R410A

Commercial Air Conditioners

Midea

Service Manual

Aqua Tempo Super II Series

CONTENTS

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Part 1

General Information

Part 1 - General Information

1 Unit Capacities and External Appearance

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

Capacity	30kW	60kW
Model	MC-SU30-RN1L	MC-SU30-RN1L
Appearance		
Power supply	380-415V/3Ph/50Hz	

2 Water outlet temperature range

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

Mode		Range
Cooling	Normal	5-20℃
	Low water outlet	0-20℃
Heating	Normal	25-55℃

Note:
1. Use dial switch S5_1 on the main PCB to select the water outlet temperature range.

Part 2

Component Layout and Refrigerant Circuits

Part 2 - Component Layout and Refrigerant Circuits

1 Layout of Functional Components

MC-SU30-RN1L

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

Fan motor

Wired controller

Electric control box

DC inverter compressor

Accumulator

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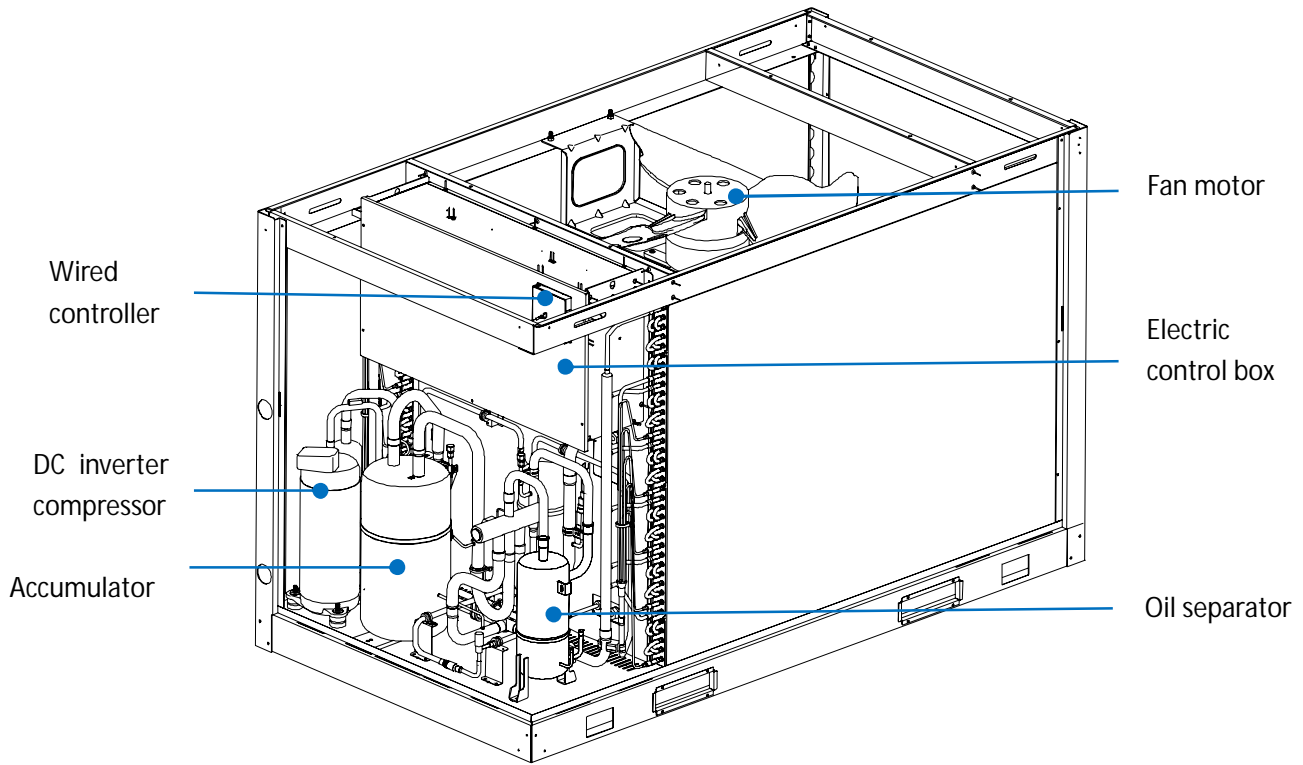
Figure 2-1.2: MC-SU30-RN1L rear view

Manual air purge valve

Water inlet pipe

Water side heat exchanger

Safety valve

Manual water drain valve

Water flow switch

Water outlet pipe

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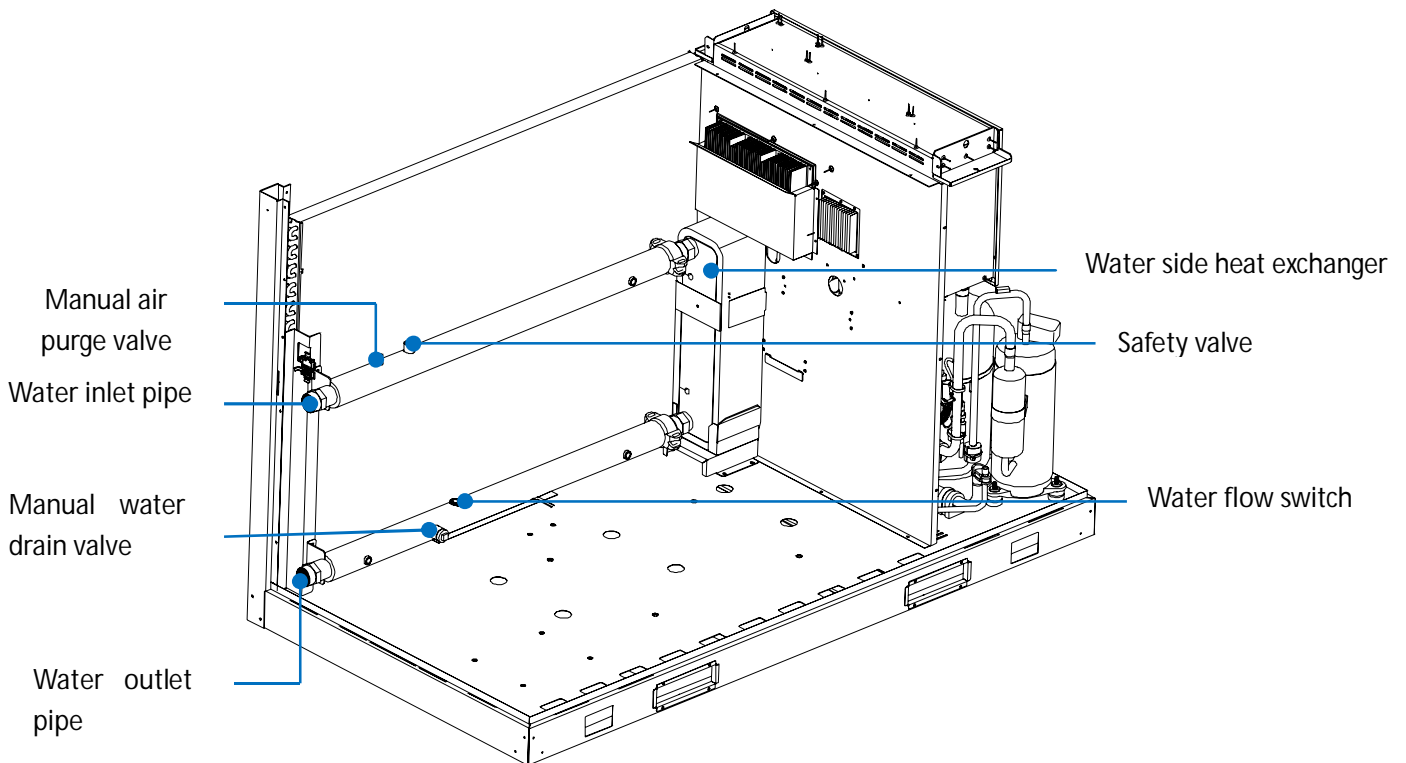
Figure 2-1.3: MC-SU30-RN1L top view

Accumulator

High pressure sensor

High pressure switch

Four-way valve

Electronic expansion valve

Low pressure switch

Solenoid valve SV4

Discharge temperature switch

Low pressure gauge point

High pressure gauge point
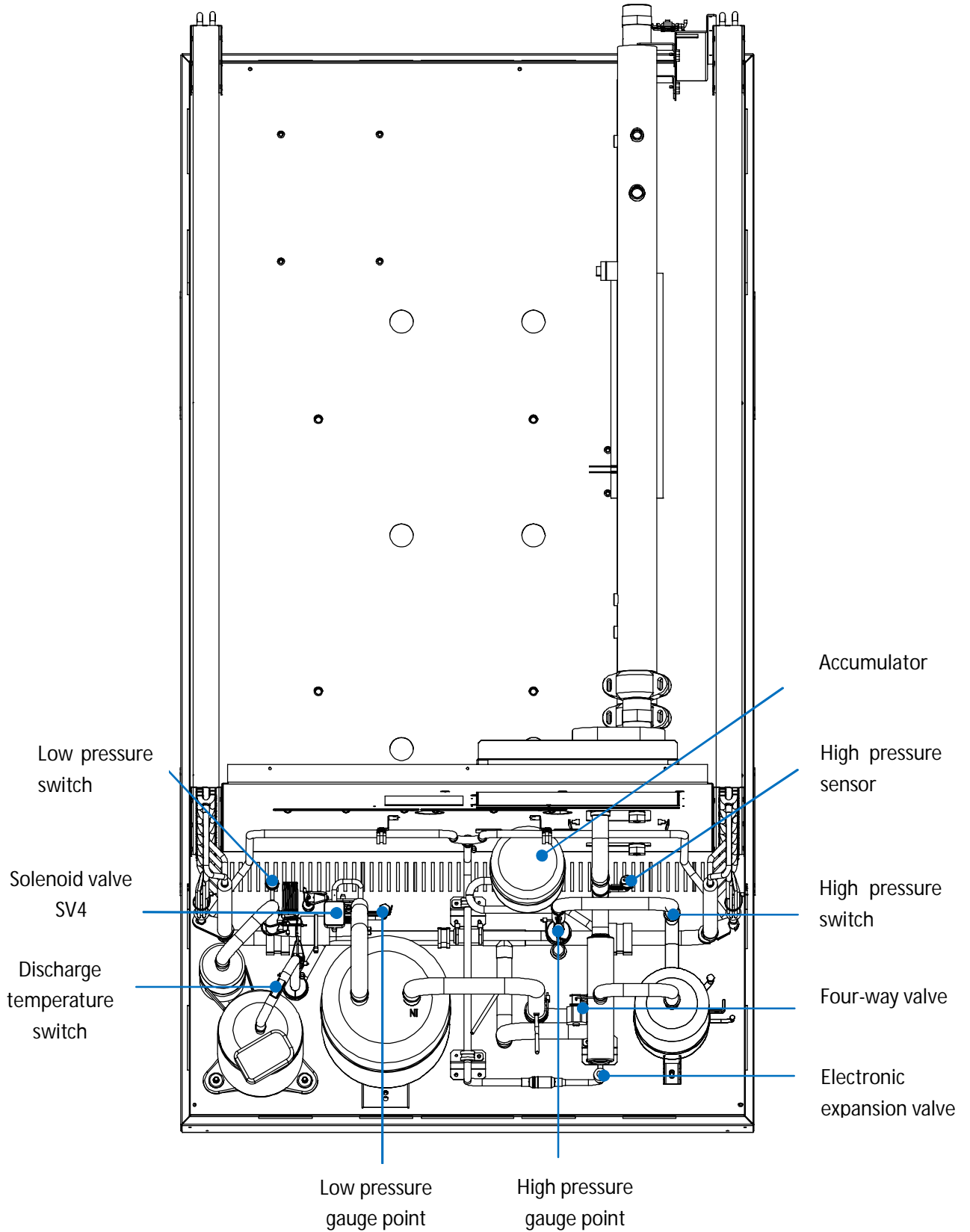
MC-SU60-RN1L

Figure 2-1.4: MC-SU60-RN1L front view

Fan motor

Electric control box

DC inverter compressor

Oil separator
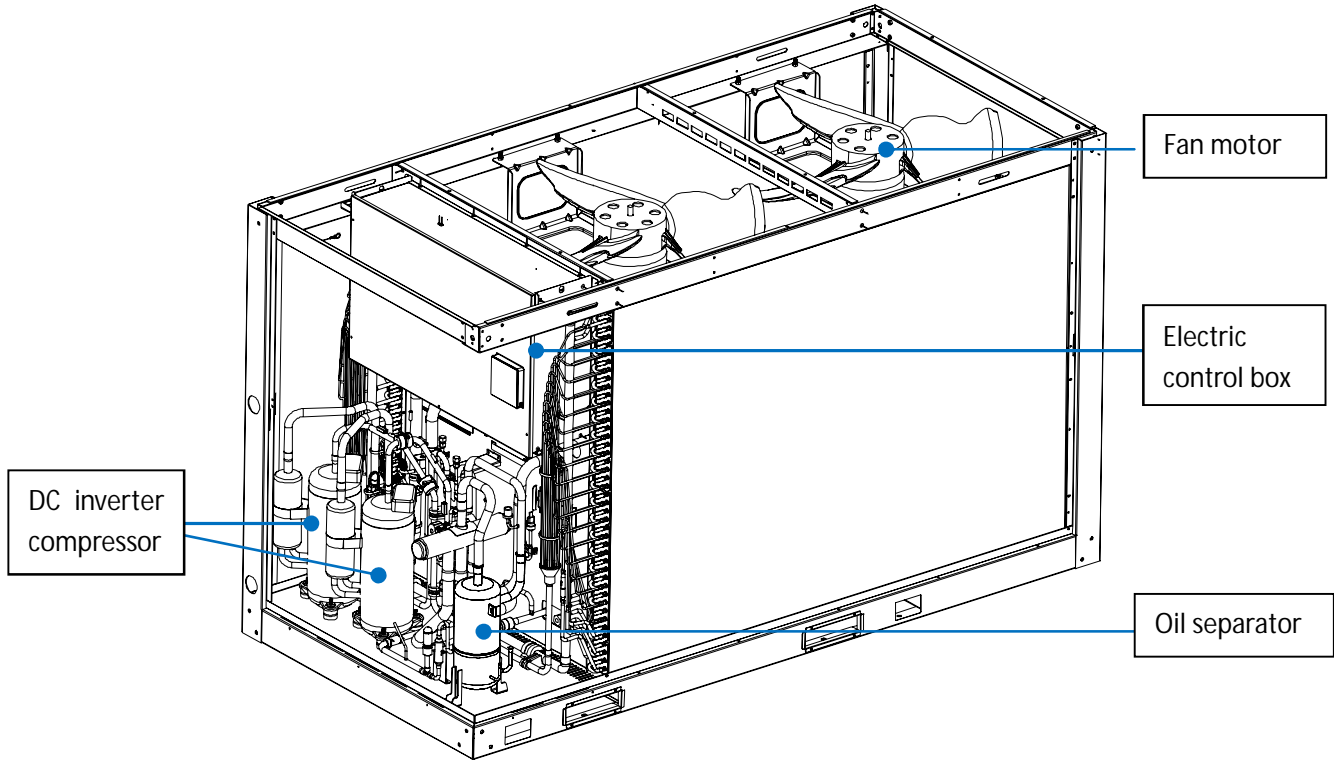
Figure 2-1.5: MC-SU60-RN1L rear view

Safety valve

Air purge valve

Water inlet pipe

Manual water drain valve

Water outlet pipe

Accumulator

Water side heat exchanger

Accumulator

Water flow switch

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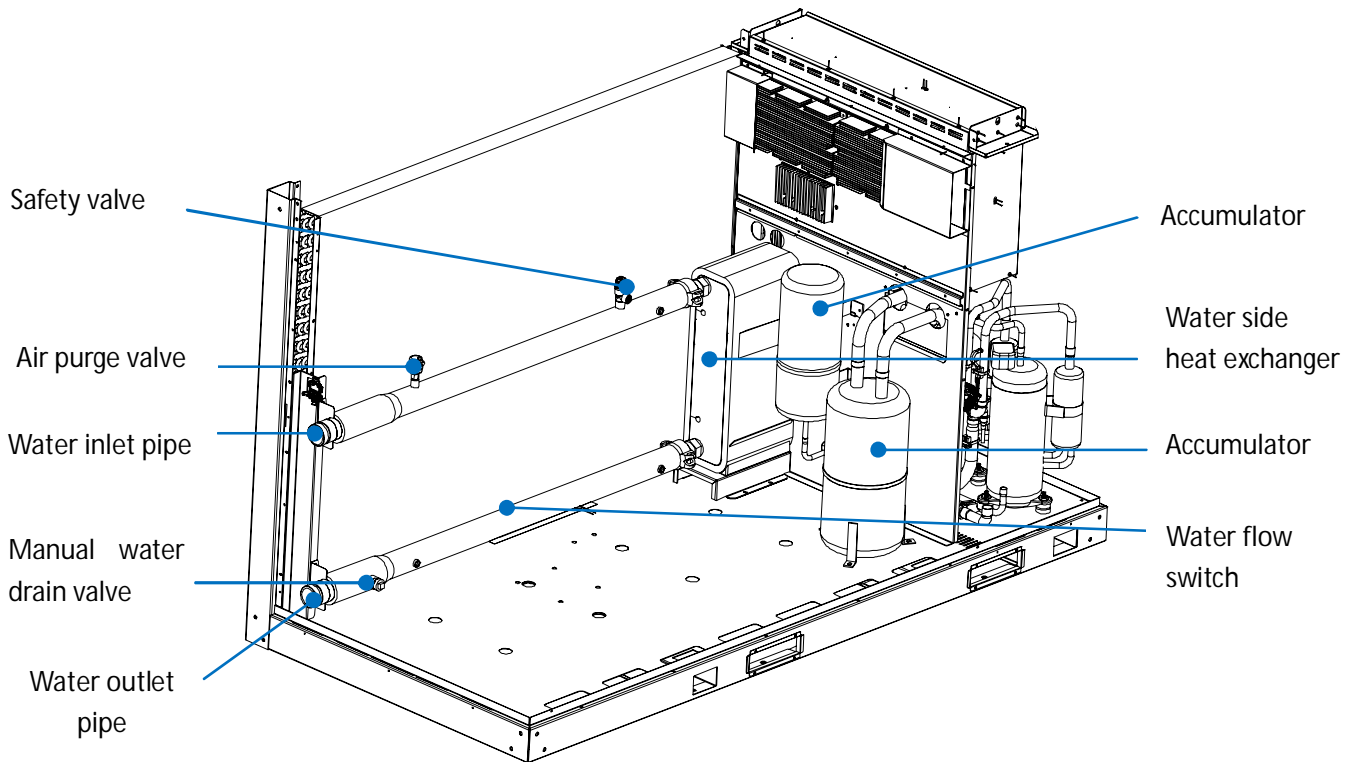
Figure 2-1.6: MC-SU60-RN1L top view

Low pressure switch

Solenoid valve SV4

Discharge temperature switch

High pressure sensor

High pressure switch

Four-way valve

Electronic expansion valve

Low pressure gauge point

High pressure gauge point
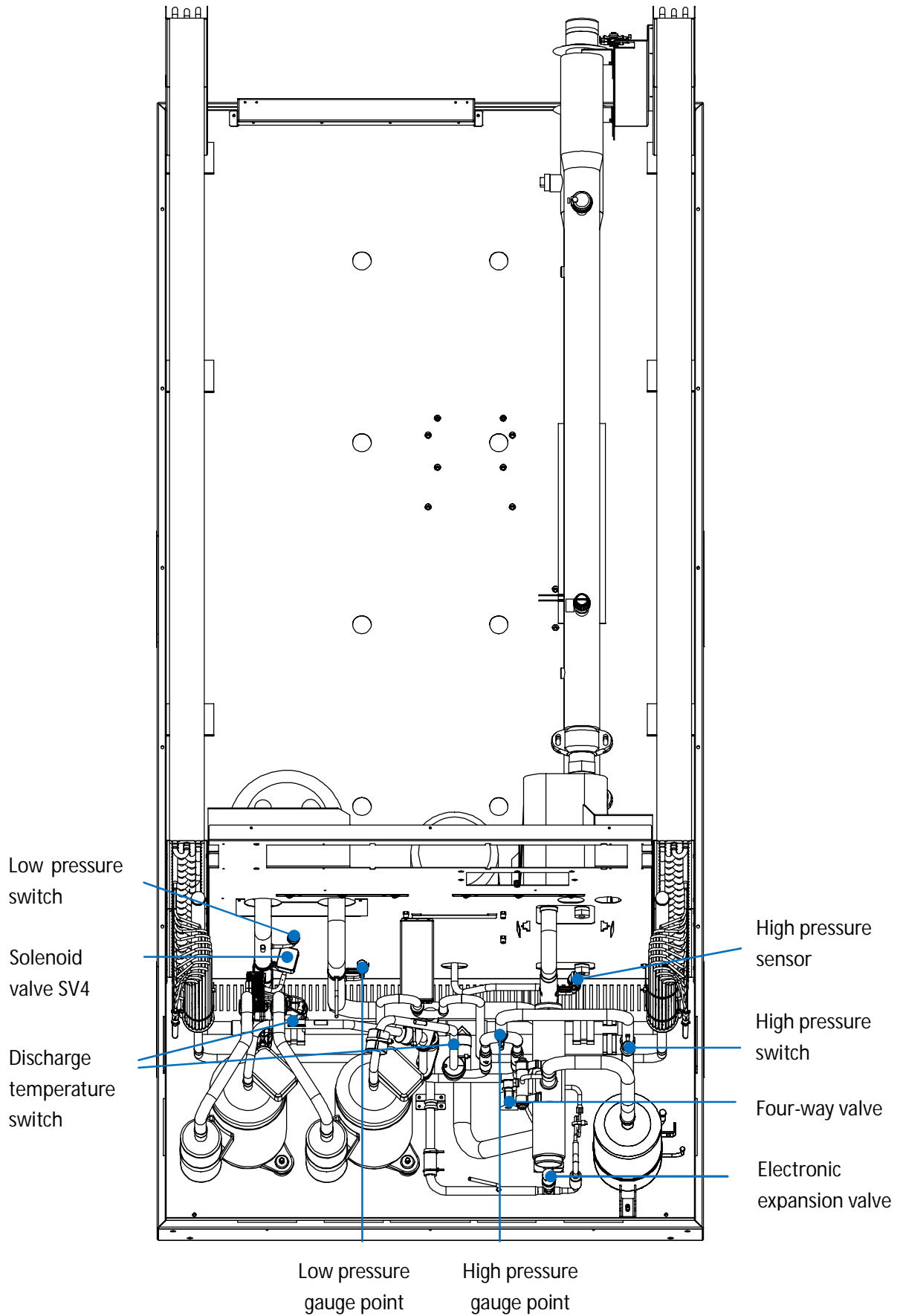
2 Piping Diagrams

MC-SU30-RN1L

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

Legend			
1	Compressor	Tp1	Discharge temperature sensor 1
2	Low pressure switch	Tp2	Discharge temperature sensor 2
3	Discharge temperature control switch	T3	Air side heat exchanger refrigerant outlet temperature sensor
4	High pressure switch	T4	Outdoor ambient temperature sensor
5	Oil separator	TZ/7	Air side heat exchanger refrigerant total outlet temperature sensor
6	Air side heat exchanger	Taf1	Water side heat exchanger anti-freezing temperature sensor 1
7	Pressure sensor	Taf2	Water side heat exchanger anti-freezing temperature sensor 2
8	Accumulator	Twi	Water side heat exchanger water inlet temperature sensor
9	Water side heat exchanger	Two	Water side heat exchanger water outlet temperature sensor
10	Water flow switch	Tw	Combined water outlet temperature sensor
11	Filter	Th	Air suction temperature sensor
EXV	Electronic expansion valve	SV4	Oil return solenoid valve
ST1	4-way valve		

MC-SU60-RN1L

Figure 2-2.2: MC-SU60-RN1L piping diagram

| Legend			
1	Compressor	Tp1	Discharge temperature sensor 1
2	Low pressure switch	Tp2	Discharge temperature sensor 2
3	Discharge temperature control switch	T3	Air side heat exchanger refrigerant outlet temperature sensor
4	High pressure switch	T4	Outdoor ambient temperature sensor
5	Oil separator	TZ/7	Air side heat exchanger refrigerant total outlet temperature sensor
6	Air side heat exchanger	Taf1	Water side heat exchanger anti-freezing temperature sensor 1
7	Pressure sensor	Taf2	Water side heat exchanger anti-freezing temperature sensor 2
8	Accumulator	Twi	Water side heat exchanger water inlet temperature sensor
9	Water side heat exchanger	Two	Water side heat exchanger water outlet temperature sensor
10	Water flow switch	Tw	Combined water outlet temperature sensor
11	Filter	Th	Air suction temperature sensor
EXV	Electronic expansion valve	SV4	Oil return solenoid valve
ST1	4-way valve		

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 (EXV):

   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.

3 Refrigerant Flow Diagrams

Heating operation

Figure 2-3.1: Refrigerant flow during heating operation
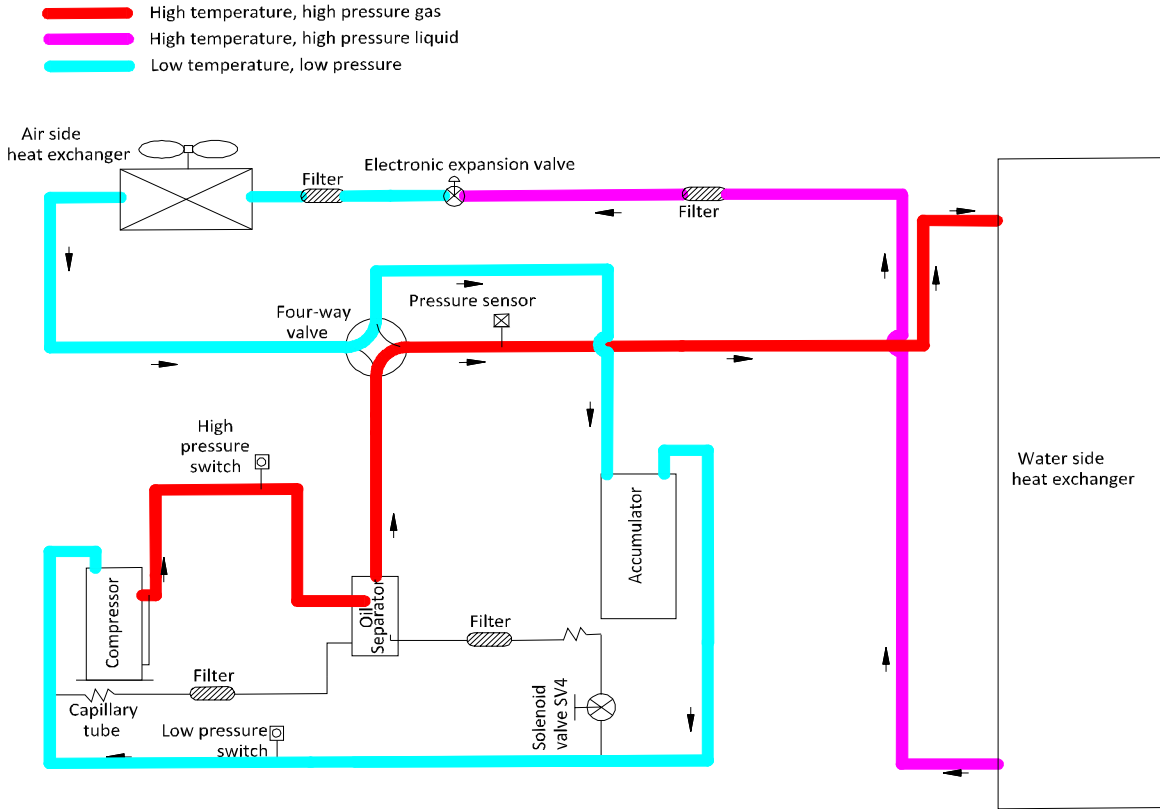
Cooling and defrosting operation

Figure 2-3.2: Refrigerant flow during cooling and defrosting operations
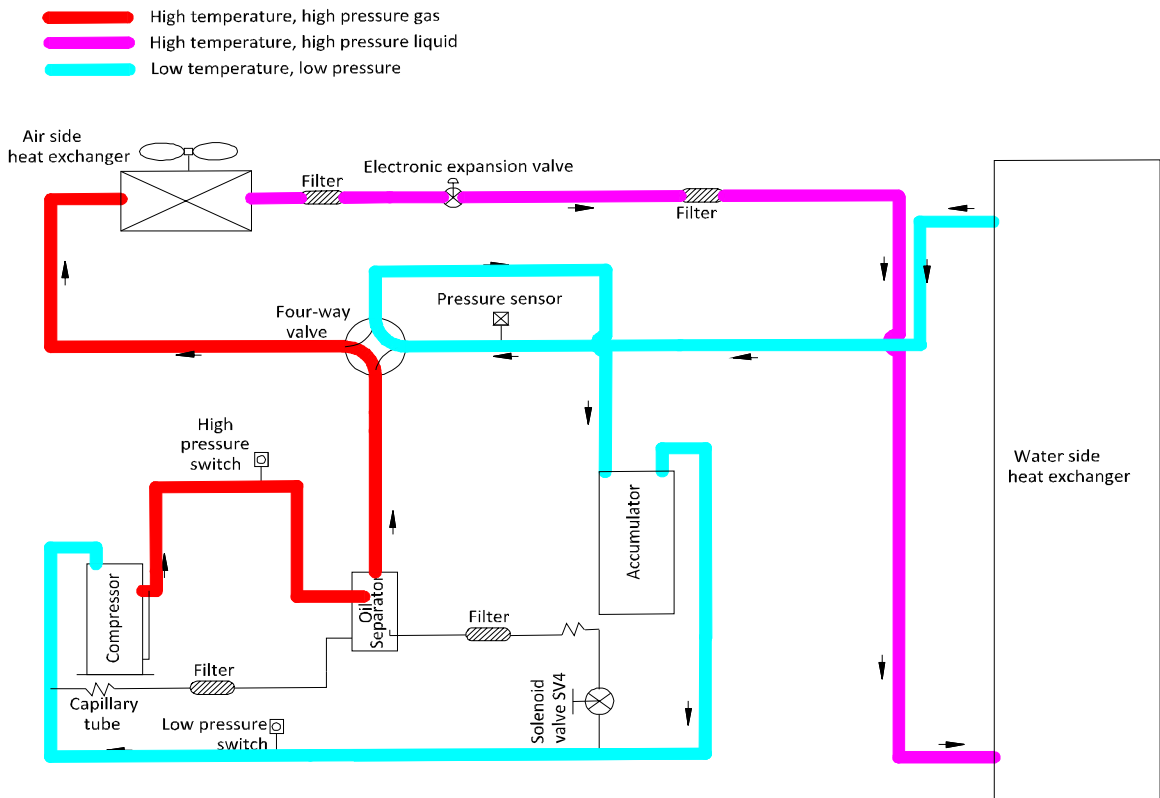
Part 3

Control

Part 3 - Control

1 General Control Scheme Flowchart

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

Stop operation	2
▪ Abnormal shutdown	
▪ System stops	

↓

Standby control	3
▪ Crankcase heater control	
▪ Water pump control	

↓ Thermo on

Startup control	4
▪ Compressor startup delay control	
▪ Compressor startup program	
▪ Startup control for heating operation	
▪ Startup control for cooling operation	

↓

Normal operation control	5
▪ Component control during normal operation	
▪ Compressor output control	
▪ Compressor step control	
▪ Water pump select control	
▪ Four-way valve control	
▪ Electronic expansion valve control	
▪ Outdoor fan control	

Thermo on

Special control 7

▪ Outdoor unit duty cycling

S5_4 on main PCB set to ON → ▪ Additional control

Conditions met for defrosting → ▪ Defrosting operation

↓

Protection control	6
▪ High pressure protection control	
▪ Low pressure protection control	
▪ Discharge temperature protection control	
▪ Compressor and inverter module protection control	
▪ Voltage protection control	
▪ DC fan motor protection control	
▪ Water side heat exchanger anti-freeze protection control	
▪ Air side heat exchanger high temperature protection control	
▪ Water side heat exchanger temperature difference protection control	

Note:

1. Numbers in the top right-hand corners of boxes indicate the relevant section of text on the following pages.

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
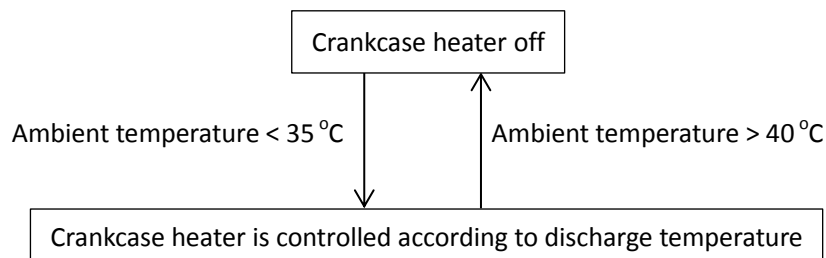
Figure 3-3.2: Crankcase heater controlled according to discharge temperature
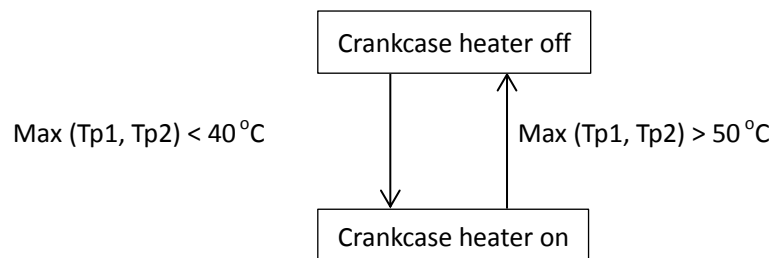
Notes:
1. Tp1: discharge temperature sensor 1, Tp2: discharge temperature sensor 2.

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.

Figure 3-4.1: Compressor startup program[1] when ambient temperature is above 10°C
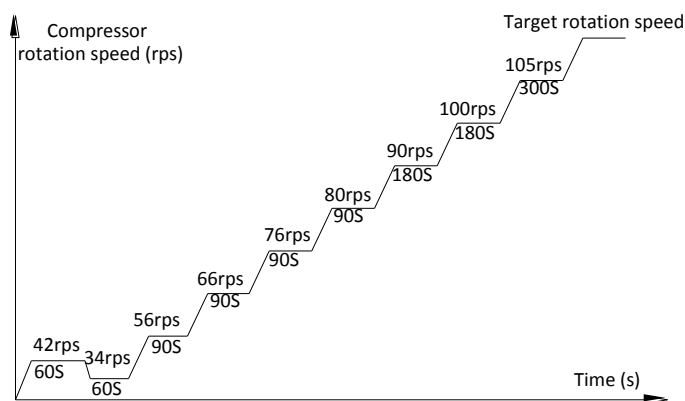
Notes:
1. Once the first, 60-second stage of the program is complete, the program proceeds to the subsequent stages in a step-by-step fashion and exits when the target rotation speed has been reached.

Figure 3-4.2: Compressor startup program[1] when ambient temperature is at or below 10°C
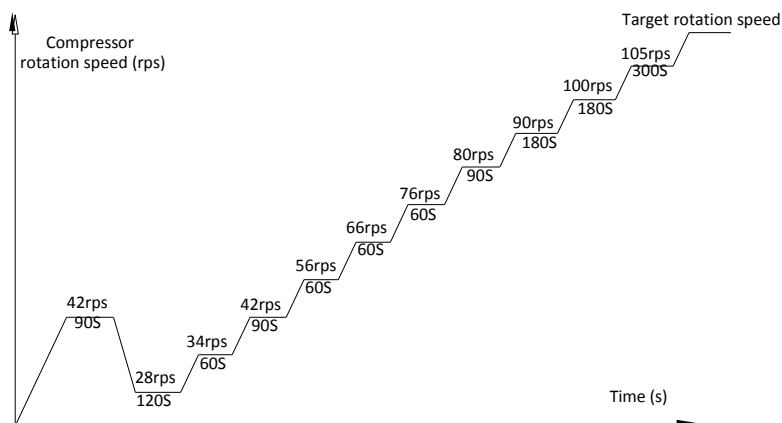
Notes:
1. Once the first, 90-second stage of the program is complete, the program proceeds to the subsequent stages in a step-by-step fashion and exits when the target rotation speed has been reached.

4.3 Startup Control for Heating Operation

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

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 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".

4.4 Startup Control for Cooling Operation

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

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 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".

5 Normal Operation Control

5.1 Component Control during Normal Operation

Table 3-5.1: Component control during heating operation

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 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 cooling operation

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 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		●	

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

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.

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 and 2-3.2 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

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)).

5.7 Outdoor Fan Control

The speed of the outdoor unit fan(s) is adjusted in steps, as shown in Table 3-5.3.

Table 3-5.3: Outdoor fan speed steps

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

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

```
                    ┌─────────────────────┐
                    │   Normal operation   │
                    └─────────────────────┘
                       │                ↑
          Pc > 4.4MPa  │                │  Pc < 3.2MPa          When P0 protection occurs 5 times
                       ↓                │                       in 120 minutes, a manual system
        ┌───────────────────────────────────────┐  →          restart is required before the system
        │ Low pressure protection, error code P0 │              can resume operation.
        │            is displayed                 │
        └───────────────────────────────────────┘
```

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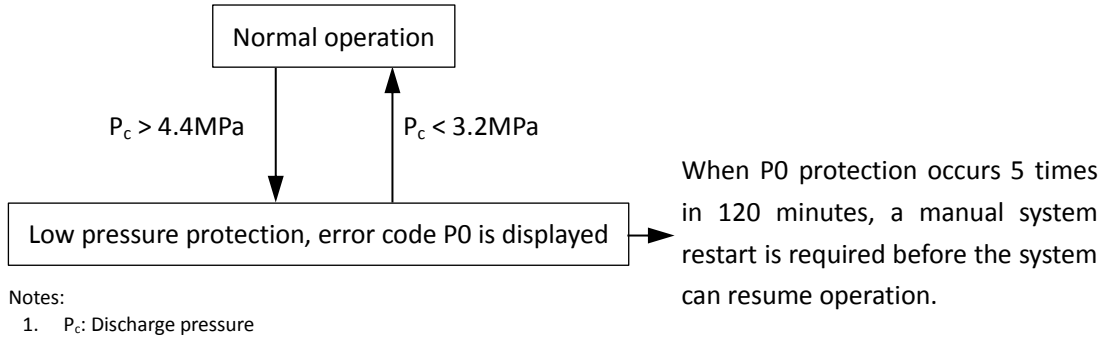
When the discharge pressure rises above 4.4MPa the system displays P0 protection and all units stop running. When the discharge pressure drops below 3.2MPa, the compressor enters re-start control.

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 3-6.2: Low pressure protection control

```
                    ┌─────────────────────┐
                    │   Normal operation   │
                    └─────────────────────┘
                       │                ↑
          Pe < 0.14MPa │                │  Pe > 0.3MPa          When P1 protection occurs 5 times
                       ↓                │                       in 120 minutes, ta manual system
        ┌───────────────────────────────────────┐  →          restart is required before the system
        │ Low pressure protection, error code P1 │              can resume operation.
        │            is displayed                 │
        └───────────────────────────────────────┘
```

Notes:
1. P_e: Suction pressure
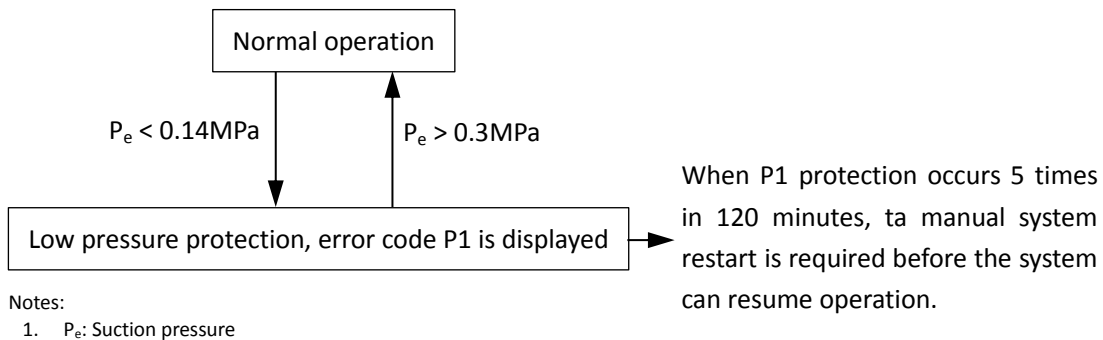
When the suction pressure drops below 0.14MPa the system displays P0 protection and all the units stop running. When the suction pressure rises above 0.3MPa, the compressor enters re-start control.

6.3 Discharge Temperature Protection Control

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

Figure 3-6.3: High discharge temperature protection control

```
                    ┌─────────────────────┐
                    │   Normal operation   │
                    └─────────────────────┘
                       │                ↑
Discharge temperature > 110°C           │  Discharge temperature < 100°C    When P0 protection occurs 5 times
                       ↓                │                                   in 120 minutes, ta manual system
        ┌───────────────────────────────────────┐  →                      restart is required before the system
        │ High discharge temperature protection,  │                        can resume operation.
        │        error code P0 is                 │
        └───────────────────────────────────────┘
```
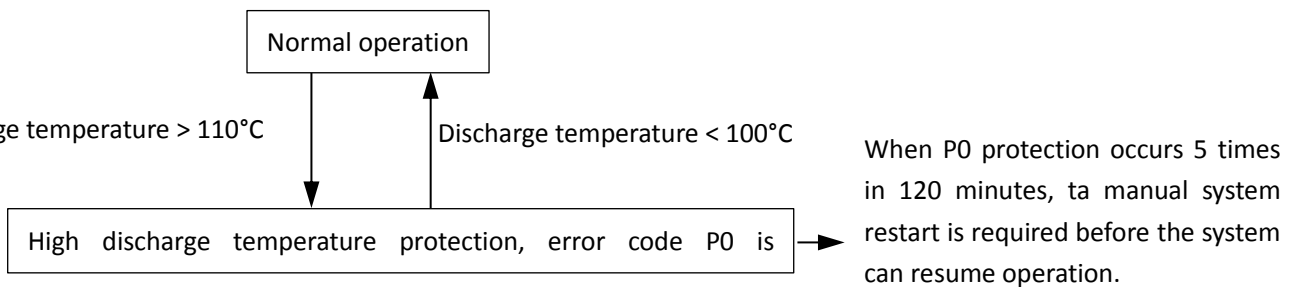
When the discharge temperature rises above 110°C the system displays P0 protection and all the units stop running. When the discharge temperature drops below 100°C, the compressor enters re-start control.

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 3-6.4: Compressor current protection control

```
            ┌─────────────────────┐
            │  Normal operation   │
            └─────────────────────┘
              │                 ▲
 Current > 25A│                 │Current < 25A
              ▼                 │
┌──────────────────────────────────────────────────┐
│ Compressor current protection, error code P4 or P5│ ──▶
│                  is displayed                      │
└──────────────────────────────────────────────────┘
```

When P4 or P5 protection occurs 5 times in 120 minutes, ~~ta~~ a manual system restart is required before the system can resume operation.
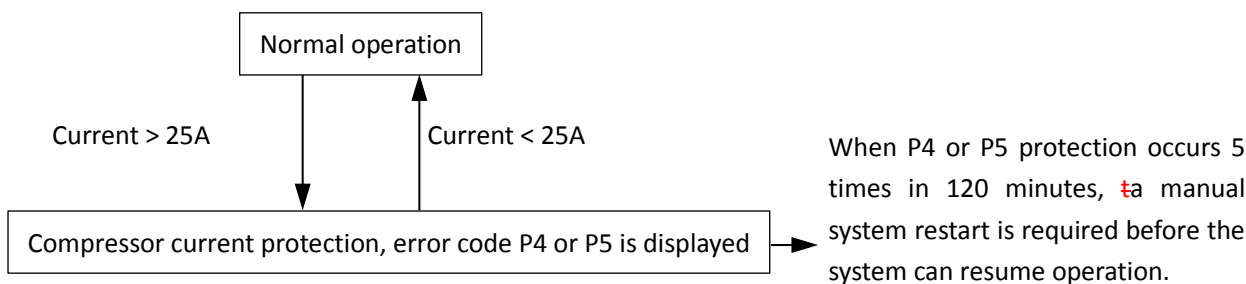
Notes:
1. P4 is the protection for the power supply phase B, P5 is the protection for the power supply phase C.

When the compressor current rises above25A, 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 3-6.5: Inverter module temperature protection control

```
            ┌─────────────────────┐
            │  Normal operation   │
            └─────────────────────┘
              │                 ▲
Tf1 or Tf2 >  │                 │Tf1 and Tf2 < 60°C
     82°C     ▼                 │
┌──────────────────────────────────────────────────┐
│ Inverter module temperature protection, error code│ ──▶
│              PL is displayed                       │
└──────────────────────────────────────────────────┘
```

C7 is displayed when PL error occurs 3 times in 100 minutes, a manual system restart is required before the system can resume operation.
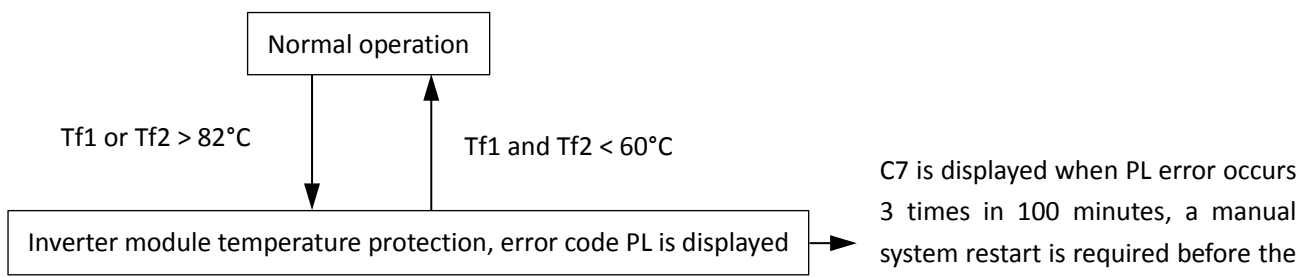
Notes:
1. Tf1:Heat sink temperature 1; Tf2:Heat sink temperature 2

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.

6.5 Voltage Protection Control

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

Figure 3-6.6: Compressor voltage protection control

```
            ┌─────────────────────┐
            │  Normal operation   │
            └─────────────────────┘
              │                 ▲
Voltage ≥ 260V│                 │180V ≤ Voltage < 250V
or Voltage <  ▼                 │
    165V
┌──────────────────────────────────────────────────┐
│ Compressor voltage protection, error code H1      │
│              is displayed                          │
└──────────────────────────────────────────────────┘
```
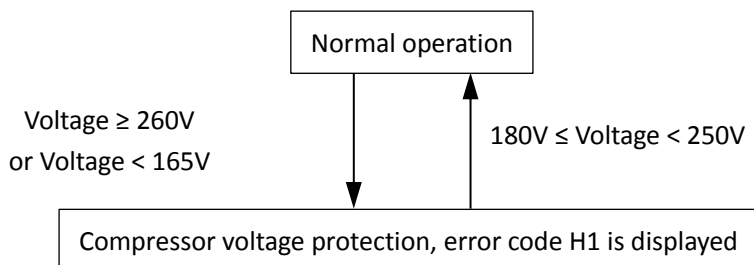
When the phase voltage of AC power supply is at or above 260V for more than 30 seconds, the system displays H1 protection and all the units stop running. When the phase voltage drops below 250V for more than 30 seconds, the units restart once the compressor re-start delay has elapsed. When the phase 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 3-6.7: Anti-freeze protection control in normal cooling mode

$Min(Tw/Two/Twi/Taf^1) \leq 4°C$

$Tw > 15°C$

Normal operation

Anti-freeze protection, error code Pb is displayed
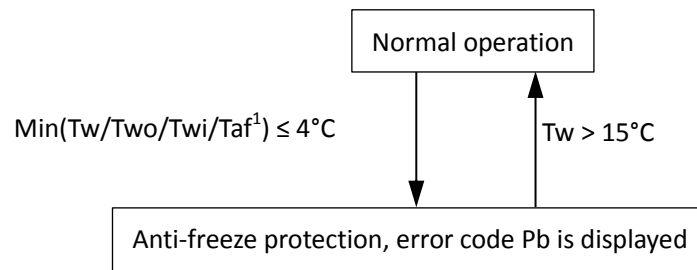
Note:
1. Taf include Taf1 and Taf2.

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 3-6.8: Anti-freeze protection control in low water outlet cooling mode

$Min(Tw/Two/Twi/Taf^1) \leq 0°C$

$Tw > 15°C$

Normal operation

Anti-freeze protection, error code Pb is displayed
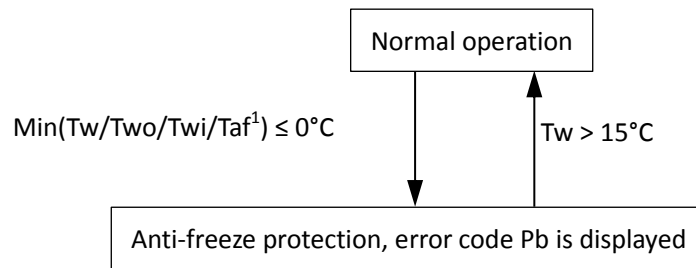
Note:
1. Taf include Taf1 and Taf2.

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.

Part 3 - Control

6.8 Air Side Heat Exchanger High Temperature Protection Control

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

Figure 3-6.9: Air side heat exchanger high temperature protection control 1

```
                    ┌──────────────────────┐
                    │   Normal operation   │
                    └──────────────────────┘
              T3 > 65°C  │            ▲  T3 < 60°C
                         ▼            │
         ┌────────────────────────────────────────────┐
         │ High temperature protection, error code P7  │
         │                is displayed                 │
         └────────────────────────────────────────────┘
```
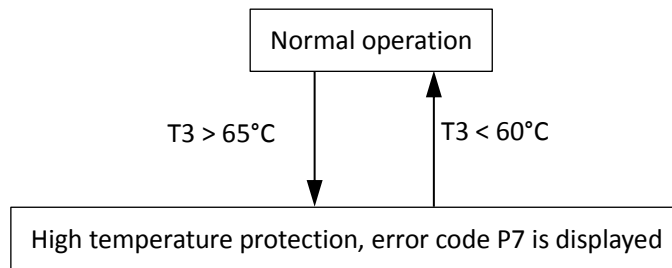
Note:

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 3-6.10: Air side heat exchanger temperature protection control 2

```
                    ┌──────────────────────┐
                    │   Normal operation   │
                    └──────────────────────┘
           Tz/7 ≥ 62°C │            ▲  Tz/7 < 62°C
                       ▼            │
         ┌────────────────────────────────────────────┐
         │ High temperature protection, error code P7  │
         │                is displayed                 │
         └────────────────────────────────────────────┘
```
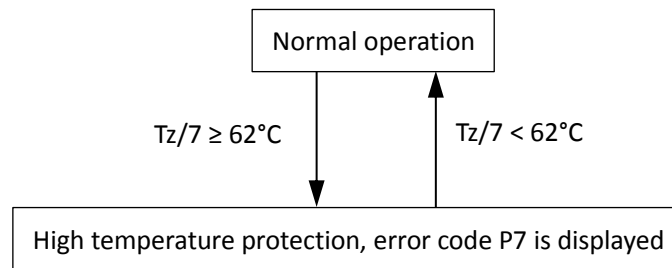
Note:

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 3-6.11: Water side heat exchanger temperature difference protection control

```
                ┌──────────────────────┐
                │   Normal operation   │
                └──────────────────────┘
   │ Twi-Two │ ≥ 12°C │          ▲  │ Twi-Two │ < 6°C
                      ▼          │
   ┌────────────────────────────────────────┐        When P9 protection occurs 3 times
   │ Temperature difference protection,      │ ────►   in 60 minutes, a manual system
   │ error code P9 is displayed              │        restart is required before the system
   └────────────────────────────────────────┘            can resume operation.
```
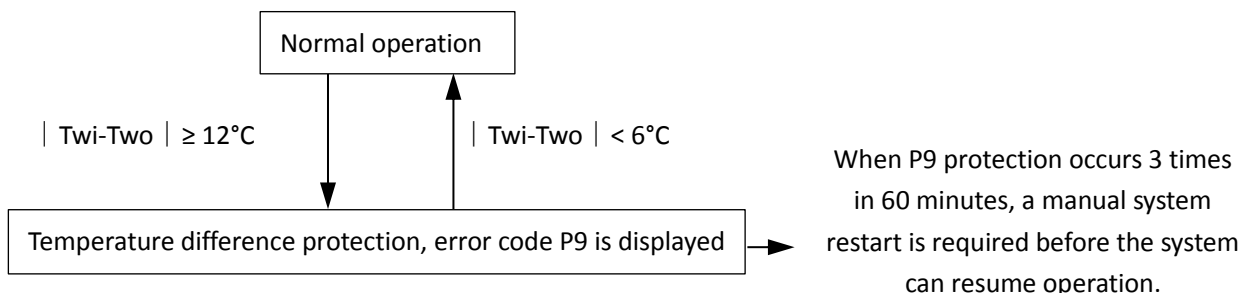
Notes:

1. Twi: Water side heat exchanger inlet temperature

2. Two: Water side heat exchanger outlet temperature

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 3-6.12: Water side heat exchanger low temperature protection control in normal cooling mode

```
              ┌─────────────────────┐
              │  Normal operation   │
              └─────────────────────┘
Min (Taf1 or Taf2) ≤ 3°C      Min (Taf1 and Taf2) >10°C
              ┌─────────────────────────────────────────┐
              │ Low temperature protection, error code PE is │
              └─────────────────────────────────────────┘
```
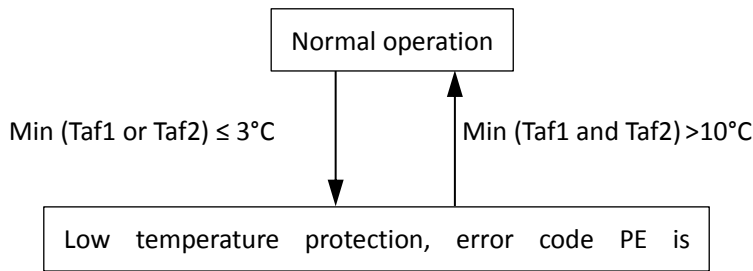
Notes:

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 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 3-6.13: Water side heat exchanger low temperature protection control in low water outlet mode
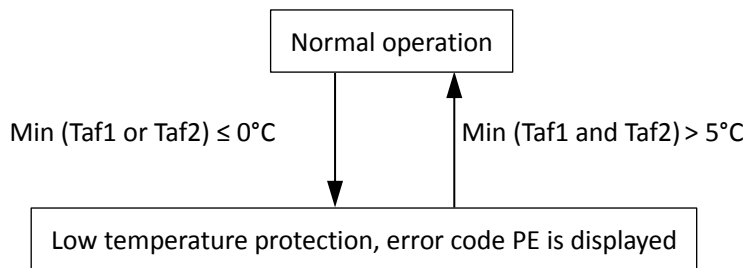
```
              ┌─────────────────────┐
              │  Normal operation   │
              └─────────────────────┘
Min (Taf1 or Taf2) ≤ 0°C      Min (Taf1 and Taf2) > 5°C
              ┌─────────────────────────────────────────┐
              │ Low temperature protection, error code PE is displayed │
              └─────────────────────────────────────────┘
```

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 3-6.14: Water side heat exchanger low pressure protection control in normal cooling mode

```
          ┌─────────────────────┐
          │  Normal operation   │
          └─────────────────────┘
        Pe < 0.6Mpa       Pe > 0.6Mpa
          │                   │
          ▼                   │
┌──────────────────────────────────┐
│ Low pressure protection, error    │ ──▶
│ code PC is                        │
└──────────────────────────────────┘
```

When system displays PC protection and a manual system restart is required before the system can resume operation.

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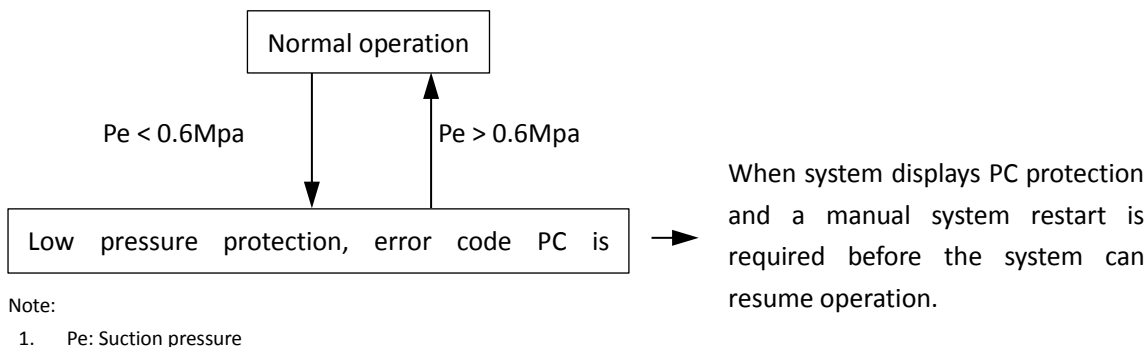
In normal cooling mode, when the suction pressure drops below 0.6Mpa, the system displays PE protection and all the units stop running. When the suction pressure is above 0.6Mpa or higher, the compressor enters re-start control. It will not display the PC error when the suction pressure drops below 0.6Mpa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

Figure 3-6.15: Water side heat exchanger low pressure protection control in low water outlet cooling mode

```
          ┌─────────────────────┐
          │  Normal operation   │
          └─────────────────────┘
        Pe < 0.4Mpa       Pe > 0.4Mpa
          │                   │
          ▼                   │
┌──────────────────────────────────┐
│ Low pressure protection, error    │ ──▶
│ code PC is                        │
└──────────────────────────────────┘
```

When system displays PC protection and a manual system restart is required before the system can resume operation.

Note:
1.   Pe: Suction pressure
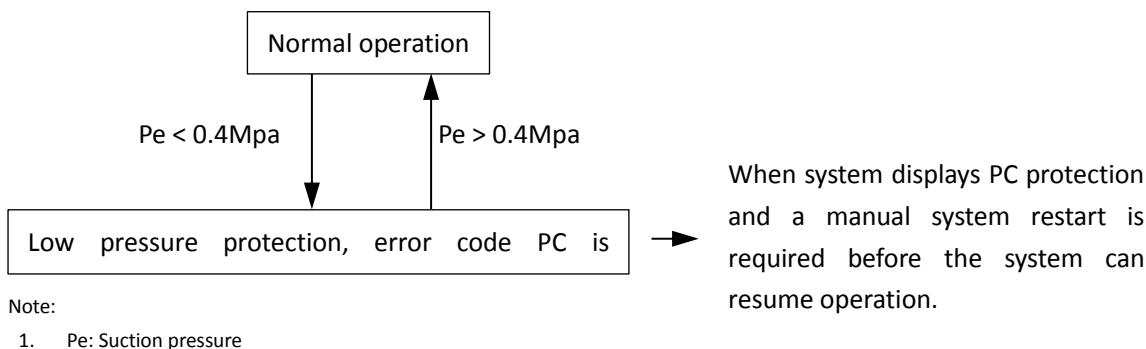
In low water outlet cooling mode, when the suction pressure drops below 0.4Mpa, the system displays PE protection and all the units stop running. When the suction pressure is above 0.4Mpa or higher, the compressor enters re-start control. It will not display the PC error when the suction pressure drops 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 units[1]
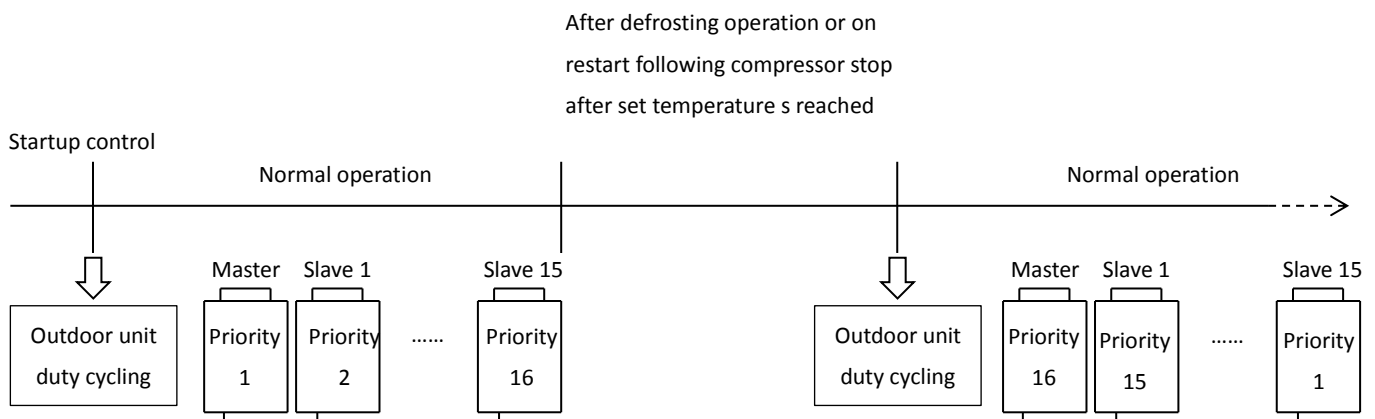
Notes:
1. The address settings on the outdoor unit main PCBs for master unit and slave unit do not change.

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

Component	Wiring diagram label	30kW	60kW	Control functions and states
Inverter compressor A	COMP A	●	●	Runs at defrosting operation rotation speed
Inverter compressor B	COMP B		●	
DC fan motor A	FAN A	●	●	Off
DC fan motor B	FAN B		●	
Electronic expansion valve	EXV 1	●	●	Full open
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	●	●	Off
Water side heat exchanger heater 2	EVA-HEAT 2		●	
Water flow switch heater	W-HEAT1	●	●	Off
Electric auxiliary heat	E-HEAT_L	●	●	According to ambient temperature
Crank case heater 1	HEAT1	●	●	Off
Crank case heater 2	HEAT2		●	

7.3 Additional control

When dial switch S5_4 on main PCB is switched ON, additional control is valid, connect a controller or not is permissible.

When dial switch S5_4 is switched OFF, additional control is invalid. This function is only valid on the master unit.

When dial switch S5_4 is switched ON and disconnect a wired controller:

- The system ON/OFF state is controlled by the ON/OFF port (CN44 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 (CN44 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_4 is switched ON and connect a wired controller, the water outlet temperature and hysteresis temperature can be set by the wired controller.

8 Role of Temperature Sensors in Control Functions

Table 3-8.1: Names and functions of the temperature sensors

Number	Sensor name[1]	Sensor code	Mode	Control functions
1	Discharge pipe temperature sensor 1/ Discharge pipe temperature sensor 2	Tp1/Tp2	Heating	▪ Crankcase heater control[1] ▪ Electronic expansion valve control[2] ▪ Compressor output control[3] ▪ Discharge temperature protection control[4]
			Cooling	▪ Crankcase heater control[1] ▪ Compressor output control[3] ▪ Discharge temperature protection control[4]
2	Outdoor ambient temperature sensor	T4	Heating	▪ Crankcase heater control[1] ▪ Electric auxiliary heater control ▪ Water flow switch heater control ▪ Compressor output control[3] ▪ Electronic expansion valve control[2] ▪ Outdoor fan control[5]
			Cooling	▪ Crankcase heater control[1] ▪ Compressor output control[3] ▪ Defrosting operation control[6] ▪ Electronic expansion valve control[2] ▪ Outdoor fan control[5]
3	Air side heat exchanger refrigerant outlet temperature sensor	T3	Heating	▪ Outdoor fan control[5] ▪ Electronic expansion valve control[2]
			Cooling	▪ Defrosting operation control[6] ▪ Air side heat exchanger high temperature protection control[7]
4	Total cooling outlet temperature sensor	TZ/7	Heating	None
			Cooling	▪ Outdoor fan control[5] ▪ Compressor output control[3] ▪ Air side heat exchanger high temperature protection control[7]
5	Water side heat exchanger anti-freezing temperature sensor1/Water side heat exchanger anti-freezing temperature sensor 2	Taf1/Taf2	Heating	None
			Cooling	▪ Water side heat exchanger heater control ▪ Water side heat exchanger anti-freeze protection control[8] ▪ Water side heat exchanger low temperature protection control[9]
6	Suction pipe temperature sensor	Th	Heating	▪ Electronic expansion valve control[2]
			Cooling	▪ Electronic expansion valve control[2]
7	Water inlet temperature sensor	Twi	Heating	▪ Water flow switch heater control
			Cooling	▪ Electronic expansion valve control[2] ▪ Compressor output control[3] ▪ Water flow switch heater control ▪ Water side heat exchanger anti-freeze protection control[8] ▪ Water side heat exchanger temperature difference protection control[10]
8	Water outlet temperature sensor	Two	Heating	▪ Compressor output control[3] ▪ Water flow switch heater control
			Cooling	▪ Compressor output control[3] ▪ Defrosting operation control[6] ▪ Water flow switch heater control ▪ Water side heat exchanger anti-freeze protection control[8] ▪ Water side heat exchanger temperature difference protection control[10]

Part 3 - Control

9	Total water outlet temperature sensor	Tw	Heating	▪ Compressor output control[3] ▪ Electric auxiliary heater control
			Cooling	▪ Compressor output control[3] ▪ Water side heat exchanger anti-freeze protection control[8]
10	Inverter module temperature sensor 1/ Inverter module temperature sensor 2	Tf1/Tf2	Heating	▪ Compressor output control[3] ▪ Inverter module temperature protection[11]
			Cooling	▪ Compressor output control[3] ▪ Outdoor fan control[5] ▪ Inverter module temperature protection[11]

Notes:

1. Refer to part 3, 3.1 "Crankcase Heater Control".

2. Refer to part 3, 5.6 "Electronic Expansion Valve Control".

3. Refer to part 3, 5.2 "Compressor Output Control".

4. Refer to part 3, 6.3 "Discharge Temperature Protection Control".

5. Refer to part 3, 5.7 "Outdoor Fan Control".

6. Refer to part 3, 7.2 "Defrosting Operation".

7. Refer to part 3, 6.8 "Air Side Heat Exchanger High Temperature Protection Control".

8. Refer to part 3, 6.7 "Water Side Heat Exchanger Anti-freeze Protection Control ".

9. Refer to part 3, 6.10 "Water Side Heat Exchanger Low Temperature Protection Control ".

10. Refer to part 3, 6.9 "Water Side Heat Exchanger Temperature Difference Protection Control ".

11. Refer to part 3, 6.4 "Compressor and Inverter Module Protection Control "

12. All sensor names in his service manual referring to refrigerant flow is named according refrigerant flow during cooling operation refer to part2,3 "Refrigerant Flow Diagram ".

Part 4

Diagnosis and Troubleshooting

1 Outdoor Unit Electric Control Box Layout

MC-SU30-RN1L

Figure 4-1.1: Electric control box front view- top layer
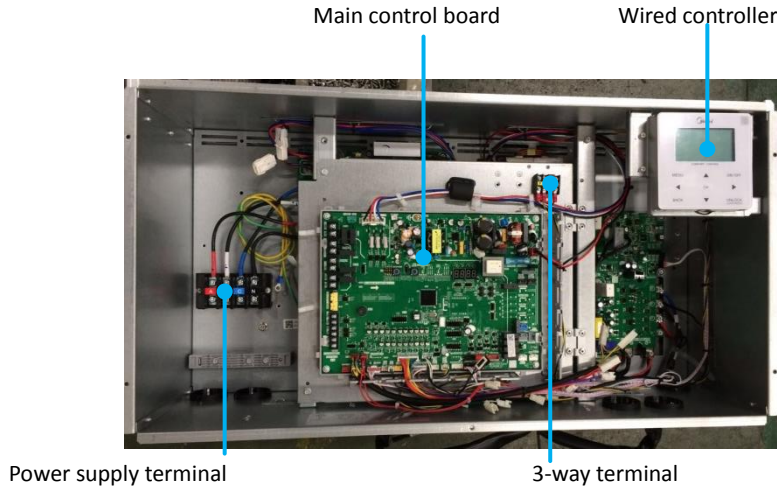
Figure 4-1.2: Electric control box front view-bottom layer
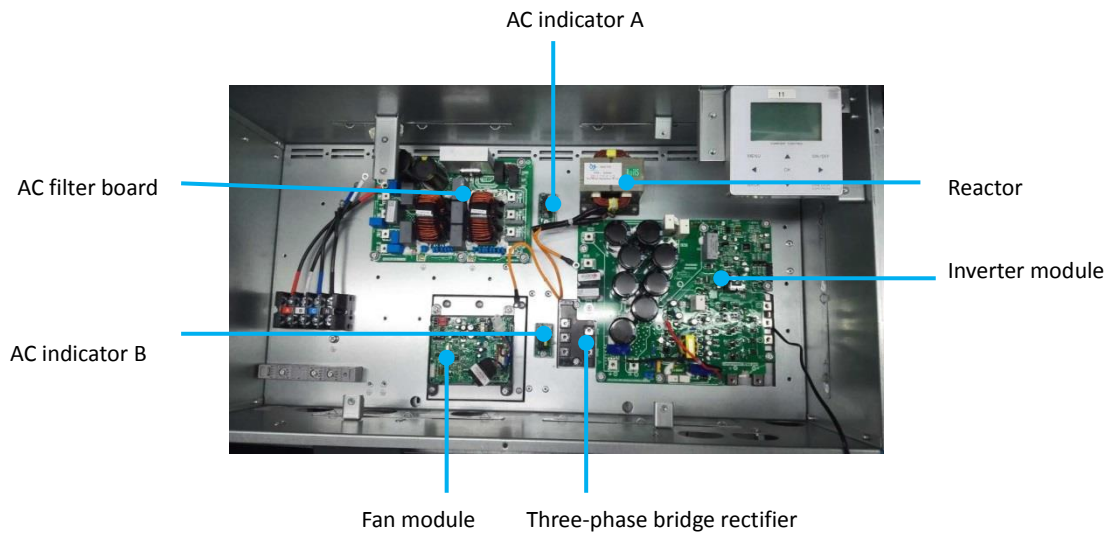
Figure 4-1.3: Electric control box front view-top layer

AC filter board A   Main control board   Wired controller

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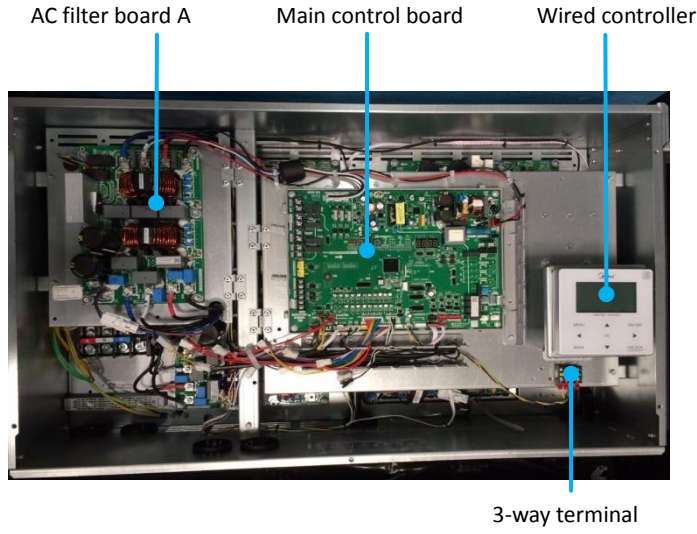
Figure 4-1.4: Electric control box side view-bottom layer

Inverter module A   Three-phase bridge rectifier B   Inverter module B

Reactor A

AC indicator A

Three-phase bridge rectifier A

Power supply terminal

Reactor B

Fan module B

AC filter board B   AC indicator B   Fan module A

Part 4 - Diagnosis and Troubleshooting
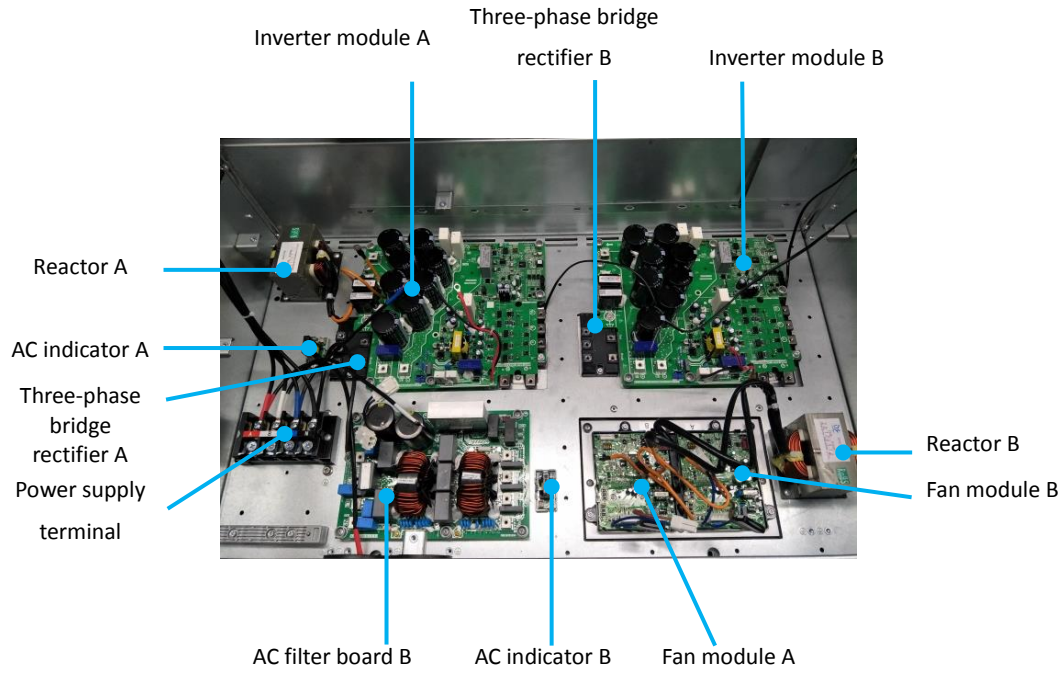
2 Outdoor Unit PCBs

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, MC-SU30-RN1L model each has one board while MC-SU30-RN1L model have one main control board and the other boards each has two boards.

The locations of each PCB in the outdoor unit electric control boxes are shown in Figures 4-1.1 to 4-1.4 in Part 4, 1 "Outdoor Unit Electric Control Box Layout".

2.2 Main PCB

Figure 4-2.1: Outdoor unit main PCB
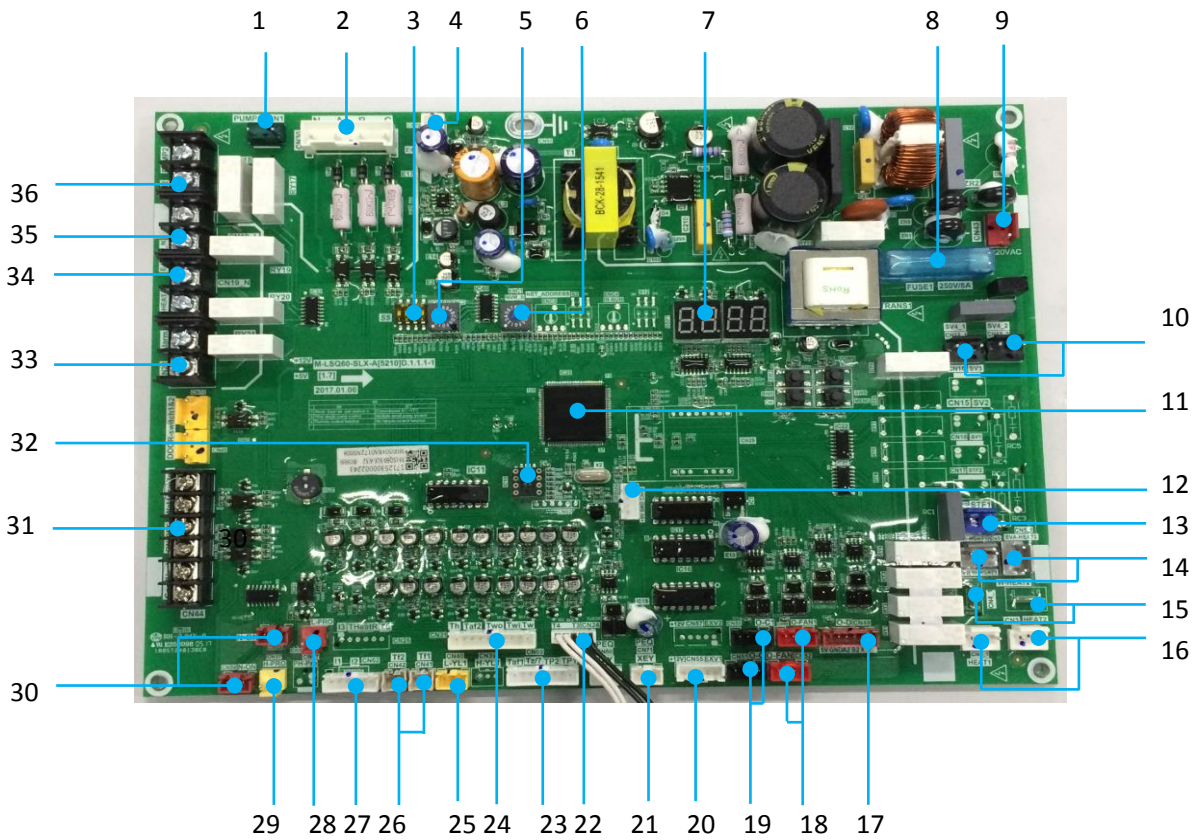
Note:

1. Label descriptions are given in Table 4-2.1

Table 4-2.1:Outdoor unit main PCB

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	2.5-2.7 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	CN47	High pressure switch and discharge temperature switch (es) 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_N	Electric auxiliary heater N line connection	On/off signal
35	CN19_L	Electric auxiliary heater N line connection	On/off signal
36	CN2	Pump 2 connection	On/off signal

2.2.1 Main PCB field setting

Table 4-2.2: Main PCB switch settings

Switch		Description	ON	OFF	Default factory setting
S5 ON 1 2 3 4 OFF	S5-1	Water outlet temperature[1]	Low	Normal	OFF
	S5-2	ON/OFF function	Activated	Deactivated	OFF
	S5-3	Water pump	One large pump controlled by master unit	One small pump per unit	OFF
	S5-4	Reserved	-	-	OFF
ENC2	ENC2	0: MC-SU30-RN1L	-	-	0
		3: MC-SU60-RN1L	-	-	3
ENC1	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.

2.2.2 Function of buttons SW3 to SW6

Table 4-2.3: Function of buttons SW1 to SW4

Button	Function
SW3	Up
SW4	Down
SW5	Menu
SW5	Ok

2.2.3 SW2 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

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 3-5.3 in Part 3, 5.6 "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

Outdoor unit state		Parameters displayed on DSP1	Parameters displayed on DSP2	
Standby		0	1	DSP1 ↓ ↑ DSP2
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	

2.3 Compressor Inverter Module Board

Figure 4-2.2: Compressor inverter module PCB
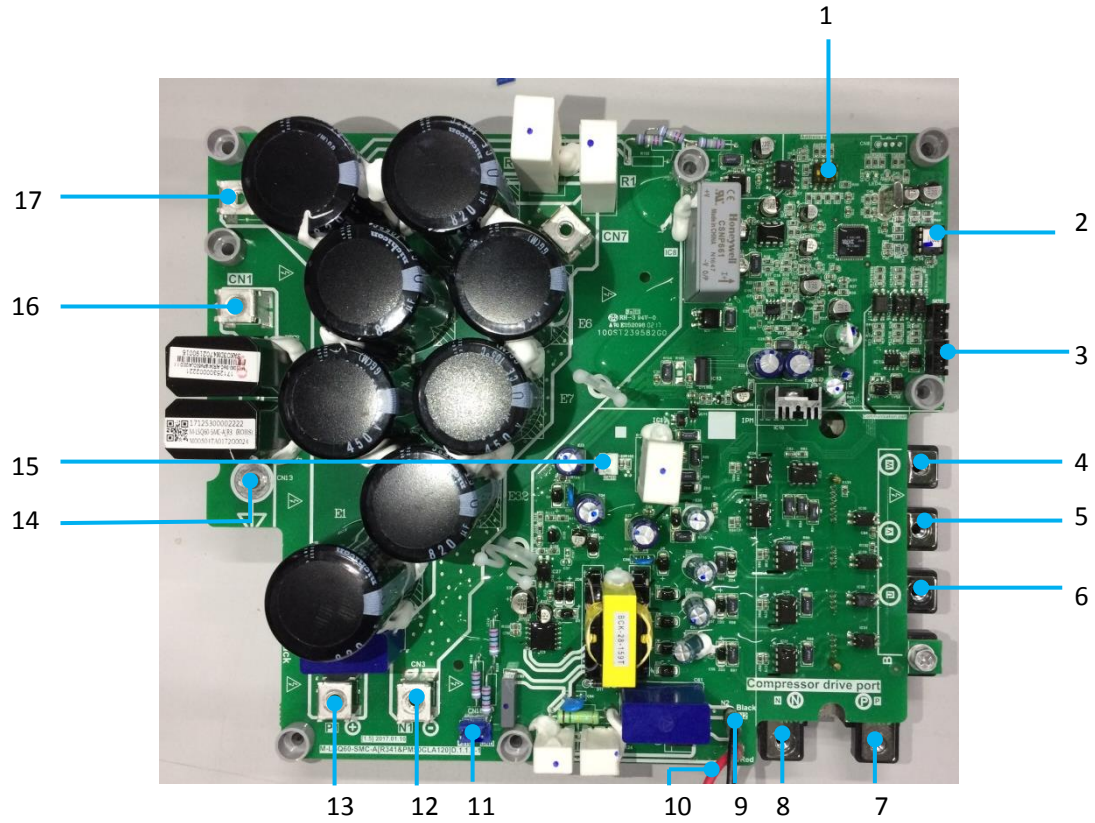
Notes:
1. Label descriptions are given in Table 4-2.6.

Table 4-2.6: Compressor inverter module PCB

Label in Figure 4-2.2	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

2.3.1 Compressor Inverter Module PCB field setting

Table 4-2.7: Compressor inverter module PCB switch settings

Switch	Description
SW1 ON / OFF 1 2 3	000: MC-SU30-RN1L compressor inverter module address setting
	000: MC-SU60-RN1L compressor A inverter module address setting
	001: MC-SU60-RN1L compressor B inverter module address setting

2.4 Fan Module Board

Figure 4-2.3: Fan module PCB
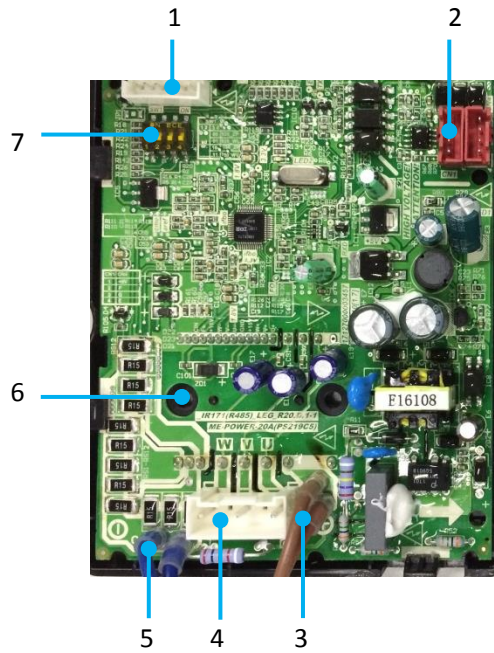
Table 4-2.8: Fan module PCB

Label in Figure 4-2.3	Code	Content	Voltage
1	CN2	EEPROGRAM	-
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	-

2.4.1 Fan Module PCB field setting

Table 4-2.9: Fan module PCB switch settings

Switch		Description
SW1 ON 1 2 3 4 OFF	SW1-1 SW1-2	00: MC-SU30-RN1L fan module address setting
		00: MC-SU60-RN1L fan module A address setting
		01: MC-SU60-RN1L fan module B address setting
	SW1-3 SW1-4	Reserved

2.5 AC Filter Board

Figure 4-2.4: AC filter board[1]
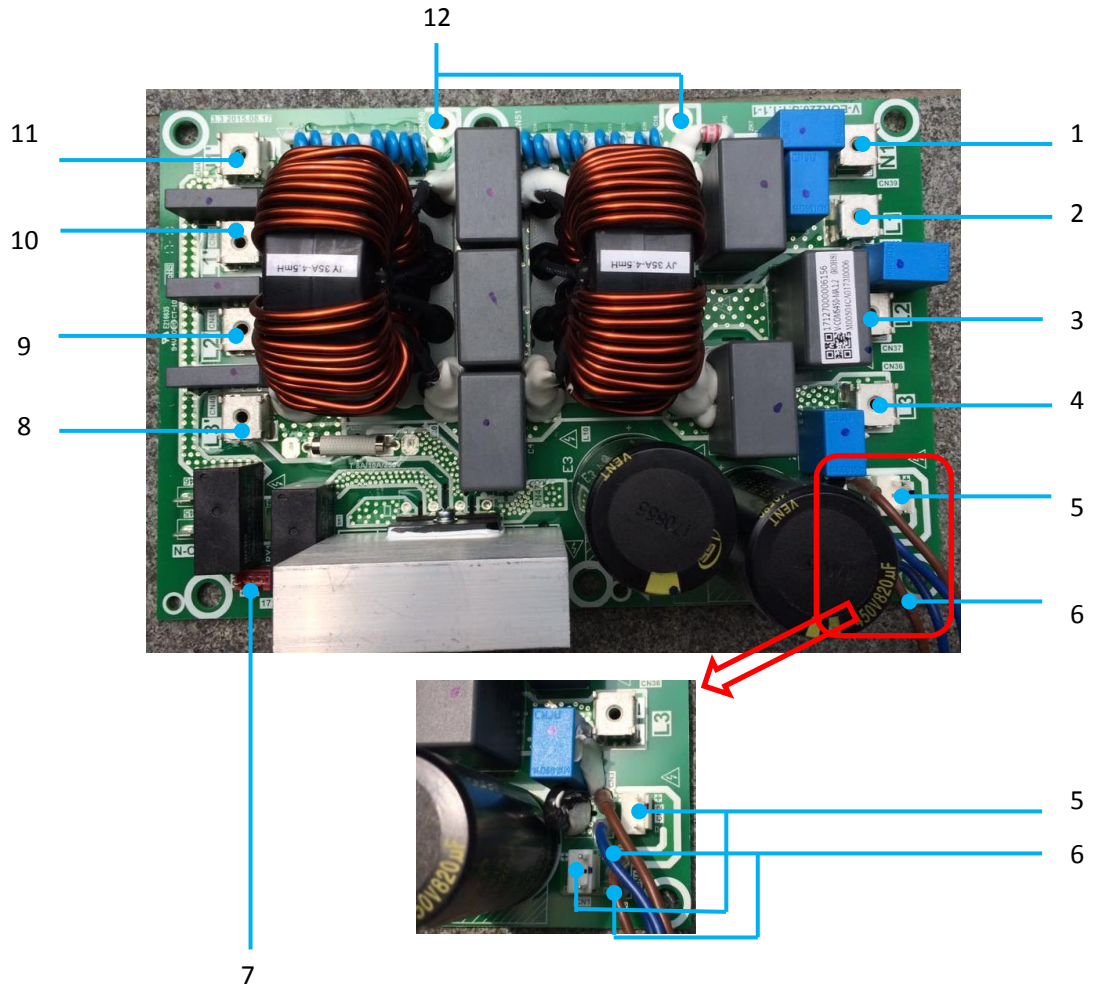
Notes:
1.   Label descriptions are given in Table 4-2.10.

Table 4-2.10: MHC-V10(12, 14, 16)W/D2N1 outdoor unit main PCB for

refrigerant system

Label in Figure 4-2.4	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	-

3 Error Code Table

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
1Eb	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

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 Troubleshooting

4.2.1 Digital display output
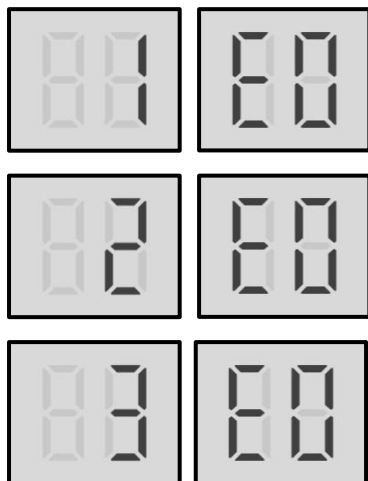
4.2.2 Description

- 1E0 indicates main PCB EEPROM error.
- 2E0 indicates IPM inverter module (compressor A) EEPROM error.
- 3E0 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

```
          ┌─────────────────────┐
          │         E0          │
          └─────────────────────┘
                     │
                     ▼
  ┌──────────────────────────────┐   Yes   ┌──────────────────────────────┐
  │ Main PCB or IPM inverter       │───────▶│ Ensure the EEPROM is connected │
  │ module EEPROM[1] is not        │         │ properly                       │
  │ connected properly             │         └──────────────────────────────┘
  └──────────────────────────────┘
                     │ No
                     ▼
  ┌──────────────────────────────┐   Yes   ┌──────────────────────────────┐
  │ EEPROM damaged                 │───────▶│ Replace the EEPROM             │
  └──────────────────────────────┘         └──────────────────────────────┘
                     │ No
                     ▼
  ┌──────────────────────────────┐
  │ Replace refrigerant system     │
  │ Main PCB or IPM inverter module│
  └──────────────────────────────┘
```
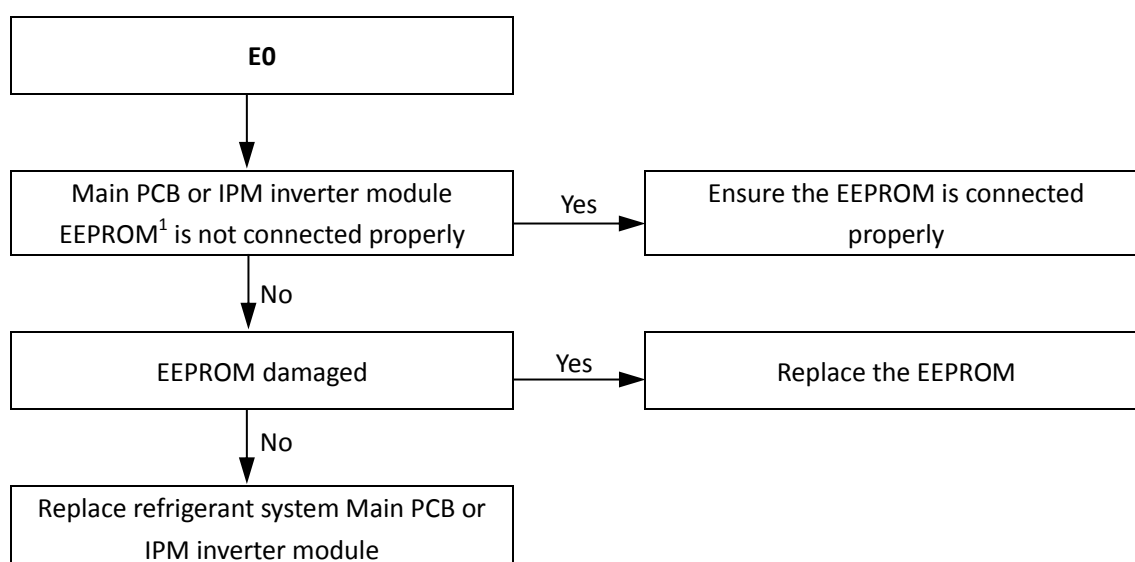
Notes:
1. Main PCB EEPROM is designated IC10 on the main PCBs (labeled 32 in Figure 4-2.1 in Part 4, 2.2 "Main PCB").
2. Compressor inverter module PCB EEPROM is designated IC14 on compressor inverter module PCB (labeled 2 in Figure 4-2.2 in Part 4, 2.3 "Compressor inverter module PCB").

4.3 E1 Troubleshooting

4.3.1 Digital display output
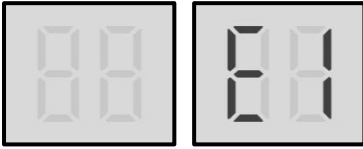
4.3.2 Description

- 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

```
                    ┌─────────────────────────────┐
                    │             E1              │
                    └──────────────┬──────────────┘
                                   │
                                   ▼
    ┌─────────────────────────────┐        Yes    ┌─────────────────────────────┐
    │  The phase sequence of the  │───────────────▶│ Exchange any two of the 3   │
    │    3-phase power supply      │                │      phase wires            │
    │    is incrorrect[1]          │                └─────────────────────────────┘
    └──────────────┬──────────────┘
                   │ No
                   ▼
    ┌─────────────────────────────┐        Yes    ┌─────────────────────────────┐
    │  Some power supply terminals │───────────────▶│ Ensure all supply terminals │
    │       are loose[2]           │                │  are securely fastened      │
    └──────────────┬──────────────┘                └─────────────────────────────┘
                   │ No
                   ▼
    ┌─────────────────────────────┐        Yes    ┌─────────────────────────────┐
    │ The power supply is abnormal │───────────────▶│ Check the power supply      │
    │                              │                │      equipment              │
    └──────────────┬──────────────┘                └─────────────────────────────┘
                   │ No
                   ▼
    ┌─────────────────────────────┐
    │ Replace refrigerant system   │
    │        main PCB              │
    └─────────────────────────────┘
```
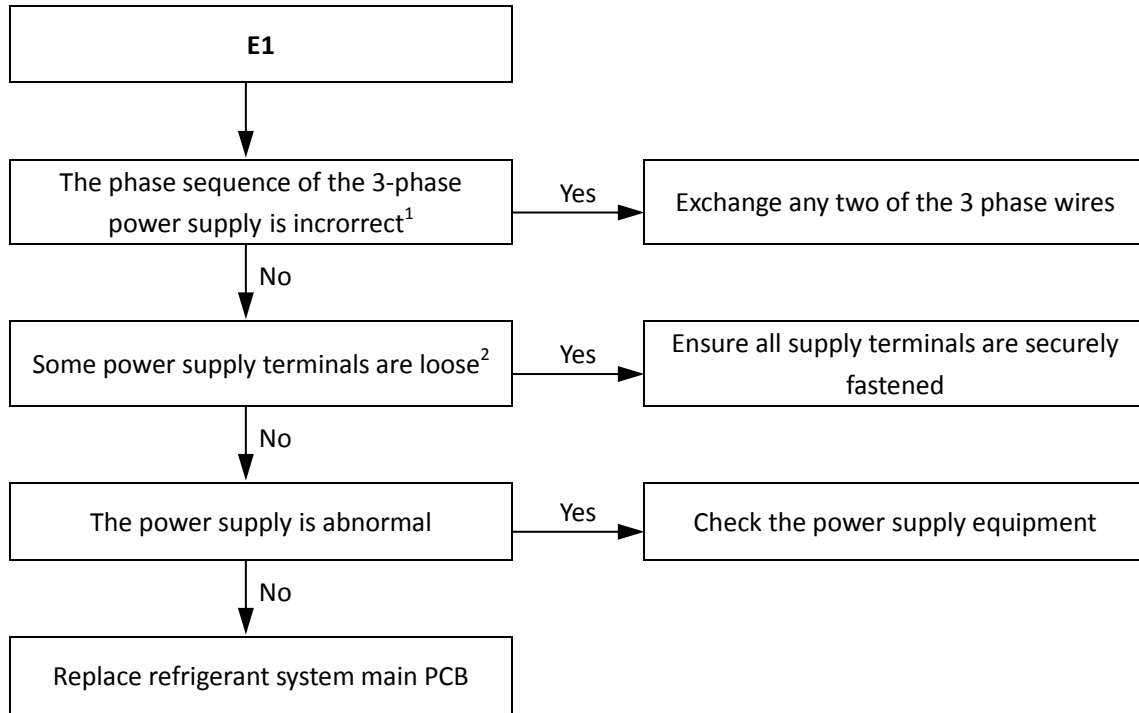
Notes:
1. The A, B, C terminals of 3-phase power supply should match compressor phase sequence requirements. If the phase sequence is inverted, the compressor will operate inversely. If the wiring connection of each outdoor unit is in A, B, C phase sequence, and multiple units are connected, the current 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
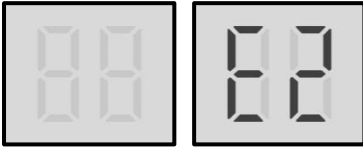
4.4.2 Description

- 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

```
┌─────────────────────────────┐
│             E2              │
└─────────────────────────────┘
              │
              ▼
┌─────────────────────────────┐   Yes   ┌─────────────────────────────┐
│ Communication wires P Q E   │ ──────▶ │ Reconnect the communication │
│ have short circuited,       │         │ wires                       │
│ disconnected or are         │         └─────────────────────────────┘
│ misconnected[1]             │
└─────────────────────────────┘
              │ No
              ▼
┌─────────────────────────────┐   Yes   ┌─────────────────────────────┐
│ Communication wires P Q E   │ ──────▶ │ Connect the communication   │
│ are not connected in a      │         │ wires in a daisy chain      │
│ daisy chain                 │         └─────────────────────────────┘
└─────────────────────────────┘
              │ No
              ▼
┌─────────────────────────────┐   Yes   ┌─────────────────────────────┐
│ Wires between outdoor main  │ ──────▶ │ Ensure the wires are        │
│ PCB and electric control    │         │ connected properly          │
│ box communication terminals │         └─────────────────────────────┘
│ block are loose             │
└─────────────────────────────┘
              │ No
              ▼
┌─────────────────────────────┐   Yes   ┌─────────────────────────────┐
│ Interference from high      │ ──────▶ │ Ensure the communication    │
│ voltage (220V or higher)    │         │ wires and high voltage      │
│ wires                       │         │ wires are separated         │
└─────────────────────────────┘         └─────────────────────────────┘
              │ No
              ▼
┌─────────────────────────────┐   Yes   ┌─────────────────────────────┐
│ Communication wires are     │ ──────▶ │ Remove the source of        │
│ close to a source of        │         │ interference, or add        │
│ electromagnetic radiation   │         │ additional shielding to the │
│ such as transformer or      │         │ communication wires         │
│ strong fluorescent lamp     │         └─────────────────────────────┘
└─────────────────────────────┘
              │ No
              ▼
┌─────────────────────────────┐   Yes   ┌─────────────────────────────┐
│ Damaged control box         │ ──────▶ │ Replacing electric control  │
│ communication terminals     │         │ box communication terminals │
│ block                       │         │ block resolves the error    │
└─────────────────────────────┘         └─────────────────────────────┘
              │ No
              ▼
┌─────────────────────────────┐   Yes   ┌─────────────────────────────┐
│ The length of communication │ ──────▶ │ Reduce the wire length to   │
│ wire is over 1200m          │         │ less than 1200mm or         │
│                             │         │ strengthen the signal       │
└─────────────────────────────┘         └─────────────────────────────┘
              │ No
              ▼
┌─────────────────────────────┐
│ Replace main PCB or user    │
│ interface                   │
└─────────────────────────────┘
```

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, Fb, Fd Troubleshooting

4.5.1 Digital display output

`88`	`E3`
`88`	`E4`
`88`	`E5`
`88`	`E7`
`1`	`Eb`
`2`	`Eb`
`1`	`Ed`
`2`	`Ed`
`88`	`EF`
`88`	`EP`
`88`	`EU`
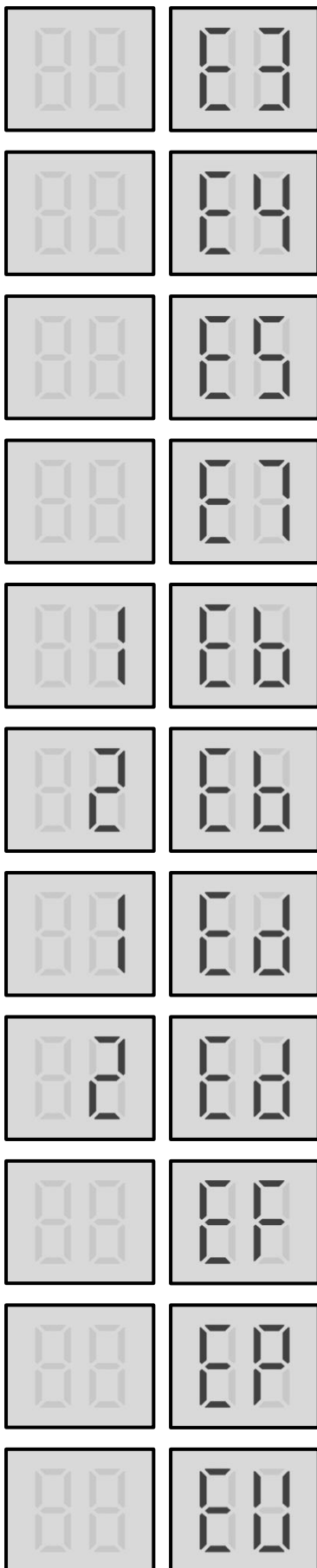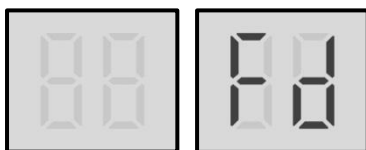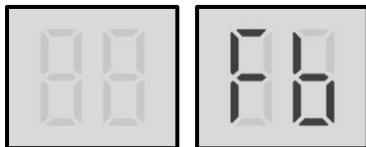
4.5.2 Description

- E3 indicates a combined water outlet temperature sensor error.
- E4 indicates a water outlet temperature sensor error.
- E5 indicates an air side heat exchanger refrigerant outlet temperature sensor error.
- E7 indicates an outdoor ambient temperature sensor error.
- 1Eb indicates a water side heat exchanger anti-freezing temperature sensor 1 error.
- 2Eb indicates a water side heat exchanger anti-freezing temperature sensor 2error.
- 1Ed indicates a discharge pipe temperature sensor 1 error.
- 2Ed indicates a discharge pipe temperature sensor 2 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.
- 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

```
┌─────────────────────────────────────┐
│ E3 / E4 / E5 / E7 / Eb / Ed / EF /   │
│ EP / EU / Fb / Fd                    │
└─────────────────────────────────────┘
                  │
                  ▼
┌─────────────────────────────────┐  Yes  ┌──────────────────────────────────┐
│ Temperature sensor or pressure   │─────▶│ Ensure the sensor is connected    │
│ sensor connection on main PCB is │      │ properly                          │
│ loose                            │      └──────────────────────────────────┘
└─────────────────────────────────┘
                  │ No
                  ▼
┌─────────────────────────────────┐  Yes  ┌──────────────────────────────────┐
│ Temperature or pressure sensor   │─────▶│ Replace the sensor                │
│ has short-circuited or failed[2] │      └──────────────────────────────────┘
└─────────────────────────────────┘
                  │ No
                  ▼
┌─────────────────────────────────┐
│ Replace main PCB                 │
└─────────────────────────────────┘
```
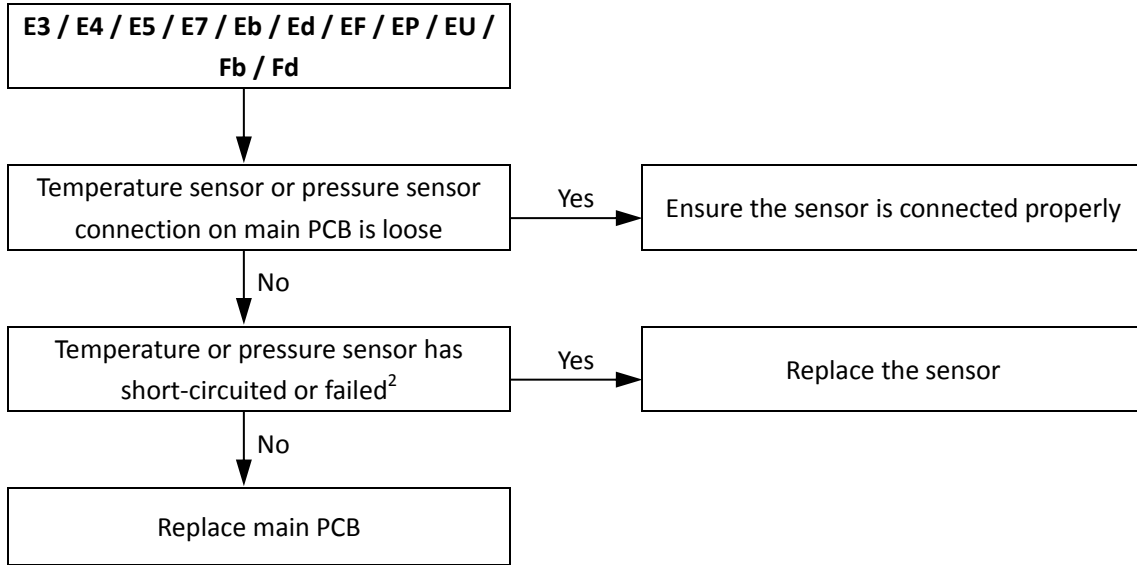
Notes:
1. All the sensors are connected to port CN24, CN69, CN31 and CN40 on the main PCB (labeled 22, 23, 24, 25 in Figure 4-2.1 in Part 4, 2.2 "Outdoor unit main PCB").
2. Measure sensor resistance. If the resistance is too low, the sensor has short-circuited. If the resistance is not consistent with the sensor's resistance characteristics table, the sensor has failed. Refer to Table 4-5.1 or 4-5.2 in Part 4, 5.1 "Temperature Sensor Resistance Characteristics".

Part 4 – Diagnosis and Troubleshooting

4.6 E9 Troubleshooting

4.6.1 Digital display output
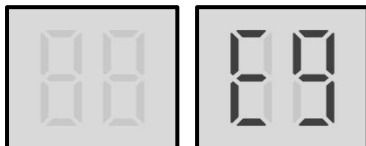
4.6.2 Description

- 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.

4.6.3 Possible causes

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

4.6.4 Procedure

```
┌─────────────────────────────────┐
│              E9                 │
└─────────────────────────────────┘
                │
                ▼
┌─────────────────────────────────┐         ┌─────────────────────────────────┐
│ Water flow switch connection on  │   Yes   │ Ensure the switch is connected    │
│ main PCB is loose¹               │────────▶│ properly                          │
└─────────────────────────────────┘         └─────────────────────────────────┘
                │ No
                ▼
┌─────────────────────────────────┐         ┌─────────────────────────────────┐
│                                 │   Yes   │ Check the water piping and valves.│
│                                 │────────▶│ Make sure the water piping is     │
│ Water flow is insufficient²      │         │ clean, there is no air in the     │
│                                 │         │ water piping and all valves are   │
│                                 │         │ open. Make sure the water pump    │
│                                 │         │ capacity is enough.               │
└─────────────────────────────────┘         └─────────────────────────────────┘
                │ No
                ▼
┌─────────────────────────────────┐         ┌─────────────────────────────────┐
│ Water flow switch is damaged     │   Yes   │ Replace the water flow switch     │
└─────────────────────────────────┘────────▶└─────────────────────────────────┘
                │ No
                ▼
┌─────────────────────────────────┐
│ Replace main PCB                 │
└─────────────────────────────────┘
```

Note:

1. 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").

Part 4 – Diagnosis and Troubleshooting

4.7 EC Troubleshooting

4.7.1 Digital display output
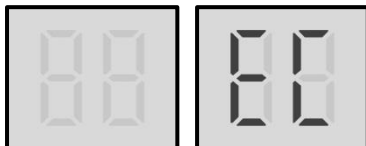
4.7.2 Description

- 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.

4.7.3 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.

4.7.4 Procedure

```
┌─────────────────────────────────────┐
│                 EC                   │
└─────────────────────────────────────┘
                    │
                    ▼
┌─────────────────────────────┐   Yes   ┌────────────────────────────────┐
│ Some outdoor units in the   │───────▶ │  Power on all the outdoor units │
│ system are powered off¹      │         └────────────────────────────────┘
└─────────────────────────────┘
                    │ No
                    ▼
┌─────────────────────────────┐   Yes   ┌────────────────────────────────┐
│ The power supply is abnormal │───────▶ │  Check the power supply equipment│
└─────────────────────────────┘         └────────────────────────────────┘
                    │ No
                    ▼
┌─────────────────────────────┐
│ Troubleshoot as for an E2    │
│ error²                       │
└─────────────────────────────┘
```
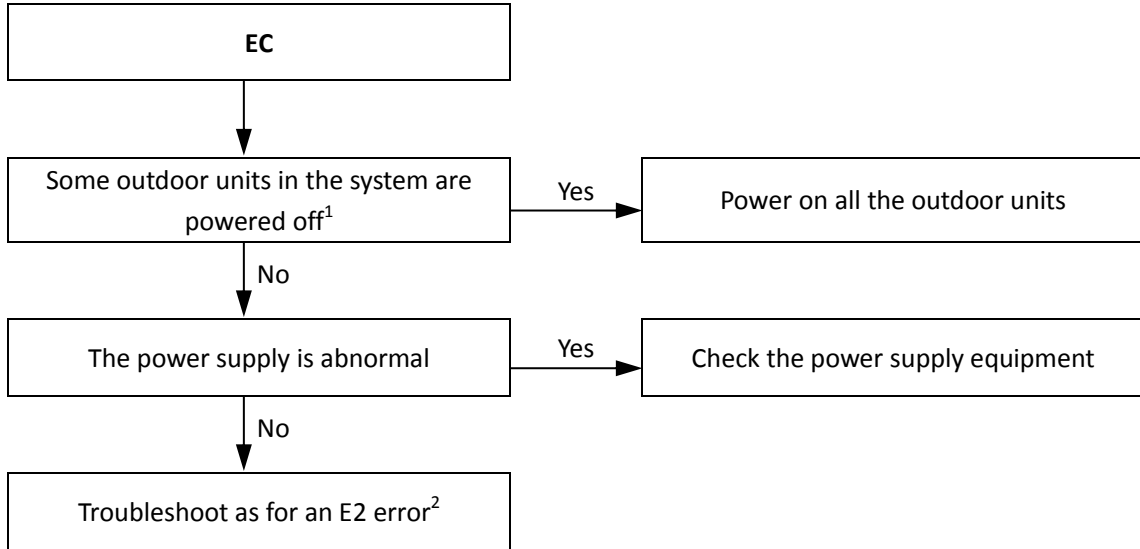
Notes:
1. Check digital display on the main PCB. If digital display is on, the main PCB is powered on, if digital display is off, the main PCB is powered off. Refer to Figure 4-2.1 in Part 4, 2.2 "Outdoor unit main PCB".
2. See Part 4, 4.4 "E2 Troubleshooting".

Part 4 - Diagnosis and Troubleshooting

4.8 EH Troubleshooting

4.8.1 Digital display output
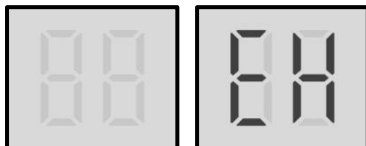
4.8.2 Description

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

4.9 P0 Troubleshooting

4.9.1 Digital display output
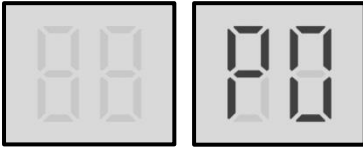
4.9.2 Description

- 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.

4.9.3 Possible causes

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

4.9.4 Procedure

```
┌─────────────────────────────┐
│             P0              │
└─────────────────────────────┘
              │
              ▼
┌─────────────────────────────┐          ┌─────────────────────────────┐
│ High pressure switch or      │   Yes    │ Ensure High pressure switch  │
│ discharge temperature switch │ ───────▶ │ or discharge temperature     │
│ connection on main PCB is    │          │ switch are connected properly│
│ loose[1]                     │          │                              │
└─────────────────────────────┘          └─────────────────────────────┘
              │ No
              ▼
┌─────────────────────────────┐          ┌─────────────────────────────┐
│ High pressure switch or      │   Yes    │ Replace the high pressure    │
│ discharge temperature switch │ ───────▶ │ switch or discharge          │
│ have short-circuited or      │          │ temperature switch           │
│ failed[2]                    │          │                              │
└─────────────────────────────┘          └─────────────────────────────┘
              │ No
              ▼
┌─────────────────────────────┐          ┌─────────────────────────────┐
│ The high pressure side is    │   Yes    │ Inspect the system and fix   │
│ blocked, caused by crushed   │ ───────▶ │ the error                    │
│ or bent pipe or blocked EXV[3]│         │                              │
└─────────────────────────────┘          └─────────────────────────────┘
              │ No
              ▼
┌─────────────────────────────┐          ┌─────────────────────────────┐
│ The heat exchange is poor[4] │   Yes    │ Inspect the system and fix   │
│                              │ ───────▶ │ the error                    │
└─────────────────────────────┘          └─────────────────────────────┘
              │ No
              ▼
┌─────────────────────────────┐          ┌─────────────────────────────┐
│ The water flow rate is not   │   Yes    │ Inspect the water system and │
│ sufficient in cooling mode   │ ───────▶ │ fix the error                │
└─────────────────────────────┘          └─────────────────────────────┘
              │ No
              ▼
┌─────────────────────────────┐
│ Replace outdoor main PCB     │
└─────────────────────────────┘
```

Notes:
1. 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").
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.

4.10 P1 Troubleshooting

4.10.1 Digital display output
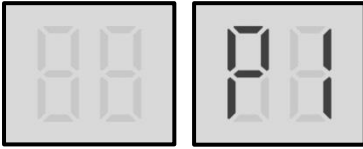
4.10.2 Description

- 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.

4.10.3 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.

4.10.4 Procedure

```
                        ┌─────────────────────────┐
                        │            P1           │
                        └────────────┬────────────┘
                                     │
                                     ▼
       ┌─────────────────────────┐      Yes  ┌─────────────────────────┐
       │ Insufficient refrigerant │  ──────▶  │ Add refrigerant or       │
       │ caused by refrigerant    │           │ inspect the system for   │
       │ leakage¹                 │           │ leaks                    │
       └────────────┬────────────┘           └─────────────────────────┘
                    │ No
                    ▼
       ┌─────────────────────────┐      Yes  ┌─────────────────────────┐
       │ The low pressure side is │  ──────▶  │ Inspect the system and   │
       │ blocked, caused by       │           │ fix the error. If the    │
       │ crushed or bent pipe,    │           │ filter is blocked by ice,│
       │ blocked EXV, or dirty    │           │ the piping should        │
       │ filter²                  │           │ be cleaned               │
       └────────────┬────────────┘           └─────────────────────────┘
                    │ No
                    ▼
       ┌─────────────────────────┐      Yes  ┌─────────────────────────┐
       │ The air side heat        │  ──────▶  │ Inspect the refrigerant  │
       │ exchanger heat exchange  │           │ system and fix the       │
       │ is poor in heating mode³ │           │ error                    │
       └────────────┬────────────┘           └─────────────────────────┘
                    │ No
                    ▼
       ┌─────────────────────────┐      Yes  ┌─────────────────────────┐
       │ The water flow rate is   │  ──────▶  │ Inspect the water system │
       │ not sufficient in        │           │ and fix the              │
       │ cooling mode⁴            │           │ error                    │
       └────────────┬────────────┘           └─────────────────────────┘
                    │ No
                    ▼
       ┌─────────────────────────┐
       │ Replace main PCB        │
       └─────────────────────────┘
```

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.

4.11 P4, P5 Troubleshooting

4.11.1 Digital display output
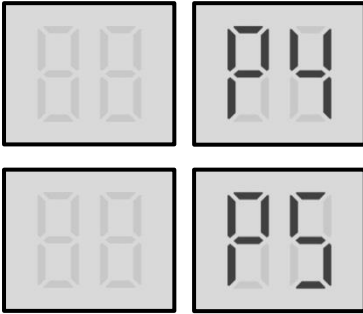
4.11.2 Description

- P4 indicates current protection on Phase B.
- P5 indicates current protection on Phase C.
- When the compressor current rises above the protection value 25A, the system displays P3 or P4 protection and all units stop running. When the current returns to the normal range, P3 or P4 is removed and normal operation resumes. When P3 or P4 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

- 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.

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```
┌─────────────────────────┐
│         P4/P5           │
└────────────┬────────────┘
             ▼
┌─────────────────────────┐   Yes   ┌──────────────────────────────┐
│ The power supply is      │────────▶│ Check the power supply        │
│ abnormal                 │         │ equipment                     │
└────────────┬────────────┘         └──────────────────────────────┘
             │ No
             ▼
┌─────────────────────────┐   Yes   ┌──────────────────────────────┐
│ Excess refrigerant       │────────▶│ Discharge part of the         │
│                          │         │ refrigerant. Add oil          │
│                          │         │ if it leaks during dishcarge  │
└────────────┬────────────┘         └──────────────────────────────┘
             │ No
             ▼
┌─────────────────────────┐   Yes   ┌──────────────────────────────┐
│ System contains air or   │────────▶│ Flush all refrigerant then    │
│ nitrogen                 │         │ vacuum the system and         │
│                          │         │ recharge refrigerant. Add oil │
│                          │         │ to the system if it leaks     │
└────────────┬────────────┘         └──────────────────────────────┘
             │ No
             ▼
┌─────────────────────────┐   Yes   ┌──────────────────────────────┐
│ The condenser heat       │────────▶│ Inspect the system and fix    │
│ exchange is poor[1]      │         │ the error                     │
└────────────┬────────────┘         └──────────────────────────────┘
             │ No
             ▼
┌─────────────────────────┐   Yes   ┌──────────────────────────────┐
│ The high pressure side   │────────▶│ Inspect the system and fix    │
│ is blocked, caused by    │         │ the error                     │
│ crushed or bent pipe or  │         │                               │
│ blocked EXV[2]           │         │                               │
└────────────┬────────────┘         └──────────────────────────────┘
             │ No
             ▼
┌─────────────────────────┐   Yes   ┌──────────────────────────────┐
│ Inverter module has      │────────▶│ Replace the inverter module   │
│ short-circuited[3]       │         │                               │
└────────────┬────────────┘         └──────────────────────────────┘
             │ No
             ▼
┌─────────────────────────┐   Yes   ┌──────────────────────────────┐
│ Compressor has           │────────▶│ Replace the compressor        │
│ malfunctioned[4]         │         │                               │
└────────────┬────────────┘         └──────────────────────────────┘
             │ No
             ▼
┌─────────────────────────┐
│ Replace outdoor main PCB │
└─────────────────────────┘
```

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.

4.12 P6 Troubleshooting

4.12.1 Digital display output
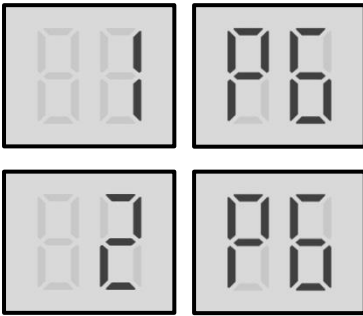
4.12.2 Description

- 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.

4.12.3 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.

4.12.4 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 5-4.3 and Table 5-4.1.

Figure 4-4.1: Button SW3 on main PCB
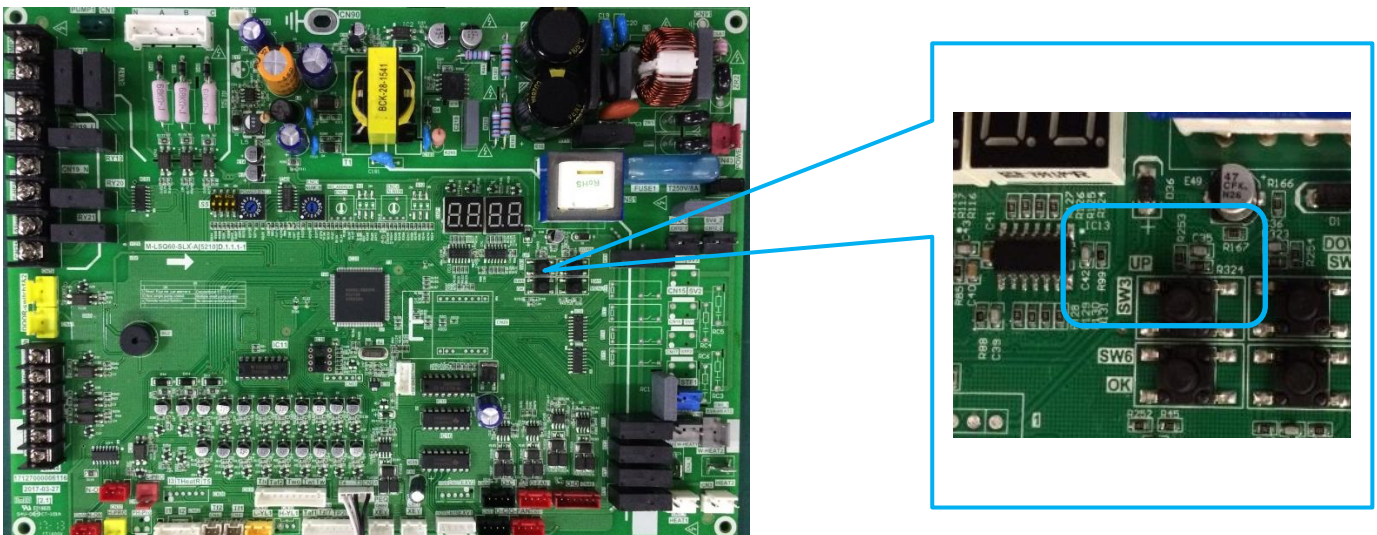
Table 4-4.1: Specific error codes for error xH4

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:

1. '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 cjcled5

n 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 5-4.4 and Table 5-4.2.

Figure 4-4.2: LED indicators LED4 and LED5 on main PCB
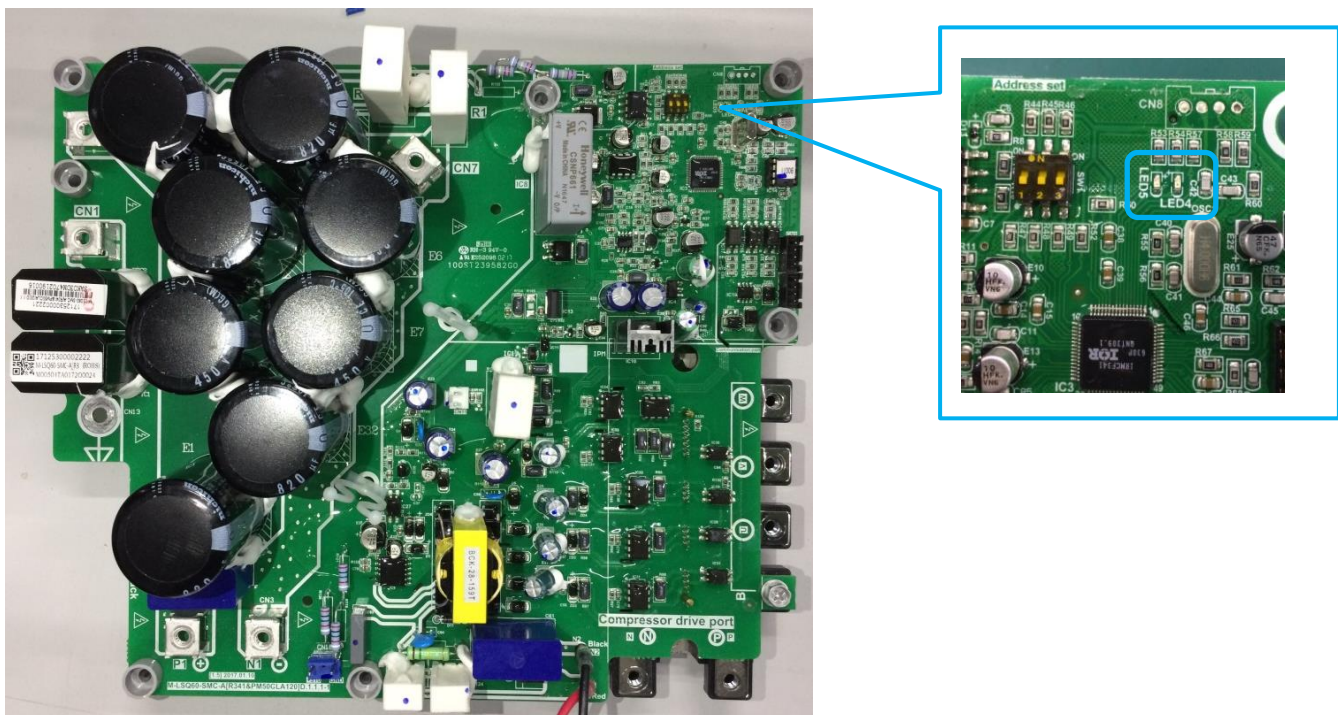
Table 5-4.2: Errors indicated on LED4/6

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

4.12.5 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

Current sensor

DC bus wire

DC filter board N terminal

Inverter module N terminal
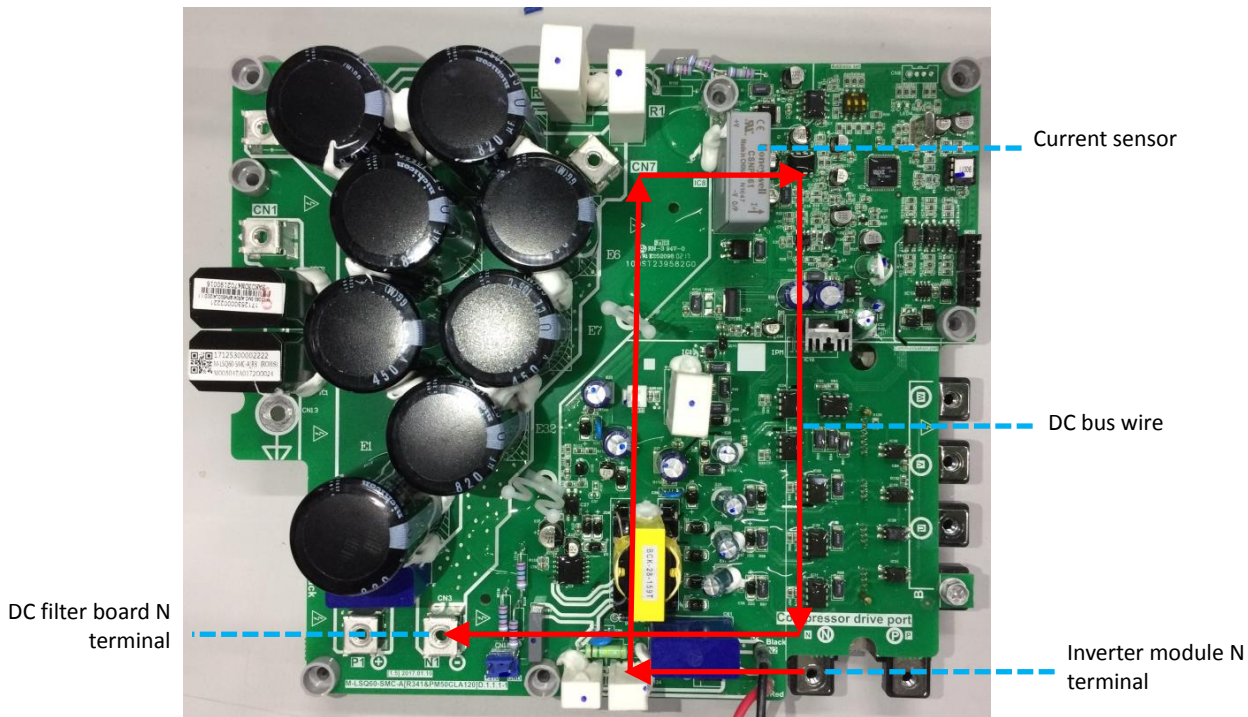
4.12.6 xL0 troubleshooting

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, 4.12.7 "xL1/xL4 troubleshooting" or Part 4, 4.12.8 "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

4.12.7 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
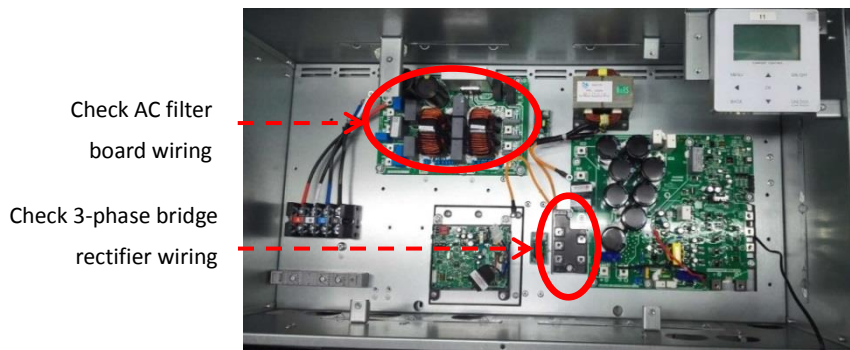
Check AC filter board wiring

Check 3-phase bridge rectifier wiring

4.12.8 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

4.12.9 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, 4.12.6 "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

Unit with error   **Unit operating normally**

Power line (U, V, W terminals)

- 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".

4.12.10 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.)

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

This oil is black - it has been carbonized

This oil is a little yellow, but is clear and transparent and the condition is acceptable

This oil is still transparent but there are impurities which may clog the filter

Part 4 - Diagnosis and Troubleshooting

Cloudy or gray oil indicates abnormal system operation

This oil contains particles of copper

4.13 P7 Troubleshooting

4.13.1 Digital display output
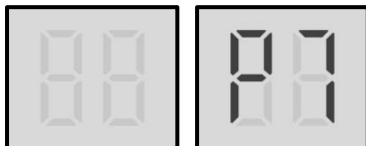
4.13.2 Description

- 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.

4.13.3 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.

4.13.4 Procedure

```
┌─────────────────────────┐
│           P7            │
└─────────────────────────┘
             │
             ▼
┌─────────────────────────┐    Yes    ┌─────────────────────────┐
│ Air side heat exchanger │──────────▶│ Ensure the temperature  │
│ refrigerant outlet      │           │ sensor is connected     │
│ temperature sensor or   │           │ properly                │
│ air side heat exchanger │           └─────────────────────────┘
│ refrigerant total outlet│
│ temperature sensor is   │
│ loose¹                  │
└─────────────────────────┘
             │ No
             ▼
┌─────────────────────────┐    Yes    ┌─────────────────────────┐
│ Fan motor wiring        │──────────▶│ Ensure fan motor wiring │
│ connection is wrong     │           │ is connected properly   │
└─────────────────────────┘           └─────────────────────────┘
             │ No
             ▼
┌─────────────────────────┐    Yes    ┌─────────────────────────┐
│ Air side heat exchanger │──────────▶│ Replace the temperature │
│ refrigerant outlet      │           │ sensor                  │
│ temperature sensor or   │           └─────────────────────────┘
│ air side heat exchanger │
│ refrigerant total outlet│
│ temperature sensor has  │
│ short-circuited or      │
│ failed²                 │
└─────────────────────────┘
             │ No
             ▼
┌─────────────────────────┐    Yes    ┌─────────────────────────┐
│ The air side heat       │──────────▶│ Inspect the system and  │
│ exchanger heat exchange │           │ fix the error           │
│ is poor³                │           └─────────────────────────┘
└─────────────────────────┘
             │ No
             ▼
┌─────────────────────────┐    Yes    ┌─────────────────────────┐
│ The fan or fan motor is │──────────▶│ Inspect the system and  │
│ blocked or damaged      │           │ fix the error           │
└─────────────────────────┘           └─────────────────────────┘
             │ No
             ▼
┌─────────────────────────┐
│ Replace outdoor main PCB│
└─────────────────────────┘
```

Notes:

1. 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").
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 4-5.1 in Part 4, 5.1 "Temperature Sensor Resistance Characteristics".
3. Check air side heat exchanger, fan(s) and air outlets for dirt/blockages.

4.14 P9 Troubleshooting

4.14.1 Digital display output
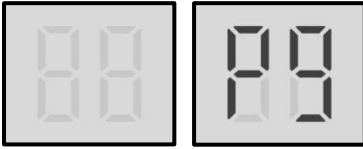
4.14.2 Description

- 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.

4.14.3 Possible causes

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

4.14.4 Procedure

```
                    ┌─────────────────────────┐
                    │           P9            │
                    └─────────────────────────┘
                                 │
                                 ▼
   ┌─────────────────────────────────────┐   Yes   ┌──────────────────────────────┐
   │ Water side heat exchanger water      │ ──────▶ │ Ensure the temperature sensor│
   │ inlet / outlet temperature sensor    │         │ is connected properly        │
   │ is loose[1]                          │         └──────────────────────────────┘
   └─────────────────────────────────────┘
                     │ No
                     ▼
   ┌─────────────────────────────────────┐   Yes   ┌──────────────────────────────┐
   │ Water side heat exchanger water      │ ──────▶ │ Replace the temperature      │
   │ inlet / outlet temperature sensor    │         │ sensor                       │
   │ has short-circuited or failed[2]     │         └──────────────────────────────┘
   └─────────────────────────────────────┘
                     │ No
                     ▼
   ┌─────────────────────────────────────┐   Yes   ┌──────────────────────────────┐
   │ Water piping contains air            │ ──────▶ │ Purge air from the water     │
   │                                      │         │ system                       │
   └─────────────────────────────────────┘         └──────────────────────────────┘
                     │ No
                     ▼
   ┌─────────────────────────────────────┐   Yes   ┌──────────────────────────────┐
   │ The water flow rate is not           │ ──────▶ │ Inspect the system and fix   │
   │ sufficient, caused by crushed or     │         │ the error                    │
   │ bent water piping, pump capacity     │         └──────────────────────────────┘
   │ or high resistance in water piping   │
   └─────────────────────────────────────┘
                     │ No
                     ▼
   ┌─────────────────────────────────────┐
   │ Replace outdoor main PCB            │
   └─────────────────────────────────────┘
```

Notes:
1. 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. 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 4-5.1 in Part 5, 5.1 "Temperature Sensor Resistance Characteristics".

4.15 Pb Troubleshooting

4.15.1 Digital display output
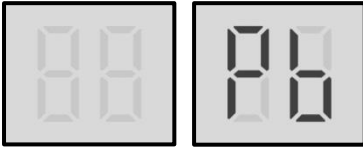
4.15.2 Description

- 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.

4.15.3 Possible causes

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

4.15.4 Procedure

```
                        ┌─────────────┐
                        │     Pb      │
                        └──────┬──────┘
                               │
  ┌──────────────────────────────────────┐   Yes  ┌──────────────────────────────┐
  │ Min(Tw/Two/Twi/Taf) ≤ 4°C in normal   │───────▶│ Normal system protection. The│
  │ cooling mode or min(Tw/Two/Twi/Taf) ≤ │        │ system will resume           │
  │ 0°C in low water outlet mode[1]        │        │ automatically[2]             │
  └──────────────────────────────────────┘        └──────────────────────────────┘
                               │ No
  ┌──────────────────────────────────────┐   Yes  ┌──────────────────────────────┐
  │ Tw/Two/Twi/Taf temperature sensor     │───────▶│ Ensure the temperature sensor│
  │ loose                                  │        │ is connected properly        │
  └──────────────────────────────────────┘        └──────────────────────────────┘
                               │ No
  ┌──────────────────────────────────────┐   Yes  ┌──────────────────────────────┐
  │ Tw/Two/Twi/Taf temperature sensor has │───────▶│ Replace the temperature      │
  │ short-circuited or failed[3]           │        │ sensor                       │
  └──────────────────────────────────────┘        └──────────────────────────────┘
                               │ No
  ┌──────────────────────────────────────┐
  │ Replace outdoor main PCB               │
  └──────────────────────────────────────┘
```

Notes:
1. 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").
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 4-5.1 in Part 5, 5.1 "Temperature Sensor Resistance Characteristics".

4.16 PC Troubleshooting

4.16.1 Digital display output
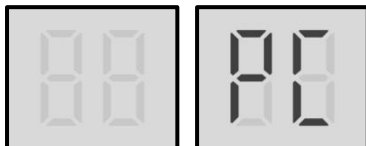
4.16.2 Description

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

4.16.3 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.

4.16.4 Procedure

```
                        ┌─────────────────────┐
                        │         PC          │
                        └─────────────────────┘
                                  │
                                  ▼
        ┌─────────────────────────────────┐   Yes   ┌─────────────────────────────────┐
        │ Low pressure sensor connection  │────────▶│ Ensure the sensor is connected  │
        │ on main PCB is loose¹           │         │ properly                        │
        └─────────────────────────────────┘         └─────────────────────────────────┘
                      │ No
                      ▼
        ┌─────────────────────────────────┐   Yes   ┌─────────────────────────────────┐
        │ Low pressure sensor has short-  │────────▶│ Replace the sensor              │
        │ circuited or failed²            │         │                                 │
        └─────────────────────────────────┘         └─────────────────────────────────┘
                      │ No
                      ▼
        ┌─────────────────────────────────┐   Yes   ┌─────────────────────────────────┐
        │ Insufficient refrigerant caused │────────▶│ Add refrigerant or inspect the  │
        │ by refrigerant leakage³         │         │ system for leaks                │
        └─────────────────────────────────┘         └─────────────────────────────────┘
                      │ No
                      ▼
        ┌─────────────────────────────────┐   Yes   ┌─────────────────────────────────┐
        │ The low pressure side is        │────────▶│ Inspect the system and fix the  │
        │ blocked, caused by crushed or   │         │ error. If the filter is blocked │
        │ bent pipe, blocked EXV, or      │         │ by ice, the piping should be    │
        │ dirty filter⁴                   │         │ cleaned                         │
        └─────────────────────────────────┘         └─────────────────────────────────┘
                      │ No
                      ▼
        ┌─────────────────────────────────┐   Yes   ┌─────────────────────────────────┐
        │ The air side heat exchanger     │────────▶│ Inspect the refrigerant system  │
        │ heat exchange is poor in        │         │ and fix the error               │
        │ heating mode⁵                   │         │                                 │
        └─────────────────────────────────┘         └─────────────────────────────────┘
                      │ No
                      ▼
        ┌─────────────────────────────────┐   Yes   ┌─────────────────────────────────┐
        │ The water flow rate is not      │────────▶│ Inspect the water system and    │
        │ sufficient in cooling mode⁶     │         │ fix the error                   │
        └─────────────────────────────────┘         └─────────────────────────────────┘
                      │ No
                      ▼
        ┌─────────────────────────────────┐
        │ Replace main PCB                │
        └─────────────────────────────────┘
```

Part 4 - Diagnosis and Troubleshooting

Notes:
1. 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") .
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.

4.17 PE Troubleshooting

4.17.1 Digital display output

4.17.2 Description

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

4.17.3 Possible causes

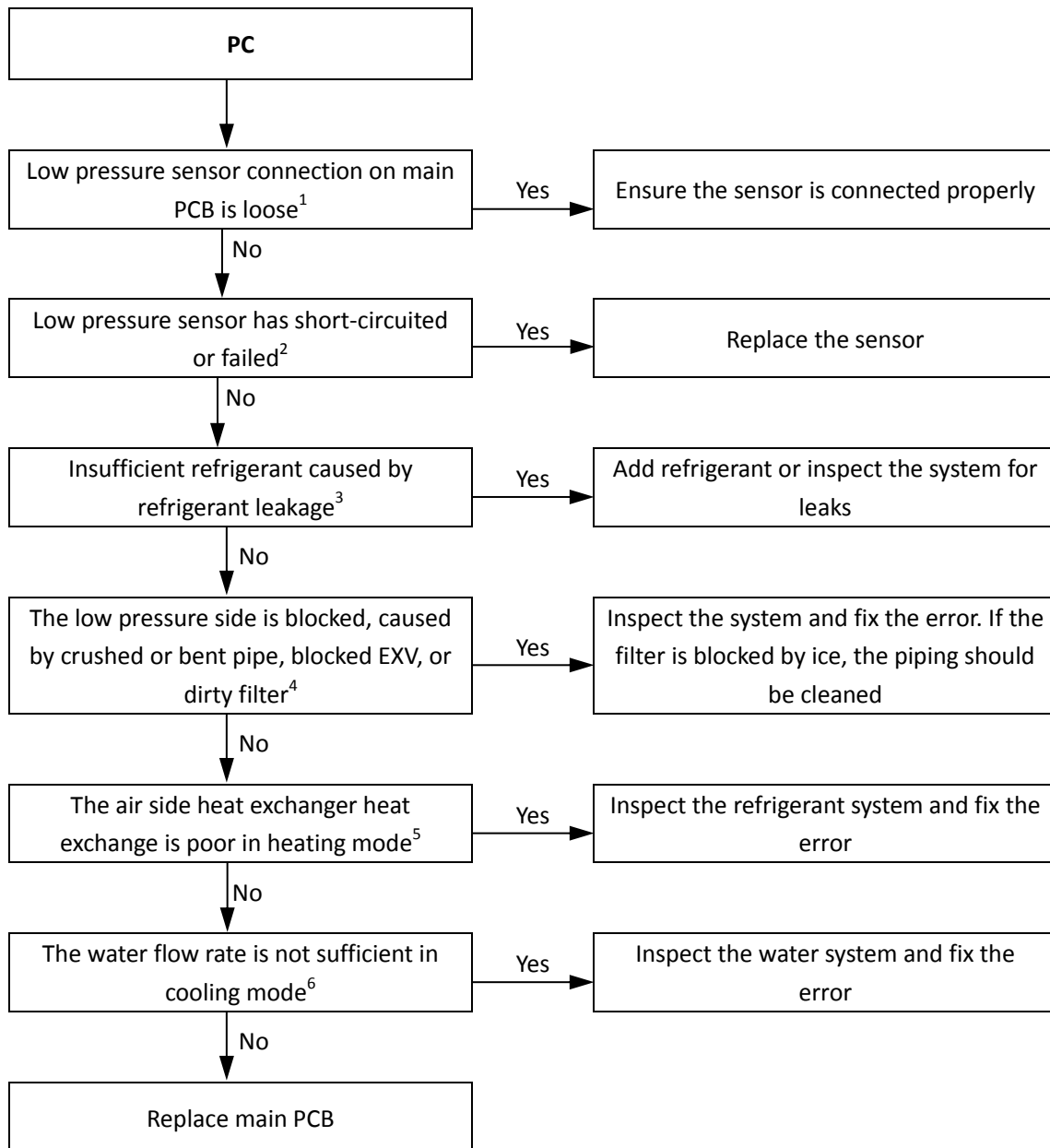- Temperature sensor not connected properly or has malfunctioned.
- Insufficient refrigerant.
- Low pressure side blockage.
- Poor evaporator heat exchange in heating mode.
- Insufficient water flow in cooling mode.
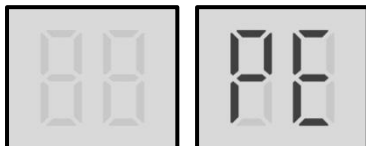- Main PCB damaged.

4.17.4 Procedure

```
                    ┌─────────────────────────┐
                    │            PE            │
                    └─────────────────────────┘
                                 │
                                 ▼
        ┌─────────────────────────┐                    ┌─────────────────────────┐
        │ Taf temperature sensor  │        Yes         │ Ensure the sensor is     │
        │ connection on main PCB  │──────────────────▶ │ connected properly       │
        │ is loose[1]             │                    └─────────────────────────┘
        └─────────────────────────┘
                   │ No
                   ▼
        ┌─────────────────────────┐                    ┌─────────────────────────┐
        │ Taf temperature sensor  │        Yes         │ Replace the sensor       │
        │ has short-circuited or  │──────────────────▶ └─────────────────────────┘
        │ failed[2]               │
        └─────────────────────────┘
                   │ No
                   ▼
        ┌─────────────────────────┐                    ┌─────────────────────────┐
        │ Insufficient refrigerant│        Yes         │ Add refrigerant or       │
        │ caused by refrigerant   │──────────────────▶ │ inspect the system for   │
        │ leakage[3]              │                    │ leaks                    │
        └─────────────────────────┘                    └─────────────────────────┘
                   │ No
                   ▼
        ┌─────────────────────────┐                    ┌─────────────────────────┐
        │ The low pressure side is│                    │ Inspect the system and   │
        │ blocked, caused by      │        Yes         │ fix the error. If the    │
        │ crushed or bent pipe,   │──────────────────▶ │ filter is blocked by ice,│
        │ blocked EXV, or dirty   │                    │ the piping should be     │
        │ filter[4]               │                    │ cleaned                  │
        └─────────────────────────┘                    └─────────────────────────┘
                   │ No
                   ▼
        ┌─────────────────────────┐                    ┌─────────────────────────┐
        │ The air side heat       │        Yes         │ Inspect the refrigerant  │
        │ exchanger heat exchange │──────────────────▶ │ system and fix the       │
        │ is poor in heating      │                    │ error                    │
        │ mode[5]                 │                    └─────────────────────────┘
        └─────────────────────────┘
                   │ No
                   ▼
        ┌─────────────────────────┐                    ┌─────────────────────────┐
        │ The water flow rate is  │        Yes         │ Inspect the water system │
        │ not sufficient in       │──────────────────▶ │ and fix the error        │
        │ cooling mode[6]         │                    └─────────────────────────┘
        └─────────────────────────┘
                   │ No
                   ▼
        ┌─────────────────────────┐
        │ Replace main PCB        │
        └─────────────────────────┘
```

Part 4 - Diagnosis and Troubleshooting

Notes:
1. 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. Measure sensor resistance. If the resistance is too low, the sensor has short-circuited. If the resistance is not consistent with the sensor's resistance characteristics table, the sensor has failed. Refer to Part 2, 1 "Layout of Functional Components" and to Table 4-5.3 in Part 4, 5.1 "Temperature Sensor Resistance Characteristics".
3. To check for insufficient refrigerant: an insufficiency of refrigerant causes compressor discharge temperature to be higher than normal, discharge and suction pressures to be lower than normal and compressor current to be lower than normal, and may cause frosting to occur on the suction pipe. These issues disappear once sufficient refrigerant has been charged into the system.
4. A low pressure side blockage causes compressor discharge temperature to be higher than normal, suction pressure to be lower than normal and compressor current to be lower than normal, and may cause frosting to occur on the suction pipe. For normal system parameters.
5. Check 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.

4.18 PL Troubleshooting

4.18.1 Digital display output
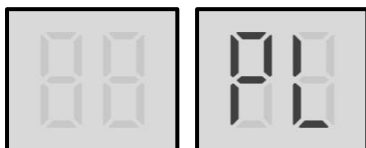
4.18.2 Description

- 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, a manual system restart is required before the system can resume operation.
- Error code is displayed on the main PCB and user interface.

4.18.3 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.

4.18.4 Procedure

```
                    ┌─────────────────────────┐
                    │           PL            │
                    └─────────────────────────┘
                                 │
                                 ▼
        ┌─────────────────────────────────┐  Yes  ┌─────────────────────────────┐
        │ The inverter module heat sink is│──────▶│ Clean or replace the heat    │
        │ blocked or dirty¹               │       │ sink                         │
        └─────────────────────────────────┘       └─────────────────────────────┘
                                 │ No
                                 ▼
        ┌─────────────────────────────────┐  Yes  ┌─────────────────────────────┐
        │ The screws connecting the heat  │──────▶│ Tighten the screws and make  │
        │ sink to the inverter module are │       │ sure the heat sink is        │
        │ loose²                          │       │ well-connected               │
        └─────────────────────────────────┘       └─────────────────────────────┘
                                 │ No
                                 ▼
        ┌─────────────────────────────────┐  Yes  ┌─────────────────────────────┐
        │ Inverter module temperature     │──────▶│ Ensure the sensor is         │
        │ sensor connection on main PCB   │       │ connected properly           │
        │ is loose³                       │       │                              │
        └─────────────────────────────────┘       └─────────────────────────────┘
                                 │ No
                                 ▼
        ┌─────────────────────────────────┐  Yes  ┌─────────────────────────────┐
        │ Inverter module temperature     │──────▶│ Replace the sensor           │
        │ sensor has short circuited or   │       │                              │
        │ failed⁴                         │       │                              │
        └─────────────────────────────────┘       └─────────────────────────────┘
                                 │ No
                                 ▼
        ┌─────────────────────────────────┐  Yes  ┌─────────────────────────────┐
        │ Fan motor wiring connection is  │──────▶│ Check the fan motor wiring   │
        │ wrong                           │       │ connection                   │
        └─────────────────────────────────┘       └─────────────────────────────┘
                                 │ No
                                 ▼
        ┌─────────────────────────────────┐
        │ Replace outdoor main PCB        │
        └─────────────────────────────────┘
```

Notes:
1. Refer to Figures 4-1.2 and 4-1.4 in Part 4, 1 "Outdoor Unit Electric Control Box Layout".
2. Refer to Figures 4-1.2 and 4-1.4 in Part 4, 1 "Outdoor Unit Electric Control Box Layout".
3. 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").
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 4-5.3 "Temperature Sensor Resistance Characteristics".

Part 4 - Diagnosis and Troubleshooting

4.19 PU/FF Troubleshooting

4.19.1 Digital display output
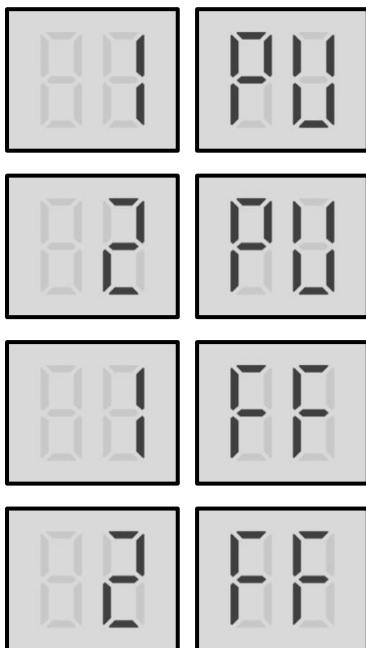
4.19.2 Description

- 1PU indicates fan module A protection.
- 2PU indicates fan module B 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. The cause of an HH error should be addressed promptly in order to avoid system damage.
- Error code is only displayed on the main PCB and user interface.

4.19.3 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.

4.19.4 Procedure

```
        ┌──────────────────────────┐
        │          PU/FF           │
        └──────────────────────────┘
                     │ No
                     ▼
┌──────────────────────────────────┐        ┌──────────────────────────────────┐
│ Some power wires or communication │  Yes   │ Ensure power and communication   │
│ wires of fan module are not       │──────▶ │ wires are connected properly     │
│ connected properly[1]             │        │                                  │
└──────────────────────────────────┘        └──────────────────────────────────┘
                     │ No
                     ▼
┌──────────────────────────────────┐        ┌──────────────────────────────────┐
│ The fan motor is blocked or has   │  Yes   │ Remove obstruction or replace the│
│ failed[2]                         │──────▶ │ fan motor                        │
└──────────────────────────────────┘        └──────────────────────────────────┘
                     │ No
                     ▼
┌──────────────────────────────────┐        ┌──────────────────────────────────┐
│ The power supply is abnormal      │  Yes   │ Check the power supply equipment │
│                                   │──────▶ │                                  │
└──────────────────────────────────┘        └──────────────────────────────────┘
                     │ No
                     ▼
┌──────────────────────────────────┐        ┌──────────────────────────────────┐
│ Voltage between P and N on fan    │  Yes   │ Replace AC filter board          │
│ module is abnormal[3]             │──────▶ │                                  │
└──────────────────────────────────┘        └──────────────────────────────────┘
                     │ No
                     ▼
┌──────────────────────────────────┐
│ Replacing the fan module resolves │
│ the error                         │
└──────────────────────────────────┘
                     │ No
                     ▼
┌──────────────────────────────────┐
│ Replace main PCB                  │
└──────────────────────────────────┘
```

Notes:
1. Refer to Figures 4-1.2 and 4-14 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 and 4-1.4 in Part 4, 1 "Outdoor Unit Electric Control Box Layout" and to Figure 4-2.3 in Part 4, 2 "Fan module PCB"

Part 4 - Diagnosis and Troubleshooting

4.20 H0 Troubleshooting
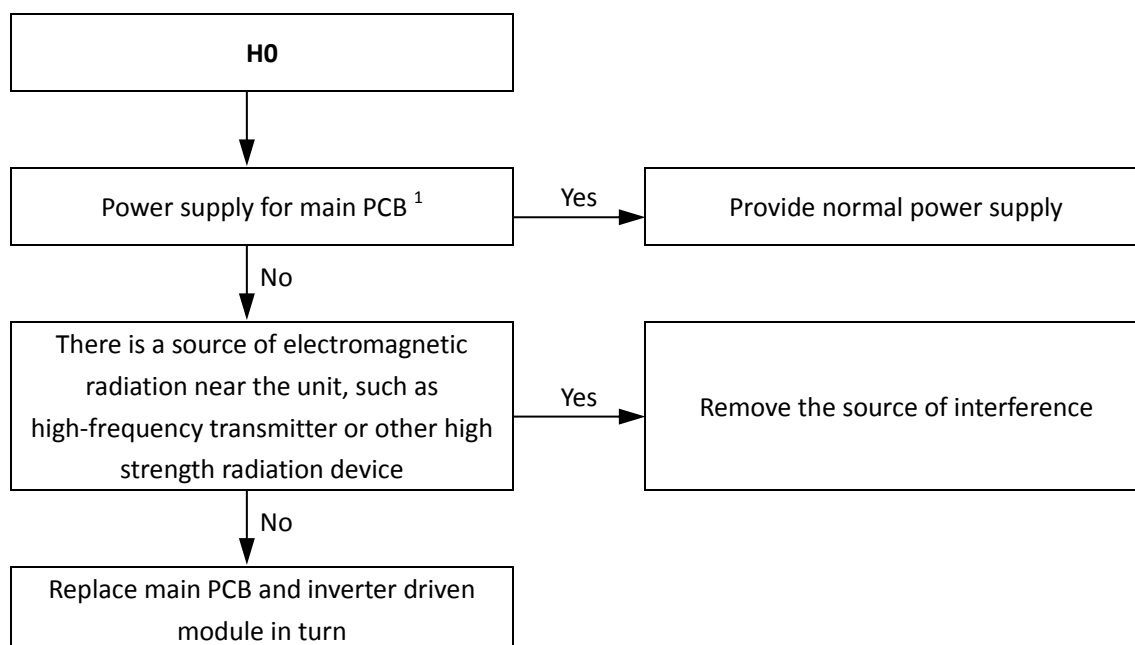
4.20.1 Digital display output
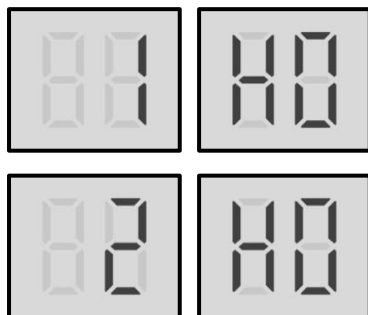
4.20.2 Description

- 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.

4.20.3 Possible causes

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

4.20.4 Procedure

```
        ┌─────────────────────────┐
        │           H0            │
        └─────────────────────────┘
                     │
                     ▼
        ┌─────────────────────────┐   Yes   ┌──────────────────────────┐
        │ Power supply for main    │────────▶│ Provide normal power     │
        │ PCB [1]                  │         │ supply                   │
        └─────────────────────────┘         └──────────────────────────┘
                     │ No
                     ▼
        ┌─────────────────────────┐
        │ There is a source of     │
        │ electromagnetic          │   Yes   ┌──────────────────────────┐
        │ radiation near the unit, │────────▶│ Remove the source of     │
        │ such as high-frequency   │         │ interference             │
        │ transmitter or other high│         └──────────────────────────┘
        │ strength radiation device│
        └─────────────────────────┘
                     │ No
                     ▼
        ┌─────────────────────────┐
        │ Replace main PCB and     │
        │ inverter driven module   │
        │ in turn                  │
        └─────────────────────────┘
```

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").

4.21 H1 Troubleshooting
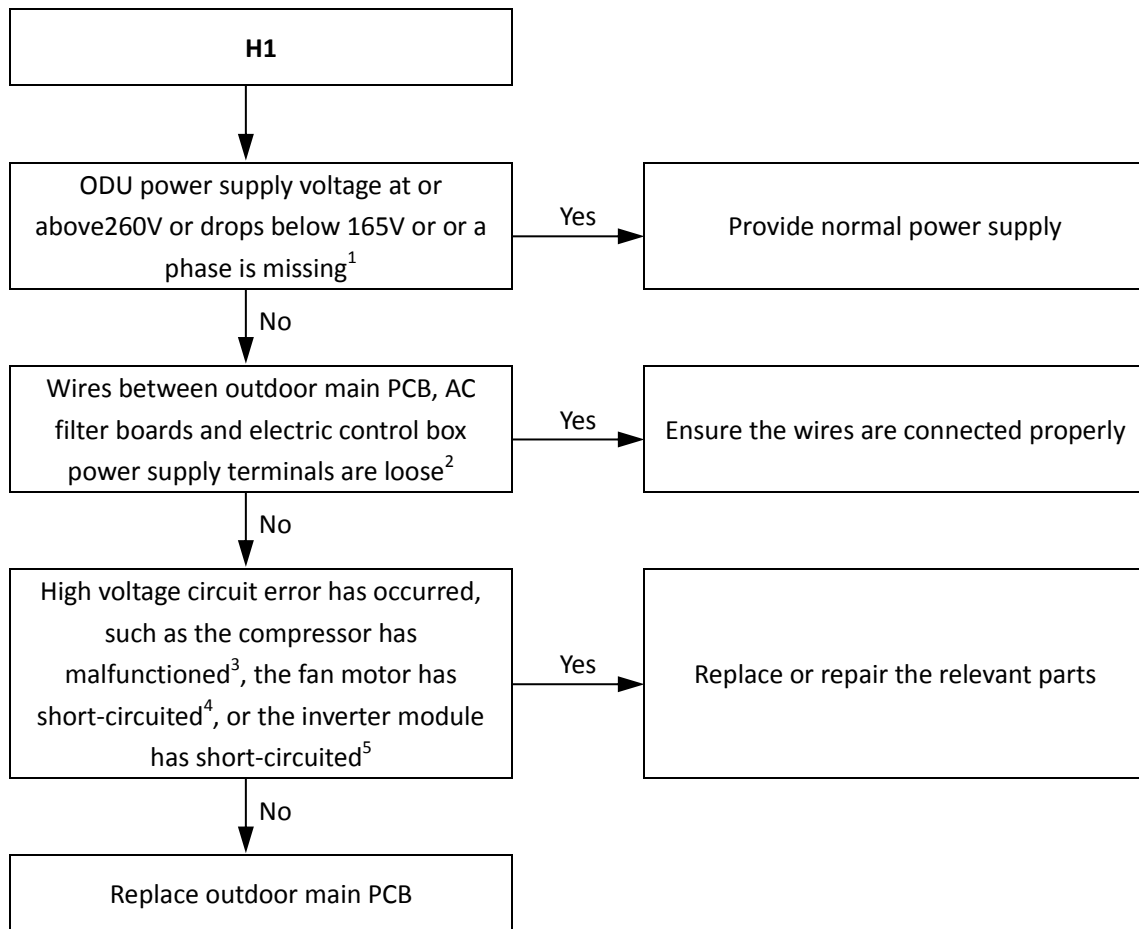
4.21.1 Digital display output
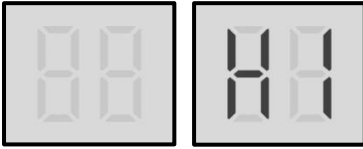
4.21.2 Description

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

4.21.3 Possible causes

- Outdoor unit power supply voltage at or above260V or drops below 165V or a phase is missing.
- Loosened wiring within electric control box.
- High voltage circuit error.
- Main PCB damaged.

4.21.4 Procedure

```
┌─────────────────────────────┐
│              H1             │
└─────────────────────────────┘
              │
              ▼
┌─────────────────────────────┐         ┌──────────────────────────────┐
│ ODU power supply voltage at  │  Yes    │                              │
│ or above260V or drops below  │────────▶│  Provide normal power supply │
│ 165V or or a phase is        │         │                              │
│ missing[1]                   │         └──────────────────────────────┘
└─────────────────────────────┘
              │ No
              ▼
┌─────────────────────────────┐         ┌──────────────────────────────┐
│ Wires between outdoor main   │  Yes    │                              │
│ PCB, AC filter boards and    │────────▶│ Ensure the wires are         │
│ electric control box power   │         │ connected properly           │
│ supply terminals are loose[2]│         └──────────────────────────────┘
└─────────────────────────────┘
              │ No
              ▼
┌─────────────────────────────┐         ┌──────────────────────────────┐
│ High voltage circuit error   │  Yes    │                              │
│ has occurred, such as the    │────────▶│ Replace or repair the        │
│ compressor has malfunctioned[3],│      │ relevant parts               │
│ the fan motor has            │         └──────────────────────────────┘
│ short-circuited[4], or the   │
│ inverter module has          │
│ short-circuited[5]           │
└─────────────────────────────┘
              │ No
              ▼
┌─────────────────────────────┐
│  Replace outdoor main PCB   │
└─────────────────────────────┘
```

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 4-1.4 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. Refer to Figures 4-4.4 and 4-4.5 in Part 4, 4.12.6 "xL0 troubleshooting".
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 4-1.2and 4-1.4 in Part4, 1 "Outdoor Unit Electric Control Box Layout" and to Figure 4-4.6.

4.22 H6 Troubleshooting

4.22.1 Digital display output
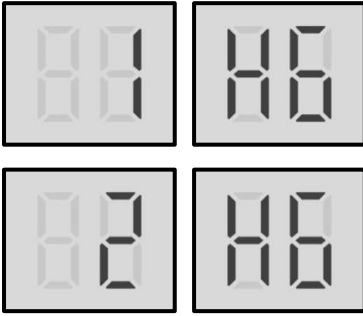
4.22.2 Description

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

4.22.3 Possible causes

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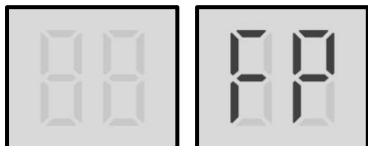- Compressor Inverter module damaged.

4.22.4 Procedure

Refer to P6 protection: xL1 and Xl2.

4.23 FP Troubleshooting
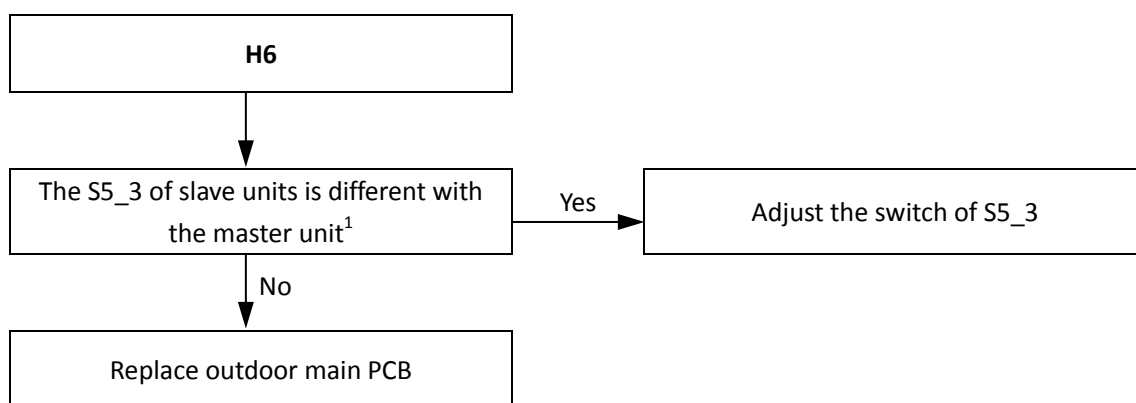
4.23.1 Digital display output

4.23.2 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.

4.23.3 Possible causes

- The S5_3 of slave units is different with the master unit.
- Main PCB damaged.

4.23.4 Procedure

```
┌─────────────────────────────┐
│             H6              │
└─────────────────────────────┘
               │
               ▼
┌─────────────────────────────┐    Yes    ┌─────────────────────────────┐
│ The S5_3 of slave units is  │──────────▶│  Adjust the switch of S5_3  │
│ different with              │           └─────────────────────────────┘
│ the master unit[1]          │
└─────────────────────────────┘
               │ No
               ▼
┌─────────────────────────────┐
│   Replace outdoor main PCB  │
└─────────────────────────────┘
```

Note:

1.   Dial switch S5 on the main PCB (labeled 3 in Figure 4-2.1 in Part 4, 2.2 "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 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

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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		

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		

Part 4 - Diagnosis and Troubleshooting

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 high, the system is being run in low water outlet cooling mode with the following settings: temperature 0°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
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 and 2-2.2 in Part 2, 2 "Piping Diagrams".

Table 5-5.5: Outdoor unit in low water outlet 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	2-15	3-18	4-20	5-20	6-16
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
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	0.3-6	2-6	3-6	4-6	5-6
DC inverter compressor current	A	4-12	2-16	3-17	4-18	5-16

Note:

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

Table 5-5.4: 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
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 and 2-2.2 in Part 2, 2 "Piping Diagrams".

Part 4 – Diagnosis and Troubleshooting

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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.