OMEGA

OTEC™

ACMI Series
Air Cooled Heatpump Chiller
Service Manual

220-240V/1/50-60Hz

CONTENTS

Part 1

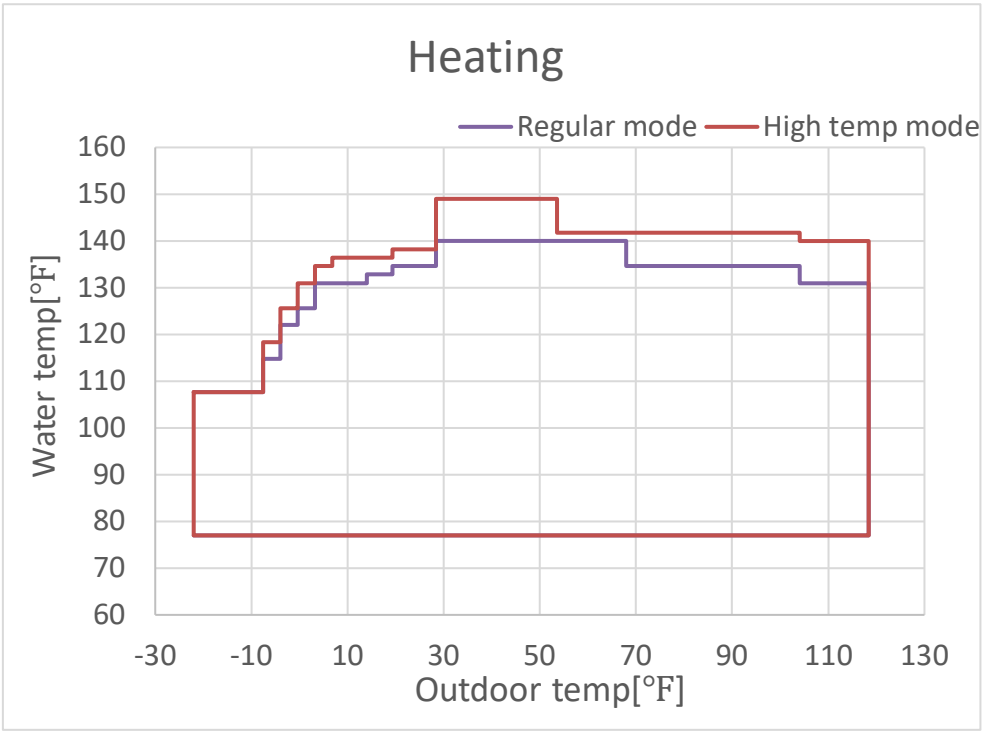
General Information

1 Unit Capacities and External Appearance

Model	ACMI020H4T-DHD070
Power supply	208~230V/3PH/50-60Hz
Appearance	

2 Water outlet temperature range

Heating and cooling operating range



Notes:

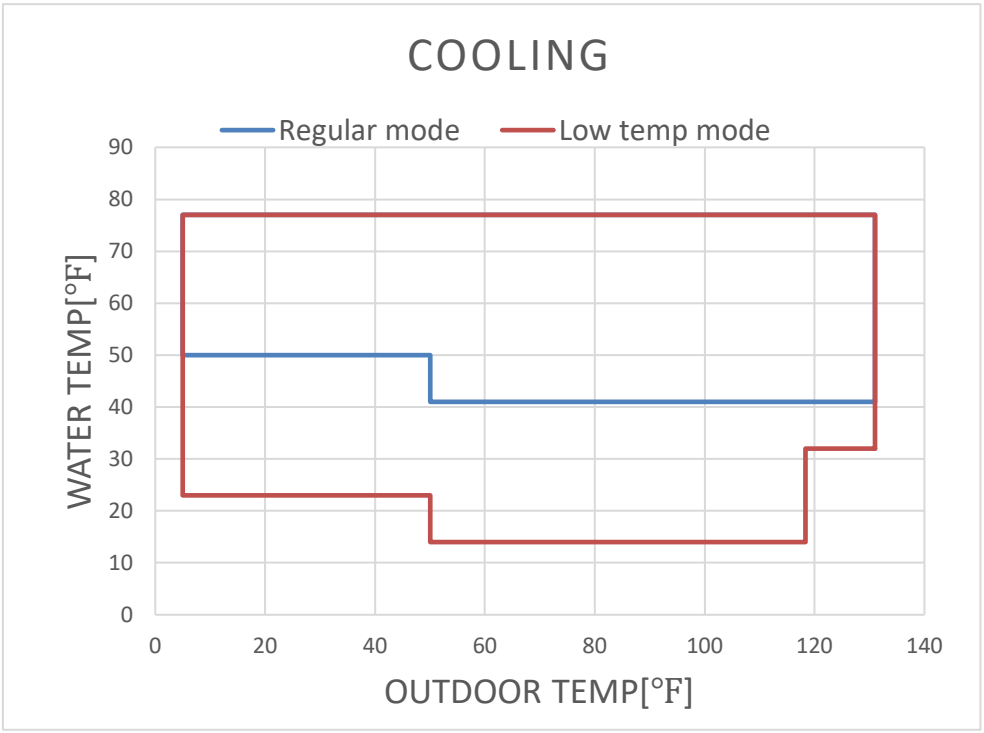
Outdoor temp：Ambient temperature(℉)

Water temp：Leaving water temperature(℉)

*The DWH temperature of the heat pump can reach 140 ℉ when it is run alone, and the DWH temperature can reach 158 ℉ when it is paired with the electric auxiliary heating.

*It is recommended to customize the centralized drainage module if operating under ambient temperature 5℉.

If the unit is operating in the temperature range with High temp mode and its water temp is higher than regular mode, the dial code S1-2 needs to be set to ON. The frequency conversion water pump needs to be matched, and the minimum water flow of the water pump should be able to be as low as 17.61 gpm.



Notes:

Outdoor temp：Ambient temperature(℉)

Water temp：Leaving water temperature(℉)

*It is recommended to customize the centralized drainage module if operating under ambient temperature 5 ℉.

If the unit is operating in a the temperature range with shadow, the antifreeze system must be used instead of the water system, and the antifreeze (especially the glycol solution) must meet the following two requirements at the same time:

Volume concentration ≥30%;

The freezing point temperature of antifreeze < the coldest temperature at the using site -10 ℉.Otherwise, the water side pipes and heat exchanger may be frozen!

Tsafe is set to 14 °F in the low water output control in service menu of the wired controller, allowing the unit to enter the cooling low water output mode control to obtain water output below 32 °F.

When switching from the antifreeze system to the water system, the Tsafe must be changed to 41 °F to avoid freezing of the water side pipes and heat exchanger!

3 R32 service notice

Safety precaution about the appliances using flammable refrigerant

WARNING

The following precautions should be complied with when installation, service, maintenance and repair, and decommissioning of appliances using flammable refrigerant.

3.1 General

This appliance employed **A2L** flammable refrigerant R32.

3.2 Symbols

	**WARNING**	This symbol shows that this appliance used a flammable refrigerant. If the refrigerant is leaked and exposed to an external ignition source, there is a risk of fire.
	**CAUTION**	This symbol shows that the manual should be read carefully.
	**CAUTION**	This symbol shows that only a competent service personnel should be handling this equipment with reference to the technical manual.
	**CAUTION**	This symbol shows that information is available such as the operating manual or installation manual.

WARNING

Do not use means to accelerate the defrosting process or to clean, other than those recommended by the manufacturer.

The appliance shall be stored in a room without continuously operating ignition sources (for example: open flames, an operating gas appliance or an operating electric heater).

Do not pierce or burn.

Be aware that refrigerants might not contain an odor.

3.3 Installation

WARNING

Every working procedure that affects safety means shall only be carried out by competent personnel.

Examples for such working procedures are:

- breaking into the refrigerating circuit;
- opening of sealed components;
- opening of ventilated enclosures.

3.3.1 General

⚠WARNING

Protection devices, piping and fittings shall be protected as far as possible against adverse environmental effects, for example the danger of water collecting and freezing in relief pipes or the accumulation of dirt and debris;

Provision shall be made for expansion and contraction of long runs of piping;

Piping in refrigerating systems shall be so designed and installed as to minimize the likelihood of hydraulic shock damaging the system;

Steel pipes and components shall be protected against corrosion with a rustproof coating before applying any insulation;

3.3.2 Potable water source

⚠CAUTION

If a potable water source is used for the equipment's water supply, the source water supply shall be protected against back siphonage by the equipment.

3.4 Information on servicing

3.4.1 General

⚠CAUTION

Servicing shall be performed only **Be Performed Only By Trained and Certified Service Personnel.**

3.4.2 Checks to the area

Prior to beginning work on systems containing flammable refrigerants, safety checks are necessary to ensure that the risk of ignition is minimised. For repair to the refrigerating system, Clause 4.3 to Clause 4.7 shall be completed prior to conducting work on the system.

3.4.3 Work procedure

Work shall be undertaken under a controlled procedure so as to minimise the risk of a flammable gas or vapour being present while the work is being performed.

3.4.4 General work area

All maintenance staff and others working in the local area shall be instructed on the nature of work being carried out. Work in confined spaces shall be avoided.

The area around the workspace shall be sectioned off. Ensure that the conditions within the area have been made safe by control of flammable material.

3.4.5 Checking for presence of refrigerant

The area shall be checked with an appropriate refrigerant detector prior to and during work, to ensure the technician is aware of potentially toxic or flammable atmospheres. Ensure that the leak detection equipment being used is suitable for use with all applicable refrigerants, i.e. non-sparking, adequately sealed or intrinsically safe.

3.4.6 Presence of fire extinguisher

If any hot work is to be conducted on the refrigerating equipment or any associated parts, appropriate fire extinguishing equipment shall be available to hand. Have a dry powder or CO2 fire extinguisher adjacent to the charging area.

3.4.7 No ignition sources

No person carrying out work in relation to a **refrigerating system** which involves exposing any pipe work shall use any sources of ignition in such a manner that it can lead to the risk of fire or explosion. All possible ignition sources, including cigarette smoking, should be kept

sufficiently far away from the site of installation, repairing, removing and disposal, during which refrigerant can possibly be released to the surrounding space. Prior to work taking place, the area around the equipment is to be surveyed to make sure that there are no flammable hazards or ignition risks. "No Smoking" signs shall be displayed.

3.4.8 Ventilated area

Ensure that the area is in the open or that it is adequately ventilated before breaking into the system or conducting any hot work. A degree of ventilation shall continue during the period that the work is carried out. The ventilation should safely disperse any released refrigerant and preferably expel it externally into the atmosphere.

3.4.9 Checks to the refrigerating equipment

Where electrical components are being changed, they shall be fit for the purpose and to the correct specification. At all times the manufacturer's maintenance and service guidelines shall be followed. If in doubt, consult the manufacturer's technical department for assistance.

*The following checks shall be applied to installations using **flammable refrigerants**:*

- *the **refrigerant charge** is in accordance with the room size within which the refrigerant containing parts are installed;*
- *the ventilation machinery and outlets are operating adequately and are not obstructed;*
- *if an indirect refrigerating circuit is being used, the secondary circuit shall be checked for the presence of refrigerant;*
- *marking to the equipment continues to be visible and legible. Markings and signs that are illegible shall be corrected;*
- *refrigerating pipe or components are installed in a position where they are unlikely to be exposed to any substance which can corrode refrigerant containing components, unless the components are constructed of materials which are inherently resistant to being corroded or are suitably protected against being so corroded.*

3.4.10 Checks to electrical devices

Repair and maintenance to electrical components shall include initial safety checks and component inspection procedures. If a fault exists that could compromise safety, then no electrical supply shall be connected to the circuit until it is satisfactorily dealt with. If the fault cannot be corrected immediately but it is necessary to continue operation, an adequate

temporary solution shall be used. This shall be reported to the owner of the equipment so all parties are advised.

Initial safety checks shall include:

- that capacitors are discharged: this shall be done in a safe manner to avoid possibility of sparking;
- that no live electrical components and wiring are exposed while charging, recovering or purging the system;
- that there is continuity of earth bonding.

3.5 Repairs to sealed components and intrinsically safe components

⚠WARNING

Sealed electrical components shall be replaced.

3.6 Repair to intrinsically safe components

⚠WARNING

Intrinsically safe components must be replaced.

3.7 Cabling

Check that cabling will not be subject to wear, corrosion, excessive pressure, vibration, sharp edges or any other adverse environmental effects. The check shall also take into account the effects of aging or continual vibration from sources such as compressors or fans.

3.8 Detection of flammable refrigerants

Under no circumstances shall potential sources of ignition be used in the searching for or detection of refrigerant leaks. A halide torch (or any other detector using a naked flame) shall not be used.

The following leak detection methods are deemed acceptable for all refrigerant systems.

Electronic leak detectors may be used to detect refrigerant leaks but, in the case of **flammable refrigerants**, the sensitivity can be inadequate, or can need re-calibration. (Detection equipment shall be calibrated in a refrigerant-free area.) Ensure that the detector is not a potential source of ignition and is suitable for the refrigerant used. Leak detection equipment shall be set at a percentage of the ***LFL*** of the refrigerant and shall be calibrated to the refrigerant employed, and the appropriate percentage of gas (25 % maximum) is confirmed.

Leak detection fluids are also suitable for use with most refrigerants but the use of detergents containing chlorine shall be avoided as the chlorine can react with the refrigerant and corrode the copper pipe-work.

NOTE Examples of leak detection methods are

- bubble method,
- fluorescent agent method.

If a leak is suspected, all naked flames shall be removed/extinguished.

If a leakage of refrigerant is found which requires brazing, all of the refrigerant shall be recovered from the system, or isolated (by means of shut-off valves) in a part of the system remote from the leak. Removal of refrigerant shall be according to Clause 9.

3.9 Removal and evacuation

⚠CAUTION

Oxygen free nitrogen (OFN) shall then be purged through the system both before and during the brazing process.

When breaking into the refrigerant circuit to make repairs - or for any other purpose - conventional procedures shall be used. However, for flammable refrigerants it is important that best practice be followed, since flammability is a consideration. The following procedure shall be adhered to:

- safely remove refrigerant following local and national regulations;
- evacuate;
- purge the circuit with inert gas (optional for A2L);
- evacuate (optional for A2L);
- continuously flush with inert gas when using flame to open circuit;
- open the circuit.

The refrigerant charge shall be recovered into the correct recovery cylinders if venting is not allowed by local and national codes. For appliances containing flammable refrigerants, the system shall be purged with oxygen-free nitrogen to render the appliance safe for flammable refrigerants. This process might need to be repeated several times. Compressed air or oxygen shall not be used for purging refrigerant systems.

For appliances containing flammable refrigerants, refrigerants purging shall be achieved by breaking the vacuum in the system with oxygen-free nitrogen and continuing to fill until the working pressure is achieved, then venting to atmosphere, and finally pulling down to a vacuum (optional for A2L). This process shall be repeated until no refrigerant is within the system (optional for A2L). When the final oxygen-free nitrogen charge is used, the system shall be vented down to atmospheric pressure to enable work to take place.

The outlet for the vacuum pump shall not be close to any potential ignition sources, and ventilation shall be available.

⚠CAUTION

An inert gas, specifically, is dry oxygen free nitrogen(OFN).

The system shall be “flushed” with OFN to render the unit safe. This process may need to be repeated several times.

⚠CAUTION

This operation is absolutely vital if brazing operations on the pipework are to take place.

3.10 Charging procedures

In addition to conventional charging procedures, the following requirements shall be followed.

- Ensure that contamination of different refrigerants does not occur when using charging equipment. Hoses or lines shall be as short as possible to minimise the amount of refrigerant contained in them.
- Cylinders shall be kept in an appropriate position according to the instructions.
- Ensure that the **refrigerating system** is earthed prior to charging the system with refrigerant.
- Label the system when charging is complete (if not already labelled).
- Extreme care shall be taken not to overfill the refrigerating system.

Prior to recharging the system, it shall be pressure-tested with the appropriate purging gas. The system shall be leak-tested on completion of charging but prior to commissioning. A follow up leak test shall be carried out prior to leaving the site.

3.11 Decommissioning

Before carrying out this procedure, it is essential that the technician is completely familiar with the equipment and all its detail. It is recommended good practice that all refrigerants are recovered safely. Prior to the task being carried out, an oil and refrigerant sample shall be taken in case analysis is required prior to re-use of recovered refrigerant. It is essential that electrical power is available before the task is commenced.

a) Become familiar with the equipment and its operation.

b) Isolate system electrically.

c) Before attempting the procedure, ensure that:

- mechanical handling equipment is available, if required, for handling refrigerant cylinders;
- all personal protective equipment is available and being used correctly;
- the recovery process is supervised at all times by a competent person;
- recovery equipment and cylinders conform to the appropriate standards.

d) Pump down refrigerant system, if possible.

e) If a vacuum is not possible, make a manifold so that refrigerant can be removed from various parts of the system.

f) Make sure that the cylinder is situated on the scales before recovery takes place.

g) Start the recovery machine and operate in accordance with instructions.

h) Do not overfill cylinders (no more than 80 % volume liquid charge).

i) Do not exceed the maximum working pressure of the cylinder, even temporarily.

j) When the cylinders have been filled correctly and the process completed, make sure that the cylinders and the equipment are removed from site promptly and all isolation valves on the equipment are closed off.

k) Recovered refrigerant shall not be charged into another REFRIGERATING SYSTEM unless it has been cleaned and checked.

3.12 Labelling

Equipment shall be labelled stating that it has been de-commissioned and emptied of refrigerant. The label shall be dated and signed. For appliances containing FLAMMABLE REFRIGERANT, ensure that there are labels on the equipment stating the equipment contains FLAMMABLE REFRIGERANT.

3.13 Recovery

When removing refrigerant from a system, either for servicing or decommissioning, it is required to follow good practice so that all refrigerants are removed safely.

When transferring refrigerant into cylinders, ensure that only appropriate refrigerant recovery cylinders are employed. Ensure that the correct number of cylinders for holding the total system charge is available. All cylinders to be used are designated for the recovered refrigerant and labelled for that refrigerant (i.e. special cylinders for the recovery of refrigerant). Cylinders shall be complete with pressure-relief valve and associated shut-off valves in good working order. Empty recovery cylinders are evacuated and, if possible, cooled before recovery occurs.

The recovery equipment shall be in good working order with a set of instructions concerning the equipment that is at hand and shall be suitable for the recovery of the FLAMMABLE REFRIGERANT. If in doubt，the manufacturer should be consulted. In addition, a set of calibrated weighing scales shall be available and in good working order. Hoses shall be complete with

leak-free disconnect couplings and in good condition.

The recovered refrigerant shall be processed according to local legislation in the correct recovery cylinder, and the relevant waste transfer note arranged. Do not mix refrigerants in recovery units and especially not in cylinders.

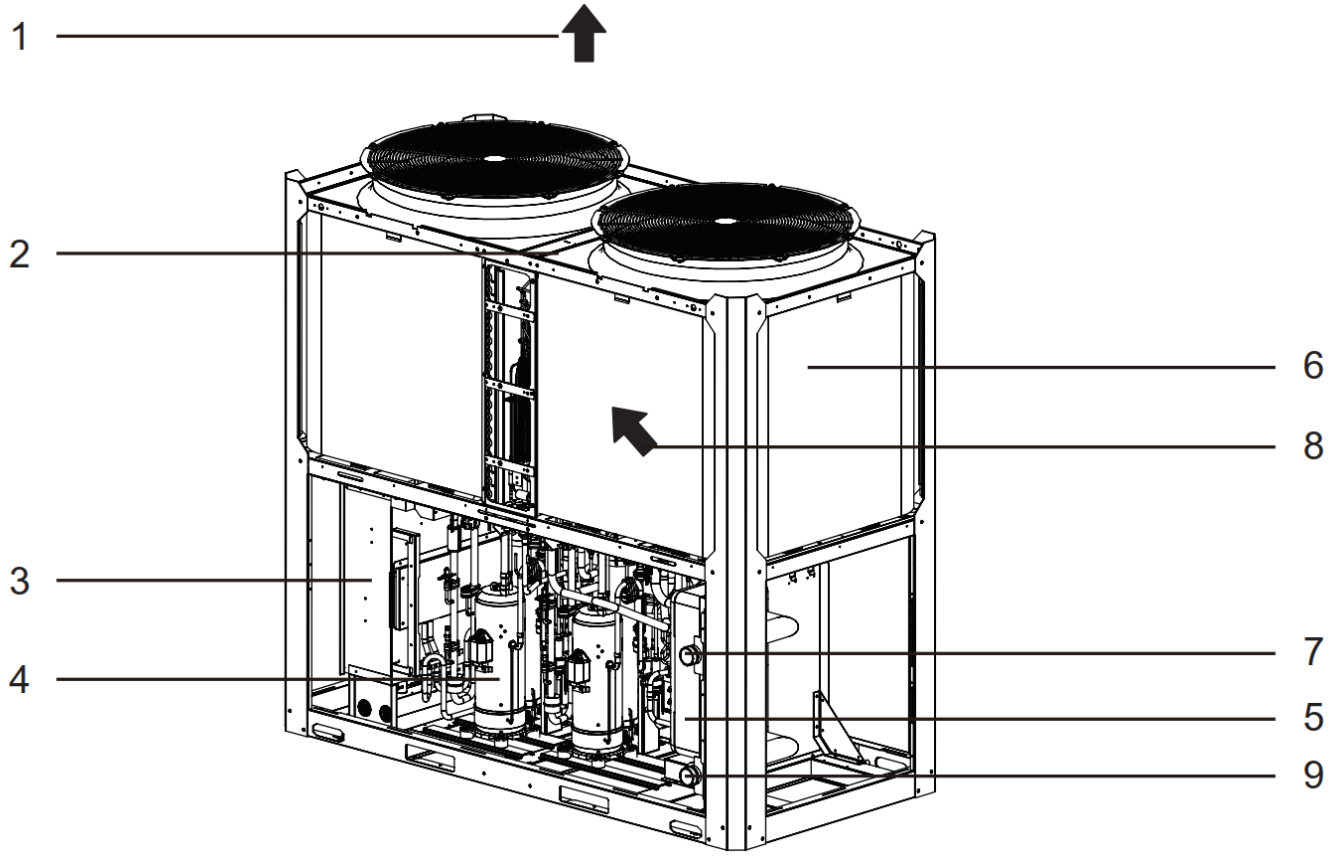
If compressors or compressor oils are to be removed, ensure that they have been evacuated to an acceptable level to make certain that FLAMMABLE REFRIGERANT does not remain within the lubricant. The compressor body shall not be heated by an open flame or other ignition sources to accelerate this process. When oil is drained from a system, it shall be carried out safely.

Part 2

Component Layout and Refrigerant Circuits

1 Layout of Functional Components

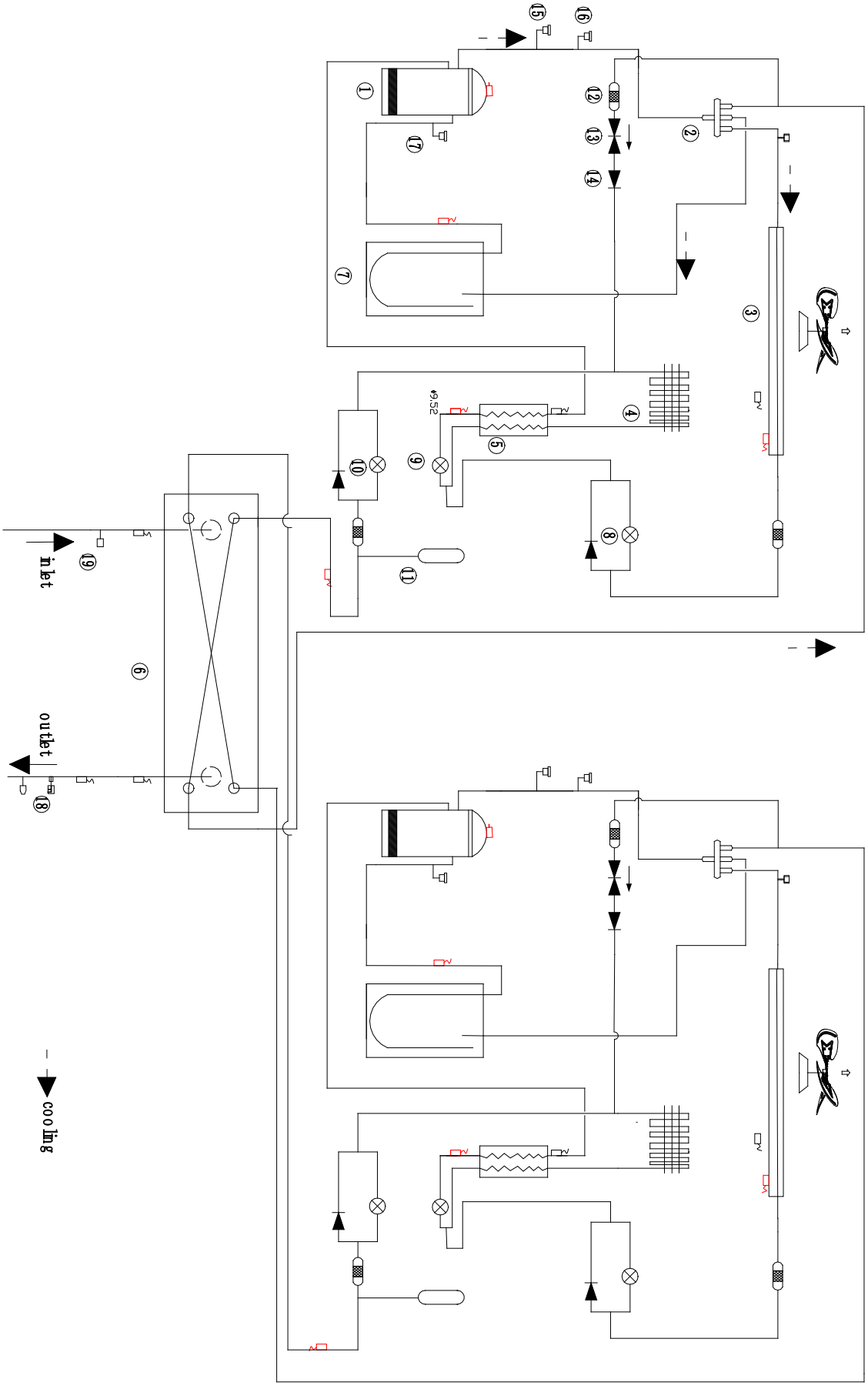
ACMI020H4T-DHD070



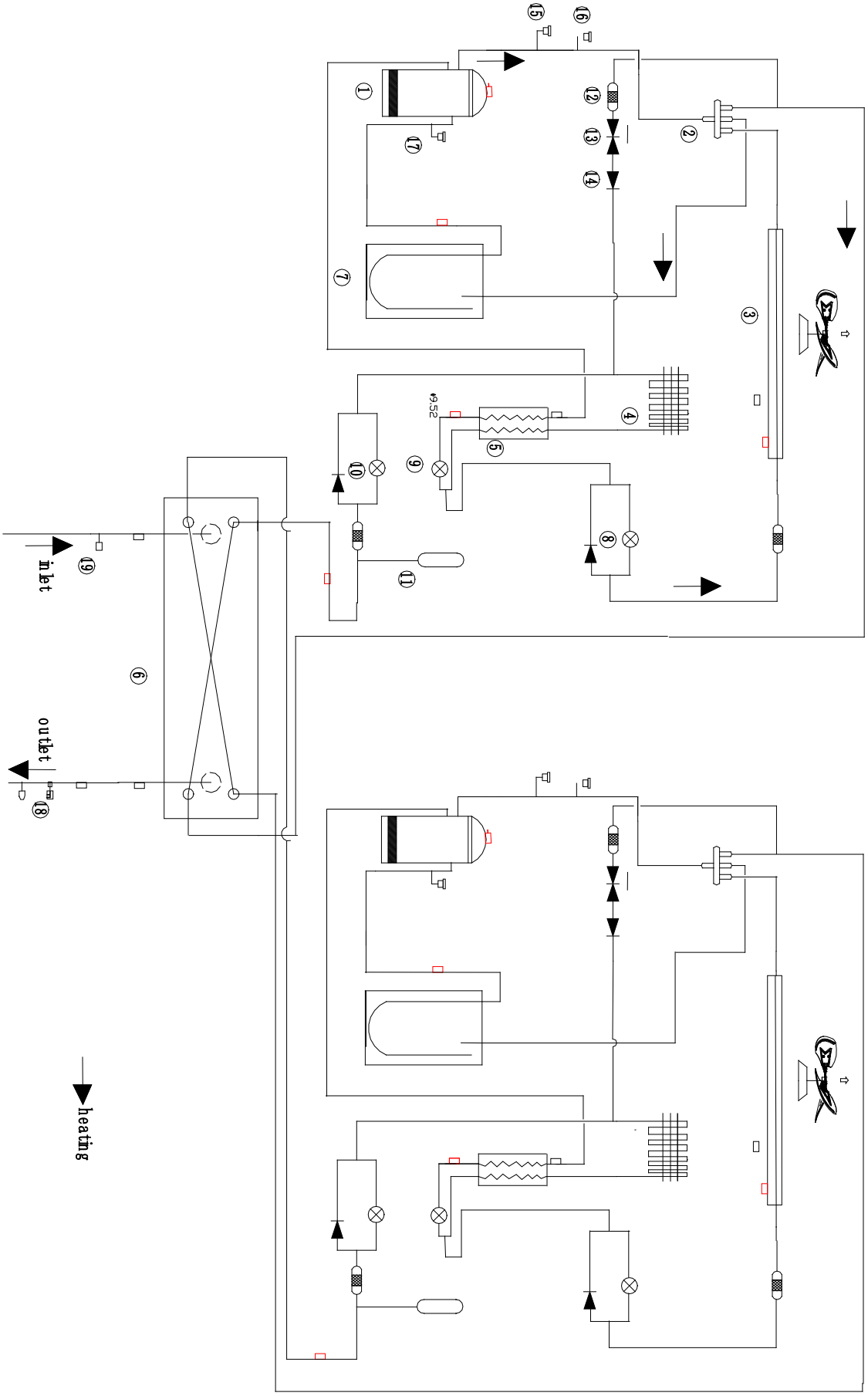
NO.	Component	NO.	Component
1	Air outlet	6	Heat exchanger
2	Top cover	7	Water outlet
3	Electric control box	8	Air inlet
4	Compressor	9	Water inlet
5	Plate heat exchanger	10	Wire controller (It can be placed indoors)

2 Piping and Refrigerant Flow Diagrams

2.1 Cooling operation



2.2 Heating operation



Legend					
No.	Symbol	Description	No.	Symbol	Description
1	COM	Compressor	12	GLQ	Liquid filter
2	ST1-A/ST1-B	Four-way valve	13	SV6	Solenoid valve
3	FAN A/B	DC fan	14	DXF	Check valve
4	/	Refrigerant heat exchanger	15	H-SW	High-pressure switch
5	/	Economizer	16	H-YL	High-pressure sensor
6	/	Plate heat exchanger	17	L-YL	Low-pressure sensor
7	/	Gas-liquid separator	18	W-SW	Water flow switch
8	EXVA	Electronic Expansion Valve	19	/	Safety valve
9	EXVC	Electronic Expansion Valve			
10	EXVB	Electronic Expansion Valve			
11	/	Liquid receiver			

2.3 Key components

No.	component	function	specifications	
1	DC inverter compressor	Circulation power for heat pump systems	70kWR32： APBA065AGA-YA1S	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	70kWR32： YK-4.3/3.2-C-3500 (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	70kWR32: 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	Refrigerant condenser	Heat dissipation for electronic control box improves electronic control reliability	70kWR32: Dual Module	2
18	plate exchange heating tape	Heating for plate heat exchanger	DJRD-200X80D-4200-25W-VHR	2
19	Water-side anti-freezing	Taf1: Water tank anti-freezing	Taf1： WD/SWD3970-L10000-AMP2(RSG)	customizable

	temperature Taf1/2	temperature		
		Taf2: Plate exchange anti-freezing temperature	Taf2：CGQ-WD/SWD3970-L3200-AMP2	1
20.1	Pressure sensors	Detecting high pressure	CGQ-YL-4.6MPa-L3000-L	2
20.2	Pressure sensors	Detecting low pressure	CGQ-YL-2.0M-L-3000	2
21	Gas-liquid separator	Storage of excess refrigerant	70kWR32：:QYFLQ-22*22*2.1*127*V7.2，7.2L，Pipe diameter 22, oil return hole 2.1	2
22	Return gas temperature Th	/	CGQ-WD/GW4100-L3300-XAP2	2
23	Outdoor ambient temperature T4	Detection of outdoor ambient temperature	CGQ-WD/SW4100-L2600-XHB2B	1
24	Inlet water temperature Twi	/	CGQ-WD/GW3970-L4500-AMP2-P4420	1
25	Water-side safety valve	Pressure relief when water-side pressure is too high	AQF-06B-G1/2	1
26	Discharge valve	Discharge of water-side air	PQF-03	1
27	Outlet temperature Two	/	CGQ-WD/SWD3970-L3200-AMP2	1
28	Water flow switch	Protection in case of low water flow	70kWR32：SLKG-38-42-3500-AMP	1
29	Total outlet temperature Tw	/	CGQ-WD/GW3970-L4500-AMP2-P4420	1
30	Plate heat exchanger	Heat exchange between water and refrigerant	HBL133-54D-V	1
31	Target flow electric heating belt	Water-side anti-freezing heating	DJRD-200X80D-4200-25W-VHR	1
32	High and low pressure pin valve	For refrigerant charging	/	4
33	Tank temperature T5	Detecting the hot water temperature in the tank	WD/SWD3970-L10000-AMP2(RSG)	1
34	Wired Controller	/	KJRM-120H3/BMWK0-E	1
35	Economizer	Heat exchanger for gas injection	C12L-EZ-20	2
36	Injection electronic expansion valve EXVC	Throttling effect during jet enthalpy increase	D16MISZ-1R 1.6mm	2
37	Auxiliary entry temperature sensor T6A	/	CGQ-WD/GW4100-L2500-XHP4-P2250-2	2
38	Auxiliary out temperature sensor T6B	/	CGQ-WD/GW4100-L2500-XHP4-P2250-2	2
39	muffler	Reduced noise during spraying	GLQ-12.7*9.52*10*150*M30 with filter 30 mesh	1
40	SV6	Heating anti-condensation solenoid valve	FDF6A-048-RK	2
41	SV6 series connection check valve	Prevent reverse jacking of SV6 during refrigeration	DXF-18	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.

Part 3

Control and Field settings

1 Control Functions

1.1 Standby control

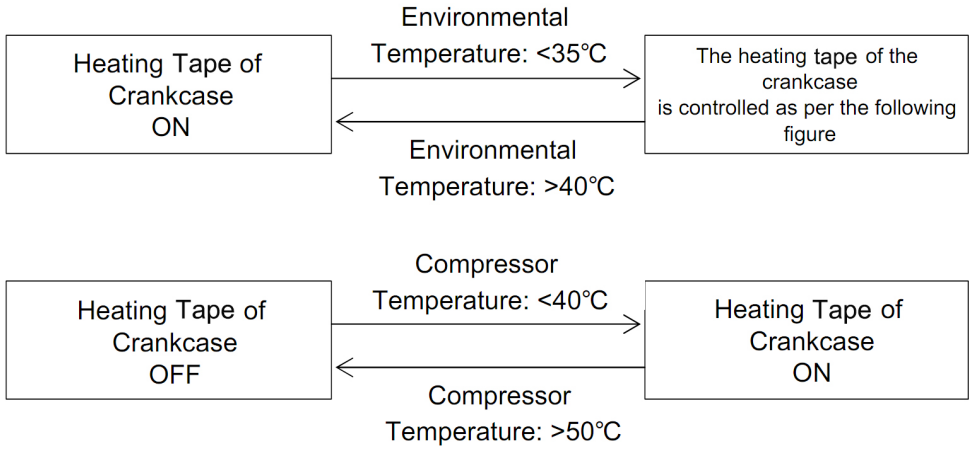
1.1.1 Control of first start and restart after shutdown

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

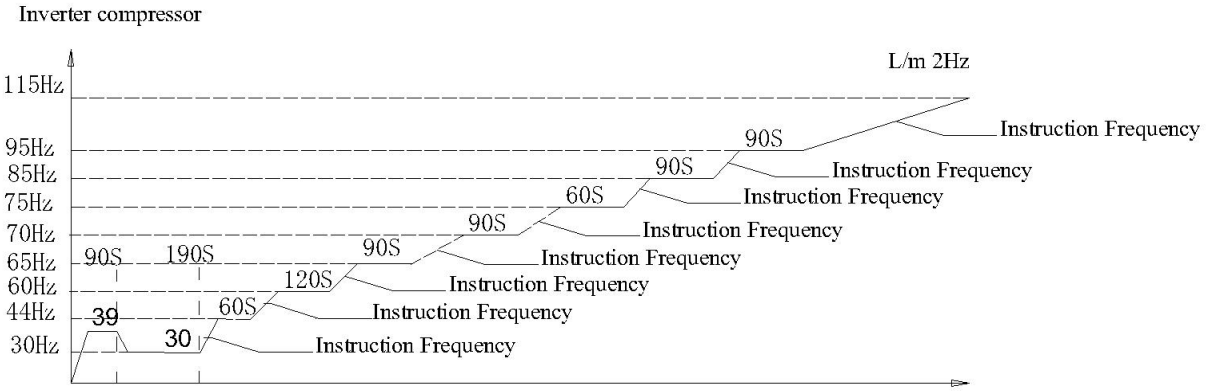
In order to prevent the refrigerant from dissolving in the cooling oil of the compressor during shutdown, this mode is used to control the heating tape of the crankcase.

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.

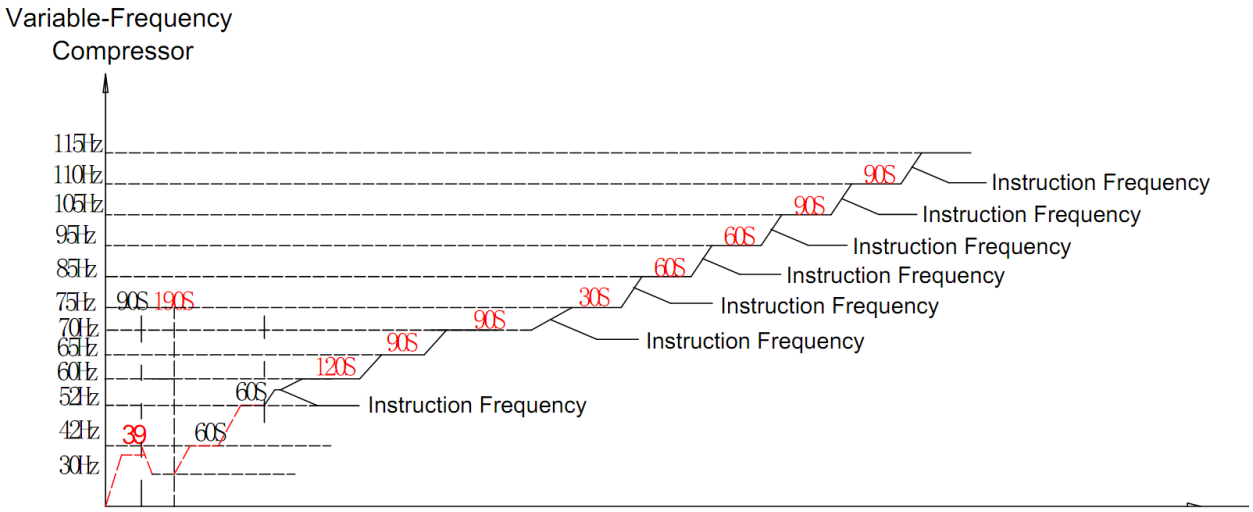


1.2 Start Control

1.2.1 Cooling start frequency-raising control



1.2.2 **Heating start frequency-raising control**



1.3 Shutdown control

1.3.1 Fault shutdown

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

1.3.2 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.

1.3.3 Temperature reaching shutdown

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

1.4 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		20 tons	Achieving Conditions	Contents	Remarks
Silent Mode Selection	Standard mode	32	This mode is set through the Wired Controller (factory default)		
	Night silent mode 1	28	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 104℉(40℃). The mode can be entered when the minimum T3 is less than or equal to 95℉(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	The maximum frequency output is less than or equal to Power_Silence_Max 70 kW: 90 Hz	
	Super-silent mode	25	This mode is set through the Wired Controller	The maximum frequency output is less than or equal to Power_SuperSilence_Max 70 kW: 84 Hz	

1.5 Variable-frequency water pump control

Input	
Control Logic Input	Remarks:
Machine address	Master must be configured with address 0#. The other addresses are used for slaves.
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) 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) 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.

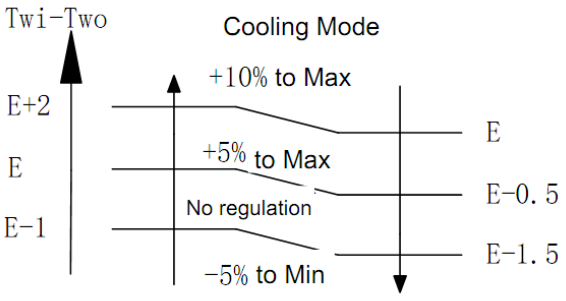
③ Notes for Input and output of the control logic

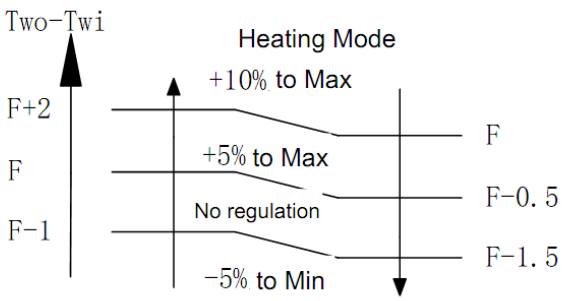
1.5.1 **Temperature difference control of variable frequency water pump**

1) Control of target water temperature difference

Twi	＜15℃	15≤Twi＜18℃	18≤Twi＜25℃	≥25℃	
	＜59°F	59≤Twi＜64.4°F	64.4≤Twi＜77°F	≥77°F	
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	＜41℃	41≤Twi＜44℃	44≤Twi＜48℃	48≤Twi＜52℃	≥52℃
	＜105.8°F	105.8≤Twi＜ 111.2°F	111.2≤Twi＜ 118.4°F	118.4≤Twi＜125.6°F	≥125.6°F
F	5.5	6.5	7.5	8.5	10.5
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 (50%, max ratio)	Variable-frequency water pump: MIN (50%, 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





1.6 Control of Four-Way Valve STF

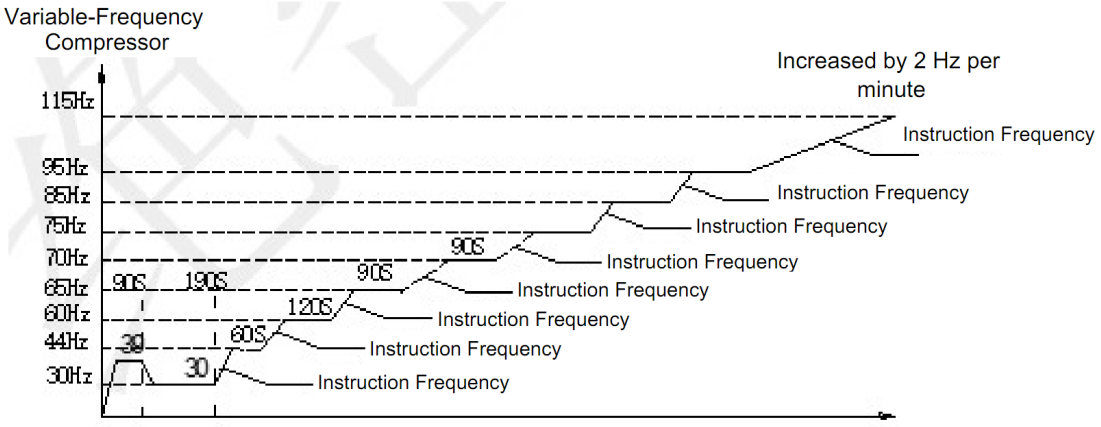
Power-on is not required in heating, which is carried out when defrosting is entered. Power-off will occur when defrosting exits;

The valve is constantly powered on during cooling operation

1.7 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



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

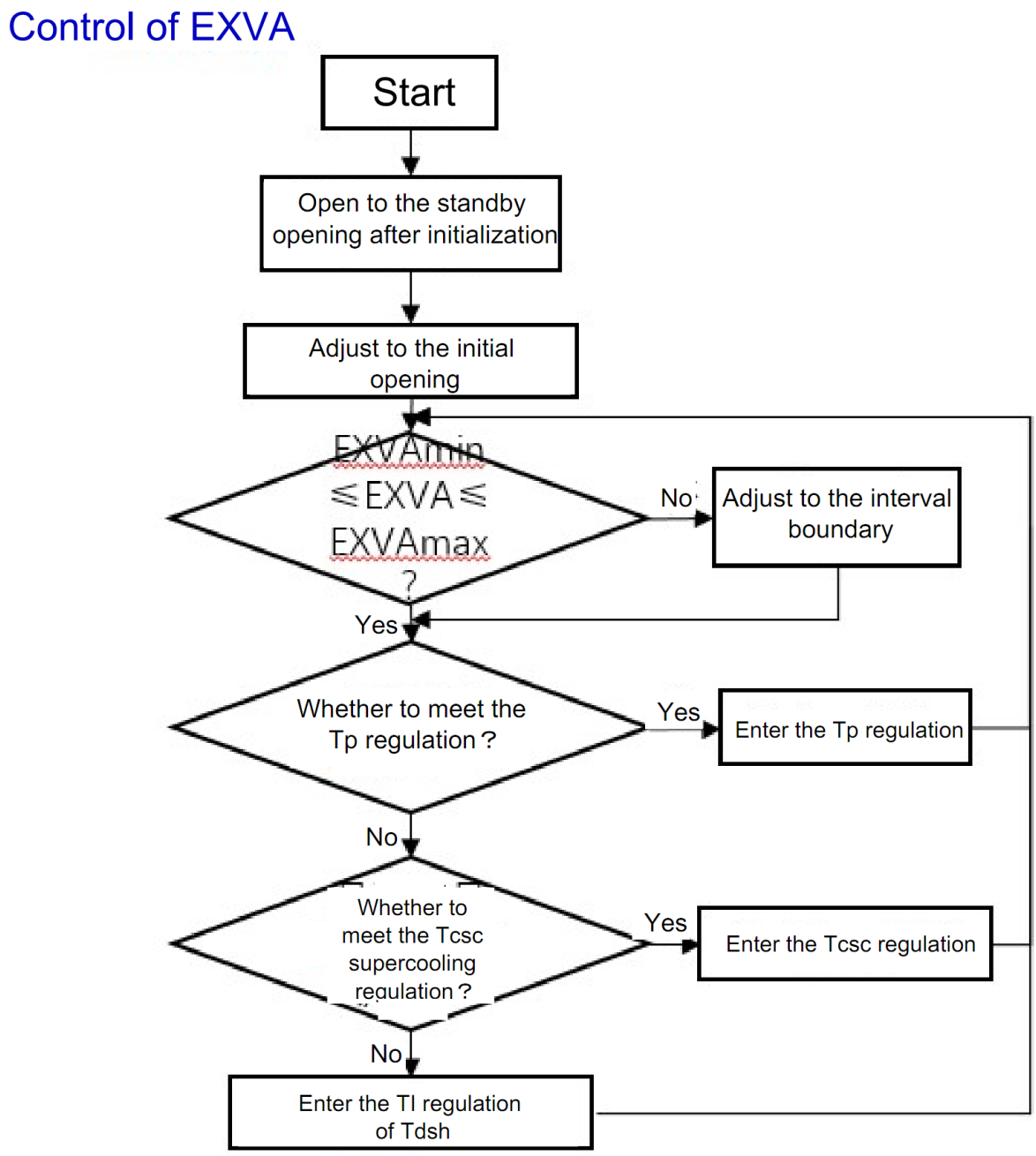
The water heating temperature energy demand frequency increase or decrease are shown as follows

1.8 Control of Electronic Expansion Valves

1.8.1 Control of EXVA

EXVA remains at 480P during cooling

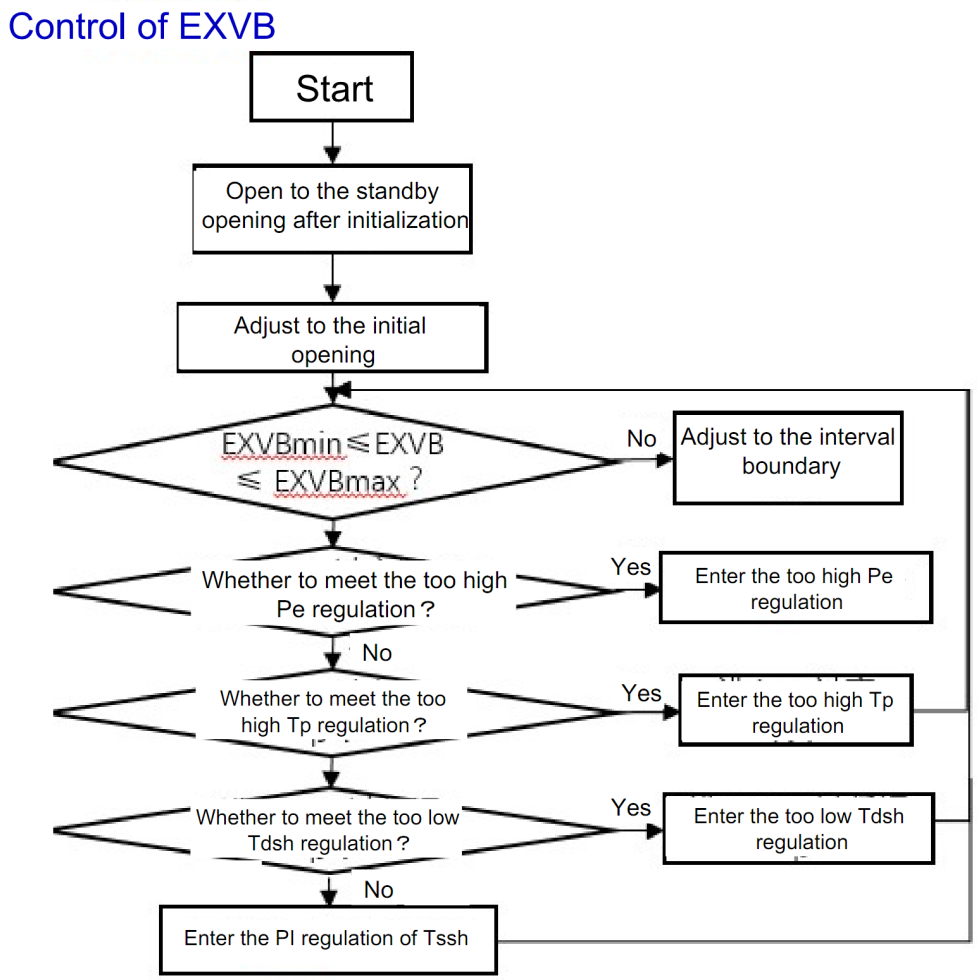
The overall framework for control during heating operation is shown in the following figure:



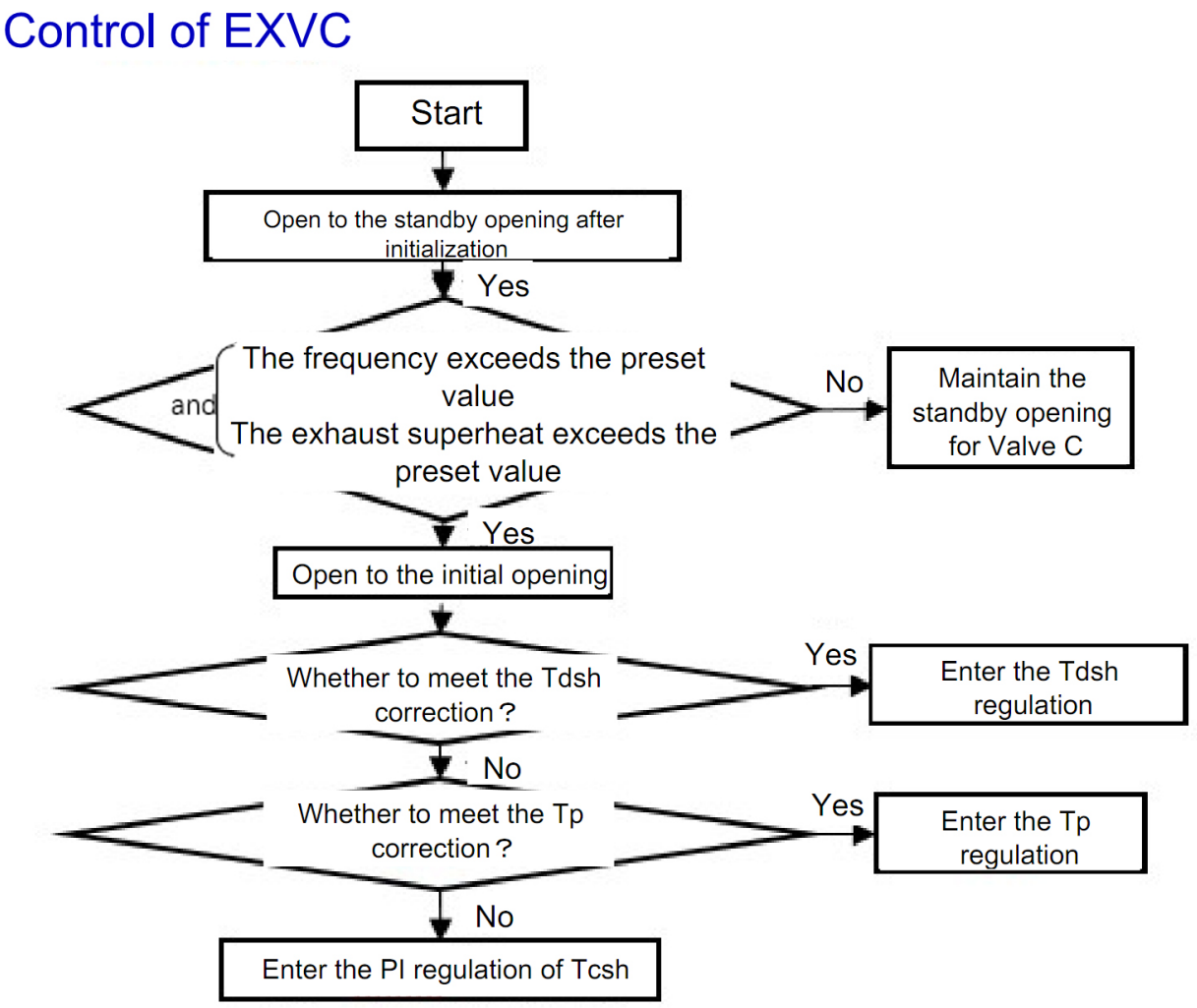
1.8.2 **Control of EXVB**

EXVB remains at 480P during heating

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



1.8.3 **Control of EXVC**



1.9 Cooling Control & Heating Control

1.9.1 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

1.9.2 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

1.10 Key Function Control Logic

1.10.1 Anti-freezing operation Control

Water pimp runs for 5 min → No → Electric auxiliary heating heat1 according to Tw start and stop

Detect Min (Twi, Two, Tw, Taf2) = A ℃ (continuous for 5s entering antifreeze) → Whether Min (Twi, Two, Tw, Taf2) = A ℃ → After the compressor runs in heating mode for 5 min, Whether Min (Twi, Two, Tw, Taf2) = A ℃ → No → Continue running

↓ Exit antifreeze

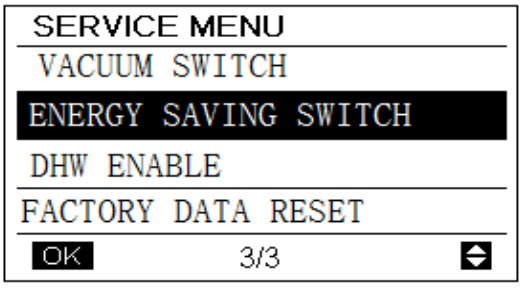
↓ Exit antifreeze

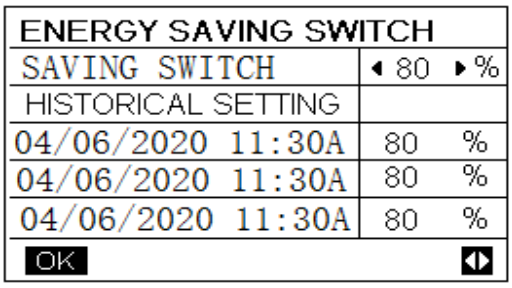
Water Pump Operation + Heat Pump Operation + Electric Auxiliary Heating Operation

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.

1.10.2 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.





1.10.3 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.

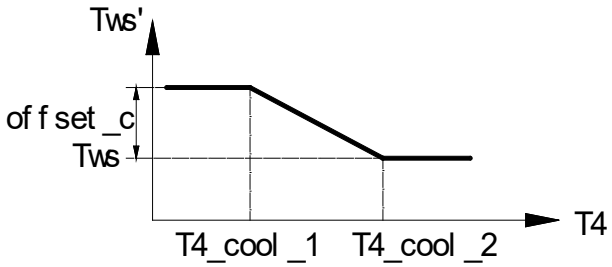
The cooling/heating mode is controlled by the H/C port. Disconnecting the H/C port sets the system to cooling mode, with an internal default set temperature of 44.6℉ (7°C) and an internal default hysteresis (δ) of 35.6℉ (2°C). Short-circuiting the H/C port sets the system to heating mode, with an internal default set temperature of 113℉ (45°C) and an internal default hysteresis (δ) of 35.6℉ (2°C) (can be set by wired-controller).

If a wired controller is also connected, the set temperature, hysteresis, and other parameters can be adjusted through the wired controller.

1.10.4 **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:

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

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

In case of any fault and protection, the corresponding actions of different faults and protections are shown in the table below:

Description of Failure Shutdown					
System stop		Unit stop		Master and slave system's judgement on stop respectively	
E3	Total water outlet temperature sensor malfunction	E4	Unit water outlet malfunction		
E8	Three-phase protector	E7	T4 sensor malfunction	1E5	T3 sensor malfunction
E9	Water flow switch malfunction (single pump mode)	EF	Return water temperature sensor	EP	Exhaust sensor malfunction
E0	Model mismatch fault	1Eb	Taf1 sensor malfunction (multi-pump mode)	FF	1FF Fan 1 malfunction
E6	Tank Temperature Sensor (Single Pump Mode)	2Eb	Taf2 sensor malfunction		
2E2	60s fault of communication between main control and extension board (main engine time service)	P3	Ambient Over-Temperature Protection of Refrigeration T4		
E2	Communication failure of master wire controller	P9	Inlet and outlet water temperature difference protection	Ed	Exhaust sensor malfunction
H5	Overvoltage protection	PA	Abnormal inlet and outlet temperature difference protection	3E2	Master-slave address communication failure within one machine
FP	Inconsistency of dialing codes for multiple pumps	PE	Refrigeration evaporator cryogenic antifreeze protection	F4	1F4 3 occurrences of 1L0 or 1L1 protection within 60min
E1	Phase sequence fault	PH	Heating T4 Over-Temperature Protection		
1Eb	Taf1 sensor malfunction (single pump mode)	E9	Water flow switch malfunction (single pump mode)	Fb	LP pressure sensor malfunction
		E6	Water tank temperature sensor (multi-pump mode)	HC	High pressure sensor fault
		1E2	Master and slave communication failure	Fd	Return temperature sensor malfunction
		2E2	60s fault of communication between main control and extension board (slave time service)	F6	1F6 System bus voltage fault
				1F0	IPM Module A Communication Failure
				C7	3 PL protections in 100 min
				F2	DSH super-heat deficiency
				EE	1EE T6A sensor malfunction 2EE T6B sensor malfunction
				EU	Tz sensor malfunction
				1H9	Drive model mismatch
				1P0	System Exhaust Over-Temperature or Exhaust Over-Pressure Protection
				P1	System protection for low pressure
				P4	1P4 System A AC Protection 2P4 System A Bus Current Protection
				P7	High temperature protection of system condenser
				PC	Evaporator pressure is too low during refrigeration
				PL	Tfin Module over-temperature protection
				PU	1PU DC Fan A Module Protection
				bH	1bH module 1 malfunction
				HE	A Valve unplugged in fault 1HE B Valve unplugged in fault 2HE C Valve unplugged in fault 3HE

Notes: The shutdown of the system means that all the parallel units have been stopped; the shutdown of a unit means that only the corresponding unit is stopped in case of any fault; The judgment shutdown of the master and slave systems means that when a fault occurs, only the corresponding refrigerant circulation system in a single unit will be stopped.

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. If the main unit also fails, the T4 values of the remaining normally operating machines in the same controller will be used, and the average value will be taken.

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 R32 70 kW; for the model R290 70 kW, please refer to the pressure frequency limiting instructions in the compressor control.

b) For the x high-pressure 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-pressure 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 temperature in heating mode 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 temperature in cooling mode 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**

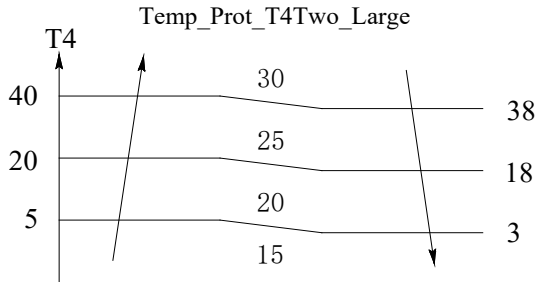
1) For standby detection, in the standby or shutdown mode (3 min after the compressor stops),
   1.1) If the low pressure detection value Pe is less than 0.02 MPa, and Pc is greater than or equal to 0.1 MPa, Fb is reported. If the above conditions are not met, the fault will automatically recover after 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 41 ℉(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

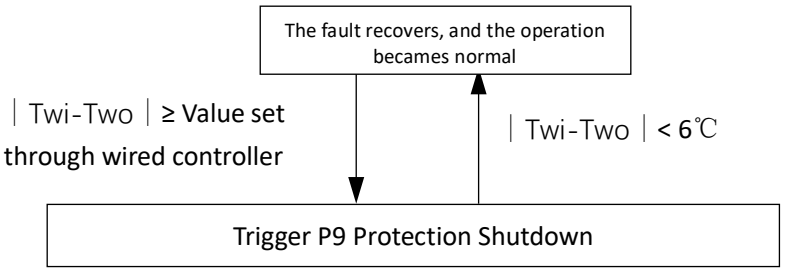
1) When Min (T4, Two)-Tc is detected to be greater than or equal to Temp_Prot_T4Two_Large in the unit in the standby or shutdown mode (3 minutes after the compressor is stopped), it is judged that the refrigerant system of the unit is insufficient, and P1 protection is reported, without locking. When 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.

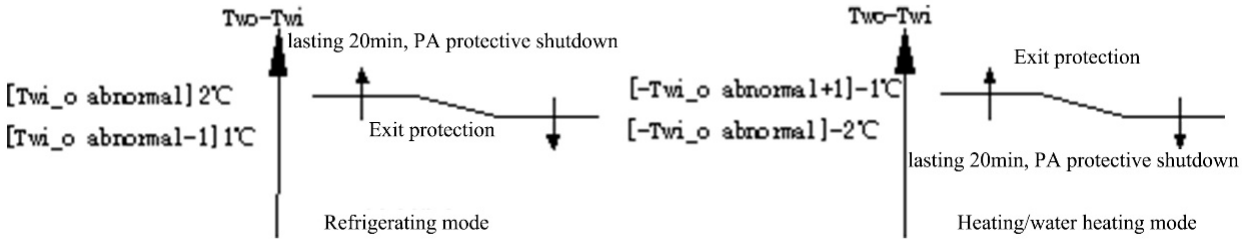
o) Excessive inlet and water outlet temperature difference protection P9

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

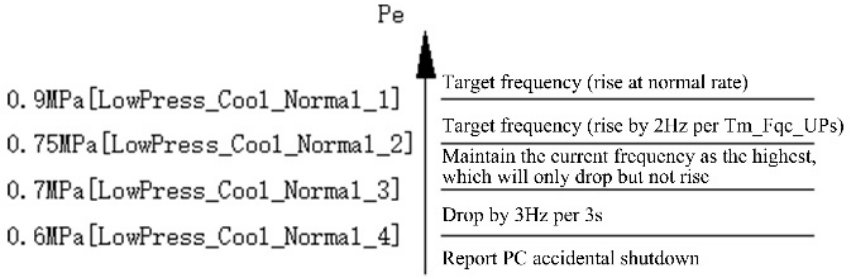
After the compressor is started, the abnormal inlet and water outlet temperature difference protection PA is detected



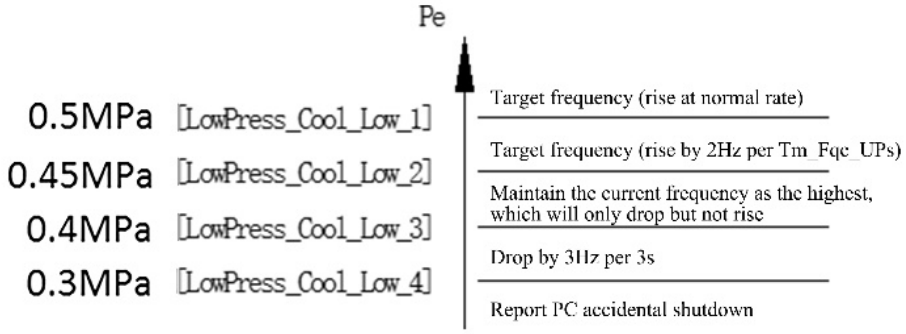
q) Too low evaporator pressure protection pc during cooling

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. Normal 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. Low-temperature cooling type: In the cooling mode, if Taf2 is less than or equal to -15 ℃ and lasts for 3 s, the shutdown procedures shall be implemented, until Taf2 is greater than -7 ℃, 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), Power on: Display frequency Defrost: dFdF (alternately displayed with current operating frequency)
1	0.xx	Host address
2	1.xx	Outdoor unit matching (e.g. R32 model: display 70; 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	Display "--" (reserved for THeatR heat recovery sensor temperature)
18	17.xx	Exhaust temperature 1
19	18.xx	Display "--" (reserved for exhaust temperature 2)
20	19.xx	Radiator temperature 1
21	20.xx	Display "--" (reserved for radiator temperature 2)
22	21.xx	Exhaust superheat Tdsh
23	22.xx	Compressor A current
24	23.xx	Display "--" (reserved for compressor B current)
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))

		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	Display "--" (reserved for DC voltage B)
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.

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 41 ℉(5 °C).
- If the outdoor ambient temperature is low, the system is being run in heating mode with the following settings: temperature 140 ℉(60 °C).
- The system has been running normally for more than 30 minutes.

Outdoor unit in normal cooling mode operating parameters

Outdoor ambient temperature	**℃**	< 10	10 to 25	25 to 35	35 to 55	
	℉	< 50	50 to 77	77 to 95	95 to 131	
Outlet water temperature	**℃**	10	7	7	7	
	℉	50	44.6	44.6	44.6	
Average discharge temperature	**℃**	40-80	65-100	65-105	75-107	
	℉	104-176	149-212	149-221	167-224.6	
Average discharge superheat	**℃**	15-40	25-45	22-45	25-45	
	℉	59-104	77-113	71.6-113	77-113	
Discharge pressure	**MPa**	1.4-2.7	2.1-3.0	2.3-3.8	2.7-4.1	
Average suction superheat	**℃**	2-4	2-6	2-6	2-8	
	℉	35.6-39.2	35.6-42.8	35.6-42.8	35.6-46.4	
Suction pressure	**MPa**	0.7-1.3	0.7-1.0	0.7-1.3	0.7-1.4	
Average suction temperature	**℃**	1-30	3-30	3-35	5-40	
	℉	33.8-86	37.4-86	37.4-95	41-104	
T3	**℃**	5-40	15-40	30-48	35-62	
	℉	41-104	59-104	86-118.4	95-143.6	
Tz/7	**℃**	/	/	/	/	
	℉	/	/	/	/	
Taf	**℃**	8-25	5-25	5-25	5-25	
	℉	46.4-77	41-77	41-77	41-77	
T6A/B	**℃**	/	5-30	8-30	10-40	
	℉	/	41-86	46.4-86	50-104	
Twi	**℃**	10-20	10-30	10-30	10-30	
	℉	50-68	50-86	50-86	50-86	
Two	**℃**	8-20	5-25	5-25	5-25	
	℉	46.4-68	41-77	41-77	41-77	
Tw	**℃**	8-25	5-25	5-25	5-25	
	℉	46.4-77	41-77	41-77	41-77	

Outdoor unit in heating mode operating parameters

Outdoor ambient temperature	**℃**	< -10	-10 to 0	0 to 7	7 to 20	> 20
	℉	< 14	14 to 32	32 to 44.6	44.6 to 68	> 68
Average discharge temperature	**℃**	60-105	60-105	60-105	65-105	65-100
	℉	140-221	140-221	140-221	149-221	149-212
Average discharge superheat	**℃**	35-50	35-45	28-45	25-40	20-35
	℉	95-122	95-113	82.4-113	77-104	68-95
Discharge pressure	**MPa**	1.6-3.5	1.8-3.7	2.0-3.9	2.0-4.0	2.5-4.1

Average suction superheat	**℃**	0-2	0-3	1-3	1-4	3-8
	℉	32-35.6	32-37.4	33.8-37.4	33.8-39.2	37.4-46.4
Suction pressure	**MPa**	0.2-0.5	0.3-0.65	0.3-0.9	0.6-1.2	0.7-1.4
Average suction temperature	**℃**	-25 to -10	-22 to 0	-10 to 7	0 to 15	5 to 25
	℉	-13 to 14	-7.6 to 32	14 to 44.6	32 to 59	41 to 77
T3	**℃**	-25 to -15	-22 to -2	-12 to 5	0 to 15	5 to 25
	℉	-13 to 5	-7.6 to 28.4	10.4 to 41	32 to 59	41 to 77
Tz/7	**℃**	20 to 55	20 to 55	20 to 55	20 to 55	20 to 55
	℉	68 to 131	68 to 131	68 to 131	68 to 131	68 to 131
Taf	**℃**	20-58	20-60	20-60	20-60	20-58
	℉	68-136.4	68-140	68-140	68-140	68-136.4
T6A/B	**℃**	-10-35	0-45	0-40	8-40	20-40
	℉	14-95	32-113	32-104	46.4-104	68-104
Twi	**℃**	20-50	20-50	20-50	20-50	20-50
	℉	68-122	68-122	68-122	68-122	68-122
Two	**℃**	25-58	25-60	25-60	25-60	25-58
	℉	77-136.4	77-140	77-140	77-140	77-136.4
Tw	**℃**	25-58	25-60	25-60	25-60	25-58
	℉	77-136.4	77-140	77-140	77-140	77-136.4

4 Table of Fault Codes

E0	Main Control Model Error
E1	Phase Sequence Fault
E2	Host Wired Controller Communication Fault (displayed for the host)/Host and Slave Communication Fault (displayed for the slave)
2E2	Main Control and Expansion Board 60s Communication Fault
3E2	Communication Fault between Master and Slave Addresses within a Single Unit
E3	Fault of Main Water Outlet Temperature Sensor
E4	Fault of Water Outlet Temperature Sensor of Unit
1E5	Fault of Condenser Tube Temperature Sensor T3A
E6	Fault of Water Tank Temperature Sensor T5
E7	Fault of Environmental Temperature Sensor
E8	Fault of Power Phase Sequence Protector Output
E9	Water Flow Detection Fault
1Eb	Fault of Anti-Freezing Protection Sensor Taf1 of Water Tank Pipeline
2Eb	Fault of Low-Temperature Antifreeze Temperature Sensor Taf2 of Cooling Evaporator
EC	Reduced Slave Module Fault of Slave
Ed	Fault of System Exhaust Temperature Sensor
EE	1EE Fault of Refrigerant Exchange Temperature Sensor T6A of Vapor Injection Board 2EE Fault of Refrigerant Exchange Temperature Sensor T6B of Vapor Injection Board
EF	Fault of Return Water Temperature Sensor of Unit
EP	Failure Fault Alarm of Exhaust Sensor
EU	Tz Sensor Fault
P0	Too High Exhaust Temperature Protection and Exhaust Pressure Protection of System
1P0	High-Pressure Switch Disconnection Protection of System
P1	Low-Pressure Protection of System
P3	Too High Environmental Temperature Protection for Cooling T4
P4	1P4 AC Current Protection for System A 2P4 Busbar Current Protection for System A
P7	High Temperature Protection of System Condenser
P9	Inlet and Water Outlet Temperature Difference Protection
PA	Abnormal Inlet and Water Outlet Temperature Difference Protection
PC	Too Low Evaporator Pressure Protection during Cooling
PE	Low-Temperature Antifreeze Protection for Cooling Evaporator
PH	Too High Temperature Protection for Heating T4
PL	Too High Protection for Tfin Module, occurring for 3 times within 100 min, and C7 reported
1PU	Module Protection of DC Fan A
H5	Too High or Too Low Voltage
1H9	Driver Model Mismatch Fault
HC	High-Pressure Pressure Sensor Fault
HE	Unplugging Fault 1HE of Valve A Unplugging Fault 2HE of Valve B Unplugging Fault 3HE of Valve C
1F0	Communication Fault of IPM Module A
F2	Insufficient DSH Superheat
F4	1F4, the 1L0 or 1L1 protection occurs for 3 times within 60 min

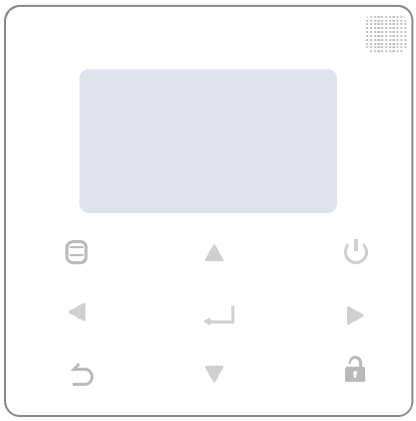
F6	1F6 Busbar Voltage Fault of System A
Fb	Low-Pressure Pressure Sensor Fault
Fd	Return Air Temperature Sensor Fault
1FF	Fault of Fan 1
FP	Inconsistent Dialing of Multiple Water Pumps
1bH	Fault of Module 1
1L10	Hardware Overcurrent Protection (The fault code is only displayed for the wired controller, and not displayed for the main board)
1L11	Instantaneous Overcurrent Protection for Phase Current (The fault code is only displayed for the wired controller, and not displayed for the main board)
1L12	Continuous 30S Phase Current Overcurrent Protection (The fault code is only displayed for the wired controller, and not displayed for the main board)
1L20	Module Over-Temperature Protection (The fault code is only displayed for the wired controller, and not displayed for the main board)
1L30	Too Low Busbar Voltage Fault (The fault code is only displayed for the wired controller, and not displayed for the main board)
1L31	Too High Busbar Voltage Fault (The fault code is only displayed for the wired controller, and not displayed for the main board)
1L32	Severely High Busbar Voltage Fault (The fault code is only displayed for the wired controller, and not displayed for the main board)
1L34	Phase Loss Fault in Three-Phase Power Supply (The fault code is only displayed for the wired controller, and not displayed for the main board)
1L43	Abnormal Current Sampling Bias (The fault code is only displayed for the wired controller, and not displayed for the main board)
1L45	Motor Code Mismatching (The fault code is only displayed for the wired controller, and not displayed for the main board)
1L46	IPM Protection (FO) (The fault code is only displayed for the wired controller, and not displayed for the main board)
1L47	Module Model Mismatching (The fault code is only displayed for the wired controller, and not displayed for the main board)
1L50	Start Failure (The fault code is only displayed for the wired controller, and not displayed for the main board)
1L51	Stalling Fault (The fault code is only displayed for the wired controller, and not displayed for the main board)
1L52	Motor Stalling Protection (The fault code is only displayed for the wired controller, and not displayed for the main board)
1L60	Phase Loss Protection of Fan Motor (The fault code is only displayed for the wired controller, and not displayed for the main board)
1L65	IPM Short Circiut Fault (The fault code is only displayed for the wired controller, and not displayed for the main board)
1L66	FCT Detection Fault (The fault code is only displayed for the wired controller, and not displayed for the main board)
1L6A	U-Phase Upper Tube Open Circuit (The fault code is only displayed for the wired controller, and not displayed for the main board)
1L6B	U-Phase Lower Tube Open Circuit (The fault code is only displayed for the wired controller, and not displayed for the main board)
1L6C	V-Phase Upper Tube Open Circuit (The fault code is only displayed for the wired controller, and

	not displayed for the main board)
1L6D	V-Phase Lower Tube Open Circuit (The fault code is only displayed for the wired controller, and not displayed for the main board)
1L6E	W-Phase Upper Tube Open Circuit (The fault code is only displayed for the wired controller, and not displayed for the main board)
1L6F	W-Phase Lower Tube Open Circuit (The fault code is only displayed for the wired controller, and not displayed for the main board)

5 Installation and Field Setting

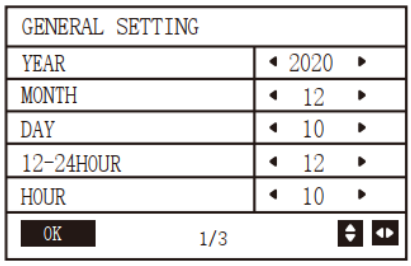
During installation, the unit's settings and parameters should be configured by the installer to suit the installation configuration, climate conditions and end-user preferences. The relevant settings are accessible and programmable through the SERVICE and PROJECT menu on the wired controller's user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

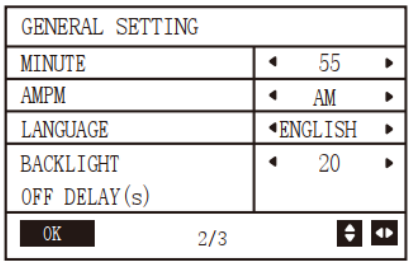
KJRM-120H3/BMWKO-E

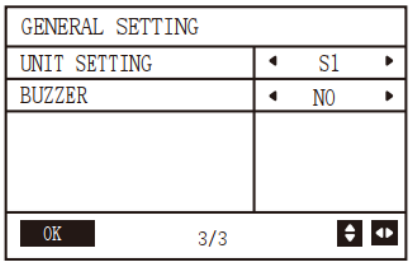


Icon	Function
	Enter the menu structure from the home page
	Navigate the cursor on the display/navigate in the menu structure/ adjust the settings
	Turn on or off the space operation mode
	Come back to the up level
	Long press for unlocking /locking the controller
	Go to the next step when programming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

Setting the unit (SI or PI)







If you want to change the wire controller's unit setting, click GENERAL SETTING, find UNIT SETTING in the page 3.

5.1 Service menu

5.1.1 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

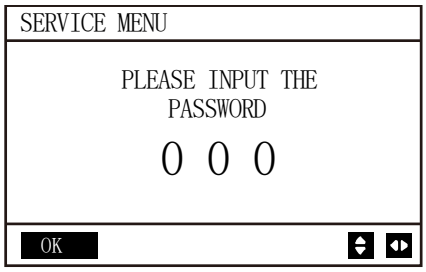
11. DHW ENABLE

12. FACTORY DATA RESET

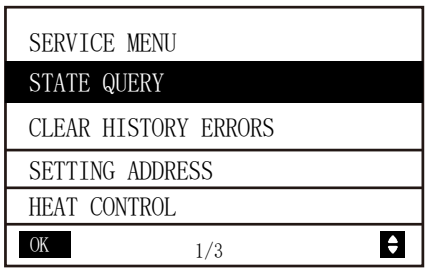
5.1.2 **Service Menu**

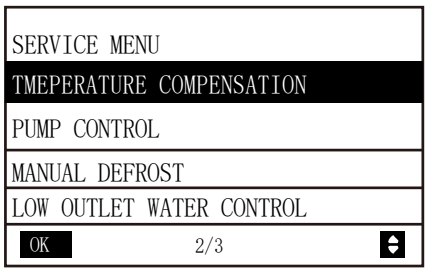
MENU > **Service Menu**

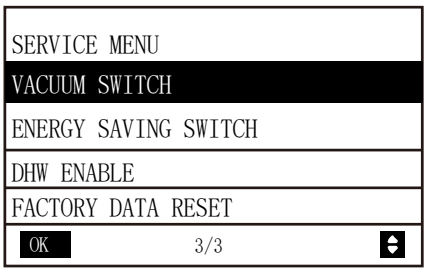
Service Menu allows installers to input the system configuration and set the system parameters. Enter the password, using ◄ ► to navigate between digits and using ▼ ▲ to adjust the numerical values, and then press ↵. The password is 234.



The following pages will be displayed after putting the password.

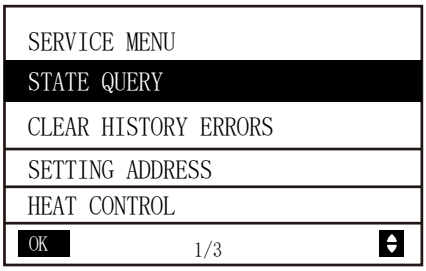




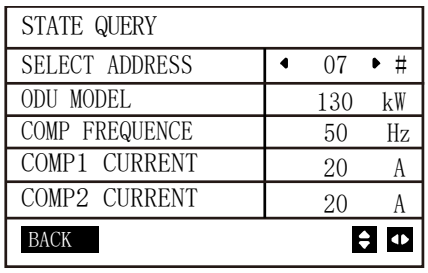


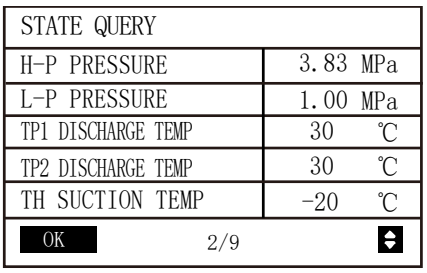
5.1.3 **State query**

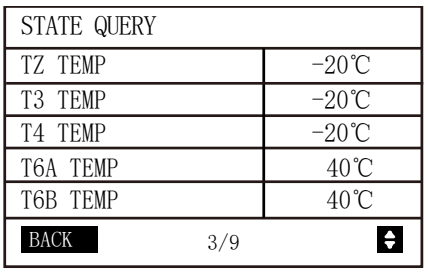
MENU > **Service Menu** > **State query**

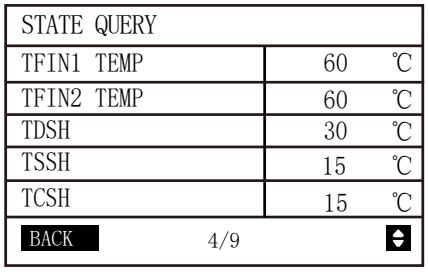


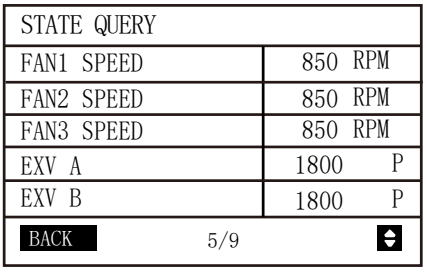
STATE QUERY allows installers to check the operation parameters. Press ◄ ► to select the address of units.

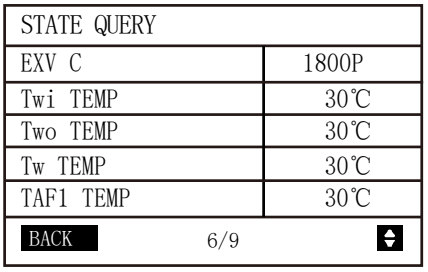


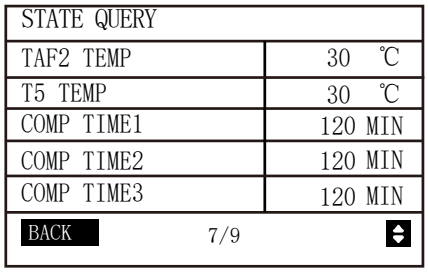


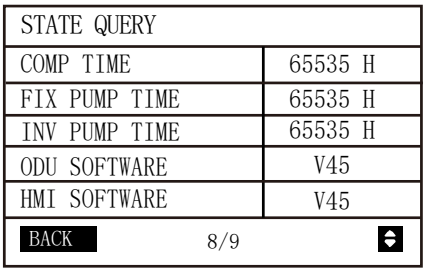


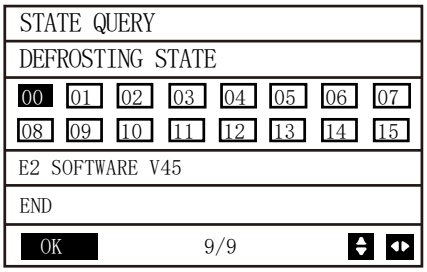










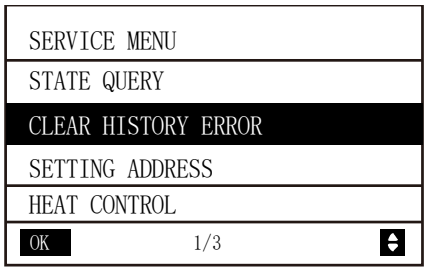


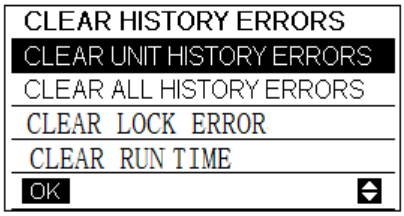
Note:

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.

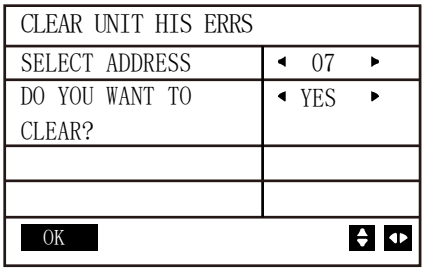
5.1.4 **Clear history errors**

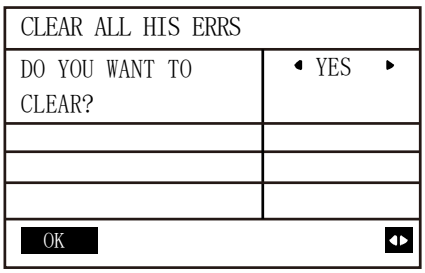
MENU > **Service Menu** > **Clear history errors**

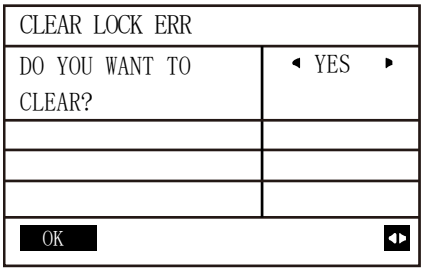


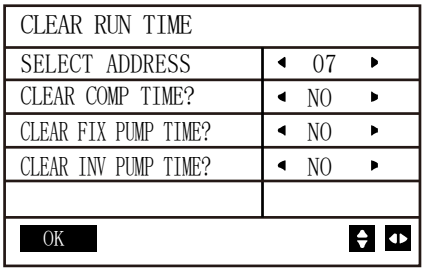


CLEAR HISTORY ERRORS is used to clear the history error codes and component operation time.



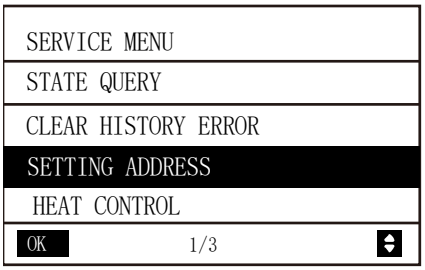




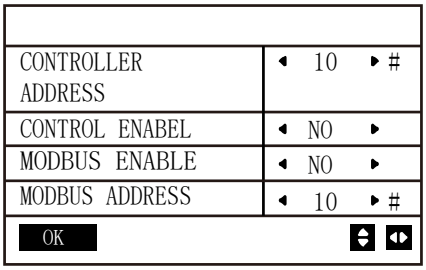


5.1.5 **Setting address**

MENU > **Service Menu** > **Setting address**



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

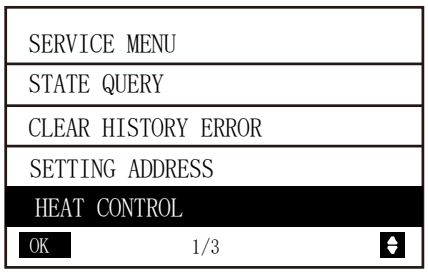
If CONTROL ENABLE sets as YES, it means the controller can set all the parameters; if CONTROL ENABLE sets as NO, it means the controller can only display the parameters.

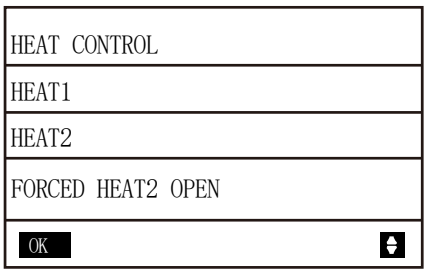
If the chiller system access to MODBUS system, MODBUS ENABLE should be set as YES. Please note that in this case, **COMTROL ENABLE** should be also set as YES, otherwise the units cannot be controlled.

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

5.1.6 **Heat control**

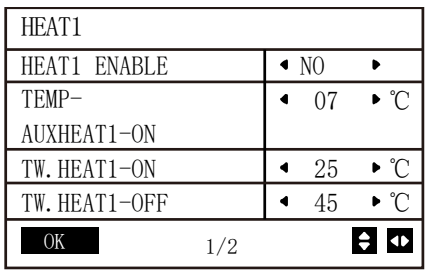
MENU > **Service Menu** > **Heat control**

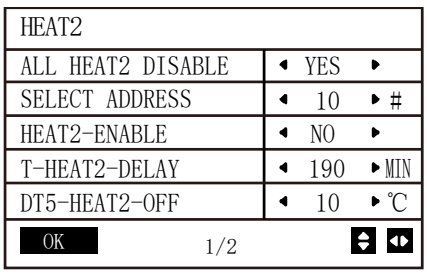


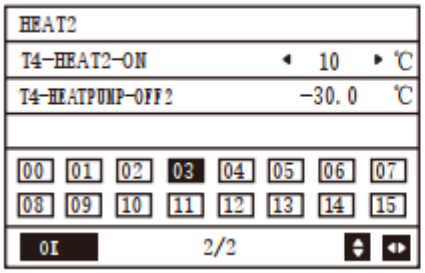


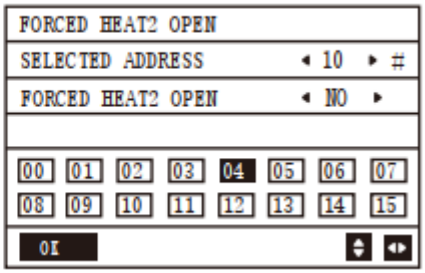
HEAT1 means pipe electric heating in heating mode.

HEAT2 means tank electric heating in DHW mode.









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.

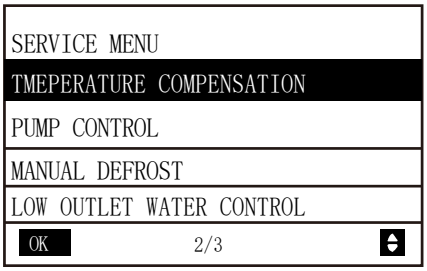
DT5-HEAT2-OFF sets the temperature difference between the actual water temperature and setting temperature above which the tank booster heater turns off.

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

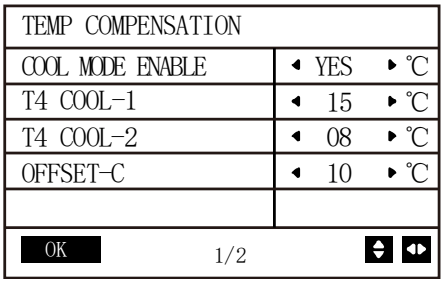
If **FORCED HEAT2 OPEN** is set as YES, when T5<T5S-1, then tank electric heater turns on; when T5≥T5S, then tank electric heater off. (00~15 means unit address)

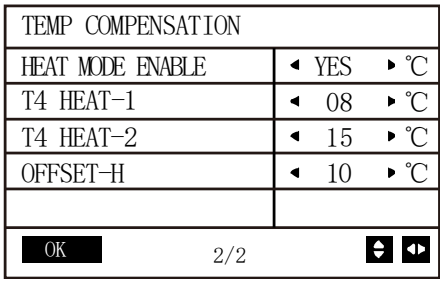
5.1.7 **Temperature Compensation**

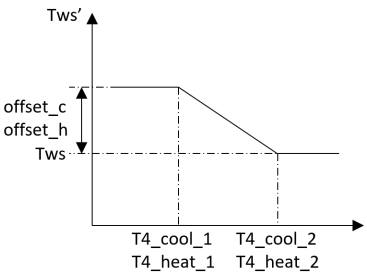
MENU > **Service Menu** > **Temperature Compensation**



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.







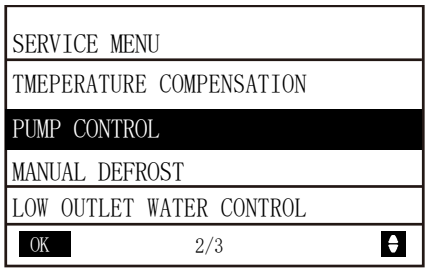
T4 COOL-1, **T4 COOL-2** set the ambient temperature for cooling mode.

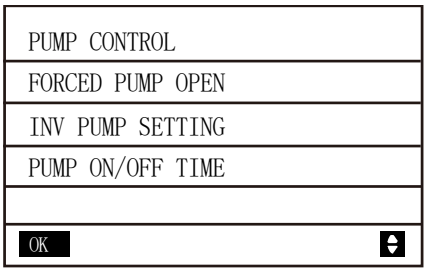
T4 HEAT-1, **T4 HEAT-2** set the ambient temperature for heating mode.

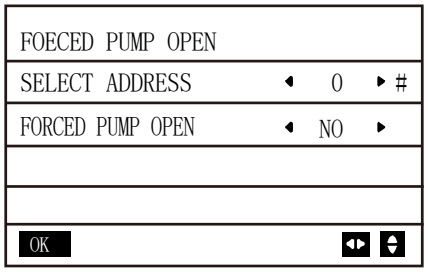
Offset_c, **Offset_h** is the temperature difference between current water temperature and T4_cool_1, T4_heat_1 corresponding water temperature.

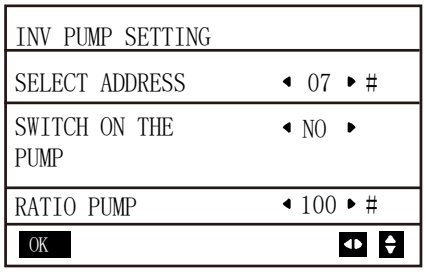
5.1.8 **Pump Control**

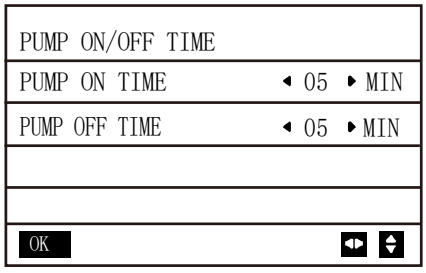
MENU > **Service Menu** > **Pump Control**











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.

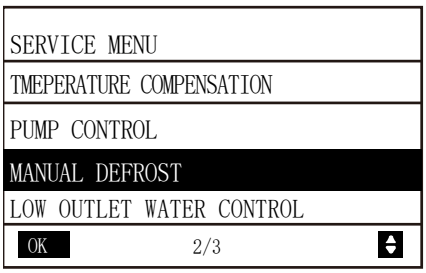
PUMP ON TIME sets the pump operation time after the unit stops.

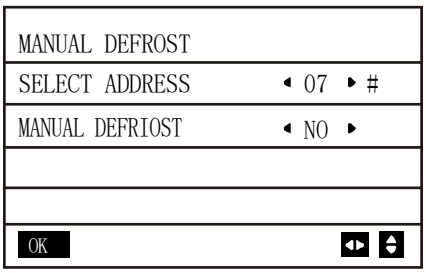
If PUMP OFF TIME sets as 0, the pump will run all the time. Otherwise, the pump will operate intermittently according to the PUMP ON TIME and PUMP OFF TIME setting.

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

5.1.9 **Manual Defrost**

MENU > **Service Menu** > **Manual Defrost**



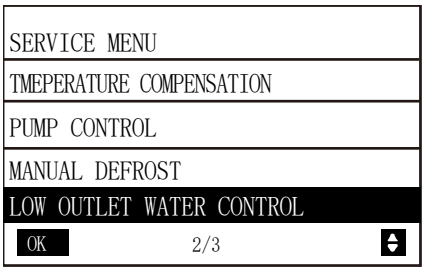


MANUAL DEFROST can force the unit to enter the defrost mode manually.

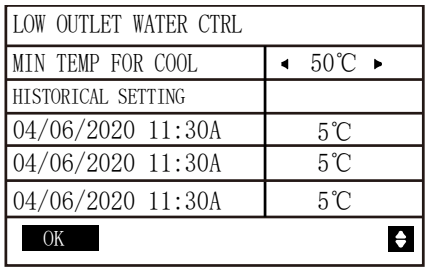
If the external unit successfully enters the defrost mode after the “MANUAL DEFROST” is turned on, the defrost icon will be displayed at homepage of the wired controller.

5.1.10 **Low outlet water temperature control**

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

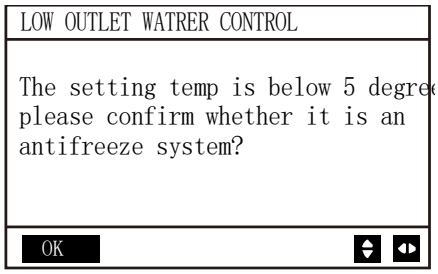


At this page, the historical minimum water outlet temperature setting (setting range -10~25℃) can be viewed.



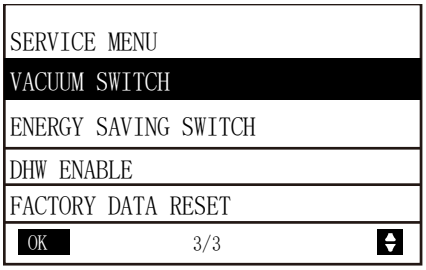
MIN TEMP FOR COOL sets the lowest water temperature for cooling mode. Please notice that When the setting temperature is less than 5℃, antifreeze liquid should be added in the water system.

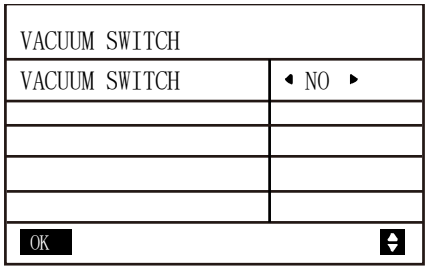
Tsafe=MIN TEMP FOR COOL



5.1.11 **Vacuum switch**

MENU > **Service Menu** > **Vacuum switch**

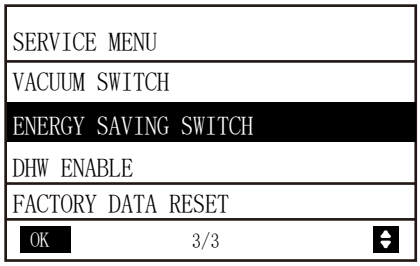


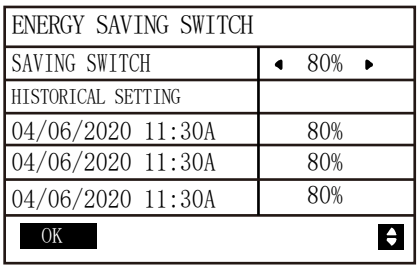


VACUUM SWITCH is used for vacuuming.

5.1.12 **Energy saving mode**

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



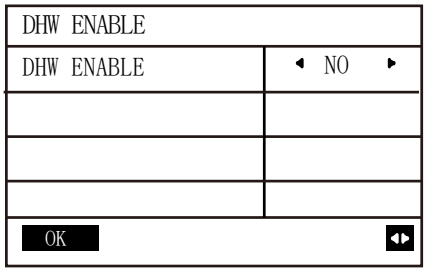


For projects with temporary electricity supply restrictions, the outdoor unit supports 7 levels of energy management which can be set to output 40-100% capacity. It prevents tripping during electricity supply restriction conditions and remains system continue to operate. The historical energy saving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

5.1.13 **DHW ENABLE**

MENU > **Service Menu** > **DHW ENABLE**

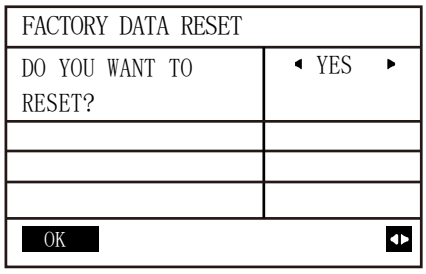
Domestic hot water function can be customized.



5.1.14 **Factory data reset**

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

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



5.2 Project meun

5.2.1 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

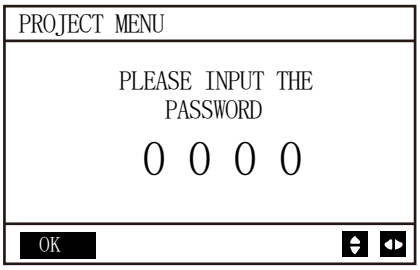
8. INV PUMP RATIO
MIN RATIO
MAX RATIO

5.2.2 **Project Menu**

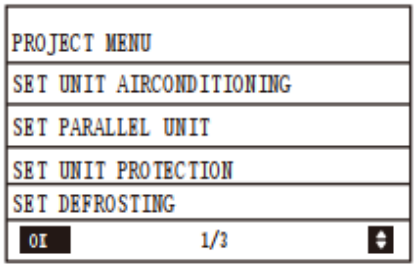
MENU > **Project Menu**

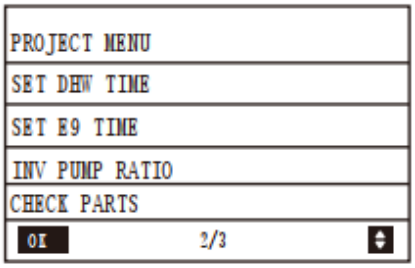
Project Menu allows installers to input the system configuration and set the system parameters. Enter the password, using ◄ ► to navigate between digits and using ▼ ▲ to adjust the numerical values, and then press **OK**.

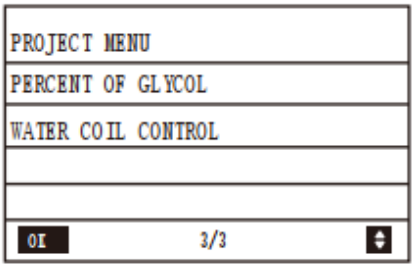
If you need the password, please contact your sales representative.



The following pages will be displayed after putting the password.

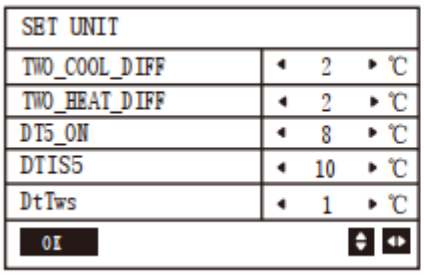


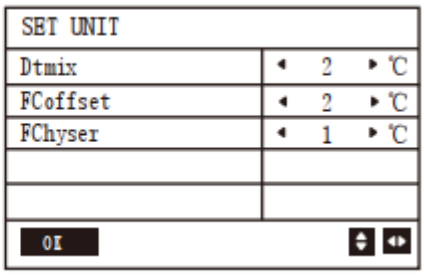




5.2.3 **SET UNIT-AIRCONDITIONING**

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 ℃	

5.2.4 **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.

5.2.5 **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 ℃ (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.

5.2.6 **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

5.2.7 **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.

5.2.8 **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.

5.2.9 **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.

5.2.10 **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

*For Aqua thermal Super 60Hz, only equipped with SV1, SV6.

5.3 Parameters setting

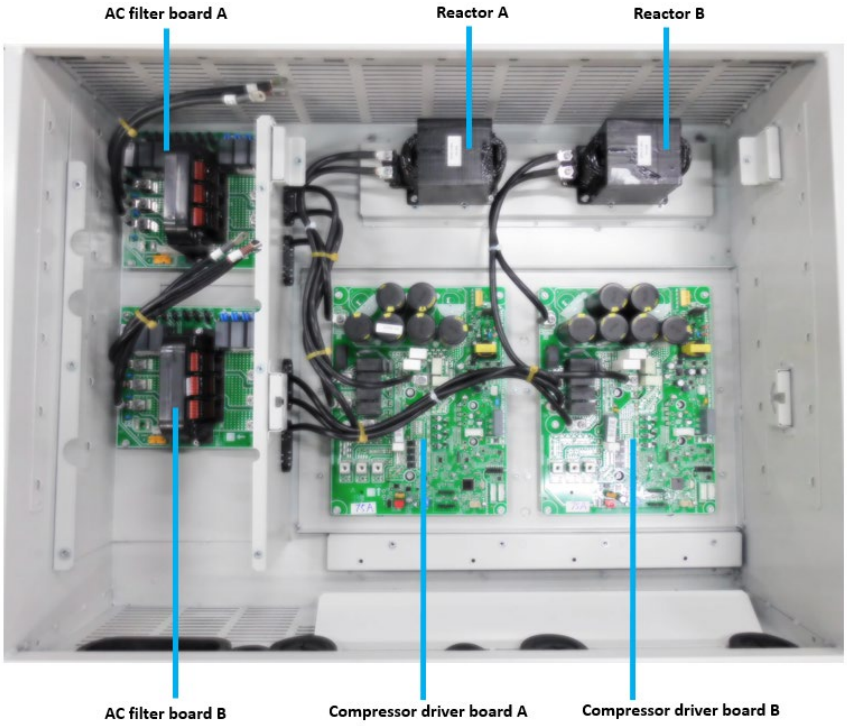
Parameters	Setting range	Default value	Adjustment range
t_frost	20 ~ 120 min	35 min	5 min
T_defrost_in	23~41℉(-5~5℃)	32℉(0℃)	1℉(0.5℃)
T_defrost_out	14~50℉(-10~+10℃)	32℉(0℃)	1℉(0.5℃)
Tim_Cap_adj	60~360 s	80 s	20 s
Two_cool_Diff	33.8~41℉(1℃~5℃)	35.6℉(2℃)	1℉(0.5℃)
Two_heat_Diff	33.8~41℉(1℃~5℃)	35.6℉(2℃)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

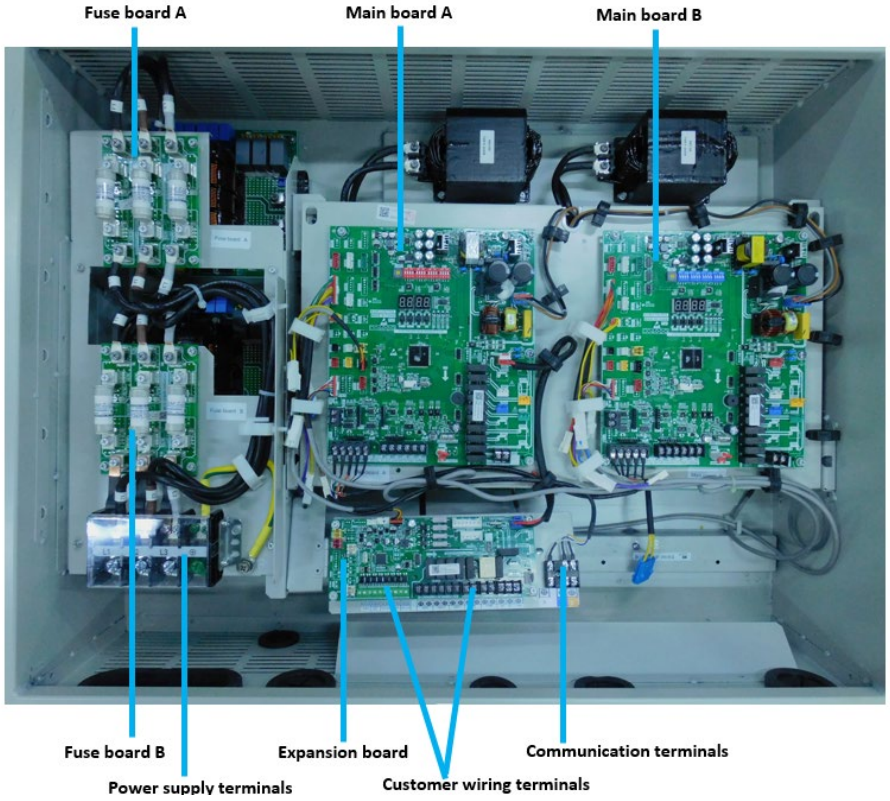
Part 4 Diagnosis and Troubleshooting

1 Electric Control Box Layout

1. Lower layer of electric control box:



2.Upper layer of electric control box：



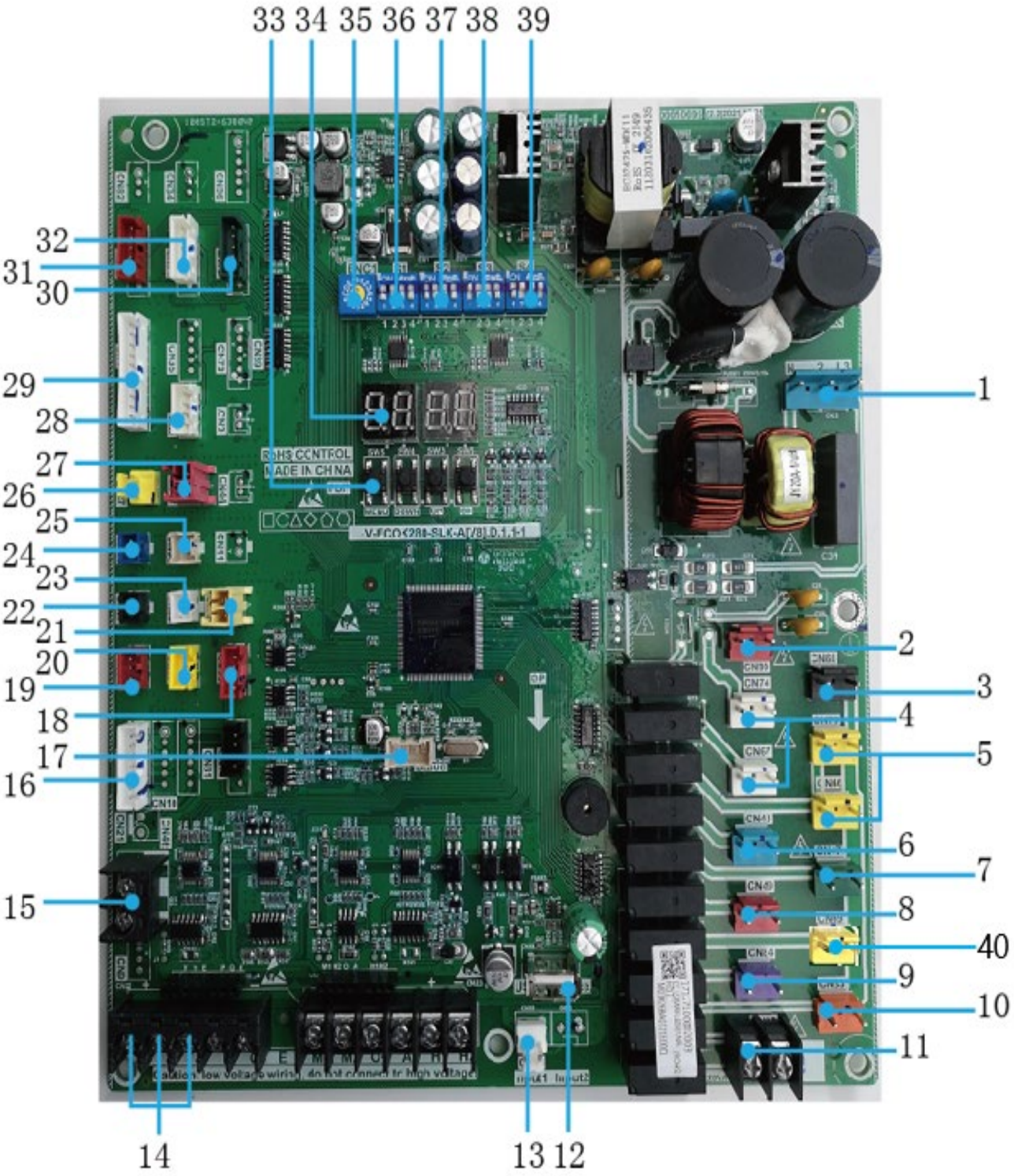
2 PCB Introduction

2.1 Types

Aqua thermal Super 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	Direction
1	CN32	POWER	Main board power supply	208-230V AC	Input
2	CN99	/	Expansion board power supply	208-230V AC	Output
3	CN68	PUMP	Reserved	208-230V AC	Output
4	CN74/CN67	CCH	Reserved/Crankcase Heater	208-230V AC	Output
5	CN75/CN66	EVA-HEAT	Reserved/Electronic heating belt for plate heat exchanger	208-230V AC	Output
6	CN48	ST1	Four-way valve	208-230V AC	Output
7	CN47	SV6	Solenoid valve	208-230V AC	Output
8	CN49	PAN-HEAT1	Water tray electric heating belt	208-230V AC	Output
9	CN84	SV8A	Reserved	0V	Output
10	CN83	SV8B	Reserved	0V	Output
11	CN93	ALARM	The alarm signal output of the unit (ON/OFF signal)	Determined by external wiring	Input/Output
12	CN65	USB	Program update port (USB)	5V DC	Input/Output
13	CN28	PH-PRO	Three-phase protector output switch	12V DC	Input
14	CN22	XYEPQ	Outdoor units communication and wired controller communication port	5V DC	Input/Output
15	CN46	AC1, AC2	The power supply port of the wired controller	12V DC	Output
16	CN26	O-Motor	Compressor inverter module and Fan inverter module communication ports	12V/5V DC	Input/Output
17	CN300	DEBUG	Program burn in port (Reserved)	3.3V DC	Input/Output
18	CN33	MS	Communicate with slave board	12V/3.3V DC	Input/Output
19	CN41	L-YLA	System low pressure sensor	5V DC	Input
20	CN40	H-YLA	System high pressure sensor	5V DC	Input
21	CN45	Taf2	Probe of outlet water side antifreeze temp	3.3V DC	Input
22	CN37	T3	pipe temperature sensor of the condenser	3.3V DC	Input
23	CN30	T4	outdoor ambient temperature sensor	3.3V DC	Input
24	CN16	/	Reserved	3.3V DC	Input
25	CN38	/	Reserved	3.3V DC	Input
26	CN27	TP-PRO	Discharge temperature switch protection (protection code P0,provent the compressor from over temperature 115℃)	3.3V DC	Input
27	CN42	L-PRO	Reserved	3.3V DC	Input
28	CN8	T6A/T6B	Refrigerant inlet temperature of EVI plate heat exchanger/Refrigerant outlet temperature of EVI plate heat exchanger	3.3V DC	Input
29	CN4	Twi	Unit water inlet temperature sensor	3.3V DC	Input
		Th	System suction temperature sensor	3.3V DC	Input
		Two	Unit water outlet temperature sensor	3.3V DC	Input
		Tz/7	coil final (BPHE) outlet temperature sensor	3.3V DC	Input
		Tp	DC inverter compressor discharge temperature sensor	3.3V DC	Input
30	CN72	EXVC	Port for electrical expansion valve C	12V DC	Output
31	CN70	EXVA	Port for electrical expansion valve A	12V DC	Output
32	CN71	EXVB	Port for electrical expansion valve B	12V DC	Output
33	SW3	UP	Up button	3.3V DC	Input
	SW4	DOWM	Down button	3.3V DC	Input
	SW5	MENU	Menu Buttons	3.3V DC	Input
	SW6	OK	Confirm button	3.3V DC	Input
34	DSP1/DSP2	/	Digital tube 1) In case of stand-by, the address of the module is displayed; 2) In case of normal operation, 10. is displayed (10 is followed by dot). 3) In case of fault or protection, fault code or protection	3.3V DC	Output

			code is displayed.		
35	ENC1	/	ENC1:NET_ADDRESS DIP switch 0-F of outdoor unit network address is enabled, which represent address 0-15.	3.3V DC	Input
36	S1	S1	Dip switch	3.3V DC	Input
37	S2	S2	Reserved	3.3V DC	Input
38	S3	S3	Dip switch	3.3V DC	Input
39	S4	S4	Reserved	3.3V DC	Input
40	CN69	PAN-HEAT2	Water tray electric heating belt	208-230V AC	Output

2.2.2 **Main PCB field setting**

DIP switch, buttons and digital display positions of units.

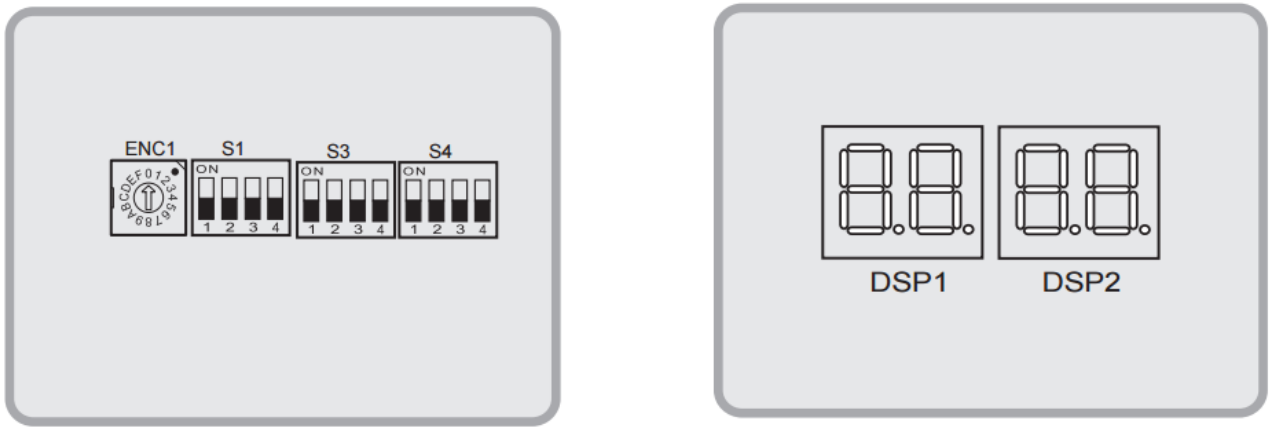
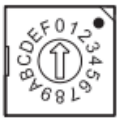
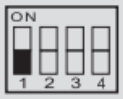
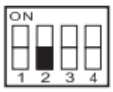
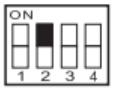
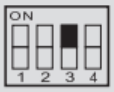
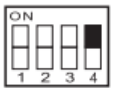
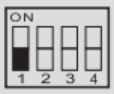
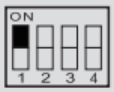


Fig. 7-1 Display positions

Table 7-1

			Meaning	Notes
ENC1 system address		0-F	Each unit is composed of two independent refrigerant circulation systems, and each refrigerant circulation system corresponds to its own address dialing code. Among them, 0# address is the A system of the host, 1# address is the B system of the host, and the address dialing code of other unit computer systems is dialing code in order from small to large.	Host system A address dial code to 0#; Each refrigerant circulation system should choose the address dialing code; Other system address dialing code cannot be repeated
S1-1 remote control		OFF	When the dial code is off, the unit has no remote control, can only be controlled by the wired controller (factory default).	This dial is valid for 0# address, but not for other addresses
		ON	When the dial code is on, the remote control of the unit takes effect. 1. Control the start and stop of the unit through the ON/OFF port of the mainboard extension board. Short-circuit unit starts, disconnected unit shuts down; 2. Adjust the unit operation mode through the H/C port on the expansion board. The short connection is heating mode, and the disconnection is cooling mode. 3. If the unit is connected with the wired controller, the wired controller can only change the setting temperature, boot back error and other parameters (if there is no wired controller, it is controlled by the default value).	This dial is valid for 0# address, but not for other addresses

S1-2 heating outlet temperature selection		OFF	When the dial code is off, the maximum temperature of the heating mode can be set to 140 ℉ (factory default).	Each system in the system controlled by the same one-line controller needs to select S1-2, and it is recommended to select the same.
		ON	When the dial code is on, the maximum temperature of the heating mode can be set to 149 ℉. Note that only when the unit is equipped with a frequency conversion pump and the water flow range meets our company's requirements, this dial code can be set to ON, otherwise it may lead to the unit not reaching the set temperature.	
S1-3 multi pump & single pump selection		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; 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. 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 constant and variable water pump linkage control		OFF	When a single unit machine is matched with a single fixed speed water pump or a single variable frequency water pump, this dial code should be OFF (factory default).	Each system in the system controlled by the same line controller needs to select S1-4.
		ON	When the hydrodynamic equipment of a single unit machine is a constant speed water pump and parallel variable frequency water pump, this dial code should be ON. When the dial code is on, the fixed speed water pump and the variable frequency water pump will be adjusted.	
S3-1 unit machine system differentiation		OFF	This dial code is used to distinguish the AB system in A single unit machine. When the dial code is off, the system is A system.	This dial has been set, installation and debugging need not be changed. When appeared?? Failure, need to check whether the dial is correct.
		ON	This dial code is used to distinguish the AB system in a single unit machine. When the dial code is on, it means that the system is B system.	

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 5 ℉~158 ℉. If the temperature is higher than 158 ℉, it is displayed as 158 ℉. 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

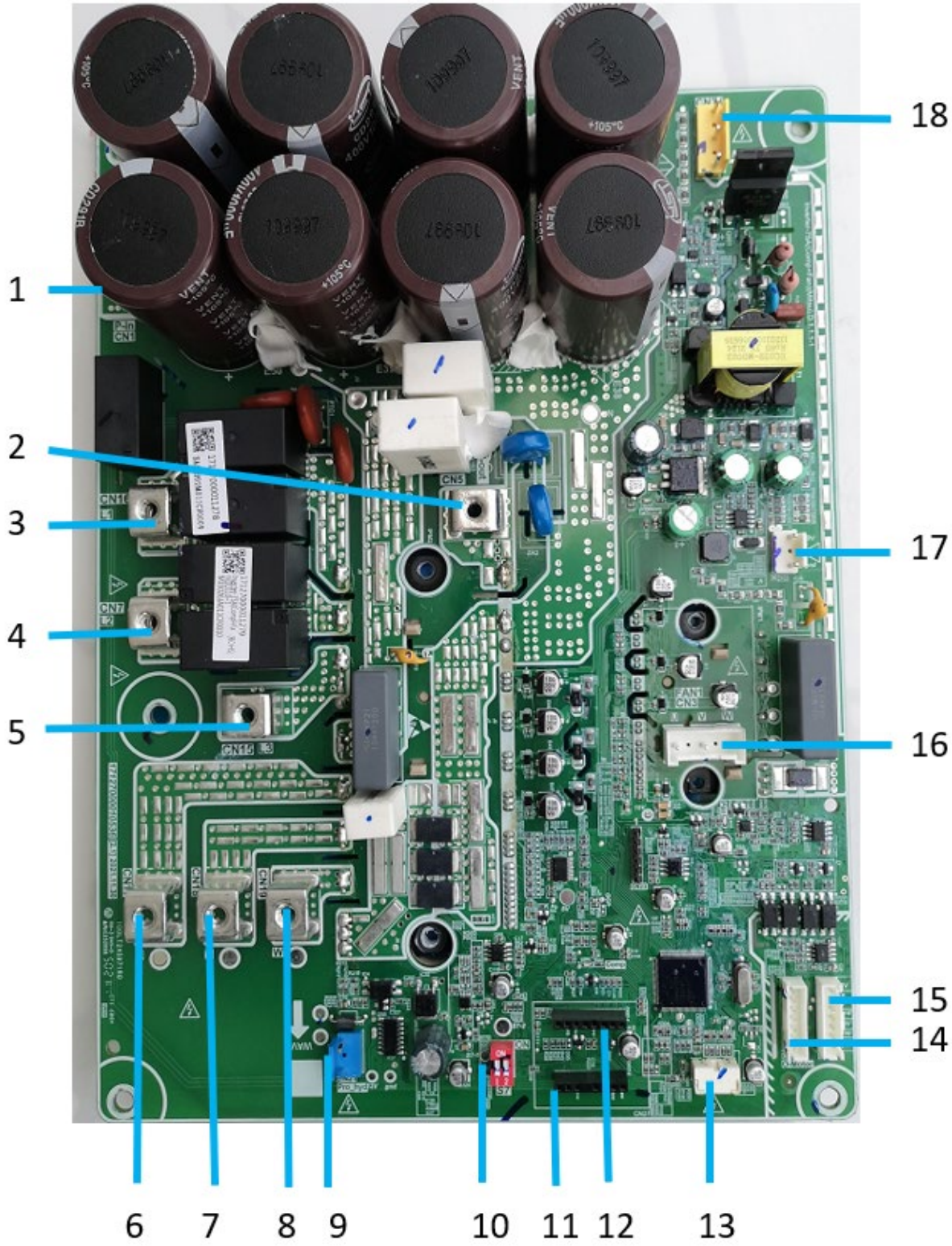
They are used for displaying the total online Modular units of the whole unit system and the number of the Modular unit under running state, respectively, with display scope 0~16.

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.

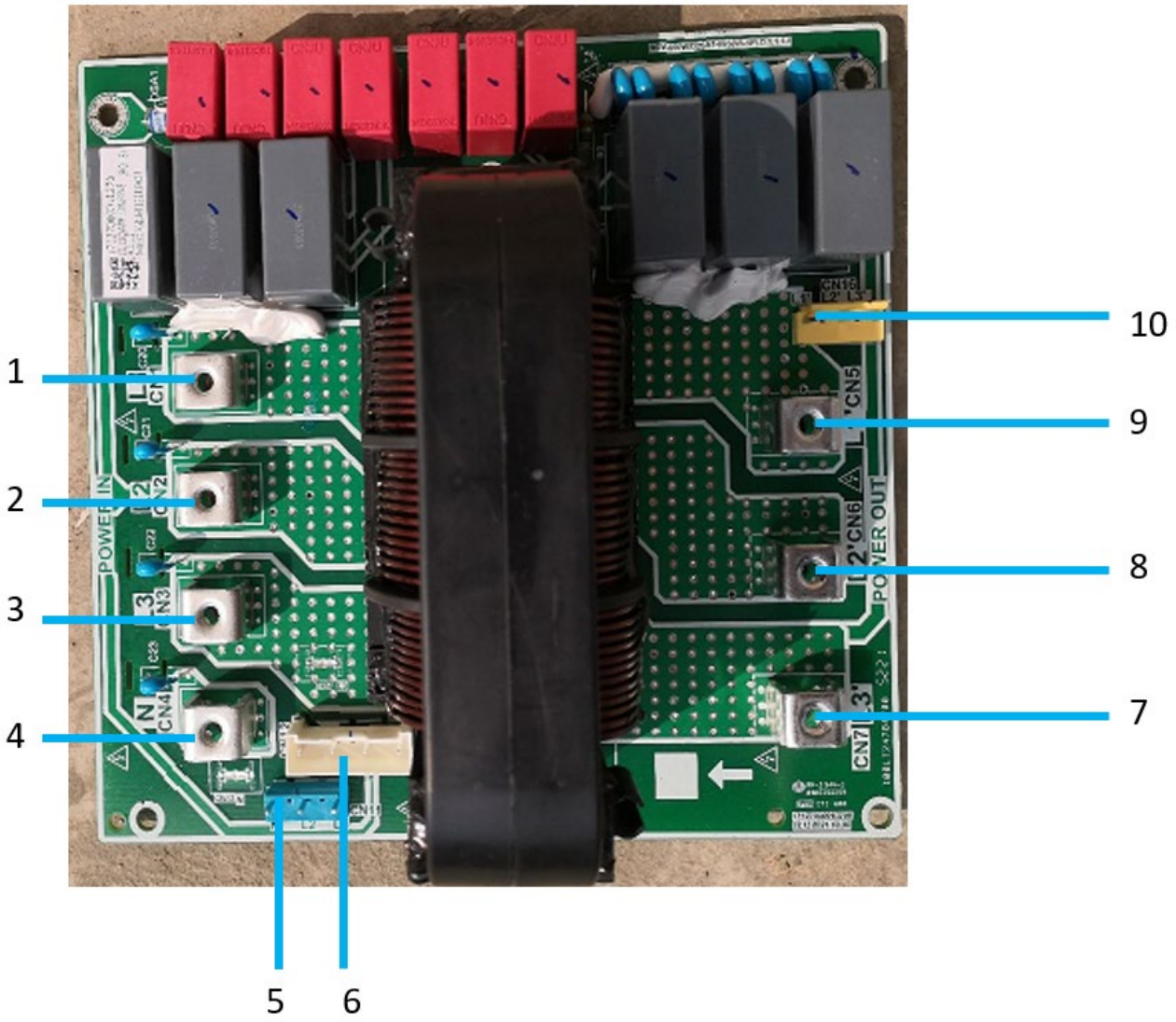
2.3 Compressor Module Board & Fan Driver Board

2.3.1 Compressor Inverter Module PCB component



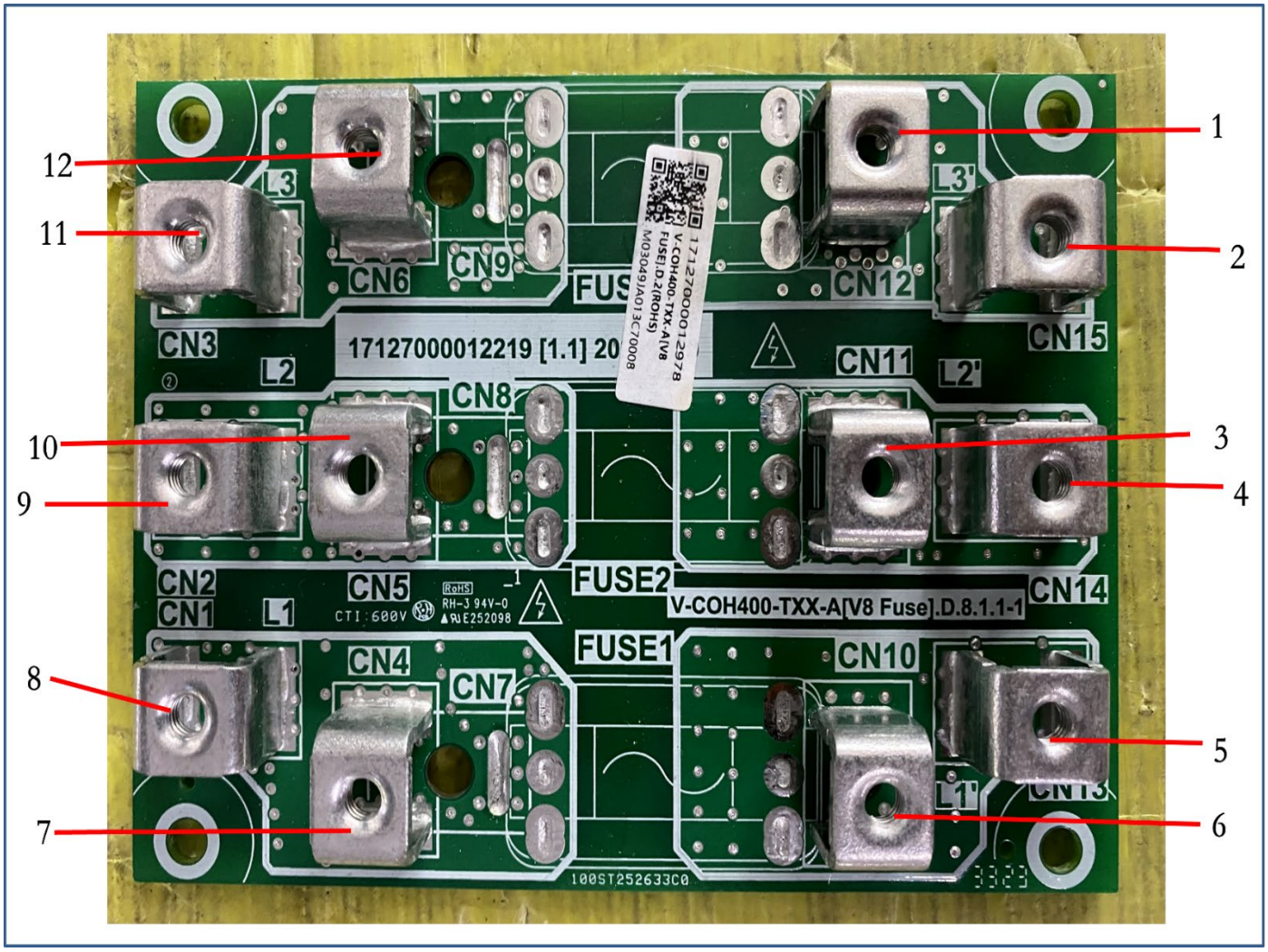
No.	Port Code	Port	Content	Voltage	Direction
1	CN1	P-in	Input from reactor	/	Input
2	CN5	P-out	Output for reactor	/	Output
3	CN16	L1	Power input port	208-230V AC	Input
4	CN7	L2			
5	CN15	L3			
6	CN17	U	Power output for compressor	208-230V AC	Output
7	CN18	V			
8	CN19	W			
9	CN21	H-SW	High pressure switch	12V DC	Input
10	S7	S7	Module address DIP switch	5V DC	Input
11	CN27-1		PED board socket	5V DC	Input/Output
12	CN27-2		PED board socket	5V DC	Input/Output
13	CN25	DEBUG	Program burn in port	5V DC	Input/Output
14	CN8	O-Motor	PTC relay control port/communication port	5V/12V DC	Input/Output
15	CN9	O-Motor	PTC relay control port/communication port	5V/12V DC	Input/Output
16	CN3	UVW	Port output for fan	208-230V AC	Output
17	CN26		Fan module board power supply port	19V DC	Output
18	CN38	P N	DC fan power output port	294-325V DC	Output

2.4 AC Filter Board



No.	Port Code	Port	Content	Voltage	Direction
1	CN1	L1	Power input L1	208-230V AC	Input
2	CN2	L2	Power input L2		Input
3	CN3	L3	Power input L3		Input
4	CN4	/	Reserved	0V	Input
5	CN11	/	Reserved	208-230V AC	Output
6	CN12	/	Main board power supply	208-230V AC	Output
7	CN7	L3’	Output power L3'	208-230V AC	Output
8	CN6	L2'	Output power L2'		Output
9	CN5	L1'	Output power L1'		Output
10	CN16	/	Power port for three-phase water pump	208-230V AC	Output

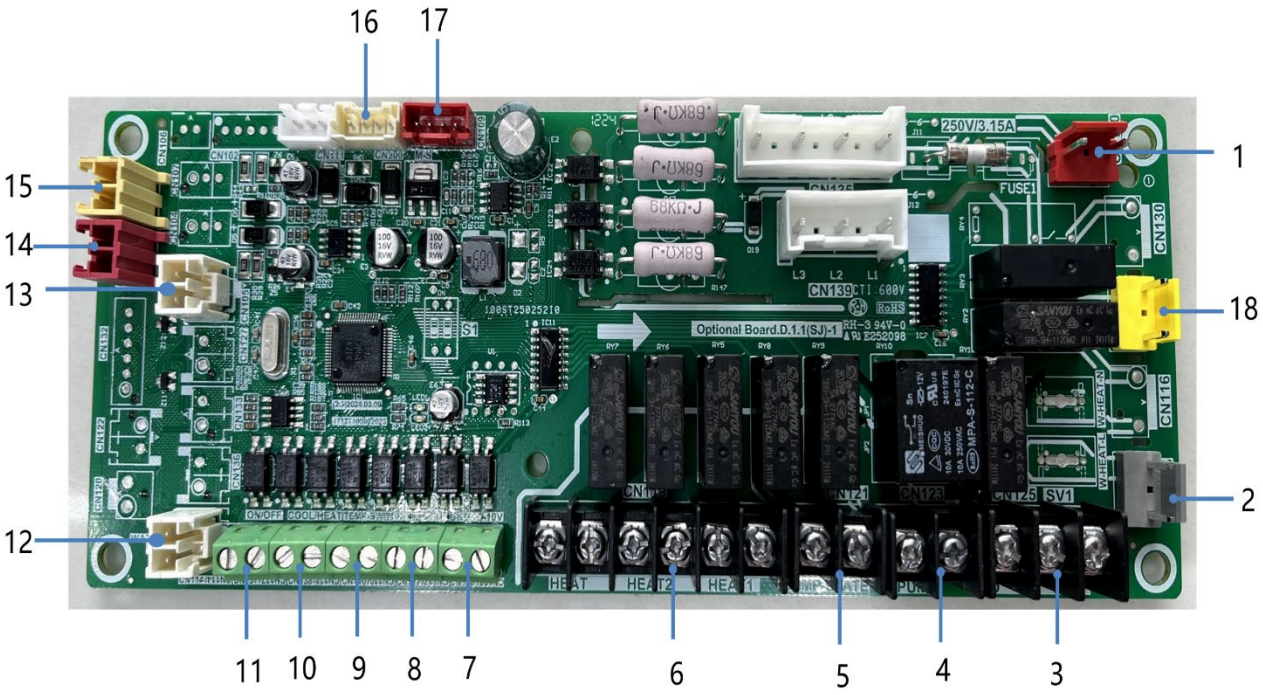
2.5 Fuse Board



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

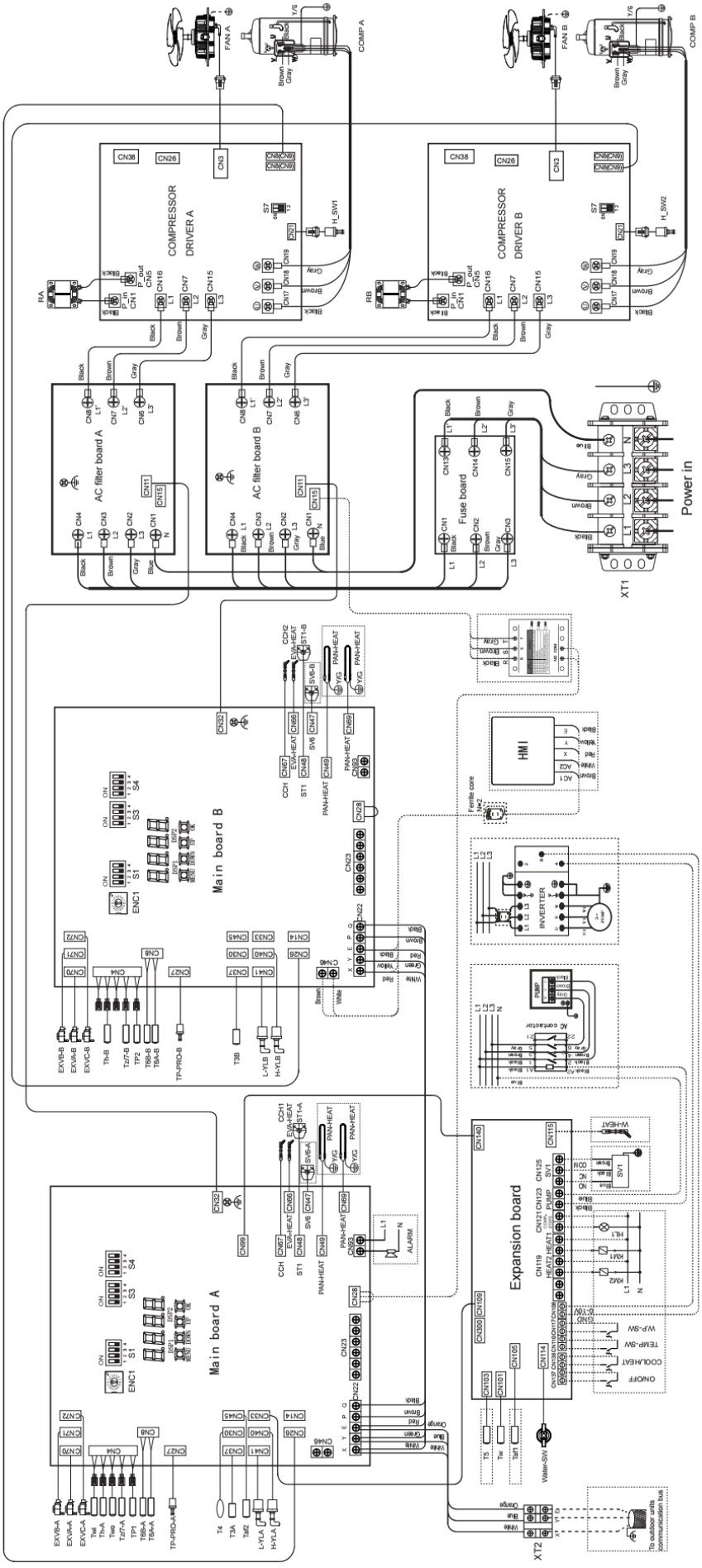
2.6 Expansion Board



	Port Code	Port	Content	Voltage	Direction
1	CN140	POWER	Expansion board power supply	208-230V AC	Input
2	CN115	W-HEAT	Electric heater of water flow switch	208-230V AC	Output
3	CN125	SV1	Three-way valve (hot-water valve)	208-230V AC	Output
4	CN123	PUMP	Port controlled by the contactor of the constant speed water pump	Determined by external wiring	Input/output
5	CN121	COMP-STATE	Compressor status indication	Determined by external wiring	Input/output
6	CN119	HEAT1/HEAT2	Pipeline Auxiliary Heater/Hot Water Tank Auxiliary Heater	Determined by external wiring	Output
7	CN108	PUMP-V	Inverter pump 0-10V output control signal	0-10V DC	Output
8	CN117	W.P-SW	Water pressure switching port.	12V DC	Input
9	CN110	TEMP-SW	Target water temperature switch	12V DC	Input
10	CN138	COOL/HEAT	Remote function of cool/heat signal	12V DC	Input
11	CN137	ON/OFF	Remote function of on/off signal	12V DC	Input
12	CN114	WATER-SWITCH	Water flow switch signal	12V DC	Input
13	CN105	Taf1	Probe of inlet water side antifreeze temp	3.3V DC	Input
14	CN101	TW	Probe of final unit water outlet temp	3.3V DC	Input
15	CN103	T5	Probe of water tank	3.3V DC	Input
16	CN300	DEBUG	Program burn in port	3.3V DC	Input/output
17	CN109	MS	Conmunicate with main board	12V/3.3V DC	Input/output
18	CN118	/	Reserved	208-230V AC	Output

3 Wiring diagram

3.1 Single unit

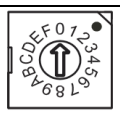
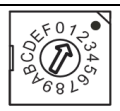


S1-1		Normal control, Valid for S1-1 OFF (factory default)
		Remote control, Valid for S1-1 ON
S1-2		Normal temperature effluent, Valid for S1-2 OFF (factory default)
		High temperature effluent, Valid for S1-2 ON
S1-3		Single water pump control, Valid for S1-3 OFF(factory default)
		Multiple water pumps control, Valid for S1-3 ON
S1-4		Single frequency conversion water pump control, Valid for S1-4 OFF(factory default)
		Single frequency conversion water pump + single constant speed water pump control, 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(factory default)
		R290 model, Valid for S3-2 ON
S3-3		Single Wall Exchanger, Valid for S3-3 OFF(factory default)
		Double Wall Exchanger, Valid for S3-3 ON

S4	DIP switch for capacity selection	
		70KW(20Tons) unit select 0000

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

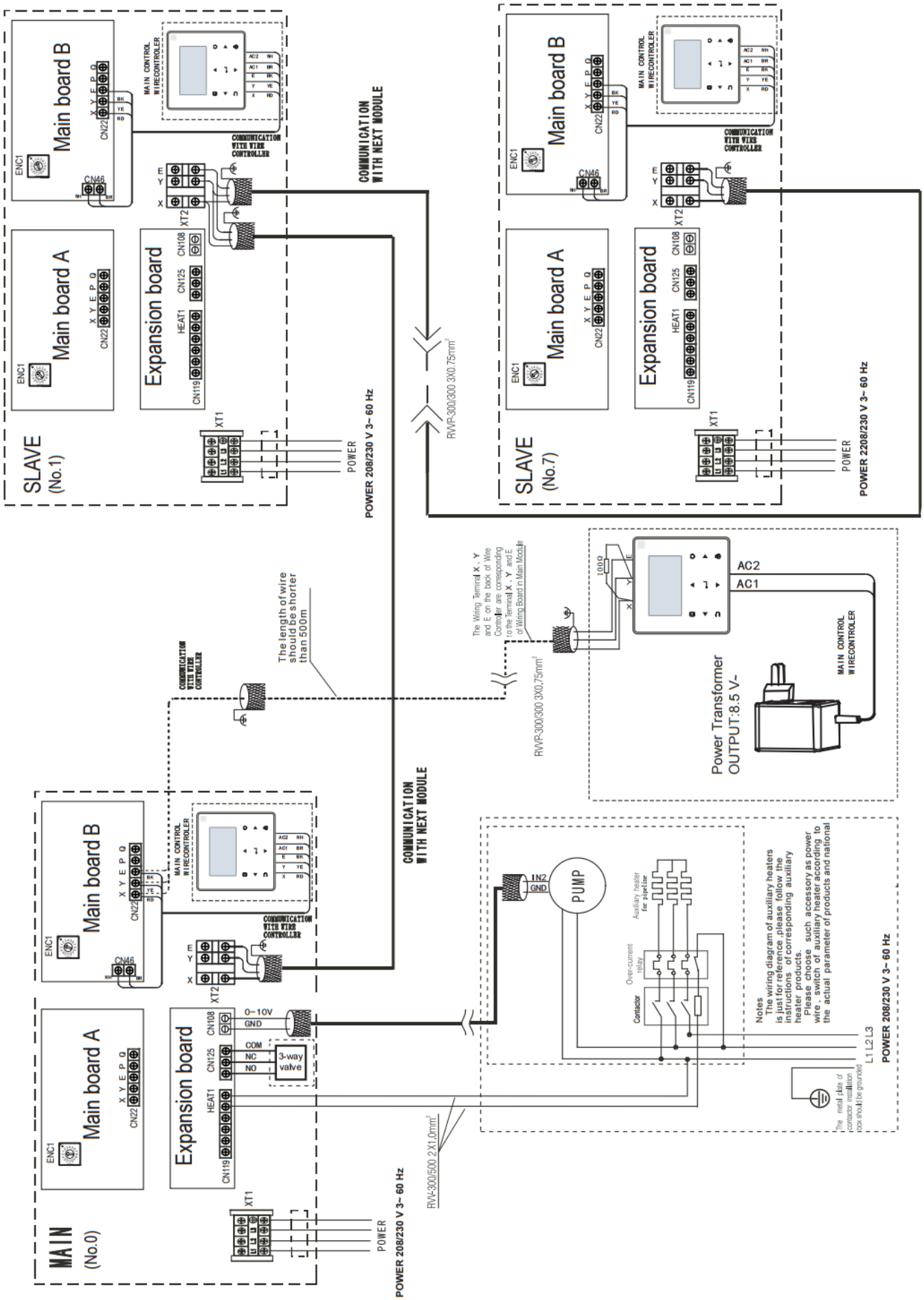
ENC1	0-F valid for unit address setting on the DIP switches, 0 indicates the master unit and 1-F the slave units (parallel connection)	
		Main board A is set as the master unit (factory default)
		Main board B is set as the master unit (factory default)

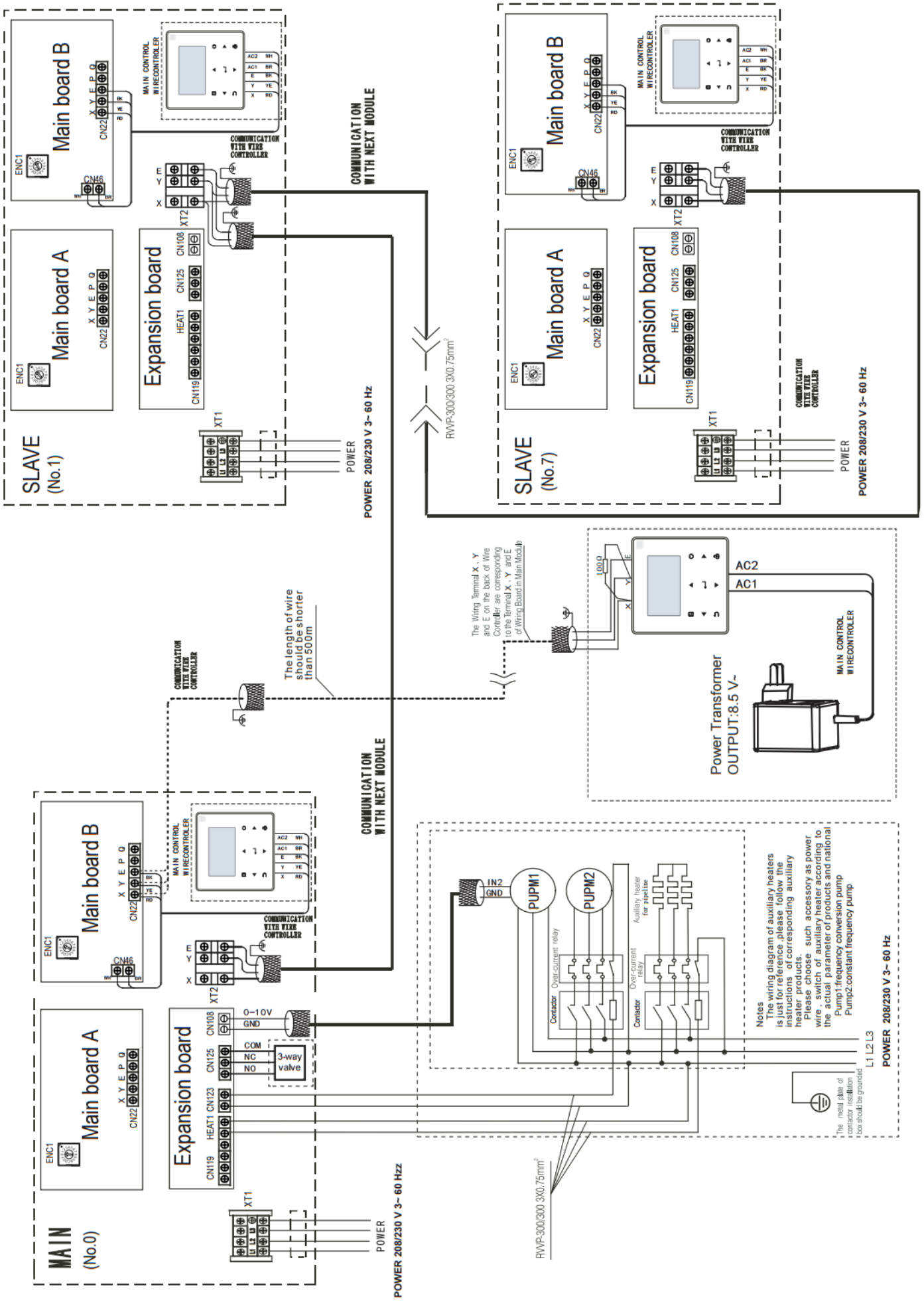
1.Single constant speed water pump control (S1-4 OFF)		Connect to the Expansion board 'PUMP' port
'2.Single variable frequency conversion water pump control (S1-4 OFF)		Connect to the Slave board '0-10V' port
3.Constant speed water pump + variable frequency conversion water pump (S1-4 ON)		Connect to the Slave board 'PUMP' port and '0-10V' port

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 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 T6A-B	Refrigerant inlet temperature of EVI plate heat exchanger
T6B-A T6B-B	Refrigerant outlet temperature of EVI plate heat exchanger
Tz/7-A Tz/7-B	Probe of coil final outlet temp
Taf1	Probe of inlet water side antifreeze temp
Taf2	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 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 EXVA-B/EXVB-B/EXVC-B	Electronic expansion valve
CCH1/CCH2	Crankcase heater
EVA-HEAT1 EVA-HEAT2	Electronic heating bele for plate heat exchanger
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 WIRECONTROLLER
COMMUNICATION WITH WIRE CONTROLLER
COMMUNICATION WITH NEXT MODULE
RWP-300/300 3X0.75mm²
POWER 208/230 V 3~ 60 Hz
SLAVE
(No.7)
MAIN
(No.0)
The length of wire should be shorter than 500m
The Wiring Terminal X、Y and E on the back of Wire Controller are corresponding to the Terminal X、Y and E of Wiring Board in Main Module
Power Transformer
OUTPUT:8.5 V-
AC2
AC1
0-10V
GND
COM
NC
NO
3-way valve
IN2
PUPM1
PUPM2
Contactor
Over-current relay
Auxiliary heater for pipeline
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
L1 L2 L3
The metal plate of contactor installation box should be grounded

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	/
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 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	P4	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 60 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	Automatic recovery after the fault is rectified
	1L32	High bus voltage error	Power fault
	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	L60	Fan motor phase loss protection	Diagnostic fault
	L65	IPM short circuit error	
	L66	FCT detection error	
	L6A	Open circuit of U-phase upper tube	
	L6B	Open circuit of U-phase lower tube	
	L6C	Open circuit of V-phase upper tube	
	L6D	Open circuit of V-phase lower tube	
	L6E	Open circuit of W-phase upper tube	
	L6F	Open circuit of W-phase lower tube	

5 Troubleshooting

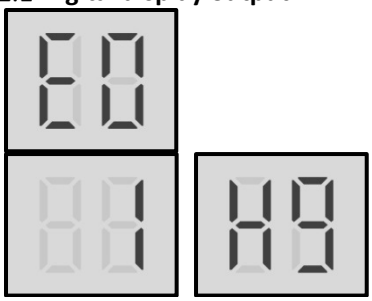
5.1 Warning

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



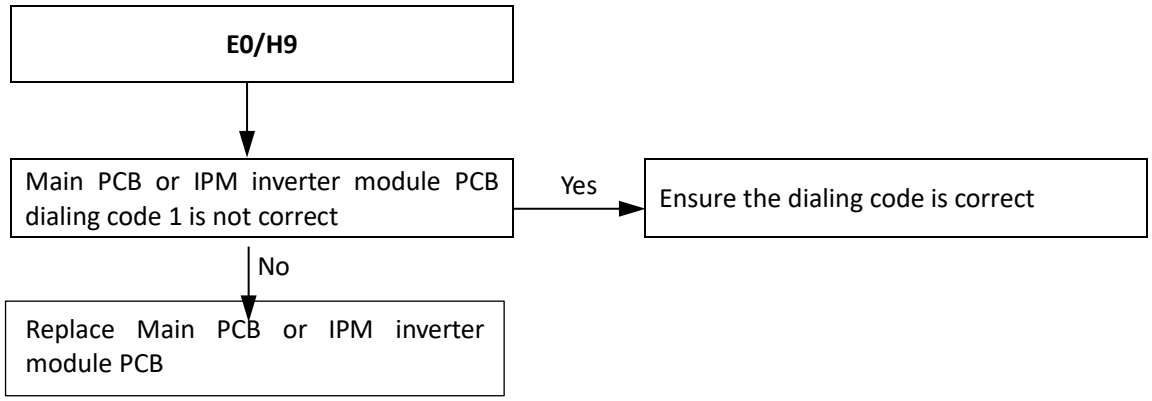
5.2.2 Description

- 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 (Including master and slave units) stop running.
- Error code is displayed on main PCB and user interfaced 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

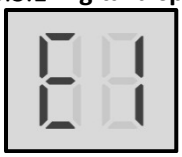


Notes:

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



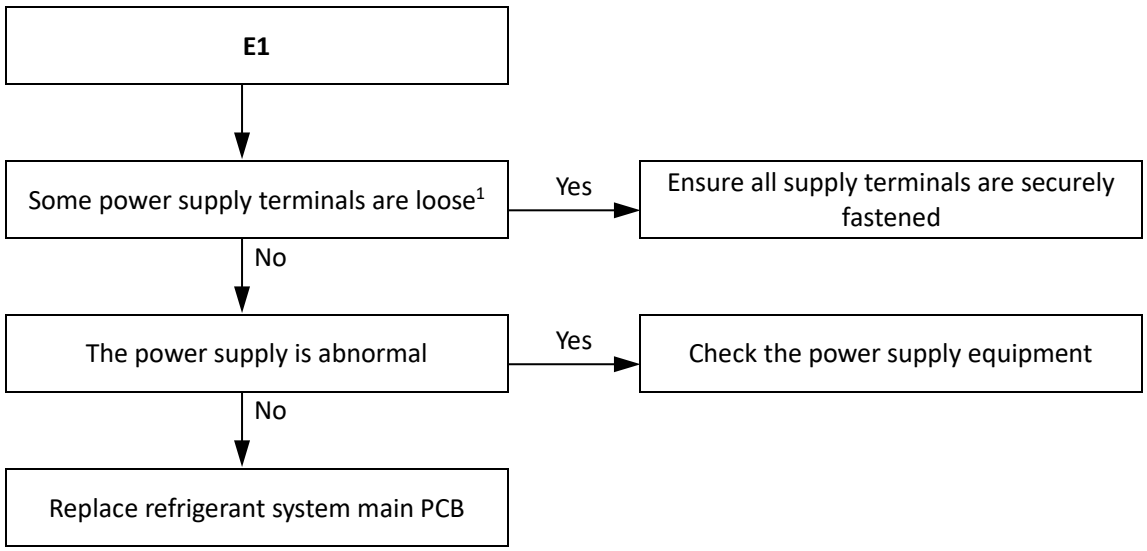
5.3.2 Description

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

5.3.3 Possible causes

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

5.3.4 Procedure

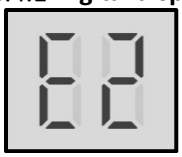


Notes:

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



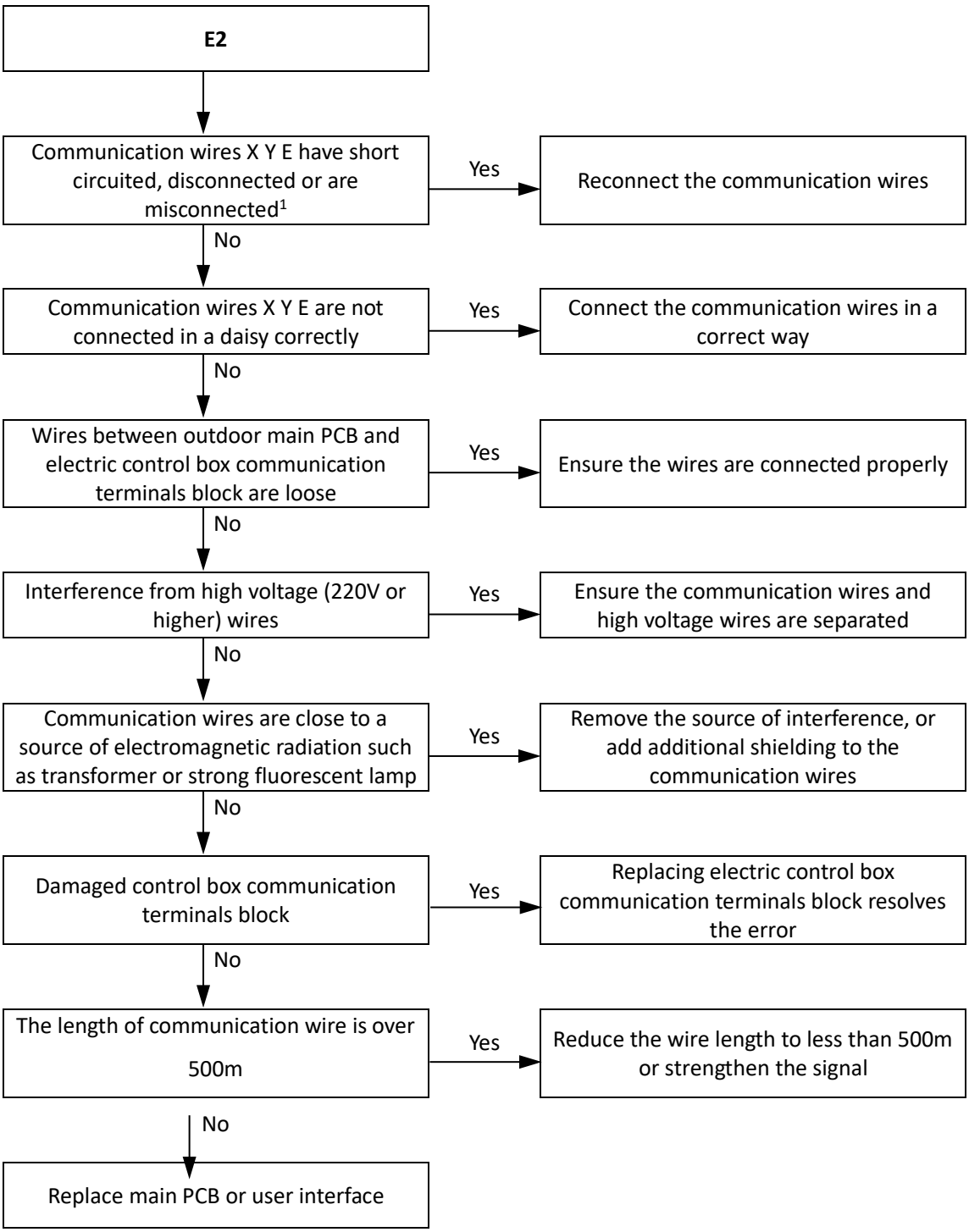
5.4.2 Description

- 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**

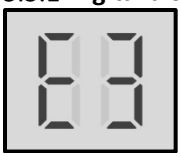


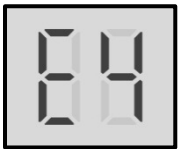
Notes:

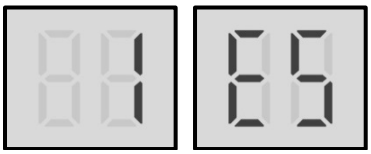
1. Measure the resistance among X, Y and E. The normal resistance between X and Y is 120Ω, between X and E is infinite, between Y and E is infinite. Communication wiring has polarity. Ensure that the X wire is connected to X terminals and the Y wire is connected to Y terminals.

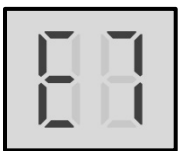
5.5 E3, E4, E5, E6,E7, Eb, Ed, EE, EF, EP, EU, Fb, Fd Troubleshooting

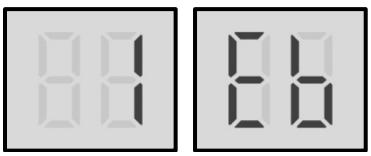
5.5.1 Digital display output

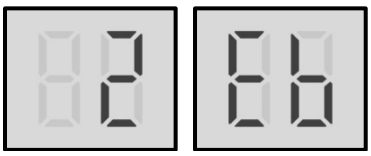


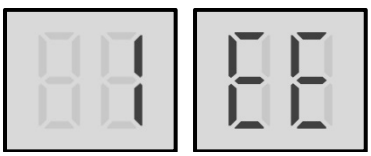


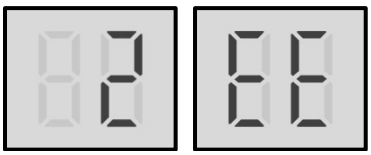












5.5.2 **Description**

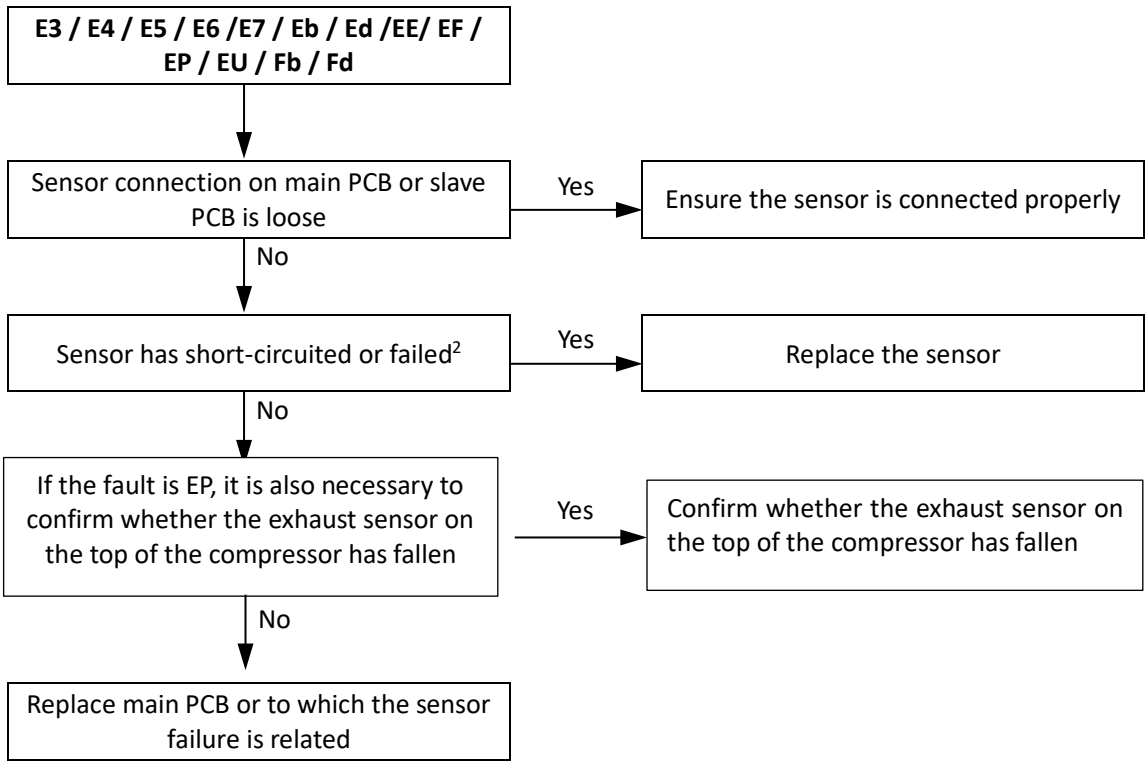
- E3 indicates total water outlet temperature sensor error Tw (valid for the main unit)
- E4 unit water outlet temperature sensor error Two
- 1E5 indicates condenser tube temperature sensor T3A error
- E6 Water tank temperature sensor T5 failure
- E7 indicates ambient temperature sensor error T4
- 1Eb 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
- EP indicates discharge temperature sensor failure error
- 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 Twi
- EU indicates water side heat exchanger refrigerant total outlet temperature sensor Tz error in heating mode
- Fb indicates Low pressure sensor error L-YL
- 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

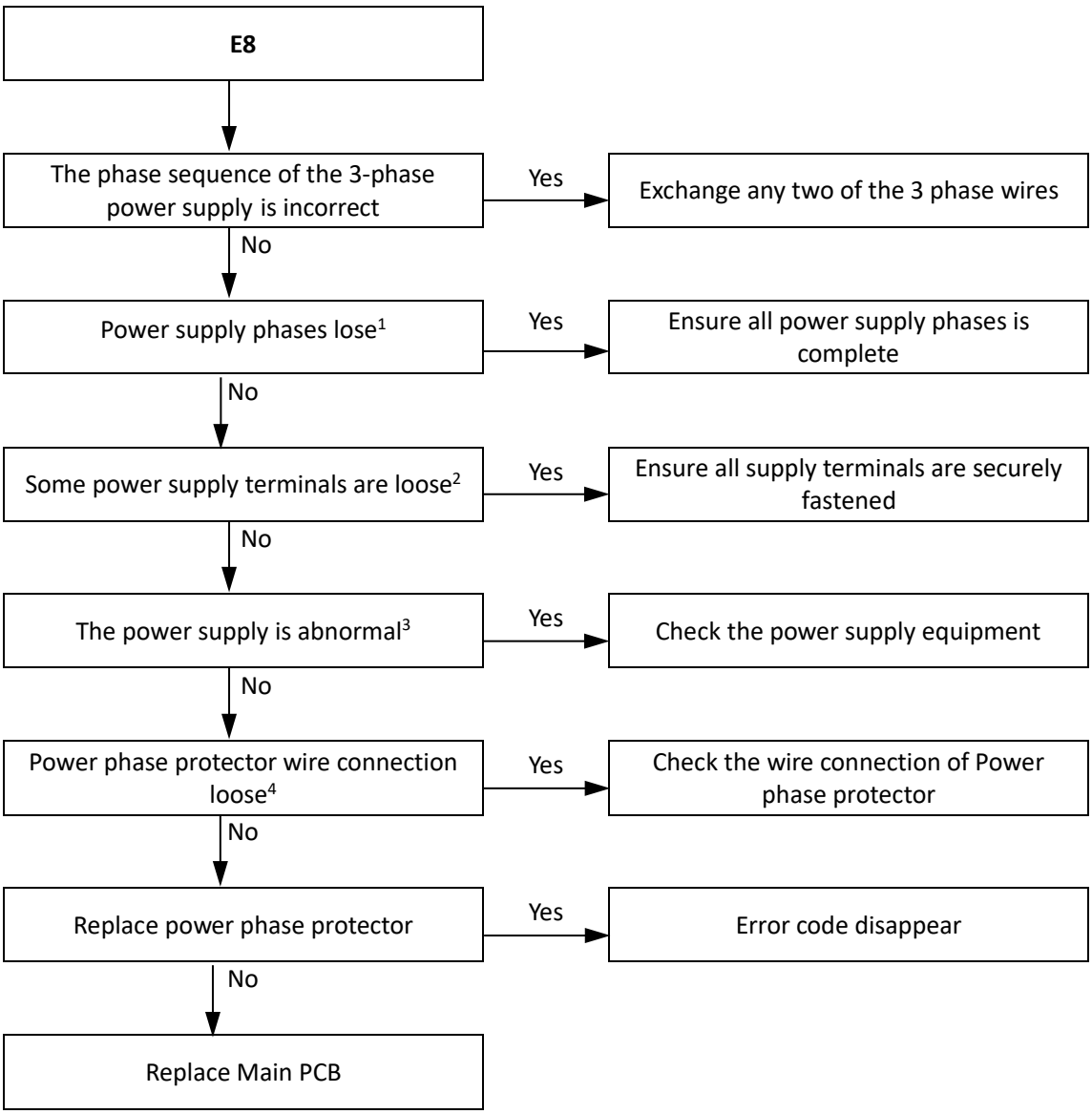
5.6.2 Description

- 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.
- Incorrect wiring of the third party power phase monitor device.
- Not correct setting on third party power phase monitor device.

5.6.4 **Procedure**



Notes:

1. The red LED on the power phase protector will on.
2. The red LED on the power phase protector will flash with 1HZ.
3. 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.
4. 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.
5. Wire connected to port CN28 on the main PCB (labeled 34 in Part 4, 2.2.1 Main PCB component)

5.7 E9 Troubleshooting

5.7.1 **Digital display output**

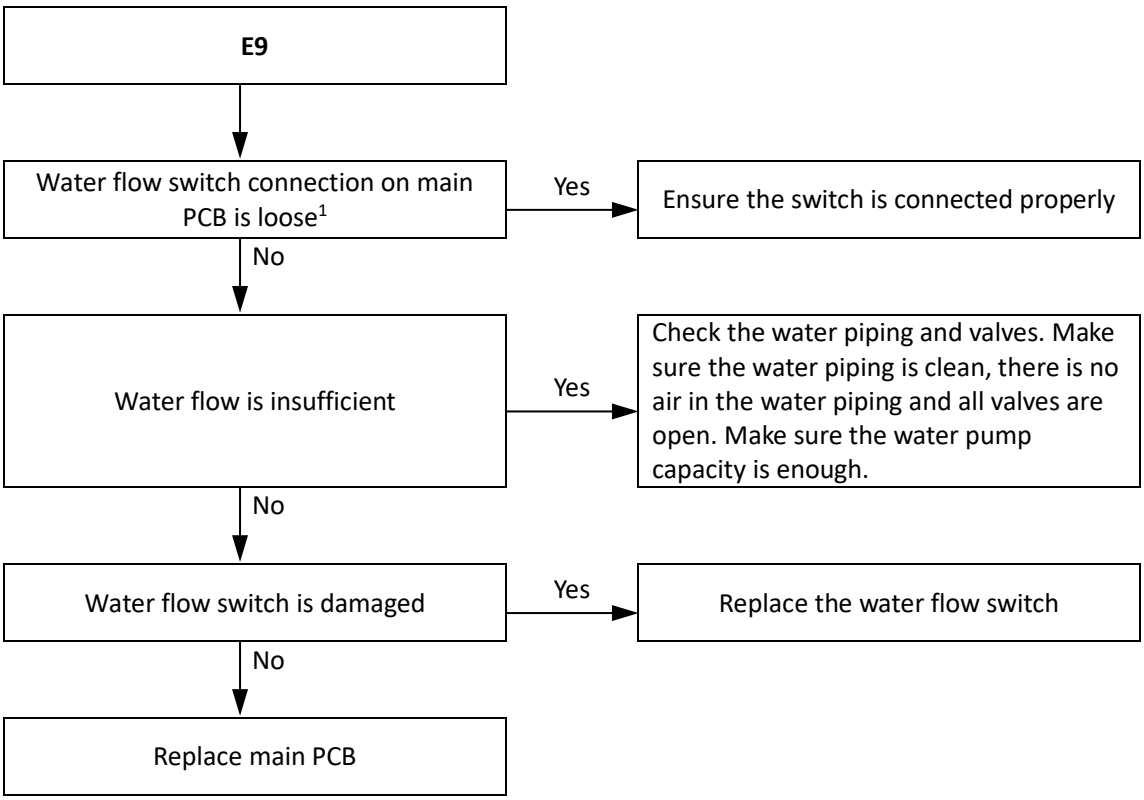
5.7.2 **Description**

- 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. Error code E9 will remain until resolved.
- 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

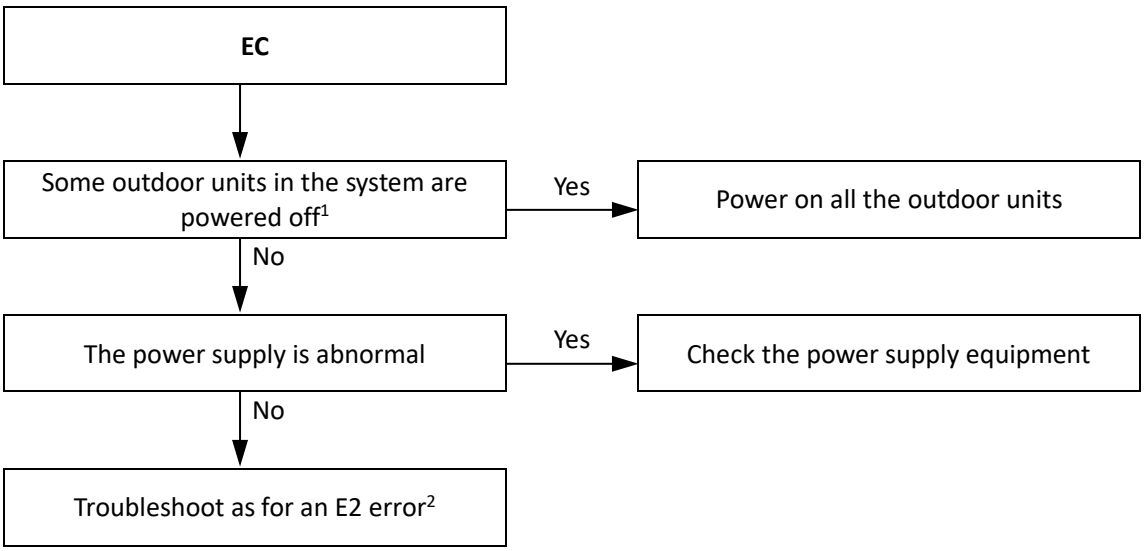
5.8.2 Description

- 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.

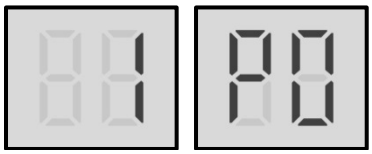
5.8.4 **Procedure**



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



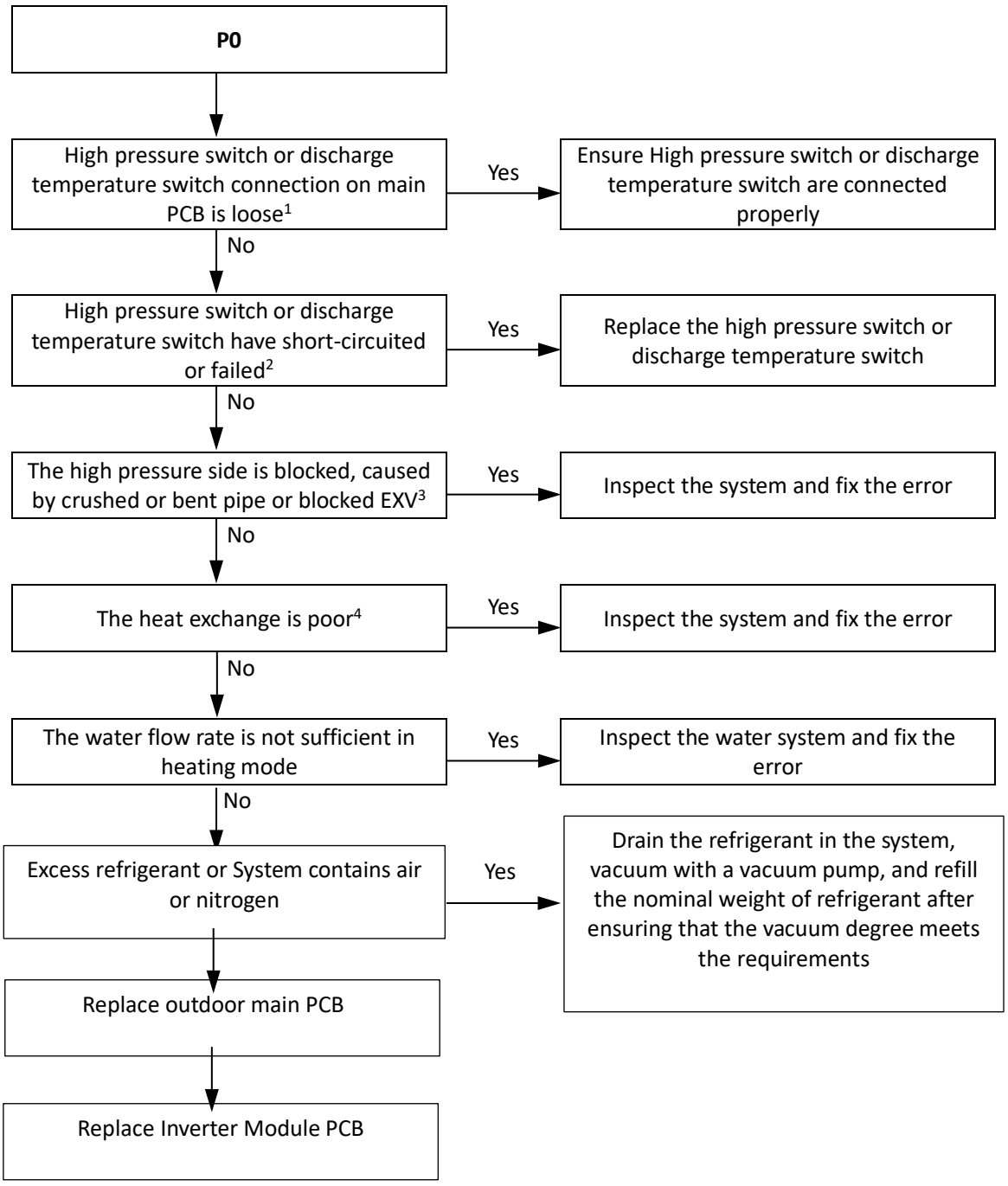
5.9.2 Description

- Discharge pipe high pressure or discharge temperature switch protection. When the discharge pressure rises above 4.3MPa or discharge temperature rises above 115°C, the system displays P0 protection and unit stop running. When the discharge pressure falls below 3.2MPa 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

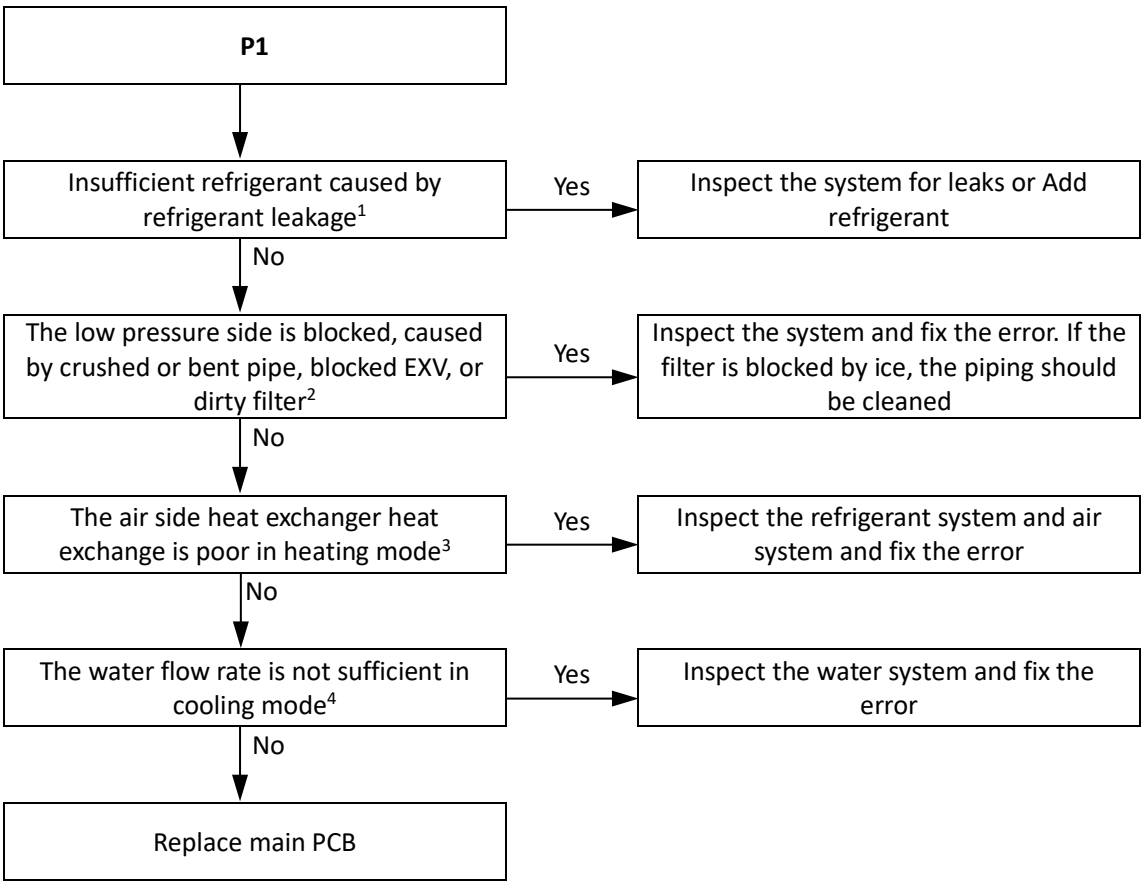
5.10.2 Description

- P1 indicates suction pipe low pressure if it happens during the operation. 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 indicates that the refrigerant quantity of the refrigerant system of the unit is insufficient if it happens in standby or shutdown mode (after the compressor stops for 3 min). It's affirmed there is a lack of refrigerant 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 indicates, if the exhaust superheat is too high and lasts for 30 min if it happens during the operation of the compressor, 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**

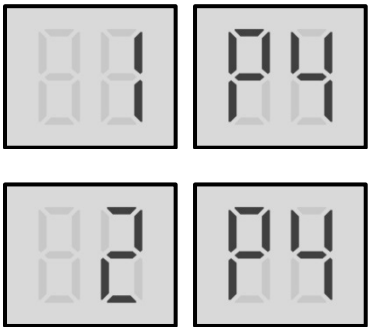


Notes:

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



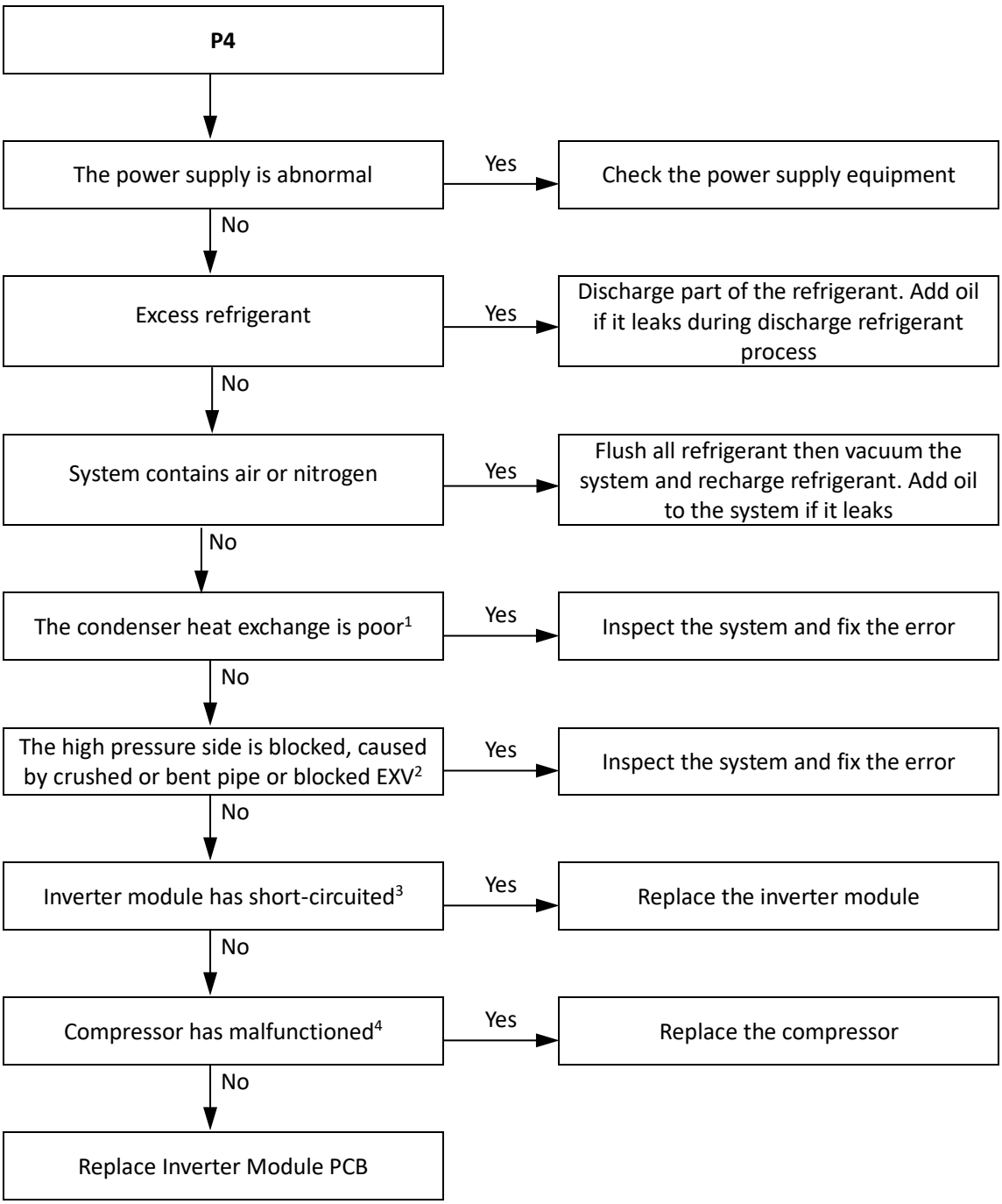
5.11.2 Description

- 1 P4 indicates system current protection
- 2 P4 indicates system DC bus current protection
- When the compressor current rises above the protection value 48A(DC bus current rises above 58A) , 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 0.124Ω(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

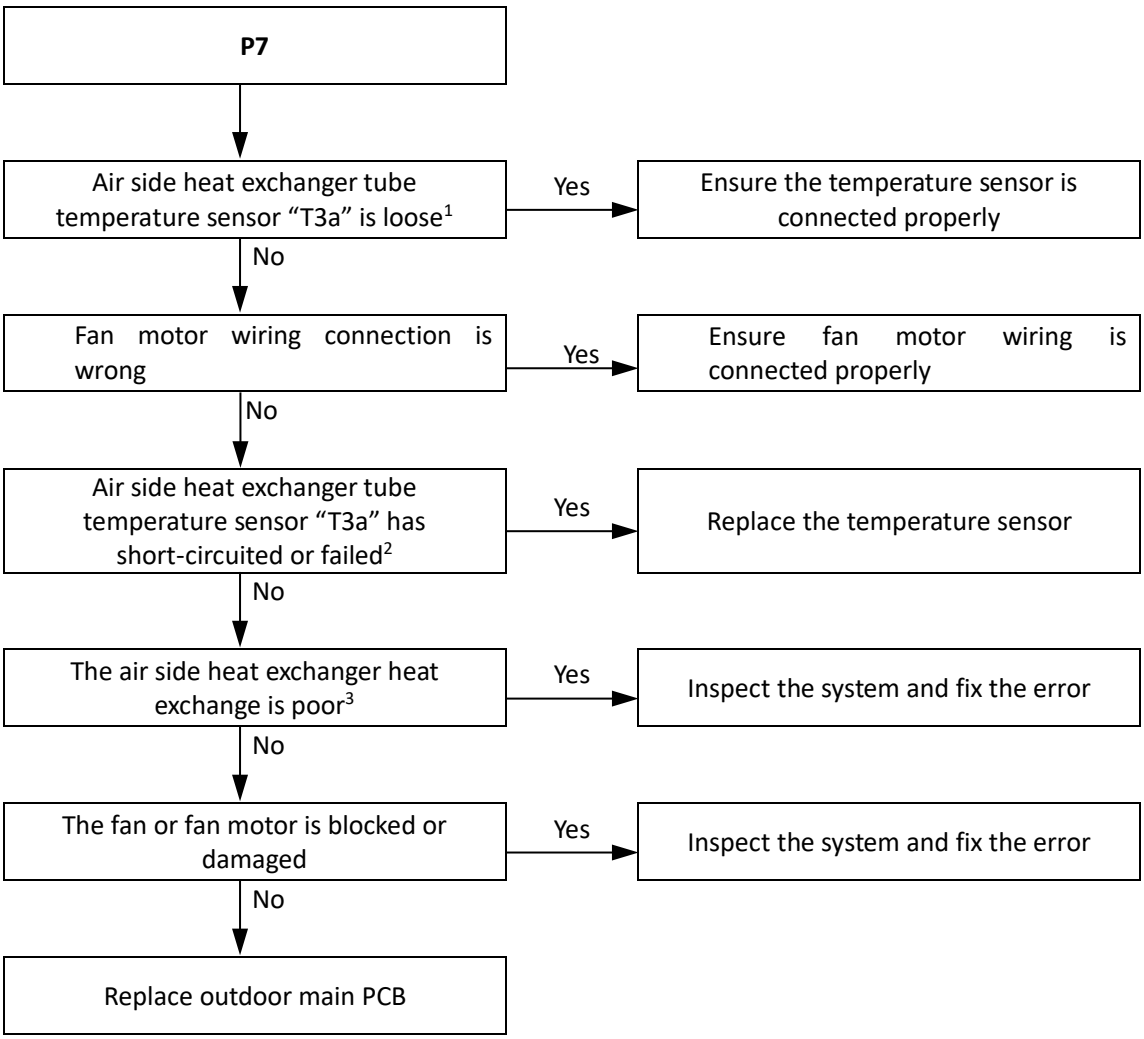
5.12.2 Description

- 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 64°C, the system displays P7 protection and unit stop running. When the tube temperature of air side heat exchanger returns drops below 55°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

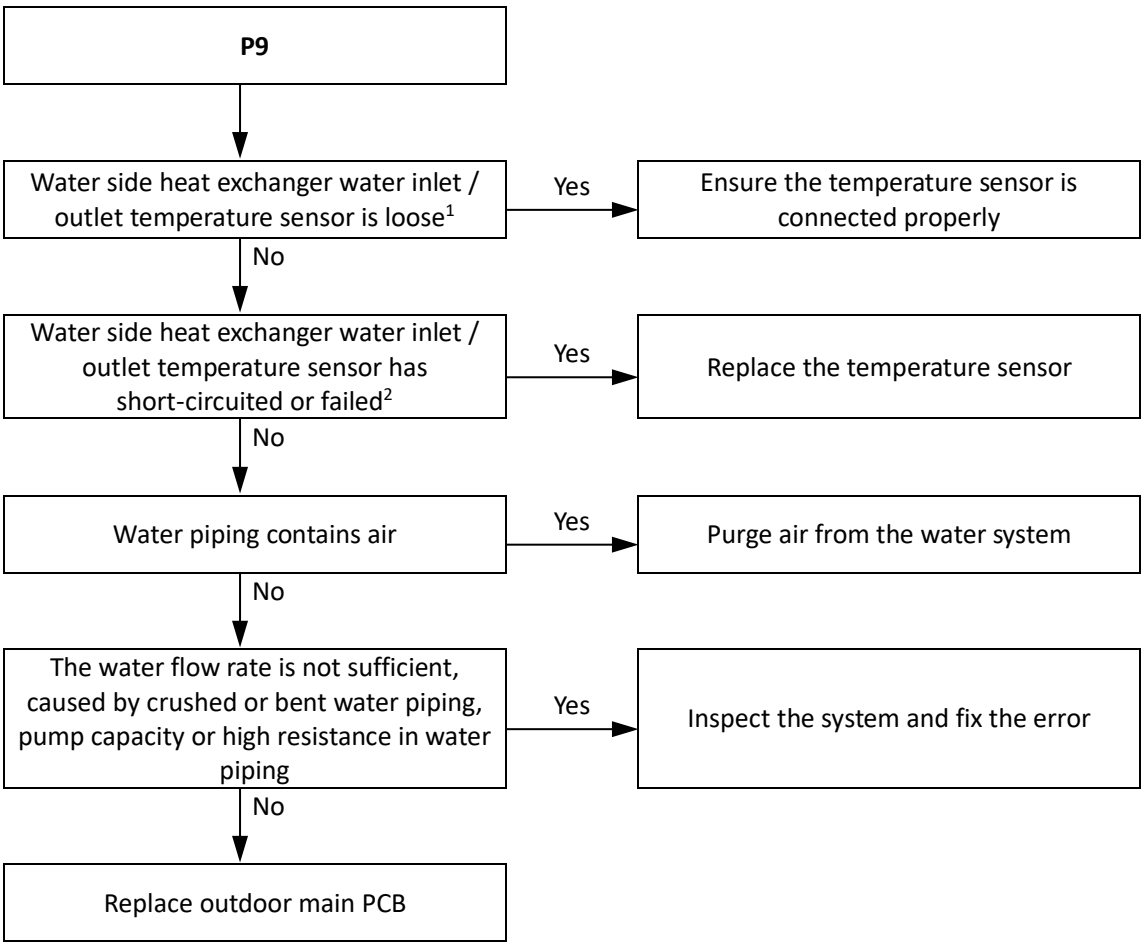
5.13.2 Description

- 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

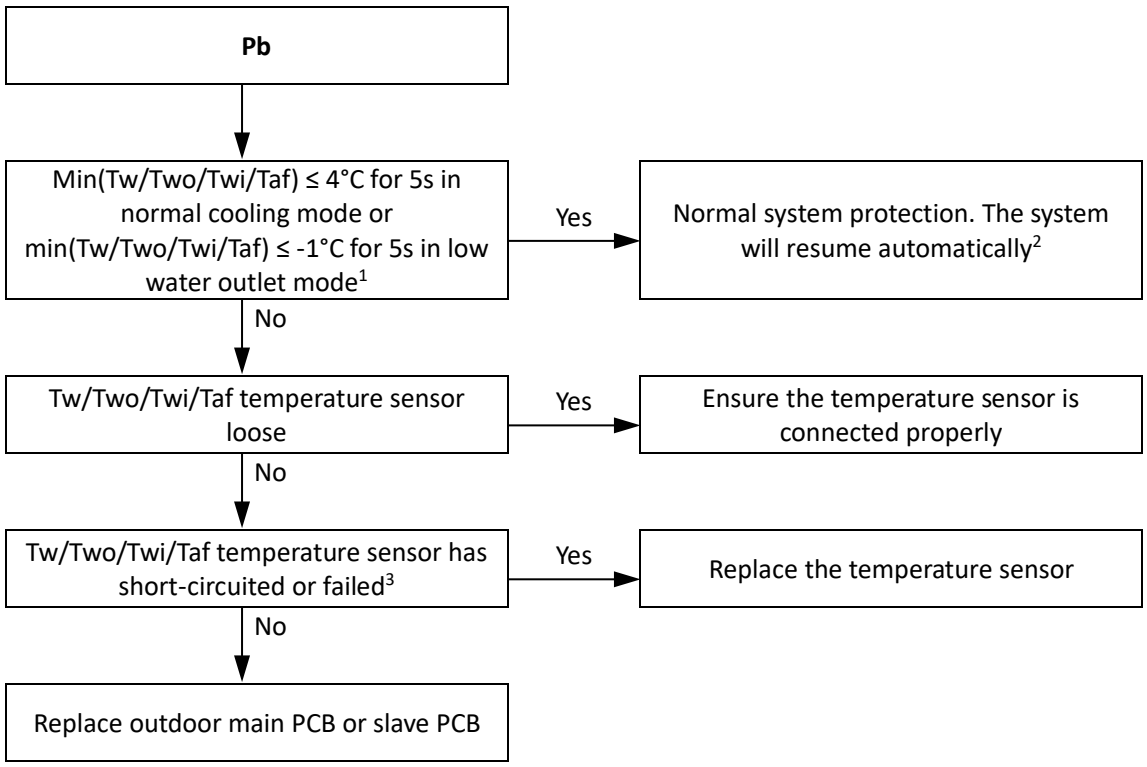
5.14.2 Description

- 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

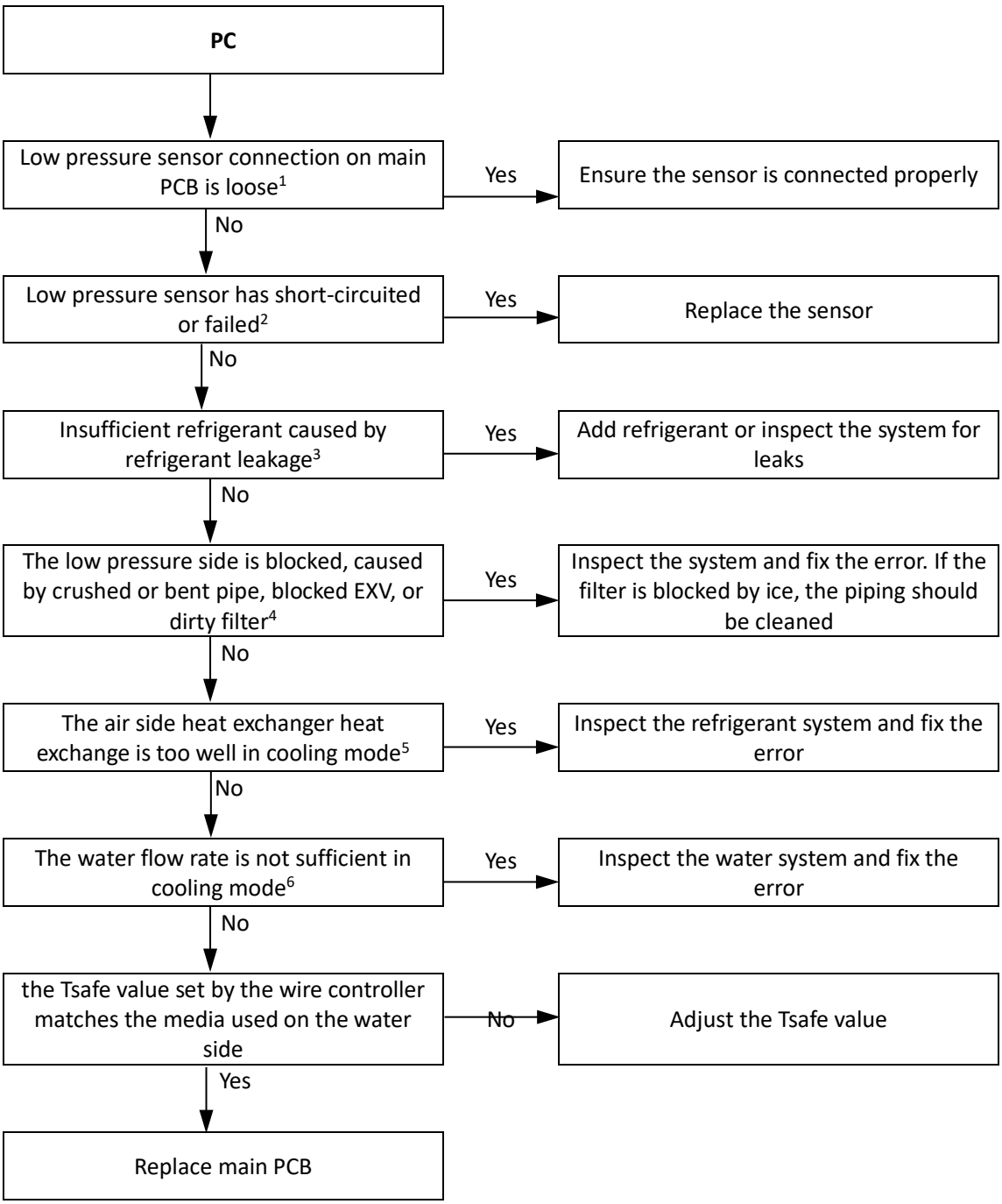
5.15.2 Description

- 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

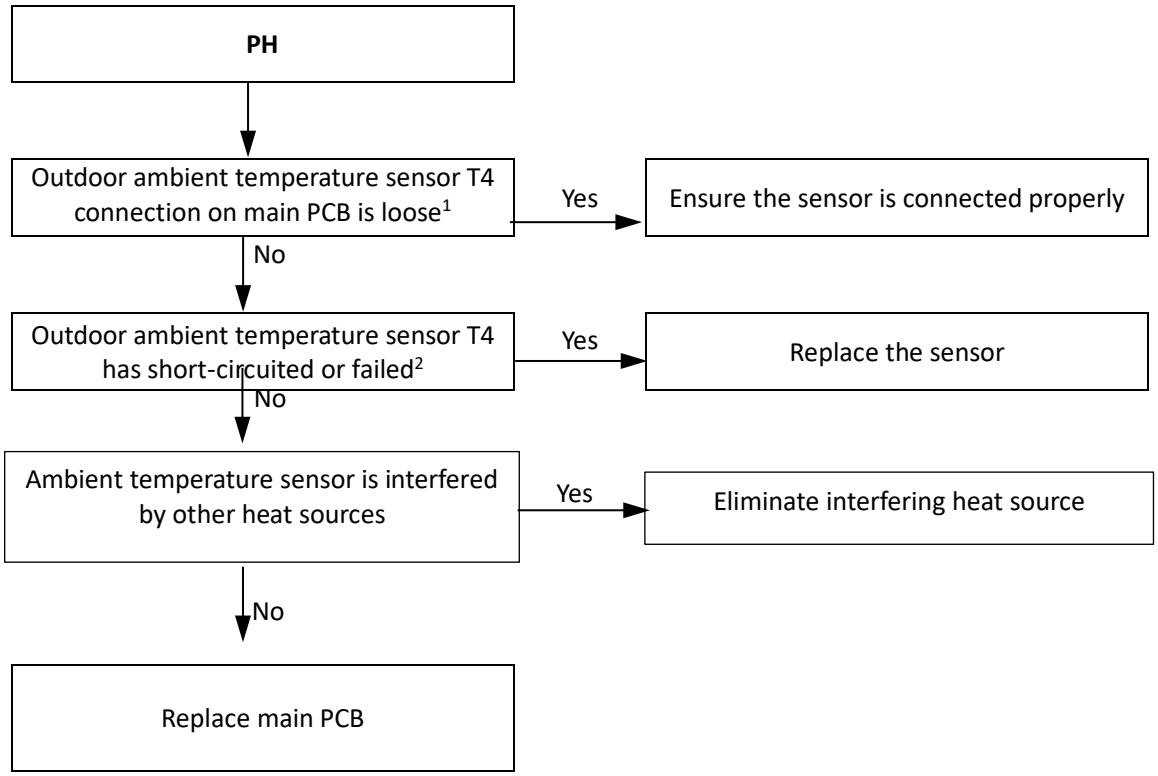
5.16.2 Description

- 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.

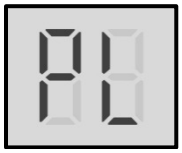
5.17.4 **Procedure**

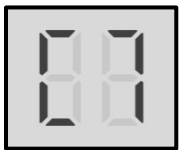
Notes:

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





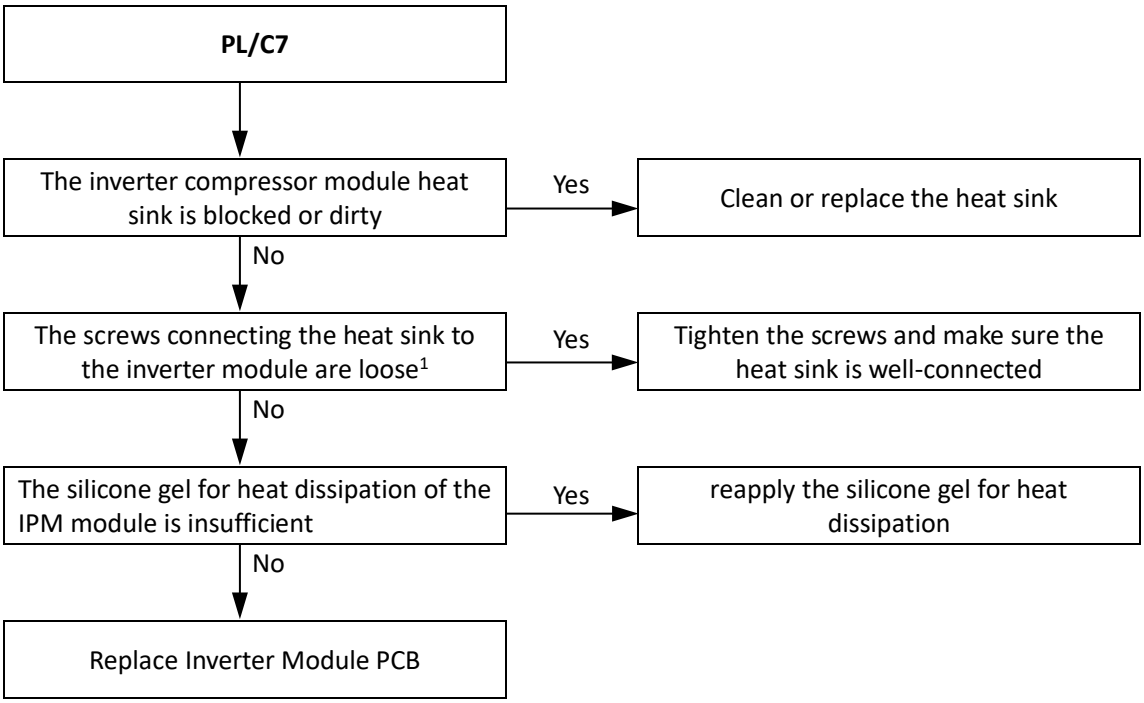
5.18.2 Description

- 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

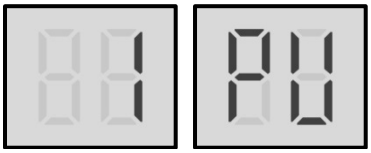
- Blocked, dirty or loose heat sink.
- Screws securing the IPM module of the compressor are loose
- The silicone gel for heat dissipation of the IPM module is insufficient.
- Main PCB damaged.

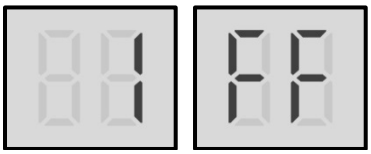
5.18.4 Procedure



5.19 PU/FF Troubleshooting

5.19.1 Digital display output





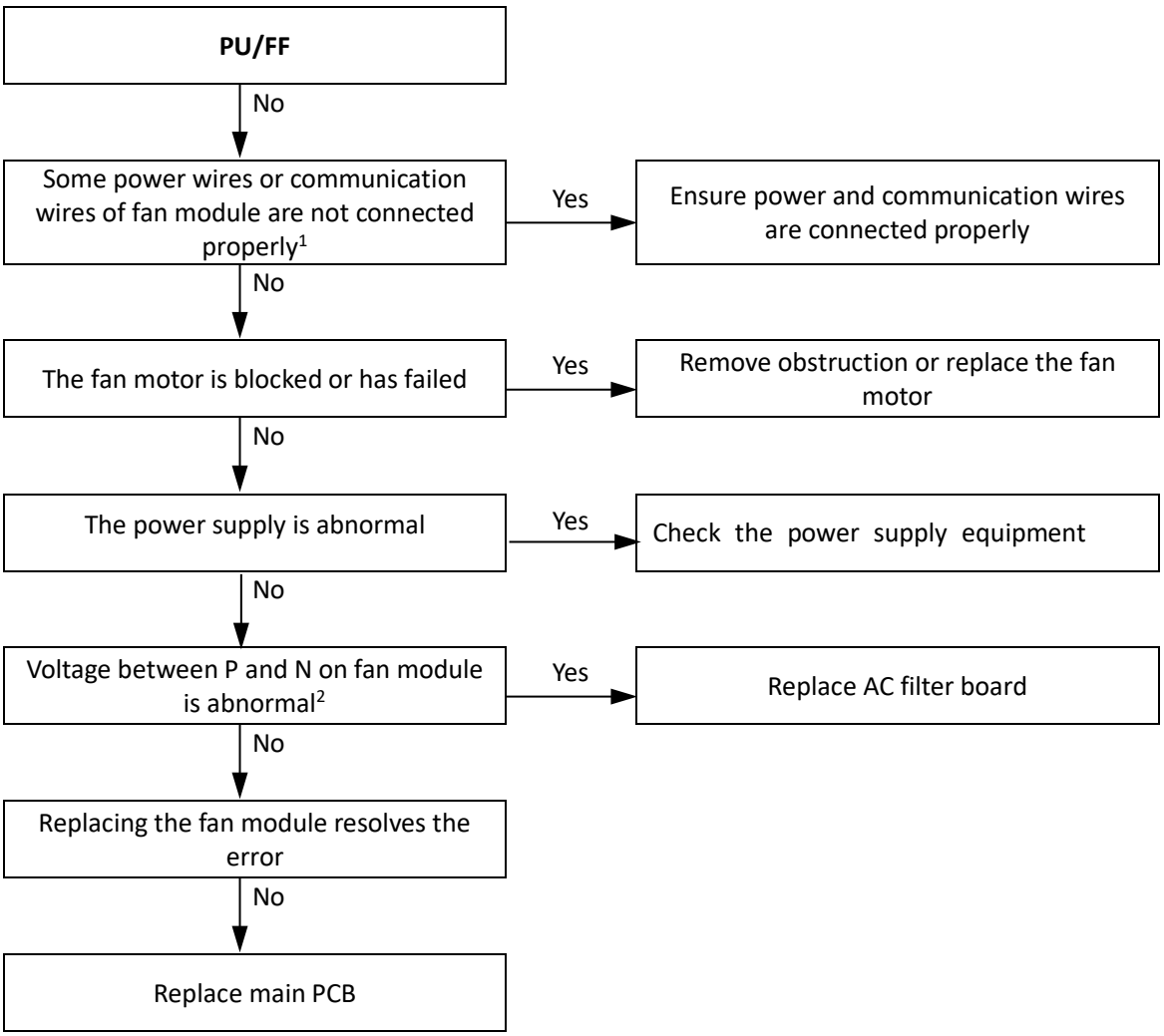
5.19.2 Description

- 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.

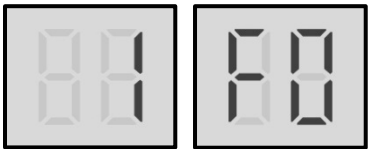
5.19.4 **Procedure**



Notes:
1. Check coherence with wiring diagram and fix it or fix the wire connection that is loose, if any.
2. The normal voltage between P and N on the fan module is 294-326V 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.

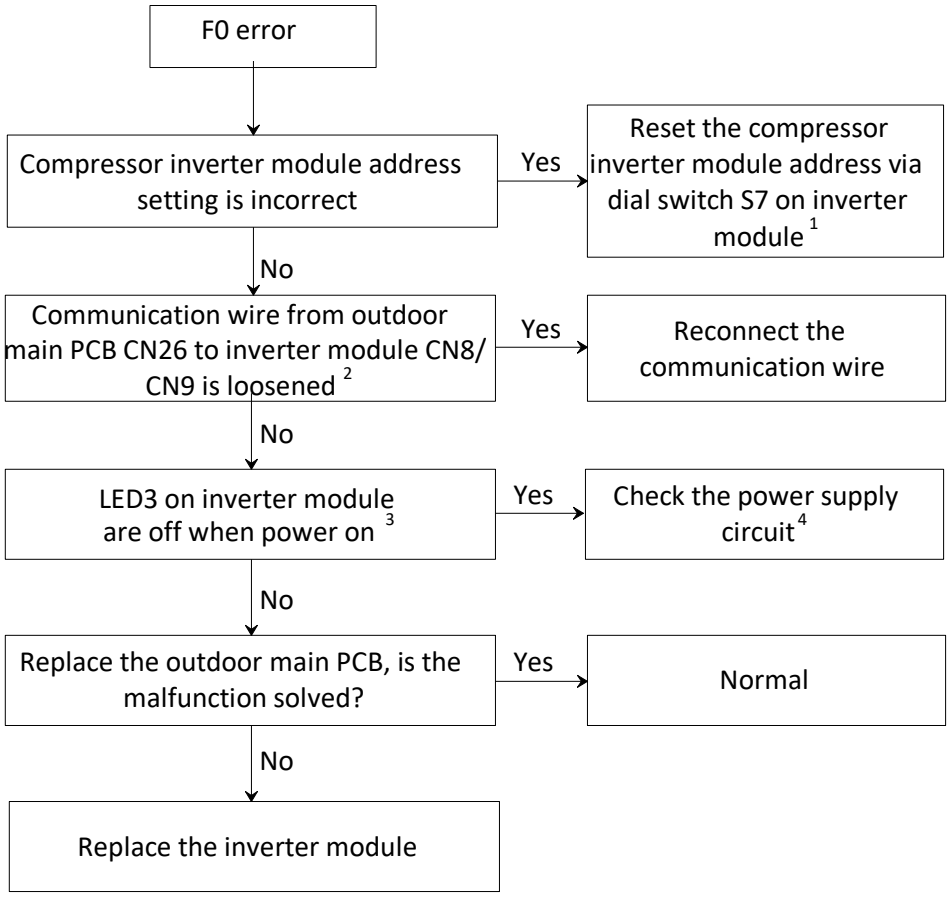
5.20.3 Trigger / recover condition

- Trigger condition: Main control chip and inverter driver chip cannot communication for 2 minutes.
- Recover condition: Communication go back to normal. The system resume automatically.
- 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

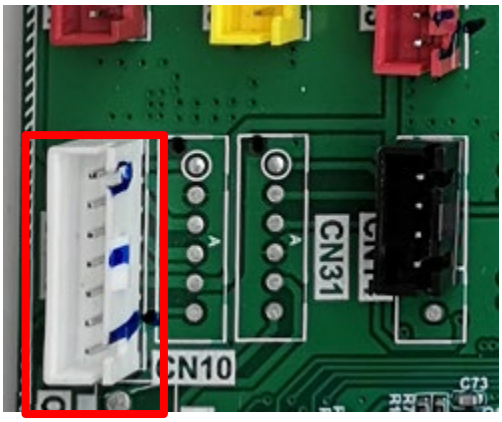
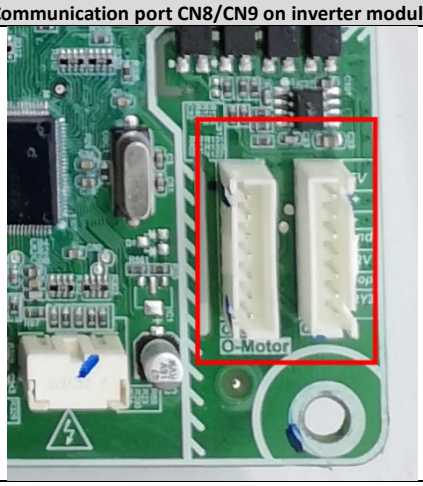


Notes:

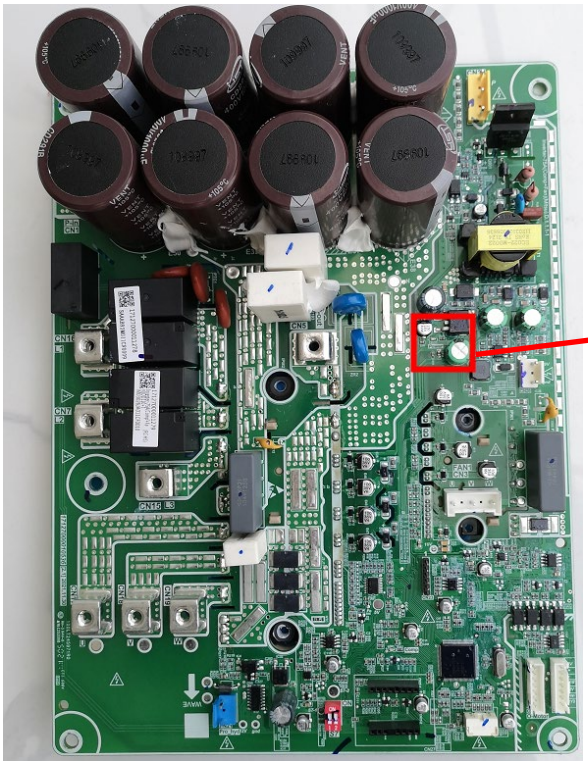
1. Compressor inverter module address is set through dial switch S7 on the inverter module. The compressor inverter module A/B location refers to the wiring diagram.

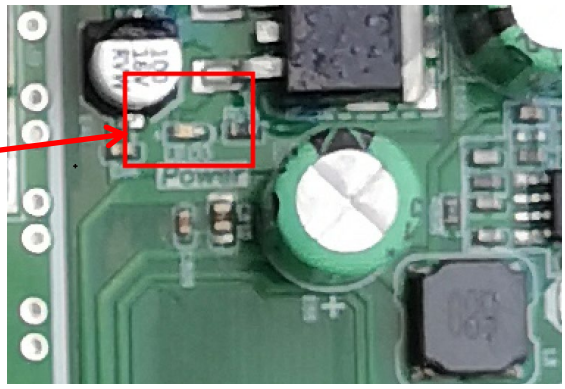
Switch	Description	S7-1	S7-2
S7 	Compressor inverter module address setting	OFF	OFF

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 CN5/CN6/CN7 of filter board and CN6/CN7/CN15 of compressor module board, the normal voltage should be 208-230VAC

5.21 H5 Troubleshooting

5.21.1 Digital display output

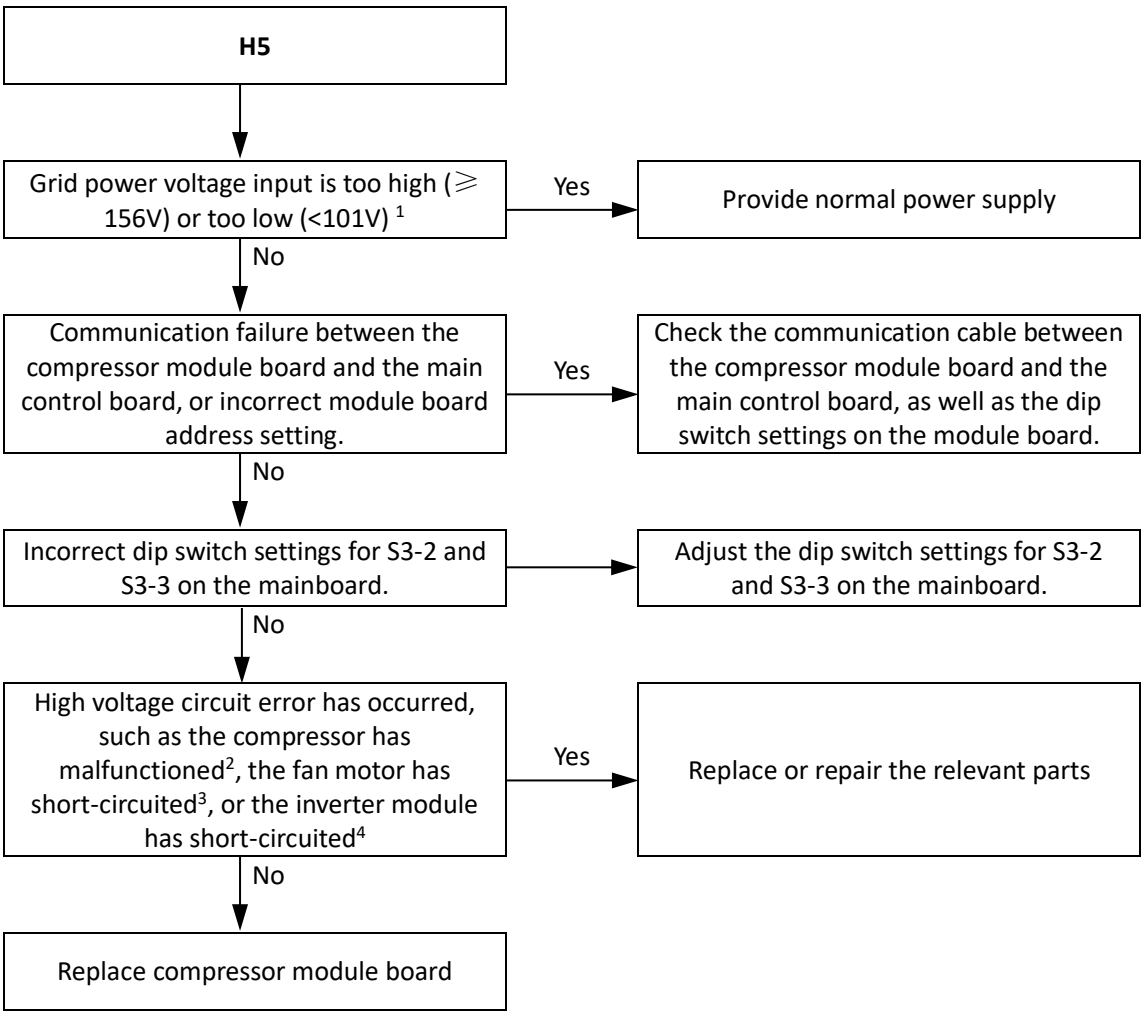
5.21.2 Description

- 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 156V or drops below 101V 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**

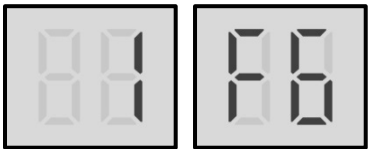


Notes:

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 ≥156V or <101V).
2. The normal resistances of the inverter compressor is 0.124Ω(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

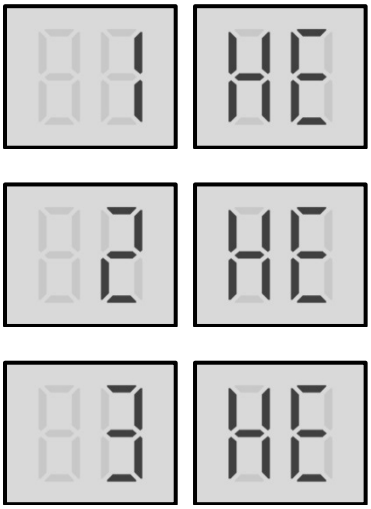
- Abnormal power supply voltage
- Loosened wiring within electric control box.
- High voltage circuit error.
- AC filter board damaged.
- 3-pahse bridge rectifier damaged.
- Compressor Inverter module damaged.

5.22.4 Procedure

Refer to P6 protection troubleshooting: xL1 and xL2.

5.23 HE Troubleshooting

5.23.1 Digital display output



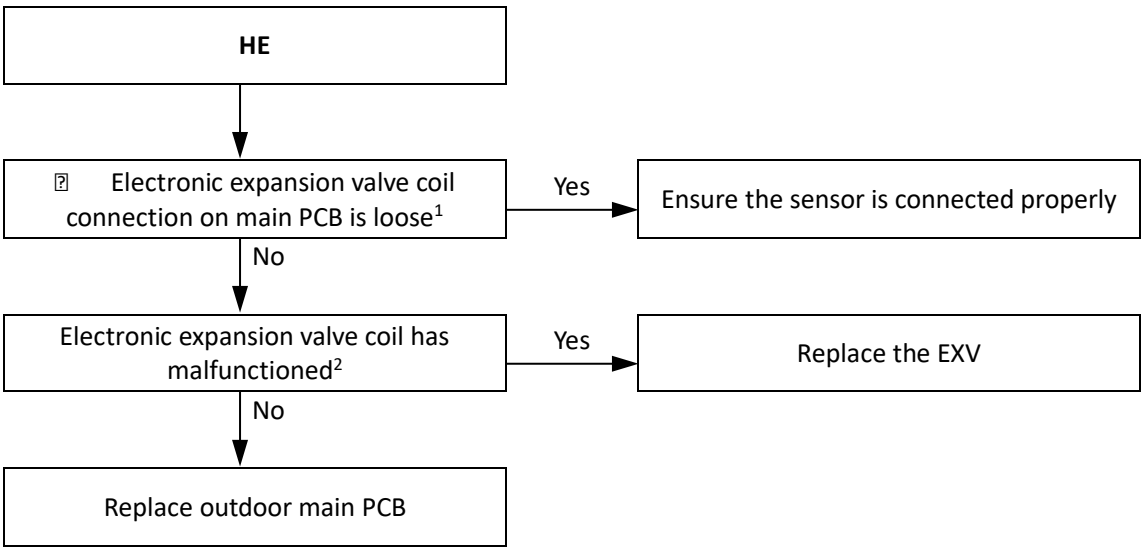
5.23.2 Description

- 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

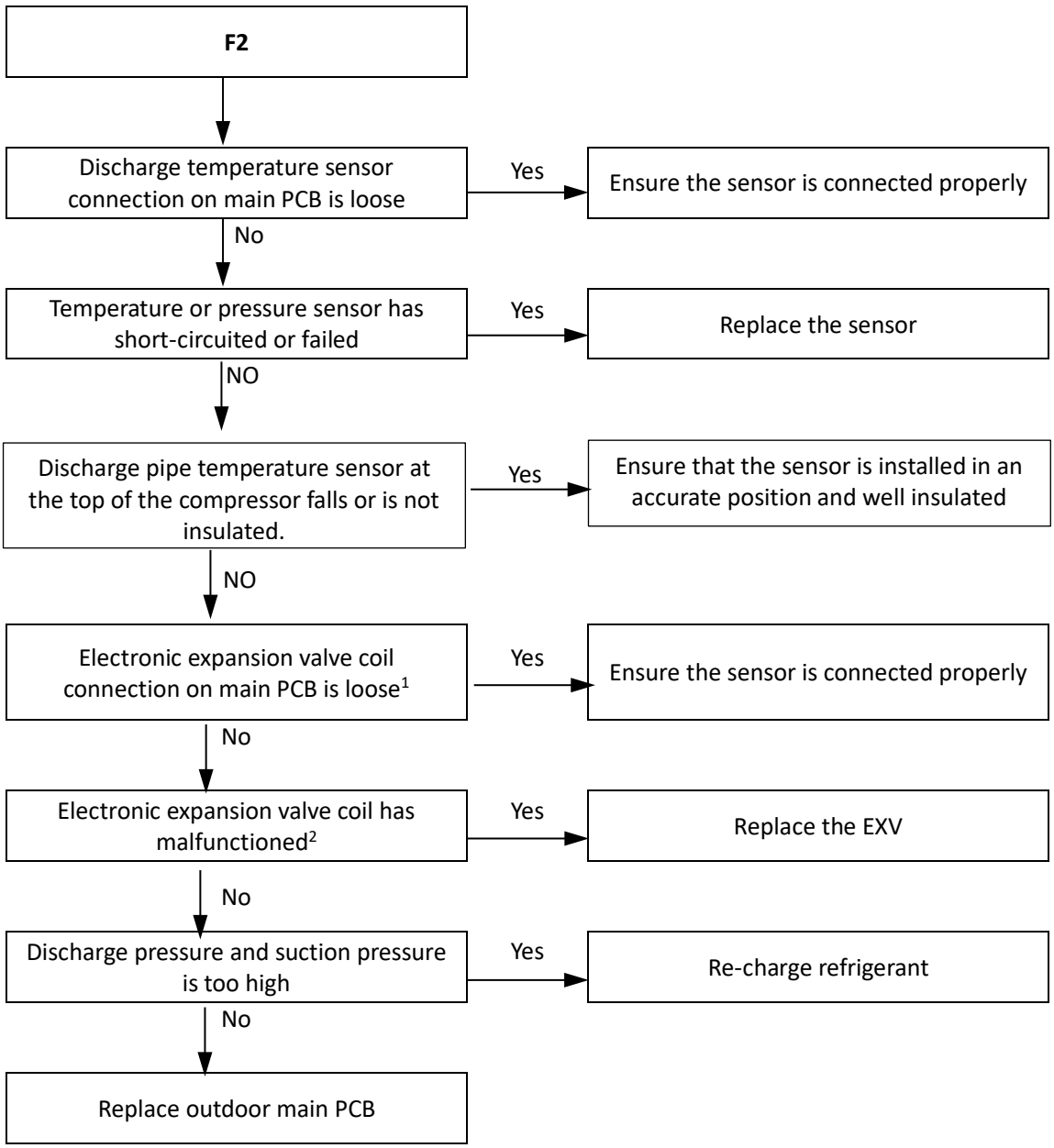
5.24.2 Description

- Insufficient discharge gas 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.

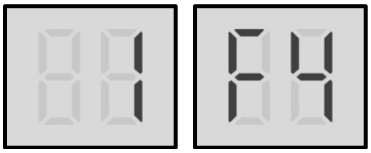
5.24.4 **Procedure**



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 L0 or L1 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 L0 or L1 error troubleshooting.

5.25.4 Procedure

- Refer to L0 or L1 error troubleshooting.

5.26 FP Troubleshooting

5.26.1 Digital display output

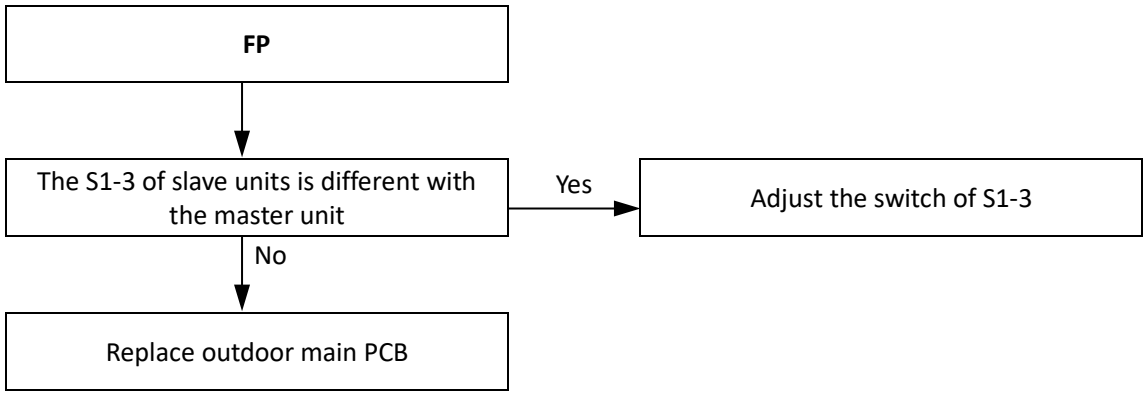
5.26.2 Description

- 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

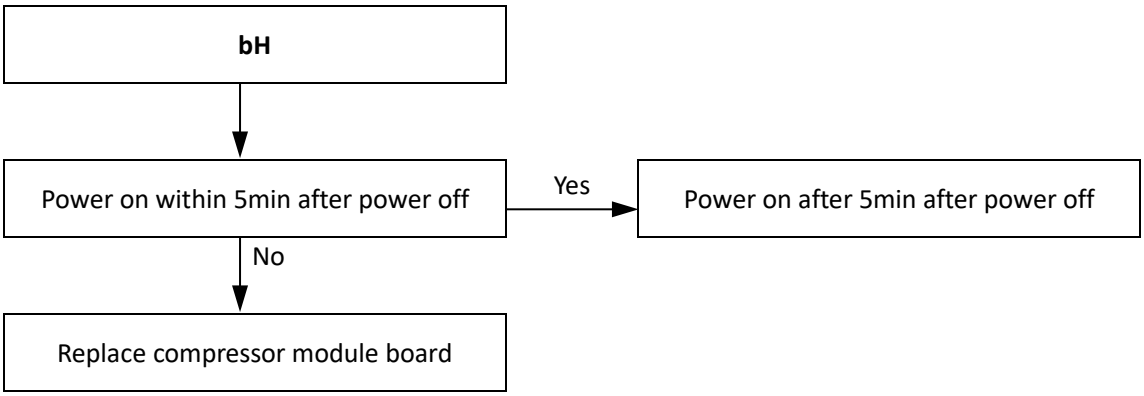
5.27.2 Description

- 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

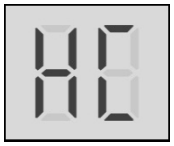
- Power on within 5min after power off
- Compressor module board damaged

5.27.4 Procedure



5.28 HC troubleshooting

5.28.1 Digital display output



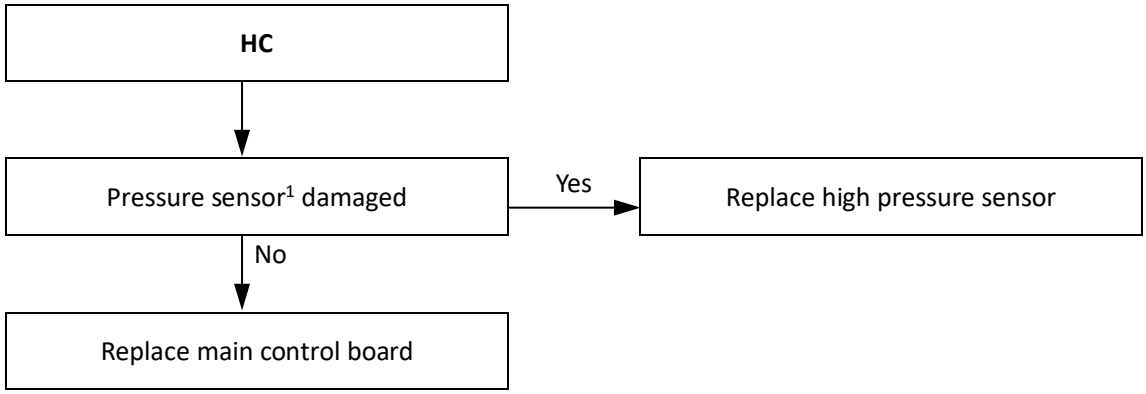
5.28.2 Description

- 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

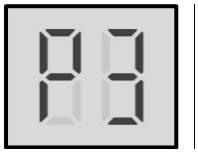


Note:

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



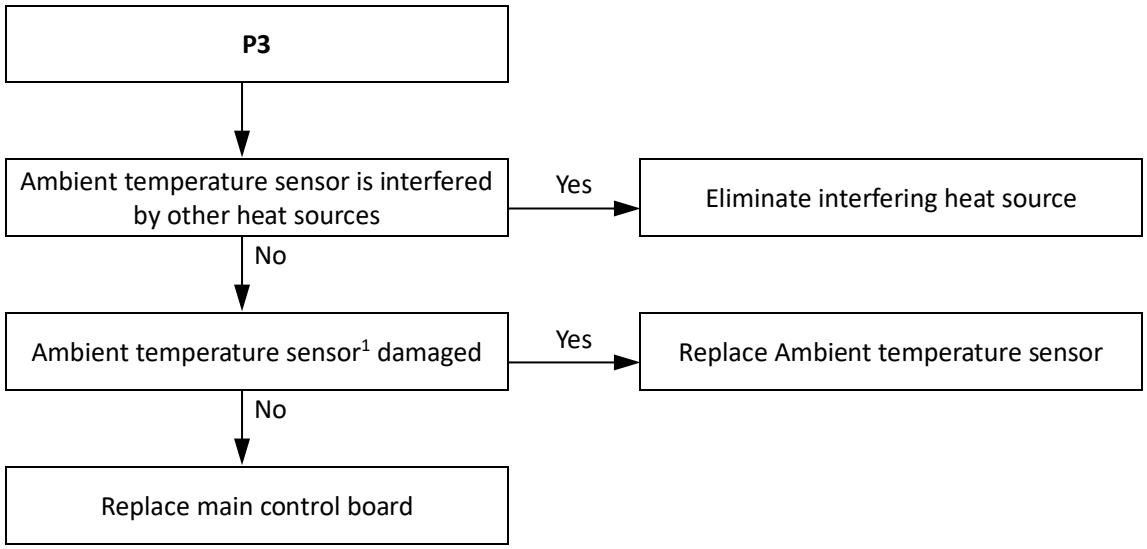
5.29.2 Description

- 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

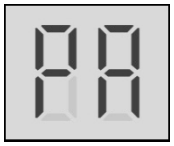


Note:

2. 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



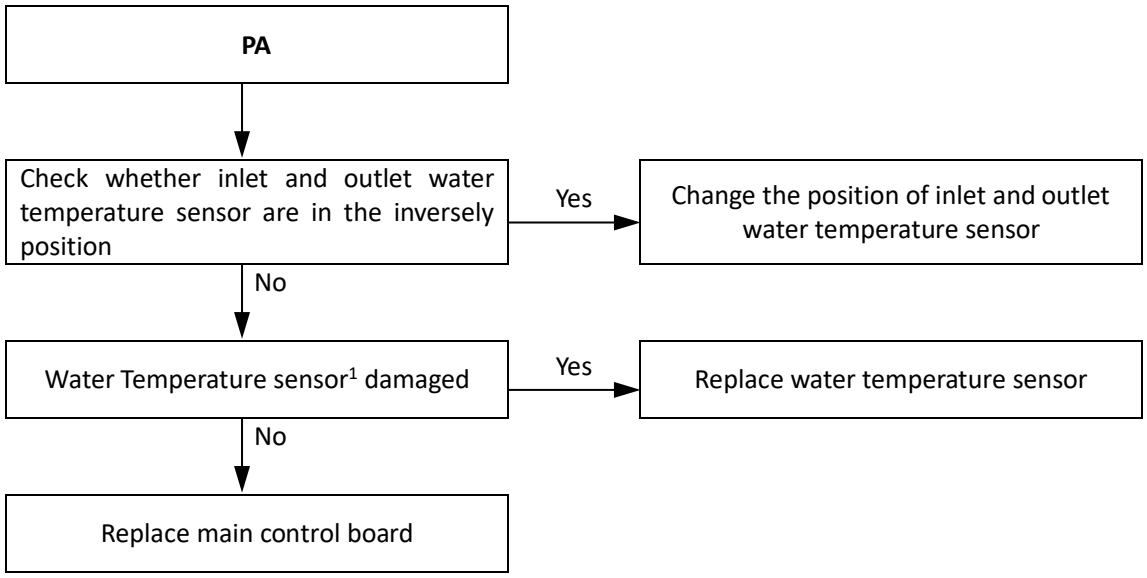
5.30.2 Description

- 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;

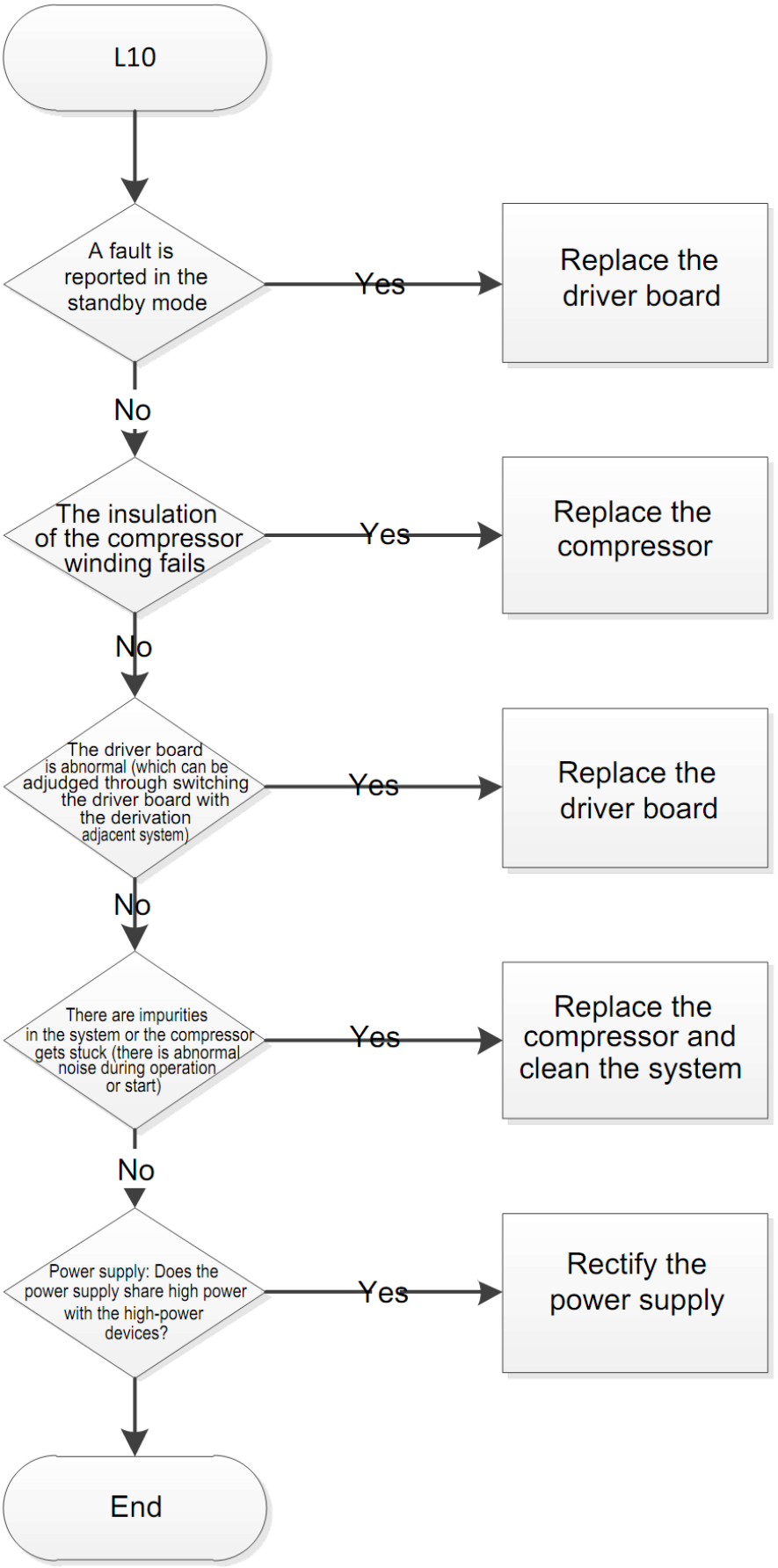
■ Condensation occurs to the IPM module, causing a short circuit between control pins;

■ 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.

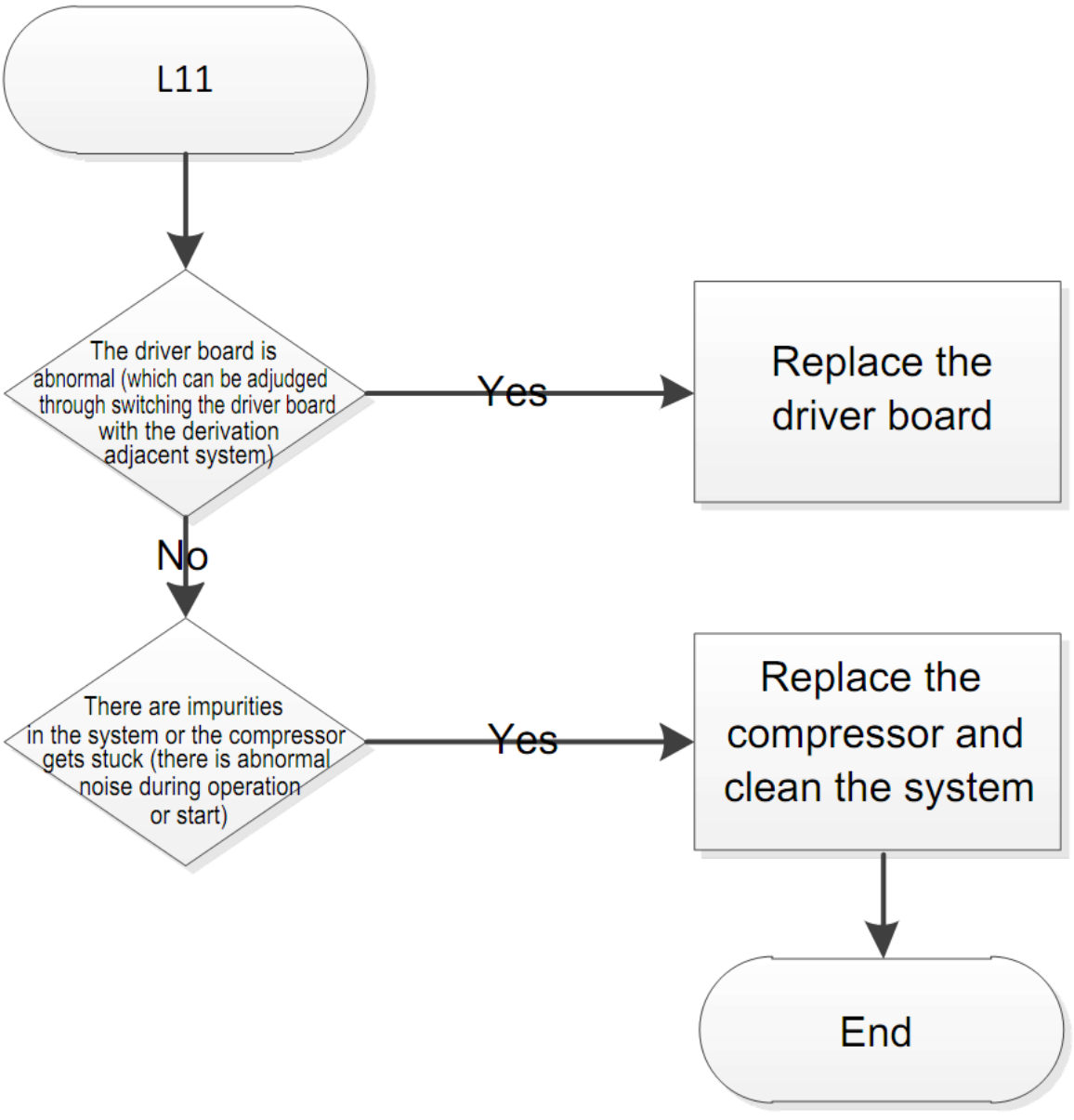
6.3.2 Triggering/recovery conditions

- 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 105°.
- After the fault, the compressor stops running. If the fault disappears after one minute, the compressor is started again.

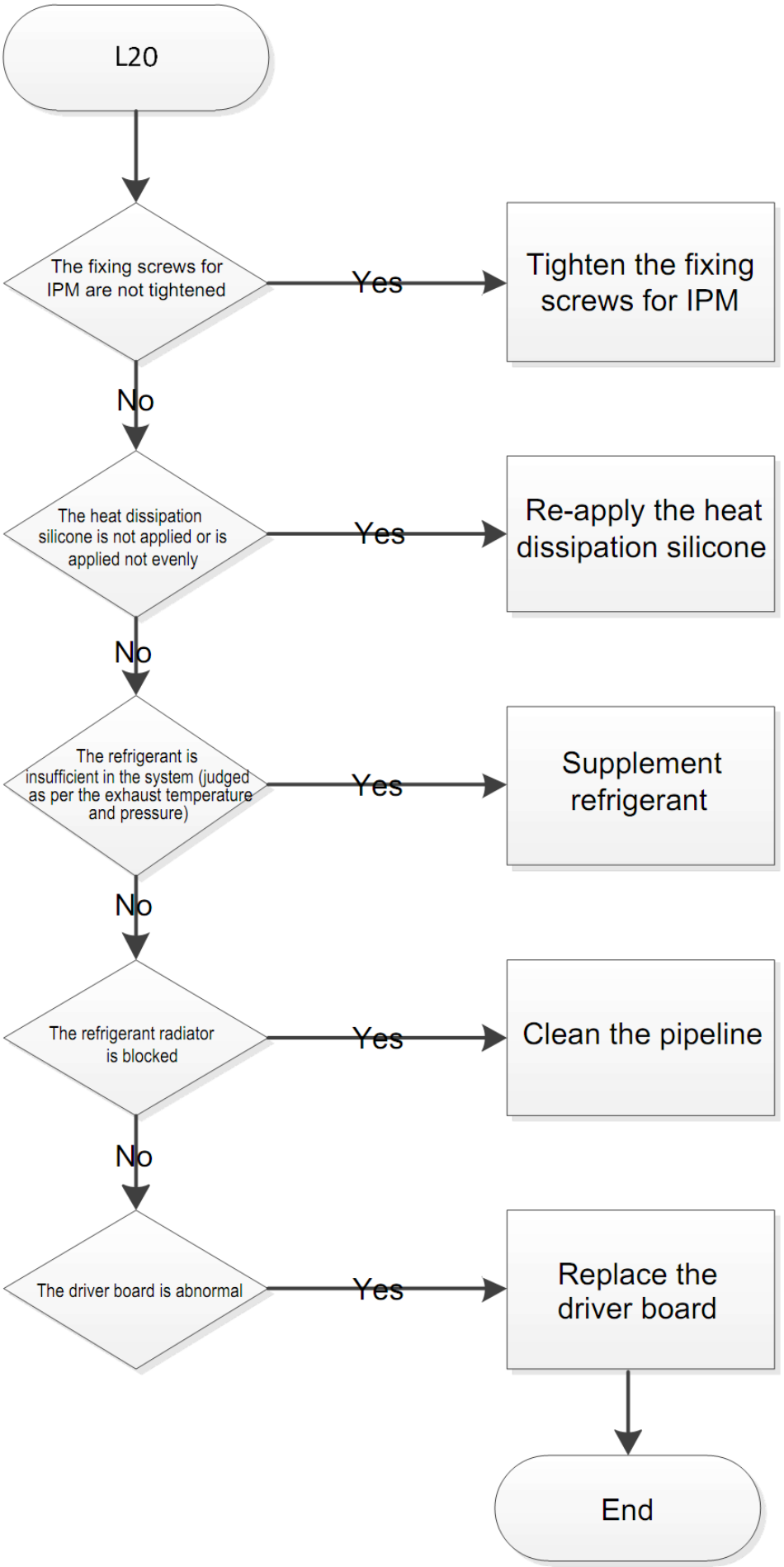
6.4.2 **Triggering/recovery conditions**

- Triggering conditions: The temperature of the IPM module exceeds 105°.
- 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 105°).
- 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.

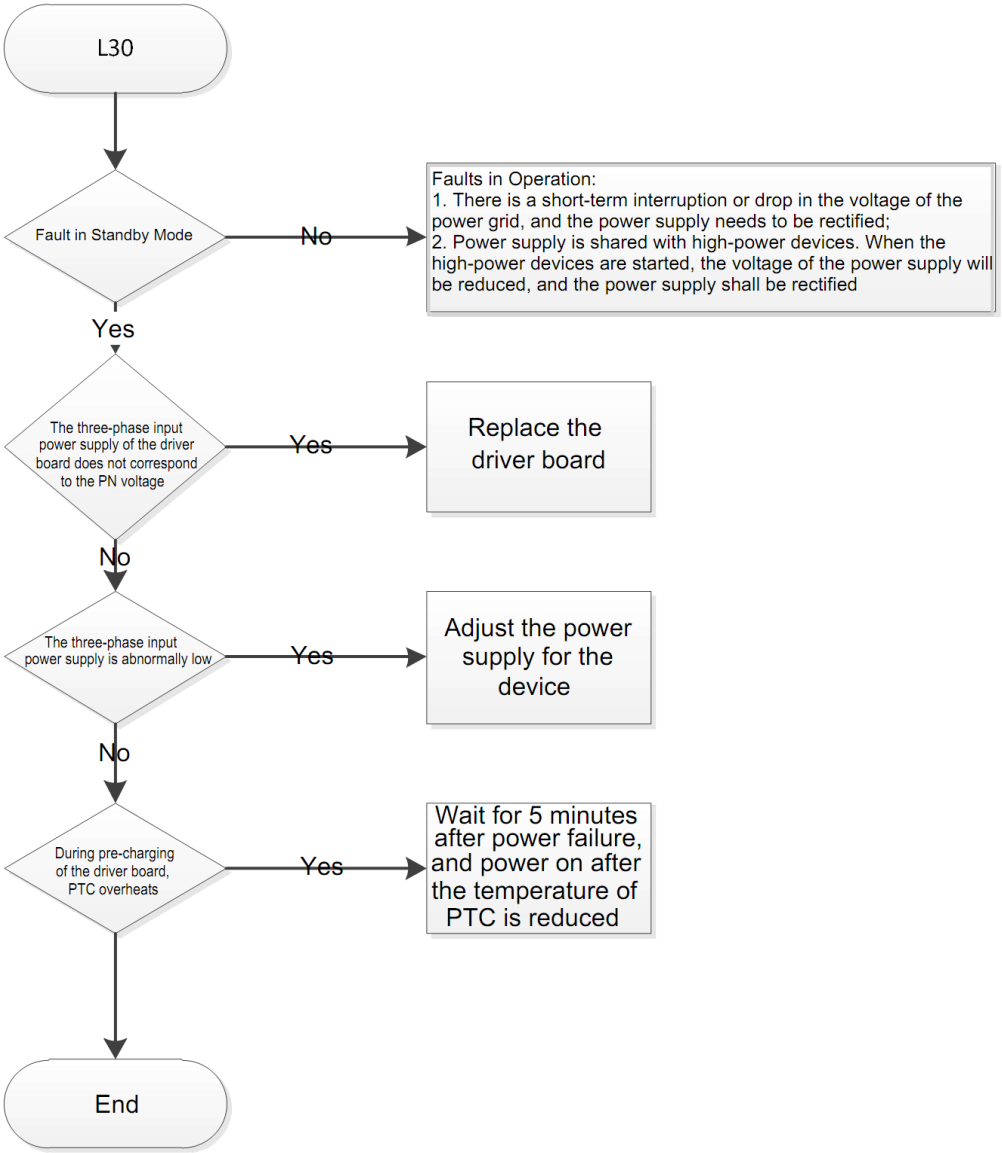
6.5.3 Possible reasons

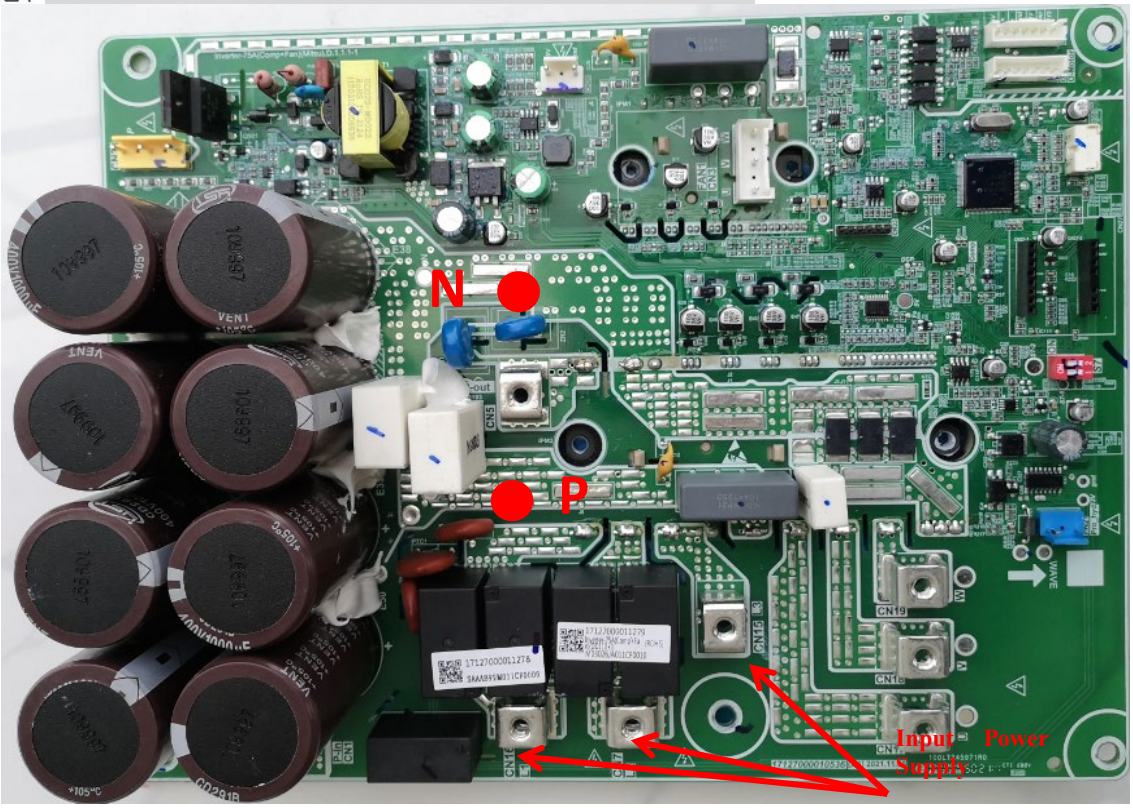
■ The input voltage is too low, causing too low voltage of the busbar;

■ 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 (750V 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.

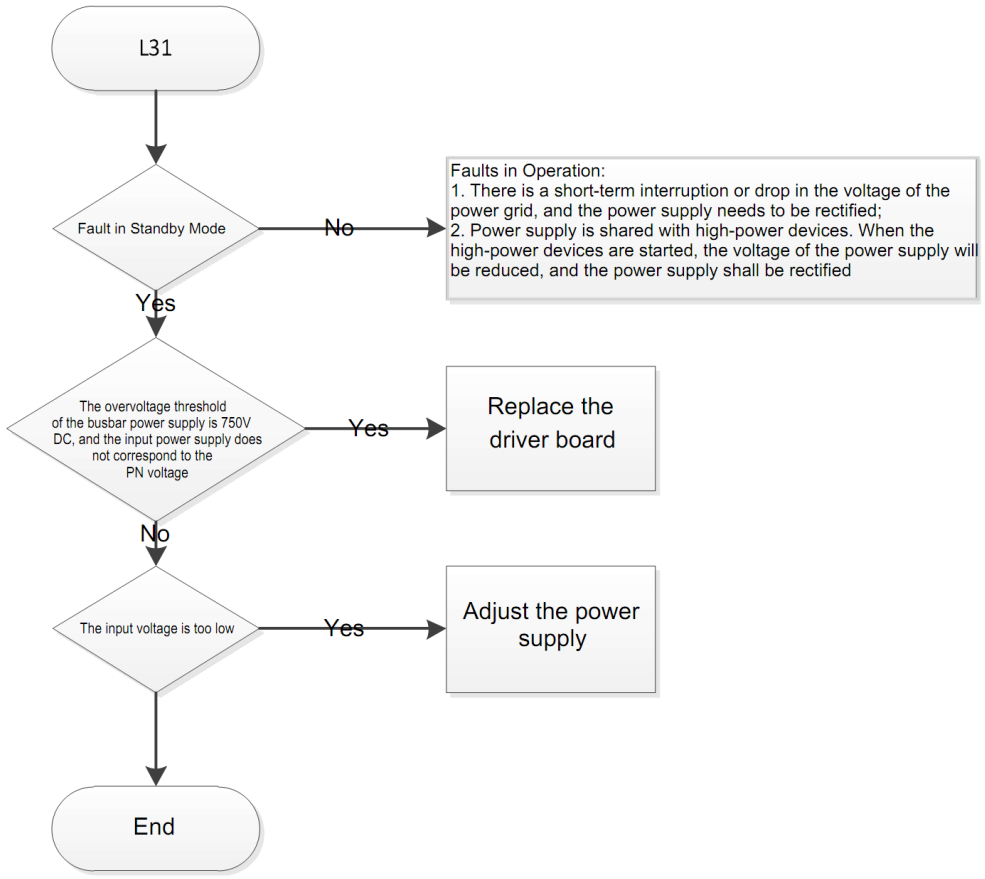
6.6.3 **Possible reasons**

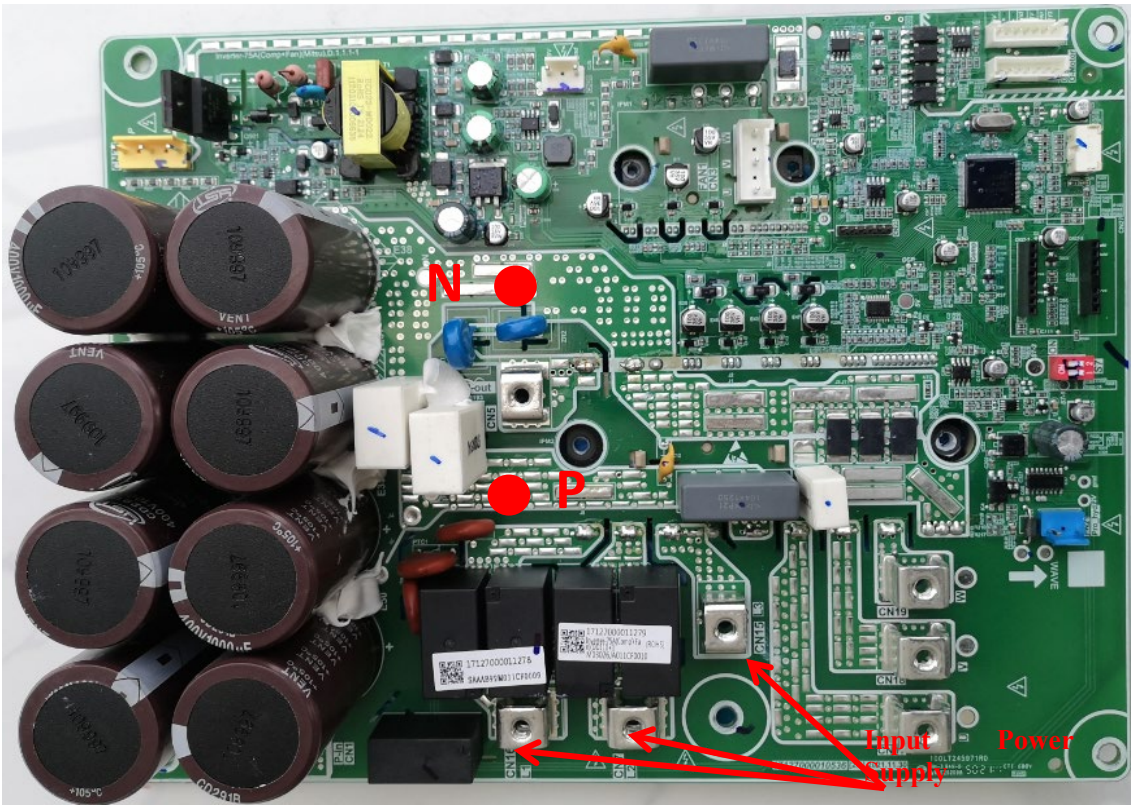
■ The input voltage is too low, causing too low voltage of the busbar;

■ 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 L31: 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 (770V).

■ 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.

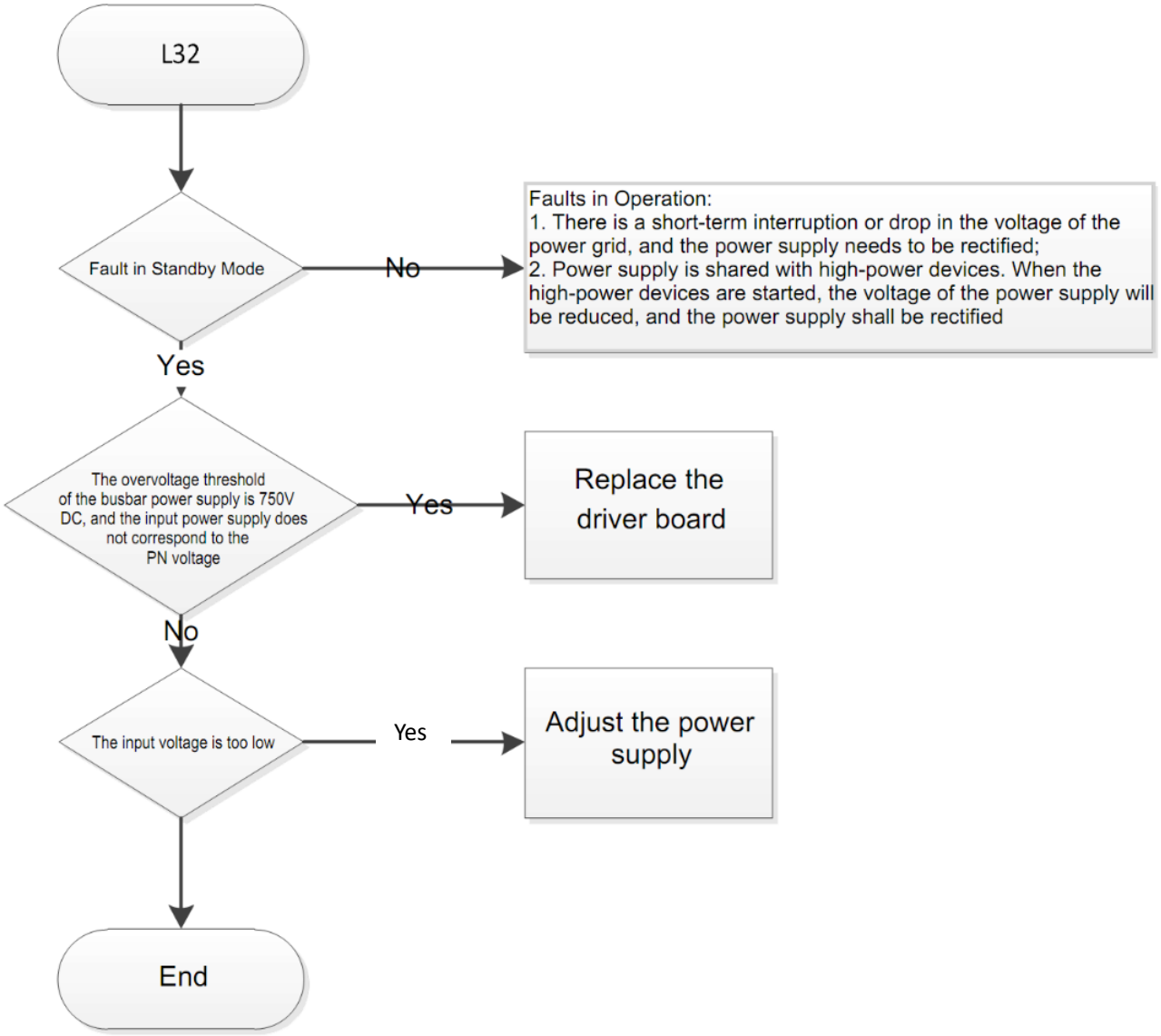
6.7.3 Possible reasons

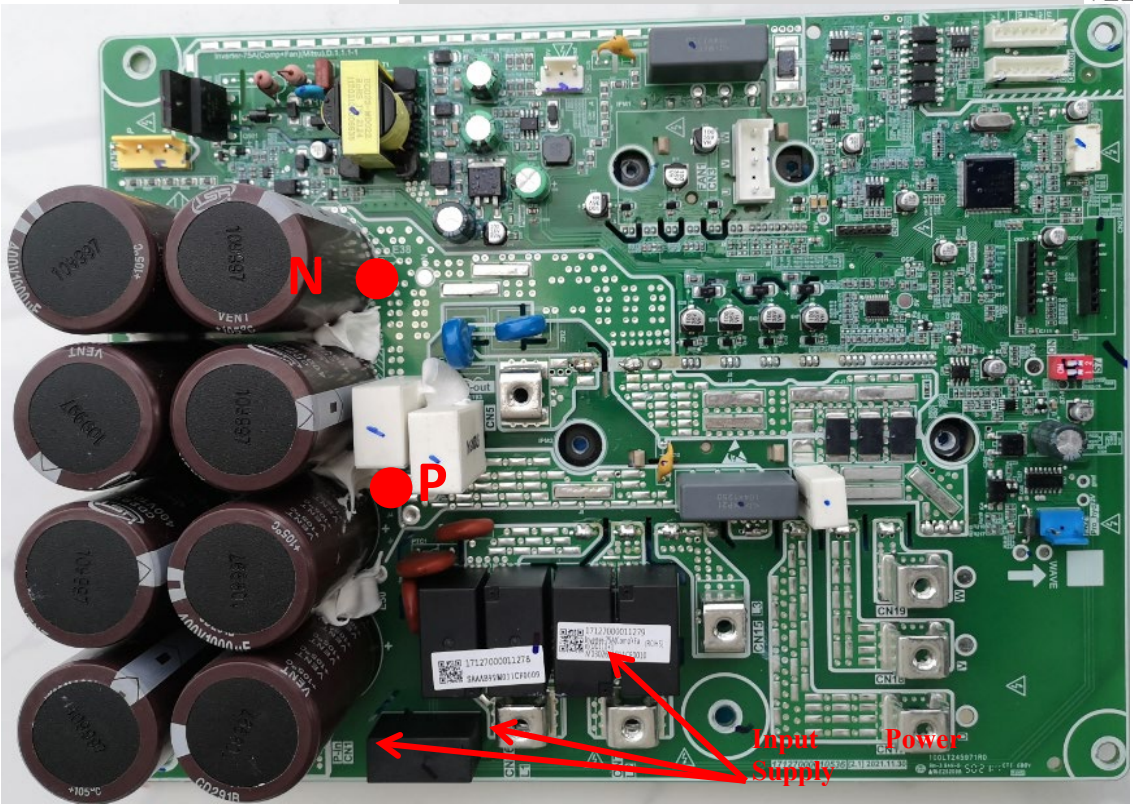
■ The input voltage is too low, causing too low voltage of the busbar;

■ 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.

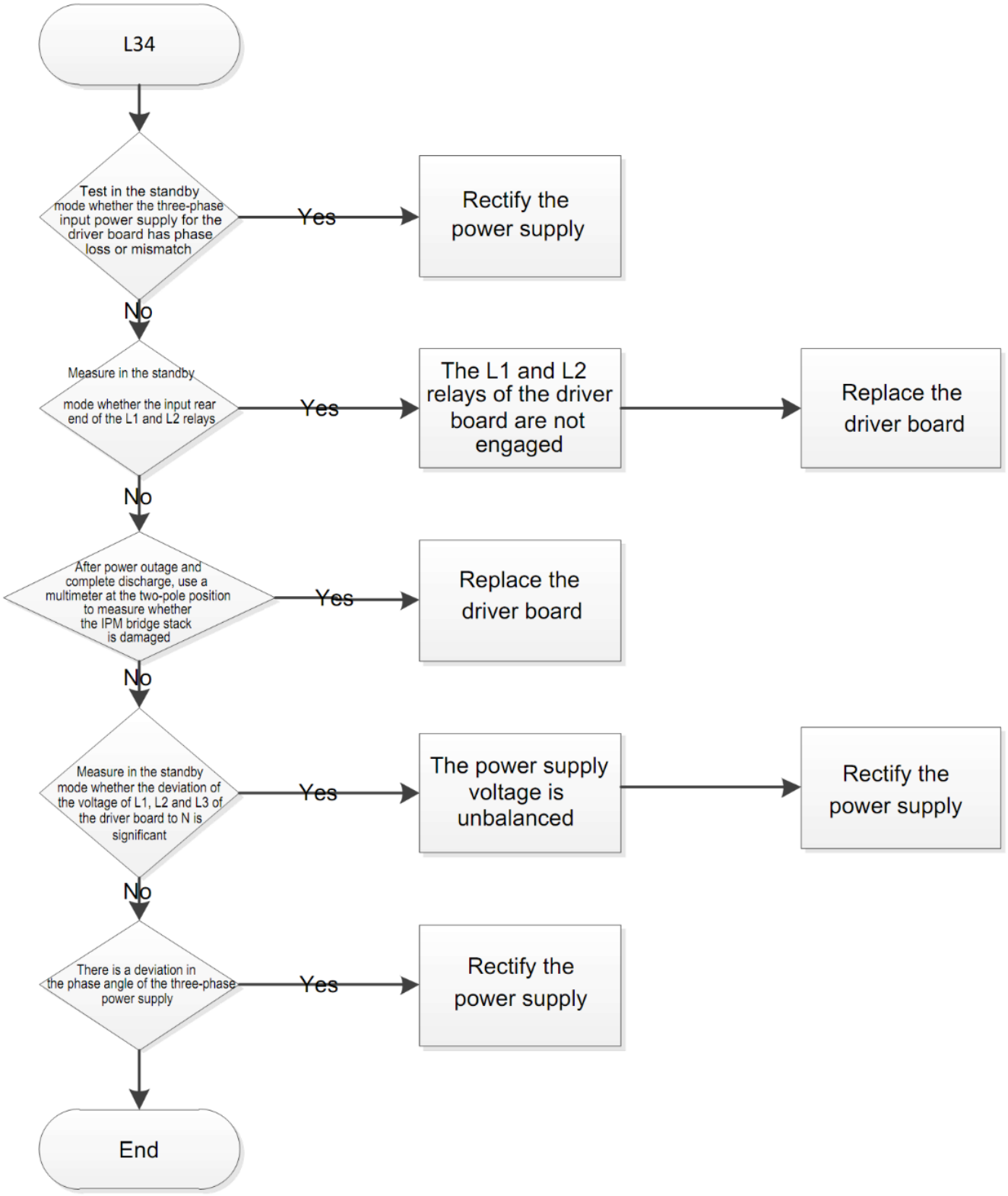
6.8.2 **Triggering/recovery conditions**

- 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.

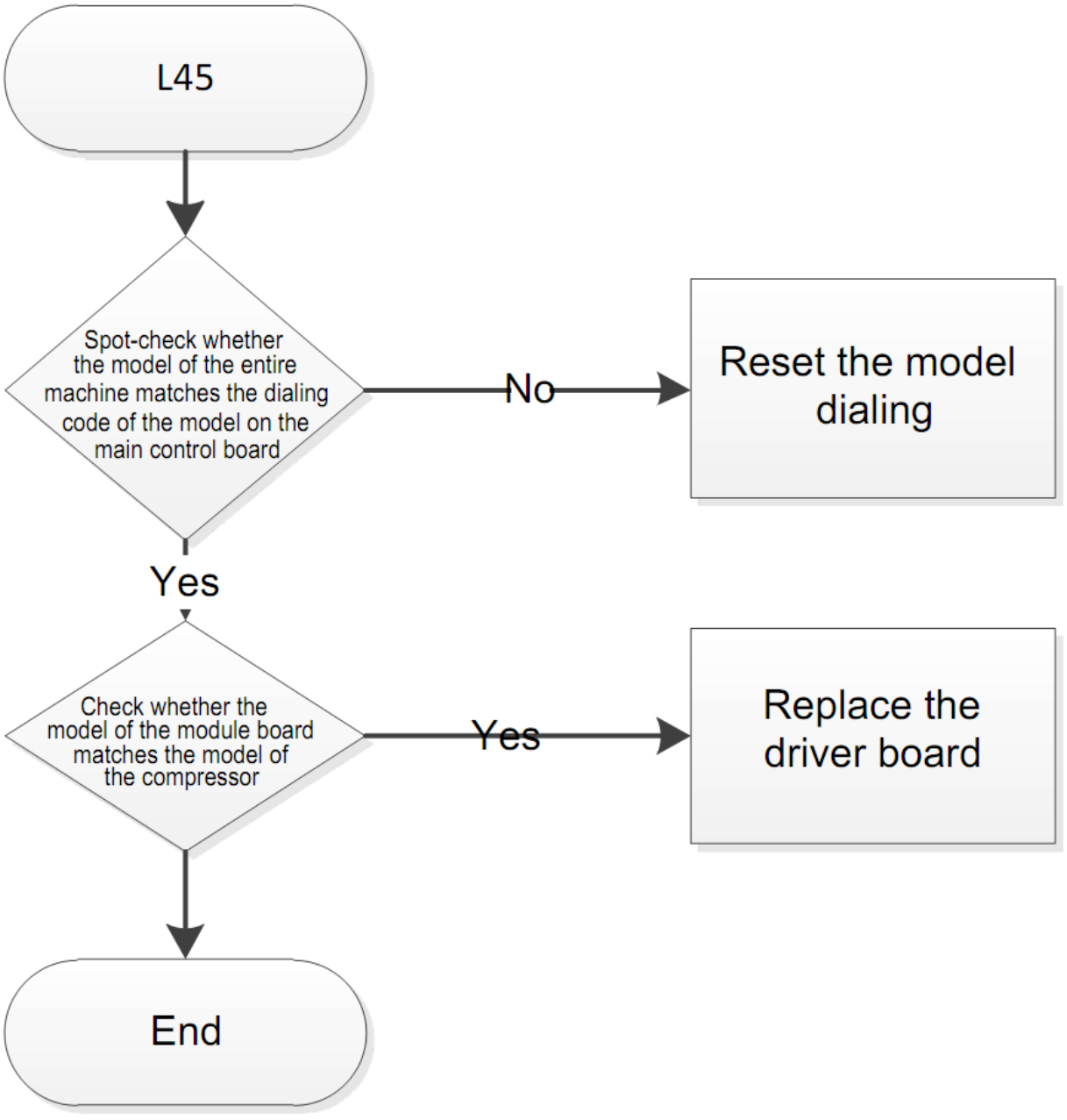
6.10.2 **Triggering/recovery conditions**

- 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.

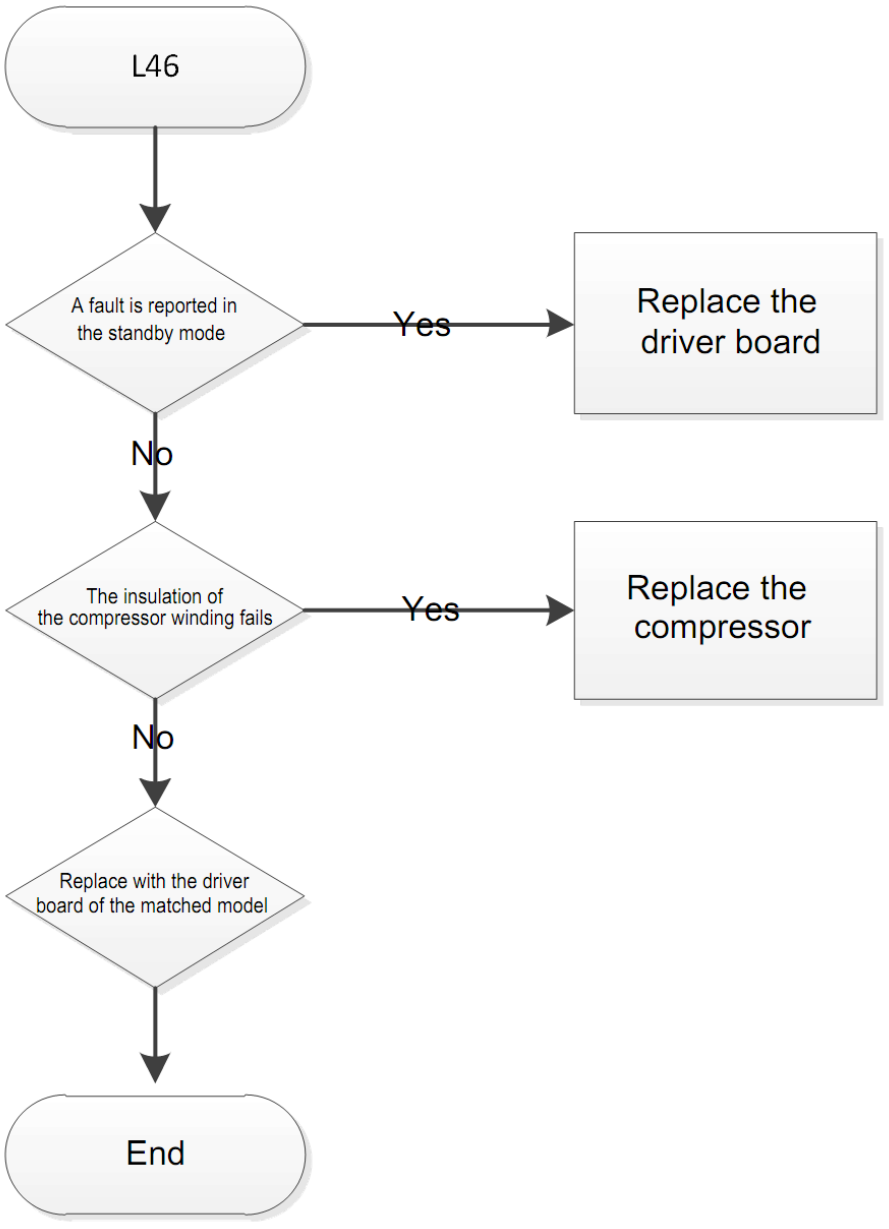
6.11.2 **Triggering/recovery conditions**

- 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.

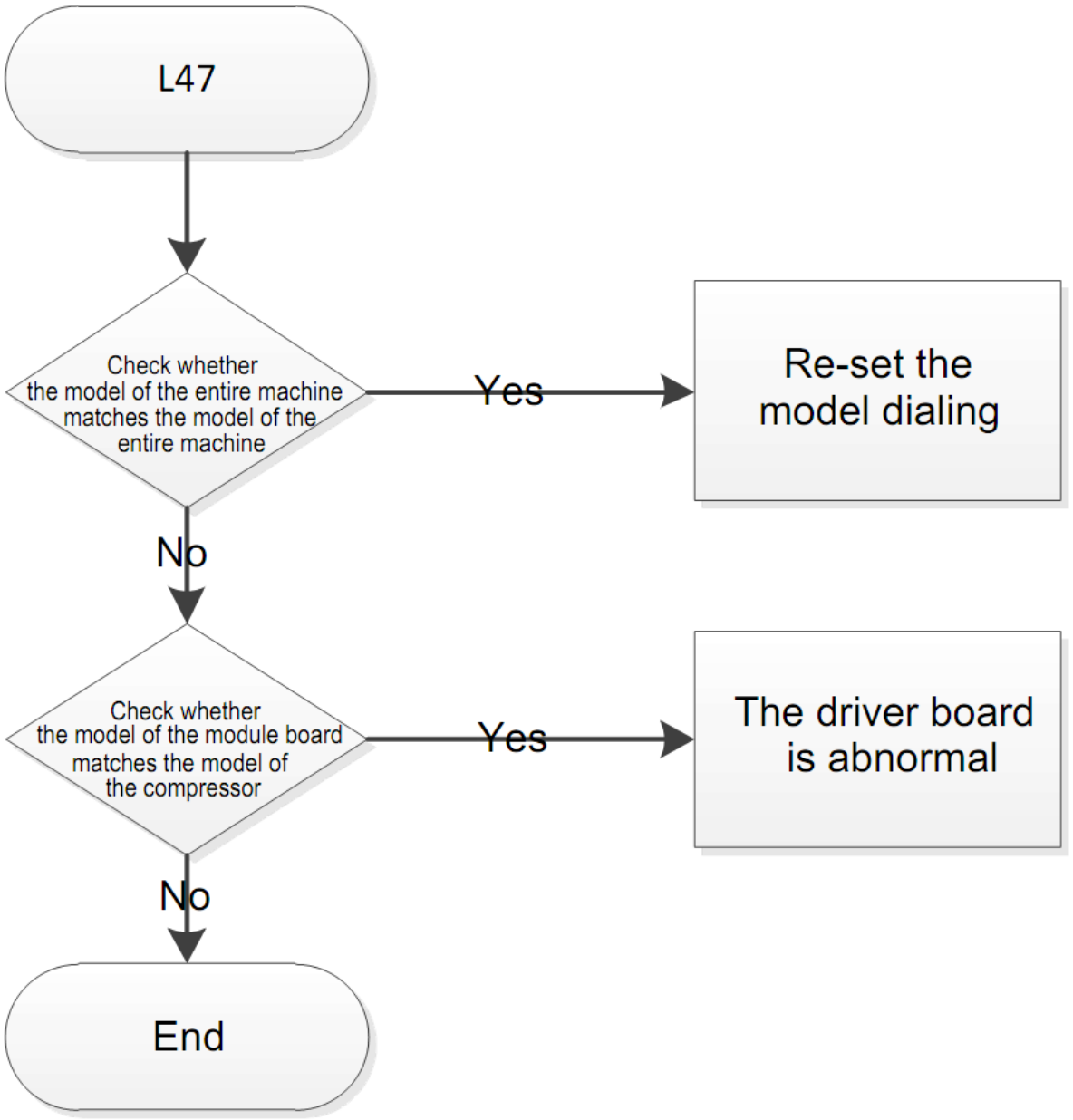
6.12.3 **Possible reasons**

■ 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.

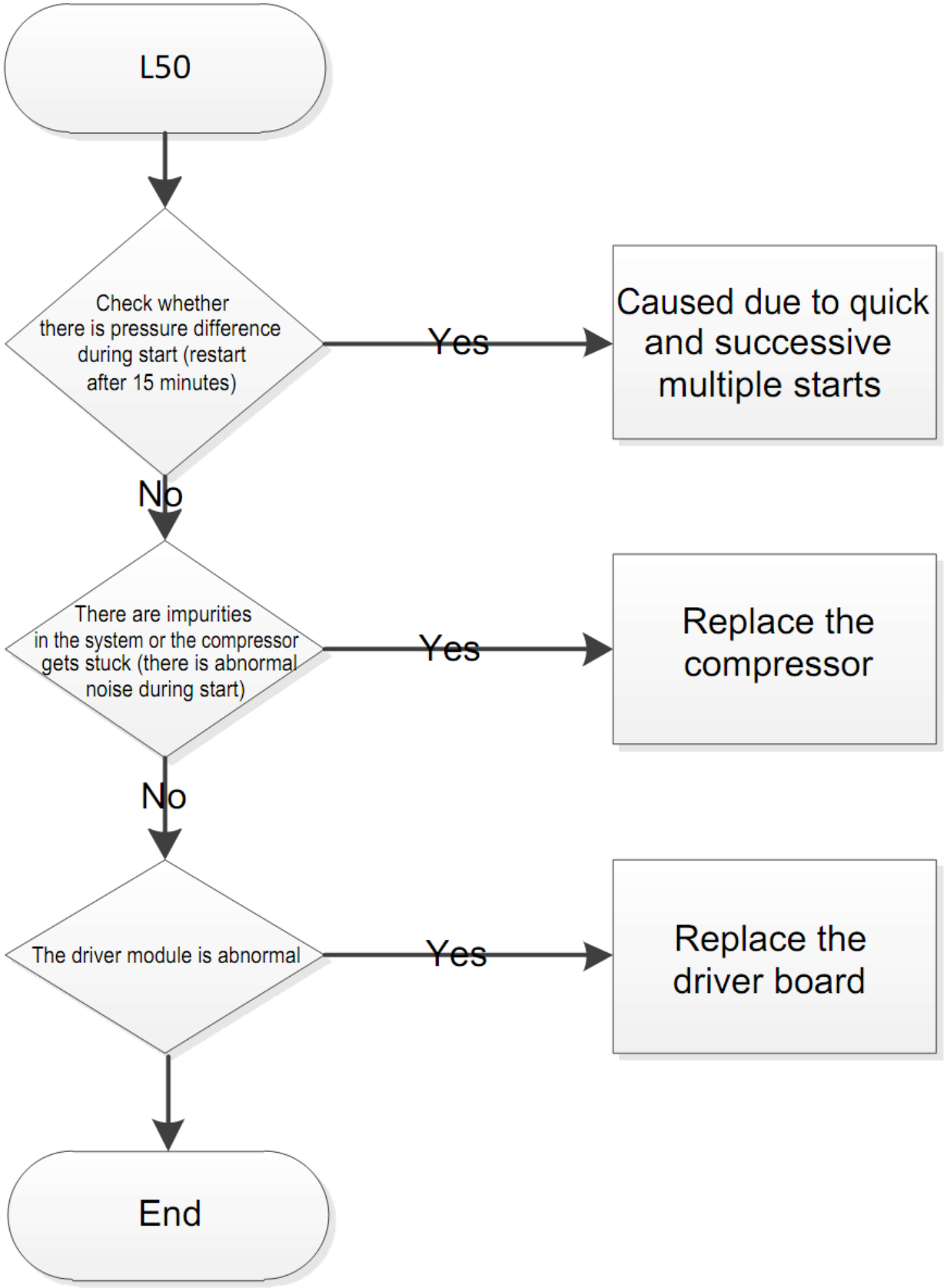
6.13.2 Triggering/recovery conditions

- 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 L65: IPM Short Circuit Protection

6.18.1 **Fault description**

- FCT is detected faulty.
- 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: In the FCT mode, the module is detected faulty.
- Recovery conditions: Replace the driver module without any issues.
- Reset method: The compressor will recover after the fault exit conditions are met.

6.18.3 **Possible reasons**

- The driver board is faulty.

6.18.4 **Fault handling process**

② Check whether there is false welding of IPM, and whether the PWM related transmission circuits of MCU are welded;

6.19 L6b: IPM U-Phase Lower Tube Open Circuit

6.19.1 **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.

6.19.2 **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.

6.19.3 **Possible reasons**

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

6.19.4 **Fault handling process**

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

6.20 L6C: IPM V-Phase Upper Tube Open Circuit

6.20.1 **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.

6.20.2 **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.

6.20.3 **Possible reasons**

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

6.20.4 **Fault handling process**

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

6.21 L6d: IPM V-Phase Lower Tube Open Circuit

6.22 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.

6.22.1 **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.

6.22.2 **Possible reasons**

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

6.22.3 **Fault handling process**

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

6.23 L6E: IPM W-Phase Upper Tube Open Circuit

6.23.1 **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.

6.23.2 **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.

6.23.3 **Possible reasons**

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

6.23.4 **Fault handling process**

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

6.24 L6F: IPM W-Phase Lower Tube Open Circuit

6.24.1 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.

6.24.2 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.

6.24.3 Possible reasons

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

6.24.4 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)

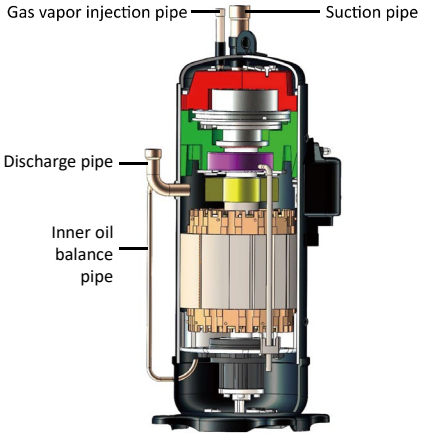
- If the oil from a compressor is spoiled (lightly or heavily), drain the oil from the oil separator and accumulator in that unit and then replace them.

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 principle during changing compressor is to keep the system oil amount is the same as original state.

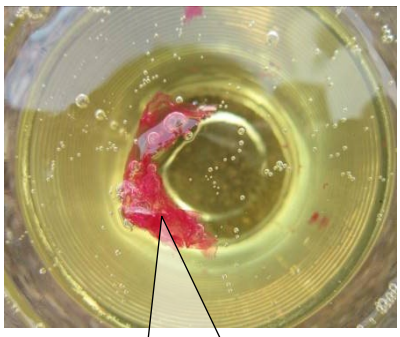
Step 8: Vacuum drying and refrigerant charging

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

Inspecting compressor oil

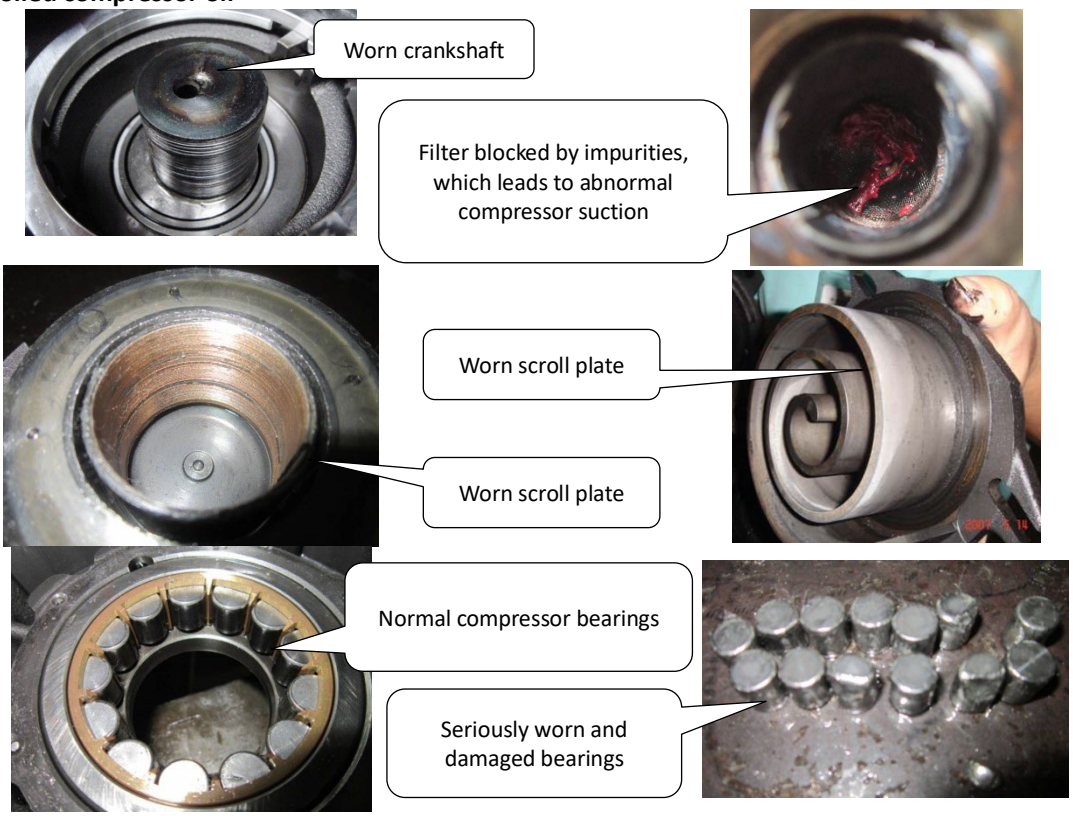
This oil is black - it has been carbonized

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

Effects of spoiled compressor oil



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

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

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

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

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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