SERVICE MANUAL

EVI DC INVERTER AIR TO WATER HEAT PUMP

CONTENTS

Part 1
General Information

1 Unit Capacities and External Appearance

1.1 Unit Capacities

Table 1-1.1: Capacity range

Capacity	10kW	15kW	18kW
Model	035ZA/(BE)-R32	050ZA/(BE)-R32	060ZA/(BE)-R32

1.2 External Appearance

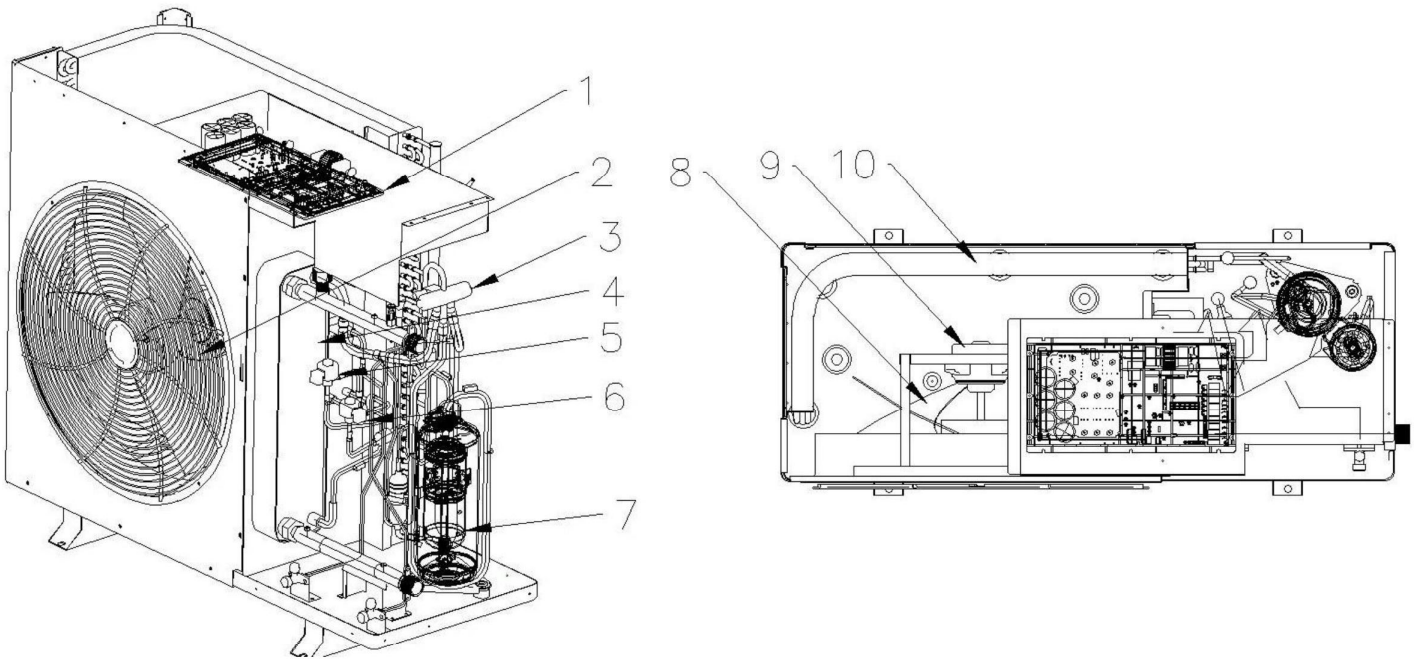
Table 1-1.2: Appearance

10kW	15/18kW
	

Part 2
Components Layout

1 Layout of Functional Components

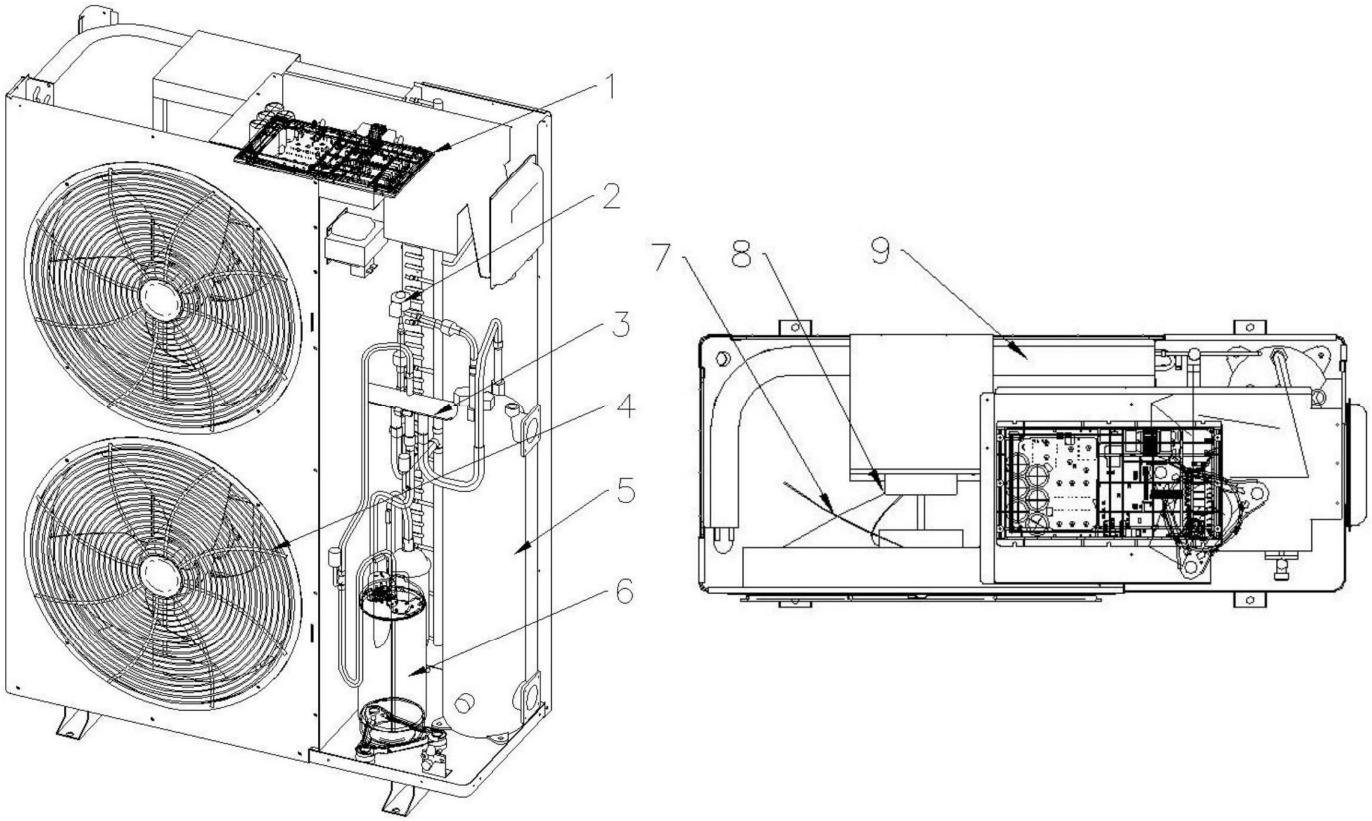
Figure 2-1.1: 035ZA/(BE)-R32 exploded view for reference



1	Electric control box
2	Fan grill
3	4-way valve
4	Plate heat exchanger
5	Main electronic expansion valve
6	EVI electronic expansion valve
7	EVI DC inverter compressor
8	Fan blade
9	Fan motor
10	Hydrophilic aluminum fin heat exchanger

1 Layout of Functional Components

Figure 2-1.2: 050ZA/(BE)-R32, 060ZA/(BE)-R32 exploded view for reference



1	Electric control box
2	Electronic expansion valve
3	4-way valve
4	Fan grill
5	Tube and shell heat exchanger
6	EVI DC inverter compressor
7	Fan blade
8	Fan motor
9	Hydrophilic aluminum fin heat exchanger

Key components:

1. **Compressor:**
   Compresses the refrigerant that absorbed heat from the air to further raise the refrigerant pressure and temperature to release the raised heat to the water. EVI DC inverter compressor is variable frequency compressor with Enhanced Vapor Injection technology that can improve the heating efficiency under cold climate.
2. **Gas-liquid separator:**
   Part of the compressor to separate liquid refrigerant and oil to protect compressor from liquid hammering.
3. **Tube and shell heat exchanger:**
   Release the heat (absorbed from the evaporator and the heat converted by the compressor) to the water through the refrigerant gas.
4. **Aluminum fin heat exchanger:**
   Absorbs heat from the air by vaporizing the refrigerant liquid flowing through the expansion valve.
5. **Electronic expansion valve:**
   Controls refrigerant flow and reduces refrigerant pressure.
6. **Four way valve:**
   Controls refrigerant flow direction. Open in cooling mode and closed in heating mode. When open, the air side heat exchanger functions as a condenser and water side heat exchanger functions as an evaporator; when closed, the air side heat exchanger functions as an evaporator and water side heat exchanger function as a condenser.
7. **Water flow switch:**
   Detects water flow rate to protect compressor and water pump in the event of insufficient water flow.
8. **DC inverter controller:**
   Control the heat pump unit, decompose and execute various instructions, and provide supervision and feedback in order to ensure the security and stability of the heat pump.
9. **Fan motor:**
   Works to improve the heat exchange efficiency of the aluminum fin heat exchanger.

Refrigerant Amount

Table 2-1.5: Refrigerant amount for different models

Model	035ZA/(BE)-R32	050ZA/(BE)-R32	060ZA/(BE)-R32
R32	52.91 OZ	70.55 OZ	70.55 OZ

Part 3
Control

1 Startup Control

1.1 Compressor Startup Delay Control

In initial startup control and in restart control (except in oil return operation and defrosting operation), compressor startup is delayed such that a 3-minute re-start delay time has elapsed since the compressor stopped, in order to prevent frequent compressor on/off and to equalize the pressure within the refrigerant system.

1.2 Compressor Startup Control

In initial startup control and in re-start control, compressor startup is controlled according to outdoor ambient temperature and water temperature. When there's heating/cooling demand calls, and after water pump works for 30s, compressor will start to increase rotation speed gradually until reach the startup platform and stays for 60 second stage. Once the 60 second stage is complete, the program proceeds to the subsequent stages to work in target rotation speed according to different outdoor ambient temperature and water temperature.

2 Normal Operation Control

2.1 Compressor Output Control

The compressor rotation speed is controlled according to the load requirement. Before compressor startup, the unit determines the compressor target speed according to outdoor ambient temperature and water temperature and then runs the appropriate compressor startup program. Refer to Part 3, 1.2 "Compressor Startup Program". Once the startup program is complete, the compressor runs at the target rotation speed.

During operation the compressor speed is controlled according to the setting and actual water temperature, the refrigerant system pressure, refrigerant temperature and ambient temperature.

2.2 Four-way Valve Control

The four-way valve is used to change the direction of refrigerant flow through the water side heat exchanger in order to switch between cooling and heating/DHW operations.

During heating and DHW operations, the four-way valve is powered off; during cooling and defrosting operations, the four-way valve is powered on.

2.3 Electronic Expansion Valve Control

The position of the electronic expansion valve of the main refrigerant circuit is controlled and adjusted according to the superheat degree.

- Superheat degree in heating mode = Suction temperature - Coil temperature.
- Super heat degree in cooling mode = Suction temperature - Cooling coil temperature.

2.4 DC Fan Motor Control

The speeds of the DC fans are adjusted in steps, as described below.

(1) DC fan motor starts 5s ahead of the compressor.

(2) In cooling mode, DC fan motor operates at 800RPM.

(3) In heating/hot water mode, when ambient temperature≤11°C, DC fan motor operates at 800RPM; when ambient temperature ≥13°C, DC fan motor operates at 750RPM.

(4) User Parameter 1 is the setting for the high speed limit of the DC fan motor. When the setting of this parameter *10 is lower than the RPM above, DC fan motor will operate according to the setting of this parameter; when the setting of this parameter is ≤ 40, this parameter will be invalid.

2.5 Water Pump Control

The water pump runs 30s prior to the compressor, and stops after compressor stops for 30s.

- In cooling/ heating mode, after water reaches the setting temperature, water pump works according to the setting of User Parameter 44. (0: Runs 1min in interval (User Parameter 45, default setting 5mins, 1: Stop running, 2: Keep running)
- In hot water mode, water pump stops working after hot water tank temperature reaches the setting temperature.
- Within 150s of the first power on, the water pump will not receive signal output for working demand.
- As long as three way valve is switched, the water pump will stop receiving signal output for 120s.
- Under standby status, if outdoor temperature ≤ the setting of User Parameter 46, water pump keeps running. If outdoor temperature ≥ the setting of User Parameter 46+2°C or the unit turn on, water pump works as described above.

2.6 Auxiliary Electric Heating Control

Auxiliary electric heating (activated when meeting either ABCD conditions or only E condition):

A. Heating mode, hot water mode, hot water + heating/ cooling mode

B. Ambient temperature < parameter 25

C. Set temperature - water tank/inlet temperature > 5°C (Note: Use inlet temperature for heating mode and water tank temperature for hot water mode.)

D. Continuous operation of the compressor for 30 minutes and (the water outlet temperature after 30mins) - (current water outlet temperature) < 1°C.

E. When there is a heating demand, if the compressor is stopped for more than 5 minutes and none of the closing conditions below are met, then the electric heating will be activated to heat up the water. After the compressor restarts (which can be understood as system fault protection exclusion), the electric heating will be turned off, and control will be the same as before, where it will only be activated when meeting various opening conditions.

The auxiliary electric heating will be turned off when meeting any of the following conditions:

A. Temperature ≥ set temperature

B. Switch to cooling mode

C. Remote On/Off switch (CN36) or air conditioner interlock switch (CN35) disconnected

D. Shutdown state

Note: When the electric heating is activated, the circulating water pump must be turned on.

Note: Hold the FUNCTION + UP buttons for 3 seconds during startup can activate/deactivate the auxiliary electric heating control (provided that none of the turn-off conditions are met).

2.7 Compressor Crankcase Heater Control

Conditions for Crankcase Heater to Turn On:

A) Upon initial power-up, if the following conditions are met simultaneously:

1)Outdoor temperature is <10°C ;

2)Outdoor coil temperature is <10°C ;

B) During standby mode, if the following conditions are met simultaneously:

1)The unit has been in the off state for ≥6 hours;

2)Outdoor temperature is <10°C ;

3)Outdoor coil temperature is <10°C.

Conditions for Crankcase Heater to Turn Off:

The heater will turn off when any of the following conditions are met:

A) An operation command is received during the preheating process (timed start or user start);

B) Outdoor temperature is >13°C ;

C) Any temperature malfunction occurs during the preheating process.

2.8 Drain Pan Heater Control

The drain pan heater will be turned on when the following conditions are met at the same time:

1.Outdoor ambient temperature is ≤1°C

2.Heating or hot water mode is selected

3.The compressor is turned on

The drain pan heater will be turned off when any of the following conditions are met:

1. Outdoor ambient temperature is >3°C

2. Mode is switched to cooling or turned off.

3. The compressor is turned off.

2.9 Remote ON/OFF Switch

1) When the remote on/off switch is closed, the unit is allowed to turn on the compressor for cooling, heating, or hot water mode (i.e. when there is a cooling, heating, or hot water demand and no shutdown protection has occurred, the unit will turn on the compressor).

2) When the remote on/off switch is open, the unit is not allowed to turn on the compressor, fan, or circulating water pump. During this time, if there is an anti-freezing situation, the unit will turn on the compressor, fan, and circulating water pump based on the anti-freezing conditions.

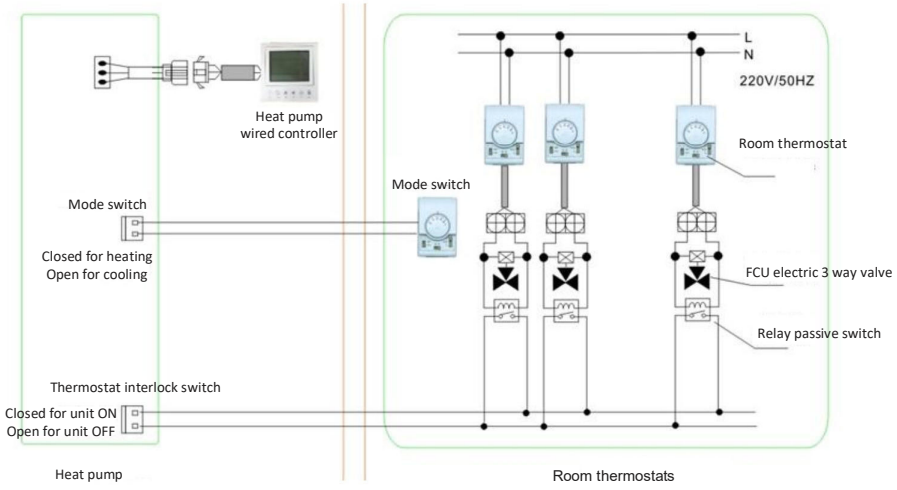
2.10 Thermostat Interlock Switch

1) When the thermostat interlock switch is closed, the unit is allowed to turn on the compressor for cooling or heating mode (i.e. when there is a cooling or heating demand and no shutdown protection has occurred, the unit will turn on the compressor).
2) When the thermostat interlock switch is open, the unit is not allowed to turn on the compressor, fan, or circulating water pump for cooling or heating. During this time, if there is an anti-freezing situation, the unit will turn on the compressor, fan, and circulating water pump based on the anti-freezing conditions.
3) Note: When the thermostat interlock switch is open, it will not prevent the unit from heating the water in hot water mode.

2.11 Mode Switch

1) If the unit detects that there is no wired controller connected after power-on, it will operate in a specific mode according to the mode switch. If the wired controller is connected again at this time, the unit will be controlled by the mode switch, and the wired controller will only be used to adjust the set parameters and monitor the operating status.
2) Once the mode switch control is entered, the unit will not exit the mode switch control even if there is a power outage and power is restored. The method to exit the mode switch control is to switch the mode using the wired controller or operate the power switch using the wired controller.
3) The mode switch control varies depending on the model selected by the dip switch. Specified as follows:

Function	Mode Switch open	Mode Switch Closed
Hot Water	Hot Water	Hot Water
Heating	Heating	Heating
Cooling	Cooling	Cooling
Hot Water + Heating	Heating	Hot Water
Hot Water + Cooling	Hot Water	Cooling
Hot Water + Heating + Cooling	Hot Water + Heating	Hot Water + Cooling
Cooling + Heating	Heating	Cooling



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2.12 Running Parameters

o1	Water tank temperature	Actual value is the reading value (℃)
o2	Inlet water temperature	Actual value is the reading value (℃)
o3	Outlet water temperature	Actual value is the reading value (℃)
o4	Ambient temperature	Actual value is the reading value (℃)
o5	Reserved	Not applicable
o6	EVI EEV opening	Actual value is the reading value x10 (step)
A1	Discharge temperature	Actual value is the reading value (℃)
A2	Coil temperature	Actual value is the reading value (℃)
A3	Suction temperature	Actual value is the reading value (℃)
A4	AC current	Actual value is the reading value (A)
A5	Main EEV opening	Actual value is the reading value x10
A6	Condensing coil temperature	Actual value is the reading value (℃)
A7	DC bus voltage	Actual value is the reading value x10 (V)
A8	IPM module temperaure	Actual value is the reading value (℃)
A9	Real-time power input	Actual value is the reading value x100 (W)
A10	DC fan motor speed	Actual value is the reading value x100 (RPM)
A11	High pressure value	Actual value is the reading value (bar)
A12	Low pressure value	Actual value is the reading value (bar)
A13	AC voltage	Actual value is the reading value x10 (V)
A14	Compressor frequency	Actual value is the reading value (Hz)
A15	EE code high order	/
A16	EE code low order	/
A17	Compressor phase current	Actual value is the reading value (A)
A18	Main control code low order	/
A19	Main control code high order	/
A20	Drive board EE verification code	/
A21	PWM water pump speed feedback	/
A22	Low pressure sensor converted saturation temperature	Actual value is the reading value (℃)

2.13 User Interface Parameters

Parameter	Description	Setting range	Default	Remarks
0	On/Off temperature difference (hysteresis)	1-30℃	Inlet water control (set by parameter 39)	Outlet water control (set by parameter 39)
			Cooling 3℃	Cooling 8℃
			Underfloor heating 4℃	Underfloor heating 9℃
			Fan coil heating 10℃	Fan coil heating 10℃
			Hot water 5℃	Hot water 5℃
1	DC fan motor maximum speed limit	4-100	4	**Actual =setting*10**
				When setting ⩽40, this limit is invalid
2	Timing temperature change	0-1	0	0: OFF
				1: ON
3	Reserved	0-30	15	
4	Reserved	24-50	30	
5	Timing period 1	23:00-06:00 h	23:00h	Valid when parameter 2 is 1
6	Timing period 2	06:00-09:00 h	6:00 h	Valid when parameter 2 is 1
7	Timing period 3	09:00-17:00 h	9:00 h	Valid when parameter 2 is 1
8	Timing period 4	17:00-23:00 h	17:00 h	Valid when parameter 2 is 1
9	Temp setting for timing period 1	20-55℃	35℃	Valid when parameter 2 is 1
10	Temp setting for timing period 2	20-55℃	35℃	Valid when parameter 2 is 1
11	Temp setting for timing period 3	20-55℃	30℃	Valid when parameter 2 is 1
12	Temp setting for timing period 4	20-55℃	40℃	Valid when parameter 2 is 1
13	Highest temperature setting allowed in any heating mode	20-90℃	50℃	Outlet water control default 55℃
14	Indoor temperature control bit (in development, not applicable yet)	0~1	0	
15	Indoor temperature compensation value (in development, not applicable yet)	-10~10℃	0	
16	Logical selection of indoor temperature and AC on/off switch (in development, not applicable yet)	0~1	0	
17	Reserved		0	
18	Reserved		0	
19	Reserved		0	
20	Condensing coil antifreeze protection	-30~3	-1	
21	Reserved	4~45	4	
22	Compressor frequency maximum limit	4-120	100	When setting ⩽30, this limit is invalid
23	Indoor temperature setting (in development, not applicable yet)	10~55℃	20	

2.13 User Interface Parameters

24	Maximum ambient temperature for heating	10-80℃	28	
25	Ambient temperature to start backup electric heater	-45-45℃	18	
26	Frequency decrease value for quiet running mode	1-20Hz	5	
27	Frequency increase value for fast heating mode	1-20Hz	5	
28	Time delay to switch mode when using Auto Mode	0-99 (*10min)	0	
29	Compressor cumulative running time to enter defrost	0-90min	60MIN	
30	Coil temperature to enter defrost mode	-20℃-5℃	-7	
31	Defrost ambient temperature setting	-20℃-5℃	-10	
32	Temp. difference between outdoor temp. and coil temp. to enter defrost	0℃-30℃	10	
33	Delay time to start defrosting	0-90min	45	
34	Maximum defrost run time (to exit defrost mode after starting)	5-45	12	
35	Outdoor coil temp. to exit defrost mode	-5-60℃	5	
36	Temp setting allowed for return water cycle	20-99℃	40℃	
37	Time setting for return water cycle	1-60min	6min	
38	Low ambient temperature protection setting (when compressor will be stopped)	-41-0℃	-30℃	As the lowest temperature the sensor can detect is -30℃, so actually the lowest available for this parameter setting is -30℃, if you set this parameter to be lower than -30, like -31, this protection is invalid. So please set in range of -30~0℃
39	Water inlet/outlet control selection	10-120min	50	40: turn off when inlet water temp setting is reached 41: turn off when outlet water temp setting is reached 42: reduce frequency when outlet water temp is reached Other value: reduce frequency when inlet water temp is reached
40	Under cooling status, when ambient≤ the absolute value of Parameter 40, compressor stop working	-45-45	15	If this parameter is set to negative number, the P16 low outlet water temperature protection will be invalid for glycol system. If for water system, please set this to positive number. For example, if need cooling for ambient temp>20℃, then for water system, this parameter needs to be set to 20, for glycol system, this parameter needs to be set to -20.
41	In heating mode, the α value of the constant temp target frequency formula	1-100	10	
42	In cooling mode, the α value of the constant temp target frequency formula	1-100	10	
43	Switching time of three-way valve 2	1-99min	5	In mode switch control, any setting of this parameter can exit mode switch control
44	Water pump working mode	0-2	2	0: run at intervals, 1: follow the comprssor, 2: run all the time
45	Water pump running time interval	1-30min	5	If parameter 44 is 0
46	Low ambient temp setting to turn on water pump when the unit is in OFF status When ambient ≤ para 46, run water pump When ambient> para 46+2℃, stop water pump	-25℃-5℃	-1 ℃	If remote on/off switch or AC on/off switch is disconnected, water pump will stop
47	Water system cleaning function (water flow protection will be shielded)	0-3	0	0: OFF 1: Run pump 2: Run pump and three way valve 1 3: Run pump and three way valve 1&2 If remote on/off switch or AC on/off switch is disconnected, water pump will stop
48	Activate manual frequency/main EEV/EVI EEV setting	0/1		0: No 1: Yes
49	Frequency setting	0-120		If parameter 48 is 1
50	Main EEV opening setting	0-480		
51	EVI EEV opening setting	0-480		
52	Adaptive defrost maximum extension time. If defrost time ≤8mins, the next defrost cycle is exted by 5mins	0-90	15	Extension time of 5mins for each cycle
53	Adaptive defrost minimum reduction time. If defrost time ≥11mins, the next defrost cycle is shortened by 5mins	-90-0	-15	Reduction time of 5mins for each cycle
54	Water pump interval start time	1-30	3	
55	Whether to accept grid control	0-1	0	
56	The running time setting after 2hrs of shutdown during peak power consumption	3-240min	60	
57	The hot water mode setting temp when using free electricity	8-Parameter 13	55	
58	The heating mode setting temp when using free electricity	8-Parameter 13	50	

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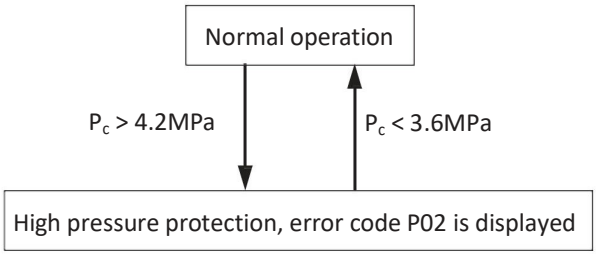
3 Protection Control

3.1 High Pressure Protection Control

This control protects the refrigerant system from abnormally high pressure and protects the compressor from transient spikes in pressure.

Figure 3-3.1: High pressure protection control



Notes:

1. P_c: Discharge pressure

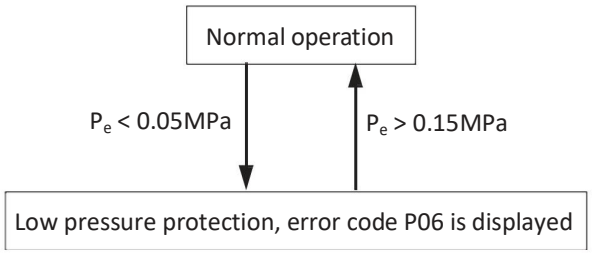
After compressor starts and the discharge pressure rises above 4.2MPa for 5s, the system displays P02 protection and the unit stops running. When the discharge pressure drops below 3.6MPa, the compressor recovers to normal operation.

Notes: If this protection occurs for 6 times within 1 hour, the unit will be locked and need to be restored by powering off.

3.2 Low Pressure Protection Control

This control protects the refrigerant system from abnormally low pressure and protects the compressor from transient drops in pressure.

Figure 3-3.2: Low pressure protection control



Notes:

1. P_e: Suction pressure

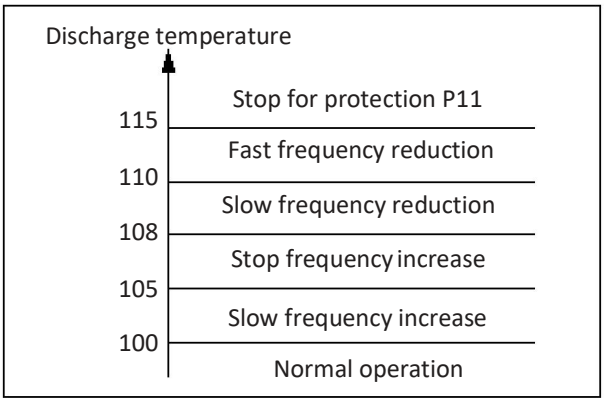
After compressor works for 5mins and the suction pressure drops below 0.05MPa for 5s, the system displays P06 protection and the unit stops running. When the suction pressure rises above 0.15MPa, the compressor recovers to normal operation.

Notes: If this protection occurs for 6 times within 1 hour, the unit will be locked and need to be restored by powering off.

3.3 Discharge Temperature Protection Control

This control protects the compressor from abnormally high temperatures and transient spikes in temperature.

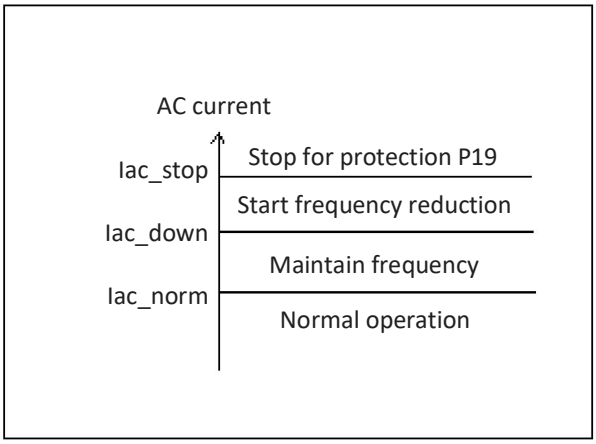
Figure 3-3.3: High discharge temperature protection control



3.4 Compressor Current Protection Control

This control protects the compressor from abnormally high currents.

Figure 3-3.4: Compressor current protection control



The compressor current protection control differs for cooling and heating/hot water mode, and also differs for different drive board models. Details specified as follows:

(1) Cooling mode:

Drive board model	Iac_ stop	Iac down	Iac norm
XW01ZFE3J2	12	10	8
XW01ZFE3J3	18	16	14
XW01ZFE3J5	23	21	18
XW01ZFE4Y6	33	31	27
XW01ZFE4Y8	38	35	33
Hiker120	39	37	34

(2) Heating/hot water mode:

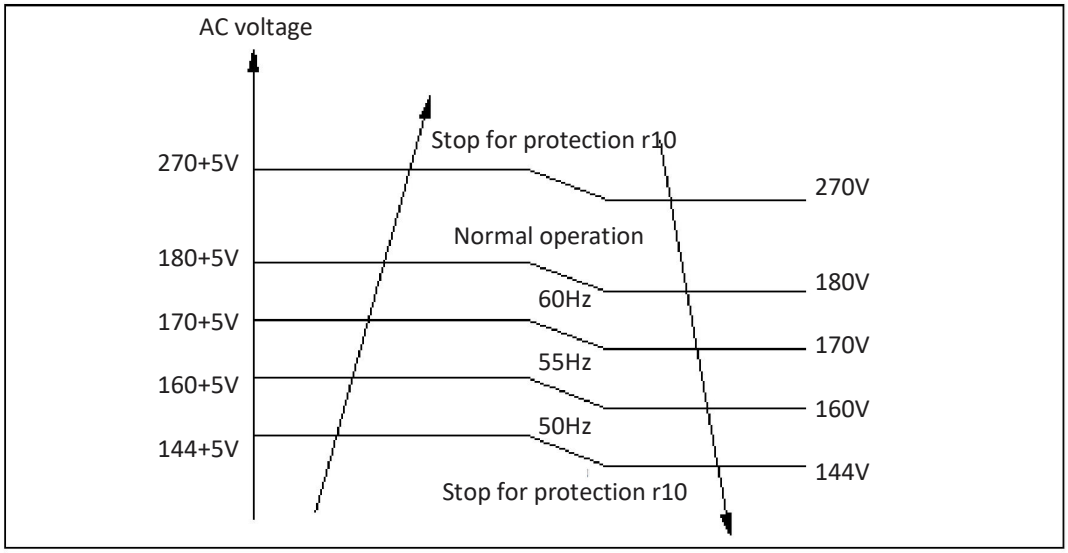
Drive board model	Iac_ stop	Iac down	Iac norm
XW01ZFE3J2	12	10	8
XW01ZFE3J3	19	17	15
XW01ZFE3J5	24	22	19
XW01ZFE4Y6	34	32	28
XW01ZFE4Y8	38	35	33
Hiker120	39	37	34

Notes: This protection is for single phase models only.

3.5 AC Voltage Protection Control

This control protects the unit from abnormally high or abnormally low AC voltages.

Figure 3-3.5: AC voltage protection control



(1) When AC voltage VAC ≥ 270+5V, unit stops for protection r10, unit will recover when VAC ＜ 270V for 60s.

(2) When AC voltage VAC＜ 180V for 5s, compressor working frequency will be limited to 60Hz, frequency limit will be canceled when VAC ≥ 180+5V for 60s.

(3) When AC voltage VAC＜ 170V for 5s, compressor working frequency will be limited to 55Hz, redetermine based on the current voltage frequency limit value when VAC ≥ 170+5V for 60s.

(4) When AC voltage VAC＜ 160V for 5s, compressor working frequency will be limited to 50Hz, redetermine based on the current voltage frequency limit value when VAC ≥ 160+5V for 60s.

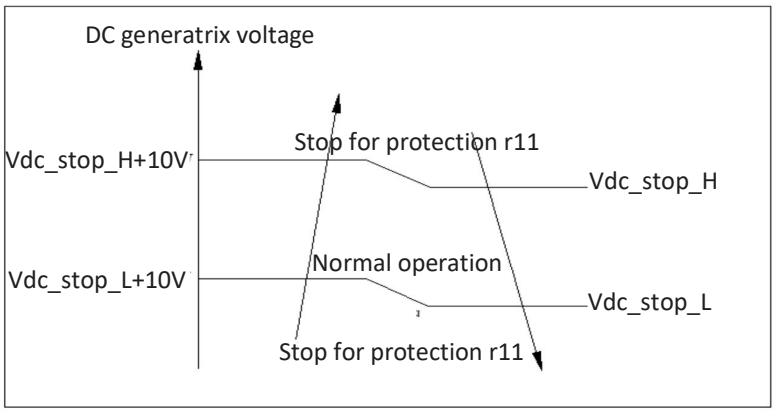
(5) When AC voltage VAC ＜ 144V, unit stops for protection r10, recover to normal operation when VAC ≥ 144+5V for 60s.

Notes: This protection is for single phase models only.

3.6 DC Generatrix Voltage Protection Control

This control protects the unit from abnormally high or abnormally low generatrix voltages.

Figure 3-3.6: DC generatrix voltage protection control



(1) When DC generatrix voltage VDC＜Vdc_stop_L or VDC ≥ Vdc_stop_H+10V for 10s, compressor stops for protection r11.

(2) When DC generatrix voltage VDC ≥ Vdc_stop_L+10V or VDC＜Vdc_stop_H, and meet compressor 3min protection, compressor recovers to normal operation.

The protection values Vdc_stop_H and Vdc_stop_L are different for different models as follows:

① Single phase models: Vdc_stop_L=140V ; Vdc_stop_H=390V

② Three phase models: Vdc_stop_L=320V ; Vdc_stop_H=408V

3.7 Abnormal Compressor Drive Protection Control

During the startup or operation of the compressor, if:

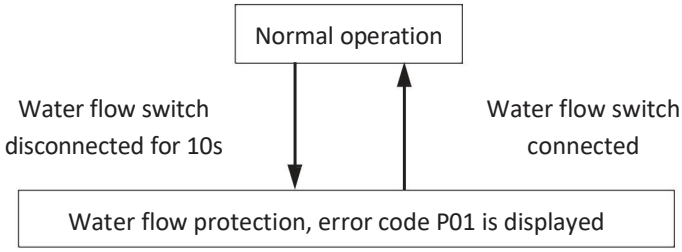
- no feedback signal is detected from the compressor, or
- an abnormal load is detected, or
- the compressor fails to start properly

The compressor will be shut down and restarted after 3 minutes. (In case of startup abnormality, it is possible to restart the compressor continuously for three times. If it still cannot start normally, it will stop the unit with error code r02. After restarting, this fault will be cleared.)

3.8 Water Flow Protection Control

This control protects the unit from abnormal water flow volume that will affect the heat exchange of the water system.

Figure 3-3.8: Water flow protection control



After the water pump is turned on, it will start detecting the water flow switch after 20 seconds. If the water flow switch remains disconnected for 10 seconds, the water pump will be immediately stopped.

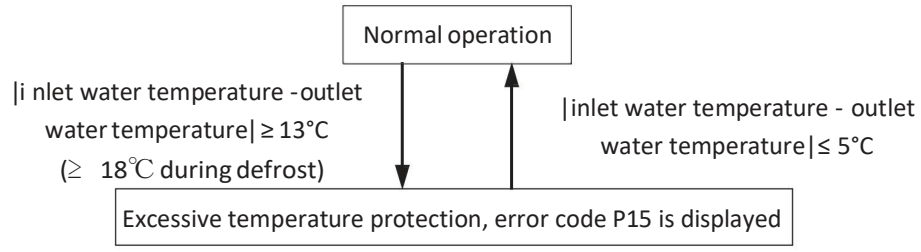
If the water flow switch continues to be disconnected for 10 seconds during the operation of the heat pump unit, the heat pump unit will be stopped with error code P01. (If the auxiliary electric heating has been turned on, it will also be stopped together.)

When the water flow switch is closed, the system will resume operation.

3.9 Excessive Temperature Difference Protection Control

This control protects the unit from abnormal temperature difference that reflects the problem on water system.

Figure 3-3.9: Excessive temperature difference protection control



In heating or cooling mode, when the unit starts and after the compressor works for 1 minute, if |inlet water temperature - outlet water temperature| ≥ 13°C (≥ 18°C during defrost) for 10 seconds, the system will activate the protection for excessive temperature difference between inlet and outlet water. The compressor and fan will stop running, while the water pump continues to run normally.

After 2 minutes, if |inlet water temperature - outlet water temperature| ≤5°C, the system will exit this protection.

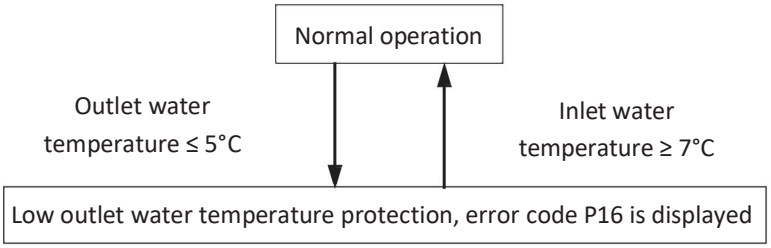
If this protection is activated during defrost mode, the defrosting will be stopped and the protection will be cleared.

Note: If the protection is activated 3 times within 30 minutes, the unit will be locked and can only be restored by restarting the power.

3.10 Low Outlet Water Temperature Protection Control

This control protects the unit from low water temperature that will cause freezing in water system that will damage the heat exchanger.

Figure 3-3.10: Low outlet water temperature protection control



In cooling mode or defrost mode, after the compressor has been running for 1 minute, if the outlet water temperature is ≤ 5°C, it will be judged as low temperature protection. The compressor and fan will stop running, while the water pump continues to run normally.

After the low temperature protection is activated, if the inlet water temperature is ≥ 7 °C, the system will exit the low temperature protection and the unit will resume normal operation.

If this protection occurs during defrost, the defrost will be stopped and the protection will be cleared.

Note: If this protection occurs 3 times within 30 minutes, the unit will be locked without circulation water pump signal output. The unit can only be restored by restarting the power.

Note: This protection can be set to invalid if the system is using glycol/brine that with lower freezing point.

3.11 Anti-freeze Protection Control

This control protects the water side heat exchanger from ice formation.

Antifreeze protection does not display any error code. After entering level 1 antifreeze protection, only the water pump icon will flash. After entering level 2 antifreeze protection, both the sun and water pump icons will flash, indicating entry into level 2 antifreeze protection.

1. Antifreeze protection is detected in the following situations:

1) During heating mode when the unit is turned off, the remote on/off switch is disconnected, and the thermostat interlock switch is disconnected.

2) During hot water mode, heating mode, hot water + heating mode and water reaches the setting temperature and the unit is shutdown.

3) When a fault occurs during operation and causes the unit to stop.

2. The actions of antifreeze protection:

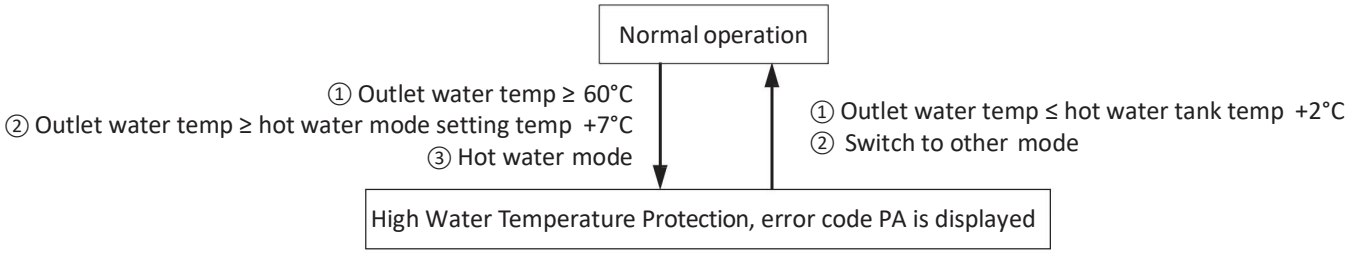
1) When 2°C ＜outlet temperature ≤ 4°C and ambient temperature ≤ 1°C , unit enters level 1 antifreeze protection. The water pump will continue to operate until outlet temperature ≥ 6°C or ambient temperature > 2°C, then unit exits level 1 antifreeze protection.

2) When outlet temperature ≤ 2°C and ambient temperature ≤1°C, unit enters level 2 antifreeze protection. The unit will automatically start and run in heating mode until outlet temperature ≥ 20°C or ambient temperature > 2°C, then unit exits the antifreeze protection.

3.12 High Water Temperature Protection Control

This control protects the system from high water temperature that will cause high pressure of the system.

Figure 3-3.12: High Water Temperature Protection Control



When the outlet water temperature reaches 60°C and reaches over hot water mode setting temperature + 7°C in hot water mode, the system displays PA protection and the compressor and fan motor stop running, while the circulation water pump keeps running.

When the outlet water temperature is below hot water tank temp +2°C or unit is switched to other modes, error disappears and unit runs normally.

4 Special Control

4.1 Defrosting Operation

In order to recover heating capacity, the defrosting operation is conducted when the outdoor unit air side heat exchanger is performing as a condenser. The defrosting operation is controlled according to outdoor ambient temperature, air side heat exchanger refrigerant outlet temperature, compressor running time and the defrost time.

The defrosting operation is as follows:

- When outdoor ambient temperature > -10°C (set by user interface parameter 31)
  A. Compressor cumulative running time reaches 60mins (set by user interface parameter 29) + automatic adaptive defrost time (one cycle between two defrosting times, with cumulative timing) and compressor works for consecutive 5mins.
  B. The air side heat exchanger refrigerant outlet temperature ≤ 7°C for more than 5mins.
  → The defrost operation starts when the above AB conditions occurs.

- When outdoor ambient temperature ≤ -10°C (set by user interface parameter 31)
  A. Compressor cumulative running time reaches 60mins (set by user interface parameter 29) + automatic adaptive defrost time (one cycle between two defrosting times, with cumulative timing) and compressor works for consecutive 5mins.
  B. The air side heat exchanger refrigerant outlet temperature ≤ 7°C for more than 5mins.
  C. The outdoor ambient temperature - air side heat exchanger refrigerant outlet temperature > 10°C (set by user interface parameter 32)
  D. Compressor cumulative running time reaches 105mins (set by user interface parameter 29 + user interface parameter 33) + automatic adaptive defrost time (one cycle between two defrosting times, with cumulative timing) and compressor works for consecutive 5mins.
  → The defrost operation starts when the above ABC or ABD conditions occurs.

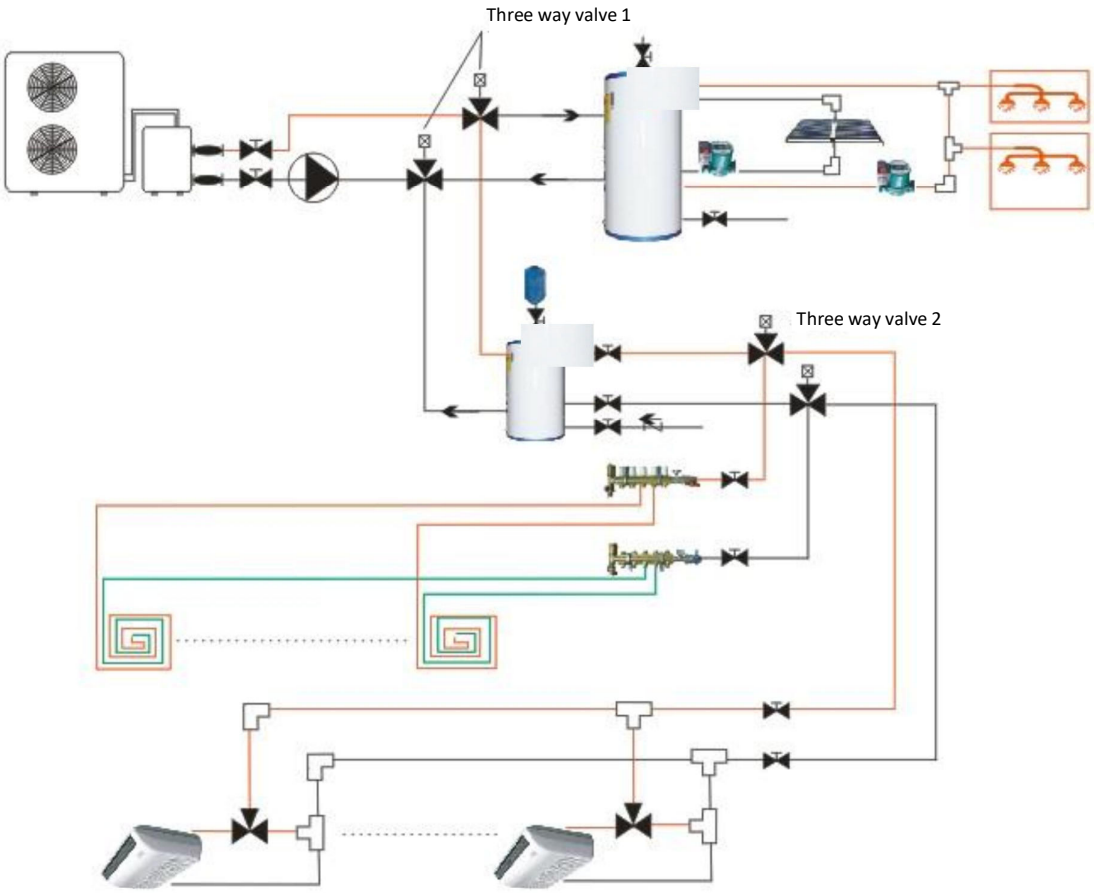
The defrosting operation ceases when any one of the following condition occurs:

- Defrosting operation duration ≥ 12 minutes (set by user interface parameter 34).
- The air side heat exchanger refrigerant outlet temperature ≥ 5°C (set by user interface parameter 35).
- The |inlet water temperature - outlet water temperature| ≥ 18°C for more than 10 seconds.
- Water side heat exchanger water outlet temperature ≤ 5°C.

4.2 Secondary Three Way Valve Operation

Secondary three way valve is installed when the installation site is using different types of terminal equipments.

Figure 3-4.2: Secondary three way valve control



* Fan coil heating mode is with the SUN icon flashing on the wired controller, 3-way valve 2 powered off.
* Underfloor heating mode is with the SUN icon keep lighted on the wired controller, 3-way valve 2 powered on.

In auto mode, 3-way valve 2 will be switching according to user interface parameter 43. When the water has not reached the setting temp, 3-way valve 2 will not switch, once water temp reaches the setting temp and compressor stops, 3-way valve 2 will start to count until time delay reaches user interface parameter 43, then it will switch.

5 Role of Temperature Sensors in Control Functions

Table 3-5.1: Names and functions of the temperature sensors

Number	Sensor name	Sensor code	Control functions
1	Discharge temperature sensor	Td	▪ Electronic expansion valve control[1] ▪ Discharge superheat control[2]
2	Outdoor ambient temperature sensor	Ta	▪ Compressor startup control[3] ▪ Compressor output control[4] ▪ Electronic expansion valve control[1] ▪ DC fan motor control[5] ▪ Water pump control[6] ▪ Auxiliary electric heater control[7] ▪ Crankcase heater control[8] ▪ Drain pan heater control[9] ▪ Defrosting operation control[10] ▪ Freeze prevention control[11]
3	Air side heat exchanger refrigerant outlet temperature sensor	Tc	▪ Electronic expansion valve control[1] ▪ Crankcase heater control[8] ▪ Defrosting operation control[10]
4	Water side heat exchanger refrigerant outlet (gas pipe) temperature sensor	Te	▪ Electronic expansion valve control[1]
5	Suction pipe temperature sensor	Tsu	▪ Electronic expansion valve control[1]
6	Water inlet temperature sensor	Ti	▪ Compressor startup control[3] ▪ Compressor output control[4] ▪ Auxiliary electric heater control[7] ▪ Freeze prevention control[11] ▪ Excessive temperature difference protection control[12]
7	Water outlet temperature sensor	To	▪ Freeze prevention control[11] ▪ Excessive temperature difference protection control[12] ▪ Low outlet water temperature protection control[13] ▪ High water temperature protection control[14]
8	Domestic hot water tank temperature sensor	Tw	▪ Auxiliary electric heater control[7]

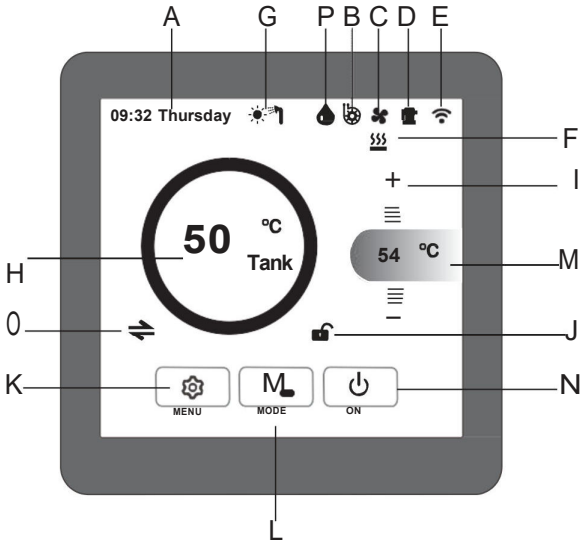
Notes:

1. Refer to Part 3, 2.3 “Electronic Expansion Valve Control”.
2. Refer to Part 3, 3.3 “High Discharge Temperature Protection Control”.
3. Refer to Part 3, 1.2 “Compressor Startup Control”.
4. Refer to Part 3, 2.1 “Compressor Output Control”.
5. Refer to Part 3, 2.4 “DC Fan Motor Control”.
6. Refer to Part 3, 2.5 “Water Pump Control”.
7. Refer to Part 3, 2.6 “Auxiliary Electric Heater Control”.
8. Refer to Part 3, 2.7 “Crankcase Heater Control”.
9. Refer to Part 3, 2.8 “Drain Pan Heater Control”.
10. Refer to Part 3, 4.1 “Defrosting Operation”.
11. Refer to Part 3, 3.11 “Anti-freeze Protection Control”.
12. Refer to Part 3, 3.9 “Excessive Temperature Difference Protection Control”.
13. Refer to Part 3, 3.10 “Low Outlet Water Temperature Protection Control”.
14. Refer to Part 3, 3.12 “High Water Temperature Protection Control”.

6 Use of Wire Controller

6.1 Icon Description

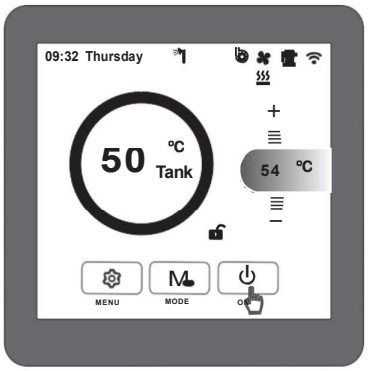
symbol	icon	instructions
A	09:32 Thursday	Time
B		water pump
C		Fan turbine
D		Compressor
E		WiFi
F		Electric heating
G		Mode display
H	50 ℃	Real-time Temperature Display
I	+/−	Adjust the set temperature
J		Keyboard Lock
K		Menu key
L		Mode selection
M	54 ℃	Set Temperature
N		The unit is on/off
O		Inlet water temperature/outlet water temperature/tank temperature in combination modeSettings toggle
P		Defrost



6.2 Use of Wire Controller

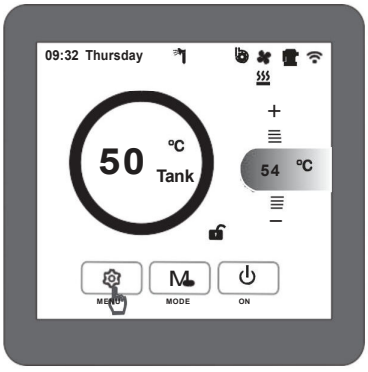
1 Start/shut down the unit

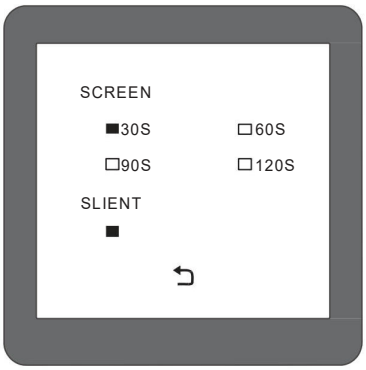
In standby mode, press the button ON to enter the startup state. In the startup state, press the button OFF, at which point the unit enters the shutdown state.



2 Wire Controller Setting

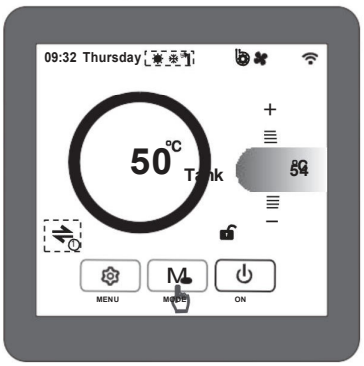
Under the main interface, press the Menu key MENU to enter the menu interface, and then press TIME to enter the remote controller settings interface, where you can adjust the time, date, language, on-screen time, and wire controller mute as needed.

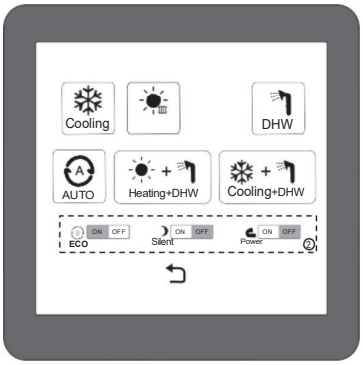




3 Mode selection

Under the main interface, press M to enter the mode selection interface:





:Cooling mode
(the circle on the display is blue, and the temperature in the circle is the inlet/outlet temperature)
:Heating mode
(the circle on the display is yellow, and the temperature in the circle is the inlet/outlet temperature)
:Hot water mode
(the circle on the display is red, and the temperature in the circle is the temperature of the tank)
:Automatic mode
:Heating + hot water mode
(tap the icon ⇌ to switch between different modes to check and set the temperature.)
:Cooling + hot water mode
(tap the icon ⇌ to switch between different modes to check and set the temperature.))
:Energy-saving solutions
:Silent solutions
:Powerful solutions

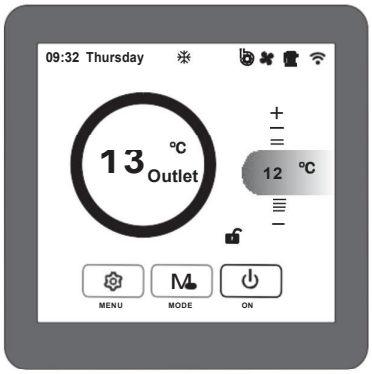
Note:

①Function icons are only displayed and operable in combination mode.

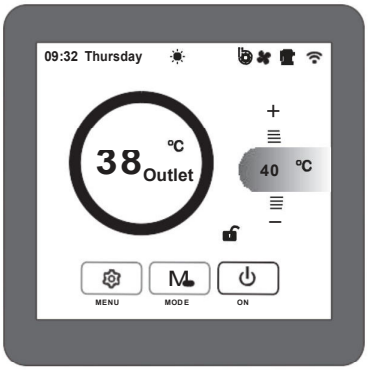
②If you need to enable the energy-saving, silent, or powerful plans, you can only set one plan, and you cannot turn on multiple plans at the same time.

③All possible modes are listed above and are for reference only. Some modes are only available on select models.

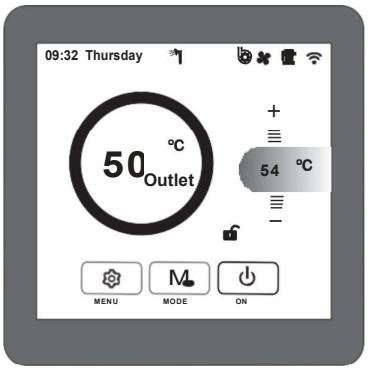
1) Cooling/Heating/Hot Water Mode



Cooling Mode (Blue Ring)

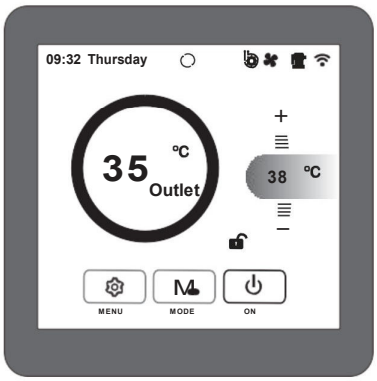


Heating Mode (Yellow Ring)



Hot Water Mode (Red Ring)

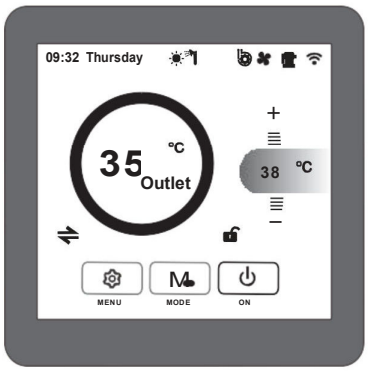
2) Automatic Mode



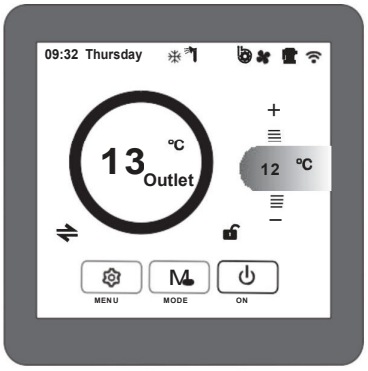
Automatic Mode (Red Ring/Yellow Ring/Blue Ring)

Note:
①In this mode, only the incoming and outgoing water temperatures can be set.
②In this mode, the aperture will cycle through red, yellow, and blue colors, and the numerical values within the aperture represent the actual water intake/Outflowing Water Temperature.

3) Heating + Hot Water Mode / Cooling + Hot Water Mode



Heating + Hot Water Mode (Red Ring/Yellow Ring)

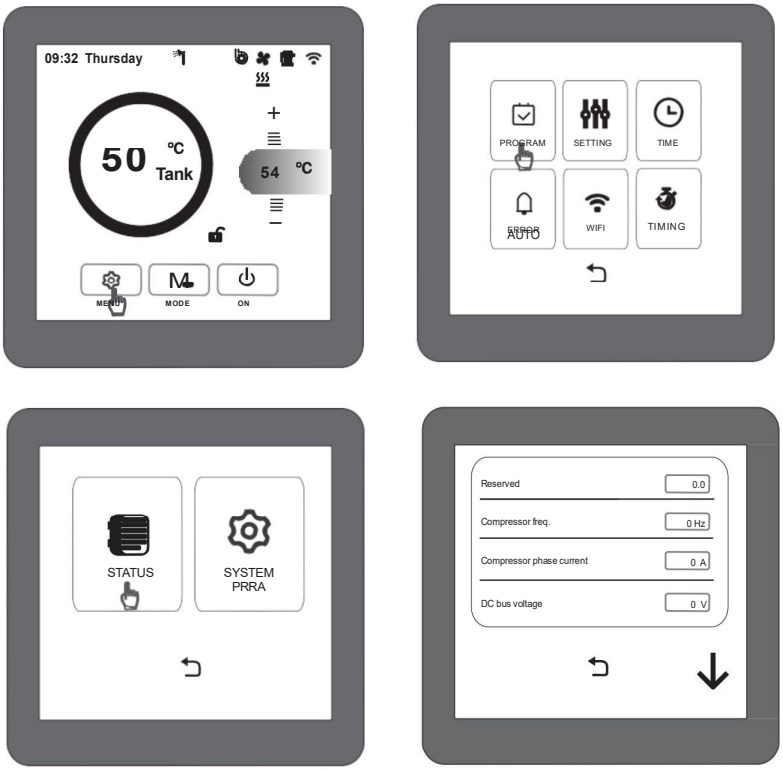


Cooling + Hot Water Mode (Red Ring/Bule Ring)

Note:
①In this mode, the main interface will appear with a switch icon ⇌ , and you can switch between different modes by tapping it.
②By toggling, you can set:
Heating/Hot Water Temperature (Heating + Hot Water Mode)
Cooling/Hot Water Temperature (Cooling + Hot Water Mode)

4 Query the running status of the unit

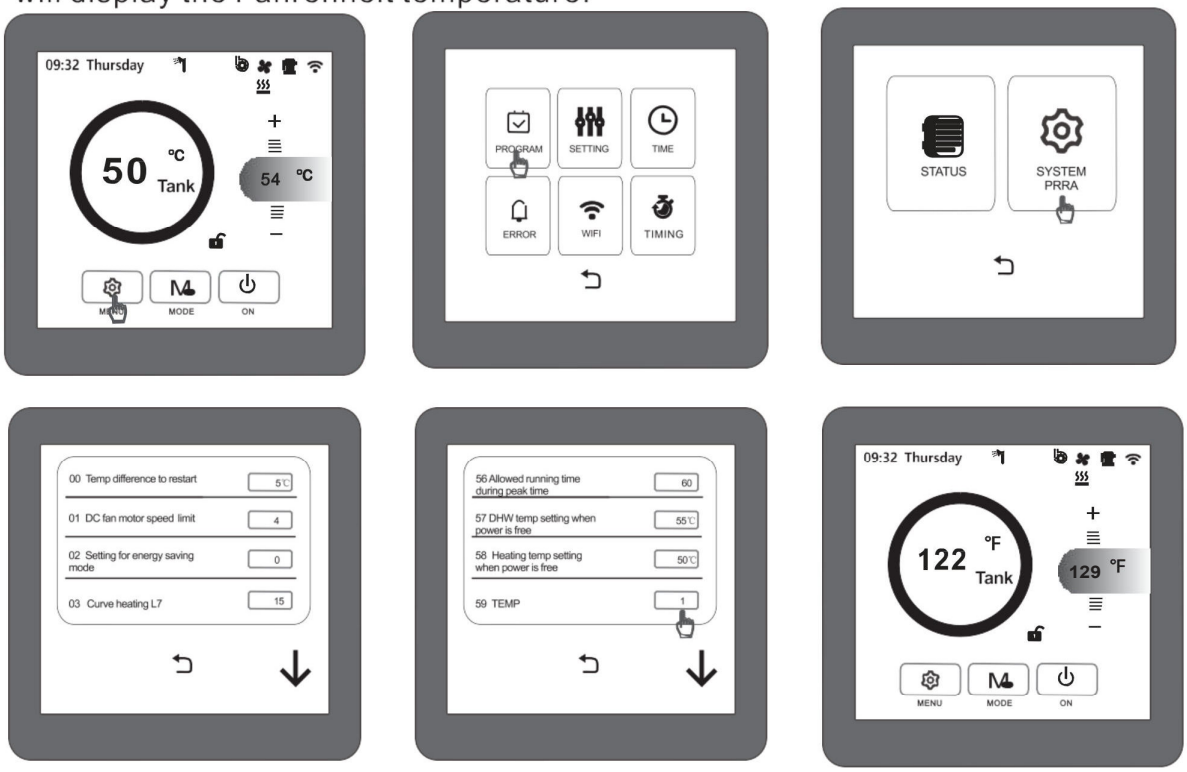
In the main interface, press ⚙ to enter the settings interface, press PROGRAM, and then click STATUS to enter the unit operation status interface, and press ↓ ↑ to turn pages to query the unit operation status.



5 User parameters

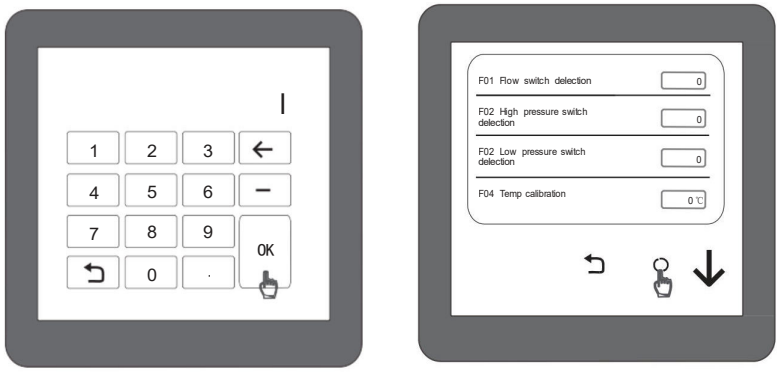
In the main interface, press ⚙ to enter the settings interface, press PROGRAM, then click SYSTEM PRRA to enter the user parameters interface, and press ↓ ↑ to turn pages to query.

Turn to the last page and set the parameter for "TEMP" to "1", and the wire controller will display the Fahrenheit temperature.



6 Factory parameters

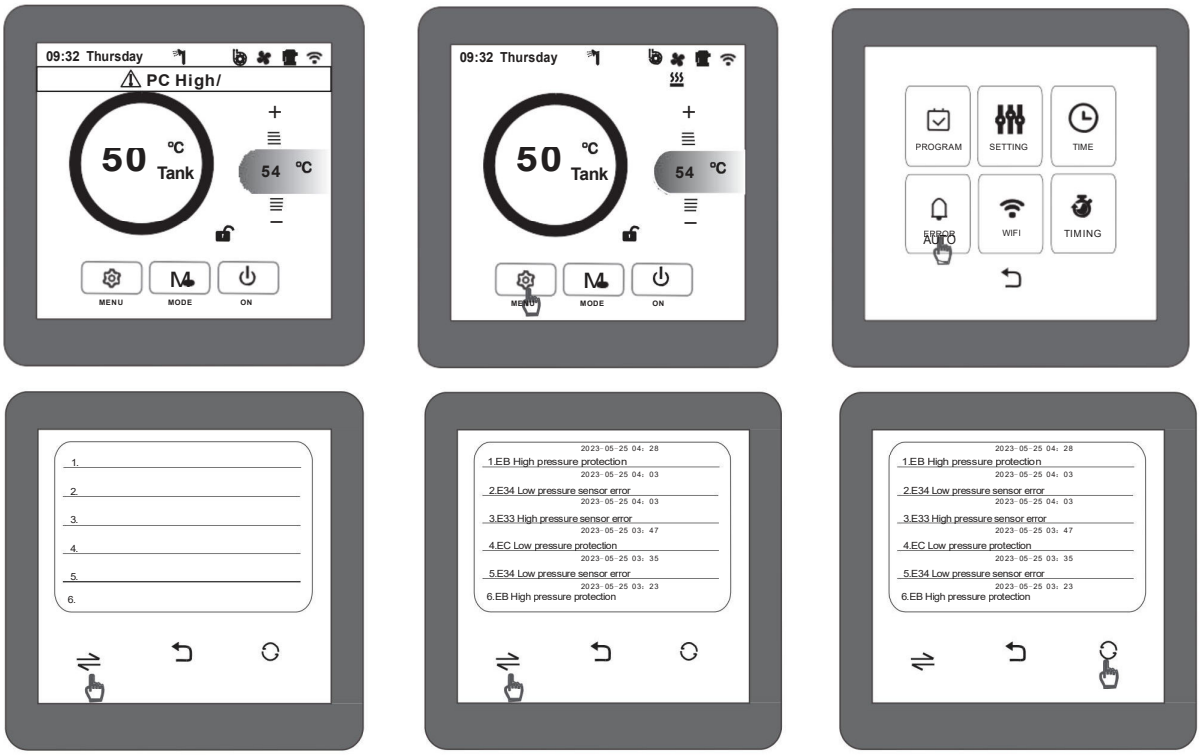
In the main interface, press [⚙] to enter the settings interface, then press SETTING, enter the password in the box, click [OK] to enter the factory parameter interface. You can press ↓ ↑ to flip through the page. Long press ↻ and you will hear "beep", indicating a factory reset.



7 Fault code

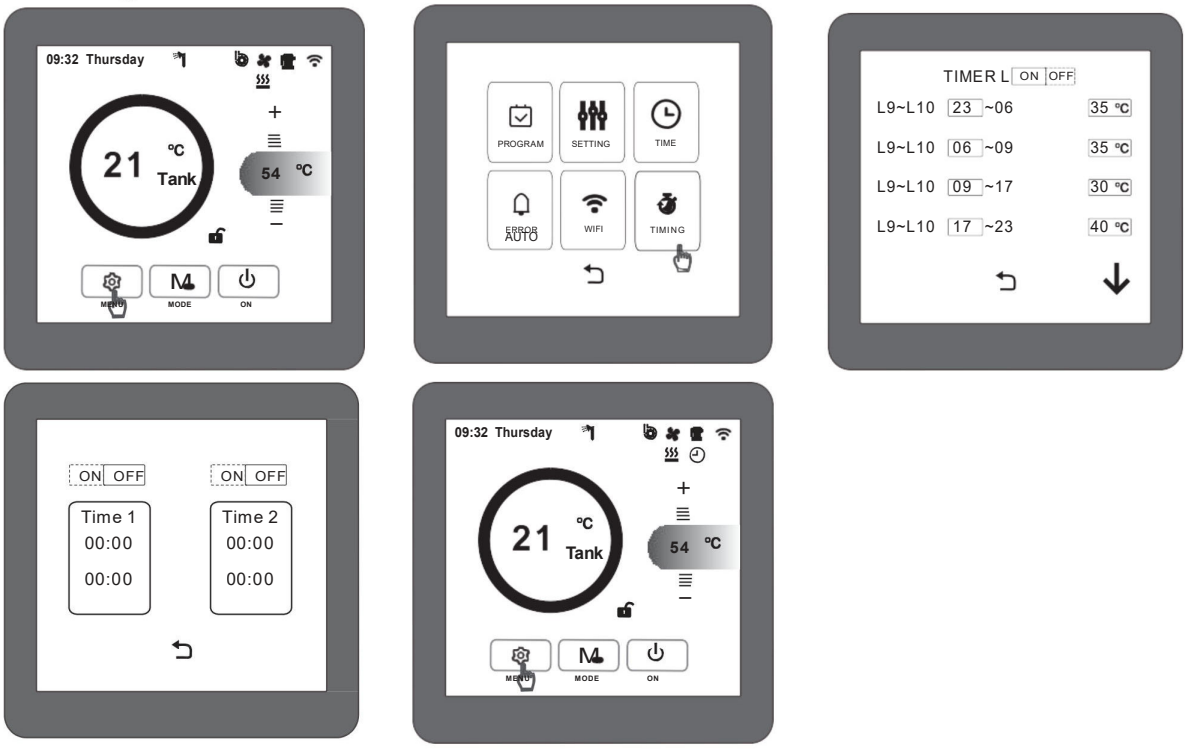
When the unit malfunctions, the main interface will display a red message reminder "⚠PC High/ "

In the main interface, press [⚙] to enter the settings interface, then press ERROR to view the current fault, press ⇌ to view the fault record, and long press ↻ to clear all fault records.



8 Timer setting

In the main interface, press to enter the menu interface, press to enter the custom time period temperature setting interface, press ON OFF to activate the current setting； Press to enter the timed power on/off setting interface, where you can set the power on/off time period as needed. Touch ON OFF above each time period to activate the corresponding power on/off time period. Users can set up to two time periods simultaneously. After setting the timer, there is a '' on the main interface.

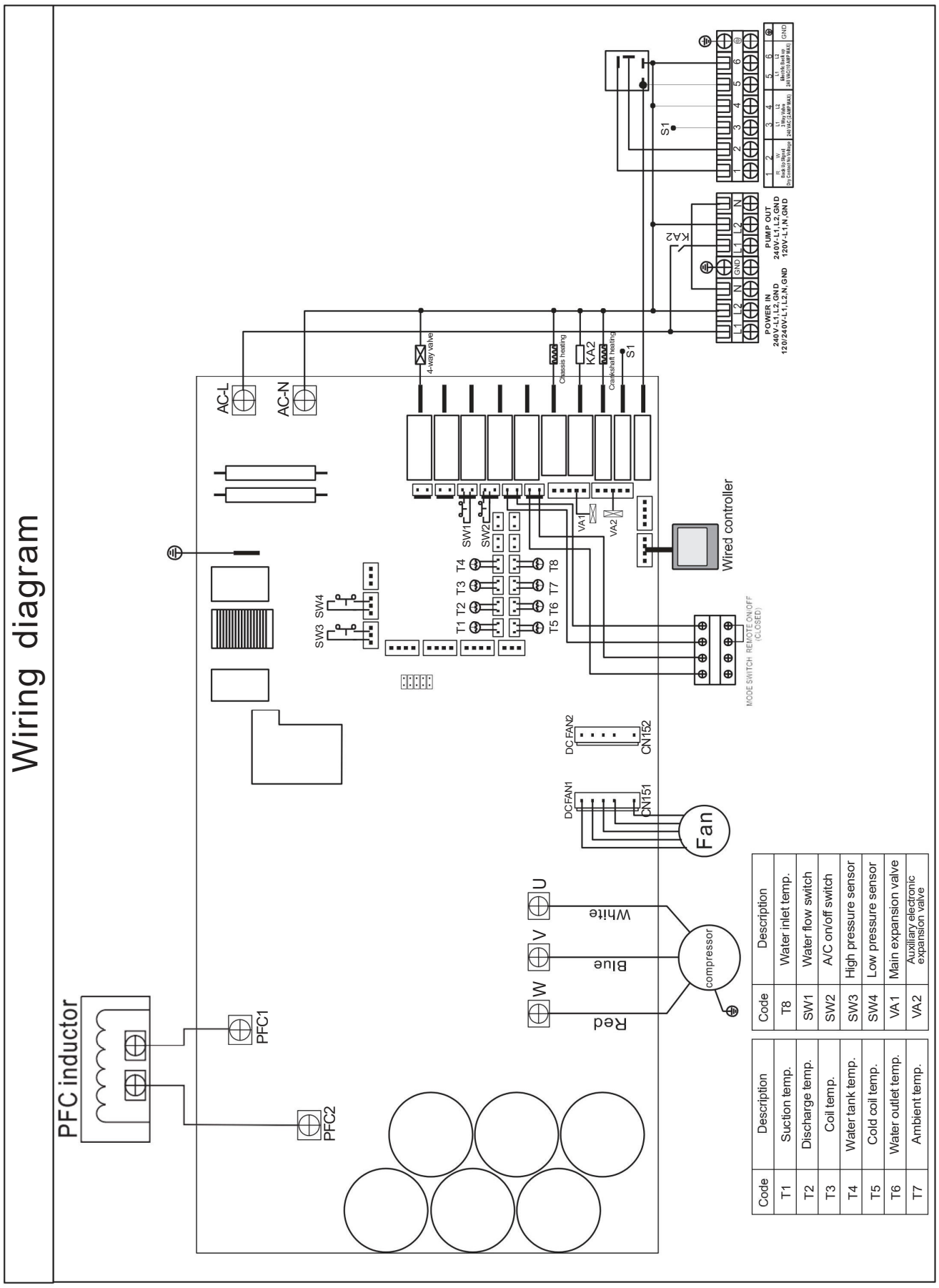


9 Forced defrosting

In the main interface, press to enter the menu interface, press and hold until the remote control emits two beeping beeps, at which point the forced defrost function is turned on and the defrost icon is displayed on the main interface.

7 Wiring diagram

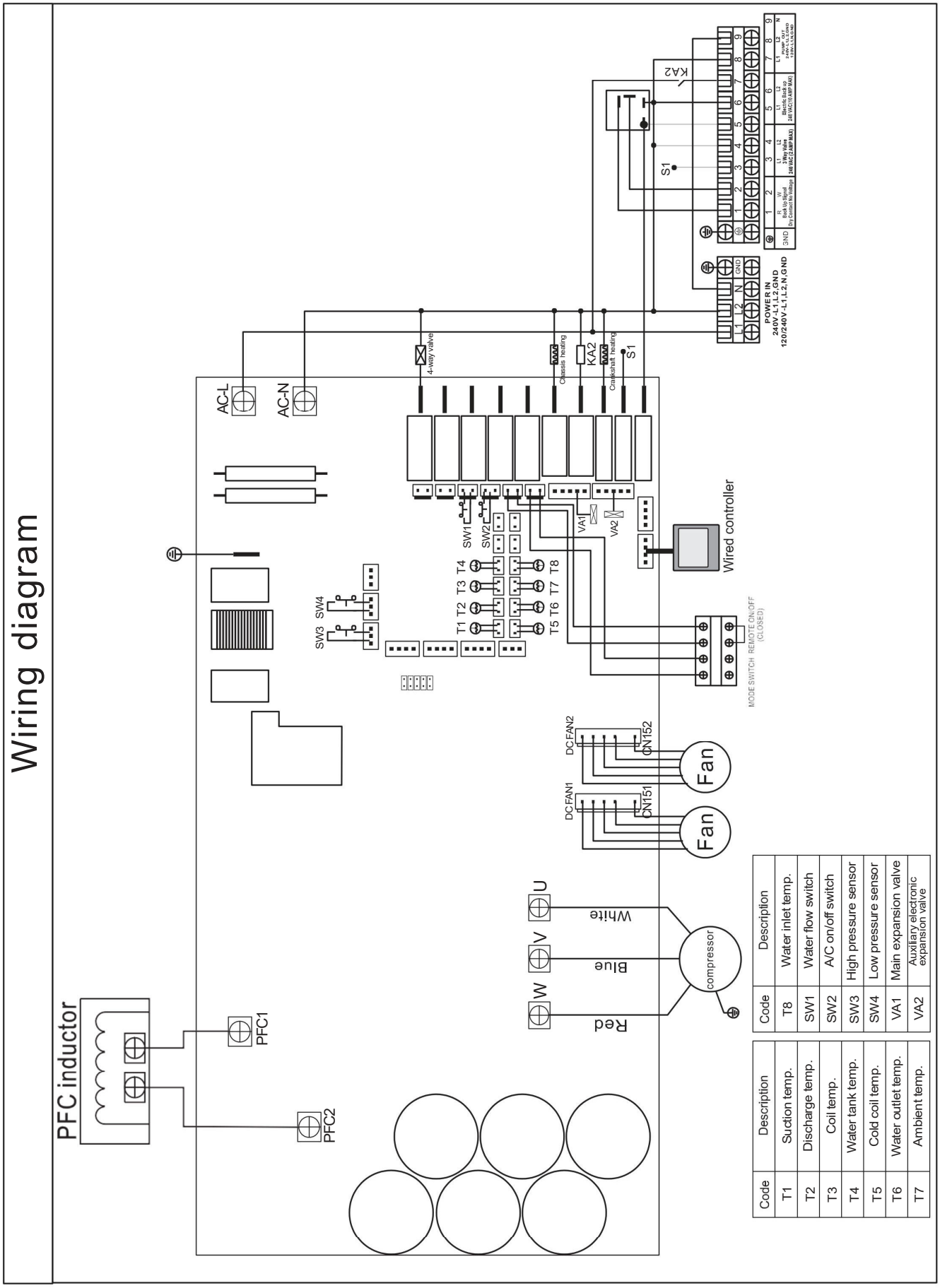
7.1 MACHRW035ZA/(BE)-R32



Code	Description
T1	Suction temp.
T2	Discharge temp.
T3	Coil temp.
T4	Water tank temp.
T5	Cold coil temp.
T6	Water outlet temp.
T7	Ambient temp.

Code	Description
T8	Water inlet temp.
SW1	Water flow switch
SW2	A/C on/off switch
SW3	High pressure sensor
SW4	Low pressure sensor
VA1	Main expansion valve
VA2	Auxiliary electronic expansion valve

Wiring diagram



Code	Description
T1	Suction temp.
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T3	Coil temp.
T4	Water tank temp.
T5	Cold coil temp.
T6	Water outlet temp.
T7	Ambient temp.

Code	Description
T8	Water inlet temp.
SW1	Water flow switch
SW2	A/C on/off switch
SW3	High pressure sensor
SW4	Low pressure sensor
VA1	Main expansion valve
VA2	Auxiliary electronic expansion valve

33

Part 4
Diagnosis and Troubleshooting

1 Outdoor Unit Electric Control Box Layout

Figure 4-1.1: Electric control box of 035ZA/(BE)-R32 for reference

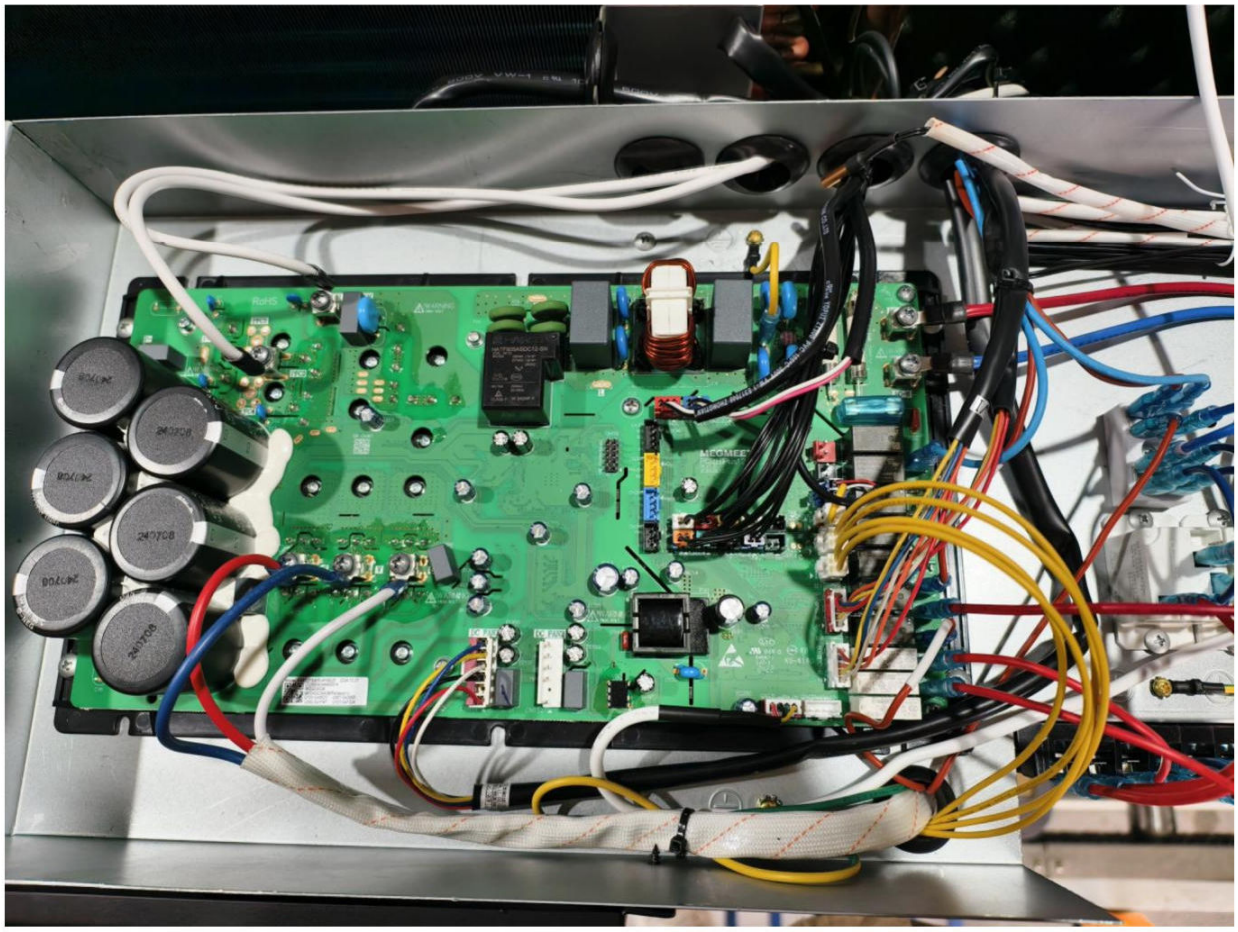
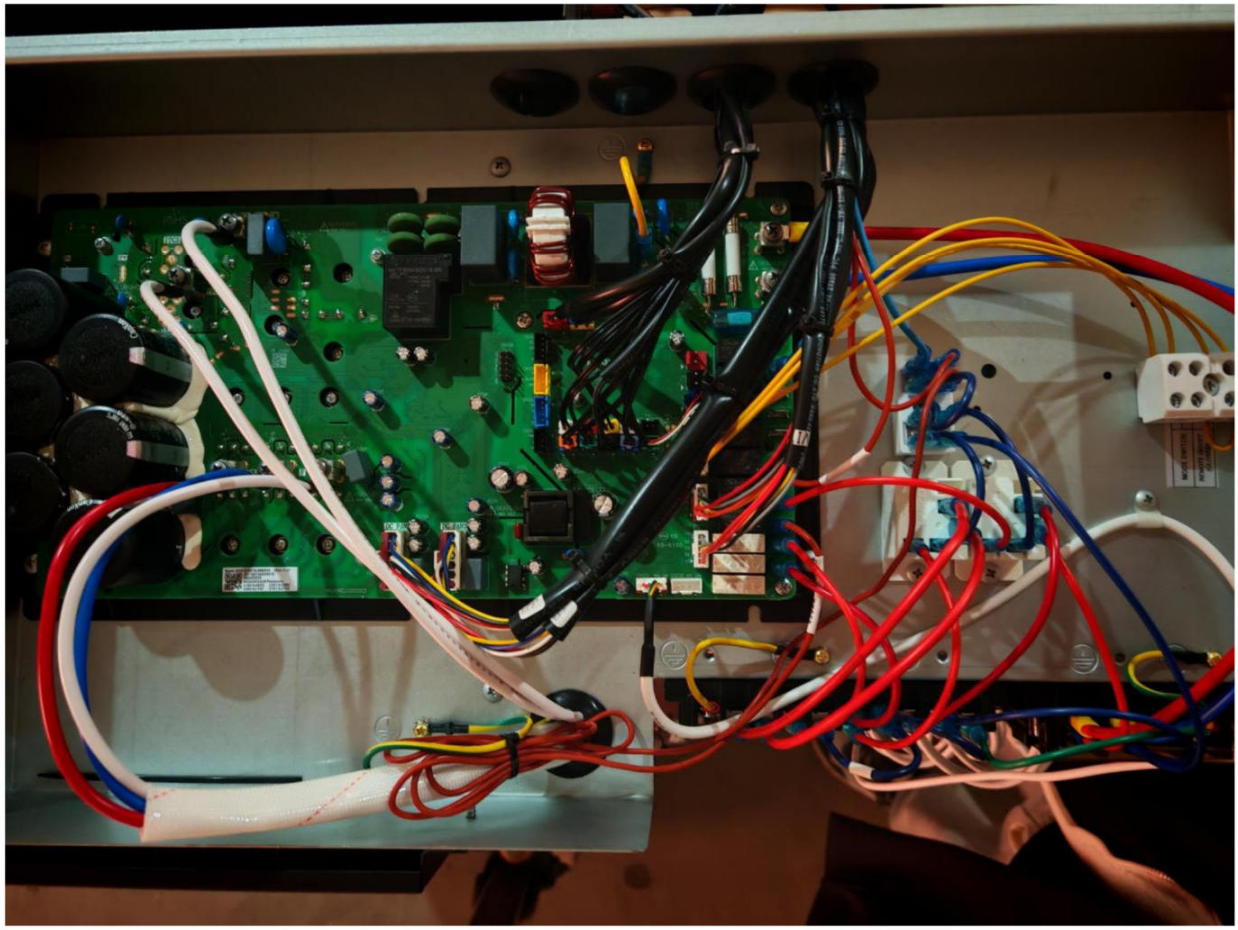


Figure 4-1.2: Electric control box of 050ZA/(BE)-R32, 060ZA/(BE)-R32 for reference



2 Outdoor Unit PCB

2.1 Types

All models have a main control board (PCB) and a drive board (inverter module).

The location of PCB in the outdoor unit electric control boxes are shown in Figures 4-1.1 to 4-1.3 in Part 4, 1 “Outdoor Unit Electric Control Box Layout”.

2.2 PCB Instruction

Figure 4-2.1: Main control board (PCB) of 035ZA/(BE)-R32, 050ZA/(BE)-R32, 060ZA/(BE)-R32

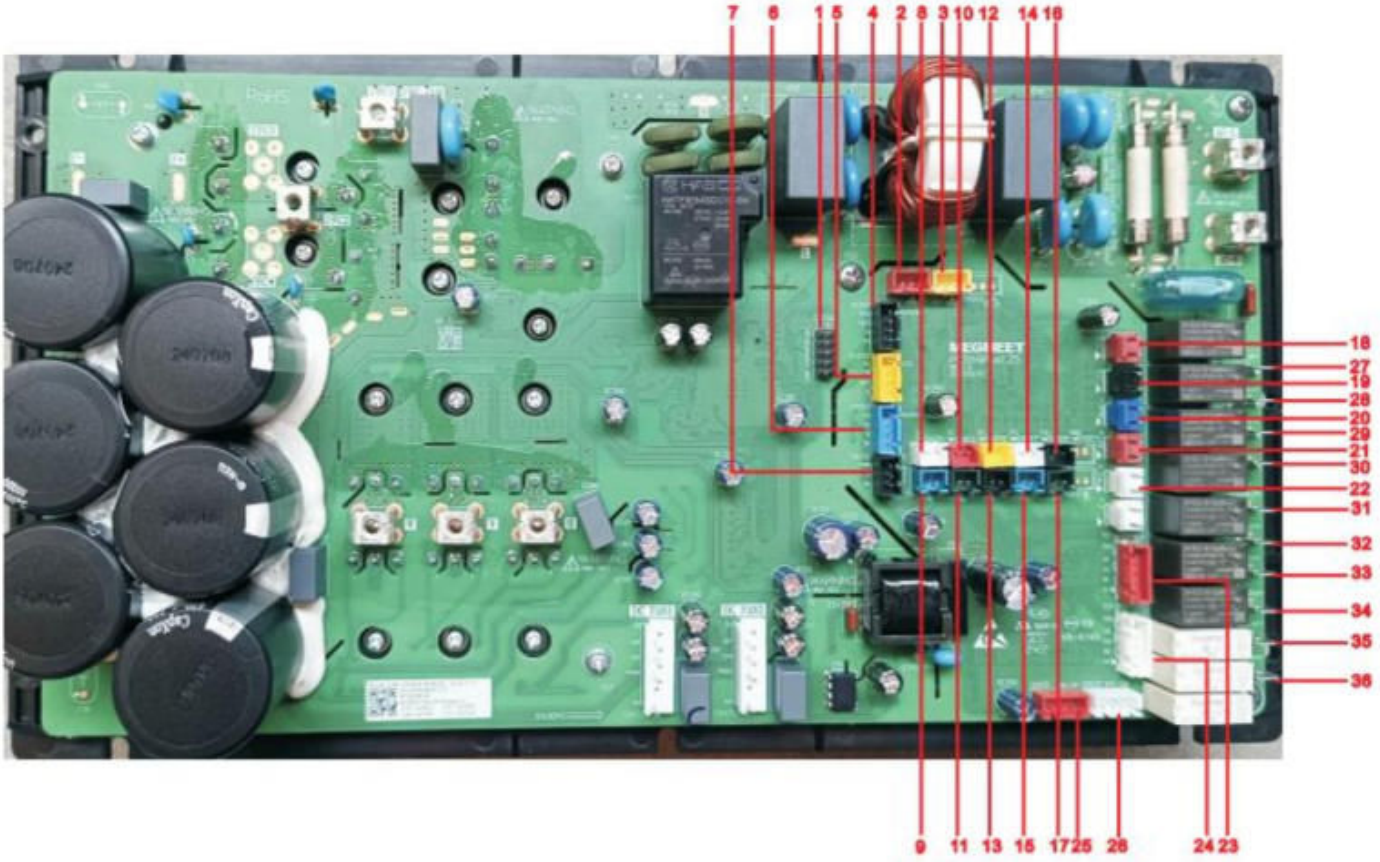


Table 4-2.1: Main control board (PCB) of 035ZA/(BE)-R32, 050ZA/(BE)-R32, 060ZA/(BE)-R32

Label in Figure 4-2.1	Code	Content
1	CN102	DSP/compressor parameters/drive control
2	CN311	High pressure sensor
3	CN312	Low pressure sensor
4	CN301	EE Program burning port
5	CN302	Program burning port
6	CN303	Computer monitoring
7	CN310	DC water pump
8	CN201	Suction temp.
9	CN202	Cold internal coil temp.
10	CN203	Discharge temp.
11	CN204	Water outlet temp.
12	CN205	Coil temp.
13	CN206	Ambient temp.
14	CN207	Water tank temp.
15	CN208	Water inlet temp.
16	CN209	EUV power grid
17	CN210	Grid SG
18	CN221	High voltage switch
19	CN222	Low voltage switch
20	CN223	Water flow switch
21	CN224	Air conditioning online switch
22	CN211A	Emergency switch
23	CN251	Main expansion valve
24	CN252	Auxiliary expansion valve
25	CN231	Wire controller
26	CN232	Remote module
27	L201	Four-way valve
28	L202	AC Fan
29	L203	Reserve
30	L204	Secondary water pump
31	L205	Unloading valve
32	L206	Chassis heating belt
33	L207	Water circulating pump
34	L208	Crankshaft heating belt
35	L209	Three-way valve
36	L210	Electric heating

3 Error Code Table

Table 4-3.1: Error code table

Error Code	Content	Remarks	PCB LED Flash Time
E01	Discharge temperature sensor fault		8
E05	Outdoor coil temperature sensor fault		10
E09	Suction temperature sensor fault		9
E13	Condensing coil temperature sensor fault		29
E18	Outlet water temperature sensor		31
E19	Inlet water temperature sensor	No backup heating output	30
E20	Water tank temperature sensor fault	No backup heating output	
E21	Controller communication fault	Unit off and no backup heating output	4
E22	Outdoor ambient temperature sensor fault		11
E26	Indoor board and outdoor board communication fault(For split unit)		
E27	Communication fault between main control board and drive board		3
E28	Main control board EEPROM fault		28
E33	Main road high pressure sensor fault		The light is always on
E34	Main road loop low pressure sensor fault		The light is always on
r01	IPM modular temperature too high		17
r02	Compressor start fault	Unit lockdown after 6 times in half an hour	5
r06	Compressor phase current protection		14
r10	High/low AC current protection or phase loss protection for 3 phase models		15
r11	DC bus voltage too high or too low protection		16
r13	IPM modular fault	Unit lockdown after 6 times in half anhour	6
P01	Water flow switch protection	Unit lockdown after 3 times	27
P02	High pressure protection	Unit lockdown after 6 times in an hour	19
P06	Low pressure protection	Unit lockdown after 6 times in an hour	20
P11	Discharge temperature too high protection		18
P15	Large temp difference protection between water inlet and outlet	Unit lockdown after 3 times	33
P16	Outlet water temperature too low protection	Unit lockdown after 3 times	34
P19	AC current protection		13
P27	Condensing coil temperature too high protection		21
P30	Condensing coil temperature antifreeze protection		24
PA	High outlet water temp protection		35
PC	High/low ambient temp protection		22
EB	High pressure protection(pressure sensor)		19
EC	EEV loop low pressure protection		20
FA	DC fan motor protection	Unit lockdown after 3 times	12

4 Troubleshooting

4.1 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 heat pump 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.

4.2 P01 Troubleshooting

4.2.1 Digital display output

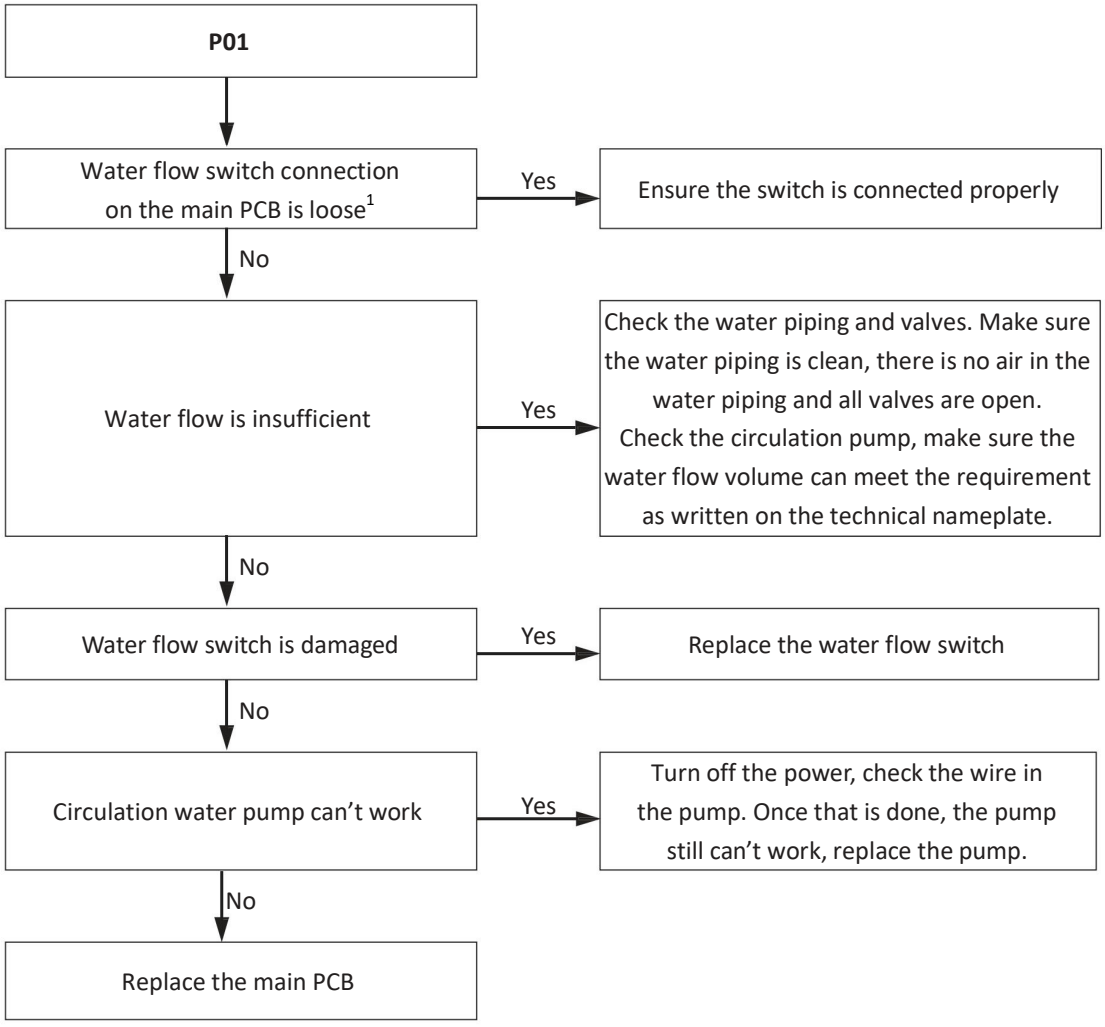
4.2.2 Description

- Water flow failure.
- Heat pump stops running.
- When P01 error occurs for 3 times, a manual system restart is required before the system can resume operation.
- Error code is displayed on the wired controller.

4.2.3 Possible causes

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

4.2.4 Procedure



Notes:

1. Water flow switch connection is port CN223 on the main PCB (labeled 20 in Figure 4-2.1).

4.3 E21 Troubleshooting

4.3.1 Digital display output

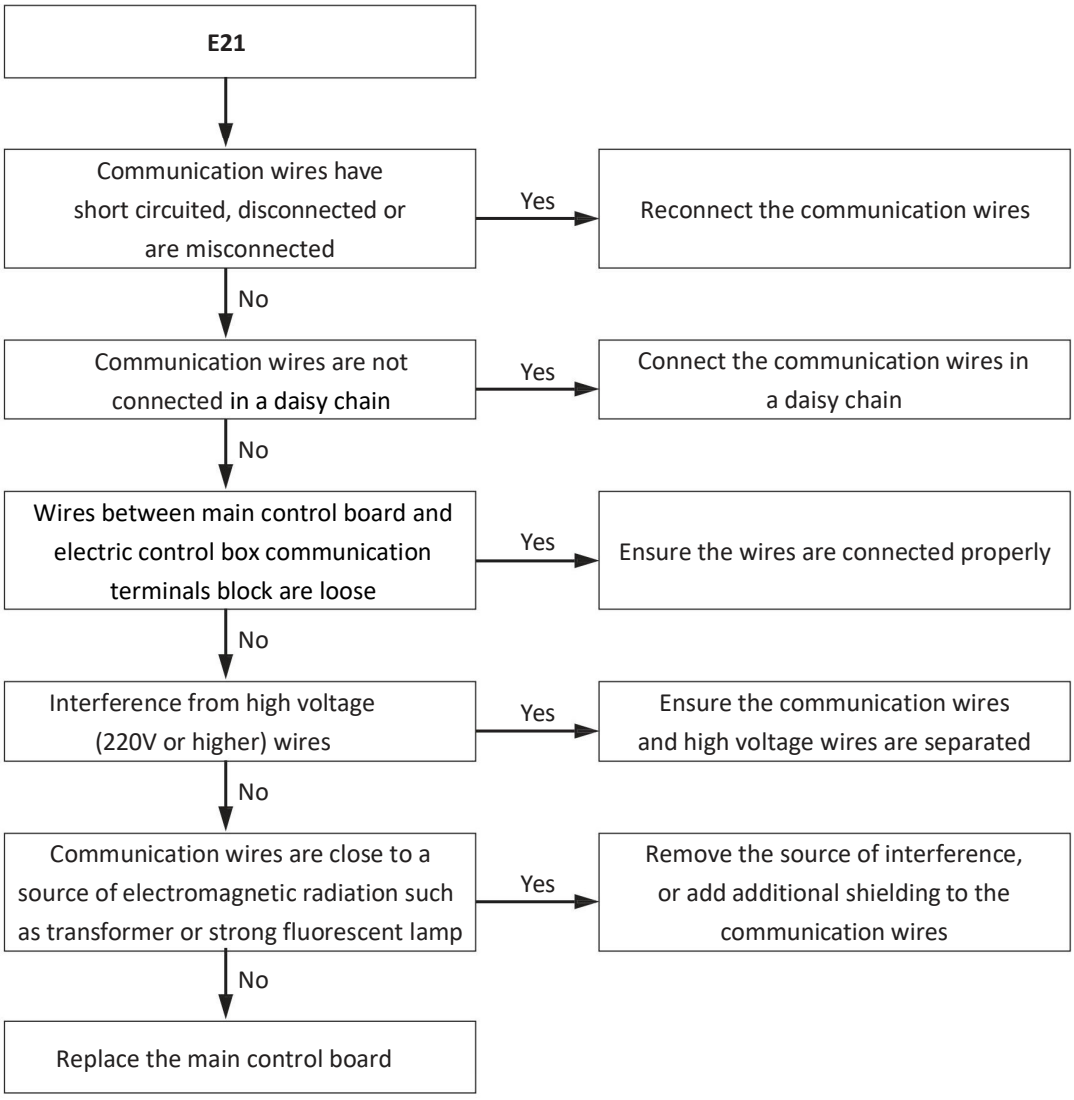
4.3.2 Description

- Communication error between wired controller and main control board.
- Heat pump stops running.
- Error code is displayed on the wired controller.

4.3.3 Possible causes

- Communication wires between wired controller and main control board not connected properly.
- Communication wiring terminals misconnected.
- Loosened wiring within electric control box.
- Interference from high voltage wires or other sources of electromagnetic radiation.
- Damaged main control board or electric control box communication terminals block.

4.3.4 Procedure



4.4 E01, E05, E09, E13, E18, E19, E20, E22 Troubleshooting

4.4.1 Digital display output

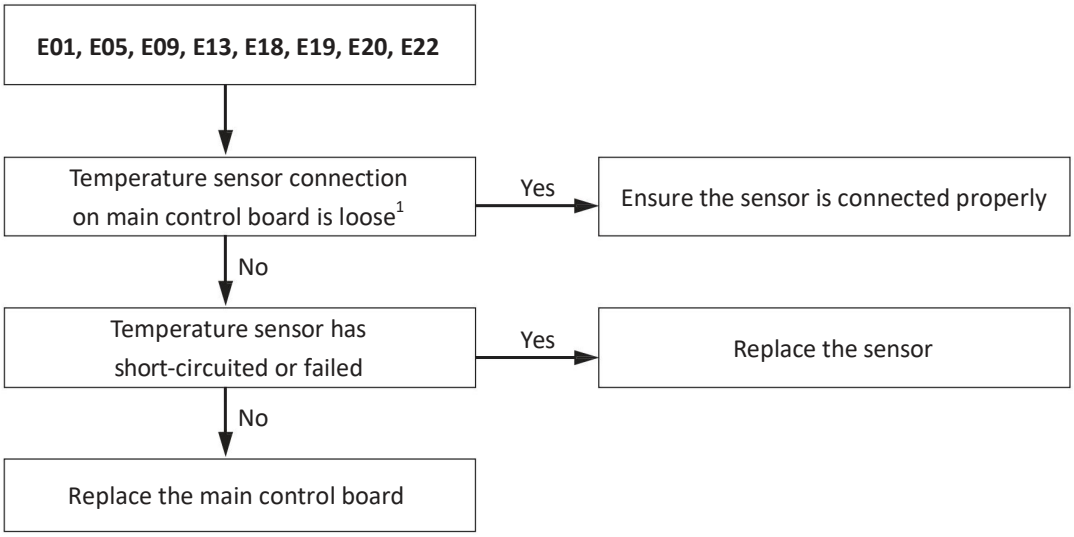
4.4.2 Description

- E01 indicates discharge temperature sensor error
- E05 indicates air side heat exchanger refrigerant outlet temperature sensor error.
- E09 indicates compressor suction pipe temperature sensor error.
- E13 indicates water side heat exchanger refrigerant outlet temperature sensor error.
- E18 indicates water side heat exchanger water outlet temperature sensor error.
- E19 indicates water side heat exchanger water inlet temperature sensor error.
- E20 indicates water tank temperature sensor error.
- E22 indicates outdoor ambient temperature sensor error.
- Heat pump stops running.
- Error code is displayed on the wired controller.

4.4.3 Possible causes

- Temperature sensor not connected properly or has malfunctioned.
- Damaged main control board.

4.4.4 Procedure



Notes:

1. Discharge temperature sensor connection is port CN203 on te main PCB (labeled 10 in Figure 4-2.1).
   Outdoor coil temperature sensor connection is port CN205 on the main PCB (labeled 12 in Figure 4-2.1).
   Suction temperature sensor connection is port CN201 on the main PCB (labeled 8 in Figure 4-2.1).
   Condensing coil temperature sensor connection is port CN202 on the main PCB (labeled 9 in Figure 4-2.1).
   Outlet water temperature sensor connection is port CN204 on the main PCB (labeled 11 in Figure 4-2.1).
   Inlet water temperature sensor connection is port CN208 on the main PCB (labeled 15 in Figure 4-2.1).
   Water tank temperature sensor connection is port CN207 on the main PCB (labeled 33 in Figure 4-2.1).
   Outdoor ambient temperature sensor connection is port CN206 on the main PCB (labeled 13 in Figure 4-2.1).

4.5 E28 Troubleshooting

4.5.1 Digital display output

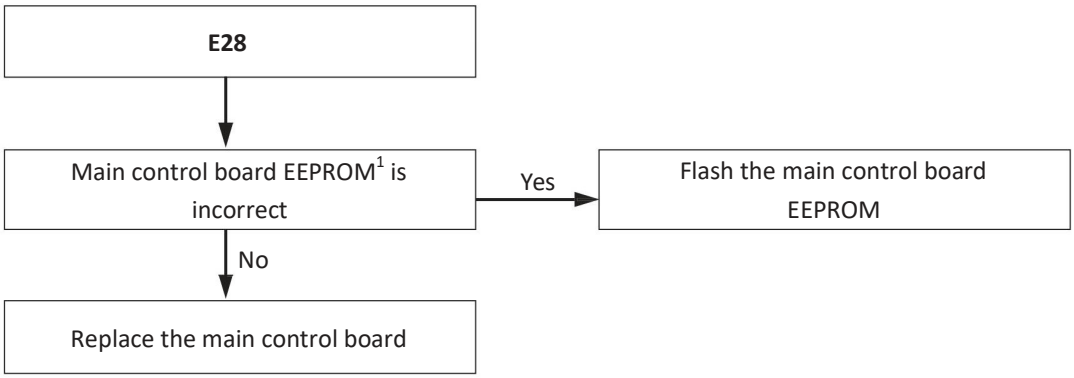
4.5.2 Description

- Main control board EEPROM error.
- Heat pump stops running.
- Error code is displayed on the wired controller.

4.5.3 Possible causes

- Main control board EEPROM is not connected properly.
- Main control board damaged.

4.5.4 Procedure



Notes:

1. Main control board EEPROM is designated CN301 on the main control board (labeled 4 in Figure 4-2.1).

4.6 r11 Troubleshooting

4.6.1 Digital display output

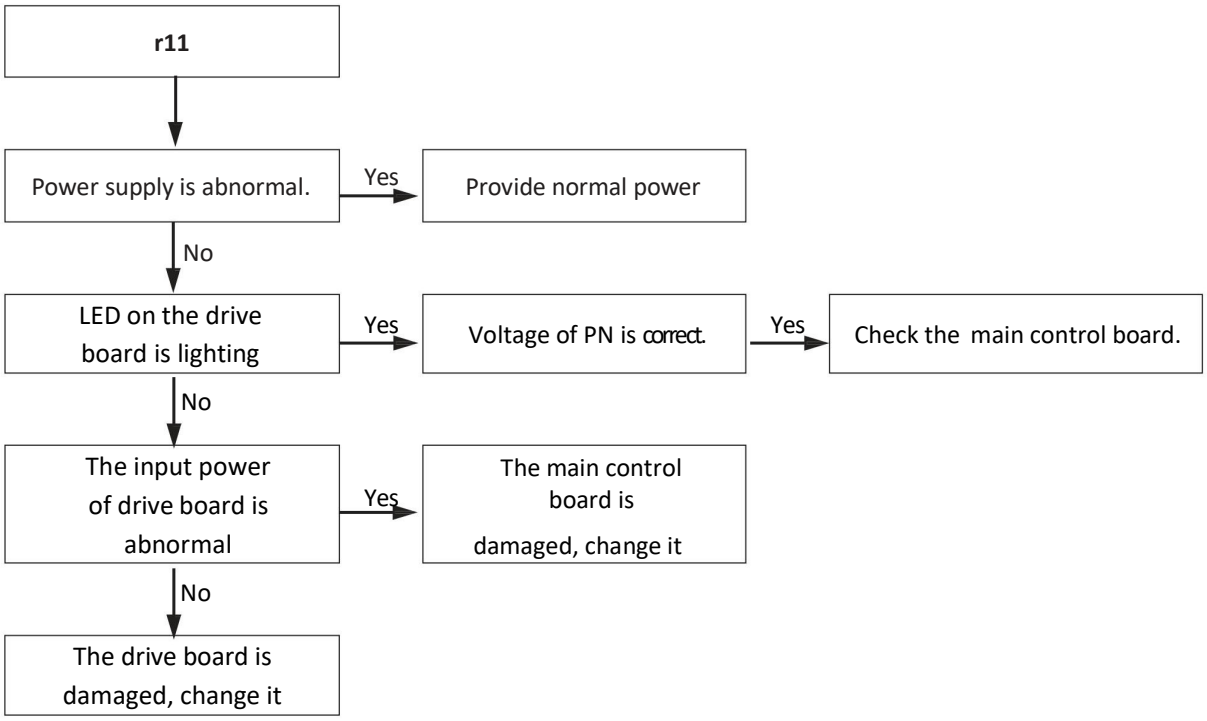
4.6.2 Description

- Low or high DC generatrix voltage.
- Heat pump stops running.
- Error code is displayed on the wired controller.

4.6.3 Possible causes

- The DC generatrix voltage is too low or too high.

4.6.4 Procedure



45

4.7 E26 Troubleshooting

4.7.1 Digital display output

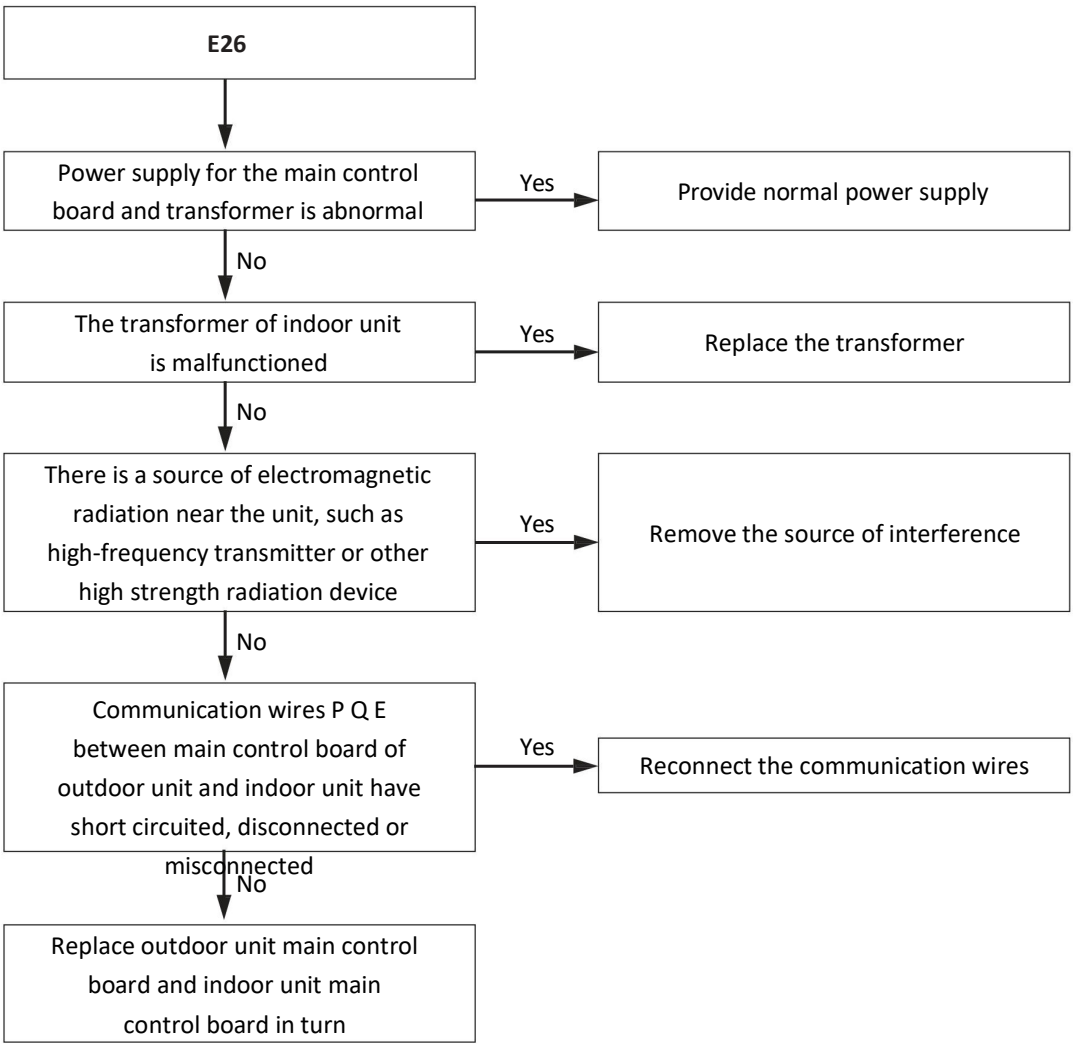
4.7.2 Description

- Communication error between outdoor unit and indoor unit.
- Heat pump stops running.
- Error code is displayed on the wired controller.

4.7.3 Possible causes

- Power supply abnormal.
- Transformer malfunction.
- Interference from a source of electromagnetic radiation.
- Outdoor unit main control board or indoor unit main control board damaged.

4.7.4 Procedure



4.8 E27 Troubleshooting

4.8.1 Digital display output

4.8.2 Description

- Communication error between outdoor unit main control board and drive board.
- Heat pump stops running.
- Error code is displayed on the wired controller.

4.8.3 Possible causes

- Wrong wiring connection between main control board and module drive board.
- Loose connection on inductor or inductor damaged.
- Module drive board short circuit or damaged.
- Interference on communication signal DC voltage.
- Main control board or module drive board damaged.

4.9 FA Troubleshooting

4.9.1 Digital display output

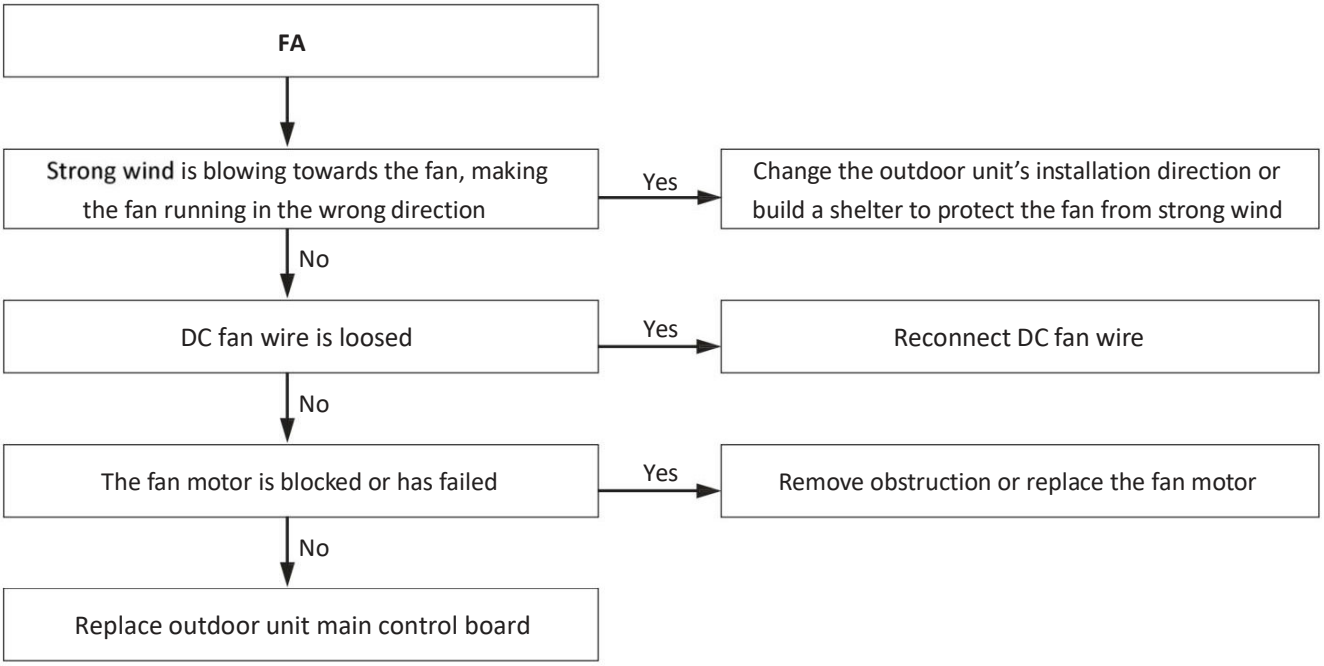
4.9.2 Description

- FA indicates DC fan error.
- If FA protection has occurred 3 times, a manual system restart is required before the system can resume operation. The cause of FA error should be addressed promptly in order to avoid system damage.
- Heat pump stops running.
- Error code is displayed on the wired controller.

4.9.3 Possible causes

- DC fan wire is loosed.
- High wind speed.
- Fan motor blocked or has failed.
- Drive board damaged.
- Main control board is damaged.

4.9.4 Procedure



4.10 r10 Troubleshooting

4.10.1 Digital display output

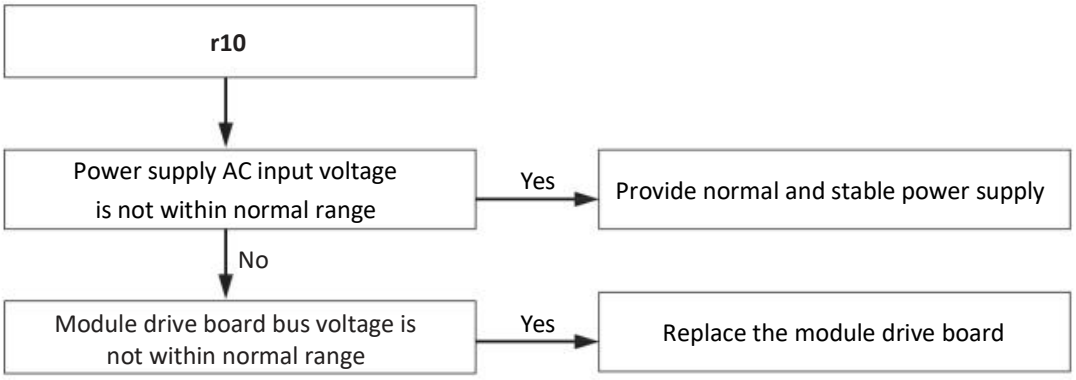
4.10.2 Description

- Abnormal AC input voltage or abnormal module drive board DC voltage.
- Heat pump stops running.
- Error code is displayed on the wired controller.

4.10.3 Possible causes

- Power supply AC input voltage not within normal range (140V~290V).
- Module drive board bus voltage not within normal range (290V~410V).

4.10.4 Procedure



Measure the bus voltage in DC motor connector pin 1 & pin 3 in module drive board:

4.11 P06 Troubleshooting

4.11.1 Digital display output

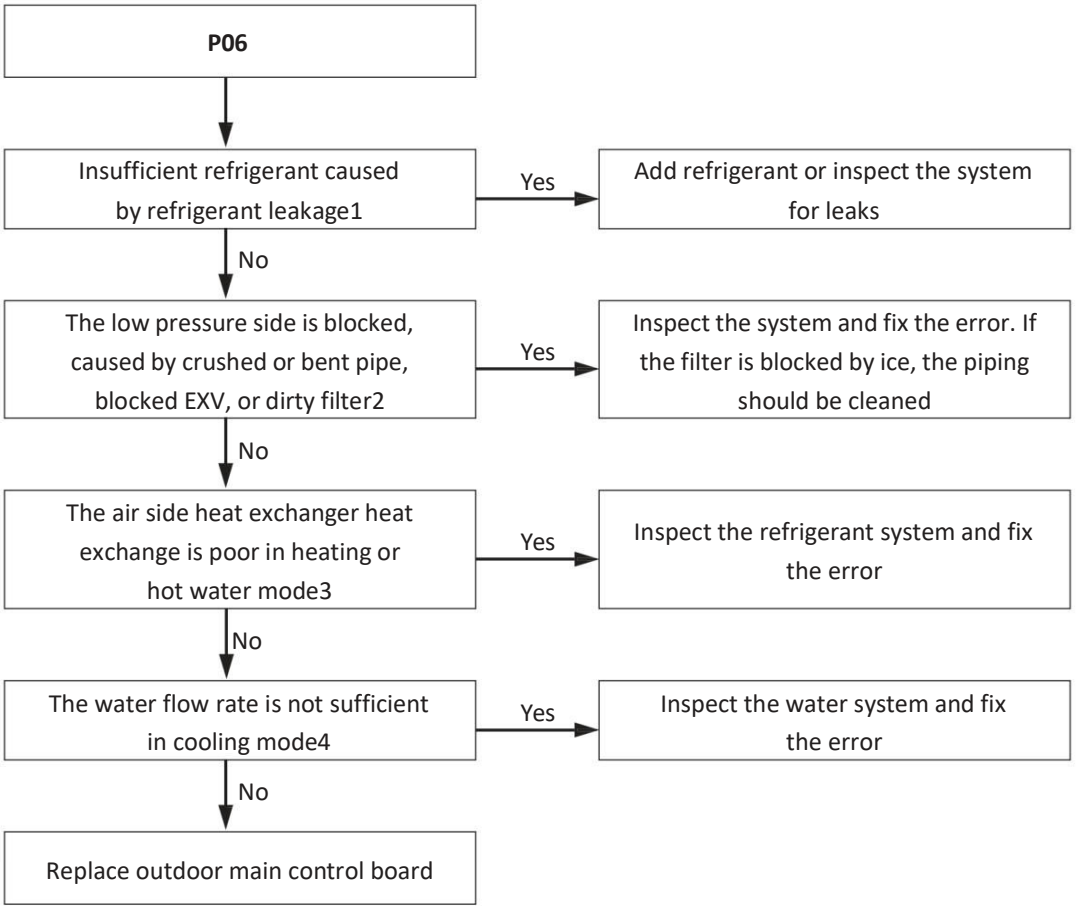
4.11.2 Description

- P06 indicates suction pipe low pressure protection. When the suction pressure falls below 0.05MPa, the system displays P06 protection and heat pump stops running. When the pressure rises above 0.15MPa, P06 is removed and normal operation resumes.
- If P06 occurred 6 times in an hour, a manual system restart is required before the system can resume operation. The cause of P06 error should be addressed promptly in order to avoid system damage.
- Error code is displayed on the wired controller.

4.11.3 Possible causes

- Low pressure switch not connected properly or has malfunctioned.
- Insufficient refrigerant.
- Low pressure side blockage.
- Poor evaporator heat exchange in heating mode or hot water mode.
- Insufficient water flow in cooling mode.
- Outdoor unit main control board damaged.

4.11.4 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 and air outlets for dirt/blockages.
4. Check water side heat exchanger, water piping, circulator pumps and water flow switch for dirt/blockages.

4.12 P02 Troubleshooting

4.12.1 Digital display output

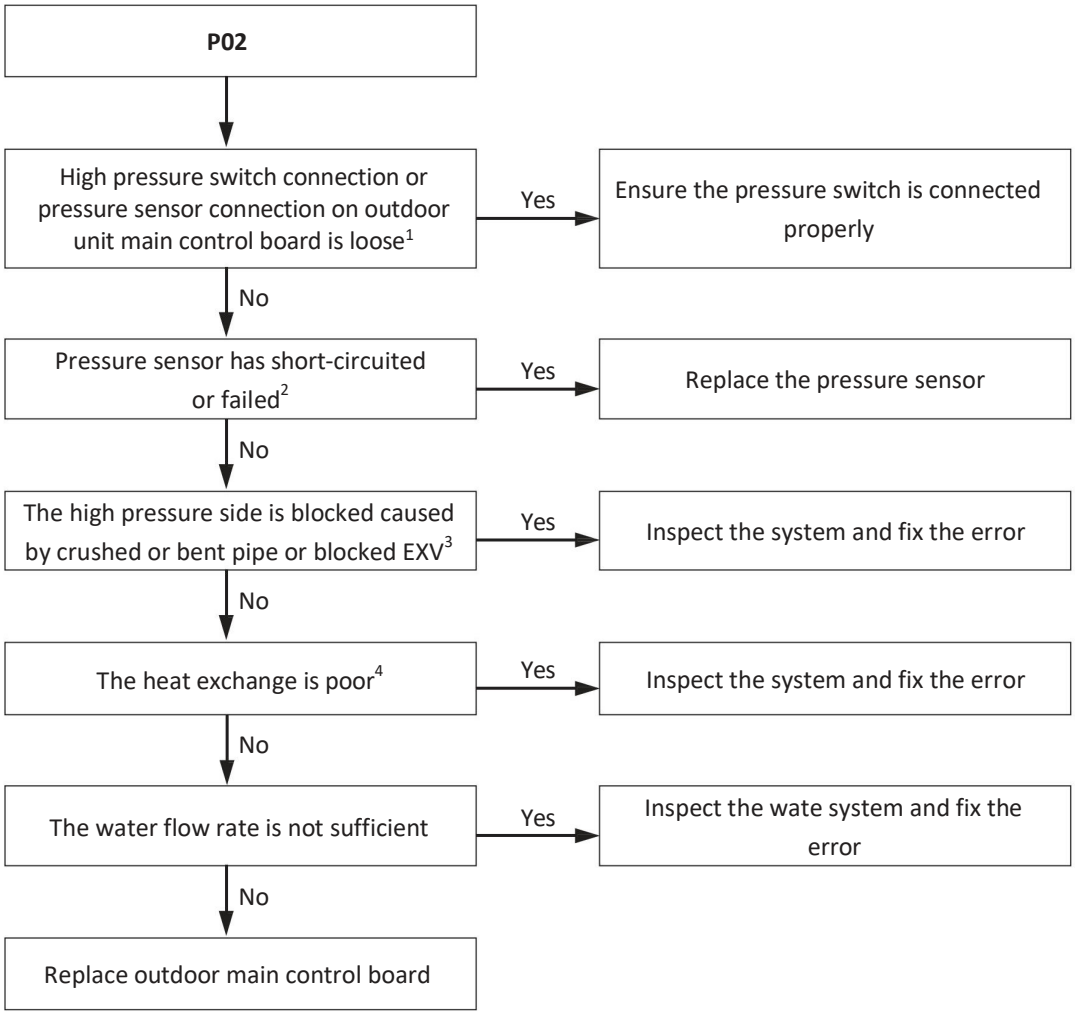
4.12.2 Description

- Discharge pipe high pressure protection. When the discharge pressure rises above 4.2MPa, the system displays P02 protection and heat pump stops running. When the discharge pressure falls below 3.6MPa, P02 is removed and normal operation resumes.
- If P02 occurred 6 times in an hour, a manual system restart is required before the system can resume operation. The cause of P02 error should be addressed promptly in order to avoid system damage.
- Error code is displayed on the wired controller.

4.12.3 Possible causes

- Pressure sensor/switch not connected properly or has malfunctioned.
- Excess refrigerant.
- System contains air or nitrogen.
- High pressure side blockage.
- Poor condenser heat exchange.
- Outdoor unit main control board damaged.

4.12.4 Procedure



Notes:

1. High pressure sensor connection is port CN311 on the main control board PCB (labeled 2 in Figure 4-2.1).
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. 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.

4.13 P19 Troubleshooting

4.13.1 Digital display output

4.13.2 Description

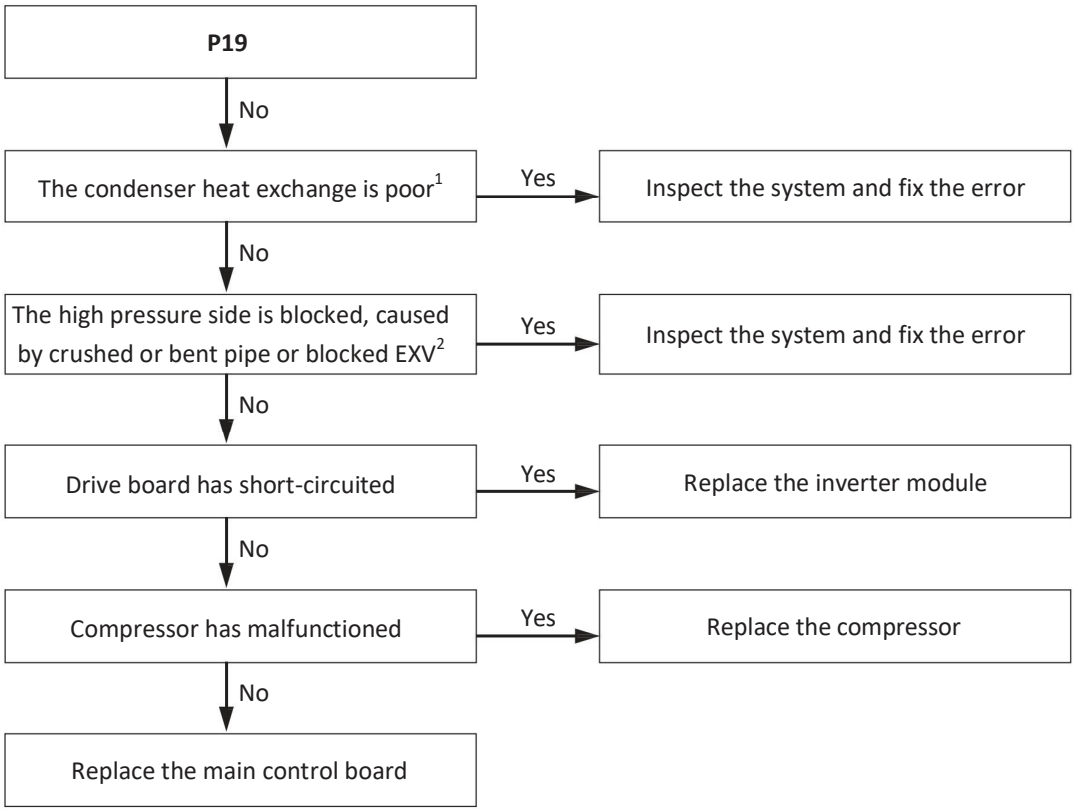
- Compressor current protection.
- When the compressor current rises above the protection value[1], the system displays P19 protection and heat pump stops running. When the current returns to the normal range, P19 is removed and normal operation resumes.
- Error code is displayed on the wired controller.

4.13.3 Possible causes

- Poor condense heat exchange.
- High pressure side blockage.
- Drive board damaged.
- Compressor damaged.
- Main control board damaged.

Notes:
1. Refer to the Compressor Current Protection Control (described in Figure 3-3.4).

4.13.4 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 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.

4.14 P11 Troubleshooting

4.14.1 Digital display output

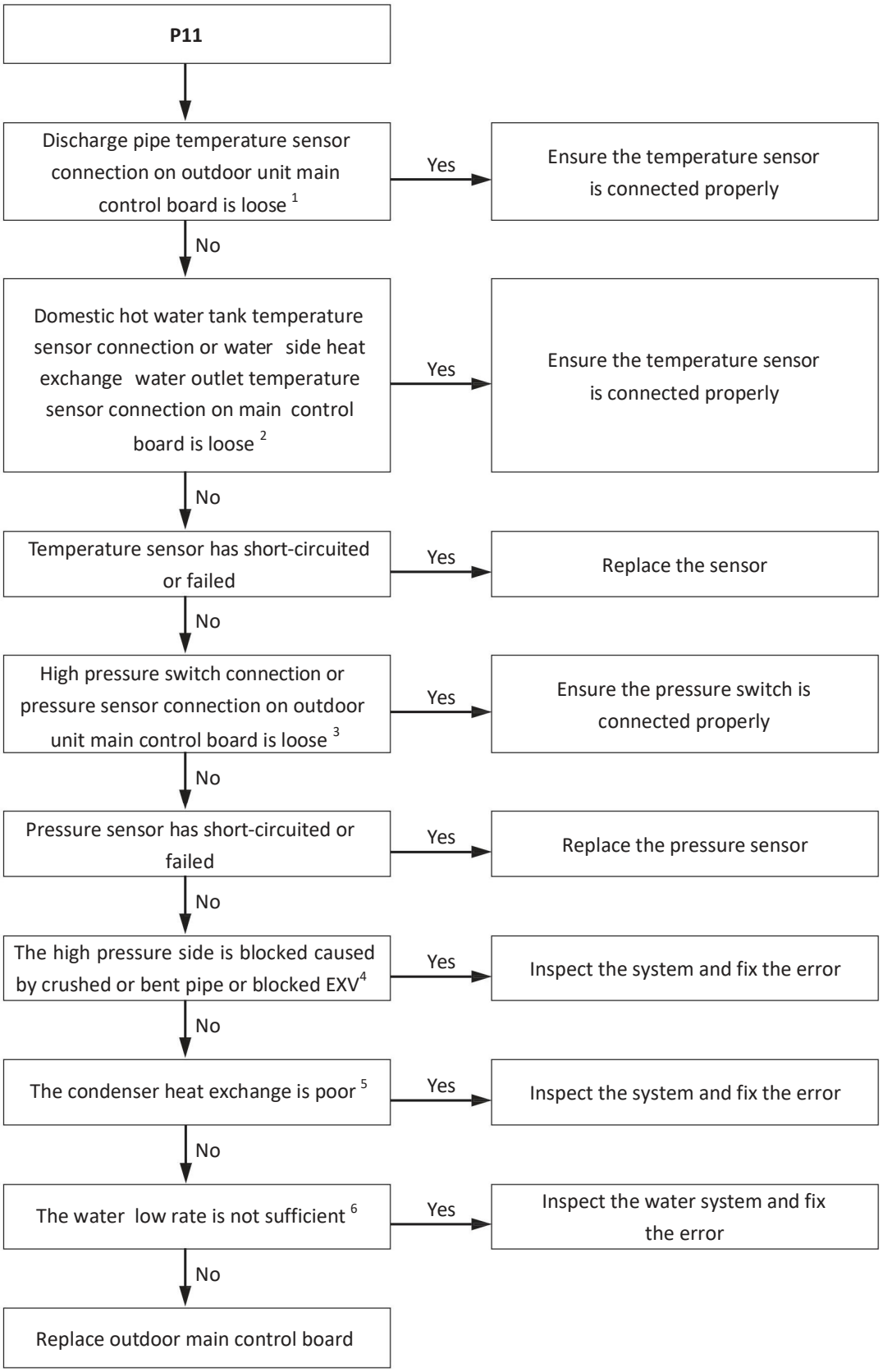
4.14.2 Description

- Discharge temperature protection.
- When the compressor discharge temperature rises above 115°C, the system display P11 protection and heat pump stops running. When the discharge temperature falls below 100℃, P11 is removed and normal operation resumes.
- Error code is displayed on the wired controller.

4.14.3 Possible causes

- Temperature sensor error.
- High pressure side blockage.
- Poor condenser heat exchange.
- Main control board damaged.

4.14.4 Procedure



Notes:

1. Discharge pipe temperature sensor connectionis port CN203 on the main control board PCB (labeled 10 in Figure 4-2.1).
2. Water side heat exchanger water outlet temperature sensor connection is port CN204 on the main control board PCB (labeled 11 in Figure 4-2.1).

Domestic hot wate tank temperature sensor connection is port CN207 on the main control board PCB (labeled 33 in Figure 4-2.1).

3. High pressure sensor connection is port CN311 on the main control board PCB (labeled 2 in Figure 4-2.1).
4. 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.
5. Check air side heat exchanger, fan and air outlets for dirt/blockages.
6. Check the water side heat exchanger, water piping, circulator pumps and water flow switch for dirt/blockages.

4.15 P15 Troubleshooting

4.15.1 Digital display output

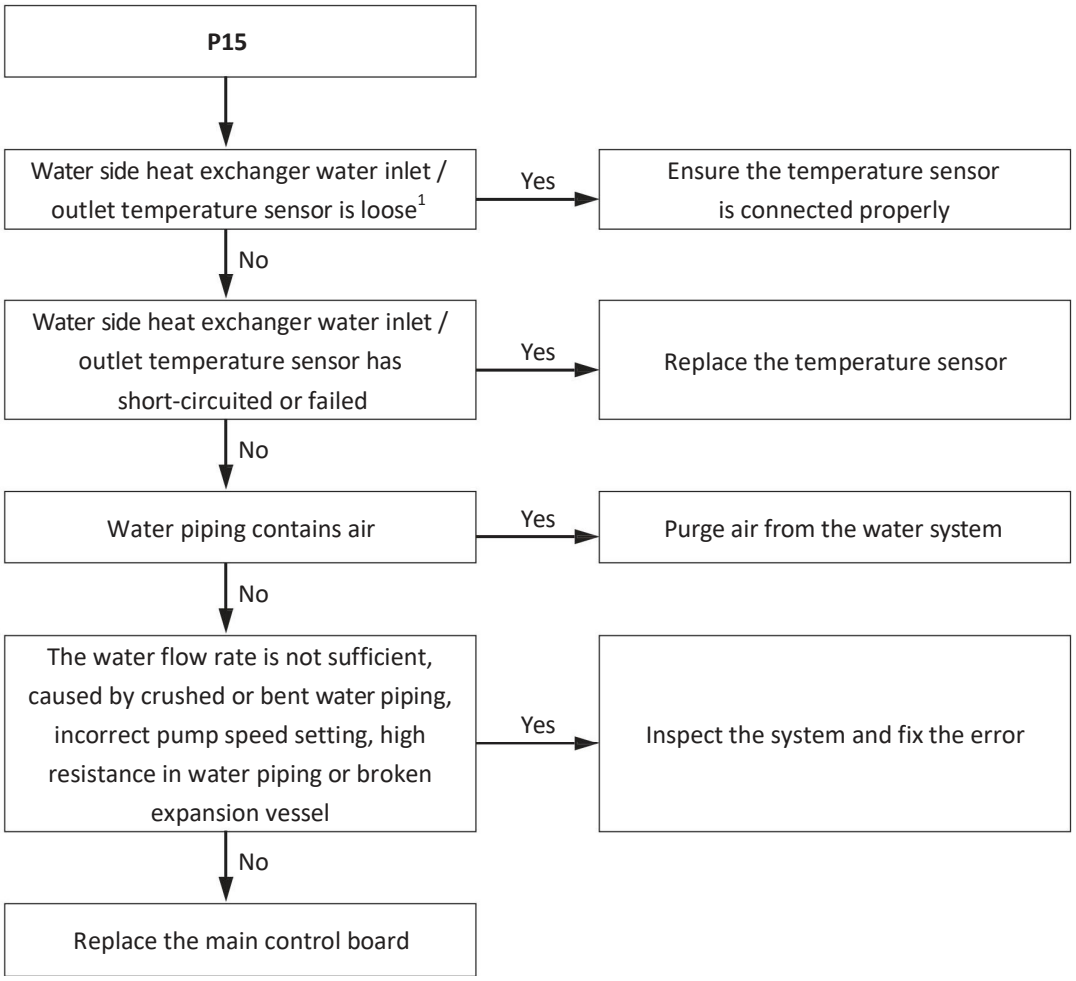
4.15.2 Description

- high temperature difference between water side heat exchanger water inlet and water outet temperatures protection.
- Heat pump stops running.
- If P15 occurred 3 times, a manual system restart is required before the system can resume operation. The cause of P15 error should be addressed promptly in order to avoid system damage.
- Error code is displayed on the wired controller.

4.15.3 Possible causes

- Temperature sensor not connected properly or has malfunctioned.
- Water piping contains air.
- Insufficient water flow.
- The main control board damaged.

4.15.4 Procedure



Notes:

1. Water side heat exchanger water inlet temperature sensor connection is port CN208 on main control board PCB (labeled 15 in Figure 4-2.1).
   Water side heat exchanger water outlet temperature sensor connection is port CN204 on the main control board PCB (labeled 11 in Figure 4-2.1).

4.16 P27 Troubleshooting

4.16.1 Digital display output

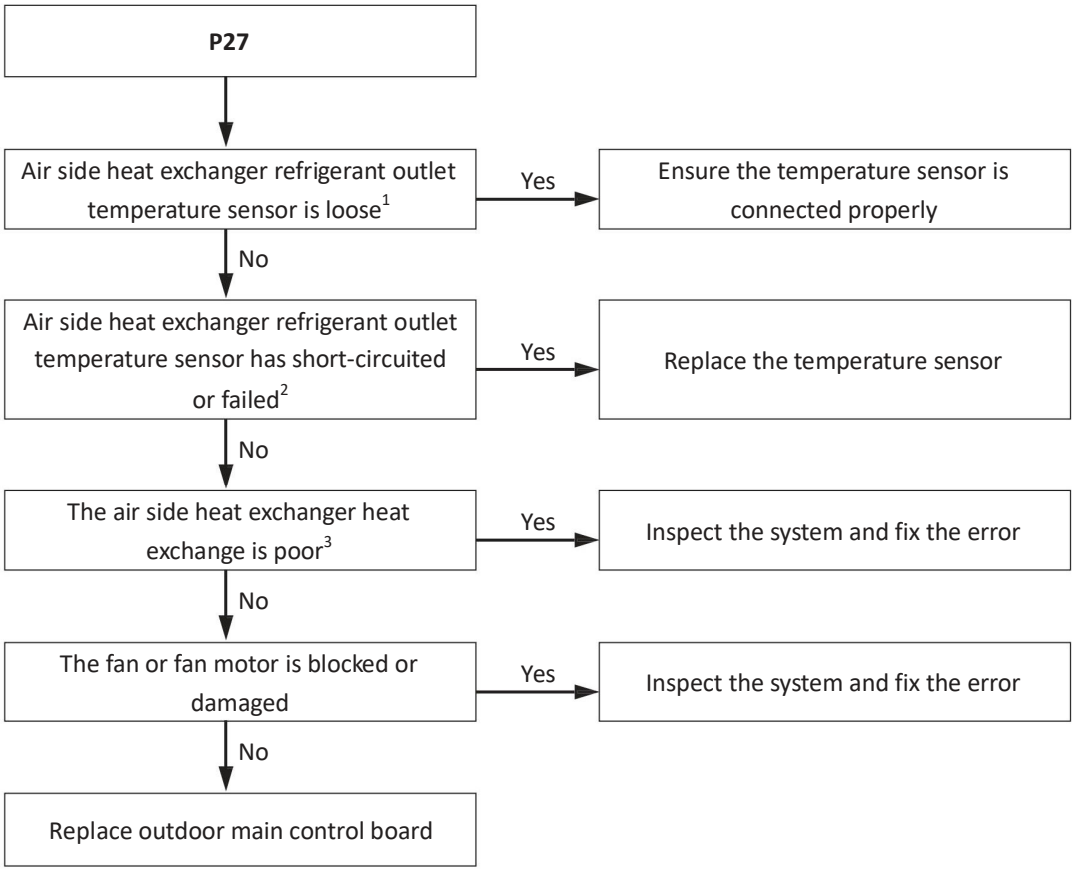
4.16.2 Description

- High temperature protection of air side heat exchanger refrigerant outlet in cooling mode. When the air side heat exchanger refrigerant outlet temperature is higher than 63°C for more than 10 seconds, the system displays P27 protection and heat pump stops running. When the air side heat exchanger refrigerant outlet temperature returns drops below 52°C , P27 is removed and normal operation resumes.
- Error code is displayed on the wired controller.

4.16.3 Possible causes

- Temperature sensor not connected properly or has malfunctioned.
- Poor condenser heat exchange.
- Fan motor damaged.
- The main control board damaged.

4.16.4 Procedure



Notes:

1. Air side heat exchanger refrigerant outlet temperature sensor connection is port CN202 on main control board PCB (labeled 9 in Figure 4-2.1). Outdoor ambient temperature sensor connection is port CN206 on main control board PCB (labeled 13 in Figure 4-2.1).
2. Check air side heat exchanger, fan and air outlets for dirt/blockages.
3. High pressure sensor connection is port CN311 on main control board PCB (labeled 2 in Figure 4-2.1).

4.17 r02 Troubleshooting

4.17.1 Digital display output

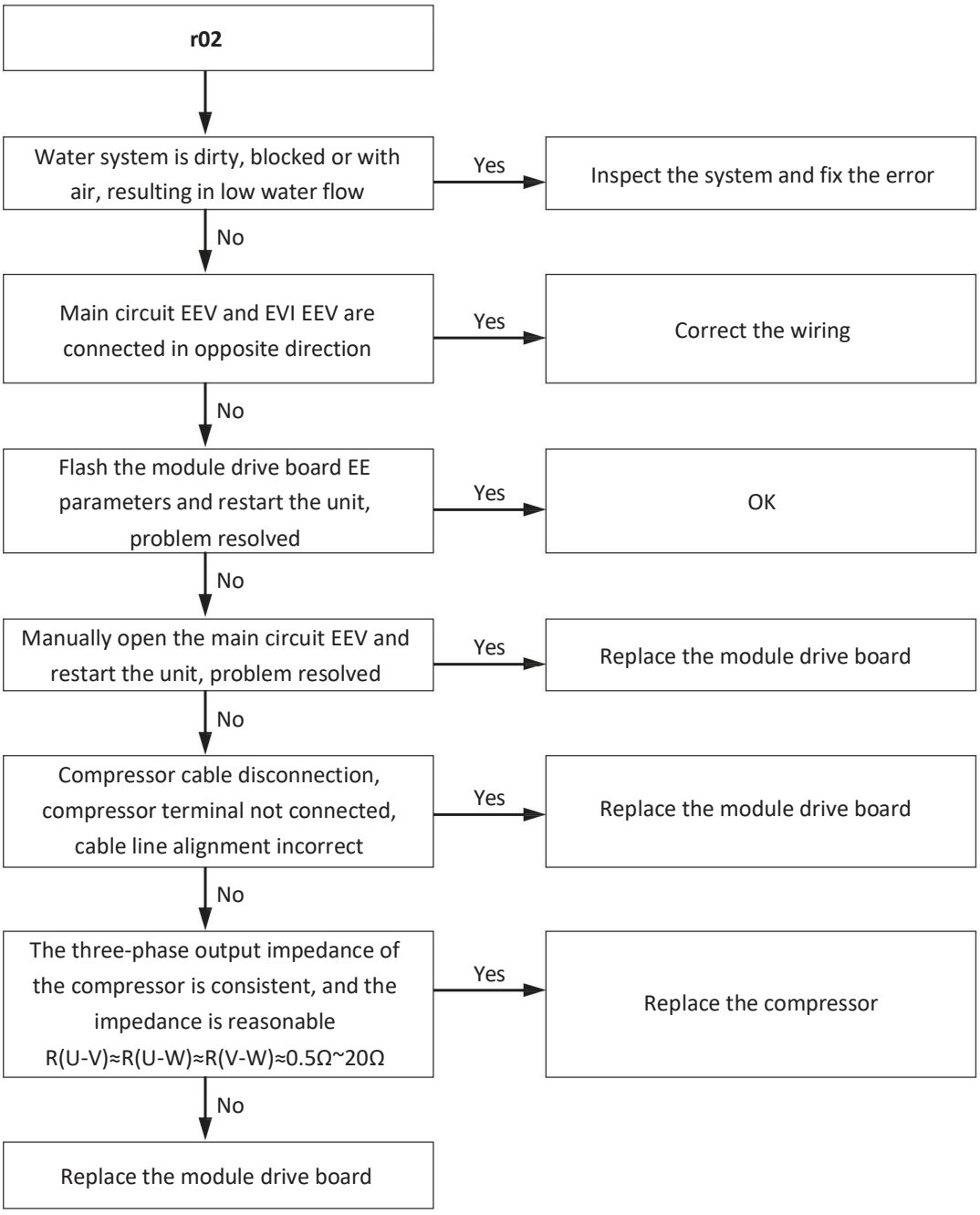
4.17.2 Description

- Compressor abnormal startup (phase loss, reverse rotation) .
- Heat pump stops running.
- If r02 occurred 6 times in half an hour, a manual system restart is required before the system can resume operation.
- Error code is displayed on the wired controller.

4.17.3 Possible causes

- Abnormal water system.
- Main circuit EEV and EVI EEV wiring misconnected.
- Module drive board EE parameters problem.
- Compressor cable disconnected or wrong connection.
- Abnormal compressor impedance.
- Module drive board damaged.

4.17.4 Procedure



4.18 r01 Troubleshooting

4.18.1 Digital display output

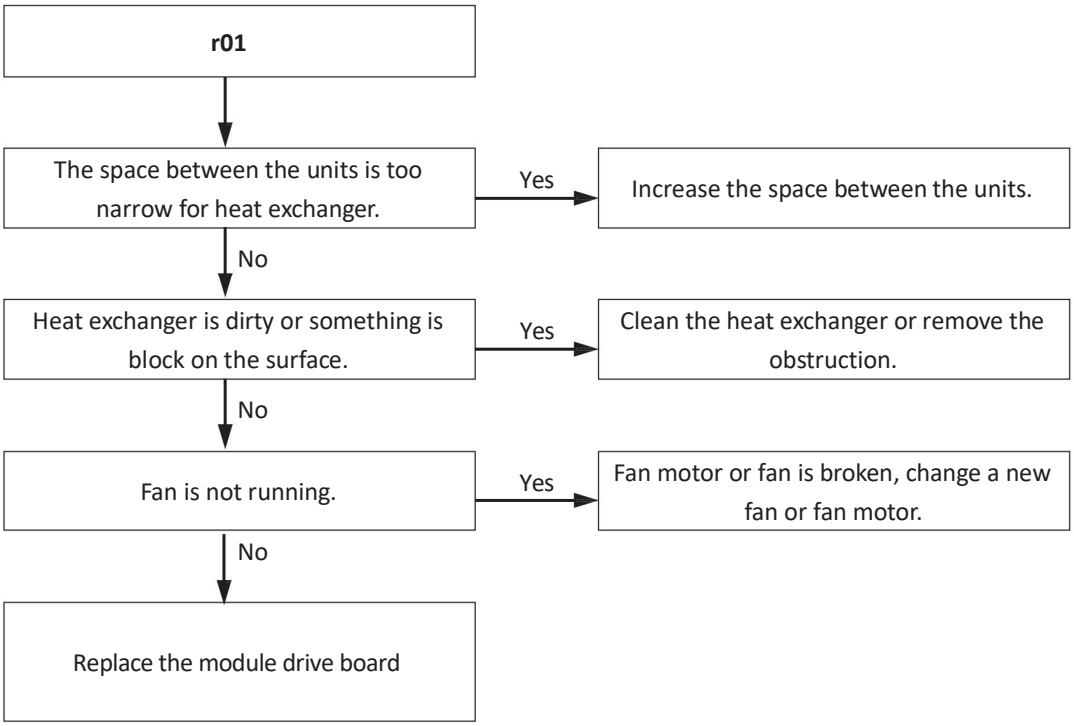
4.18.2 Description

- IPM module temperature too high protection
- Heat pump stops running.
- Error code is displayed on the wired controller.

4.18.3 Possible causes

- The space between the units is too narrow for heat exchanger.
- Heat exchanger is dirty or something is block on the surface.
- Fan is not running.
- Module drive board damaged.

4.18.4 Procedure



5 Appendix to Part 4

5.1 Temperature Sensor Resistance Characteristics

Table 4-5.1: air side heat exchanger refrigerant outlet temperature sensor, compressor suction pipe temperature sensor, water side heat exchanger refrigerant outlet temperature sensor, water side heat exchanger water outlet temperature sensor, water side heat exchanger water inlet temperature sensor, water tank temperature sensor, outdoor ambient temperature sensor resistance characteristics

Temp [℃]	Rmin. [kΩ]	Rnom. [kΩ]	Rmax. [kΩ]
-40	109.1	113.7	118.4
-39	102.9	107.1	111.5
-38	97.00	101.0	105.0
-37	91.54	95.23	99.05
-36	86.43	89.85	93.41
-35	81.63	84.82	88.12
-34	77.14	80.10	83.17
-33	72.92	75.68	78.53
-32	68.96	71.53	74.19
-31	65.24	67.63	70.11
-30	61.75	63.98	66.28
-29	58.46	60.54	62.68
-28	55.38	57.31	59.31
-27	52.47	54.28	56.14
-26	49.74	51.42	53.16
-25	47.17	48.74	50.35
-24	44.75	46.21	47.72
-23	42.46	43.83	45.23
-22	40.31	41.59	42.90
-21	38.28	39.47	40.69
-20	36.37	37.48	38.62
-19	34.56	35.60	36.66
-18	32.86	33.83	34.82
-17	31.25	32.15	33.08
-16	29.73	30.57	31.44
-15	28.29	29.08	29.89
-14	26.93	27.67	28.42
-13	25.65	26.34	27.04
-12	24.43	25.08	25.73
-11	23.28	23.88	24.50
-10	22.19	22.75	23.33
-9	21.16	21.69	22.22
-8	20.18	20.67	21.18
-7	19.26	19.72	20.18
-6	18.38	18.81	19.24
-5	17.55	17.95	18.36
-4	16.76	17.13	17.51
-3	16.01	16.36	16.71
-2	15.29	15.62	15.95
-1	14.62	14.93	15.24
0	13.98	14.26	14.55
1	13.37	13.63	13.90
2	12.79	13.04	13.29
3	12.24	12.47	12.70
4	11.71	11.93	12.15
5	11.21	11.42	11.62
6	10.74	10.93	11.12
7	10.29	10.46	10.64
8	9.853	10.02	10.19

Temp [°C]	Rmin. [kΩ]	Rnom. [kΩ]	Rmax. [kΩ]
9	9.444	9.601	9.760
10	9.054	9.200	9.349
11	8.682	8.819	8.957
12	8.327	8.455	8.584
13	7.989	8.108	8.229
14	7.667	7.778	7.890
15	7.359	7.463	7.567
16	7.065	7.162	7.259
17	6.785	6.875	6.966
18	6.518	6.602	6.686
19	6.262	6.340	6.418
20	6.018	6.091	6.163
21	5.785	5.852	5.920
22	5.562	5.625	5.687
23	5.349	5.407	5.465
24	5.145	5.199	5.252
25	4.950	5.000	5.050
26	4.761	4.811	4.860
27	4.580	4.630	4.679
28	4.407	4.456	4.506
29	4.242	4.291	4.340
30	4.083	4.132	4.181
31	3.932	3.980	4.029
32	3.787	3.835	3.883
33	3.648	3.695	3.743
34	3.515	3.562	3.609
35	3.387	3.434	3.481
36	3.265	3.311	3.358
37	3.148	3.193	3.239
38	3.035	3.081	3.126
39	2.928	2.972	3.017
40	2.825	2.869	2.913
41	2.725	2.769	2.813
42	2.630	2.673	2.716
43	2.539	2.581	2.624
44	2.452	2.493	2.535
45	2.368	2.409	2.450
46	2.287	2.327	2.368
47	2.209	2.249	2.289
48	2.135	2.174	2.213
49	2.063	2.102	2.141
50	1.994	2.032	2.070
51	1.928	1.965	2.003
52	1.864	1.901	1.938
53	1.803	1.839	1.876
54	1.744	1.780	1.816
55	1.687	1.722	1.758
56	1.633	1.667	1.702
57	1.580	1.614	1.648
58	1.530	1.563	1.597
59	1.481	1.514	1.547
60	1.434	1.466	1.499

Temp [°C]	Rmin. [kΩ]	Rnom. [kΩ]	Rmax. [kΩ]
61	1.389	1.421	1.452
62	1.346	1.376	1.408
63	1.304	1.334	1.365
64	1.263	1.293	1.323
65	1.224	1.254	1.283
66	1.187	1.215	1.245
67	1.151	1.179	1.207
68	1.116	1.143	1.171
69	1.082	1.109	1.137
70	1.049	1.076	1.103
71	1.018	1.044	1.071
72	0.9874	1.013	1.040
73	0.9582	0.9837	1.009
74	0.9300	0.9550	0.9806
75	0.9027	0.9273	0.9524
76	0.8764	0.9005	0.9252
77	0.8509	0.8746	0.8988
78	0.8264	0.8496	0.8734
79	0.8026	0.8254	0.8488
80	0.7797	0.8020	0.8250
81	0.7575	0.7794	0.8019
82	0.7360	0.7576	0.7797
83	0.7153	0.7364	0.7581
84	0.6952	0.7160	0.7373
85	0.6758	0.6962	0.7171
86	0.6571	0.6771	0.6976
87	0.6390	0.6586	0.6788
88	0.6214	0.6407	0.6605
89	0.6045	0.6234	0.6428
90	0.5880	0.6066	0.6257
91	0.5721	0.5904	0.6091
92	0.5568	0.5746	0.5930
93	0.5418	0.5594	0.5775
94	0.5274	0.5446	0.5624
95	0.5134	0.5303	0.5477
96	0.4999	0.5165	0.5336
97	0.4867	0.5030	0.5198
98	0.4740	0.4900	0.5065
99	0.4617	0.4774	0.4936
100	0.4497	0.4652	0.4810
101	0.4381	0.4533	0.4689
102	0.4269	0.4418	0.4571
103	0.4160	0.4306	0.4457
104	0.4054	0.4198	0.4346
105	0.3952	0.4093	0.4238

Table 4-5.2: Compressor discharge pipe temperature sensor resistance characteristics

T [℃]	R [k Ω]	T [℃]	R [k Ω]	T [℃]	R [k Ω]	T [℃]	R [k Ω]	T [℃]	R [k Ω]	T [℃]	R [k Ω]	T [℃]	R [k Ω]
-30	866.96	12	90.426	54	15.41	96	3.7351	138	1.1744	180	0.4496	222	0.2004
-29	815.7	13	86.262	55	14.844	97	3.6238	139	1.1455	181	0.4403	223	0.1969
-28	767.71	14	82.312	56	14.302	98	3.5162	140	1.1174	182	0.4313	224	0.1934
-27	722.87	15	78.561	57	13.782	99	3.4123	141	1.0901	183	0.4225	225	0.1901
-26	680.87	16	75.001	58	13.284	100	3.312	142	1.0636	184	0.4138	226	0.1868
-25	641.59	17	71.625	59	12.807	101	3.215	143	1.0379	185	0.4054	227	0.1836
-24	604.82	18	68.416	60	12.348	102	3.1214	144	1.0128	186	0.3972	228	0.1804
-23	570.34	19	65.368	61	11.909	103	3.031	145	0.9886	187	0.3892	229	0.1773
-22	538.03	20	62.474	62	11.487	104	2.9435	146	0.9649	188	0.3814	230	0.1743
-21	507.74	21	59.719	63	11.083	105	2.8589	147	0.942	189	0.3738	231	0.1713
-20	479.34	22	57.104	64	10.694	106	2.7772	148	0.9197	190	0.3664	232	0.1684
-19	452.68	23	54.62	65	10.321	107	2.6982	149	0.898	191	0.3591	233	0.1656
-18	427.67	24	52.253	66	9.9628	108	2.6218	150	0.8769	192	0.352	234	0.1628
-17	404.17	25	50	67	9.6187	109	2.5479	151	0.8564	193	0.3451	235	0.1601
-16	382.11	26	47.857	68	9.2882	110	2.4764	152	0.8364	194	0.3383	236	0.1574
-15	361.35	27	45.817	69	8.9706	111	2.4072	153	0.817	195	0.3317	237	0.1548
-14	341.86	28	43.877	70	8.6655	112	2.3403	154	0.7982	196	0.3253	238	0.1522
-13	323.53	29	42.027	71	8.3723	113	2.2755	155	0.7798	197	0.319	239	0.1497
-12	306.29	30	40.265	72	8.0903	114	2.2128	156	0.762	198	0.3128	240	0.1472
-11	290.06	31	38.585	73	7.8193	115	2.1522	157	0.7446	199	0.3068	241	0.1448
-10	274.78	32	36.987	74	7.5586	116	2.0934	158	0.7277	200	0.3009	242	0.1425
-9	260.4	33	35.462	75	7.3077	117	2.0365	159	0.7112	201	0.2952	243	0.1401
-8	246.85	34	34.007	76	7.0667	118	1.9814	160	0.6952	202	0.2896	244	0.1379
-7	234.08	35	32.619	77	6.8345	119	1.928	161	0.6796	203	0.2841	245	0.1356
-6	222.02	36	31.297	78	6.6109	120	1.8764	162	0.6645	204	0.2787	246	0.1335
-5	210.69	37	30.034	79	6.396	121	1.8263	163	0.6497	205	0.2735	247	0.1313
-4	199.98	38	28.827	80	6.189	122	1.7778	164	0.6353	206	0.2684	248	0.1292
-3	189.86	39	27.677	81	5.9894	123	1.7308	165	0.6213	207	0.2634	249	0.1272
-2	180.34	40	26.578	82	5.7976	124	1.6852	166	0.6077	208	0.2585	250	0.1252
-1	171.33	41	25.528	83	5.6126	125	1.6411	167	0.5944	209	0.2537		
0	162.81	42	24.524	84	5.4346	126	1.5983	168	0.5814	210	0.2491		
1	154.78	43	23.566	85	5.2629	127	1.5567	169	0.5688	211	0.2445		
2	147.19	44	22.648	86	5.0974	128	1.5165	170	0.5566	212	0.24		
3	140	45	21.773	87	4.9379	129	1.4774	171	0.5446	213	0.2357		
4	133.21	46	20.935	88	4.7842	130	1.4396	172	0.5329	214	0.2314		
5	126.79	47	20.134	89	4.6359	131	1.4028	173	0.5216	215	0.2272		
6	120.72	48	19.368	90	4.4931	132	1.3672	174	0.5105	216	0.2231		
7	114.96	49	18.635	91	4.3552	133	1.3327	175	0.4997	217	0.2191		
8	109.51	50	17.932	92	4.2222	134	1.2991	176	0.4892	218	0.2152		
9	104.34	51	17.26	93	4.0939	135	1.2665	177	0.4789	219	0.2114		
10	99.456	52	16.616	94	3.97	136	1.2349	178	0.4689	220	0.2076		
11	94.826	53	16.001	95	3.8506	137	1.2042	179	0.4591	221	0.204		