R410A

Commercial Air Conditioners

Service Manual

Mini TVR Plus

4TVH0076GE000AA

4TVH0096GE000AA

4TVH0115GE000AA

CONTENTS

Part 1

General Information

1 Indoor and Outdoor Unit Capacities

1.1 Indoor Units

Table 1-1.1: Indoor unit abbreviation codes

Abbreviation code	Type
Q1	One-way Cassette
Q2	Two-way Cassette
Q4C	Compact Four-way Cassette
Q4	Four-way Cassette
T2	Medium Static Pressure Duct

Abbreviation code	Type
T1	High Static Pressure Duct
G	Wall-mounted
DL	Ceiling & Floor
F	Floor Standing

Table 1-1.2: Indoor unit capacity range

Capacity			Capacity index	Q1	Q2	Q4C	Q4	T2	T1	G	DL	F
kW	kBtu/h	HP										
1.8	5	0.6	18	18	—	—	—	—	—	—	—	—
2.2	7	0.8	22	22	22	22	—	22	—	22	—	22
2.8	9	1	28	28	28	28	28	28	—	28	—	28
3.6	12	1.25	36	36	36	36	36	36	—	36	36	36
4.5	15	1.6	45	45	45	45	45	45	—	45	45	45
5.6	19	2	56	56	56	—	56	56	—	56	56	56
7.1	24	2.5	71	71	71	—	71	71	71	71	71	71
8.0	27	3	80	—	—	—	80	80	80	80	80	80
9.0	30	3.2	90	—	—	—	90	90	90	90	90	—
10.0	34	3.6	100	—	—	—	100	—	—	—	—	—
11.2	38	4	112	—	—	—	112	112	112	—	112	—
14.0	48	5	140	—	—	—	140	140	140	—	140	—
16.0	55	6	160	—	—	—	—	—	160	—	160	—
20.0	68	7	200	—	—	—	—	—	200	—	—	—
25.0	85	9	250	—	—	—	—	—	250	—	—	—
28.0	96	10	280	—	—	—	—	—	280	—	—	—
40.0	136	14	400	—	—	—	—	—	400	—	—	—
45.0	154	16	450	—	—	—	—	—	450	—	—	—
56.0	191	20	560	—	—	—	—	—	560	—	—	—

1.2 Heat recovery ventilator

Table 1-1.4: Heat recovery ventilator capacity range

Capacity	m^3/h	200	300	400	500	800	1000	1500	2000
	CFM	120	180	240	300	470	590	880	1180

1.3 Outdoor Units

Table 1-1.5: Outdoor unit capacity range

Capacity	Model Name
8HP	4TVH0076GE000AA
10HP	4TVH0096GE000AA
12HP	4TVH0115GE000AA

2 External Appearance

2.1 Indoor Units

Table 1-2.1: Indoor unit appearance

One-way Cassette Q1 	Two-way Cassette Q2 
Compact Four-way Cassette Q4C 	Four-way Cassette Q4 
Medium Static Pressure Duct T2 	High Static Pressure Duct T1 
Wall-mounted G 	Ceiling & Floor DL 
Floor Standing F 	

2.2 Heat Recovery Ventilator

Table 1-2.3: Heat recovery ventilator appearance

Heat Recovery Ventilator


2.3 Outdoor Units

Table 1-2.4: Outdoor unit appearance

8/10/12HP


3 Nomenclature

3.1 Indoor Units

4	T	V	E	0	0	0	7	E	F	0	0	0	A	A
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15

Legend		
No.	**Code**	**Remarks**
1	4	R-410A
2	T	Trane
3	V	TVR
4		Indoor Unit Type E: One - Way Cassette G: Two - Way Cassette B: Compact Four - Way Cassette C: Four - Way Cassette D: Medium Static Pressure Duct A: High Static Pressure Duct W: Wall - Mounted C: Ceiling & Floor S, N, U: Floor Standing F: Fresh air processing unit
5	0	Currently not used
6	0	Btu/h x 1000
7	0	
8	7	
9	E	TVR Ultra
10	F	380V50-60Hz/1P
11	0	Currently not used
12	0	Currently not used
13	0	Currently not used
14	A	First design sequence
15	A	First service sequence

3.2 Heat recovery ventilator

AC Series

T	E	R	V	0	1	2	0	A	B	0	A	A
1	2	3	4	5	6	7	8	9	10	11	12	13

Legend		
No.	**Code**	**Remarks**
1	T	Energy recovery Fan Trane TVR
2	E	
3	R	
4	V	
5	0	CFM
6	1	
7	2	
8	0	
9	A	TVR
10	B	1: 380V/60Hz/1Ph B: 380/50Hz/1Ph
11	0	Currently not used
12	A	First design sequence
13	A	First service sequence

3.3 Outdoor Units

4	T	V	H	0	0	7	6	G	E	0	0	0	A	A
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15

Legend		
No.	**Code**	**Remarks**
1	4	R-410A
2	T	Trane
3	V	Air Cooled
4	H	Heat Pump
5	0	Currently not used
6	0	Btu/h x 1000
7	7	
8	6	
9	G	TVR Mini Plus DC
10	E	380V50-60Hz/1P
11	0	Currently not used
12	0	Currently not used
13	0	0: Standard C: Corrosion treatment
14	A	First design sequence
15	A	First design sequence

4 Combination Ratio

$$\text{Combination ratio} = \frac{\text{Sum of capacity indexes of the indoor units}}{\text{Capacity index of the outdoor unit}}$$

Table 1-4.1: Indoor and outdoor unit combination ratio limitations

Type	Minimum combination ratio	Maximum combination ratio		
		Standard indoor units only	Fresh air processing units only	Fresh air processing units and standard indoor units together
Outdoor units	50%	130%	100%	100%[1]

Table 1-4.2: Combinations of Indoor and outdoor units

Outdoor unit capacity			Sum of capacity indexes of connected indoor units (standard indoor units only)	Sum of capacity indexes of connected indoor units (fresh air processing units and standard indoor units together)	Maximum number of connected indoor units
kW	HP	Capacity index			
22.4	8	224	112 to 291.2	126 to 224	13
28.0	10	280	140 to 364	140 to 280	16
33.5	12	335	167.5 to 435.5	167.5 to 335	20

5 Selection Procedure

5.1 Procedure

Step 1: Establish design conditions

Design temperature and humidity (indoor and outdoor)
Required heat load of each room
System peak load
Piping length, level differences
Indoor unit specifications (type and quantity)

Step 2: Select indoor units

Decide indoor unit safety factor

Select indoor unit models ensuring that:
Indoor unit capacity corrected for indoor air temperature WB[1] ≥ Required heat load × Indoor unit safety factor

Step 3: Select outdoor unit

Determine required total heat load on the outdoor unit

Use the sum of the peak load of each room

Use the system peak load

Provisionally select outdoor unit capacity based on combination ratio limitations

Confirm that the number of indoor units connected to the outdoor unit is within limitation

Correct cooling and heating capacities of the outdoor unit for the following items:
Outdoor air temperature / Indoor air temperature WB / Combination ratio / Piping length, level difference / Piping heat loss / Frost accumulation (for heating capacity only)

Is corrected outdoor unit capacity ≥ Required total heat load on outdoor unit?

No

Yes

VRF system selection is complete

Notes:

1. If the indoor design temperature falls between two temperatures listed in the indoor unit's capacity table, calculate the corrected capacity by interpolation. If the indoor unit selection is to be based on total heat load and sensible heat load, select indoor units which satisfy not only the total heat load requirements of each room but also the sensible heat load requirements of each room. As with total heat capacity, the sensible heat capacity of indoor units should be corrected for indoor temperature, interpolating where necessary. For the indoor unit capacity tables, refer to the indoor unit technical manuals.

5.2 Example

The following is a selection example based on total heat load for cooling.

Figure 1-5.1: Room plan

<table>
<tr><td rowspan="3">Room A</td><td>Room D</td><td>Room E</td></tr>
<tr><td colspan="2"></td></tr>
<tr><td>Room B</td><td>Room C</td></tr>
</table>

Step 1: Establish design conditions

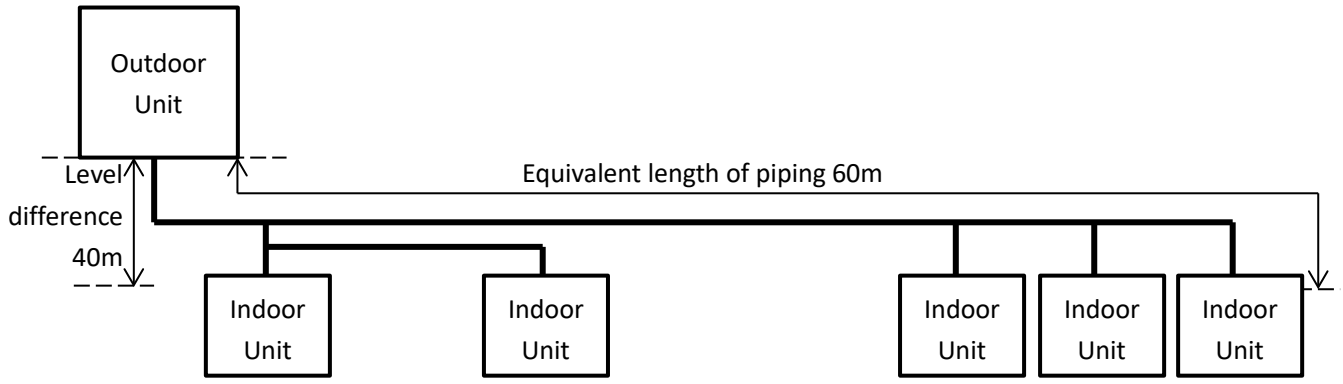
- Indoor air temperature 25°C DB, 18°C WB; outdoor air temperature 33°C DB.
- Determine peak load of each room and system peak load. As shown in Table 1-5.1, the system peak load is 27.5kW.

Table 1-5.1: Required heat load of each room (kW)

Time	Room A	Room C	Room D	Room E	Room F	Total
9:00	9.1	3.0	3.0	2.9	2.9	20.9
12:00	7.4	5.1	5.1	4.0	4.0	25.6
14:00	9.3	4.9	4.9	4.2	4.2	**27.5**
16:00	8.3	3.9	3.9	3.8	3.8	23.7

- The maximum piping lengths and level differences in this example are as given in Figure 1-5.2.

Figure 1-5.2: System diagram



- Indoor unit type for all rooms: Medium Static Pressure Duct (T2).

Step 2: Select indoor units

- In this example, a safety factor is not used (i.e. the safety factor is 1).
- Select indoor unit models using the medium static pressure duct cooling capacity table. Each indoor unit's corrected capacity needs to be greater than or equal to the peak load of the relevant room. The selected indoor units are shown in Table 1-5.3.

Table 1-5.2: Extract from medium static pressure duct (T2) cooling capacity table

Model	Capacity index	Indoor air temperature													
		14°C WB		16°C WB		18°C WB		19°C WB		20°C WB		22°C WB		24°C WB	
		20°C DB		23°C DB		26°C DB		27°C DB		28°C DB		30°C DB		32°C DB	
		TC	SHC	TC	SHC	TC	SHC	TC	SHC	TC	SHC	TC	SHC	TC	SHC
T2	22	1.5	1.4	1.8	1.5	2.1	1.6	2.2	1.6	2.3	1.7	2.4	1.5	2.4	1.5
	28	1.9	1.7	2.3	1.9	2.6	2.1	2.8	2.1	3.0	2.1	3.1	2.0	3.1	1.9
	36	2.5	2.1	2.9	2.3	3.4	2.5	3.6	2.6	3.8	2.7	4.2	2.8	3.9	2.3
	45	3.1	2.6	3.7	2.8	4.2	3.1	4.5	3.2	4.8	3.2	4.9	3.1	5.1	2.9
	56	3.9	3.0	4.6	3.3	5.3	3.6	5.6	3.7	5.9	3.8	6.2	3.7	6.2	3.4
	71	4.9	3.9	5.8	4.3	6.7	4.7	7.1	4.9	7.5	4.8	7.8	4.6	7.8	4.3
	80	5.5	4.4	6.6	4.9	7.5	5.3	8.0	5.5	8.4	5.5	8.8	5.2	8.8	4.8
	90	6.2	5.3	7.3	5.8	8.4	6.3	9.0	6.4	9.6	6.5	9.9	6.1	9.9	5.7
	112	7.7	6.4	9.1	7.1	10.5	7.7	11.2	7.8	11.9	8.1	12.5	7.8	12.5	7.4
	140	9.7	7.8	11.3	8.6	13.2	9.6	14.0	9.8	14.8	9.8	15.7	9.7	15.4	8.8

Abbreviations:
TC: Total capacity (kW); SHC: Sensible heat capacity (kW)

Table 1-5.3: Selected indoor units

	Room A	Room B	Room C	Room D	Room E
Peak heat load (kW)	9.3	5.1	5.1	4.2	4.2
Selected indoor unit	4TVD0038EF000AA	4TVD0018EF000AA	4TVD0018EF000AA	4TVD0015EF000AA	4TVD0015EF000AA
Corrected TC (kW)	10.5	5.3	5.3	4.2	4.2

Step 3: Select outdoor unit

- Determine the required total heat load from the indoor units to the outdoor unit based on either the sum of the peak loads of each room or the system peak load. In this example, it is determined based on the system peak load. Therefore, the required heat load is 27.5kW.
- Provisionally select an outdoor unit using the sum of the capacity indexes (CIs) of the selected indoor units (as shown in Table 1-5.4), ensuring that the combination ratio is between 50% and 130%. Refer to Table 1-5.5. As the sum of CIs of the indoor units is 314, outdoor units 10HP and 12HP are potentially suitable. Start from the smaller, which is the 10HP unit.

Table 1-5.4: Sum of indoor unit capacity indexes

Model	Capacity Index	No. of units
4TVD0038EF000AA	112	1
4TVD0018EF000AA	56	2
4TVD0015EF000AA	45	2

Sum of CIs	314

Table 1-5.5: Combinations of Indoor and outdoor units

Outdoor unit capacity			Sum of capacity indexes of connected indoor units (standard indoor units only)	Maximum number of connected indoor units
kW	HP	Capacity index		
28.0	10	280	140 to 364	140 to 280
33.5	12	335	167.5 to 435.5	167.5 to 335

- The number of connected indoor units is 5 and the maximum number of connected indoor units on the 10HP outdoor unit is 16, so the number of connected indoor units is within the limitation.
- Calculate the corrected capacity of the outdoor unit:
  a) The sum of the indoor unit CIs is 314 and the CI of the 10HP outdoor unit (4TVH0096GE000AA) is 280, so the combination ratio is 314 / 280 = 112%.
  b) Using the outdoor unit's cooling capacity table, interpolate to obtain the capacity ("B") corrected for outdoor air temperature, indoor air temperature, and combination ratio. Refer to Tables 1-5.6 and 1-5.7.

Table 1-5.6: Extract from Table 2-8.1 4TVH0096GE000AA cooling capacity

CR	Outdoor air temp. (°C DB)	Indoor air temp. (°C DB / °C WB)	
		25.8 / 18.0	
		TC	PI
		kW	kW
120%	31	30.31	6.09
	33	29.87	6.33
	35	29.40	6.58
110%	31	30.23	6.03
	33	29.64	6.37
	35	29.15	6.62

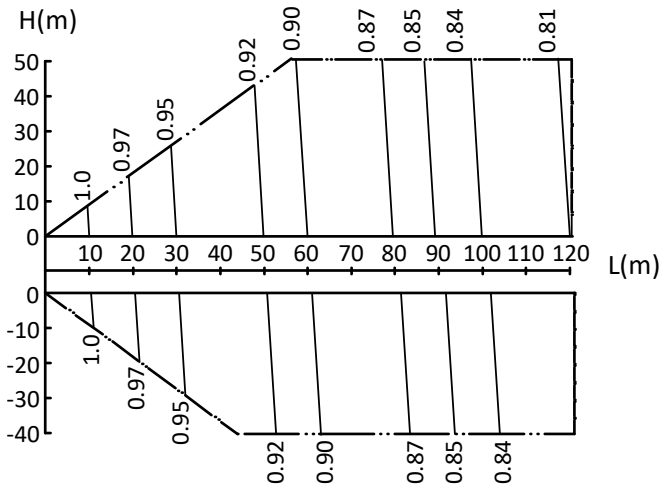
Table 1-5.7: Cooling capacity calculated by interpolation

CR	Outdoor air temp. (°C DB)	Indoor air temp. (°C DB / °C WB)	
		25.8 / 18.0	
		TC	PI
		kW	kW
120%			
	33	29.87	6.33
	B = 29.69[1]		
110%			
	33	29.64	6.37

Notes:
1. 29.64 + (29.87 – 29.64) × (112 – 110) / (120 – 110) = 29.69

c) Find the correction factor for piping length and level difference ("K1")

Figure 1-5.3: V4+i rate of change in cooling capacity



Notes:

1. The horizontal axis shows equivalent length of piping between farthest indoor unit and first outdoor branch joint; the vertical axis shows the largest level difference between indoor unit and outdoor unit. For level differences, positive values indicate that the outdoor unit is above the indoor unit, negative values indicate that the outdoor unit is below the indoor unit.

d) Calculate the corrected capacity of 4TVH0096GE000AA ("C") by using K1:

$$C = B \times K1 = 29.69 \times 0.898 = 26.66kW$$

- The corrected capacity 26.66 kW is lower than required total heat load 27.5kW, so selection is not complete. Step 3 should be repeated from the point where the outdoor unit capacity is provisionally selected.

Repeat Step 3: Select outdoor unit

- Determine the required total heat load from the indoor units to the outdoor unit based on either the sum of the peak loads of each room or the system peak load. In this example, it is determined based on the system peak load. Therefore, the required heat load is 27.5kW.
- Provisionally select an outdoor unit using the sum of the capacity indexes (CIs) of the selected indoor units (as shown in Table 1-5.4), ensuring that the combination ratio is between 50% and 130%. Refer to Table 1-5.5. As the sum of CIs of the indoor units is 314, outdoor units 10HP and 12HP are potentially suitable. For the 10HP unit is not suitable, try to select 12Hp unit.

Table 1-5.8: Sum of indoor unit capacity indexes

Model	Capacity Index	No. of units
4TVD0038EF000AA	112	1
4TVD0018EF000AA	56	2
4TVD0015EF000AA	45	2

Sum of CIs	314

Table 1-5.9: Combinations of Indoor and outdoor units

Outdoor unit capacity			Sum of capacity indexes of connected indoor units (standard indoor units only)	Maximum number of connected indoor units
kW	HP	Capacity index		
28.0	10	280	140 to 364	140 to 280
33.5	12	335	167.5 to 435.5	167.5 to 335

- The number of connected indoor units is 5 and the maximum number of connected indoor units on the 12HP outdoor unit is 20, so the number of connected indoor units is within the limitation.

- Calculate the corrected capacity of the outdoor unit:
  a) The sum of the indoor unit CIs is 314 and the CI of the 10HP outdoor unit (4TVH0115GE000AA) is 335, so the combination ratio is 314 / 335 = 94%.
  b) Using the outdoor unit's cooling capacity table, interpolate to obtain the capacity ("B") corrected for outdoor air temperature, indoor air temperature, and combination ratio. Refer to Tables 1-5.10 and 1-5.11.

Table 1-5.10: Extract from Table 2-8.2 4TVH0115GE000AA cooling capacity

CR	Outdoor air temp. (°C DB)	Indoor air temp. (°C DB / °C WB)	
		25.8 / 18.0	
		TC	PI
		kW	kW
100%	31	32.84	8.47
	33	32.84	8.87
	35	32.84	9.05
90%	31	28.13	6.77
	33	28.13	7.10
	35	28.13	7.24

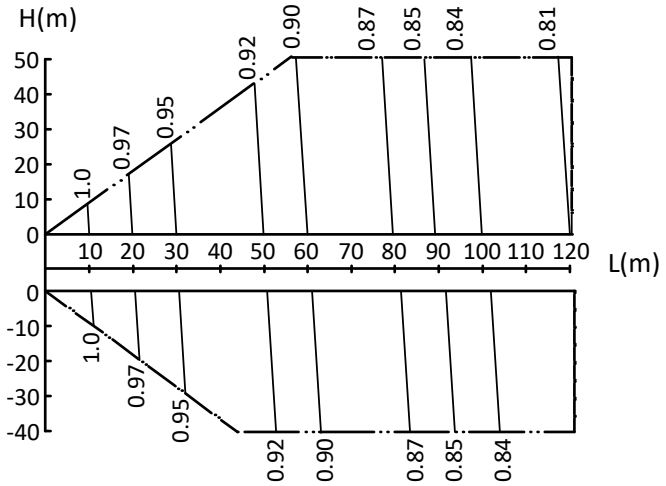
Table 1-5.11: Cooling capacity calculated by interpolation

CR	Outdoor air temp. (°C DB)	Indoor air temp. (°C DB / °C WB)	
		25.8 / 18.0	
		TC	PI
		kW	kW
100%			
	33	32.84	8.87
	B = 29.69[1]		
90%			
	33	28.13	7.10

Notes:
1. 28.13 + (32.84 – 28.13) × (100 – 94) / (100 – 90) = 30.96

c) Find the correction factor for piping length and level difference ("K1")

Figure 1-5.4: V4+i rate of change in cooling capacity



Notes:

2. The horizontal axis shows equivalent length of piping between farthest indoor unit and first outdoor branch joint; the vertical axis shows the largest level difference between indoor unit and outdoor unit. For level differences, positive values indicate that the outdoor unit is above the indoor unit, negative values indicate that the outdoor unit is below the indoor unit.

d) Calculate the corrected capacity of 4TVH0115GE000AA ("C") by using K1:

$$C = B \times K1 = 30.96 \times 0.898 = 27.8kW$$

- The corrected capacity 27.8 kW is larger than required total heat load 27.5kW, so selection is complete.

Part 2

Component Layout and Refrigerant Circuits

1 Layout of Functional Components

Figure 2-1.1: front view

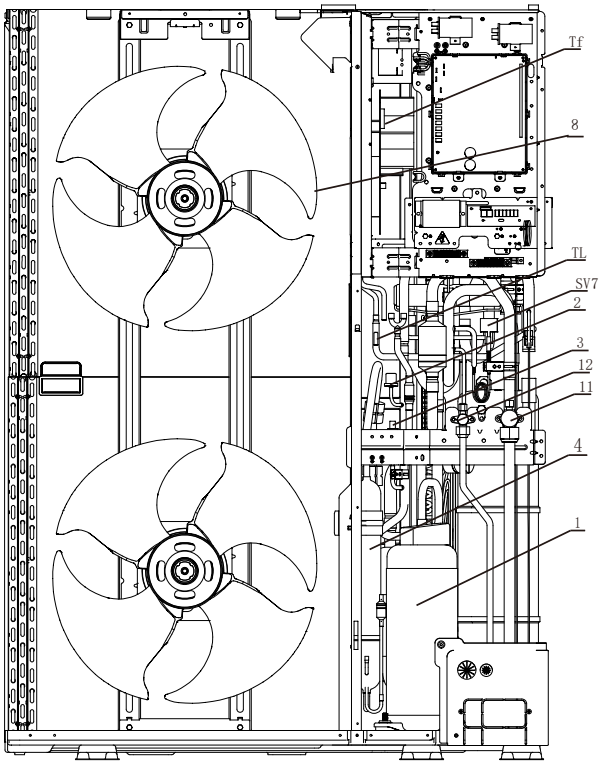


Figure 2-1.2: side view

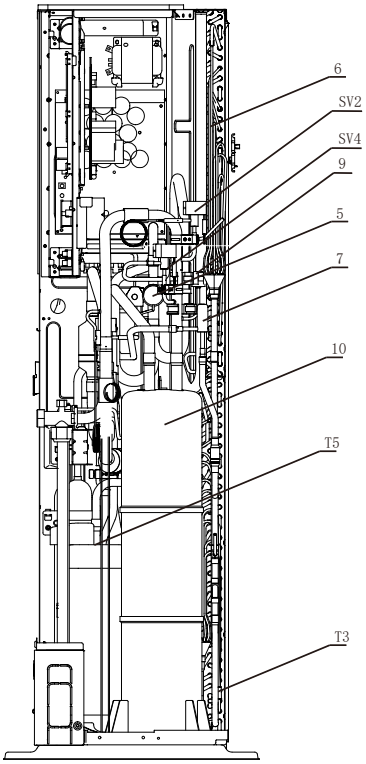
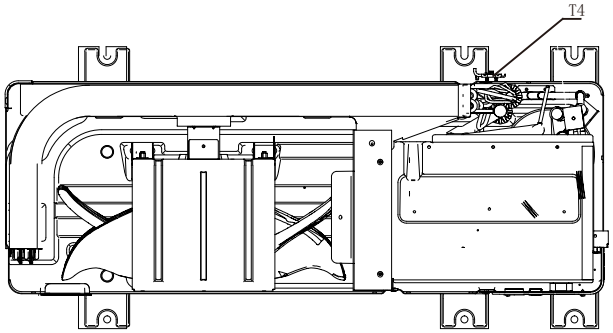


Figure 2-1.3: top view



Legend				
No.	**Parts name**		**No.**	**Parts name**
1	Compressor		11	Stop valve (gas side)
2	High pressure switch		12	Stop valve (liquid side)
3	High pressure sensor		T3	Heat exchanger temperature outlet sensor
4	Oil separator		T4	Outdoor ambient temperature sensor
5	Four-way valve		T5	Discharge temperature sensor
6	Heat exchanger		Tf	Heat sink temperature sensor
7	Electronic expansion valve (EXV)		TL	Refrigerant cooling pipe temperature sensor
8	Fan		SV2	Liquid injection valve
9	Low pressure switch		SV4	Oil return valve
10	Accumulator		SV7	Refrigerant bypass valve

2 Piping Diagrams

Figure 2-1.1: 8HP piping diagram

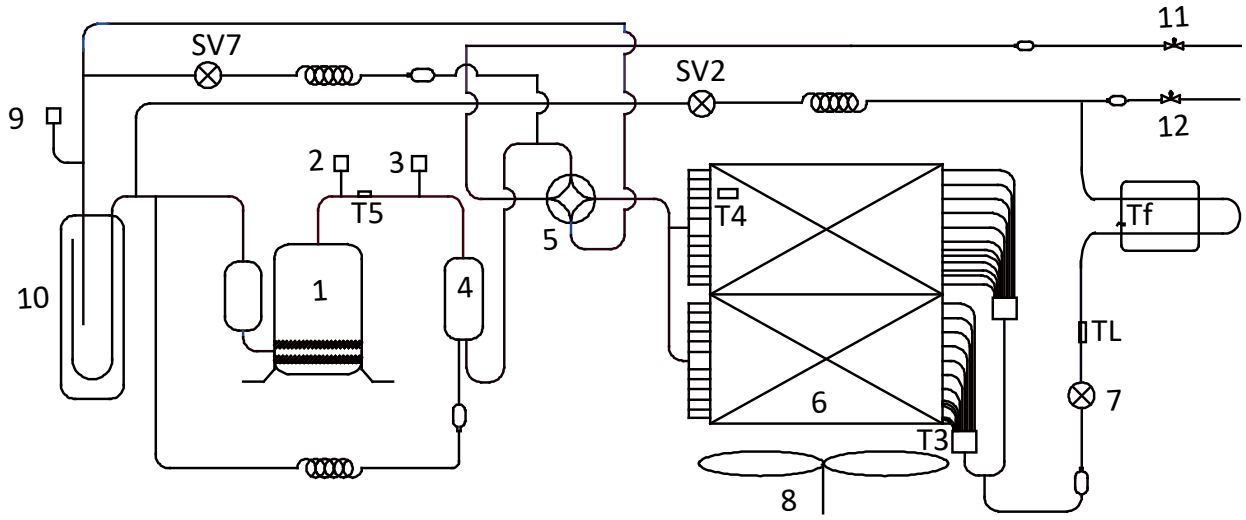
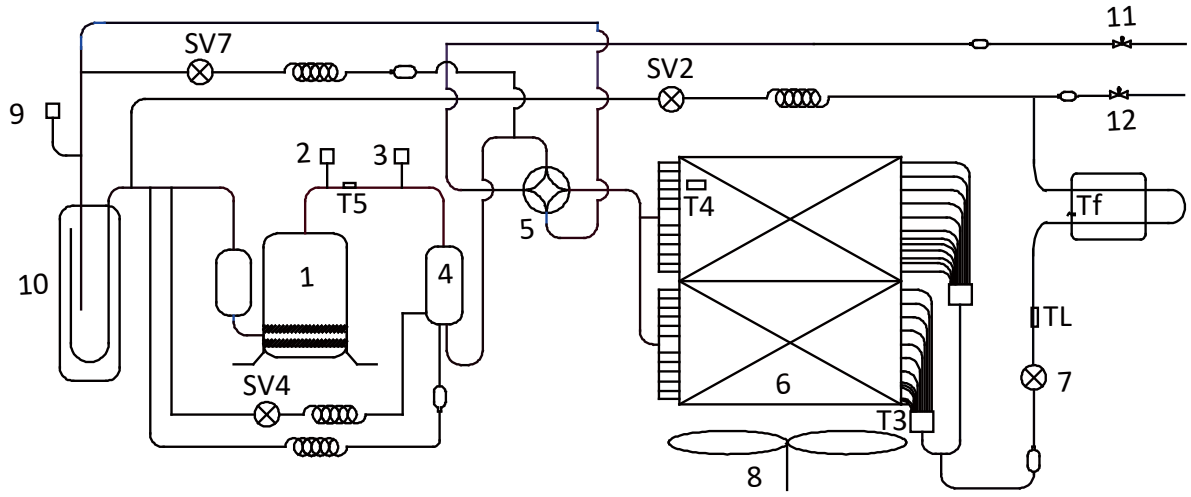


Figure 2-2.2: 10/12HP piping diagram



Legend				
No.	**Parts name**		**No.**	**Parts name**
1	Compressor		11	Stop valve (gas side)
2	High pressure switch		12	Stop valve (liquid side)
3	High pressure sensor		T3	Heat exchanger temperature sensor
4	Oil separator		T4	Outdoor ambient temperature sensor
5	Four-way valve		T5	Discharge temperature sensor
6	Heat exchanger		Tf	Heat sink temperature sensor
7	Electronic expansion valve (EXV)		TL	Refrigerant cooling pipe temperature sensor
8	Fan		SV2	Liquid injection valve
9	Low pressure switch		SV4	Oil return valve
10	Accumulator		SV7	Refrigerant bypass valve

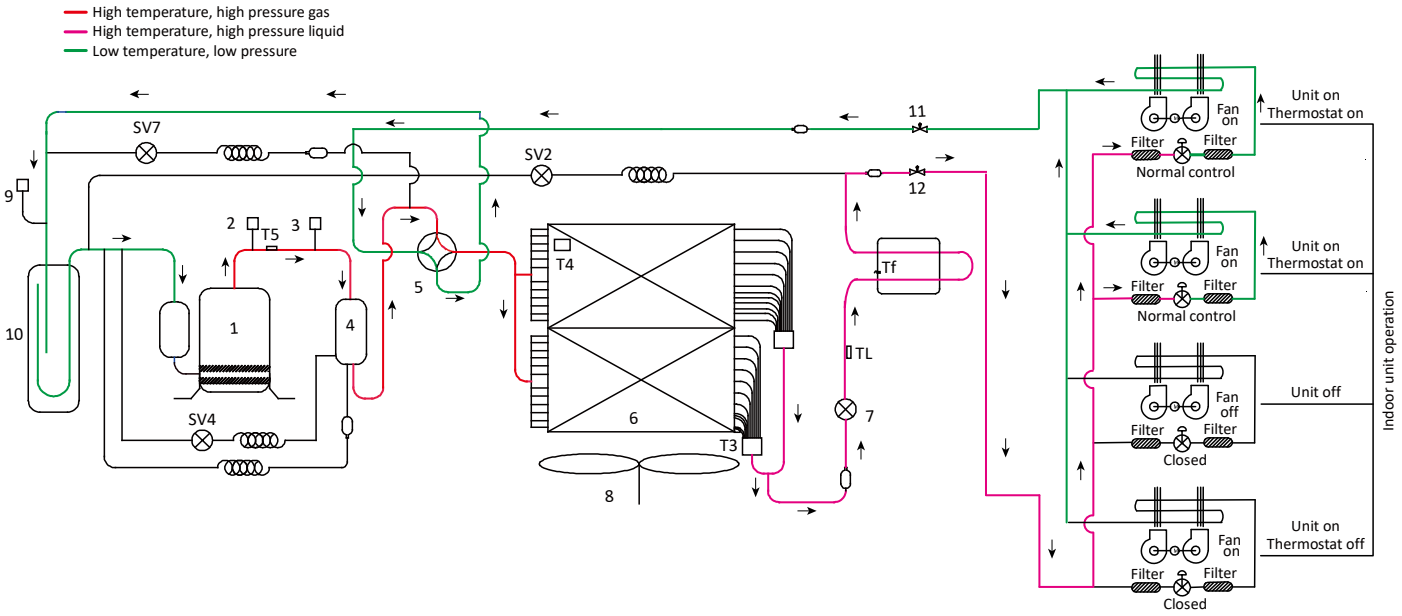
Key components:

1. **Oil separator:**
   Separates oil from gas refrigerant pumped out of the compressor and quickly returns it to the compressor. Separation efficiency is up to 99%.
2. **Accumulator:**
   Stores liquid refrigerant and oil to protect compressor from liquid hammering.
3. **Electronic expansion valve (EXV):**
   Controls refrigerant flow and reduces refrigerant pressure.
4. **Four-way valve:**
   Controls refrigerant flow direction. Closed in cooling mode and open in heating mode. When closed, the heat exchanger functions as a condenser; when open, the heat exchanger functions as an evaporator.
5. **Solenoid valve SV2:**
   Protects the compressor. If compressor discharge temperature rises above 98°C, SV2 opens and sprays a small amount of liquid refrigerant to cool the compressor. SV2 closes again once the discharge temperature has fallen below 85°C.
6. **Solenoid valve SV4:**
   Returns oil to the compressor. Opens once the compressor has run for 200 seconds and closes 600 seconds later and then opens for 3 minutes every 20 minutes.
7. **Solenoid valve SV7:**
   Allows refrigerant return to the compressor directly. Opens when indoor air temperature is close to the set temperature to avoid frequent compressor on/off.
8. **High and low pressure switches:**
   Regulate system pressure. When system pressure rises above the upper limit or falls below the lower limit, the high or low pressure switches turn off, stopping the compressor. After 5 minutes, the compressor restarts.

3 Refrigerant Flow Diagrams

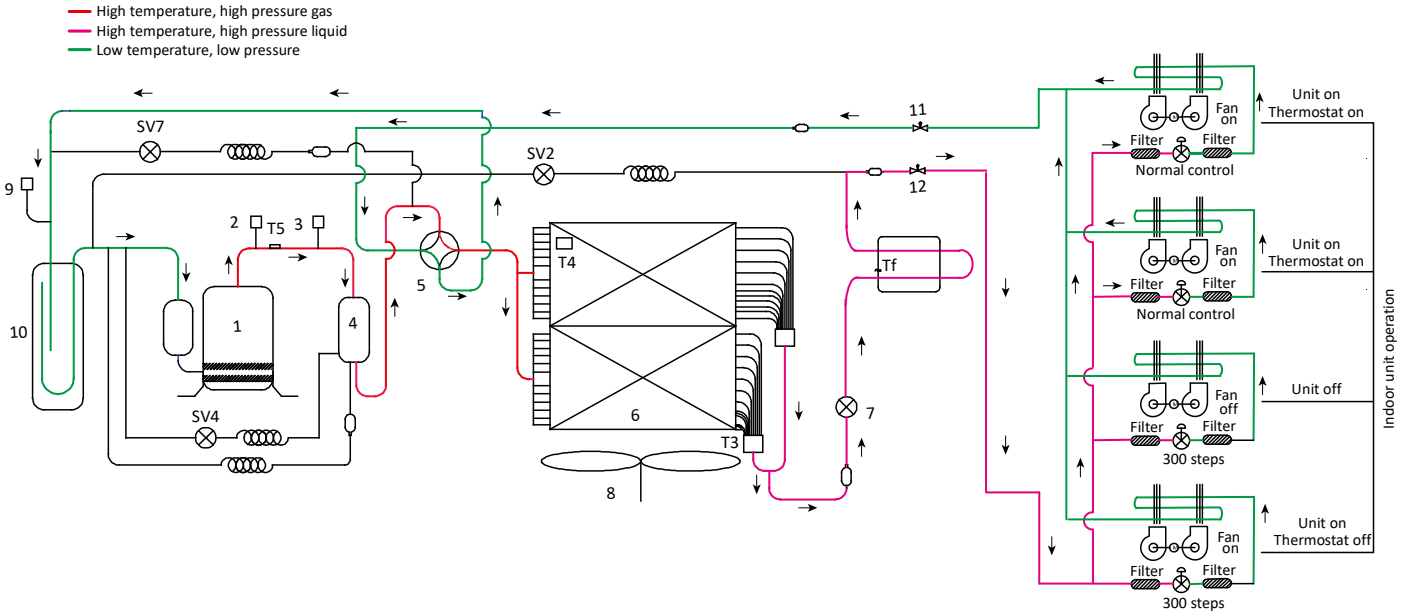
Cooling operation

Figure 2-3.1: refrigerant flow during cooling operation (8HP outdoor unit doesn't has SV4)



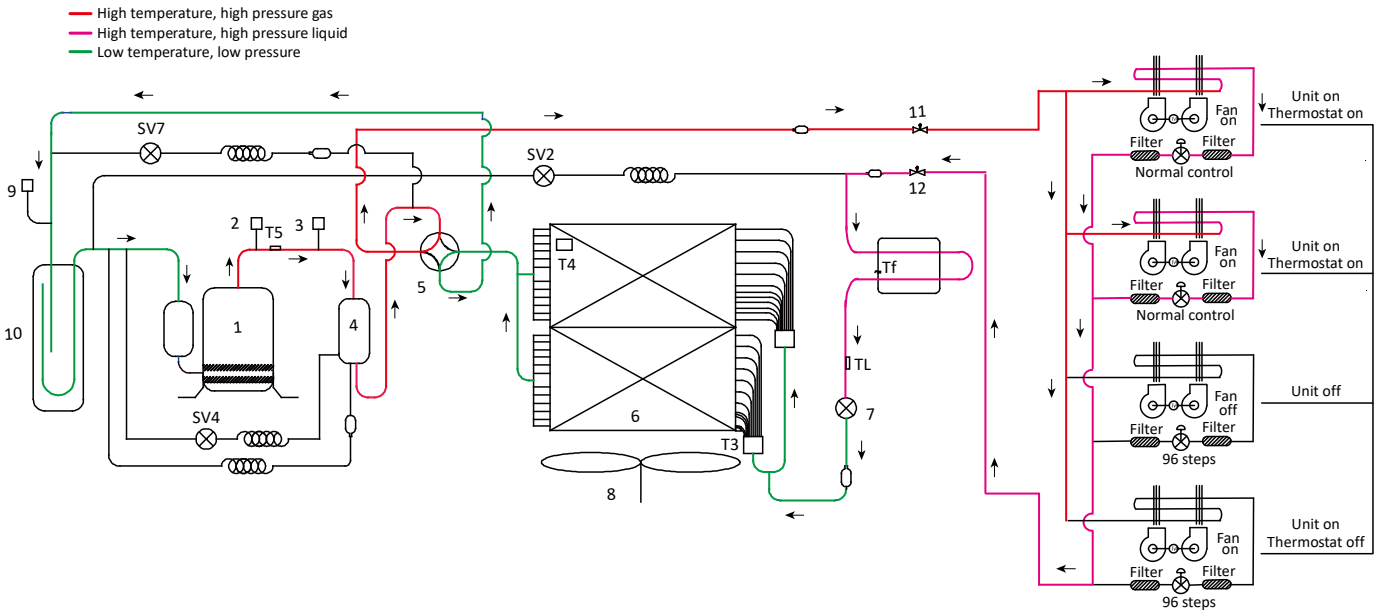
Oil return operation in cooling mode

Figure 2-3.2: refrigerant flow during oil return operation in cooling mode (8HP outdoor unit doesn't has SV4)



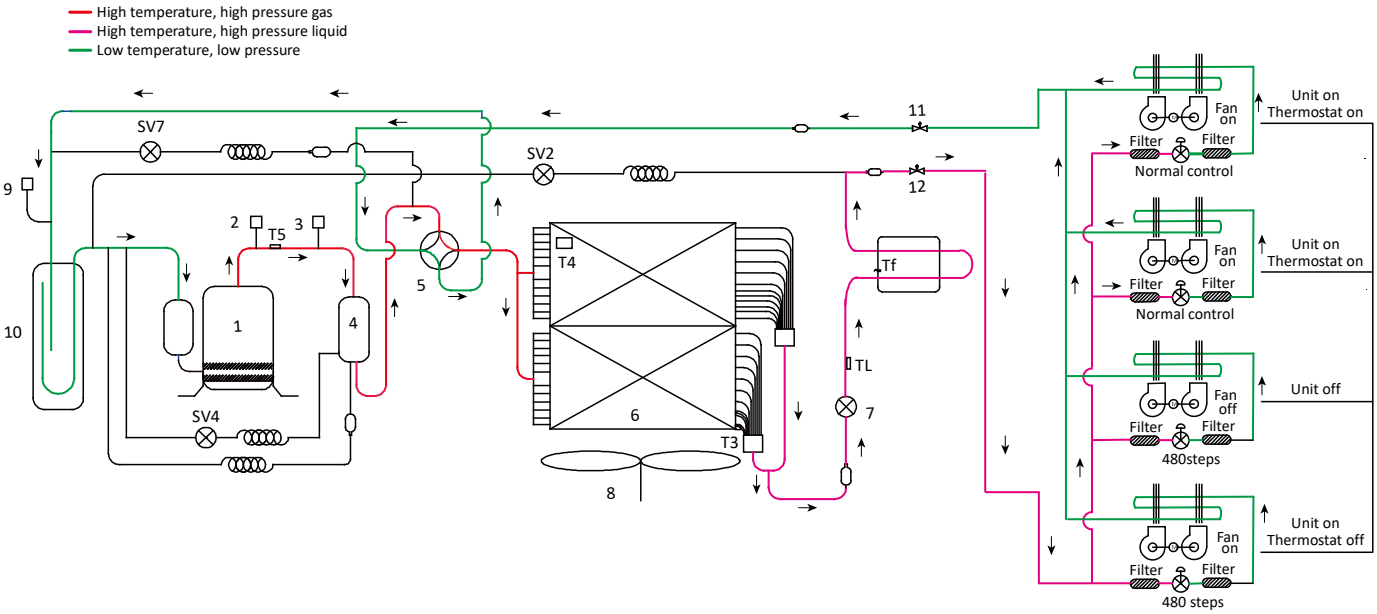
Heating operation

Figure 2-3.3: refrigerant flow during heating operation (8HP outdoor unit doesn't has SV4)



Oil return operation in heating mode

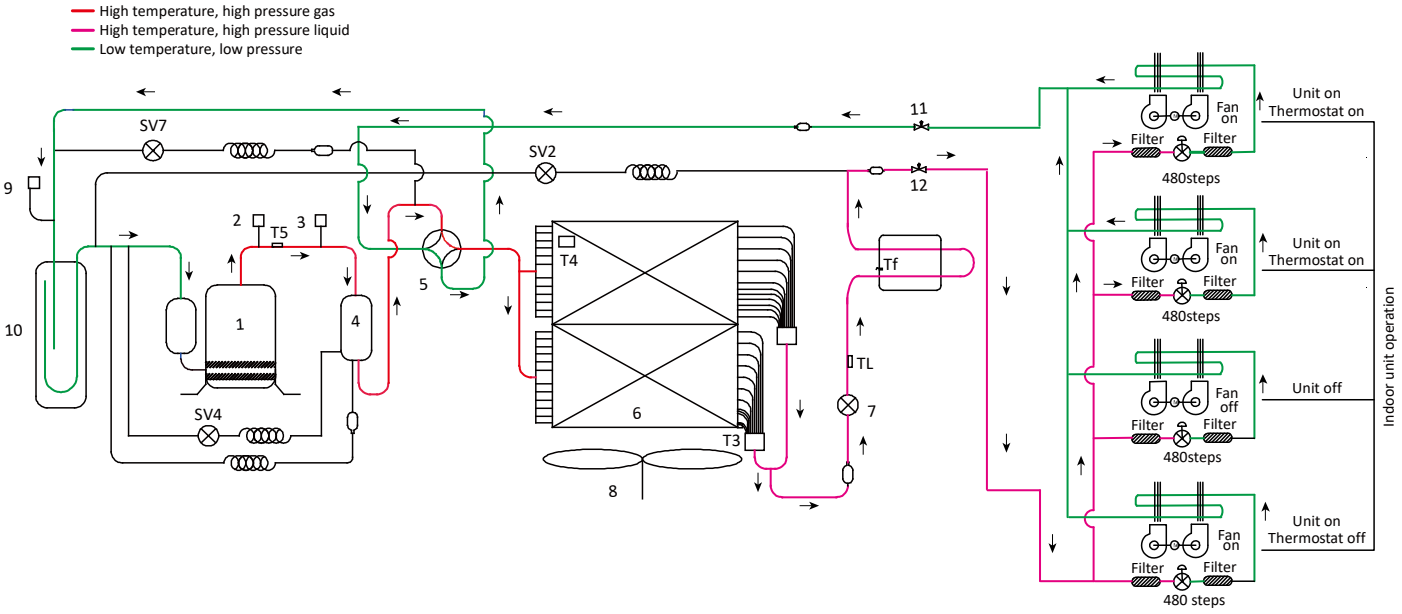
Figure 2-3.4: refrigerant flow during oil return operation in heating mode (8HP outdoor unit doesn't has SV4)



Service Manual

Defrosting operation

Figure 2-3.5: refrigerant flow during defrosting operation (8HP outdoor unit doesn't has SV4)

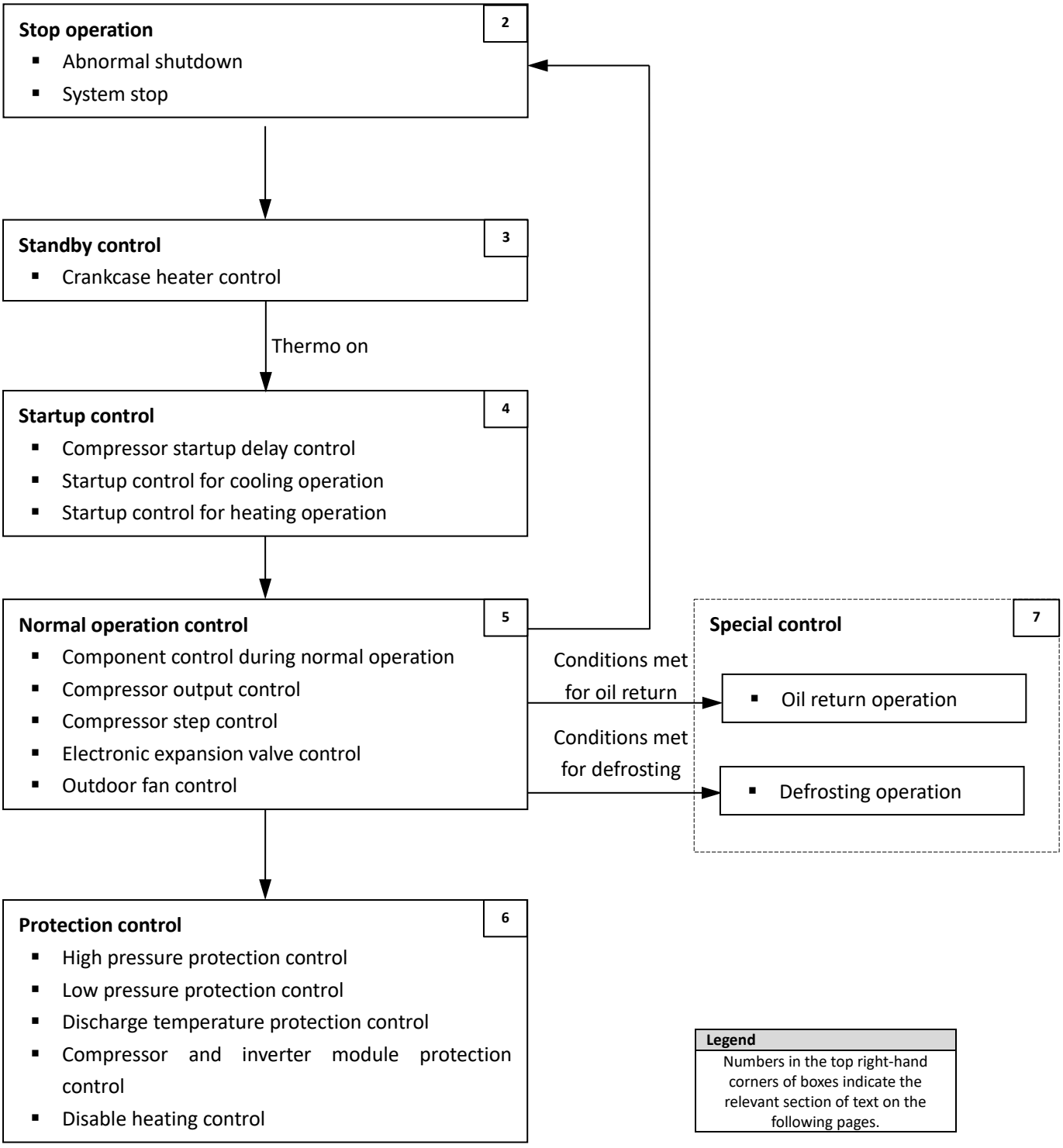


Part 3

Control

1 General Control Scheme Flowchart

Sections 3-2 to 3-7 on the following pages detail when each of the controls in the flowchart below is activated.



2 Stop Operation

The stop operation occurs for one of the three following reasons:

1. Abnormal shutdown: in order to protect the compressors, if an abnormal state occurs the system makes a 'stop with thermo off' operation and an error code is displayed on the outdoor unit digital displays.
2. The system stops when the set temperature has been reached.

3 Standby Control

3.1 Crankcase Heater Control

The crankcase heater is used to prevent refrigerant from mixing with compressor oil when the compressor is stopped. The crankcase heater is controlled according to outdoor ambient temperature and the compressor on/off state. When the outdoor ambient temperature is above 8°C or the compressor is running, the crankcase heater is off; when the outdoor ambient temperature is at or below 8°C and either the compressor has been stopped for more than 3 hours or the unit has just been powered-on (either manually or when the power has returned following a power outage), the crankcase heater turns on.

4 Startup Control

4.1 Compressor Startup Delay Control

In initial startup control and in restart control (except in oil return operation and defrosting operation), compressor startup is delayed such that a minimum of 5 minutes has elapsed since the compressor stopped, in order to prevent frequent compressor on/off and to equalize the pressure within the refrigerant system.

4.2 Startup Control for Cooling Operation

Table 3-4.1: Component control during startup in cooling mode

Component	Wiring diagram label	8-12Hp	Control functions and states
Inverter compressor	COMP	●	Controlled according to load requirement, operating frequency increased by 1 step / sec
Upper DC fan motor	FAN_UP	●	Fan speed[1] controlled according to discharge pressure (P_c): ▪ At initial speed for 20 seconds. ▪ Subsequently, P_c checked every 10 seconds: • $P_c \geq 2.8$MPa => 1 step increase. • $P_c \leq 2.1$MPa => 1 step decrease.
Lower DC fan motor	FAN_DOWN	●	
Electronic expansion valve	EEV1	●	Position (steps) from 0 (fully closed) to 480 (fully open), controlled according to discharge temperature
Four-way valve	ST1	●	Off
Solenoid valve (liquid refrigerant injection)	SV2	●	Off
Solenoid valve (oil balance)	SV4	●	Closed for 200 secs, open for 600 secs, then closed
Solenoid valve (indoor units bypass)	SV7	●	Open for 5 mins, then controlled according to indoor heat exchanger refrigerant outlet temperature (T2B)

Notes:
1. Refer to Table 3-5.3 in Part 3, 5.5 “Outdoor Fan Control”.

4.3 Startup Control for Heating Operation

Table 3-4.2: Component control during startup in heating mode

Component	Wiring diagram label	8-12Hp	Control functions and states
Inverter compressor	COMP	●	Controlled according to load requirement, operating frequency increased by 1 step / sec
Upper DC fan motor	FAN_UP	●	Fan speed[1] controlled according to ambient temperature (T4) and discharge pressure (P_c): ▪ T4 ≥ 0°C, start up after the compressor running for 10s. ▪ T4 < 0°C, start up after the compressor running for 30s.
Lower DC fan motor	FAN_DOWN	●	
Electronic expansion valve	EEV	●	Position (steps) from 0 (fully closed) to 480 (fully open), controlled according to discharge superheat temperature
Four-way valve	ST1	●	On
Solenoid valve (liquid refrigerant injection)	SV2	●	Off
Solenoid valve (oil balance)	SV4	●	Closed for 200 secs, open for 600 secs, then closed
Solenoid valve (indoor units bypass)	SV7	●	When T4 < 3°C and compressor frequency is ≥ 52Hz , open for 10 minutes and then closed

Notes:

1. Refer to Table 3-5.3 in Part 3, 5.5 “Outdoor Fan Control”.

5 Normal Operation Control

5.1 Component Control during Normal Operation

Table 3-5.1: Component control during normal cooling operation

Component	Wiring diagram label	8-12Hp	Control functions and states
Inverter compressor	COMP	●	Controlled according to load requirement
Upper DC fan motor	FAN_UP	●	Fan speed[1] controlled according to ambient temperature (T4) and discharge pressure (P_c):
Lower DC fan motor	FAN_DOWN	●	
Electronic expansion valve	EEV1	●	Position (steps) from 0 (fully closed) to 480 (fully open), controlled according to discharge temperature
Four-way valve	ST1	●	Off
Solenoid valve (liquid refrigerant injection)	SV2	●	Open when compressor discharge temperature rises above 98°C, closes again once the discharge temperature has fallen below 85°C
Solenoid valve (oil balance)	SV4	●	Opens for 3 minutes every 20 minutes
Solenoid valve (indoor units bypass)	SV7	●	Controlled according to indoor heat exchanger refrigerant outlet temperature (T2B)

Notes:
1. Refer to Table 3-5.3 in Part 3, 5.5 “Outdoor Fan Control”.

Table 3-5.2: Component control during heating operation

Component	Wiring diagram label	8-12Hp	Control functions and states
Inverter compressor	COMP	●	Controlled according to load requirement
Upper DC fan motor	FAN_UP	●	Fan speed[1] controlled according to outdoor unit heat exchanger refrigerant temperature (T3)
Lower DC fan motor	FAN_DOWN	●	
Electronic expansion valve	EEV1	●	Position (steps) from 0 (fully closed) to 480 (fully open), controlled according to discharge superheat temperature
Four-way valve	ST1	●	On
Solenoid valve (liquid refrigerant injection)	SV2	●	Open when compressor discharge temperature rises above 98°C, closes again once the discharge temperature has fallen below 85°C
Solenoid valve (oil balance)	SV4	●	Opens for 3 minutes every 20 minutes
Solenoid valve (indoor units bypass)	SV7	●	Open after oil return operation and defrost operation, controlled according to compressor running time and frequency

Notes:
1. Refer to Table 3-5.3 in Part 3, 5.5 “Outdoor Fan Control”.

5.2 Compressor Output Control

The compressor rotation speed is controlled according to the load requirement. Before compressor startup, the outdoor unit first estimates the indoor unit load requirement according to the nominal capacity of indoor units currently running, and then correct for ambient temperature. The compressors then start up according to the corrected load requirement.

During operation the compressors are controlled according to the nominal capacity of indoor units currently running and the indoor unit heat exchanger temperatures.

5.3 Compressor Step Control

The running speed of the compressors in rotations per second (rps) is one third of the frequency (in Hz) of the electrical input to the compressor motors. The compressor speed can be altered in increments of 1 rps.

5.4 Electronic Expansion Valve Control

The position of electronic expansion valves EXV is controlled in steps from 0 (fully closed) to 480 (fully open).

In cooling mode:

- When the outdoor unit is in standby:
  - EXV is at position 352 (steps).
- When the outdoor unit is running:
  - EXV is controlled according to discharge temperature.

In heating mode:

- When the outdoor unit is in standby:
  - EXV is at position 352 (steps).
- When the outdoor unit is running:
  - EXV is controlled according to discharge superheat.

5.5 Outdoor Fan Control

The speed of the outdoor unit fans is adjusted in steps, as shown in Table 3-5.3.

Table 3-5.3: Outdoor fan speed steps

Fan speed index	8HP		10Hp/12Hp	
	Upper fan[1]	Lower fan[2]	Upper fan[1]	Lower fan[2]
1	0	180	0	180
2	0	310	0	310
3	310	340	310	340
4	380	400	380	400
5	460	480	460	480
6	540	560	540	560
7	620	640	620	640
8	740	760	740	760
9	800	820	800	820
10	820	840	860	880
11	840	860	900	900

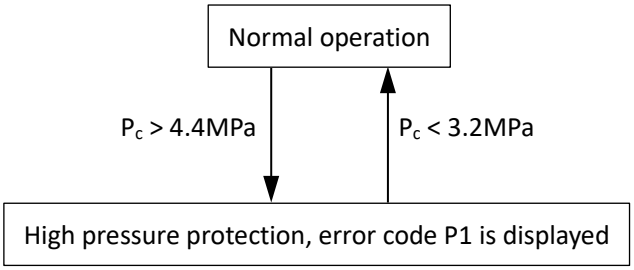
Notes:
The upper fan is labelled FAN_UP in the wiring diagram. Refer to the Engineering Data Book Part 2, 5 “Wiring diagram”.
The lower fan is labelled FAN_DOWN in the wiring diagram. Refer to the Engineering Data Book Part 2, 5 “Wiring diagram”.

6 Protection Control

6.1 High Pressure Protection Control

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

Figure 3-6.1: High pressure protection control



Notes:

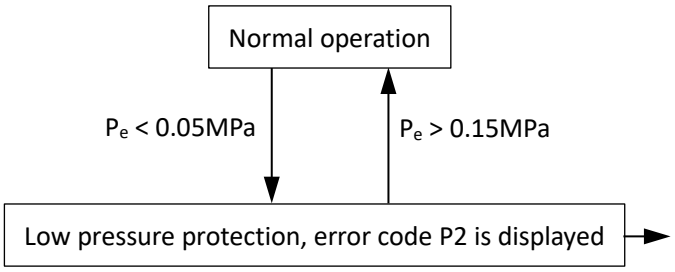
1. P_c: Discharge pressure

When the discharge pressure rises above 4.4MPa the system displays P1 protection and the unit stops running. When the discharge pressure drops below 3.2MPa, the compressor enters re-start control.

6.2 Low Pressure Protection Control

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

Figure 3-6.2: Low pressure protection control



When P2 protection occurs 3 times in 60 minutes, the H5 error is displayed. When an H5 error occurs, a manual system restart is required before the system can resume operation.

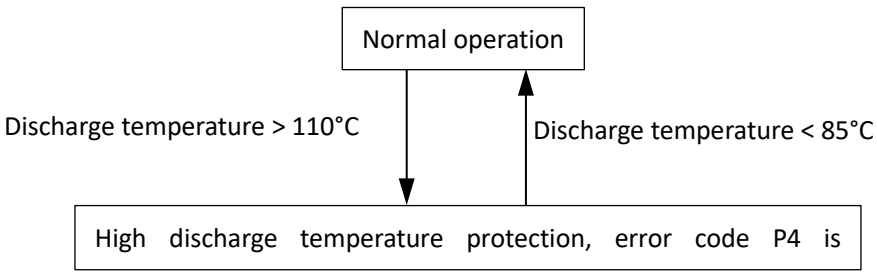
Notes:

1. P_e: Suction pressure

6.3 Discharge Temperature Protection Control

This control protects the compressors from abnormally high temperatures and transient spikes in temperature. It is performed for each compressor.

Figure 3-6.3: High discharge temperature protection control



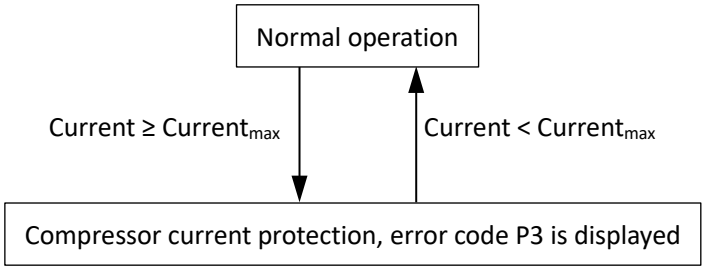
When the discharge temperature rises above 110°C the system displays P4 protection and the unit stops running. When the discharge temperature drops below 85°C, the compressor enters re-start control.

When P4 protection occurs 3 times in 100 minutes, the H6 error is displayed. When an H6 error occurs, a manual system restart is required before the system can resume operation.

6.4 Compressor and Inverter Module Protection Control

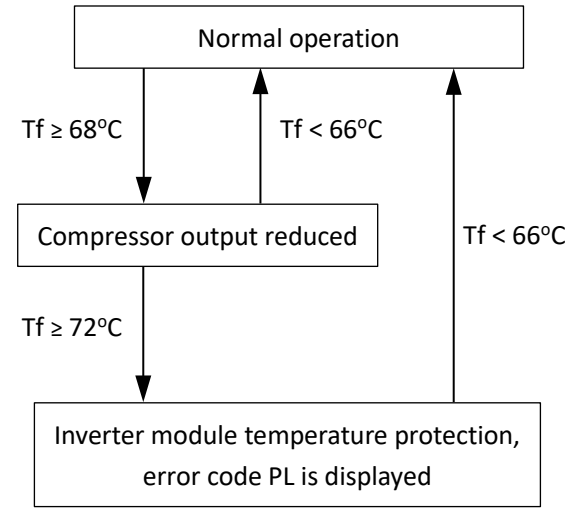
This control protects the compressors from abnormally high currents and protects the inverter modules from abnormally high temperatures.

Figure 3-6.4: Compressor current protection control



Compressor model	ATQ580D66UNT	LNB65FAGMC
Current$_{max}$	29A	29A

Figure 3-6.5: Inverter module temperature protection control

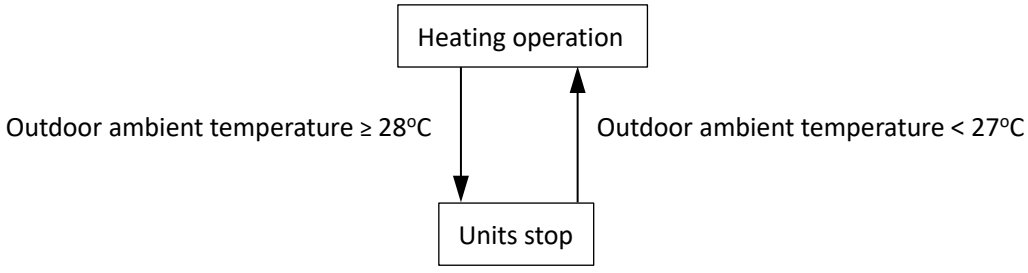


Notes:
1. Tf: Heat sink temperature

6.5 Disable Heating Control

When the outdoor ambient temperature rises above or equal to 28°C heating mode is disabled to prevent the mechanical load on compressors becoming too high and to prevent low compression ratios which can result in insufficient compressor internal oil lubrication. When the outdoor ambient temperature drops below 27°C, the compressor enters re-start control.

Figure 3-6.6: Disable heating control



7 Special Control

7.1 Oil Return Operation

In order to prevent compressors from running out of oil, the oil return operation is conducted to recover oil that has flowed out of the compressor(s) and into the piping system. This operation is performed for all units including units that are in standby.

Timing of oil return operation:

- When the initial cumulative operating time reaches 140 minutes and then every 8 hours.

Tables 3-7.1 and 3-7.2 show component control during oil return operation in cooling mode.

Table 3-7.1: Outdoor unit component control during oil return operation in cooling mode

Component	Wiring diagram label	10Hp/12Hp	Control functions and states
Inverter compressor	COMP	•	Controlled according to load requirement
Upper DC fan motor	FAN_UP	•	Fan speed controlled according to discharge pressure
Lower DC fan motor	FAN_DOWN	•	
Electronic expansion valve	EEV1	•	Position 300 (steps)
Four-way valve	ST1	•	Off
Solenoid valve (liquid refrigerant injection)	SV2	•	Normal control
Solenoid valve (oil balance)	SV4	•	Normal control
Solenoid valve (indoor units bypass)	SV7	•	Normal control

Table 3-7.2: Indoor unit component control during oil return operation in cooling mode

Component	Unit state	Control functions and states
Fan	Thermo on	Remote controller setting
	Standby	Off
	Thermo off	Off
Electronic expansion valve	Thermo on	Normal control
	Standby	300 (steps)
	Thermo off	300 (steps)

Tables 3-7.3 and 3-7.4 show component control during oil return operation in heating mode.

Table 3-7.3: Outdoor unit component control during oil return operation in heating mode

Component	Wiring diagram label	10Hp/12Hp	Control functions and states
Inverter compressor	COMP	•	Controlled according to load requirement
Upper DC fan motor	FAN_UP	•	Fan speed controlled according to outdoor ambient temperature (T4), outdoor unit heat exchanger refrigerant temperature (T3) and discharge pressure (Pc)
Lower DC fan motor	FAN_DOWN	•	
Electronic expansion valve	EEV1	•	Position 350 (steps)
Four-way valve	ST1	•	Off
Solenoid valve (liquid refrigerant injection)	SV2	•	Normal control
Solenoid valve (oil balance)	SV4	•	Normal control
Solenoid valve (indoor units bypass)	SV7	•	Normal control

Table 3-7.4: Indoor unit component control during oil return operation in heating mode

Component	Unit state	Control functions and states
Fan	Thermo on	Normal control
	Standby	Off
	Thermo off	Off
Electronic expansion valve	Thermo on	Normal control
	Standby	480 (steps)
	Thermo off	480 (steps)

7.2 Defrosting Operation

In order to recover heating capacity, the defrosting operation is conducted when the outdoor unit heat exchanger is performing as an evaporator. The defrosting operation is controlled according to outdoor ambient temperature, outdoor heat exchanger temperature, indoor heat exchanger temperature and outdoor unit running time. When the outdoor unit is running in defrosting, the digital display on outdoor main PCB will display “df”.

Table 3-7.5: Outdoor unit component control during defrosting operation

Component	Wiring diagram label	10Hp/12Hp	Control functions and states
Inverter compressor	COMP	•	Controlled according to load requirement
Upper DC fan motor	FAN_UP	•	Off
Lower DC fan motor	FAN_DOWN	•	
Electronic expansion valve	EEV1	•	Position 480 (steps)
Four-way valve	ST1	•	Off
Solenoid valve (liquid refrigerant injection)	SV2	•	Normal control
Solenoid valve (oil balance)	SV4	•	Normal control
Solenoid valve (indoor units bypass)	SV7	•	Normal control

Table 3-7.6: Indoor unit component control during defrosting operation

Component	Unit state	Control functions and states
Fan	Thermo on	Off
	Standby	Off
	Thermo off	Off
Electronic expansion valve	Thermo on	480 (steps)
	Standby	480 (steps)
	Thermo off	480 (steps)

Part 4
Field Settings

1 Outdoor Unit Field Settings

1.1 PCB Switches and Switch Settings

Figure 4-1.1: Outdoor unit main PCB switches

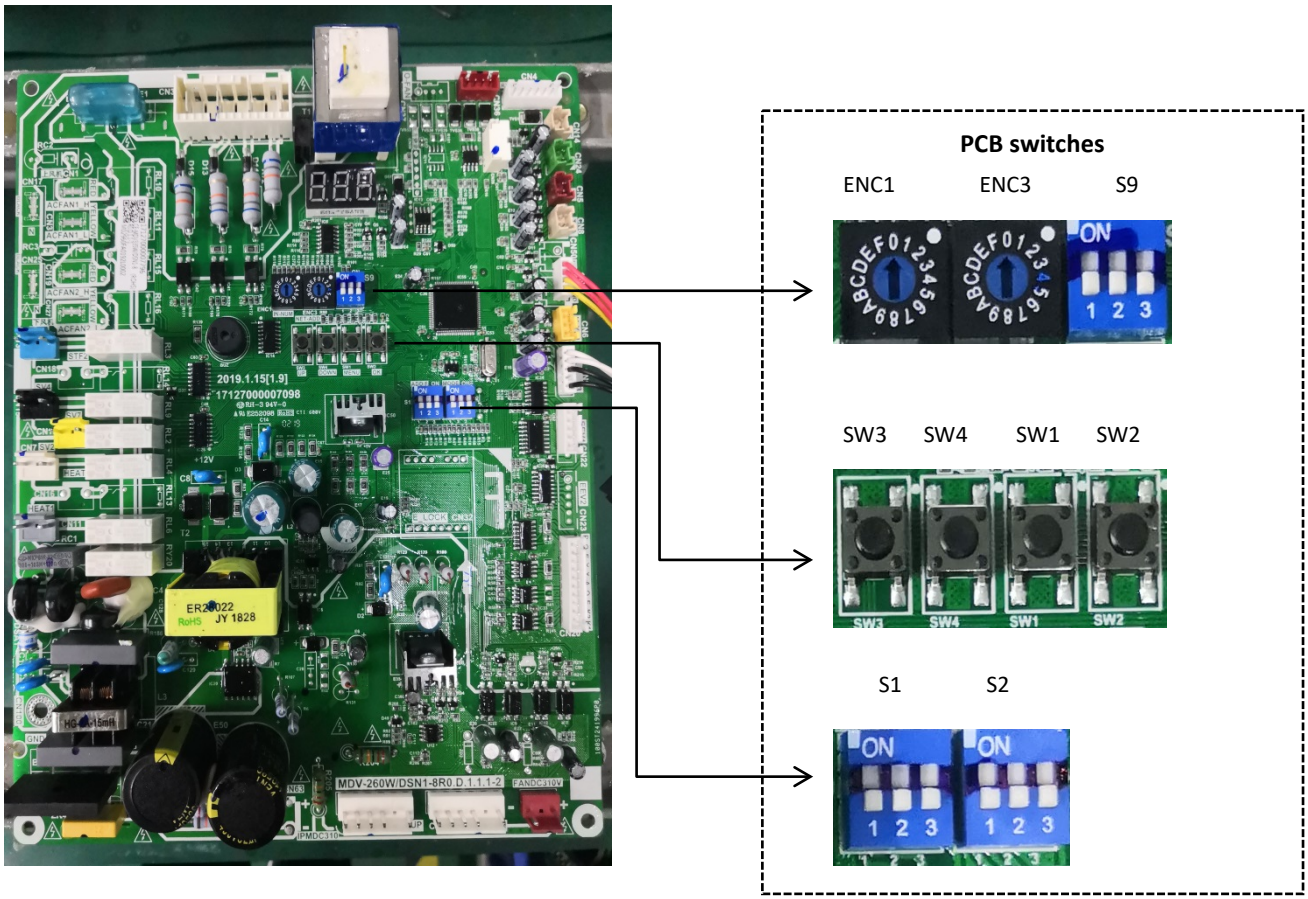


Table 4-1.1: Outdoor unit main PCB switch settings

Switch	Setting	Switch positions[1]	Description
ENC1 S9-3	Number of indoor units		The number of indoor units is in the range 0-15 0-9 on ENC1 indicate 0-9 indoor units; A-F on ENC1 indicate 10-15 indoor units
			The number of indoor units is in the range 16-31 0-9 on ENC1 indicate 16-25 indoor units; A-F on ENC1 indicate 26-31 indoor units
ENC3	Network address		Only 0, 1, 2, 3, 4, 5, 6, 7 should be selected (default is 0)
S1-1	Indoor unit generation		Connected to 2nd generation DC indoor unit (default)
			Connected to AC or 1st generation DC indoor unit[2]
S1-2	Clear indoor unit addresses		No action (default)
			Clear indoor unit addresses
S1-3	Reserved		Reserved
S2	Priority mode[3]		Auto priority (default)
			Cooling priority
			First on priority
			Heating only
			Cooling only
			Heating priority[3]
S9-1	Outdoor unit capacity[5]		8HP
			10Hp
			12Hp
S9-3	Reserved		Reserved

Notes:

1. Black denotes the switch position.
2. When the system connected to both 2nd generation IDU and AC or 1st generation IDU, SW1-1 should be positioned to 1. The VRF-AHU control kit should be treated as AC IDU.
3. Refer to Part 4, 1.2.1 “Priority mode setting”.
4. When S2 in other switch positions not mentioned above indicates heating priority mode.
5. Switch S9 is factory-set and its setting should not be changed.

1.2 Modes Set on Main PCB

1.2.1 Priority mode setting

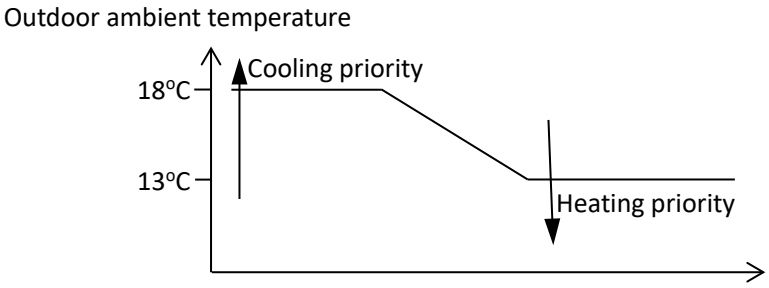
Priority mode can only be set on the outdoor unit. When an indoor unit is in mode conflict with the outdoor units the unit displays the mode conflict error. The digital display on indoor main PCB will display error code E0.

Figure 4-1.2: Indoor unit digital displays

There are five priority mode options:

1. **Auto priority mode (default):** In auto priority mode, the outdoor unit will operate in heating priority mode or cooling priority mode according to the outdoor ambient temperature.
   a) When the outdoor ambient temperature is below 13°C, the outdoor units run in heating priority mode. The heating priority mode does not change until the outdoor ambient temperature is above 18°C.
   b) When the outdoor ambient temperature is above 18°C, the outdoor units run in cooling priority mode. The cooling priority mode does not change until the outdoor ambient temperature is below 13°C.
   c) When the outdoor unit restarts under the outdoor ambient between 13°C and 18°C, the outdoor unit runs the same priority as before the last stop.
   d) When the outdoor unit is initial startup under outdoor ambient temperature between 13°C and 18°C, the outdoor unit runs in heating priority mode.

Figure 4-1.3: Auto priority mode control



1.1. Heating priority mode:

a) **During cooling operation:** If an indoor unit requests heating, the outdoor unit stops and then restarts in heating mode after 5 minutes. Indoor units requesting heating then start in heating mode and indoor units requesting cooling display the mode conflict error.

b) **During heating operation:** If an indoor unit requests cooling, the outdoor unit ignores the request and continues to run in heating mode. The indoor unit requesting cooling displays the mode conflict error. If all the indoor units requesting heating are later turned off and one or more indoor units are still requesting cooling, the outdoor unit restarts in cooling mode after 5 minutes and any indoor units requesting cooling then start in cooling mode.

1.2. Cooling priority mode:

a) **During heating operation:** If an indoor unit requests cooling, the outdoor unit stops and then restarts in cooling mode after 5 minutes. Indoor units requesting cooling then start in cooling mode and indoor units requesting heating display the mode conflict error.

b) **During cooling operation:** If an indoor unit requests heating, the outdoor units ignore the request and continue to run in cooling mode. The indoor unit requesting heating displays the mode conflict error. If all the indoor units requesting cooling are later turned off and one or more indoor units are still requesting heating, the outdoor unit restarts in heating mode after 5 minutes and any indoor units requesting heating then start in heating mode.

2. **Cooling priority mode**: refer to above "1.2. Cooling priority mode" descriptions.

3. **First on priority mode:** The outdoor unit operates in the mode of the first on indoor unit is being requested. Indoor units that are in a mode different to the first on unit display the mode conflict error.
4. **Heating only mode:** The outdoor unit only operates in heating mode. Indoor units requesting heating operate in heating mode. Indoor units requesting cooling or in fan only mode display the mode conflict error.
5. **Cooling only mode:** The outdoor unit only operates in cooling mode. Indoor units requesting cooling operate in cooling mode; indoor units in fan only mode operate in fan only mode. Indoor units requesting heating display the mode conflict error.

Part 5

Electrical Components and Wiring Diagrams

1 Outdoor Unit Electric Control Box Layout

Figure 5-1.1: front view of electric control box

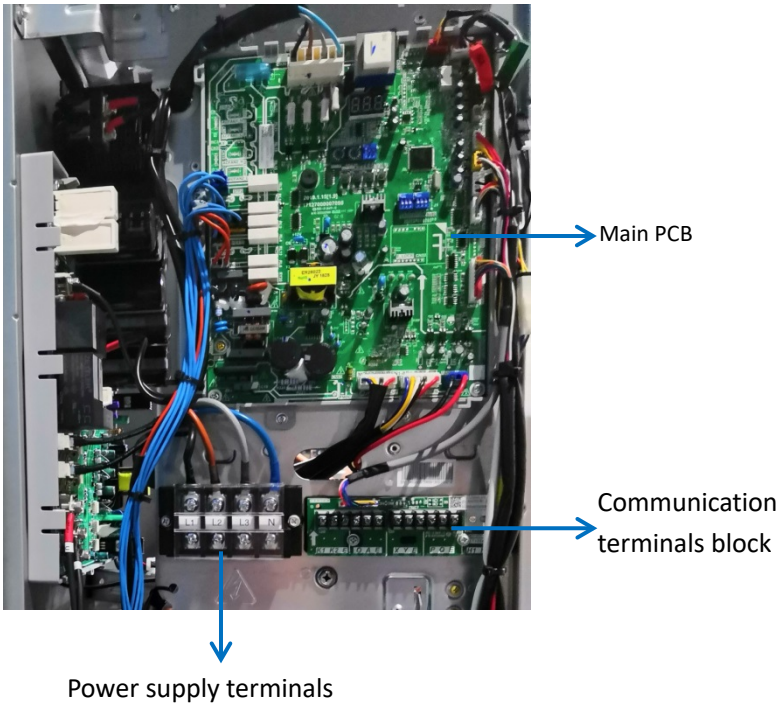
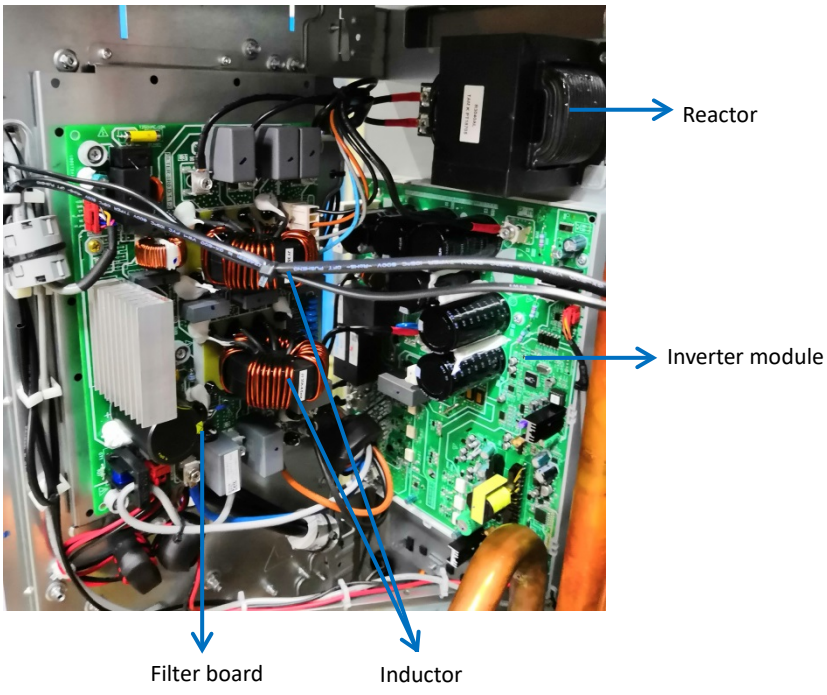


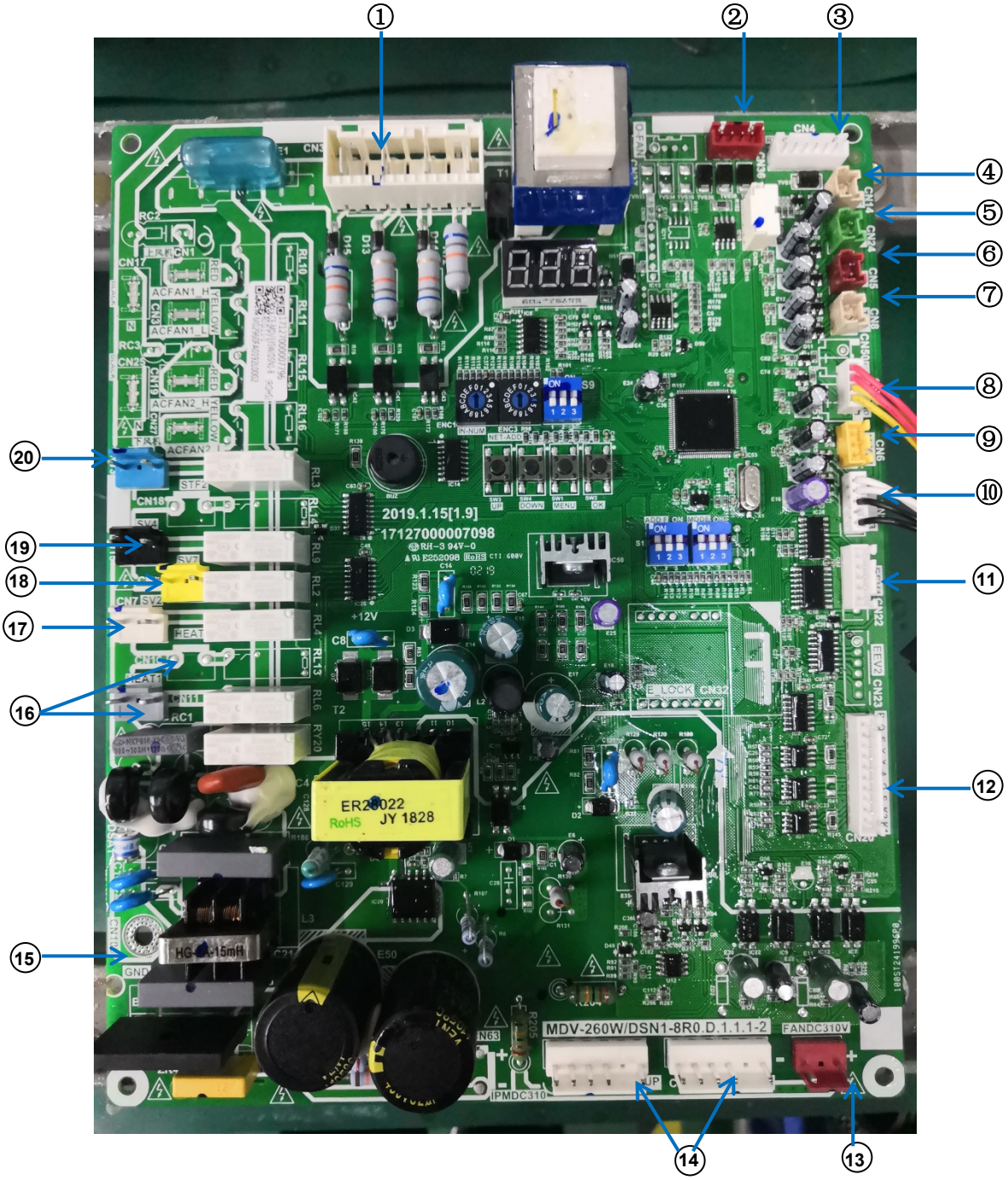
Figure 5-1.2: rear view of electric control box



2 Outdoor Unit Main PCB

2.1 Ports

Figure 5-2.1: Outdoor unit main PCB ports[1]



Notes:

1. Label descriptions are given in Table 5-2.1.

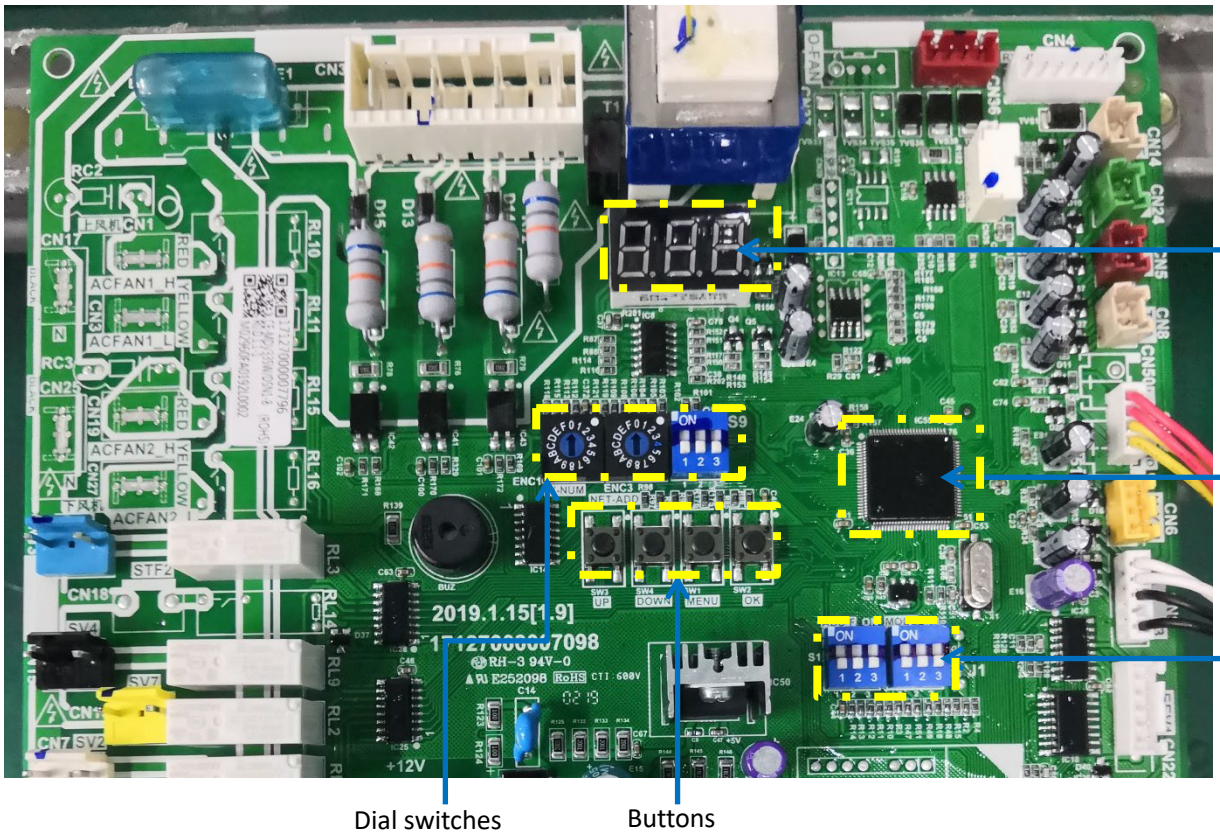
Table 5-2.1: Main PCB ports

Label in Figure 5-2.1	Port code	Content	Port voltage
1	CN30	Power input of main board	220V AC between A/B/C and N; 380V AC between A,B and C
2	CN36	Inverter module connection	0V or 5V DC
3	CN4	Control port of filter board	0V or 12V DC
4	CN14	Heat sink temperature sensor (Tf) connection	0-5V DC (varying)
5	CN24	Refrigerant cooling pipe temperature sensor (TL) connection	0-5V DC (varying)
6	CN5	Discharge pipe temperature sensor (T5) connection	0-5V DC (varying)
7	CN8	Heat exchanger temperature sensor (T3A) connection (Reserved)	0-5V DC (varying)
8	CN12	High pressure sensor and low pressure sensor connections	0-5V DC (varying)
9	CN6	High pressure switch connection	0V or 5V DC
10	CN9	Heat exchanger temperature sensor outlet (T3) and ambient temperature sensor (T4) connections	0-5V DC (varying)
11	CN22	EEV drive port	0V or 12V DC
12	CN20	Communication port	0-5V DC (varying)
13	CN53	DC fan motor power supply connection	310V DC
14	CN107 CN109	DC fan motor control port	0-310V DC (varying)
15	CN100	Ground connection	
16	CN11 CN16	Power supply to compressor crankcase heater	220V AC
17	CN7	Solenoid valve SV2 drive port	220V AC
18	CN10	Solenoid valve SV7 drive port	220V AC
19	CN15	Solenoid valve SV4 drive port	220V AC
20	CN13	Four-way valve drive ports	220V AC

2.2 Components

2.2.1 Layout

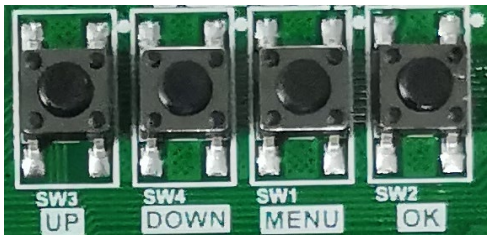
Figure 5-2.2: Outdoor unit main PCB components



2.2.2 Function of buttons SW1 to SW4

Table 5-2.2: Function of buttons SW1 to SW4

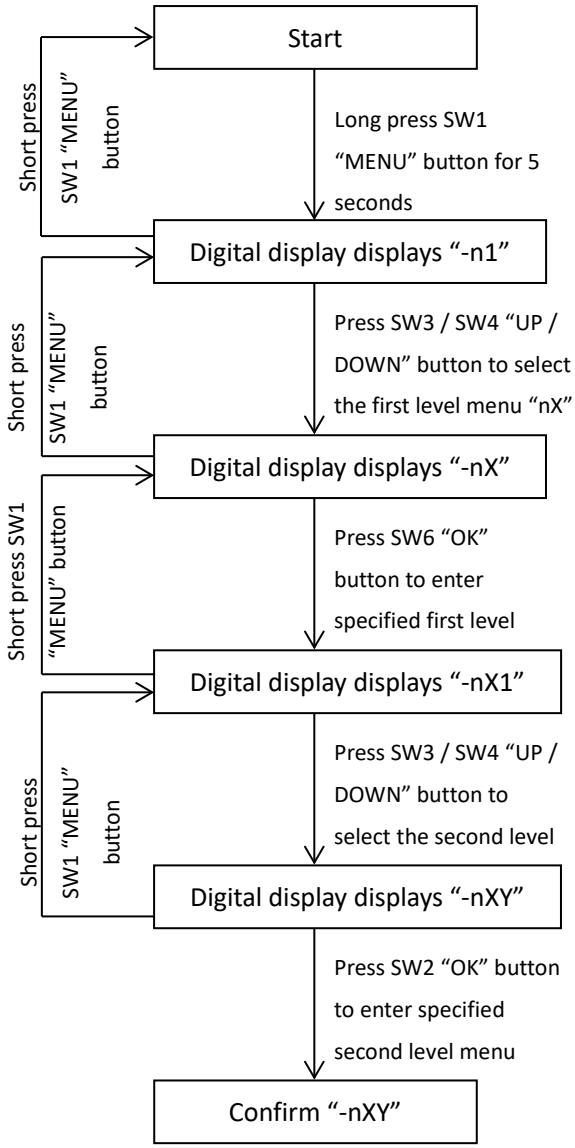
Button	Function
SW3 (UP)	In menu mode: previous and next buttons for menu modes. Not in menu mode: previous and next buttons for system check information.
SW4 (DOWN)	
SW1 (MENU)	Enter / exit menu mode.
SW2 (OK)	Confirm to enter specified menu mode.



2.2.3 Menu mode

1. Long press SW1 “MENU” button for 5 seconds to enter menu mode, and the digital display displays “n1”;
2. Press SW3 / SW4 “UP / DOWN” button to select the first level menu “n1”, “n2”, “n3”, “n4”, “nb” or “nF”;
3. Press SW2 “OK” button to enter specified first level menu, for example, enter “n3” mode;
4. Press SW3 / SW4 “UP / DOWN” button to select the second level menu from “n31” to “n34”;
5. Press SW2 “OK” button to enter specified second level menu, for example, enter “n32” mode;

Menu mode selection flowchart:



Menu mode function:

Table 5-2.3: Menu mode function

Digital display content	Menu mode	Remarks
n14	Force cooling mode	All indoor units running in cooling mode
n16	Maintenance mode	The system does not check the indoor units' number.
n27	Vacuum mode	It is only used in maintenance process. The digital display displays "R01", and all solenoid valves are opened and EXVs are positioned to 480 steps.
n31	History error codes	Displays recent 10 history error codes
n32	Cleaning history error codes	
n34	Factory reset	
nb3	Exit auto power save mode	
nb4	Enter auto power save mode	
nF1	Adjust T2	Only 40 to 50 could be selected (default value is 44).
nF2	Adjust T2B	Only 5 to 15 could be selected (default value is 8).

How to exit specified menu mode:

Table 5-2.4: Exit specified menu mode method:

Menu mode	Manual exit method	Automatic exit method
Debug mode 1 (2)	Long press SW2 "OK" button when the digital display is not in menu selection state	After running 60 minutes
Maintenance mode	/	After running 60 minutes
Vacuum mode	Long press SW2 "OK" button when the digital display is not in menu selection state	After running 8 hours
Auto power save mode	Select "nb3"	/

In the non-menu selection state, long press SW2 "OK" button for 3s, it will automatically exit all test modes.

2.2.4 UP / DOWN system check button

Before pressing UP or DOWN button, make sure that the system has been operating steadily for more than one hour. On pressing UP or DOWN button, the parameters listed in Table 5-2.5 will be displayed in sequence.

Table 5-2.5: System check

DSP content	Parameters displayed on DSP	Remarks
0.--	Unit capacity (Hp)	Actual value = value displayed
1.--	Setting number of indoor units	
2.--	Operating mode	Refer to Note 1
3.--	Fan speed index	Refer to Note 2
4.--	Total capacity of outdoor unit	
5.--	Total capacity requirement of indoor units	
6.--	Main heat exchanger pipe (T3) temperature (°C)	Actual value = value displayed
7.--	Outdoor ambient (T4) temperature (°C)	Actual value = value displayed
8.--	Inverter compressor discharge temperature (°C)	Actual value = value displayed
9.--	Invert module (TF) temperature (°C)	Actual value = value displayed
10.--	Refrigerant cooling pipe (TL) temperature (°C)	Actual value = value displayed
11.--	Compressor discharge pressure (MPa)	Actual value = value displayed × 0.1
12.--	Discharge superheat degree (°C)	Actual value = value displayed
13.--	EXVA position	Actual value = value displayed × 8
14.--	Actual current (A)	Actual value = value displayed
15.--	Inverter compressor current (A)	Actual value = value displayed
16.--	Actual voltage (V)	Actual value = value displayed
17.--	DC bus voltage (V)	Actual value = value displayed
18.--	Indoor heat exchanger pipe (T2/T2B) temperature (°C)	Actual value = value displayed
19.--	Priority mode	Refer to Note 3
20.--	Number of indoor units currently in communication with outdoor unit	Actual value = value displayed
21.--	Number of indoor units currently operating	Actual value = value displayed
22.--	Most recent error or protection code	“nn“ is displayed if no error or protection events have occurred since start-up
23.--	Software version	
-- --	--	End

Notes:

1. Operating mode:
   - 0: off; 2: cooling; 3: heating; 4: forced cooling.
2. The fan speed index is related to the fan speed in rpm and can take any integer value in the range 1 (slowest) to 9 (fastest).
3. Priority mode:
   - 0: heating priority; 1: cooling priority; 2: first ON priority; 3: heating only; 4: cooling only; 5: test mode 1; 6: test mode 2.

2.2.5 Digital display output

Table 5-2.6: Digital display output in different operating states

Outdoor unit state	Parameters displayed on DSP	
Standby	The number of indoor units in communication with the outdoor unit	
Normal operation	Frequency limitation code[1] and running speed of the compressor in rotations per second	
Error or protection	Error or protection code	
In menu mode	Refer to Table 5-2.3	
System check	Refer to Table 5-2.5	

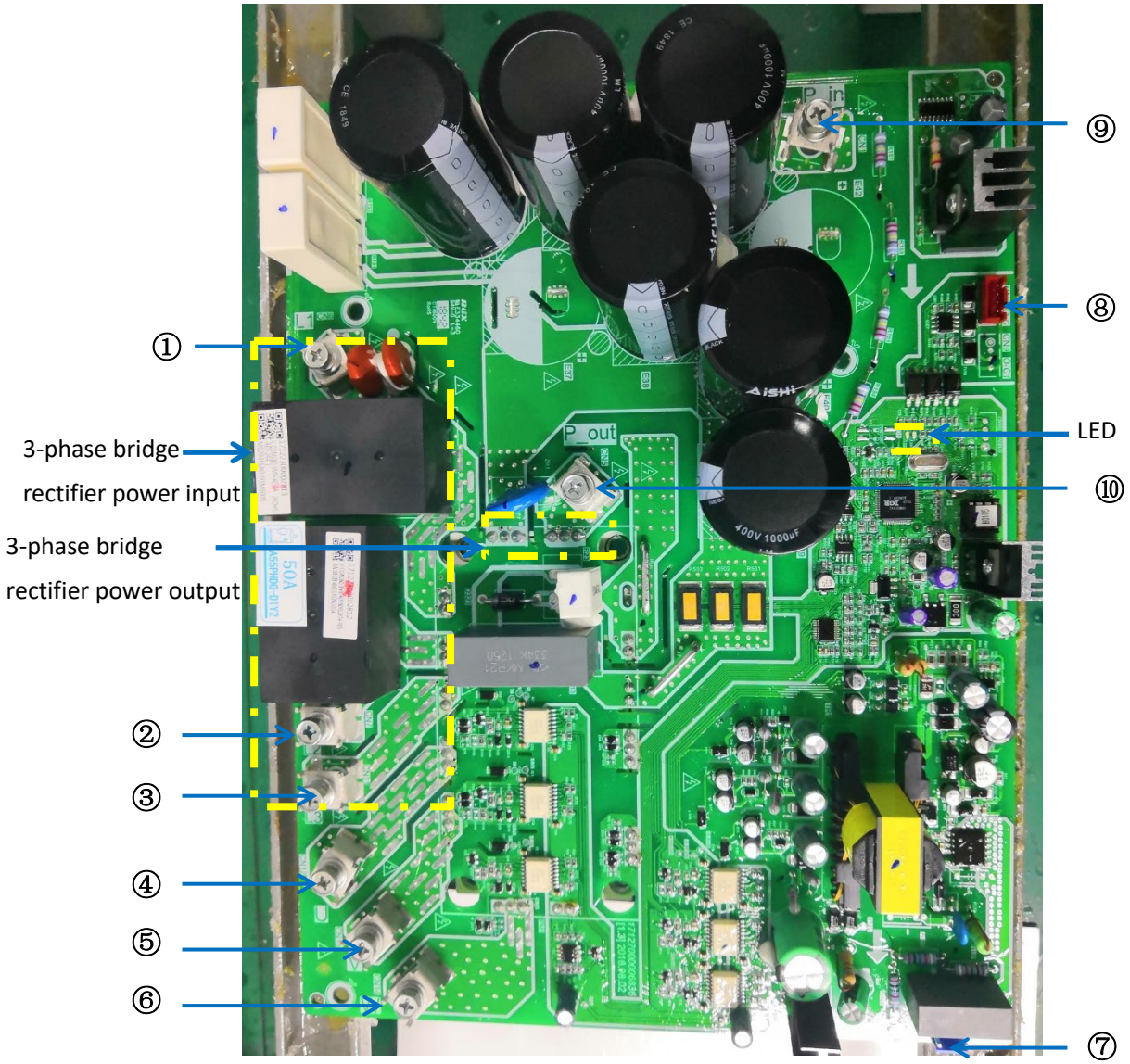
Notes:

1. Frequency limitation code:
   - P: Compressor discharge temperature frequency limitation; C: Pressure frequency limitation; A: Ambient temperature frequency limitation; F: Heat sink temperature frequency limitation; U: Voltage frequency limitation; H: Current frequency limitation; d: DC voltage frequency limitation.

3 Compressor Inverter Module

3.1 Ports

Figure 5-3.1: Outdoor unit inverter module ports[1]



Notes:

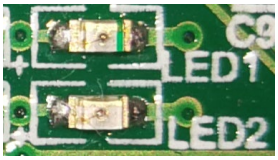
1. Label descriptions are given in Table 5-3.1.

Table 5-3.1: Inverter module ports

Label in Figure 5-2.1	Port code	Content	Port voltage
1	CN6	Power input L1 of inverter module	380V AC
2	CN7	Power input L2 of inverter module	380V AC
3	CN11	Power input L3 of inverter module	380V AC
4	CN12	Power output U of inverter module to compressor	Above 156V DC (varying according to frequency)
5	CN13	Power output V of inverter module to compressor	Above 156V DC (varying according to frequency)
6	CN14	Power output W of inverter module to compressor	Above 156V DC (varying according to frequency)
7	CN2	DC power supply input	310V DC
8	CN8	Main PCB connection	0-5V DC (varying)
9	CN1	DC bus input connect to reactor	350-640V DC (varying)
10	CN5	DC bus output connect to reactor	350-640V DC (varying)

3.1.1 LED indicators LED1 and LED2

Table 5-3.1: LED indicators LED1 and LED2

Indicator	LED indicator function and status	
LED 1	Inverter module operating indicator. Continuously on if the compressor is running normally and flashing if an inverter module error has occurred[1].	
LED 2	Inverter module error indicator. Continuously on if an inverter module error has occurred[1].	

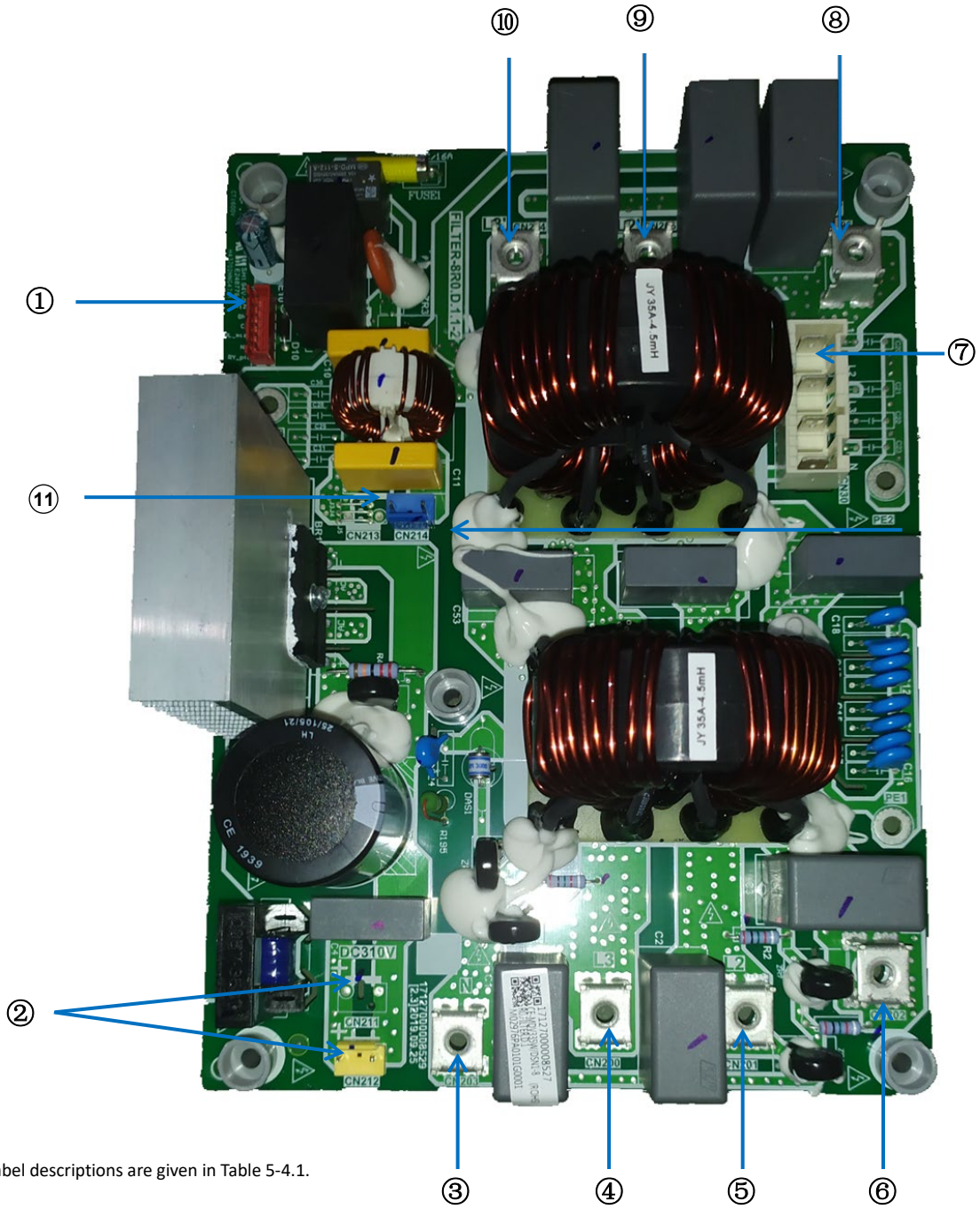
Note:

1. If an inverter module error occurs, refer to Part 6, “H4 Troubleshooting”. The error code is displayed on the digital display.

4 Filter Board

4.1 Ports

Figure 5-4.1: Outdoor unit filter board ports[1]



Notes:

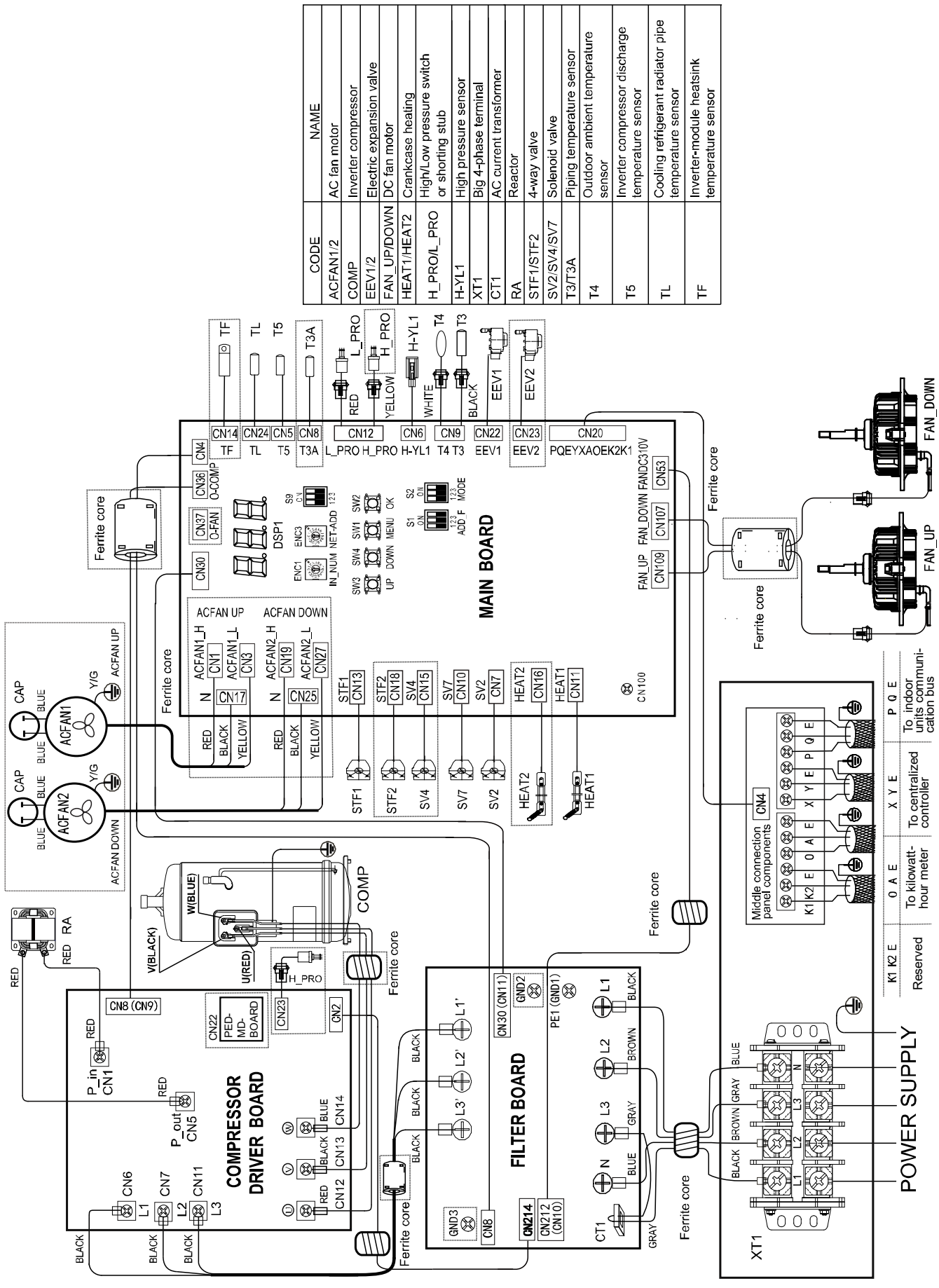
1. Label descriptions are given in Table 5-4.1.

Table 5-4.1: Filter board ports

Label in Figure 5-4.1	Port code	Content	Port voltage
1	CN8	Control port of filter board	12V DC
2	CN211 CN212	Power supply to inverter board (CN211) and DC fan motor (CN212) of filter board	310V DC
3	CN203	Power input N of filter board	220V AC between L1/L2/L3 and N; 380V AC between L1,L2 and L3
4	CN200	Power input L1 of filter board	220V AC between L1/L2/L3 and N; 380V AC between L1,L2 and L3
5	CN201	Power input L2 of filter board	220V AC between L1/L2/L3 and N; 380V AC between L1,L2 and L3
6	CN202	Power input L3 of filter board	220V AC between L1/L2/L3 and N; 380V AC between L1,L2 and L3
7	CN30	Power supply output to main PCB	220V AC between L1/L2/L3 and N; 380V AC between L1,L2 and L3
8	CN206	Power output L1 of filter board	220V AC between L1/L2/L3 and N; 380V AC between L1,L2 and L3
9	CN205	Power output L2 of filter board	220V AC between L1/L2/L3 and N; 380V AC between L1,L2 and L3
10	CN204	Power output L3 of filter board	220V AC between L1/L2/L3 and N; 380V AC between L1,L2 and L3
11	CN214	Power supply to inverter board (CN214) of filter board	220V AC

5 Wiring Diagrams

Figure 5-5.1: 10Hp/12HP wiring diagram



Part 6
Diagnosis and Troubleshooting

1 Error Code Table

Table 6-1.1: Error code table

Error code[1]	Content	Remarks	Manual re-start required[1]
E1	Phase sequence error	Displayed on the outdoor unit PCB	Yes
E2	Communication error between indoor and outdoor units	Displayed on the outdoor unit PCB	No
E4	Outdoor heat exchanger temperature sensor (T3) error or outdoor ambient temperature sensor (T4) error	Displayed on the outdoor unit PCB	No
E5	Abnormal power supply voltage	Displayed on the outdoor unit PCB	No
E6	DC fan motor error	Displayed on the outdoor unit PCB	No
Eb	E6 error appears 6 times in 1 hour	Displayed on the outdoor unit PCB	Yes
E7	Outdoor compressor discharge temperature sensor (T5) error	Displayed on the outdoor unit PCB	No
EH	Outdoor refrigerant cooling pipe temperature sensor (TL) error	Displayed on the outdoor unit PCB	No
F1	DC bus voltage error	Displayed on the outdoor unit PCB	No
H0	Communication error between main control chip and inverter driver chip	Displayed on the outdoor unit PCB	No
H4	Inverter module protection, P6 protection appears three times in 30 minutes	Displayed on the outdoor unit PCB	Yes
H5	P2 protection appears three times in 60 minutes	Displayed on the outdoor unit PCB	No
H7	Number of indoor units detected by outdoor unit not same as number set on main PCB	Displayed on the outdoor unit PCB	No
P1	Discharge pipe high pressure protection	Displayed on the outdoor unit PCB	No
P2	Suction pipe low pressure protection	Displayed on the outdoor unit PCB	No
P3	Compressor current protection	Displayed on the outdoor unit PCB	No
P4	Discharge temperature protection	Displayed on the outdoor unit PCB	No
P5	Outdoor heat exchanger temperature protection	Displayed on the outdoor unit PCB	No
P8	Typhoon protection	Displayed on the outdoor unit PCB	No
PE	Indoor heat exchanger temperature protection	Displayed on the outdoor unit PCB	No
PL	Heat sink high temperature protection	Displayed on the outdoor unit PCB	No
L0	Inverter module protection	Displayed on the outdoor unit PCB	Yes
L1	DC bus low voltage protection	Displayed on the outdoor unit PCB	Yes
L2	DC bus high voltage Heat sink temperature sensor protection	Displayed on the outdoor unit PCB	Yes
L4	MCE error	Displayed on the outdoor unit PCB	Yes
L5	Zero speed protection	Displayed on the outdoor unit PCB	Yes
L7	Phase sequence error	Displayed on the outdoor unit PCB	Yes
L8	Compressor frequency variation greater than 15Hz within one second protection	Displayed on the outdoor unit PCB	Yes
L9	Actual compressor frequency differs from target frequency by more than 15Hz protection	Displayed on the outdoor unit PCB	Yes

Notes:

1. For some error codes, a manual restart is required before the system can resume operation.

2 Troubleshooting

2.1 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.

2.2 E1: Phase sequence error

2.2.1 Digital display output

2.2.2 Description

- Phase sequence error.
- The system stops running.
- Error code is displayed on the outdoor unit PCB.

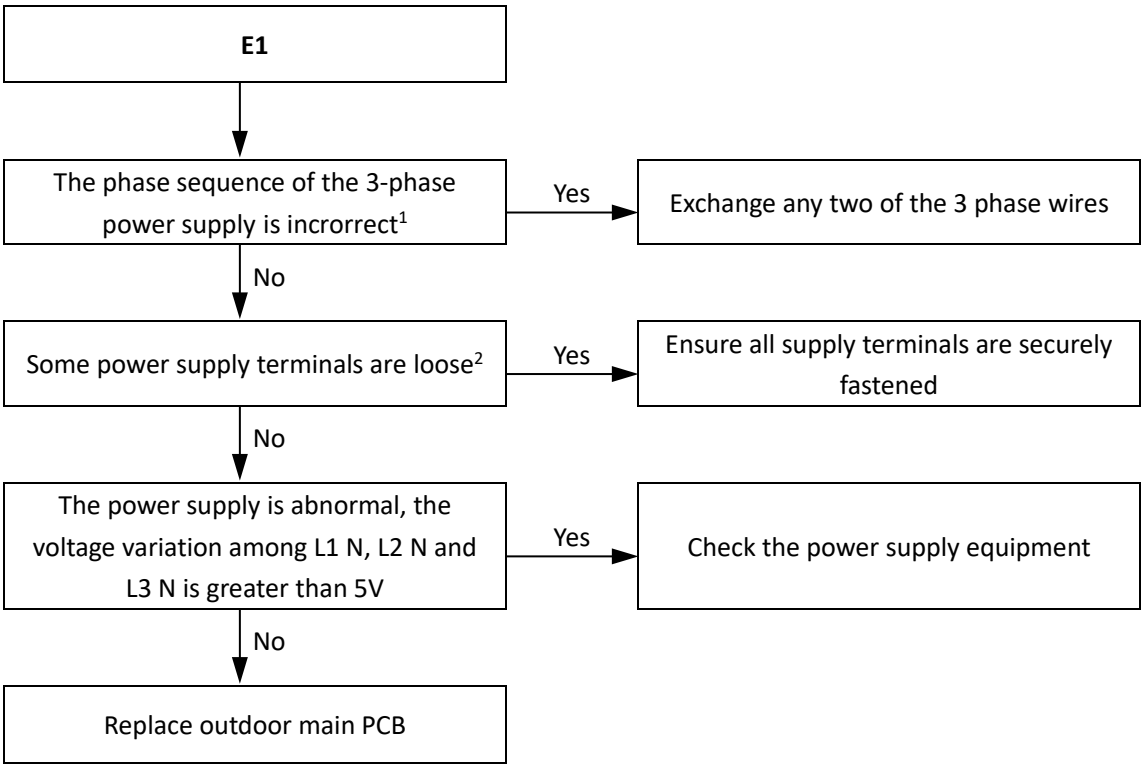
2.2.3 Trigger / recover condition

- Trigger condition: Wrong phase connection for 1.6s or phase missing for 48s.
- Recover condition: Correct phase connection.
- Reset method: Manually restart.

2.2.4 Possible causes

- Power supply phases not connected in correct sequence.
- Power supply terminals loose.
- Power supply abnormal.
- Main PCB damaged.

2.2.5 Procedure

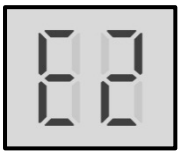


Notes:

1. The L1, L2, L3 terminals of the 3-phase power supply should match compressor phase sequence requirements. If the phase sequence is inverted, the compressor will operate inversely.
2. Loose power supply terminals can cause the compressor to operate abnormally and compressor current to be very large.

2.3 E2: Communication error between indoor and outdoor unit

2.3.1 Digital display output



2.3.2 Description

- Communication error between indoor and outdoor unit.
- The system stops running.
- Error code is displayed on the outdoor unit PCB.

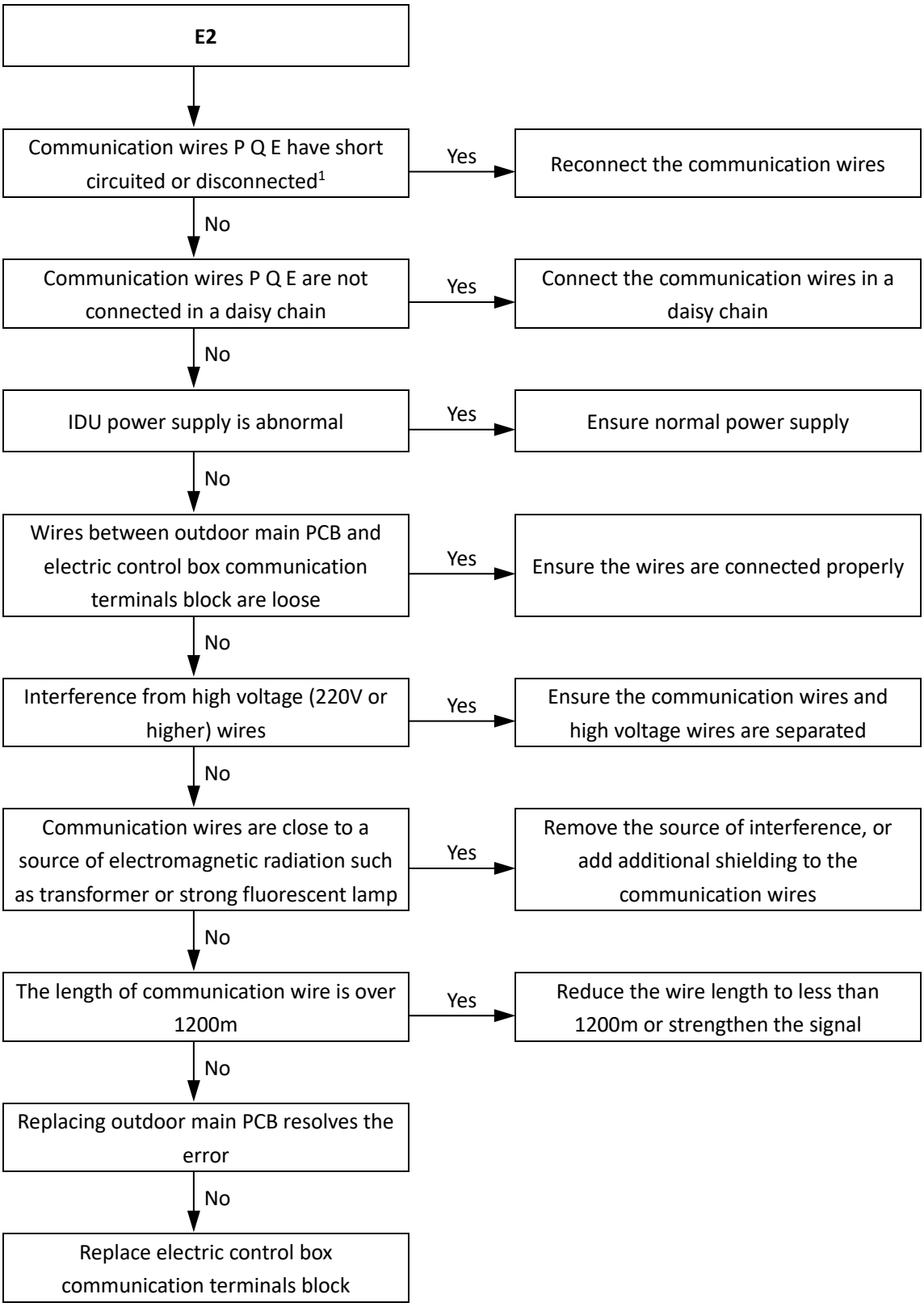
2.3.3 Trigger / recover condition

- Trigger condition: Indoor units and the outdoor unit cannot communicate for 2 minutes after the system is powered on for 20 minutes.
- Recover condition: Communication go back to normal.
- Reset method: Resume automatically.

2.3.4 Possible causes

- Communication wires between indoor and outdoor units not connected properly.
- Indoor unit power supply abnormal.
- Loosened wiring within electric control box.
- Interference from high voltage wires or other sources of electromagnetic radiation.
- Communication wire too long.
- Damaged main PCB or electric control box communication terminals block.

2.3.5 Procedure

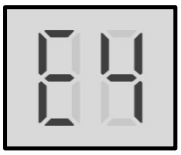


Notes:

1. Measure the resistance among P, Q and E. The normal resistance between P and Q is 120Ω, between P and E is infinite, between Q and E is infinite.

2.4 E4: Temperature sensor (T3/T4) error

2.4.1 Digital display output



2.4.2 Description

- Outdoor heat exchanger temperature sensor (T3) error or outdoor ambient temperature sensor (T4) error.
- The system stops running.
- Error code is displayed on the outdoor unit PCB.

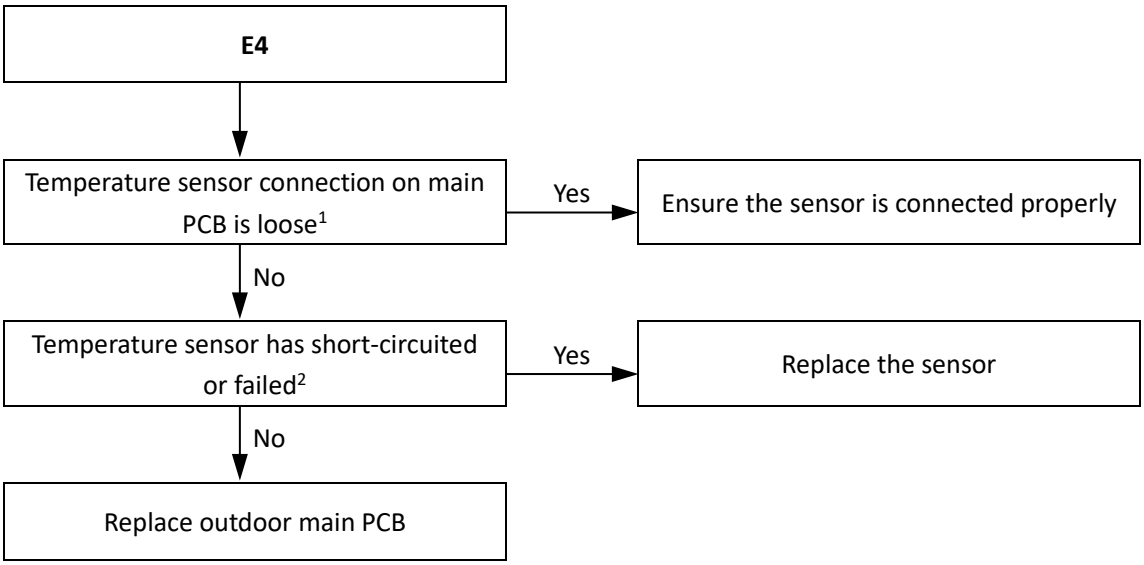
2.4.3 Trigger / recover condition

- Trigger condition: The main control board cannot receive the feedback signal of temperature sensor T3 or T4.
- Recover condition: The main control board can receive the feedback signal of temperature sensor T3 or T4.
- Reset method: Resume automatically.

2.4.4 Possible causes

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

2.4.5 Procedure



Notes:

1. Outdoor ambient temperature sensor (T4) and heat exchanger temperature sensor (T3) connection is port CN9 on the main PCB (labeled 10 in Figure 5-2.1 in Part 5, 2.1 “Ports”).
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 Table 6-3.1 in Part 6, 3.1 “Temperature Sensor Resistance Characteristics”.

2.5 E5: Abnormal power supply voltage

2.5.1 Digital display output

2.5.2 Description

- Abnormal power supply voltage.
- The system stops running.
- Error code is displayed on the outdoor unit PCB.

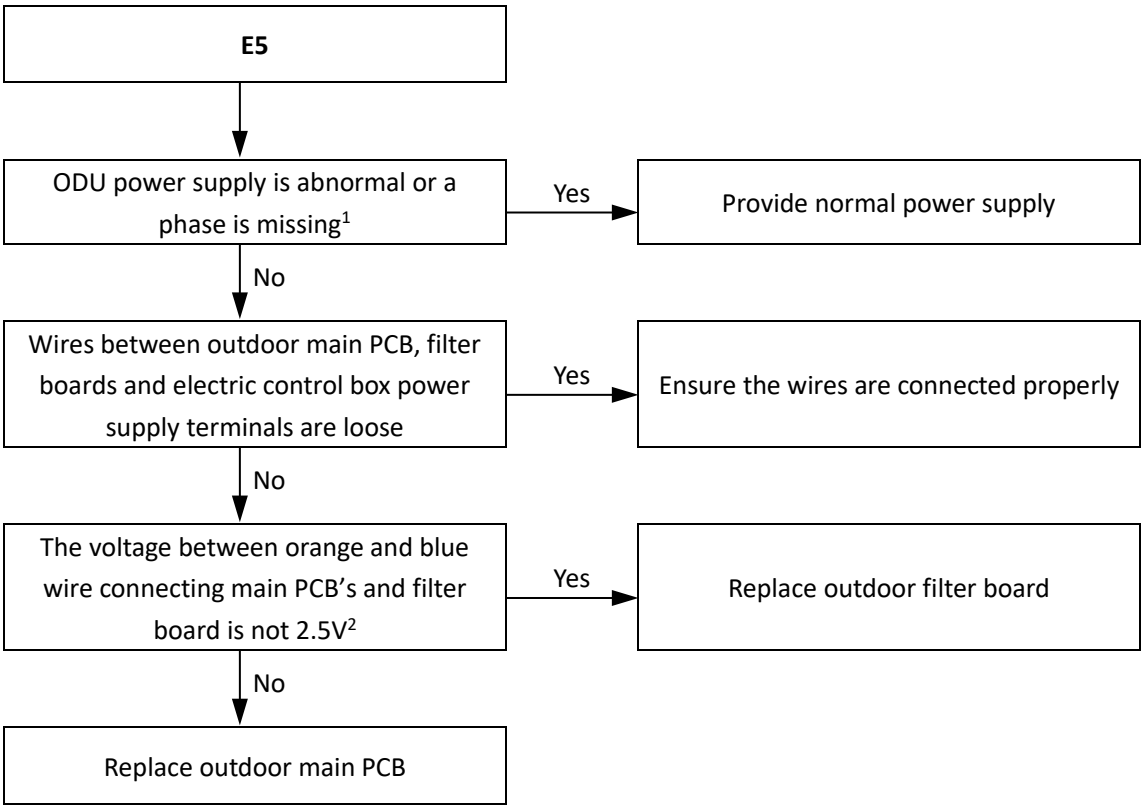
2.5.3 Trigger / recover condition

- Trigger condition: Outdoor unit power supply phase voltage < 172V.
- Recover condition: Outdoor unit power supply phase voltage is > 265V.
- Reset method: Resume automatically.

2.5.4 Possible causes

- Outdoor unit power supply voltage is abnormal or a phase is missing.
- Loosened wiring within electric control box.
- High voltage circuit error.
- Main PCB damaged.

2.5.5 Procedure



Notes:

1. The normal voltage between L1and N, L2 and N, and L3 and N is 172-265V.
2. Control port of filter board is CN4 on the main PCB (labeled 3 in Figure 5-2.1 in Part 5, 2.1 "Ports").

2.6 E6, Eb: DC fan motor error

2.6.1 Digital display output

2.6.2 Description

- DC fan motor error.
- The system stops running.
- Error code is displayed on the outdoor unit PCB.

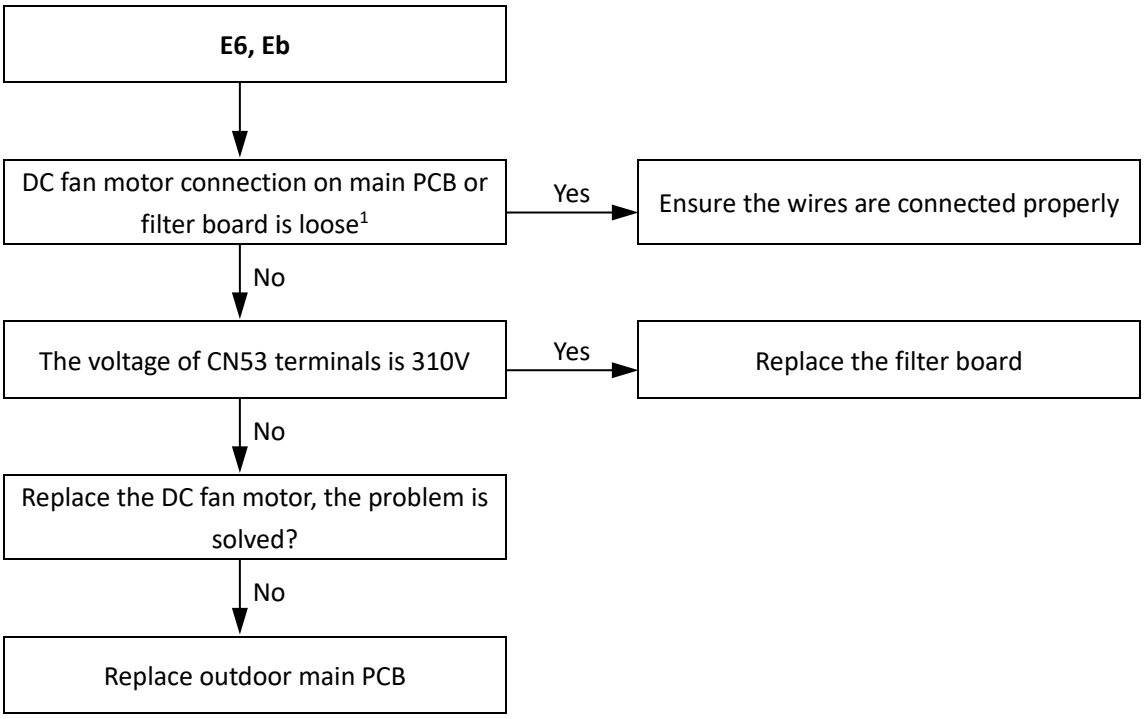
2.6.3 Trigger / recover condition

- Trigger condition:
  For E6 protection: Actual fan speed is < 120 rps more than 20S or the actual fan speed differs from target speed by more 200rps for more than 3 minutes.
  For Eb protection: E6 protection appears six times in 60 minutes.
- Recover condition: Actual fan speed is > 120 rps and the actual fan speed differs from target speed less than 200rps.
- Reset method: Resume automatically.
  For E6 protection: Resume automatically.
  For Eb protection: Manually restart.

2.6.4 Possible causes

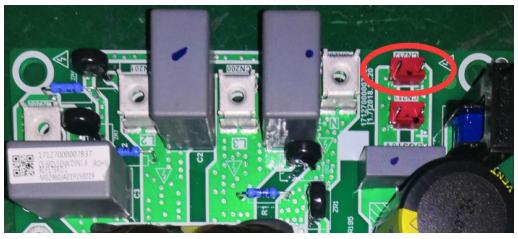
- Loosened wiring within electric control box.
- DC fan motor damaged.
- Filter board damaged.
- Main PCB damaged.

2.6.5 Procedure



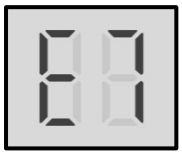
Notes:

1. DC fan motor connections on main PCB are ports CN017, CN109 (labeled 14 in Figure 5-2.1 in Part 5, 2.1 “Ports”) and CN53 (labeled 13 in Figure 5-2.1 in Part 5, 2.1 “Ports”). DC fan motor connection on filter board is ports CN212 (labeled 2 in Figure 5-4.1 in Part 5, 4.1 “Ports”).

DC fan motor connection ports CN36 on main PCB	DC fan motor connection port CN212 on filter board
	

2.7 E7: Temperature sensor (T5) error

2.7.1 Digital display output



2.7.2 Description

- A compressor discharge pipe temperature sensor (T5) error.
- The system stops running.
- Error code is displayed on the outdoor unit PCB.

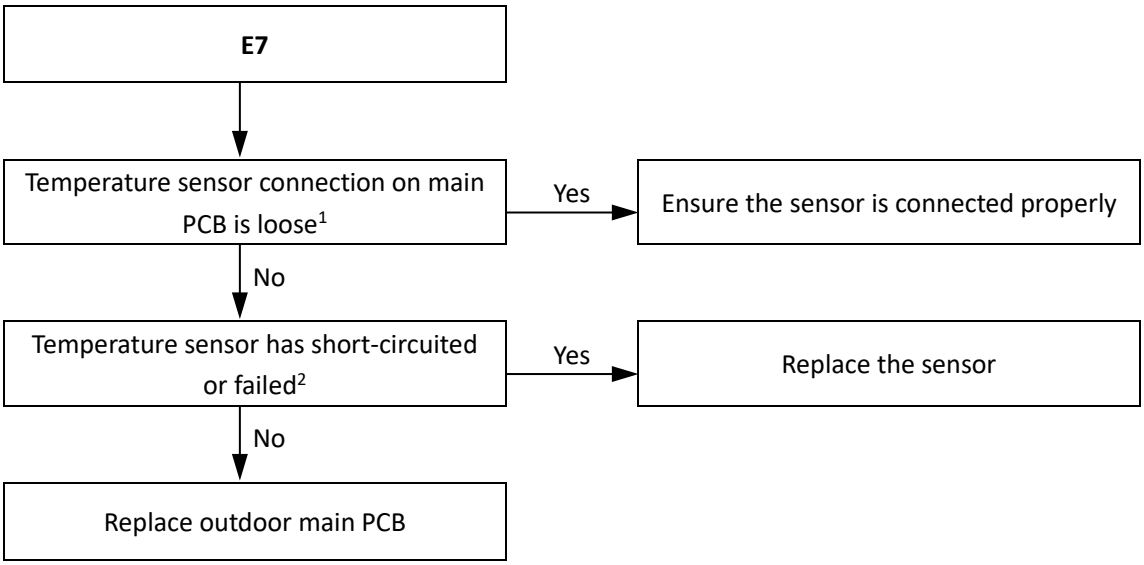
2.7.3 Trigger / recover condition

- Trigger condition: Discharge temperature < 10°C for 5 minutes after compressor startup for 15 minutes.
- Recover condition: Discharge temperature go back to normal.
- Reset method: Manually restart.

2.7.4 Possible causes

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

2.7.5 Procedure



Notes:

1. Compressor discharge pipe temperature sensor connection is port CN5 on the main PCB (labeled 6 in Figure 5-2.1 in Part 5, 2.1 “Ports”).
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 Table 6-3.2 in Part 6, 3.1 “Temperature Sensor Resistance Characteristics”.

2.8 EH: Outdoor refrigerant cooling pipe temperature sensor (TL) error

2.8.1 Digital display output

2.8.2 Description

- An outdoor refrigerant cooling pipe temperature sensor (TL) error.
- The system stops running.
- Error code is displayed on the outdoor unit PCB.

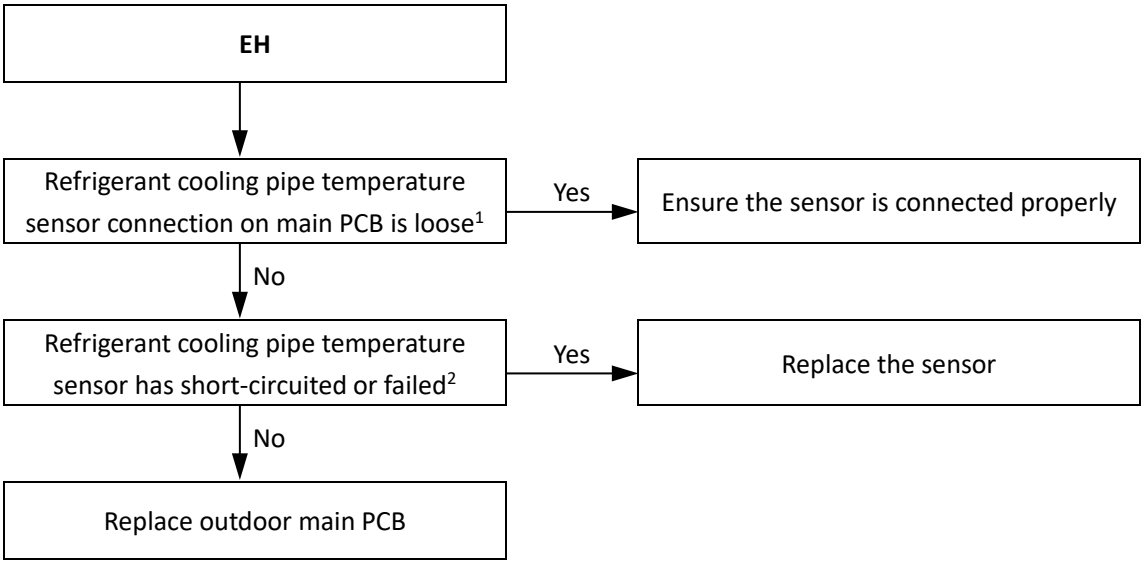
2.8.3 Trigger / recover condition

- Trigger condition: The main control board cannot receive the feedback signal of temperature sensor TL.
- Recover condition: The main control board can receive the feedback signal of temperature sensor TL.
- Reset method: Manually restart.

2.8.4 Possible causes

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

2.8.5 Procedure



Notes:

1. Outdoor refrigerant cooling pipe temperature sensor connection is port CN24 on the main PCB (labeled 5 in Figure 5-2.1 in Part 5, 2.1 “Ports”).
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 Table 6-3.1 in Part 6, 3.1 “Temperature Sensor Resistance Characteristics”.

2.9 F1: DC bus voltage error

2.9.1 Digital display output

2.9.2 Description

- F1 indicates compressor DC bus voltage error.
- The system stops running.
- Error code is displayed on the unit with the error.

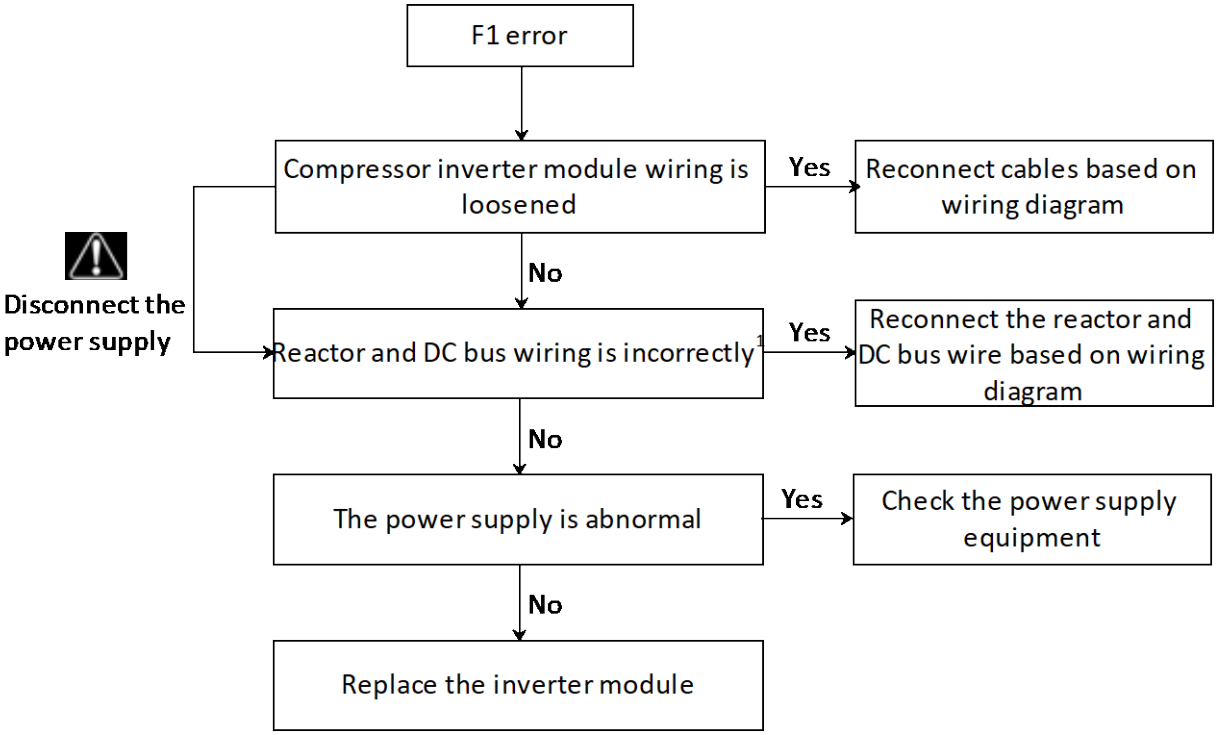
2.9.3 Trigger / recover condition

- Trigger condition: DC bus voltage < 200V continuously for 5 seconds.
- Recover condition: DC bus voltage goes back to normal.
- Reset method: Restart automatically.

2.9.4 Possible causes

- Loosened wiring of the compressor inverter module.
- Incorrect wiring of the reactor and DC bus wire.
- Abnormal power supply.
- Inverter module damaged.

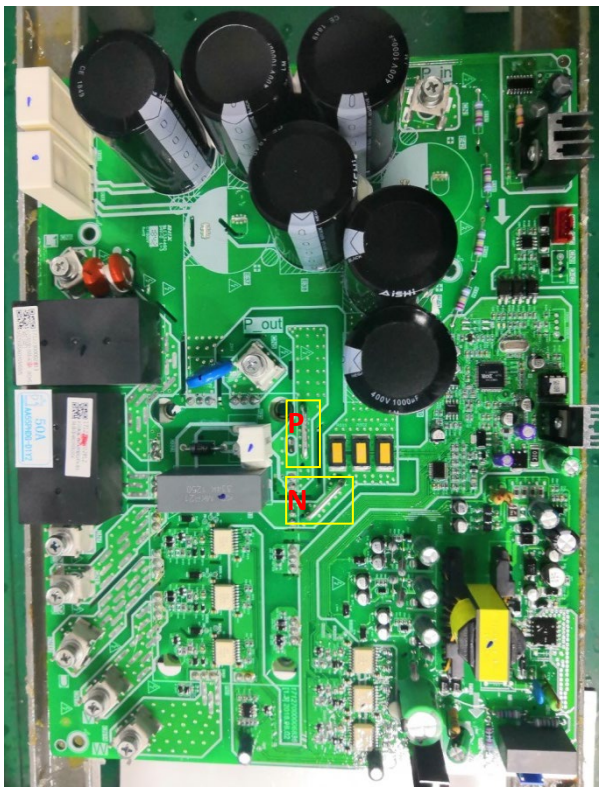
2.9.5 Procedure



Note:

1. The normal DC voltage between terminals P and N on inverter module should be 450-650V.

Figure 6-2.1: P and N terminals on Inverter module



2.10 H0: Communication error

2.10.1 Digital display output

2.10.2 Description

- H0 indicates a communication error between the main control chip and the compressor inverter driver chip.
- The system stops running.
- Error code is displayed on the outdoor unit PCB.

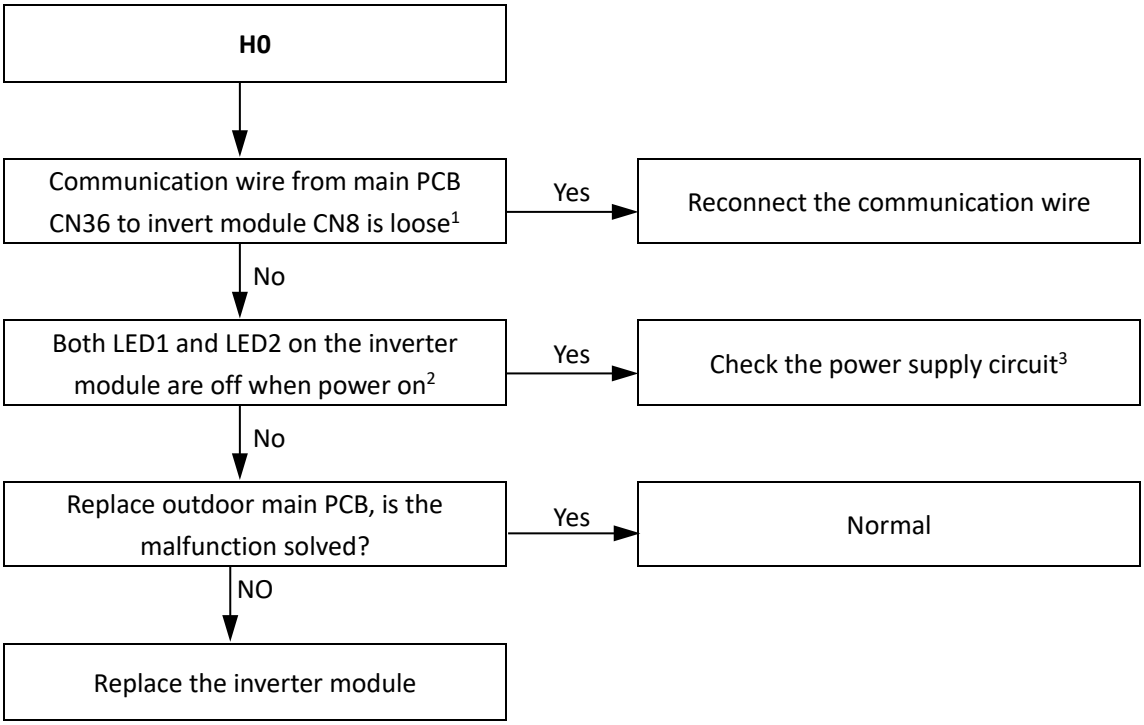
2.10.3 Trigger / recover condition

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

2.10.4 Possible causes

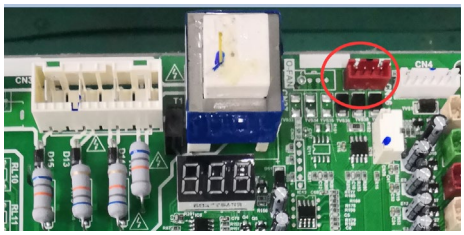
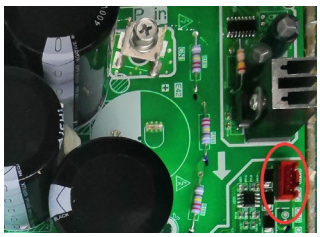
- Loosened communication wiring from the main PCB to the inverter module.
- Bridge rectifier damaged.
- Main PCB damaged.
- Compressor inverter module damaged.

2.10.5 Procedure



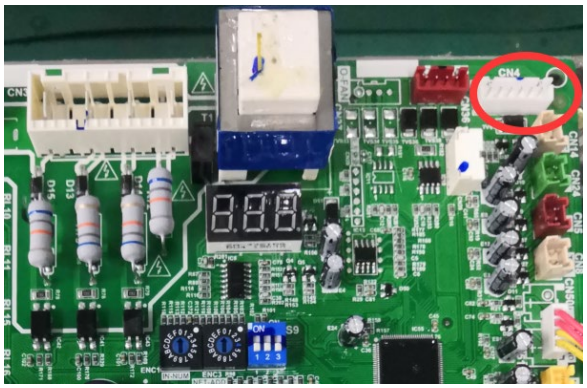
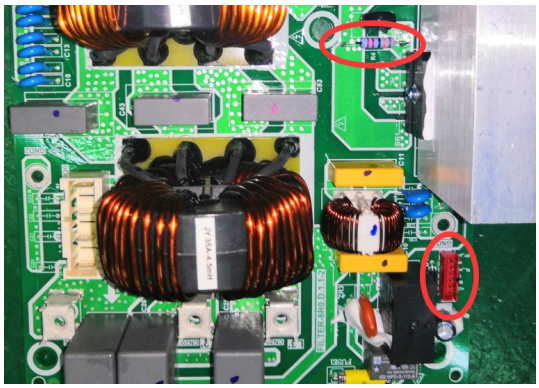
Notes:

1. Communication wire from outdoor main PCB CN36 to inverter module CN8.

Communication port CN36 on main PCB	Communication port CN8 on inverter module
	

2. LED1/2 on inverter module

3. Check the power supply for the compressor inverter module, port CN211 on filter board, the normal voltage should be DC310V; Check the single phase bridge and fuse on filter board; check the connection cable from ODU main PCB port CN4 to filter board port CN8 which is 12V DC power control port.

Communication port CN4 on main PCB	Communication port CN8 and fuse on filter board
	

2.11 H4: Inverter module protection

2.11.1 Digital display output

2.11.2 Description

- H4 indicates compressor inverter module protection.
- The system stops running.
- Error code is displayed on the outdoor unit PCB.

2.11.3 Trigger / recover condition

- Trigger condition: Compressor appears three inverter module protections.
- Recover condition: Inverter module goes back to normal.
- Reset method: Manually restart.

2.11.4 Possible causes

- Inverter module protection.
- DC bus low or high voltage protection.
- MCE error.
- Zero speed protection.
- Phase sequence error.
- Excessive compressor frequency variation.
- Actual compressor frequency differs from target frequency.

2.11.5 Specific error codes for H4 inverter module protection

If an H4 error code is displayed, enter menu mode “n31” (refer to Part 5, 2.2.3 “menu mode”) to check the history error code to check the following specific error code: L0, L1, L2, L4, L5, L7, L8, L9.

Table 6-2.1: Specific error codes for error xH4

Specific error code[1]	Content
L0	Inverter module protection
L1	DC bus low voltage protection
L2	DC bus high voltage protection
L4	MCE error
L5	Zero speed protection
L7	Phase sequence error
L8	Compressor frequency variation greater than 15Hz within one second protection
L9	Actual compressor frequency differs from target frequency by more than 15Hz protection

The specific error codes L0, L1, L2 and L4 can also be obtained from the inverter module LED indicators. If an inverter module error has occurred, LED2 is continuously on and LED1 flashes.

Figure 6-2.2: LED indicators LED1 and LED2 on inverter module

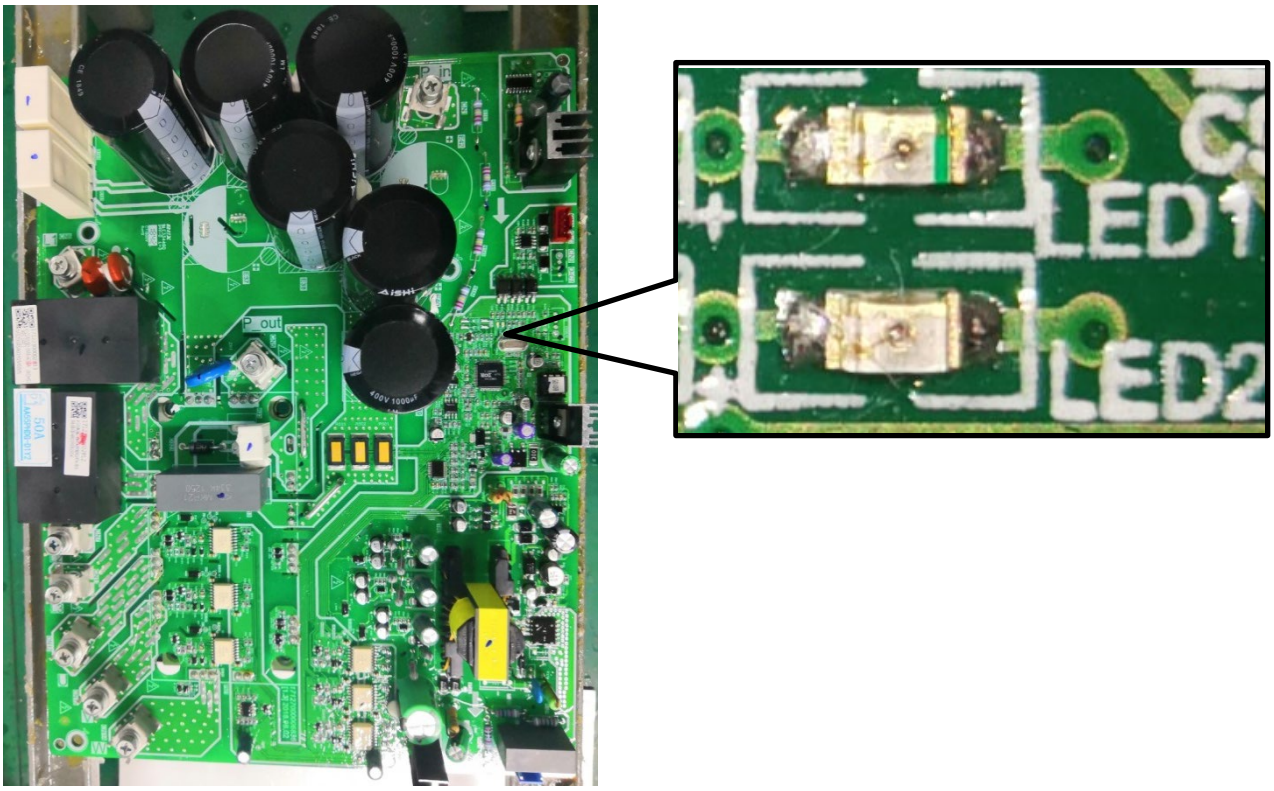
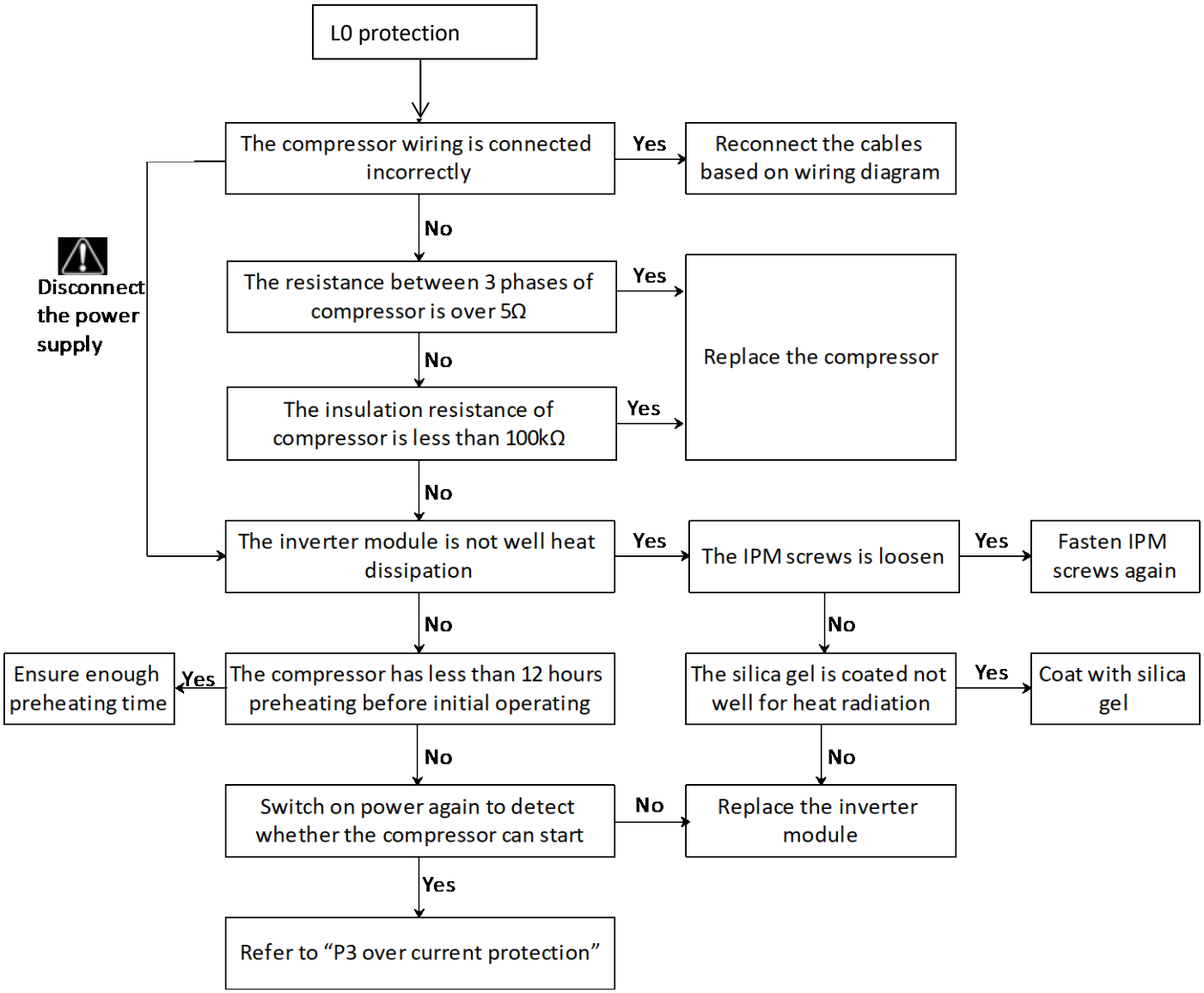


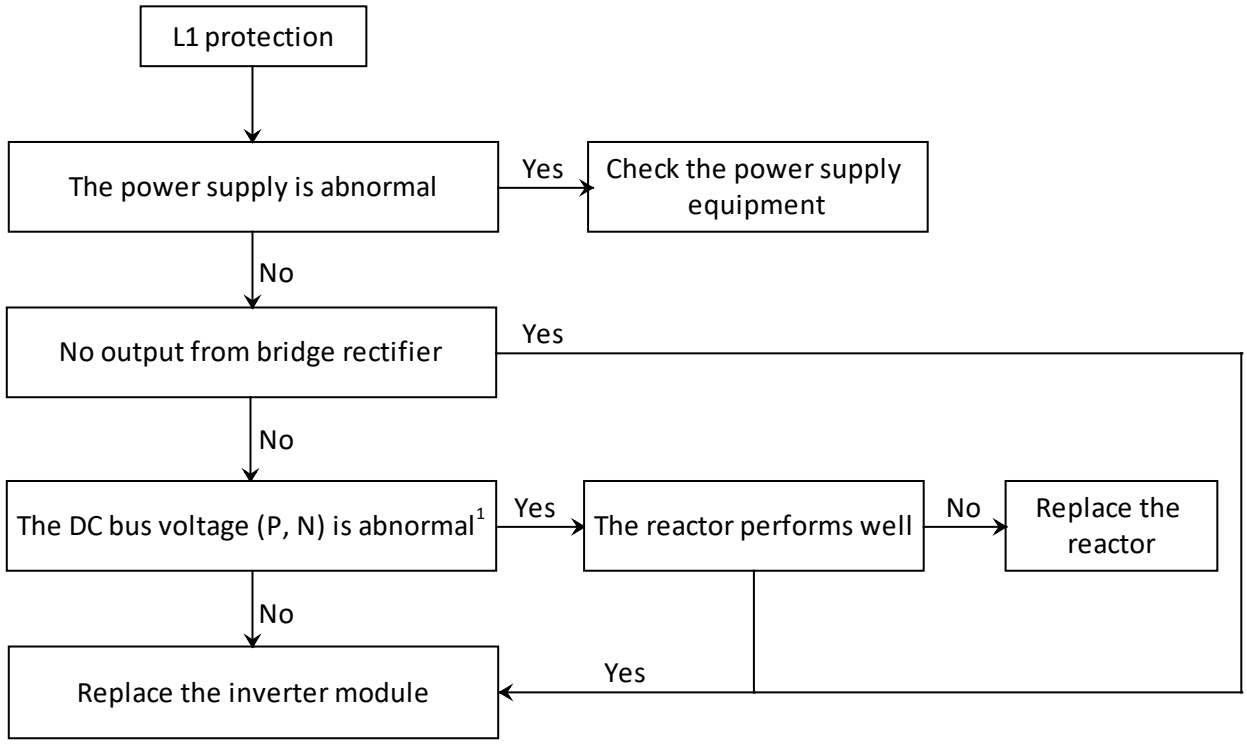
Table 2-6.2: Errors indicated on LED1

LED1 flashing pattern	Corresponding error
Flashes 8 times and stops for 1 second, then repeats	L0 - Inverter module protection
Flashes 9 times and stops for 1 second, then repeats	L1 - DC bus low voltage protection
Flashes 10 times and stops for 1 second, then repeats	L2 - DC bus high voltage protection
Flashes 12 times and stops for 1 second, then repeats	L4 - MCE error

2.11.6 L0: Inverter module protection



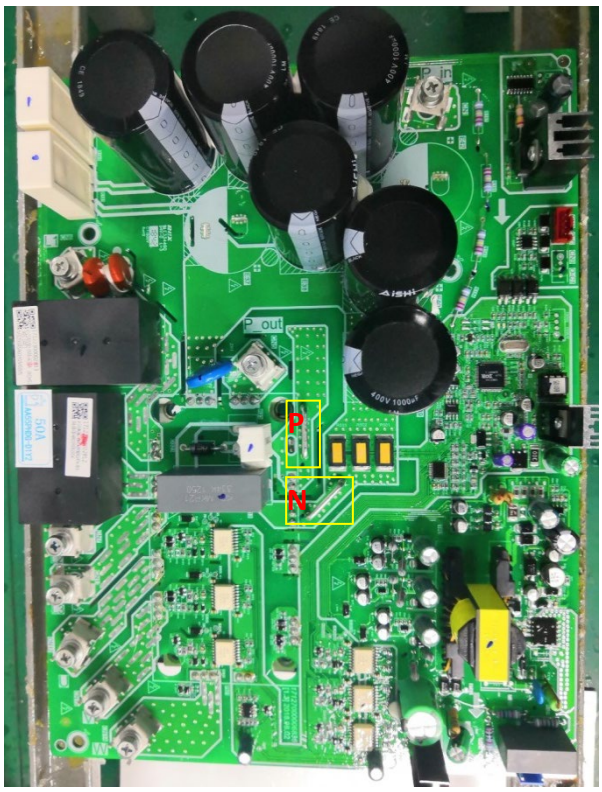
2.11.7 L1: DC bus low voltage protection



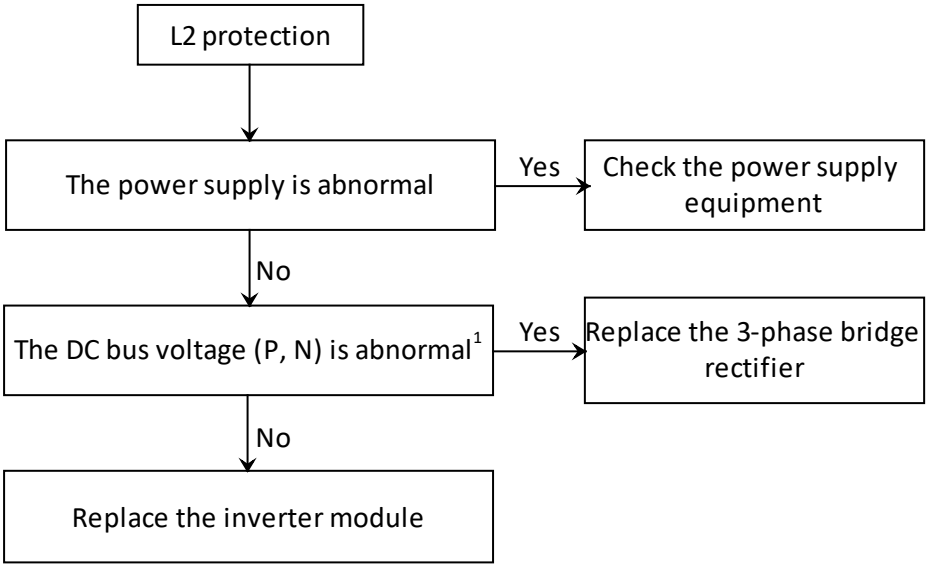
Note:

1. The normal DC voltage between terminals P and N on inverter module should be 450-650V. When the voltage is lower than 350V, L1 protection will be appeared.

Figure 6-2.3: P and N terminals on Inverter module



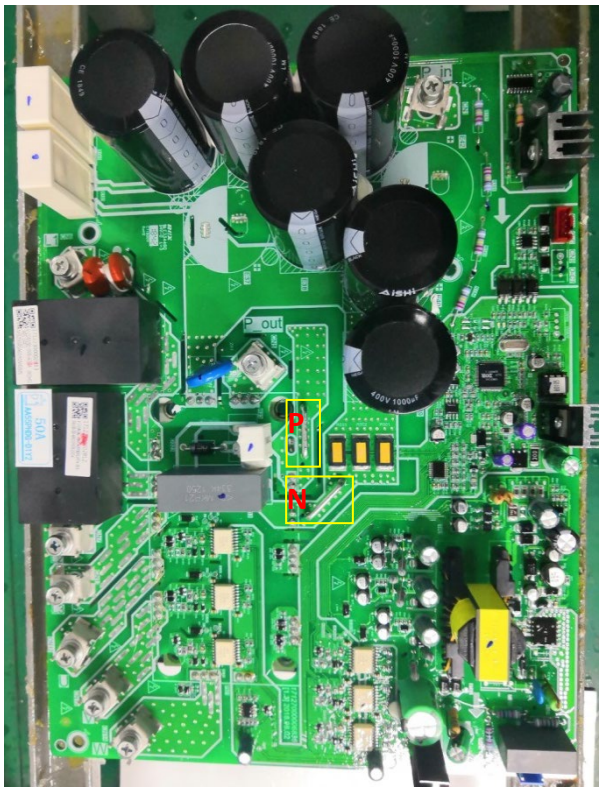
2.11.8 L2: DC bus high voltage protection



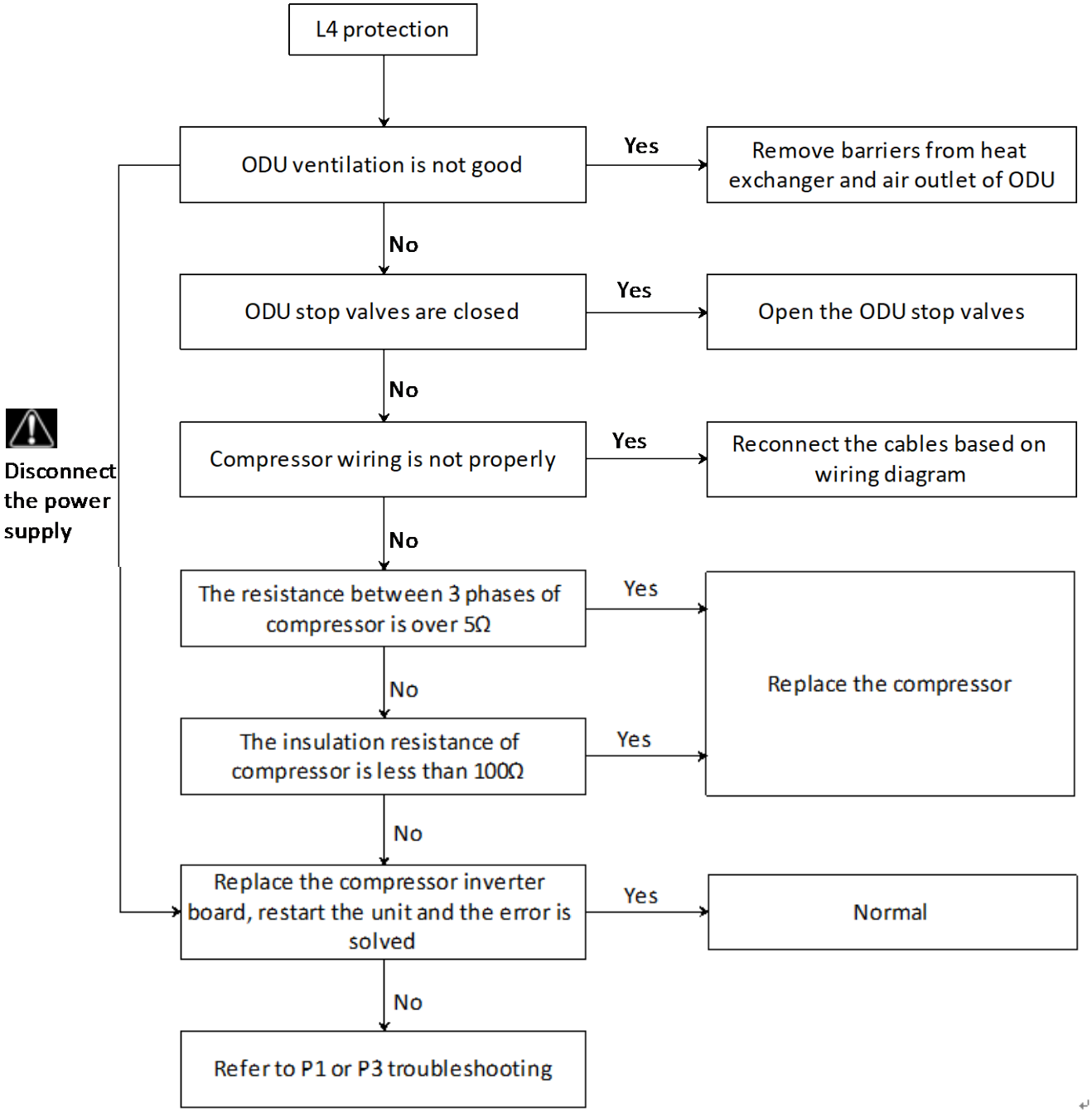
Note:

1. The normal DC voltage between terminals P and N on inverter module should be 450-650V. When the voltage is higher than 700V, L2 protection will be appeared.

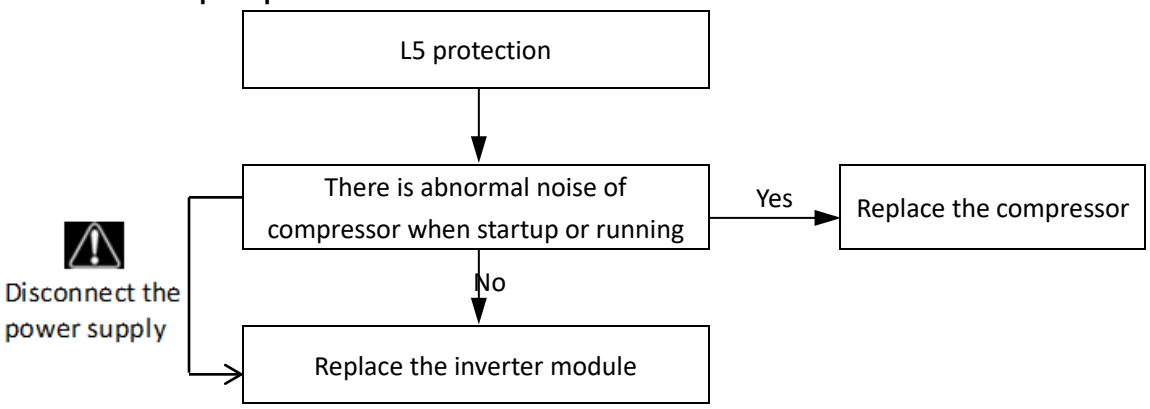
Figure 6-2.4: P and N terminals on Inverter module



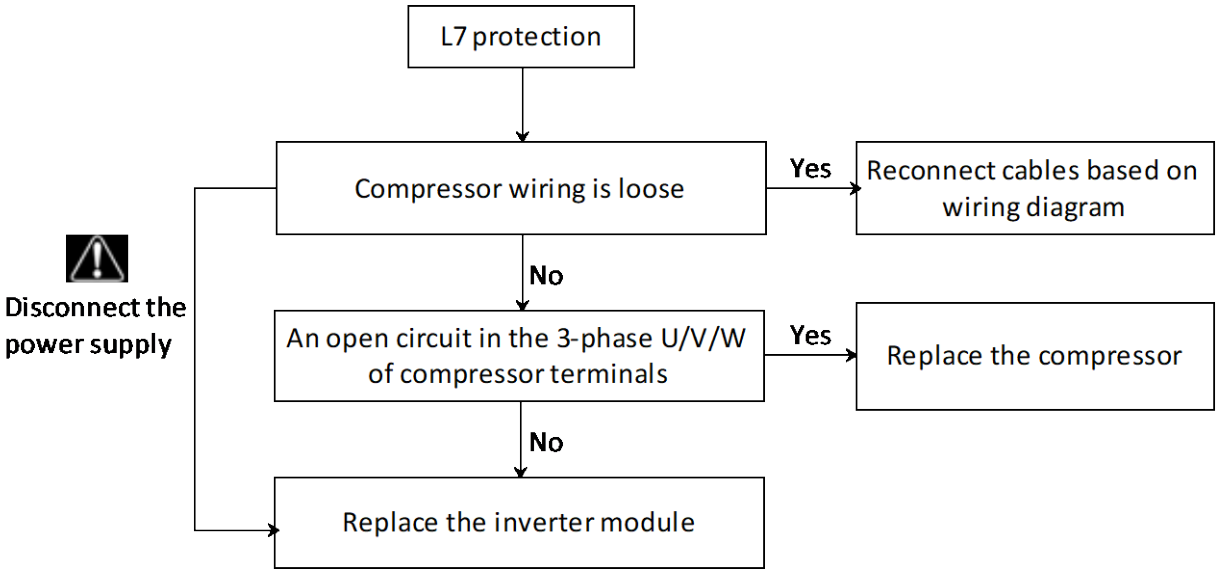
2.11.9 L4: MCE error



2.11.10 L5: Zero speed protection

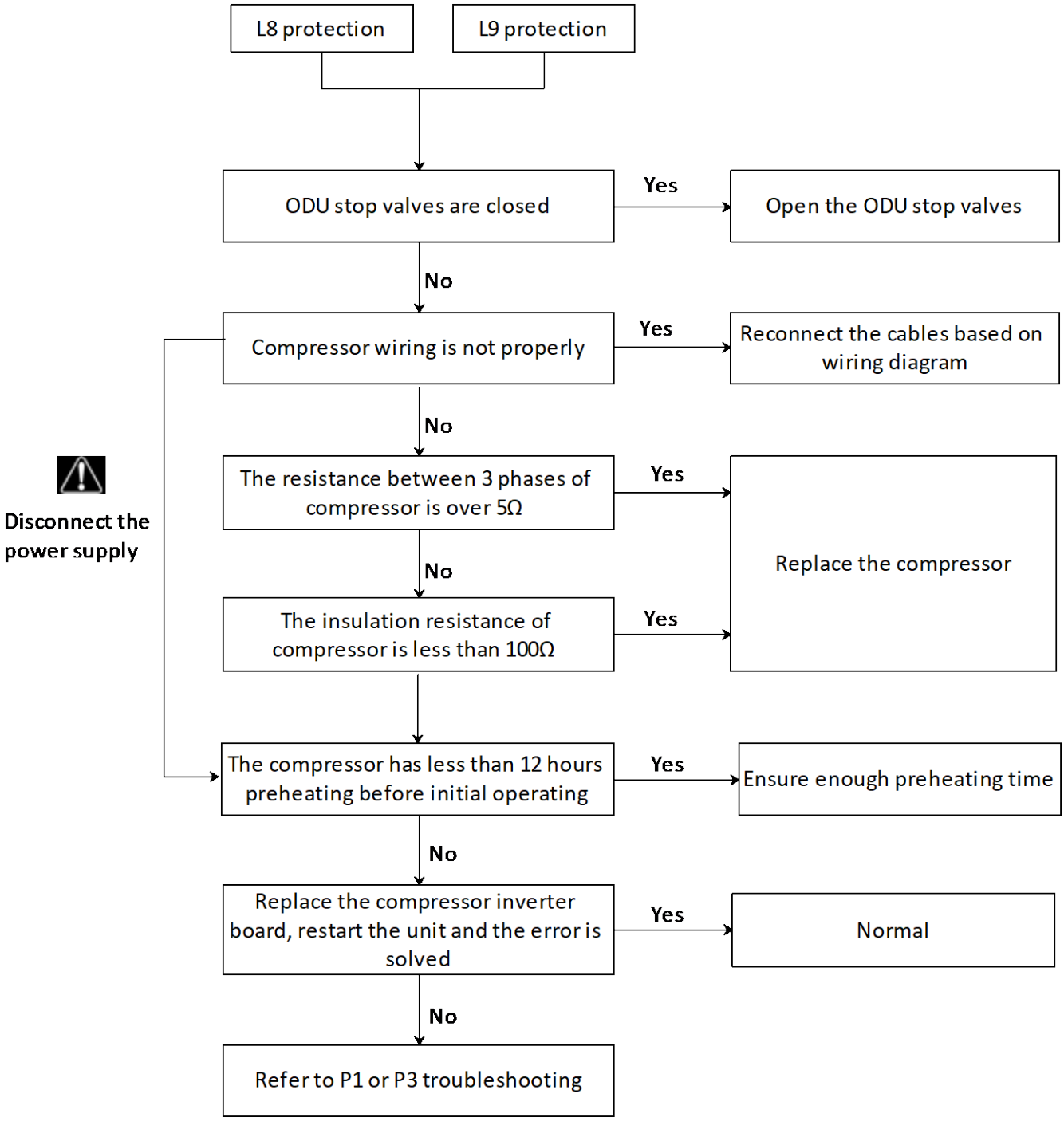


2.11.11 L7: Phase sequence error



2.11.12 L8: Compressor frequency variation greater than 15Hz within one second protection

L9: Actual compressor frequency differs from target frequency by more than 15Hz protection



2.11.13 Compressor replacement procedure

Figure 6-2.5: Draining oil from a compressor

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 6-2.7 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 spoiled (lightly or heavily), go to Step 4.

Step 4: Replace oil separator and accumulator

- 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.

Figure 6-2.6: Compressor piping

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 compressor in Step 3, use clean oil to clean them before re-fitting it into the unit. 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

- Add 2.3L of oil to each of the compressors from which oil was drained in Step 3.
- Only use FV50S oil. Different compressors require different types of oil. Using the wrong type of oil leads to various problems.
- Add additional 1.5L oil to the accumulator from which oil was drained in Step 4 such that the total amount of oil is 3.8L.

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. Refer to the Engineering Data Book, Part 3.

Figure 6-2.7: Inspecting compressor oil

2.12 H7: Unmatched total number of indoor units

2.12.1 Digital display output

2.12.2 Description

- Number of indoor units detected by the outdoor unit not same as number set on main PCB.
- The system stops running.
- Error code is displayed on the outdoor unit PCB.

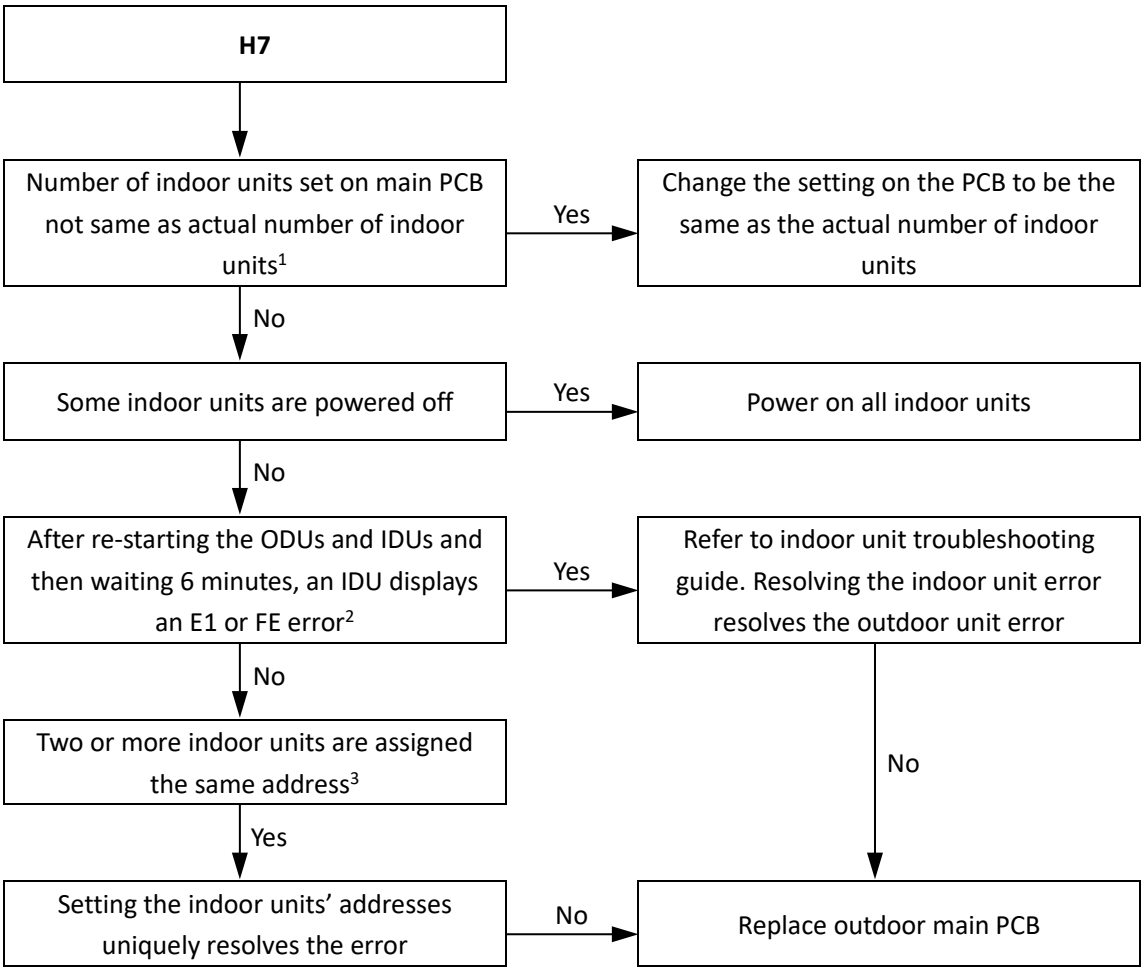
2.12.3 Trigger / recover condition

- Trigger condition: At least one indoor unit cannot be detected by the outdoor unit for more than 20 minutes for the first time powered on or at least one indoor unit cannot be detected by the outdoor unit for more than 3 minutes.
- Recover condition: Number of indoor units detected by the outdoor unit is same as number set on main PCB.
- Reset method: Resume automatically.

2.12.4 Possible causes

- Number of indoor units set on main PCB not same as actual number of indoor units.
- Some indoor units are powered off.
- Communication wires between indoor and outdoor units not connected properly.
- Indoor unit PCB damaged.
- Indoor unit without address or indoor unit address duplicated.
- Main PCB damaged.

2.12.5 Procedure



Notes:

1. The number of indoor units can be set on switches ENC1 and S9-3 on the main PCB.
2. Indoor unit error code E1 indicates a communication error between indoor and outdoor unit. Indoor unit error code FE indicates that an indoor unit has not been assigned an address.
3. Indoor unit addresses can be checked and manually assigned using indoor unit remote/wired controllers. Alternatively, indoor unit addresses can be automatically assigned by the outdoor unit.

2.13 H8: High pressure sensor error

2.13.1 Digital display output

2.13.2 Description

- High pressure sensor error.
- The system stops running.
- Error code is displayed on the unit with the error.

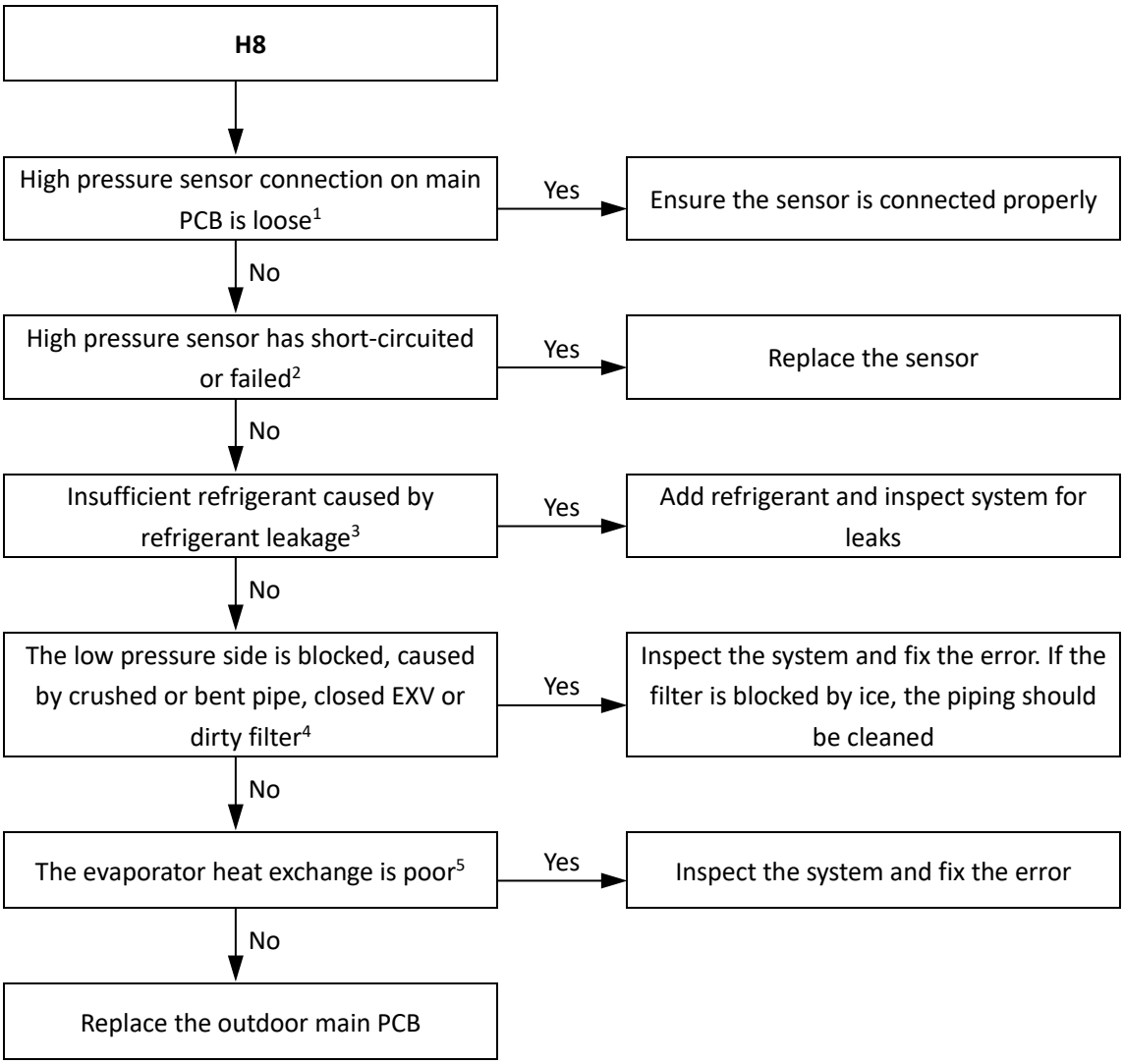
2.13.3 Trigger / recover condition

- Trigger condition: Discharge pressure ≤ 0.3MPa.
- Recover condition: Discharge pressure > 0.3MPa.
- Reset method: Resume automatically.

2.13.4 Possible causes

- Pressure sensor not connected properly or has malfunctioned.
- Insufficient refrigerant.
- Low pressure side blockage.
- Poor evaporator heat exchange.
- Main PCB damaged.

2.13.5 Procedure



Notes:

1. High pressure sensor connection is port CN12 on the main PCB (labeled 8 in Figure 5-2.1 in Part 5, 2.1 “Ports”).
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. 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. For normal system parameters refer to Table 6-3.4 and 6-3.5 in Part 6, 3.2 “Normal Operating Parameters of Refrigerant 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 refer to Table 6-3.4 and 6-3.5 in Part 6, 3.2 “Normal Operating Parameters of Refrigerant System”.
5. In cooling mode check indoor heat exchangers, fans and air outlets for dirt/blockages. In heating mode check outdoor heat exchangers, fans and air outlets for dirt/blockages.

2.14 P1: Discharge pipe high pressure protection

2.14.1 Digital display output

2.14.2 Description

- Discharge pipe high pressure protection.
- The system stops running.
- Error code is displayed on the outdoor unit PCB.

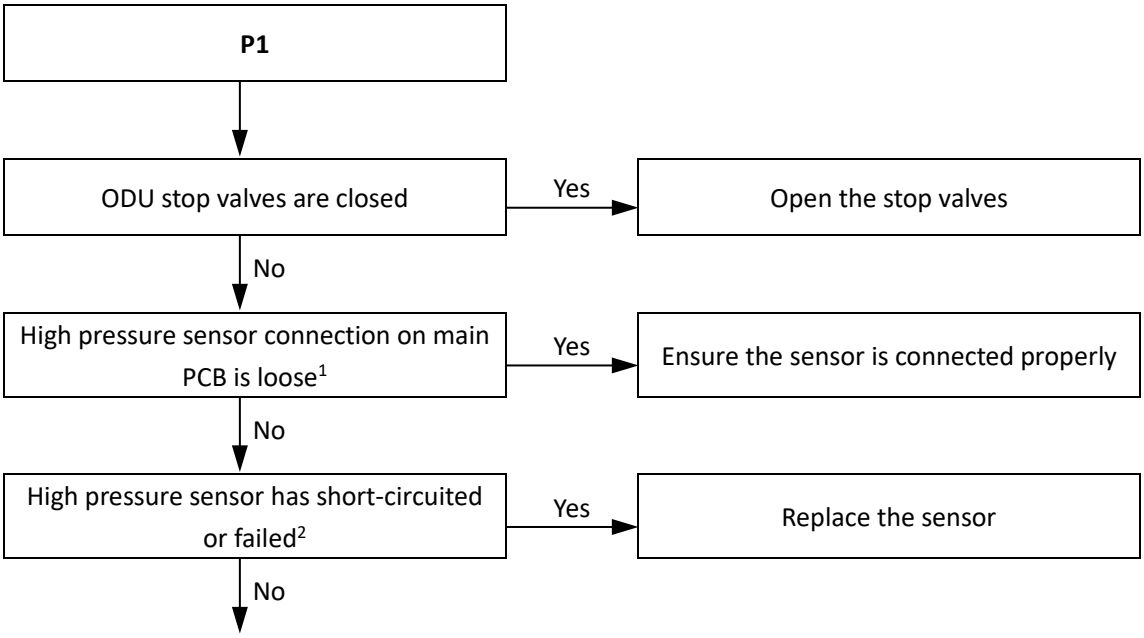
2.14.3 Trigger / recover condition

- Trigger condition: Discharge pressure ≥ 4.4MPa.
- Recover condition: Discharge pressure ≤ 3.2MPa.
- Reset method: Resume automatically.

2.14.4 Possible causes

- Outdoor unit stop valves are closed.
- Pressure sensor/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.

2.14.5 Procedure



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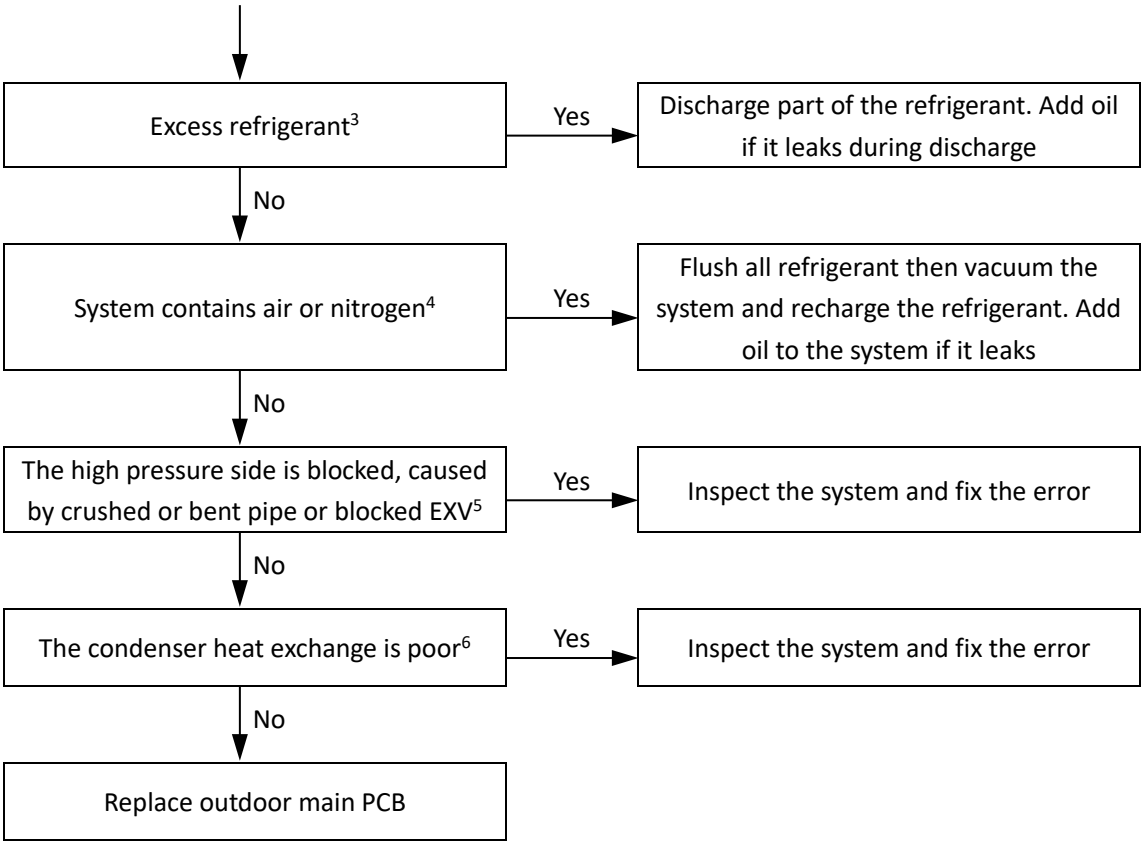


Notes:

1. The high pressure sensor connection is port CN12 on the main PCB (labeled 8 in Figure 5-2.1 in Part 5, 2.1 “Ports”).
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. Excess refrigerant causes discharge temperature to be lower than normal, discharge pressure to be higher than normal and suction pressure to be higher than normal. For normal system parameters refer to Table 6-3.4 and 6-3.5 in Part 6, 3.2 “Normal Operating Parameters of Refrigerant System”.
4. Air or nitrogen in the system causes discharge temperature to be higher than normal, discharge pressure to be higher than normal, compressor current to be higher than normal, abnormal compressor noise and an unsteady pressure meter reading. For normal system parameters refer to Table 6-3.4 and 6-3.5 in Part 6, 3.2 “Normal Operating Parameters of Refrigerant System”.
5. 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. For normal system parameters refer to Table 6-3.4 and 6-3.5 in Part 6, 3.2 “Normal Operating Parameters of Refrigerant System”.
6. In cooling mode check outdoor heat exchangers, fans and air outlets for dirt/blockages. In heating mode check indoor heat exchangers, fans and air outlets for dirt/blockages.

2.15 P2, H5: Suction pipe low pressure protection

2.15.1 Digital display output

2.15.2 Description

- Suction pipe low pressure protection.
- The system stops running.
- Error code is displayed on outdoor unit PCB.

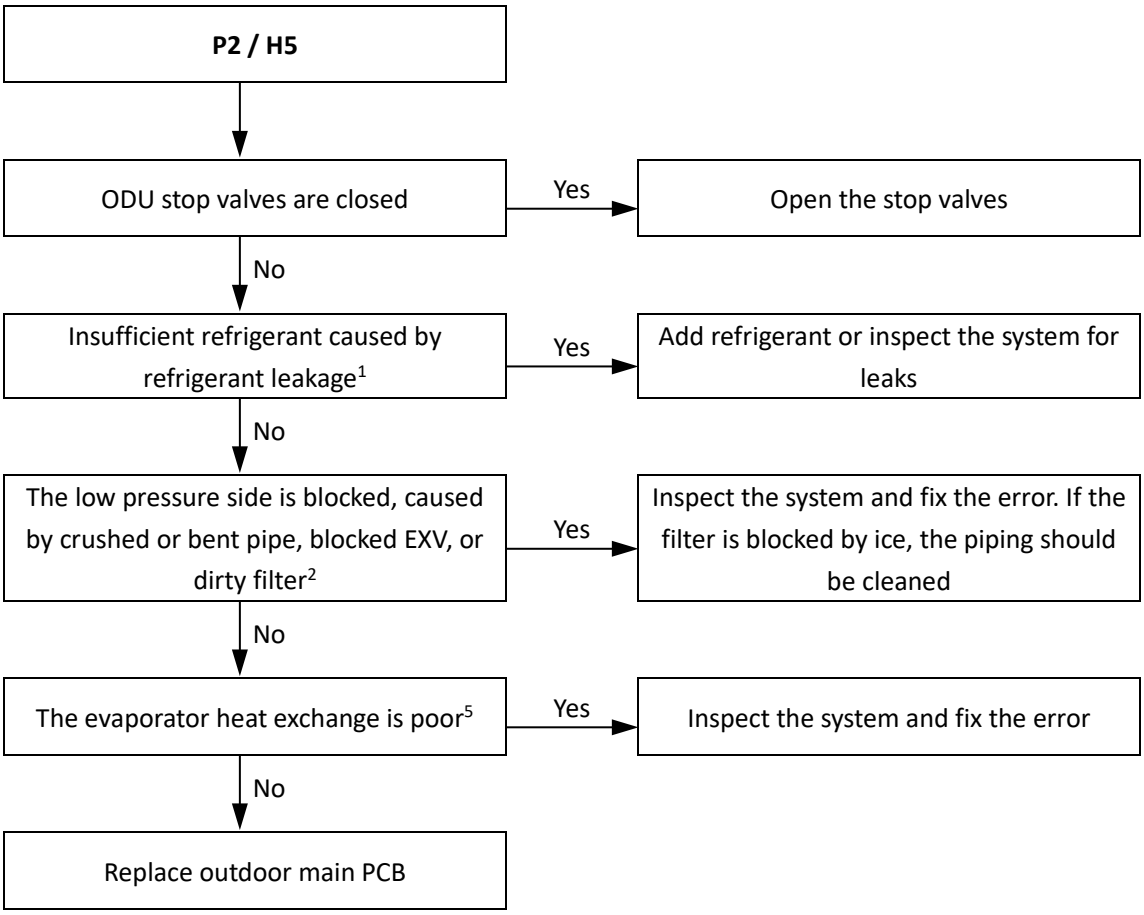
2.15.3 Trigger / recover condition

- Trigger condition:
  For P2 protection: Suction pressure ≤ 0.05MPa.
  For H5 protection: P2 protection appears three times in 30 minutes.
- Recover condition: Suction pressure ≥ 0.15MPa.
- Reset method:
  For P2 protection: Resume automatically.
  For H5 protection: Manually restart.

2.15.4 Possible causes

- Outdoor unit stop valves are closed.
- Insufficient refrigerant.
- Low pressure side blockage.
- Poor evaporator heat exchange.
- Main PCB damaged.

2.15.5 Procedure

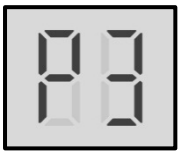


Notes:

1. 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. For normal system parameters refer to Table 6-3.4 and 6-3.5 in Part 6, 3.2 “Normal Operating Parameters of Refrigerant 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 refer to Table 6-3.4 and 6-3.5 in Part 6, 3.2 “Normal Operating Parameters of Refrigerant System”.
3. In cooling mode check indoor heat exchangers, fans and air outlets for dirt/blockages. In heating mode check outdoor heat exchangers, fans and air outlets for dirt/blockages.

2.16 P3: Compressor current protection

2.16.1 Digital display output



2.16.2 Description

- P3 indicates current protection on compressor.
- The system stops running.
- Error code is displayed on the outdoor unit PCB.

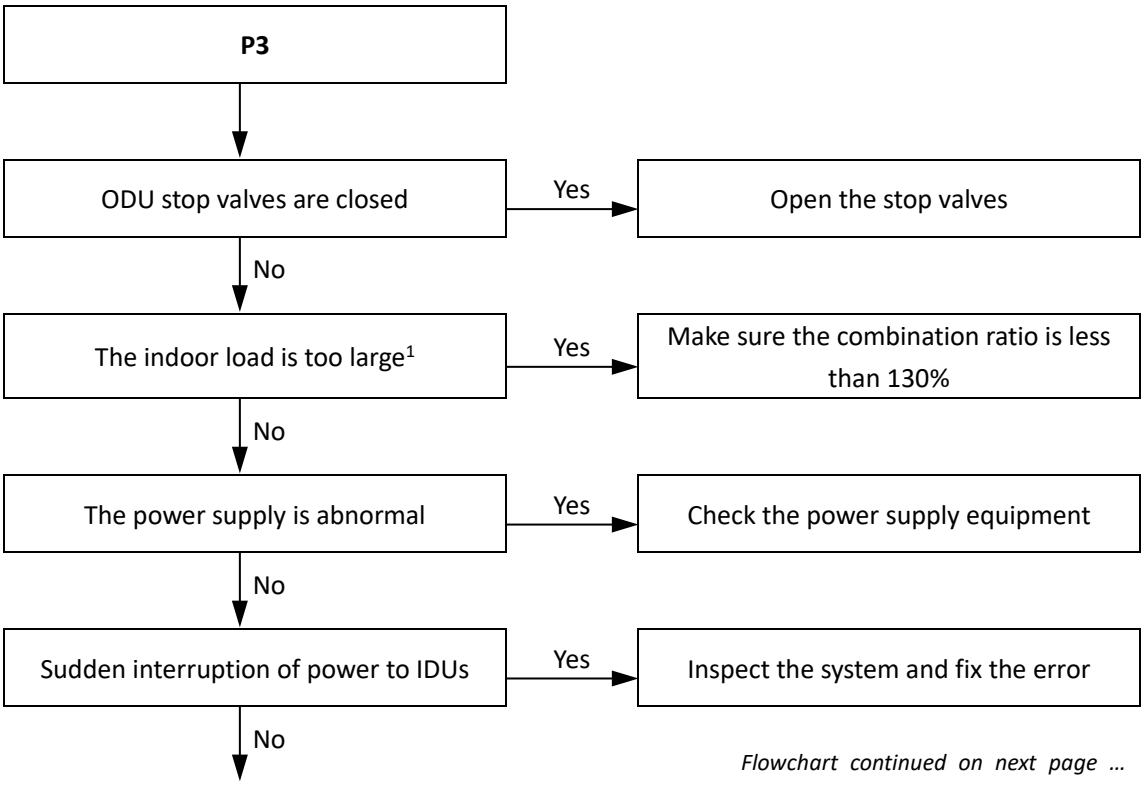
2.16.3 Trigger / recover condition

- Trigger condition: Current of compressor LNB65FAGMC ≥ 29A.
- Recover condition: Current of compressor LNB65FAGMC < 29A.
- Reset method: Resume automatically.

2.16.4 Possible causes

- Outdoor unit stop valves are closed.
- Indoor load too large.
- Power supply abnormal.
- Sudden interruption of power to IDUs.
- Excess refrigerant.
- System contains air or nitrogen.
- Poor condenser heat exchange.
- High pressure side blockage.
- Inverter module damaged.
- Compressor damaged.
- Main PCB damaged.

2.16.5 Procedure



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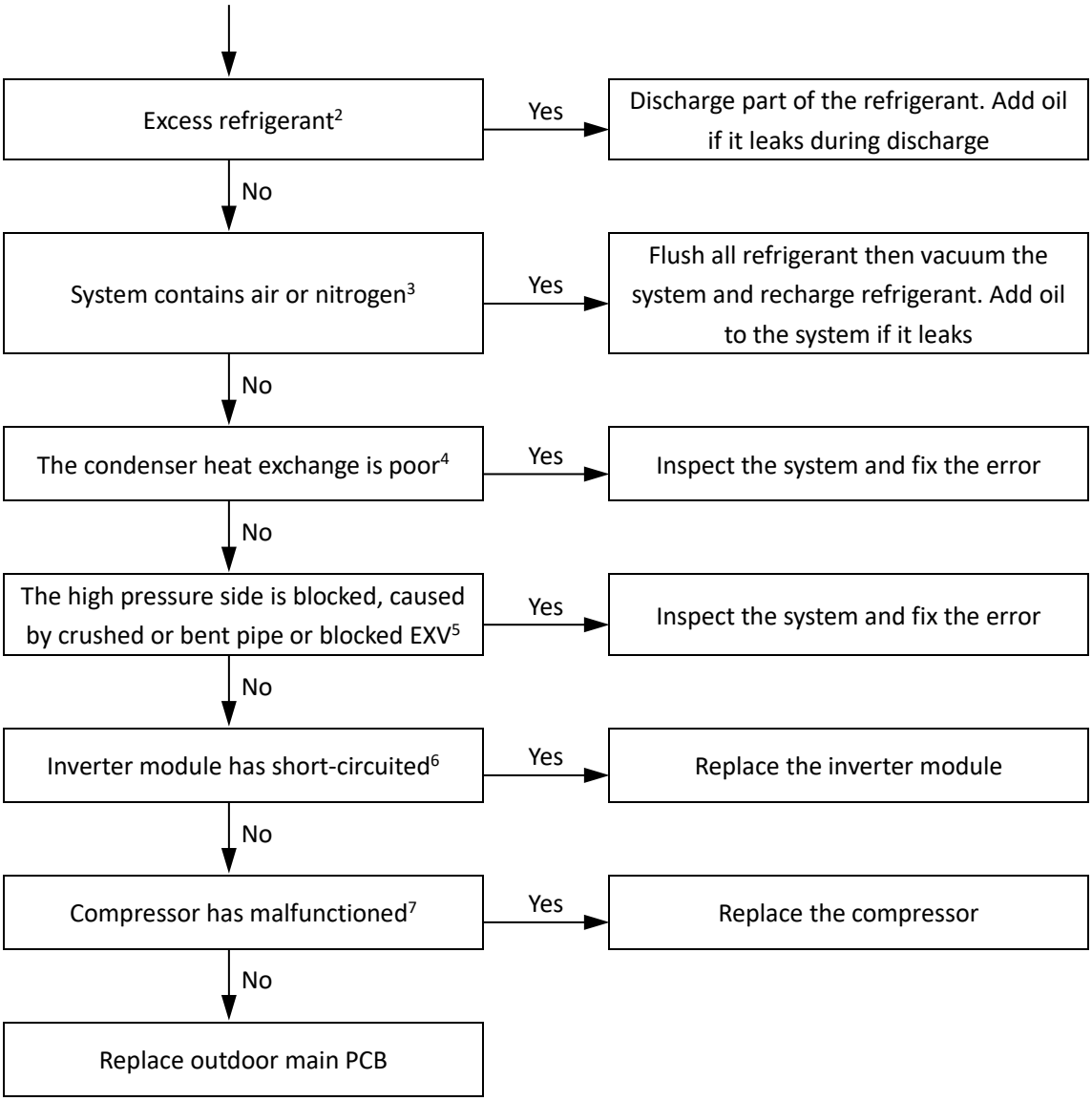
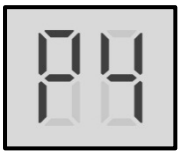


Notes:

1. An indoor load that is too large causes suction and discharge temperatures to be higher than normal. For normal system parameters refer to Table 6-3.4 and 6-3.5 in Part 6, 3.2 “Normal Operating Parameters of Refrigerant System”.
2. Excess refrigerant causes discharge temperature to be lower than normal, discharge pressure to be higher than normal and suction pressure to be higher than normal. For normal system parameters refer to Table 6-3.4 and 6-3.5 in Part 6, 3.2 “Normal Operating Parameters of Refrigerant System”.
3. Air or nitrogen in the system causes discharge temperature to be higher than normal, discharge pressure to be higher than normal, compressor current to be higher than normal, abnormal compressor noise and an unsteady pressure meter reading. For normal system parameters refer to Table 6-3.4 and 6-3.5 in Part 6, 3.2 “Normal Operating Parameters of Refrigerant System”.
4. In cooling mode check outdoor heat exchangers, fans and air outlets for dirt/blockages. In heating mode check indoor heat exchangers, fans and air outlets for dirt/blockages.
5. 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. For normal system parameters refer to Table 6-3.4 and 6-3.5 in Part 6, 3.2 “Normal Operating Parameters of Refrigerant System”.
6. Set a multi-meter to buzzer mode and test any two terminals of P N U V W of the inverter module. If the buzzer sounds, the inverter module has short-circuited.
7. The normal resistances of the inverter compressor are 0.7-1.5Ω 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.

2.17 P4: Discharge temperature protection

2.17.1 Digital display output



2.17.2 Description

- Discharge temperature protection.
- The system stops running.
- Error code is displayed on the unit with the error.

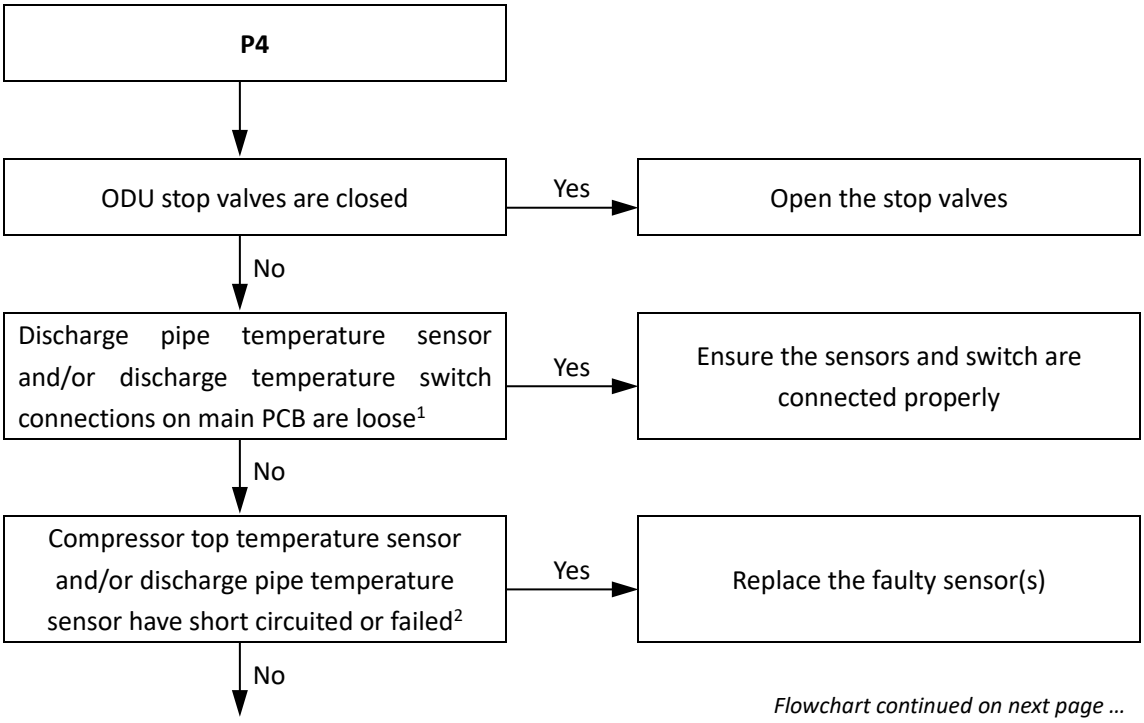
2.17.3 Trigger / recover condition

- Trigger condition:
  Discharge temperature (T5) > 110°C.
- Recover condition: Discharge temperature (T5) < 85 °C.
- Reset method:
  Resume automatically.

2.17.4 Possible causes

- Outdoor unit stop valves are closed.
- Temperature sensor/switch not connected properly or has malfunctioned.
- Insufficient refrigerant.
- System blockage.
- Indoor load too large.
- System contains air or nitrogen.
- Poor condenser heat exchange.
- Main PCB damaged.

2.17.5 Procedure



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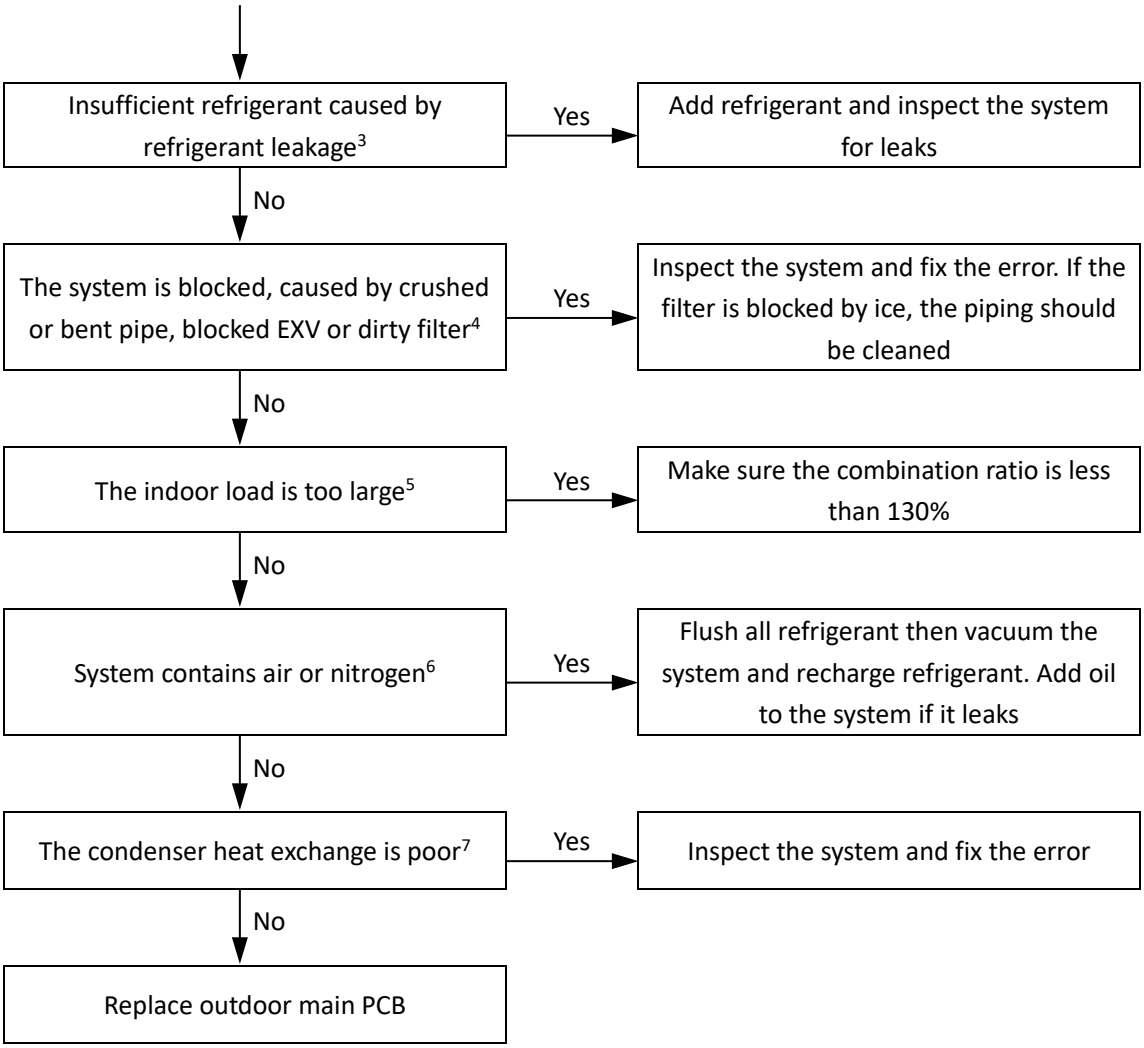


Notes:

1. Compressor top temperature sensor and discharge pipe temperature sensor connections are ports CN4 and CN5 on the main PCB (labeled 3 and 4, respectively, in Figure 5-2.1 in Part 5, 2.1 “Ports”). The discharge temperature switch connection is port CN18 on the main PCB (labeled 2 in Figure 5-2.1 in Part 5, 2.1 “Ports”).
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 Table 6-3.2 in Part 6, 3.1 “Temperature Sensor Resistance Characteristics”.
3. 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. For normal system parameters refer to Table 6-3.4 and 6-3.5 in Part 6, 3.2 “Normal Operating Parameters of Refrigerant 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 refer to Table 6-3.4 and 6-3.5 in Part 6, 3.2 “Normal Operating Parameters of Refrigerant System”.
5. An indoor load that is too large causes suction and discharge temperatures to be higher than normal. For normal system parameters refer to Table 6-3.4 and 6-3.5 in Part 6, 3.2 “Normal Operating Parameters of Refrigerant System”.
6. Air or nitrogen in the system causes discharge temperature to be higher than normal, discharge pressure to be higher than normal, compressor current to be higher than normal, abnormal compressor noise and an unsteady pressure meter reading. For normal system parameters refer to Table 6-3.4 and 6-3.5 in Part 6, 3.2 “Normal Operating Parameters of Refrigerant System”.
7. In cooling mode check outdoor heat exchangers, fans and air outlets for dirt/blockages. In heating mode check indoor heat exchangers, fans and air outlets for dirt/blockages.

2.18 P5: Outdoor heat exchanger temperature protection

2.18.1 Digital display output

2.18.2 Description

- Outdoor heat exchanger temperature protection.
- The system stops running.
- Error code is displayed on the unit with the error.

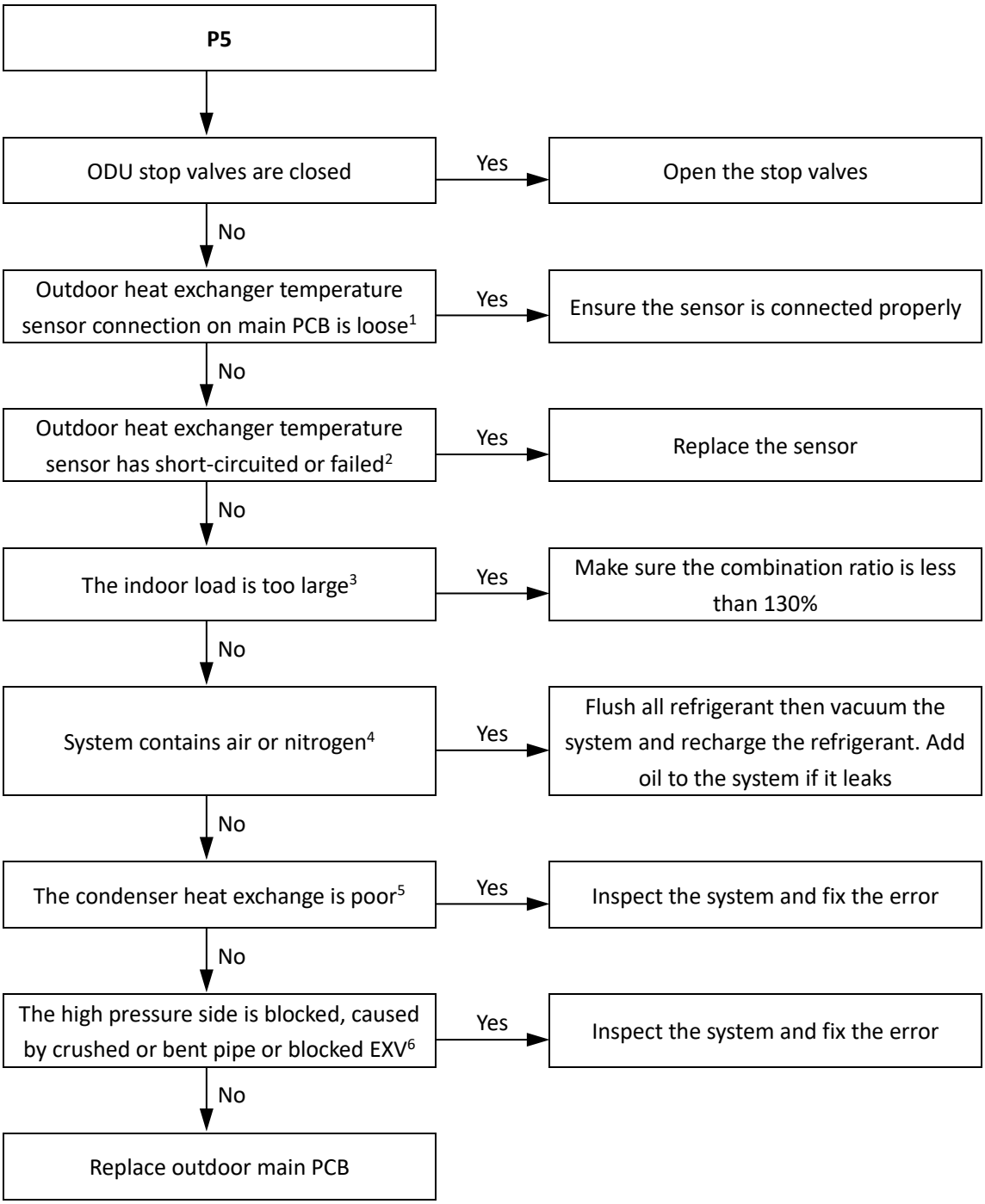
2.18.3 Trigger / recover condition

- Trigger condition: Outdoor heat exchanger temperature (T3) ≥ 65°C.
- Recover condition: Outdoor heat exchanger temperature (T3) < 55 °C.
- Reset method: Resume automatically.

2.18.4 Possible causes

- Outdoor unit stop valves are closed.
- Temperature sensor not connected properly or has malfunctioned.
- Indoor load too large.
- System contains air or nitrogen.
- Poor condenser heat exchange.
- High pressure side blockage.
- Main PCB damaged.

2.18.5 Procedure



Notes:

1. Outdoor heat exchanger temperature sensor connection is port CN1 on the main PCB (labeled 11 in Figure 5-2.1 in Part 5, 2.1 “Ports”).
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 Table 6-3.1 in Part 6, 3.1 “Temperature Sensor Resistance Characteristics”
3. An indoor load that is too large causes suction and discharge temperatures to be higher than normal. For normal system parameters refer to Table 6-3.4 and 6-3.5 in Part 6, 3.2 “Normal Operating Parameters of Refrigerant System”.
4. Air or nitrogen in the system causes discharge temperature to be higher than normal, discharge pressure to be higher than normal, compressor current to be higher than normal, abnormal compressor noise and an unsteady pressure meter reading. For normal system parameters refer to Table 6-3.4 and 6-3.5 in Part 6, 3.2 “Normal Operating Parameters of Refrigerant System”.
5. In cooling mode check outdoor heat exchangers, fans and air outlets for dirt/blockages. In heating mode check indoor heat exchangers, fans and air outlets for dirt/blockages.
6. 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. For normal system parameters refer to Table 6-3.4 and 6-3.5 in Part 6, 3.2 “Normal Operating Parameters of Refrigerant System”.

2.19 P8: Typhoon protection

2.19.1 Digital display output

2.19.2 Description

- P8 indicates strong wind protection.
- The system stops running.
- Error code is displayed on the outdoor unit PCB.

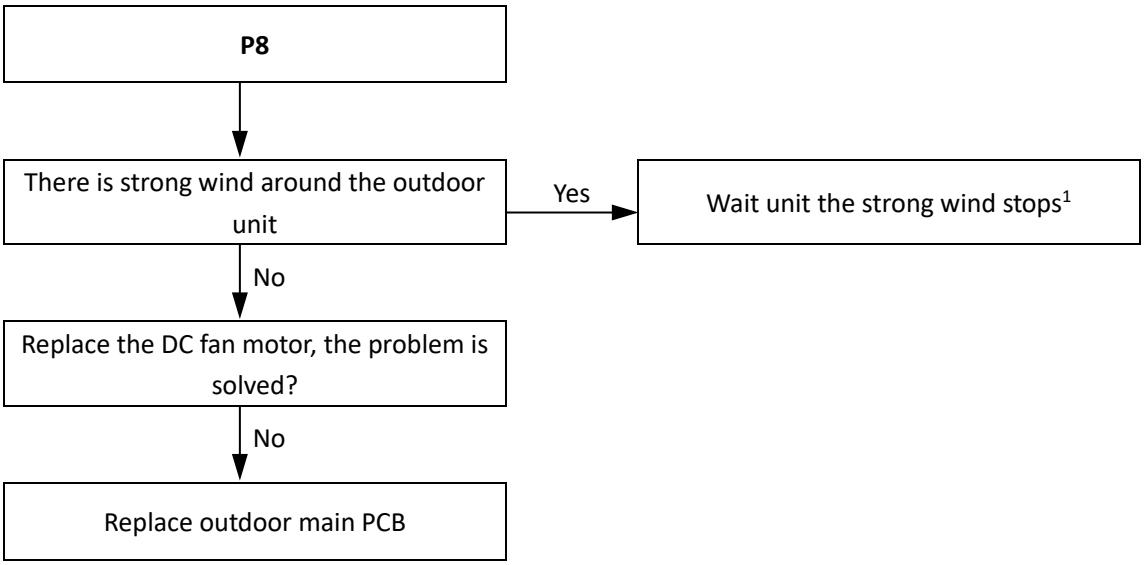
2.19.3 Trigger / recover condition

- Trigger condition:
  Fan speed ≥400rps when the outdoor unit is not start up.
- Recover condition:
  Both the upper and lower fan speed < 400rps for more than 120S.
- Reset method:
  Resume automatically.

2.19.4 Possible causes

- There is strong wind around the outdoor unit.
- DC fan motor is damaged.
- Main PCB damaged.

2.19.5 Procedure



Notes:

1. P8 protection recovers in 2 minutes when the strong wind stops.

2.20 PL: Inverter module temperature protection

2.20.1 Digital display output

2.20.2 Description

- PL indicates inverter module temperature protection.
- The system stops running.
- Error code is displayed on the outdoor unit PCB.

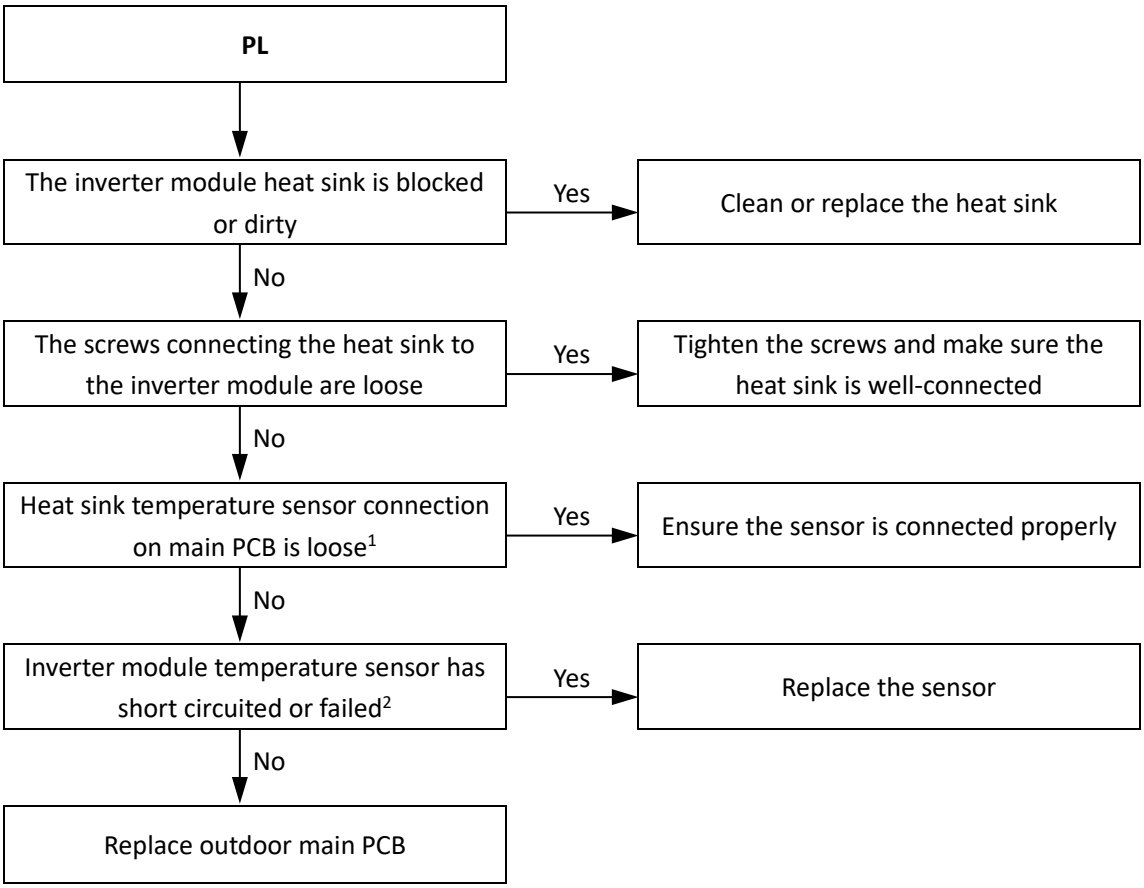
2.20.3 Trigger / recover condition

- Trigger condition:
  Inverter module heat sink temperature (Tf) ≥ 72°C.
- Recover condition:
  Inverter module heat sink temperature (Tf) < 66°C
- Reset method:
  Resume automatically.

2.20.4 Possible causes

- Blocked, dirty or loose heat sink.
- Temperature sensor not connected properly or has malfunctioned.
- Main PCB damaged.

2.20.5 Procedure



Notes:

2. Heat sink temperature sensor connection is port CN14 on the main PCB (labeled 4 in Figure 5-2.1 in Part 5, 2.1 “Ports”).
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 Table 6-3.3 in Part 6, 3.1 “Temperature Sensor Resistance Characteristics”.

3 Appendix to Part 6

3.1 Temperature Sensor Resistance Characteristics

Table 6-3.1: Outdoor ambient temperature sensor, outdoor heat exchanger temperature sensor and refrigerant cooling pipe temperature sensor resistance characteristics

Temperature (°C)	Resistance (kΩ)	Temperature (°C)	Resistance (kΩ)	Temperature (°C)	Resistance (kΩ)	Temperature (°C)	Resistance (kΩ)
-20	115.3	**20**	12.64	**60**	2.358	**100**	0.6297
-19	108.1	**21**	12.06	**61**	2.272	**101**	0.6115
-18	101.5	**22**	11.50	**62**	2.191	**102**	0.5939
-17	96.34	**23**	10.97	**63**	2.112	**103**	0.5768
-16	89.59	**24**	10.47	**64**	2.037	**104**	0.5604
-15	84.22	**25**	10.00	**65**	1.965	**105**	0.5445
-14	79.31	**26**	9.551	**66**	1.896	**106**	0.5291
-13	74.54	**27**	9.124	**67**	1.830	**107**	0.5143
-12	70.17	**28**	8.720	**68**	1.766	**108**	0.4999
-11	66.09	**29**	8.336	**69**	1.705	**109**	0.4860
-10	62.28	**30**	7.971	**70**	1.647	**110**	0.4726
-9	58.71	**31**	7.624	**71**	1.591	**111**	0.4596
-8	56.37	**32**	7.295	**72**	1.537	**112**	0.4470
-7	52.24	**33**	6.981	**73**	1.485	**113**	0.4348
-6	49.32	**34**	6.684	**74**	1.435	**114**	0.4230
-5	46.57	**35**	6.400	**75**	1.387	**115**	0.4116
-4	44.00	**36**	6.131	**76**	1.341	**116**	0.4006
-3	41.59	**37**	5.874	**77**	1.291	**117**	0.3899
-2	39.82	**38**	5.630	**78**	1.254	**118**	0.3796
-1	37.20	**39**	5.397	**79**	1.2133	**119**	0.3695
0	35.20	**40**	5.175	**80**	1.174	**120**	0.3598
1	33.33	**41**	4.964	**81**	1.136	**121**	0.3504
2	31.56	**42**	4.763	**82**	1.100	**122**	0.3413
3	29.91	**43**	4.571	**83**	1.064	**123**	0.3325
4	28.35	**44**	4.387	**84**	1.031	**124**	0.3239
5	26.88	**45**	4.213	**85**	0.9982	**125**	0.3156
6	25.50	**46**	4.046	**86**	0.9668	**126**	0.3075
7	24.19	**47**	3.887	**87**	0.9366	**127**	0.2997
8	22.57	**48**	3.735	**88**	0.9075	**128**	0.2922
9	21.81	**49**	3.590	**89**	0.8795	**129**	0.2848
10	20.72	**50**	3.451	**90**	0.8525	**130**	0.2777
11	19.69	**51**	3.318	**91**	0.8264	**131**	0.2708
12	18.72	**52**	3.192	**92**	0.8013	**132**	0.2641
13	17.80	**53**	3.071	**93**	0.7771	**133**	0.2576
14	16.93	**54**	2.959	**94**	0.7537	**134**	0.2513
15	16.12	**55**	2.844	**95**	0.7312	**135**	0.2451
16	15.34	**56**	2.738	**96**	0.7094	**136**	0.2392
17	14.62	**57**	2.637	**97**	0.6884	**137**	0.2334
18	13.92	**58**	2.540	**98**	0.6682	**138**	0.2278
19	13.26	**59**	2.447	**99**	0.6486	**139**	0.2223

Table 6-3.2: Compressor discharge pipe temperature sensor resistance characteristics

Temperature (°C)	Resistance (kΩ)	Temperature (°C)	Resistance (kΩ)	Temperature (°C)	Resistance (kΩ)	Temperature (°C)	Resistance (kΩ)
-20	542.7	**20**	68.66	**60**	13.59	**100**	3.702
-19	511.9	**21**	65.62	**61**	13.11	**101**	3.595
-18	483.0	**22**	62.73	**62**	12.65	**102**	3.492
-17	455.9	**23**	59.98	**63**	12.21	**103**	3.392
-16	430.5	**24**	57.37	**64**	11.79	**104**	3.296
-15	406.7	**25**	54.89	**65**	11.38	**105**	3.203
-14	384.3	**26**	52.53	**66**	10.99	**106**	3.113
-13	363.3	**27**	50.28	**67**	10.61	**107**	3.025
-12	343.6	**28**	48.14	**68**	10.25	**108**	2.941
-11	325.1	**29**	46.11	**69**	9.902	**109**	2.860
-10	307.7	**30**	44.17	**70**	9.569	**110**	2.781
-9	291.3	**31**	42.33	**71**	9.248	**111**	2.704
-8	275.9	**32**	40.57	**72**	8.940	**112**	2.630
-7	261.4	**33**	38.89	**73**	8.643	**113**	2.559
-6	247.8	**34**	37.30	**74**	8.358	**114**	2.489
-5	234.9	**35**	35.78	**75**	8.084	**115**	2.422
-4	222.8	**36**	34.32	**76**	7.820	**116**	2.357
-3	211.4	**37**	32.94	**77**	7.566	**117**	2.294
-2	200.7	**38**	31.62	**78**	7.321	**118**	2.233
-1	190.5	**39**	30.36	**79**	7.086	**119**	2.174
0	180.9	**40**	29.15	**80**	6.859	**120**	2.117
1	171.9	**41**	28.00	**81**	6.641	**121**	2.061
2	163.3	**42**	26.90	**82**	6.430	**122**	2.007
3	155.2	**43**	25.86	**83**	6.228	**123**	1.955
4	147.6	**44**	24.85	**84**	6.033	**124**	1.905
5	140.4	**45**	23.89	**85**	5.844	**125**	1.856
6	133.5	**46**	22.89	**86**	5.663	**126**	1.808
7	127.1	**47**	22.10	**87**	5.488	**127**	1.762
8	121.0	**48**	21.26	**88**	5.320	**128**	1.717
9	115.2	**49**	20.46	**89**	5.157	**129**	1.674
10	109.8	**50**	19.69	**90**	5.000	**130**	1.632
11	104.6	**51**	18.96	**91**	4.849		
12	99.69	**52**	18.26	**92**	4.703		
13	95.05	**53**	17.58	**93**	4.562		
14	90.66	**54**	16.94	**94**	4.426		
15	86.49	**55**	16.32	**95**	4.294		
16	82.54	**56**	15.73	**96**	4.167		
17	78.79	**57**	15.16	**97**	4.045		
18	75.24	**58**	14.62	**98**	3.927		
19	71.86	**59**	14.09	**99**	3.812		

Table 6-3.3: Heat sink temperature sensor resistance characteristics

Temperature (°C)	Resistance (kΩ)	Temperature (°C)	Resistance (kΩ)	Temperature (°C)	Resistance (kΩ)	Temperature (°C)	Resistance (kΩ)
-30	971.4	**10**	109.0	**50**	19.70	**90**	5.000
-29	912.8	**11**	103.9	**51**	18.97	**91**	4.855
-28	858.2	**12**	99.02	**52**	18.26	**92**	4.705
-27	807.3	**13**	94.44	**53**	17.59	**93**	4.566
-26	759.7	**14**	90.11	**54**	16.94	**94**	4.431
-25	715.3	**15**	86.00	**55**	16.32	**95**	4.301
-24	673.6	**16**	82.09	**56**	15.73	**96**	4.176
-23	634.7	**17**	78.38	**57**	15.16	**97**	4.055
-22	598.2	**18**	74.87	**58**	14.62	**98**	3.938
-21	564.1	**19**	71.53	**59**	14.10	**99**	3.825
-20	532.2	**20**	68.36	**60**	13.60	**100**	3.716
-19	502.2	**21**	65.34	**61**	13.12	**101**	3.613
-18	474.1	**22**	62.47	**62**	12.65	**102**	3.514
-17	447.7	**23**	59.75	**63**	12.22	**103**	3.418
-16	423.0	**24**	57.17	**64**	11.79	**104**	3.326
-15	399.8	**25**	54.71	**65**	11.39	**105**	3.235
-14	378.0	**26**	52.36	**66**	10.99	**106**	3.148
-13	357.5	**27**	50.13	**67**	10.62	**107**	3.063
-12	338.2	**28**	48.01	**68**	10.25	**108**	2.982
-11	320.1	**29**	45.99	**69**	9.909	**109**	2.902
-10	303.1	**30**	44.07	**70**	9.576	**110**	2.826
-9	287.1	**31**	42.23	**71**	9.253	**111**	2.747
-8	272.0	**32**	40.48	**72**	8.947	**112**	2.672
-7	257.8	**33**	38.81	**73**	8.646	**113**	2.599
-6	244.4	**34**	37.23	**74**	8.362	**114**	2.528
-5	231.9	**35**	35.71	**75**	8.089	**115**	2.460
-4	220.0	**36**	34.27	**76**	7.821	**116**	2.390
-3	208.7	**37**	32.89	**77**	7.569	**117**	2.322
-2	198.2	**38**	31.58	**78**	7.323	**118**	2.256
-1	188.2	**39**	30.33	**79**	7.088	**119**	2.193
0	178.8	**40**	29.13	**80**	6.858	**120**	2.132
1	169.9	**41**	27.98	**81**	6.640	**121**	2.073
2	161.5	**42**	26.89	**82**	6.432	**122**	2.017
3	153.6	**43**	25.85	**83**	6.230	**123**	1.962
4	146.1	**44**	24.85	**84**	6.033	**124**	1.910
5	139.1	**45**	23.90	**85**	5.847	**125**	1.859
6	132.3	**46**	22.98	**86**	5.667		
7	126.0	**47**	22.10	**87**	5.492		
8	120.0	**48**	21.26	**88**	5.322		
9	114.3	**49**	20.47	**89**	5.159		

3.2 Normal Operating Parameters of Refrigerant System

Under the following conditions, the operating parameters given in Tables 6-3.4 and 6-3.5 should be observed:

- The outdoor unit can detect all the indoor units.
- The number of indoor units displayed on DSP is steady and is equal to the actual number of indoor units installed.
- All stop valves are open and all indoor unit EXVs are connected to their unit's PCB.
- All the indoor units are currently running.
- If the outdoor ambient temperature is high, the system is being run in cooling mode with the following settings: temperature 17°C; fan speed high.
- If the outdoor ambient temperature is low, the system is being run in heating mode with the following settings: temperature 30°C; fan speed high.
- The system has been running normally for more than 30 minutes.

Table 6-3.4: Outdoor unit cooling mode operating parameters

Outdoor ambient temperature	**°C**	< 10	10 to 26	26 to 31	31 to 41	> 41
Average discharge temperature	**°C**	60-76	62-78	65-82	67-92	69-92
Average discharge superheat	**°C**	17-30	17-33	17-34	17-36	10-32
Discharge pressure	**MPa**	2.3-2.8	2.3-2.8	2.4-3.6	2.6-3.8	3.1-4.2
Suction pressure	**MPa**	0.6-0.7	0.7-0.9	0.8-1.0	1.0-1.2	1.2-1.4
DC inverter compressor current	**A**	7-18	10-20	12-25	15-27	18-25

Table 6-3.5: Outdoor unit heating mode operating parameters

Outdoor ambient temperature	**°C**	< -10	-10 to 0	0 to 5	5 to 10	10 to 17	> 17
Average discharge temperature	**°C**	56-74	57-76	58-78	61-82	63-82	63-82
Average discharge superheat	**°C**	17-35	17-35	17-35	17-33	14-33	14-33
Discharge pressure	**MPa**	1.7-2.4	1.8-2.5	1.9-3.0	2.2-3.2	2.3-3.2	2.3-3.2
Suction pressure	**MPa**	1.4-1.6	1.5-1.7	1.6-2.2	1.8-2.6	1.8-2.6	2.0-2.4
DC inverter compressor current	**A**	11-23	12-25	10-25	10-26	10-22	13-20