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R410A

Commercial Air Conditioners

Service Manual

Aqua Tempo Super II Series



All DC Inverter

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Part 1

General Information

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1 Unit Capacities and External Appearance

Table 1-2.1: Aqua Tempo Super II unit capacity range and unit appearances

Capacity	30kW	60kW	90kW
Model	MC-SU30-RN1L MC-SU30M-RN1L	MC-SU60-RN1L MC-SU60M-RN1L	MC-SU90-RN1L MC-SU90M-RN1L
Appearance			
Power supply	380-415V/3Ph/50Hz		

Note:

- The 30kW and 60kW units can not be combined with 90kW unit.

2 Water outlet temperature range

Table 1-2.1: Aqua Tempo Super II unit water outlet temperature range

Mode		Range
Cooling	Normal	5-20°C ¹
	Low water outlet	0-20°C(reserved) ²
Heating	Normal	25-55°C

Notes:

- For 30kW and 60kW units, when the ambient temperature is below 15°C, the water outlet temperature range is 5-20°C, for 90kW unit, the water outlet temperature range is 10-20°C. When the ambient temperature is above 15°C, all the units water outlet temperature range is 5-20°C.
- For 30kW and 60kW units, use dial switch S5_1 on the main PCB to select the water outlet temperature range, for 90kW unit, use dial switch S12_3 on the main PCB to select the water outlet temperature range.

Part 2

Component Layout and Refrigerant Circuits

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1 Layout of Functional Components

MC-SU30-RN1L

Figure 2-1.1: MC-SU30-RN1L front view

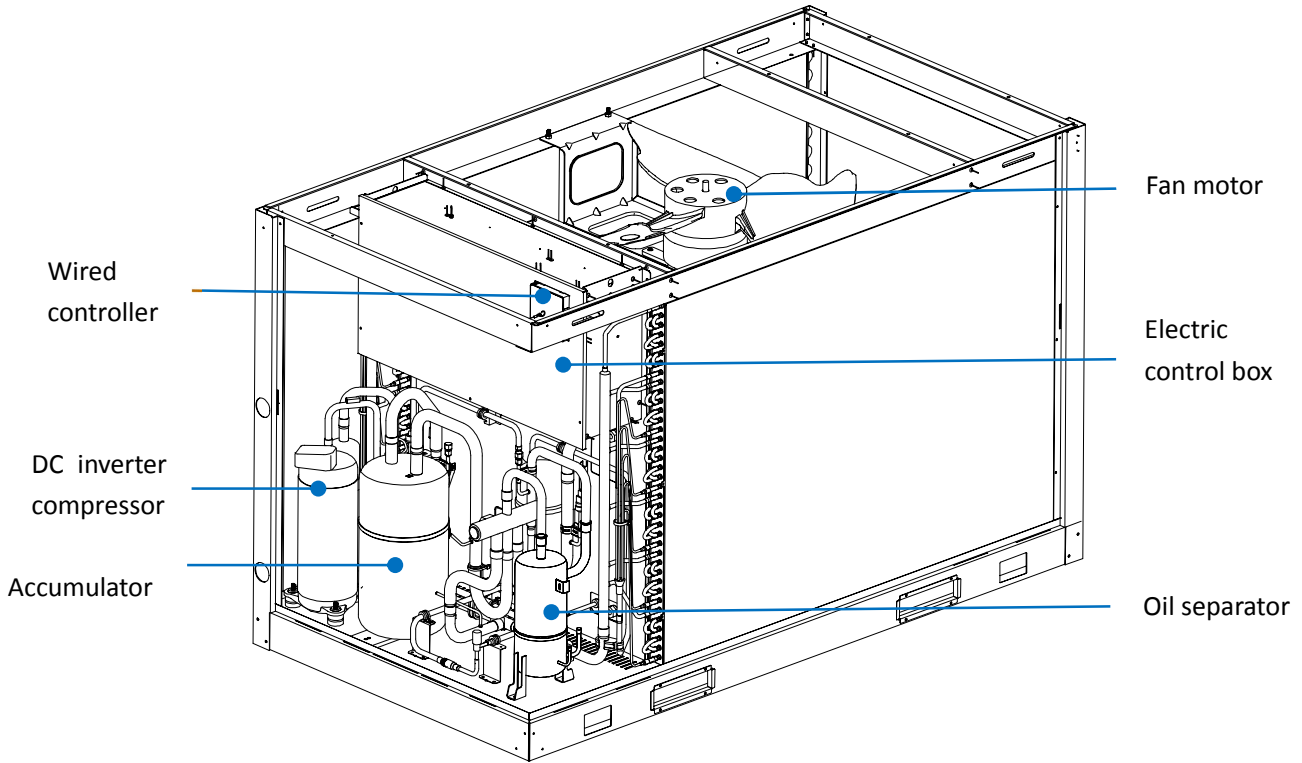


Figure 2-1.2: MC-SU30-RN1L rear view

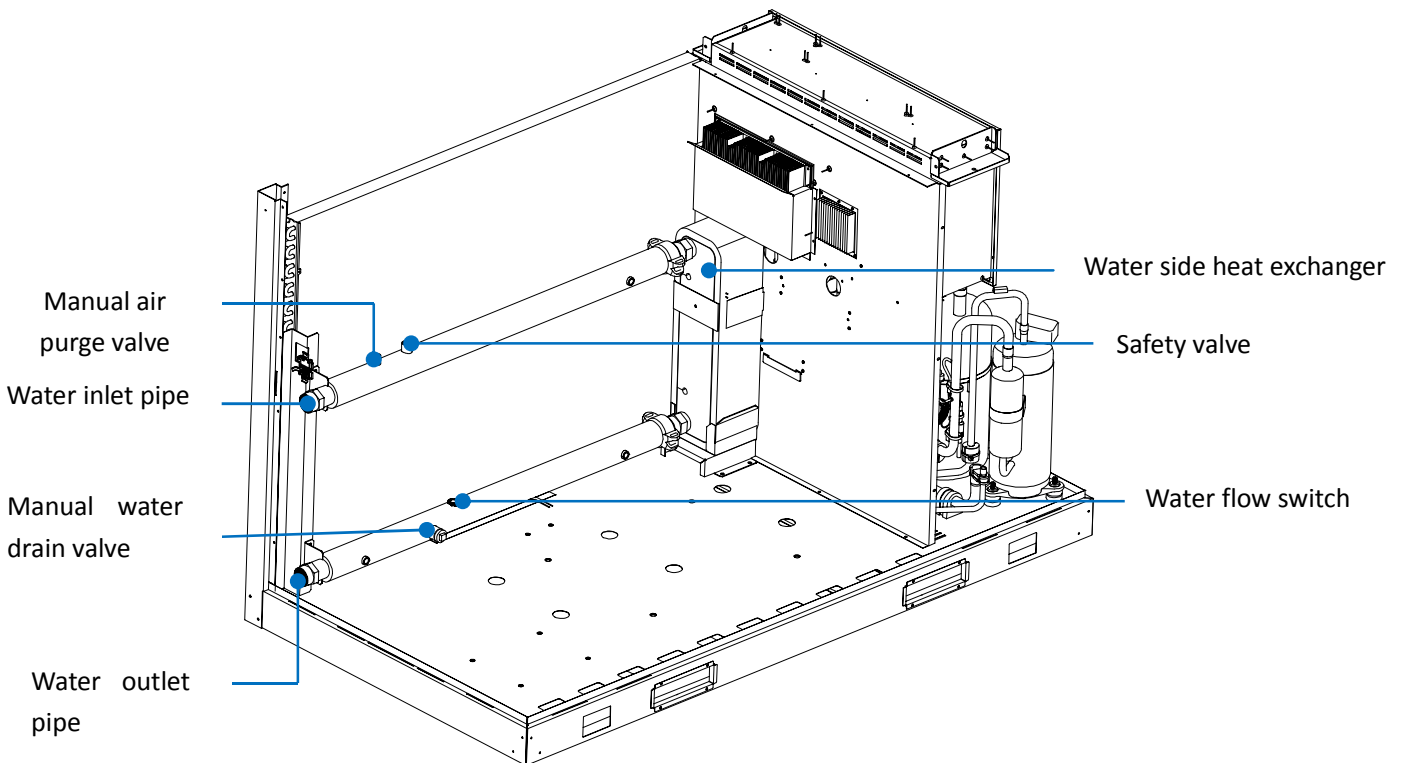
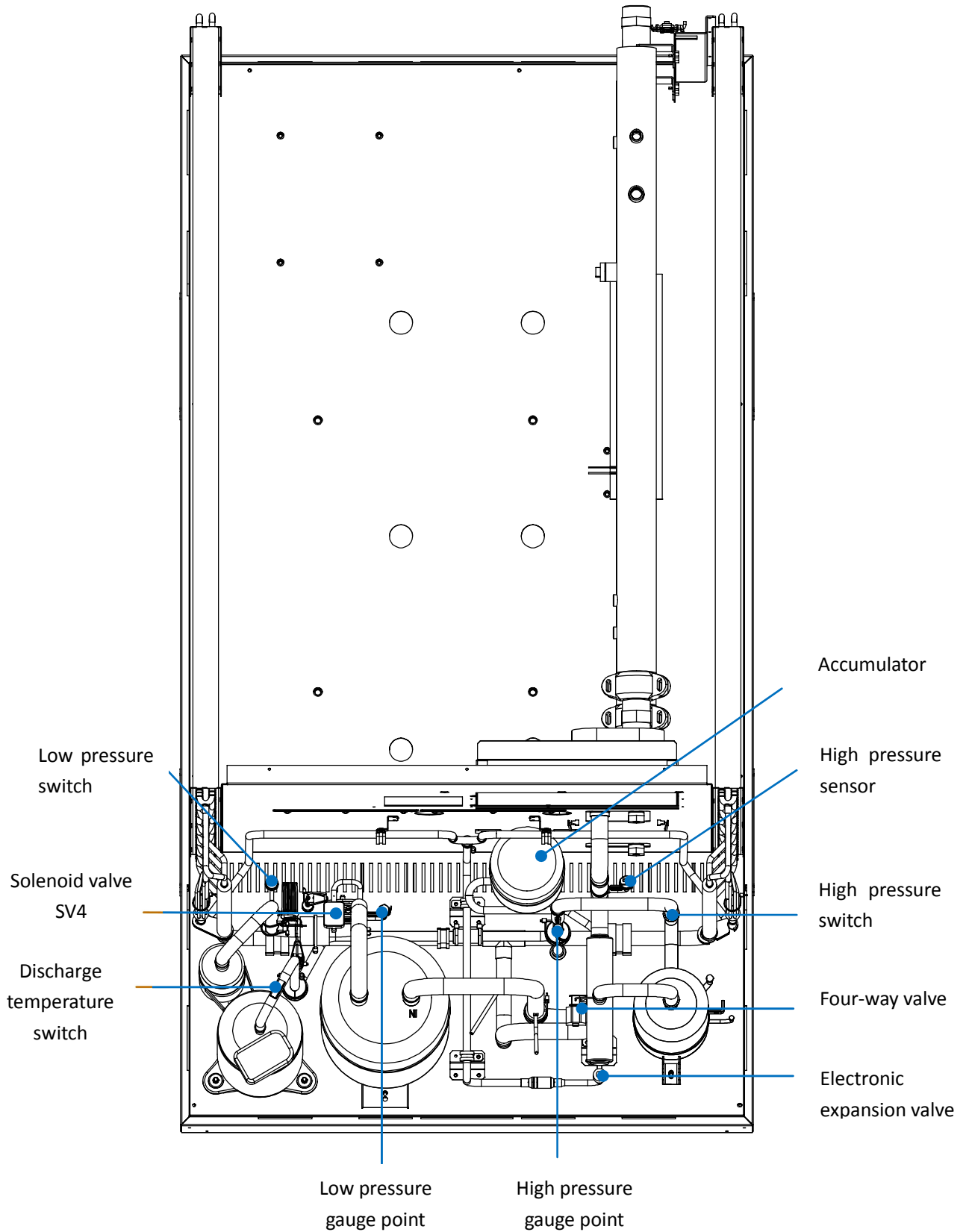


Figure 2-1.3: MC-SU30-RN1L top view



Aqua Tempo Super II



MC-SU30M-RN1L

Figure 2-1.4: MC-SU30M-RN1L front view

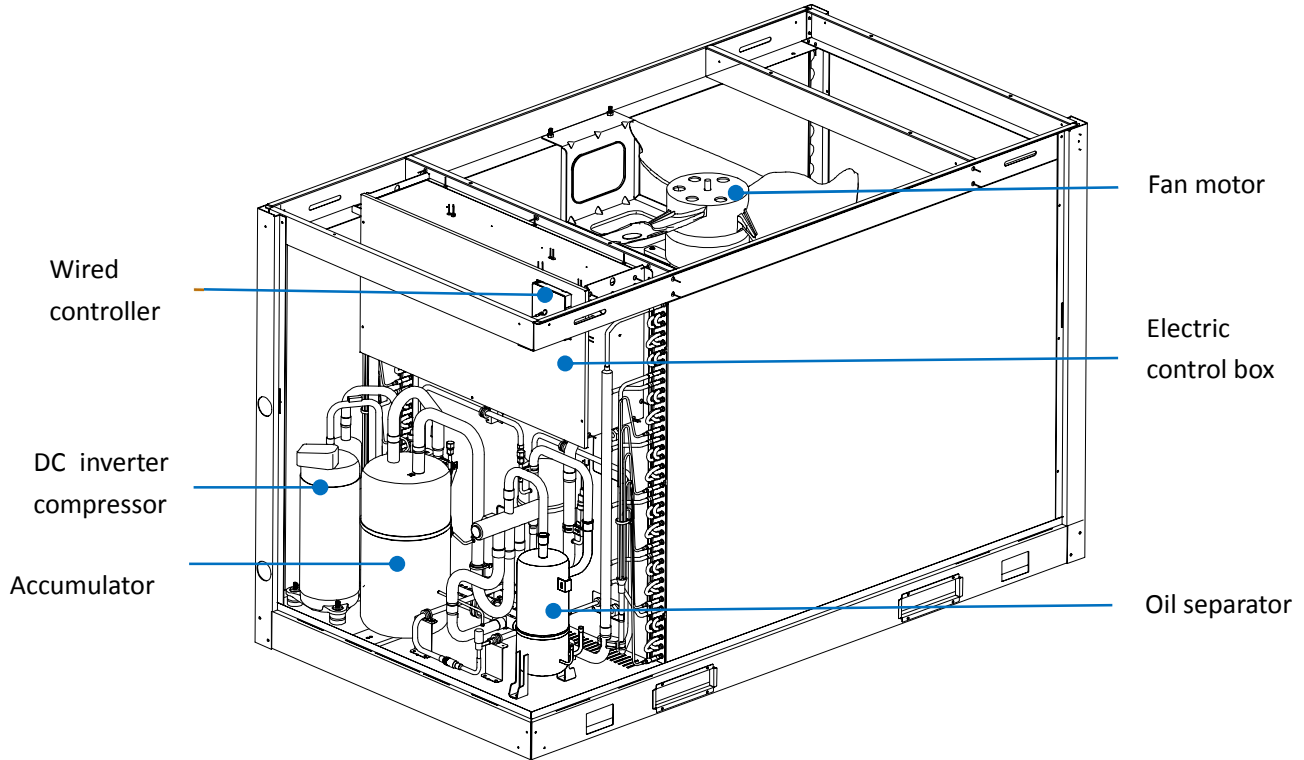


Figure 2-1.5: MC-SU30M-RN1L rear view

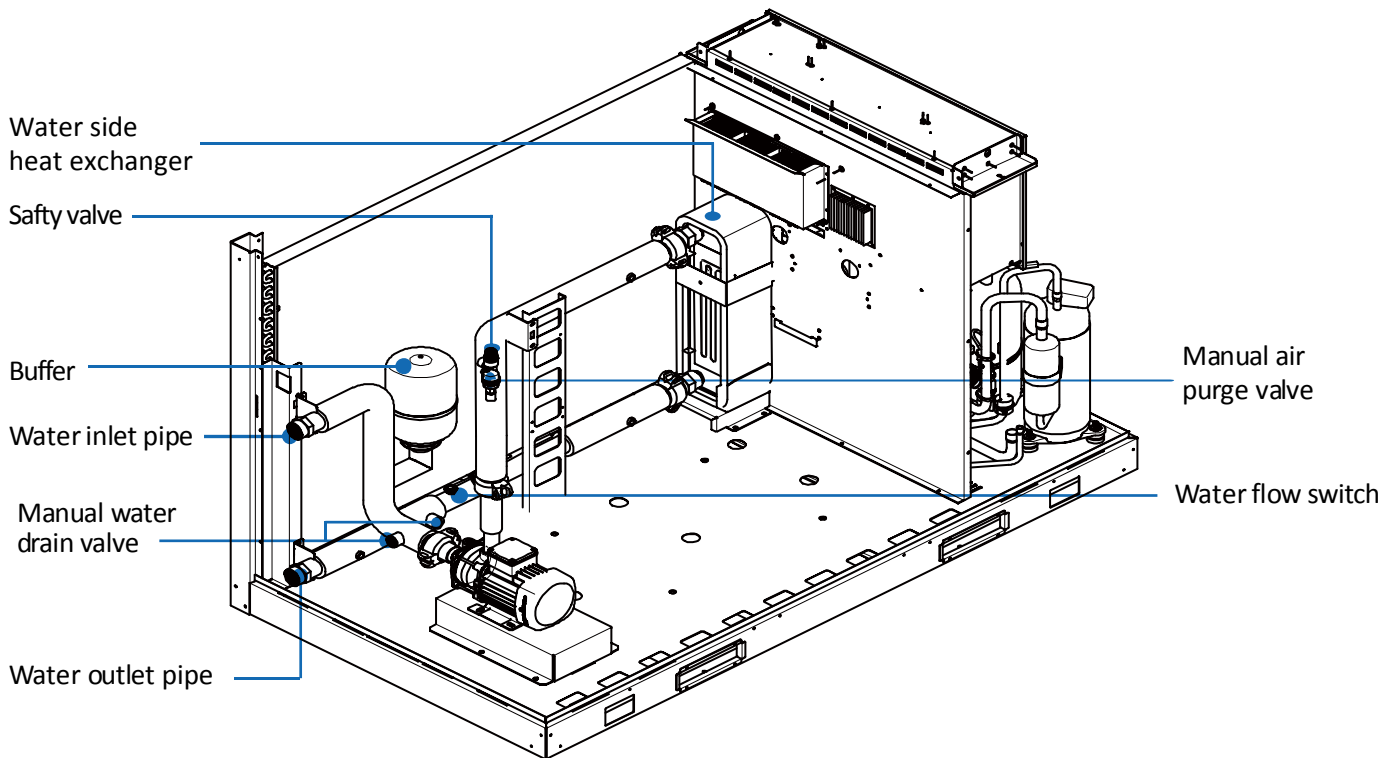
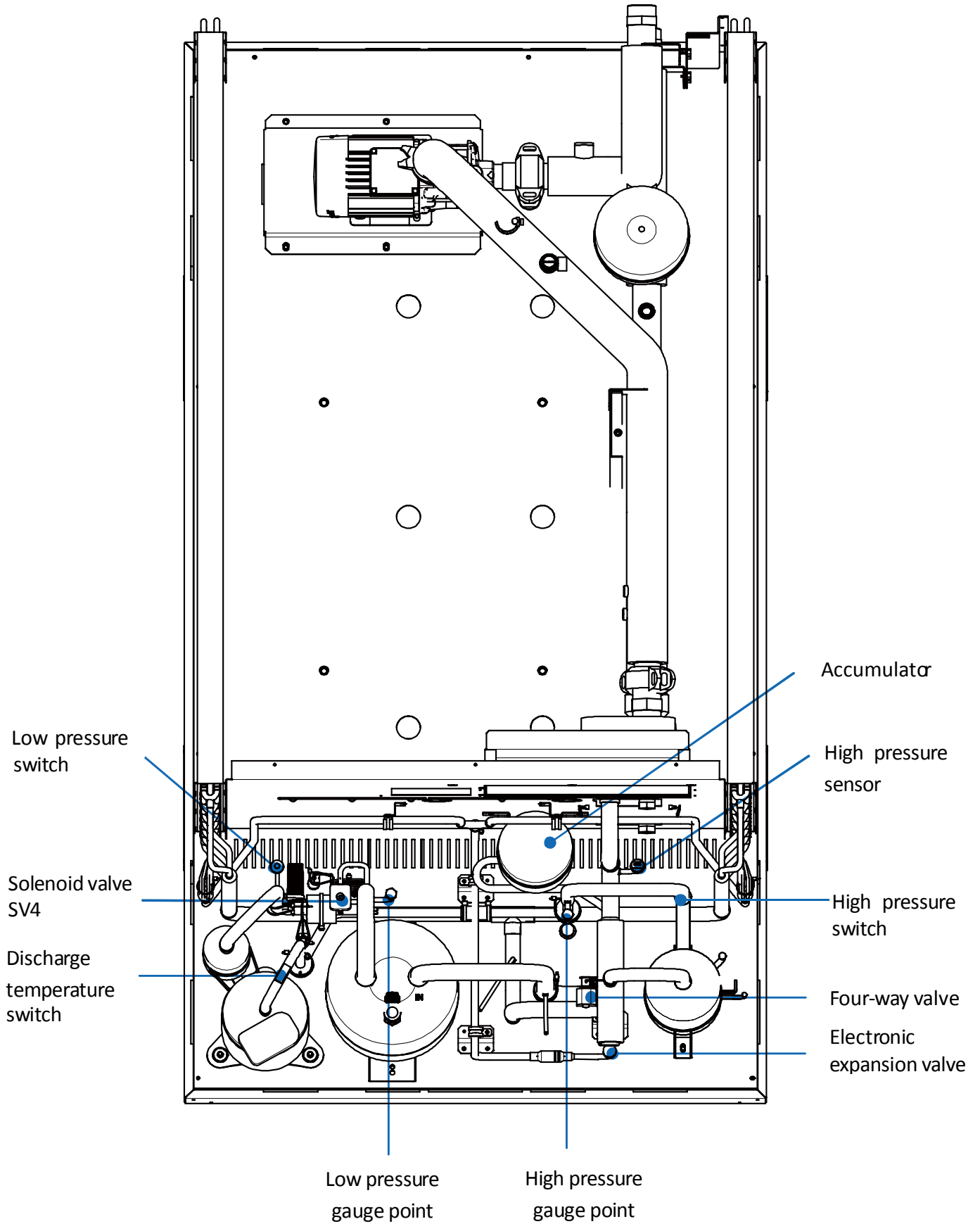


Figure 2-1.6: MC-SU30M-RN1L top view



Part 2 - Component Layout and Refrigerant Circuits

Aqua Tempo Super II



MC-SU60-RN1L

Figure 2-1.7: MC-SU60-RN1L front view

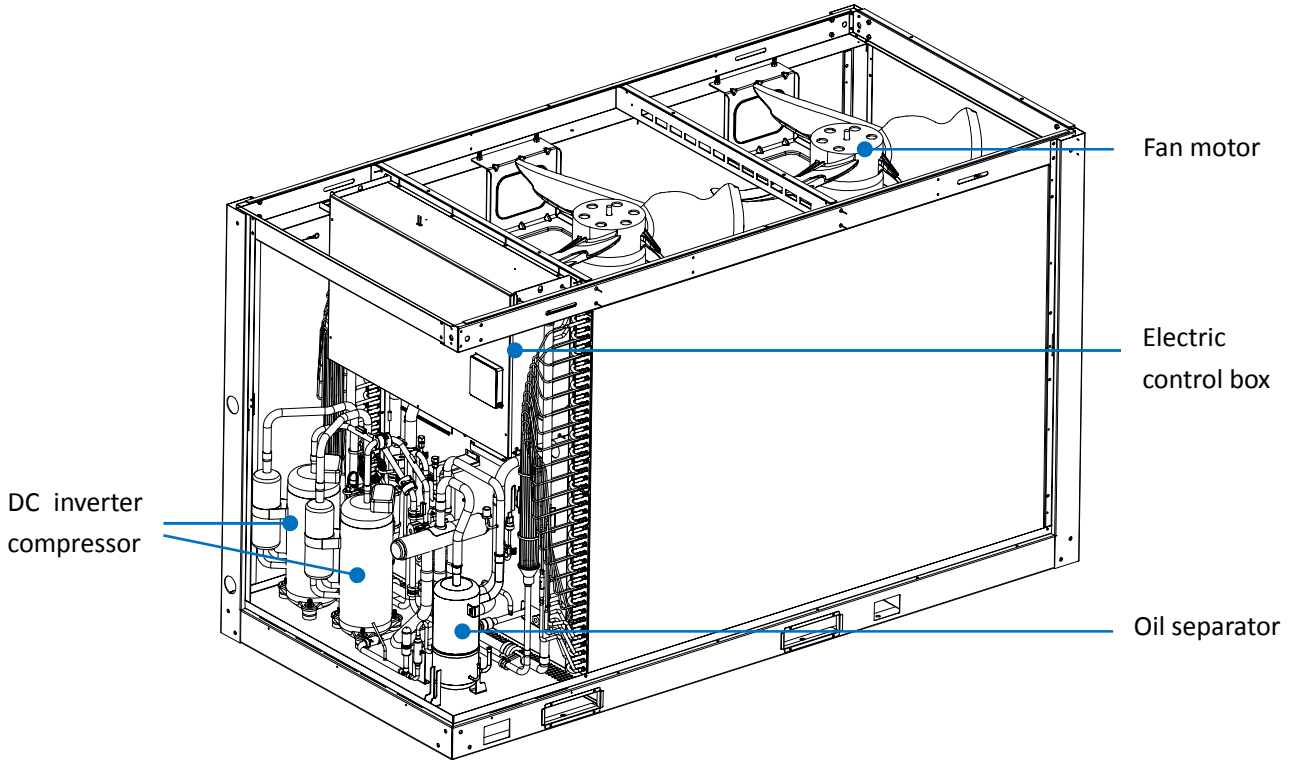


Figure 2-1.8: MC-SU60-RN1L rear view

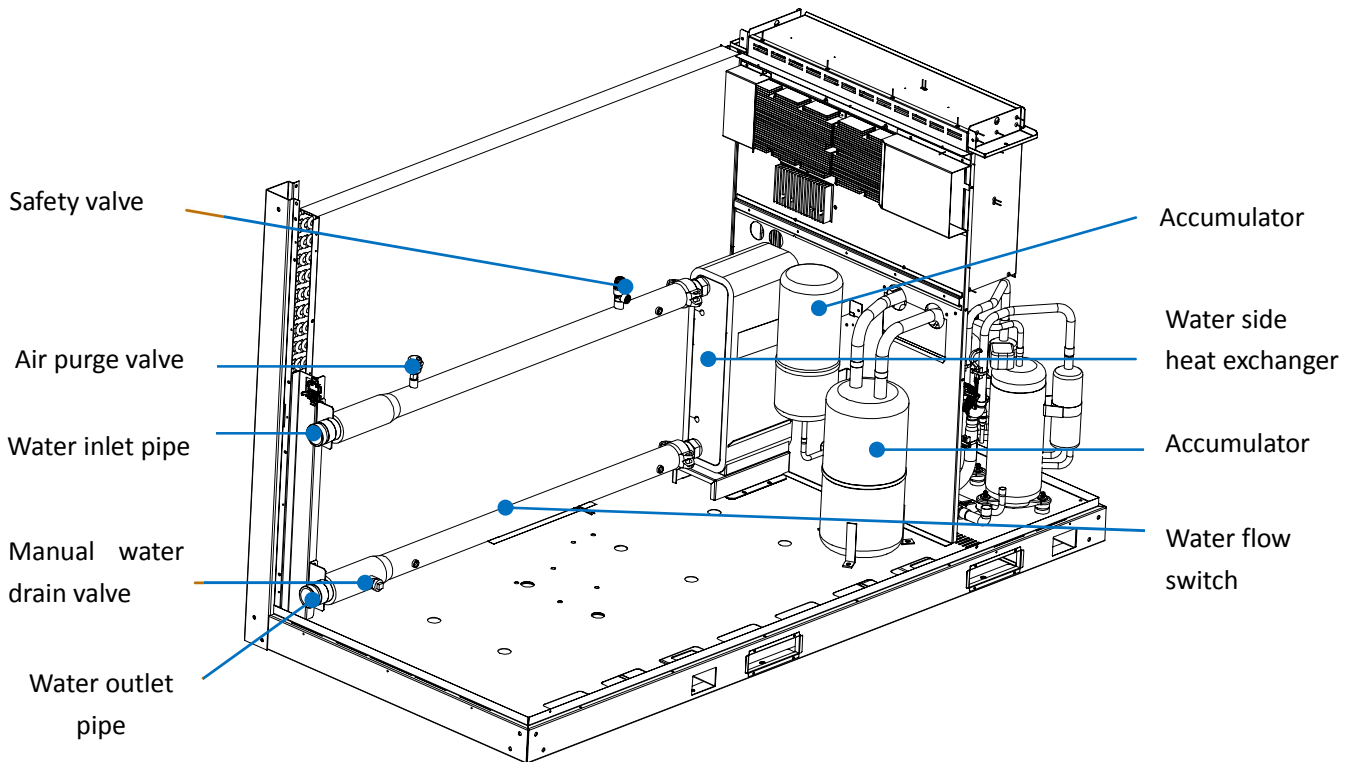
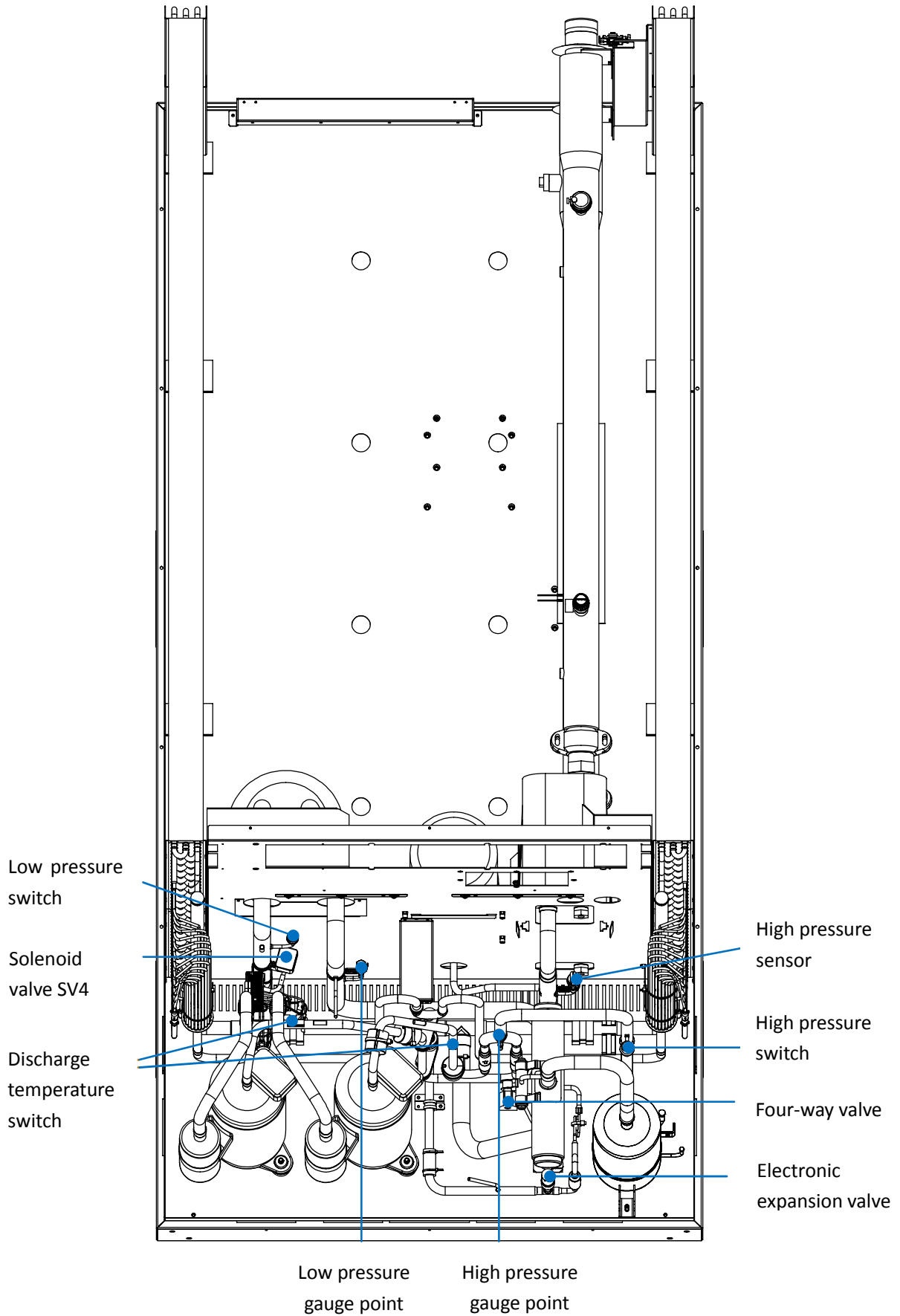


Figure 2-1.9: MC-SU60-RN1L top view



Aqua Tempo Super II



MC-SU60M-RN1L

Figure 2-1.10: MC-SU60M-RN1L front view

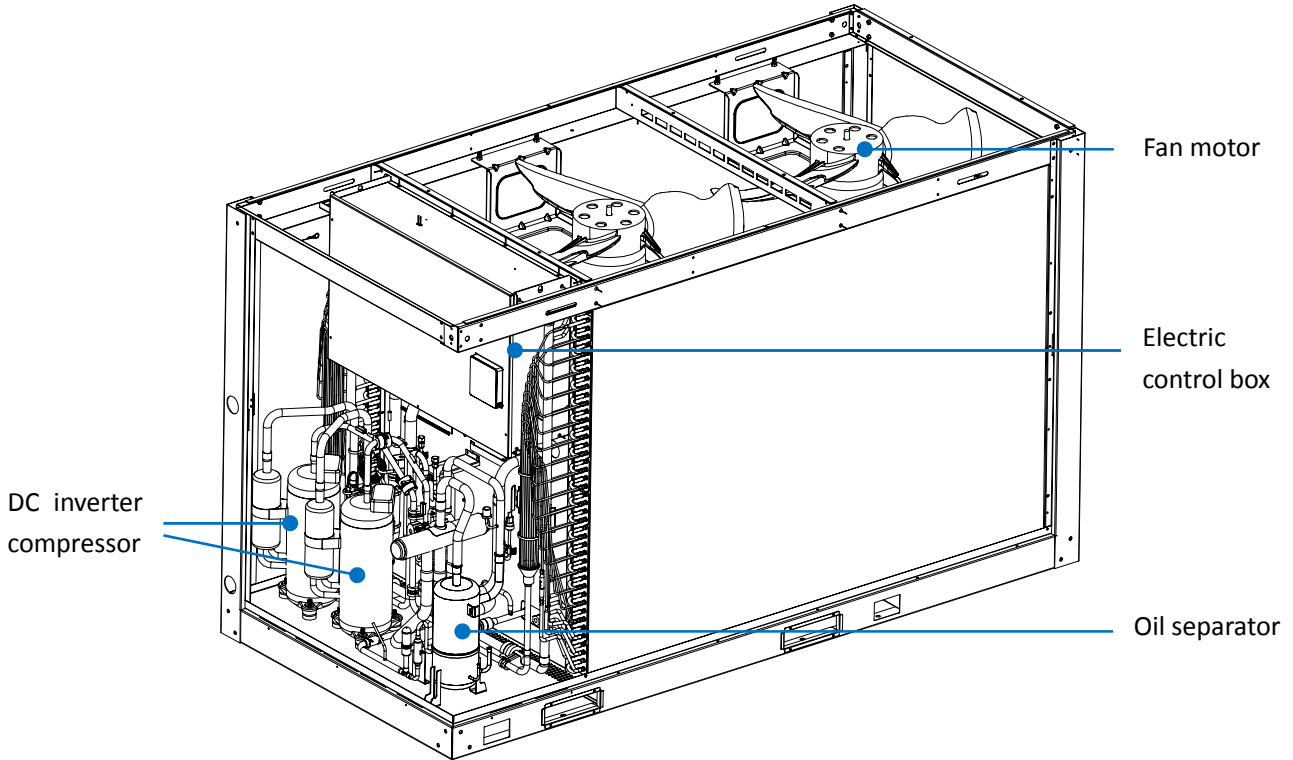


Figure 2-1.11: MC-SU60M-RN1L rear view

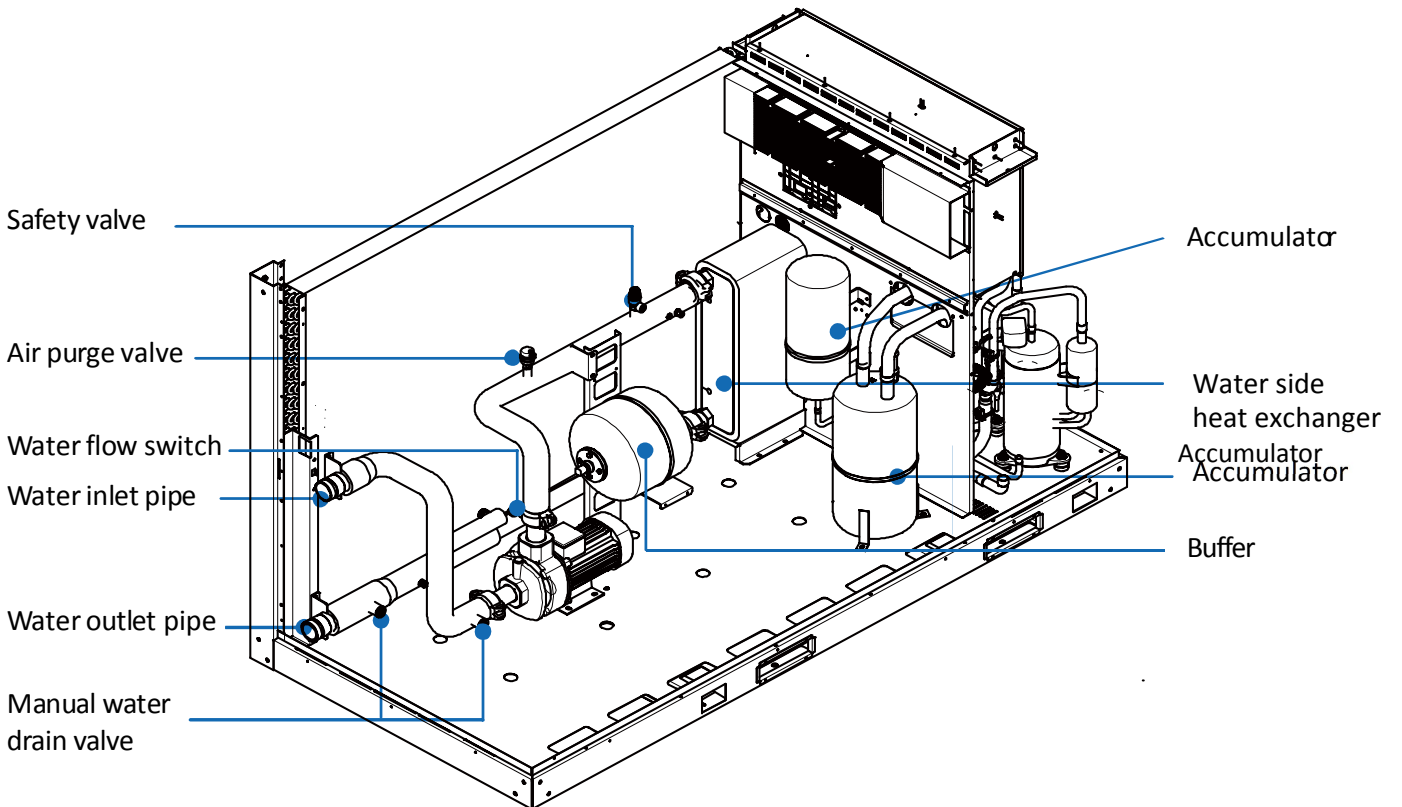
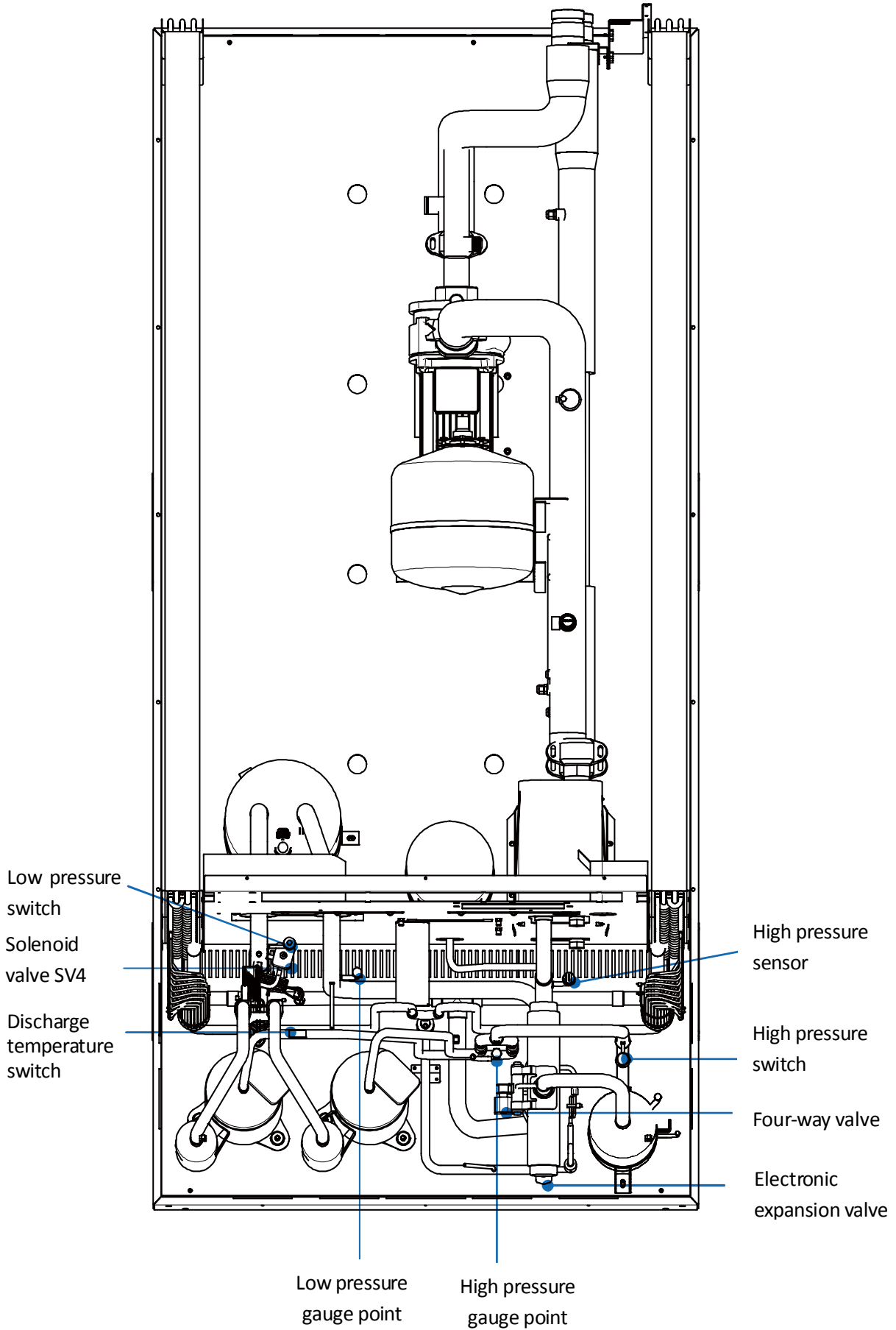


Figure 2-1.12: MC-SU60M-RN1L top view



Aqua Tempo Super II



MC-SU90-RN1L

Figure 2-1.13: MC-SU90-RN1L front view

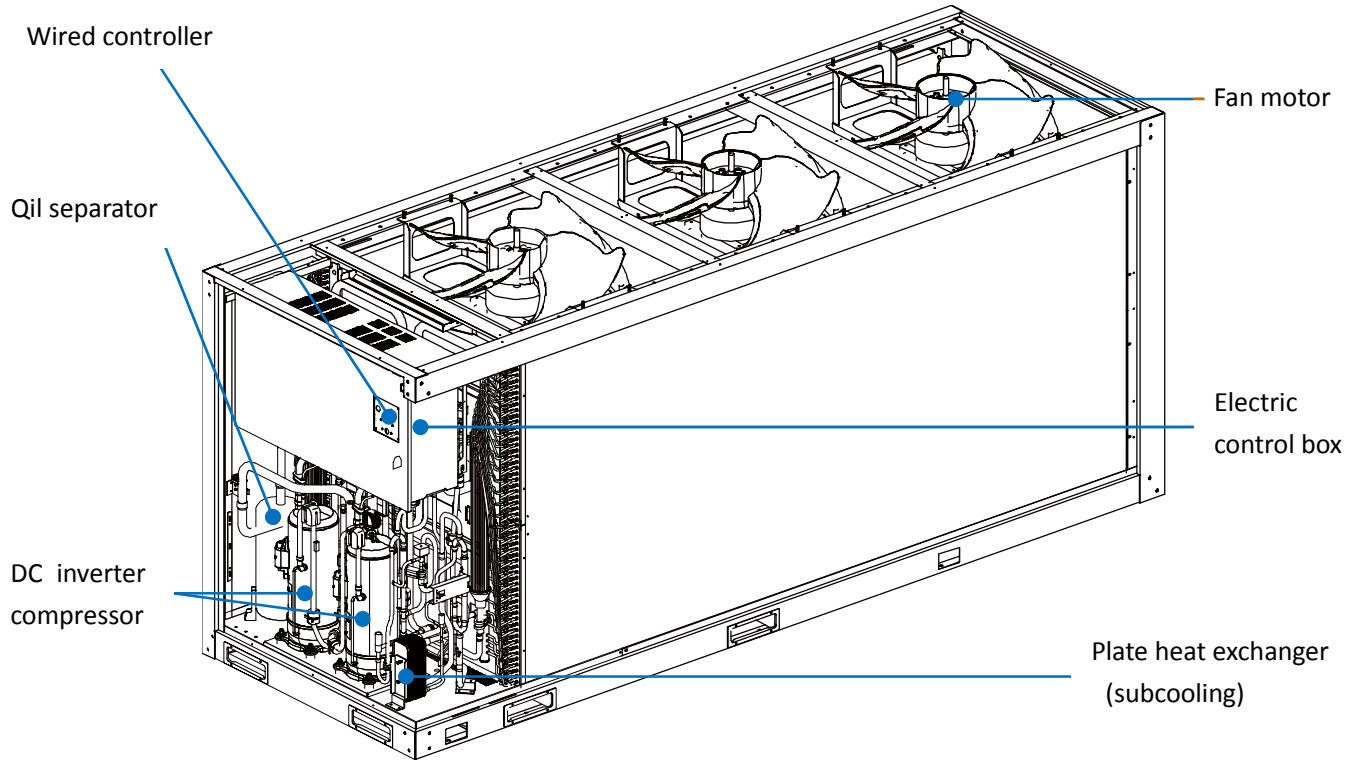


Figure 2-1.14: MC-SU90-RN1L rear view

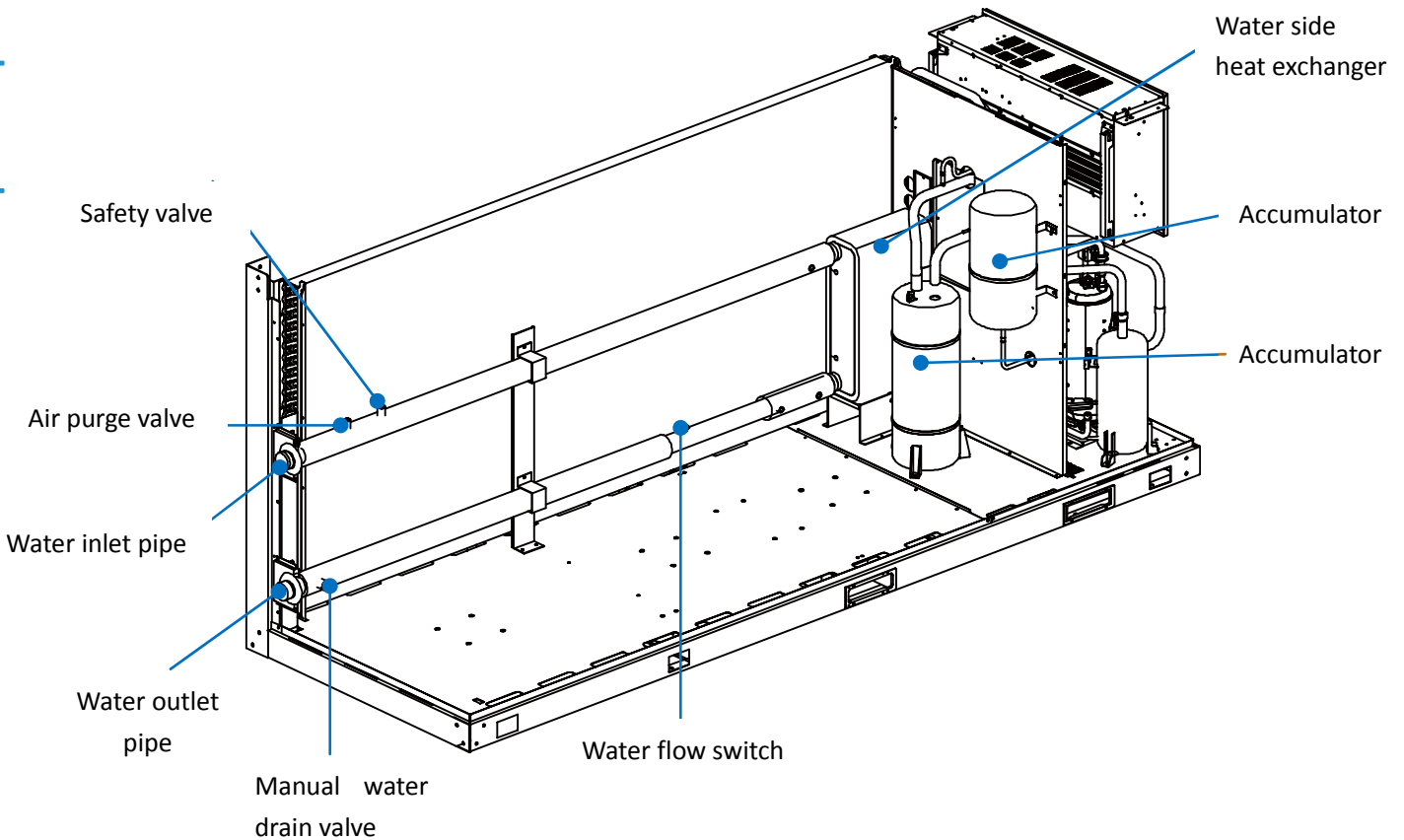
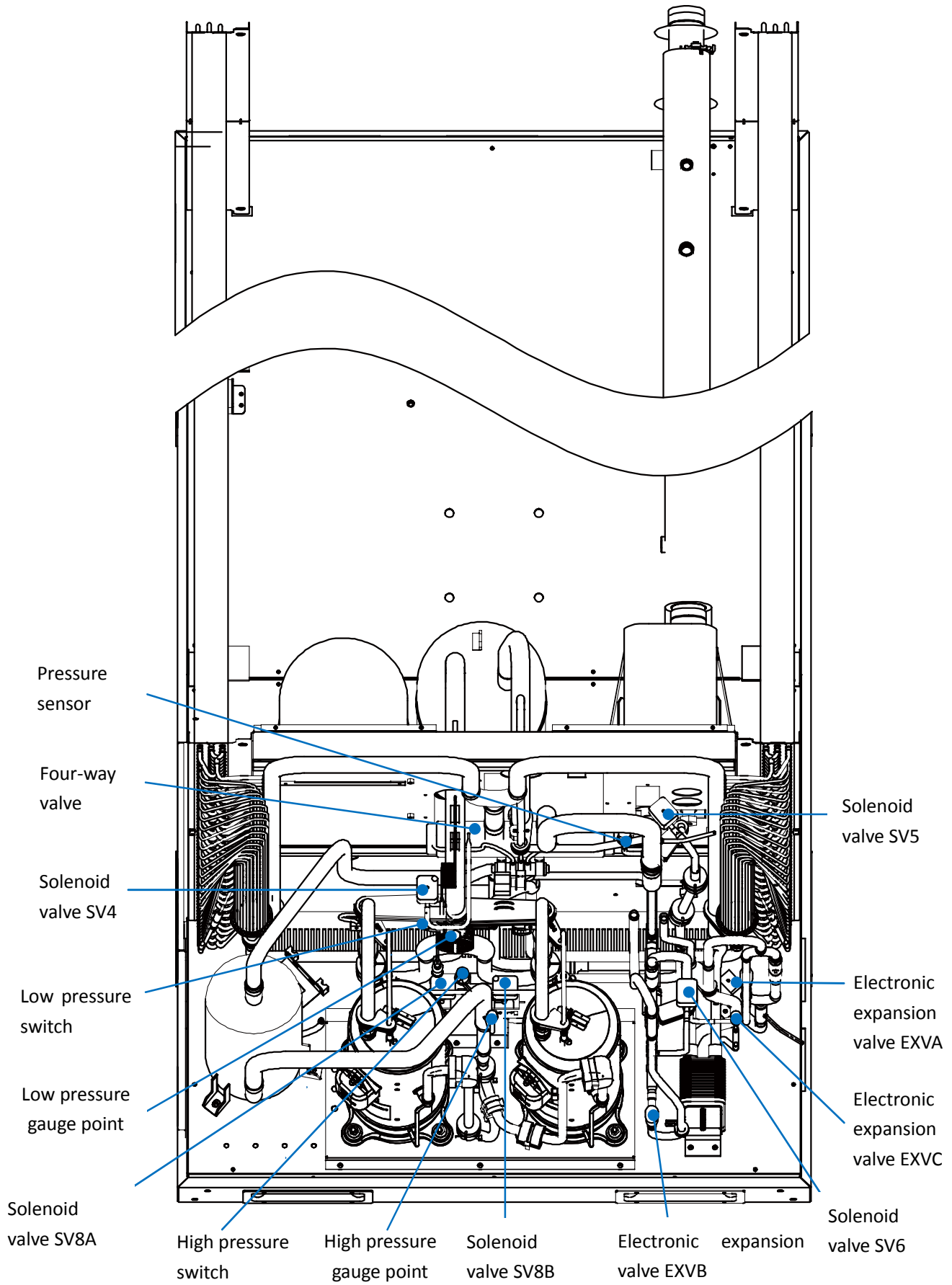


Figure 2-1.15: MC-SU90-RN1L top view



Aqua Tempo Super II



MC-SU90M-RN1L

Figure 2-1.16: MC-SU90M-RN1L front view

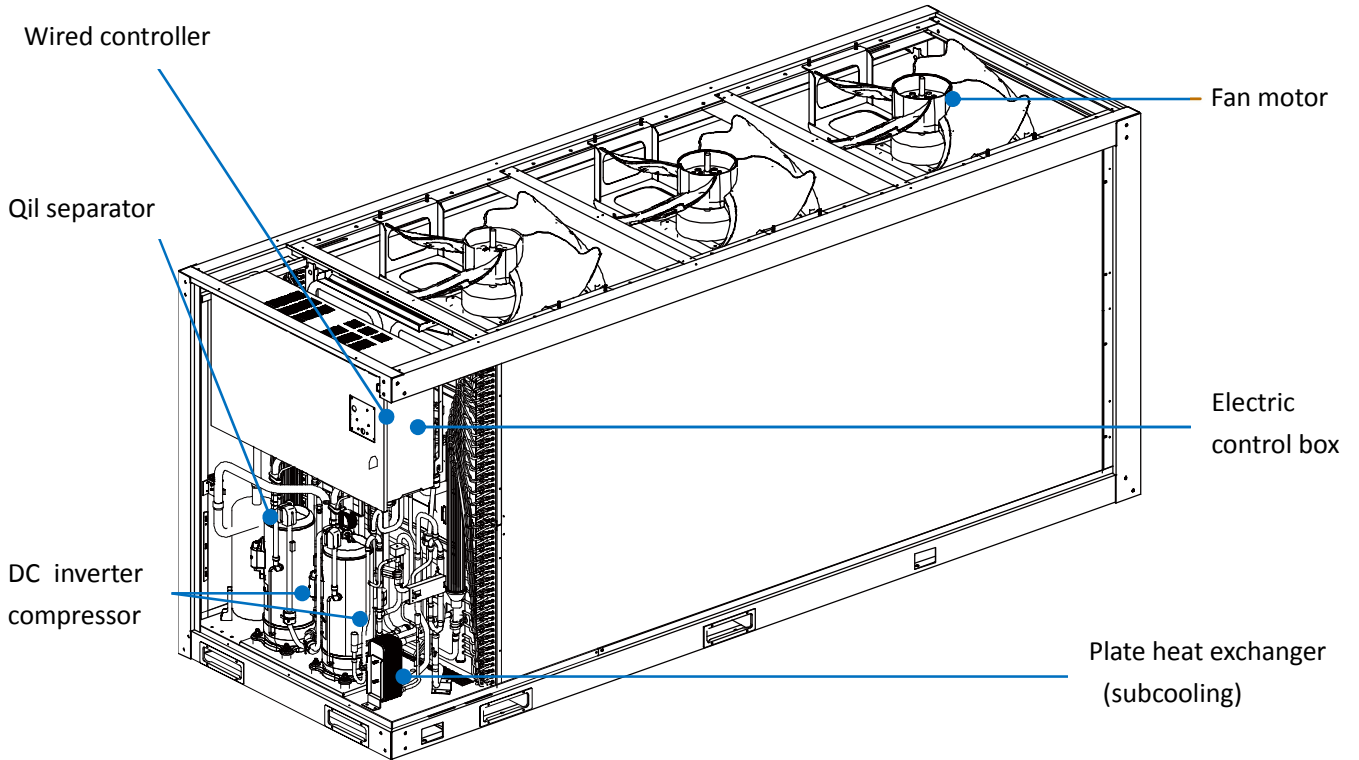
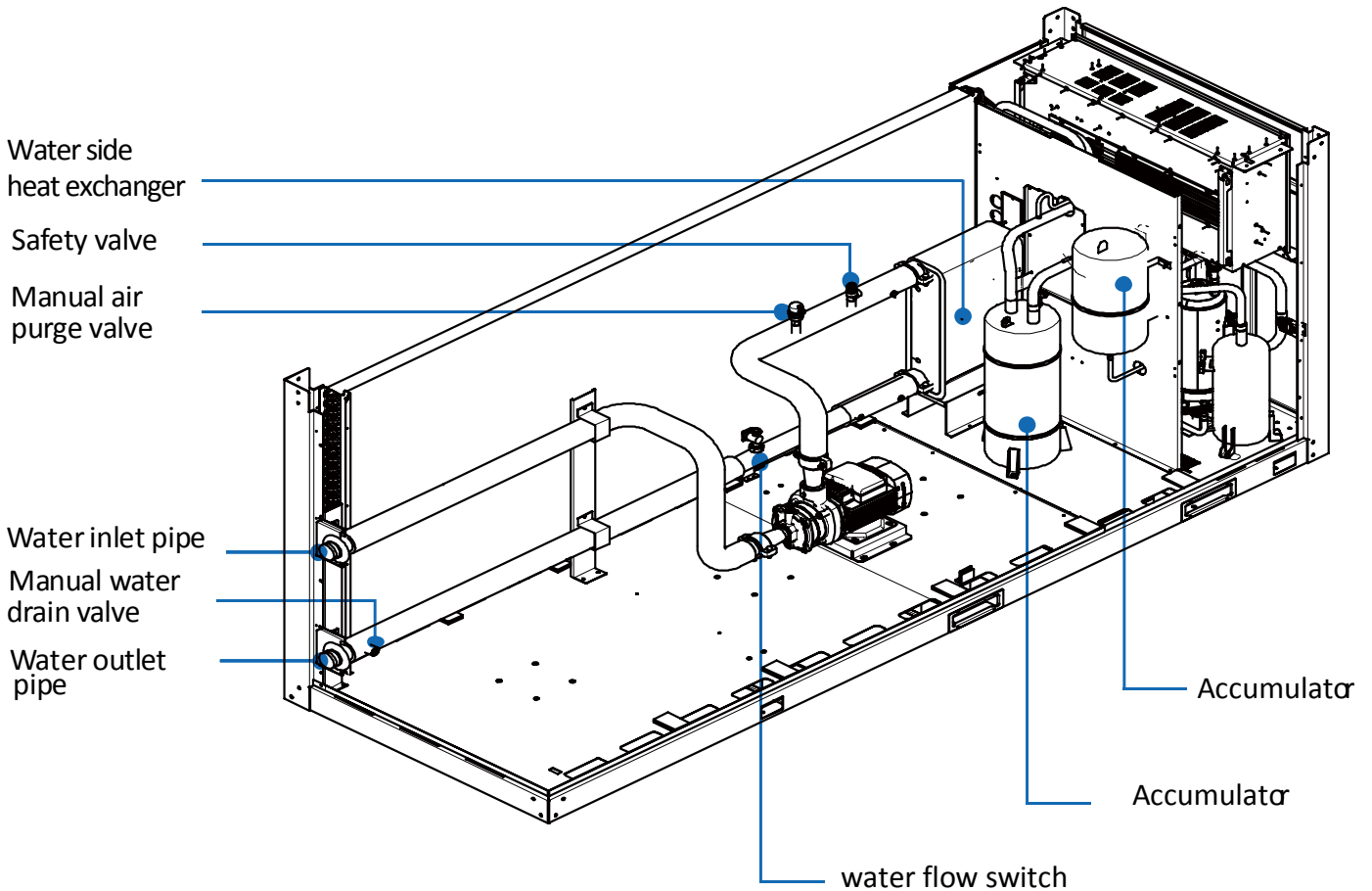
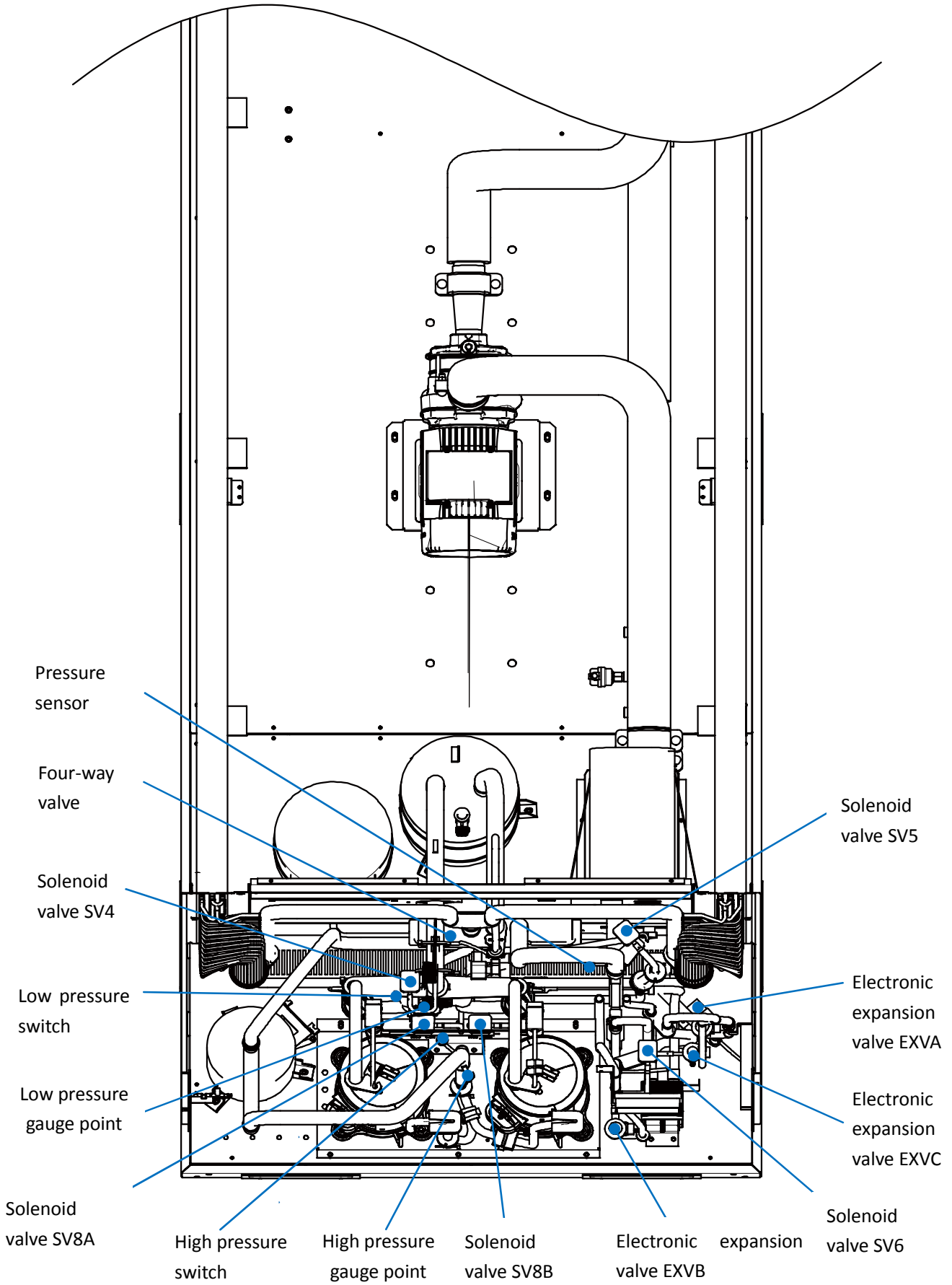


Figure 2-1.17: MC-SU90-RN1L rear view



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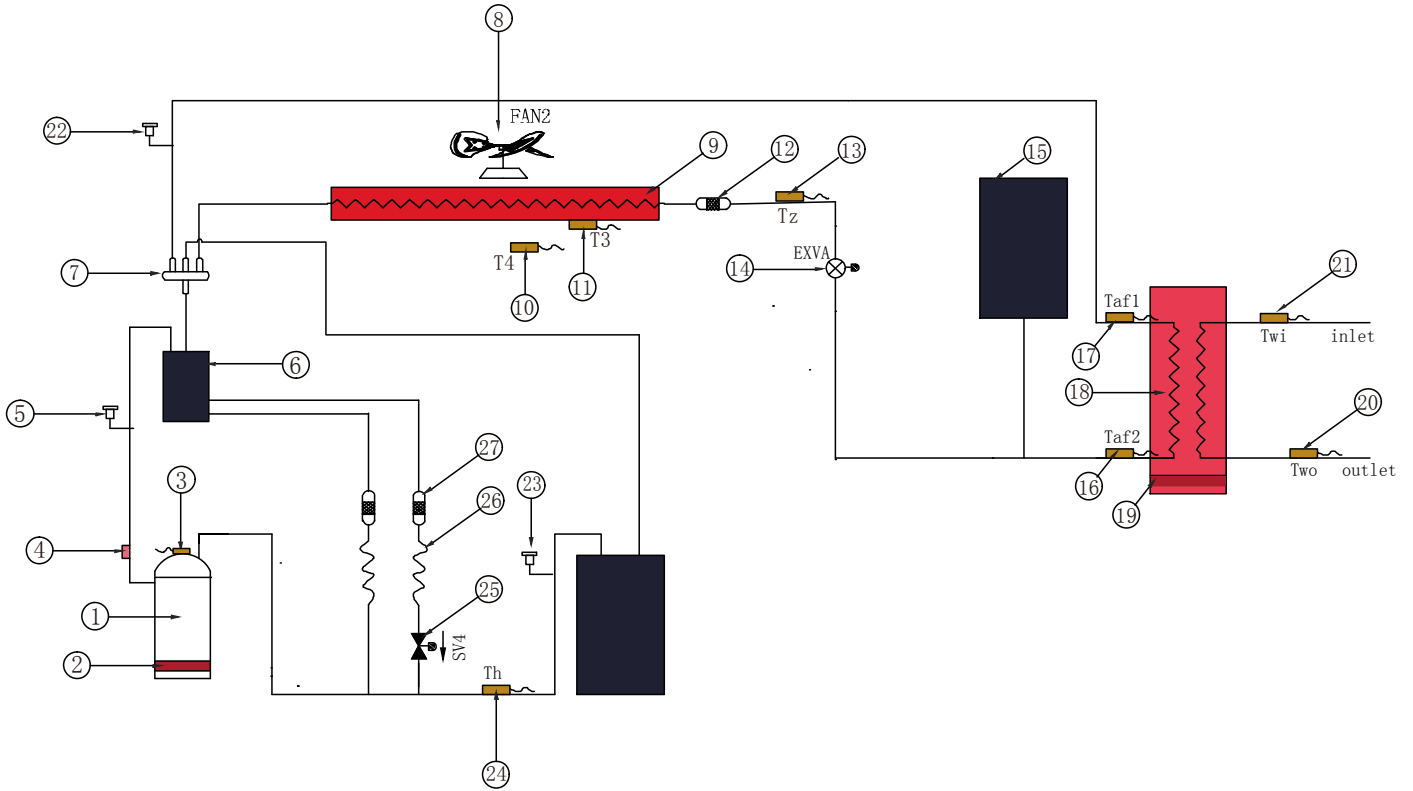
Figure 2-1.18: MC-SU90M-RN1L top view



2 Piping Diagrams

MC-SU30-RN1L

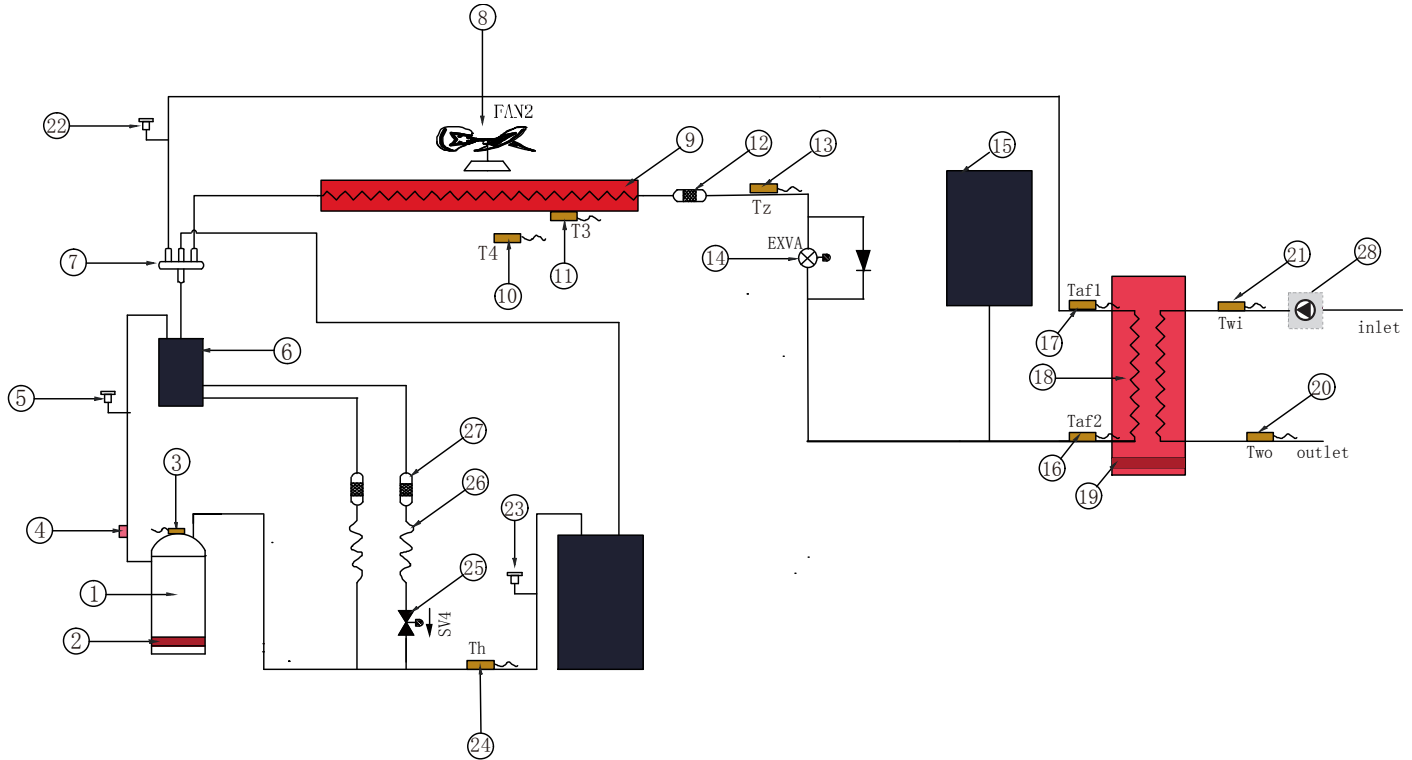
Figure 2-2.1: MC-SU30-RN1L piping diagram



Legend			
1	Compressor	2	CCH (Crankcase heater)
3	Tp (DC inverter compressor discharge temperature sensor)	4	Switch_Tp(Discharge temperature control switch)
5	PRO-H (High pressure switch)	6	Oil separator
7	4-way valve	8	FAN
9	Air side heat exchanger	10	T4 (Outdoor ambient temperature)
11	T3 (Air side heat exchanger temperature sensor)	12	Filter
13	TZ (Total cooling outlet temperature sensor)	14	EXVA (System electronic expansion valve A)
15	Accumulator	16	Taf2 (Water side heat exchanger anti-freezing temperature sensor2)
17	Taf1 (Water side heat exchanger anti-freezing temperature sensor1)	18	Water side heat exchanger
19	Water side heat exchanger anti-freezing heater	20	Two(Water outlet temperature sensor)
21	Two (Water inlet temperature sensor)	22	System pressure sensor
23	PRO-L (Low pressure switch)	24	Th (Air suction temperature sensor)
25	SV4 (Oil return solenoid valve)	26	Capillary
27	Filter		

MC-SU30M-RN1L

Figure 2-2.2: MC-SU30M-RN1L piping diagram



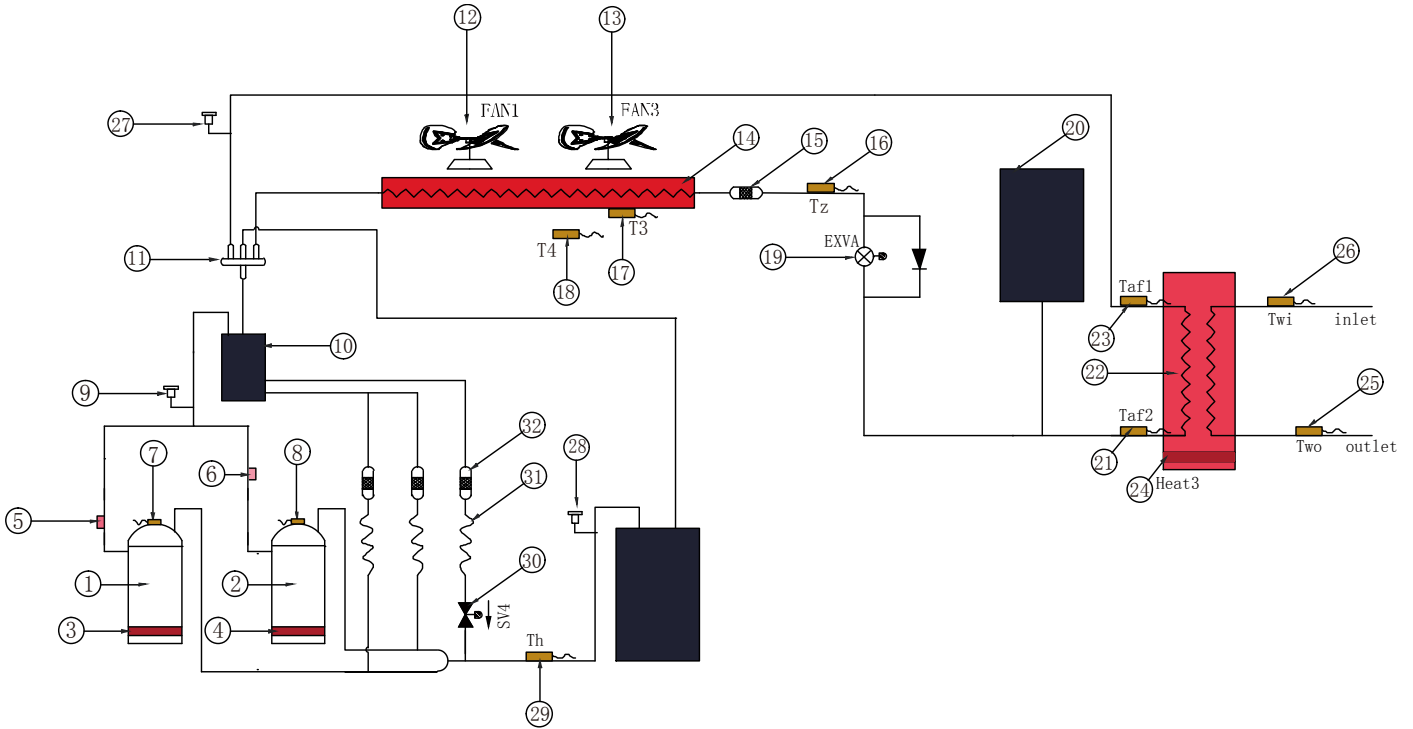
Legend			
1	Compressor	2	CCH (Crankcase heater)
3	Tp (DC inverter compressor discharge temperature sensor)	4	Switch_Tp(Discharge temperature control switch)
5	PRO-H (High pressure switch)	6	Oil separator
7	4-way valve	8	FAN
9	Air side heat exchanger	10	T4 (Outdoor ambient temperature)
11	T3 (Air side heat exchanger temperature sensor)	12	Filter
13	TZ (Total cooling outlet temperature sensor)	14	EXVA (System electronic expansion valve A)
15	Accumulator	16	Taf2 (Water side heat exchanger anti-freezing temperature sensor2)
17	Taf1 (Water side heat exchanger anti-freezing temperature sensor1)	18	Water side heat exchanger
19	Water side heat exchanger anti-freezing heater	20	Two(Water outlet temperature sensor)
21	Twi (Water inlet temperature sensor)	22	System pressure sensor
23	PRO-L (Low pressure switch)	24	Th (Air suction temperature sensor)
25	SV4 (Oil return solenoid valve)	26	Capillary
27	Filter	28	Pump

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MC-SU60-RN1L

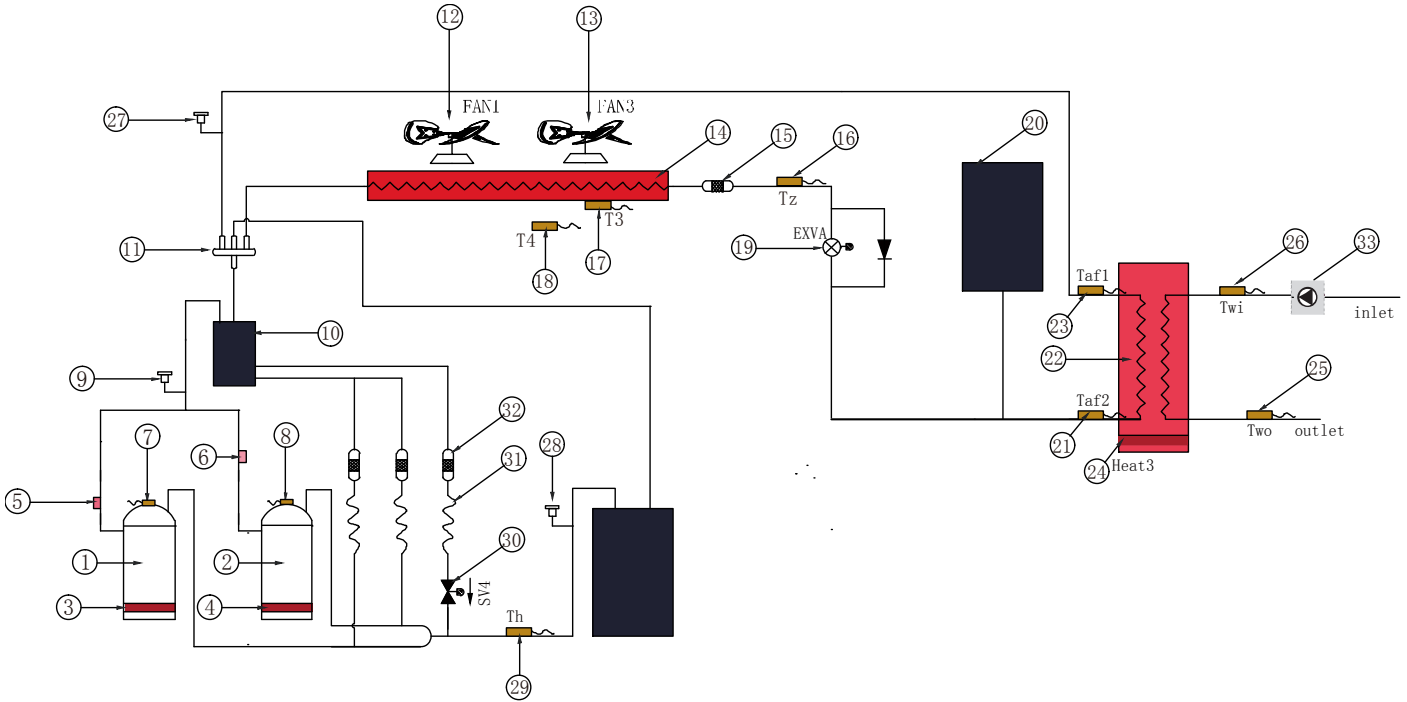
Figure 2-2.3: MC-SU60-RN1L piping diagram



Legend			
1	Compressor1	2	Compressor2
3	CCHA (Crankcase heater A)	4	CCHB (Crankcase heater B)
5	Switch_TpA (Discharge temperature control switch A)	6	Switch_TpB (Discharge temperature control switch B)
7	Tp1 (DC inverter compressor 1 discharge temperature sensor)	8	Tp2 (DC inverter compressor 2 discharge temperature sensor)
9	PRO-H (High pressure switch)	10	Oil separator
11	4-way valve	12	FAN1
13	FAN2	14	Air side heat exchanger
15	Filter	16	TZ (Total cooling outlet temperature sensor)
17	T3 (Air side heat exchanger temperature sensor)	18	T4 (Outdoor ambient temperature)
19	EXVA (System electronic expansion valve 1)	20	Accumulator
21	Taf2 (Water side heat exchanger anti-freezing temperature sensor2)	22	Water side heat exchanger
23	Taf1 (Water side heat exchanger anti-freezing temperature sensor1)	24	Antifreeze heater of plate heat exchanger
25	Two (Water outlet temperature sensor)	26	Twi (Water inlet temperature sensor)
27	System pressure sensor	28	PRO-L (Low pressure switch)
29	Th (Air suction temperature sensor)	30	SV4 (Oil return solenoid valve)
31	Capillary	32	Filter

MC-SU60M-RN1L

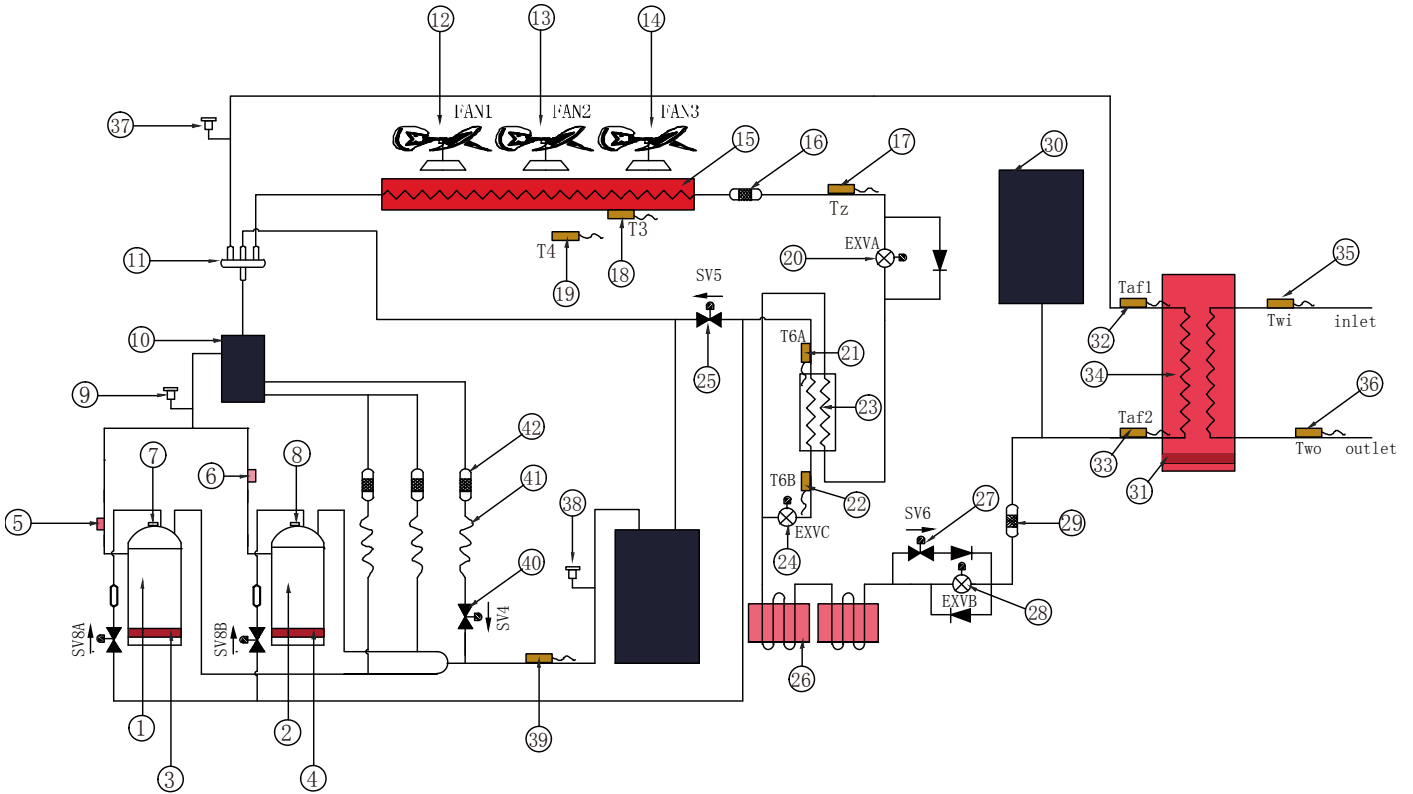
Figure 2-2.4: MC-SU60M-RN1L piping diagram



Legend			
1	Compressor1	2	Compressor2
3	CCHA (Crankcase heater A)	4	CCHB (Crankcase heater B)
5	Switch_TpA (Discharge temperature control switch A)	6	Switch_TpB (Discharge temperature control switch B)
7	Tp1 (DC inverter compressor 1 discharge temperature sensor)	8	Tp2 (DC inverter compressor 2 discharge temperature sensor)
9	PRO-H (High pressure switch)	10	Oil separator
11	4-way valve	12	FAN1
13	FAN2	14	Air side heat exchanger
15	Filter	16	TZ (Total cooling outlet temperature sensor)
17	T3 (Air side heat exchanger temperature sensor)	18	T4 (Outdoor ambient temperature)
19	EXVA (System electronic expansion valve 1)	20	Accumulator
21	Taf2 (Water side heat exchanger anti-freezing temperature sensor2)	22	Water side heat exchanger
23	Taf1 (Water side heat exchanger anti-freezing temperature sensor1)	24	Antifreeze heater of plate heat exchanger
25	Two (Water outlet temperature sensor)	26	Two (Water inlet temperature sensor)
27	System pressure sensor	28	PRO-L (Low pressure switch)
29	Th (Air suction temperature sensor)	30	SV4 (Oil return solenoid valve)
31	Capillary	32	Filter
33	Pump		

MC-SU90-RN1L

Figure 2-2.5: MC-SU90-RN1L piping diagram

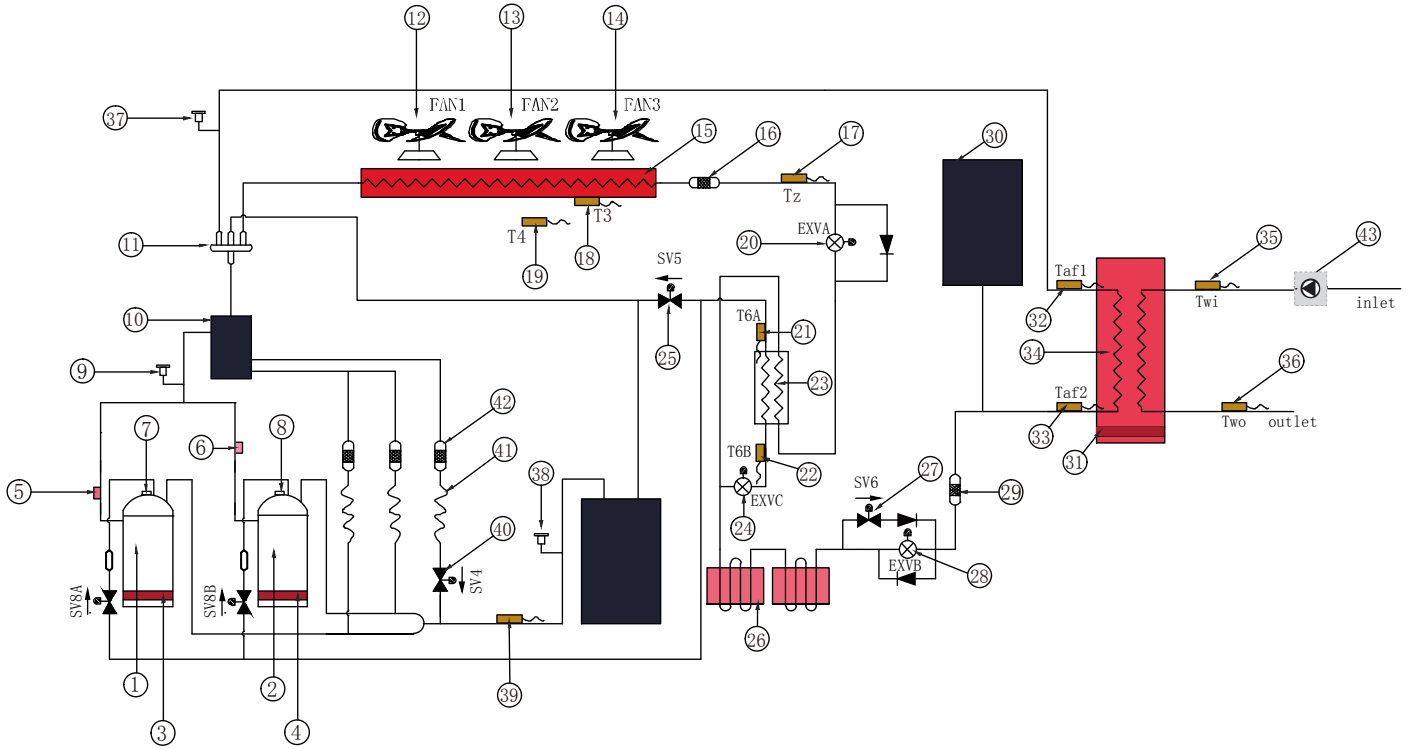


Legend

1	Compressor1	2	Compressor2
3	CCHA (Crankcase heater A)	4	CCHB (Crankcase heater B)
5	Switch_TpA (Discharge temperature control switch A)	6	Switch_TpB (Discharge temperature control switch B)
7	Tp1 (DC inverter compressor 1 discharge temperature)	8	Tp2 (DC inverter compressor 2 discharge temperature)
9	PRO-H (High pressure switch)	10	Oil separator
11	4-way valve	12	FAN1
13	FAN2	14	FAN3
15	Air side heat exchanger	16	Filter
17	TZ (Total cooling outlet temperature sensor)	18	T3 (Air side heat exchanger temperature sensor)
19	T4 (Outdoor ambient temperature)	20	EXVA (System electronic expansion valve 1)
21	T6B (Refrigerant outlet temperature sensor of EVI plate heat exchanger)	22	T6A (Refrigerant inlet temperature sensor of EVI plate heat exchanger)
23	Plate heat exchanger (PHE) subcooling	24	EXVC (EVI electronic expansion valve)
25	SV5 (Multifunctional solenoid valve)	26	Unit for cooling electronic control board
27	SV6 (Liquid side bypass solenoid valve)	28	EXVB (System electronic expansion valve 2)
29	Filter	30	Accumulator
31	Antifreeze heater of plate heat exchanger	32	Taf1 (Water side heat exchanger anti-freezing temperature sensor1)
33	Taf2 (Water side heat exchanger anti-freezing temperature sensor2)	34	Water side Plate heat exchanger
35	Two (Water outlet temperature sensor)	36	Twi (Water inlet temperature sensor)
37	System pressure sensor	38	PRO-L (Low pressure switch)
39	Th (Air suction temperature sensor)	40	SV4 (Oil return solenoid valve)
41	Capillary	42	Filter

MC-SU90M-RN1L

Figure 2-2.6: MC-SU90M-RN1L piping diagram



Legend			
1	Compressor1	2	Compressor2
3	CCHA (Crankcase heater A)	4	CCHB (Crankcase heater B)
5	Switch_TpA (Discharge temperature control switch A)	6	Switch_TpB (Discharge temperature control switch B)
7	Tp1 (DC inverter compressor 1 discharge temperature)	8	Tp2 (DC inverter compressor 2 discharge temperature)
9	PRO-H (High pressure switch)	10	Oil separator
11	4-way valve	12	FAN1
13	FAN2	14	FAN3
15	Air side heat exchanger	16	Filter
17	TZ (Total cooling outlet temperature sensor)	18	T3 (Air side heat exchanger temperature sensor)
19	T4 (Outdoor ambient temperature)	20	EXVA (System electronic expansion valve 1)
21	T6B (Refrigerant outlet temperature sensor of EVI plate heat exchanger)	22	T6A (Refrigerant inlet temperature sensor of EVI plate heat exchanger)
23	Plate heat exchanger (PHE) subcooling	24	EXVC (EVI electronic expansion valve)
25	SV5 (Multifunctional solenoid valve)	26	Unit for cooling electronic control board
27	SV6 (Liquid side bypass solenoid valve)	28	EXVB (System electronic expansion valve 2)
29	Filter	30	Accumulator
31	Antifreeze heater of plate heat exchanger	32	Taf1 (Water side heat exchanger anti-freezing temperature sensor1)
33	Taf2 (Water side heat exchanger anti-freezing temperature sensor2)	34	Water side Plate heat exchanger
35	Two (Water outlet temperature sensor)	36	Twi (Water inlet temperature sensor)
37	System pressure sensor	38	PRO-L (Low pressure switch)
39	Th (Air suction temperature sensor)	40	SV4 (Oil return solenoid valve)
41	Capillary	42	Filter
43	Pump		

Aqua Tempo Super II

Key components:

1. **Compressor**
Maintains pressure differential between high and low pressure sides of the refrigerant system.
2. **Fan:**
Ventilates the air side heat exchanger.
3. **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%.
4. **Accumulator:**
Stores liquid refrigerant and oil to protect the compressor from liquid hammering.
5. **Electronic expansion valve (EXVA/B/C):**
Controls refrigerant flow and reduces refrigerant pressure.
6. **Four-way valve:**
Controls refrigerant flow direction. Closed in cooling mode and open in heating mode. When closed, the air side heat exchanger functions as a condenser and water side heat exchanger functions as an evaporator; when open, the air side heat exchanger functions as an evaporator and water side heat exchanger function as a condenser.
7. **High and low pressure switches:**
Regulate refrigerant system pressure. When the refrigerant system pressure rises above the upper limit or falls below the lower limit, the high or low pressure switches turn off, stopping the compressor.
8. **Discharge temperature switch:**
Protects the compressor from abnormally high temperatures and transient spikes in temperature.
9. **Air purge valve:**
Automatically removes air from the water circuit.
10. **Safety valve:**
Prevents excessive water pressure by opening at 43.5psi (3bar) and discharging water from the water circuit.
11. **Water flow switch:**
Detects water flow rate to protect the compressor and water pump in the event of insufficient water flow.
12. **Water pump:**
Circulates water in the water circuit.
13. **Pressure sensor:**
Measures refrigerant system pressure.
14. **Crankcase heater:**
Prevents refrigerant from mixing with compressor oil when the compressors are stopped.
15. **Water side heat exchanger electric heater:**
Protects the water side heat exchanger from ice formation.
16. **Water flow switch electric heater:**
Provides additional heating when heating capacity provided by the heat pump is insufficient due to low ambient temperatures, it also protects external water pipes from freezing.
17. **Solenoid valve SV4:**
Returns oil to the compressor. It opens after 17 minutes of compressor operation, closes after 3 minutes, then opens again for 3 minutes at 17 minute increments.
18. **Plate heat exchanger:**
In cooling mode, it can improve super-cooling degree and the super-cooled refrigerant can achieve better heat exchange in indoor side. In heating mode, the refrigerant comes from the plate heat exchanger going to the compressor can enhance the refrigerant enthalpy and improve the heating capacity in low ambient temperature. Refrigerant volume in plate heat exchanger is controlled according to temperature different between plate heat exchanger inlet and outlet.
19. **Solenoid valve SV5:**

Prevent vibration of injection pipe

20. Solenoid valve SV6:

Increasing refrigerant circulating flow rate in in cooling mode.

21. Solenoid valve SV8A / SV8B:

Allows refrigerant from plate heat exchanger inject directly to the compressor. SV8A opens when compressor A startup and closes when compressor A stop. SV8B delays opening when compressor B startup and closes when compressor B stop.

3 Refrigerant Flow Diagrams

Heating operation

Figure 2-3.1: Refrigerant flow during heating operation for 30kW unit

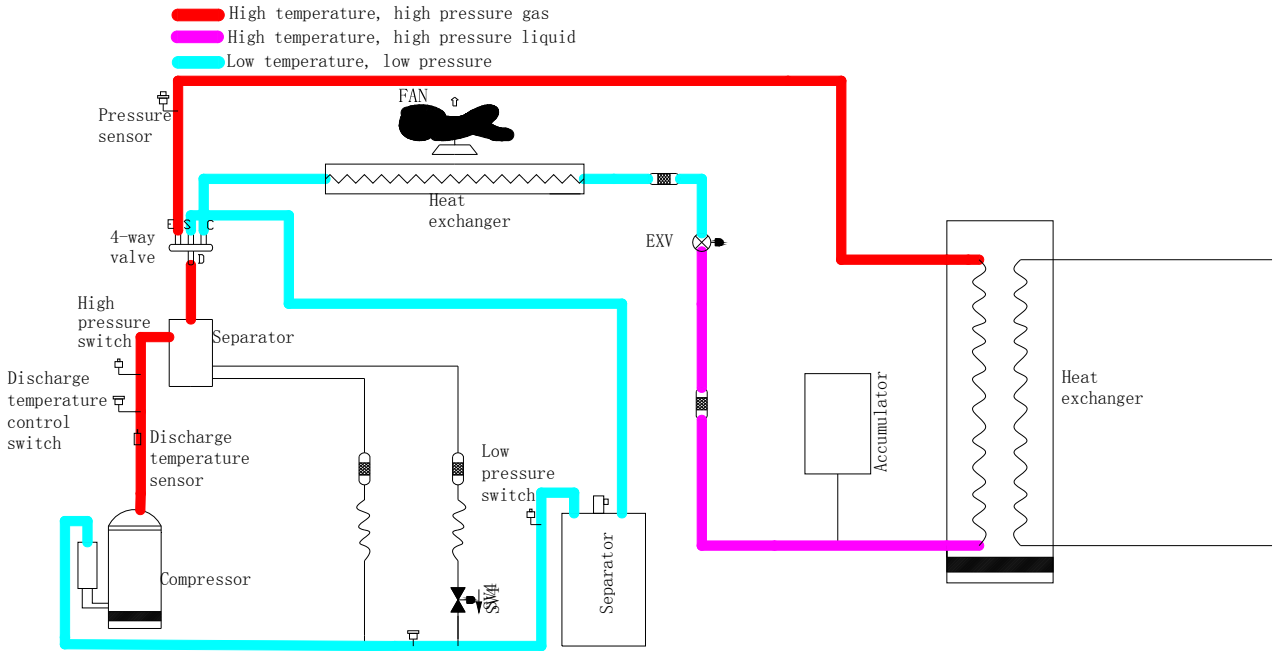


Figure 2-3.2: Refrigerant flow during heating operation for 60kW unit

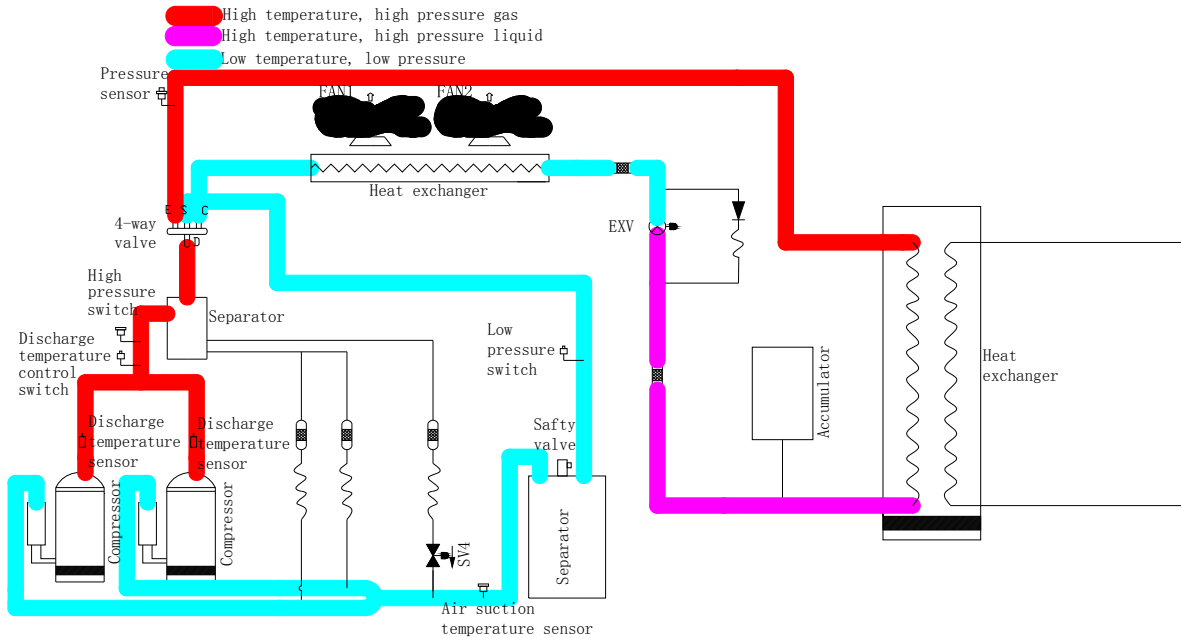
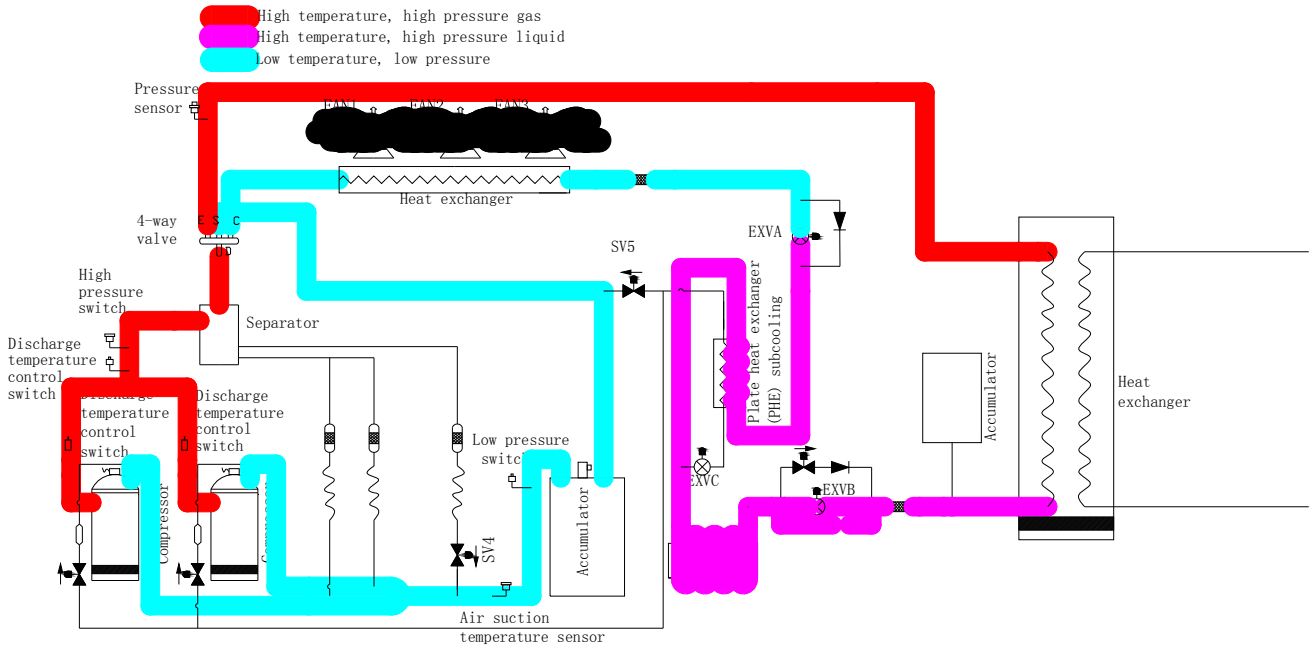


Figure 2-3.3: Refrigerant flow during heating operation for 90kW unit



Cooling and defrosting operation

Figure 2-3.4: Refrigerant flow during cooling and defrosting operations for 30kW unit

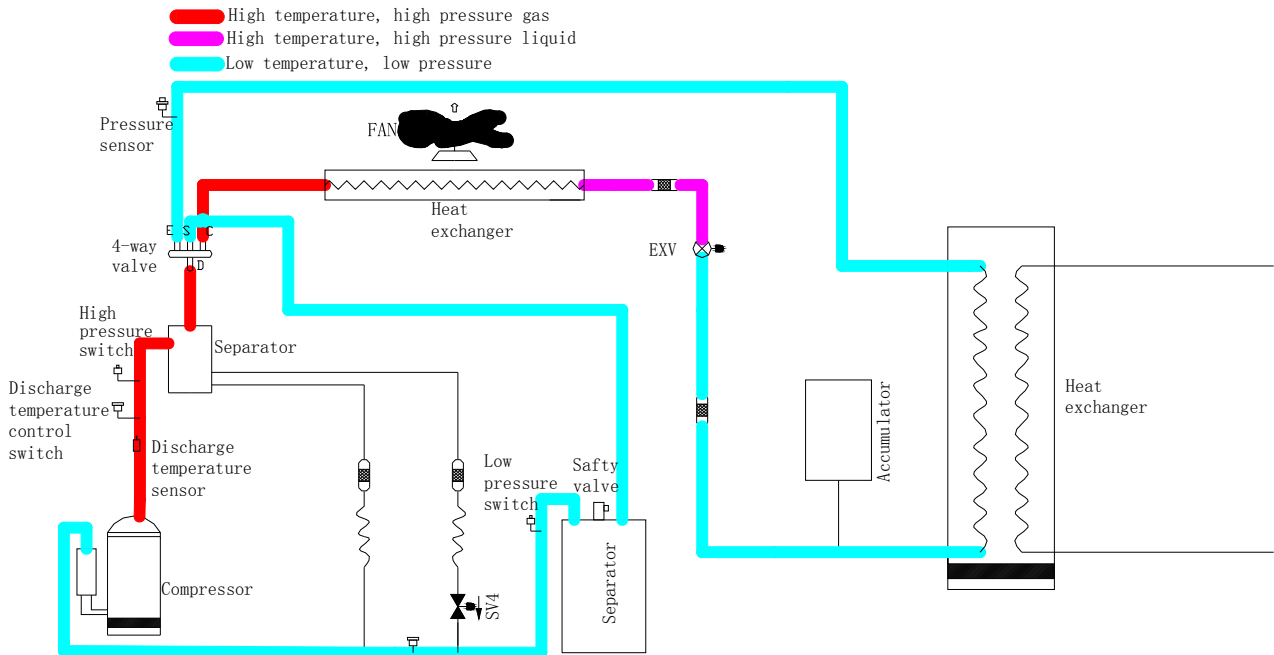


Figure 2-3.5: Refrigerant flow during cooling and defrosting operations for 60kW unit

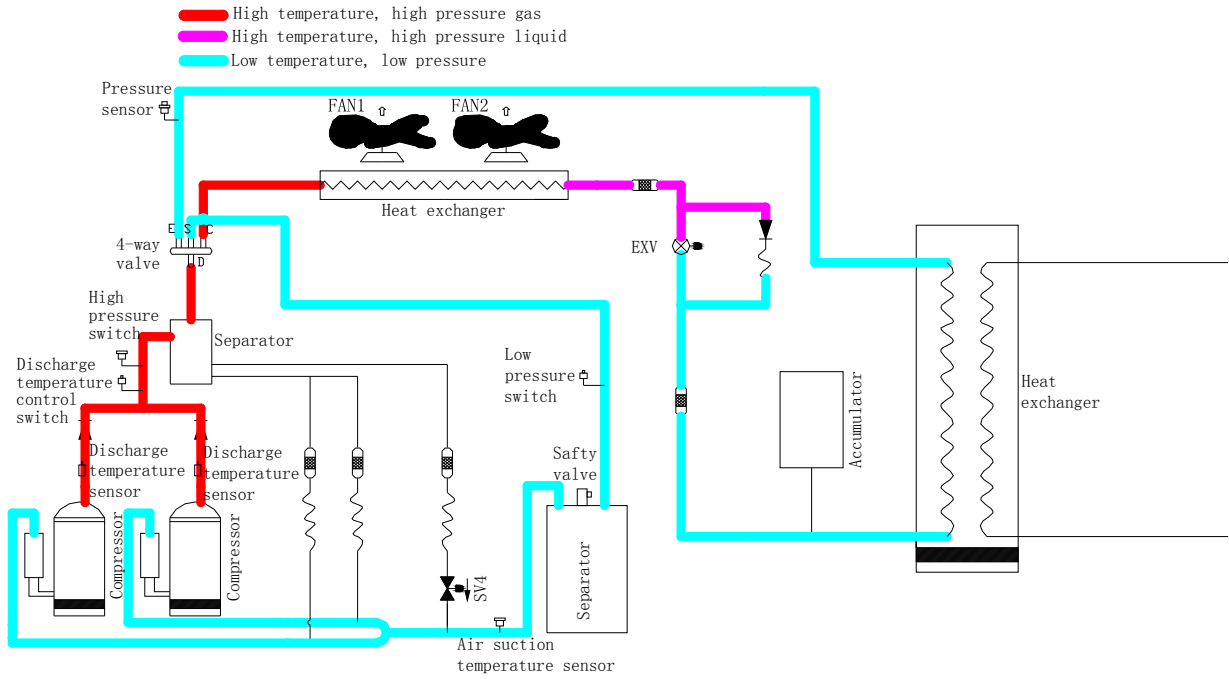
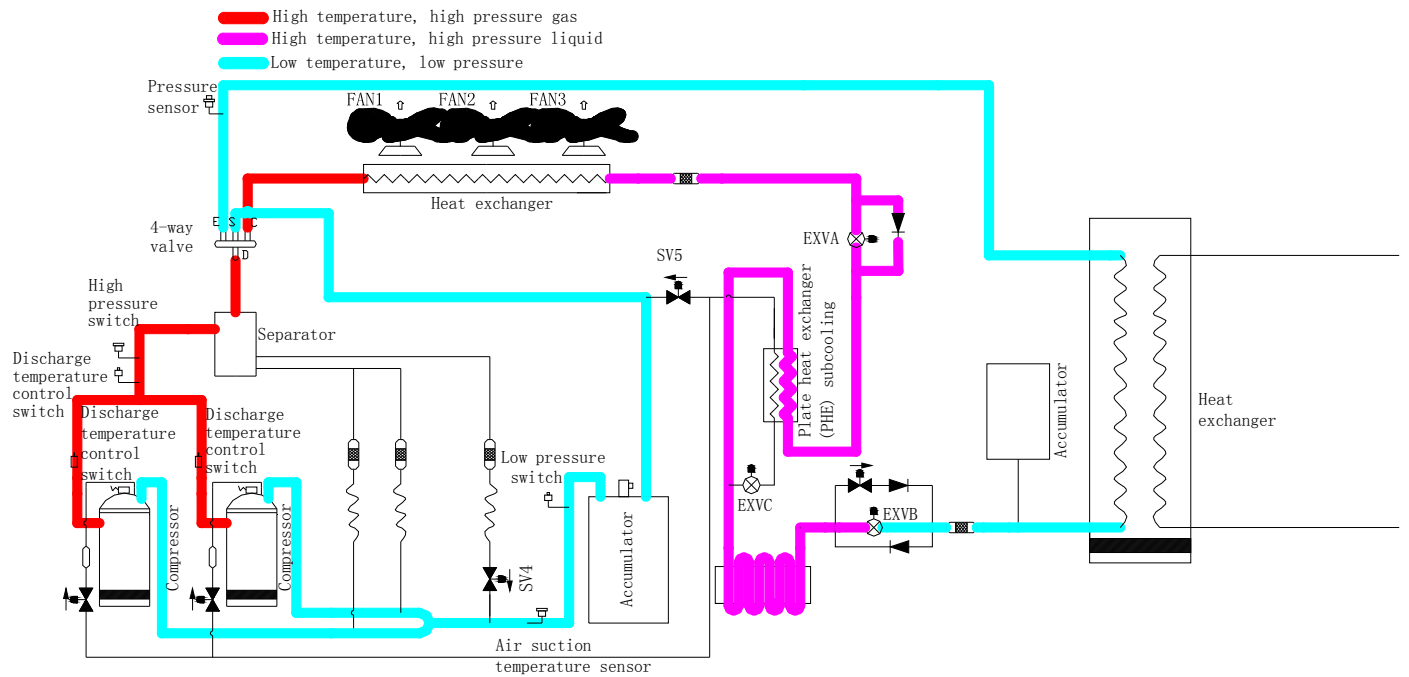


Figure 2-3.6: Refrigerant flow during cooling and defrosting operations for 90kW unit



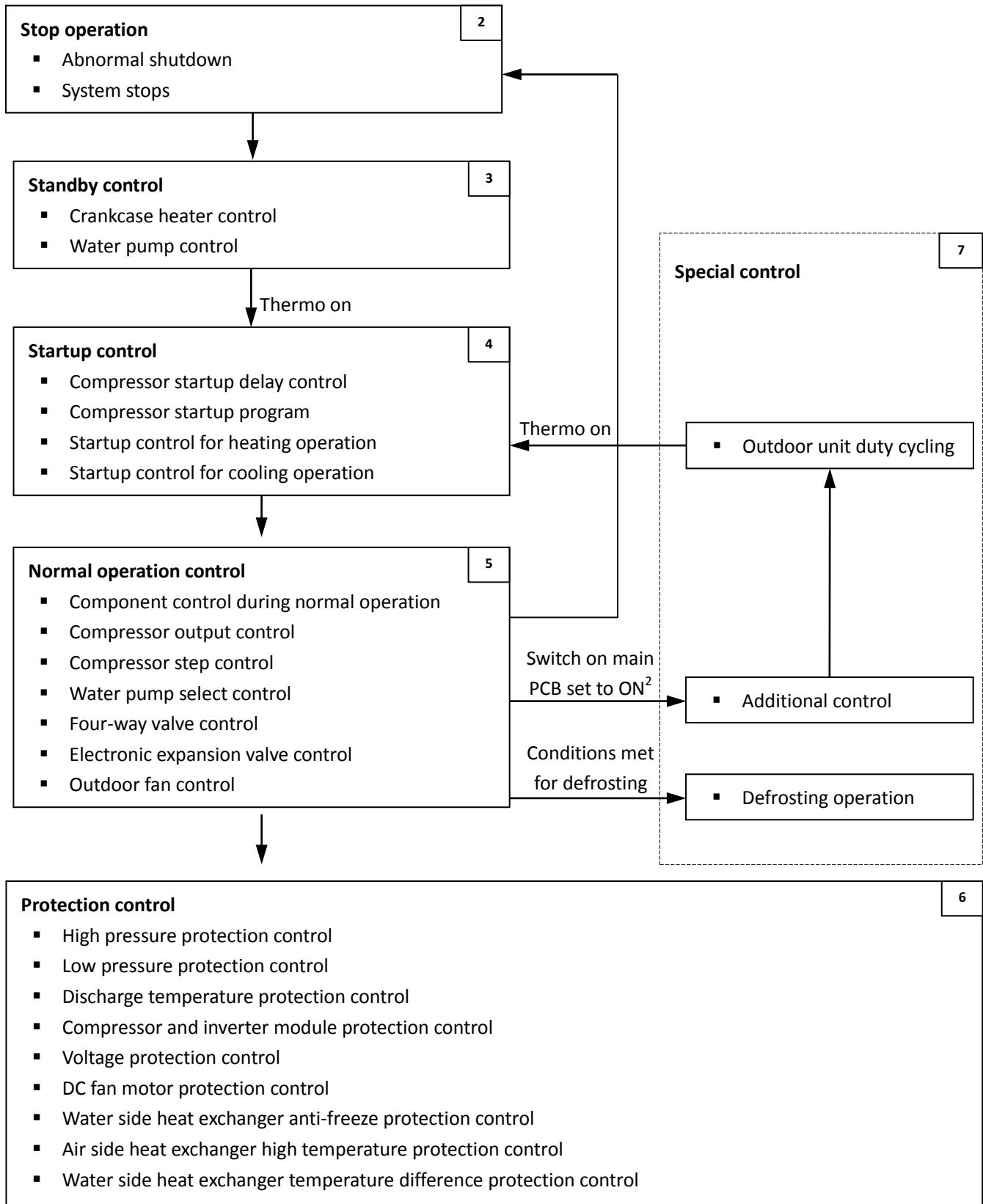
Part 3

Control

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4	Startup Control.....	32
5	Normal Operation Control	37
6	Protection Control	44
7	Special Control	52

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.



Note:

1. Numbers in the top right-hand corners of boxes indicate the relevant section of text on the following pages.
2. For 30kW and 60kW units is S5_2 to set additional control, for 90kW unit is S5_3 to set additional control.

2 Stop Operation

The stop operation occurs for one of the 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's PCB digital displays and on the user interface.
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 compressors are stopped. The crankcase heater is controlled according to the outdoor ambient temperature and discharge temperature. When the outdoor ambient temperature is above 40°C, the crankcase heater is off; when the outdoor ambient temperature is below 35°C, the crankcase heater is controlled according to discharge temperature. Refer to Figures 3-3.1 and 3-3.2.

Figure 3-3.1: Crankcase heater controlled according to outdoor ambient temperature

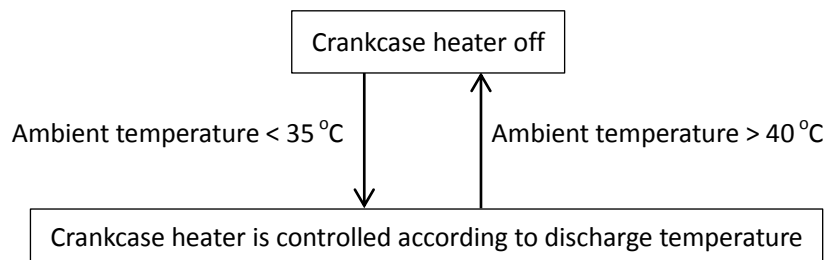
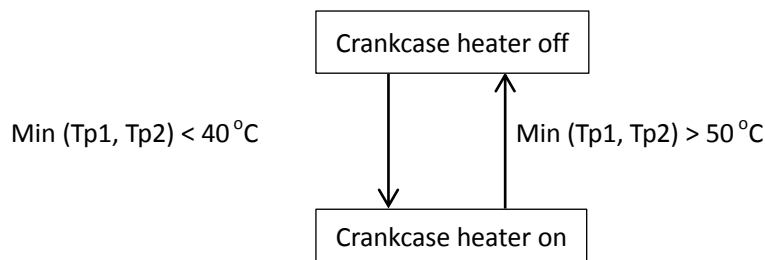


Figure 3-3.2: Crankcase heater controlled according to discharge temperature



Notes:

1. Tp1: discharge temperature sensor 1, Tp2: discharge temperature sensor 2.

3.2 Water Pump Control

When the outdoor unit is in standby, the circulator pumps run continuously.

4 Startup Control

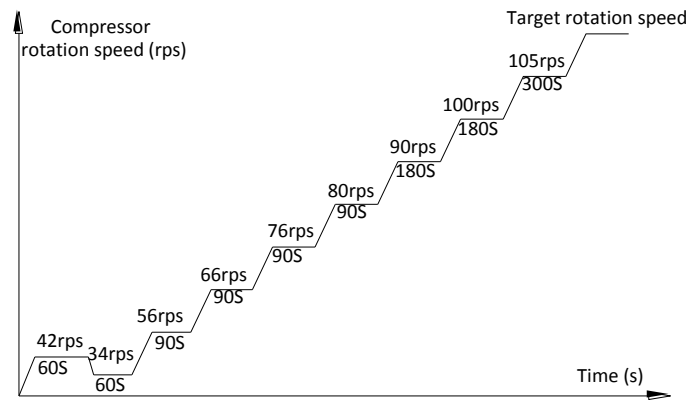
4.1 Compressor Startup Delay Control

In initial startup control and restart control (except in defrosting operation), compressor startup is delayed such that a minimum 7 minutes has elapsed since the compressor stopped, in order to prevent frequency compressor on/off and to equalize the pressure within the refrigerant system.

4.2 Compressor Startup Program

In initial startup control and in re-start control, compressor startup is controlled according to outdoor ambient temperature and discharge temperature. Compressor startup follows one of two startup programs until the target rotation speed is reached. Refer to Figures 3-4.1, 3-4.2, 3-4.3, 3-4.4.

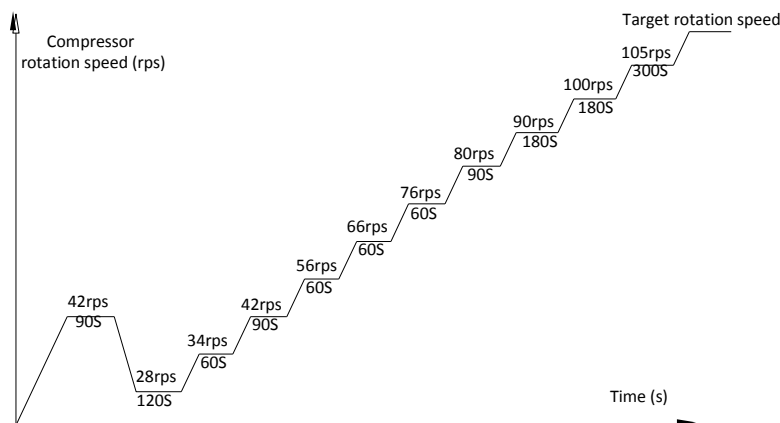
Figure 3-4.1: 30kW and 60kW units compressor startup program¹ when ambient temperature is above 10°C



Notes:

- Once the first, 60-second stage of the program is complete, the program proceeds to the subsequent stages in a step-by-step fashion and exits when the target rotation speed has been reached.

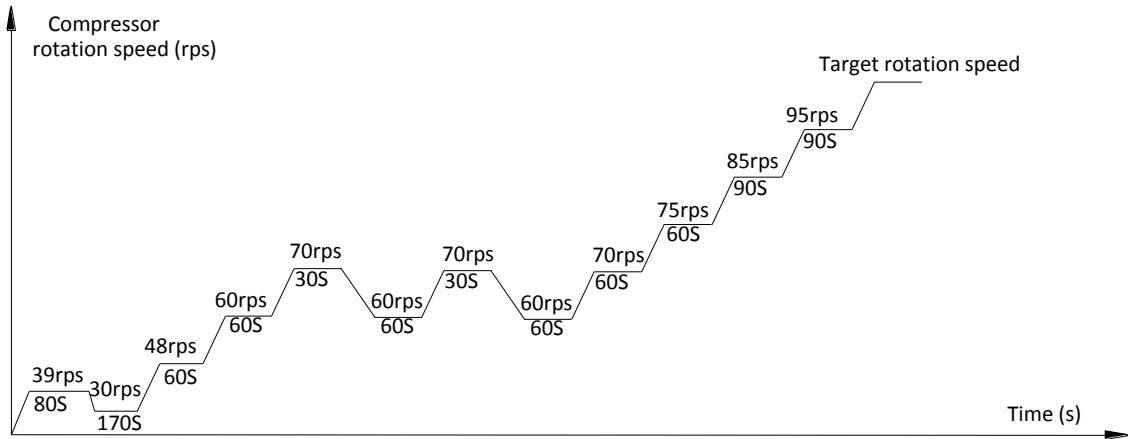
Figure 3-4.2: 30kW and 60kW units compressor startup program¹ when ambient temperature is at or below 10°C



Notes:

- Once the first, 90-second stage of the program is complete, the program proceeds to the subsequent stages in a step-by-step fashion and exits when the target rotation speed has been reached.

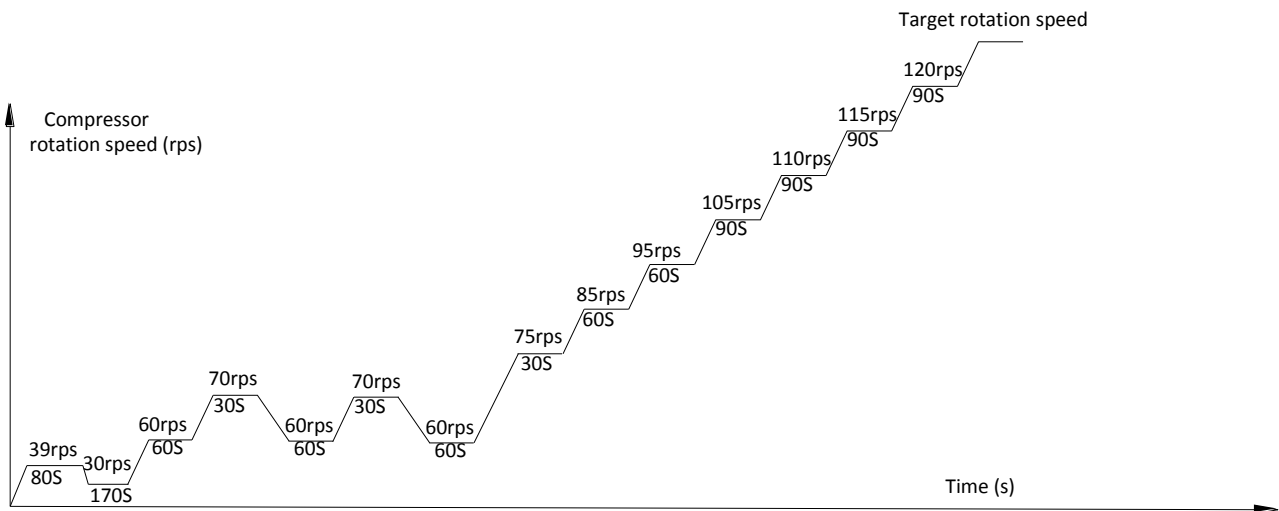
Figure 3-4.3: 90kW unit compressor startup program¹ when ambient temperature is above 10°C



Notes:

- Once the first, 80-second stage of the program is complete, the program proceeds to the subsequent stages in a step-by-step fashion and exits when the target rotation speed has been reached.

Figure 3-4.4: 90kW unit compressor startup program¹ when ambient temperature is at or below 10°C



Notes:

- Once the first, 80-second stage of the program is complete, the program proceeds to the subsequent stages in a step-by-step fashion and exits when the target rotation speed has been reached.

4.3 Startup Control for Heating Operation

Table 3-4.1: Component control during startup in heating mode (30kW and 60kW units)

Component	Wiring diagram label	30kW	60kW	Control functions and states
Inverter compressor A	COMP A	●	●	Compressor startup program selected according to ambient temperature and discharge temperature ¹
Inverter compressor B	COMP B		●	
DC fan motor A	FAN A	●	●	Controlled according to ambient temperature
DC fan motor B	FAN B		●	
Electronic expansion valve	EXV 1	●	●	Position (steps) from 0 (fully closed) to 480 (fully open), controlled according to outdoor ambient temperature, unit capacity.
Four-way valve	STF1	●	●	On after the compressor startup for 10s
Solenoid valve (oil balance)	SV4_1	●	●	Closed for 200s, open for 600s, then closed
Water pump1	PUPM1	●	●	On
Water pump2	PUPM2	●	●	
Water side heat exchanger heater 1	EVA-HEAT 1	●	●	According to water side heat exchanger anti-freezing temperature (Taf)
Water side heat exchanger heater 2	EVA-HEAT 2		●	
Water flow switch	Water switch	●	●	On
Water flow switch heater	W-HEAT1	●	●	Controlled according to ambient temperature, water inlet temperature and water outlet temperature
Electric auxiliary heater	E-HEAT_L/ E-HEAT_N	●	●	Controlled according to ambient temperature and total water outlet temperature after the compressor is on
Crank case heater 1	HEAT1	●	●	Controlled according to ambient temperature and discharge temperature
Crank case heater 2	HEAT2		●	

Notes:

1. Refer to Figure 3-4.1, Figure 3-4.2 and in Part 3, 4.2 "Compressor Startup Program".

Table 3-4.2: Component control during startup in heating mode (90kW unit)

Component	Wiring diagram label	90kW	Control functions and states
Inverter compressor A	COMP A	●	Compressor startup program selected according to ambient temperature and discharge temperature ¹
Inverter compressor B	COMP B	●	
DC fan motor A	FAN A	●	Controlled according to ambient temperature, high pressure value, air side heat exchanger temperature
DC fan motor B	FAN B	●	
DC fan motor C	FAN C	●	
Electronic expansion valve A	EXV A	●	Position (steps) from 0 (fully closed) to 2000 (fully open), controlled according to outdoor ambient temperature, air suction superheat
Electronic expansion valve B	EXV B	●	2880P
Electronic expansion valve C	EXV C	●	Closed
Four-way valve	STF1	●	On after the compressor startup for 10s
Solenoid valve (oil balance)	SV4	●	Closed for 200s, open for 600s, then closed
Solenoid valve	SV5	●	Open 60S, after the compressor starts for 4min, according to the EXVC
Solenoid valve	SV6	●	Closed
Solenoid valve	SV8A	●	Closed
Solenoid valve	SV8B	●	Closed
Water pump1	PUPM-1	●	On
Water pump2	PUPM-V	●	
Water side heat exchanger heater	EVA-HEAT	●	According to water side heat exchanger anti-freezing temperature (Taf)
Water flow switch	Pro_W	●	On

Water flow switch heater	W-HEAT-L/W-H EAT-N	•	Controlled according to ambient temperature, water inlet temperature and water outlet temperature
Electric auxiliary heater (pipe)	HEAT1	•	Controlled according to ambient temperature and total water outlet temperature after the compressor is on
Crank case heater	CCH	•	Controlled according to ambient temperature and discharge temperature

Notes:

1. Refer to Figure 3-4.3, Figure 3-4.4 and in Part 3, 4.2 "Compressor Startup Program".

4.4 Startup Control for Cooling Operation

Table 3-4.3: Component control during startup in cooling mode (30kW and 60kW units)

Component	Wiring diagram label	30kW	60kW	Control functions and states
Inverter compressor A	COMP A	•	•	Compressor startup program selected according to ambient temperature and discharge temperature ¹
Inverter compressor B	COMP B		•	
DC fan motor A	FAN A	•	•	Controlled according to air side heat exchanger refrigerant total outlet temperature (Tz/7)
DC fan motor B	FAN B		•	
Electronic expansion valve	EXV 1	•	•	Position (steps) from 0 (fully closed) to 480 (fully open), controlled according to outdoor ambient temperature, outdoor unit initial frequency
Four-way valve	STF1	•	•	Off
Solenoid valve (oil balance)	SV4_1	•	•	Closed for 200s, open for 600s, then closed
Water pump1	PUPM1	•	•	On
Water pump2	PUPM2			
Water side heat exchanger heater 1	EVA-HEAT 1	•	•	According to water side heat exchanger anti-freezing temperature (Taf)
Water side heat exchanger heater 2	EVA-HEAT 2		•	
Water flow switch	Water switch	•	•	On
Water flow switch heater	W-HEAT1	•	•	Controlled according to ambient temperature, water inlet temperature and water outlet temperature
Electric auxiliary heat	E-HEAT_L/ E-HEAT_N	•	•	Off
Crank case heater 1	Heat 1	•	•	Controlled according to ambient temperature and discharge temperature
Crank case heater 2	Heat 2		•	

Notes:

1. Refer to Figure 3-4.1, Figure 3-4.2 and in Part 3, 4.2 "Compressor Startup Program".

Table 3-4.4: Component control during startup in cooling mode (90kW unit)

Component	Wiring diagram label	90kW	Control functions and states
Inverter compressor A	COMP A	•	Compressor startup program selected according to ambient temperature and discharge temperature ¹
Inverter compressor B	COMP B	•	
DC fan motor A	FAN A	•	Controlled according to ambient temperature and air side heat exchanger refrigerant total outlet temperature (Tz/7)
DC fan motor B	FAN B	•	
DC fan motor C	FAN C	•	
Electronic expansion valve A	EXV A	•	2880P
Electronic expansion valve B	EXV B	•	Air suction superheat
Electronic expansion valve C	EXV C	•	Closed
Four-way valve	STF1	•	Closed
Solenoid valve (oil balance)	SV4	•	Closed for 200s, open for 600s, then closed
Solenoid valve	SV5	•	Open 60S, after the compressor starts for 4min,

			according to the EXVC
Solenoid valve	SV6	●	Open for 300s and close
Solenoid valve	SV8A	●	Closed
Solenoid valve	SV8B	●	Closed
Water pump1	PUPM-1	●	On
Water pump2	PUPM-V	●	
Water side heat exchanger heater	EVA-HEAT	●	According to water side heat exchanger anti-freezing temperature (Taf)
Water flow switch	Pro_W	●	On
Water flow switch heater	W-HEAT-L/W-H EAT-N	●	Controlled according to ambient temperature, water inlet temperature and water outlet temperature
Electric auxiliary heater (pipe)	HEAT1	●	Controlled according to ambient temperature and total water outlet temperature after the compressor is on
Crank case heater	CCH	●	Controlled according to ambient temperature and discharge temperature

Notes:

1. Refer to Figure 3-4.3, Figure 3-4.4 and in Part 3, 4.2 "Compressor Startup Program".

5 Normal Operation Control

5.1 Component Control during Normal Operation

Table 3-5.1: Component control during heating operation (30kW and 60kW units)

Component	Wiring diagram label	30kW	60kW	Control functions and states
Inverter compressor A	COMP A	●	●	Controlled according to load requirement
Inverter compressor B	COMP B		●	
DC fan motor A	FAN A	●	●	Controlled according to air side heat exchanger pipe temperature and discharge pressure
DC fan motor B	FAN B		●	
Electronic expansion valve	EXV 1	●	●	Position (steps) from 0 (fully closed) to 480 (fully open), controlled according to discharge superheat and compressor frequency, and use suction temperature, air side heater exchanger temperature, discharge temperature to modify the control.
Four-way valve	STF1	●	●	On
Solenoid valve (oil balance)	SV4_1	●	●	Open regularly
Water pump1	PUPM1	●	●	On
Water pump2	PUPM2	●	●	
Water side heat exchanger heater 1	EVA-HEAT 1	●	●	Off
Water side heat exchanger heater 2	EVA-HEAT 1		●	
Water flow switch	Water switch	●	●	On
Water flow switch heater	W-HEAT1	●	●	Off
Electric auxiliary heater	E-HEAT_L/ E-HEAT_N	●	●	Controlled according to ambient temperature
Crank case heater 1	HEAT1	●	●	Off
Crank case heater 2	HEAT2		●	

Table 3-5.2: Component control during heating operation (90kW unit)

Component	Wiring diagram label	90kW	Control functions and states
Inverter compressor A	COMP A	●	Controlled according to load requirement
Inverter compressor B	COMP B	●	
DC fan motor A	FAN A	●	Controlled according to ambient temperature
DC fan motor B	FAN B	●	
DC fan motor C	FAN C	●	
Electronic expansion valve A	EXV A	●	Position (steps) from 0 (fully closed) to 2000 (fully open), controlled according to outdoor ambient temperature, air suction superheat
Electronic expansion valve A	EXV B	●	2880P
Electronic expansion valve A	EXV C	●	According to inlet and outlet superheat of plate heat exchanger
Four-way valve	STF1	●	On
Solenoid valve (oil balance)	SV4	●	Open regularly
Solenoid valve	SV5	●	according to the EXVC
Solenoid valve	SV6	●	closed
Solenoid valve	SV8A	●	On
Solenoid valve	SV8B	●	On
Water pump1	PUPM-1	●	On
Water pump2	PUPM-V	●	
Water side heat exchanger heater	EVA-HEAT	●	According to water side heat exchanger anti-freezing temperature (Taf)
Water flow switch	Pro_W	●	On

Water flow switch heater	W-HEAT-L/W-H EAT-N	•	Controlled according to ambient temperature, water inlet temperature and water outlet temperature
Electric auxiliary heater (pipe)	HEAT1	•	Controlled according to ambient temperature and total water outlet temperature after the compressor is on
Crank case heater	CCH	•	Controlled according to ambient temperature and discharge temperature

Table 3-5.3: Component control during cooling operation (30kW and 60kW units)

Component	Wiring diagram label	30kW	60kW	Control functions and states
Inverter compressor A	COMP A	•	•	Controlled according to load requirement
Inverter compressor B	COMP B		•	
DC fan motor A	FAN A	•	•	Controlled according to air side heat exchanger refrigerant total outlet temperature (Tz/7)
DC fan motor B	FAN B		•	
Electronic expansion valve	EXV 1	•	•	Position (steps) from 0 (fully closed) to 480 (fully open), controlled according to suction superheat, water inlet temperature and compressor frequency.
Four-way valve	STF1	•	•	Off
Solenoid valve (oil balance)	SV4_1	•	•	Open regularly
Water pump1	PUPM1	•	•	On
Water pump2	PUPM2	•	•	
Water side heat exchanger heater 1	EVA-HEAT 1	•	•	According to water side heat exchanger anti-freezing temperature (Taf)
Water side heat exchanger heater 2	EVA-HEAT 2		•	
Water flow switch	Water switch	•	•	On
Water flow switch heater	W-HEAT1	•	•	Off
Electric auxiliary heater	E-HEAT_L/ E-HEAT_N	•	•	Off
Crank case heater 1	HEAT1	•	•	Off
Crank case heater 2	HEAT2		•	

Table 3-5.4: Component control during cooling mode (90kW unit)

Component	Wiring diagram label	90kW	Control functions and states
Inverter compressor A	COMP A	•	Controlled according to load requirement
Inverter compressor B	COMP B	•	
DC fan motor A	FAN A	•	Controlled according to ambient temperature and air side heat exchanger refrigerant total outlet temperature (Tz/7)
DC fan motor B	FAN B	•	
DC fan motor C	FAN C	•	
Electronic expansion valve A	EXV A	•	2880P
Electronic expansion valve B	EXV B	•	Air suction superheat
Electronic expansion valve C	EXV C	•	According to inlet and outlet superheat of plate heat exchanger
Four-way valve	STF1	•	Closed
Solenoid valve (oil balance)	SV4	•	Open regularly
Solenoid valve	SV5	•	according to the EXVC
Solenoid valve	SV6	•	Closed
Solenoid valve	SV8A	•	Closed
Solenoid valve	SV8B	•	Closed
Water pump1	PUPM-1	•	On
Water pump2	PUPM-V	•	
Water side heat exchanger heater	EVA-HEAT	•	According to water side heat exchanger

			anti-freezing temperature (Taf)
Water flow switch	Pro_W	•	On
Water flow switch heater	W-HEAT-L/W-H EAT-N	•	Controlled according to ambient temperature, water inlet temperature and water outlet temperature
Electric auxiliary heater	HEAT1/HEAT2	•	Controlled according to ambient temperature and total water outlet temperature after the compressor is on
Crank case heater	CCH	•	Controlled according to ambient temperature and discharge temperature

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5.2 Compressor Output Control

The compressor rotation speed is controlled according to the load requirement. Before compressor startup, the outdoor unit determines the compressor target speed according to outdoor ambient temperature, discharge temperature and then runs the appropriate compressor startup program. Refer to Part 3, 4.2 “Compressor Startup Program”. Once the startup program is complete, the compressor runs at the target rotation speed.

The compressor speed is controlled according to two parts in normal operation:

In cooling mode: In a single system, the compressor speed is controlled according to the water outlet temperature and water outlet setting temperature. In a combination system, the compressor of master unit is controlled according total water outlet temperature and water outlet setting temperature, the compressor of the slave unit is controlled according to water inlet and water outlet temperature. Both in a single system and combination system, the compressor speed is limited by the inverter module temperature (Tf), ambient temperature, discharge temperature and air side heat exchanger refrigerant total outlet temperature (Tz/7).

In heating mode: In a single system, the compressor speed is controlled according to the water outlet temperature and water outlet setting temperature. In a combination system, all compressors are controlled according to the total water outlet temperature and the water outlet setting temperature. Both in a single system and combination system, the compressor speed is limited by inverter module temperature (Tf), ambient temperature, discharge temperature, discharge pressure.

5.3 Compressor Step Control

The running speed of six-pole compressors in rotations per second (rps) is one third of the frequency (in Hz) of the electrical input to the compressor motor. The frequency of the electrical input to the compressor motors can be altered at a rate of 1Hz in two seconds.

5.4 Water pump select control

For 30kW and 60kW units model

When the dial switch S5_3 on the main PCB is switched ON, the system runs “one small pump per unit” mode, when S5_3 is switched OFF, the system run “one large pump controlled by master unit” mode.

- One pump control: only the master unit output pump signal, no pump signal output on the slave units.
- Multiple pump control: output pump signal on all units.
- S5_3 in one system must be switched to the same position or not error code FP will be displayed.

For 90kW unit model

When the dial switch S12_2 on the main PCB is switched ON, the system runs “one small pump per unit” mode, when S12_2 is switched OFF, the system run “one large pump controlled by master unit” mode.

- One pump control: only the master unit output pump signal, no pump signal output on the slave units.
- Multiple pump control: output pump signal on all units.
- S12_2 in one system must be switched to the same position or not error code FP will be displayed.

5.5 Four-way Valve Control

The four-way valve is used to change the direction of refrigerant flow through the water side heat exchanger in order to switch between cooling and heating operations. Refer to Figures 2-3.1 ,2-3.2, 2-3.3, 2-3.4, 2-3.5, 2-3.6 in Part 2, 3 “Refrigerant Flow Diagrams”.

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

5.6 Electronic Expansion Valve Control

For 30kW and 60kW UNITS model

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

- At power-on:
 - The EXV first closes fully, then moves to the standby position (352 (steps)). After 30seconds the EXV moves to an initial running position, which is determined according to the operating mode and outdoor ambient temperature.
 - When the unit operate in cooling mode, after 60 seconds, the EXV is controlled according to suction superheat, water inlet temperature and compressor frequency.
 - When the unit operates in heating mode, after a further 60 seconds, the EXV is controlled according to discharge superheat and compressor frequency, and uses the suction temperature, air side heater exchanger temperature, discharge temperature to modify the control.
- When the outdoor unit is in standby:
 - The EXV is at position 352 (steps).
- When the outdoor unit stops:
 - The EXV first closes fully, then moves to the standby position (352 (steps)).

For 90kW unit model

EXVA and EXVB control

The positions of electronic expansion valves EXVA and EXVB are controlled in steps from 0 (fully closed) to 2880 (fully open).

In cooling mode:

- When all outdoor units are in standby:
 - All EXVAs and EXVBs are at position 2000 (steps).
- When some outdoor units are running and some outdoor units are in standby:
 - EXVAs and EXVBs on running outdoor units are controlled according to discharge temperature. EXVAs and EXVBs of units in standby are fully closed.
- When all outdoor units are running:
 - All EXVAs and EXVBs are controlled according to discharge temperature.

In heating mode:

- When all outdoor units are in standby:
 - All EXVAs and EXVBs are at position 2000 (steps).
- When some outdoor units are running and some outdoor units are in standby:
 - EXVAs and EXVBs on running outdoor units are controlled according to discharge superheat. EXVAs and EXVBs of units in standby are fully closed.
- When all outdoor units are running:
 - All EXVAs and EXVBs are controlled according to discharge superheat.

EXVC control

The positions of electronic expansion valves EXVC are controlled in steps from 0 (fully closed) to 480 (fully open).

In cooling / heating mode:

- When all outdoor units are in standby:

- All EXVCs are fully closed.
- When some outdoor units are running and some outdoor units are in standby:
 - EXVCs on running outdoor units are controlled according to temperature different between plate heat exchanger inlet and outlet. EXVCs of units in standby are fully closed.
- When all outdoor units are running:
 - All EXVCs are controlled according to temperature different between plate heat exchanger inlet and outlet.

5.7 Outdoor Fan Control

The speed of the outdoor unit fan(s) is adjusted in steps, as shown in Table 3-5.5.

Table 3-5.5: Outdoor fan speed steps for (30kW and 60kW units)

Fan speed index	Fan speed (rpm)		
	30kW	60kW	
	FAN A	FAN A	FAN B
0	0	0	0
1	150	150	0
2	200	200	0
3	250	250	0
4	300	300	250
5	360	360	300
6	430	430	360
7	480	530	460
8 (super silent mode)	530	650	580
9	650	760	680
10(silent mode)	710	850	800
11	800	900	850
12(standard ESP mode)	820	950	900

Abbreviations:
ESP: External static pressure

Table 3-5.6: Outdoor fan speed steps for (90kW unit)

Fan speed index	Fan speed (rpm)		
	90kW		
	FAN A	FAN B	FAN C
0	0	0	0
1	0	150	0
2	0	190	0
3	0	230	0
4	0	270	0
5	0	330	0
6	150	150	150
7	150	170	150
8 (super silent mode)	170	150	170
9	190	170	190
10	210	190	210
11	230	210	230
12	250	230	250
13	270	250	270

14	290	270	290
15	310	290	270
16	330	310	330
17	350	330	350
18	370	350	370
19	400	370	400
20	430	400	430
21	470	430	470
22	510	470	510
23	550	510	550
24	600	550	600
25(silent mode)	650	600	650
26	700	650	700
27	750	700	750
28	800	750	800
29	820	820	820
30	840	840	840
31	860	860	860
32(standard ESP mode)	880	880	880
33	910	910	910
34	940	940	940
35	970	970	970

Abbreviations:

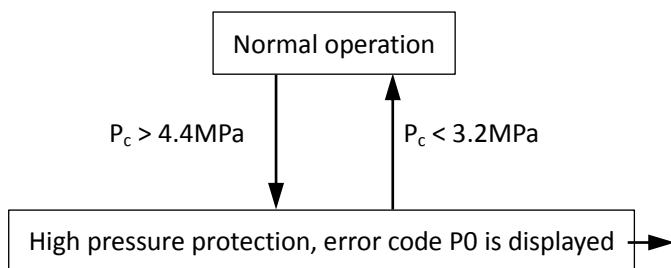
ESP: External static pressure

6 Protection Control

6.1 High Pressure Protection Control

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

Figure 3-6.1: High pressure protection control for 30kW and 60kW units



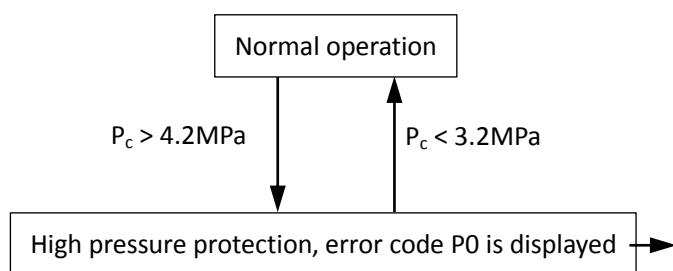
Notes:

1. P_c : Discharge pressure

When P0 protection occurs 5 times in 120 minutes, a manual system restart is required before the system can resume operation.

When the discharge pressure rises above 4.4MPa the system displays P0 protection and all units stop running. When the discharge pressure drops below 3.2MPa, the compressor enters re-start control.

Figure 3-6.2: High pressure protection control for 90kW unit



Notes:

1. P_c : Discharge pressure

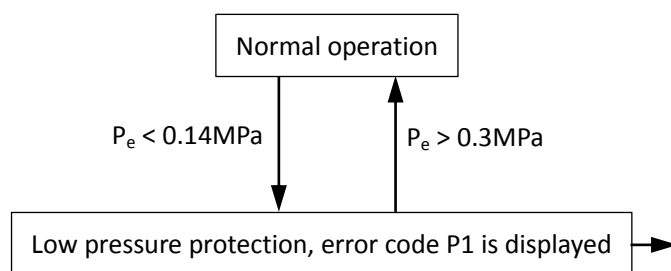
When P0 protection occurs 5 times in 120 minutes, a manual system restart is required before the system can resume operation.

When the discharge pressure rises above 4.2MPa the system displays P0 protection and all units stop 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 refrigerant system from abnormally low pressure and protects the compressor from transient drops in pressure.

Figure 3-6.3: Low pressure protection control for 30kW and 60kW units



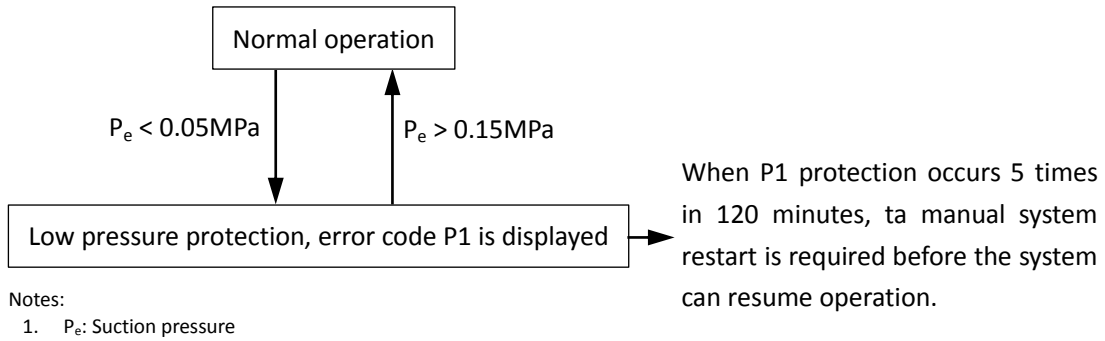
Notes:

1. P_e : Suction pressure

When P1 protection occurs 5 times in 120 minutes, manual system restart is required before the system can resume operation.

When the suction pressure drops below 0.14MPa the system displays P1 protection and all the units stop running. When the suction pressure rises above 0.3MPa, the compressor enters re-start control.

Figure 3-6.4: Low pressure protection control for 90kW unit

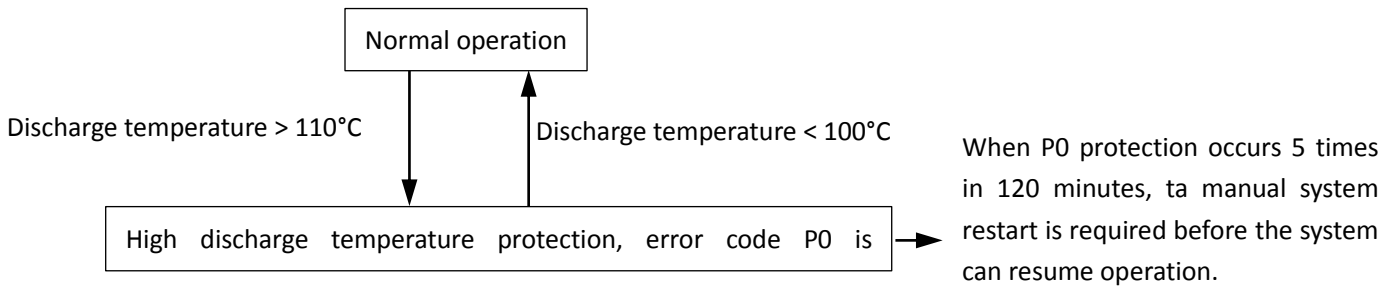


When the suction pressure drops below 0.05MPa the system displays P1 protection and all the units stop running. When the suction pressure rises above 0.15MPa, the compressor enters re-start control.

6.3 Discharge Temperature Protection Control

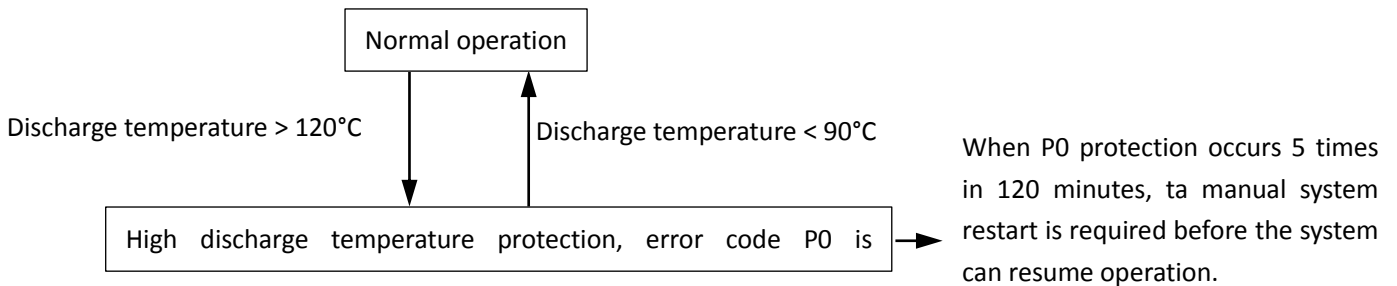
This control protects the compressor from abnormally high temperatures and transient spikes in temperature.

Figure 3-6.5: High discharge temperature protection control for 30kW and 60kW units



When the discharge temperature rises above 110°C the system displays P0 protection and all the units stop running. When the discharge temperature drops below 100°C, the compressor enters re-start control.

Figure 3-6.6: High discharge temperature protection control for 90kW unit

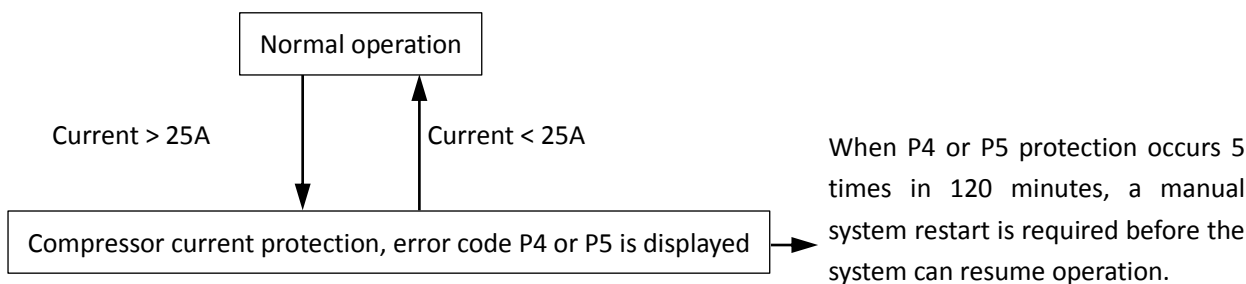


When the discharge temperature rises above 120°C the system displays P0 protection and all the units stop running. When the discharge temperature drops below 90°C, the compressor enters re-start control.

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. It is performed for each compressor and inverter module.

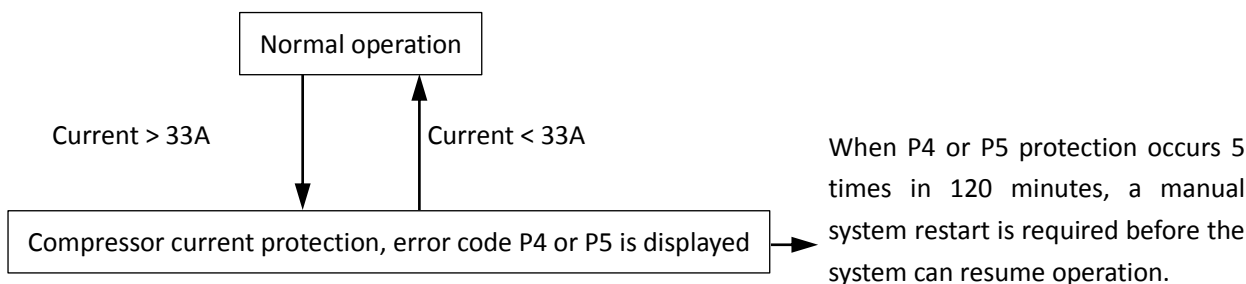
Figure 3-6.7: Compressor current protection control for 30kW and 60kW units



- Notes:
1. P4 is the protection for the power supply phase B, P5 is the protection for the power supply phase C.

When the compressor current rises above 25A, the system displays P4 or P5 protection and all the units stop running. When the compressor current drops below 25A, the compressor enters re-start control.

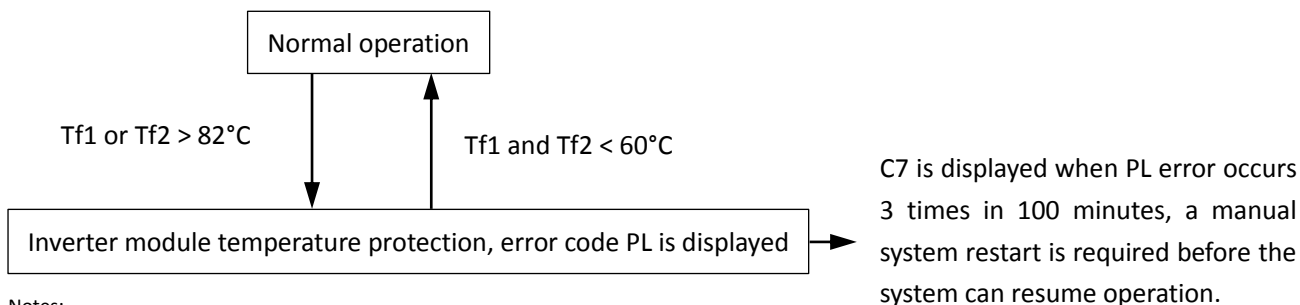
Figure 3-6.8: Compressor current protection control for 90kW unit



- Notes:
1. P4 is the protection for the power supply phase B, P5 is the protection for the power supply phase C.

When the compressor current rises above 33A, the system displays P4 or P5 protection and all the units stop running. When the compressor current drops below 33A, the compressor enters re-start control.

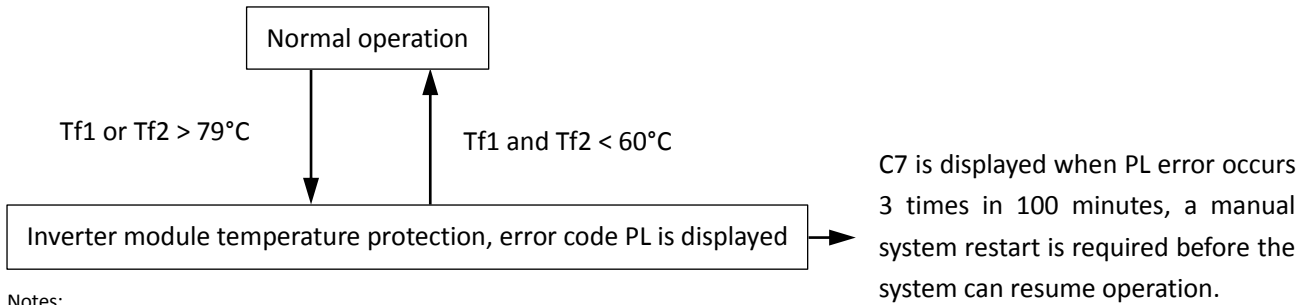
Figure 3-6.9: Inverter module temperature protection control for 30kW and 60kW units



- Notes:
1. Tf1:Heat sink temperature 1; Tf2:Heat sink temperature 2

When the Tf1 or Tf2 temperature rises above 82°C, the system displays PL protection and all the units stop running. When the Tf1 and Tf2 temperature drops below 60°C, the compressor enters re-start control.

Figure 3-6.10: Inverter module temperature protection control for 90kW unit



Notes:

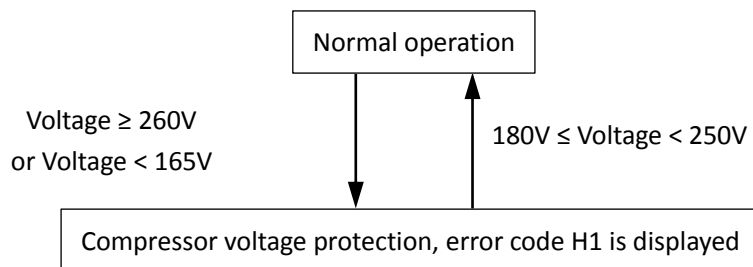
1. Tf1:Heat sink temperature 1; Tf2:Heat sink temperature 2

When the Tf1 or Tf2 temperature rises above 79°C, the system displays PL protection and all the units stop running. When the Tf1 and Tf2 temperature drops below 60°C, the compressor enters re-start control.

6.5 Voltage Protection Control

This control protects the units from abnormally high or abnormally low voltages.

Figure 3-6.11: Compressor voltage protection control



When the phase voltage of AC power supply is at or above 260V for more than 30 seconds, the system displays H1 protection and all the units stop running. When the phase voltage drops below 250V for more than 30 seconds, the units restart once the compressor re-start delay has elapsed. When the phase voltage is below 165V for more than 30 seconds, the system displays H1 protection and all the units stop running. When the AC voltage rises to at or above 180V for more than 30 seconds, the refrigerant system restarts once the compressor re-start delay has elapsed.

6.6 DC Fan Motor Protection Control

This control protects the DC fan motors from abnormal power supply. DC fan motor protection occurs when the fan module does not receive any feedback from the fan motor.

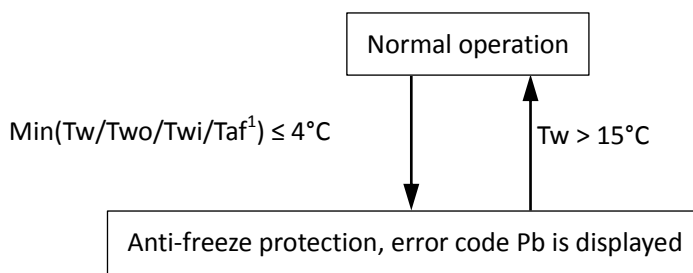
When DC fan motor protection control occurs the system displays the PU error code and the unit stops running. When PU protection occurs 2 times in 120 minutes, the FF error is displayed. When an FF error occurs, a manual system restart is required before the system can resume operation.

6.7 Water Side Heat Exchanger Anti-freeze Protection Control

This control protects the water side heat exchanger from ice formation. The water side heat exchanger electric heater is controlled according to water side heat exchanger anti-freezing temperature (Taf), water inlet temperature (Twi), water outlet temperature (Two) and total water outlet temperature (Tw).

When water side heat exchanger anti-freeze protection occurs the system displays error code Pb and all the units stop running.

Figure 3-6.12: Anti-freeze protection control in normal cooling mode

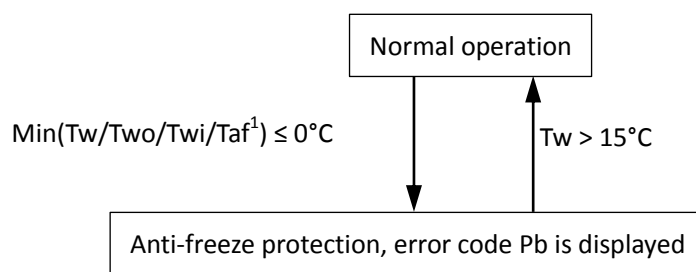


Note:

1. Taf include Taf1 and Taf2.

In standby or normal cooling mode, either water side heat exchanger anti-freezing temperature (Taf), water inlet temperature (Twi), water outlet temperature (Two) or total water outlet temperature (Tw) is below 4°C, the unit will run heating mode, until the total water outlet temperature is above 15°C, and restart the normal operation.

Figure 3-6.13: Anti-freeze protection control in low water outlet cooling mode



Note:

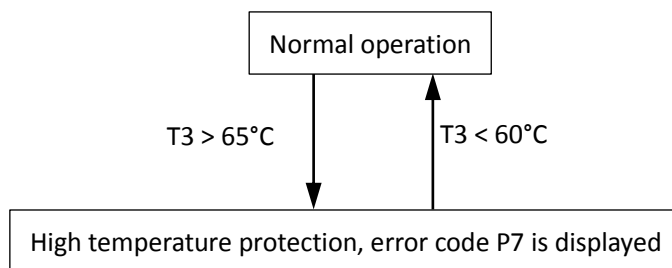
1. Taf include Taf1 and Taf2.

In low water outlet cooling mode, either water side heat exchanger anti-freezing temperature (Taf), water inlet temperature (Twi), water outlet temperature (Two) or total water outlet temperature (Tw) is below 0°C, the unit will run heating mode, until the total water outlet temperature is above 15°C, and restart the normal operation.

6.8 Air Side Heat Exchanger High Temperature Protection Control

This control protects the air side heat exchanger from high temperature.

Figure 3-6.14: Air side heat exchanger high temperature protection control¹

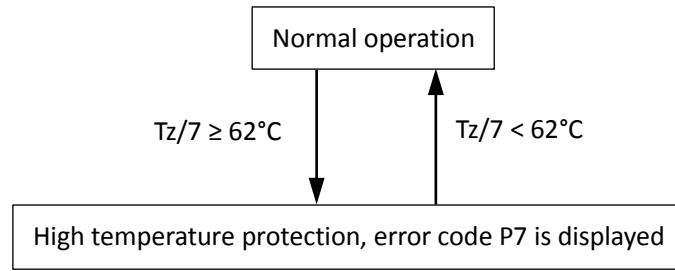


Note:

1. T3: Air side heat exchanger refrigerant outlet temperature

When the air side heat exchanger refrigerant outlet temperature (T3) rises above 65°C, the system displays P7 protection and all the units stop running. When the air side heat exchanger refrigerant outlet temperature (T3) drops below 60°C, the compressor enters re-start control.

Figure 3-6.15: Air side heat exchanger temperature protection control²



Note:

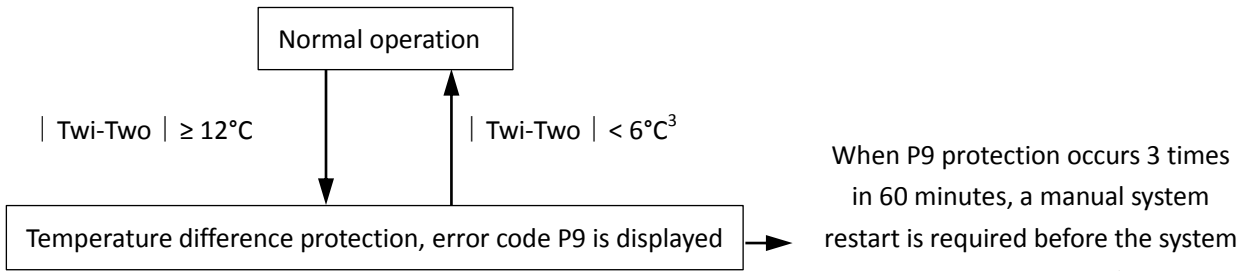
1. Tz/7: Air side heat exchanger refrigerant total outlet temperature

When the air side heat exchanger refrigerant total outlet temperature (Tz/7) temperature rises at or above 62°C, the system displays P7 protection and the unit stops running. When the air side heat exchanger refrigerant total outlet temperature (Tz/7) temperature drops below 62°C, the compressor enters re-start control.

6.9 Water Side Heat Exchanger Temperature Difference Protection Control

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

Figure 3-6.16: Water side heat exchanger temperature difference protection control



Notes:

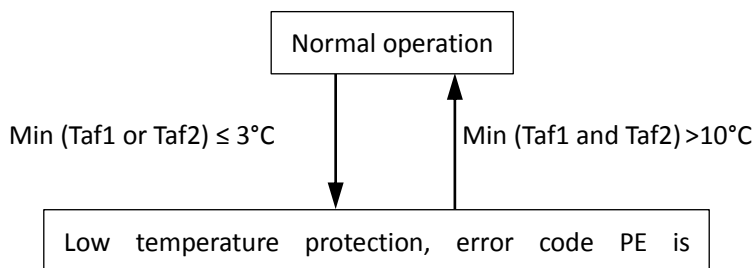
1. Twi: Water side heat exchanger inlet temperature
2. Two: Water side heat exchanger outlet temperature
3. For 30kW and 60kW units is | Twi-Two | < 6°C, for 90kW unit is | Twi-Two | ≤ 6°C

When the temperature difference rises at or above 12°C, the system displays P9 protection and all the units stop running. When the Temperature difference drops below 6°C, the compressor enters re-start control.

6.10 Water Side Heat Exchanger Low Temperature Protection Control

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

Figure 3-6.17: Water side heat exchanger low temperature protection control in normal cooling mode



Notes:

1. Taf1: Water side heat exchanger anti-freezing temperature1
2. Taf2: Water side heat exchanger anti-freezing temperature2

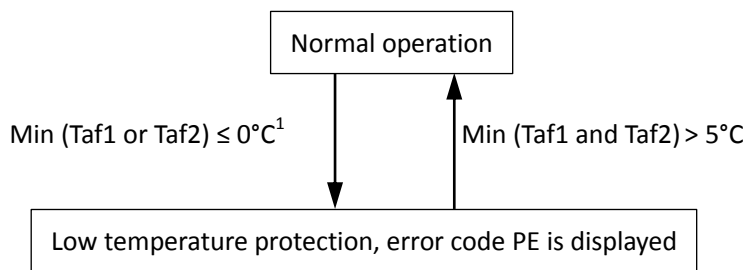
When water side heat exchanger anti-freezing temperature1 (Taf1) or water side heat exchanger anti-freezing temperature2 (Taf2) is at or below 3°C for more than 3 seconds, the system displays PE protection and the corresponding

Aqua Tempo Super II



unit stop running. When water side heat exchanger anti-freezing temperature1 (Taf1) and Water side heat exchanger anti-freezing temperature2 (Taf2) rise to 10°C or higher, the compressor enters re-start control. Use the user interface to clear the error.

Figure 3-6.18: Water side heat exchanger low temperature protection control in low water outlet mode



Notes:

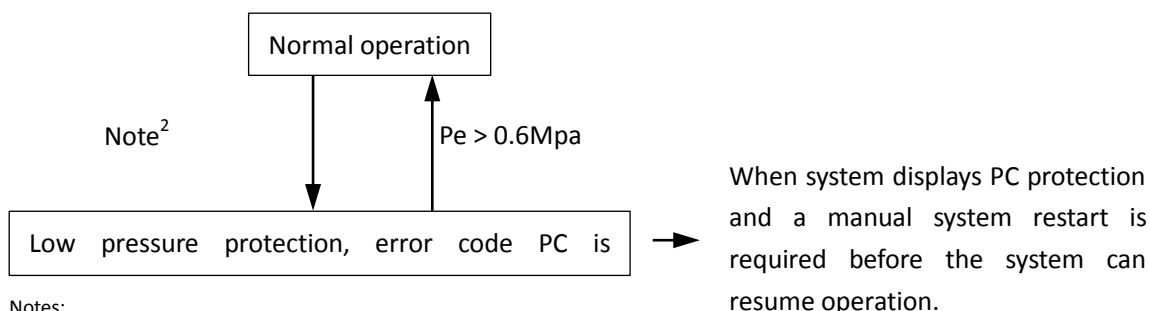
1. For 30kW and 60kW units is 0°C, for 90kW unit is -1°C

When water side heat exchanger anti-freezing temperature1 (Taf1) or water side heat exchanger anti-freezing temperature2 (Taf2) is at or below 0°C for more than 3 seconds, the system displays PE protection and orders the corresponding units to stop running. When water side heat exchanger anti-freezing temperature1 (Taf1) and Water side heat exchanger anti-freezing temperature2 (Taf2) rise to 5°C or higher, the compressor enters re-start control. Use the user interface to clear the error.

6.11 Water Side Heat Exchanger Low Pressure Protection Control

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

Figure 3-6.19: Water side heat exchanger low pressure protection control in normal cooling mode

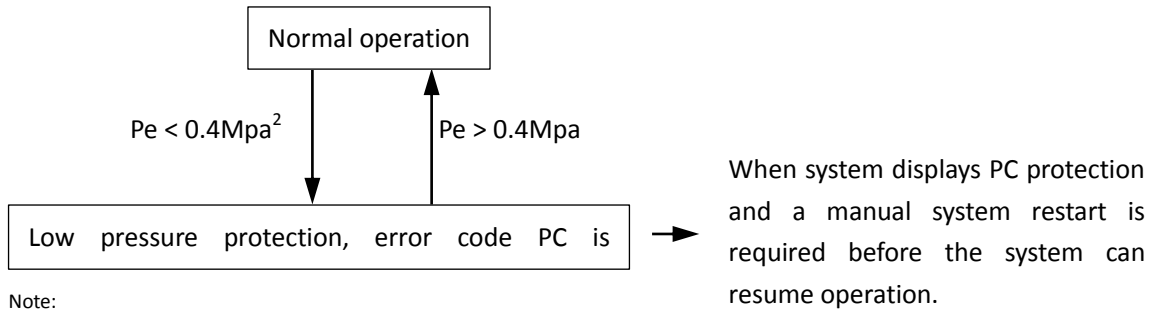


Notes:

1. Pe: Suction pressure
2. For 30kW and 60kW UNITS is $Pe < 0.6\text{Mpa}$
for 90kW unit is : $0.5\text{Mpa} < Pe \leq 0.6\text{Mpa}$ for 30s or $0.4\text{Mpa} < Pe \leq 0.5\text{Mpa}$ for 5s or $0.3\text{Mpa} < Pe \leq 0.4\text{Mpa}$ or $Pe \leq 0.3\text{Mpa}$

In normal cooling mode, when the suction pressure drops below 0.6Mpa, the system displays PC protection and all the units stop running. When the suction pressure is above 0.6Mpa or higher, the compressor enters re-start control. It will not display the PC error when the suction pressure drops below 0.6Mpa for the first time until the suction pressure drops below 0.6Mpa for the second time in 30 minutes.

Figure 3-6.20: Water side heat exchanger low pressure protection control in low water outlet cooling mode



Note:

1. Pe: Suction pressure
2. For 30kW and 60kW units is $Pe < 0.4\text{Mpa}$, for 90kW unit is $Pe \leq 0.4\text{Mpa}$

In low water outlet cooling mode, when the suction pressure drops below 0.4Mpa, the system displays PE protection and all the units stop running. When the suction pressure is above 0.4Mpa or higher, the compressor enters re-start control. It will not display the PC error when the suction pressure drops below 0.4Mpa for the first time until the suction pressure drops below 0.4Mpa for the second time in 30 minutes.

7 Special Control

7.1 Outdoor Unit Duty Cycling

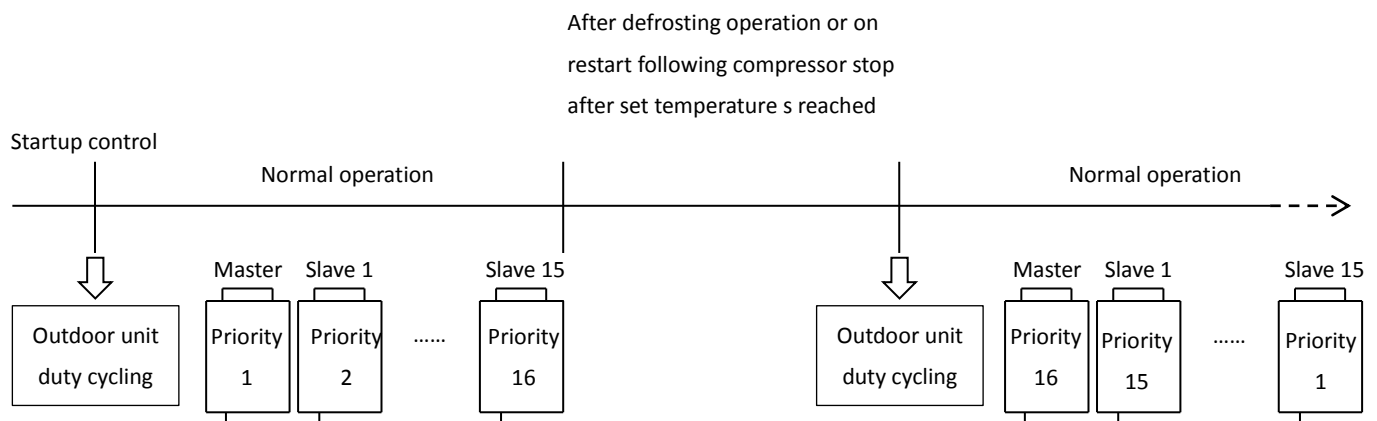
In systems with multiple outdoor units, outdoor unit duty cycling is used to balance the compressor running time.

Outdoor unit duty cycling occurs whenever all the outdoor units stop running (either because the leaving water set temperature has been reached or because a master unit error has occurred):

- When the outdoor units are powered on for the first time, if there is a load requirement, the units turn on, starting with the master unit. As the leaving water temperature approaches its set temperature, units shut down in succession, starting with the unit with the highest address. Once the set temperature has been reached, the master unit shuts down.
- The next time a load requirement exists (or, following a master unit error), the units turn on, starting with the unit with the highest address. As the leaving water temperature approaches its set temperature, units shut down in succession, starting with the unit with the lowest address (the master unit). Once the set temperature has been reached, the unit with the highest address shuts down.

Figure 3-7.1 shows an example of duty cycling in a system with 16 outdoor units.

Figure 3-7.1: Duty cycling in a system with 16 outdoor units¹



Notes:

- The address settings on the outdoor unit main PCBs for master unit and slave unit do not change.

7.2 Defrosting Operation

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

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

- Defrosting operation duration reaches 10 minutes.
- The air side heat exchanger refrigerant outlet temperature reaches the target temperature.
- The water outlet temperature is at or below 5°C.

Table 3-7.1: Component control during defrosting operation for 30kW and 60kW units

Component	Wiring diagram label	30kW	60kW	Control functions and states
Inverter compressor A	COMP A	●	●	Controlled according to load requirement
Inverter compressor B	COMP B		●	
DC fan motor A	FAN A	●	●	Off
DC fan motor B	FAN B		●	
Electronic expansion valve	EXV 1	●	●	480p
Four-way valve	STF1	●	●	Off
Solenoid valve (oil balance)	SV4_1	●	●	Open regularly
Water pump1	PUPM1	●	●	On
Water pump2	PUPM2	●	●	
Water side heat exchanger heater 1	EVA-HEAT 1	●	●	According to water side heat exchanger anti-freezing temperature (Taf)
Water side heat exchanger heater 2	EVA-HEAT 1		●	
Water flow switch	Water switch	●	●	On
Water flow switch heater	W-HEAT1	●	●	Controlled according to ambient temperature, water inlet temperature and water outlet temperature
Electric auxiliary heater	E-HEAT_L/ E-HEAT_N	●	●	Controlled according to ambient temperature and total water outlet temperature after the compressor is on
Crank case heater 1	HEAT1	●	●	Controlled according to ambient temperature and discharge temperature
Crank case heater 2	HEAT2		●	

Table 3-7.2: Component control during defrosting operation for 90kW unit

Component	Wiring diagram label	90kW	Control functions and states
Inverter compressor A	COMP A	●	Controlled according to load requirement
Inverter compressor B	COMP B	●	
DC fan motor A	FAN A	●	Off
DC fan motor B	FAN B	●	
DC fan motor C	FAN C	●	
Electronic expansion valve A	EXV A	●	2880p
Electronic expansion valve A	EXV B	●	2880P
Electronic expansion valve A	EXV C	●	96p
Four-way valve	STF1	●	Off
Solenoid valve (oil balance)	SV4	●	Open regularly
Solenoid valve	SV5	●	Open
Solenoid valve	SV6	●	Open
Solenoid valve	SV8A	●	Off
Solenoid valve	SV8B	●	Off
Water pump1	PUPM-1	●	On
Water pump2	PUPM-V	●	
Water side heat exchanger heater	EVA-HEAT	●	According to water side heat exchanger anti-freezing temperature (Taf)
Water flow switch	Pro_W	●	On
Water flow switch heater	W-HEAT-L/W-H EAT-N	●	Controlled according to ambient temperature, water inlet temperature and water outlet temperature
Electric auxiliary heater (pipe)	HEAT1	●	Controlled according to ambient temperature and total water outlet temperature after the compressor is on

Crank case heater	CCH	•	Controlled according to ambient temperature and discharge temperature
-------------------	-----	---	---

7.3 Additional control

When dial switch S5_4¹ on main PCB is switched ON, additional control is valid, connect a controller or not is permissible.

When dial switch S5_4¹ is switched OFF, additional control is invalid. This function is only valid on the master unit.

When dial switch S5_4¹ is switched ON and disconnect a wired controller:

- The system ON/OFF state is controlled by the ON/OFF port (CN44² on the main PCB). Connecting this port, system on, disconnecting this port, system off.
- The mode of the system is controlled by the Cool/Heat port (CN44² on the main PCB). Connecting this port, system running heating mode, disconnecting this port, system running cooling mode.
- The default water outlet temperature setting in heating mode is 45°C and in cooling mode is 7°C. The default hysteresis temperature setting is 2°C.
- The network icon on the wired controlled flashes, frequency and “rctc” alternate display on main PCB .

When dial switch S5_4¹ is switched ON and connect a wired controller, the wired controller is out of control.

Notes:

1. For 30kW and 60kW units is S5_4, for 90kW unit is S5_3
2. For 30kW and 60kW units is CN44, for 90kW unit is CN8

Part 4

Diagnosis and Troubleshooting

1	Outdoor Unit Electric Control Box Layout.....	56
2	Outdoor Unit PCBs.....	59
3	Error Code Table	82
4	Troubleshooting	86
5	Appendix to Part 5.....	156

1 Outdoor Unit Electric Control Box Layout

30kW unit

Figure 4-1.1: Electric control box front view- top layer

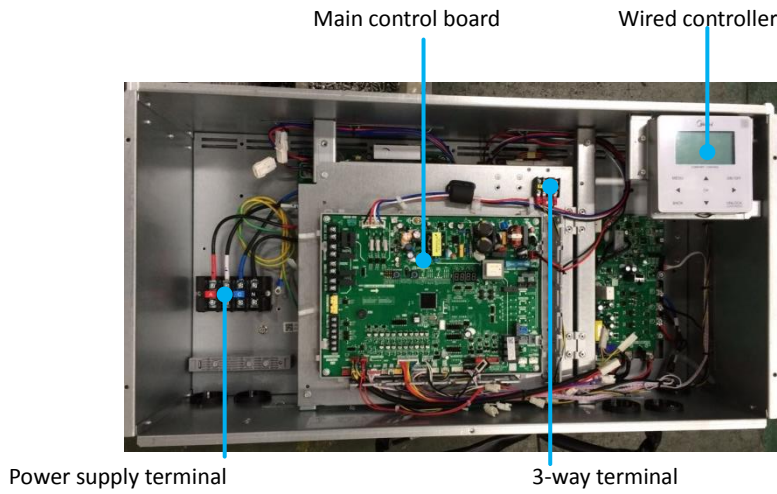


Figure 4-1.2: Electric control box front view-bottom layer

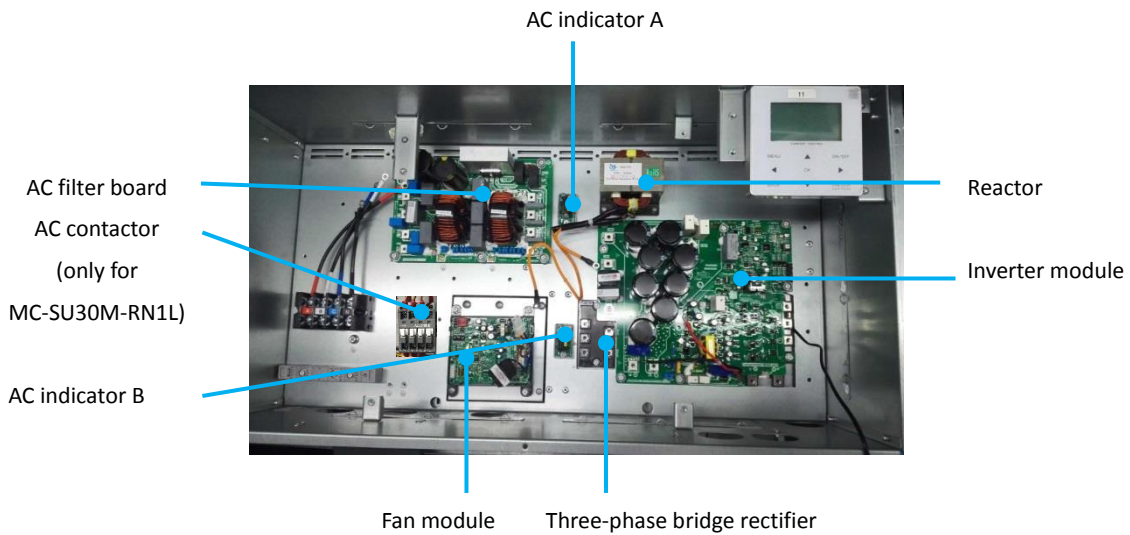


Figure 4-1.3: Electric control box front view-top layer

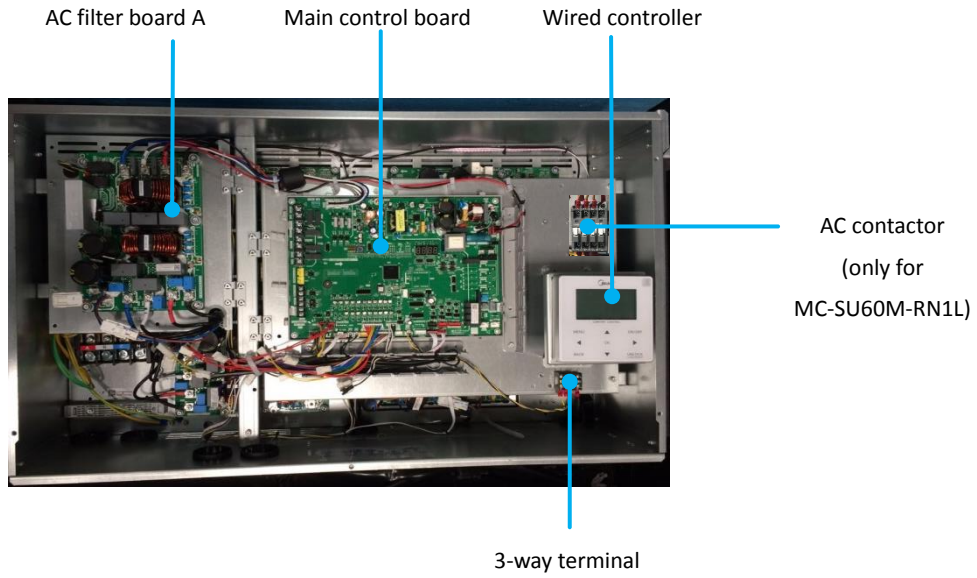
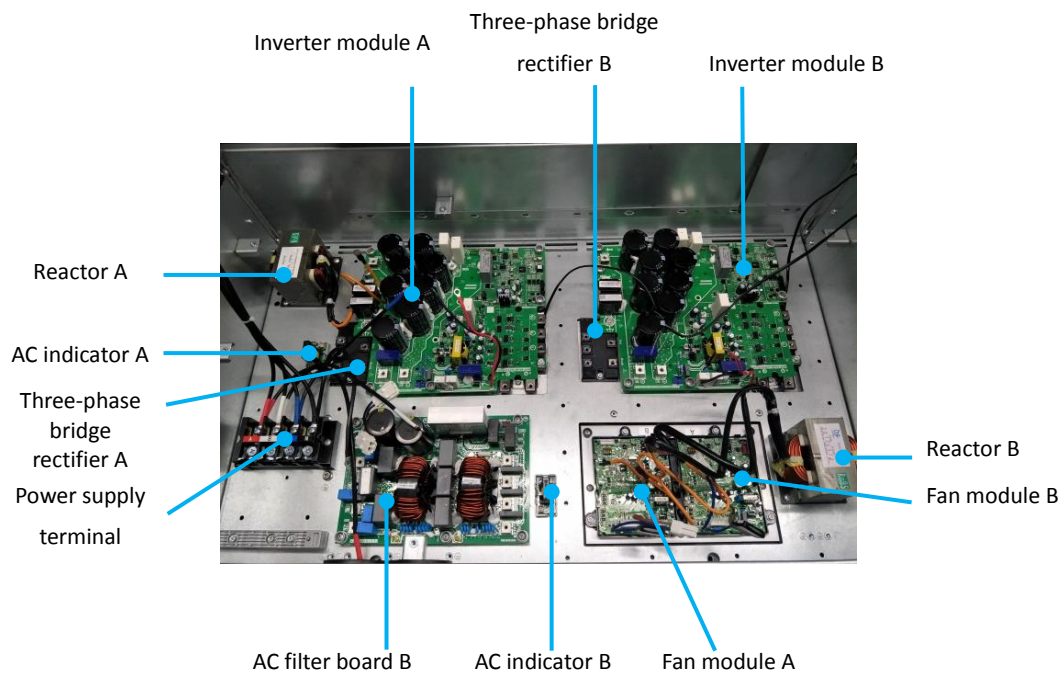


Figure 4-1.4: Electric control box side view-bottom layer



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90kW unit

Figure 4-1.5: Electric control box front view-top layer

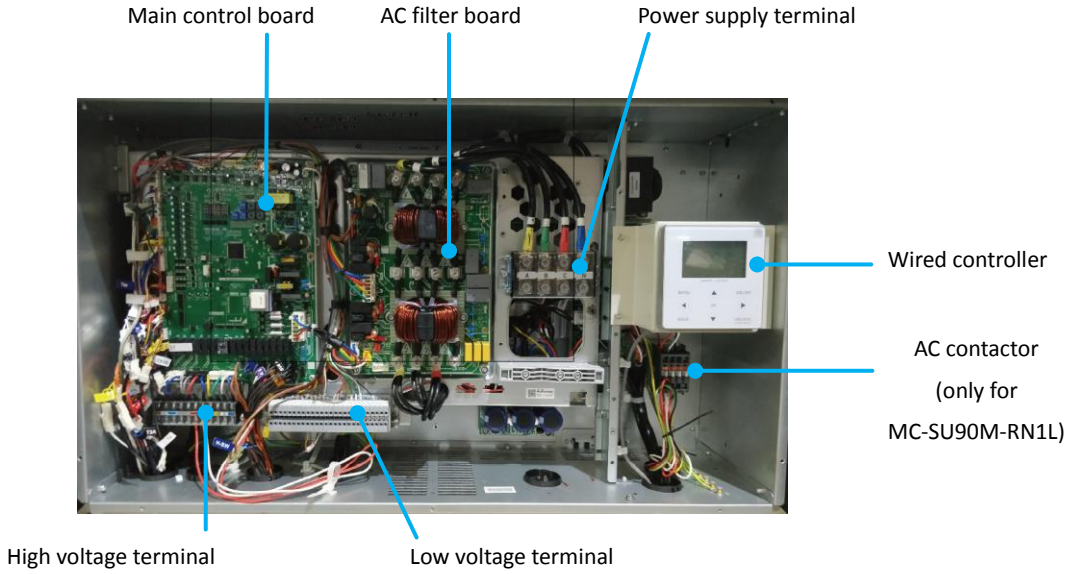
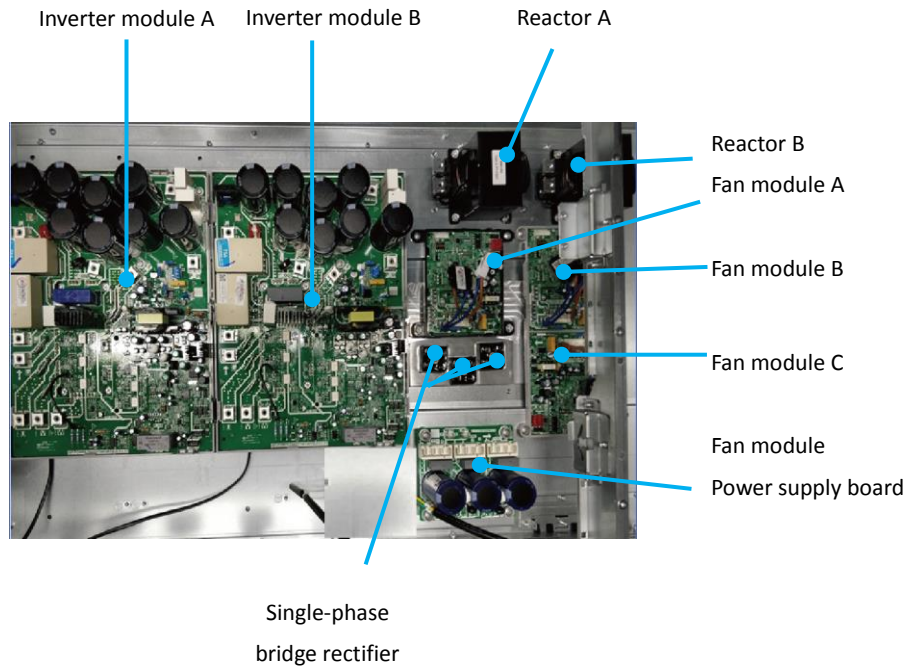


Figure 4-1.6: Electric control box side view-bottom layer



2 Outdoor Unit PCBs

2.1 Types

Aqua Tempo Super II units have four PCBs – main control board, three phase AC filter board, DC fan inverter module board and compressor inverter module board.

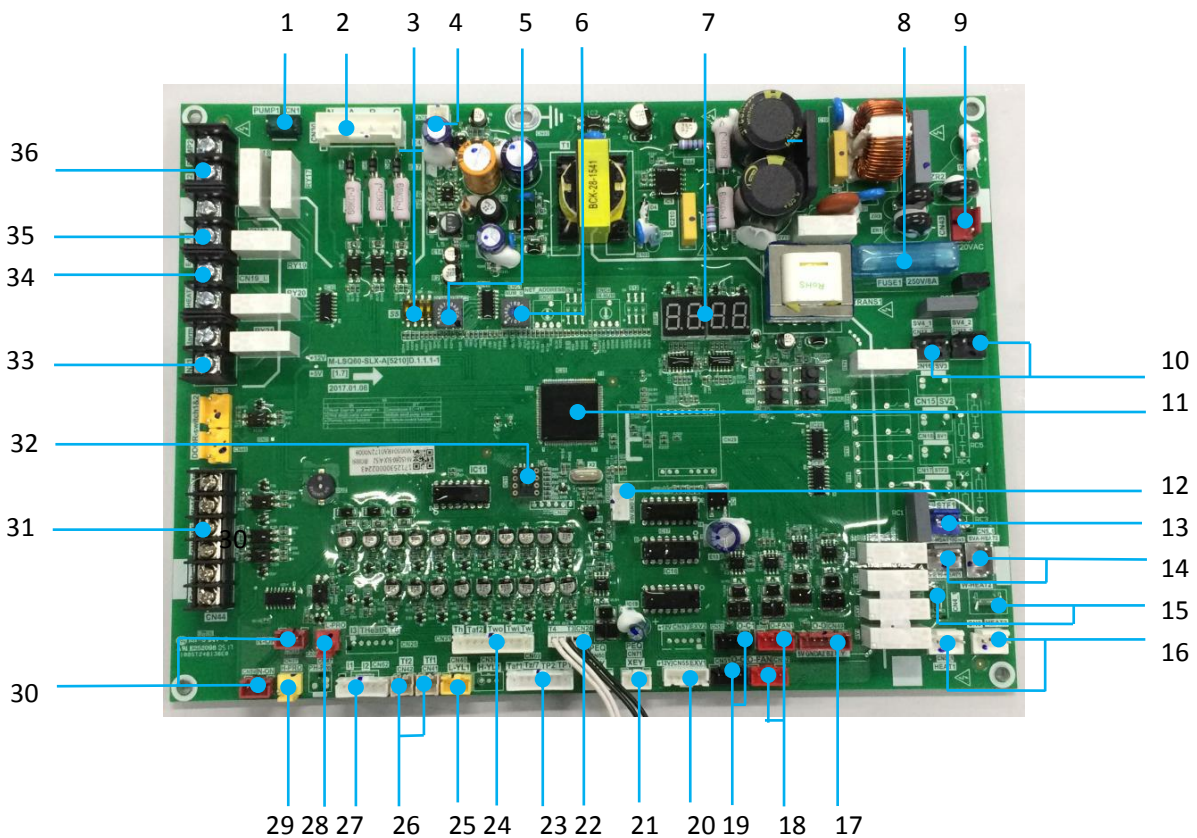
In addition to the four PCBs, 30kW unit each has one board while 60kW unit have one main control board and the other boards each has two boards.

90kW unit have one main control board, one three phase AC filter board ,one Power supply board for fan module, two compressor inverter module board and three DC fan inverter module board.

The locations of each PCB in the outdoor unit electric control boxes are shown in Figures 4-1.1 to 4-1.6 in Part 4, 1 “Outdoor Unit Electric Control Box Layout”.

2.2 Main PCB

Figure 4-2.1: Outdoor unit main PCB for 30kW and 60kW units



Note:

1. Label descriptions are given in Table 4-2.1

Table 4-2.1: Outdoor unit main PCB for 30kW and 60kW units

Label in Figure 4-2.1	Code	Content	Voltage
1	CN1	Pump 1 connection	0-220V AC(varying)
2	CN30	Power sequence detection connection	380V
3	S5	DIP switches	-
4	CN72	Power supply to user interface	9V DC
5	ENC1	Unit capacity dial switch	-
6	ENC3	Address dial switch	-
7	DSP1	Digital display	-
8	FUS1	Fuse	220V AC
9	CN43	Power input	220V AC
10	CN12_1, CN12_2	Solenoid valve(SV4) drive ports	0-220V AC(varying)
11	IC25	Main control chip	-
12	CN64	Debug port	5V DC
13	CN16	Four-way valve drive port	0-220V AC(varying)
14	CN5, CN5_1	Water side heat exchanger heater connections	0-220V AC(varying)
15	CN4, CN4_1	Water flow switch heater connection	0-220V AC(varying)
16	CN3, CN3_1	Compressor crankcase heater connections	0-220V AC(varying)
17	CN49	Reserved communication port	2.5-2.7V DC
18	CN52, CN53	Fan inverter module communication ports	2.5-2.7V DC
19	CN50, CN51	Compressor inverter module communication ports	2.5-2.7V DC
20	CN55	EXV drive port	12V DC
21	CN60, CN71	Wired controller communication ports	2.5-2.7V DC
22	CN24	Outdoor ambient temperature sensor and air side heat exchanger refrigerant outlet temperature sensor connections	0-5V DC (varying)
23	CN69	Water side heat exchanger anti-freezing temperature sensor 1, air side heat exchanger refrigerant total outlet temperature sensor, discharge temperature sensor 2 and discharge temperature sensor 1 connections	0-5V DC (varying)
24	CN31	Air suction temperature sensor, water side heat exchanger anti-freezing temperature sensor 2, water side heat exchanger water outlet temperature sensor, water side heat exchanger water inlet temperature sensor and combined water outlet temperature sensor connections	0-5V DC (varying)
25	CN40	Pressure sensor connection	0-5V DC (varying)
26	CN41, CN42	Inverter module temperature sensor 1 and Inverter module temperature sensor 2 connections	0-5V DC (varying)
27	CN62	AC indicator A and AC indicator B connections	0-5V DC (varying)
28	CN65	Low pressure switch connection	0 or 5V DC (varying)
29	CN37	High pressure switch and discharge temperature switch connections	0 or 5V DC (varying)
30	CN58, CN59	AC filter board communication ports	12V DC

31	CN44	Water flow switch, additional control and Cool/heat connections	0 or 12V DC
32	IC10	EEPROM	-
33	CN21	Remote alarm connection	On/off signal
34	CN19_L	Electric auxiliary heater L line connection	On/off signal
35	CN19_N	Electric auxiliary heater N line connection	On/off signal
36	CN2	Reserved	On/off signal

2.2.1 Main PCB field setting

Table 4-2.2: Main PCB switch settings for 30kW and 60kW units

Switch	Description	ON	OFF	Default factory setting	
	S5-1	Water outlet temperature ¹ (Reserved)	Low	Normal	OFF
	S5-2	Reserved	-	-	OFF
	S5-3	Water pump	One small pump per unit	One large pump controlled by master unit	OFF
	S5-4	ON/OFF function ²	Activated	Deactivated	OFF
	ENC2	0: 30kW	-	-	0
		3: 60kW	-	-	3
	ENC1	0: master unit 1,2,3...F: slave units	-	-	0
			-	-	

Note:

1. Low water outlet temperature range: 0°C to 20°C; normal water outlet temperature range: 5°C to 20°C.
2. Please refer to "Part 3, 7.3 Additional control" for detail operation method of using remote control

2.2.2 Function of buttons SW3 to SW6

Table 4-2.3: Function of buttons SW3 to SW6 for 30kW and 60kW units

Button	Function
SW3	Up
SW4	Down
SW5	Menu
SW5	Ok

2.2.3 SW4 system check button

Before pressing SW3 or SW4, allow the system to operate steadily for more than an hour. On pressing SW4, the parameters listed in Table 4-2.4 will be displayed in sequence.

Table 4-2.4: SW4 system check for 30kW and 60kW units

Number	Parameters displayed on digital display	Remarks
0	Operating status	Standby: ODU address (DSP1 display) + number of on-line units (DSP2 display) On: display frequency Defrosting: dF and operating frequency flash alternately at 1s intervals frequency Anti-freezing protection: Pb and operating frequency flash alternately at 1s intervals
1	Outdoor unit address	Actual value = value displayed
2	Outdoor unit capacity	0:30KW; 3:60KW
3	Number of outdoor units (main unit display)	Actual value = value displayed
4	Unit capacity corrected for ambient temperature	Actual value = value displayed
5	Operating mode	8: Off; 0: Standby; 1: Cooling; 2: Heating
6	Fan A speed index	Refer to Note1
7	Fan B speed index	Refer to Note1
8	Air side heat exchanger refrigerant outlet temperature (sensor T3)	Actual value = value displayed
9	Outdoor ambient temperature (sensor T4)	Actual value = value displayed
10	Reserved	-
11	Water side heat exchanger anti-freezing temperature1 (sensor Taf1)	Actual value = value displayed
12	Water side heat exchanger anti-freezing temperature2 (sensor Taf2)	Actual value = value displayed
13	Total water outlet temperature(Tw)	Actual value = value displayed
14	Water inlet temperature(Twi, displays to decimal places)	Actual value = value displayed
15	Water outlet temperature(Two)	Actual value = value displayed
16	Air side heat exchanger refrigerant total outlet temperature (Tz/7)	Actual value = value displayed
17	Reserved	-
18	Compressor discharge temperature 1 (sensor Tp1)	Actual value = value displayed
19	Compressor discharge temperature 2 (sensor Tp2)	Actual value = value displayed
20	Compressor module temperature(Tf1)	Actual value = value displayed
21	Compressor module temperature(Tf2)	Actual value = value displayed
22	Air discharge superheat degree	Actual value = value displayed
23	Power supply phase B current	Actual value = value displayed
24	Power supply phase C current	Actual value = value displayed
25	Reserved	-
26	EXV 1 position	Steps=value displayed*4
27	Reserved	-
28	Compressor discharge pressure(in heating mode)	Actual value = value displayed
29	Compressor suction pressure (displays to decimal places in cooling mode)	Actual value = value displayed
30	Air suction superheat degree	Actual value = value displayed
31	Air suction temperature (Th)	Actual value = value displayed
32	Silent selection	Refer to Note2
33	Static pressure selection	0
34	Reserved	-
35	Reserved	-

36	Most recent error or protection code	“--”is displayed if no error or protection events have occurred since start-up
37	Limit frequency number	0: no limits; 1: ambient temperature(T4) limit frequency; 2: voltage limit frequency; 3: air discharge limit frequency; 4: low voltage ratio; 5: instant limit frequency; 6: current limit frequency; 7: voltage limit frequency; 8: pressure ratio and capacity demand adjusting; 9: cooling low pressure limit frequency)
38	Defrosting process status	The first digit: T4 selection solution; The second digit: scheme's range; The third and fourth digits : defrosting time
39	EEPROM mismatch indicator:	1 : failure; 0 : no failure
40	Defrosting scheme	Actual value = value displayed
41	Initial frequency	Actual value = value displayed
42	Tc(+30)/Te(+25)	Actual value = value displayed
43	Online units statistic	Actual value = value displayed
44	Program version	Actual value = value displayed
45	---	-

Notes:

1. The fan speed index is related to the fan speed in rpm as described in Table 3-5.5 in Part 3, 5.7 “Outdoor Fan Control”.
2. Silent mode:
 - 0: night silent mode; 1: silent mode; 2: super silent mode; 3: no silent mode.

2.2.4 Digital display output

Table 4-2.5: Digital display output in different operating states for 30kW and 60kW units

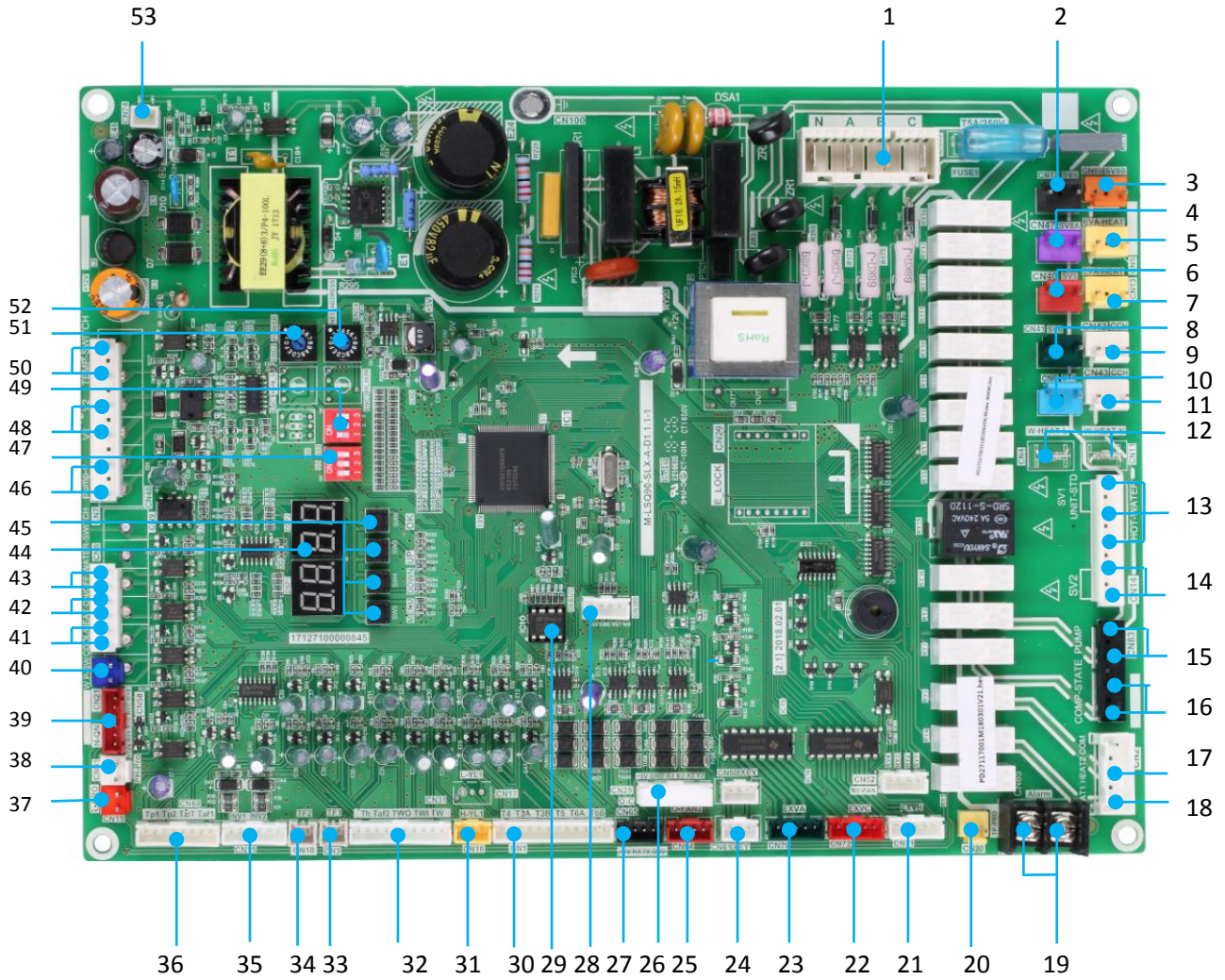
Outdoor unit state		Parameters displayed on DSP1	Parameters displayed on DSP2
Standby		0	1
Normal operation	For single compressor units	None	Running speed of compressor
	For dual compressor units	Running speed of compressor A in rotations per second	Running speed of compressor B in rotations per second
Error or protection		-- or placeholder	Error or protection code
System check		Refer to Table 4-2.4	Refer to Table 4-2.4

DSP1

DSP2

2.3 Main PCB

Figure 4-2.2: Outdoor unit main PCB for 90kW unit



Note:

1. Label descriptions are given in Table 4-2.6

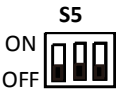
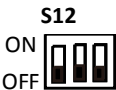
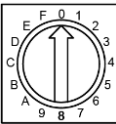
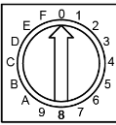
Table 4-2.6: Outdoor unit main PCB for MC-SU90(M)-RN1L

Label in Figure 4-2.2	Code	Content	Voltage
1	CN30	Power sequence detection connection	380V AC
2	CN12	Quick return oil solenoid valve(SV4) drive port	0-220V AC(varying)
3	CN80	Injection solenoid valve(SV8B) of compressor system B drive port	0-220V AC(varying)
4	CN47	Injection solenoid valve(SV8A) of compressor system A drive port	0-220V AC(varying)
5	CN5	Water side heat exchanger heater connections	0-220V AC(varying)
6	CN40	Multi-function solenoid valve(SV5) drive port	0-220V AC(varying)
7	CN13	Water side heat exchanger heater connections	0-220V AC(varying)
8	CN41	Liquid bypass solenoid valve(SV6) drive port	0-220V AC(varying)
9	CN42	Compressor crankcase heater connections	0-220V AC(varying)
10	CN6	Four-way valve (STF)drive port	0-220V AC(varying)
11	CN43	Compressor crankcase heater connections	0-220V AC(varying)
12	CN4/CN11	Electric heater of water flow switch	0-220V AC(varying)
13	CN14	Three-way valve(SV1) drive port (reserved)	0-220V AC(varying)
14	CN14	Two-way valve(reserved) drive port (reserved)	0-220V AC(varying)
15	CN83	Pump connection	0-220V AC(varying)
16	CN83	COMP-STATE drive port	On/off signal
17	CN2	Water Tank Auxiliary Heater(HEAT2) connections	On/off signal
18	CN2	Pipeline Auxiliary Heater(HEAT1) connections	On/off signal
19	CN85	Remote alarm connection (ON/OFF signal)	On/off signal
20	CN20	Discharge temperature switch (es) connections	0 or 12V DC
21	CN71	EXVB drive port	12V DC
22	CN72	EXVC drive port	12V DC
23	CN70	EXVA drive port	12V DC
24	CN61	Wired controller communication ports	2.5-2.7VDC(varying)
25	CN64	Fan inverter module communication ports	2.5-2.7VDC(varying)
26	CN28	Reserved	2.5-2.7VDC(varying)
27	CN65	Compressor inverter module communication ports	2.5-2.7VDC(varying)
28	CN300	Program debug port	5V DC
29	IC10	EEPROM	-
30	CN1	Outdoor ambient temperature sensor, air side heat exchanger refrigerant total outlet temperature sensor A, air side heat exchanger refrigerant total outlet temperature sensor B, water tank temperature sensor, Refrigerant inlet temperature of EVI plate heat exchanger A, Refrigerant outlet temperature of EVI plate heat exchanger B	0 or 5V DC (varying)
31	CN16	Low pressure sensor connection	0 or 5V DC (varying)
32	CN31	Air suction temperature sensor, water side heat exchanger anti-freezing temperature sensor 2, water side heat exchanger water outlet temperature sensor, water side heat exchanger water inlet temperature sensor and combined water outlet temperature sensor connections	0 or 5V DC (varying)
33	CN3	Inverter module temperature sensor 1 connection	0 or 5V DC (varying)
34	CN10	Inverter module temperature sensor 2 connection	0 or 5V DC (varying)
35	CN15	AC indicator A and AC indicator B connections	0-5V DC (varying)
36	CN69	Discharge temperature sensor 2 and discharge temperature sensor 1, air side heat exchanger refrigerant total outlet temperature sensor, Water side heat exchanger anti-freezing temperature sensor 1 connections	0 or 5V DC (varying)

37	CN19	Low pressure protection switch	0 or 12V DC
38	CN91	Three-phase protector output switch	0 or 12V DC
39	CN58	AC filter board communication port	0 or 12V DC
40	CN21	Reserved	0 or 12V DC
41	CN8	Cool/Heat signal	0 or 12V DC
42	CN8	Additional control signal	0 or 12V DC
43	CN8	Water flow switch signal	0 or 12V DC
44	-	SW3:Up button SW4:Down button SW5:Menu button SW6:OK button	-
45	DSP1 DSP2	Digital display	-
46	CN7	Inverter water pump signal (reserved)	0-10VDC (varying)
47	S5	Dip switch	-
48	CN7	Reserved	0-10VDC
49	CN7	Target water temperature switching port	0 or 12V DC
50	ENC2	Power capacity switch	-
51	CN74	Power supply to user interface	9V DC
52	ENC4	NET_ADDRESS switch	-
53	S12	Dip switch	-

2.3.1 Main PCB field setting

Table 4-2.7: Main PCB switch settings for 90kW unit

Switch		Description	ON	OFF	Default factory setting
	S5-1	Reserved	-	-	OFF
	S5-2	Reserved	-	-	OFF
	S5-3	Additional control ¹	Activated	Deactivated	OFF
	S12-1	Reserved	-	-	ON
	S12-2	Water pump	One small pump per unit	One large pump controlled by master unit	OFF
	S12-3	Water outlet temperature ² (Reserved)	Low	Normal	OFF
	ENC2	2: 90kW	-	-	2
	ENC4	0: master unit 1,2,3...F: slave units	-	-	0

- Note:
- Low water outlet temperature range: 0°C to 20°C; normal water outlet temperature range: 5°C to 20°C.
 - When using ON/OFF function, first is to dial the S5-3 switch and then short circuit the terminal on the main PCB. The operation method is as follows:
 Remote off: dial S5-3 to ON
 Remote cool: dial S5-3 to ON and short circuit the additional control terminal
 Remote heat: dial S5-3 to ON and short circuit the additional control terminal and cool/heat terminal.

2.3.2 Function of buttons SW3 to SW6

Table 4-2.8: Function of buttons SW3 to SW6 for 90kW unit

Button	Function
SW3	Up
SW4	Down
SW5	Menu
SW5	Ok

2.3.3 SW4 system check button

Before pressing SW3 or SW4, allow the system to operate steadily for more than an hour. On pressing SW4, the parameters listed in Table 4-2.9 will be displayed in sequence.

Table 4-2.9: SW4 system check for 90kW unit

Number	Parameters displayed on digital display	Remarks
0	Operating status	Standby: ODU address (DSP1 display) + number of on-line units (DSP2 display) On: display frequency Defrosting: dF and operating frequency flash alternately at 1s intervals frequency Anti-freezing protection: Pb and operating frequency flash alternately at 1s intervals
1	Outdoor unit address	Actual value = value displayed
2	Outdoor unit capacity	90
3	Number of outdoor units (main unit display)	Actual value = value displayed
4	Unit capacity corrected for ambient temperature(reserved)	-
5	Operating mode	8: Off; 0: Standby; 1: Cooling; 2: Heating
6	Fan speed index	Refer to Note1
7	Fan speed index(reserved)	-
8	Air side heat exchanger refrigerant outlet temperature (minimum T3A and T3B)	Actual value = value displayed
9	Outdoor ambient temperature (sensor T4)	Actual value = value displayed
10	Reserved	-
11	Water side heat exchanger anti-freezing temperature1 (sensor Taf1)	Actual value = value displayed
12	Water side heat exchanger anti-freezing temperature2 (sensor Taf2)	Actual value = value displayed
13	Total water outlet temperature(Tw)	Actual value = value displayed
14	Water inlet temperature(Twi, displays to decimal places)	Actual value = value displayed
15	Water outlet temperature(Two)	Actual value = value displayed
16	Air side heat exchanger refrigerant total outlet temperature (Tz/7)	Actual value = value displayed
17	Reserved	-
18	Compressor discharge temperature 1 (sensor Tp1)	Actual value = value displayed
19	Compressor discharge temperature 2 (sensor Tp2)	Actual value = value displayed
20	Compressor module temperature(Tfin1)	Actual value = value displayed
21	Compressor module temperature(Tfin2)	Actual value = value displayed
22	Air discharge superheat degree	Actual value = value displayed
23	Compressor A current	Actual value = value displayed

24	Compressor B current	Actual value = value displayed
25	Reserved	-
26	EXV A position	Steps=value displayed*20
27	EXV B position	Steps=value displayed*20
28	EXV C position	Steps=value displayed*4
29	Compressor discharge pressure(in heating mode)	Actual value = value displayed
30	Compressor suction pressure (displays to decimal places in cooling mode)	Actual value = value displayed
31	Air suction superheat degree	Actual value = value displayed
32	Air suction temperature (Th)	Actual value = value displayed
33	Silent selection	Refer to Note2
34	Static pressure selection	0
35	Reserved	-
36	Reserved	-
37	Limit frequency number	0: no limits; 1: ambient temperature(T4) limit frequency; 2: air discharge limit frequency; 3:total cooling outlet temperature(Tz/7) 4:inverter module temperature 5:pressure limit frequency 6: current limit frequency; 7: voltage limit frequency;
38	Defrosting process status	The first digit: T4 selection solution; The second digit: scheme's range; The third and fourth digits : defrosting time
39	EEPROM mismatch indicator:	1 : failure; 0 : no failure
40	Defrosting scheme	Actual value = value displayed
41	Initial frequency	Actual value = value displayed
42	Tc (saturation temperature corresponding to the high pressure in heating mode))	Actual value = value displayed
43	Te (saturation temperature corresponding to the low pressure in cooling mode))	Actual value = value displayed
44	Refrigerant inlet temperature of EVI plate heat exchanger (T6A)	Actual value = value displayed
45	Refrigerant outlet temperature of EVI plate heat exchanger (T6B)	Actual value = value displayed
46	Program version	Actual value = value displayed
47	Most recent error or protection code	“--”is displayed if no error or protection events have occurred since start-up
48	---	-

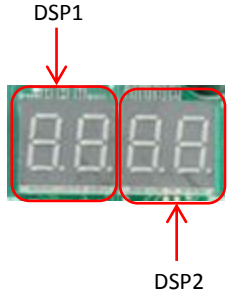
Notes:

1. The fan speed index is related to the fan speed in rpm as described in Table 3-5.6 in Part 3, 5.7 “Outdoor Fan Control”.
2. Silent mode:
 - 0: night silent mode; 1: silent mode; 2: super silent mode; 3: no silent mode.

2.3.4 Digital display output

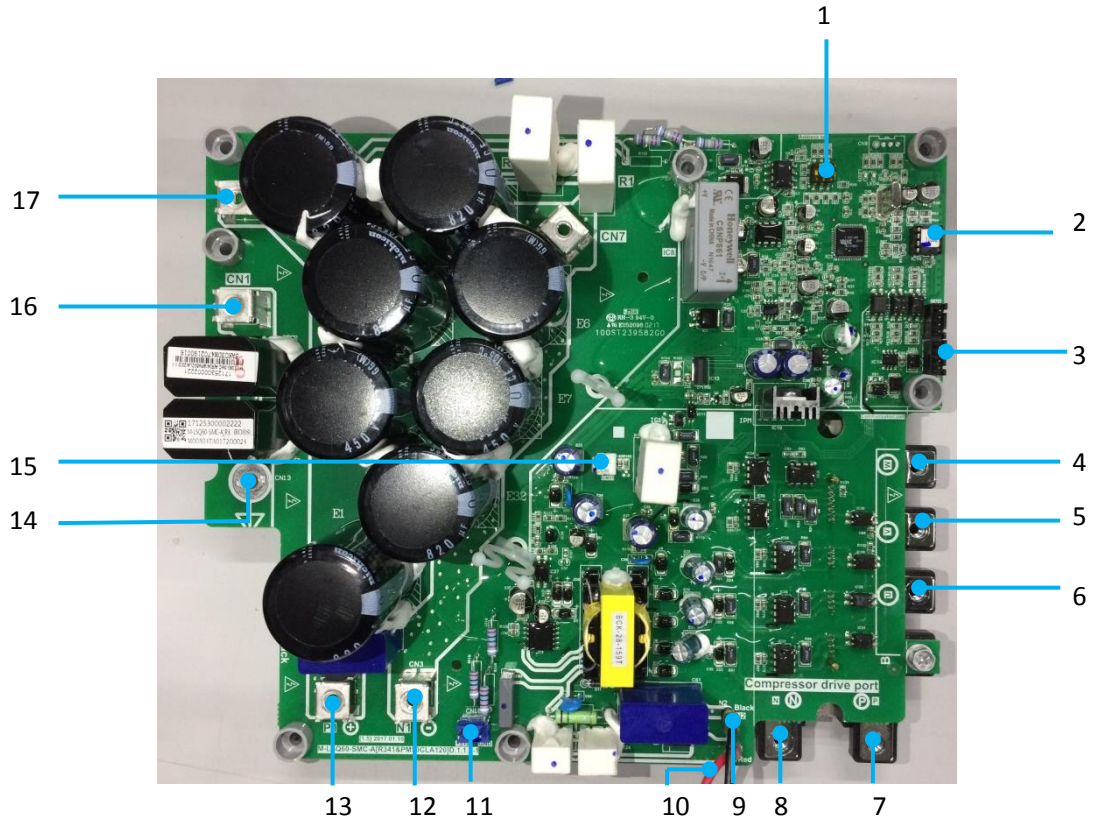
Table 4-2.10: Digital display output in different operating states for 90kW unit

Outdoor unit state		Parameters displayed on DSP1	Parameters displayed on DSP2
Standby		0	1
Normal operation	For single compressor units	None	Running speed of compressor
	For dual compressor units	Running speed of compressor A in rotations per second	Running speed of compressor B in rotations per second
Error or protection		-- or placeholder	Error or protection code
System check		Refer to Table 4-2.9	Refer to Table 4-2.9



2.4 Compressor Inverter Module Board

Figure 4-2.3: Compressor inverter module PCB for 30kW and 60kW units



Notes:

1. Label descriptions are given in Table 4-2.11.

Table 4-2.11: Compressor inverter module PCB for 30kW and 60kW units

Label in Figure 4-2.3	Code	Content	Voltage
1	SW1	Inverter module address switch	-
2	IC14	EEPROM	-
3	CN9 CN10	Inverter module communication port	2.5-2.7V DC
4	W	Compressor connections	$V_{UV} = V_{UW} = V_{VW}$ 0-380V AC
5	V		
6	U		
7	N	IPM module input port N	$V_{PN} = 540V$ DC
8	P	IPM module input port P	
9	N2	IPM module protection port N2	$V_{P2N2} = 540V$ DC
10	P2	IPM module protection port P2	
11	CN15	Power supply inverter module board	310V DC
12	N1	IPM module power supply port N1	$V_{P1N1} = 540V$ DC
13	P1	IPM module power supply port P1	
14	CN3	Three-phase bridge rectifier positive port	540V DC relative to N
15	CN11	Three-phase bridge rectifier control port	15V DC
16	CN1	Reactor port	540V DC relative to N
17	CN4	Capacity positive port	540V DC relative to N

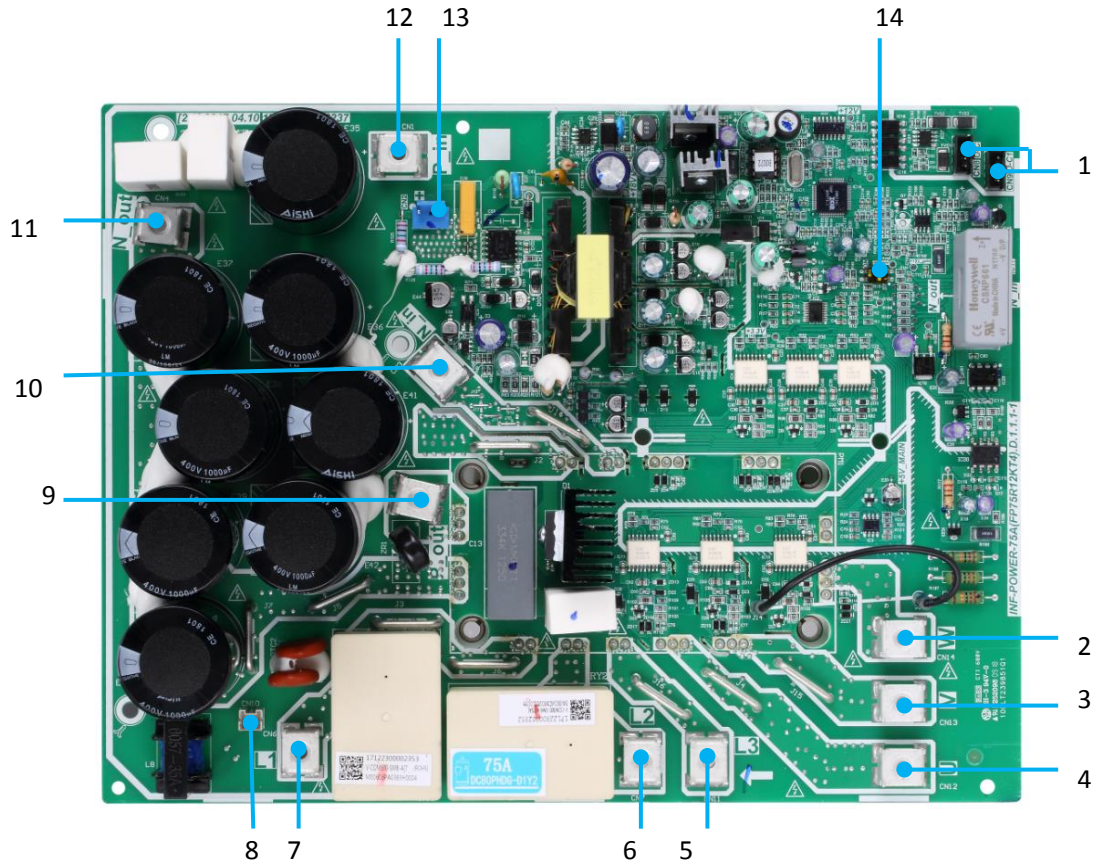
2.4.1 Compressor Inverter Module PCB field setting

Table 4-2.12: Compressor inverter module PCB switch settings for 30kW and 60kW units

Switch	Description
	000: 30kW unit compressor inverter module address setting
	000: 60kW unit compressor A inverter module address setting
	001: 60kW unit compressor B inverter module address setting

2.5 Compressor Inverter Module Board

Figure 4-2.4: Compressor inverter module PCB for 90kW unit



Notes:

1. Label descriptions are given in Table 4-2.13.



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Table 4-2.13: Compressor inverter module PCB for 90kW unit

Label in Figure 4-2.4	Code	Content	Voltage
1	CN9 CN10	Inverter module communication port	2.5-2.7V DC
2	W	Compressor connections	$V_{UV} = V_{Uw} = V_{Vw}$ 0-380V AC
3	V		
4	U		
5	L3	Three-phase power supply in	$V_{L1L2} = V_{L2L3} = V_{L1L3} =$ 380V AC
6	L2		
7	L1		
8	CN10	AC indicator	0-5V DC (varying)
9	CN5	Three-phase bridge rectifier positive port(P_OUT)	$V_{P_OUT} = V_{N_OUT} = 540V$
11	CN4	Three-phase bridge rectifier negative port(N_OUT)	DC
10	CN1	Capacity positive port(P_IN)	$V_{P_IN} = V_{N_IN} = 540V$
12	CN3	Capacity negative port(N_IN)	DC
13	CN2	Transformer input	310V DC
14	S7	DIP switch	-

2.5.2 Compressor Inverter Module PCB field setting

Table 4-2.14: Compressor inverter module PCB switch settings for 90kW unit

Switch	Description
S7 ON  OFF 	00: 90kW unit compressor A inverter module address setting
	01: 90kW unit compressor B inverter module address setting

2.6 Fan Module Board

Figure 4-2.5: Fan module PCB for all models

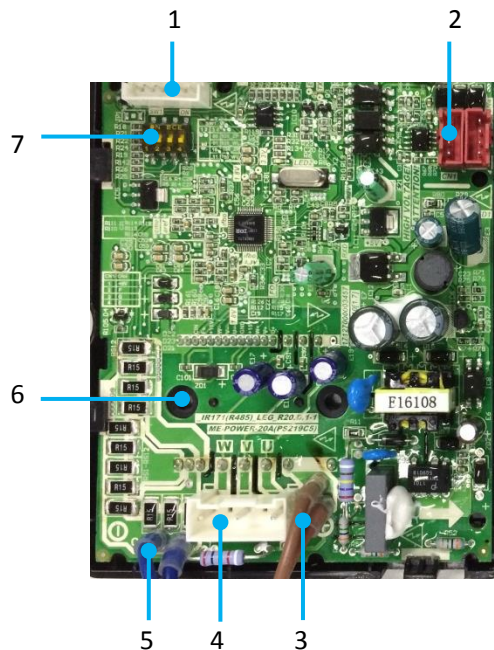


Table 4-2.15: Fan module PCB

Label in Figure 4-2.5	Code	Content	Voltage
1	CN2	EEPROM	-
2	CN1 CN4	Communication port for inverter module	2.5-2.7 DC
3	P	Power supply for inverter module	$V_{PN} = 310V$ DC
4	CN3	Power supply for the fan motor	$V_{UV} = V_{Uw} = V_{Vw}$ 0-310V AC
5	N	Power supply for inverter module	$V_{PN} = 310V$ DC
6	U3	IPM	-
7	SW1	Address for the inverter module	-

2.6.1 Fan Module PCB field setting

Table 4-2.16: Fan module PCB switch settings for all models

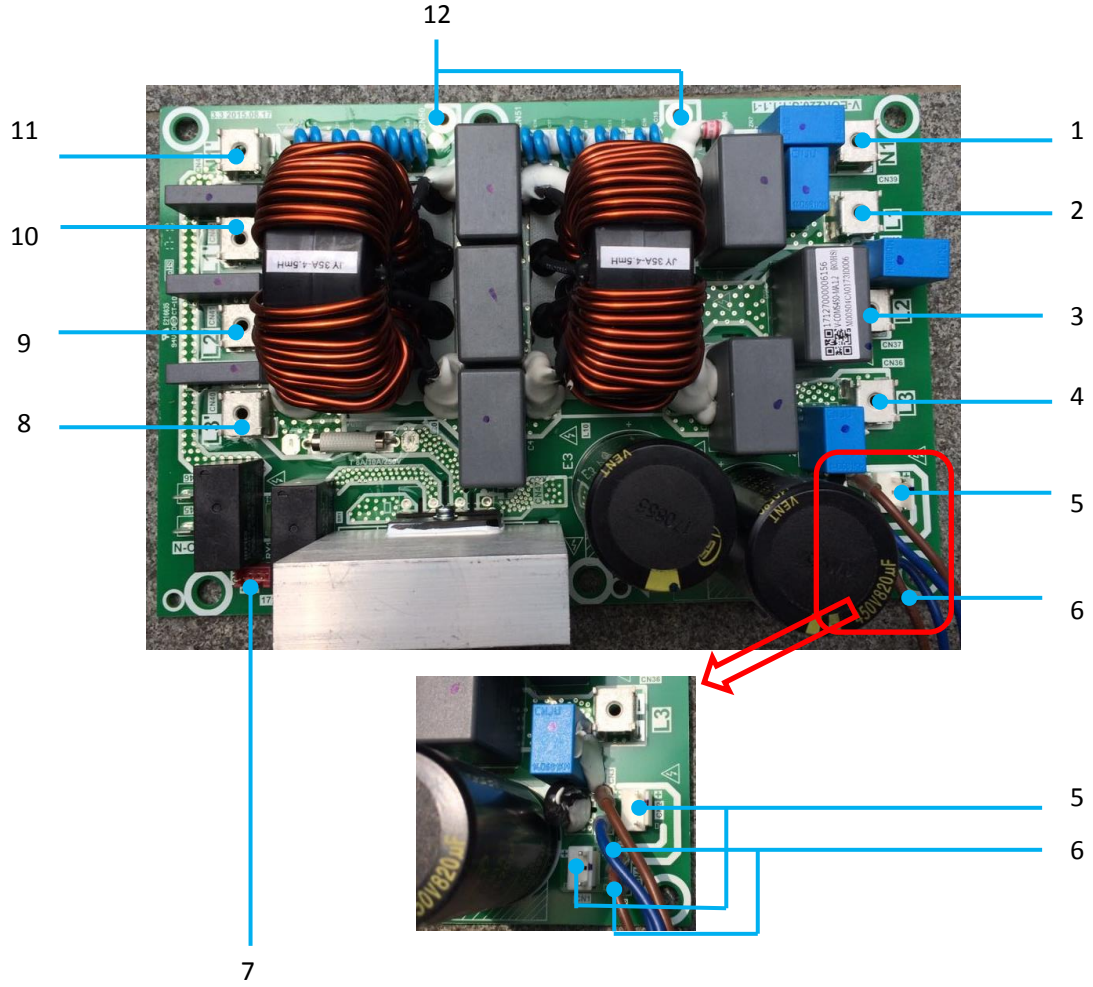
Switch	Description
	00: 30kW unit fan module address setting
	00: 60kW and 90 kW units fan module A address setting
	01: 60kW and 90 kW units fan module B address setting
	10: 90kW unit fan module C address setting
SW1-3 SW1-4	Reserved

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2.7 AC Filter Board

Figure 4-2.6: AC filter board¹ for 30kW and 60kW units



Notes:

1. Label descriptions are given in Table 4-2.17.

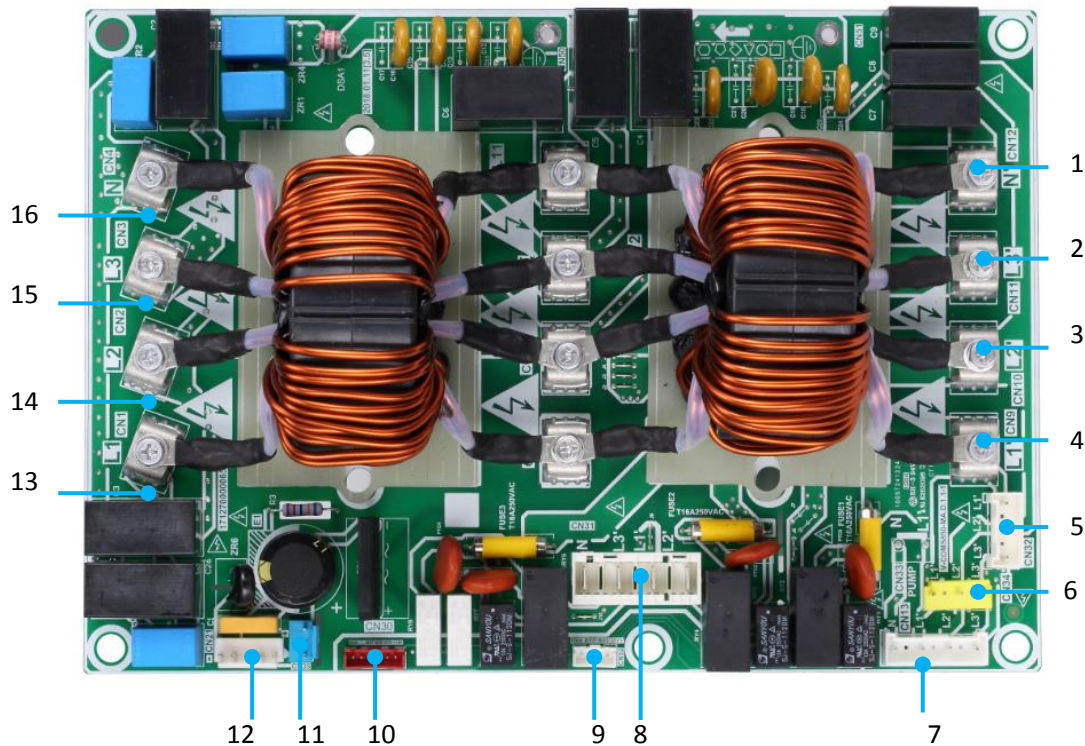
Table 4-2.17: AC filter board for 30kW and 60kW units

Label in Figure 4-2.6	Code	Content	Voltage
1	CN39	N1	$V_{L1N1}=V_{L2N1}=V_{L3N1}=220V$
V	CN38	L1	
3	CN37	L2	
4	CN36	L3	
5	CN1 CN2	Power supply for compressor inverter module	310V DC
6	CN3 CN4	Power supply for fan inverter module	310V DC
7	CN6	AC filter board communication port	12 DC
8	CN40	L3'	$V_{L1'N1'}=V_{L2'N1'}=V_{L3'N1'}=220V$
9	CN41	L2'	
10	CN42	L1'	
11	CN43	N1'	
12	GND	GND	-

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2.8 AC Filter Board

Figure 4-2.7: AC filter board¹ for 90kW unit



Notes:

1. Label descriptions are given in Table 4-2.18.

Table 4-2.18: AC filter board for 90kW unit

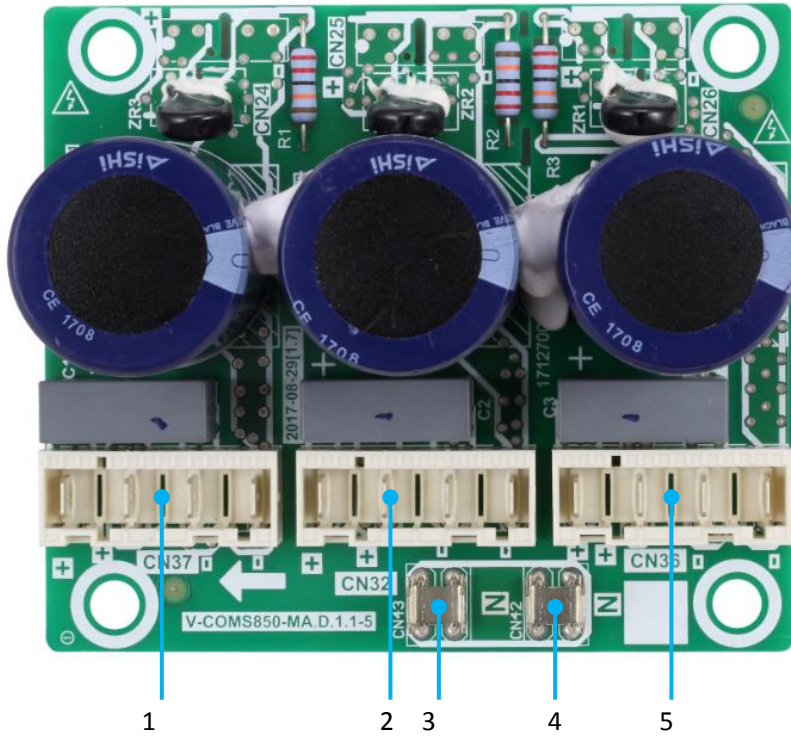
Label in Figure 4-2.7	Code	Content	Voltage
1	CN12	N'	$V_{L1'N1'}=V_{L2'N1'}=V_{L3'N1'}=220V$
2	CN11	L1'	
3	CN10	L2'	
4	CN9	L3'	
5	CN32	Power supply for compressor inverter module	310V DC
6	CN34	Power supply for fan inverter module	310V DC
7	CN13	Power supply for main PCB	$V_{L1'N}=V_{L2'N}=V_{L3'N}=220V$
8	CN31	Power supply for fan module board	$V_{L1'N}=V_{L2'N}=V_{L3'N}=220V$
9	CN52	Relay driver signal for fan from main PCB	0 or 12V DC
10	CN30	Relay driver signal for compressor from main PCB	0 or 12V DC
11	CN35	High pressure switch connection	0 or 310V DC
12	CN21	Power supply for inverter module board	310V DC
13	CN1	L1	$V_{L1N}=V_{L2N}=V_{L3N}=220V$
14	CN2	L2	
15	CN3	L3	
16	CN4	N	

Aqua Tempo Super II



2.9 Fan Module Power Board

Figure 4-2.8: Fan module power board¹ for 90kW unit



Notes:

1. Label descriptions are given in Table 4-2.19.

Table 4-2.19: Fan power board for 90kW unit

Label in Figure 4-2.8	Code	Content	Voltage
1	CN37	Port output for fan C rectifier bridge and input for fan C inverter module board	310V DC
2	CN32	Port output for fan B rectifier bridge and input for fan B inverter module board	
3	CN43	N port for single phase rectifier bridge	$V_{L1'N}=V_{L2'N}=V_{L3'N}=220V$
4	CN42	N port for fan rectifier bridge	
5	CN36	Port output for fan A rectifier bridge and input for fan A inverter module board	310V DC

3 Error Code Table

Table 4-2.20: Error Code Table (30kW and 60kW units)

Error code	Content	Remarks
1E0	Main PCB EEPROM mismatch	Displayed on main PCB and user interface
2E0	Inverter module A EEPROM mismatch	Displayed on main PCB and user interface
3E0	Inverter module B EEPROM mismatch	Displayed on main PCB and user interface
E1	Power phase sequence error	Displayed on main PCB and user interface
E2	Communication error between main PCB and wired controller	Displayed on main PCB and user interface
E3	Total water outlet temperature sensor (Tw) error (displayed on master unit only)	Displayed on main PCB and user interface
E4	Outlet water temperature sensor (Two) error	Displayed on main PCB and user interface
E5	Air-side heat exchanger temperature sensor (T3) error	Displayed on main PCB and user interface
E7	Outdoor ambient temperature sensor (T4) error	Displayed on main PCB and user interface
E9	Water flow failure	Displayed on main PCB and user interface
1Eb	Water-side heat exchanger anti-freezing temperature sensor1 (Taf1) error	Displayed on main PCB and user interface
2Eb	Water-side heat exchanger anti-freezing temperature sensor2 (Taf2) error	Displayed on main PCB and user interface
EC	Number of units detected by wired controller has decreased	Displayed on main PCB and user interface
1Ed	Compressor discharge temperature sensor1 (Tp1) error	Displayed on main PCB and user interface
2Ed	Compressor discharge temperature sensor2 (Tp2) error	Displayed on main PCB and user interface
EF	Inlet water temperature sensor (Twi) error	Displayed on main PCB and user interface
EH	System self-check error	Displayed on main PCB and user interface
EP	Compressor discharge temperature sensor error	Displayed on main PCB and user interface
EU	Total cooling outlet temperature sensor (Tz/7) error	Displayed on main PCB and user interface
P0	Compressor discharge temperature protection	Displayed on main PCB and user interface
P1	Compressor suction temperature protection	Displayed on main PCB and user interface
P4	Power supply phase B Current protection	Displayed on main PCB and user interface
P5	Power supply phase C Current protection	Displayed on main PCB and user interface
1P6	System A inverter module protection	Displayed on main PCB and user interface
2P6	System A inverter module protection	Displayed on main PCB and user interface
P7	Condenser tube and Total cooling outlet high temperature protection	Displayed on main PCB and user interface
P9	Water-side heat exchanger inlet/outlet temperature difference protection	Displayed on main PCB and user interface
PA	Inlet water high temperature in cooling mode	Displayed on main PCB and user interface
Pb	System anti-freezing protection	Displayed on main PCB and user interface
PC	Evaporator pressure low in cooling mode	Displayed on main PCB and user interface
PE	Low-temperature protection of evaporator (manual recovery)	Displayed on main PCB and user interface
PL	Module high temperature protection	Displayed on main PCB and user interface
1PU	DC fan 1 module protection	Displayed on main PCB and user interface

2PU	DC fan 2 module protection	Displayed on main PCB and user interface
1H0	System A IPM module Communication error	Displayed on main PCB and user interface
2H0	System B IPM module Communication error	Displayed on main PCB and user interface
H1	Under/Over voltage protection	Displayed on main PCB and user interface
1H6	System 1 DC bus voltage error	Displayed on main PCB and user interface
2H6	System 2 DC bus voltage error	Displayed on main PCB and user interface
Fb	Pressure sensor error	Displayed on main PCB and user interface
Fd	Air suction temperature(Th) protection error	Displayed on main PCB and user interface
1FF	DC fan 1 error	Displayed on main PCB and user interface
2FF	DC fan 2 error	Displayed on main PCB and user interface
FP	DIP inconsistency of multiple water pumps(Power failure recovery required)	Displayed on main PCB and user interface
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	-
dF	Defrosting indicator	Displayed on main PCB and user interface

Table 4-2.21: Error Code Table (90kW unit)

Error code	Content	Remarks
E0	Main PCB EEPROM mismatch	Displayed on main PCB and user interface
E1	Power phase sequence error	Displayed on main PCB and user interface
E2	Communication error between main PCBs; Communication error between main PCB and wired controller	Displayed on main PCB and user interface
E3	Total water outlet temperature sensor (Tw) error (displayed on master unit only)	Displayed on main PCB and user interface
E4	Outlet water temperature sensor (Two) error	Displayed on main PCB and user interface
1E5	Air-side heat exchanger temperature sensor (T3A) error	Displayed on main PCB and user interface
2E5	Air-side heat exchanger temperature sensor (T3B) error	Displayed on main PCB and user interface
E7	Outdoor ambient temperature sensor (T4) error	Displayed on main PCB and user interface
E8	Power phase protector output error	Displayed on main PCB and user interface
E9	Water flow failure	Displayed on main PCB and user interface
1Eb	Water-side heat exchanger anti-freezing temperature sensor1 (Taf1) error	Displayed on main PCB and user interface
2Eb	Water-side heat exchanger anti-freezing temperature sensor2 (Taf2) error	Displayed on main PCB and user interface
EC	Number of units detected by wired controller has decreased	Displayed on main PCB and user interface
1Ed	Compressor discharge temperature sensor1 (Tp1) error	Displayed on main PCB and user interface
2Ed	Compressor discharge temperature sensor2 (Tp2) error	Displayed on main PCB and user interface
1EE	Plate heat exchanger cooling refrigerant outlet temperature (T6A) sensor	Displayed on main PCB and user interface
2EE	Plate heat exchanger cooling refrigerant outlet temperature (T6A) sensor	Displayed on main PCB and user interface
EF	Inlet water temperature sensor (Twi) error	Displayed on main PCB and user interface
EH	System self-check error	Displayed on main PCB and user interface
EP	Compressor discharge temperature sensor error	Displayed on main PCB and user interface
EU	Total cooling outlet temperature sensor (Tz/7) error	Displayed on main PCB and user interface
P0	Compressor discharge temperature protection or system discharge pipe high pressure protection	Displayed on main PCB and user interface
P1	Compressor suction low pressure protection	Displayed on main PCB and user interface
P2	Total cooling outlet temperature (Tz/7) too high protection	Displayed on main PCB and user interface
P4	System A current protection	Displayed on main PCB and user interface
P5	System B current protection	Displayed on main PCB and user interface
P6	inverter module protection	Displayed on main PCB and user interface
P7	Condenser tube high temperature protection	Displayed on main PCB and user interface
P9	Water-side heat exchanger inlet/outlet temperature difference protection	Displayed on main PCB and user interface
Pb	System anti-freezing protection	Displayed on main PCB and user interface
PC	Evaporator pressure low in cooling mode	Displayed on main PCB and user interface
PE	Low-temperature protection of evaporator (manual	Displayed on main PCB and user interface

	recovery)	
PH	Ambient temperature (T4) too high in heating mode	Displayed on main PCB and user interface
PL	Inverter module high temperature (Tfin1 or Tfin2) protection	Displayed on main PCB and user interface
1PU	DC fan 1 module protection	Displayed on main PCB and user interface
2PU	DC fan 2 module protection	Displayed on main PCB and user interface
3PU	DC fan 3 module protection	Displayed on main PCB and user interface
H5	Under/Over voltage protection	Displayed on main PCB and user interface
1H9	Inverter module A EEPROM mismatch	Displayed on main PCB and user interface
2H9	Inverter module B EEPROM mismatch	Displayed on main PCB and user interface
1HE	Electronic expansion valve (EXVA) connection error	Displayed on main PCB and user interface
2HE	Electronic expansion valve (EXVB) connection error	Displayed on main PCB and user interface
3HE	Electronic expansion valve (EXVC) connection error	Displayed on main PCB and user interface
1F0	System A IPM module Communication error	Displayed on main PCB and user interface
2F0	System B IPM module Communication error	Displayed on main PCB and user interface
F2	Superheat insufficient error	Displayed on main PCB and user interface
1F4	L0 or L1 protection of system 1 occurs 3 times in 60 minutes	Displayed on main PCB and user interface
2F4	L0 or L1 protection of system 1 occurs 3 times in 60 minutes	Displayed on main PCB and user interface
1F6	System 1 DC bus voltage error	Displayed on main PCB and user interface
2F6	System 2 DC bus voltage error	Displayed on main PCB and user interface
1F9	Inverter module temperature sensor (Tfin1) error	Displayed on main PCB and user interface
2F9	Inverter module temperature sensor (Tfin2) error	Displayed on main PCB and user interface
Fb	Pressure sensor error	Displayed on main PCB and user interface
Fd	Air suction temperature(Th) protection error	Displayed on main PCB and user interface
1FF	DC fan 1 error	Displayed on main PCB and user interface
2FF	DC fan 2 error	Displayed on main PCB and user interface
3FF	DC fan 3 error	Displayed on main PCB and user interface
FP	DIP inconsistency of multiple water pumps(Power failure recovery required)	Displayed on main PCB and user interface
C7	PL occurs 3 times	
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	-
dF	Defrosting indicator	Displayed on main PCB and user interface

4 Troubleshooting

4.1 Warning

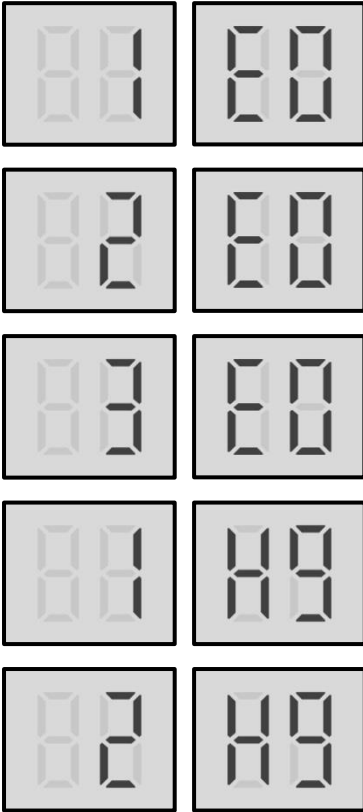
Warning



- 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/H9 Troubleshooting

4.2.1 Digital display output



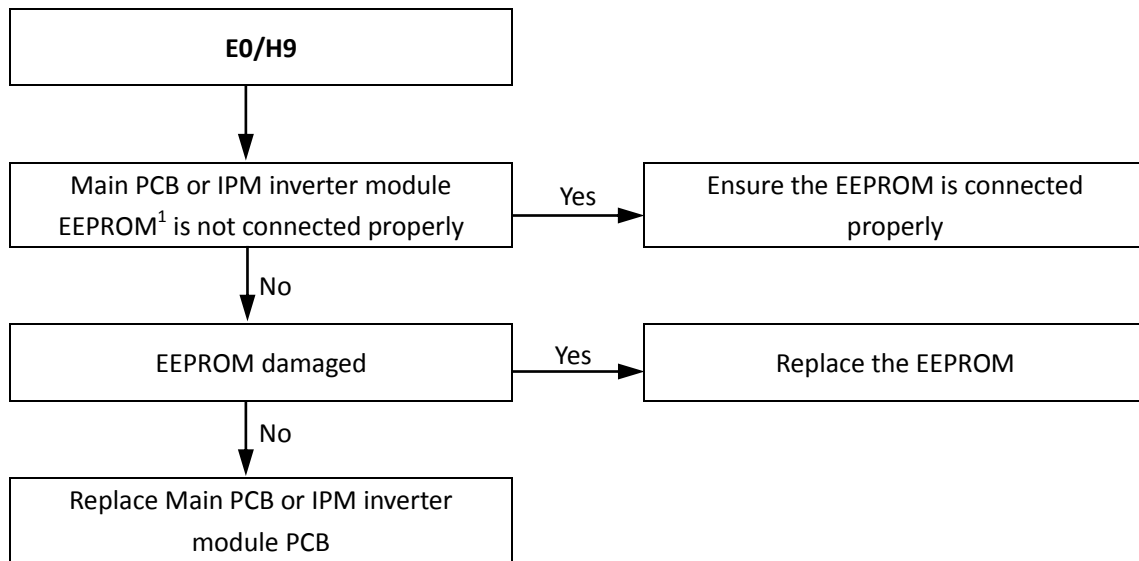
4.2.2 Description

- 1E0 indicates main PCB EEPROM error.
- 2E0/1E9 /1H9 indicates IPM inverter module (compressor A) EEPROM error.
- 3E0/2E9/2H9 indicates IPM inverter module (compressor B) EEPROM error.
- All units stop running.
- Error code is displayed on main PCB and user interface.

4.2.3 Possible causes

- Main PCB or IPM inverter module EEPROM is not connected properly.
- Main PCB or IPM inverter module damaged.
- EEPROM damaged.

4.2.4 Procedure



Notes:

For 30kW and 60kW units,

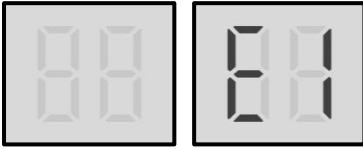
1. Main PCB EEPROM is designated IC10 on the main PCBs (labeled 32 in Figure 4-2.1 in Part 4, 2.2 "Main PCB").
2. Compressor inverter module PCB EEPROM is designated IC14 on compressor inverter module PCB (labeled 2 in Figure 4-2.3 in Part 4, 2.4 "Compressor inverter module PCB").

For 90kW unit

1. Main PCB EEPROM is designated IC10 on the main PCBs (labeled 29 in Figure 4-2.2 in Part 4, 2.2 "Main PCB").
2. Compressor inverter module PCB EEPROM is designated IC25 on compressor inverter module PCB (labeled 14 in Figure 4-2.4 in Part 4, 2.5 "Compressor inverter module PCB").

4.3 E1 Troubleshooting

4.3.1 Digital display output



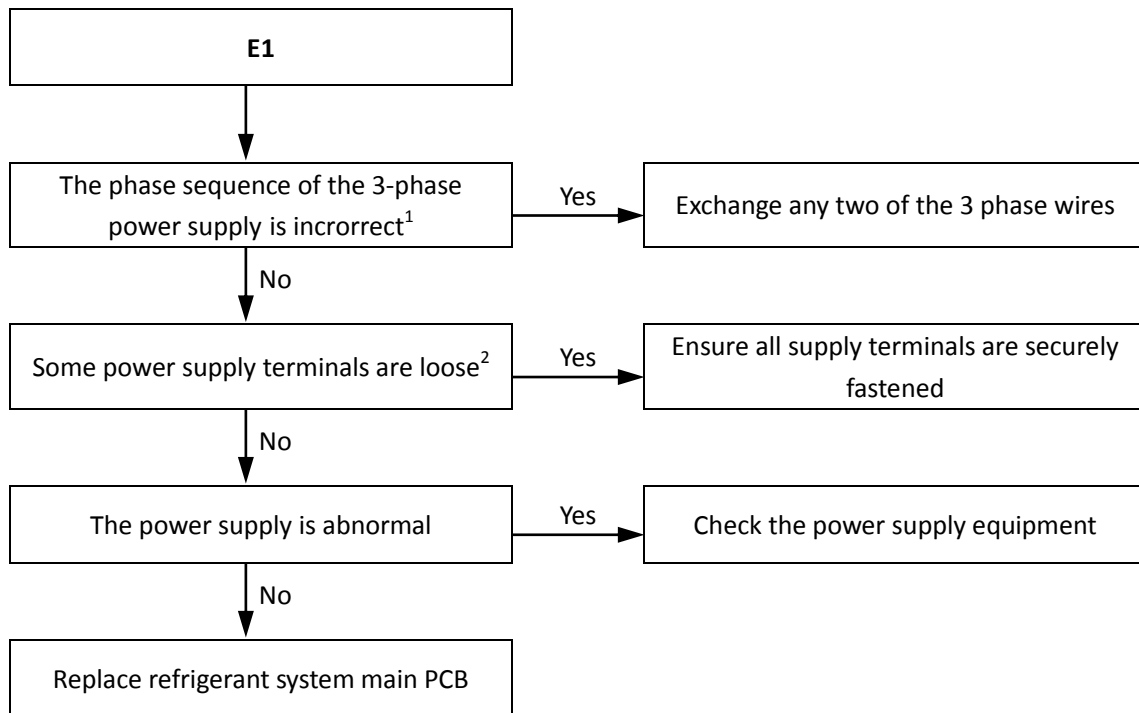
4.3.2 Description

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

4.3.3 Possible causes

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

4.3.4 Procedure

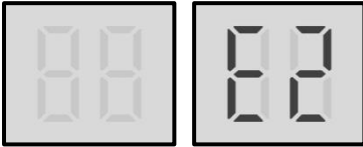


Notes:

1. The A, B, C terminals of 3-phase power supply should match compressor phase sequence requirements. If the phase sequence is inverted, the compressor will operate inversely. If the wiring connection of each outdoor unit is in A, B, C phase sequence, and multiple units are connected, the current difference between C phase and A, B phases will be very large as the power supply load of each outdoor unit will be on C phase. This can easily lead to tripped circuits and terminal wiring burnout. Therefore if multiple units are to be used, the phase sequence should be staggered, so that the current is distributed among the three phases equally.
2. Loose power supply terminals can cause the compressors to operate abnormally and compressor current to be very large.

4.4 E2 Troubleshooting

4.4.1 Digital display output



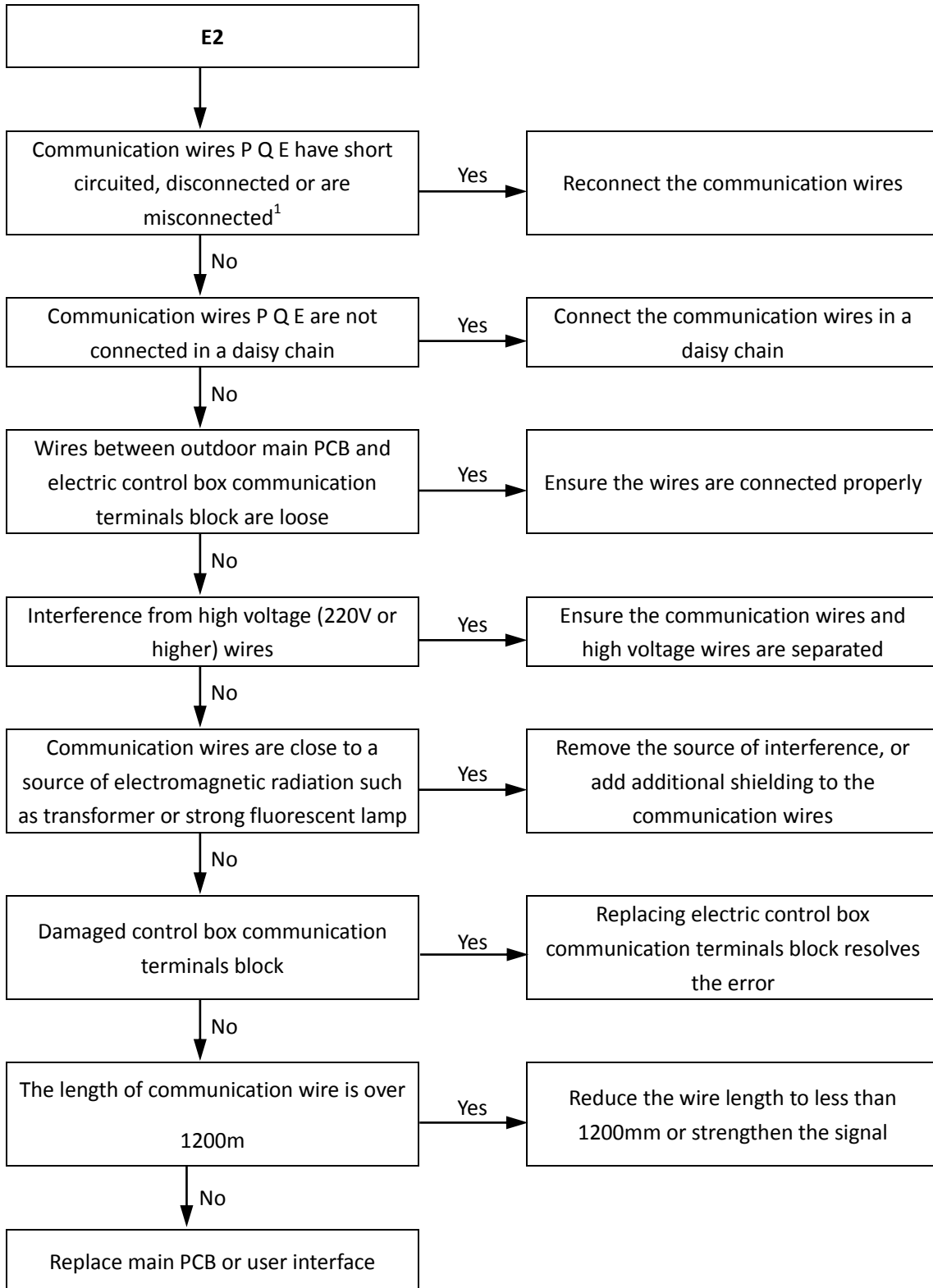
4.4.2 Description

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

4.4.3 Possible causes

- Communication wires between outdoor unit and user interface not connected properly.
- Communication wiring P Q E terminals misconnected.
- Loosened wiring within electric control box.
- Interference from high voltage wires or other sources of electromagnetic radiation.
- Communication wire too long.
- Damaged main PCB, user interface or electric control box communication terminals block.

4.4.4 Procedure

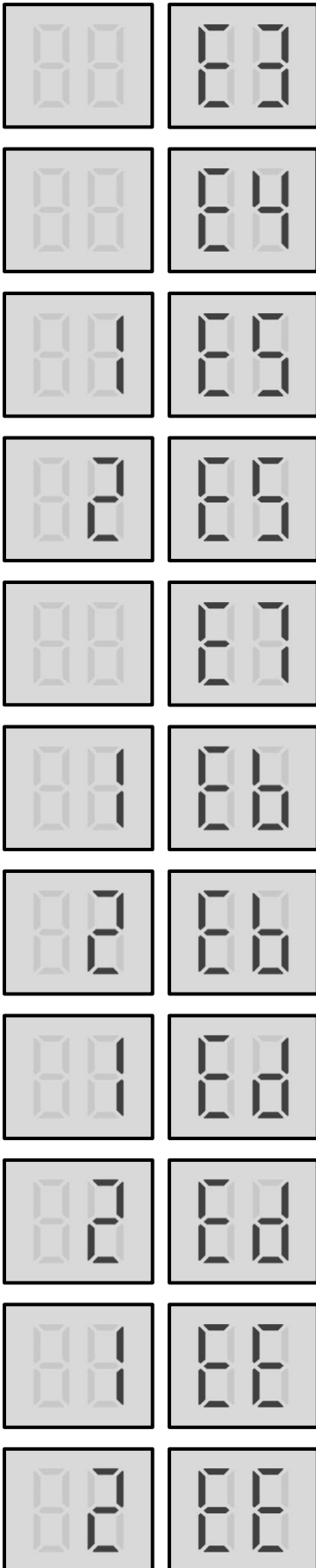


Notes:

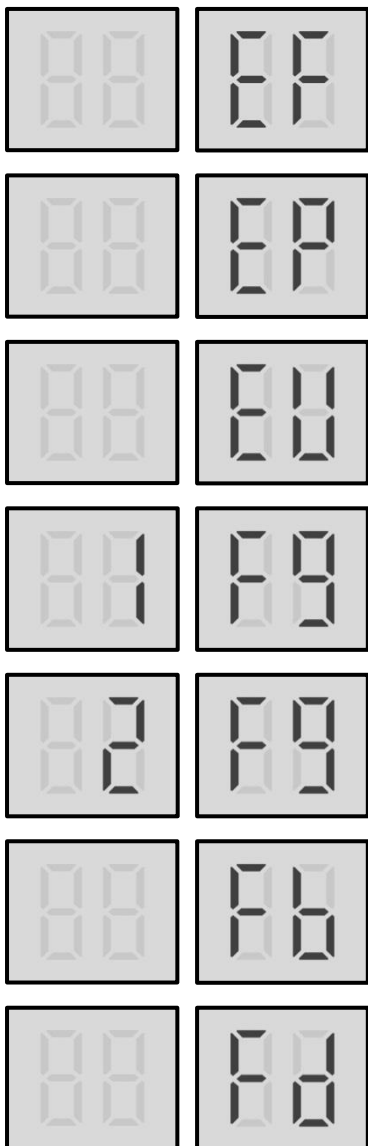
1. Measure the resistance among P, Q and E. The normal resistance between P and Q is 120Ω, between P and E is infinite, between Q and E is infinite. Communication wiring has polarity. Ensure that the P wire is connected to P terminals and the Q wire is connected to Q terminals.

4.5 E3, E4, E5, E7, Eb, Ed, EF, EP, EU, F9,Fb, Fd Troubleshooting

4.5.1 Digital display output



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4.5.2 Description

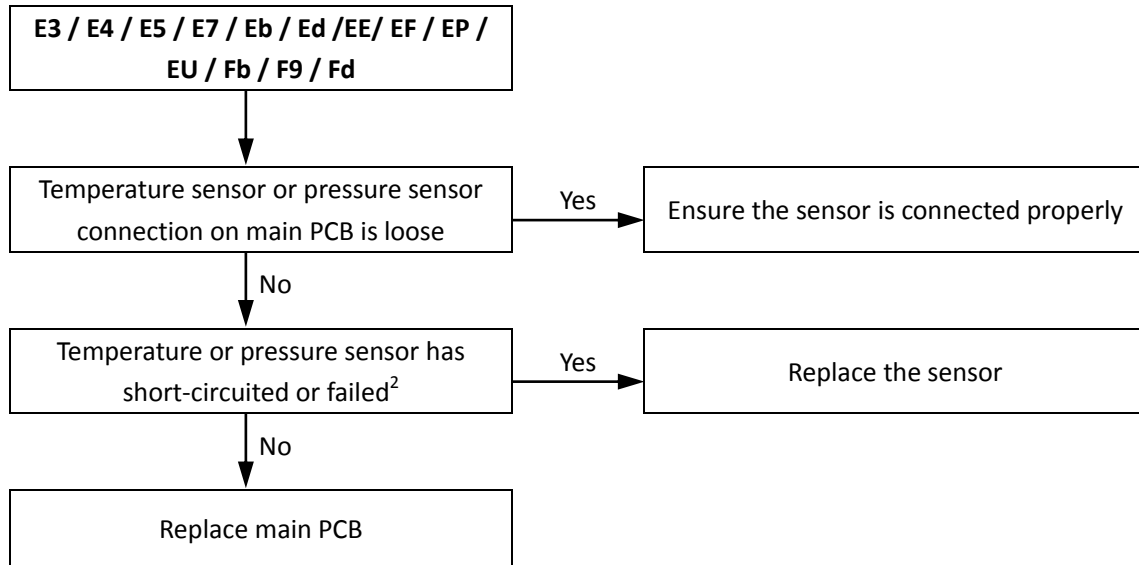
- E3 indicates a combined water outlet temperature sensor error.
- E4 indicates a water outlet temperature sensor error.
- 1E5 indicates an air side heat exchanger refrigerant outlet temperature sensor A error.
- 2E5 indicates an air side heat exchanger refrigerant outlet temperature sensor B error.
- E7 indicates an outdoor ambient temperature sensor error.
- 1Eb indicates a water side heat exchanger anti-freezing temperature sensor A error.
- 2Eb indicates a water side heat exchanger anti-freezing temperature sensor B error.
- 1Ed indicates a discharge pipe temperature sensor A error.
- 2Ed indicates a discharge pipe temperature sensor B error.
- 1EE indicates plate heat exchanger cooling refrigerant inlet temperature sensor (T6A) error.
- 2EE indicates plate heat exchanger cooling refrigerant outlet temperature sensor (T6B) error.
- EF indicates a water inlet temperature sensor error.
- EP indicates a discharge pipe temperature sensor failure alarm.
- EU indicates an air side heat exchanger refrigerant total outlet temperature sensor error.
- 1F9 indicates inverter module temperature sensor(TfinA) error.
- 2F9 indicates inverter module temperature sensor(TfinB) error.
- Fb indicates a pressure sensor error.
- Fd indicates an air suction temperature sensor error.
- All stop running.

- Error code is displayed on main PCB and user interface.

4.5.3 Possible causes

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

4.5.4 Procedure

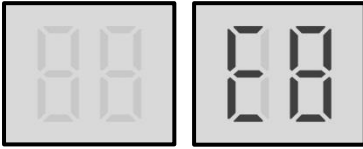


Notes:

- For 30kW and 60kW units, all the sensors are connected to port CN24, CN69, CN31 and CN40 on the main PCB (labeled 22, 23, 24, 25 in Figure 4-2.1 in Part 4, 2.2 "Outdoor unit main PCB").
For 90kW unit, all the sensors are connected to port CN1, CN16, CN31, CN3, CN10 and CN69 on the main PCB (labeled 30, 31, 32, 33, 34, 36 in Figure 4-2.2 in Part 4, 2.3 "Outdoor unit main PCB").
- Measure sensor resistance. If the resistance is too low, the sensor has short-circuited. If the resistance is not consistent with the sensor's resistance characteristics table, the sensor has failed. Refer to Table 5-5.1 or 5-5.2 or 5-5.3 in Part 5, 5.1 "Temperature Sensor Resistance Characteristics".

4.6 E8 Troubleshooting

4.6.1 Digital display output



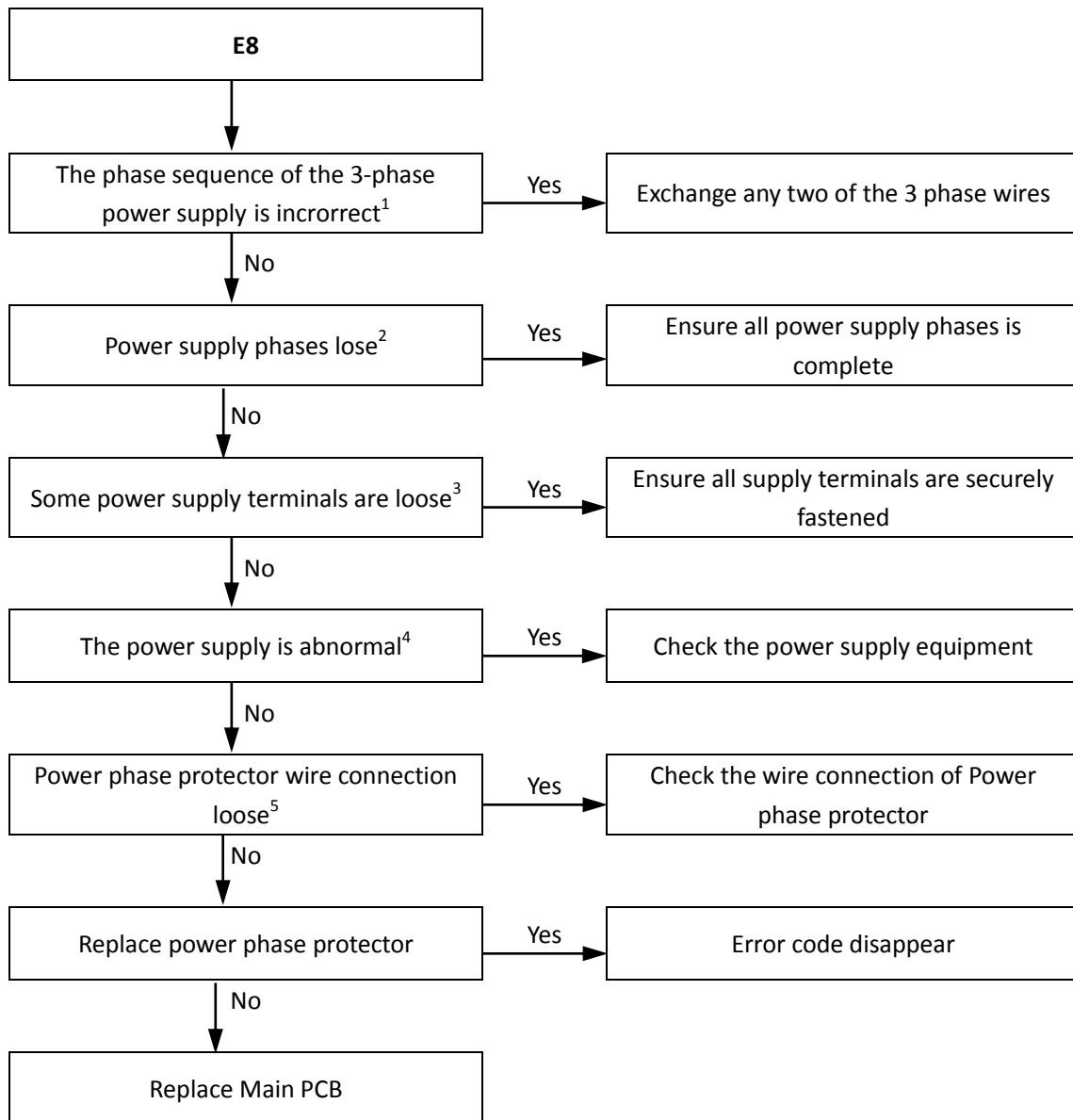
4.6.2 Description

- Power phase protector output error
- When this error occurs in the main unit, all units stop running. When this error occurs in the slave unit, the slave unit stop running.
- Error code is displayed on main PCB and user interface.

4.6.3 Possible causes

- Power supply phases not connected in correct sequence or lose.
- Power supply terminals or Power phase protector wire connection loose.
- Power supply abnormal.
- Damaged main PCB.
- Damaged power phase protector.

4.6.4 Procedure

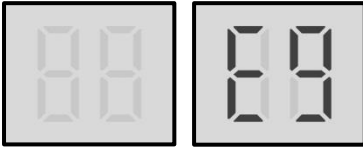


Notes:

1. The red LED on the power phase protector will on.
2. The red LED on the power phase protector will flash with 1HZ.
3. The A, B, C terminals of 3-phase power supply should match compressor phase sequence requirements. If the phase sequence is inverted, the compressor will operate inversely. If the wiring connection of each outdoor unit is in A, B, C phase sequence, and multiple units are connected, the current difference between C phase and A, B phases will be very large as the power supply load of each outdoor unit will be on C phase. This can easily lead to tripped circuits and terminal wiring burnout. Therefore if multiple units are to be used, the phase sequence should be staggered, so that the current is distributed among the three phases equally.
4. The red LED on the power phase protector will flash with 3HZ. Loose power supply terminals can cause the compressors to operate abnormally and compressor current to be very large.
5. For 90kW unit, wire connected to port CN91 on the main PCB (labeled 38 in Figure 4-2.2 in Part 4, 2.3 "Outdoor unit main PCB").

4.7 E9 Troubleshooting

4.7.1 Digital display output



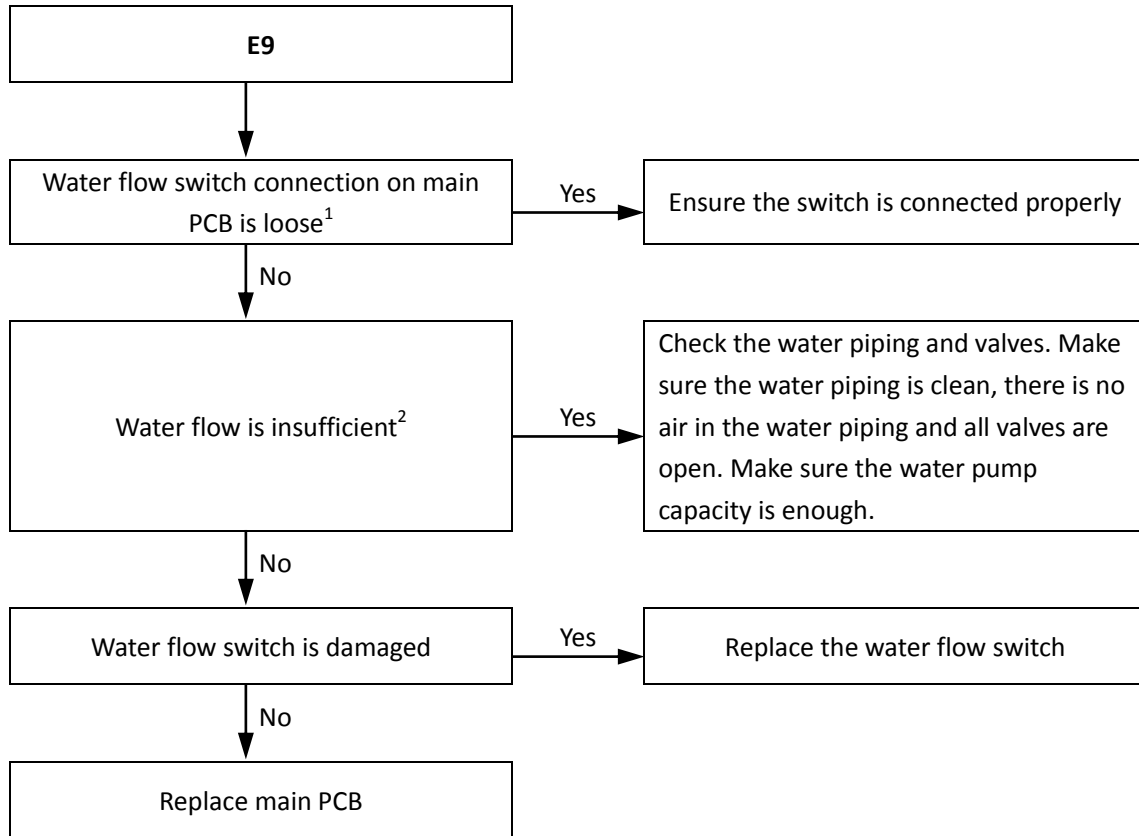
4.7.2 Description

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

4.7.3 Possible causes

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

4.7.4 Procedure

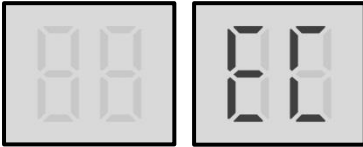


Notes:

1. For 30kW and 60kW units, water flow switch connection is port CN44 on the main PCB (labeled 31 in Figure 4-2.1 in Part 4, 2.2 "Outdoor unit main PCB"). For 90kW unit, water flow switch connection is port CN8 on the main PCB (labeled 43 in Figure 4-2.2 in Part 4, 2.3 "Outdoor unit main PCB").

4.8 EC Troubleshooting

4.8.1 Digital display output



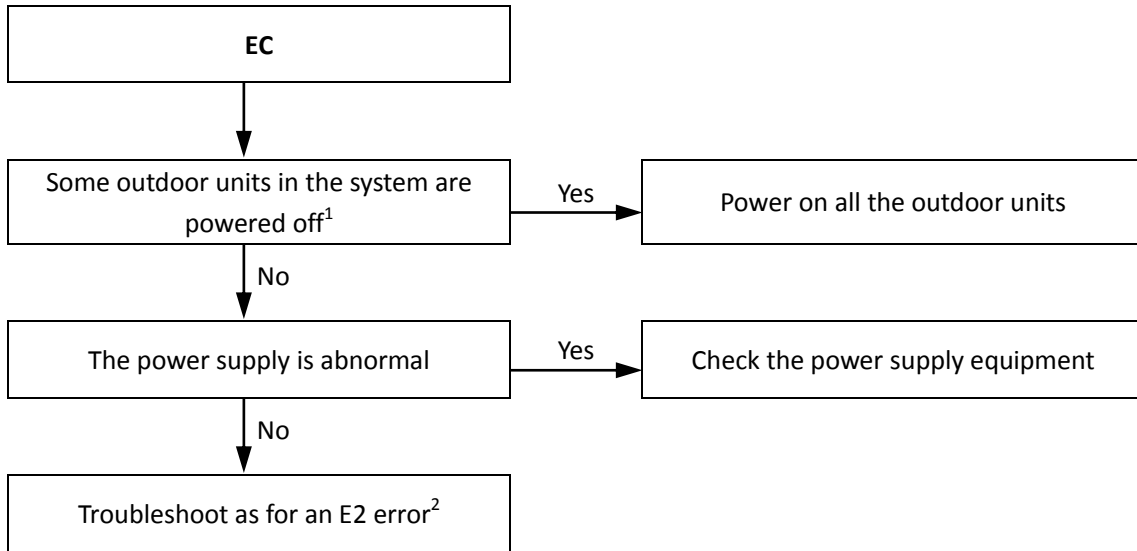
4.8.2 Description

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

4.8.3 Possible causes

- Some outdoor units are powered off.
- Power supply abnormal.
- Incorrect outdoor unit address setting.
- Communication wires between outdoor units not connected properly.
- Loosened wiring within electric control box.
- Damaged main PCB or electric control box communication terminals block.

4.8.4 Procedure

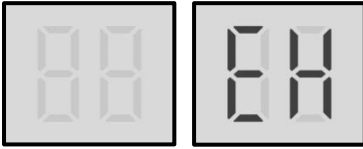


Notes:

1. Check digital display on the main PCB. If digital display is on, the main PCB is powered on, if digital display is off, the main PCB is powered off. For 30kW and 60kW units L, refer to Figure 4-2.1 in Part 4, 2.2 "Outdoor unit main PCB"; For 90kW unit, refer to Figure 4-2.2 in Part 4, 2.3 "Outdoor unit main PCB".
2. See Part 4, 4.4 "E2 Troubleshooting".

4.9 EH Troubleshooting

4.9.1 Digital display output



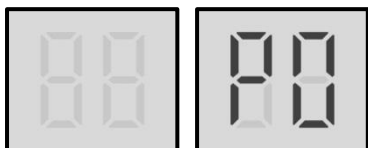
4.9.2 Description

- EH indicates system self-check in the factory, it will not display in the normal operating.

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4.10 P0 Troubleshooting

4.10.1 Digital display output



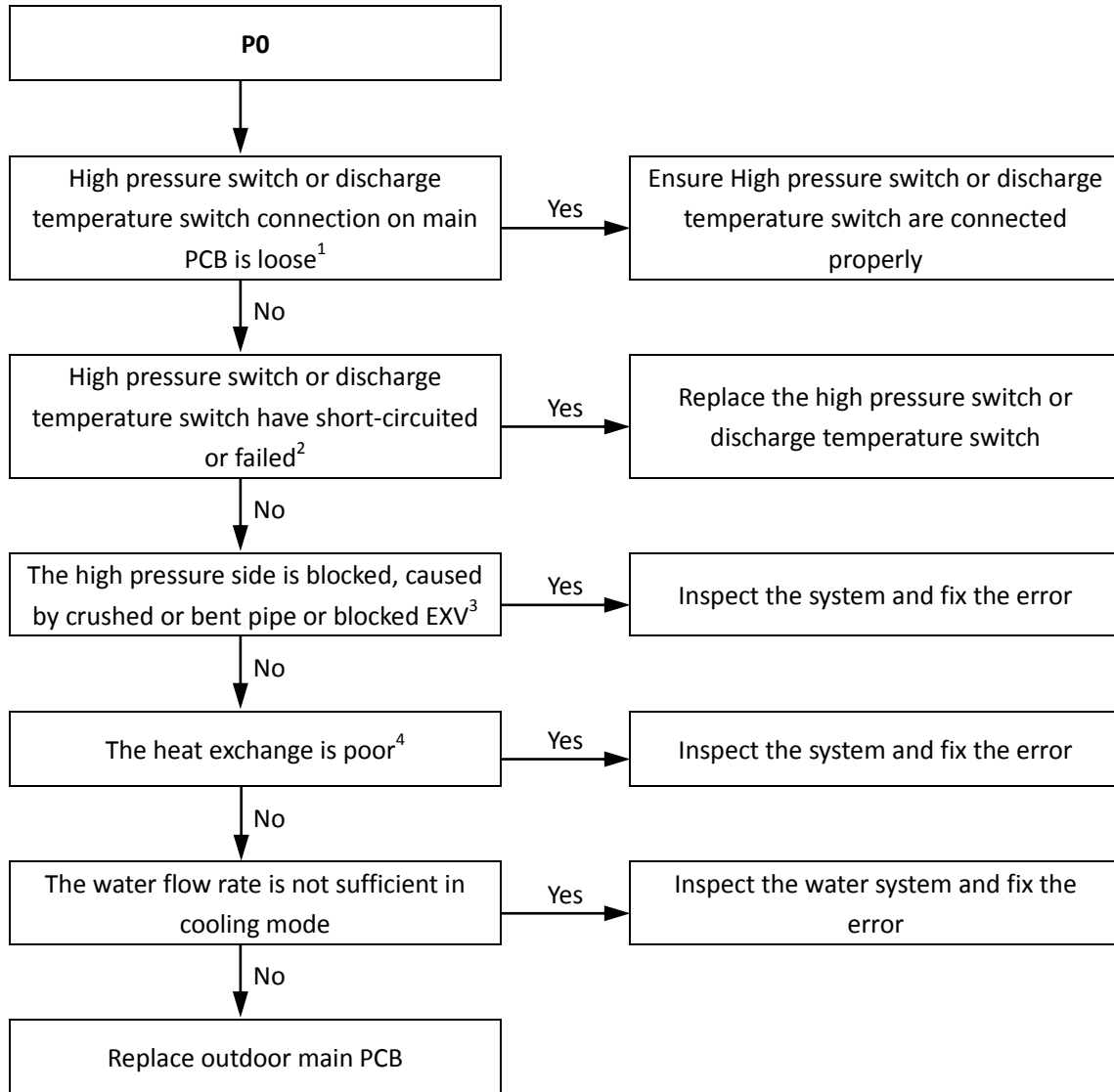
4.10.2 Description

- Discharge pipe high pressure or discharge temperature switch protection. When the discharge pressure rises above 4.4MPa or discharge temperature rises above 115°C, the system displays P0 protection and all units stop running. When the discharge pressure falls below 3.2MPa or discharge temperature fall below 75°C, P0 is removed and normal operation resumes. When P0 error occurs 5 times in 120 minutes, a manual system restart is required before the system can resume operation.
- Error code is displayed on main PCB and user interface.

4.10.3 Possible causes

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

4.10.4 Procedure

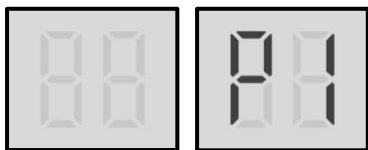


Notes:

1. For 30kW and 60kW units, high pressure switch connection is port CN47 on the main PCB (labeled 29 in Figure 4-2.1 in Part 4, 2.2 "Outdoor unit main PCB").
For 90kW unit, high pressure switch connection is port CN20 on the main PCB (labeled 20 in Figure 4-2.2 in Part 4, 2.3 "Outdoor unit main PCB")
2. Measure the resistance among the three terminals of the pressure sensor. If the resistance is of the order of mega Ohms or infinite, the pressure sensor has failed.
3. High pressure side blockage causes discharge temperature to be higher than normal, discharge pressure to be higher than normal and suction pressure to be lower than normal.
4. In heating mode check water side heat exchanger, water piping, circulator pumps and water flow switch for dirt/blockages. In cooling mode check air side heat exchanger, fan(s) and air outlets for dirt/blockages.

4.11 P1 Troubleshooting

4.11.1 Digital display output



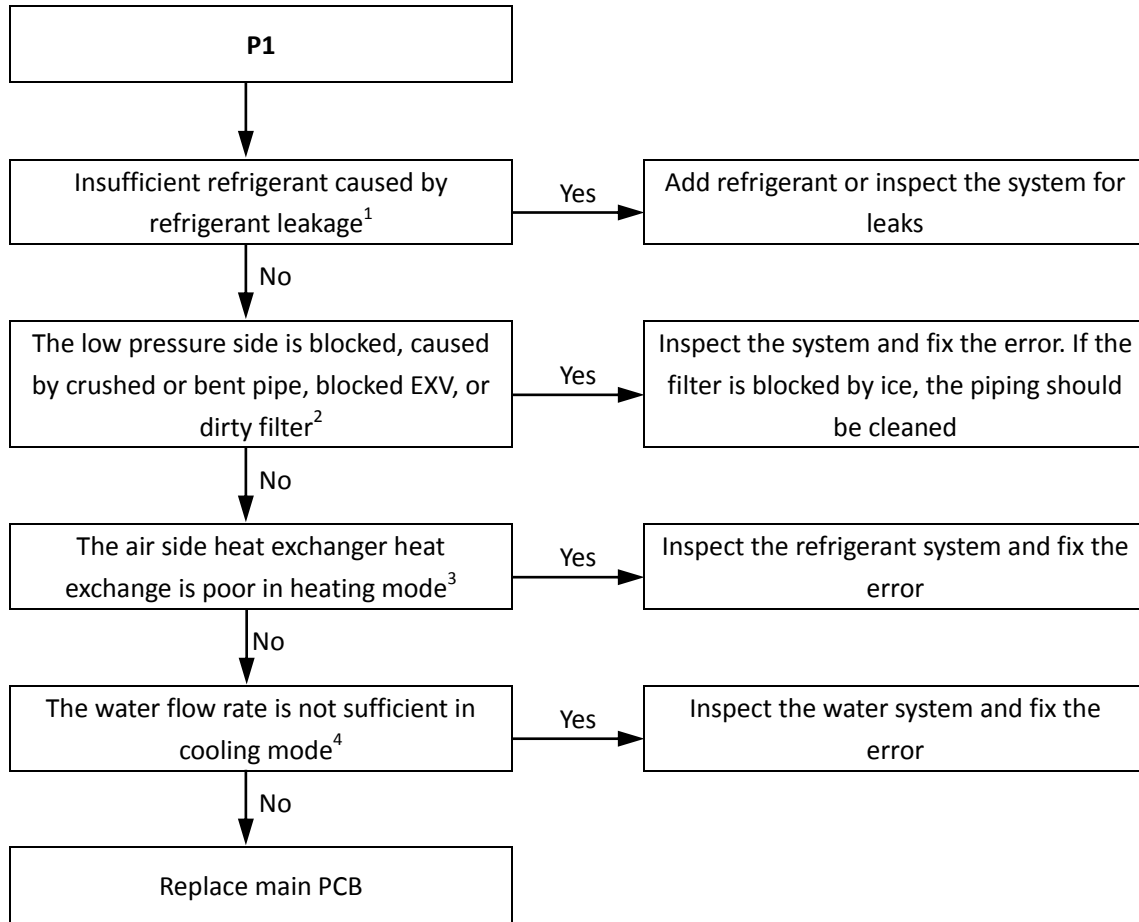
4.11.2 Description

- P1 indicates suction pipe low pressure protection. When the suction pressure falls below 0.05MPa, the system displays P1 protection and all units stop running. When the pressure rises above 0.15MPa, P1 is removed and normal operation resumes. When P1 error occurs 5 times in 120 minutes, a manual system restart is required before the system can resume operation.
- Error code is displayed on main PCB and user interface.

4.11.3 Possible causes

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

4.11.4 Procedure



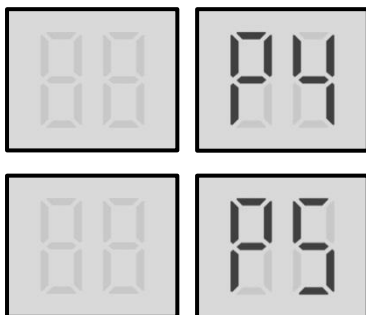
Notes:

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

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4.12 P4, P5 Troubleshooting

4.12.1 Digital display output



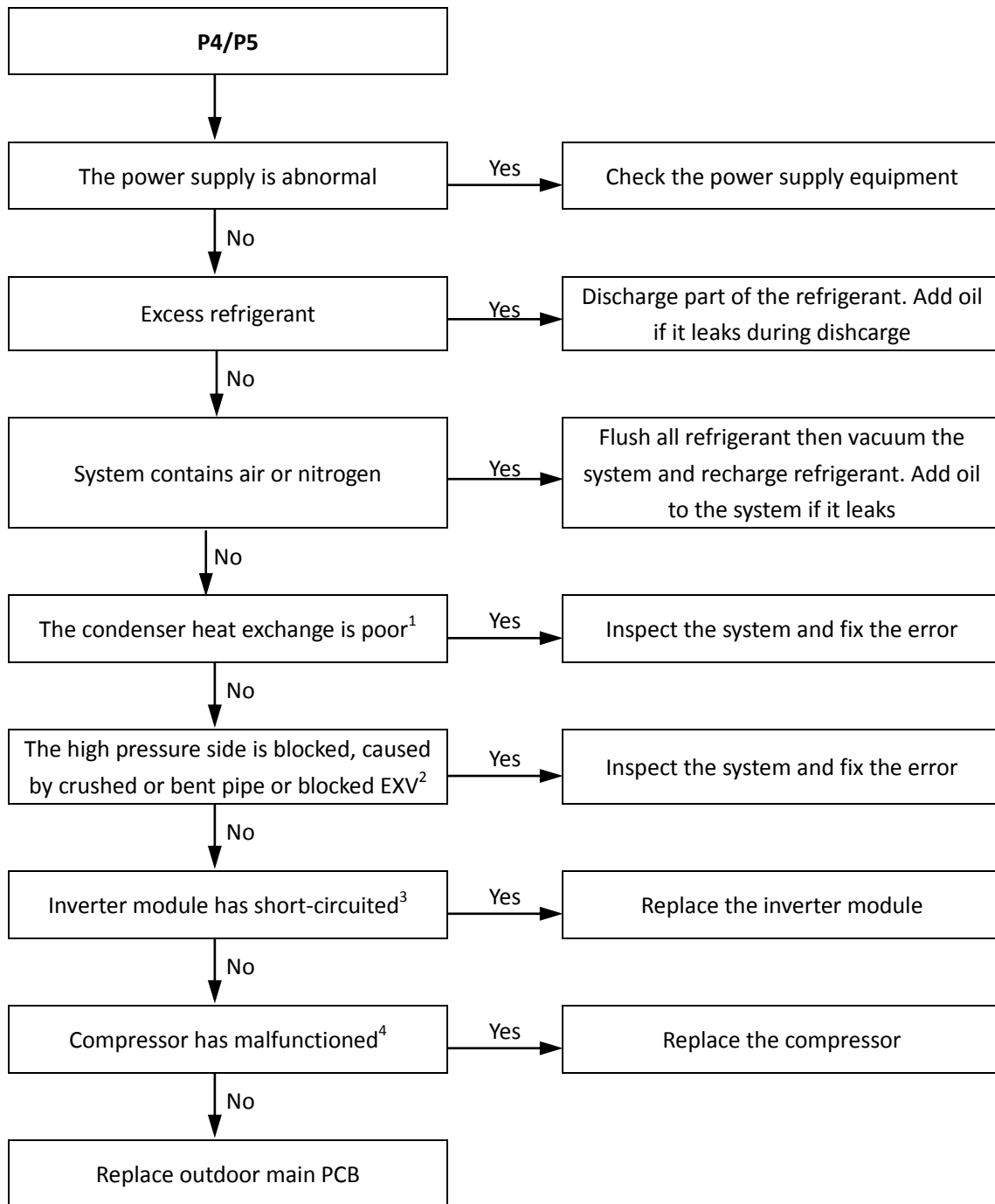
4.12.2 Description

- P4 indicates current protection on Phase B of system A.
- P5 indicates current protection on Phase C of system B.
- When the compressor current rises above the protection value 25A, the system displays P4 or P5 protection and all units stop running. When the current returns to the normal range, P4 or P5 is removed and normal operation resumes. When P4 or P5 error occurs 5 times in 120 minutes, a manual system restart is required before the system can resume operation.
- Error code is displayed on main PCB and user interface.

4.12.3 Possible causes

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

4.12.4 Procedure



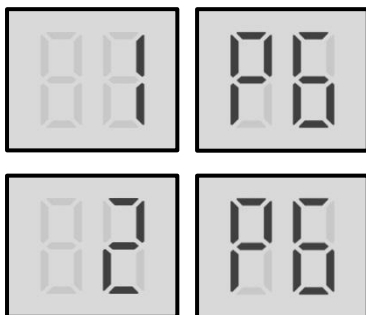
Notes:

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

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4.13 P6 Troubleshooting for 30kW and 60kW units

4.13.1 Digital display output



4.13.2 Description

- 1P6 indicates compressor A inverter module protection.
- 2P6 indicates compressor B inverter module protection.
- When a P6 error occurs, a manual system restart is required before the system can resume operation. The cause of a P6 error should be addressed promptly in order to avoid system damage.
- All units stop running.
- Error code is displayed on the main PCB and user interface.

4.13.3 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.

4.13.4 Specific error codes for xH4 inverter module protection

If a P6 error code is displayed, press button SW3 (to No.36 item) until one of the following specific error codes is displayed on the digital display: xL0, xL1, xL2, xL4, xL5, xL7, xL8, xL9. Refer to Figure 4-4.1 and Table 4-4.1.

Figure 4-4.1: Button SW3 on main PCB

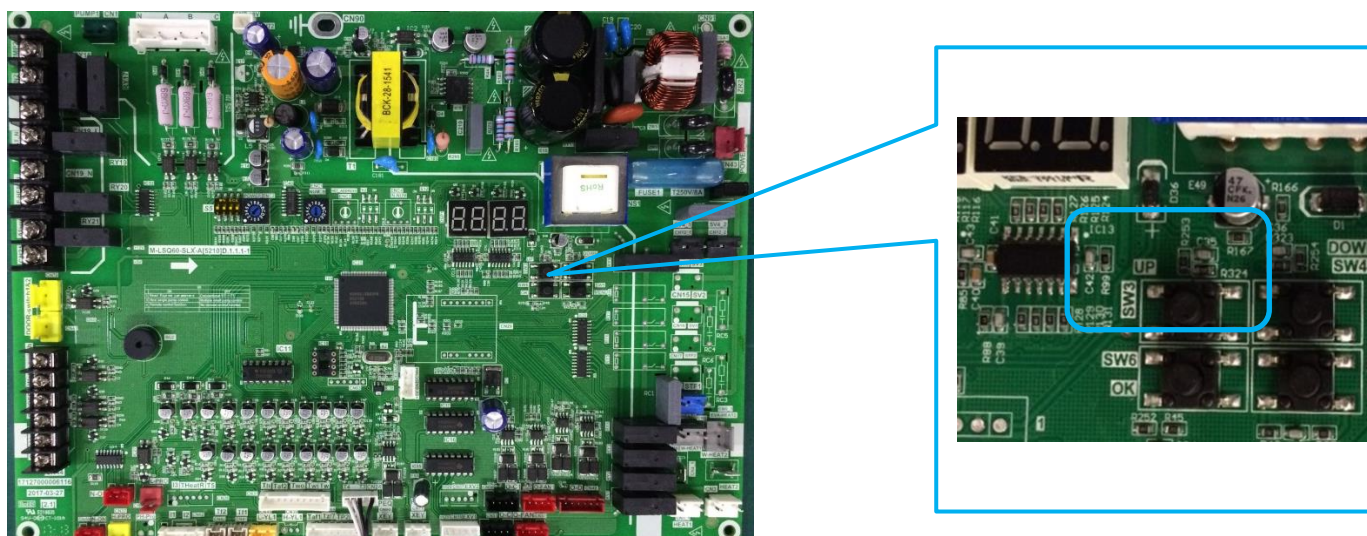


Table 4-4.1: Specific error codes for error xH4

Specific error code ¹	Content
xL0	Inverter module protection
xL1	DC bus low voltage protection
xL2	DC bus high voltage protection
xL4	MCE error
xL5	Zero speed protection
xL7	Phase sequence error
xL8	Compressor frequency variation greater than 15Hz within one second protection
xL9	Actual compressor frequency differs from target frequency by more than 15Hz protection

Notes:

- 'x' is a placeholder for the compressor system (compressor and related electrical components), with 1 representing compressor system A and 2 representing compressor system B.

The specific error codes xL0, xL1, xL2 and xL4 can also be obtained from the inverter module LED indicators. If an inverter module error has occurred, LED5 is continuously on and LED4 flashes. Refer to Figure 4-4.2 and Table 4-4.2.

Figure 4-4.2: LED indicators LED4 and LED5 on main PCB

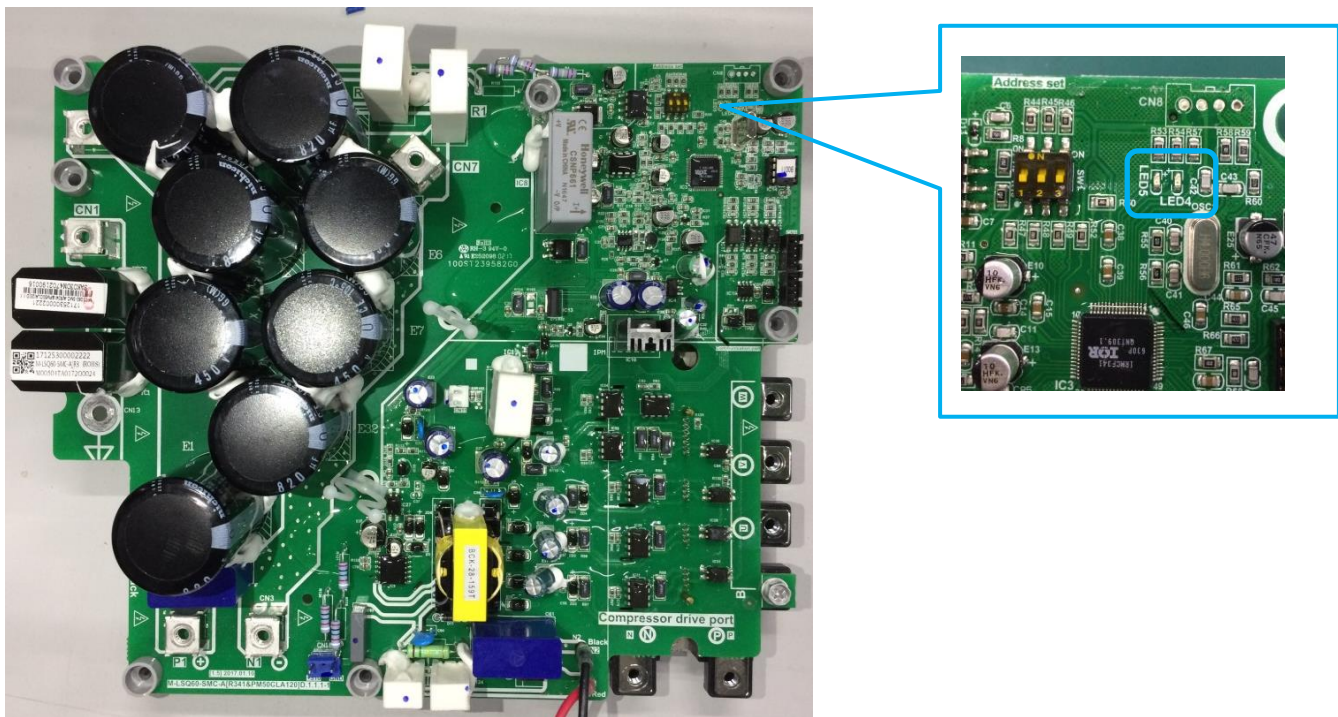


Table 4-4.2: Errors indicated on LED4/6

LED4/6 flashing pattern	Corresponding error
Flashes 8 times and stops for 1 second, then repeats	xL0 - Inverter module protection
Flashes 9 times and stops for 1 second, then repeats	xL1 - DC bus low voltage protection
Flashes 10 times and stops for 1 second, then repeats	xL2 - DC bus high voltage protection
Flashes 12 times and stops for 1 second, then repeats	xL4 - MCE error

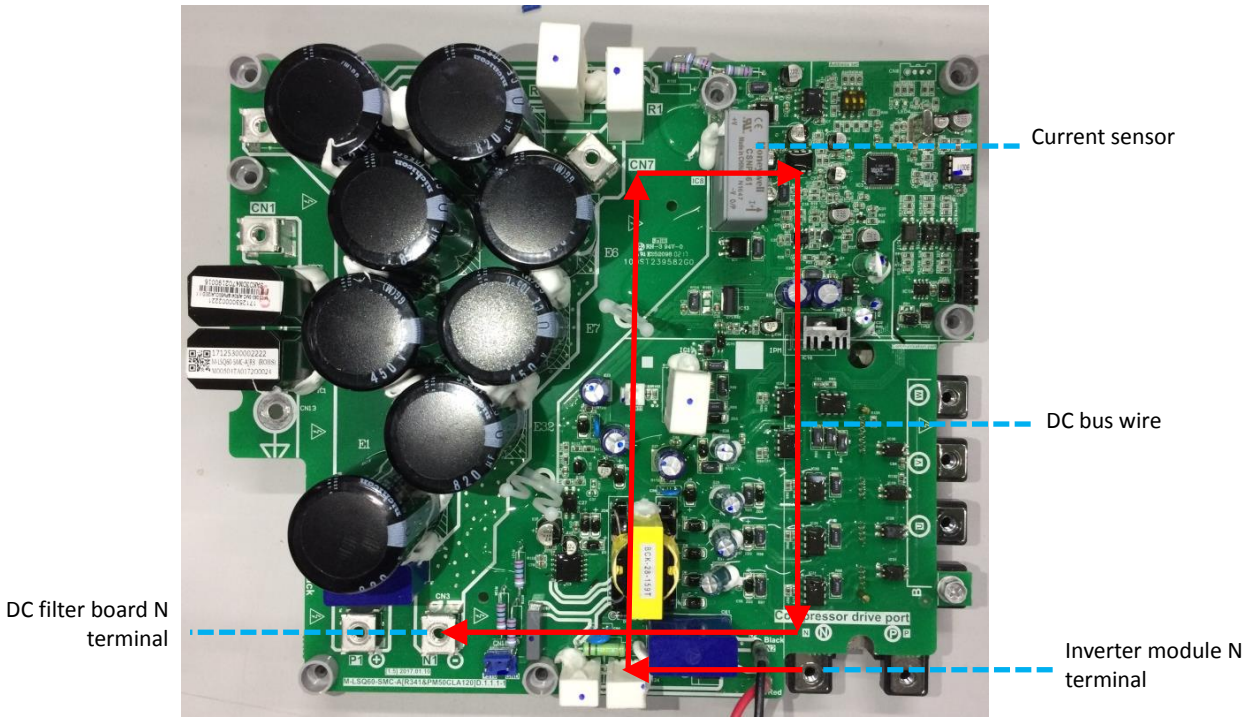
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4.13.5 First troubleshooting step

To troubleshoot XP6 errors, first ensure that the DC bus wire is connected correctly. The DC bus wire should run from the N terminal on the inverter module, through the current sensor (in the direction indicated by the arrow on the current sensor), and end at the N terminal on the DC filter board.

Figure 4-4.3: DC detection wire connection method



4.13.6 xL0 troubleshooting

Step 1: Check compressor

- Check that compressor wiring is all connected properly.
- 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.

Figure 4-4.4: Measuring resistances among compressor terminals

Figure 4-4.5: Measuring resistances between compressor terminals and ground



- If the resistances are normal, go to Step 2.

Step 2: Check inverter module

- The DC voltage between terminals P1 and N1 should be 1.41 times the local power supply voltage. The DC voltage between terminals P and N should be 510-580V. If either voltage is not in the normal range, troubleshoot as for xL1 or xL2 errors. Refer to Part 4, 4.13.7 “xL1/xL4 troubleshooting” or Part 4, 4.13.8 “xL2 troubleshooting”.
- Disconnect the terminals U, N, W from the inverter compressor. Measure the resistance among terminals P, N, U, V, W. All the resistances should be infinite. If any of them are not infinite, the inverter module is damaged and should be replaced.

Figure 4-4.6: Inverter module terminals



4.13.7 xL1/xL4 troubleshooting

Step 1: Check inverter module

- Check the DC voltage between terminals P and N. The normal value is 510-580V. If the voltage is lower than 510V, go to Step 2.

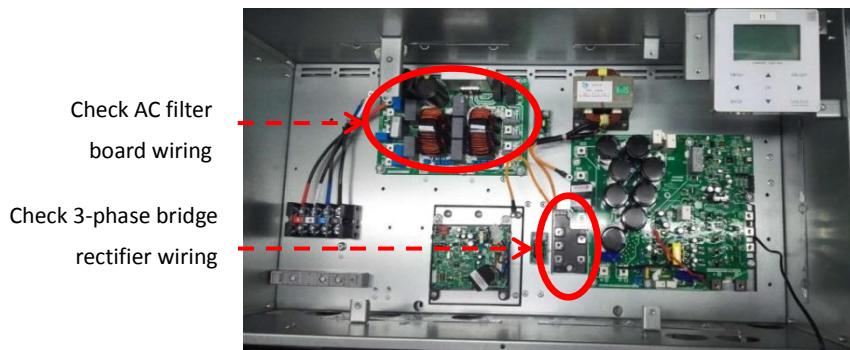
Figure 4-4.7: Inverter module terminals



Step 2: Check rectifier wiring circuit

- If the wires are loose, fasten the wires. If the wires are OK, replace the main PCB.

Figure 4-4.8: Rectifier and AC filter board in electric control box



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4.13.8 xL2 troubleshooting

Step 1: Check inverter module

- Check the DC voltage between terminals P and N. The normal value is 510-580V, if the voltage is higher than 580V, go to Step 2.

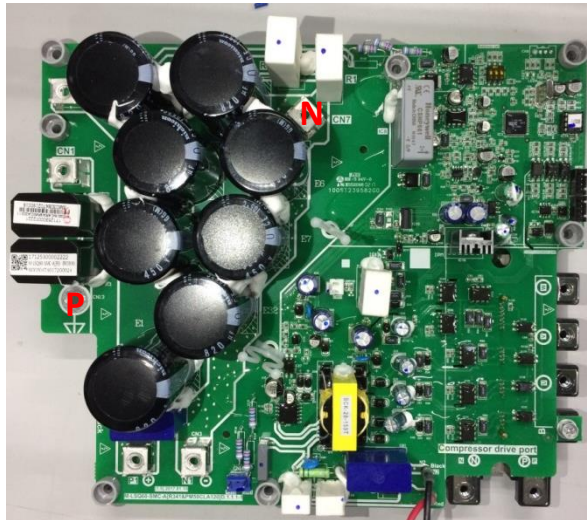
Figure 4-4.9: Inverter module terminals



Step 2: Check inverter module

- Check the voltage between terminals P and N on the capacitor board. The normal value is 510-580V. If the voltage is not in the normal range, there is a problem with the electrolytic capacitor power supply. Check the power supply for high or unstable voltage. If the power supply voltage value is normal, then the main PCB has malfunctioned and needs to be replaced.

Figure 4-4.10: Inverter module terminals



4.13.9 xL8/xL9 troubleshooting

Step 1: Check compressor

- 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.
- Refer to Figures 4-4.4 and 4-4.5 in Part 4, 4.13.6 “xL0 troubleshooting”. If the resistance values are normal, go to Step 2.

Step 2: Check compressor and main PCB

- If there is another unit nearby (either in the same system or another system) that is operating normally, its electric

control box can be used to determine whether the xL8/xL9 error is being caused by a compressor fault or a main PCB fault:

- If using another unit in the same system as the unit with the error to perform the test, set it as the master unit (address 0); if using a unit in another system, use the master unit.
- Disconnect the power wires of the compressor referenced in the xL8/xL9 error code.
- In the unit that is operating normally, disconnect the power wires that connect a compressor to the electric control box and use them to connect the compressor with the xL8/xL9 error to the electric control box of the unit that is operating normally. Ensure that the U, V, W terminals are connected in the right order, and then start the system that is operating normally.
- If the compressor with the xL8/xL9 error runs normally, replace the main PCB of the unit with the xL8/xL9 error and ensure the wiring is correct; if the compressor with the xL8/xL9 error still does not run normally, it needs to be replaced. Refer to Part 4, 4.12.10 “Compressor replacement procedure”.

Figure 4-4.11: Connecting compressor to an error-free unit



- If there is no error-free unit nearby:
 - Replace the main PCB of the unit with the xL8/xL9 error and ensure the wiring is correct. If the compressor with the xL8/xL9 error runs normally, a fault with the main PCB was causing the xL8/xL9 error; if the compressor with the xL8/xL9 error still does not run normally, it needs to be replaced. Refer to Part 4, 4.12.10 “Compressor replacement procedure”.

4.13.10 Compressor replacement procedure

Step 1: Remove faulty compressor and remove oil

- Remove the faulty compressor from the outdoor unit.
- Before removing the oil, shake the compressor so as to not allow impurities to remain settled at the bottom.
- Drain the oil out of the compressor and retain it for inspection. Normally the oil can be drained out from the compressor discharge pipe. Refer to Figure 4-4.12.

Figure 4-4.12: Draining oil from a compressor



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 5-4.16 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. Refer to Figure 4-4.13.)

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Step 3: Check oil in other compressors in the system

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

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

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

Step 5: Check filters(s)

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

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

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

Step 7: Add compressor oil

- Add 2L of oil to the new compressor through the discharge pipe, using a funnel.
- Add 2L of oil to each of the compressors from which oil was drained in Step 3.
- Only use FV68H oil. Different compressors require different types of oil. Using the wrong type of oil leads to various problems.
- Add additional oil to the accumulators such that the total amount of oil is 4.6L .

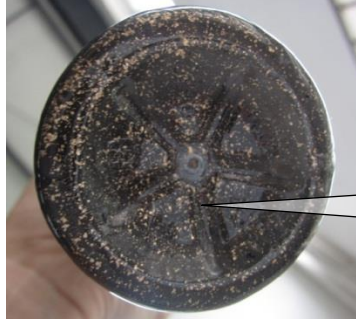
Step 8: Vacuum drying and refrigerant charging

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

Figure 4-4.13: Inspecting compressor oil



Cloudy or gray
oil indicates
abnormal
system
operation

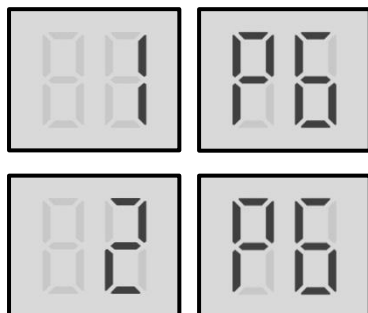


This oil contains
particles of copper

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4.14 P6 Troubleshooting for 90kW unit

4.14.1 Digital display output



4.14.2 Description

- 1P6 indicates compressor A inverter module protection.
- 2P6 indicates compressor B inverter module protection.
- When a P6 error occurs, a manual system restart is required before the system can resume operation. The cause of a P6 error should be addressed promptly in order to avoid system damage.
- All units stop running.
- Error code is displayed on the main PCB and user interface.

4.14.3 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.

4.14.4 Specific error codes for XP6 inverter module protection

If a xP6 error code is displayed, press button SW3 (to No.47 item) until one of the following specific error codes is displayed on the digital display: xL0, xL1, xL2, xL4, xL5, xL7, xL8, xL9. Refer to Table 4-4.3.

Table 4-4.3: Specific error codes for error xP6

Specific error code ¹	Content
xL0	Inverter module protection
xL1	DC bus low voltage protection
xL2	DC bus high voltage protection
xL4	MCE error
xL5	Zero speed protection
xL7	Phase sequence error
xL8	Compressor frequency variation greater than 15Hz within one second protection
xL9	Actual compressor frequency differs from target frequency by more than 15Hz protection

Notes:

2. 'x' is a placeholder for the compressor system (compressor and related electrical components), with 1 representing compressor system A and 2 representing compressor system B.

The specific error codes xL0, xL1, xL2 and xL4 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 4-4.14: LED indicators LED1 and LED2 on inverter module

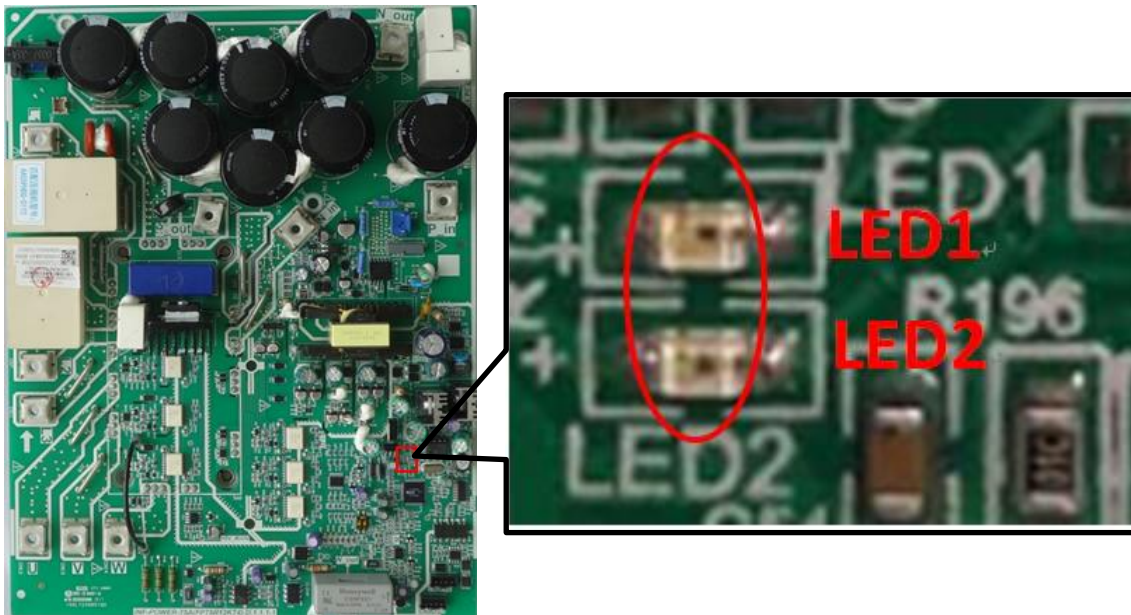
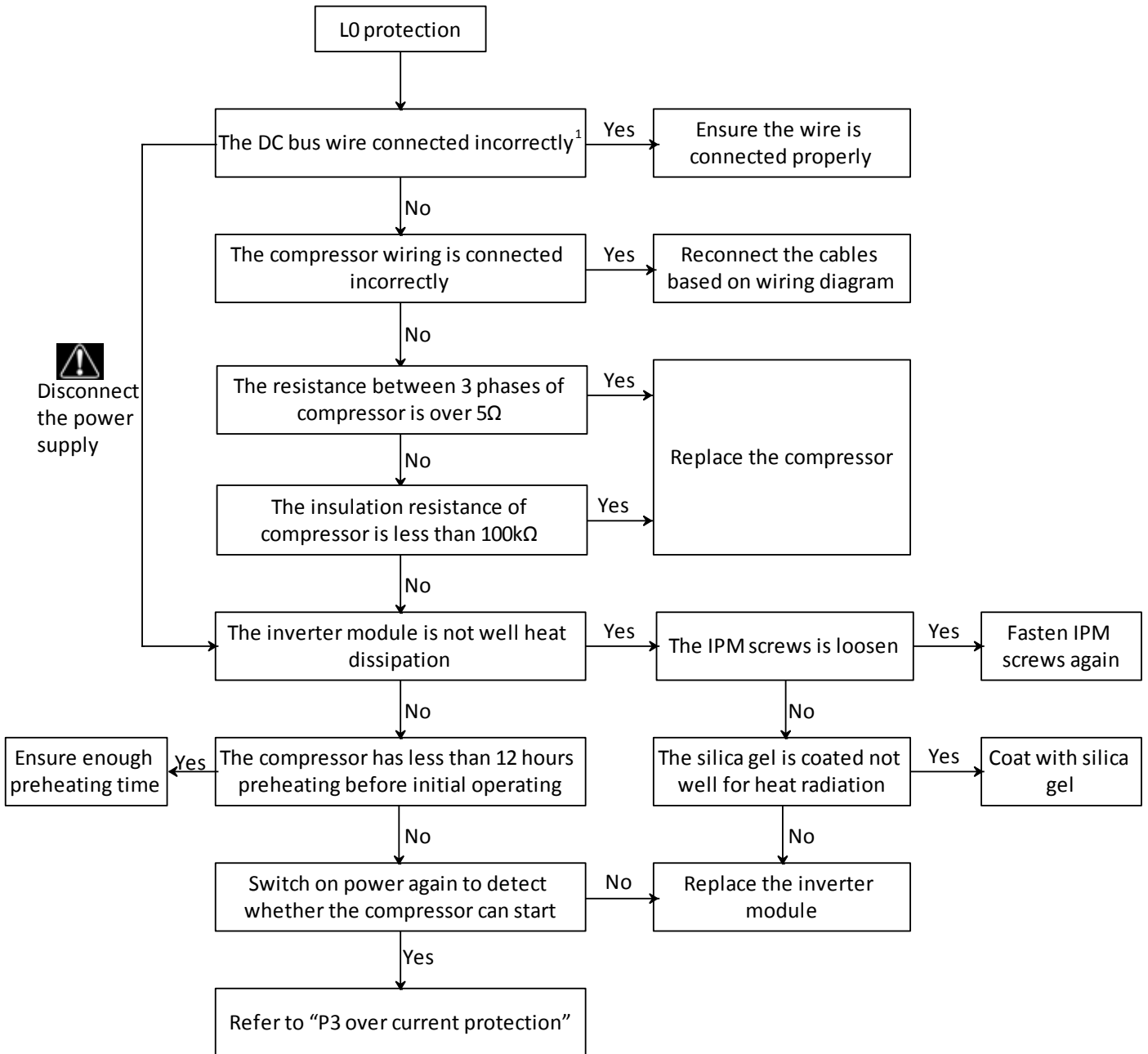


Table 4-4.4: Errors indicated on LED1

LED1 flashing pattern	Corresponding error
Flashes 8 times and stops for 1 second, then repeats	xL0 - Inverter module protection
Flashes 9 times and stops for 1 second, then repeats	xL1 - DC bus low voltage protection
Flashes 10 times and stops for 1 second, then repeats	xL2 - DC bus high voltage protection
Flashes 12 times and stops for 1 second, then repeats	xL4 - MCE error

4.14.5 L0: Inverter module protection

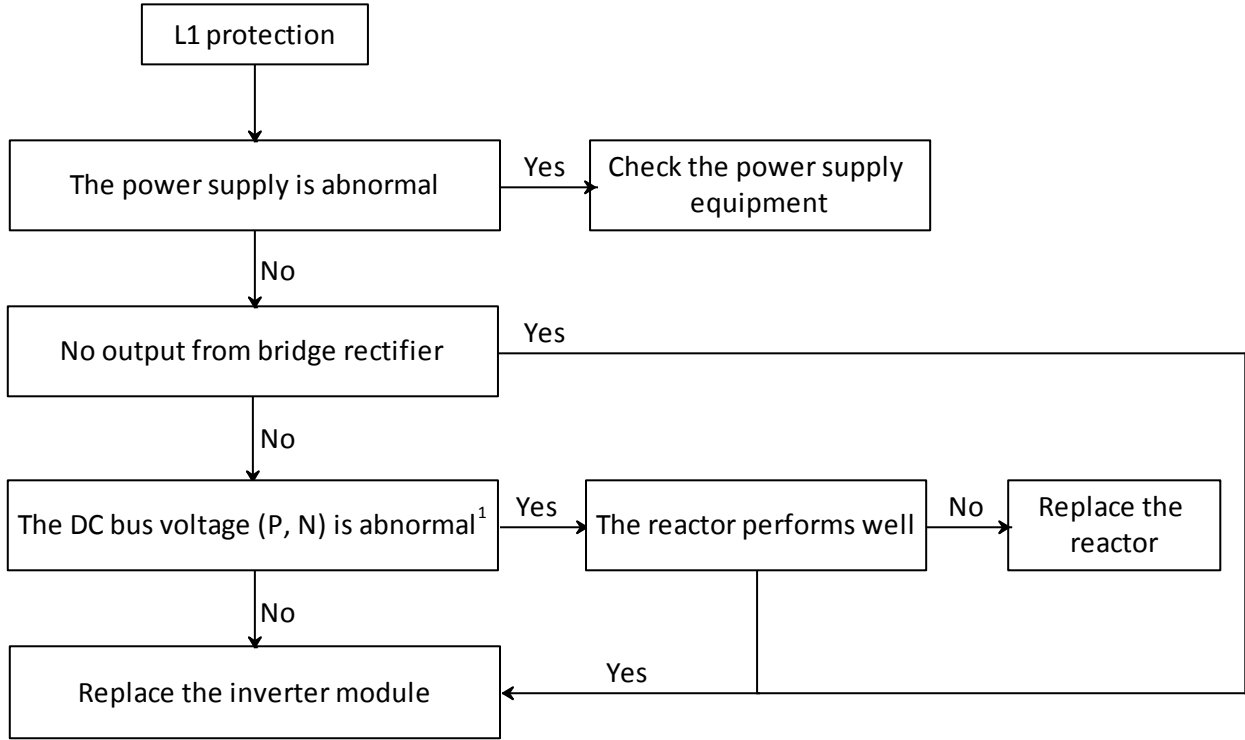


- Note:
- The DC bus wire should run from the N_{in} terminal on the inverter module, through the current sensor (in the direction indicated by the arrow on the current sensor), and end at the N_{out} terminal on the inverter module.

Figure 4-4.15: DC detection wire connection method



4.14.6 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.

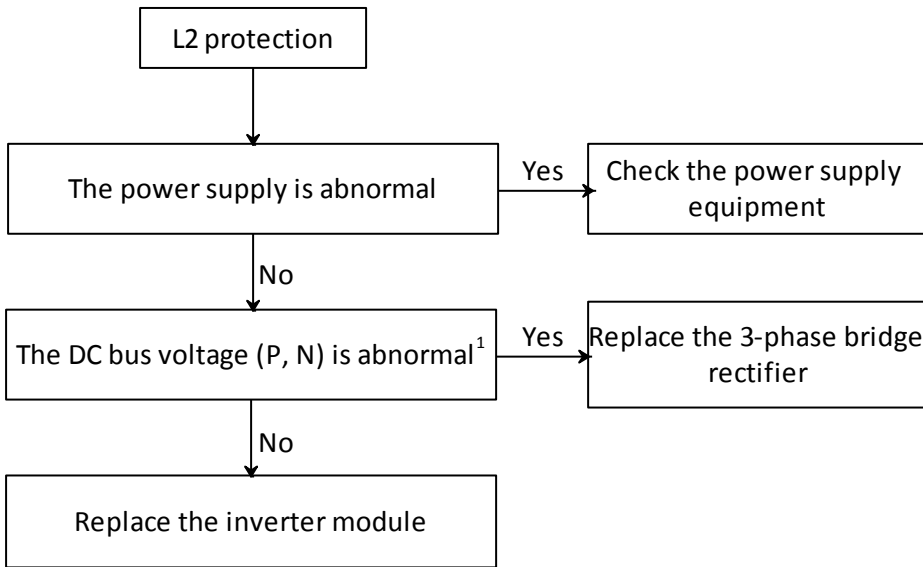
Figure 4-4.16: Inverter module terminals



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4.14.7 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.

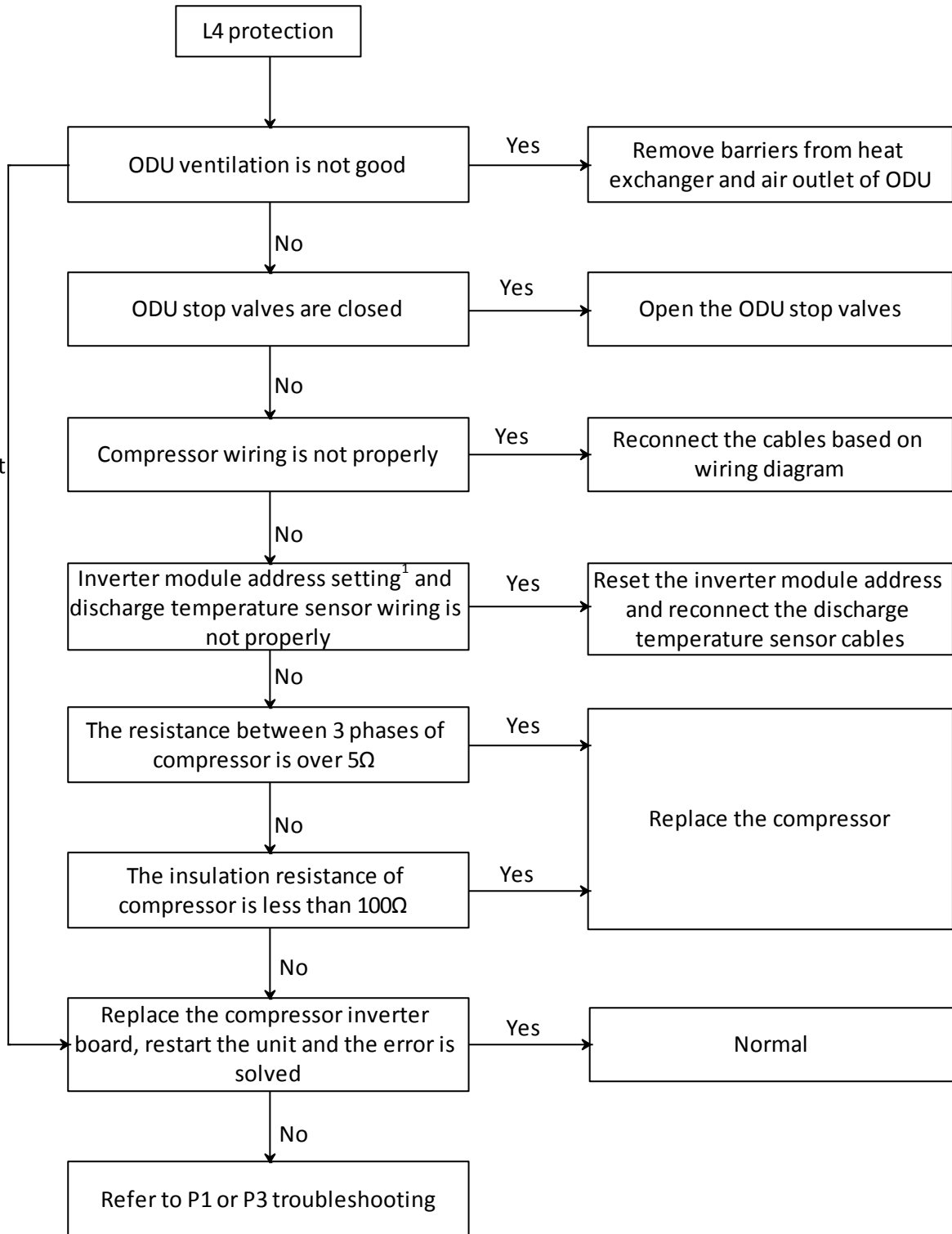
Figure 4-4.17: Inverter module terminals



4.14.8 L4: MCE error



Disconnect the power supply

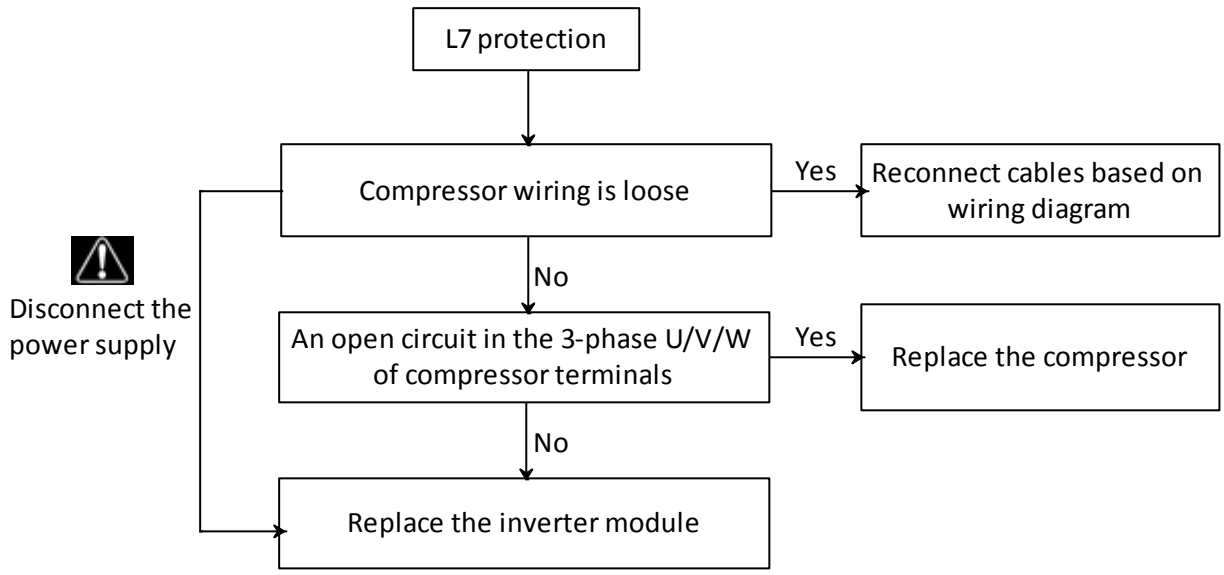


Notes:

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

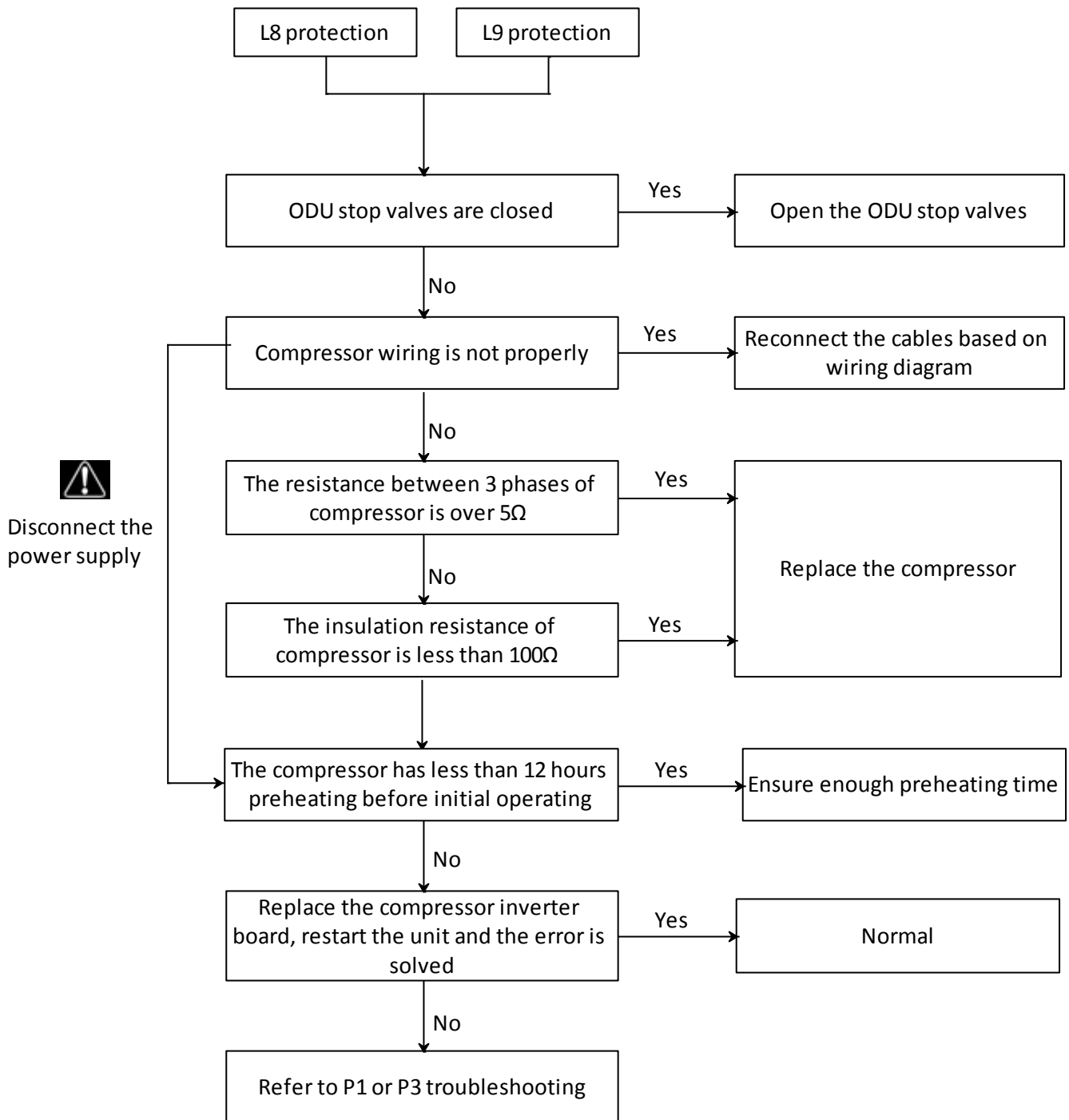
S7 on inverter module	Inverter module address
	00 for compressor inverter module A
	01 for compressor inverter module B

4.14.9 L7: Phase sequence error



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

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



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4.14.11 Compressor replacement procedure

Step 1: Remove faulty compressor and remove oil

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

Figure 4-4.18: Draining oil from a compressor



Step 2: Inspect oil from faulty compressor

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

Step 3: Check oil in other compressors in the system

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

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

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

Step 5: Check filters(s)

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

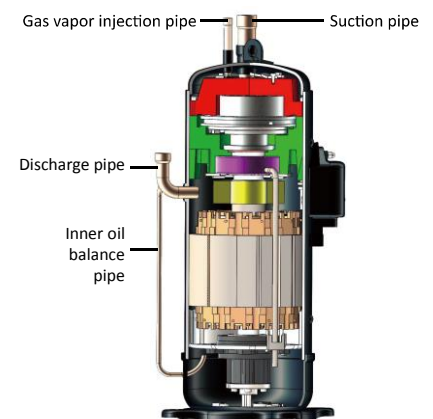
Step 6: Replace the faulty compressor and re-fit the other compressors

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

Step 7: Add compressor oil

- Add 1.1L of oil to the new compressor through the discharge pipe, using a funnel.
- Add 1.1L of oil to each of the compressors from which oil was drained in Step 3.
- Only use FV68H oil. Different compressors require different types of oil. Using the wrong type of oil leads to various problems.
- Add additional oil to the accumulators such that the total amount of oil is 5L.

Figure 4-4.19: Compressor piping



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 Aqua Tempo Super II Engineering Data, Part 3.

Figure 4-4.20: Inspecting compressor oil

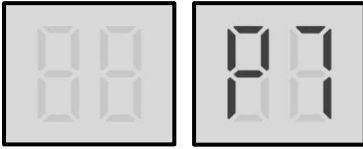


Figure 4-4.21: Effects of spoiled compressor oil



4.15 P7 Troubleshooting

4.15.1 Digital display output



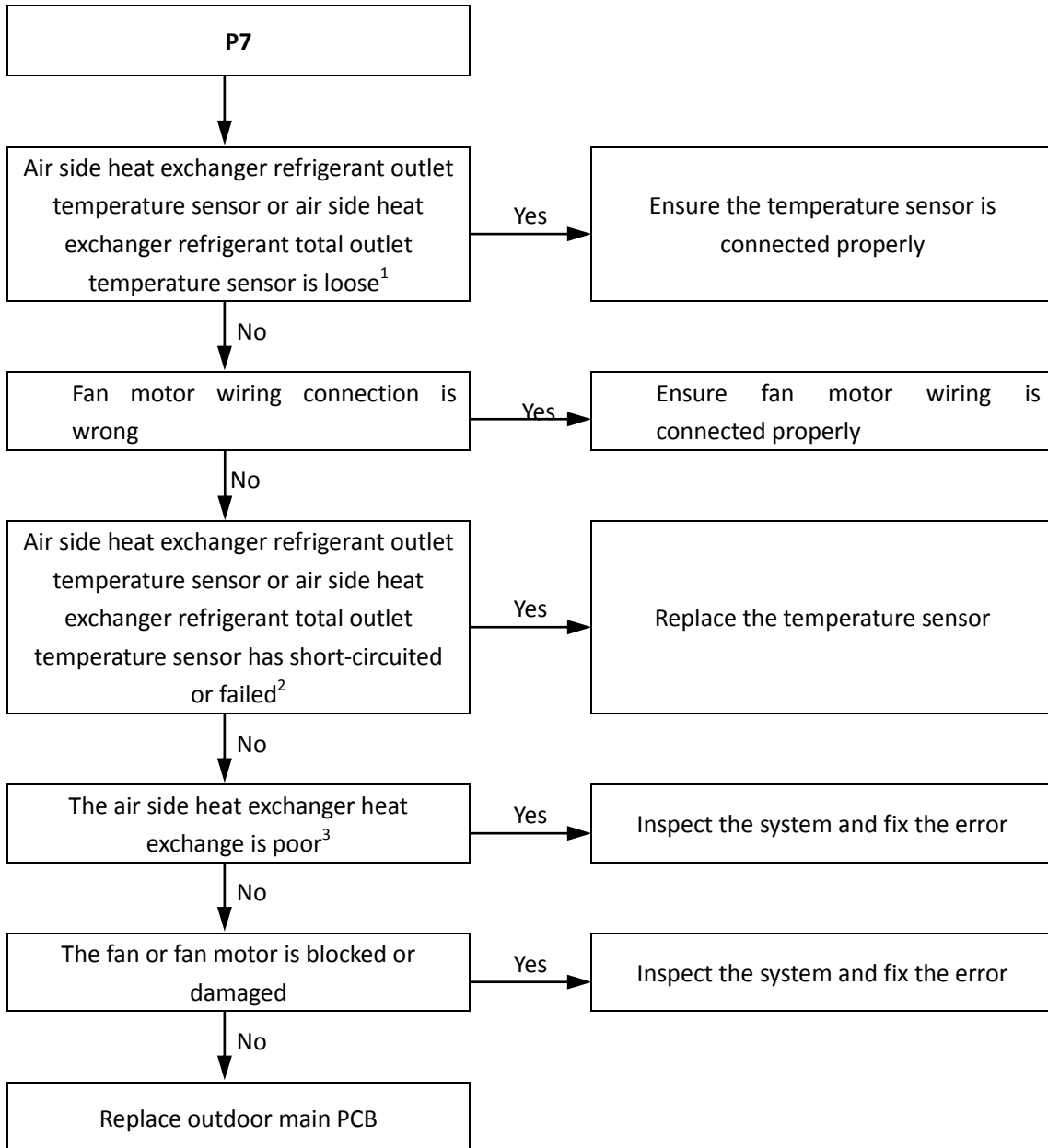
4.15.2 Description

- High temperature protection of air side heat exchanger refrigerant outlet temperature sensor or air side heat exchanger refrigerant total outlet temperature sensor in cooling mode. When the air side heat exchanger refrigerant outlet temperature is higher than 65°C or air side heat exchanger refrigerant total outlet temperature is higher than 62°C for more than 3 seconds, the system displays P7 protection and all units stop running. When the air side heat exchanger refrigerant outlet temperature returns drops below 52°C, P7 is removed and normal operation resumes.
- All units stop running.
- Error code is displayed on main PCB and user interface.

4.15.3 Possible causes

- Air side heat exchanger refrigerant outlet temperature sensor or air side heat exchanger refrigerant total outlet temperature sensor not connected properly or has malfunctioned.
- Fan motor wiring connection is wrong.
- Poor condenser heat exchange.
- Fan motor damaged.
- Main PCB damaged.

4.15.4 Procedure

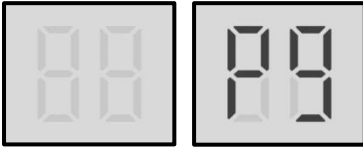


Notes:

- For 30kW and 60kW units, air side heat exchanger refrigerant outlet temperature sensor and air side heat exchanger refrigerant total outlet temperature sensor connection port is CN24 and CN69 on the main PCB (labeled 22 and 23 in Figure 4-2.1 in Part 4, 2.2 "Outdoor unit main PCB"). For 90kW unit, air side heat exchanger refrigerant outlet temperature sensor and air side heat exchanger refrigerant total outlet temperature sensor connection port is CN1 on the main PCB (labeled 30 in Figure 4-2.2 in Part 4, 2.3 "Outdoor unit main PCB").
- Measure sensor resistance. If the resistance is too low, the sensor has short-circuited. If the resistance is not consistent with the sensor's resistance characteristics table, the sensor has failed. Refer to Table 5-5.1 in Part 5, 5.1 "Temperature Sensor Resistance Characteristics".
- Check air side heat exchanger, fan(s) and air outlets for dirt/blockages.

4.16 P9 Troubleshooting

4.16.1 Digital display output



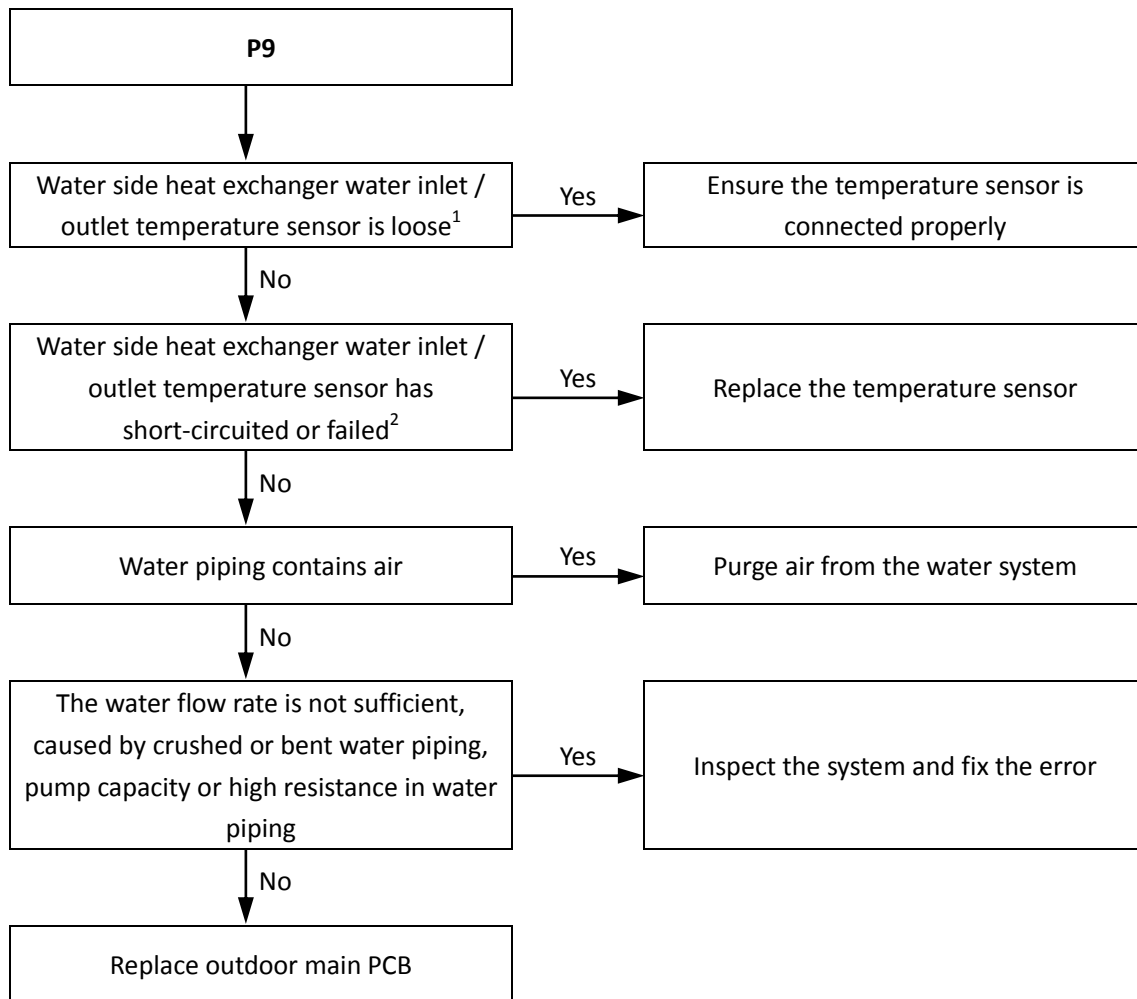
4.16.2 Description

- High temperature difference between water side heat exchanger water inlet and water outlet temperatures protection.
- All units stop running.
- Error code is displayed on main PCB and user interface.

4.16.3 Possible causes

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

4.16.4 Procedure

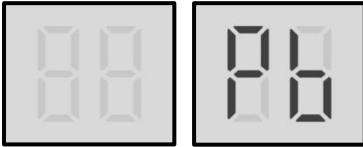


Notes:

1. For 30kW and 60kW units, water side heat exchanger water inlet temperature sensor and water side heat exchanger water outlet temperature sensor connections are port CN31 on the main PCB (labeled 24 in Figure 4-2.1 in Part 4, 2.2 "Outdoor unit main PCB").
2. For 90kW unit, water side heat exchanger water inlet temperature sensor and water side heat exchanger water outlet temperature sensor connections are port CN31 on the main PCB (labeled 32 in Figure 4-2.2 in Part 4, 2.3 "Outdoor unit main PCB").
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 5-5.1 in Part 5, 5.1 "Temperature Sensor Resistance Characteristics".

4.17 Pb Troubleshooting

4.17.1 Digital display output



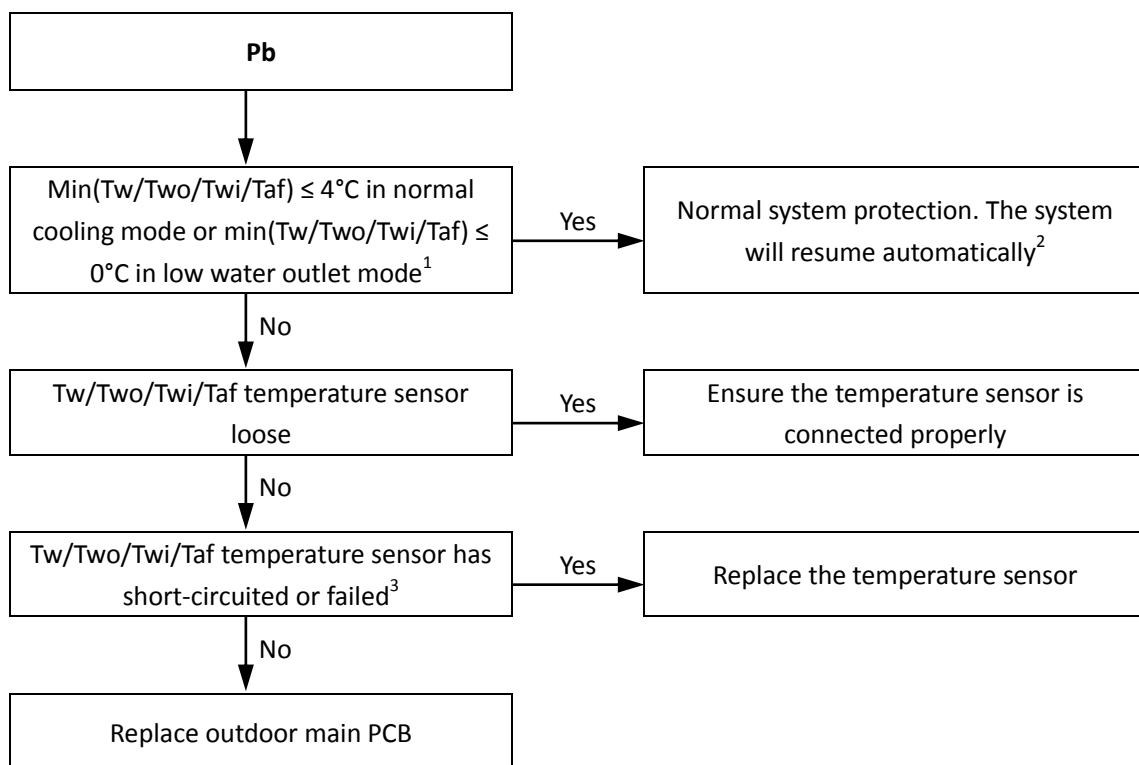
4.17.2 Description

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

4.17.3 Possible causes

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

4.17.4 Procedure



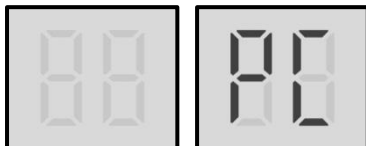
Notes:

1. For 30kW and 60kW units, combined water outlet temperature sensor (Tw), Water side heat exchanger water outlet temperature sensor(Two), water side heat exchanger water inlet temperature sensor (Twi) and water side heat exchanger anti-freezing temperature sensor(Taf, include Taf1 and Taf2) connections are ports CN69 and CN31 on the main PCB (labeled 23 and 24 in Figure 4-2.1 in Part 4, 2.2 "Outdoor unit main PCB"). For 90kW unit, Combined water outlet temperature sensor (Tw), Water side heat exchanger water outlet temperature sensor(Two), water side heat exchanger water inlet temperature sensor (Twi) and water side heat exchanger anti-freezing temperature sensor(Taf, include Taf1 and Taf2) connections are ports CN69 and CN31 on the main PCB (labeled 36 and 32 in Figure 4-2.2 in Part 4, 2.3 "Outdoor unit main PCB").
2. Refer to Part 3, 6.7 "Water Side Heat Exchanger Anti-freeze Protection Control".
3. Measure sensor resistance. If the resistance is too low, the sensor has short-circuited. If the resistance is not consistent with the sensor's resistance characteristics table, the sensor has failed. Refer to Table 5-5.1 in Part 5, 5.1 "Temperature Sensor Resistance Characteristics".

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4.18 PC Troubleshooting

4.18.1 Digital display output



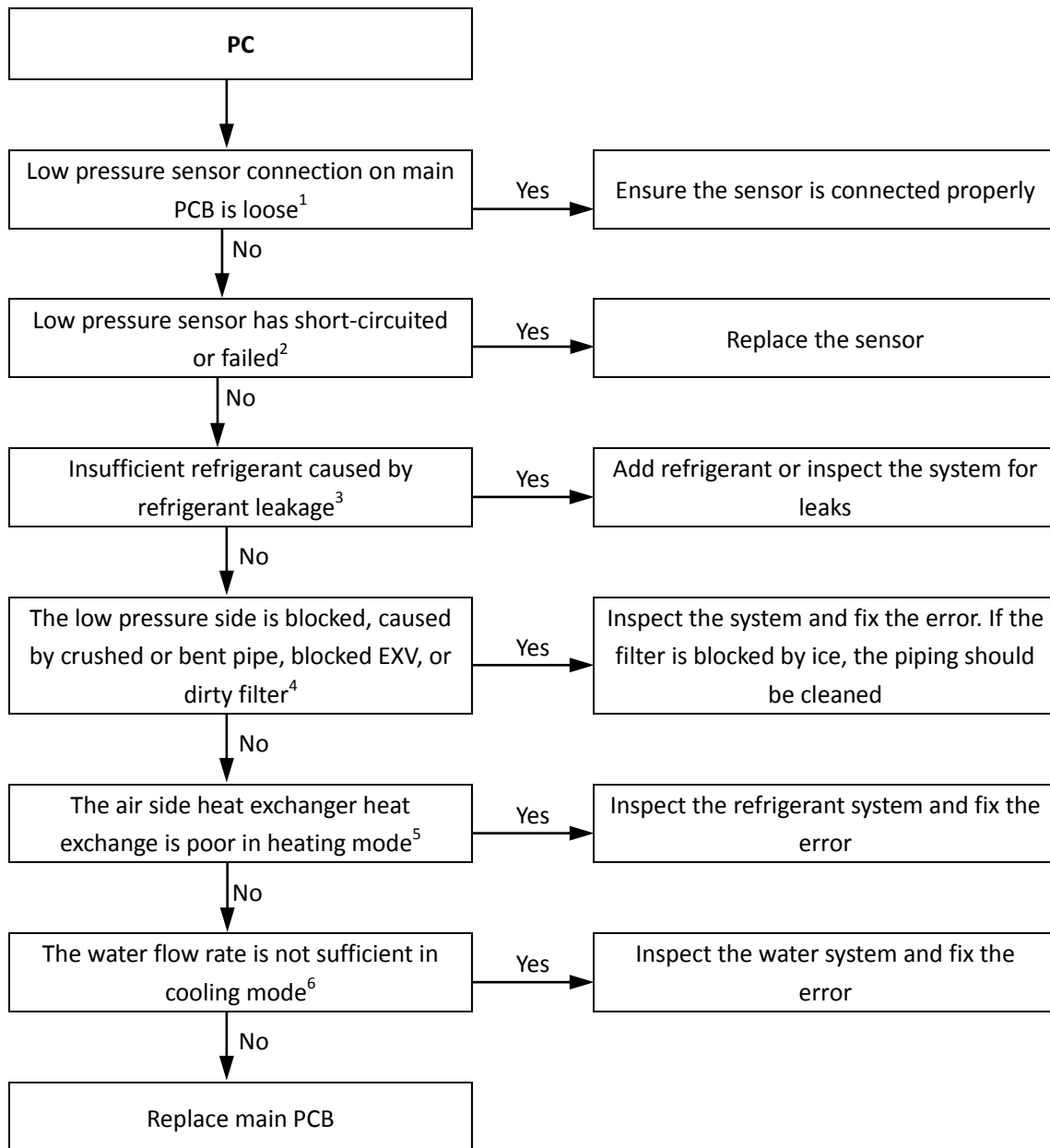
4.18.2 Description

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

4.18.3 Possible causes

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

4.18.4 Procedure



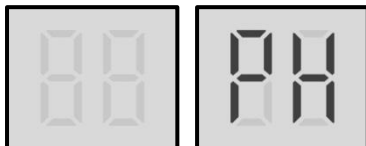
Notes:

1. For 30kW and 60kW units, low pressure sensor connection is port CN40 on the main PCB (labeled 25 in Figure 4-2.1 in Part 4, 2.2 "Outdoor unit main PCB").
For 90kW unit, Low pressure sensor connection is port CN16 on the main PCB (labeled 31 in Figure 4-2.2 in Part 4, 2.3 "Outdoor unit main PCB").
2. Measure the resistance among the three terminals of the pressure sensor. If the resistance is of the order of mega Ohms or infinite, the pressure sensor has failed.
3. To check for insufficient refrigerant: An insufficiency of refrigerant causes compressor discharge temperature to be higher than normal, discharge and suction pressures to be lower than normal and compressor current to be lower than normal, and may cause frosting to occur on the suction pipe. These issues disappear once sufficient refrigerant has been charged into the system.
4. A low pressure side blockage causes compressor discharge temperature to be higher than normal, suction pressure to be lower than normal and compressor current to be lower than normal, and may cause frosting to occur on the suction pipe. For normal system parameters.
5. Check air side heat exchanger, fan(s) and air outlets for dirt/blockages.
6. Check water side heat exchanger, water piping, circulator pumps and water flow switch for dirt/blockages.

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4.19 PH Troubleshooting

4.19.1 Digital display output



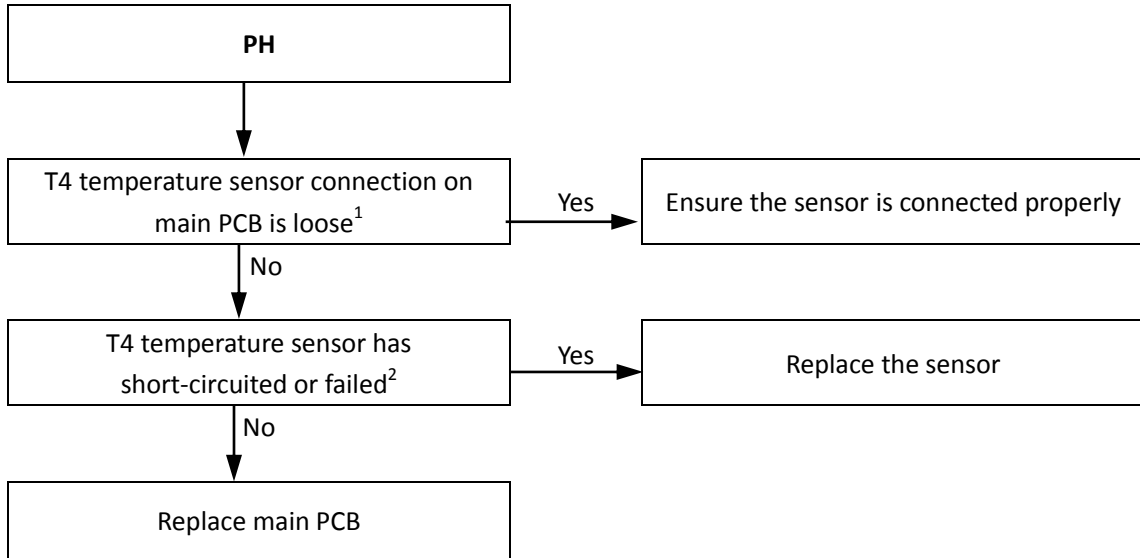
4.19.2 Description

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

4.19.3 Possible causes

- Temperature sensor not connected properly or has malfunctioned.
- Actual ambient temperature is higher than 43°C.
- Main PCB damaged.

4.19.4 Procedure



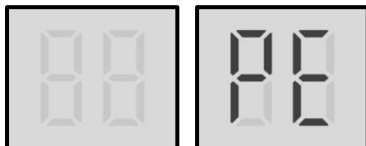
Notes:

1. For 30kW and 60kW units, low pressure sensor connection is port CN24 on the main PCB (labeled 22 in Figure 4-2.1 in Part 4, 2.2 "Outdoor unit main PCB").
For 90kW unit, Low pressure sensor connection is port CN1 on the main PCB (labeled 30 in Figure 4-2.2 in Part 4, 2.3 "Outdoor unit main PCB").
2. Measure sensor resistance. If the resistance is too low, the sensor has short-circuited. If the resistance is not consistent with the sensor's resistance characteristics table, the sensor has failed. Refer to Table 5-5.1 in Part 5, 5.1 "Temperature Sensor Resistance Characteristics".

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4.20 PE Troubleshooting

4.20.1 Digital display output



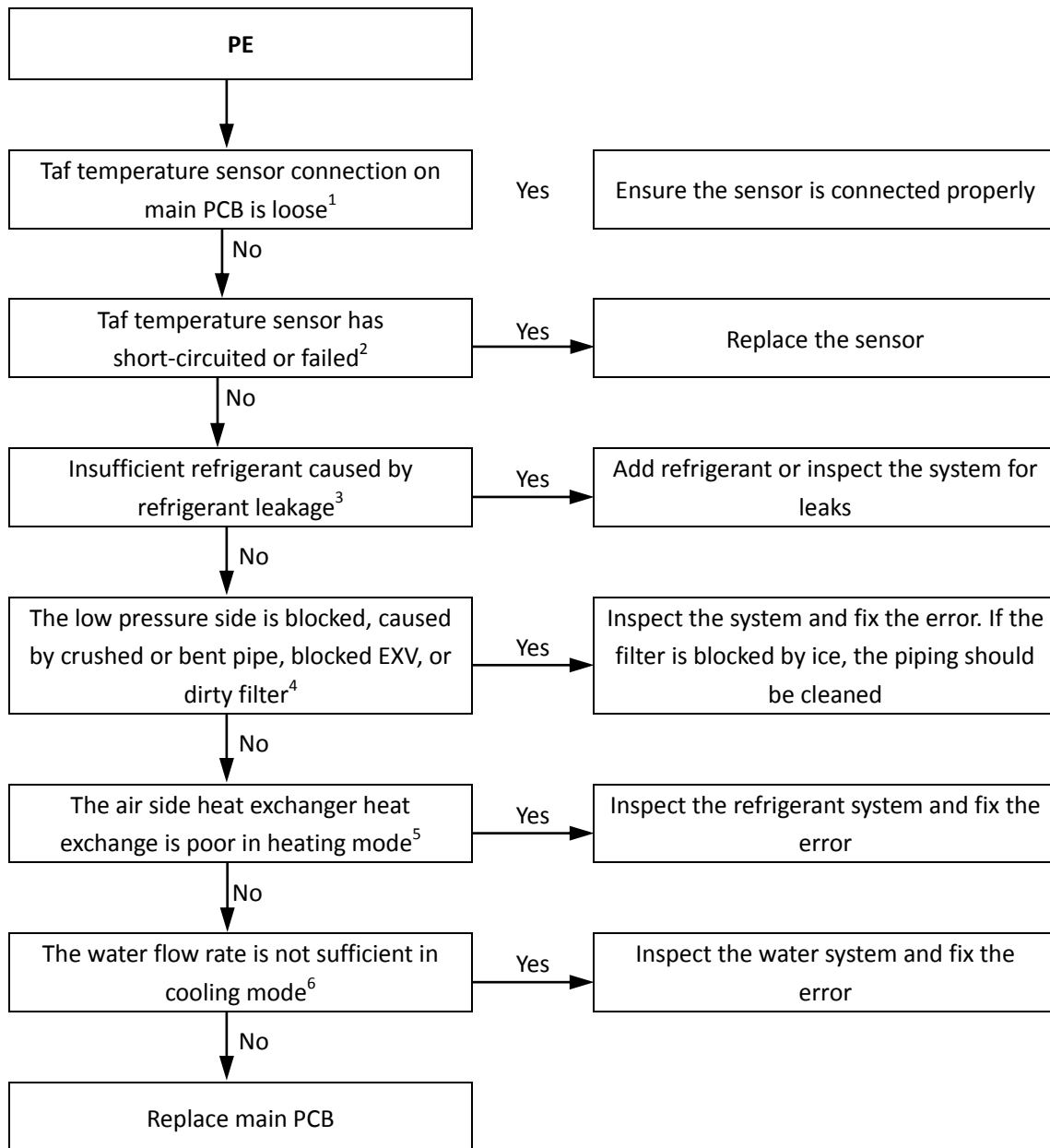
4.20.2 Description

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

4.20.3 Possible causes

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

4.20.4 Procedure



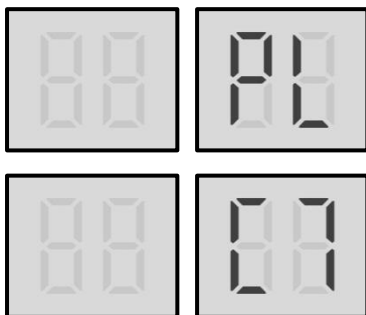
Notes:

1. For 30kW and 60kW units, water side heat exchanger anti-freezing temperature sensor (Taf, include Taf1 and Taf2) connection are ports CN69 and CN31 on the main PCB (labeled 23 and 24 in Figure 4-2.1 in Part 4, 2.2 "Outdoor unit main PCB").
2. For 90kW unit, water side heat exchanger anti-freezing temperature sensor (Taf, include Taf1 and Taf2) connection are ports CN69 and CN31 on the main PCB (labeled 36 and 32 in Figure 4-2.2 in Part 4, 2.3 "Outdoor unit main PCB").
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 Table 5-5.3 in Part 5, 5.1 "Temperature Sensor Resistance Characteristics".
4. To check for insufficient refrigerant: an insufficiency of refrigerant causes compressor discharge temperature to be higher than normal, discharge and suction pressures to be lower than normal and compressor current to be lower than normal, and may cause frosting to occur on the suction pipe. These issues disappear once sufficient refrigerant has been charged into the system.
5. 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.
6. Check air side heat exchanger, fan(s) and air outlets for dirt/blockages.
7. Check water side heat exchanger, water piping, circulator pumps and water flow switch for dirt/blockages.

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4.21 PL/C7 Troubleshooting

4.21.1 Digital display output



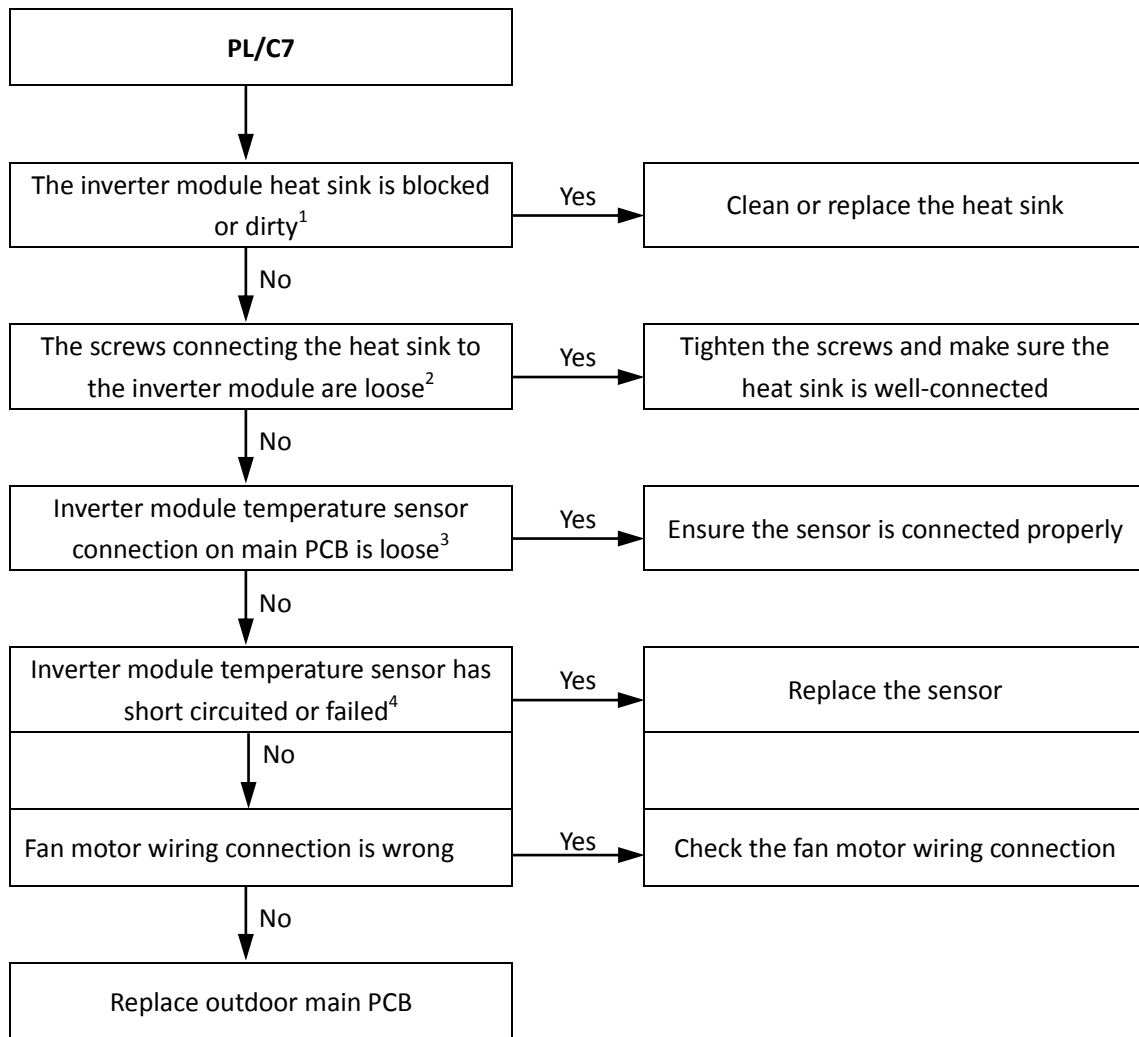
4.21.2 Description

- PL indicates inverter module temperature protection. When the main inverter module temperature rises above 82°C, the system displays PL protection and all the units stop running. When the inverter module temperature drops below 60°C, the compressor enters re-start control
- When a PL error occurs 3 times in 100 minutes, C7 will display, a manual system restart is required before the system can resume operation.
- Error code is displayed on the main PCB and user interface.

4.21.3 Possible causes

- Blocked, dirty or loose heat sink.
- Temperature sensor not connected properly or has malfunctioned.
- Fan motor wiring connection is wrong.
- Main PCB damaged.

4.21.4 Procedure



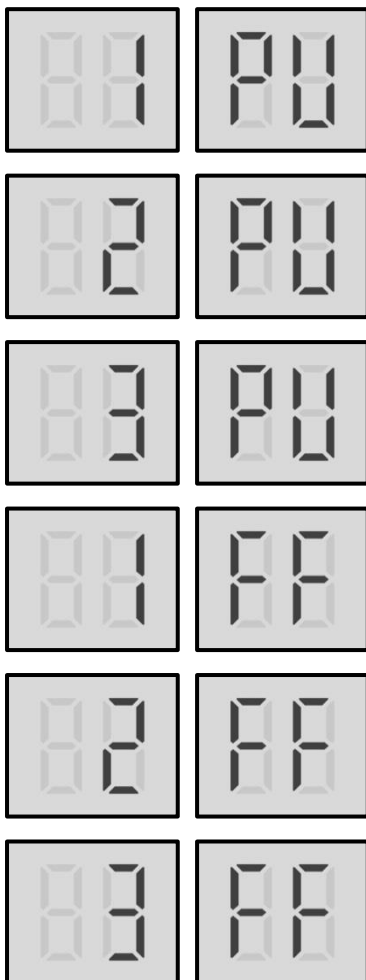
Notes:

1. Refer to Figures 4-1.2 , 4-1.4 and 4-1.6 in Part 4, 1 "Outdoor Unit Electric Control Box Layout".
2. Refer to Figures 4-1.2 , 4-1.4 and 4-1.6 in Part 4, 1 "Outdoor Unit Electric Control Box Layout".
3. For 30kW and 60kW units, inverter module temperature sensor connection are ports CN41 and CN42 on the main PCB (labeled 26 in Figure 4-2.1 in Part 4, 2.2 "Outdoor unit main PCB").
For 90kW unit, inverter module temperature sensor connection are ports CN3 and CN10 on the main PCB (labeled 33 and 34 in Figure 4-2.2 in Part 4, 2.3 "Outdoor unit main PCB").
4. 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 5-5.3 in Part 5, 5.1 "Temperature Sensor Resistance Characteristics".

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4.22 PU/FF Troubleshooting

4.22.1 Digital display output



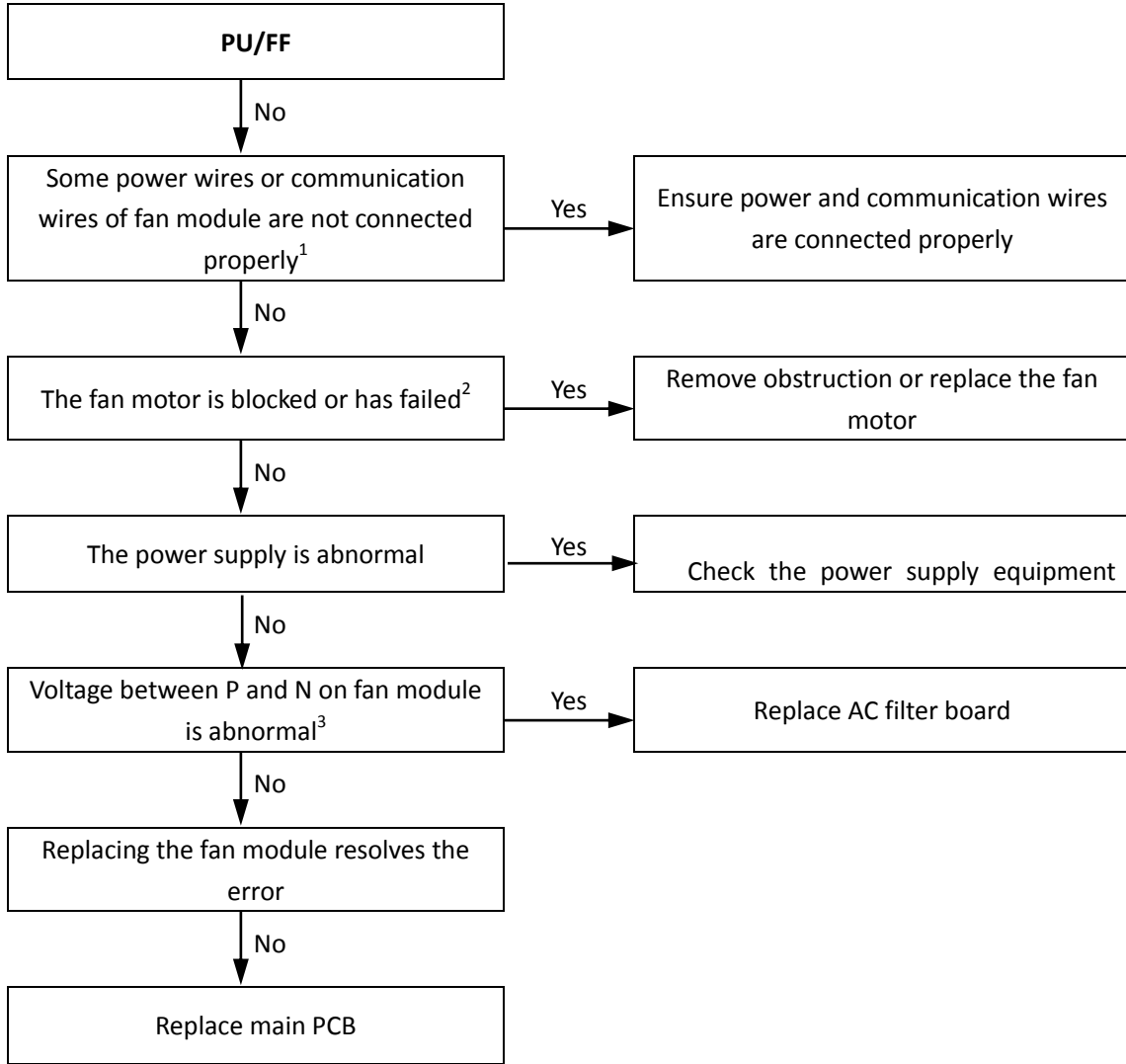
4.22.2 Description

- 1PU/FF indicates fan module A protection.
- 2PU /FF indicates fan module B protection.
- 3PU/FF indicates fan module C protection.
- FF indicates PU protection has displayed 2times. When a FF occurred 3 times in 20 minutes, a manual system restart is required before the system can resume operation.
- All units stop running.
- Error code is only displayed on the main PCB and user interface.

4.22.3 Possible causes

- Switch SW1 incorrectly set.
- Power or communication wires not connected properly.
- Fan motor blocked or has failed.
- Power supply abnormal.
- AC filter board damaged.
- Fan module damaged.
- Inverter module PCB damaged.

4.22.4 Procedure



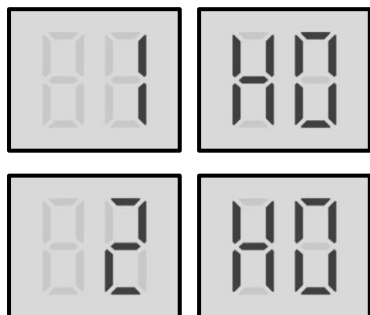
Notes:

1. Refer to Figures 4-1.2, 4-1.4 and 4-1.6 in Part 4, 1 "Outdoor Unit Electric Control Box Layout".
2. Refer to Part 2, 1 "Layout of Functional Components".
3. The normal voltage between P and N on the fan module is 310V DC. Refer to Figures 4-1.2, 4-1.4 and 4-1.6 in Part 4, 1 "Outdoor Unit Electric Control Box Layout" and to Figure 4-2.5 in Part 4, 2.6 "Fan module power board"

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4.23 H0 Troubleshooting for 30kW and 60kW Units

4.23.1 Digital display output



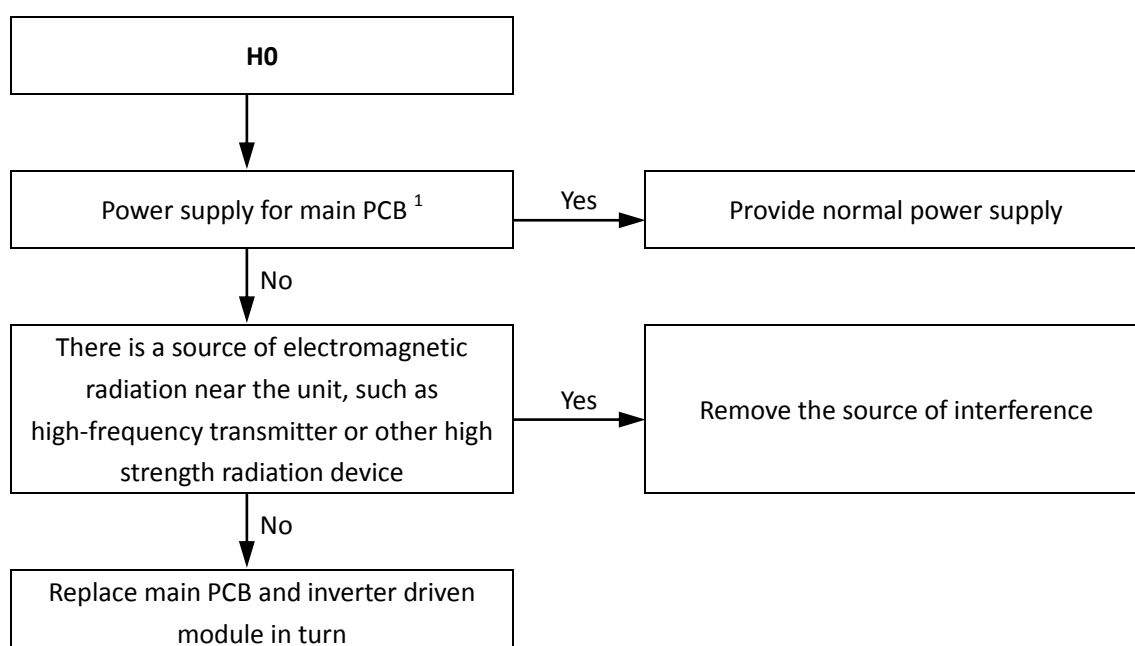
4.23.2 Description

- 1H0 indicates a Communication error between main control chip and compressor A inverter driver chip.
- 2H0 indicates a Communication error between main control chip and compressor B inverter driver chip.
- All units stop running.
- Error code H0 is displayed on main PCB and user interface.

4.23.3 Possible causes

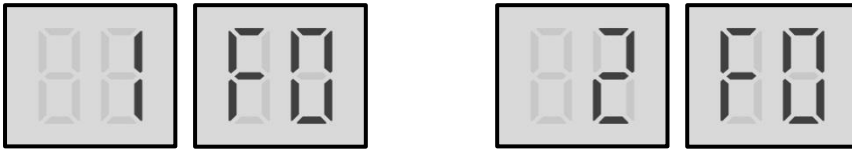
- Power supply abnormal.
- Interference from a source of electromagnetic radiation.
- Main PCB or inverter driven module damaged.

4.23.4 Procedure



Notes:

1. Measure the voltages of power input port and on the main PCB. The normal voltage of power input port terminals is 220V. Refer to CN43 on the main PCB (labeled 9 in Figure 4-2.1 in Part 4, 2.2 "Outdoor unit main PCB").

4.24 F0: Communication error for 90kW Unit
4.24.1 Digital display output


In the error code, 'x' is a placeholder for the compressor system (compressor and related electrical components), with 1 representing compressor system A and 2 representing compressor system B.

4.24.2 Description

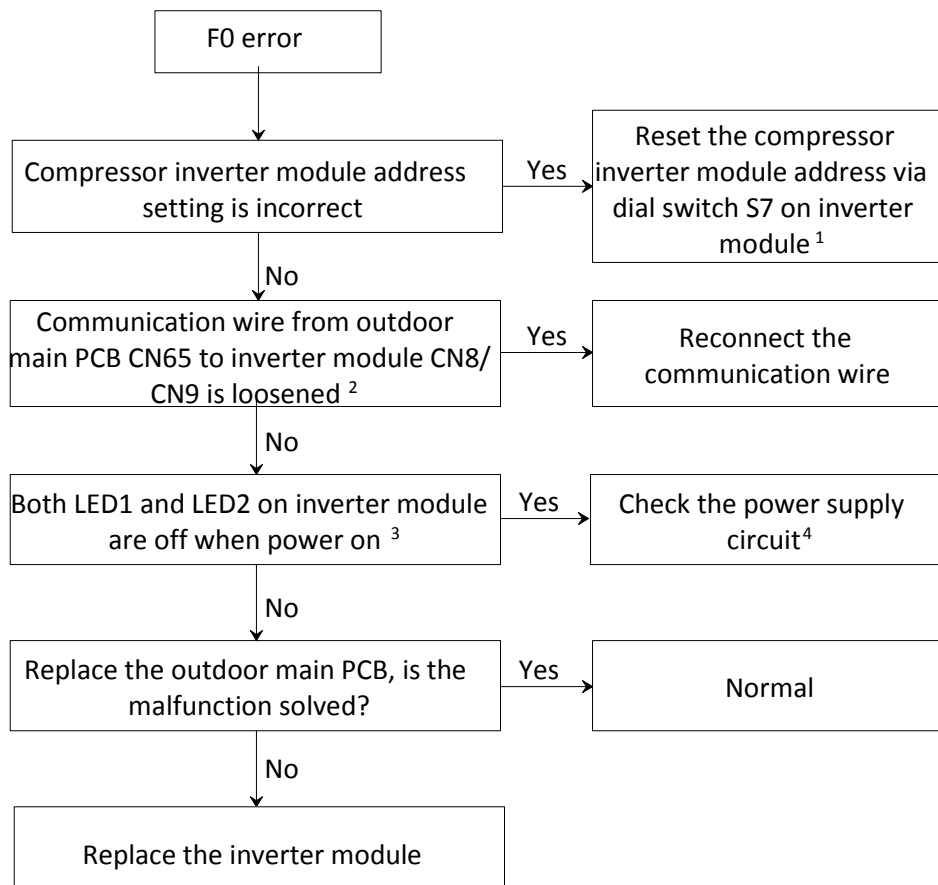
- 1F0 indicates a communication error between the main control chip and the compressor A inverter driver chip.
- 2F0 indicates a communication error between the main control chip and the compressor B inverter driver chip.
- All units stop running.
- Error code is only displayed on the unit with the error.

4.24.3 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.

4.24.4 Possible causes

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



4.24.5 Procedure


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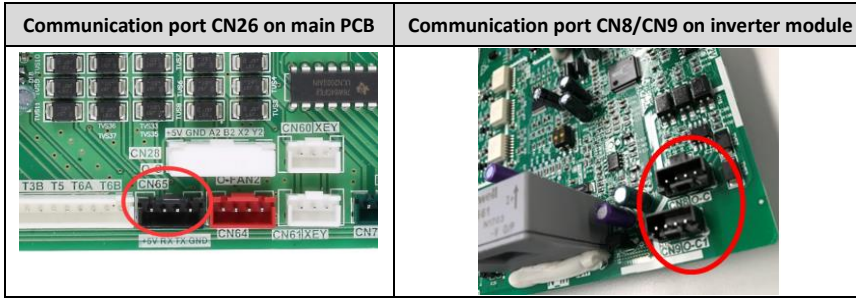


Notes:

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

S7 on inverter module	Inverter module address
	00 for compressor inverter module A
	01 for compressor inverter module B

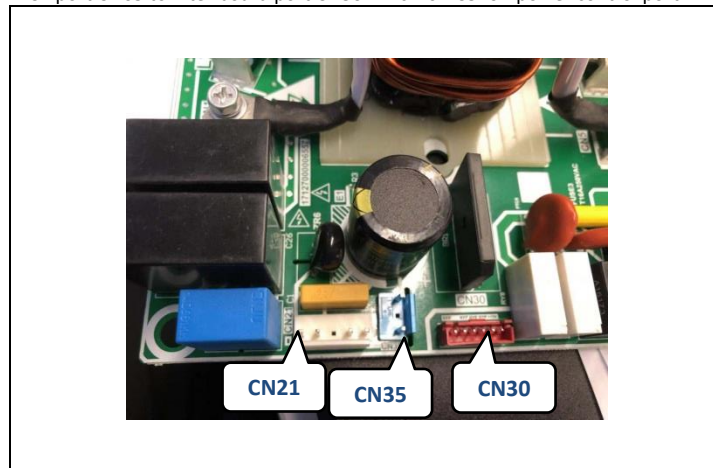
- Communication wire from outdoor main PCB CN65 to inverter module CN8/CN9.



- LED1/2 on inverter module

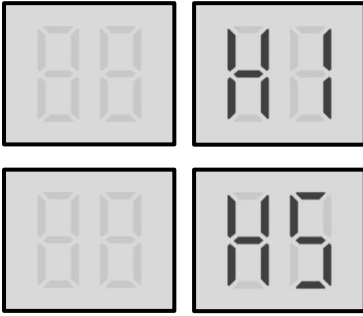


- Check the power supply for the compressor inverter module, port CN21 on filter board, the normal voltage should be DC310V; check the high pressure switch connection port CN35 on filter board, the normal resistance should be zero; Check the single phase bridge and fuse on filter board; check the connection cable from ODU main PCB port CN65 to filter board port CN30 which is DC310V power control port.



4.25 H1/H5 Troubleshooting

4.25.1 Digital display output



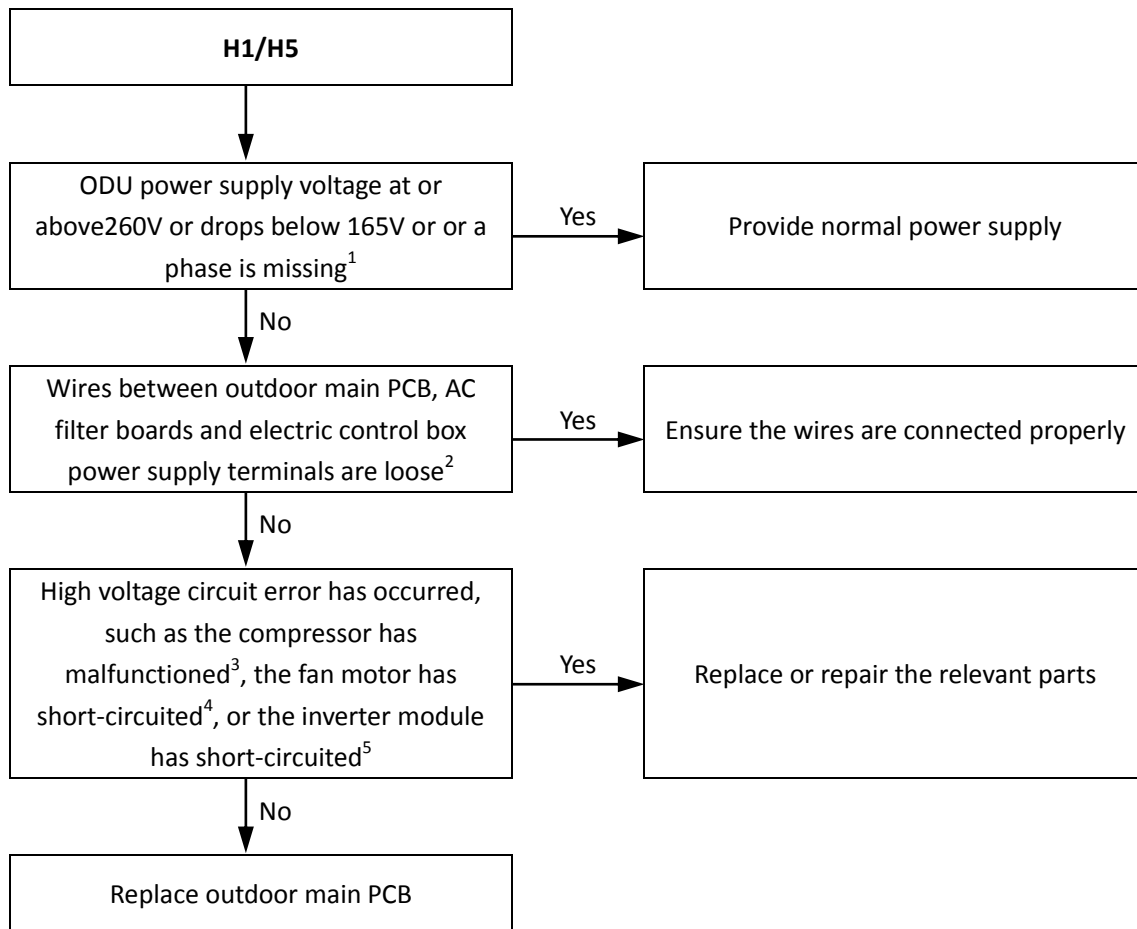
4.25.2 Description

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

4.25.3 Possible causes

- Outdoor unit power supply voltage at or above 260V or drops below 165V or a phase is missing.
- Loosened wiring within electric control box.
- High voltage circuit error.
- Main PCB damaged.

4.25.4 Procedure

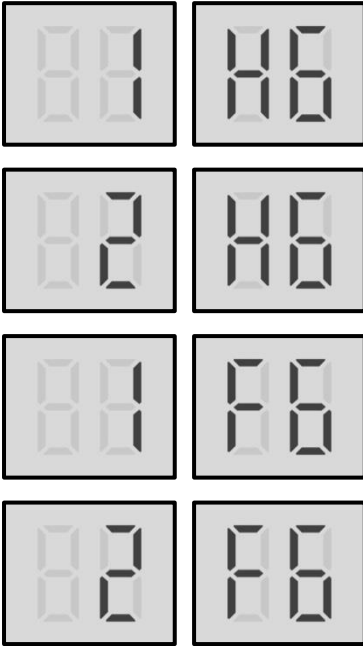


Notes:

1. The normal voltage between A and N, B and N, and C and N is 198-242V.
2. Refer to Figures 4-1.2 to 4-1.6 in Part 4, 1 "Outdoor Unit Electric Control Box Layout".
3. 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.
4. The normal resistances of the fan motor coil among U V W are less than 10Ω. If a measured resistance is 0Ω, the fan motor has short-circuited. Refer to Part 2, 1 "Layout of Functional Components".
5. Set a multi-meter to buzzer mode and test any two terminals of P N and U V W of the inverter module. If the buzzer sounds, the inverter module has short-circuited. Refer to Figures 4-1.2 and 4-1.6 in Part 4, 1 "Outdoor Unit Electric Control Box Layout".

4.26 H6/F6 Troubleshooting

4.26.1 Digital display output



4.26.2 Description

- DC bus voltage protection.
- Only occurred in standby status.
- Error code is displayed on main PCB and user interface.

4.26.3 Possible causes

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

4.26.4 Procedure

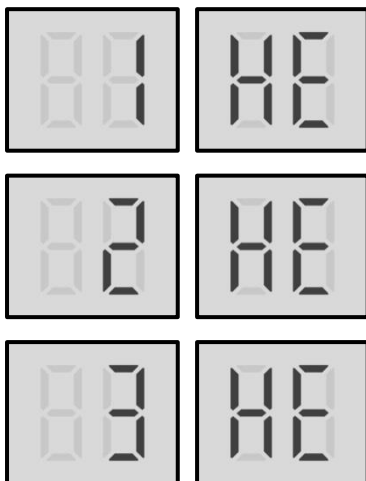
H6 refer to 30kW and 60kW units P6 protection troubleshooting: xL1 and xL2.

F6 refer to 90kW unit P6 protection troubleshooting: xL1 and xL2.

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4.27 HE Troubleshooting for 90kW unit

4.27.1 Digital display output



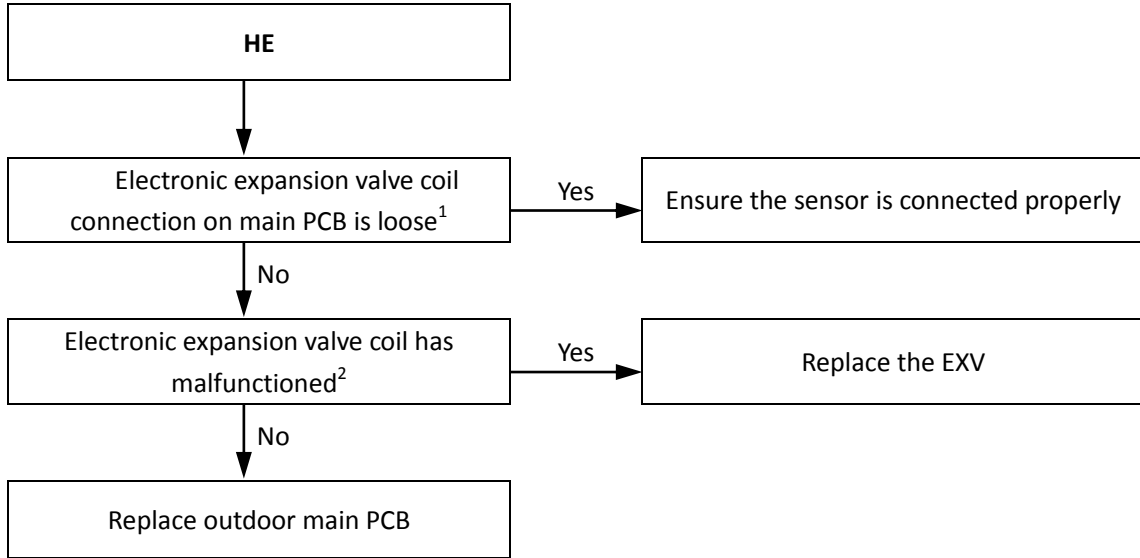
4.27.2 Description

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

4.27.3 Possible causes

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

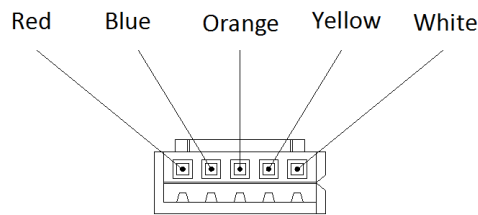
4.27.4 Procedure



Notes:

1. Electronic expansion valve coil connections are port CN70, CN71 and CN72 on the main PCB (labeled 23, 21 and 22, respectively, in Figure4-2.2 in Part 4, 2.3 "Outdoor unit main PCB").
2. The normal resistances between EXV coil wiring terminals RED and white / yellow / orange / blue are 40-50Ω. If any of the resistances differ from the value, the EXV coil has malfunctioned.

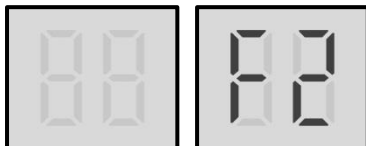
Figure 4-4.22: EXV coil wiring terminals



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4.28 F2 Troubleshooting

4.28.1 Digital display output



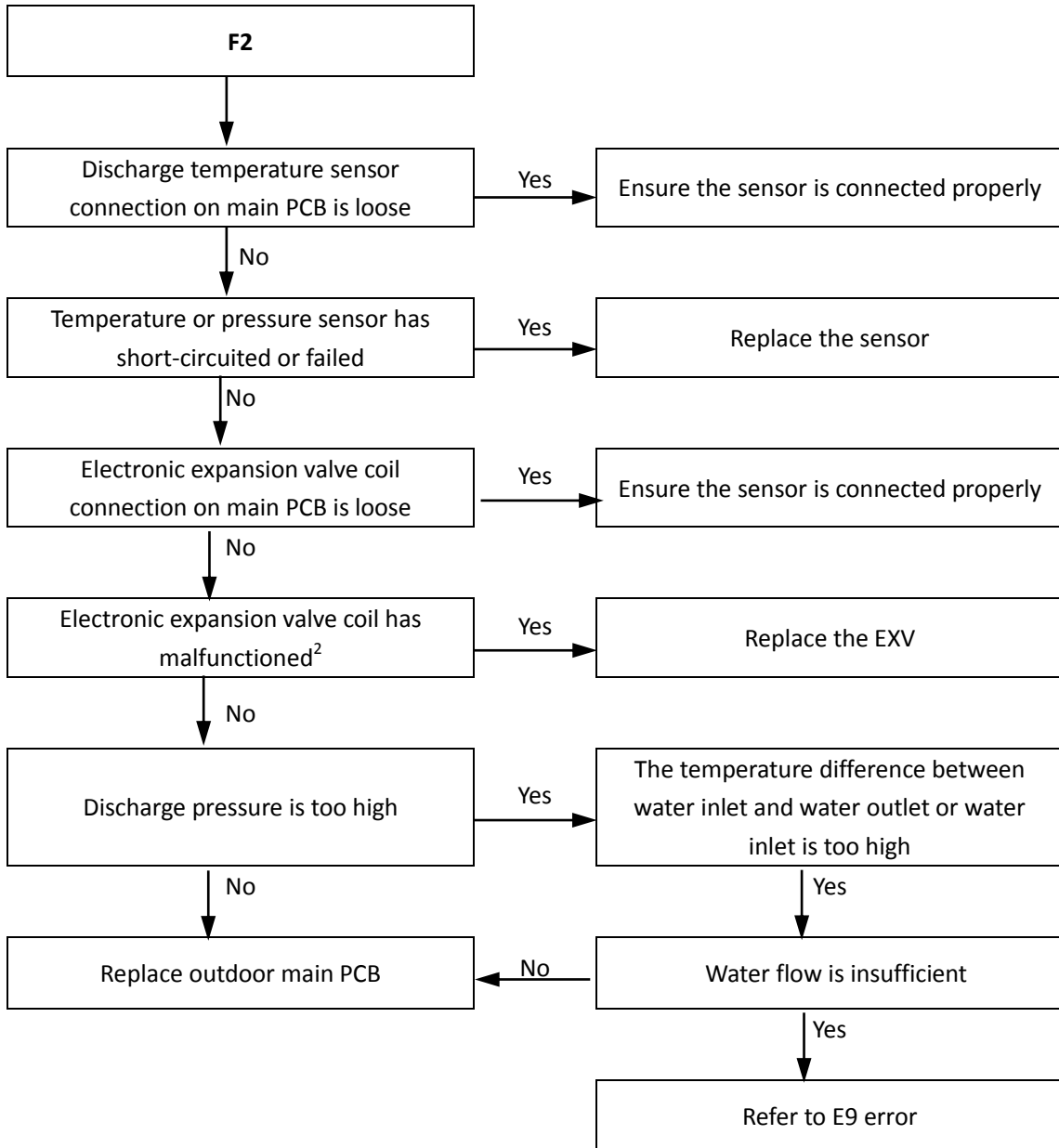
4.28.2 Description

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

4.28.3 Possible causes

- Discharge pipe temperature sensor connected properly or has malfunctioned.
- Electronic expansion valve coil not connected properly or has malfunctioned.
- Damaged main PCB.

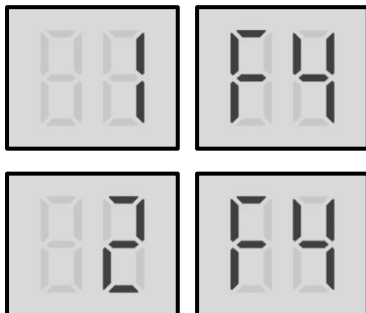
4.28.4 Procedure



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4.29 F4 Troubleshooting

4.29.1 Digital display output



4.29.2 Description

- When a L0 or L1 error occurs 3 times in 100 minutes, F4 will display, a manual system restart is required before the system can resume operation.

4.29.3 Possible causes

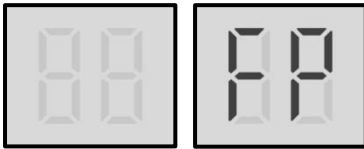
- Refer to L0 or L1 error troubleshooting.

4.29.4 Procedure

- Refer to L0 or L1 error troubleshooting.

4.30 FP Troubleshooting

4.30.1 Digital display output



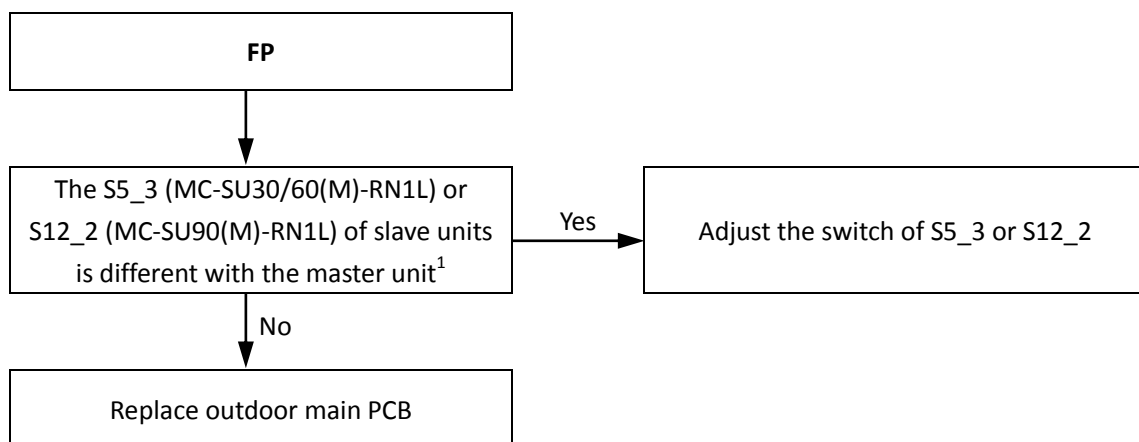
4.30.2 Description

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

4.30.3 Possible causes

- The S5_3 (30kW and 60kW units) or S12_2 (90kW unit) of slave units is different with the master unit.
- Main PCB damaged.

4.30.4 Procedure



Notes:

1. For 30kW and 60kW units, dial switch S5 on the main PCB (labeled 3 in Figure 4-2.1 in Part 4, 2.2 "Outdoor unit main PCB")
2. For 90kW unit, dial switch S12 on the main PCB (labeled 53 in Figure 4-2.2 in Part 4, 2.3 "Outdoor unit main PCB")

5 Appendix to Part 5

5.1 Temperature Sensor Resistance Characteristics

Table 5-5.1: Outdoor ambient temperature sensor and outdoor heat exchanger or plate 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 5-5.2: Compressor top temperature sensor and 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		

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Table 5-5.3: 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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5.2 Normal Operating Parameters of Refrigerant System

Under the following conditions, the operating parameters given in Tables 5-5.4 and 5-5.5 should be observed:

- If the outdoor ambient temperature is high, the system is being run in normal cooling mode with the following settings: temperature 5°C.
- If the outdoor ambient temperature is low, the system is being run in heating mode with the following settings: temperature 55°C.
- The system has been running normally for more than 30 minutes.

Table 5-5.4: Outdoor unit in normal cooling mode operating parameters

Outdoor ambient temperature	°C	< 10	10 to 25	25 to 35	35 to 48	> 48
Average discharge temperature	°C	50-80	55-85	60-90	65-98	70-100
Average discharge superheat	°C	17-30	17-33	17-34	17-36	10-32
Discharge pressure	MPa	1.7-2.8	1.8-2.8	2.0-3.6	2.5-3.8	3.1-4.2
Average suction superheat	°C	3-7	4-9	5-11	6-12	8-12
Suction pressure	MPa	0.6-0.9	0.7-1.0	0.8-1.2	1.0-1.3	1.2-1.4
Average suction temperature	°C	5-15	5-18	5-20	6-20	8-15
T3	°C	0-12	12-30	28-46	40-52	50-56
Tz/7	°C	22-25	12-28	28-45	40-52	50-55
Taf	°C	5-25	5-25	5-25	5-25	5-25
T6A/B	°C	-2-17	0-20	3-35	5-40	12-43
Twi	°C	0-30	0-30	0-30	0-30	0-30
Two	°C	5-25	5-25	5-25	5-25	5-25
Tw	°C	5-25	5-25	5-25	5-25	5-25
DC fan motor current	A	0.2-6	2-6	3-6	4-6	5-6
DC inverter compressor current	A	6-12	2-16	3-17	4-18	5-16

Note:

1. All the sensors please refer to Figure 2-2.1, 2-2.2 and 2-2.3 in Part 2, 2 "Piping Diagrams".

Table 5-5.5: Outdoor unit in heating mode operating parameters

Outdoor ambient temperature	°C	< -10	-10 to 0	0 to 7	7 to 20	> 20
Average discharge temperature	°C	40-95	42-96	44-97	45-97	50-98
Average discharge superheat	°C	17-35	17-35	17-35	17-33	14-33
Discharge pressure	MPa	1.7-2.6	1.8-2.8	1.9-3.3	2.2-3.5	2.3-3.8
Average suction superheat	°C	-2-0	-2-2	-1-4	0-6	1-8
Suction pressure	MPa	0.2-0.5	0.3-0.7	0.4-0.9	0.6-1.2	0.8-1.4
Average suction temperature	°C	-22 to -11	-16 to 2	-10 to 5	0 to 15	5 to 18
T3	°C	-20 to -11	-16 to 0	-10 to 2	1 to 12	5 to 15
Tz/7	°C	-19 to -4	-14 to 1	-5 to -2	1 to 6	2 to 10
Taf	°C	15-45	15-50	15-55	15-55	15-55
T6A/B	°C	-2-20	0-25	3-35	8-40	13-43
Twi	°C	15-40	15-45	15-50	15-50	15-50
Two	°C	18-45	18-50	18-55	18-55	18-55
Tw	°C	18-45	18-50	18-55	18-55	18-55
DC fan motor current	A	5-6	4-6	2-6	0.5-6	0.3-6
DC inverter compressor current	A	1-15	1-16	1-17	2-18	2-18

Note:

1. All the sensors please refer to Figure 2-2.1, 2-2.2 and 2-2.3 in Part 2, 2 "Piping Diagrams".

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Note: Product specifications change from time to time as product improvements and developments are released and may vary from those in this document.

