with tank booster heater, ALL HEAT2 DISABLE should be set as YES.

**HEAT2-ENABLE** sets the state of tank booster heater of SELECT ADDRESS.

**T-HEAT2-DELAY** sets the delay time for tank booster heater to turn on after the compressor starts.

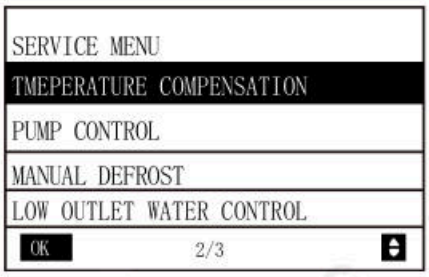
**DT5-HEAT2-OFF** sets the temperature difference between the actual water temperature and setting temperature above which the tank booster heater turns off.

**T4_HEAT2_ON** sets the ambient temperature that tank booster heater turns on. (00~15 means unit address)

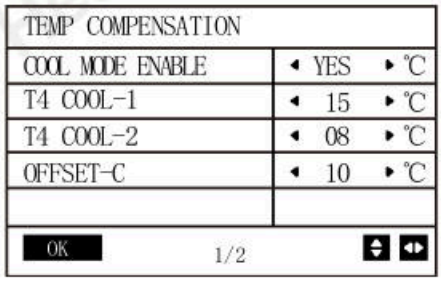
If **FORCED HEAT2 OPEN** is set as YES, when T5<T5S-1, then tank electric heater turns on; when T5≥T5S, then tank electric heater off. (00~15 means unit address)

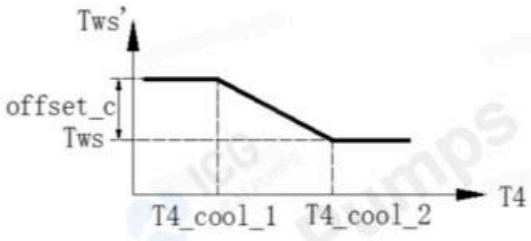
### 4.1.7 Temperature Compensation

**MENU > Service Menu > Temperature Compensation**

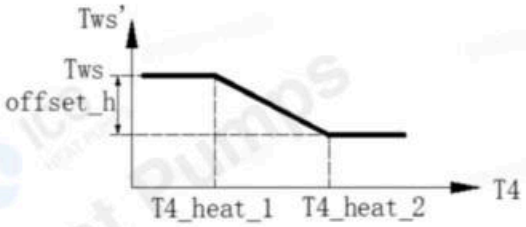



With the help of **TEMPERATURE COMPENSATION**, water temperature will automatically change as outside air temperature changes. When outdoor air temperature increases/decreases, the heating load will decrease/increase and water temperature will decrease/increase automatically. When outdoor air temperature decreases/increases, the cooling load will decrease/increase and water temperature will increase/decrease automatically.



| TEMP COMPENSATION | |
|---|---|
| HEAT MODE ENABLE | ◂ YES ▸ ℃ |
| T4 HEAT-1 | ◂ 08 ▸ ℃ |
| T4 HEAT-2 | ◂ 15 ▸ ℃ |
| OFFSET-H | ◂ 10 ▸ ℃ |
| | |
| OK 2/2 | |




**T4 COOL-1**, **T4 COOL-2** set the ambient temperature for cooling mode.

**T4 HEAT-1**, **T4 HEAT-2** set the ambient temperature for heating mode.

**Offset_c**, **Offset_h** is the temperature difference between current water temperature and T4_cool_1, T4_heat_1 corresponding water temperature.

### 4.1.8 Pump Control

**MENU > Service Menu > Pump Control**

| SERVICE MENU |
|---|
| TMEPERATURE COMPENSATION |
| PUMP CONTROL |
| MANUAL DEFROST |
| LOW OUTLET WATER CONTROL |
| OK 2/3 |

| PUMP CONTROL |
|---|
| FORCED PUMP OPEN |
| INV PUMP SETTING |
| PUMP ON/OFF TIME |
| |
| OK |

| FOECED PUMP OPEN | |
|---|---|
| SELECT ADDRESS | ◂ 0 ▸ # |
| FORCED PUMP OPEN | ◂ NO ▸ |
| | |
| | |
| OK | |

| INV PUMP SETTING | |
|---|---|
| SELECT ADDRESS | ◂ 07 ▸ # |
| SWITCH ON THE PUMP | ◂ NO ▸ |
| RATIO PUMP | ◂ 100 ▸ # |
| OK | |

| PUMP ON/OFF TIME | |
|---|---|
| PUMP ON TIME | ◂ 05 ▸ MIN |
| PUMP OFF TIME | ◂ 05 ▸ MIN |
| | |
| | |
| OK | |

**FORCED PUMP OPEN** is used to control the fixed frequency pump (filed supplied) operation.

**INV PUMP SETTING** is used to control the inverter water pump (field supplied) operation, the setting range of RATIO-PUMP is 30%-100%. It should ensure its flow meet the requirement of whole unit, otherwise the unit may be damaged.

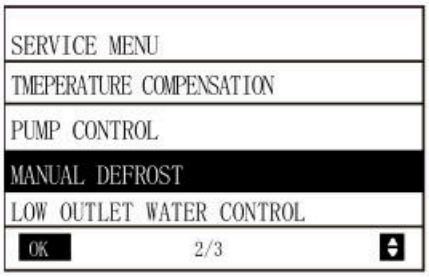
**PUMP ON TIME** sets the pump operation time after the unit stops.

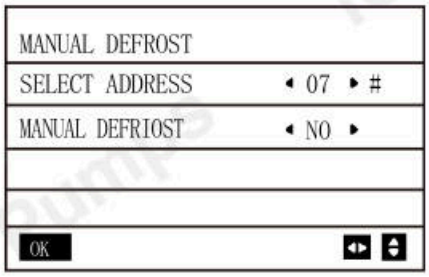
If PUMP OFF TIME sets as 0, the pump will run all the time. Otherwise, the pump will operate intermittently according to the PUMP ON TIME and PUMP OFF TIME setting.

| | Set range | Default value | Adjustment range |
|---|---|---|---|
| PUMP ON TIME | 5~60min | 5 | 5 |
| PUMP OFF TIME | 0~60min | 0 | 5 |

### 4.1.9 Manual Defrost

**MENU > Service Menu > Manual Defrost**



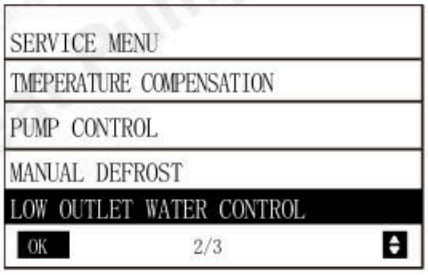




**MANUAL DEFROST** can force the unit to enter the defrost mode manually.

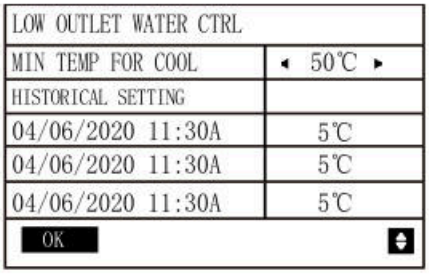
If the external unit successfully enters the defrost mode after the "MANUAL DEFROST" is turned on, the defrost icon will be displayed at homepage of the wired controller.

### 4.1.10 Low outlet water temperature control

**MENU > Service Menu > Low outlet water temperature control**

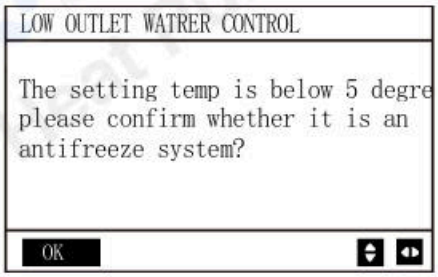



At this page, the historical minimum water outlet temperature setting (setting range -10~25℃) can be viewed.



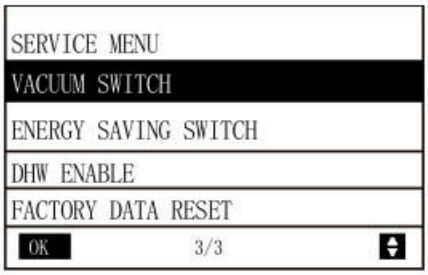

**MIN TEMP FOR COOL** sets the lowest water temperature for cooling mode. Please notice that When the setting temperature is less than 5℃, antifreeze liquid should be added in the water system.

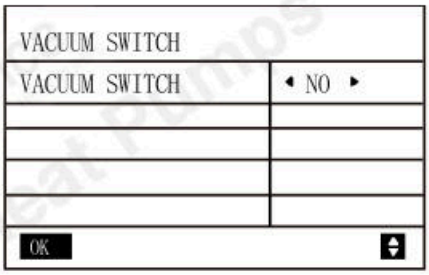
Tsafe=MIN TEMP FOR COOL



### 4.1.11 Vacuum switch

**MENU > Service Menu > Vacuum switch**

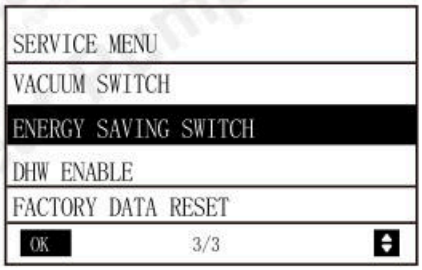


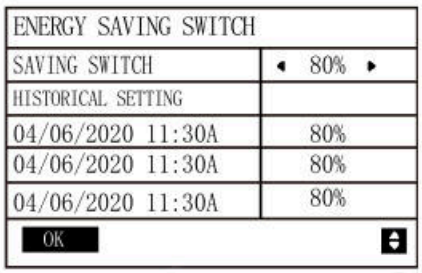




**VACUUM SWITCH** is used for vacuuming.

### 4.1.12 Energy saving mode

**MENU > Service Menu > Energy saving mode**



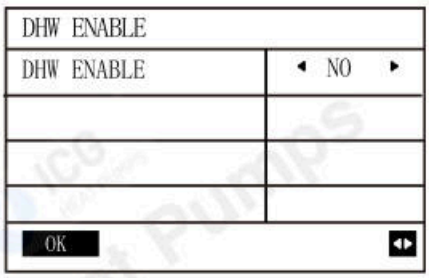




For projects with temporary electricity supply restrictions, the outdoor unit supports 7 levels of energy management which can be set to output 40-100% capacity. It prevents tripping during electricity supply restriction conditions and remains system continue to operate. The historical energy saving switch setting can be viewed.

### 4.1.13 DHW ENABLE

**MENU > Service Menu > DHW ENABLE**

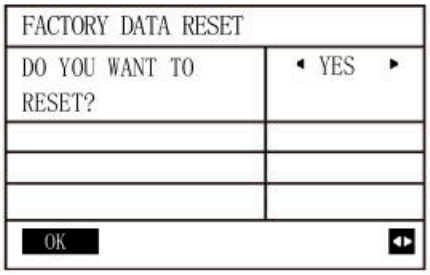
Domestic hot water function can be customized.




### 4.1.14 Factory data reset

**MENU > Service Menu > Factory data reset**

Factory data reset is used to reset all the data to the factory default setting.



## 4.2 Project meun

### 4.2.1 Structure

**For PROJECT Menu**

1. SET UNIT-AIRCONDITIONING
2. SET PARALLEL UNIT
3. SET UNIT PROTECTION
4. SET DEFROSTING
5. SET DHW TIME
6. SET E9 TIME
7. INV PUMP RATIO
8. CHECK PARTS

**1. SET UNIT-AIRCONDITIONING**
TWO_COOL_DIFF
TWO_HEAT_DIFF
DT5_ON
DTIS5
DtTws

**2. SET PARALLEL UNIT**
TIM_CAP_ADJ
TW_COOL_DIFF
TW_HEAT_DIF
RATIO_COOL_FIRST
RATIO_HEAT_FIRST

**3. SET UNIT PROTECTION**
T_DIFF_PRO
TWI_O_ABNORMAL

**4. SET DEFROSTING**
T_FROST
T_DEFROST_IN
T_DEFROST_OUT

**5.** SET DHW TIME
SELECT ADDRESS
COOL MIN TIME 0.5h
COOL MAX TIME
HEAT MIN TIME
HEAT MAX TIME
DHW MIN TIME
DHW MAX TIME

**6. SET E9 TIME**
E9 PROTECT TIME
E9 DETECTION METHOD

**7. INV PUMP RATIO**
MIN RATIO
MAX RATIO

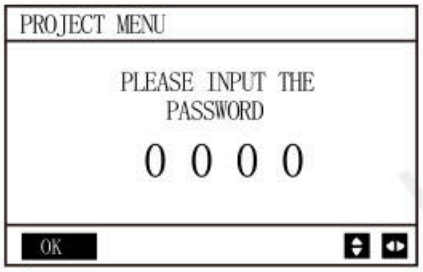
**8. INV PUMP RATIO**
MIN RATIO
MAX RATIO

### 4.2.2 Project Menu

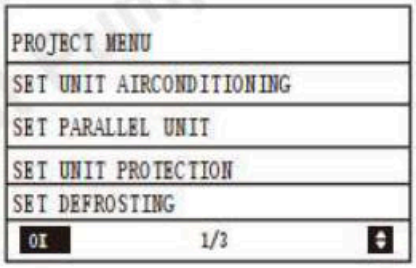
**MENU > Project Menu**

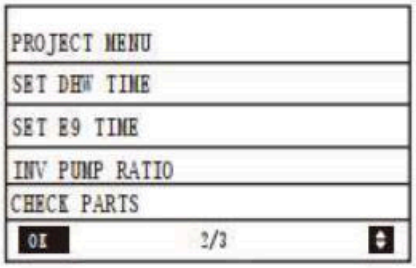
Project Menu allows installers to input the system configuration and set the system parameters. Enter the password, using ◄ ► to navigate between digits and using ▼ ▲ to adjust the numerical values, and then press **OK**.

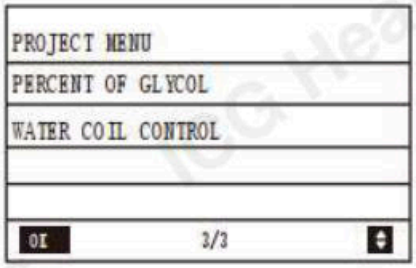
If you need the password, please contact us.




The following pages will be displayed after putting the password.

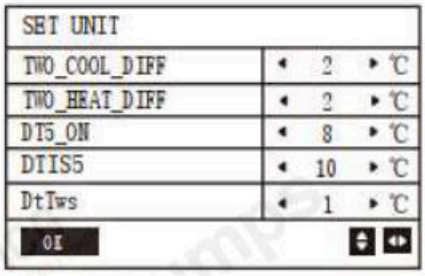


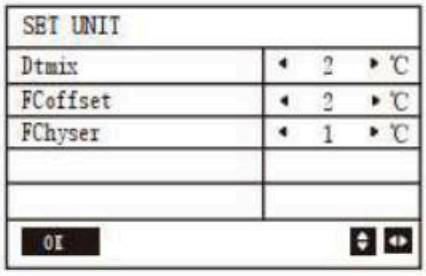




### 4.2.3 SET UNIT-AIRCONDITIONING

**MENU > Project Menu > SET UNIT-AIRCONDITIONING**




**TWO_COOL_DIFF** sets the minimum temperature difference between the leaving water temperature (Two) and the leaving water set temperature (TwoS) above which the unit will start for cooling mode. When Two - TwoS ≥ TWO_COOL_DIFF, unit starts. When TwoS - Two ≥ 2 lasts for 5s, unit stops.

**TWO_HEAT_DIFF** sets the minimum temperature difference between the leaving water temperature (Two) and the leaving water set temperature (TwoS) above which the unit will start for heating mode. When TwoS – Two ≥ TWO_HEAT_DIFF, unit starts. When Two - TwoS ≥ 2 lasts for 5s, unit stops.

| Parameter | Setting range | Note |
|---|---|---|
| Two_COOL_DIFF | 1 ℃~5 ℃ | |
| Two_HEAT_DIFF | 1 ℃~5 ℃ | |
| dT5_ON | 2 ℃~10 ℃ | DHW |
| Dt1s5 | 5 ℃~20 ℃ | |

### 4.2.4 SET PARALLEL UNIT

**MENU > Project Menu > SET PARALLEL UNIT**

| SET PAPALLEL UNIT | | |
|---|---|---|
| TIM_CAP_ADJ | ◂ 180 ▸ | S |
| TW_COOL_DIFF | ◂ 2 ▸ | ℃ |
| TW_HEAT_DIFF | ◂ 2 ▸ | ℃ |
| RATIO_COOL_FIRST | ◂ 0 ▸ | % |
| RATIO_HEAT_FIRST | ◂ 50 ▸ | % |
| OK | | |

| Parameter | Setting range |
|---|---|
| Tim_Cap_Adj | 60 s∽360 s |
| Tw_Cool_diff | 1 ℃∽5 ℃ |
| Tw_Heat_diff | 1 ℃∽5 ℃ |
| Ratio_cool_first | 0 %∽100 % |
| Ratio_heat_first | 0 %∽100 % |

**TIM_CAP_ADJ** sets the period of capacity adjustment

**TW_COOL_DIFF** sets the minimum temperature difference between the total leaving water temperature (Tw) and the total leaving water set temperature (TwS) above which the unit will start for cooling mode. When Tw - TwS ≥ TW_COOL_DIFF + 1, unit starts. When TwoS - Tw ≥ 2 lasts for 5s, unit stops.

**TW_HEAT_DIFF** sets the minimum temperature difference between the total leaving water temperature (Tw) and the total leaving water set temperature (TwS) above which the unit will start for heating mode. When TwS – Tw ≥ TW_HEAT_DIFF + 1, unit starts. When Tw - TwS ≥ 1 lasts for 5s, unit stops.

**RATIO_COOL_FIRST** sets the number of initial startup units for cooling mode.

**RATIO_HEAT_FIRST** sets the number of initial startup units for heating mode.

### 4.2.5 SET UNIT PROTECTION

**MENU > Project Menu > SET UNIT PROTECTION**

| SET UNIT PROTECTION | | |
|---|---|---|
| T_DIFF_PRO | ◂ 12 ▸ | ℃ |
| TWI_O ABNORMAL | ◂ 2 ▸ | ℃ |
| | | |
| | | |
| | | |
| OK | | |

| Parameter | Setting range |
|---|---|
| T_DIFF_PRO | 8 ℃ to 15 ℃/8 ℃ to 25 ℃<br>(The range of Settings varies according to the mode) |
| TWI_O_ABNORMAL | 1 ℃ to 5 ℃ |

**T_DIFF_PRO** set the absolute difference between entering water temperature (Twi) and leaving water temperature (Two). If | Twi - Two | ≥ T_DIFF_PRO, unit stops and error code P9 appears. Normal heat pumps when | Twi-Two | ≥12℃ [T_DIFF_PRO], or high temperature heat pumps | Twi-Two | ≥20℃, error code disappears.

**TWI_O_ABNORMAL** sets the difference between Inlet water temperature (Twi) and Outlet water temperature (Two). For cooling mode, if Two – Twi ≥ TWI_O_ABNORMAL and lasts for 20min, unit stops and error code PA appears. If Two – Twi ≤ TWI_O_ABNORMAL – 1, error code disappears. For heating mode, if Twi – Two ≥ TWI_O_ABNORMAL and lasts for 20min, unit stops and error code PA appears. If Twi – Two ≤ TWI_O_ABNORMAL - 1, error code disappears.

### 4.2.6 SET DEFROSTING

**MENU > Project Menu > SET DEFROSTING**

| SET DEFROSTING | |
|---|---|
| T_FROST | ◂ 35 ▸min |
| T_DEFROST_IN | ◂ 0 ▸℃ |
| T_FROST_OUT | ◂ 0 ▸℃ |
| | |
| | |
| OK | |

| Parameter | Setting range |
|---|---|
| T_FROST | 20 min to 120 min |
| T_DEFROST_IN | -5 ℃ to 5 ℃ |
| T_FROST_OUT | -10 ℃ to 10 ℃ |

**T_FROST:** When the running time of heating/hot water production exceeds this set value, then select different defrosting schemes; However, this cannot be understood as the minimum defrosting period, because there are other special cases of defrosting control that do not follow this time

**T_DEFROST_IN:** When the running time of heating/hot water production exceeds t_frost, and the T3 temperature is less than this set value, then select different defrosting schemes

**T_FROST_OUT:** This setting can adjust the required T3 defrosting exit temperature. T3 has a default defrosting exit temperature in the program. This setting changes the frost exit time by + or - a temperature above the default value

### 4.2.7 DHW time setting

**MENU > Project Menu > SET DHW TIME**

| SET DHW TIME | |
|---|---|
| SELECT ADDRESS | ◂ 07 ▸# |
| COOL MAX TIME | ◂ 08 ▸h |
| COOL MIN TIME | ◂ 0.5 ▸h |
| HEAT MAX TIME | ◂ 08 ▸h |
| HEAT MIN TIME | ◂ 0.5 ▸h |
| OK | 1/2 |

| SET DHW TIME | |
|---|---|
| DHW MIN TIME | ◂ 0.5 ▸h |
| DHW MAX TIME | ◂ 08 ▸h |
| | |
| | |
| | |
| OK | 2/2 |

| Parameter | Setting range |
|---|---|
| SELECT ADDRESS | 0 to 15 |
| COOL MIN TIME | 0.5 h to 24 h |
| COOL MAX TIME | 0.5 h to 24 h |
| HEAT MIN TIME | 0.5 h to 24 h |
| HEAT MAX TIME | 0.5 h to 24 h |
| DHW MIN TIME | 0.5 h to 24 h |
| DHW MAX TIME | 0.5 h to 24 h |

**COOL MAX TIME** sets the maximum operation time for cooling mode when DHW requirement exists.

**COOL MIN TIME** sets the minimum operation time for cooling mode when DHW requirement exists.

**HEAT MAX TIME** sets the maximum operation time for heating mode when DHW requirement exists.

**HEAT MIN TIME** sets the minimum operation time for heating mode when DHW requirement exists.

**DHW MIN TIME** sets the minimum operation time for DHW mode.

**DHW MAX TIME** sets the maximum operation time for DHW mode.

### 4.2.8 SET E9 TIME

**MENU > Project Menu > SET E9 TIME**

| SET E9 TIME | |
|---|---|
| E9 PROTECT TIME | ◂ 10 ▸ S |
| E9 DETECTION METHOD | ◂ 1 ▸ # |
| | |
| | |
| | |
| OK | |

**E9 PROTECT TIME** sets the delay time of water flow detection

n. When unit starts, water flow will not be detected until at least (2+ **E9 PROTECT TIME/60**) minutes have elapsed.

**E9 DETECTION METHOD** sets the method of water flow detection. If "1" is selected, the water flow switch is detected after water pump starts. If "2" is selected, the water flow switch is both detected before and after the water pump starts.

### 4.2.9 INV PUMP RATIO

**MENU > Project Menu > INV PUMP RATIO**

| INV PUMP RATIO | |
|---|---|
| MIN RATIO | ◂ 70 ▸ % |
| MAX RATIO | ◂ 100 ▸ % |
| | |
| | |
| | |
| OK | |

| | | |
|---|---|---|
| MIN RATIO | MINIMUM RATIO | 25 % to 100 % |
| MAX RATIO | MAXIMUM RATIO | 70 % to 100 % |

**MIN RATIO** sets the minimum output ratio of inverter pump which is installed in the main water pipe.

**MAX RATIO** sets the maximum output ratio of inverter pump which is installed in the main water pipe.

### 4.2.10 CHECK PARTS

**MENU > Project Menu > CHECK PARTS**

State of different parts can be checked in this menu.

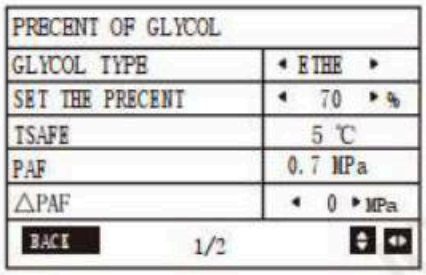
| CHECK PARTS | |
|---|---|
| SELECT ADDRESS | ◂ 07 ▸ # |
| FIX PUMP STATE | OFF |
| INV PUMP STATE | 80% |
| FOUR-WAY VALVE | OFF |
| SV1 STATE | OFF |
| BACK | 1/3 |

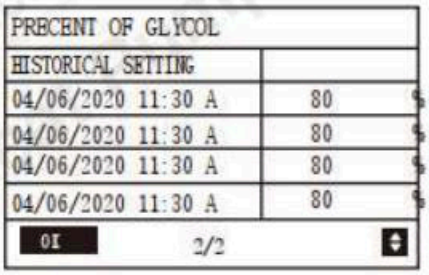
| CHECK PARTS | |
|---|---|
| SV2 STATE | OFF |
| SV4 STATE | OFF |
| SV5 STATE | OFF |
| SV6 STATE | OFF |
| SV8A STATE | OFF |
| BACK | 2/3 |

| CHECK PARTS | |
|---|---|
| SV8B STATE | OFF |
| HEAT1 STATE | OFF |
| HEAT2 STATE | OFF |
| COIL VALVE | OFF |
| | |
| BACK | 3/3 |

### 4.2.11 **PERCENT OF GLYCOL**

Select "PERCENT OF GLYCOL" and press " ↵ " to entry submenu. Display as follows:




Press "▲" or "▼" to select item to be set and press "◄ "or "►" to set value. Press " " to confirm. Back to homepage if there is no operation within 60s. Up to 16 historical setting records.

| Parameter | Setting range |
|---|---|
| GLYCOL TYPE | ETHE/PROP |
| SET THE PERCENT | 0 % to 50 % |
| TSAFE | DISPLAY |
| PAF | DISPLAY |
| △PAF | 0 MPa to 0.2 MPa |
| HISTORICAL SETTING | 04/06/2020 12:00 A |
| HISTORICAL SETTING | 04/06/2020 12:00 A |
| HISTORICAL SETTING | 04/06/2020 12:00 A |

## 4.3 Parameters setting

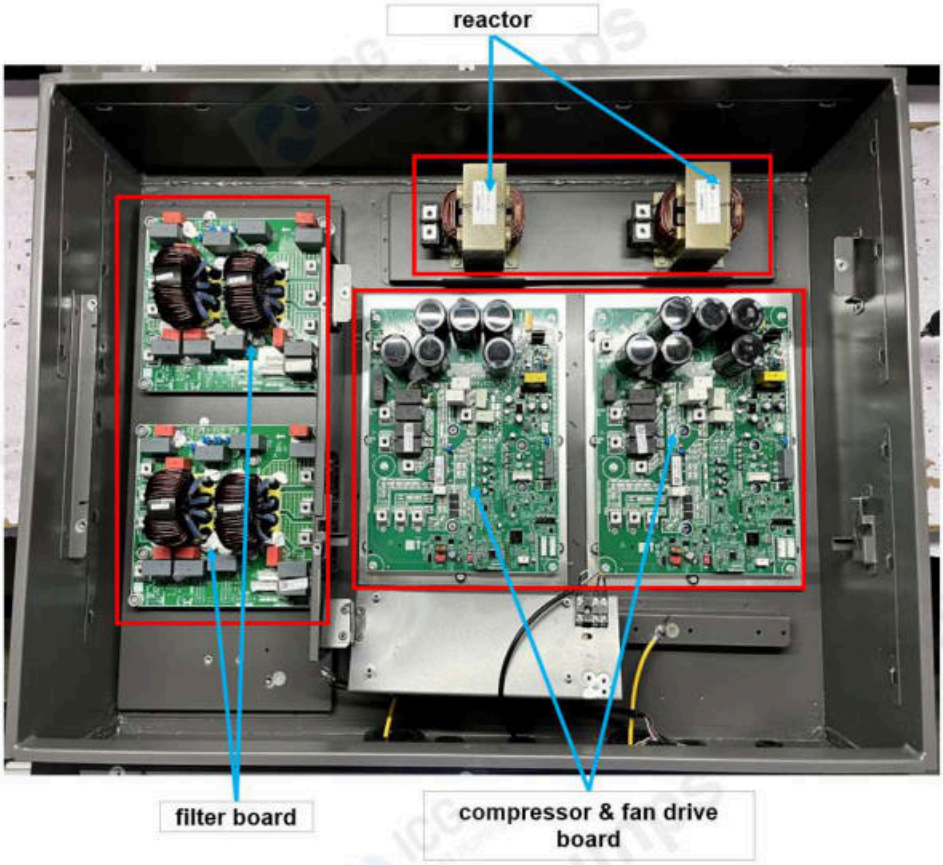
| Parameters | Setting range | Default value | Adjustment range |
|---|---|---|---|
| t_frost | 20 ~ 120 min | 35 min | 5 min |
| T_defrost_in | 23~41°F(-5~5°C) | 32°F(0°C) | 1°F(0.5°C) |
| T_defrost_out | 14~50°F(-10~+10°C) | 32°F(0°C) | 1°F(0.5°C) |
| Tim_Cap_adj | 60~360 s | 80 s | 20 s |
| Two_cool_Diff | 33.8~41°F(1°C~5°C) | 35.6°F(2°C) | 1°F(0.5°C) |
| Two_heat_Diff | 33.8~41°F(1°C~5°C) | 35.6°F(2°C) | 1°F(0.5°C) |
| Tw_cool_Diff | 33.8~41°F(1°C~5°C) | 35.6°F(2°C) | 1°F(0.5°C) |
| Tw_heat_Diff | 33.8~41°F(1°C~5°C) | 35.6°F(2°C) | 1°F(0.5°C) |
| Heat1 ENABLE | Yes/No | No | / |
| Temp_AuxHeat1_On | 5~50°F(-15°C~10°C) | 23°F(-5°C) | 1°F(0.5°C) |
| dTw_heat1_ON | 33.8~59°F(1°C~10°C) | 35.6°F(2°C) | 1°F(0.5°C) |
| t_HEAT1_DELAY | 15~120 min | 30 min | 5 min |
| T4_HEATPUMP_OFF1 | -22~59°F(-30°C~10°C) | -22°F(-30°C) | 1°F(0.5°C) |
| Unit_select | PI/SI | -- | -- |
| T_diff_Pro | Normal 46.4~59°F(8°C~15°C) | 53.6°F(12°C) | 1°F(0.5°C) |
| | High temp.46.4~77°F(8°C~25°C) | 68°F(20°C) | 1°F(0.5°C) |
| TWI-O ABNORMAL | 33.8~41°F(1°C~5°C) | 35.6°F(2°C) | 1°F(0.5°C) |
| Ratio_cool_First | 0~100% | 50% | 5% |
| Ratio_heat_First | 0~100% | 50% | 5% |
| Heat2 ENABLE | Yes/No | No | / |
| dT5_ON | 35.6~50°F(2°C~10°C) | 46.4°F(8°C) | 1°F(0.5°C) |
| dT1S5 | 41~68°F(5°C~20°C) | 50°F(10°C) | 1°F(0.5°C) |
| t_HEAT2_DELAY | 60~240 min | 90 min | 5 min |
| dT5_HEAT2_OFF | 35.6~50°F(2°C~10°C) | 41°F(5°C) | 1°F(0.5°C) |
| T4_HEAT2_ON | 5~68°F(-15°C~20°C) | 23°F(-5°C) | 1°F(0.5°C) |
| T4_HEATPUMP_OFF2 | -22~59°F(-30°C~10°C) | -22°F(-30°C) | 1°F(0.5°C) |
| Double Set Point | Yes/No | No | / |
| Set Point 1 | Cooling 14~77°F(-10°C~25°C) | Cooling 44.6°F(7°C) | 1°F(0.5°C) |
| | Heating 77~140°F(25°C~60°C) | Heating 95°F(35°C) | 1°F(0.5°C) |
| Set Point 2 | Cooling 14~77°F(-10°C~25°C) | Cooling 50°F(10°C) | 1°F(0.5°C) |
| | Heating 77~140°F(25°C~60°C) | Heating 50°F(30°C) | 1°F(0.5°C) |
| Temp_Compensation | Yes/No | No | / |
| T4_cool_1 | 59~86°F(15°C~30°C) | 77°F(25°C) | 1°F(0.5°C) |
| T4_cool_2 | 95~113°F(35°C~45°C) | 104°F(40°C) | 1°F(0.5°C) |
| Offset_C | 32~59°F(0°C~15°C) | 50°F(10°C) | 1°F(0.5°C) |
| T4_heat_1 | -13~59°F(-25°C~15°C) | 41°F(5°C) | 1°F(0.5°C) |
| T4_ heat _2 | 59~86°F(15°C~30°C) | 59°F(15°C) | 1°F(0.5°C) |
| Offset_H | 32~86°F(0°C~30°C) | 50°F(10°C) | 1°F(0.5°C) |
| RATIO_PUMP | 30%~100% | 100% | 5% |
| PUMP ON TIME | 5~60 min | 5 min | 5 min |
| PUMP OFF TIME | 0~60 min | 0 min | 5 min |
| MIN TEMP FOR COOL | 14~77°F(-10°C~25°C) | 44.6°F(7°C) | 1°F(0.5°C) |
| ENERGY SAVING SWITCH | 40~100% | 100% | 10% |

| | | | |
|---|---|---|---|
| DHW ENABLE | Yes/No | No | / |
| DHW SWITCH | Yes/No | No | / |
| DHW FIRST | Yes/No | No | / |
| COOL MIN TIME | 0.5~24 h | 0.5 h | 0.5 h |
| COOL MAX TIME | 0.5~24 h | 8 h | 0.5 h |
| HEAT MIN TIME | 0.5~24 h | 0.5 h | 0.5 h |
| HEAT MAX TIME | 0.5~24 h | 8 h | 0.5 h |
| DHW MIN TIME | 0.5~24 h | 0.5 h | 0.5 h |
| DHW MAX TIME | 0.5~24 h | 8 h | 0.5 h |
| E9 PROTECT TIME | 2∽20 s | 5 s | 1 |
| MIN RATIO | 25∽100% | 25% | 5% |
| MAX RATIO | 70∽100% | 100% | 5% |

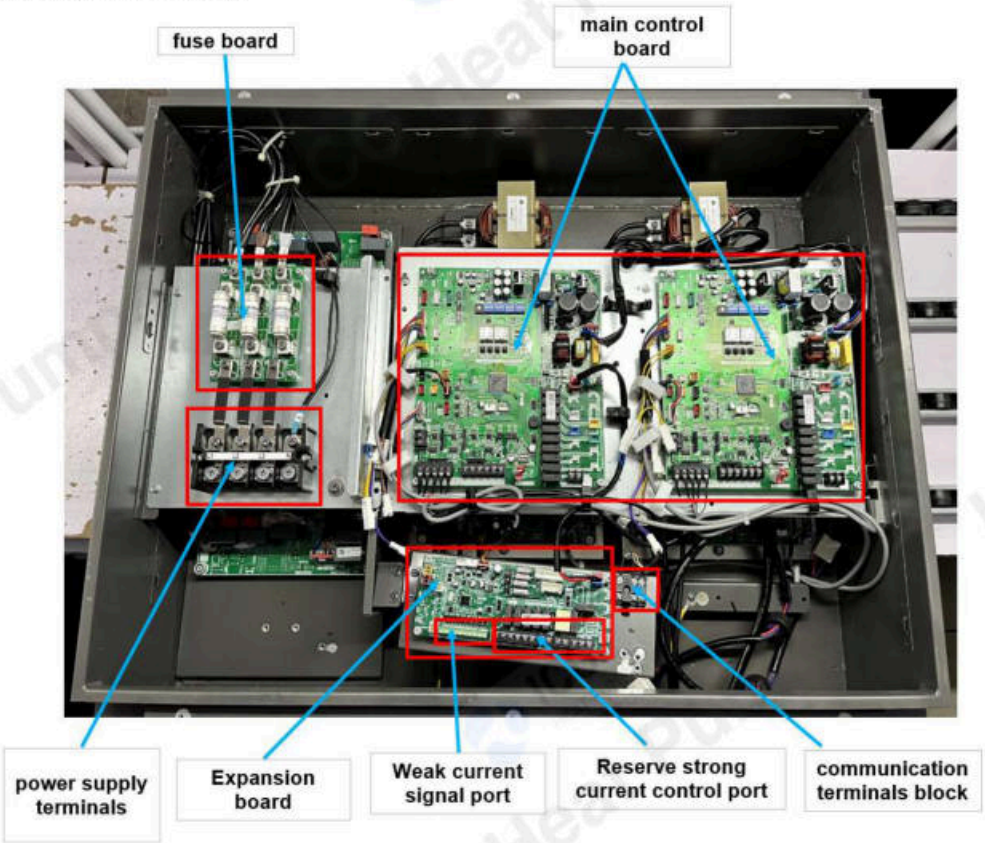
# Part 4
# Diagnosis and Troubleshooting

# 1 Electric Control Box Layout

Lower layer of electric control box:




Upper layer of electric control box:



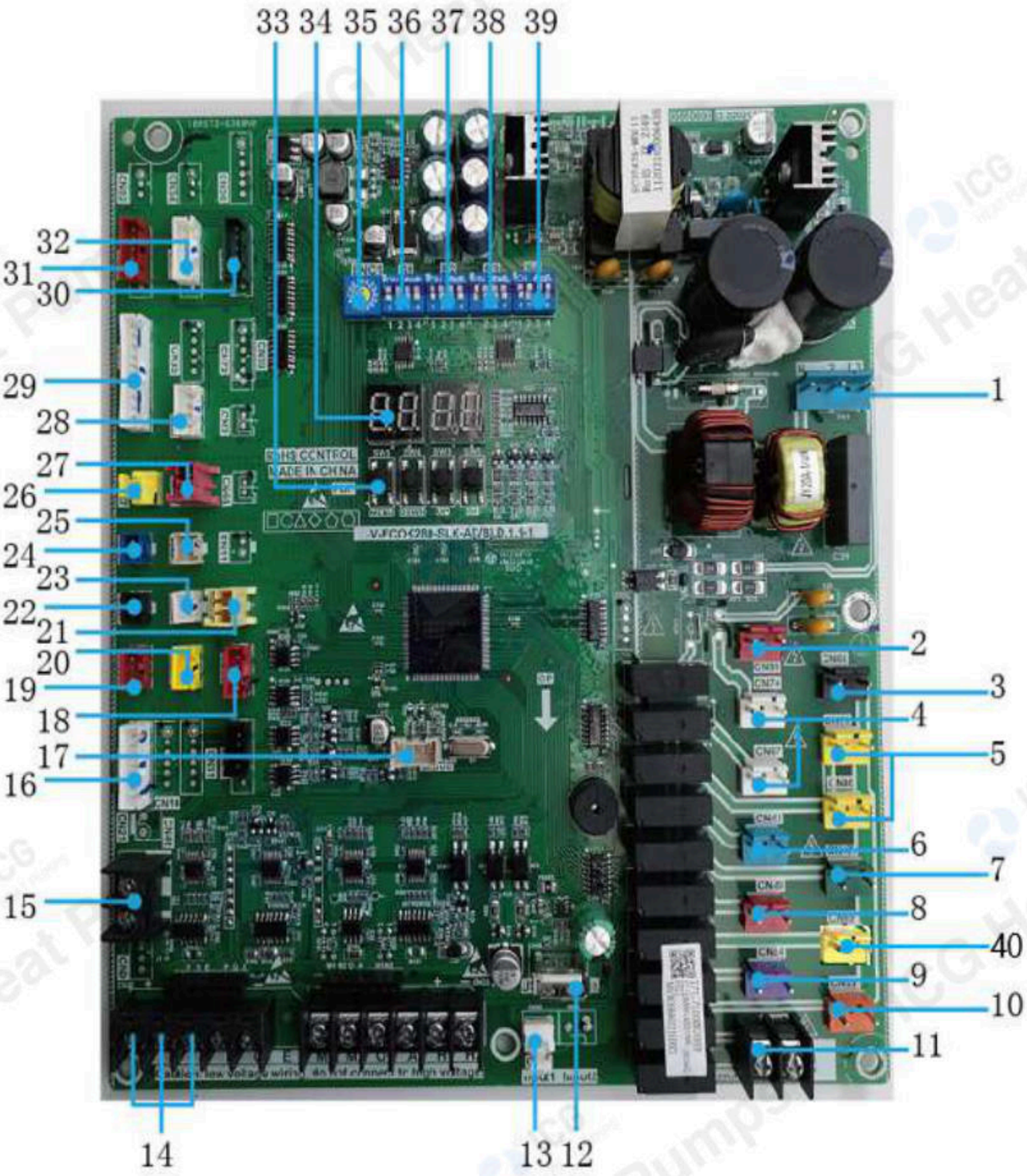
# 2 PCB Introduction

## 2.1 Types

Mars Large series unit have one main control board, one compressor inverter module boards, one compressor module & fan driver board and one filter board, one fuse board, one expansion board.

## 2.2 Main PCB

### 2.2.1 Main PCB component



| No. | Port Code | Port | Content | Voltage |
|---|---|---|---|---|
| 1 | CN32 | POWER | Main board power supply | 230VAC |
| 2 | CN99 | / | Slave board power supply | 230VAC |
| 3 | CN68 | PUMP | Reserved | / |
| 4 | CN74/CN67 | CCH | Reserved/Crankcase Heater | 230VAC |
| 5 | CN75/CN66 | EVA-HEAT | Reserved/Electronic heating belt for plate heat exchanger | 230VAC |
| 6 | CN48 | ST1 | Four-way valve | 230VAC |
| 7 | CN47 | SV6 | Solenoid valve | 230VAC |
| 8 | CN49 | PAN-HEAT1 | Water tray electric heating belt | 230VAC |
| 9 | CN84 | SV8A | Reserved | / |
| 10 | CN83 | SV8B | Reserved | / |
| 11 | CN93 | ALARM | The alarm signal output of the unit (ON/OFF signal) | / |
| 12 | CN65 | USB | Program burn in port (USB) | DC5V |
| 13 | CN28 | PH-PRO | Three-phase protector output switch | DC12V |
| 14 | CN22 | XYE | Outdoor units communication and wired controller communication port | DC5V |
| 15 | CN46 | / | The power supply port of the wired controller | DC12V |
| 16 | CN26 | O-Motor | Compressor inverter module and Fan inverter module communication ports | DC12V/DC 5V |
| 17 | CN300 | DEBUG | Program burn in port | DC3.3V |
| 18 | CN33 | MS | Communicate with slave board | DC12V |
| 19 | CN41 | L-YLA | System low pressure sensor | DC5V |
| 20 | CN40 | H-YLA | System high pressure sensor | DC5V |
| 21 | CN45 | Taf2 | Probe of outlet water side antifreeze temp | DC3.3V |
| 22 | CN37 | T3 | pipe temperature sensor of the condenser | DC3.3V |
| 23 | CN30 | T4 | outdoor ambient temperature sensor | DC3.3V |
| 24 | CN16 | / | Reserved | / |
| 25 | CN38 | / | Reserved | / |
| 26 | CN27 | TP-PRO | "Discharge temperature switch protection (protection code P0,provent the compressor from over temperature 115℃) | DC3.3V |
| 27 | CN42 | L-PRO | Reserved | DC3.3V |
| 28 | CN8 | T6A/T6B | Refrigerant inlet temperature of EVI plate heat exchanger/Refrigerant outlet temperature of EVI plate heat exchanger | DC3.3V |
| 29 | CN4 | Twi | Unit water inlet temperature sensor | DC3.3V |
| | | Th | System suction temperature sensor | DC3.3V |
| | | Two | Unit water outlet temperature sensor | DC3.3V |
| | | Tz/7 | coil final outlet temperature sensor | DC3.3V |
| | | Tp | DC inverter compressor discharge temperature sensor | DC3.3V |
| 30 | CN72 | EXVC | Port for electrical expansion valve C | DC12V |
| 31 | CN70 | EXVA | Port for electrical expansion valve A | DC12V |
| 32 | CN71 | EXVB | Port for electrical expansion valve B | DC12V |
| 33 | SW3 | UP | Up button | DC3.3V |
| | SW4 | DOWM | Down button | DC3.3V |
| | SW5 | MENU | Menu Buttons | DC3.3V |
| | SW6 | OK | Confirm button | DC3.3V |
| 34 | DSP1/DSP2 | / | "Digital tube<br>1) In case of stand-by, the address of the module is displayed;<br>2) In case of normal operation, 10. is displayed (10 is followed by dot).<br>3) In case of fault or protection, fault code or protection code is displayed." | DC3.3V |
| 35 | ENC1 | / | "ENC1:NET_ADDRESS<br>DIP switch 0-F of outdoor unit network address is enabled, which represent address 0-15." | DC3.3V |
| 36 | S1 | S1 | Dip switch | DC3.3V |
| 37 | S2 | S2 | Reserved | DC3.3V |
| 38 | S3 | S3 | Dip switch | DC3.3V |
| 39 | S4 | S4 | Dip switch | DC3.3V |
| 40 | CN69 | PAN-HEAT2 | Water tray electric heating belt | 230VAC |

### 2.2.2 Main PCB field setting

DIP switch, buttons and digital display positions of units.

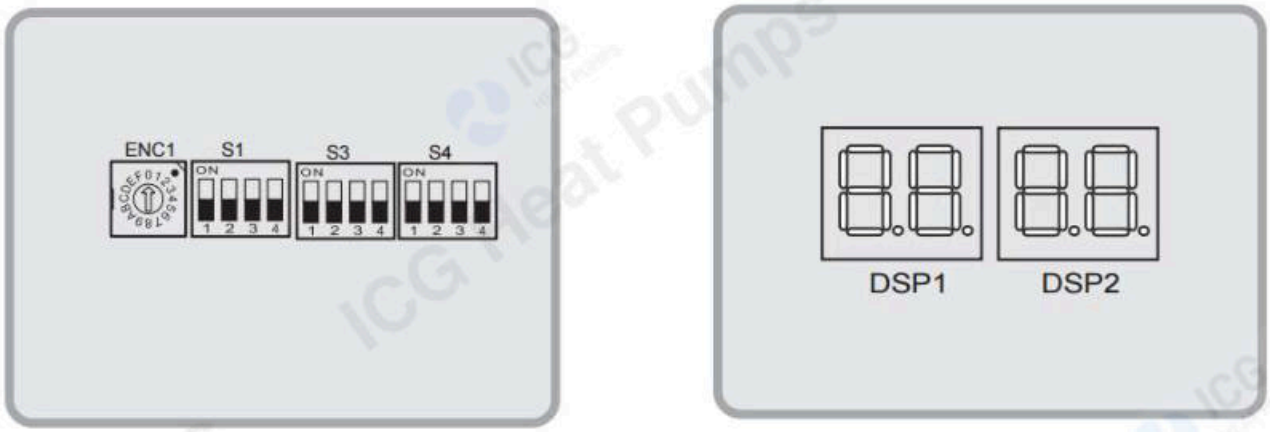
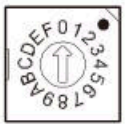
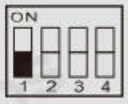
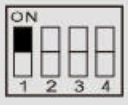
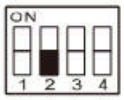
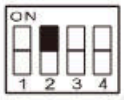
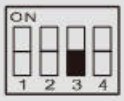
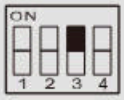
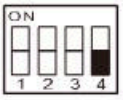
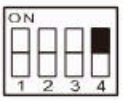
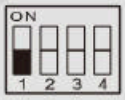
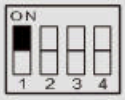



Fig. 2-1 Display positions

Table 2-1

| ENC1 S1 S2 S3 S4 | | | Meaning | Notes |
|---|---|---|---|---|
| ENC1<br>System address |  | 0-F | Each unit is composed of two independent refrigerant circulation systems, each corresponding to its own address DIP switch. Specially, address 0 corresponds to the System A of the main unit, address 1 corresponds to the System B of the main unit, and the address DIP switch settings of other unit control systems shall be carried out in ascending order. | Set the address DIP switch of the main unit system A to 0#; each refrigerant circulation system needs to set the address DIP switch separately; the address DIP switch of different systems must not be repeated. |
| S1-1<br>Remote control |  | OFF | When the DIP switch is off, the device cannot use the remote control function and can only be controlled by the wired controller (ex-factory default). | This adjustment is only applicable to Main Unit 0# and is invalid for other addresses. |
| |  | ON | When the DIP switch is turned on, the remote control function of the unit will take effect.<br>1. The start and stop of the unit can be controlled through the ON/OFF port on the main board expansion board: shorting-circuit starts the unit, while disconnecting shuts down the unit.<br>2. The running mode of the unit can be adjusted through the H/C port on the expansion board: shorting-circuit for heating mode and disconnecting it for cooling mode.<br>3. If the unit is connected to a wired controller, the wired controller can only change parameters such as the set temperature and recovery from startup errors (if not connected to a wired controller, the default values will control). | |

| | | | | |
|---|---|---|---|---|
| S1-2 |  | OFF | When the DIP switch is off, the maximum temperature for the heating mode can be set to 75℃ (ex-factory default). | In a system controlled by the same wired controller, each subsystem needs to select the S1-2 setting, and all subsystems shall maintain the same selection. |
| |  | ON | When the DIP switch is turned on, the maximum temperature for the heating mode can be set to 85℃.<br>Note: This DIP switch is only applicable to units equipped with variable frequency water pumps and whose water flow range meets the Company's requirements; otherwise, it may result in the unit being unable to reach the set temperature. | |
| S1-3 |  | OFF | When all units controlled by the same wired controller share the same main water pump, this dial code should be OFF (factory default). | Single unit this dial code should be off;<br>It is necessary to select S1-3 in the parallel system controlled by the same line controller,and the selection should be consistent, otherwise the fault FP will be displayed.<br>The model of all pumps in the same parallel system should be uniform. |
| |  | ON | When each unit in a system controlled by the same wire is equipped with a separate water pump, this dial should be ON. | |
| S1-4 |  | OFF | When a single unit is matched with a single fixed-speed water pump or a single variable-frequency water pump, this DIP switch shall be set to OFF (ex-factory default value). | For each system controlled by the same line controller, the S1-4 DIP switch configuration must be selected. |
| |  | ON | When the hydraulic equipment of a single unit adopts a combination of fixed-speed pumps and parallel variable-frequency pumps, this switch shall be set to ON. When the DIP switch is turned on, the system will perform coordinated regulation of the constant-speed water pump and the variable-frequency water pump. | |
| S3-1 |  | OFF | This DIP switch is used to distinguish between System A and System B within a single unit. When the DIP switch is in the off position, the system will be System A; when the DIP switch is on, the system will be System B. | This DIP switch has been pre-set and does not need to be changed during installation and commissioning. If a fault occurs, check whether the DIP switch settings are correct. |
| |  | ON | | |

### 2.2.3 Digital display output

The data display area is divided into Up area and Down area, with two groups of two-digit half 7-segment digital display, respectively.

a. Temperature display

Temperature display is used for displaying the total outlet water temperature of unit system, outlet water temperature, condenser pipe temperature T3A of system A, condenser pipe temperature T3B of system B, outdoor environmental temperature T4, anti-freezing temperature T6 and setting temperature Ts, with allowable data display scope -15 ℃ ~ 70 ℃. If the temperature is higher than 70 ℃, it is displayed as 70 ℃. If there is no effective date, it displays "— —" and indication point 158 ℃ is on.

b. Current display

Current display is used for displaying Modular unit system A compressor current IA or system B compressor current IB, with allowable display scope 0A~99A. If it is higher than 99A, it is displayed as 99A. If there is no effective date, it displays "— —" and indication point A is on.

c. Failure display

It is used for displaying the total failure warning date of unit or that of Modular unit, with failure display scope E0~EF, E indicating failure, 0~F indicating failure code. "E-" is displayed when there is no failure and indication point **#** is on at the same time.

d. Protection display

It is used for displaying the total system protection data of unit or the system protection data of Modular unit, with protection display scope P0~PF, P indicating system protection, 0~F indicating protection code. "P-" is displayed when there is no failure.

e. Unit number display

It is used for displaying the address number of the currently selected Modular unit, with display scope 0~15 and indication point # is on at the same time.

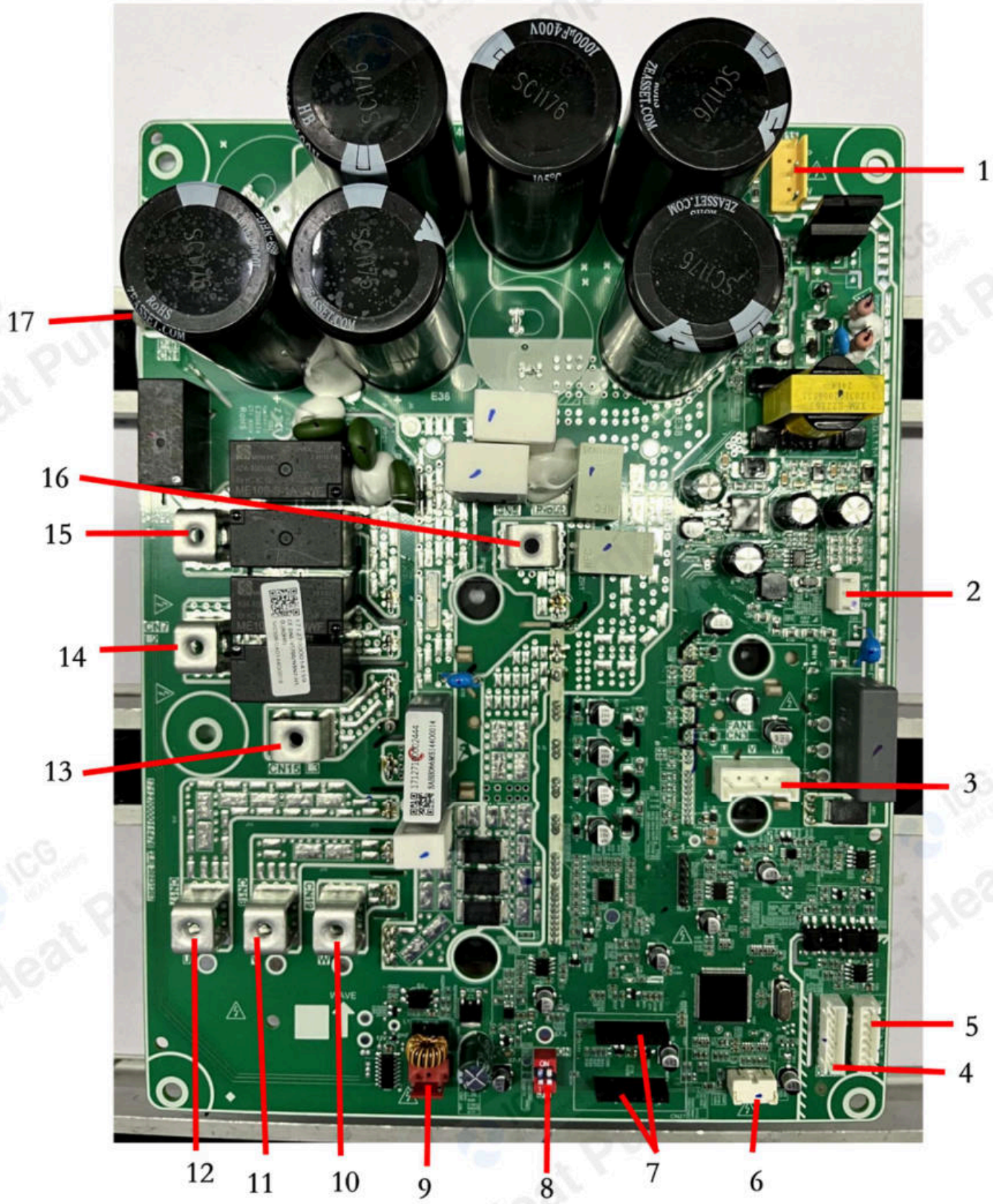
f. Display of online unit number and startup unit number

They are used for displaying the total online Modular units of the whole unit system and the number of the Modular unit under running state, respectively, with display scope 0~16.

Any time when the spot check page is entered to display or change Modular unit, it is needed to wait for the up-to-date data of the Modular unit received and selected by wired controller. Before receiving the data, the wired controller only displays "——" on the data display Down area, and the Up area displays the address number of the Modular unit. No page can be turned, which continues until the wired controller receives the communication data of this Modular unit.

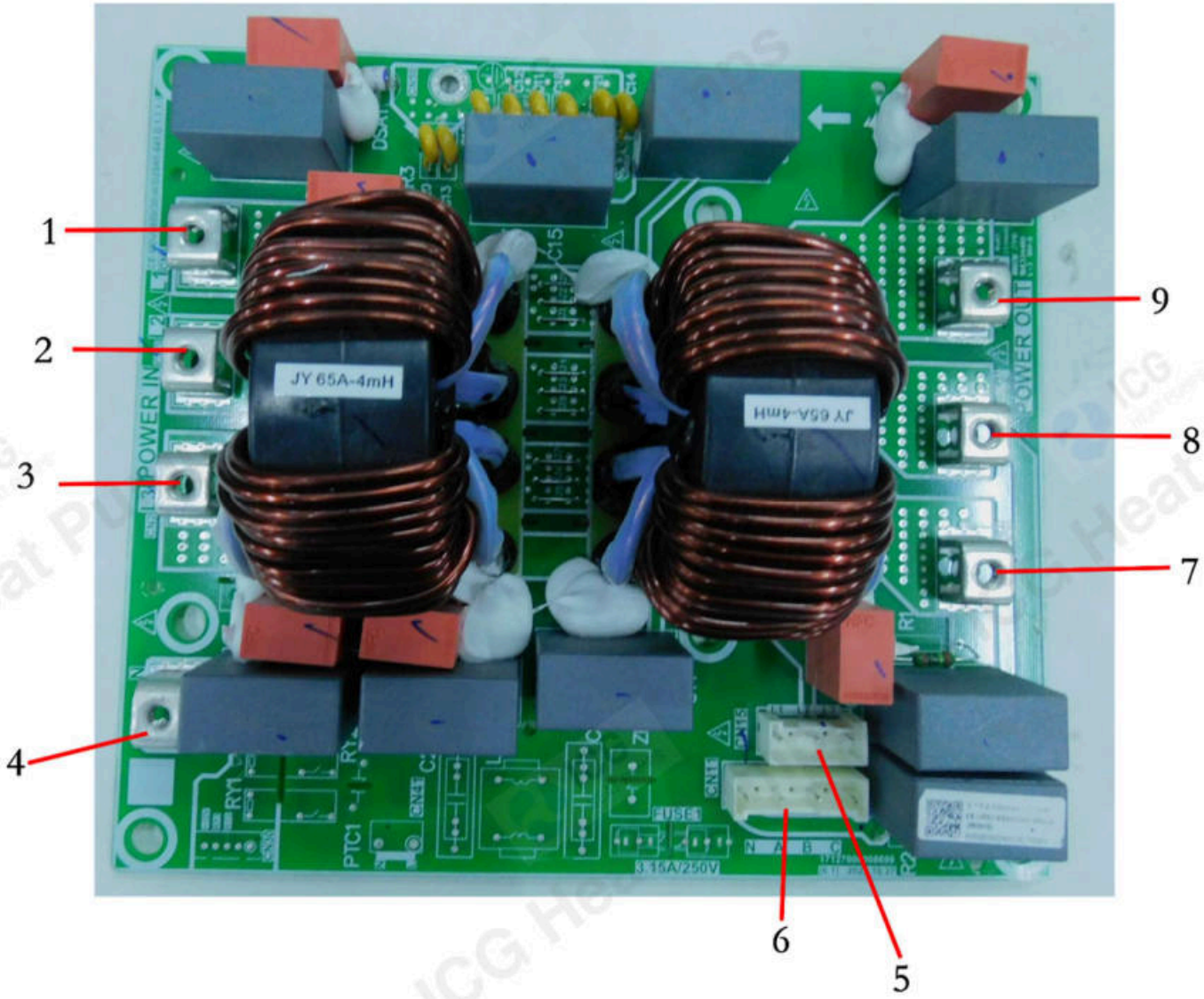
## 2.3 Compressor Module Board & Fan Driver Board

### 2.3.1 Compressor Inverter Module PCB component



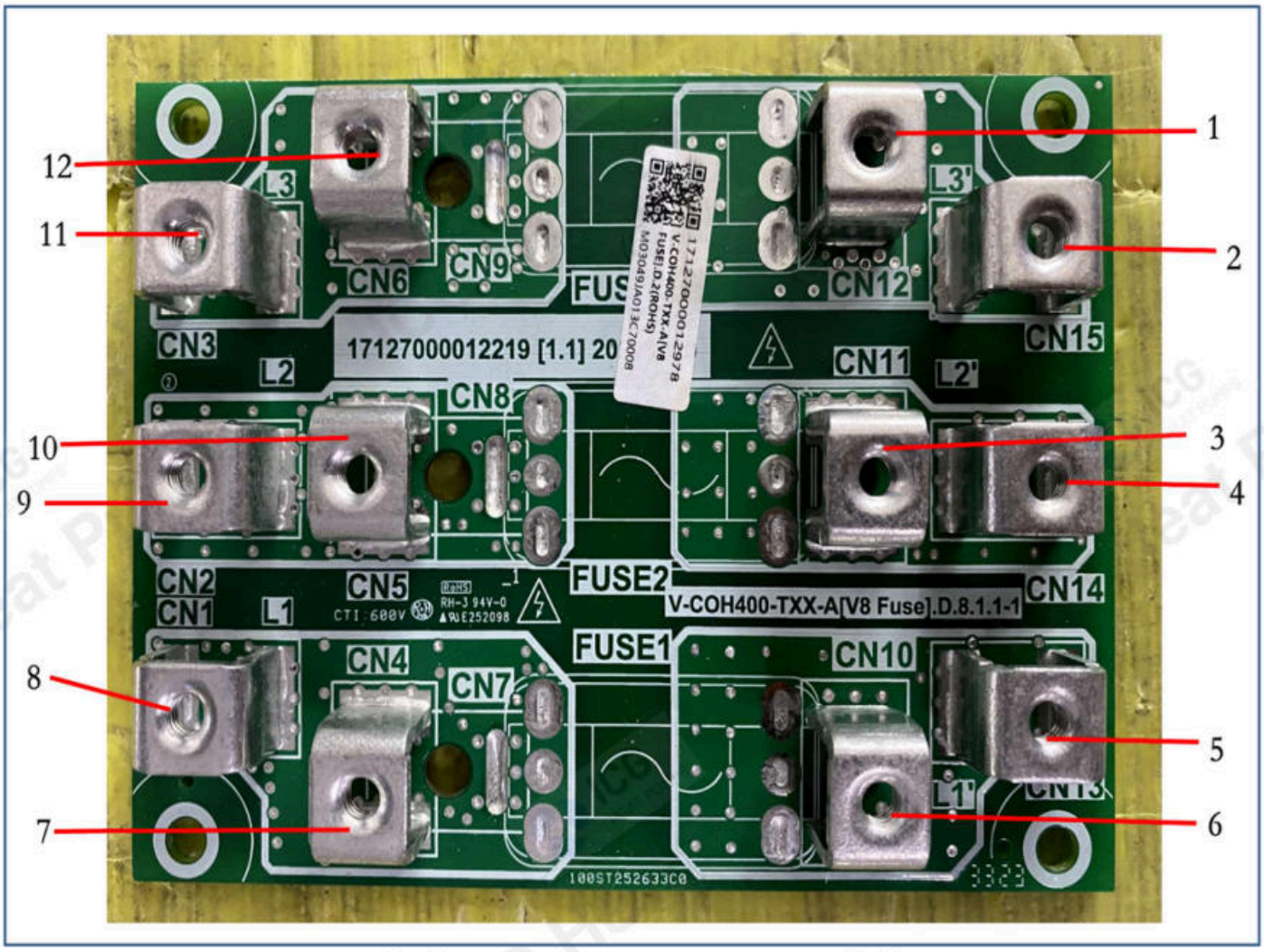
| No. | Port Code | Port | Content | Voltage |
|---|---|---|---|---|
| 1 | CN38 | P N | DC fan power output port | DC565V |
| 2 | CN26 | 19V GND | Fan module board power supply port | DC19V |
| 3 | CN3 | UVW | Port output for fan | Phase to phase voltage 46-460VAC |
| 4 | CN8 | O-Motor | PTC relay control port/communication port | DC12V/DC5V |
| 5 | CN9 | O-Motor | PTC relay control port/communication port | DC12V/DC5V |
| 6 | CN25 | / | Reserved | / |
| 7 | CN27 | / | PED board socket | DC5V |
| 8 | S7 | S7 | Module address DIP switch | / |
| 9 | CN21 | H-Pro | High pressure switch | / |
| 10 | CN19 | W | Power output for compressor | Phase to phase voltage 46-460VAC |
| 11 | CN18 | V | | Phase to phase voltage 46-460VAC |
| 12 | CN17 | U | | Phase to phase voltage 46-460VAC |
| 13 | CN15 | L3 | Power input port | AC380-415V |
| 14 | CN7 | L2 | | |
| 15 | CN16 | L1 | | |
| 16 | CN5 | P-out | Output for reactor | / |
| 17 | CN1 | P-in | Input from reactor | / |

## 2.4 AC Filter Board




| No. | Port Code | Port | Content | Voltage |
|---|---|---|---|---|
| 1 | CN4 | L1 | Power input L1 | AC380-415V |
| 2 | CN3 | L2 | Power input L2 | |
| 3 | CN2 | L3 | Power input L3 | |
| 4 | CN1 | N | Reserved | |
| 5 | CN15 | L1L2L3 | Reserved | AC380-415V |
| 6 | CN11 | N A B C | Reserved | AC380-415V |
| 7 | CN6 | L3' | Output power L3' | AC380-415V |
| 8 | CN7 | L2' | Output power L2' | |
| 9 | CN8 | L1' | Output power L1' | |

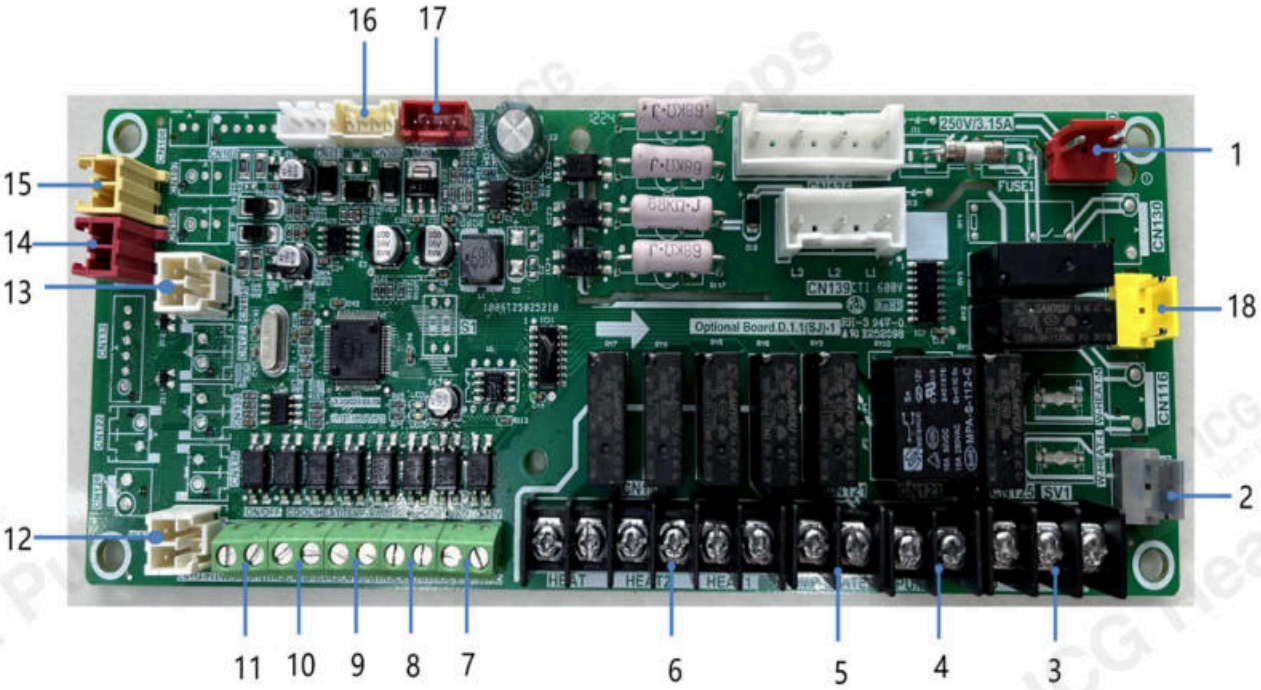
## 2.5 Fuse Board




Front back

| No. | Port Code | Port | Content | Voltage | Direction |
|---|---|---|---|---|---|
| 1 | CN12 | / | Fuse 1-1 | 208-230V AC | Input |
| 2 | CN15 | L3' | Input power L3' | 208-230V AC | Input |
| 3 | CN11 | / | Fuse 2-1 | 208-230V AC | Input |
| 4 | CN14 | L2' | Input power L2' | 208-230V AC | Input |
| 5 | CN13 | L1' | Input power L1' | 208-230V AC | Input |
| 6 | CN10 | / | Fuse 3-1 | 208-230V AC | Input |
| 7 | CN4 | / | Fuse 3-2 | 208-230V AC | Output |
| 8 | CN1 | L1 | Output power L1 | 208-230V AC | Output |
| 9 | CN2 | L2 | Output power L2 | 208-230V AC | Output |
| 10 | CN5 | / | Fuse 2-2 | 208-230V AC | Output |
| 11 | CN3 | L3 | Output power L3 | 208-230V AC | Output |
| 12 | CN6 | / | Fuse 1-2 | 208-230V AC | Output |

## 2.6 Expansion Board




| | Port Code | Port | Content | Voltage | Direction |
|---|---|---|---|---|---|
| 1 | CN140 | POWER | Expansion board power supply | 230VAC | Input |
| 2 | CN115 | W-HEAT | Electric heater of water flow switch | 230VAC | Output |
| 3 | CN125 | SV1 | Three-way valve(hot-water valve) | 230VAC | Output |
| 4 | CN123 | PUMP | Port controlled by the contactor of the fixed speed pump | / | Input/output |
| 5 | CN121 | COMP-STATE | Compressor status indication | / | Input/output |
| 6 | CN119 | HEAT1/HEAT2 | Pipeline Auxiliary Heater/Hot Water Tank Auxiliary Heater | / | Input/output |
| 7 | CN108 | PUMP-V | Inverter pump 0-10V output control signal | DC 0-10V | Output |
| 8 | CN117 | W.P-SW | Water pressure switching port. | DC12V | Input |
| 9 | CN110 | TEMP-SW | Target water temperature switch | DC12V | Input |
| 10 | CN138 | COOl/HEAT | Remote function of cool/heat signal | DC12V | Input |
| 11 | CN137 | ON/OFF | Remote function of on/off signal | DC12V | Input |
| 12 | CN114 | WATER-SWITCH | Water flow switch signal | DC12V | Input |
| 13 | CN105 | Taf1 | Probe of inlet water side antifreeze temp | DC3.3V | Input |
| 14 | CN101 | TW | Probe of finaunit water outlet temp | DC3.3V | Input |
| 15 | CN103 | T5 | Probe of water tank | DC3.3V | Input |
| 16 | CN300 | DEBUG | Program burn in port | DC3.3V | Input/output |
| 17 | CN109 | MS | Communicate with main board | DC12V | Input/output |
| 18 | CN118 | / | Reserved | / | Output |

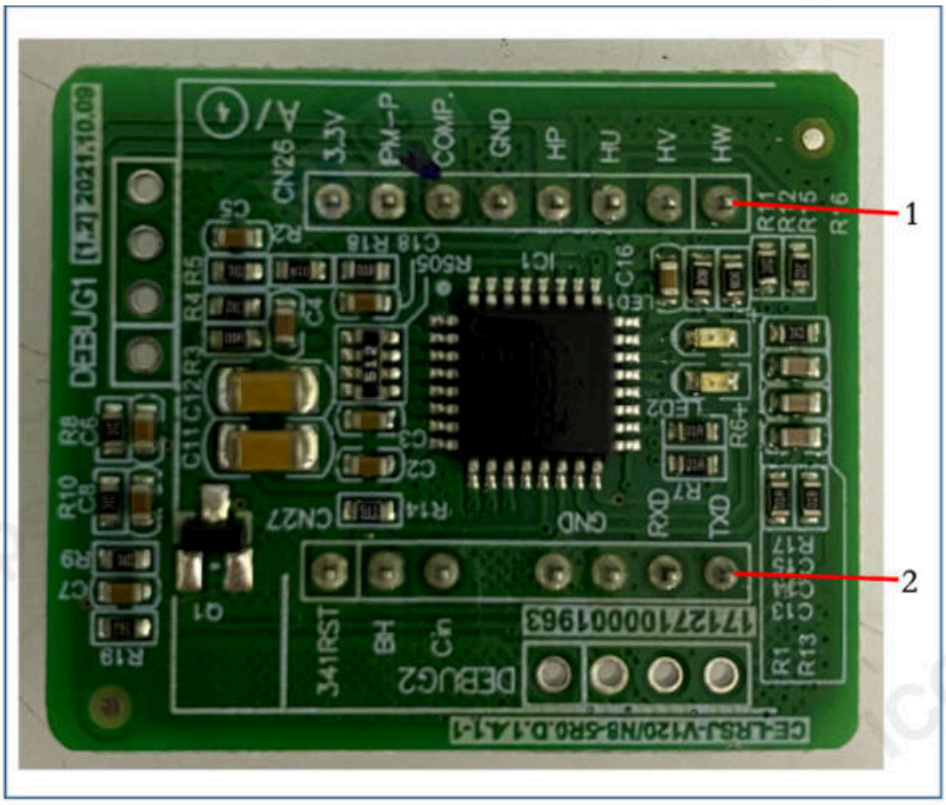
Notes：

*The main unit requires an expansion board, while the slave unit does not.

When the main unit suffers faults, the main unit stops operating, and all other units also stop running; When the subordinate unit suffers faults, only the unit stops operating, and other units are not affected.

When the main unit is under protection, only the unit stops operating, and other units keep running; When the subordinate unit is under protection, only the unit stops operating, and other units are not affected.

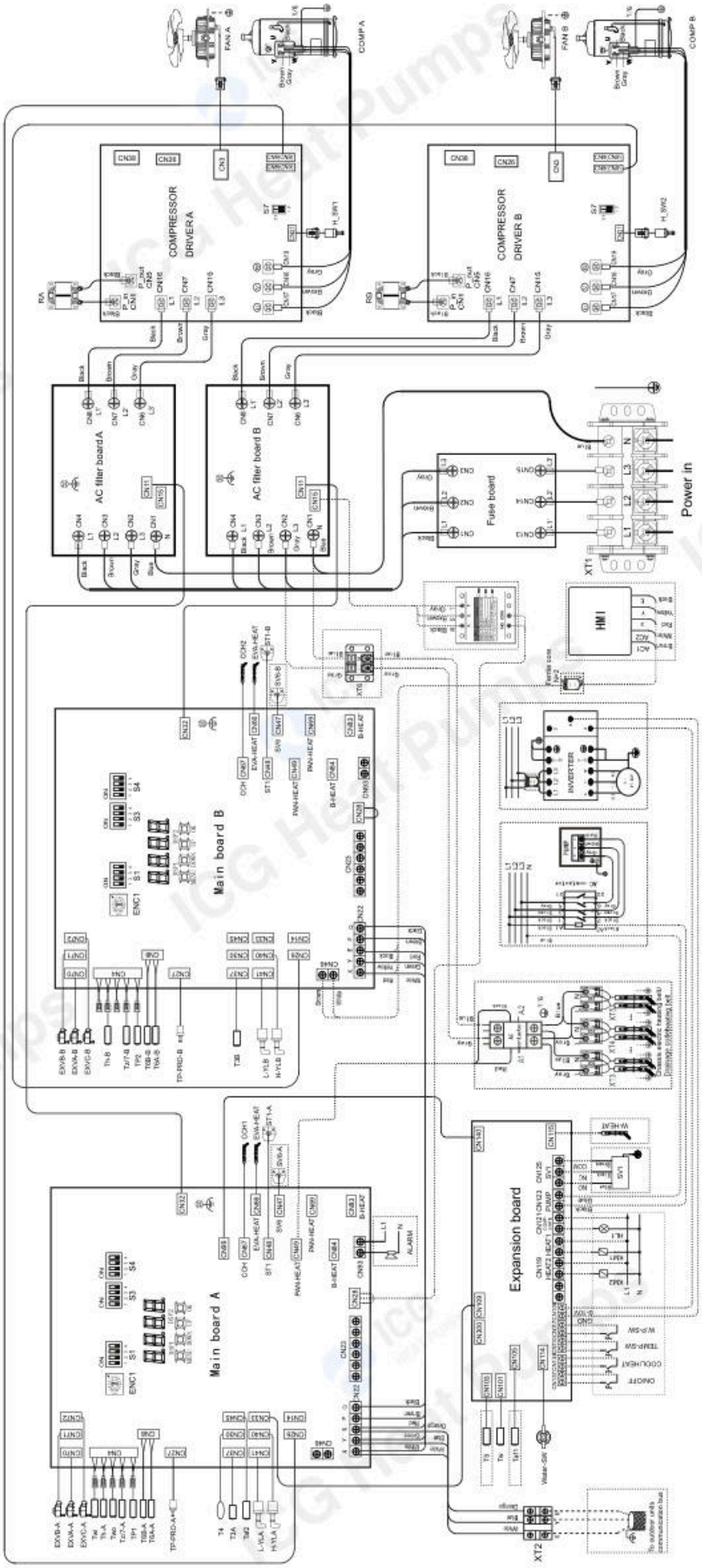
## 2.7 PED board




| Order | Code | Port | Content |
|---|---|---|---|
| 1 | CN26 | | Connect to compressor & fan drive board PCB |
| 2 | CN27 | | Connect to compressor & fan drive board PCB |

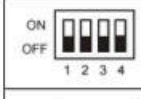
# 3 Wiring diagram

## 3.1 Single unit



| | | |
|---|---|---|
| S1-1 |  | Normal control, Valid for S1-1 OFF (factory default) |
| |  | Remote control, Valid for S1-1 ON |
| S1-2 |  | Normal temperature effluent, Valid for S1-2 OFF (factory default) |
| |  | High temperature effluent, Valid for S1-2 ON |
| S1-3 |  | Shared main water pump for parallel units, Valid for S1-3 OFF (factory default) |
| |  | Both the master and slave units in the parallel units are equipped with water pumps，Valid for S1-3 ON |
| S1-4 |  | Single unit equipped with single fixed speed pump or single variable frequency water pump, Valid for S1-4 OFF (factory default) |
| |  | Single unit equipped with fixed speed pump and variable frequency water pump, Valid for S1-4 ON |

| | | |
|---|---|---|
| S3-1 |  | System A, Valid for S3-1 OFF |
| |  | System B, Valid for S3-1 ON |
| S3-2 |  | R32 model, Valid for S3-2 OFF |
| |  | R290 model, Valid for S3-2 ON (factory default) |
| S3-3 |  | Single Wall Exchanger, Valid for S3-3 OFF (factory default) |
| |  | Double Wall Exchanger, Valid for S3-3 ON |
| S3-4 |  | Reserve, Valid for S3-4 OFF (factory default) |

| | | |
|---|---|---|
| S4 | DIP switch for capacity selection | |
| |  | 70KW unit select 0000 |
| |  | 60KW unit select 0001 |
| |  | 50KW unit select 0010 |

The equipment manufacturer reserves the right to make changes in design, appearance and specifications without prior notice.

| | | |
|---|---|---|
| ENC1 | 0-F valid for unit address setting on the DIP switches, 0 indicates the master unit and 1-F the slave units (parallel connection) | |
| |  | Main board A is set as the master unit (factory default) |
| |  | Main board B is set as the slave unit (factory default) |

| | | |
|---|---|---|
| 1.Single fixed speed pump control (S1-4 OFF) |   | Connect to the Expansion board 'PUMP' port |
| 2.Single Inverter pump control (S1-4 OFF) |   | Connect to the Slave board '0-10V' port |
| 3.Fixed speed pump + Inverter pump (S1-4 ON) |   | Connect to the Slave board 'PUMP' port and '0-10V' port |

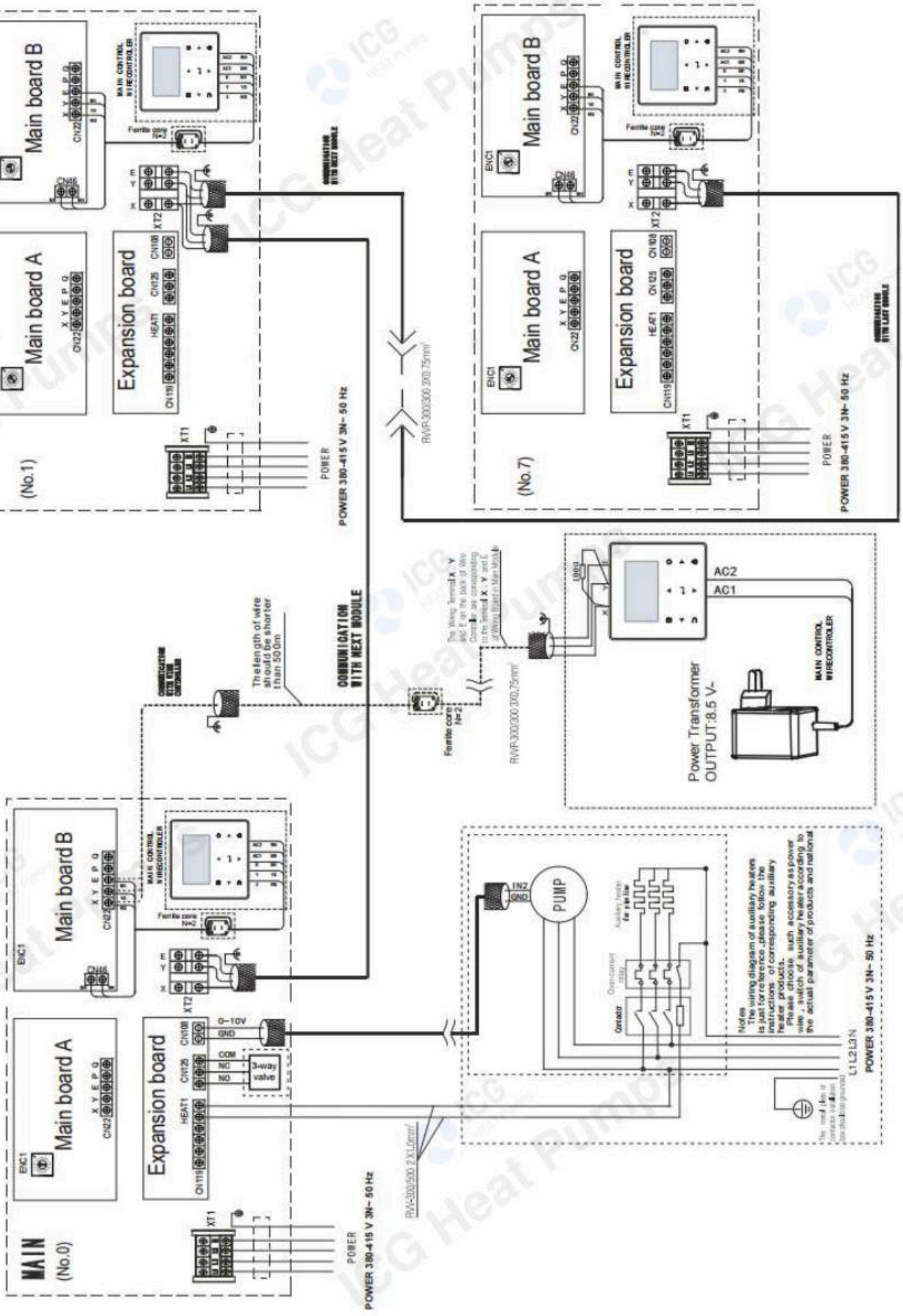
Comparison Table of Electrical Symbols and Names

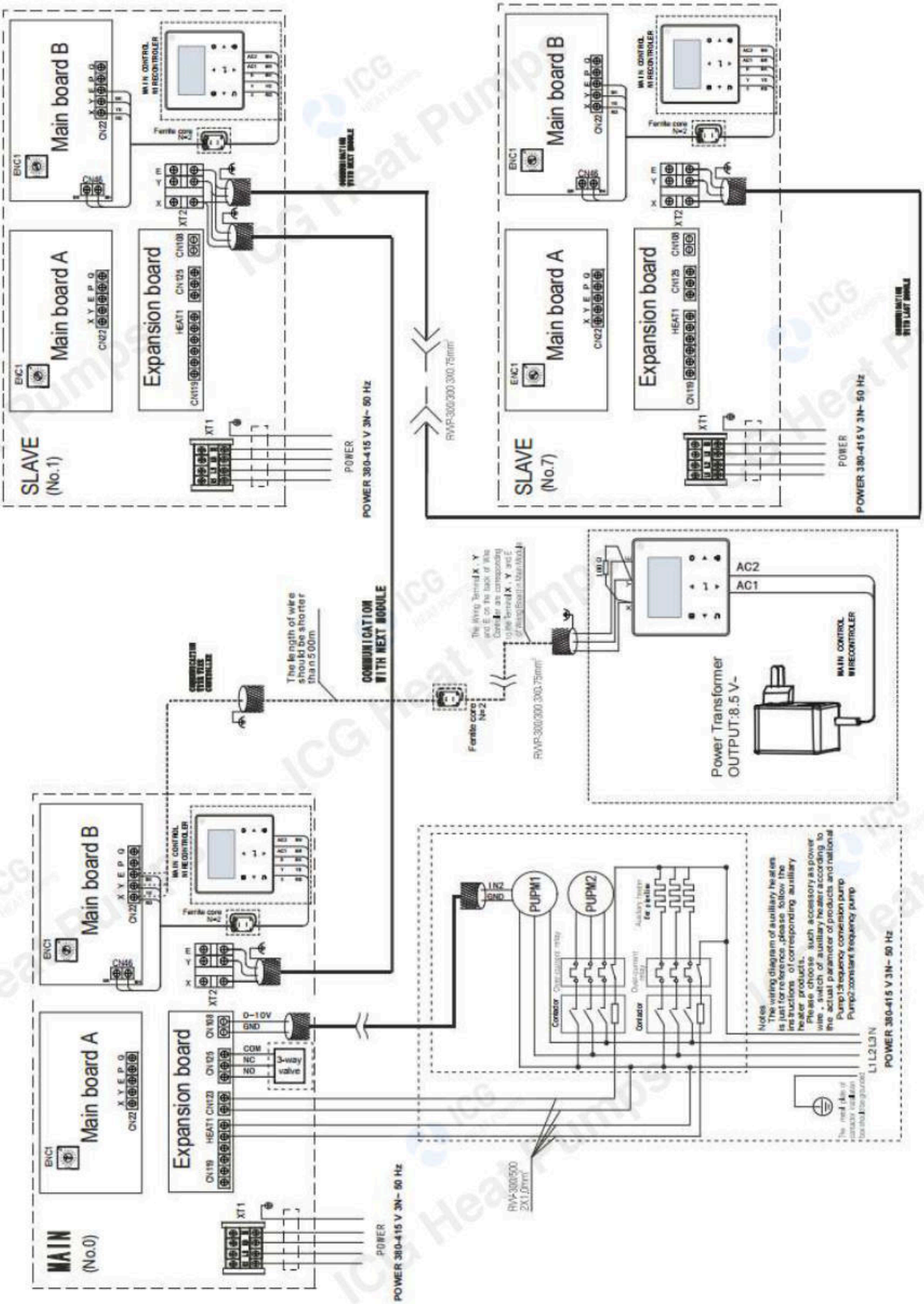
| Code | Name |
|---|---|
| COMP A/B | Compressor |
| FAN A/B | DC fan |
| ST1-A/ST1-B | Four-way valve |
| SV1 | 3-way valve |
| SV6-A/SV6-B | Solenoid valve |
| XT1/XT2 | Terminal block |
| H_SW1/2 | High pressure switch |
| TP-PRO-A<br>TP-PRO-B | Protection switch of discharge temp |
| T3A/T3B | Probe of coil outlet temp |
| T4 | Probe of ambient temp |
| T5 | Probe of water tank |
| T6A-A<br>T6A-B | Refrigerant inlet temperature of EVI plate heat exchanger |
| T6B-A<br>T6B-B | Refrigerant outlet temperature of EVI plate heat exchanger |
| Tz/7-A<br>Tz/7-B | Probe of coil final outlet temp |
| Taf1 | Probe of inlet water side antifreeze temp |
| Taf2-A<br>Taf2-B | Probe of outlet water side antifreeze temp |
| Twi | Probe of unit water inlet temp |
| Two | Probe of unit water outlet temp |
| Tw | Probe of final unit water outlet temp |
| Tp1/Tp2 | Probe of discharge temp |
| Th-A<br>Th-B | Probe of suction temp |
| H-YLA/H-YLB | Probe of high pressure |
| L-YLA/L-YLB | Probe of low pressure |
| RA/RB | Reactor |
| EXVA-A/EXVB-A/EXVC-A<br>EXVA-B/EXVB-B/EXVC-B | Electronic expansion valve |
| CCH1/CCH2 | Crankcase heater |
| EVA-HEAT-A | Electronic heating belt for plate heat exchanger |

| | |
|---|---|
| EVA-HEAT-B | |
| COOL/HEAT | Remote mode cool/heat signal |
| ON/OFF | Remote mode on/off signal |
| Water-SW | Water flow switch |
| W.P-SW | Water pressure switch |
| TEMP-SW | Targer water temperature switch |
| KM1 | Control contactor for auxiliary heater of pipe |
| KM2 | Control contactor for auxiliary heater of water tank |
| HL1 | Signal lamp of compressor status |

## 3.2 Multiple units

If multiple units are connected in cascade, the unit address should be set on the DIP switch ENC1. With 0-F being valid, 0/1 indicates the master unit and 2-F indicate slave units.




SLAVE
(No.1)
Main board B
Main board A
Expansion board
MAIN CONTROL WIRECONTROLER
POWER 380-415 V 3N~ 50 Hz
RVVP-300/300.3X0.75mm²
SLAVE
(No.7)
COMMUNICATION WITH NEXT MODULE
The length of wire should be shorter than 500m
Ferrite core NO.2
AC2
AC1
Power Transformer
OUTPUT:8.5 V~
MAIN
(No.0)
0~10V
GND
COM
NC
NO
3-way valve
PUMP1
PUMP2
Contactor
Notes
The wiring diagram of auxiliary heaters is just for reference,please follow the instructions of corresponding auxiliary heater products.
Please choose such accessory as power wire、switch of auxiliary heater according to the actual parameter of products and national
Pump1:frequency conversion pump
Pump2:constant frequency pump
L1L2L3N
RVV-300/500 2X1.0mm²

Notes：

1. When the power cord is parallel to the signal wire, make sure that they are enclosed in respective conduits and are kept a reasonable wire spacing. (Distance between the power cord and signal wire: 300 mm if below 10A, and 500mm if below 50 A)
2. In the case of multiple units' connection, the HMI can be parralled with in the same system.

# 4 Check Code Table

## 4.1 Unit

In case the unit runs under abnormal condition, failure protection code will display on both control panel and wired controller, and the indicator on the wired controller will flash with 1Hz. The display codes are shown in the following table:

| No. | Code | Content | Note |
|---|---|---|---|
| 1 | E0 | Main control EPROM error | Recovered upon failure recovery |
| 2 | E1 | Phase sequence error of main control board check | Recovered upon failure recovery |
| 3 | E2 | Communication failure between master and the HMI or master and salve | Recovered upon failure recovery |
| | 2E2 | Communication failure between main control and extension board | Recovered upon failure recovery |
| | 3E2 | Communication failure between master and salve in a unit | Recovered upon failure recovery |
| 4 | E3 | Total water outlet temperature sensor failure | Recovered upon failure recovery |
| 5 | E4 | Unit water outlet temperature sensor failure | Recovered upon failure recovery |
| 6 | 1E5 | Condenser tube temperature sensor T3A failure | Recovered upon failure recovery |
| 7 | E6 | Water tank temperature sensor T5 failure | Recovered upon failure recovery |
| 8 | E7 | Ambient temperature sensor failure | Recovered upon failure recovery |
| 9 | E8 | Power supply phase sequence protector output error | Recovered upon failure recovery |
| 10 | E9 | Water flow detection failure | Failure locking for 3 times in 60 minutes (Recovered by power off or Wired controller clear fault) |
| 11 | 1Eb | Taf1 the pipe of the tank antifreeze protection sensor failure | Recovered upon failure recovery |
| 12 | 2EB | Taf2 cooling evaporator low-temperature antifreeze protection sensor failure | Recovered upon failure recovery |
| 13 | Ed | System discharge temperature sensor failure | Recovered upon failure recovery |
| 14 | 1EE | EVI plate heat exchanger refrigerant temperature T6A sensor failure | Recovered upon failure recovery |
| | 2EE | EVI plate heat exchanger refrigerant temperature T6B sensor failure | Recovered upon failure recovery |
| 15 | EF | Unit water return temperature sensor failure | Recovered upon failure recovery |
| 16 | EP | Discharge sensor failure alarm | Recovered upon failure recovery |
| 17 | EU | Tz sensor failure | Recovered upon failure recovery |
| 18 | P0 | System high-pressure protection or discharge temperature protection | for 3 times in 60 minutes (Recovered by power off) |
| | 1P0 | System high-pressure switch disconnect protection | Recovered upon failure recovery |
| 19 | P1 | System low pressure protection (or Severe refrigerant leakage protection) | for 3 times in 60 minutes (Recovered by power off) |
| 20 | P3 | T4 ambient temperature too high in cooling mode | Recovered upon failure recovery |
| 21 | 1P4 | System A current protection | for 3 times in 60 minutes (Recovered by power off) |
| | 2P4 | System A DC bus current protection | |
| 22 | P6 | Inverter module failure | Recovered upon failure recovery |
| 23 | P7 | High temperature protection of system condenser | for 3 times in 60 minutes (Recovered by power off) |
| 24 | P9 | Water inlet and outlet temperature difference protection | Recovered upon failure recovery |
| 25 | PA | Abnormal water inlet and outlet temperature difference protection | Recovered upon failure recovery |
| 26 | PC | Cooling evaporator pressure too low | Recovered upon error recovery |
| 27 | PE | Cooling evaporator low temperature antifreeze protection | Recovered upon error recovery |
| 28 | PH | Heating T4 too high temperature protection | Recovered upon error recovery |
| 29 | PL | Tfin module temperature too high protection | for 3 times in 100 minutes (Recovered by power off) |
| | 1PU | DC fan A module protection | Recovered upon failure recovery |
| 30 | 1bh | Module 1 failure | Recovered upon error recovery |

| No. | Code | Content | Note |
|---|---|---|---|
| 31 | H5 | Voltage too high or too low | Recovered upon error recovery |
| 32 | 1H9 | Compressor inverter module is not matched | Recovered upon error recovery |
| 33 | HC | High pressure sensor failure | Recovered upon error recovery |
| 34 | 1HE | No inset A valve error | Recovered upon error recovery |
| | 2HE | No inset B valve error | Recovered upon error recovery |
| | 3HE | No inset C valve error | Recovered upon error recovery |
| 35 | 1F0 | IPM module A transmission error | Recovered upon error recovery |
| 36 | F2 | Superheat insufficient | Wait at least 20min before recovering |
| 37 | F4 | 1F4 module 1L0 or 1LE protection occurs for 3 times in 60 minutes | Recovered by power off |
| 38 | 1F6 | A system bus voltage error (PTC) | Recovered upon error recovery |
| 39 | Fb | Low pressure sensor error | Recovered upon error recovery |
| 40 | Fd | Suction temperature sensor error | Recovered upon error recovery |
| 41 | 1FF | DC fan A error | Recovered by power off |
| 42 | FP | DIP switch inconsistency of multiple water pumps | Recovered by power off |
| 43 | 1L10 | Overcurrent protection | Overcurrent fault |
| | 1L11 | Transient phase current overcurrent protection | |
| | 1L12 | Phase current overcurrent lasts 30s protection | |
| 44 | 1L20 | Module over temperature protection | Over temperature fault |
| 45 | 1L31 | Low bus voltage error | Power fault |
| | 1L32 | High bus voltage error | |
| | 1L33 | Excessively high bus voltage error | |
| | 1L34 | Phase loss error | |
| 46 | 1L43 | Phase current sampling bias abnormal | Hardware fault |
| | 1L45 | Motor code not match | |
| | 1L46 | IPM protection | |
| | 1L47 | Module type not match | |
| 47 | 1L50 | Startup failure | Control fault |
| | 1L51 | Out of step error | |
| | 1L52 | Zero speed error | |
| 48 | 1L60 | Fan motor phase loss protection | Diagnostic fault |
| | 1L65 | IPM short circuit error | |
| | 1L66 | FCT detection error | |
| | 1L6A | Open circuit of U-phase upper tube | |
| | 1L6B | Open circuit of U-phase lower tube | |
| | 1L6C | Open circuit of V-phase upper tube | |
| | 1L6D | Open circuit of V-phase lower tube | |
| | 1L6E | Open circuit of W-phase upper tube | |
| | 1L6F | Open circuit of W-phase lower tube | |

# 5 Troubleshooting

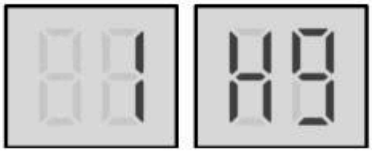
## 5.1 Warning

**Warning**

- All electrical work must be carried out by competent and suitably qualified, certified and accredited professionals and in accordance with all applicable legislation (all national, local and other laws, standards, codes, rules, regulations and other legislation that apply in a given situation).
- Power-off the outdoor units before connecting or disconnecting any connections or wiring, otherwise electric shock (which can cause physical injury or death) may occur or damage to components may occur.

## 5.2 E0/H9 Troubleshooting

### 5.2.1 Digital display output

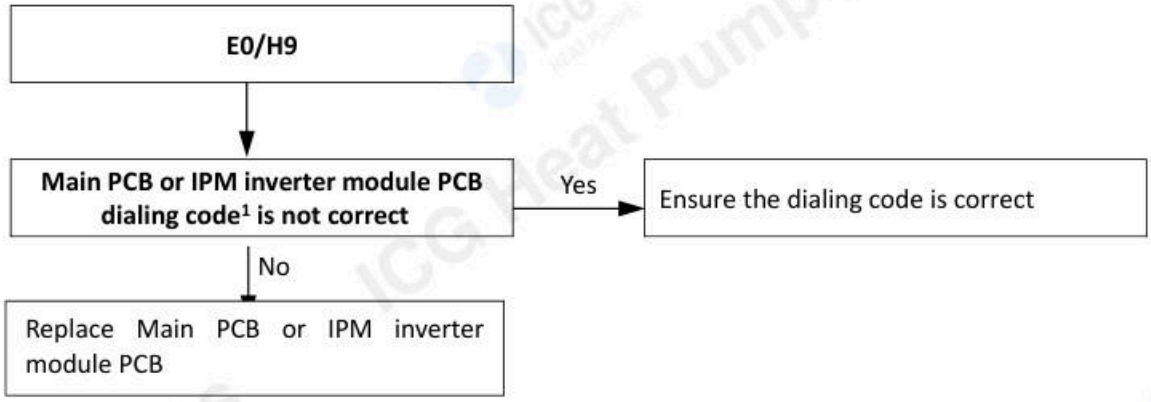

### 5.2.2 Description

- E0 indicates that the capability dialing code of the main PCB is inconsistent with the actual model.
- 1H9 indicates that the driving model of IPM inverter module (compressor) does not match.
- All units stop running.
- Error code is displayed on main PCB and user interface...d user interface.

### 5.2.3 Possible causes

- The dialing code of main PCB capability or refrigerant is error（It is caused by the discrepancy between DIP switch S3-2 and S4 and the wiring diagram.）.
- The address dialing code of the IPM inverter module PCB is error.
- Main PCB or IPM inverter module damaged.

### 5.2.4 Procedure




Notes:

1. Main PCB capability dialing code is designated S4 on the main PCBs.
2. Main PCB refrigerant dialing code is designated S3-2 on the main PCBs.
3. Compressor inverter module PCB address dialing code is designated S7 on compressor inverter module PCB .

## 5.3 E1 Troubleshooting

### 5.3.1 Digital display output

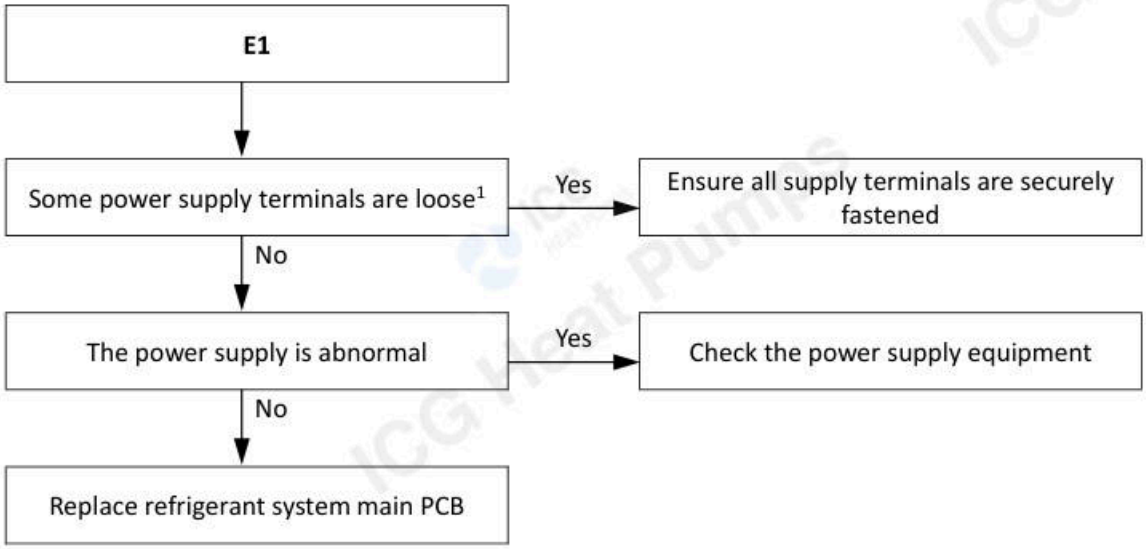

**Description**

- Phase sequence error.
- All Units stops running.
- Error code is displayed on main PCB and user interface.

### 5.3.2 Possible causes

- Power supply terminals loose.
- Power supply abnormal.
- Main PCB damaged.

### 5.3.3 Procedure




Notes:

1. Loose power supply terminals can cause the compressor to operate abnormally and compressor current to be very large.

## 5.4 E2 Troubleshooting

### 5.4.1 Digital display output

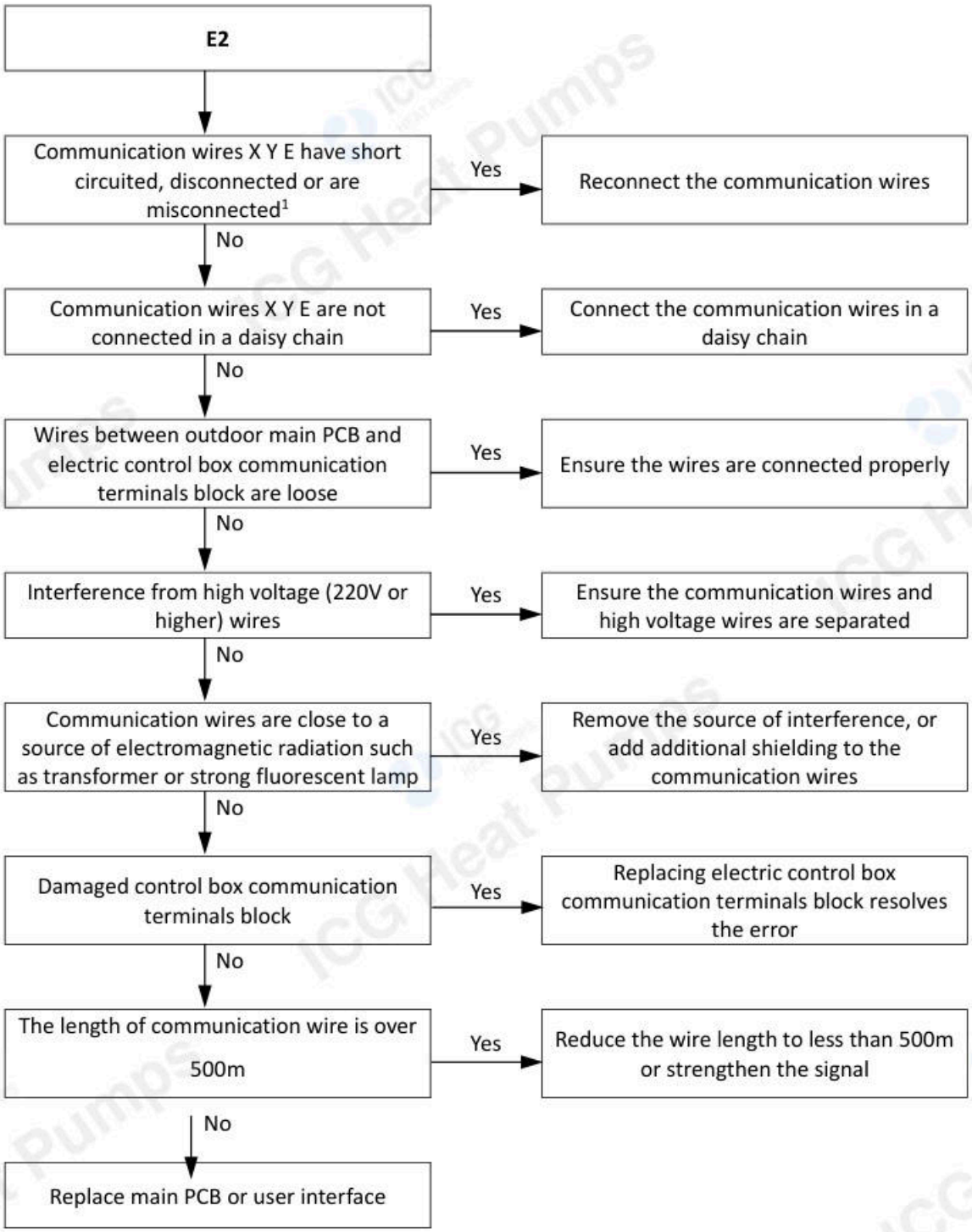

### 5.4.2 Description

- Communication error between outdoor unit and user interface.
- Communication failure between master and slave units
- All units stop running.
- Error code is displayed on main PCB and user interface.

### 5.4.3 Possible causes

- Communication wires between outdoor unit and user interface not connected properly.
- Communication wiring X Y E terminals misconnected.
- Wiring connection is loosen
- Interference from high voltage wires or other sources of electromagnetic radiation.
- Communication wire too long.
- Damaged main PCB, user interface or electric control box communication terminals block.

### 5.4.4 Procedure

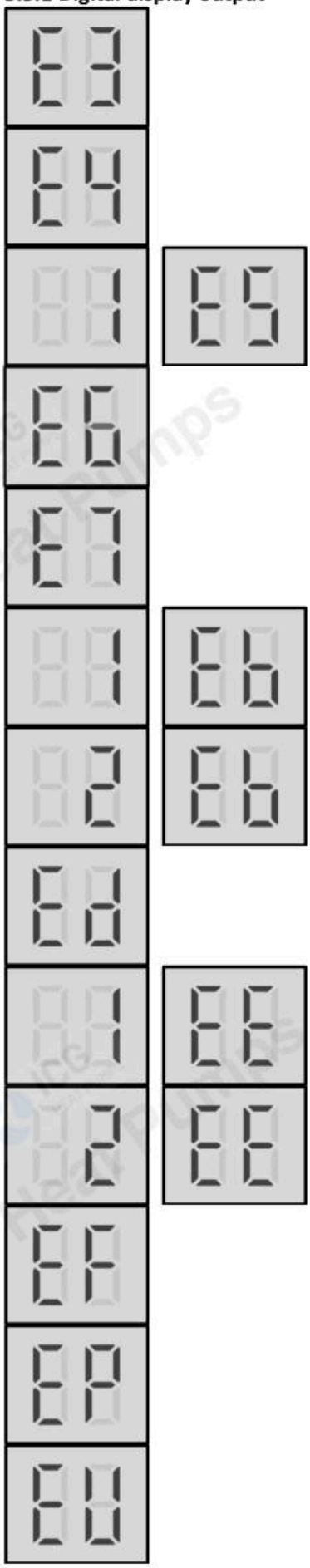



Notes:

1. Measure the resistance among X, Y and E. The normal resistance between X and Y is 120Ω, between X and E is infinite, between Y and E is infinite. Communication wiring has polarity. Ensure that the X wire is connected to X terminals and the Y wire is connected to Y terminals.

## 5.5 E3, E4, E5, E6,E7, Eb, Ed, EE, EF, EP, EU, Fb, Fd Troubleshooting

### 5.5.1 Digital display output



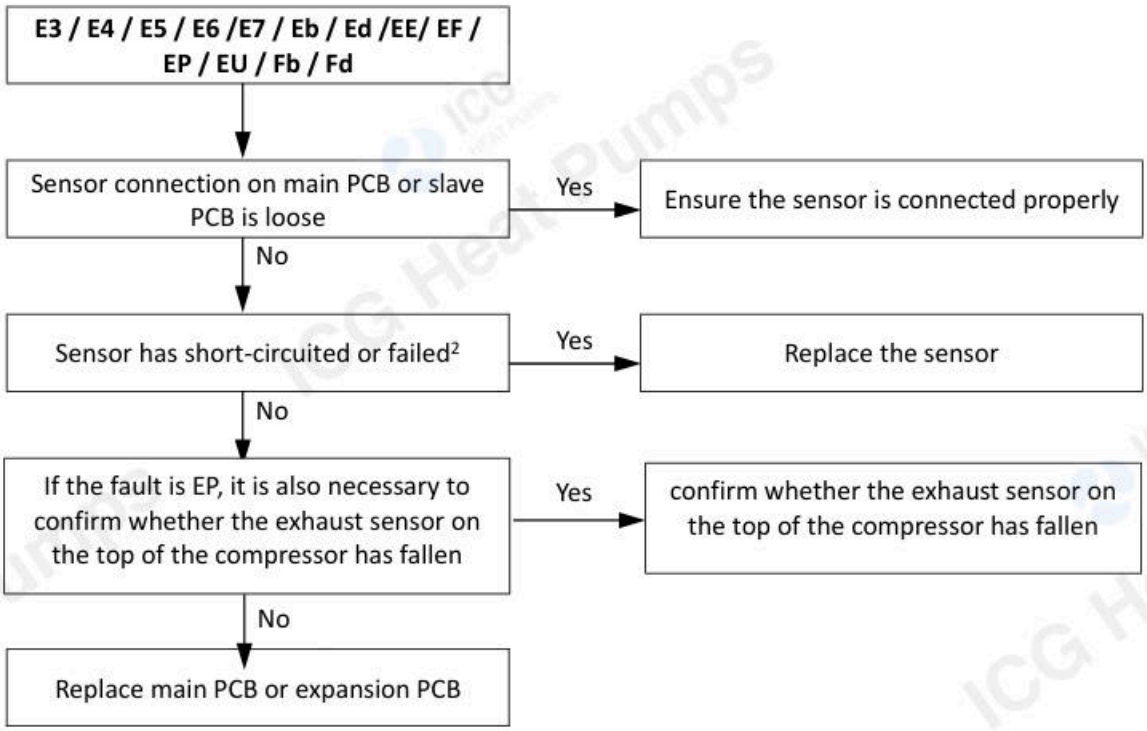

### 5.5.2 Description

- E3 indicates total water outlet temperature sensor error (valid for the main unit)
- E4 unit water outlet temperature sensor error
- 1E5 indicates condenser tube temperature sensor T3A error
- E6 Water tank temperature sensor T5 failure
- E7 indicates ambient temperature sensor error
- 1Eb indicates pipe of the tank antifreeze protection sensor Taf1 error
- 2Eb indicates cooling evaporator low-temperature antifreeze protection sensor Taf2 error
- Ed indicates discharge pipe temperature sensors Tp1 error at the same time
- 1EE indicates EVI plate heat exchanger refrigerant temperature sensor T6A error
- 2EE indicates EVI plate heat exchanger refrigerant temperature sensor T6B error
- EF indicates unit water return temperature sensor error
- EP indicates discharge temperature sensor failure error
- EU indicates water side heat exchanger refrigerant total outlet temperature sensor Tz error in heating mode.
- Fb indicates Low pressure sensor error.
- Fd indicates suction temperature sensor Th error.
- All units stop running (E3, E6, 1Eb).
- Error code is displayed on main PCB and user interface.

### 5.5.3 Possible causes

- Sensor not connected properly or has malfunctioned.
- Damaged main PCB.

### 5.5.4 Procedure




Notes:

1. Most sensors are connected to ports CN4（E4）, CN37（1E5）, CN30(E7）, CN45（2Eb）,CN4（Ed）, CN8（EE）, CN4（EF）, CN4（EP）, CN4（EU）,CN41(Fb）, CN4（Fd）on the main PCB, A few sensors are connected to ports CN101(E3),CN103(E6）,CN105(1Eb）on the slave PCB.
2. Measure sensor resistance. If the resistance is too low, the sensor has short-circuited. If the resistance is not consistent with the sensor's resistance characteristics table, the sensor has failed.

## 5.6 E8 Troubleshooting

### 5.6.1 Digital display output

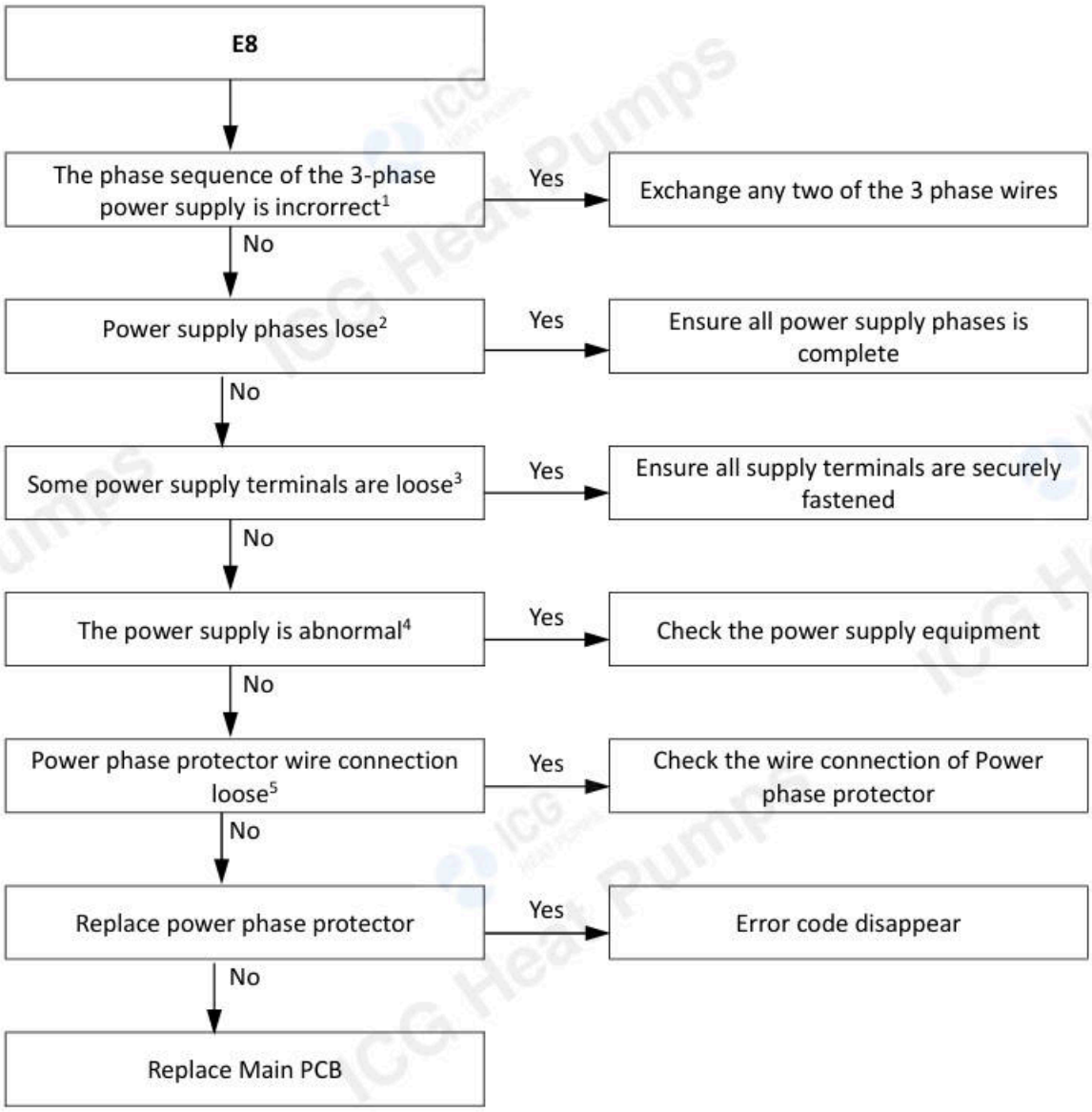

### 5.6.2 Description

- Power supply phase sequence protector output error
- All units stop running.
- Error code is displayed on main PCB and user interface.

### 5.6.3 Possible causes

- Power supply phases not connected in correct sequence or lose.
- Power supply terminals or Power phase protector wire connection loose(If the model does not have a three-wire protector, the CN28 terminal on the main control board needs to be shorted with a jumper).
- Power supply abnormal.
- Damaged main PCB.
- Damaged power phase protector.

### 5.6.4 Procedure




Notes:

1. For some models that do not have a three-phase protector, the CN28 terminal on the main control board needs to be shorted with a jumper.
2. The red LED on the power phase protector will on.
3. The red LED on the power phase protector will flash with 1HZ.
4. The A, B, C terminals of 3-phase power supply should match compressor phase sequence requirements. If the phase sequence is inverted, the compressor will operate inversely. If the wiring connection of each outdoor unit is in A, B, C phase sequence, and multiple units are connected, the current difference between C phase and A, B phases will be very large as the power supply load of each outdoor unit will be on C phase. This can easily lead to tripped circuits and terminal wiring burnout. Therefore if multiple units are to be used, the phase sequence should be staggered, so that the current is distributed among the three phases equally.
5. The red LED on the power phase protector will flash with 3HZ. Loose power supply terminals can cause the compressor to operate abnormally and compressor current to be very large.
6. Wire connected to port CN28 on the main PCB (Main PCB component)

## 5.7 E9 Troubleshooting

### 5.7.1 Digital display output

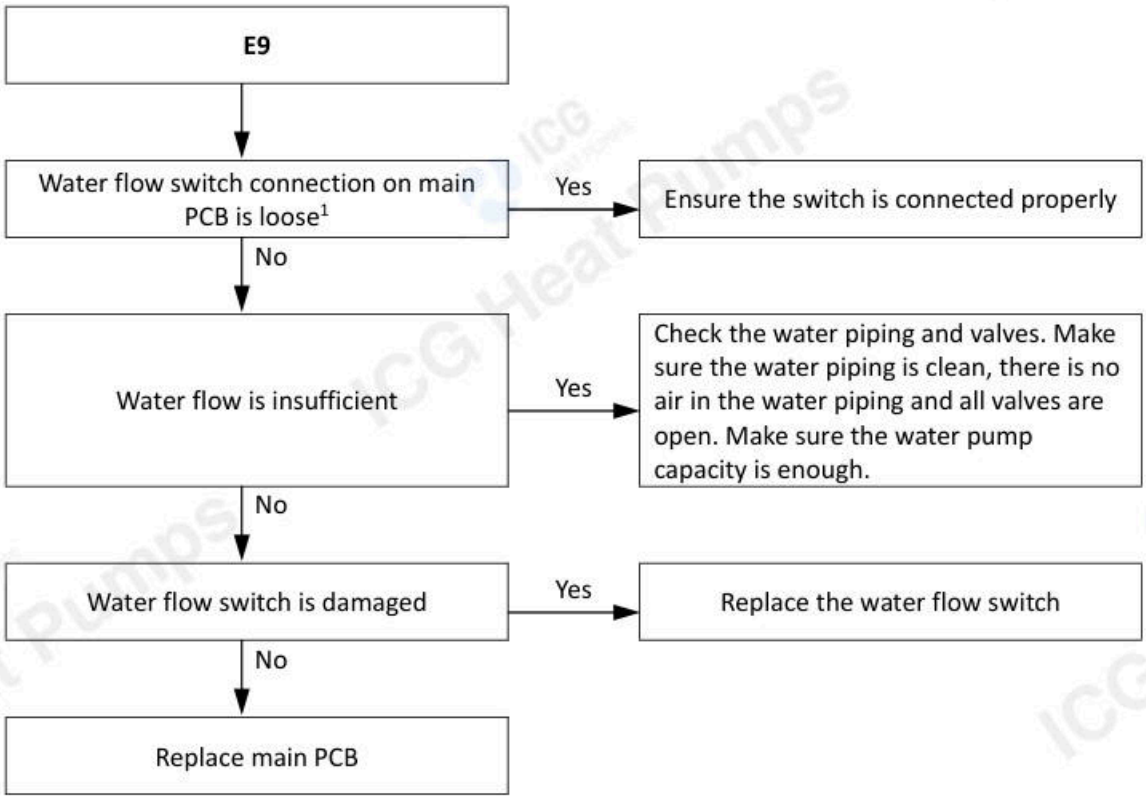

### 5.7.2 Description

- Water flow failure.
- E9 indicates water flow switch error. When E9 error occurs 3 times in 60 minutes, manual system restart is required before the system can resume operation.
- All units stop running.
- Error code is displayed on main PCB and user interface.

### 5.7.3 Possible causes

- The wire circuit is short connected or open.
- Water flow rate is too low.
- Water flow switch damaged.
- Damaged main PCB.

### 5.7.4 Procedure




Notes:

1. Water flow switch connection is port CN114 on the slave PCB.

## 5.8 EC Troubleshooting

### 5.8.1 Digital display output

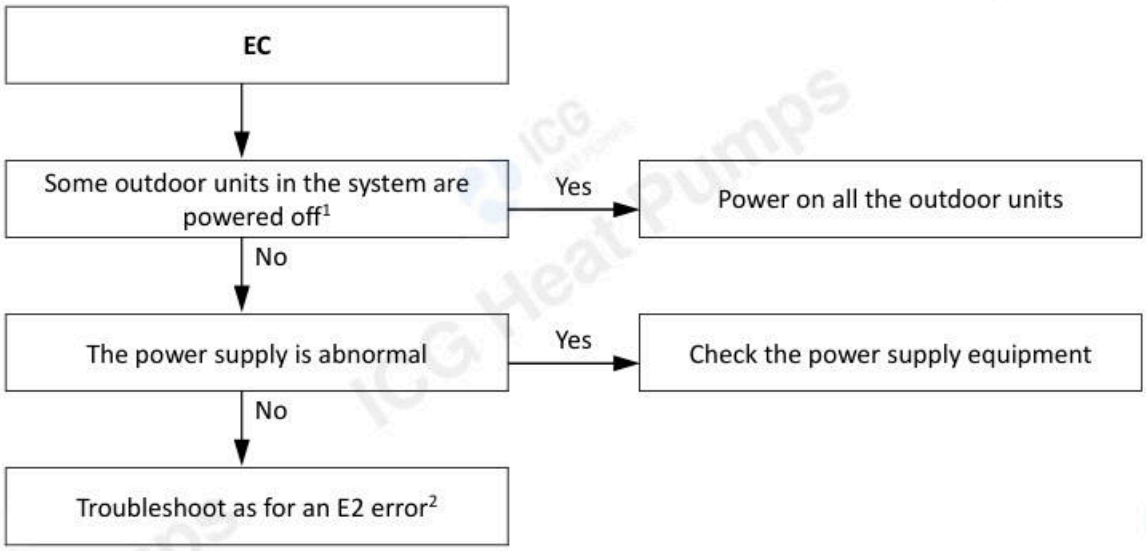

### 5.8.2 Description

- EC indicates that the number of slave units detected by master unit has decreased.
- Unit stop running.
- Error code is only displayed on the user interface.

### 5.8.3 Possible causes

- Some outdoor units power off.
- Power supply abnormal.
- Incorrect outdoor unit address setting.
- Communication wires between outdoor units not connected properly.
- Wiring connection is loosen.
- Damaged main PCB or electric control box communication terminals block.

### 5.8.4 Procedure

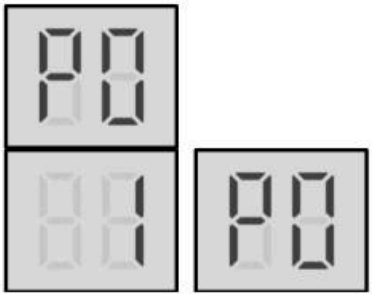



Notes:

1. Check digital display on the main PCB. If digital display is on, the main PCB is powered on, if digital display is off, the main PCB is powered off.
2. See “E2 Troubleshooting”.

## 5.9 P0 Troubleshooting

### 5.9.1 Digital display output



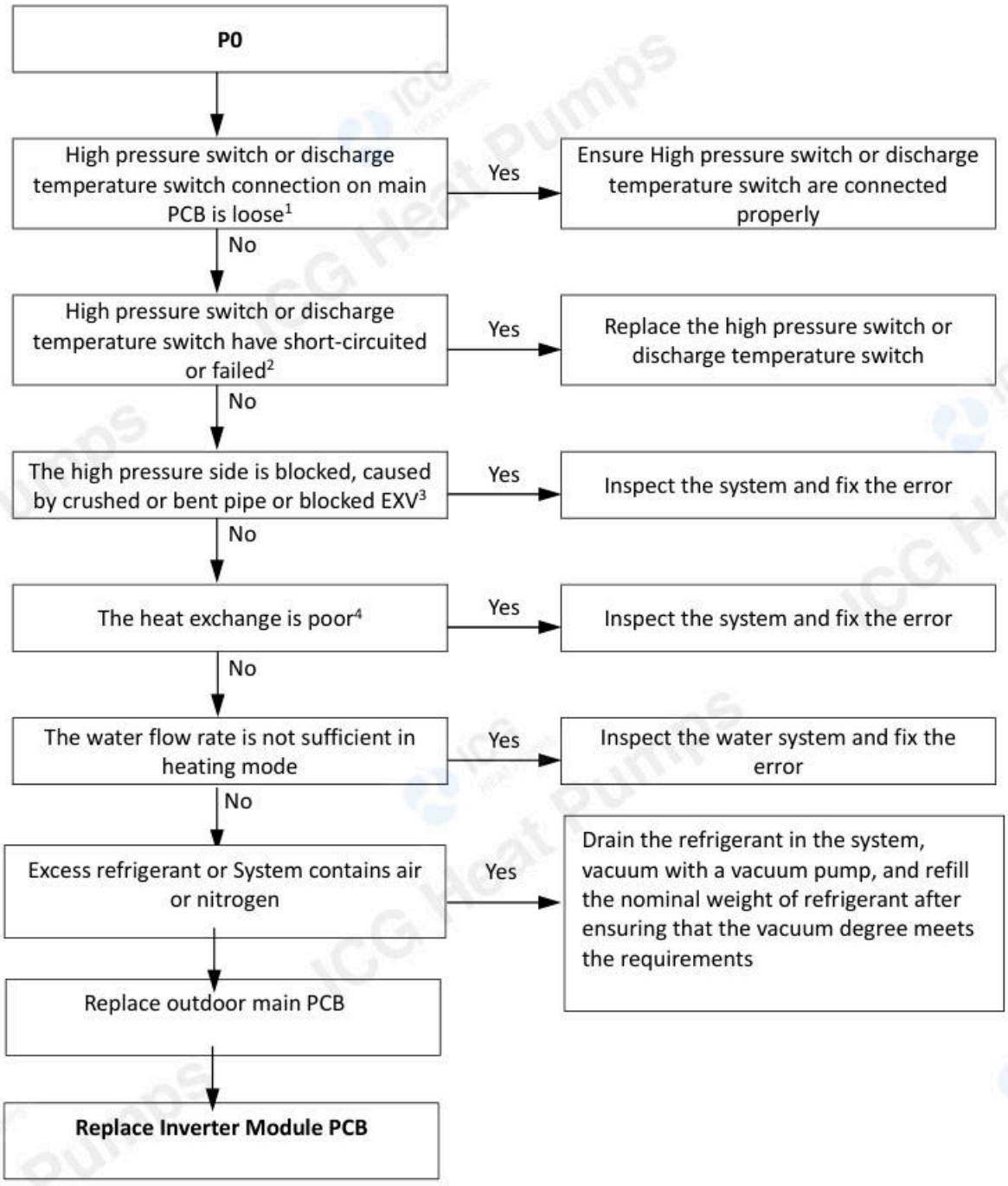

### 5.9.2 Description

- Discharge pipe high pressure or discharge temperature switch protection. When the discharge pressure rises above 3.4MPa or discharge temperature rises above 115°C, the system displays P0 protection and unit stop running. When the discharge pressure falls below 2.9MPa or discharge temperature fall below 90°C, P0 is removed and normal operation resumes. When P0 error occurs 3 times in 60 minutes, a manual system restart is required before the system can resume operation.
- Error code is displayed on main PCB and user interface.

### 5.9.3 Possible causes

- High pressure switch or discharge temperature switch not connected properly or has malfunctioned.
- Excess refrigerant.
- System contains air or nitrogen.
- High pressure side blockage.
- Poor condenser heat exchange.
- Main PCB damaged.

### 5.9.4 Procedure




Notes:

1. Discharge temperature switch connection is port CN27 on the main PCB .High pressure switch connection is port CN21 on the IPM inverter module PCB.
2. Measure the resistance among the three terminals of the pressure sensor. If the resistance is of the order of mega Ohms or infinite, the pressure sensor has failed.
3. High pressure side blockage causes discharge temperature to be higher than normal, discharge pressure to be higher than normal and suction pressure to be lower than normal.
4. In heating mode check water side heat exchanger, water piping, circulator pumps and water flow switch for dirt/blockages. In cooling mode check air side heat exchanger, fan(s) and air outlets for dirt/blockages.

## 5.10 P1 Troubleshooting

### 5.10.1 Digital display output

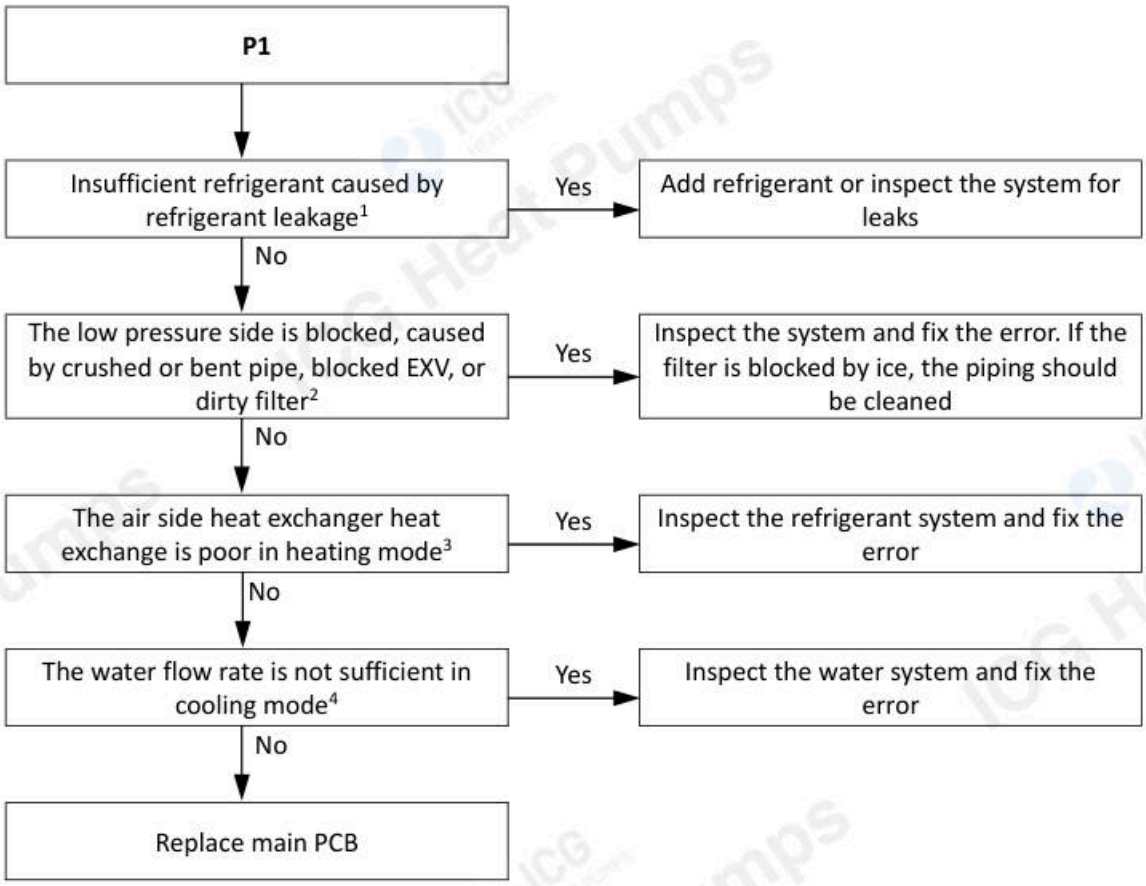

### 5.10.2 Description

- P1 one of the indicates suction pipe low pressure protection. When the suction pressure falls below 0.03MPa, the system displays P1 protection and unit stop running. When the pressure rises above 0.1MPa, P1 is removed and normal operation resumes. When P1 error occurs 3 times in 60 minutes, a manual system restart is required before the system can resume operation.
- P1 another indicates in the standby state or shutdown state, after the compressor stops for 3min, it is determined that the refrigerant quantity of the refrigerant system of the unit is insufficient through the saturation temperature corresponding to the high-pressure pressure, the system displays P1 protection, the unit does not start and the protection is not locked; When the detection pressure returns to above the judgment value, the protection is released and the unit can resume startup.
- P1 the last one indicates during the operation of the compressor of the unit, if the exhaust superheat is too high and lasts for 30min, report P1 protection first, and then judge the low refrigerant. If the low refrigerant protection is not triggered, P1 protection is removed and the operation is restarted according to the demand.
- Error code is displayed on main PCB and user interface.

### 5.10.3 Possible causes

- Insufficient refrigerant.
- Low pressure side blockage.
- Poor evaporator heat exchange in heating mode.
- Insufficient water flow in cooling mode.
- Main PCB damaged.

### 5.10.4 Procedure

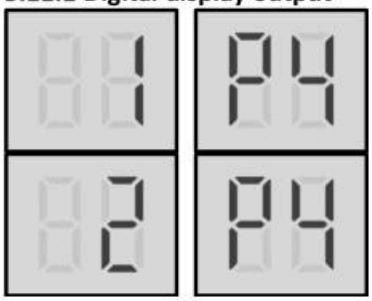



Notes:

1. To check for insufficient refrigerant: An insufficiency of refrigerant causes compressor discharge temperature to be higher than normal, discharge and suction pressures to be lower than normal and compressor current to be lower than normal, and may cause frosting to occur on the suction pipe. These issues disappear once sufficient refrigerant has been charged into the system.
2. A low pressure side blockage causes compressor discharge temperature to be higher than normal, suction pressure to be lower than normal and compressor current to be lower than normal, and may cause frosting to occur on the suction pipe. For normal system parameters.
3. Check air side heat exchanger, fan(s) and air outlets for dirt/blockages.
4. Check water side heat exchanger, water piping, circulator pumps and water flow switch for dirt/blockages.

## 5.11 P4, P5 Troubleshooting

### 5.11.1 Digital display output



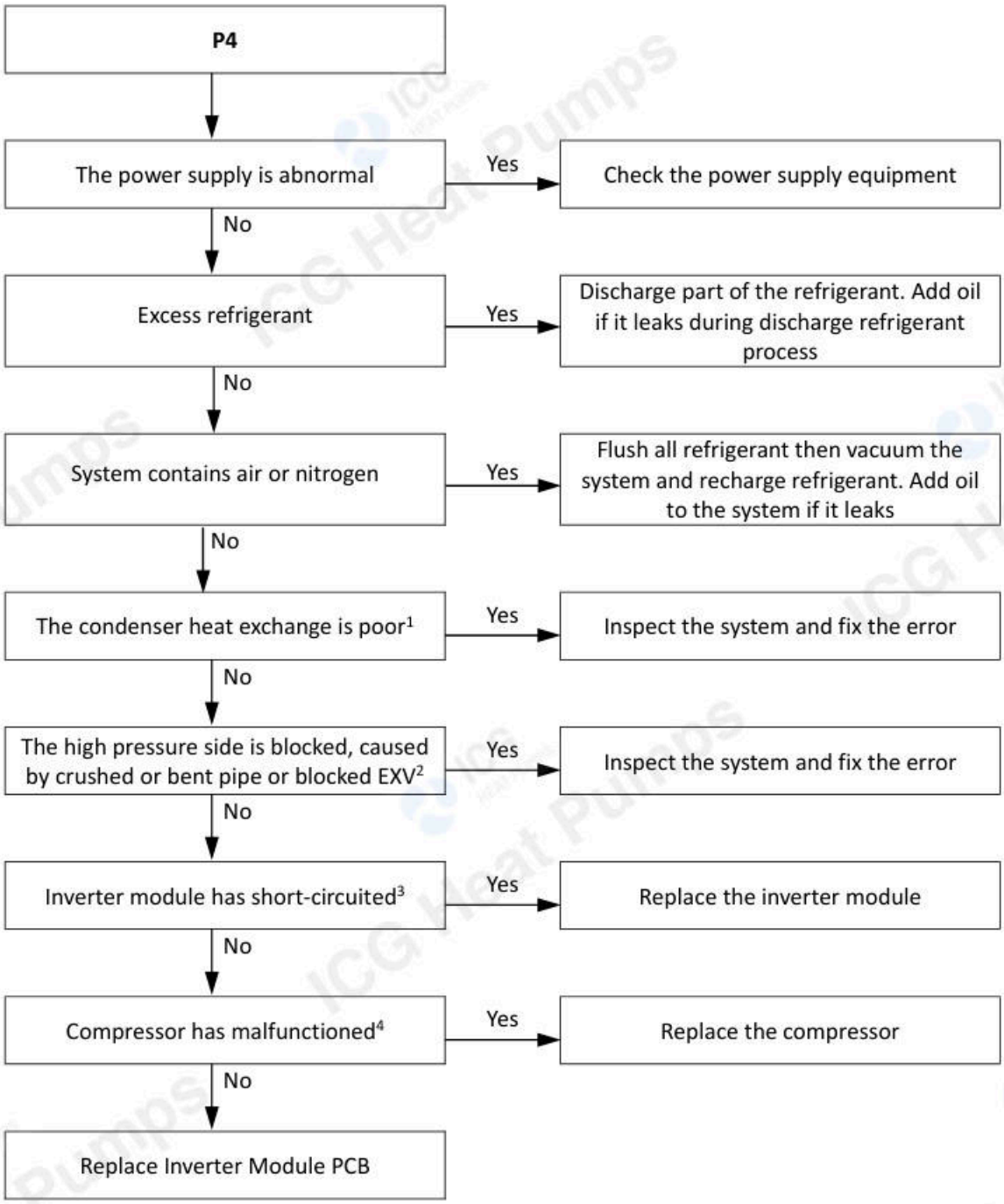

### 5.11.2 Description

- 1 P4 indicates system current protection
- 2 P4 indicates system DC bus current protection
- When the compressor current rises above the protection value 35A (DC bus current rises above 35A), the system displays P4 protection and unit stop running. When the current returns to the normal range, P4 is removed and normal operation resumes. When P4 error occurs 3 times in 60 minutes, a manual system restart is required before the system can resume operation.
- Error code is displayed on main PCB and user interface.

### 5.11.3 Possible causes

- Power supply abnormal.
- Poor condenser heat exchange.
- High pressure side blockage.
- Excess refrigerant.
- System contains air or nitrogen.
- Inverter module damaged.
- Compressor damaged.
- Main PCB damaged.

### 5.11.4 Procedure




Notes:

1. In heating mode check water side heat exchanger, water piping, circulator pumps and water flow switch for dirt/blockages. In cooling mode check air side heat exchanger, fan(s) and air outlets for dirt/blockages.
2. High pressure side blockage causes discharge temperature to be higher than normal, discharge pressure to be higher than normal and suction pressure to be lower than normal.
3. Set a multi-meter to buzzer mode and test any two terminals of P N and U V W of the inverter module. If the buzzer sounds, the inverter module has short-circuited.
4. The normal resistances of the inverter compressor is 0.139Ω (at 20℃ ambient temperature) among U V W and infinite between each of U V W and ground. If any of the resistances differ from these specifications, the compressor has malfunctioned.

## 5.12 P7 Troubleshooting

### 5.12.1 Digital display output

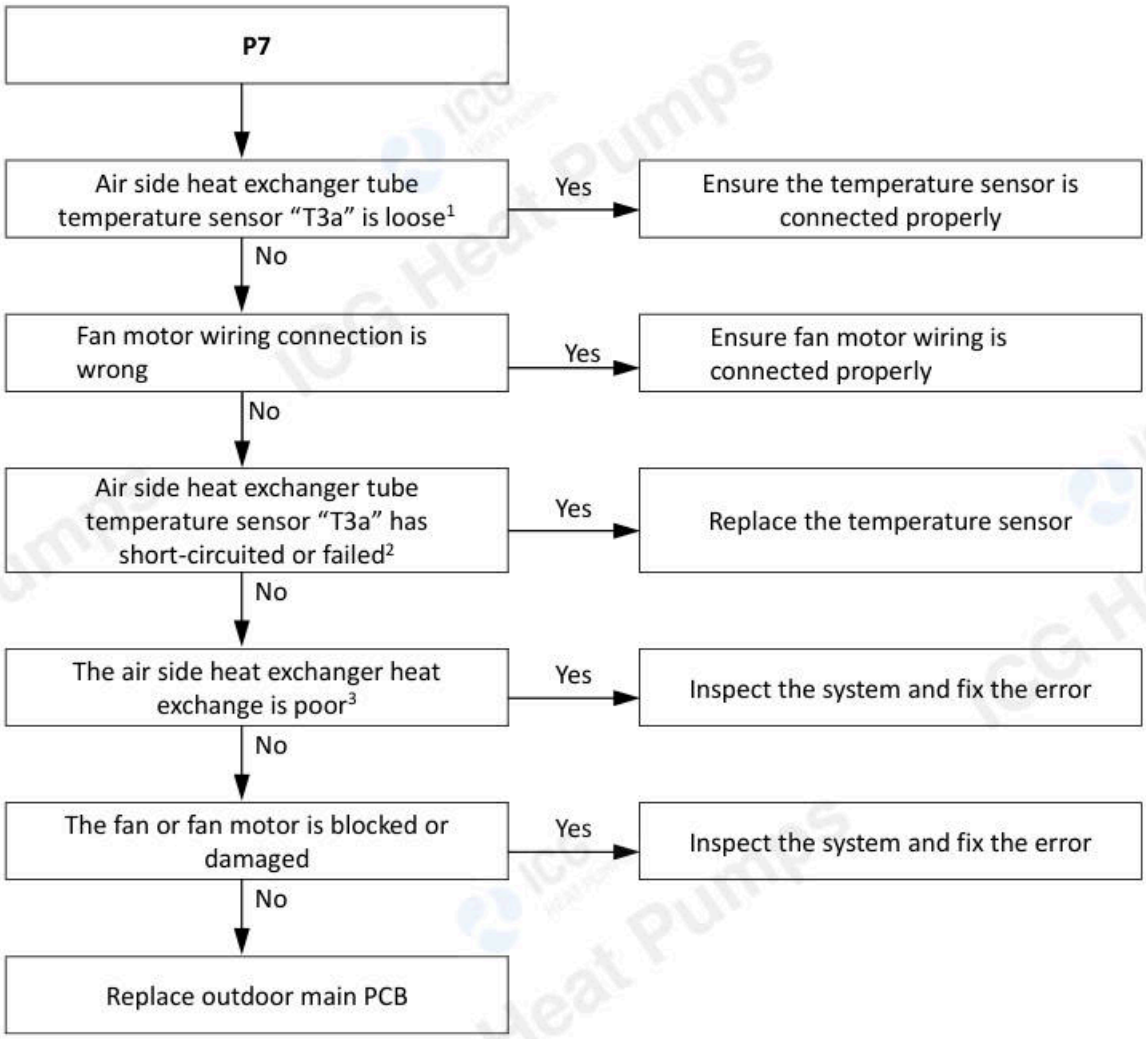

### 5.12.2 Description

- High temperature protection of air side heat exchanger tube temperature sensor “T3a” in cooling mode. When the tube temperature of air side heat exchanger is higher than 80°C, the system displays P7 protection and unit stop running. When the tube temperature of air side heat exchanger returns drops below 72°C, P7 is removed and normal operation resumes.
- Unit stop running.
- Error code is displayed on main PCB and user interface.

### 5.12.3 Possible causes

- Air side heat exchanger tube temperature sensor “T3a” not connected properly or has malfunctioned.
- Fan motor wiring connection is wrong.
- Poor condenser heat exchange.
- Fan motor damaged.
- Main PCB damaged.

### 5.12.4 Procedure




Notes:

1. Air side heat exchanger tube temperature sensor "T3a" connection port is CN37 on the main PCB.
2. Measure sensor resistance. If the resistance is too low, the sensor has short-circuited. If the resistance is not consistent with the sensor's resistance characteristics table, the sensor has failed.
3. Check air side heat exchanger, fan(s) and air outlets for dirt/blockages.

## 5.13 P9 Troubleshooting

### 5.13.1 Digital display output

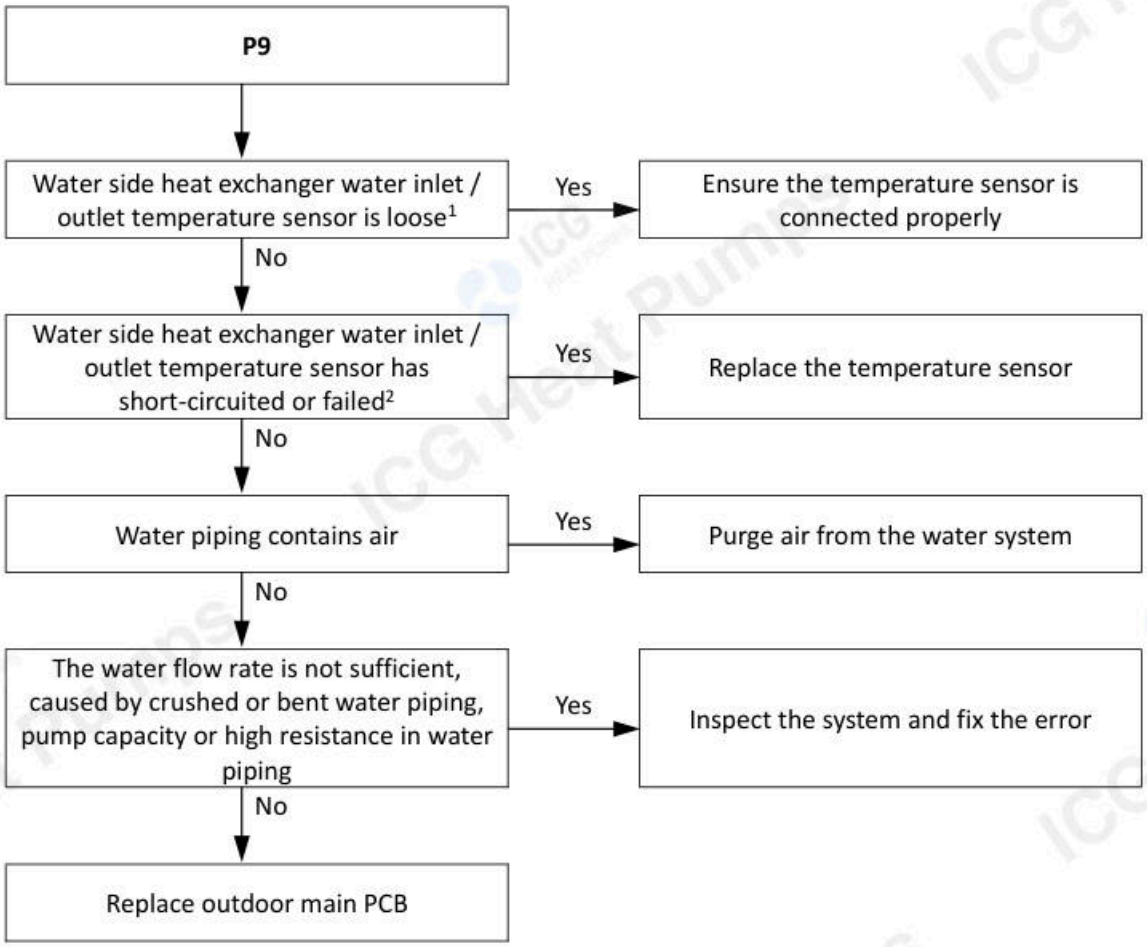

### 5.13.2 Description

- Water inlet and outlet temperature difference protection
- Unit stop running.
- Error code is displayed on main PCB and user interface.

### 5.13.3 Possible causes

- Temperature sensor not connected properly or has malfunctioned.
- Water piping contains air.
- Insufficient water flow.
- Main PCB damaged.

### 5.13.4 Procedure




Notes:

1. Water side heat exchanger water inlet temperature sensor and water side heat exchanger water outlet temperature sensor connections are port CN4 on the main PCB.
2. Measure sensor resistance. If the resistance is too low, the sensor has short-circuited. If the resistance is not consistent with the sensor's resistance characteristics table, the sensor has failed.

## 5.14 Pb Troubleshooting

### 5.14.1 Digital display output

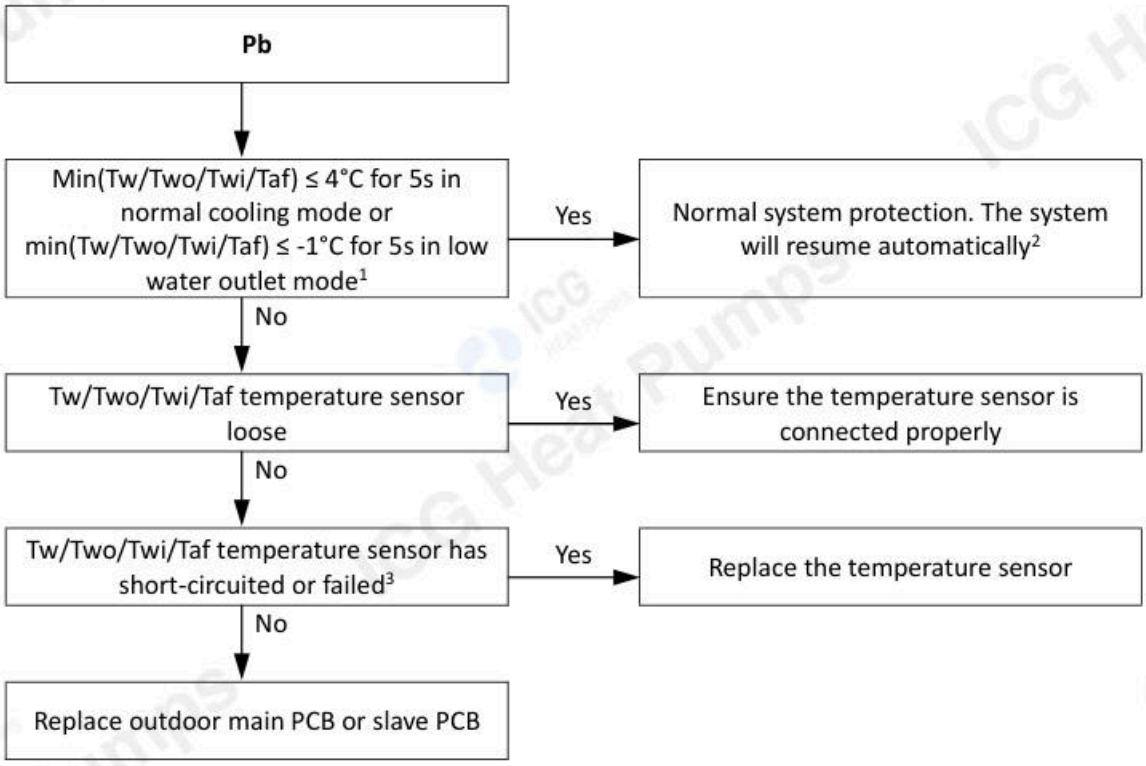

### 5.14.2 Description

- Water side heat exchanger anti-freeze protection.
- Error code is displayed on main PCB and ANTI.FREEZE icon is displayed on user interface.

### 5.14.3 Possible causes

- Normal system protection.
- Temperature sensor not connected properly or has malfunctioned.
- Main PCB or slave PCB damaged.

### 5.14.4 Procedure




Notes:

1. Combined Water side heat exchanger water outlet temperature sensor (Two), water side heat exchanger water inlet temperature sensor (Twi) and water side heat exchanger anti-freezing temperature sensor (Taf2) connections are ports CN4 and CN45 on the main PCB (labeled 29, 21 in Part 4, 2.2.1 Main PCB component).Water outlet temperature sensor (Tw) connections is ports CN101 on the slave PCB (labeled 14 in Part 4, 2.2.2 Slave PCB component).
2. Refer to Part 3, 6.7 "Water Side Heat Exchanger Anti-freeze Protection Control".
3. Measure sensor resistance. If the resistance is too low, the sensor has short-circuited. If the resistance is not consistent with the sensor's resistance characteristics table, the sensor has failed. Refer to Part 4, 6.1 "Temperature Sensor Resistance Characteristics".

## 5.15 PC Troubleshooting

### 5.15.1 Digital display output

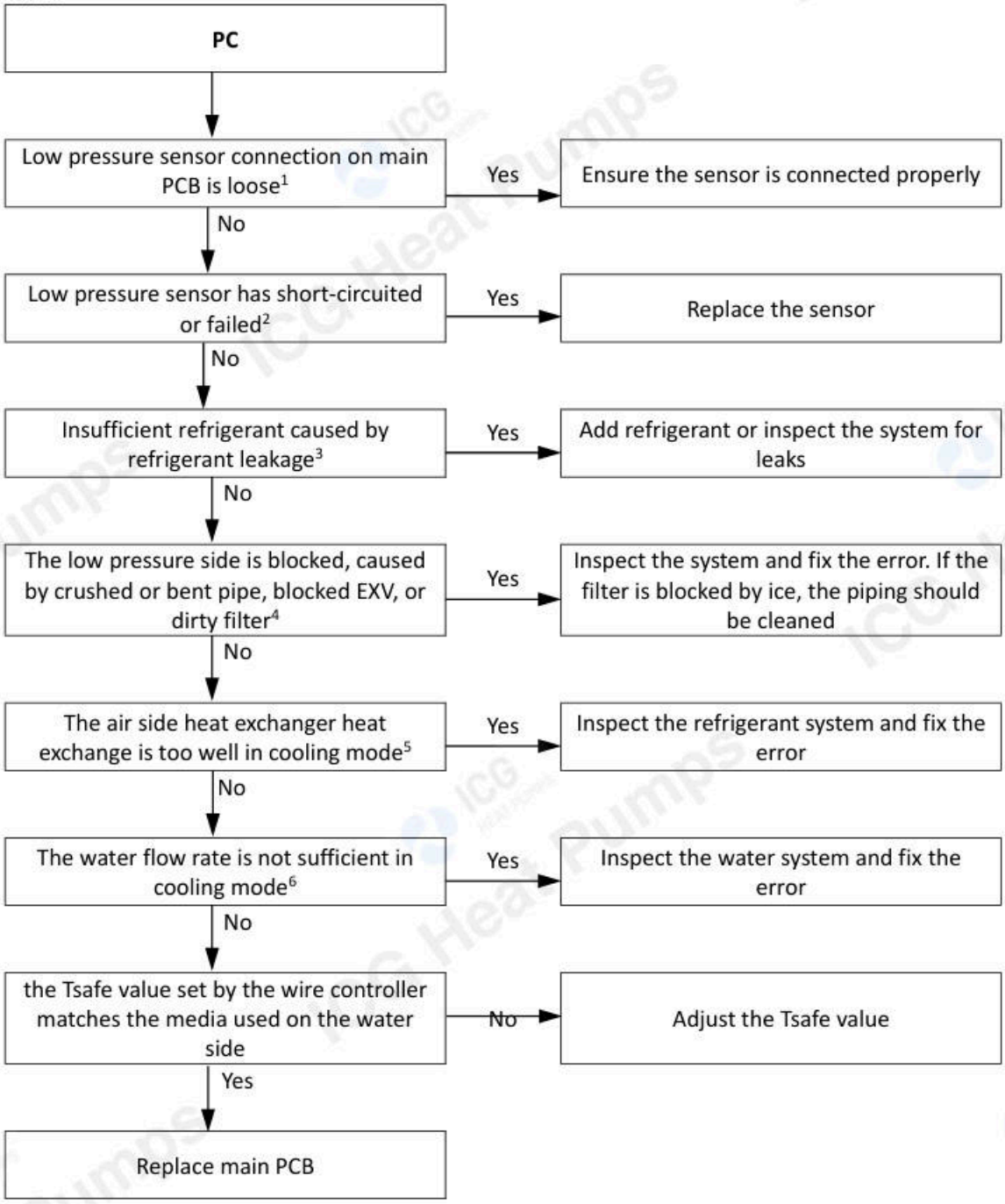

### 5.15.2 Description

- Water side heat exchanger low pressure protection.
- Unit stop running.
- Error code is displayed on main PCB and user interface.

### 5.15.3 Possible causes

- Insufficient refrigerant.
- Low pressure side blockage.
- Poor evaporator heat exchange in cooling mode.
- Insufficient water flow in cooling mode.
- Main PCB damaged.

### 5.15.4 Procedure




Notes:

1. Low pressure sensor connection is port CN42 on the main PCB.
2. Measure the resistance among the three terminals of the pressure sensor. If the resistance is of the order of mega Ohms or infinite, the pressure sensor has failed.
3. To check for insufficient refrigerant: An insufficiency of refrigerant causes compressor discharge temperature to be higher than normal, discharge and suction pressures to be lower than normal and compressor current to be lower than normal, and may cause frosting to occur on the suction pipe. These issues disappear once sufficient refrigerant has been charged into the system.
4. A low pressure side blockage causes compressor discharge temperature to be higher than normal, suction pressure to be lower than normal and compressor current to be lower than normal, and may cause frosting to occur on the suction pipe. For normal system parameters.
5. Check the environment where the air side heat exchanger is placed, whether the air temperature is too low, or there is strong wind.
6. Check water side heat exchanger, water piping, circulator pumps and water flow switch for dirt/blockages.

## 5.16 PH Troubleshooting

### 5.16.1 Digital display output

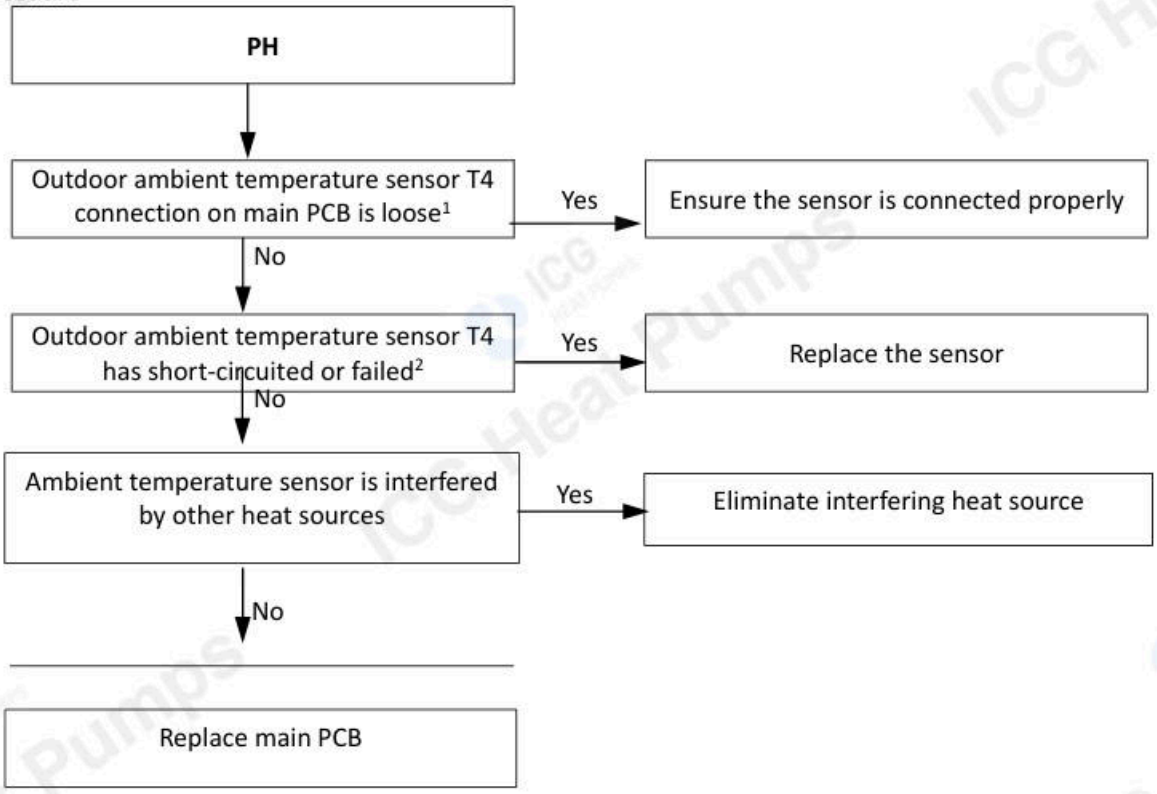

### 5.16.2 Description

- Ambient temperature too high protection in heating mode.
- Unit stop running.
- Error code is displayed on main PCB and user interface.

### 5.16.3 Possible causes

- Temperature sensor not connected properly or has malfunctioned.
- Ambient temperature sensor is interfered by other heat sources and the temperature detection value exceeds 65°C.
- Main PCB damaged.

### 5.16.4 Procedure




Notes:

1. T4 temperature sensor connection is port CN30 on the main PCB.
2. Measure sensor resistance. If the resistance is too low, the sensor has short-circuited. If the resistance is not consistent with the sensor's resistance characteristics table, the sensor has failed.

## 5.17 PE Troubleshooting

### 5.17.1 Digital display output

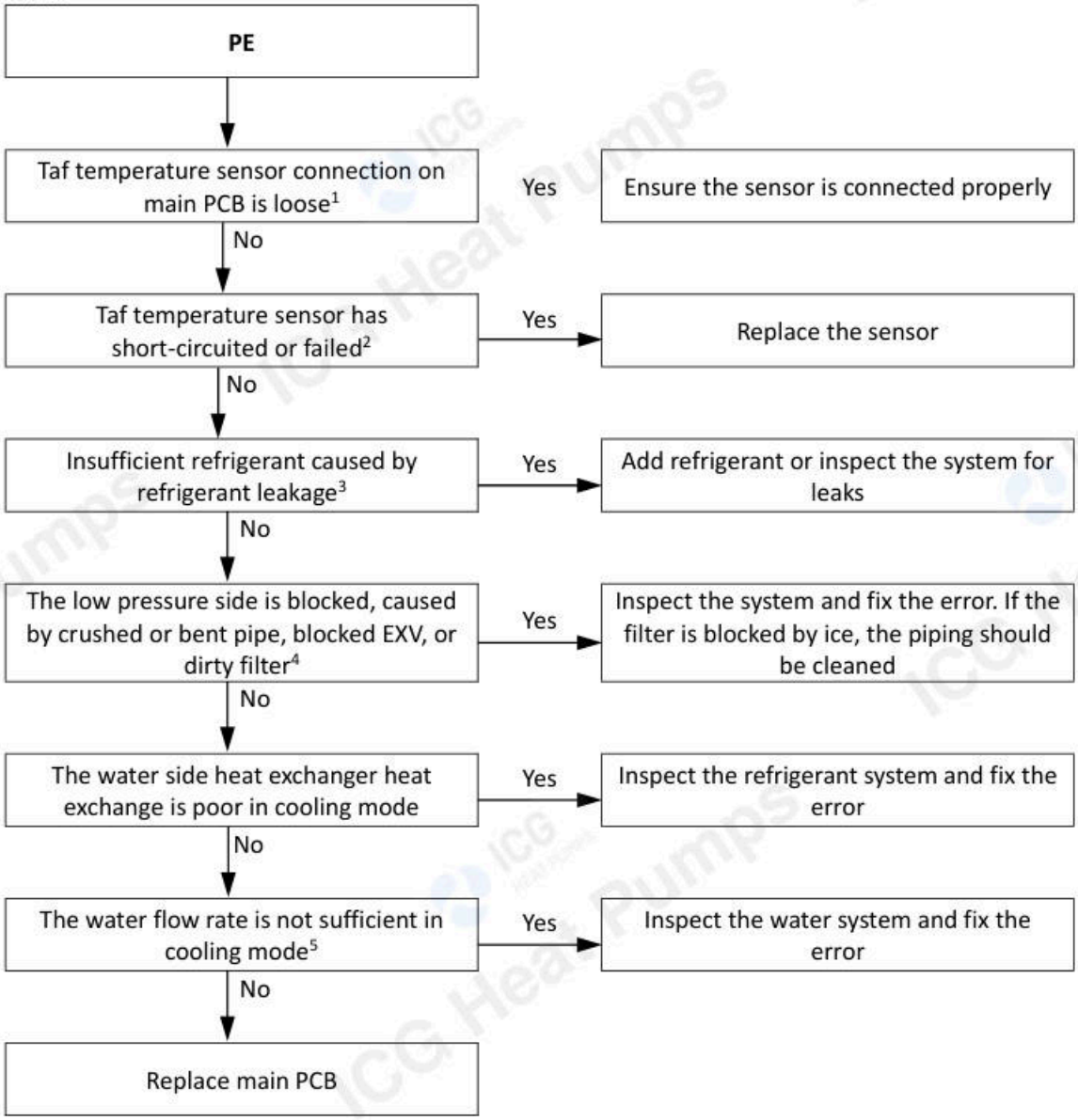

### 5.17.2 Description

- Water side heat exchanger low temperature antifreeze protection.
- Unit stop running.
- Error code is displayed on main PCB and user interface.

### 5.17.3 Possible causes

- Temperature sensor not connected properly or has malfunctioned.
- Insufficient refrigerant.
- Low pressure side blockage.
- Poor evaporator heat exchange in cooling mode.
- Insufficient water flow in cooling mode.
- Main PCB damaged.

### 5.17.4 Procedure




Notes:

1. Water side heat exchanger anti-freezing temperature sensor (Taf2) connection are ports CN45 on the main PCB.
2. Measure sensor resistance. If the resistance is too low, the sensor has short-circuited. If the resistance is not consistent with the sensor's resistance characteristics table, the sensor has failed. Refer to Part 4, 6.1 "Temperature Sensor Resistance Characteristics".
3. To check for insufficient refrigerant: an insufficiency of refrigerant causes compressor discharge temperature to be higher than normal, discharge and suction pressures to be lower than normal and compressor current to be lower than normal, and may cause frosting to occur on the suction pipe. These issues disappear once sufficient refrigerant has been charged into the system.
4. A low pressure side blockage causes compressor discharge temperature to be higher than normal, suction pressure to be lower than normal and compressor current to be lower than normal, and may cause frosting to occur on the suction pipe. For normal system parameters.
5. Check water side heat exchanger, water piping, circulator pumps and water flow switch for dirt/blockages.

## 5.18 PL/C7 Troubleshooting

### 5.18.1 Digital display output

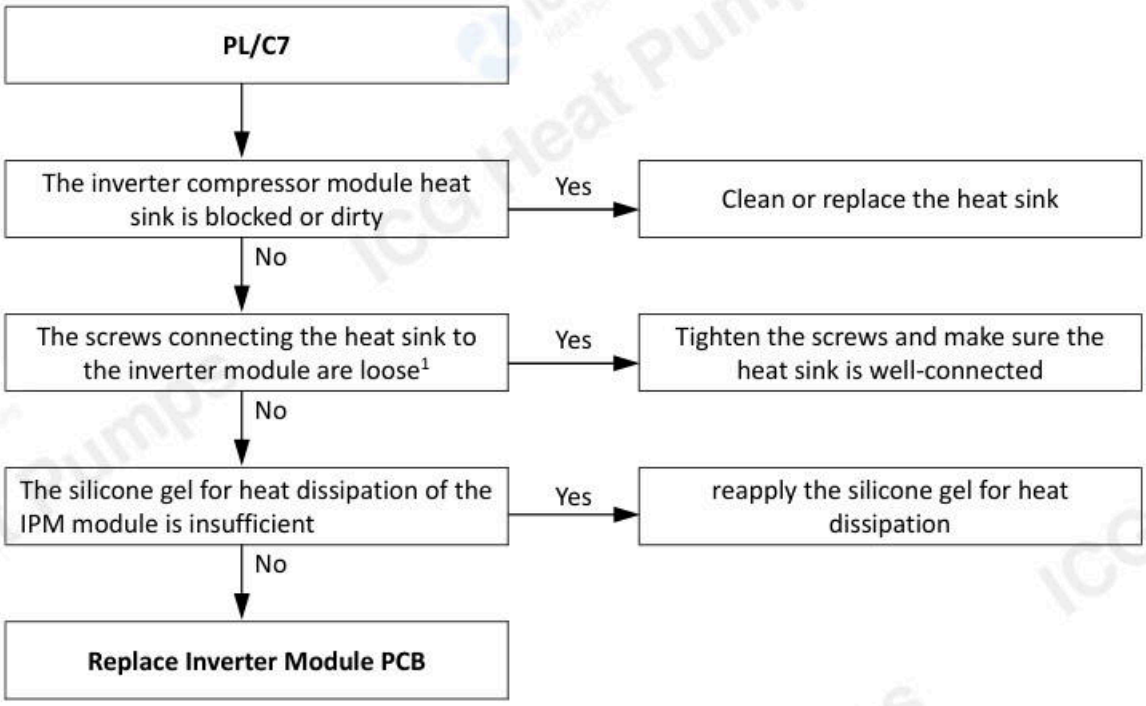

### 5.18.2 Description

- PL indicates inverter module temperature protection. When the main inverter module temperature rises above 100°C, the system displays PL protection and all the units stop running. When the inverter module temperature drops below 70°C, the compressor enters re-start control
- When a PL error occurs 3 times in 100 minutes, C7 will display, a manual system restart is required before the system can resume operation.
- Error code is displayed on the main PCB and user interface.

### 5.18.3 Possible causes

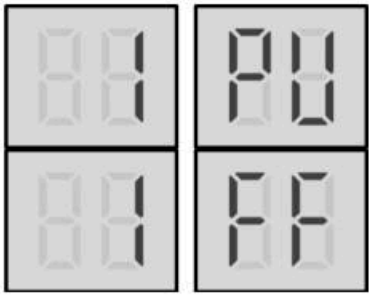
- Blocked, dirty or loose heat sink.
- Screws securing the IPM module of the compressor are loose
- The silicone gel for heat dissipation of the IPM module is insufficient.
- Main PCB damaged.

### 5.18.4 Procedure



## 5.19 PU/FF Troubleshooting

### 5.19.1 Digital display output



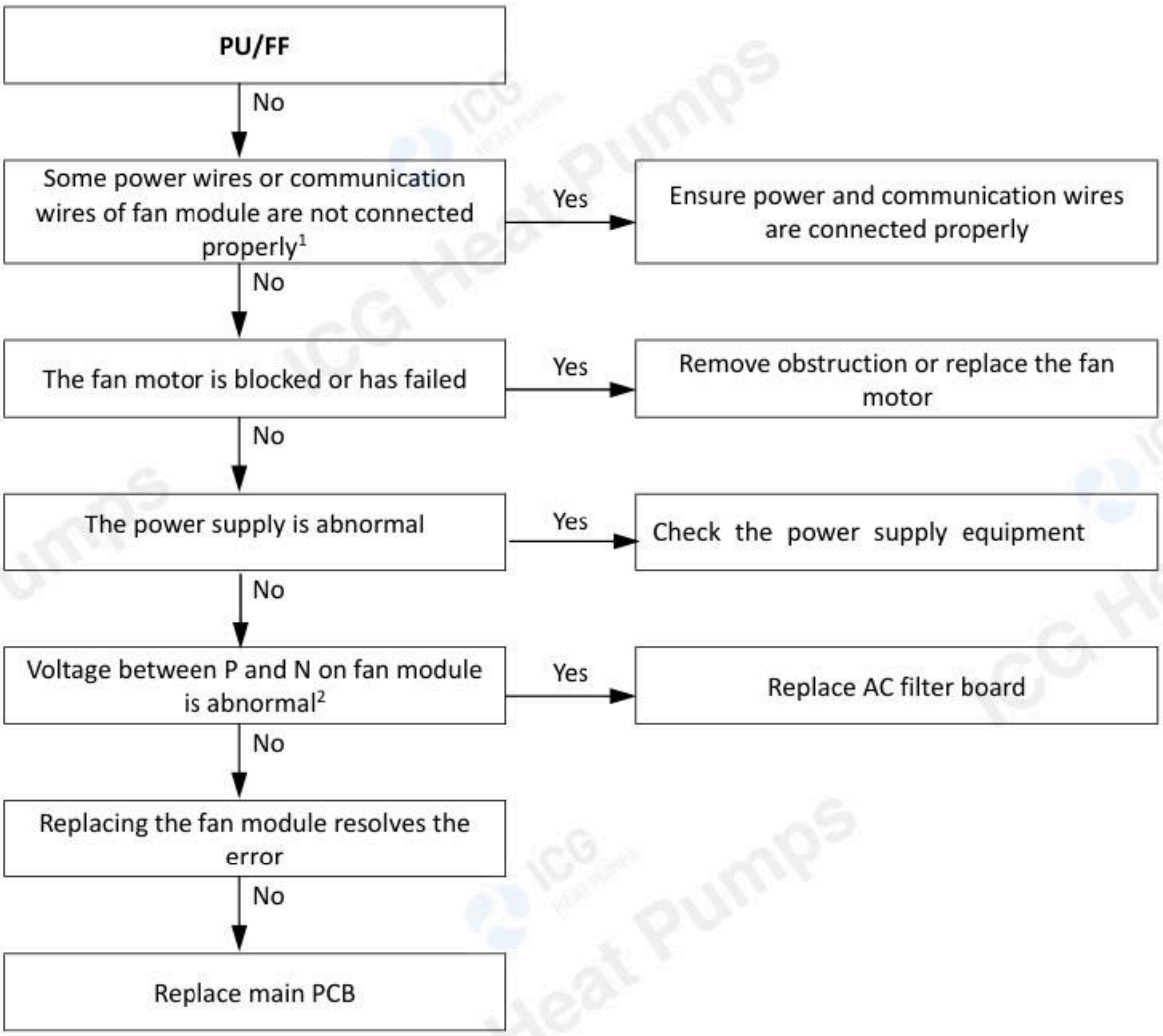

### 5.19.2 Description

- 1PU/FF indicates fan A module protection.
- FF indicates PU protection has displayed 10 times. When a FF occurred, a manual system restart is required before the system can resume operation.
- Unit stop running.
- Error code is only displayed on the main PCB and user interface.

### 5.19.3 Possible causes

- Power or communication wires not connected properly.
- Fan motor blocked or has failed.
- Power supply abnormal.
- AC filter board damaged.
- Fan module damaged.
- Inverter module PCB damaged.

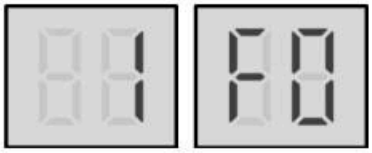
### 5.19.4 Procedure




Notes:
1. Refer to Part 4, 3 "Wiring diagram" and PCB components to make sure wire connection is firm.
2. The normal voltage between P and N on the fan module is 485-645V DC.

## 5.20 F0 Troubleshooting

### 5.20.1 Digital display output




### 5.20.2 Description

- 1F0 indicates a communication error between the main control chip and the compressor inverter driver chip.
- Unit stop running.
- Error code is only displayed on the unit with the error.

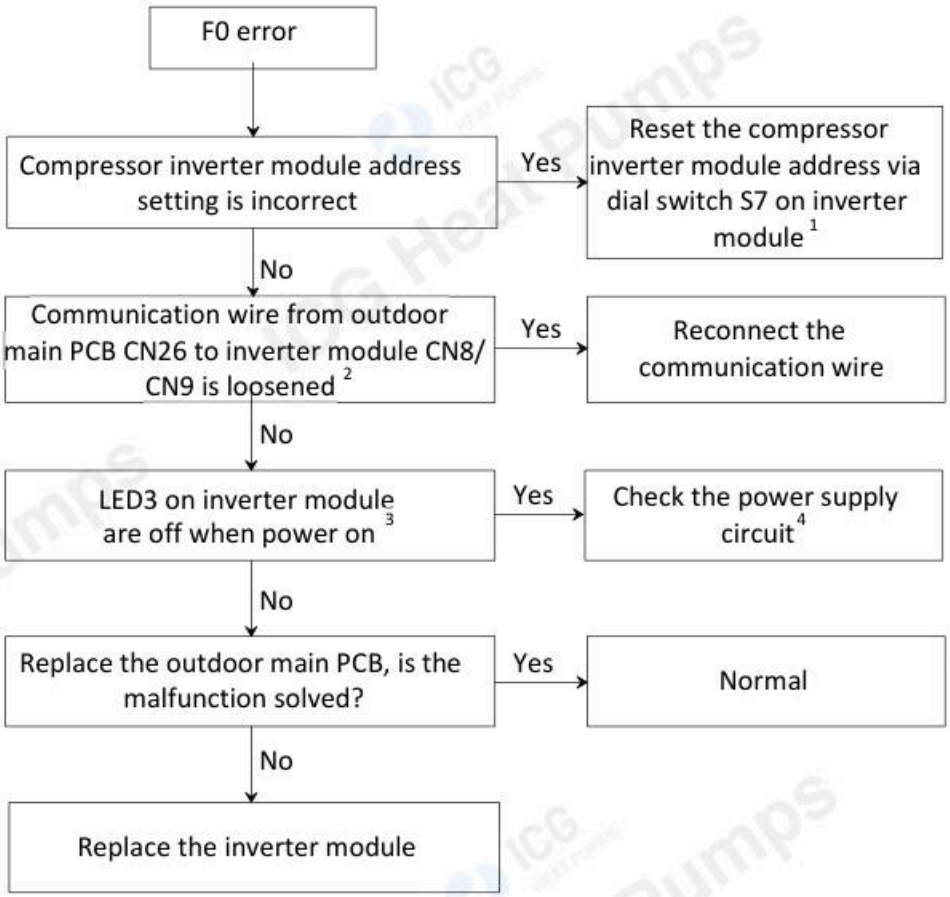
### 5.20.3 Trigger / recover condition

- Trigger condition: Main control chip and inverter driver chip cannot communication for 2 minutes.
- Recover condition: Communication go back to normal.
- Reset method: Resume automatically.

### 5.20.4 Possible causes

- Incorrect compressor inverter module address setting.
- Loosened communication wiring from the main PCB to the inverter module.
- Bridge rectifier damaged.
- Main PCB damaged.
- Compressor inverter module damaged.

### 5.20.5 Procedure

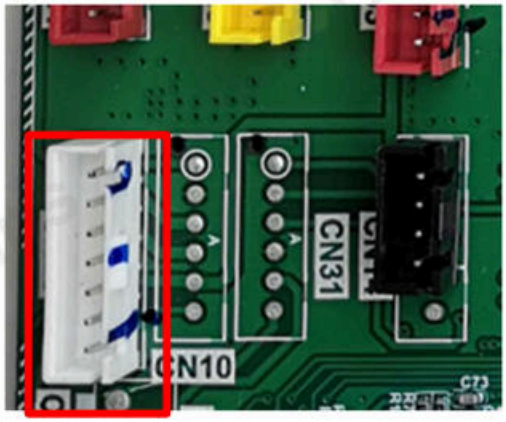


Notes:

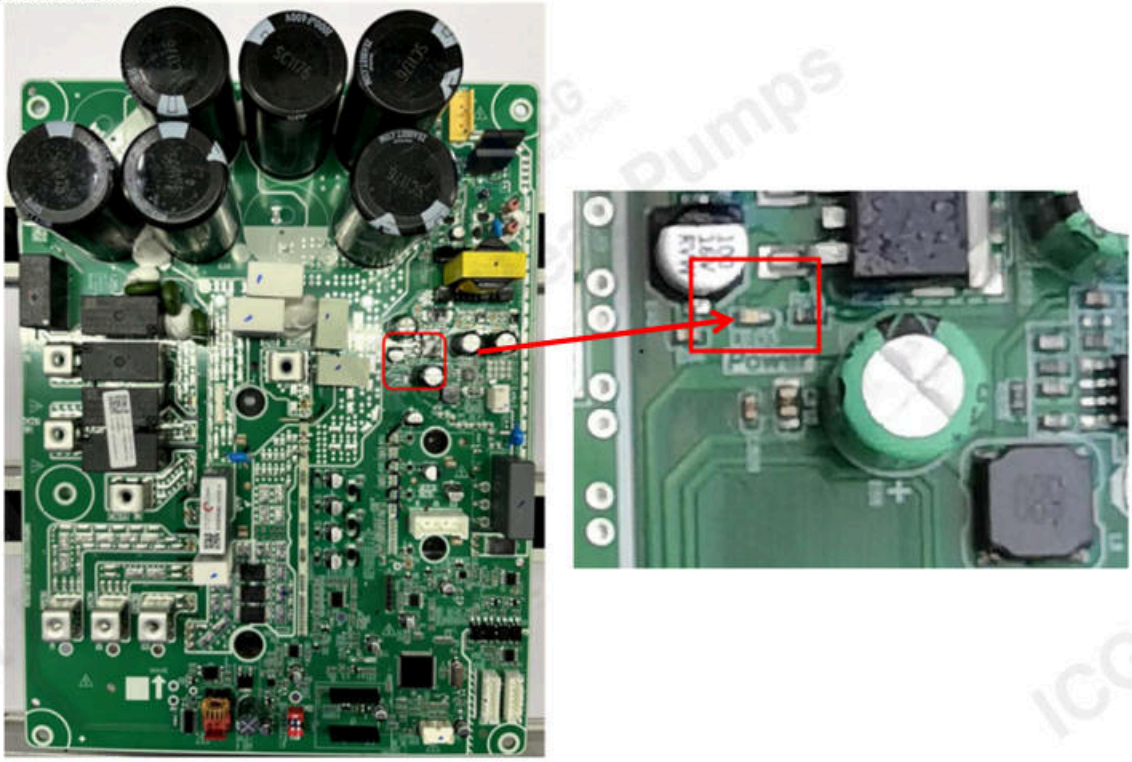
1. Compressor inverter module address is set through dial switch S7 on the inverter module. The compressor inverter module A/B location refers to the wiring diagram.

| Switch | Description | S7-1 | S7-2 |
|---|---|---|---|
| S7   | Compressor inverter module address setting | OFF | OFF |

2. Communication wire from outdoor main PCB CN26 to inverter module CN8/CN9.

| Communication port CN28 on main PCB | Communication port CN8/CN9 on inverter module |
|---|---|
|   |   |

3. LED3 on inverter module



4. Check the wired connection between CN6/CN7/CN8 of filter board and CN7/CN15/CN16 of compressor module board, the normal voltage should be 342-456VAC

## 5.21 H5 Troubleshooting

### 5.21.1 Digital display output

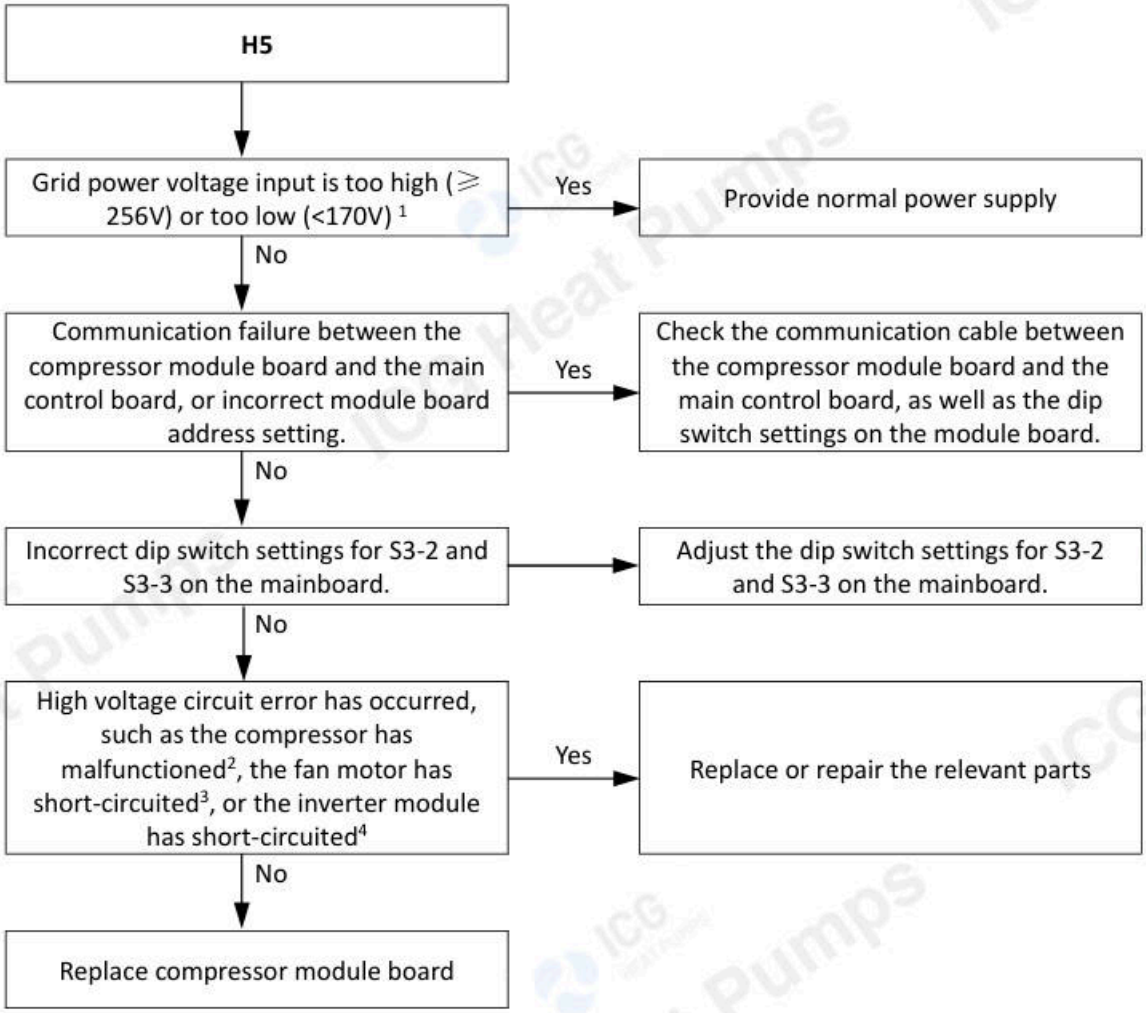

### 5.21.2 Description

- Abnormal power supply voltage.
- All units stop running.
- Error code is only displayed on main PCB and user interface.

### 5.21.3 Possible causes

- Outdoor unit power supply voltage at or above 265V or drops below 170V or a phase is missing.
- Loosened wiring within electric control box.
- High voltage circuit error.
- Incorrect compressor inverter module address setting.
- Main PCB damaged.

### 5.21.4 Procedure



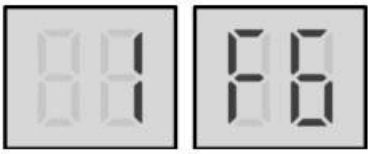

Notes:

1. The voltage is detected by the compressor module board and then sent to the main control board. The main control board determines whether there is a fault based on the voltage value sent by the compressor module board (fault is reported if voltage is ≥256V or <170V).
2. The normal resistances of the inverter compressor is 0.139Ω(at 20℃ ambient temperature) among U V W and infinite between each of U V W and ground. If any of the resistances differ from these specifications, the compressor has malfunctioned.

3. The normal resistances of the fan motor coil among U V W are less than 15Ω. If a measured resistance is 0Ω, the fan motor has short-circuited.
4. Set a multi-meter to buzzer mode and test any two terminals of P N and U V W of the inverter module. If the buzzer sounds, the inverter module has short-circuited. Refer to Part 4, 1 "Outdoor Unit Electric Control Box Layout".

## 5.22 F6 Troubleshooting

### 5.22.1 Digital display output




### 5.22.2 Description

- 1F6 indicates system buss voltage error (PTC)
- Only occurred in standby status.
- Error code is displayed on main PCB and user interface.

### 5.22.3 Possible causes

- Abnormal power supply voltage
- Loosened wiring within electric control box.
- High voltage circuit error.
- AC filter board damaged.
- 3-pahse bridge rectifier damaged.
- Compressor Inverter module damaged.

### 5.22.4 Procedure

Refer to P6 protection troubleshooting: xL1 and xL2.

## 5.23 HE Troubleshooting

### 5.23.1 Digital display output

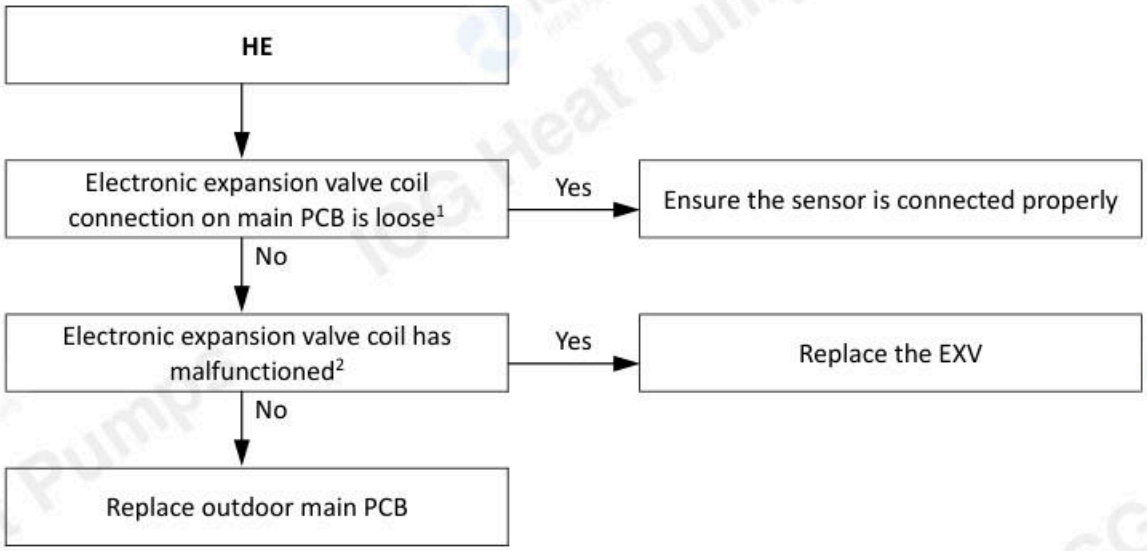

### 5.23.2 Description

- Electronic expansion valve connection error.
- Unit stop running.
- Error code is only displayed on the unit with the error.

### 5.23.3 Possible causes

- Electronic expansion valve coil not connected properly or has malfunctioned.
- Damaged main PCB.

### 5.23.4 Procedure




Notes:

1. Electronic expansion valve coil connections are port CN70, CN71 and CN72 on the main PCB
2. The normal resistances between EXV coil wiring terminals is 40-50Ω. If any of the resistances differ from the value, the EXV coil has malfunctioned.

## 5.24 F2 Troubleshooting

### 5.24.1 Digital display output

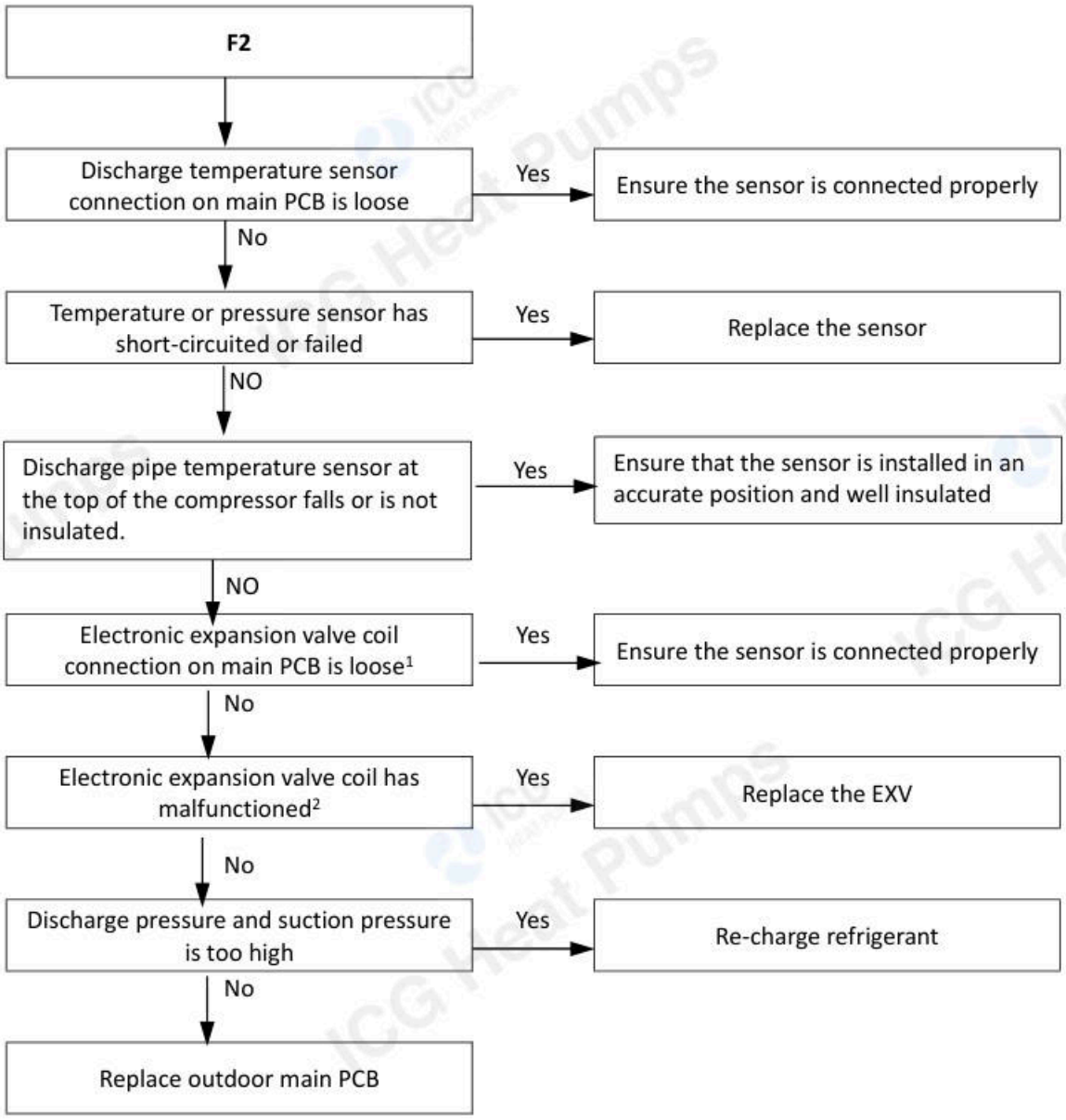

### 5.24.2 Description

- Insufficient protection of exhaust superheat.
- Unit stop running.
- Error code is only displayed on main PCB and user interface.

### 5.24.3 Possible causes

- Discharge pipe temperature sensor connected properly or has malfunctioned.
- Discharge pipe temperature sensor at the top of the compressor falls or is not insulated.
- Electronic expansion valve coil not connected properly or has malfunctioned.
- Excessive refrigerant charge
- Damaged main PCB.

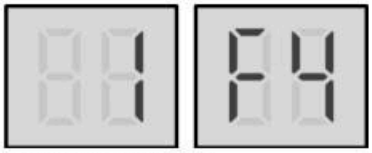
### 5.24.4 Procedure




Notes:
1. Electronic expansion valve coil connections are port CN70, CN71 and CN72 on the main PCB.
2. The normal resistances between EXV coil wiring terminals is 40-50Ω. If any of the resistances differ from the value, the EXV coil has malfunctioned.

## 5.25 F4 Troubleshooting

### 5.25.1 Digital display output



### 5.25.2 Description

- 1F4 module A L10/L11/L12/L20/L30/L34 protection occurs for 3 times in 60 minutes
- When F4 displays, a manual system restart is required before the system can resume operation.

### 5.25.3 Possible causes

- Refer to L10/L11/L12/L20/L30/L34 error troubleshooting.

### 5.25.4 Procedure

- Refer to L10/L11/L12/L20/L30/L34 error troubleshooting.

## 5.26 FP Troubleshooting

### 5.26.1 Digital display output

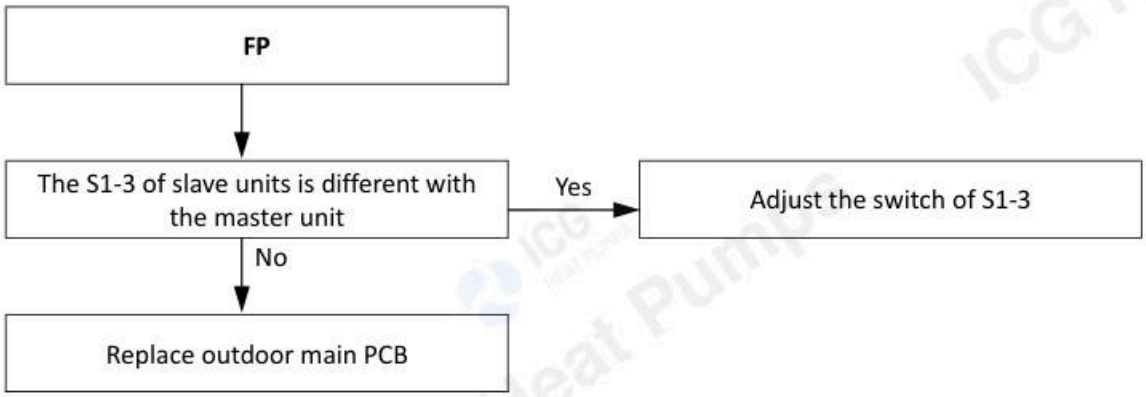

### 5.26.2 Description

- FP indicates pump in a combination system dial to different status. When the FP displayed, a manual system restart is required before the system can resume operation.
- All units stop running.
- Error code is only displayed on main PCB and user interface.

### 5.26.3 Possible causes

- The S1-3 of slave units is different with the master unit.
- Main PCB damaged.

### 5.26.4 Procedure



## 5.27 bH troubleshooting

### 5.27.1 Digital display output

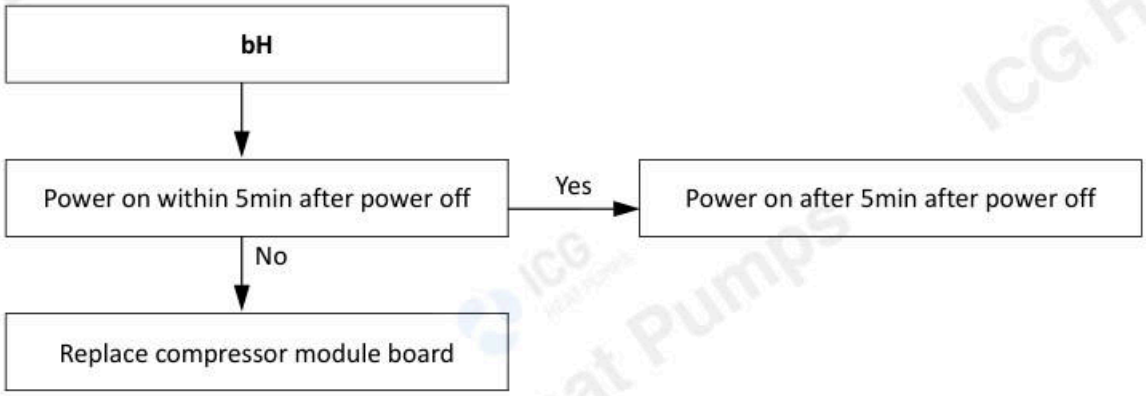

### 5.27.2 Description

- bH indicates adhesion of compressor relay or PED board damaged
- Unit stop running.
- Error code is only displayed on main PCB and user interface.

### 5.27.3 Possible causes

- Power on within 5min after power off
- Compressor module board damaged

### 5.27.4 Procedure



## 5.28 HC troubleshooting

### 5.28.1 Digital display output

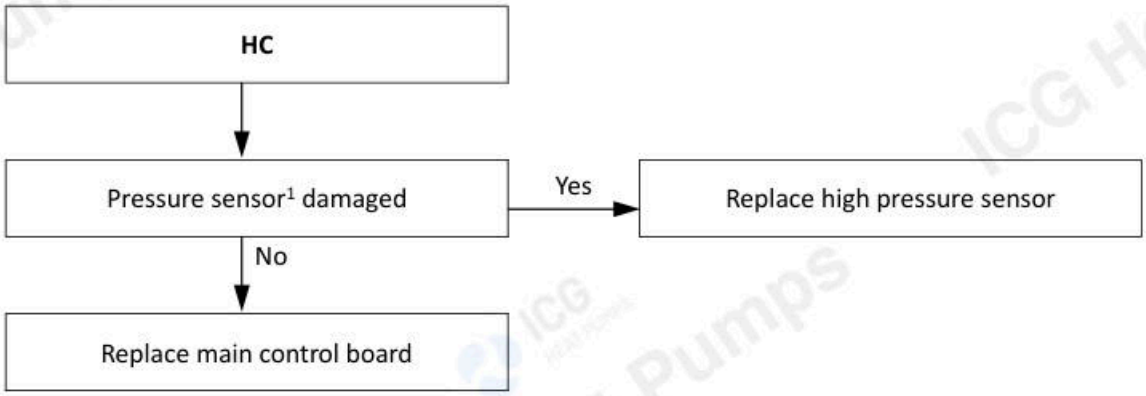

### 5.28.2 Description

- HC indicates high pressure sensor error
- Unit stop running.
- Error code is only displayed on main PCB and user interface.

### 5.28.3 Possible causes

- Pressure sensor damaged
- Main control board damaged

### 5.28.4 Procedure




Note:

1. Pressure sensor connection is port CN40 on the main PCB. Measure the resistance among the three terminals of the pressure sensor. If the resistance is of the order of mega Ohms or infinite, the pressure sensor has failed.

## 5.29 P3 troubleshooting

### 5.29.1 Digital display output

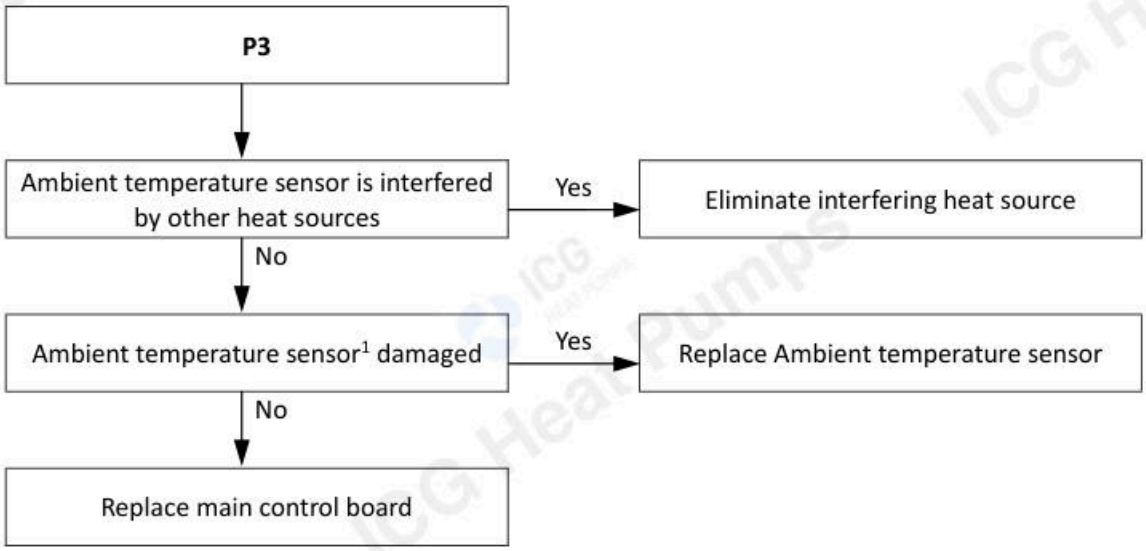

### 5.29.2 Description

- P3 indicates ambient temperature too high for cooling mode
- Unit stop running.
- Error code is only displayed on main PCB and user interface.

### 5.29.3 Possible causes

- Ambient temperature sensor is interfered by other heat sources and the temperature detection value exceeds 65°C
- Ambient temperature sensor damaged
- Main control board damaged

### 5.29.4 Procedure




Note:

1. Ambient temperature sensor connection port is CN30 on the main PCB. Measure sensor resistance. If the resistance is too low, the sensor has short-circuited. If the resistance is not consistent with the sensor's resistance characteristics table, the sensor has failed.

## 5.30 PA troubleshooting

### 5.30.1 Digital display output

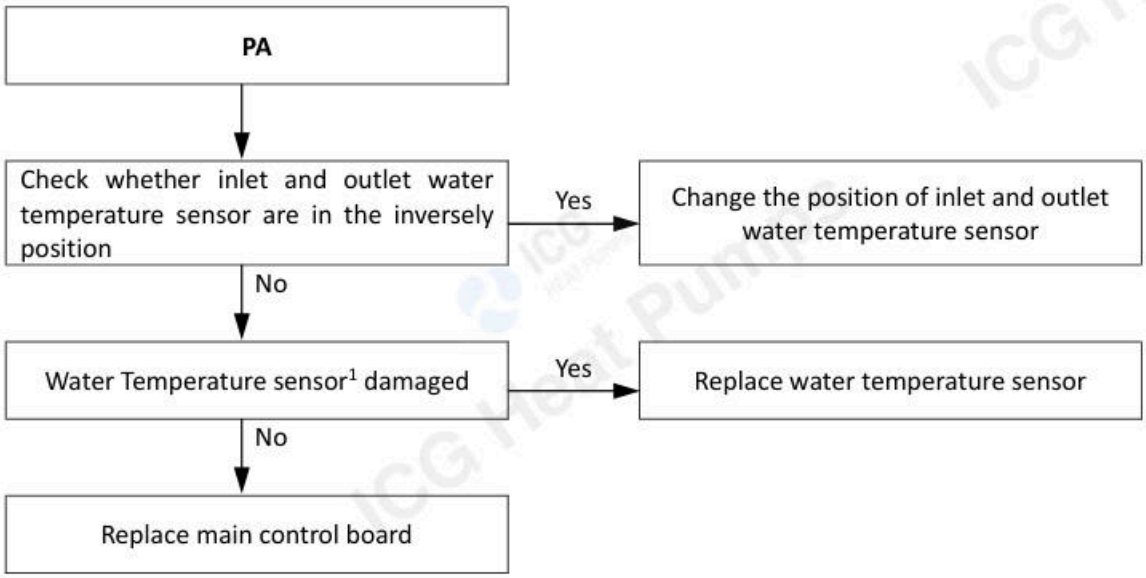

### 5.30.2 Description

- PA indicates abnormal water inlet and outlet temperature difference protection
- Unit stop running.
- Error code is only displayed on main PCB and user interface.

### 5.30.3 Possible causes

- Water temperature sensor damaged
- Inlet and outlet water temperature sensor are in the inversely position
- Water flow is too low
- Main control board damaged

### 5.30.4 Procedure




Note:

1. Inlet and outlet water temperature sensor connection port is CN4 on the main PCB. Measure sensor resistance. If the resistance is too low, the sensor has short-circuited. If the resistance is not consistent with the sensor's resistance characteristics table, the sensor has failed.

# 6 Drive Module Failure

## 6.1 Check code table

| Error Code | Fault Description | Fault Category | Whether to Repower-on |
|---|---|---|---|
| 1L10 | Hardware overcurrent protection | Overcurrent type fault | NO |
| 1L11 | Instantaneous overcurrent protection for phase current | | NO |
| 1L12 | Continuous 30s overcurrent protection for phase current | | NO |
| 1L20 | Module over-temperature protection | Over-temperature type fault | NO |
| 1L30 | Too low busbar voltage fault | Power supply type fault | NO |
| 1L31 | Too high busbar voltage fault | | NO |
| 1L32 | Severely too high busbar voltage fault | | NO |
| 1L34 | Three-phase power input phase loss fault | | NO |
| 1L43 | Abnormal current sampling bias | Hardware type fault | NO |
| 1L45 | Motor code mismatch | | YES |
| 1L46 | IPM protection (FO) | | NO |
| 1L47 | Module model mismatching (after module resistance detection) | | YES |
| 1L50 | Start failure | Control type fault | NO |
| 1L51 | Step-out fault (reserved) | | NO |
| 1L52 | Stalling protection | | NO |
| 1L60 | Motor phase loss protection | Diagnosis type fault | NO |
| 1L65 | IPM short circuit protection | | NO |
| 1L66 | FCT detection fault | | NO |
| 1L6A | IPM U-phase upper tube open circuit | | NO |
| 1L6b | IPM U-phase lower tube open circuit | | NO |
| 1L6C | IPM V-phase upper tube open circuit | | NO |
| 1L6d | IPM V-phase lower tube open circuit | | NO |
| 1L6E | IPM W-phase upper tube open circuit | | NO |
| 1L6F | IPM W-phase lower tube open circuit | | NO |

## 6.2 L10: Hardware Overcurrent

### 6.2.1 Fault description

■ The current exceeds the OCP protection value (peak) set for the hardware or the FO signal is received from the IPM module.

■ After the fault, the compressor stops running. If the fault disappears after one minute, the compressor is started again.

### 6.2.2 Triggering/recovery conditions

(1) The current reaches the OCP protection value:

■ Triggering conditions: The current reaches the OCP protection value.

■ Recovery conditions: The compressor shuts down after the fault occurs, and recovers one minute after the fault exit conditions are met.

■ Reset method: The compressor will recover one minute after the fault exit conditions are met.

(2) The dropping edge or sustained low level of the FO signal is detected:

■ Triggering conditions: The dropping edge or sustained low level of the FO signal is detected.

■ Recovery conditions: The FO signal becomes high level.

■ Reset method: The compressor will recover one minute after the fault exit conditions are met.

### 6.2.3 Possible reasons

■ There are impurities in the refrigerant system or the compressor suddenly gets stuck, causing a surge in current and triggering OCP;

■ Short circuit occurs between the phases in the compressor winding, generating instantaneous high current to trigger OCP or FO;

■ The voltage of the power supply for the system drops or is interrupted for a short time, causing an instantaneous surge in current and triggering OCP;

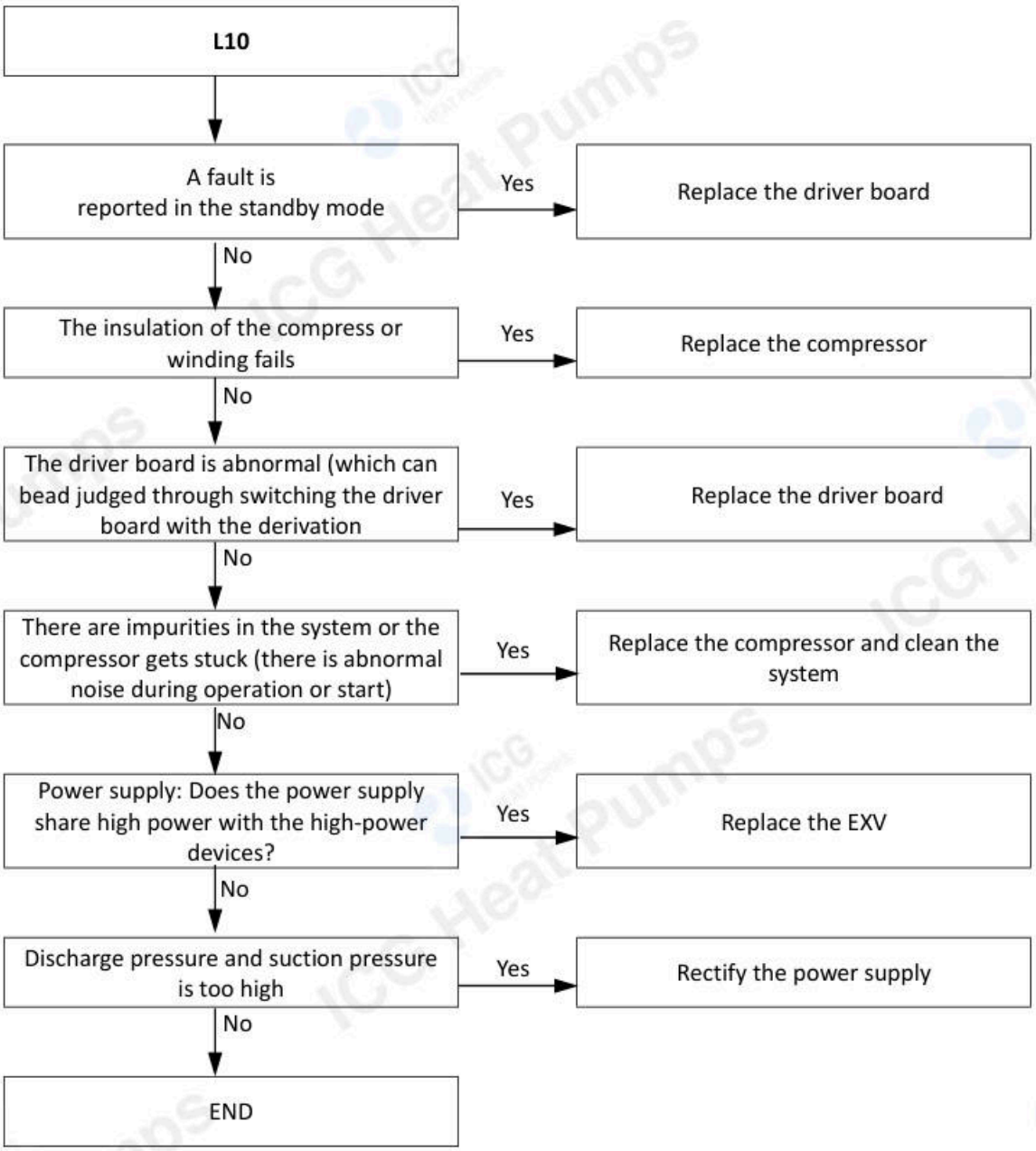
■ Condensation occurs to the IPM module, causing a short circuit between control pins;

■ Fluid returns in the system;

■ When the compressor starts, the rotor has a certain speed (commonly found when a compressor has already started or the master unit has been started, and the refrigerant drives the compressor rotor that is about to start when the four-way valve is reversed);

■ The module board is abnormal (Idc operational amplifier circuit, OCP comparison circuit, PWM circuit, IPM, and IGBT drive power circuit), causing control step-out, generating high current to trigger OCP;

### 6.2.4 Fault handling process



## 6.3 L11: Software Overcurrent

### 6.3.1 Fault description

- The current exceeds the OCP protection value set for the software.
- After the fault, the compressor stops running. If the fault disappears after one minute, the compressor is started again.

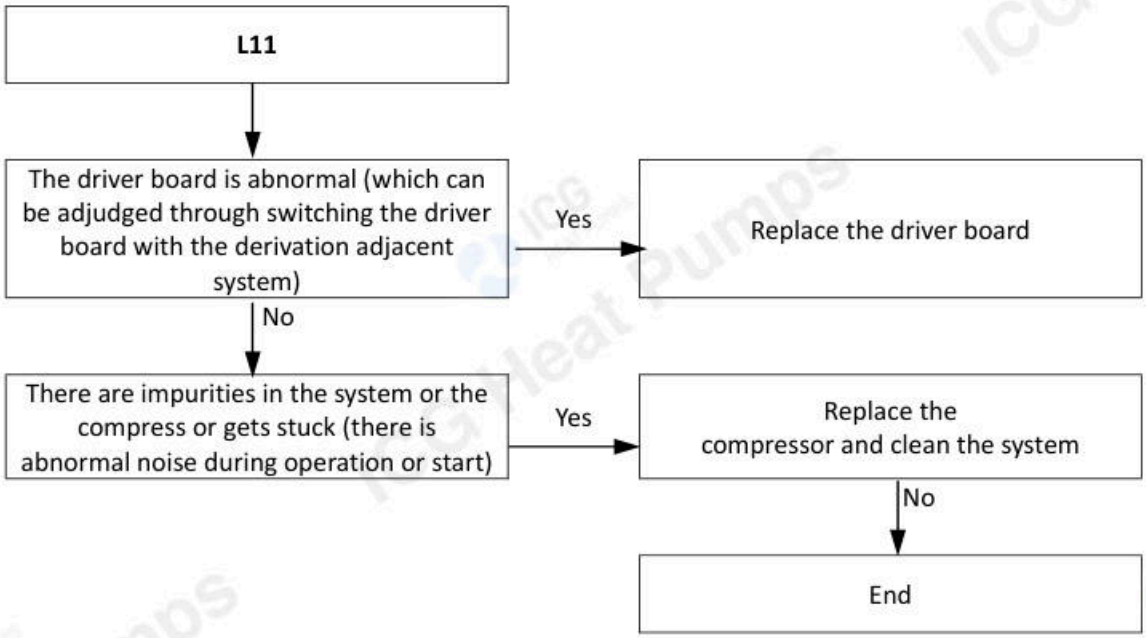
### 6.3.2 Triggering/recovery conditions

- Triggering conditions: The current of the compressor is detected to exceed the OCP protection value set for the software for three consecutive carrier cycles.
- Recovery conditions: The compressor shuts down after the fault occurs, and recovers one minute after the fault exit conditions are met.
- Reset method: The compressor will recover after the fault exit conditions are met.

### 6.3.3 Possible reasons

- There are impurities in the refrigerant system or the compressor suddenly gets stuck;
- The Idc operational amplifier sampling circuit of the module board is abnormal;

### 6.3.4 Fault handling process



## 6.4 L20: Module Over-Temperature Protection

### 6.4.1 Fault description

- The temperature of the IPM module exceeds 100℃.
- After the fault, the compressor stops running. If the fault disappears after one minute, the compressor is started again.

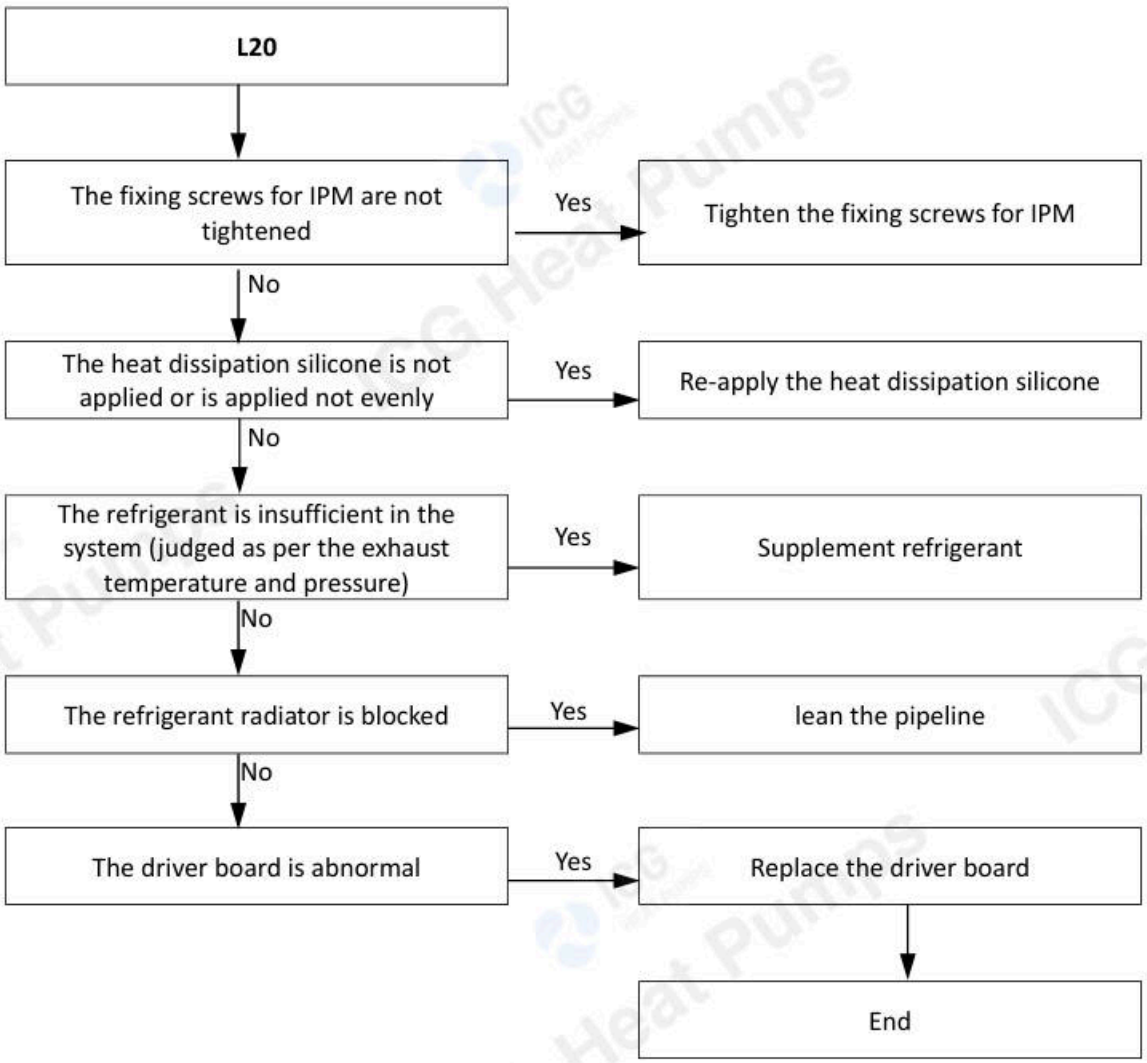
### 6.4.2 Triggering/recovery conditions

- Triggering conditions: The temperature of the IPM module exceeds100℃.
- Recovery conditions: The compressor shuts down after the fault occurs, and recovers one minute after the fault exit conditions are met (the module temperature is less than 100℃).
- Reset method: The compressor will recover after the fault exit conditions are met.

### 6.4.3 Possible reasons

- The fixing screws for IPM are not tightened, resulting in poor heat dissipation;
- The heat dissipation silicone for the IPM module is not evenly applied, resulting in poor heat dissipation;
- The refrigerant is insufficient in the system or the pipeline of the refrigerant radiator is blocked, causing poor heat dissipation of the refrigerant radiator;
- The refrigerant radiator in the system is abnormally welded, causing excessive thermal resistance and poor heat dissipation;
- The IPM temperature detection circuit for the module board is abnormal;

### 6.4.4 Fault handling process



## 6.5 L30: Too Low Busbar Voltage Fault

### 6.5.1 Fault description

■ The voltage of the busbar is lower than the too low voltage protection threshold of the busbar set for the software (350V DC).

■ After the fault, the compressor stops running. If the fault disappears after one minute, the compressor is started again.

### 6.5.2 Triggering/recovery conditions

■ Triggering conditions: The busbar voltage is too low, being lower than the too low busbar voltage protection threshold set for the software.

■ Recovery conditions: The compressor shuts down after the fault occurs, and recovers one minute after the fault exit conditions are met (the voltage of the busbar is higher than the too low voltage protection threshold of the busbar set for the software).

■ Reset method: The compressor will recover after the fault exit conditions are met.

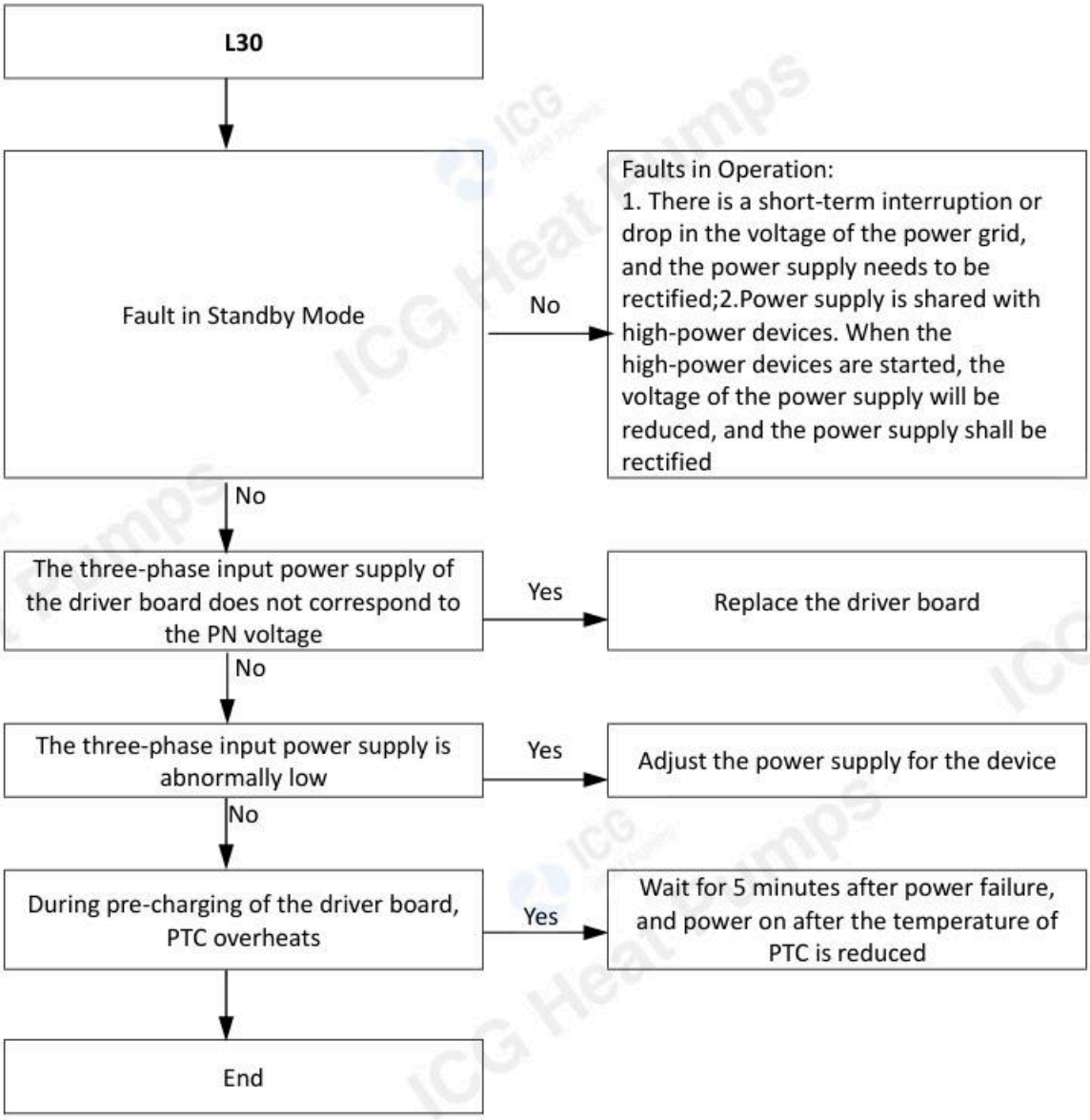
### 6.5.3 Possible reasons

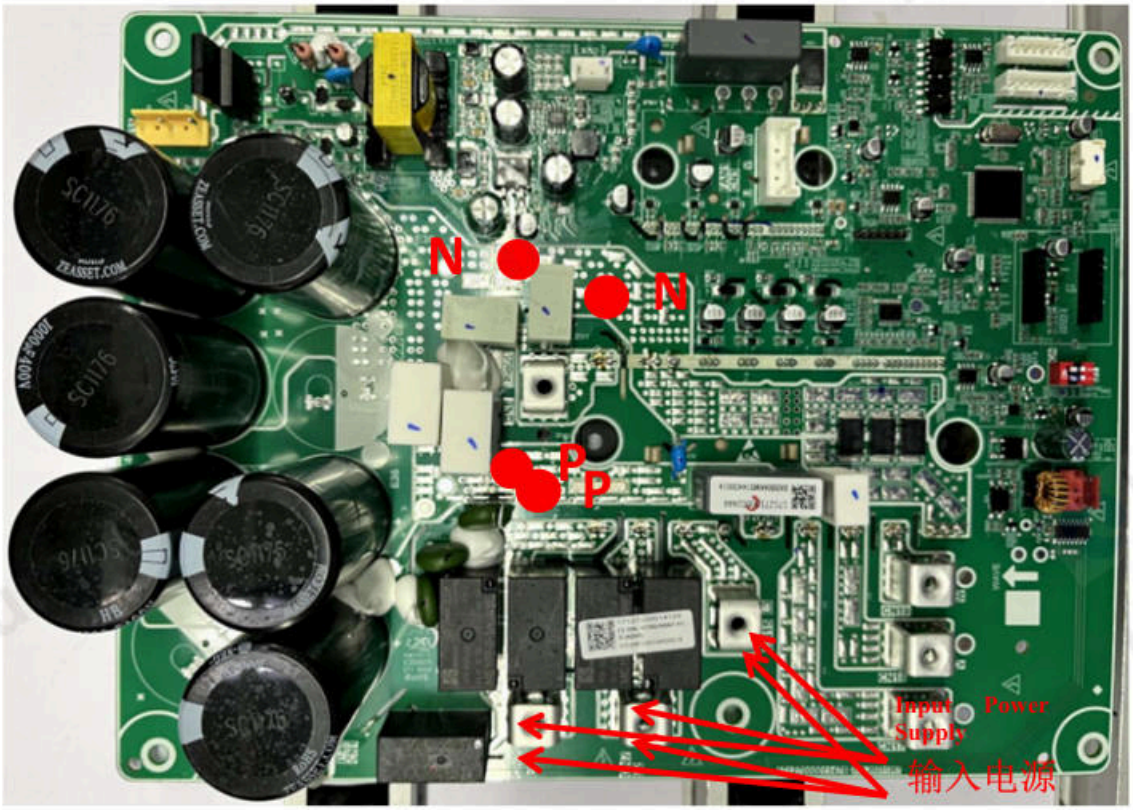
■ The input voltage is too low, causing too low voltage of the busbar;

■ The voltage of the power supply drops or is interrupted for a short time, causing too low instantaneous busbar voltage;

■ The busbar voltage detection circuit of the module board is abnormal;

### 6.5.4 Fault handling process






## 6.6 L31: Too High Busbar Voltage Fault

### 6.6.1 Fault description

■ The voltage of the busbar is higher than the too high voltage protection threshold of the busbar set for the software (800V DC).

■ After the fault, the compressor stops running. If the fault disappears after one minute, the compressor is started again.

### 6.6.2 Triggering/recovery conditions

■ Triggering conditions: The busbar voltage is too high, being higher than the too high busbar voltage protection threshold set for the software.

■ Recovery conditions: The compressor shuts down after the fault occurs, and recovers one minute after the fault exit conditions are met (the voltage of the busbar is lower than the too high voltage protection threshold of the busbar set for the software).

■ Reset method: The compressor will recover after the fault exit conditions are met.

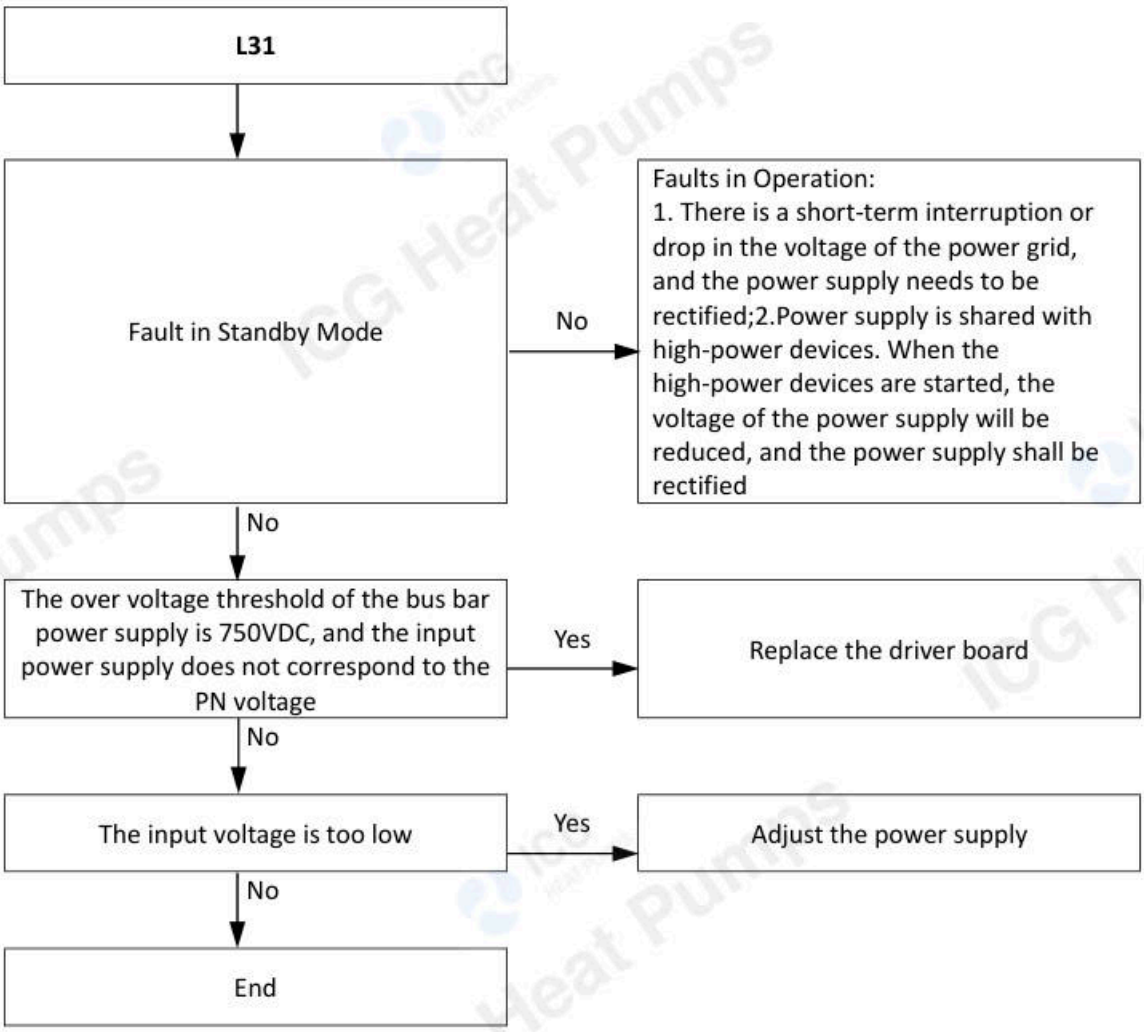
### 6.6.3 Possible reasons

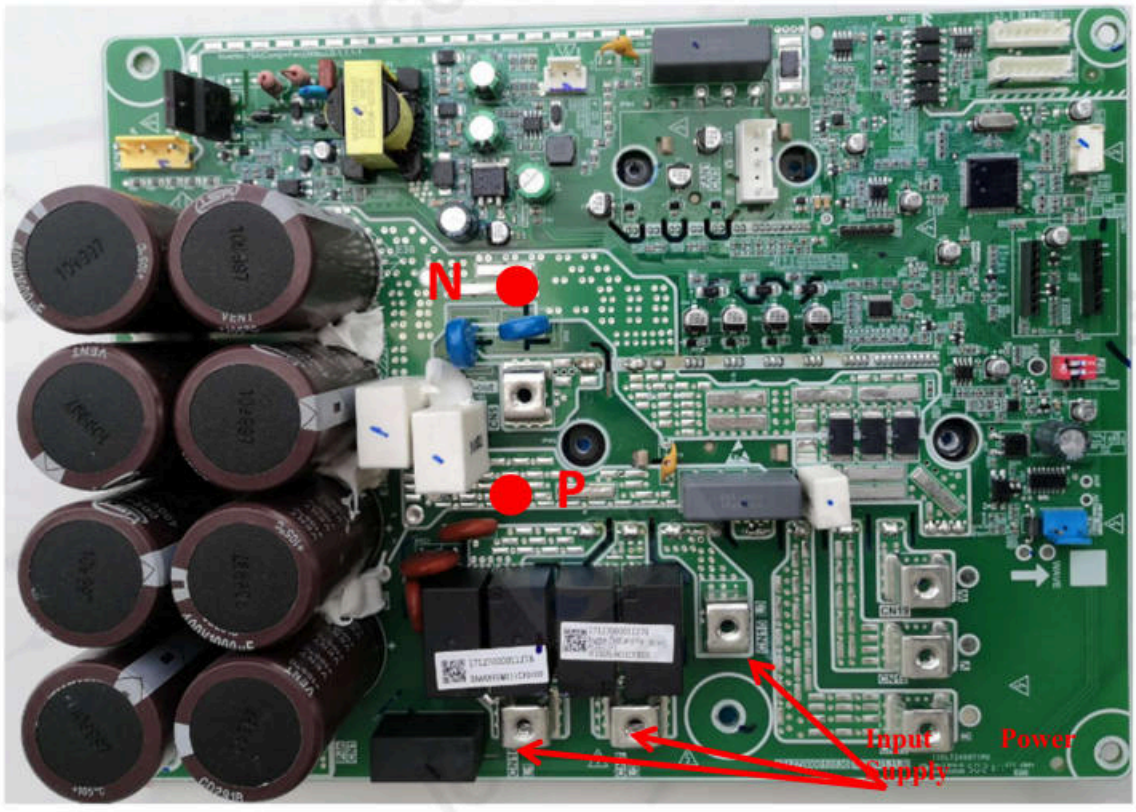
■ The input voltage is too low, causing too low voltage of the busbar;

■ The voltage in the power grid is instantaneously too high abnormally;

■ The busbar voltage detection circuit of the module board is abnormal;

### 6.6.4 Fault handling process



## 6.7 L32: Severely Too High Busbar Voltage Fault

### 6.7.1 Fault description

■ The voltage of the busbar is higher than the severe over-voltage protection threshold of the busbar set for the software (820V).

■ After the fault, the compressor stops running. If the fault disappears after one minute, the compressor is started again.

### 6.7.2 Triggering/recovery conditions

■ Triggering conditions: The busbar voltage is too high, being higher than the severe busbar over-voltage protection threshold set for the software.

■ Recovery conditions: The compressor shuts down after the fault occurs, and recovers one minute after the fault exit conditions are met (the voltage of the busbar is lower than the severe busbar over-voltage protection threshold of the busbar set for the software).

■ Reset method: The compressor will recover after the fault exit conditions are met.

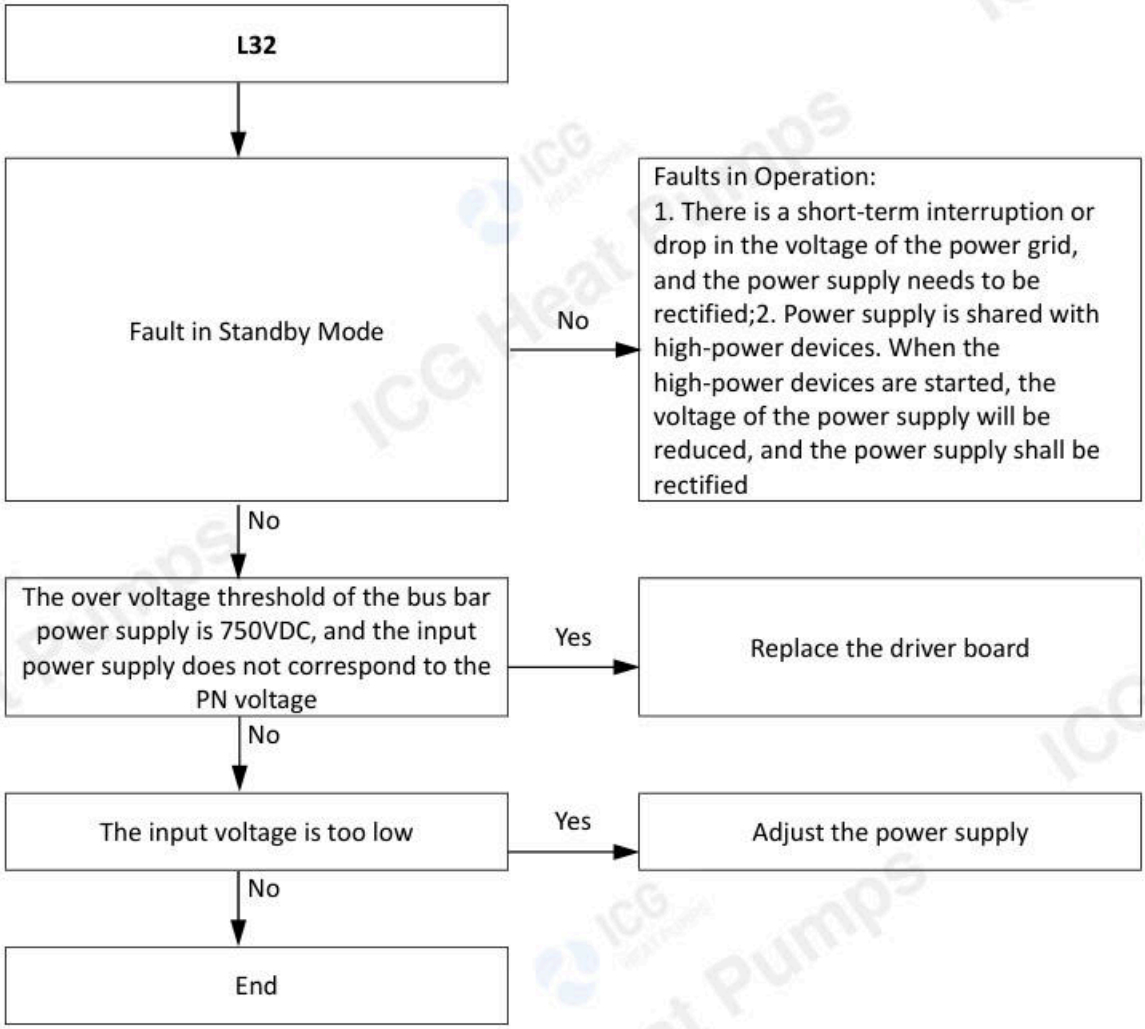
### 6.7.3 Possible reasons

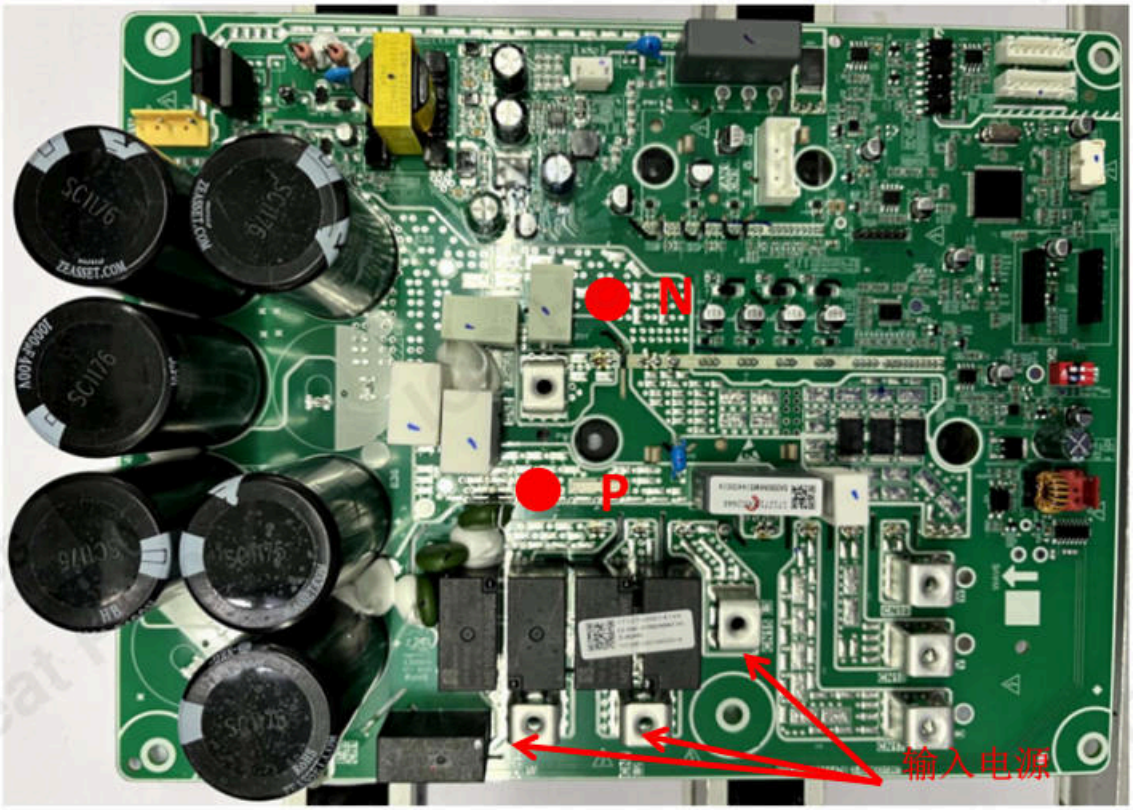
■ The input voltage is too low, causing too low voltage of the busbar;

■ The voltage in the power grid is instantaneously too high abnormally;

■ The busbar voltage detection circuit of the module board is abnormal;

### 6.7.4 Fault handling process






## 6.8 L34: Three-Phase Power Input Phase Loss Fault

### 6.8.1 Fault description

- The power input is out of phase or the three-phase power supply is severely unbalanced.
- After the fault, the compressor stops running. If the fault disappears after one minute, the compressor is started again.

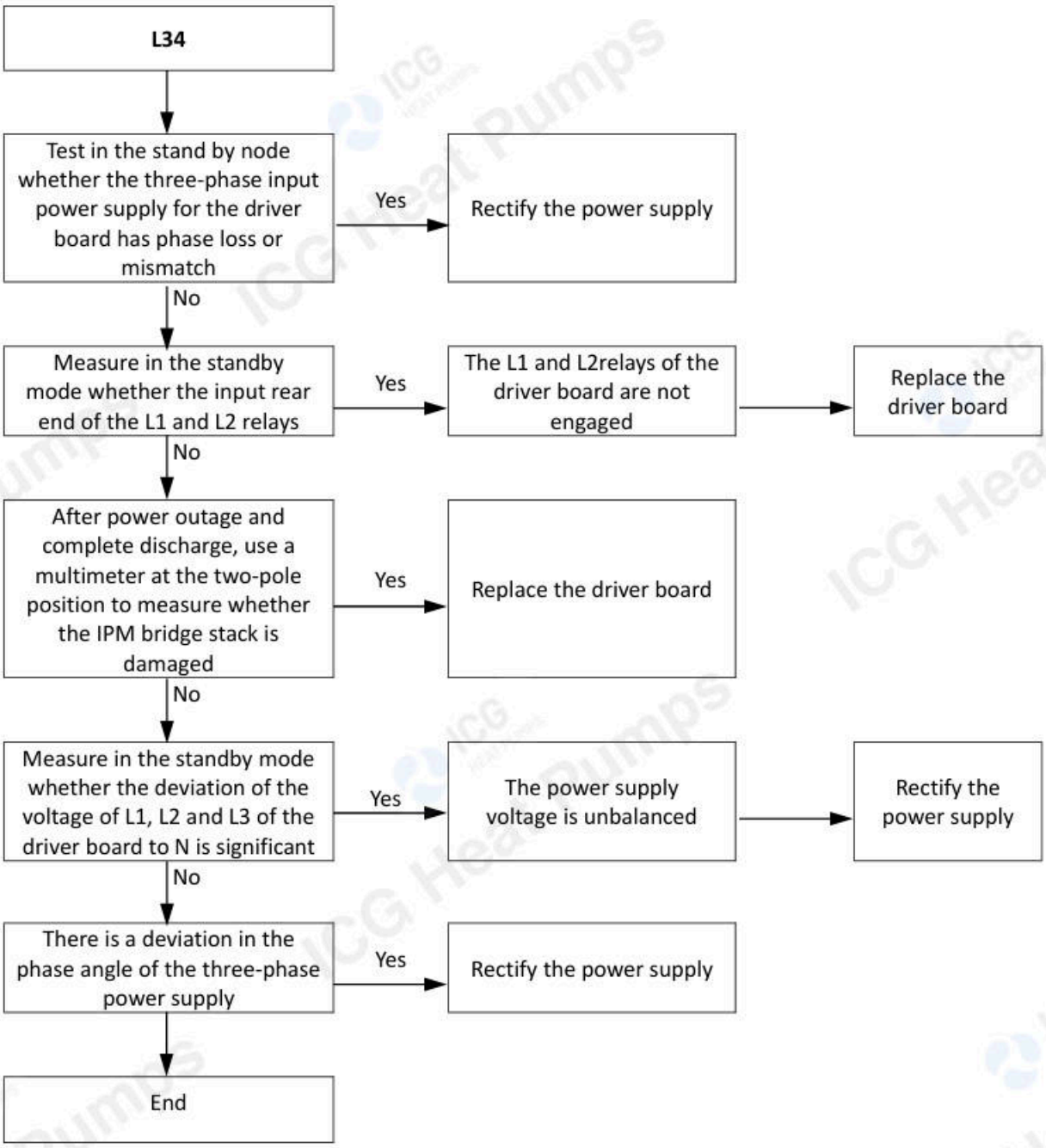
### 6.8.2 Triggering/recovery conditions

- Triggering conditions: The power input is out of phase or the three-phase power supply is severely unbalanced.
- Recovery conditions: The factors that cause phase loss are detected during power outage, such as poor power input wiring or loosened terminal screws, or disconnection of other electrical devices that share power supply with this model.
- Reset method: The compressor will recover after the fault exit conditions are met.

### 6.8.3 Possible reasons

- The wiring of the system power supply is abnormal, causing phase loss, or the N line is connected in reverse with the phase line;
- The wiring of the power line of the system is poor or the screws are not tightened properly;
- The module board is abnormal (one phase relay is not engaged);
- One or two phases of the power supply for the system have high load, resulting in imbalanced power supply voltage;
- The imbalance degree of the power grid distribution phase exceeds 3% (the phase angle is unbalanced, three-phase voltage is unbalanced, or both);

### 6.8.4 Fault handling process



## 6.9 L43: Abnormal Current Sampling Bias

### 6.9.1 Fault description

- The bias calibration of the current sampling circuit has malfunctioned.
- After this fault occurs, the compressor cannot be started, and it is necessary to check if there is a problem with the driver board.

### 6.9.2 Triggering/recovery conditions

- Triggering conditions: The AD bias value of the current sampling circuit is detected to reach half of the full range of AD.
- Recovery conditions: When this fault occurs, the compressor cannot be started and it is necessary to check whether there is a problem with the drive board. After troubleshooting, the current sampling circuit is powered on again and it is detected that the AD bias value is less than half of the full range of the AD, so this fault will not occur again.
- Reset method: The compressor will recover after the fault exit conditions are met.

### 6.9.3 Possible reasons

There is a problem with the sampling circuit of the driver board.

### 6.9.4 Fault handling methods

- Replace the module board

## 6.10 L45: Motor Code Mismatch

### 6.10.1 Fault description

- The parameters do not match.
- After this fault occurs, the compressor cannot be started, and it is necessary to check if there is a problem with the driver board.

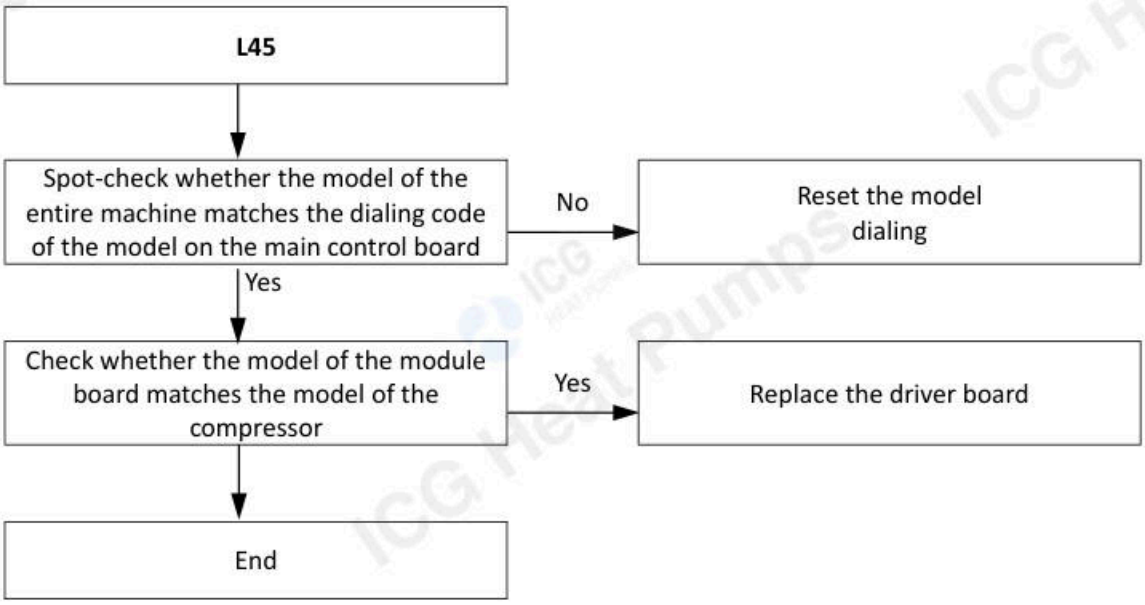
### 6.10.2 Triggering/recovery conditions

- Triggering conditions: The model of the compressor selected by the main controller through communication does not match the driving parameters of the compressor in the driver.
- Recovery conditions: Check whether the model is dialed incorrectly and select the corresponding model dial again.
- Reset method: Reselect the dialing code of the corresponding model and then power off and restart.

### 6.10.3 Possible reasons

- The ability dialing or model dialing setting of the main controller is incorrect;
- The matching model of the module board is incorrectly selected;
- The main board circuit is abnormal or the module board circuit is abnormal;

### 6.10.4 Fault handling process



## 6.11 L46: IPM Protection (FO)

### 6.11.1 Fault description

- The dropping edge or sustained low level of the FO signal of the IPM Module is detected.
- After the fault, the compressor stops running. If the fault disappears after one minute, the compressor is started again.

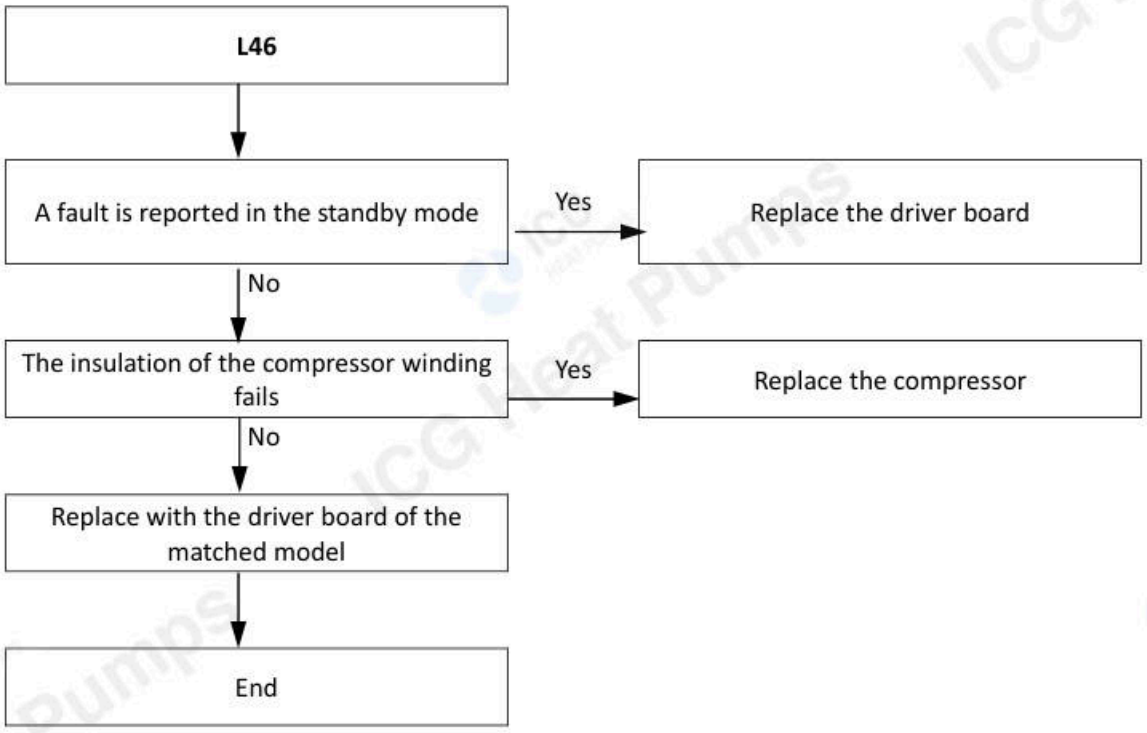
### 6.11.2 Triggering/recovery conditions

- Triggering conditions: The dropping edge or sustained low level of the FO signal of the IPM Module is detected.
- Recovery conditions: The FO signal of the IPM module is recovered to high level
- Reset method: The compressor will recover after the fault exit conditions are met.

### 6.11.3 Possible reasons

- The IPM module is internally short-circuited;
- The compressor winding is short-circuited;
- Condensation occurs to the system, causing a short circuit between the pins of the IPM module;
- The driving voltage of the lower bridge IGBT of the IPM module is lower than 10.3V;
- The module board is abnormal;

### 6.11.4 Fault handling process



## 6.12 L47: Module Type Mismatch

### 6.12.1 Fault description

■ The driver board detected through the detection resistor of the module does not match the settings in the table of driver parameters.

### 6.12.2 Triggering/recovery conditions

■ Triggering conditions: The current level of the driver board detected through the detection resistor of the module and the information of the compressor do not match the settings in the table of driver parameters.

■ Recovery conditions: The module board is incorrectly configured for this model, and the corresponding module board shall be replaced.

■ Reset method: Reselect the module board of the corresponding model and then power off and restart.

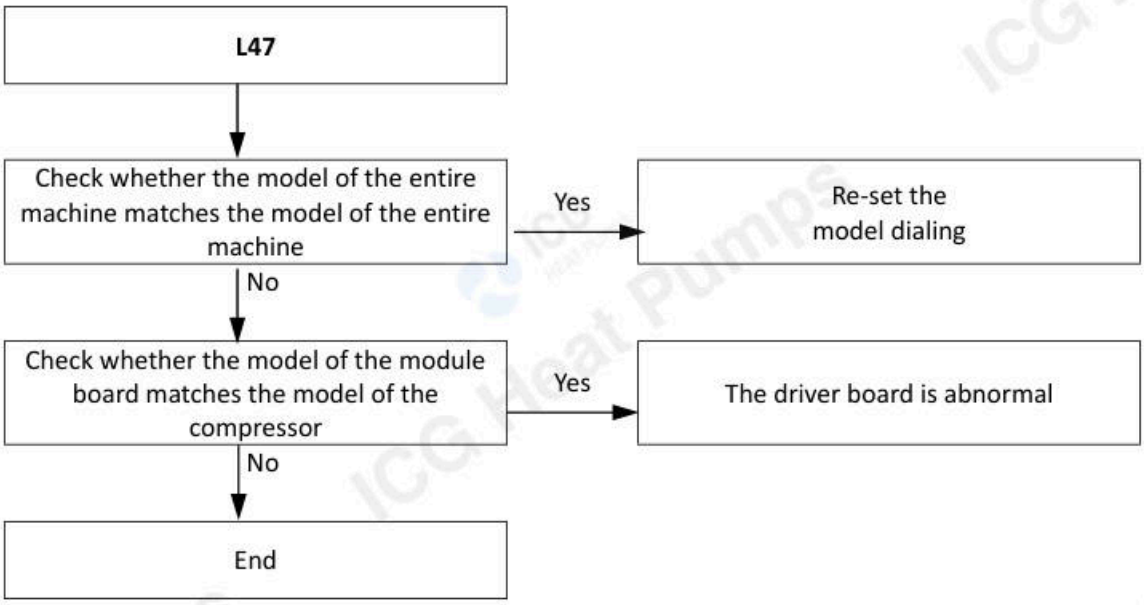
### 6.12.3 Possible reasons

■ The ability dialing or model selection of the main controller is incorrect.

■ The module board that does not match the model is used.

■ The module board is faulty;

### 6.12.4 Fault handling process



## 6.13 L50: Start Failure

### 6.13.1 Fault description

- The compressor fails to start.
- After the fault, the compressor stops running. If the fault disappears after one minute, the compressor is started again.

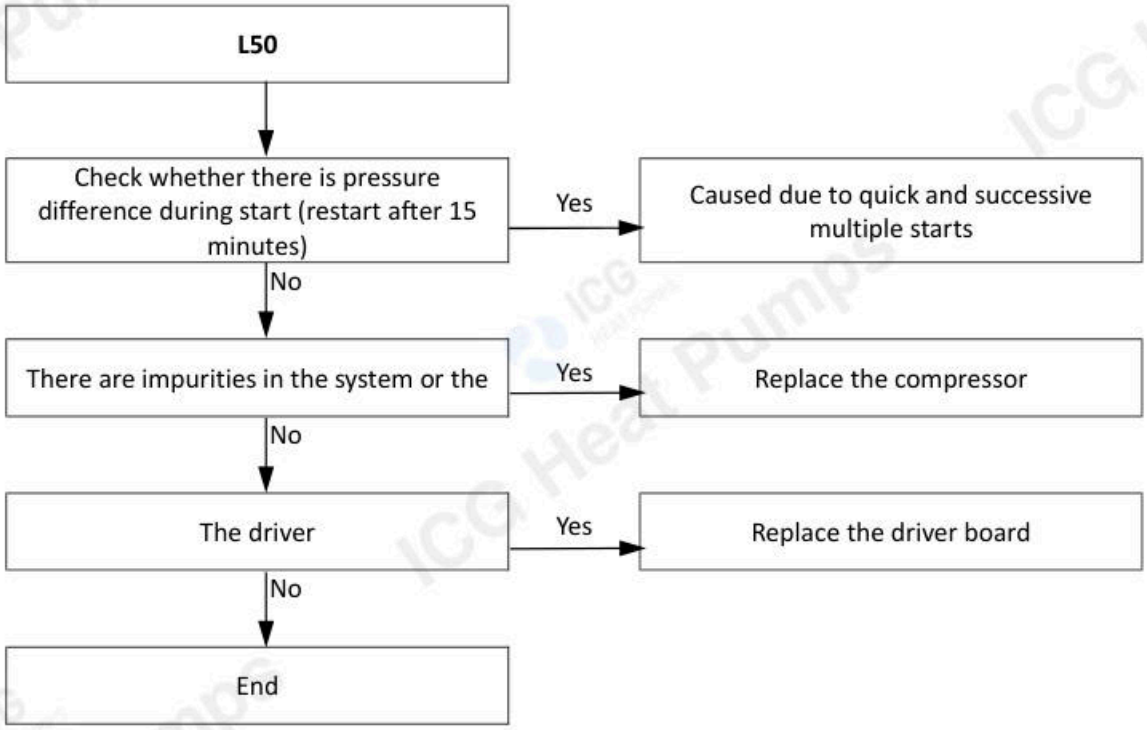
### 6.13.2 Triggering/recovery conditions

- Triggering conditions: The compressor fails to start.
- Recovery conditions: After the compressor fails to start, the compressor is restarted again. If the fault disappears after one minute, the fault is resolved after the compressor is successfully restarted.
- Reset method: After the compressor fails to start, the fault will automatically resolve after a successful restart.

### 6.13.3 Possible reasons

- There is a pressure difference during system start;
- The compressor gets stuck;

### 6.13.4 Fault handling process



## 6.14 L52: Stalling Protection

### 6.14.1 Fault description

- The compressor is stuck.
- After the fault, the compressor stops running. If the fault disappears after one minute, the compressor is started again.

### 6.14.2 Triggering/recovery conditions

- Triggering conditions: The compressor is stuck.
- Recovery conditions: The stalling fault is solved.
- Reset method: The compressor will recover after the fault exit conditions are met.

### 6.14.3 Possible reasons

- There are impurities in the system, causing that the compressor gets stuck.

### 6.14.4 Fault handling methods

If possible, the compressors are switched to start. If the problem persists, the dual compressor is replaced;

## 6.15 L60: Motor Phase Loss Protection

### 6.15.1 Fault description

- The phase loss protection occurs to the compressor.
- After the fault, the compressor stops running. If the fault disappears after one minute, the compressor is started again.

### 6.15.2 Triggering/recovery conditions

- Triggering conditions: The compressor is not wired or wiring contact is poor.
- Recovery conditions: The wiring of the compressor is checked. If the wiring is in good condition, the phase loss protection fault is eliminated and the fault is resolved.
- Reset method: The compressor will recover after the fault exit conditions are met.

### 6.15.3 Possible reasons

- The wiring of the compressor is poor or the terminal screws are not tightened properly.
- The module board is abnormal;

### 6.15.4 Fault handling process

① Check the UVW output connection line of the driver board of the compressor and the UVW wiring of the compressor;
② If possible, the lines of the compressors are switched, to confirm if the driver board is working properly, otherwise the drive board shall be replaced.

## 6.16 L61: Short-Circuit-to-Ground Protection

### 6.16.1 Fault description

- The short-circuit-to-ground protection occurs to the compressor.
- After the fault, the compressor stops running. If the fault disappears after one minute, the compressor is started again.

### 6.16.2 Triggering/recovery conditions

- Triggering conditions: The short-circuit-to-ground protection occurs to the compressor.
- Recovery conditions: Check if the compressor casing is damaged, resulting in poor insulation
- Reset method: The compressor will recover after the fault exit conditions are met.

### 6.16.3 Possible reasons

- The insulation of the compressor casing is poor.

### 6.16.4 Fault handling process

(1) Remove the compressor line, measure the ground resistance of the compressor UVW, confirm and replace the compressor.

## 6.17 L65: IPM Short Circuit Protection

### 6.17.1 Fault description

- Short circuit protection occurs to IPM corresponding to the compressor.
- After the fault, the compressor stops running. If the fault disappears after one minute, the compressor is started again.

### 6.17.2 Triggering/recovery conditions

- Triggering conditions: Short circuit protection occurs to IPM corresponding to the compressor.
- Recovery conditions: Replace the driver module without any issues.
- Reset method: The compressor will recover after the fault exit conditions are met.

### 6.17.3 Possible reasons

- The driver board is faulty and needs to be replaced.

### 6.17.4 Fault handling process

① Check whether there is false welding of IPM, and whether the PWM related transmission circuits of MCU are welded;

## 6.18 L6b: IPM U-Phase Lower Tube Open Circuit

### 6.18.1 Fault description

- Open circuit occurs to the U-Phase lower tube of IPM.
- After the fault, the compressor stops running. If the fault disappears after one minute, the compressor is started again.

### 6.18.2 Triggering/recovery conditions

- Triggering conditions: Open circuit occurs to the U-Phase lower tube of IPM corresponding to the compressor.
- Recovery conditions: Check whether the IPM module is normal
- Reset method: Replace the module board, re-power on and start.

### 6.18.3 Possible reasons

- The IPM module is damaged, and the driver board needs to be replaced.

### 6.18.4 Fault handling process

③ Check whether there is false welding of IPM, and whether the PWM related transmission circuits of MCU are welded;

## 6.19 L6C: IPM V-Phase Upper Tube Open Circuit

### 6.19.1 Fault description

- Open circuit occurs to the IPM V-Phase upper tube.
- After the fault, the compressor stops running. If the fault disappears after one minute, the compressor is started again.

### 6.19.2 Triggering/recovery conditions

- Triggering conditions: Open circuit occurs to the V-Phase upper tube of IPM corresponding to the compressor.
- Recovery conditions: Check whether the IPM module is normal
- Reset method: Replace the module board, re-power on and start.

### 6.19.3 Possible reasons

- The IPM module is damaged, and the driver board needs to be replaced.

### 6.19.4 Fault handling process

④ Check whether there is false welding of IPM, and whether the PWM related transmission circuits of MCU are welded;

## 6.20 L6d: IPM V-Phase Lower Tube Open Circuit

## 6.21 Fault description

- Open circuit occurs to the U-Phase lower tube of IPM.
- After the fault, the compressor stops running. If the fault disappears after one minute, the compressor is started again.

### 6.21.1 Triggering/recovery conditions

- Triggering conditions: Open circuit occurs to the U-Phase lower tube of IPM corresponding to the compressor.
- Recovery conditions: Check whether the IPM module is normal
- Reset method: Replace the module board, re-power on and start.

### 6.21.2 Possible reasons

- The IPM module is damaged, and the driver board needs to be replaced.

### 6.21.3 Fault handling process

⑤ Check whether there is false welding of IPM, and whether the PWM related transmission circuits of MCU are welded;

## 6.22 L6E: IPM W-Phase Upper Tube Open Circuit

### 6.22.1 Fault description

- Open circuit occurs to the IPM W-Phase upper tube.
- After the fault, the compressor stops running. If the fault disappears after one minute, the compressor is started again.

### 6.22.2 Triggering/recovery conditions

- Triggering conditions: Open circuit occurs to the W-Phase upper tube of IPM corresponding to the compressor.
- Recovery conditions: Check whether the IPM module is normal
- Reset method: Replace the module board, re-power on and start.

### 6.22.3 Possible reasons

- The IPM module is damaged, and the driver board needs to be replaced.

### 6.22.4 Fault handling process

⑥ Check whether there is false welding of IPM, and whether the PWM related transmission circuits of MCU are welded;

## 6.23 L6F: IPM W-Phase Lower Tube Open Circuit

### 6.23.1 Fault description

- Open circuit occurs to the IPM W-Phase lower tube.
- After the fault, the compressor stops running. If the fault disappears after one minute, the compressor is started again.

### 6.23.2 Triggering/recovery conditions

- Triggering conditions: Open circuit occurs to the W-Phase lower tube of IPM corresponding to the compressor.
- Recovery conditions: Check whether the IPM module is normal
- Reset method: Replace the module board, re-power on and start.

### 6.23.3 Possible reasons

- The IPM module is damaged, and the driver board needs to be replaced.

### 6.23.4 Fault handling process

Check whether there is false welding of IPM, and whether the PWM related transmission circuits of MCU are welded;

## 7 Compressor replacement procedure

**Step 1: Remove faulty compressor and remove oil**

- Remove the faulty compressor from the outdoor unit.
- Before removing the oil, shake the compressor so as to not allow impurities to remain settled at the bottom.
- Drain the oil out of the compressor and retain it for inspection. Normally the oil can be drained out from the compressor discharge pipe.

**Step 2: Inspect oil from faulty compressor**

- The oil should be clear and transparent. Slightly yellow oil is not an indication of any problems. However, if the oil is dark, black or contains impurities, the system has problems and the oil needs to be changed. Refer to Figure 4-4.20 for further details regarding inspecting compressor oil. (If the compressor oil has been spoiled, the compressor will not be being lubricated effectively. The scroll plate, crankshaft and bearings will wear. Abrasion will lead to a larger load and higher current. More electric energy will get dissipated as heat and the temperature of the motor will become increasingly high. Finally, compressor damage or burnout will result.)

**Step 3: Check oil in other compressors in the system**

- If the oil drained from the faulty compressor is clean, go to Step 6.
- If the oil drained from the faulty compressor is only lightly spoiled, go to Step 4.
- If the oil drained from the faulty compressor is heavily spoiled, check the oil in the other compressors in the system. Drain the oil from any compressors where the oil has been spoiled. Go to Step 4.

**Step 4: Replace oil separator(s) and accumulator(s)**

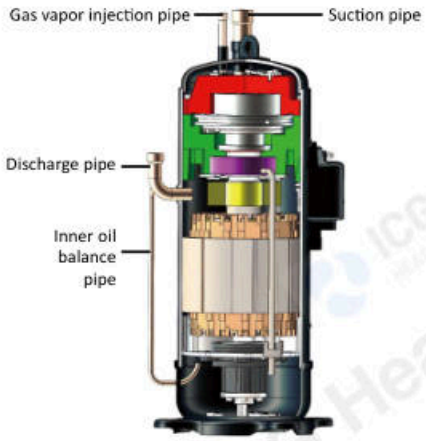
- If the oil from a compressor is spoiled (lightly or heavily), drain the oil from the oil separator and accumulator in that unit and then replace them.

**Step 5: Check filters(s)**

- If the oil from a compressor is spoiled (lightly or heavily), check the filter between the gas stop valve and the 4-way valve in that unit. If it is blocked, clean with nitrogen or replace.

**Step 6: Replace the faulty compressor and re-fit the other compressors**

- Replace the faulty compressor.
- If the oil had been spoiled and was drained from the non-faulty compressors in Step 3, use clean oil to clean them before re-fitting them into the units. To clean, add oil into the compressor through the discharge pipe using a funnel, shake the compressor, and then drain the oil. Repeat several times and then re-fit the compressors into the units. (The discharge pipe is connected to the oil pool of the compressor by the inner oil balance pipe.)




**Step 7: Add compressor oil**

- Only use FW68H oil. Different compressors require different types of oil. Using the wrong type of oil leads to various problems.
- The original system contains 6.2L oil. Each compressor contains 1.1L and 4L are added in the factory. The principle during changing compressor is to keep the system oil amount is the same as original state.

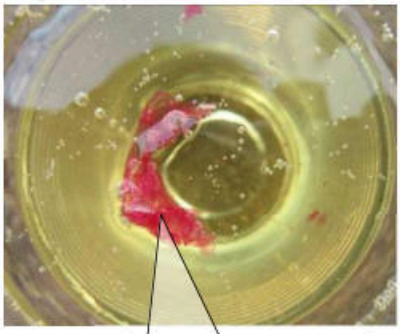
**Step 8: Vacuum drying and refrigerant charging**

- Once all the compressors and other components have been fully connected, vacuum dry the system and recharge refrigerant.

## Inspecting compressor oil

This oil is black - it has been carbonized

This oil is a little yellow, but is clear and transparent and the condition is acceptable



This oil is still transparent but there are impurities which may clog the filter

Cloudy or gray oil indicates abnormal system operation

This oil contains particles of copper

## Effects of spoiled compressor oil

Worn crankshaft

Filter blocked by impurities, which leads to abnormal compressor suction

Worn scroll plate

Worn scroll plate

Normal compressor bearings

Seriously worn and damaged bearings

# 8 Appendix

## 8.1 Temperature Sensor Resistance Characteristics

**Resistance table of exhaust temperature sensor -- 3950K(25-50) 5K(R90) 3% (with deviation)**

Contains: TP1/TP2 exhaust temperature sensor

R90=5KΩ±3%，B25/50=3950K±3%

| Temp | Resistance (KΩ) | | | Resist. tol (%) | | Temp. tol (℃) | |
|---|---|---|---|---|---|---|---|
| (℃) | Rmax | R (t) Normal | Rmin | MAX (+) | MIN (-) | MAX (+) | MIN (-) |
| -30.0 | 1093.521 | 907.487 | 721.452 | 20.50 | 20.50 | 3.44 | 3.44 |
| -29.0 | 1031.137 | 856.752 | 682.368 | 20.35 | 20.35 | 3.44 | 3.44 |
| -28.0 | 972.588 | 809.086 | 645.583 | 20.21 | 20.21 | 3.43 | 3.43 |
| -27.0 | 917.615 | 764.281 | 610.947 | 20.06 | 20.06 | 3.42 | 3.42 |
| -26.0 | 865.981 | 722.152 | 578.323 | 19.92 | 19.92 | 3.41 | 3.41 |
| -25.0 | 817.469 | 682.528 | 547.586 | 19.77 | 19.77 | 3.41 | 3.41 |
| -24.0 | 771.875 | 645.245 | 518.616 | 19.63 | 19.63 | 3.40 | 3.40 |
| -23.0 | 729.009 | 610.156 | 491.303 | 19.48 | 19.48 | 3.39 | 3.39 |
| -22.0 | 688.698 | 577.121 | 465.544 | 19.33 | 19.33 | 3.38 | 3.38 |
| -21.0 | 650.778 | 546.012 | 441.246 | 19.19 | 19.19 | 3.37 | 3.37 |
| -20.0 | 615.097 | 516.708 | 418.318 | 19.04 | 19.04 | 3.36 | 3.36 |
| -19.0 | 581.515 | 489.096 | 396.678 | 18.90 | 18.90 | 3.35 | 3.35 |
| -18.0 | 549.899 | 463.073 | 376.247 | 18.75 | 18.75 | 3.34 | 3.34 |
| -17.0 | 520.129 | 438.542 | 356.955 | 18.60 | 18.60 | 3.33 | 3.33 |
| -16.0 | 492.089 | 415.411 | 338.733 | 18.46 | 18.46 | 3.31 | 3.31 |
| -15.0 | 465.672 | 393.595 | 321.518 | 18.31 | 18.31 | 3.30 | 3.30 |
| -14.0 | 440.779 | 373.014 | 305.250 | 18.17 | 18.17 | 3.29 | 3.29 |
| -13.0 | 417.316 | 353.595 | 289.874 | 18.02 | 18.02 | 3.28 | 3.28 |
| -12.0 | 395.197 | 335.268 | 275.339 | 17.88 | 17.88 | 3.27 | 3.27 |
| -11.0 | 374.340 | 317.967 | 261.594 | 17.73 | 17.73 | 3.26 | 3.26 |
| -10.0 | 354.669 | 301.632 | 248.595 | 17.58 | 17.58 | 3.25 | 3.25 |
| -9.0 | 336.113 | 286.206 | 236.298 | 17.44 | 17.44 | 3.24 | 3.24 |
| -8.0 | 318.604 | 271.634 | 224.664 | 17.29 | 17.29 | 3.22 | 3.22 |
| -7.0 | 302.080 | 257.867 | 213.653 | 17.15 | 17.15 | 3.21 | 3.21 |
| -6.0 | 286.483 | 244.857 | 203.232 | 17.00 | 17.00 | 3.20 | 3.20 |
| -5.0 | 271.757 | 232.561 | 193.365 | 16.85 | 16.85 | 3.19 | 3.19 |
| -4.0 | 257.852 | 220.937 | 184.022 | 16.71 | 16.71 | 3.18 | 3.18 |
| -3.0 | 244.717 | 209.945 | 175.173 | 16.56 | 16.56 | 3.16 | 3.16 |
| -2.0 | 232.309 | 199.550 | 166.790 | 16.42 | 16.42 | 3.15 | 3.15 |
| -1.0 | 220.585 | 189.716 | 158.848 | 16.27 | 16.27 | 3.14 | 3.14 |
| 0.0 | 209.504 | 180.412 | 151.321 | 16.13 | 16.13 | 3.13 | 3.13 |
| 1.0 | 199.029 | 171.607 | 144.186 | 15.98 | 15.98 | 3.11 | 3.11 |
| 2.0 | 189.125 | 163.273 | 137.422 | 15.83 | 15.83 | 3.10 | 3.10 |
| 3.0 | 179.759 | 155.383 | 131.007 | 15.69 | 15.69 | 3.09 | 3.09 |
| 4.0 | 170.899 | 147.911 | 124.923 | 15.54 | 15.54 | 3.08 | 3.08 |
| 5.0 | 162.517 | 140.835 | 119.152 | 15.40 | 15.40 | 3.06 | 3.06 |
| 6.0 | 154.585 | 134.130 | 113.675 | 15.25 | 15.25 | 3.05 | 3.05 |
| 7.0 | 147.077 | 127.778 | 108.478 | 15.10 | 15.10 | 3.04 | 3.04 |
| 8.0 | 139.970 | 121.757 | 103.544 | 14.96 | 14.96 | 3.02 | 3.02 |
| 9.0 | 133.239 | 116.049 | 98.859 | 14.81 | 14.81 | 3.01 | 3.01 |
| 10.0 | 126.864 | 110.638 | 94.411 | 14.67 | 14.67 | 3.00 | 3.00 |
| 11.0 | 120.825 | 105.505 | 90.185 | 14.52 | 14.52 | 2.98 | 2.98 |
| 12.0 | 115.103 | 100.636 | 86.170 | 14.38 | 14.38 | 2.97 | 2.97 |
| 13.0 | 109.679 | 96.017 | 82.354 | 14.23 | 14.23 | 2.96 | 2.96 |
| 14.0 | 104.537 | 91.633 | 78.728 | 14.08 | 14.08 | 2.94 | 2.94 |
| 15.0 | 99.662 | 87.471 | 75.280 | 13.94 | 13.94 | 2.93 | 2.93 |
| 16.0 | 95.038 | 83.520 | 72.001 | 13.79 | 13.79 | 2.92 | 2.92 |
| 17.0 | 90.652 | 79.767 | 68.882 | 13.65 | 13.65 | 2.90 | 2.90 |
| 18.0 | 86.489 | 76.202 | 65.915 | 13.50 | 13.50 | 2.89 | 2.89 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 19.0 | 82.539 | 72.815 | 63.091 | 13.35 | 13.35 | 2.87 | 2.87 |
| 20.0 | 78.789 | 69.596 | 60.404 | 13.21 | 13.21 | 2.86 | 2.86 |
| 21.0 | 75.228 | 66.537 | 57.845 | 13.06 | 13.06 | 2.84 | 2.84 |
| 22.0 | 71.846 | 63.627 | 55.409 | 12.92 | 12.92 | 2.82 | 2.82 |
| 23.0 | 68.633 | 60.860 | 53.088 | 12.77 | 12.77 | 2.81 | 2.81 |
| 24.0 | 65.580 | 58.228 | 50.877 | 12.63 | 12.63 | 2.79 | 2.79 |
| 25.0 | 62.678 | 55.724 | 48.770 | 12.48 | 12.48 | 2.78 | 2.78 |
| 26.0 | 59.919 | 53.340 | 46.762 | 12.33 | 12.33 | 2.76 | 2.76 |
| 27.0 | 57.295 | 51.071 | 44.847 | 12.19 | 12.19 | 2.74 | 2.74 |
| 28.0 | 54.800 | 48.910 | 43.021 | 12.04 | 12.04 | 2.73 | 2.73 |
| 29.0 | 52.426 | 46.853 | 41.279 | 11.90 | 11.90 | 2.71 | 2.71 |
| 30.0 | 50.167 | 44.892 | 39.617 | 11.75 | 11.75 | 2.69 | 2.69 |
| 31.0 | 48.016 | 43.024 | 38.031 | 11.60 | 11.60 | 2.67 | 2.67 |
| 32.0 | 45.969 | 41.243 | 36.517 | 11.46 | 11.46 | 2.65 | 2.65 |
| 33.0 | 44.019 | 39.546 | 35.072 | 11.31 | 11.31 | 2.64 | 2.64 |
| 34.0 | 42.162 | 37.927 | 33.692 | 11.17 | 11.17 | 2.62 | 2.62 |
| 35.0 | 40.392 | 36.383 | 32.373 | 11.02 | 11.02 | 2.60 | 2.60 |
| 36.0 | 38.706 | 34.910 | 31.113 | 10.88 | 10.88 | 2.58 | 2.58 |
| 37.0 | 37.098 | 33.504 | 29.909 | 10.73 | 10.73 | 2.56 | 2.56 |
| 38.0 | 35.566 | 32.162 | 28.758 | 10.58 | 10.58 | 2.54 | 2.54 |
| 39.0 | 34.104 | 30.881 | 27.657 | 10.44 | 10.44 | 2.52 | 2.52 |
| 40.0 | 32.709 | 29.657 | 26.605 | 10.29 | 10.29 | 2.49 | 2.49 |
| 41.0 | 31.379 | 28.488 | 25.598 | 10.15 | 10.15 | 2.47 | 2.47 |
| 42.0 | 30.109 | 27.372 | 24.634 | 10.00 | 10.00 | 2.45 | 2.45 |
| 43.0 | 28.896 | 26.304 | 23.712 | 9.85 | 9.85 | 2.43 | 2.43 |
| 44.0 | 27.739 | 25.284 | 22.829 | 9.71 | 9.71 | 2.41 | 2.41 |
| 45.0 | 26.633 | 24.309 | 21.984 | 9.56 | 9.56 | 2.38 | 2.38 |
| 46.0 | 25.577 | 23.376 | 21.174 | 9.42 | 9.42 | 2.36 | 2.36 |
| 47.0 | 24.568 | 22.483 | 20.399 | 9.27 | 9.27 | 2.34 | 2.34 |
| 48.0 | 23.603 | 21.629 | 19.656 | 9.13 | 9.13 | 2.31 | 2.31 |
| 49.0 | 22.681 | 20.812 | 18.943 | 8.98 | 8.98 | 2.29 | 2.29 |
| 50.0 | 21.799 | 20.030 | 18.261 | 8.83 | 8.83 | 2.26 | 2.26 |
| 51.0 | 20.956 | 19.281 | 17.606 | 8.69 | 8.69 | 2.24 | 2.24 |
| 52.0 | 20.149 | 18.563 | 16.978 | 8.54 | 8.54 | 2.21 | 2.21 |
| 53.0 | 19.377 | 17.876 | 16.375 | 8.40 | 8.40 | 2.18 | 2.18 |
| 54.0 | 18.638 | 17.218 | 15.797 | 8.25 | 8.25 | 2.16 | 2.16 |
| 55.0 | 17.931 | 16.587 | 15.243 | 8.10 | 8.10 | 2.13 | 2.13 |
| 56.0 | 17.254 | 15.982 | 14.710 | 7.96 | 7.96 | 2.10 | 2.10 |
| 57.0 | 16.606 | 15.402 | 14.199 | 7.81 | 7.81 | 2.08 | 2.08 |
| 58.0 | 15.984 | 14.846 | 13.708 | 7.67 | 7.67 | 2.05 | 2.05 |
| 59.0 | 15.389 | 14.313 | 13.236 | 7.52 | 7.52 | 2.02 | 2.02 |
| 60.0 | 14.819 | 13.801 | 12.783 | 7.37 | 7.37 | 1.99 | 1.99 |
| 61.0 | 14.272 | 13.310 | 12.348 | 7.23 | 7.23 | 1.96 | 1.96 |
| 62.0 | 13.748 | 12.839 | 11.929 | 7.08 | 7.08 | 1.93 | 1.93 |
| 63.0 | 13.246 | 12.387 | 11.527 | 6.94 | 6.94 | 1.90 | 1.90 |
| 64.0 | 12.764 | 11.952 | 11.140 | 6.79 | 6.79 | 1.87 | 1.87 |
| 65.0 | 12.302 | 11.535 | 10.768 | 6.65 | 6.65 | 1.84 | 1.84 |
| 66.0 | 11.858 | 11.134 | 10.411 | 6.50 | 6.50 | 1.81 | 1.81 |
| 67.0 | 11.432 | 10.749 | 10.066 | 6.35 | 6.35 | 1.77 | 1.77 |
| 68.0 | 11.024 | 10.380 | 9.735 | 6.21 | 6.21 | 1.74 | 1.74 |
| 69.0 | 10.632 | 10.024 | 9.416 | 6.06 | 6.06 | 1.71 | 1.71 |
| 70.0 | 10.255 | 9.682 | 9.109 | 5.92 | 5.92 | 1.68 | 1.68 |
| 71.0 | 9.894 | 9.354 | 8.814 | 5.77 | 5.77 | 1.64 | 1.64 |
| 72.0 | 9.546 | 9.038 | 8.530 | 5.63 | 5.63 | 1.61 | 1.61 |
| 73.0 | 9.213 | 8.734 | 8.255 | 5.48 | 5.48 | 1.57 | 1.57 |
| 74.0 | 8.892 | 8.442 | 7.992 | 5.33 | 5.33 | 1.54 | 1.54 |
| 75.0 | 8.584 | 8.161 | 7.737 | 5.19 | 5.19 | 1.51 | 1.51 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 76.0 | 8.288 | 7.890 | 7.492 | 5.04 | 5.04 | 1.47 | 1.47 |
| 77.0 | 8.003 | 7.629 | 7.256 | 4.90 | 4.90 | 1.43 | 1.43 |
| 78.0 | 7.729 | 7.379 | 7.028 | 4.75 | 4.75 | 1.40 | 1.40 |
| 79.0 | 7.466 | 7.137 | 6.809 | 4.60 | 4.60 | 1.36 | 1.36 |
| 80.0 | 7.213 | 6.905 | 6.597 | 4.46 | 4.46 | 1.32 | 1.32 |
| 81.0 | 6.969 | 6.681 | 6.393 | 4.31 | 4.31 | 1.29 | 1.29 |
| 82.0 | 6.735 | 6.466 | 6.196 | 4.17 | 4.17 | 1.25 | 1.25 |
| 83.0 | 6.509 | 6.258 | 6.006 | 4.02 | 4.02 | 1.21 | 1.21 |
| 84.0 | 6.292 | 6.058 | 5.823 | 3.88 | 3.88 | 1.17 | 1.17 |
| 85.0 | 6.084 | 5.865 | 5.646 | 3.73 | 3.73 | 1.13 | 1.13 |
| 86.0 | 5.883 | 5.679 | 5.476 | 3.58 | 3.58 | 1.09 | 1.09 |
| 87.0 | 5.689 | 5.500 | 5.311 | 3.44 | 3.44 | 1.06 | 1.06 |
| 88.0 | 5.502 | 5.327 | 5.152 | 3.29 | 3.29 | 1.02 | 1.02 |
| 89.0 | 5.323 | 5.161 | 4.998 | 3.15 | 3.15 | 0.97 | 0.97 |
| 90.0 | 5.150 | 5.000 | 4.850 | 3.00 | 3.00 | 0.93 | 0.93 |
| 91.0 | 4.996 | 4.845 | 4.694 | 3.11 | 3.11 | 0.97 | 0.97 |
| 92.0 | 4.847 | 4.696 | 4.545 | 3.22 | 3.22 | 1.01 | 1.01 |
| 93.0 | 4.703 | 4.552 | 4.400 | 3.33 | 3.33 | 1.05 | 1.05 |
| 94.0 | 4.564 | 4.412 | 4.261 | 3.43 | 3.43 | 1.09 | 1.09 |
| 95.0 | 4.430 | 4.278 | 4.127 | 3.54 | 3.54 | 1.13 | 1.13 |
| 96.0 | 4.300 | 4.149 | 3.997 | 3.65 | 3.65 | 1.17 | 1.17 |
| 97.0 | 4.175 | 4.024 | 3.872 | 3.76 | 3.76 | 1.21 | 1.21 |
| 98.0 | 4.054 | 3.903 | 3.752 | 3.87 | 3.87 | 1.25 | 1.25 |
| 99.0 | 3.937 | 3.787 | 3.636 | 3.98 | 3.98 | 1.29 | 1.29 |
| 100.0 | 3.824 | 3.674 | 3.524 | 4.09 | 4.09 | 1.33 | 1.33 |
| 101.0 | 3.715 | 3.565 | 3.416 | 4.19 | 4.19 | 1.38 | 1.38 |
| 102.0 | 3.609 | 3.460 | 3.312 | 4.30 | 4.30 | 1.42 | 1.42 |
| 103.0 | 3.507 | 3.359 | 3.211 | 4.41 | 4.41 | 1.46 | 1.46 |
| 104.0 | 3.409 | 3.261 | 3.114 | 4.52 | 4.52 | 1.51 | 1.51 |
| 105.0 | 3.313 | 3.167 | 3.020 | 4.63 | 4.63 | 1.55 | 1.55 |
| 106.0 | 3.221 | 3.075 | 2.929 | 4.74 | 4.74 | 1.59 | 1.59 |
| 107.0 | 3.131 | 2.987 | 2.842 | 4.85 | 4.85 | 1.64 | 1.64 |
| 108.0 | 3.045 | 2.901 | 2.758 | 4.95 | 4.95 | 1.68 | 1.68 |
| 109.0 | 2.962 | 2.819 | 2.676 | 5.06 | 5.06 | 1.73 | 1.73 |
| 110.0 | 2.881 | 2.739 | 2.597 | 5.17 | 5.17 | 1.78 | 1.78 |
| 111.0 | 2.802 | 2.662 | 2.521 | 5.28 | 5.28 | 1.82 | 1.82 |
| 112.0 | 2.727 | 2.587 | 2.448 | 5.39 | 5.39 | 1.87 | 1.87 |
| 113.0 | 2.653 | 2.515 | 2.377 | 5.50 | 5.50 | 1.92 | 1.92 |
| 114.0 | 2.582 | 2.445 | 2.308 | 5.61 | 5.61 | 1.96 | 1.96 |
| 115.0 | 2.514 | 2.378 | 2.242 | 5.72 | 5.72 | 2.01 | 2.01 |
| 116.0 | 2.447 | 2.313 | 2.178 | 5.82 | 5.82 | 2.06 | 2.06 |
| 117.0 | 2.383 | 2.249 | 2.116 | 5.93 | 5.93 | 2.11 | 2.11 |
| 118.0 | 2.320 | 2.188 | 2.056 | 6.04 | 6.04 | 2.16 | 2.16 |
| 119.0 | 2.260 | 2.129 | 1.998 | 6.15 | 6.15 | 2.21 | 2.21 |
| 120.0 | 2.201 | 2.072 | 1.942 | 6.26 | 6.26 | 2.26 | 2.26 |
| 121.0 | 2.145 | 2.016 | 1.888 | 6.37 | 6.37 | 2.32 | 2.32 |
| 122.0 | 2.090 | 1.963 | 1.836 | 6.48 | 6.48 | 2.37 | 2.37 |
| 123.0 | 2.037 | 1.911 | 1.785 | 6.58 | 6.58 | 2.42 | 2.42 |
| 124.0 | 1.985 | 1.860 | 1.736 | 6.69 | 6.69 | 2.48 | 2.48 |
| 125.0 | 1.935 | 1.812 | 1.689 | 6.80 | 6.80 | 2.53 | 2.53 |

**Resistance table of water temperature sensor -- 3970(0-100) 2% 17.6K(R50) 3% (with deviation)**

Contains: Taf2 board changing anti-freezing sensor, Twi unit water inlet sensor, Two unit water outlet sensor, Tw total water outlet sensor

R50=17.6±3%，B0/100=3970±2%

| Temp | Resistance (KΩ) | | | Resist. tol (%) | | Temp. tol (℃) | |
|---|---|---|---|---|---|---|---|
| (℃) | Rmax | R (t) Normal | Rmin | (℃) | Rmax | R (t) Normal | Rmin |
| -30.0 | 953.957 | 853.724 | 753.491 | 11.74 | 11.74 | 1.98 | 1.98 |
| -29.0 | 896.053 | 802.986 | 709.918 | 11.59 | 11.59 | 1.96 | 1.96 |
| -28.0 | 842.002 | 755.557 | 669.113 | 11.44 | 11.44 | 1.95 | 1.95 |
| -27.0 | 791.530 | 711.210 | 630.889 | 11.29 | 11.29 | 1.94 | 1.94 |
| -26.0 | 744.384 | 669.728 | 595.072 | 11.15 | 11.15 | 1.92 | 1.92 |
| -25.0 | 700.328 | 630.913 | 561.498 | 11.00 | 11.00 | 1.91 | 1.91 |
| -24.0 | 659.144 | 594.580 | 530.015 | 10.86 | 10.86 | 1.90 | 1.90 |
| -23.0 | 620.629 | 560.556 | 500.483 | 10.72 | 10.72 | 1.88 | 1.88 |
| -22.0 | 584.595 | 528.683 | 472.771 | 10.58 | 10.58 | 1.87 | 1.87 |
| -21.0 | 550.871 | 498.814 | 446.757 | 10.44 | 10.44 | 1.86 | 1.86 |
| -20.0 | 519.295 | 470.812 | 422.328 | 10.30 | 10.30 | 1.85 | 1.85 |
| -19.0 | 489.718 | 444.548 | 399.379 | 10.16 | 10.16 | 1.83 | 1.83 |
| -18.0 | 462.003 | 419.907 | 377.812 | 10.02 | 10.02 | 1.82 | 1.82 |
| -17.0 | 436.022 | 396.779 | 357.537 | 9.89 | 9.89 | 1.81 | 1.81 |
| -16.0 | 411.657 | 375.063 | 338.468 | 9.76 | 9.76 | 1.79 | 1.79 |
| -15.0 | 388.797 | 354.662 | 320.527 | 9.62 | 9.62 | 1.78 | 1.78 |
| -14.0 | 367.343 | 335.492 | 303.641 | 9.49 | 9.49 | 1.77 | 1.77 |
| -13.0 | 347.198 | 317.470 | 287.743 | 9.36 | 9.36 | 1.75 | 1.75 |
| -12.0 | 328.275 | 300.521 | 272.767 | 9.24 | 9.24 | 1.74 | 1.74 |
| -11.0 | 310.495 | 284.576 | 258.658 | 9.11 | 9.11 | 1.73 | 1.73 |
| -10.0 | 293.780 | 269.569 | 245.359 | 8.98 | 8.98 | 1.71 | 1.71 |
| -9.0 | 278.060 | 255.439 | 232.818 | 8.86 | 8.86 | 1.70 | 1.70 |
| -8.0 | 263.273 | 242.131 | 220.989 | 8.73 | 8.73 | 1.69 | 1.69 |
| -7.0 | 249.357 | 229.593 | 209.828 | 8.61 | 8.61 | 1.67 | 1.67 |
| -6.0 | 236.255 | 217.774 | 199.293 | 8.49 | 8.49 | 1.66 | 1.66 |
| -5.0 | 223.915 | 206.630 | 189.345 | 8.37 | 8.37 | 1.64 | 1.64 |
| -4.0 | 212.289 | 196.119 | 179.949 | 8.25 | 8.25 | 1.63 | 1.63 |
| -3.0 | 201.332 | 186.201 | 171.070 | 8.13 | 8.13 | 1.62 | 1.62 |
| -2.0 | 191.001 | 176.840 | 162.678 | 8.01 | 8.01 | 1.60 | 1.60 |
| -1.0 | 181.258 | 168.001 | 154.744 | 7.89 | 7.89 | 1.59 | 1.59 |
| 0.0 | 172.066 | 159.653 | 147.240 | 7.77 | 7.77 | 1.57 | 1.57 |
| 1.0 | 163.391 | 151.766 | 140.141 | 7.66 | 7.66 | 1.56 | 1.56 |
| 2.0 | 155.200 | 144.311 | 133.422 | 7.55 | 7.55 | 1.55 | 1.55 |
| 3.0 | 147.466 | 137.264 | 127.062 | 7.43 | 7.43 | 1.53 | 1.53 |
| 4.0 | 140.159 | 130.599 | 121.038 | 7.32 | 7.32 | 1.52 | 1.52 |
| 5.0 | 133.253 | 124.293 | 115.332 | 7.21 | 7.21 | 1.50 | 1.50 |
| 6.0 | 126.725 | 118.326 | 109.926 | 7.10 | 7.10 | 1.49 | 1.49 |
| 7.0 | 120.554 | 112.679 | 104.803 | 6.99 | 6.99 | 1.47 | 1.47 |
| 8.0 | 114.715 | 107.330 | 99.945 | 6.88 | 6.88 | 1.46 | 1.46 |
| 9.0 | 109.191 | 102.265 | 95.338 | 6.77 | 6.77 | 1.44 | 1.44 |
| 10.0 | 103.963 | 97.466 | 90.969 | 6.67 | 6.67 | 1.43 | 1.43 |
| 11.0 | 99.013 | 92.918 | 86.822 | 6.56 | 6.56 | 1.41 | 1.41 |
| 12.0 | 94.327 | 88.607 | 82.888 | 6.45 | 6.45 | 1.40 | 1.40 |
| 13.0 | 89.887 | 84.519 | 79.152 | 6.35 | 6.35 | 1.38 | 1.38 |
| 14.0 | 85.679 | 80.642 | 75.604 | 6.25 | 6.25 | 1.37 | 1.37 |
| 15.0 | 81.692 | 76.963 | 72.234 | 6.14 | 6.14 | 1.35 | 1.35 |
| 16.0 | 77.911 | 73.471 | 69.032 | 6.04 | 6.04 | 1.34 | 1.34 |
| 17.0 | 74.326 | 70.157 | 65.989 | 5.94 | 5.94 | 1.32 | 1.32 |
| 18.0 | 70.925 | 67.011 | 63.097 | 5.84 | 5.84 | 1.31 | 1.31 |
| 19.0 | 67.699 | 64.023 | 60.347 | 5.74 | 5.74 | 1.29 | 1.29 |

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|---|---|---|---|---|---|---|---|
| 20.0 | 64.636 | 61.184 | 57.731 | 5.64 | 5.64 | 1.28 | 1.28 |
| 21.0 | 61.729 | 58.486 | 55.243 | 5.54 | 5.54 | 1.26 | 1.26 |
| 22.0 | 58.967 | 55.921 | 52.875 | 5.45 | 5.45 | 1.25 | 1.25 |
| 23.0 | 56.345 | 53.483 | 50.621 | 5.35 | 5.35 | 1.23 | 1.23 |
| 24.0 | 53.854 | 51.165 | 48.476 | 5.26 | 5.26 | 1.22 | 1.22 |
| 25.0 | 51.485 | 48.959 | 46.432 | 5.16 | 5.16 | 1.20 | 1.20 |
| 26.0 | 49.234 | 46.860 | 44.486 | 5.07 | 5.07 | 1.19 | 1.19 |
| 27.0 | 47.094 | 44.863 | 42.632 | 4.97 | 4.97 | 1.17 | 1.17 |
| 28.0 | 45.058 | 42.961 | 40.865 | 4.88 | 4.88 | 1.16 | 1.16 |
| 29.0 | 43.121 | 41.151 | 39.181 | 4.79 | 4.79 | 1.14 | 1.14 |
| 30.0 | 41.278 | 39.427 | 37.575 | 4.70 | 4.70 | 1.13 | 1.13 |
| 31.0 | 39.524 | 37.784 | 36.044 | 4.61 | 4.61 | 1.11 | 1.11 |
| 32.0 | 37.854 | 36.219 | 34.583 | 4.52 | 4.52 | 1.10 | 1.10 |
| 33.0 | 36.263 | 34.726 | 33.189 | 4.43 | 4.43 | 1.08 | 1.08 |
| 34.0 | 34.748 | 33.304 | 31.860 | 4.34 | 4.34 | 1.06 | 1.06 |
| 35.0 | 33.305 | 31.947 | 30.590 | 4.25 | 4.25 | 1.05 | 1.05 |
| 36.0 | 31.929 | 30.653 | 29.378 | 4.16 | 4.16 | 1.03 | 1.03 |
| 37.0 | 30.617 | 29.419 | 28.220 | 4.07 | 4.07 | 1.02 | 1.02 |
| 38.0 | 29.367 | 28.241 | 27.114 | 3.99 | 3.99 | 1.00 | 1.00 |
| 39.0 | 28.174 | 27.115 | 26.057 | 3.90 | 3.90 | 0.99 | 0.99 |
| 40.0 | 27.036 | 26.042 | 25.048 | 3.82 | 3.82 | 0.97 | 0.97 |
| 41.0 | 25.949 | 25.015 | 24.082 | 3.73 | 3.73 | 0.95 | 0.95 |
| 42.0 | 24.913 | 24.036 | 23.159 | 3.65 | 3.65 | 0.94 | 0.94 |
| 43.0 | 23.924 | 23.100 | 22.276 | 3.57 | 3.57 | 0.92 | 0.92 |
| 44.0 | 22.979 | 22.206 | 21.432 | 3.48 | 3.48 | 0.90 | 0.90 |
| 45.0 | 22.076 | 21.350 | 20.624 | 3.40 | 3.40 | 0.89 | 0.89 |
| 46.0 | 21.213 | 20.532 | 19.850 | 3.32 | 3.32 | 0.87 | 0.87 |
| 47.0 | 20.389 | 19.749 | 19.110 | 3.24 | 3.24 | 0.86 | 0.86 |
| 48.0 | 19.602 | 19.001 | 18.401 | 3.16 | 3.16 | 0.84 | 0.84 |
| 49.0 | 18.848 | 18.285 | 17.722 | 3.08 | 3.08 | 0.82 | 0.82 |
| 50.0 | 18.128 | 17.600 | 17.072 | 3.00 | 3.00 | 0.80 | 0.80 |
| 51.0 | 17.466 | 16.944 | 16.422 | 3.08 | 3.08 | 0.83 | 0.83 |
| 52.0 | 16.831 | 16.316 | 15.801 | 3.16 | 3.16 | 0.86 | 0.86 |
| 53.0 | 16.223 | 15.714 | 15.206 | 3.23 | 3.23 | 0.88 | 0.88 |
| 54.0 | 15.641 | 15.139 | 14.638 | 3.31 | 3.31 | 0.91 | 0.91 |
| 55.0 | 15.081 | 14.586 | 14.092 | 3.39 | 3.39 | 0.94 | 0.94 |
| 56.0 | 14.545 | 14.058 | 13.571 | 3.47 | 3.47 | 0.96 | 0.96 |
| 57.0 | 14.030 | 13.550 | 13.070 | 3.54 | 3.54 | 0.99 | 0.99 |
| 58.0 | 13.537 | 13.064 | 12.591 | 3.62 | 3.62 | 1.01 | 1.01 |
| 59.0 | 13.063 | 12.597 | 12.132 | 3.69 | 3.69 | 1.04 | 1.04 |
| 60.0 | 12.608 | 12.150 | 11.692 | 3.77 | 3.77 | 1.07 | 1.07 |
| 61.0 | 12.171 | 11.721 | 11.270 | 3.84 | 3.84 | 1.09 | 1.09 |
| 62.0 | 11.752 | 11.309 | 10.866 | 3.92 | 3.92 | 1.12 | 1.12 |
| 63.0 | 11.349 | 10.913 | 10.478 | 3.99 | 3.99 | 1.15 | 1.15 |
| 64.0 | 10.962 | 10.533 | 10.105 | 4.06 | 4.06 | 1.17 | 1.17 |
| 65.0 | 10.589 | 10.168 | 9.748 | 4.14 | 4.14 | 1.20 | 1.20 |
| 66.0 | 10.231 | 9.818 | 9.405 | 4.21 | 4.21 | 1.23 | 1.23 |
| 67.0 | 9.887 | 9.481 | 9.075 | 4.28 | 4.28 | 1.25 | 1.25 |
| 68.0 | 9.556 | 9.157 | 8.758 | 4.35 | 4.35 | 1.28 | 1.28 |
| 69.0 | 9.237 | 8.846 | 8.454 | 4.43 | 4.43 | 1.31 | 1.31 |
| 70.0 | 8.932 | 8.547 | 8.163 | 4.50 | 4.50 | 1.34 | 1.34 |
| 71.0 | 8.637 | 8.259 | 7.882 | 4.57 | 4.57 | 1.37 | 1.37 |
| 72.0 | 8.354 | 7.983 | 7.613 | 4.64 | 4.64 | 1.39 | 1.39 |
| 73.0 | 8.080 | 7.717 | 7.354 | 4.71 | 4.71 | 1.42 | 1.42 |

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|---|---|---|---|---|---|---|---|
| 74.0 | 7.818 | 7.461 | 7.105 | 4.78 | 4.78 | 1.45 | 1.45 |
| 75.0 | 7.565 | 7.215 | 6.866 | 4.85 | 4.85 | 1.48 | 1.48 |
| 76.0 | 7.322 | 6.978 | 6.635 | 4.92 | 4.92 | 1.50 | 1.50 |
| 77.0 | 7.087 | 6.750 | 6.414 | 4.99 | 4.99 | 1.53 | 1.53 |
| 78.0 | 6.861 | 6.531 | 6.201 | 5.05 | 5.05 | 1.56 | 1.56 |
| 79.0 | 6.643 | 6.319 | 5.995 | 5.12 | 5.12 | 1.59 | 1.59 |
| 80.0 | 6.433 | 6.115 | 5.798 | 5.19 | 5.19 | 1.62 | 1.62 |
| 81.0 | 6.230 | 5.919 | 5.608 | 5.26 | 5.26 | 1.64 | 1.64 |
| 82.0 | 6.035 | 5.730 | 5.425 | 5.32 | 5.32 | 1.67 | 1.67 |
| 83.0 | 5.847 | 5.548 | 5.249 | 5.39 | 5.39 | 1.70 | 1.70 |
| 84.0 | 5.666 | 5.372 | 5.079 | 5.46 | 5.46 | 1.74 | 1.74 |
| 85.0 | 5.491 | 5.204 | 4.916 | 5.52 | 5.52 | 1.77 | 1.77 |
| 86.0 | 5.323 | 5.041 | 4.759 | 5.59 | 5.59 | 1.80 | 1.80 |
| 87.0 | 5.160 | 4.884 | 4.608 | 5.65 | 5.65 | 1.82 | 1.82 |
| 88.0 | 5.003 | 4.732 | 4.462 | 5.72 | 5.72 | 1.86 | 1.86 |
| 89.0 | 4.852 | 4.587 | 4.322 | 5.78 | 5.78 | 1.88 | 1.88 |
| 90.0 | 4.706 | 4.446 | 4.186 | 5.85 | 5.85 | 1.92 | 1.92 |
| 91.0 | 4.565 | 4.310 | 4.056 | 5.91 | 5.91 | 1.94 | 1.94 |
| 92.0 | 4.429 | 4.179 | 3.929 | 5.98 | 5.98 | 1.99 | 1.99 |
| 93.0 | 4.298 | 4.053 | 3.809 | 6.04 | 6.04 | 2.01 | 2.01 |
| 94.0 | 4.172 | 3.932 | 3.692 | 6.10 | 6.10 | 2.04 | 2.04 |
| 95.0 | 4.049 | 3.814 | 3.579 | 6.16 | 6.16 | 2.08 | 2.08 |
| 96.0 | 3.932 | 3.701 | 3.471 | 6.23 | 6.23 | 2.10 | 2.10 |
| 97.0 | 3.817 | 3.591 | 3.365 | 6.29 | 6.29 | 2.15 | 2.15 |
| 98.0 | 3.708 | 3.486 | 3.265 | 6.35 | 6.35 | 2.17 | 2.17 |
| 99.0 | 3.601 | 3.384 | 3.167 | 6.41 | 6.41 | 2.21 | 2.21 |
| 100.0 | 3.499 | 3.286 | 3.073 | 6.47 | 6.47 | 2.24 | 2.24 |
| 101.0 | 3.400 | 3.191 | 2.983 | 6.54 | 6.54 | 2.25 | 2.25 |
| 102.0 | 3.303 | 3.098 | 2.894 | 6.60 | 6.60 | 2.29 | 2.29 |
| 103.0 | 3.210 | 3.009 | 2.809 | 6.66 | 6.66 | 2.33 | 2.33 |
| 104.0 | 3.120 | 2.923 | 2.727 | 6.72 | 6.72 | 2.36 | 2.36 |
| 105.0 | 3.032 | 2.840 | 2.647 | 6.78 | 6.78 | 2.39 | 2.39 |
| 106.0 | 2.948 | 2.759 | 2.571 | 6.84 | 6.84 | 2.42 | 2.42 |
| 107.0 | 2.866 | 2.681 | 2.497 | 6.90 | 6.90 | 2.45 | 2.45 |
| 108.0 | 2.787 | 2.606 | 2.425 | 6.95 | 6.95 | 2.49 | 2.49 |
| 109.0 | 2.711 | 2.533 | 2.356 | 7.01 | 7.01 | 2.52 | 2.52 |
| 110.0 | 2.637 | 2.463 | 2.288 | 7.07 | 7.07 | 2.55 | 2.55 |
| 111.0 | 2.565 | 2.394 | 2.224 | 7.13 | 7.13 | 2.58 | 2.58 |
| 112.0 | 2.496 | 2.328 | 2.161 | 7.19 | 7.19 | 2.61 | 2.61 |
| 113.0 | 2.428 | 2.264 | 2.100 | 7.25 | 7.25 | 2.65 | 2.65 |
| 114.0 | 2.363 | 2.202 | 2.041 | 7.30 | 7.30 | 2.68 | 2.68 |
| 115.0 | 2.300 | 2.142 | 1.985 | 7.36 | 7.36 | 2.71 | 2.71 |
| 116.0 | 2.239 | 2.084 | 1.930 | 7.42 | 7.42 | 2.75 | 2.75 |
| 117.0 | 2.179 | 2.028 | 1.876 | 7.47 | 7.47 | 2.78 | 2.78 |
| 118.0 | 2.122 | 1.973 | 1.825 | 7.53 | 7.53 | 2.81 | 2.81 |
| 119.0 | 2.066 | 1.920 | 1.775 | 7.59 | 7.59 | 2.85 | 2.85 |
| 120.0 | 2.012 | 1.869 | 1.726 | 7.64 | 7.64 | 2.88 | 2.88 |
| 121.0 | 1.960 | 1.820 | 1.680 | 7.70 | 7.70 | 2.91 | 2.91 |
| 122.0 | 1.909 | 1.772 | 1.634 | 7.75 | 7.75 | 2.95 | 2.95 |
| 123.0 | 1.860 | 1.725 | 1.590 | 7.81 | 7.81 | 2.98 | 2.98 |
| 124.0 | 1.812 | 1.680 | 1.548 | 7.86 | 7.86 | 3.01 | 3.01 |
| 125.0 | 1.765 | 1.636 | 1.506 | 7.92 | 7.92 | 3.05 | 3.05 |
| 126.0 | 1.720 | 1.593 | 1.466 | 7.97 | 7.97 | 3.08 | 3.08 |
| 127.0 | 1.677 | 1.552 | 1.428 | 8.03 | 8.03 | 3.12 | 3.12 |

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|---|---|---|---|---|---|---|---|
| 128.0 | 1.634 | 1.512 | 1.390 | 8.08 | 8.08 | 3.15 | 3.15 |
| 129.0 | 1.593 | 1.473 | 1.354 | 8.13 | 8.13 | 3.18 | 3.18 |
| 130.0 | 1.553 | 1.436 | 1.318 | 8.19 | 8.19 | 3.22 | 3.22 |
| 131.0 | 1.515 | 1.399 | 1.284 | 8.24 | 8.24 | 3.25 | 3.25 |
| 132.0 | 1.477 | 1.364 | 1.251 | 8.29 | 8.29 | 3.29 | 3.29 |
| 133.0 | 1.440 | 1.329 | 1.219 | 8.34 | 8.34 | 3.32 | 3.32 |
| 134.0 | 1.405 | 1.296 | 1.187 | 8.40 | 8.40 | 3.36 | 3.36 |
| 135.0 | 1.370 | 1.264 | 1.157 | 8.45 | 8.45 | 3.39 | 3.39 |
| 136.0 | 1.337 | 1.232 | 1.127 | 8.50 | 8.50 | 3.43 | 3.43 |
| 137.0 | 1.304 | 1.202 | 1.099 | 8.55 | 8.55 | 3.46 | 3.46 |
| 138.0 | 1.273 | 1.172 | 1.071 | 8.60 | 8.60 | 3.50 | 3.50 |
| 139.0 | 1.242 | 1.143 | 1.044 | 8.66 | 8.66 | 3.53 | 3.53 |
| 140.0 | 1.212 | 1.115 | 1.018 | 8.71 | 8.71 | 3.57 | 3.57 |
| 141.0 | 1.183 | 1.088 | 0.993 | 8.76 | 8.76 | 3.60 | 3.60 |
| 142.0 | 1.155 | 1.061 | 0.968 | 8.81 | 8.81 | 3.64 | 3.64 |
| 143.0 | 1.127 | 1.036 | 0.944 | 8.86 | 8.86 | 3.67 | 3.67 |
| 144.0 | 1.101 | 1.011 | 0.921 | 8.91 | 8.91 | 3.71 | 3.71 |
| 145.0 | 1.075 | 0.986 | 0.898 | 8.96 | 8.96 | 3.75 | 3.75 |
| 146.0 | 1.050 | 0.963 | 0.876 | 9.01 | 9.01 | 3.78 | 3.78 |
| 147.0 | 1.025 | 0.940 | 0.855 | 9.06 | 9.06 | 3.82 | 3.82 |
| 148.0 | 1.001 | 0.918 | 0.834 | 9.11 | 9.11 | 3.85 | 3.85 |
| 149.0 | 0.978 | 0.896 | 0.814 | 9.16 | 9.16 | 3.89 | 3.89 |
| 150.0 | 0.955 | 0.875 | 0.794 | 9.21 | 9.21 | 3.92 | 3.92 |

**Resistance table of pipe temperature sensor -- 4100K(25-50) 10K(R25) 3% (with deviation)**

Contains: T6A auxiliary inlet temperature sensor, T6B auxiliary outlet temperature sensor, Th suction temperature sensor, Tz/7 heating plate exchange outlet sensor, T4 outdoor temperature sensor, T3A/T3B evaporator sensor.

R25=10KΩ±3%，B25/50=4100K±3%

| Temp | Resistance（KΩ） | | | Resist. tol (%) | | Temp. tol (℃) | |
|---|---|---|---|---|---|---|---|
| （℃） | Rmax | R（t）Normal | Rmin | （℃） | Rmax | R（t）Normal | Rmin |
| -30.0 | 220.320 | 197.792 | 176.705 | 11.39 | 10.66 | 1.72 | 1.71 |
| -29.0 | 206.384 | 185.547 | 166.037 | 11.23 | 10.52 | 1.71 | 1.70 |
| -28.0 | 193.407 | 174.131 | 156.075 | 11.07 | 10.37 | 1.70 | 1.69 |
| -27.0 | 181.317 | 163.481 | 146.768 | 10.91 | 10.22 | 1.68 | 1.67 |
| -26.0 | 170.049 | 153.543 | 138.071 | 10.75 | 10.08 | 1.67 | 1.66 |
| -25.0 | 159.543 | 144.266 | 129.939 | 10.59 | 9.93 | 1.65 | 1.65 |
| -24.0 | 149.745 | 135.601 | 122.333 | 10.43 | 9.79 | 1.64 | 1.63 |
| -23.0 | 140.602 | 127.507 | 115.216 | 10.27 | 9.64 | 1.62 | 1.62 |
| -22.0 | 132.067 | 119.941 | 108.555 | 10.11 | 9.49 | 1.61 | 1.60 |
| -21.0 | 124.098 | 112.867 | 102.318 | 9.95 | 9.35 | 1.59 | 1.59 |
| -20.0 | 116.539 | 106.732 | 96.920 | 9.19 | 9.19 | 1.59 | 1.59 |
| -19.0 | 110.231 | 100.552 | 91.451 | 9.63 | 9.05 | 1.57 | 1.57 |
| -18.0 | 103.743 | 94.769 | 86.328 | 9.47 | 8.91 | 1.56 | 1.55 |
| -17.0 | 97.673 | 89.353 | 81.525 | 9.31 | 8.76 | 1.54 | 1.54 |
| -16.0 | 91.990 | 84.278 | 77.017 | 9.15 | 8.62 | 1.53 | 1.52 |
| -15.0 | 86.669 | 79.521 | 72.788 | 8.99 | 8.47 | 1.51 | 1.50 |
| -14.0 | 81.684 | 75.059 | 68.815 | 8.83 | 8.32 | 1.49 | 1.48 |
| -13.0 | 77.013 | 70.873 | 65.083 | 8.66 | 8.17 | 1.47 | 1.47 |
| -12.0 | 72.632 | 66.943 | 61.574 | 8.50 | 8.02 | 1.45 | 1.45 |
| -11.0 | 68.523 | 63.252 | 58.274 | 8.33 | 7.87 | 1.44 | 1.43 |
| -10.0 | 64.668 | 59.784 | 55.169 | 8.17 | 7.72 | 1.42 | 1.41 |
| -9.0 | 61.048 | 56.524 | 52.246 | 8.00 | 7.57 | 1.40 | 1.39 |
| -8.0 | 57.649 | 53.458 | 49.492 | 7.84 | 7.42 | 1.38 | 1.37 |
| -7.0 | 54.456 | 50.575 | 46.899 | 7.67 | 7.27 | 1.35 | 1.35 |
| -6.0 | 51.456 | 47.862 | 44.455 | 7.51 | 7.12 | 1.33 | 1.32 |
| -5.0 | 48.636 | 45.308 | 42.150 | 7.35 | 6.97 | 1.31 | 1.30 |
| -4.0 | 45.984 | 42.903 | 39.977 | 7.18 | 6.82 | 1.29 | 1.28 |
| -3.0 | 43.490 | 40.638 | 37.927 | 7.02 | 6.67 | 1.27 | 1.26 |
| -2.0 | 41.144 | 38.504 | 35.992 | 6.86 | 6.52 | 1.25 | 1.24 |
| -1.0 | 38.935 | 36.492 | 34.165 | 6.70 | 6.38 | 1.23 | 1.21 |
| 0.0 | 36.857 | 34.596 | 32.440 | 6.53 | 6.23 | 1.21 | 1.19 |
| 1.0 | 34.898 | 32.807 | 30.810 | 6.38 | 6.09 | 1.18 | 1.17 |
| 2.0 | 33.055 | 31.120 | 29.271 | 6.22 | 5.94 | 1.16 | 1.15 |
| 3.0 | 31.317 | 29.528 | 27.815 | 6.06 | 5.80 | 1.14 | 1.12 |
| 4.0 | 29.681 | 28.026 | 26.440 | 5.90 | 5.66 | 1.12 | 1.10 |
| 5.0 | 28.138 | 26.608 | 25.140 | 5.75 | 5.52 | 1.10 | 1.08 |
| 6.0 | 26.682 | 25.268 | 23.909 | 5.60 | 5.38 | 1.07 | 1.06 |
| 7.0 | 25.310 | 24.003 | 22.745 | 5.45 | 5.24 | 1.05 | 1.03 |
| 8.0 | 24.016 | 22.808 | 21.644 | 5.30 | 5.10 | 1.03 | 1.01 |
| 9.0 | 22.794 | 21.678 | 20.601 | 5.15 | 4.97 | 1.01 | 0.99 |
| 10.0 | 21.641 | 20.610 | 19.614 | 5.00 | 4.83 | 0.99 | 0.97 |
| 11.0 | 20.553 | 19.601 | 18.680 | 4.86 | 4.70 | 0.96 | 0.94 |
| 12.0 | 19.525 | 18.646 | 17.794 | 4.71 | 4.57 | 0.94 | 0.92 |
| 13.0 | 18.554 | 17.743 | 16.955 | 4.57 | 4.44 | 0.92 | 0.90 |
| 14.0 | 17.636 | 16.888 | 16.160 | 4.43 | 4.31 | 0.90 | 0.88 |
| 15.0 | 16.769 | 16.079 | 15.406 | 4.29 | 4.19 | 0.88 | 0.85 |
| 16.0 | 15.949 | 15.313 | 14.691 | 4.15 | 4.06 | 0.86 | 0.83 |
| 17.0 | 15.174 | 14.588 | 14.014 | 4.02 | 3.94 | 0.84 | 0.81 |
| 18.0 | 14.442 | 13.902 | 13.372 | 3.89 | 3.81 | 0.81 | 0.79 |
| 19.0 | 13.748 | 13.251 | 12.762 | 3.75 | 3.69 | 0.79 | 0.76 |

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|---|---|---|---|---|---|---|---|
| 20.0 | 13.093 | 12.635 | 12.183 | 3.62 | 3.57 | 0.77 | 0.74 |
| 21.0 | 12.471 | 12.050 | 11.634 | 3.50 | 3.46 | 0.75 | 0.72 |
| 22.0 | 11.883 | 11.496 | 11.112 | 3.37 | 3.34 | 0.73 | 0.70 |
| 23.0 | 11.327 | 10.971 | 10.617 | 3.25 | 3.23 | 0.71 | 0.68 |
| 24.0 | 10.800 | 10.473 | 10.147 | 3.12 | 3.11 | 0.69 | 0.66 |
| 25.0 | 10.300 | 10.000 | 9.700 | 3.00 | 3.00 | 0.67 | 0.63 |
| 26.0 | 9.848 | 9.551 | 9.255 | 3.11 | 3.10 | 0.69 | 0.66 |
| 27.0 | 9.418 | 9.125 | 8.834 | 3.21 | 3.19 | 0.72 | 0.69 |
| 28.0 | 9.010 | 8.721 | 8.434 | 3.31 | 3.29 | 0.75 | 0.71 |
| 29.0 | 8.621 | 8.337 | 8.055 | 3.41 | 3.38 | 0.77 | 0.74 |
| 30.0 | 8.252 | 7.972 | 7.695 | 3.51 | 3.47 | 0.80 | 0.77 |
| 31.0 | 7.900 | 7.625 | 7.353 | 3.61 | 3.57 | 0.83 | 0.79 |
| 32.0 | 7.566 | 7.296 | 7.029 | 3.70 | 3.66 | 0.85 | 0.82 |
| 33.0 | 7.247 | 6.982 | 6.721 | 3.80 | 3.74 | 0.88 | 0.84 |
| 34.0 | 6.944 | 6.684 | 6.428 | 3.89 | 3.83 | 0.91 | 0.87 |
| 35.0 | 6.656 | 6.401 | 6.150 | 3.98 | 3.92 | 0.93 | 0.90 |
| 36.0 | 6.381 | 6.131 | 5.886 | 4.08 | 4.00 | 0.96 | 0.93 |
| 37.0 | 6.119 | 5.874 | 5.634 | 4.17 | 4.09 | 0.98 | 0.95 |
| 38.0 | 5.870 | 5.630 | 5.395 | 4.26 | 4.17 | 1.01 | 0.98 |
| 39.0 | 5.631 | 5.397 | 5.167 | 4.34 | 4.26 | 1.03 | 1.01 |
| 40.0 | 5.404 | 5.175 | 4.951 | 4.43 | 4.34 | 1.06 | 1.03 |
| 41.0 | 5.188 | 4.964 | 4.745 | 4.52 | 4.42 | 1.09 | 1.06 |
| 42.0 | 4.982 | 4.763 | 4.549 | 4.60 | 4.50 | 1.12 | 1.09 |
| 43.0 | 4.785 | 4.571 | 4.362 | 4.69 | 4.58 | 1.14 | 1.12 |
| 44.0 | 4.596 | 4.387 | 4.183 | 4.77 | 4.66 | 1.17 | 1.14 |
| 45.0 | 4.417 | 4.213 | 4.014 | 4.85 | 4.74 | 1.19 | 1.17 |
| 46.0 | 4.246 | 4.046 | 3.851 | 4.93 | 4.81 | 1.22 | 1.20 |
| 47.0 | 4.082 | 3.887 | 3.697 | 5.02 | 4.89 | 1.25 | 1.23 |
| 48.0 | 3.925 | 3.735 | 3.550 | 5.10 | 4.97 | 1.28 | 1.25 |
| 49.0 | 3.776 | 3.590 | 3.409 | 5.18 | 5.04 | 1.30 | 1.28 |
| 50.0 | 3.632 | 3.451 | 3.274 | 5.25 | 5.12 | 1.33 | 1.30 |
| 51.0 | 3.495 | 3.318 | 3.146 | 5.33 | 5.19 | 1.35 | 1.33 |
| 52.0 | 3.363 | 3.191 | 3.023 | 5.41 | 5.26 | 1.41 | 1.36 |
| 53.0 | 3.237 | 3.069 | 2.905 | 5.49 | 5.34 | 1.43 | 1.38 |
| 54.0 | 3.116 | 2.952 | 2.793 | 5.56 | 5.41 | 1.46 | 1.41 |
| 55.0 | 3.001 | 2.841 | 2.685 | 5.64 | 5.48 | 1.48 | 1.44 |
| 56.0 | 2.890 | 2.734 | 2.582 | 5.71 | 5.55 | 1.51 | 1.46 |
| 57.0 | 2.784 | 2.632 | 2.484 | 5.79 | 5.62 | 1.54 | 1.49 |
| 58.0 | 2.682 | 2.534 | 2.390 | 5.86 | 5.69 | 1.56 | 1.52 |
| 59.0 | 2.585 | 2.440 | 2.299 | 5.93 | 5.76 | 1.59 | 1.54 |
| 60.0 | 2.491 | 2.350 | 2.213 | 6.01 | 5.83 | 1.62 | 1.57 |
| 61.0 | 2.401 | 2.264 | 2.130 | 6.08 | 5.90 | 1.64 | 1.60 |
| 62.0 | 2.315 | 2.181 | 2.051 | 6.15 | 5.96 | 1.67 | 1.62 |
| 63.0 | 2.233 | 2.102 | 1.975 | 6.22 | 6.03 | 1.70 | 1.65 |
| 64.0 | 2.154 | 2.026 | 1.903 | 6.29 | 6.10 | 1.72 | 1.68 |
| 65.0 | 2.077 | 1.953 | 1.833 | 6.36 | 6.16 | 1.75 | 1.70 |
| 66.0 | 2.004 | 1.883 | 1.766 | 6.42 | 6.23 | 1.77 | 1.73 |
| 67.0 | 1.934 | 1.816 | 1.702 | 6.49 | 6.29 | 1.80 | 1.76 |
| 68.0 | 1.867 | 1.752 | 1.641 | 6.56 | 6.35 | 1.83 | 1.78 |
| 69.0 | 1.802 | 1.690 | 1.582 | 6.62 | 6.41 | 1.85 | 1.81 |
| 70.0 | 1.740 | 1.631 | 1.525 | 6.69 | 6.48 | 1.88 | 1.84 |
| 71.0 | 1.680 | 1.574 | 1.471 | 6.75 | 6.54 | 1.91 | 1.86 |
| 72.0 | 1.622 | 1.519 | 1.419 | 6.82 | 6.60 | 1.93 | 1.89 |
| 73.0 | 1.567 | 1.466 | 1.369 | 6.88 | 6.66 | 1.96 | 1.92 |
| 74.0 | 1.514 | 1.416 | 1.321 | 6.94 | 6.71 | 1.98 | 1.94 |
| 75.0 | 1.463 | 1.367 | 1.275 | 7.00 | 6.77 | 2.01 | 1.97 |
| 76.0 | 1.414 | 1.321 | 1.230 | 7.06 | 6.83 | 2.04 | 2.00 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 77.0 | 1.367 | 1.276 | 1.188 | 7.12 | 6.88 | 2.06 | 2.02 |
| 78.0 | 1.321 | 1.233 | 1.147 | 7.17 | 6.94 | 2.09 | 2.05 |
| 79.0 | 1.277 | 1.191 | 1.108 | 7.23 | 6.99 | 2.12 | 2.08 |
| 80.0 | 1.235 | 1.151 | 1.070 | 7.28 | 7.04 | 2.14 | 2.11 |
| 81.0 | 1.195 | 1.113 | 1.034 | 7.33 | 7.09 | 2.17 | 2.13 |
| 82.0 | 1.156 | 1.076 | 0.999 | 7.39 | 7.14 | 2.20 | 2.16 |
| 83.0 | 1.118 | 1.041 | 0.966 | 7.44 | 7.18 | 2.22 | 2.19 |
| 84.0 | 1.082 | 1.007 | 0.934 | 7.48 | 7.23 | 2.25 | 2.21 |
| 85.0 | 1.047 | 0.974 | 0.903 | 7.53 | 7.27 | 2.27 | 2.24 |
| 86.0 | 1.014 | 0.942 | 0.874 | 7.57 | 7.31 | 2.30 | 2.27 |
| 87.0 | 0.982 | 0.912 | 0.845 | 7.62 | 7.35 | 2.33 | 2.29 |
| 88.0 | 0.951 | 0.883 | 0.818 | 7.66 | 7.39 | 2.35 | 2.32 |
| 89.0 | 0.921 | 0.855 | 0.791 | 7.69 | 7.43 | 2.38 | 2.35 |
| 90.0 | 0.892 | 0.828 | 0.766 | 7.73 | 7.46 | 2.41 | 2.37 |
| 91.0 | 0.864 | 0.802 | 0.742 | 7.76 | 7.49 | 2.43 | 2.40 |
| 92.0 | 0.838 | 0.777 | 0.719 | 7.80 | 7.52 | 2.46 | 2.43 |
| 93.0 | 0.812 | 0.753 | 0.696 | 7.82 | 7.54 | 2.48 | 2.45 |
| 94.0 | 0.787 | 0.730 | 0.675 | 7.85 | 7.57 | 2.51 | 2.48 |
| 95.0 | 0.763 | 0.708 | 0.654 | 7.87 | 7.59 | 2.54 | 2.51 |
| 96.0 | 0.740 | 0.686 | 0.634 | 7.89 | 7.61 | 2.56 | 2.53 |
| 97.0 | 0.718 | 0.666 | 0.615 | 7.91 | 7.62 | 2.59 | 2.56 |
| 98.0 | 0.697 | 0.646 | 0.597 | 7.93 | 7.63 | 2.62 | 2.59 |
| 99.0 | 0.677 | 0.627 | 0.579 | 7.94 | 7.64 | 2.64 | 2.61 |
| 100.0 | 0.657 | 0.609 | 0.562 | 7.94 | 7.65 | 2.67 | 2.64 |
| 101.0 | 0.638 | 0.591 | 0.546 | 7.95 | 7.65 | 2.70 | 2.67 |
| 102.0 | 0.620 | 0.574 | 0.530 | 7.95 | 7.65 | 2.72 | 2.69 |
| 103.0 | 0.602 | 0.558 | 0.515 | 7.94 | 7.64 | 2.75 | 2.72 |
| 104.0 | 0.585 | 0.542 | 0.501 | 7.94 | 7.63 | 2.77 | 2.75 |
| 105.0 | 0.569 | 0.527 | 0.485 | 7.92 | 7.92 | 2.80 | 2.77 |

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