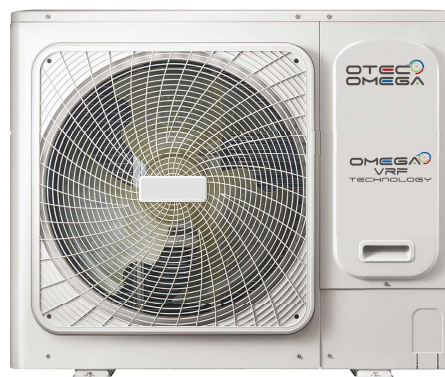
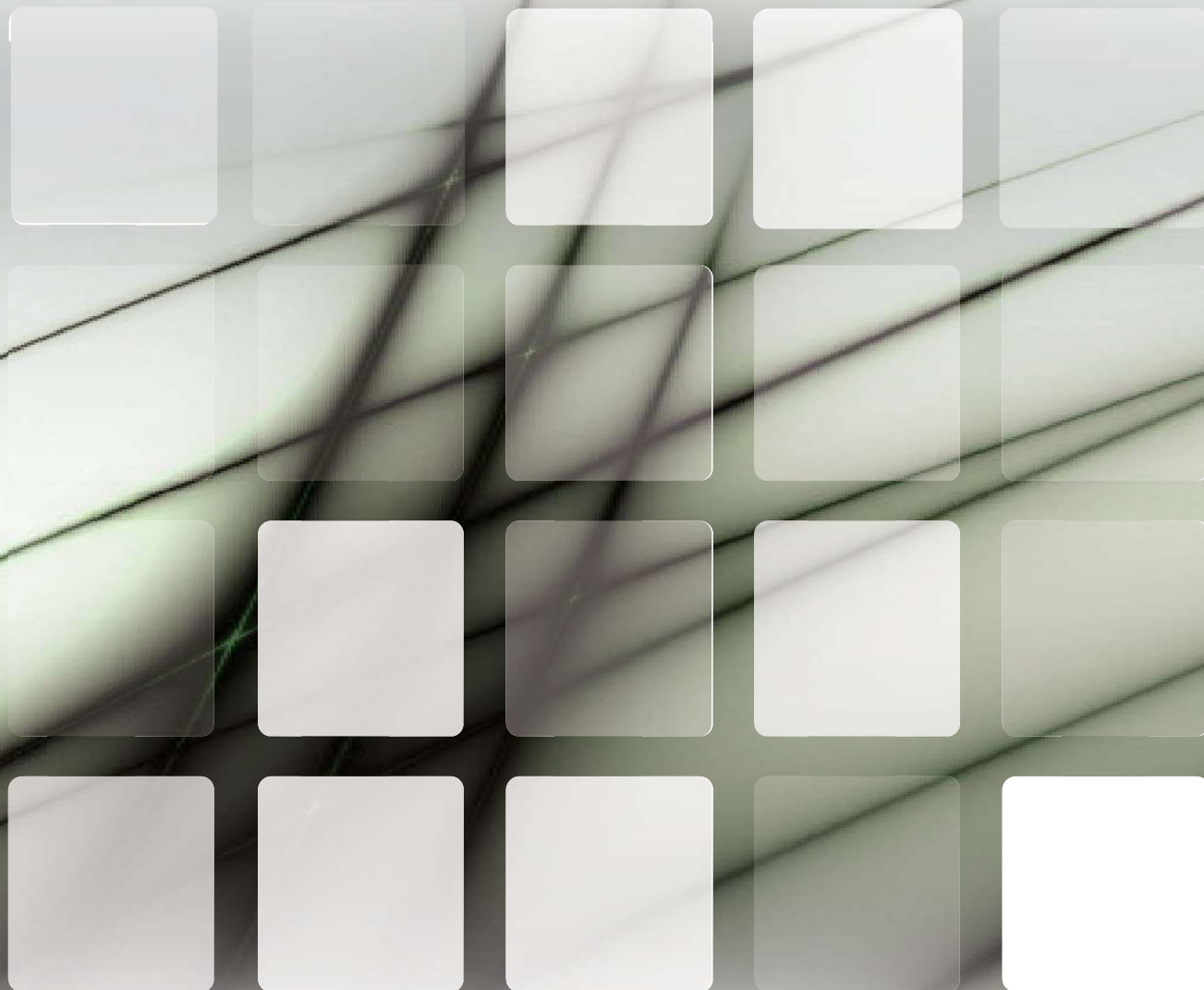


BCSF-D ULTIMA Series

Mini VRF Outdoor Unit

Service Manual

220~240V/1/50Hz



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Part 3 Field Settings and Troubleshooting.....	15

Part 1

General Information

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2	External Appearance.....	4
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1 Indoor and Outdoor Unit Capacities

1.1 Indoor Units

Table 1-1.1: Indoor unit abbreviation codes

Abbreviation code	Type
BECW	One-way Cassette
BECM	Compact Four-way Cassette
BECS	Four-way Cassette
BEMP	Medium Static Pressure Duct
BEWM	Wall-mounted

Table 1-1.2: Indoor unit capacity range

Capacity			Capacity index	BECW	BECM	BECS	BEMP	BEWM
kBtu/h	kW	HP						
5	1.5	0.54	5	—	5	—	—	—
6	1.8	0.6	6	6	—	—	—	—
7	2.2	0.8	7	7	7	—	7	7
9	2.8	1	9	9	9	9	9	9
12	3.6	1.25	12	12	12	12	12	12
15	4.5	1.6	15	15	15	15	15	15
18	5.6	2	18	18	—	18	18	18
24	7.1	2.5	24	24	—	24	24	24
28	8.0	3	28	—	—	28	28	28
32	9.0	3.2	32	—	—	32	32	32
36	10.0	3.6	36	—	—	36	—	—
40	11.2	4	40	—	—	40	40	—
48	14.0	5	48	—	—	48	48	—
56	16.0	6	56	—	—	—	56	—

Notes:

1. Atom series indoor units could connect to Atom series outdoor units.

1.2 Outdoor Units

Table 1-1.3: Outdoor unit capacity range

Capacity (kBtu/h)	Model Name
30.7	BCSF030N0A4-DTM090
37.5	BCSF040N0A6-DTM115
47.7	BCSF050N0A7-DTM140
54.6	BCSF060N0A8-DTM160
64.8	BCSF070N0A9-DTM190

Notes:

1. Atom series outdoor units could not be combined.

2 External Appearance

2.1 Indoor Units

Table 1-2.1: Indoor unit appearance

<p>One-way Cassette</p> 	<p>Four-way Cassette</p> 
<p>Compact Four-way Cassette</p> 	<p>Wall-mounted</p> 
<p>Medium Static Pressure Duct</p> 	

2.2 Outdoor Units

Table 1-2.2: Outdoor unit appearance

30/40/50 Model	60/70 Model
	

3 Combination Ratio

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

Table 1-3.1: Indoor and outdoor unit combination ratio limitations

Type	Minimum combination ratio	Maximum combination ratio
Atom Series outdoor units	45%	130%

Table 1-3.2: Combinations of Indoor and outdoor units

Outdoor unit capacity		Sum of capacity indexes of connected indoor units (standard indoor units only)	Number of connected indoor units
kBtu/h	Capacity index		
30.7	28	12.6 to 36.4	1-4
37.5	36	16.2 to 46.8	1-6
47.8	42	18.9 to 54.6	1-7
54.6	48	21.6 to 62.4	1-8
64.8	56	25.2 to 72.8	1-9

Part 2

Component Layout and Refrigerant Circuits

1 Layout of Functional Components.....	8
2 Piping Diagrams	10
3 Refrigerant Flow Diagrams	12

1 Layout of Functional Components

BCSF030N0A4-DTM090 / BCSF040N0A6-DTM115 / BCSF050N0A7-DTM140

Figure 2-1.1: BCSF030-050 top view

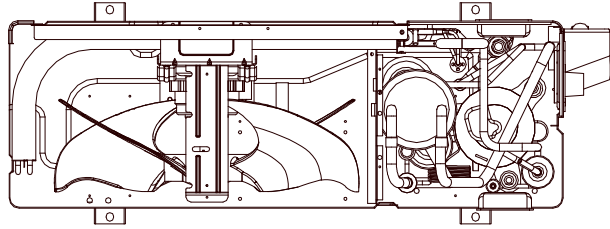
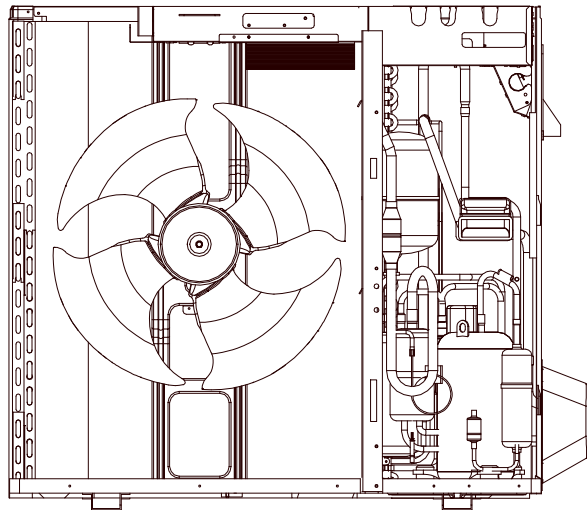


Figure 2-1.2: BCSF060, 070 front view



BCSF060N0A8-DTM160 / BCSF070N0A9-DTM190

Figure 2-1.3: BCSF060, 070 top view

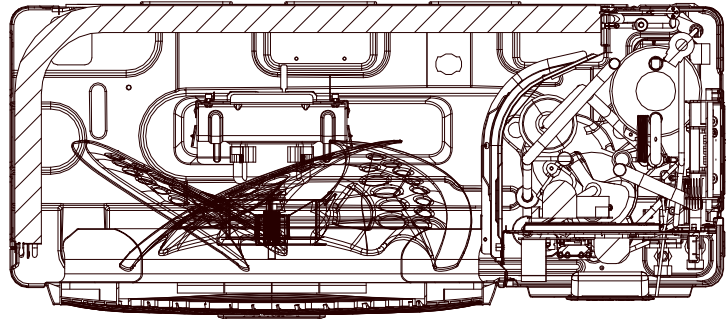
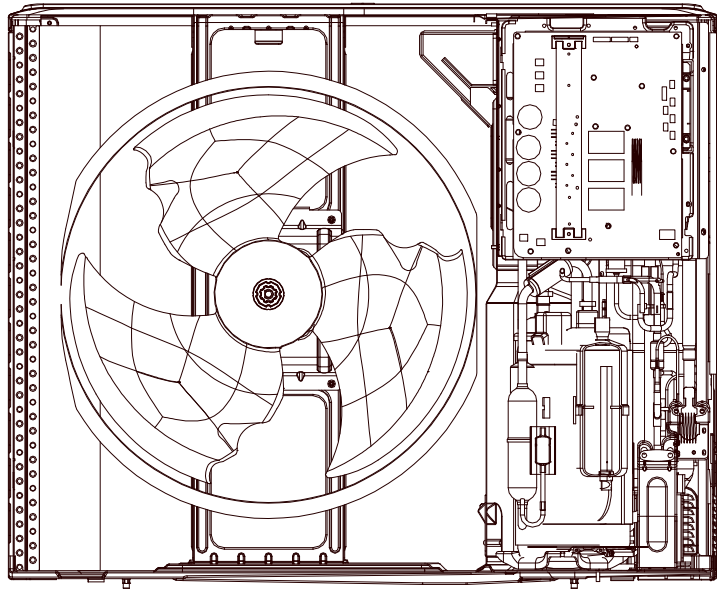


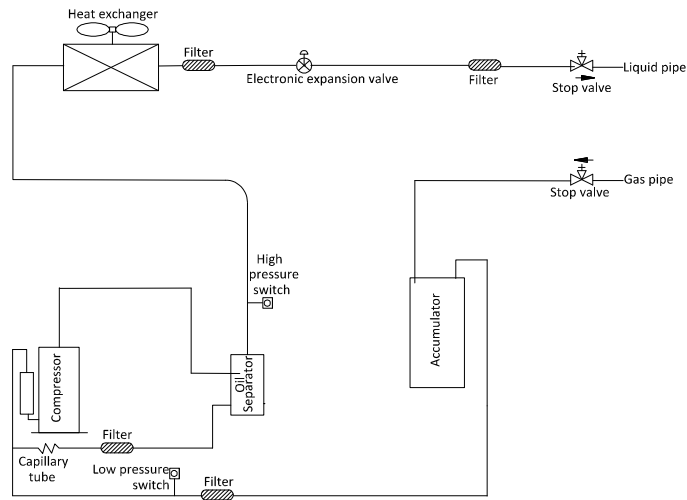
Figure 2-1.4: BCSF060, 070 front view



2 Piping Diagrams

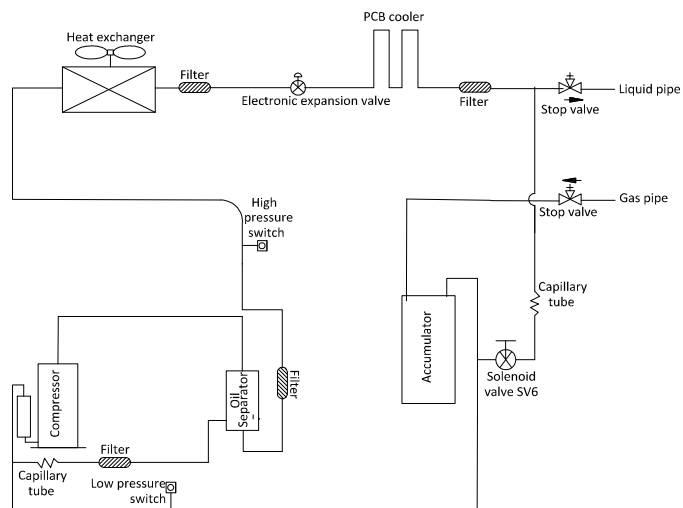
BCSF030N0A4-DTM090 / BCSF040N0A6-DTM115 / BCSF050N0A7-DTM140

Figure 2-2.1: BCSF030-050 piping diagram



BCSF060N0A8-DTM160 / BCSF070N0A9-DTM190

Figure 2-2.2: BCSF060, 070 piping diagram



Key components:

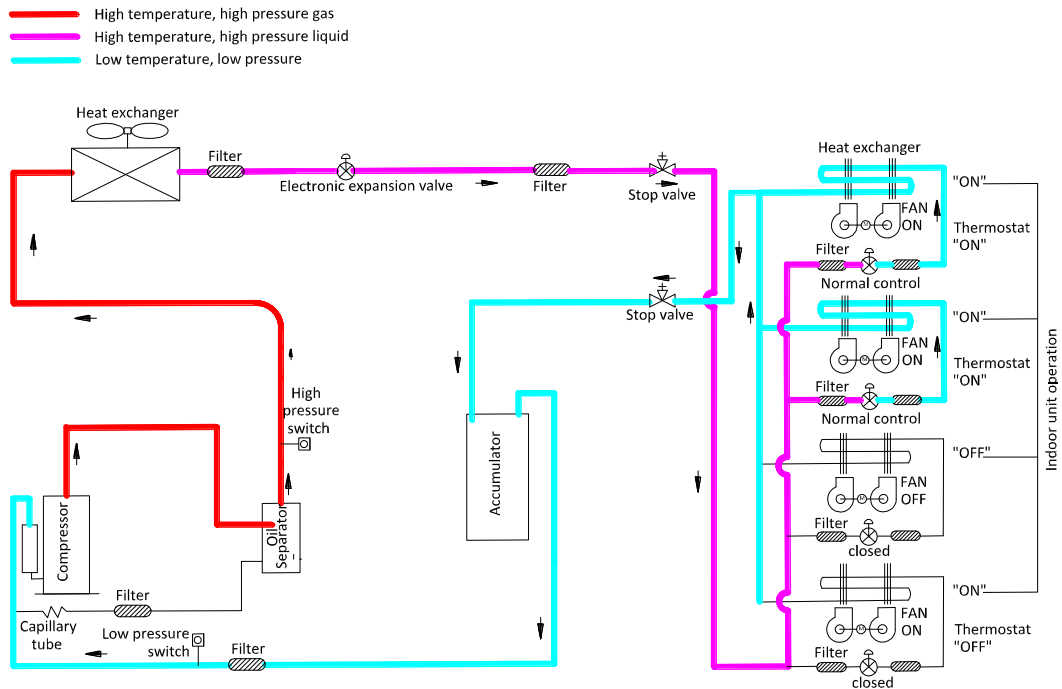
1. **Oil separator:**
Separates oil from gas refrigerant pumped out of the compressor and quickly returns it to the compressor. Separation efficiency is up to 99%.
2. **Accumulator:**
Stores liquid refrigerant and oil to protect compressor from liquid hammering.
3. **Electronic expansion valve (EXV):**
Controls refrigerant flow and reduces refrigerant pressure.
4. **Solenoid valve SV6:**
Protects the compressor. If compressor discharge temperature rises above 100°C, SV6 opens and sprays a small amount of liquid refrigerant to cool the compressor. SV6 closes again once the discharge temperature has fallen below 90°C.
5. **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 10 minutes, the compressor restarts.

3 Refrigerant Flow Diagrams

BCSF030N0A4-DTM090 / BCSF040N0A6-DTM115 / BCSF050N0A7-DTM140

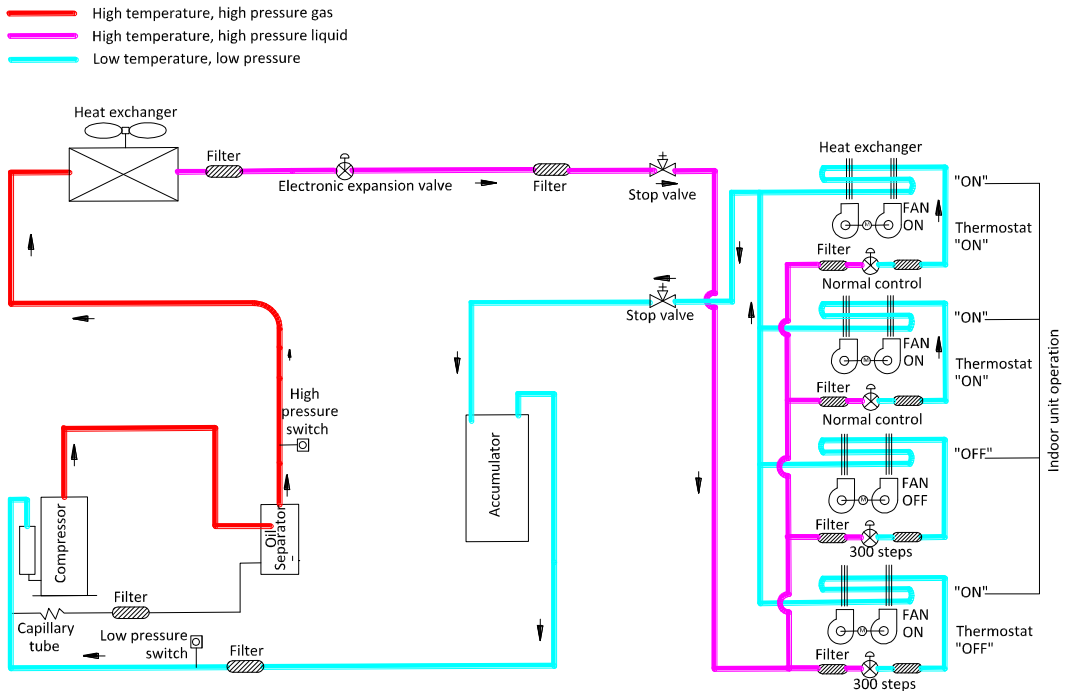
Cooling operation

Figure 2-3.1: BCSF030-050 refrigerant flow during cooling operation



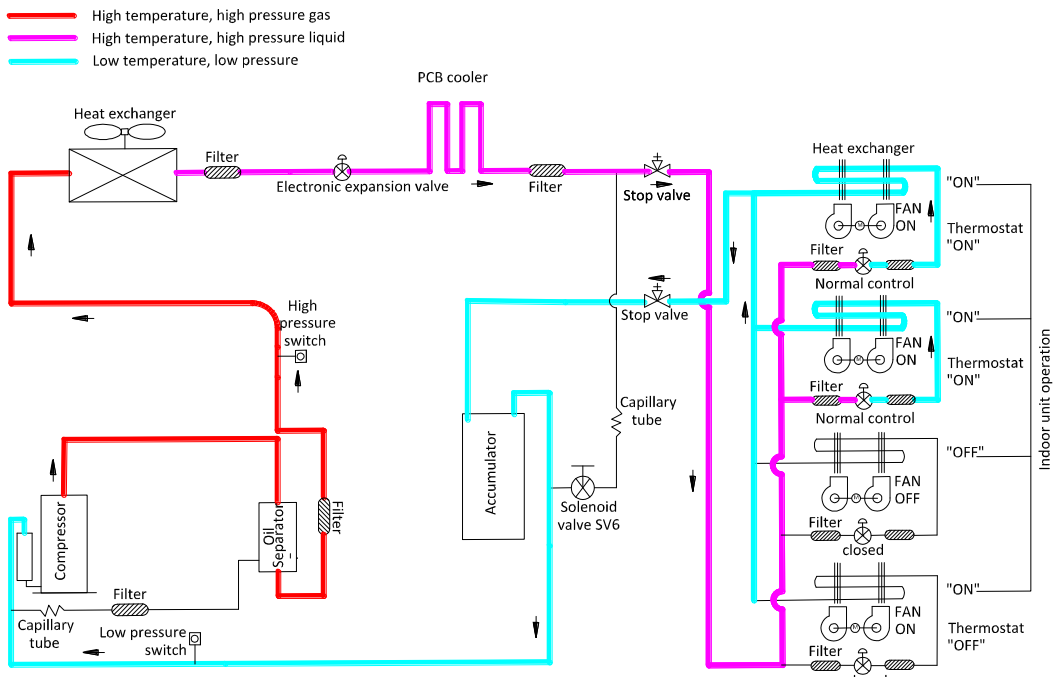
Oil return operation in cooling mode

Figure 2-3.2: BCSF030-050 refrigerant flow during oil return operation in cooling mode



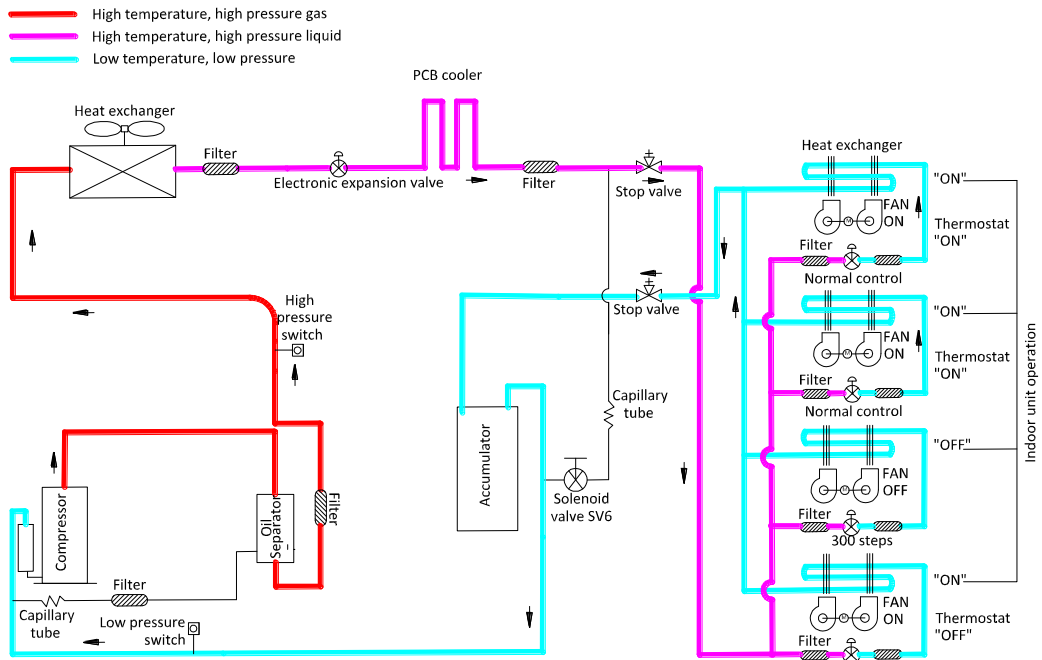
Cooling operation

Figure 2-3.5: BCSF060, 070 refrigerant flow during cooling operation



Oil return operation in cooling mode

Figure 2-3.6: BCSF060, 070 refrigerant flow during oil return operation in cooling mode





Part 3

Field settings and Troubleshooting

1 Outdoor Unit PCB Layout	16
2 Outdoor Unit Main PCB.....	17
3 Error Code Table.....	23
4 Troubleshooting	24
5 Appendix to Part 3	43

1 Outdoor Unit PCB Layout

BCSF030N0A4-DTM090 / BCSF040N0A6-DTM115 / BCSF050N0A7-DTM140

Figure 3-1.1: BCSF030-050 main PCB

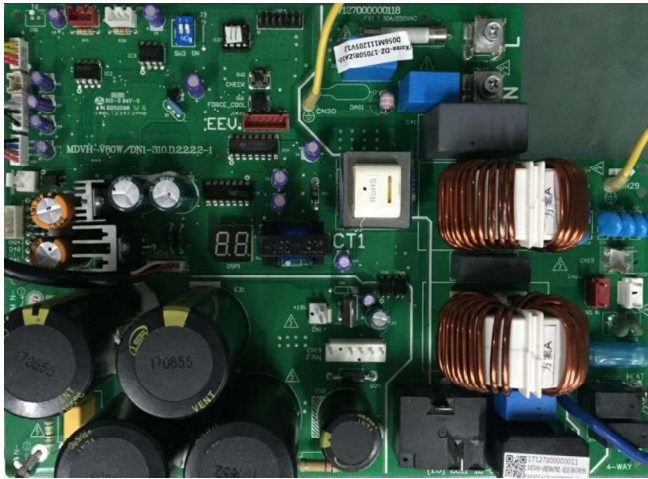


Figure 3-1.2: BCSF030-050 inverter module



BCSF060N0A8-DTM160 / BCSF070N0A9-DTM190

Figure 3-1.3: BCSF060, 070 main PCB

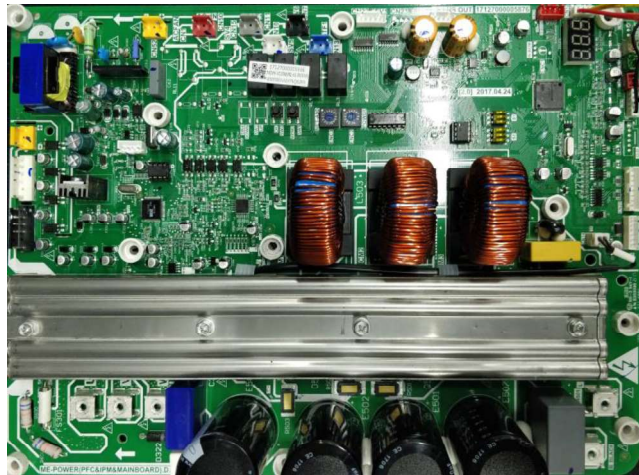
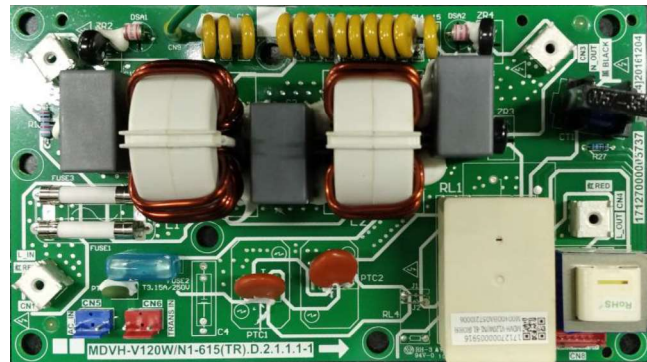


Figure 3-1.4: BCSF060, 070 filter board



2 Outdoor Unit Main PCB

2.1 Types

There are two main PCB types for Cooling Only Mini VRF outdoor units. 30/40/50 Model units share a main PCB type and 60/70 Model units share a main PCB type. When changing a main PCB, be sure to use the right type of main PCB. Refer to Fig. 3-1.1 to Fig.3-1.4.

2.2 Ports

Figure 3-2.1: Outdoor unit main PCB ports¹ (30/40/50 Model)

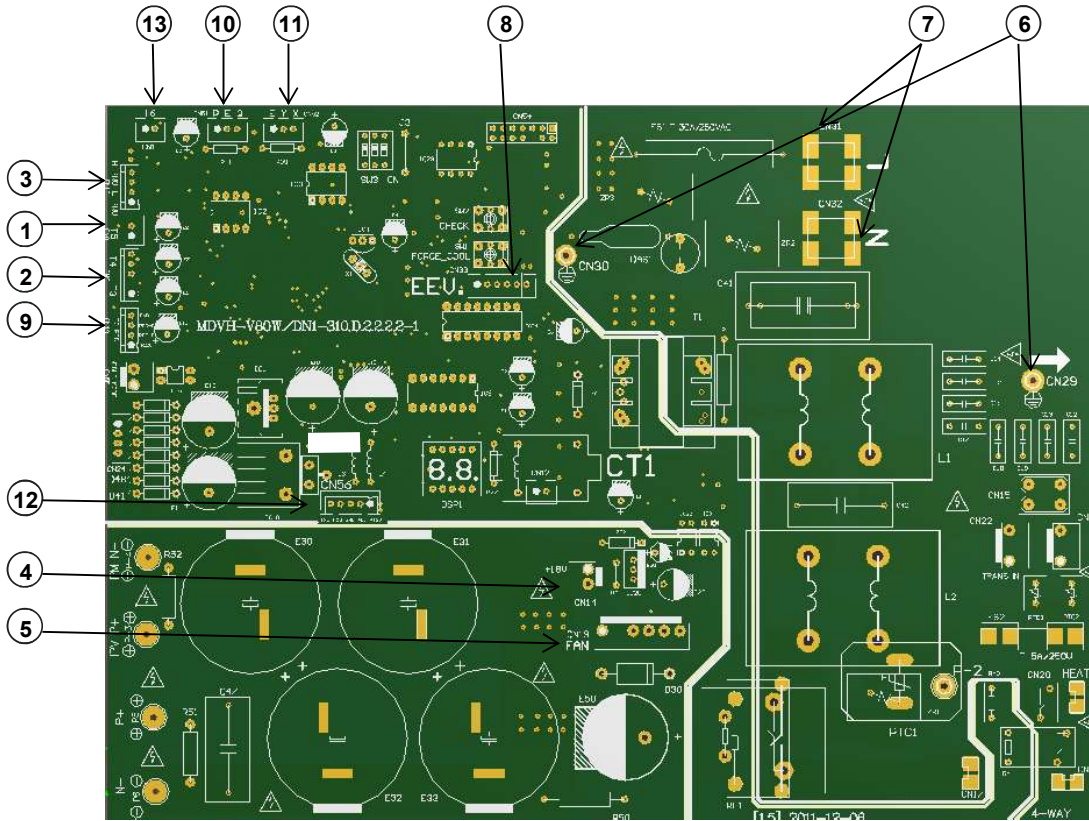


Table 3-2.1: Main PCB ports (30/40/50 Model)

Label in Figure 4-2.1	Port code	Content
1	CN8	Discharge temperature (T5) sensor connection
2	CN9	Outdoor ambient temperature (T4) sensor and outdoor heat exchanger temperature sensor (T3) connections
3	CN10	Low pressure switch and high pressure switch connections
4	CN14	Fan control power input
5	CN19	Fan drive port
6	CN29/30	Ground connections
7	CN31/32	Power supply
8	CN33	EXV drive port
9	CN49	Connects with CN101 in inverter module PCB
10	CN51	PQE communication connection
11	CN52	XYE communication connection
12	CN56	Connects with CN105
13	CN1	Reserved

Figure 3-2.2: Outdoor unit main PCB ports¹ (60/70 Model)

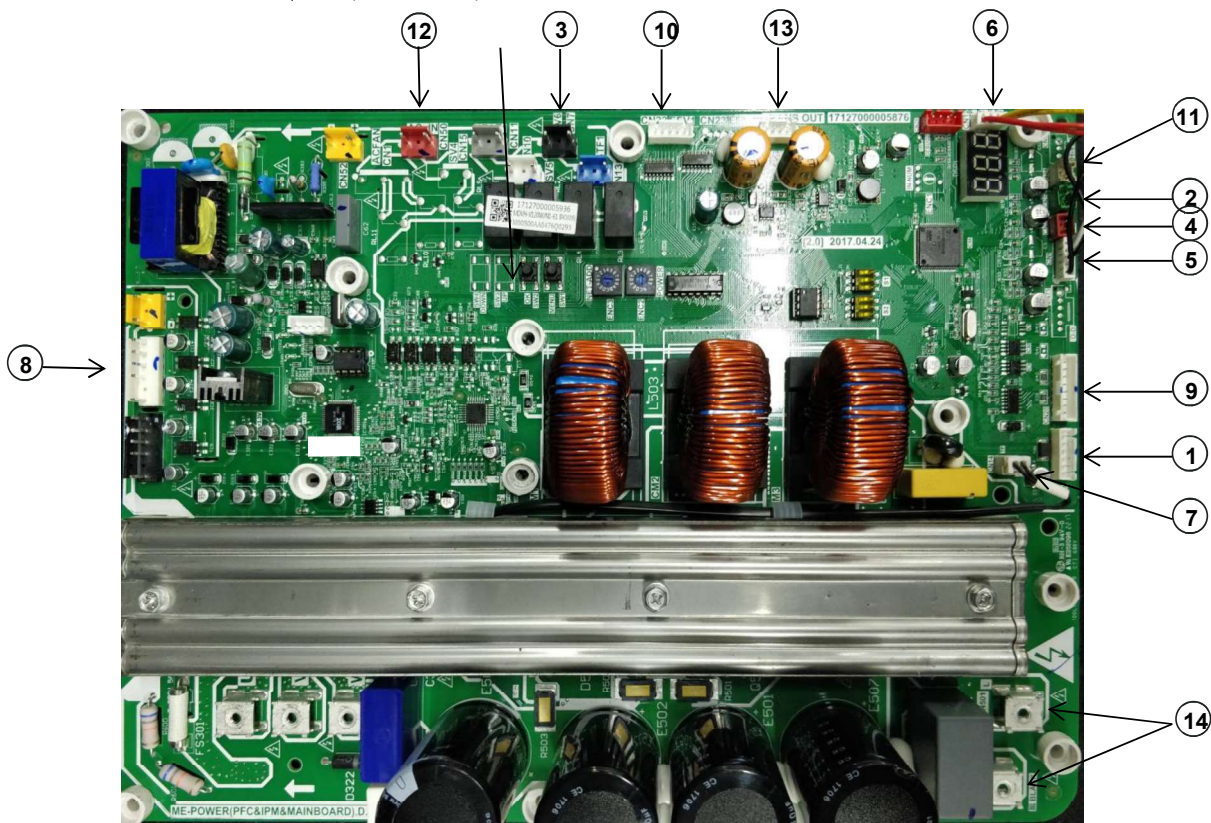


Table 3-2.2: Main PCB ports (60/70 Model)

Label in Figure 4-2.2	Port code	Content
1	CN4	Connects to CN8 in filter board
2	CN5	Discharge temperature (T5) sensor connection
3	CN7	SV6 drive port
4	CN8	Short circuit (T6) sensor connection
5	CN9	Outdoor ambient temperature (T4) sensor and outdoor heat exchanger temperature sensor (T3) connections
6	CN12	Low pressure switch and high pressure switch connections
7	CN14	Radiator temperature (TF) sensor connection
8	CN17	Fan control port
9	CN20	Communication connections
10	CN22	EXV drive port
11	CN24	Radiator pipe temperature (TL) sensor connection
12	CN50	AC power supply connection
13	CN51	Connects to CN6 in filter board
14	CN501/502	Power supply

2.3 Components

2.3.1 Layout

Figure 3-2.3: Outdoor unit main PCB components (30/40/50)

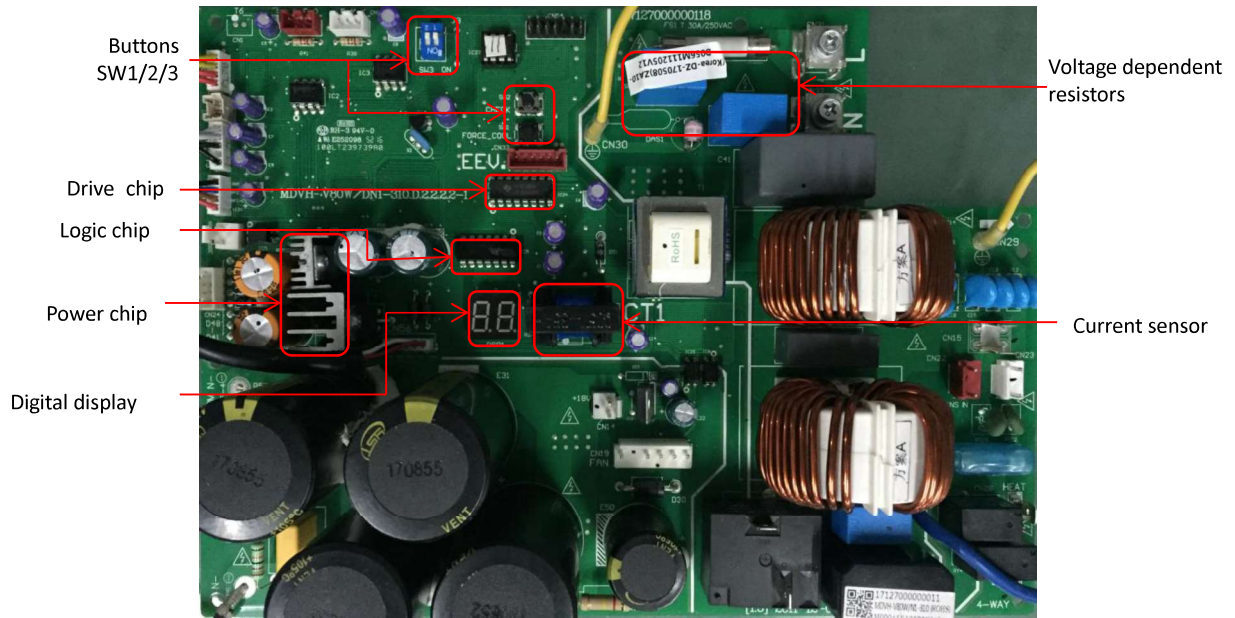
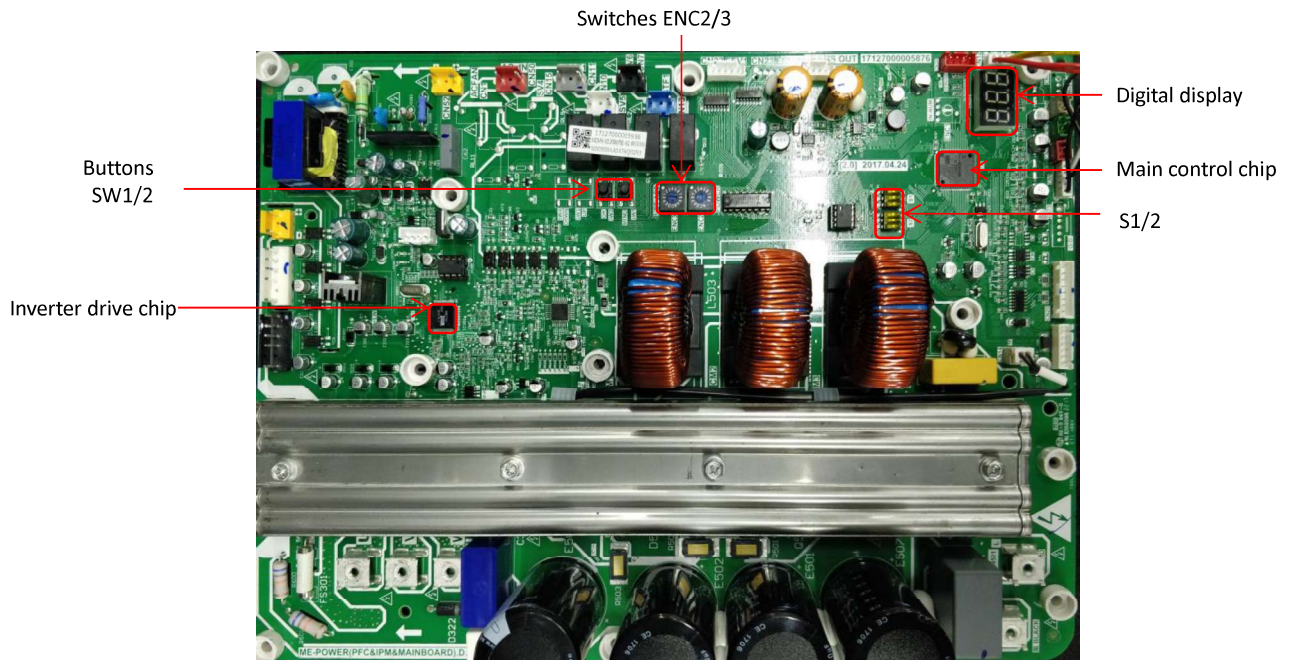


Figure 3-2.4: Outdoor unit main PCB components (60/70)



2.3.2 Function of buttons and switches

Table 3-2.3: Function of buttons SW1 to SW3 (30/40/50)

Button	Function
SW1	Force cooling
SW2	System check
SW3	Address setting
IC23	Outdoor unit capacity

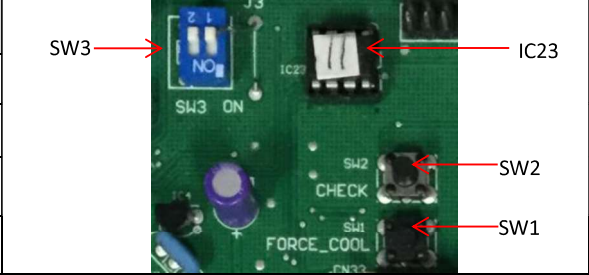
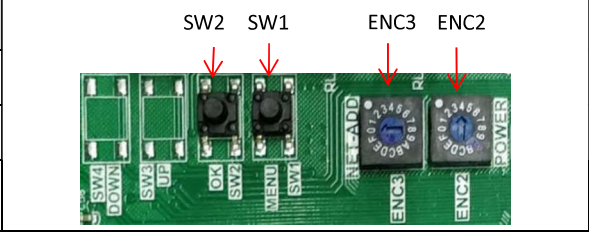


Table 3-2.4: Function of buttons (60/70)

Button	Function
SW1	Force cooling
SW2	System check
S2	Multi-function



2.3.3 Switch settings

Table 3-2.5: Outdoor unit main PCB switch settings (30/40/50)













Switch	Setting	Switch positions	Description	
 SW3	Addressing mode	1	ON	Auto addressing
			OFF	Manual addressing(Factory default)
		2	ON	Clear indoor addresses
			OFF	/

Table 3-2.6: Outdoor unit main PCB switch settings (48/56)

 S1	Multi-function	 ON: Former indoor protocol OFF: Select the protocol automatically(Factory default)
		 ON: Clean the indoor address OFF: Set the address automatically(Factory default)
		 ON: EXV control by discharge temperature(Factory default) OFF: Auto EXV control
 S2	Multi-function	 Auto priority mode (default)
		 Cooling priority mode
		 First priority mode
		 Cooling only mode
 ENC2	Outdoor unit capacity	3: 48kBtu/h, 4: 56kBtu/h,
 ENC3	Network address	Only 0, 1, 2, 3, 4, 5, 6, 7 should be selected

2.3.4 SW2 system check button

Before pressing SW2, allow the system to operate steadily for more than an hour. On pressing SW2, the parameters listed in Table 3-2.7 or Table 3-2.8 will be displayed in sequence.

Table 3-2.7: SW2 system check (30/40/50)

DSP1 content	Parameters displayed on DSP1	Remarks
- 0	Normal display	Operating frequency
- 1	Operating mode	0-Standby;2-Cooling;4-Forced cooling
- 2	Fan speed index	The fan speed index is related to the fan speed in rpm.
- 3	Indoor unit demand metric (total of all units)	
- 4	Outdoor unit output metric (after revision)	
- 5	T3-Outdoor heat exchanger pipe temperature (°C)	Actual value = value displayed
- 6	T4-Outdoor ambient temperature (°C)	Actual value = value displayed
- 7	T5-Inverter compressor discharge temperature (°C)	Actual value = value displayed
- 8	Reserved	
- 9	EXV position	Steps = value displayed ×8
10	Actual current value	Actual value = value displayed
11	Actual voltage AD value	Actual value = value displayed
12	T2B-average temperature	Actual value = value displayed
13	Number of indoor units	
14	Number of operating indoor units	
15	Model	7=30.7kBtu/h;9=37.5kBtu/h;11=47.8kBtu/h
16	Most recent error or protection code	00 is displayed if no error or protection events have occurred since start-up
17	--	End



Table 3-2.8: SW2 system check (60/70)

DSP1 content	Parameters displayed on DSP1	Remarks
- 0	Normal display	Operating frequency
- 1	Operating mode	0-Standby;2-Cooling;4-Forced cooling
- 2	Fan speed index	The fan speed index is related to the fan speed in rpm.
- 3	Indoor unit demand metric (total of all units)	
- 4	Outdoor unit output metric (after revision)	
- 5	T3-Outdoor heat exchanger pipe temperature (°C)	Actual value = value displayed
- 6	T4-Outdoor ambient temperature (°C)	Actual value = value displayed
- 7	T5-Inverter compressor discharge temperature (°C)	Actual value = value displayed
- 8	PCB cooler fin temperature (°C)	Actual value = value displayed
- 9	Cooling radiator pipe temperature	Actual value = value displayed
10	EXV position	Steps = value displayed ×8
11	Actual current value	Actual value = value displayed
12	Compressor current value	Actual value = value displayed
13	Actual voltage AC value	Actual value = value displayed
14	Actual voltage DC value	Actual value = value displayed
15	T2B-average temperature	Actual value = value displayed
16	Number of indoor units	
17	Number of operating indoor units	
18	Model	14.5=54.6kBtu/h;17=64.8kBtu/h

19	Outdoor unit address in Centralized control system	
20	Priority mode	Cooling only
21	Program version	
22	Most recent error or protection code	00 is displayed if no error or protection events have occurred since start-up
23	--	End

2.3.5 Digital display output

Table 3-2.9: Digital display output in different operating states

Outdoor unit state	Parameters displayed on DSP1 (30/40/50 Model)	Parameters displayed on DSP1 (60/70 Model)	
Standby	Number of online indoor units	Number of online indoor units	DSP1 
Normal operation	Running speed of the compressor in rotations per second	Running speed of the compressor in rotations per second	DSP1 
Error or protection	Error or protection code	Error or protection code	
System check	Refer to Table 3-2.7	Refer to Table 3-2.8	

3 Error Code Table

Table 3-3.1: Error code table

Error code ¹	Content	Remarks
E0	EEPROM malfunction	Only displayed on 30/40/50 unit
E2	Communication error between indoor and outdoor unit	
E3	Communication error between IR341 and outdoor unit	If displayed on 60/70 unit
E4	Outdoor ambient temperature sensor (T3 or T4) error	
E5	Abnormal power supply voltage	
E6	Fan malfunction	
E8	E6 has occurred 2 times in 10 minutes	Only displayed on 30/40/50 unit
E9	EEPROM malfunction	Only displayed on 60/70 unit
E.9.	Compressor signal error	Only displayed on 60/70 unit
Eb	E6 has occurred 6 times in 10 minutes	Only displayed on 60/70 unit
EF	PFC malfunction	Only displayed on 60/70 unit
EH	Radiator temperature sensor malfunction	Only displayed on 60/70 unit
P1	Discharge pipe high pressure protection	
P2	Suction pipe low pressure protection	
P3	Compressor current protection	
P4	Discharge temperature protection	
P5	Outdoor heat exchanger high temperature protection	
P6	Inverter module temperature protection	
P7	Indoor heat exchanger high temperature protection	
P8	Typhoon protection	
H0	Communication error between IR341 and outdoor unit	If displayed on 60/70 unit
H4	L0/L1 has occurred 3 times in 1 hour	Only displayed on 60/70 unit
L0	IPM module protection	Only displayed on 60/70 unit
L1	DC generatrix low voltage protection	Only displayed on 60/70 unit
L2	DC generatrix high voltage protection	Only displayed on 60/70 unit
L4	MCE malfunction	Only displayed on 60/70 unit
L5	Zero speed protection	Only displayed on 60/70 unit
L7	Phase sequence error	Only displayed on 60/70 unit
L8	Compressor frequency variation greater than 15Hz within one second protection	Only displayed on 60/70 unit
L9	Actual compressor frequency differs from target frequency by more than 15Hz protection	Only displayed on 60/70 unit
H7	Number of indoor units detected by outdoor unit not same as number set on main PCB	Only displayed on 60/70 unit
PL	Radiator temperature protection	Only displayed on 60/70 unit
F1	Bus voltage is less than 200V for 5s	Only displayed on 60/70 unit
PE	Indoor evaporator high temperature protection	Only displayed on 60/70 unit
ATL	T4 high temperature protection	Only displayed on 60/70 unit

4 Troubleshooting

4.1 Warning

Warning



- All electrical work must be carried out by competent and suitably qualified, certified and accredited professionals and in accordance with all applicable legislation (all national, local and other laws, standards, codes, rules, regulations and other legislation that apply in a given situation).
- Power-off the 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.

4.2 E0/E9 Troubleshooting

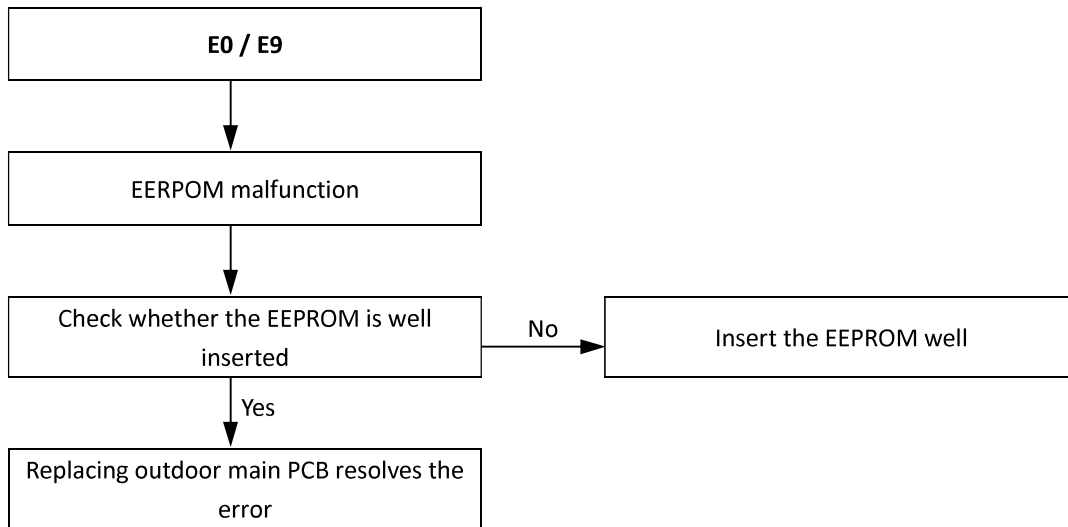
4.2.1 Description

- EEPROM malfunction.
- All units stop running.
- Error code is displayed on the outdoor unit with the error. E0 will be displayed on 30/40/50 kW unit, and E9 will be displayed on 60/70 unit.

4.2.2 Possible causes

- The EEPROM is not well inserted.
- The main PCB in outdoor unit is damaged.

4.2.3 Procedure



4.3 E2 Troubleshooting

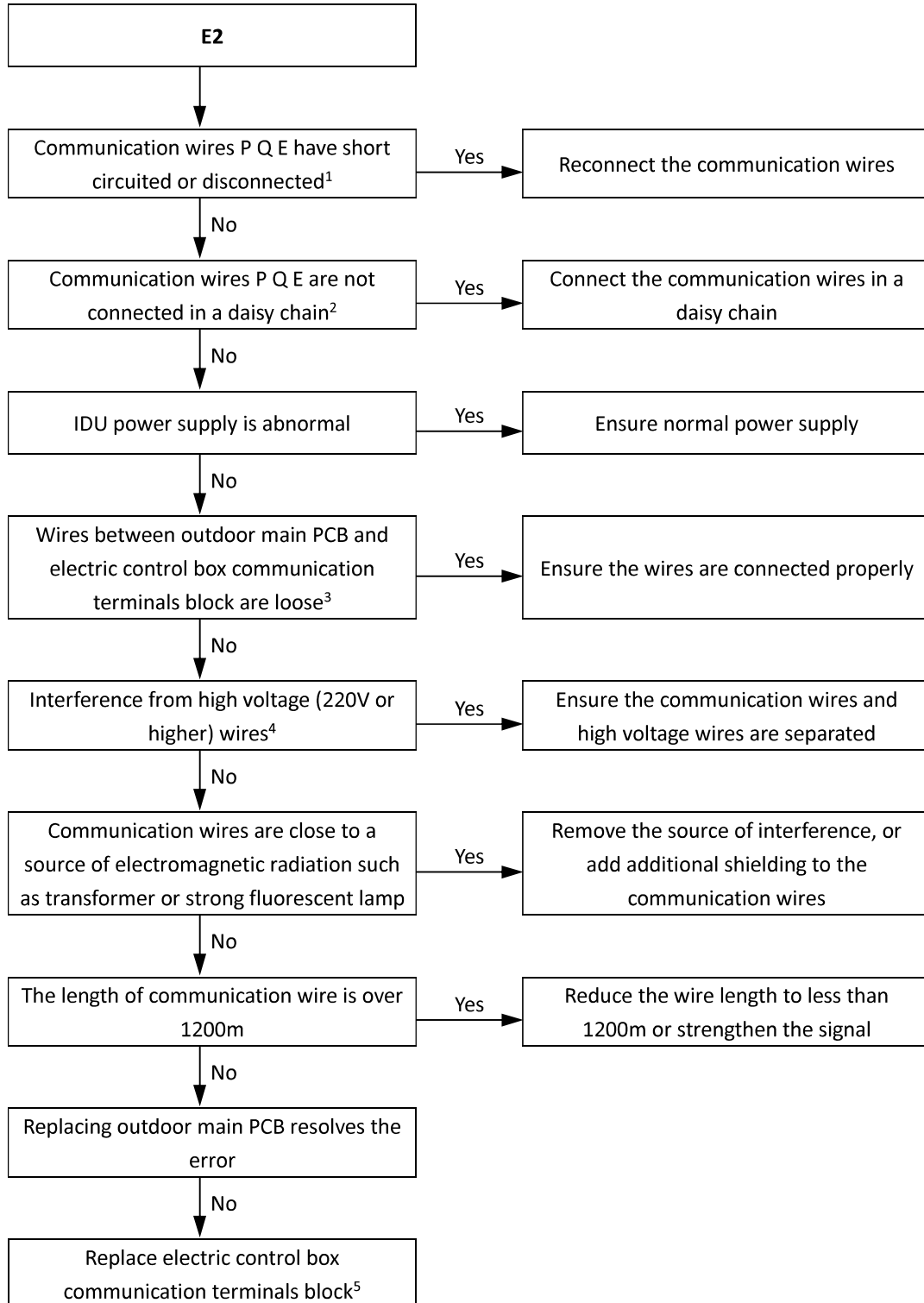
4.3.1 Description

- Communication error between indoor and master unit.
- All units stop running.

4.3.2 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.

4.3.3 Procedure



4.4 E3/H0 Troubleshooting

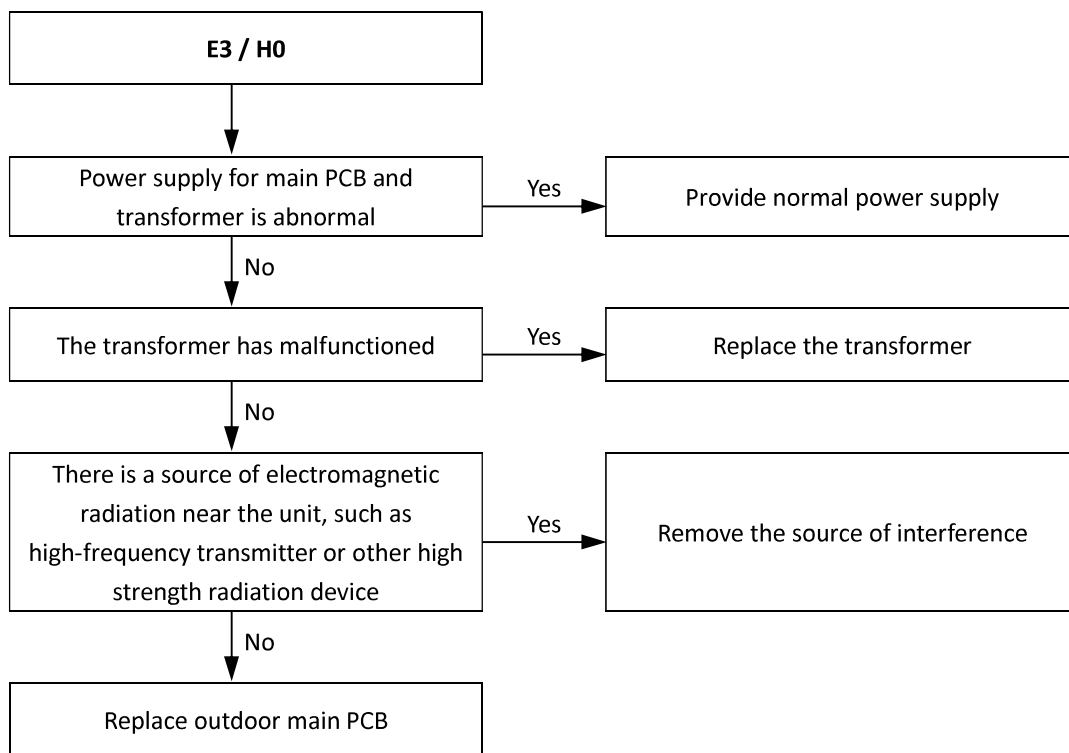
4.4.1 Description

- Communication error between the main control chip and the compressor inverter driver chip IR341
- All units stop running.
- Error code is displayed on the outdoor unit with the error. E3 will be displayed on 30/40/50 kW unit, and H0 will be displayed on 60/70 unit.

4.4.2 Possible causes

- Power supply abnormal.
- Transformer malfunction.
- Interference from a source of electromagnetic radiation.
- Main PCB damaged.

4.4.3 Procedure



4.5 E4 Troubleshooting

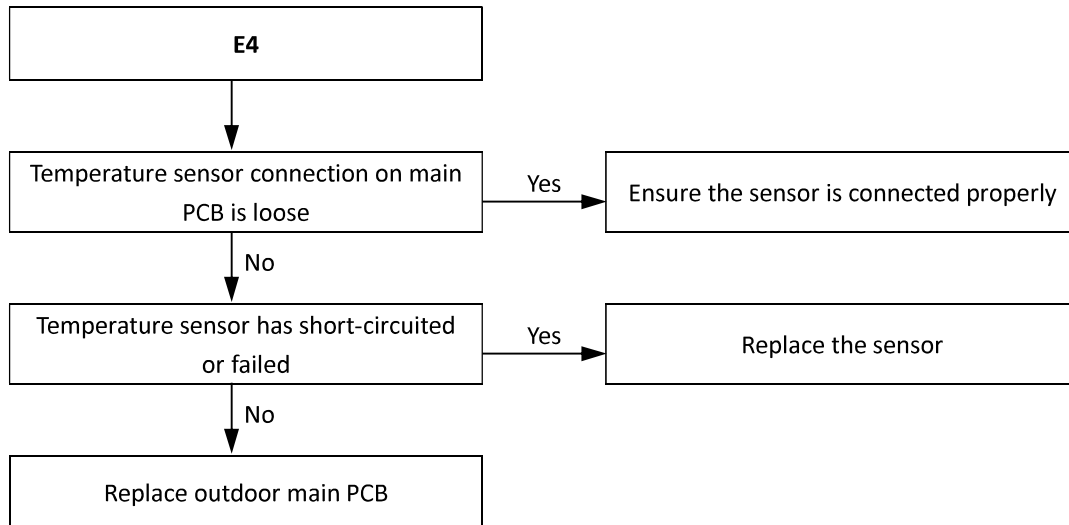
4.5.1 Description

- Outdoor ambient temperature sensor error.
- All units stop running.

4.5.2 Possible causes

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

4.5.3 Procedure



4.6 E5 Troubleshooting

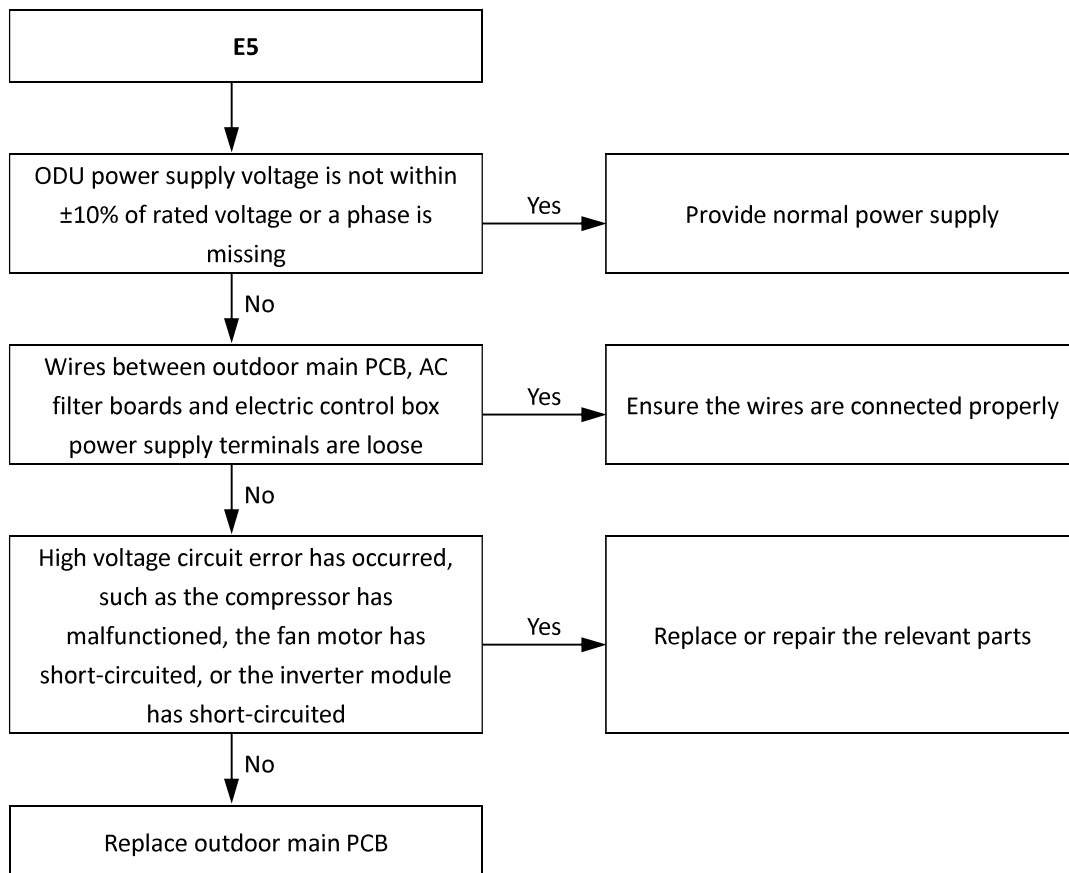
4.6.1 Description

- Abnormal power supply voltage.
- All units stop running.

4.6.2 Possible causes

- Outdoor unit power supply voltage not within $\pm 10\%$ of rated voltage or a phase is missing.
- Loosened wiring within electric control box.
- High voltage circuit error.
- Main PCB damaged.

4.6.3 Procedure



4.7 E6/E8/Eb Troubleshooting

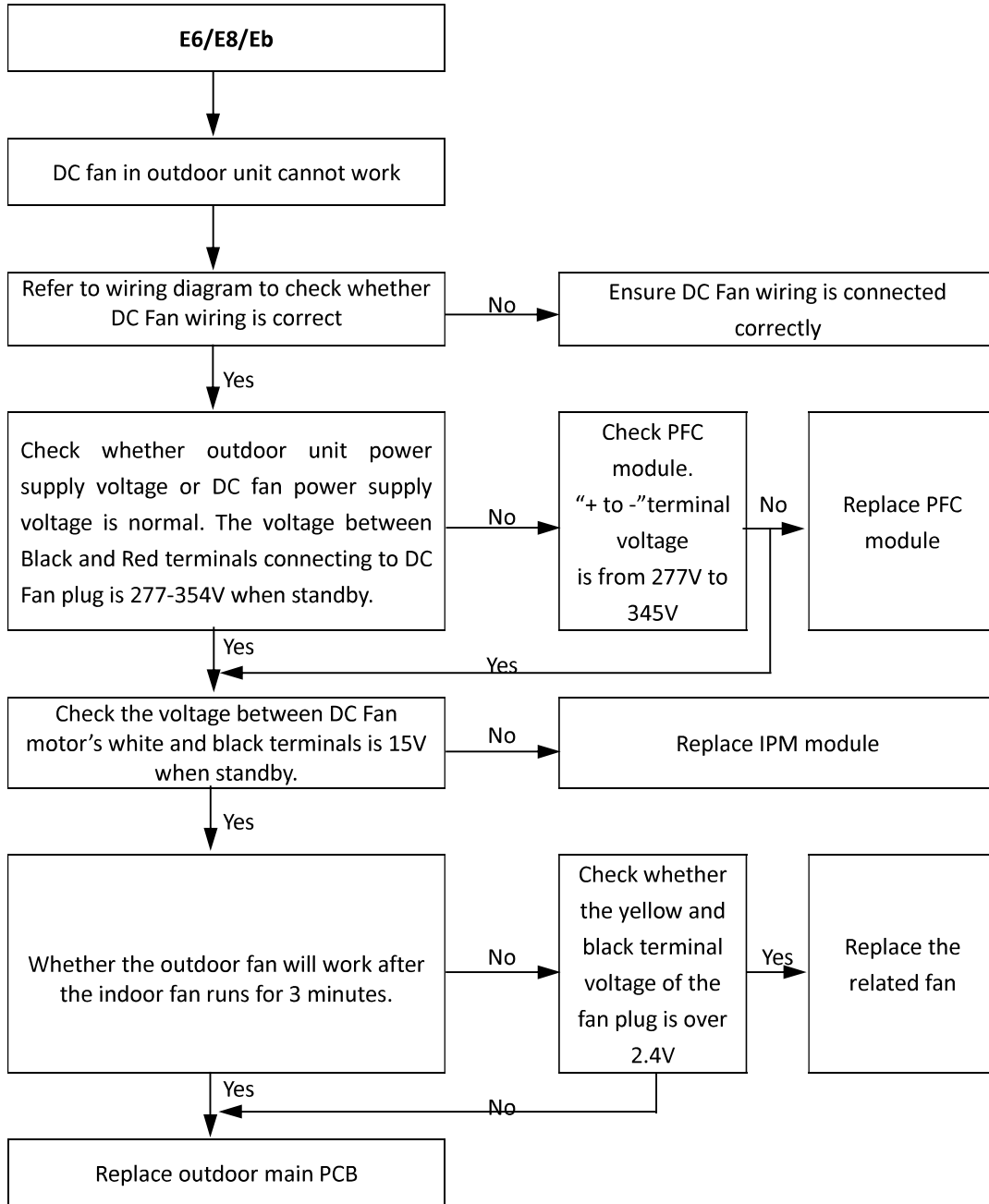
4.7.1 Description

- Fan malfunction.
- Error code E6 is for all models, and displayed on the outdoor unit with the error.
- E8 will be displayed on 30/40/50 unit if E6 has occurred 2 times in 10 minutes.
- Eb will be displayed on 60/70 unit if E6 has occurred 6 times in 10 minutes.

4.7.2 Possible causes

- Incorrect DC fan wiring.
- Outdoor unit power supply voltage or DC fan power supply voltage is abnormal.
- Damaged PFC module.
- Damaged IPM module.
- Damaged DC fan.
- Damaged main PCB.

4.7.3 Procedure



4.8 H7 Troubleshooting

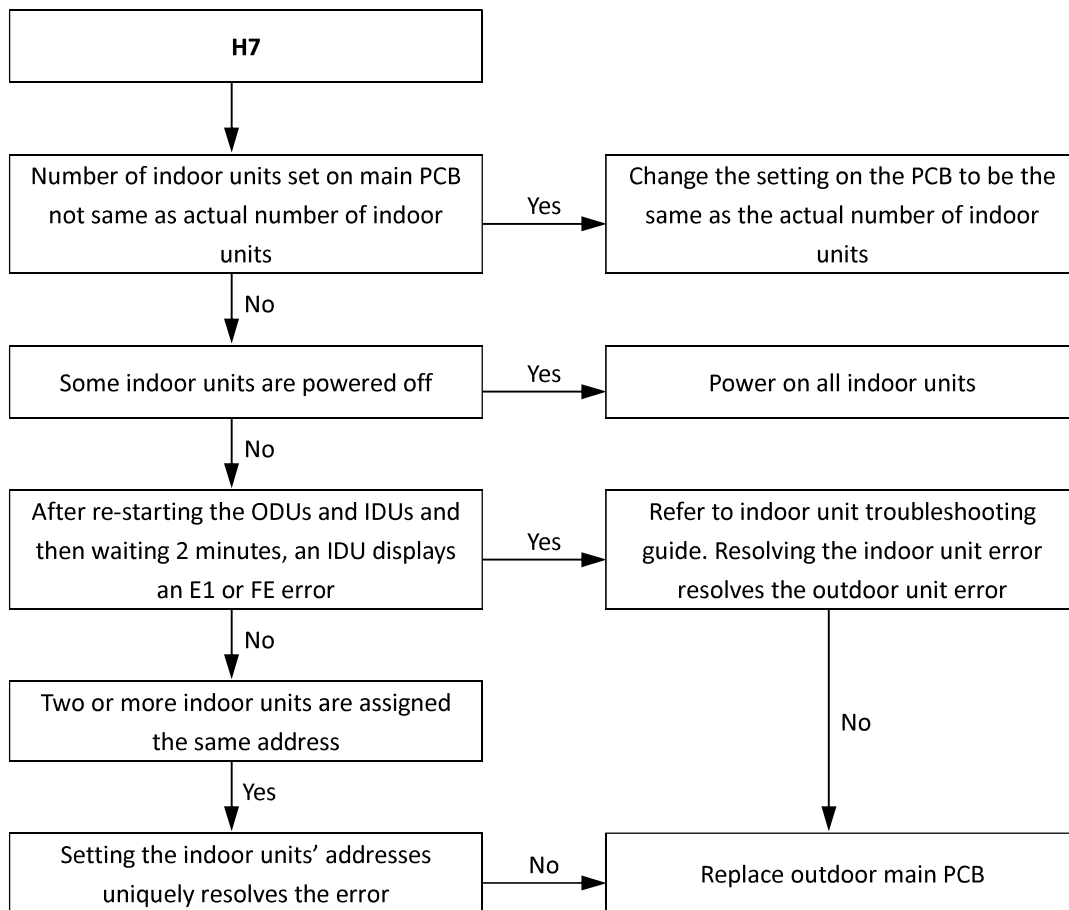
4.8.1 Description

- Number of indoor units detected by the outdoor unit not same as number set on main PCB.
- All units stop running.

4.8.2 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.

4.8.3 Procedure



4.9 P1 Troubleshooting

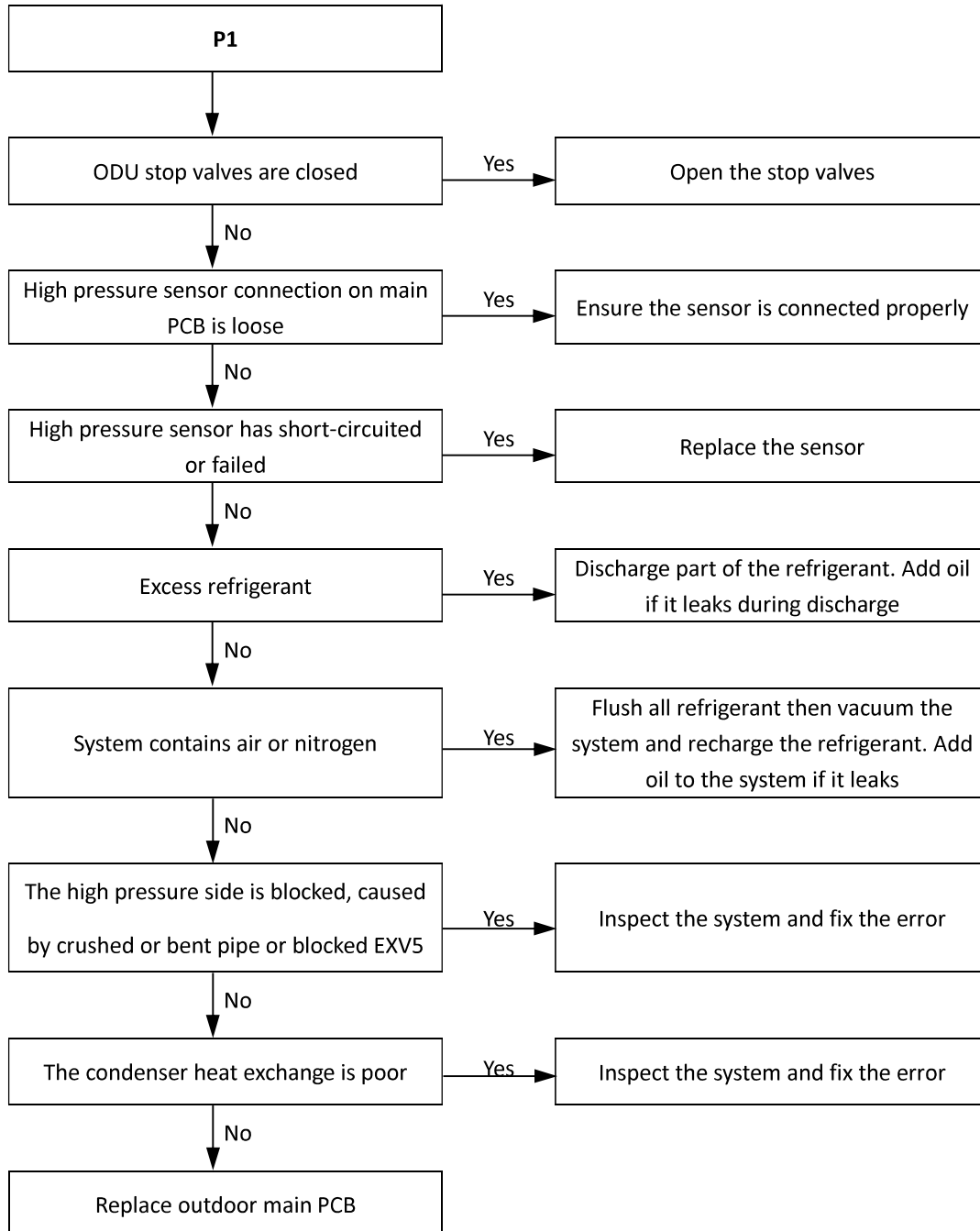
4.9.1 Description

- Discharge pipe high pressure protection. When the discharge pressure rises above 4.4MPa, the system displays P1 protection and all units stop running. When the discharge pressure falls below 3.2MPa, P1 is removed and normal operation resumes.

4.9.2 Possible causes...

- Outdoor unit stop valves are closed.
- Pressure sensor/switch not connected properly or has malfunctioned.
- Excess refrigerant.
- Sudden interruption of power to IDUs.
- System contains air or nitrogen.
- High pressure side blockage.
- Poor condenser heat exchange.
- Main PCB damaged.

4.9.3 Procedure



4.10 P2 Troubleshooting

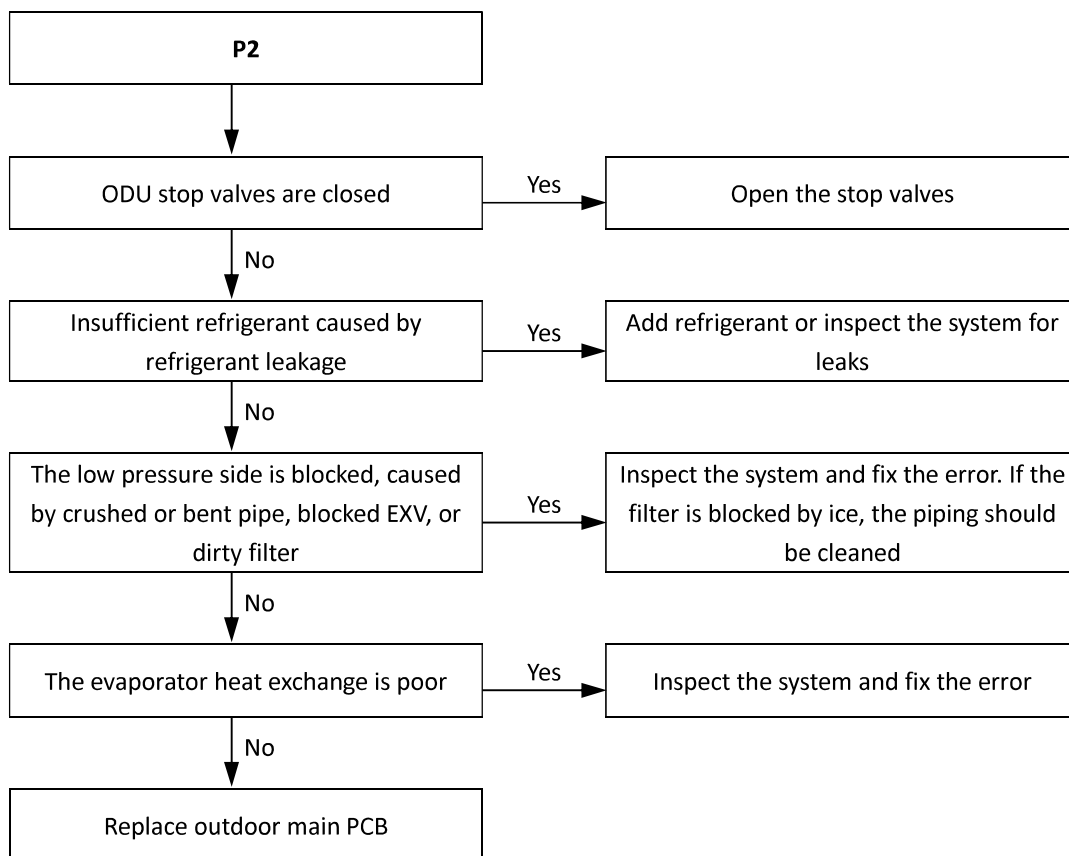
4.10.1 Description

- P2 indicates suction pipe low pressure protection. When the suction pressure falls below 0.05MPa, the system displays P2 protection and all units stop running. When the pressure rises above 0.15MPa, P2 is removed and normal operation resumes.

4.10.2 Possible causes

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

4.10.3 Procedure



4.11 P3 Troubleshooting

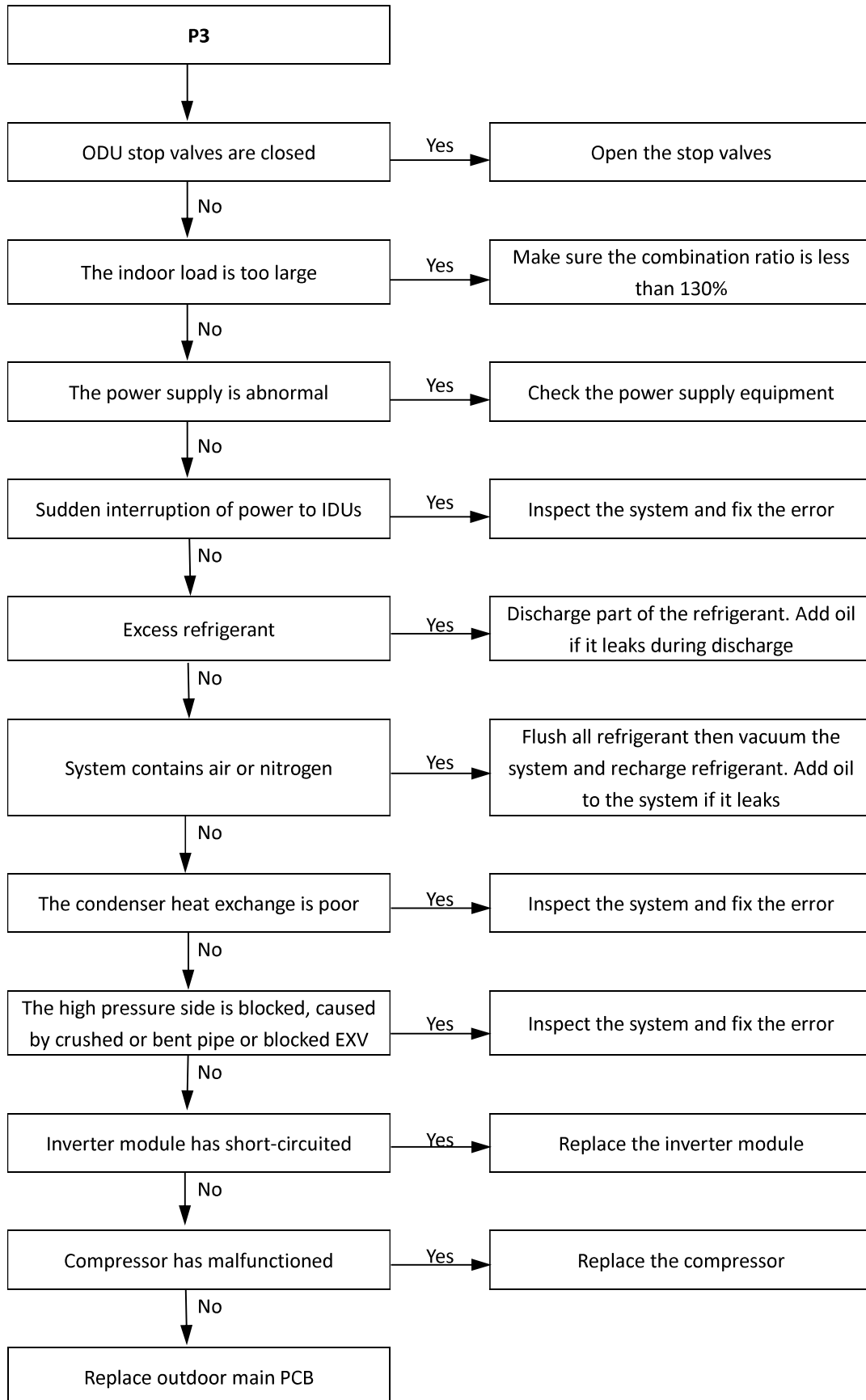
4.11.1 Description

- P3 indicates current protection on compressor.
- When the compressor current rises above the protection value, the system displays P3 protection and all units stop running. When the current returns to the normal range, P3 is removed and normal operation resumes.

4.11.2 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.

4.11.3 Procedure



4.12 P4 Troubleshooting

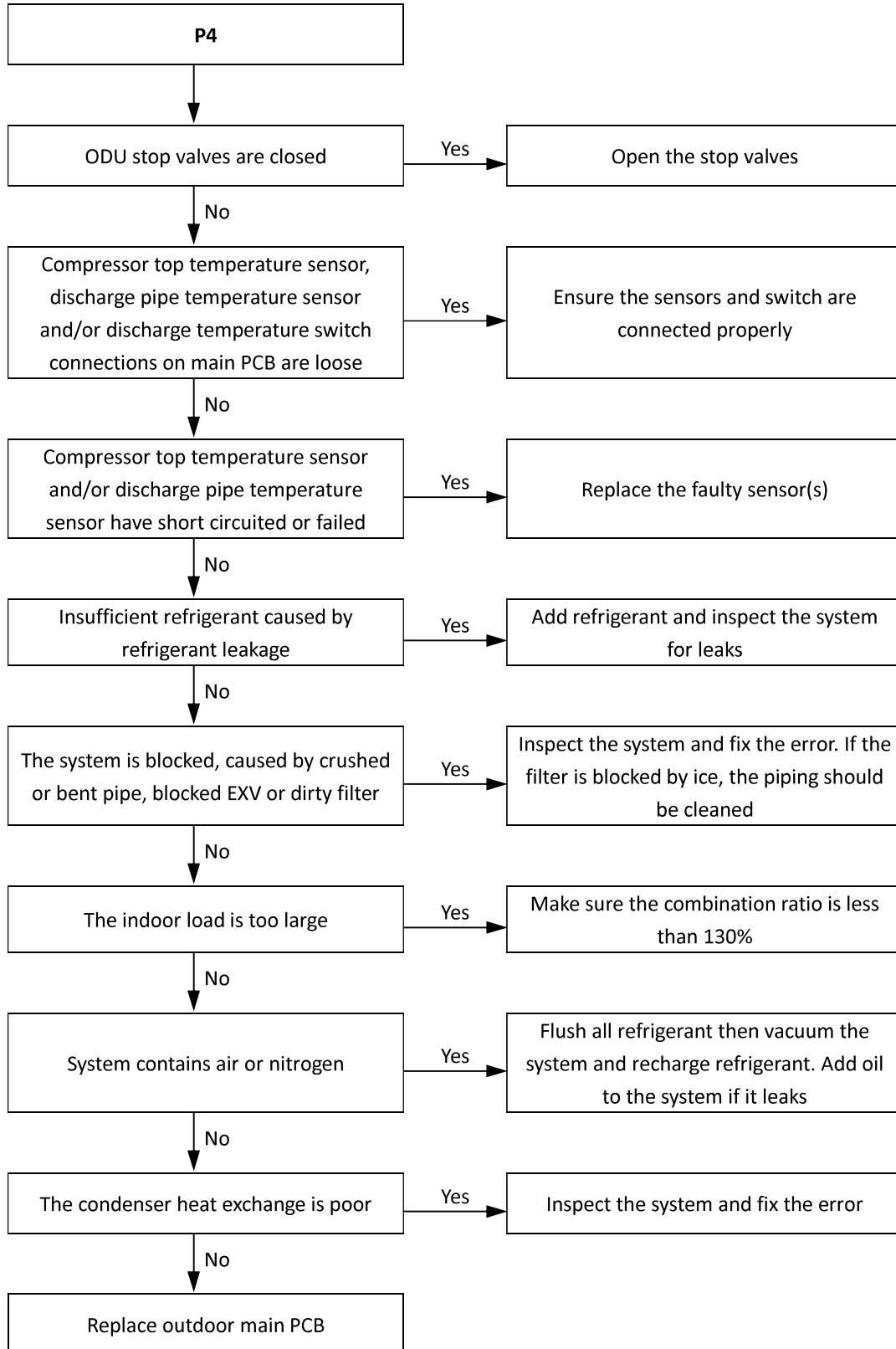
4.12.1 Description

- P4 indicates discharge temperature protection. When the discharge temperature rises above 115°C the system displays P4 protection and all units stop running.

4.12.2 Possible causes

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

4.12.3 Procedure



4.13 P5 Troubleshooting

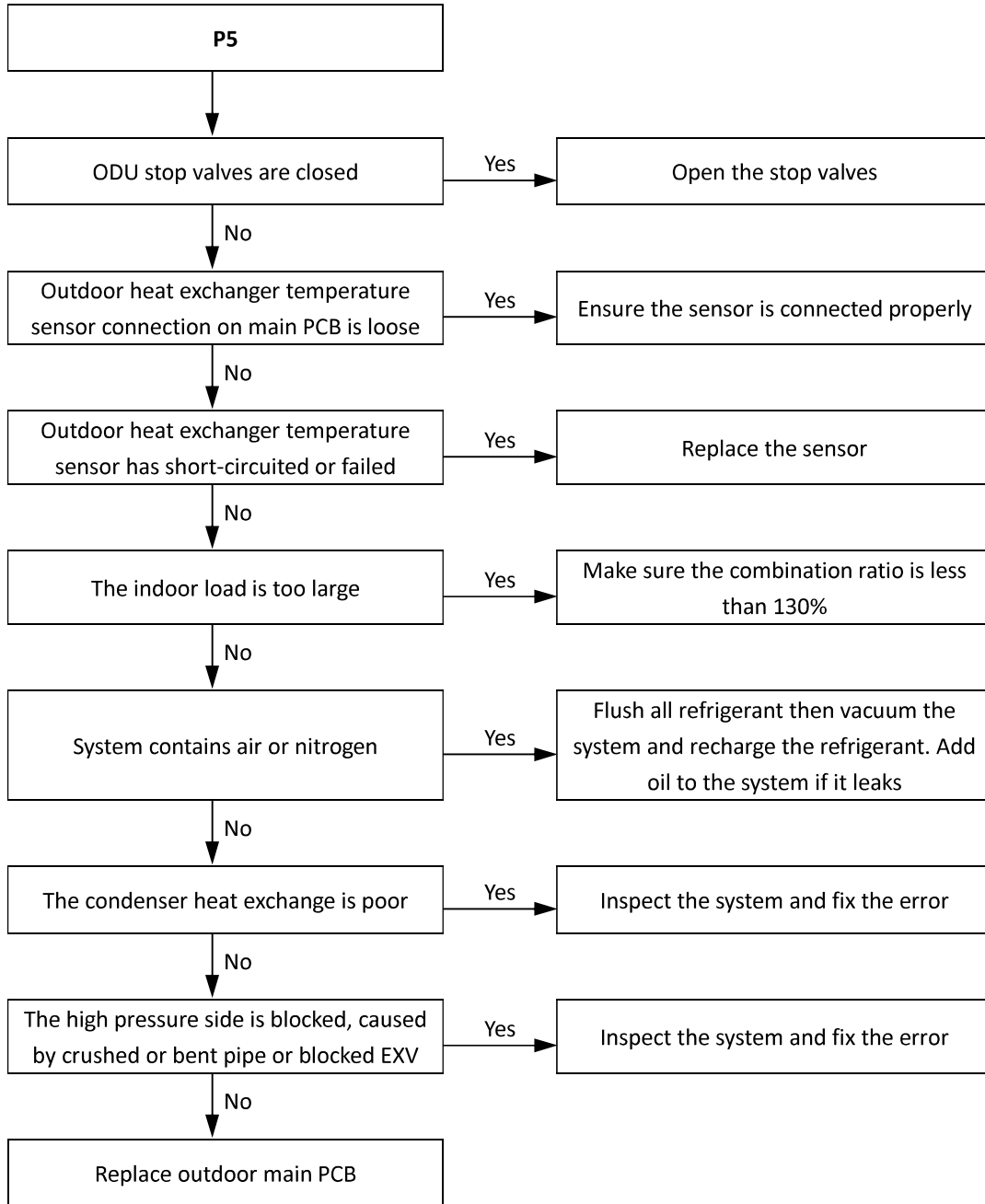
4.13.1 Description

- Outdoor heat exchanger temperature protection. When the outdoor heat exchanger temperature rises above 62°C, the system displays P5 protection and all units stop running. When the temperature returns to the normal range, P5 is removed and normal operation resumes.

4.13.2 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.

4.13.3 Procedure



4.15 P8 Troubleshooting

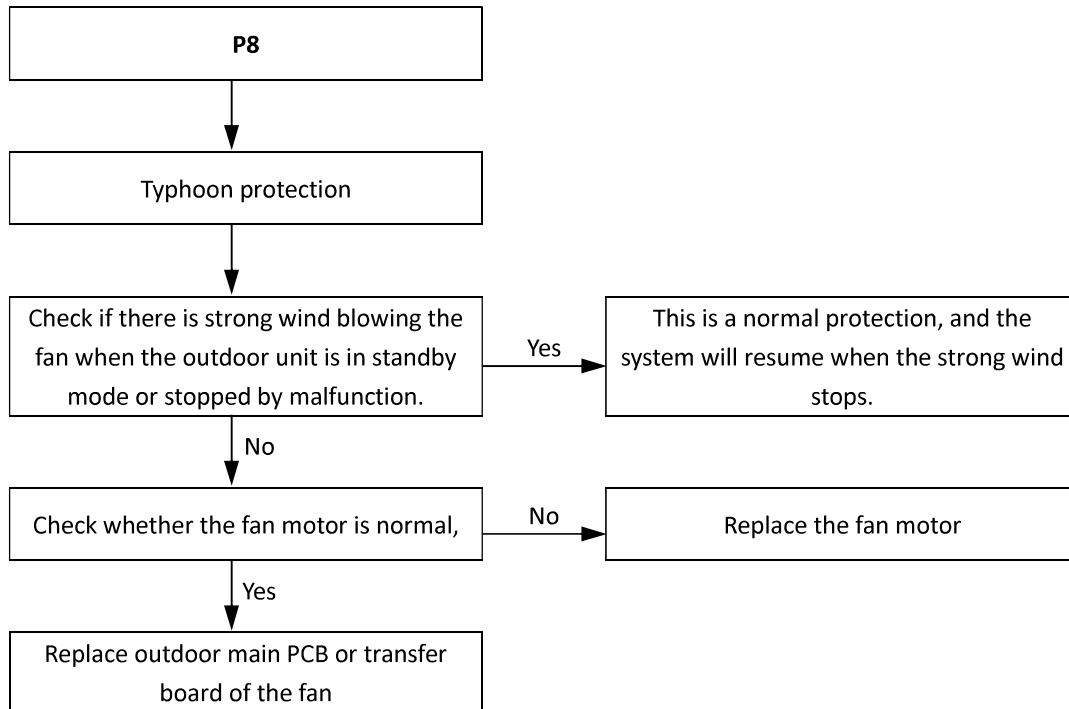
4.15.1 Description

- Outdoor fan protection.

4.15.2 Possible causes

- A strong wind is blowing the fan.
- Fan motor malfunctioned.
- Main PCB damaged.

4.15.3 Procedure



5 Appendix to Part 3

5.1 Temperature Sensor Resistance Characteristics

Table 3-5.1: Outdoor ambient temperature sensor and outdoor heat exchanger 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 3-5.2: Discharge pipe temperature sensor resistance characteristics

Temperature (°C)	Resistance (kΩ)	Temperature (°C)	Resistance (kΩ)	Temperature (°C)	Resistance (kΩ)	Temperature (°C)	Resistance (kΩ)
-20	517.845	20	69.660	60	13.773	100	3.677
-19	489.937	21	66.607	61	13.281	101	3.568
-18	463.653	22	63.703	62	12.809	102	3.463
-17	438.895	23	60.939	63	12.357	103	3.361
-16	415.569	24	58.310	64	11.923	104	3.262
-15	393.587	25	55.807	65	11.506	105	3.166
-14	372.869	26	53.424	66	11.105	106	3.091
-13	353.337	27	51.154	67	10.721	107	3.003
-12	334.920	28	48.992	68	10.352	108	2.918
-11	317.549	29	46.933	69	9.997	109	2.835
-10	301.161	30	44.970	70	9.656	110	2.755
-9	285.699	31	43.098	71	9.329	111	2.678
-8	271.104	32	41.314	72	9.014	112	2.603
-7	257.326	33	39.613	73	8.711	113	2.530
-6	244.316	34	37.989	74	8.420	114	2.46
-5	232.028	35	36.441	75	8.140	115	2.392
-4	220.418	36	34.963	76	7.871	116	2.326
-3	209.447	37	33.552	77	7.612	117	2.262
-2	199.077	38	32.205	78	7.363	118	2.200
-1	189.272	39	30.919	79	7.123	119	2.141
0	179.999	40	29.691	80	6.892	120	2.082
1	171.227	41	28.517	81	6.670	121	2.026
2	162.926	42	27.395	82	6.456	122	1.972
3	155.070	43	26.323	83	6.249	123	1.919
4	147.632	44	25.298	84	6.051	124	1.868
5	140.589	45	24.318	85	5.859	125	1.818
6	133.917	46	23.381	86	5.675	126	1.770
7	127.596	47	22.485	87	5.497	127	1.723
8	121.605	48	21.627	88	5.325	128	1.678
9	115.926	49	20.806	89	5.160	129	1.635
10	110.540	50	20.021	90	5.000	130	1.592
11	105.433	51	19.269	91	4.846		
12	100.587	52	18.548	92	4.697		
13	95.988	53	17.859	93	4.554		
14	91.622	54	17.198	94	4.415		
15	87.477	55	16.565	95	4.282		
16	83.541	56	15.958	96	4.152		
17	79.801	57	15.377	97	4.027		
18	76.248	58	14.820	98	3.907		
19	72.871	59	14.285	99	3.790		

Table 3-5.3: Inverter module 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		



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