Midea

R32

Midea Building Technologies Division

Service Manual

M thermal Arctic Mono (18~30kW)

CONTENTS

Part 1

General Information

1 Unit Capacities and External Appearance

1.1 Unit Capacities

Table 1-1.1: Capacity range

Capacity	18kW	22kW	26kW	30kW
Model	MHC-V18W/D2RN8	MHC-V22W/D2RN8	MHC-V26W/D2RN8	MHC-V30W/D2RN8

1.2 External Appearance

Table 1-1.2: Appearance

18/22/26/30kW


Part 2

Components Layout and Refrigerant Circuits

1 Layout of Functional Components

Figure 2-1.1: MHC-V18(22,26,30)W/D2RN8 front view

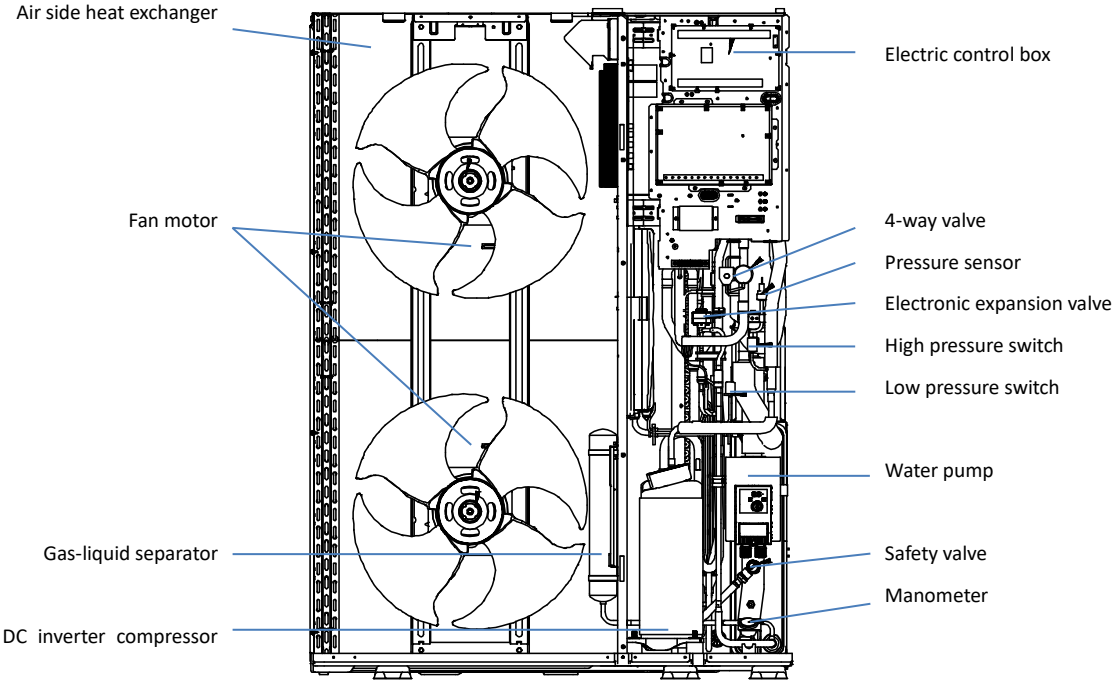
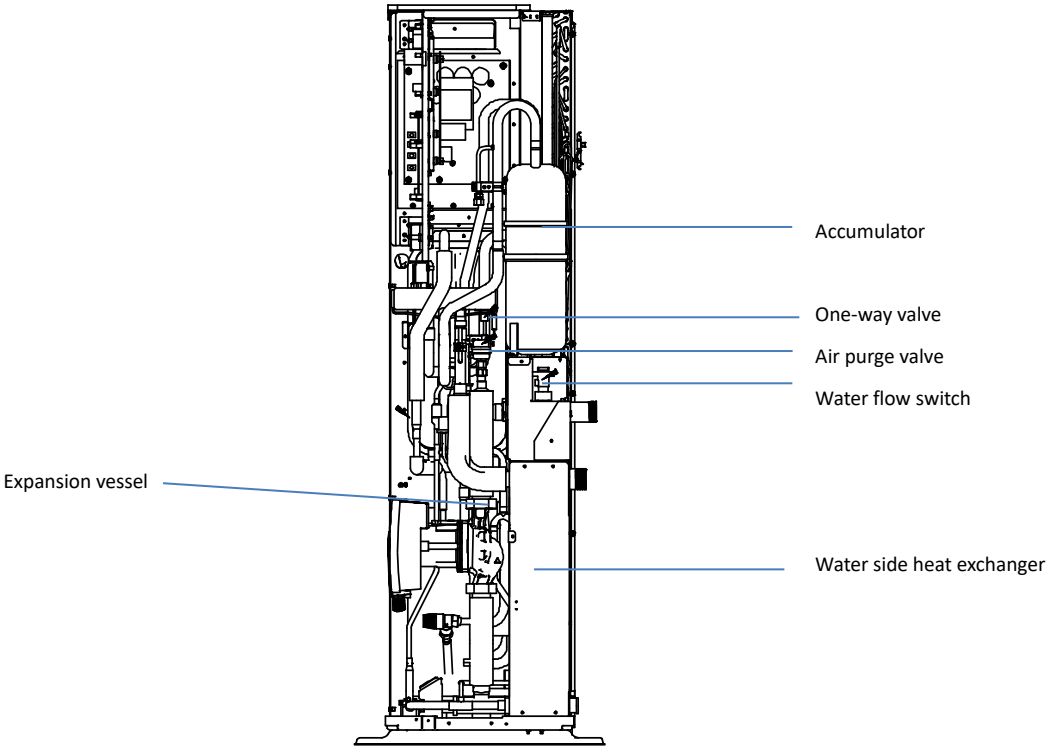
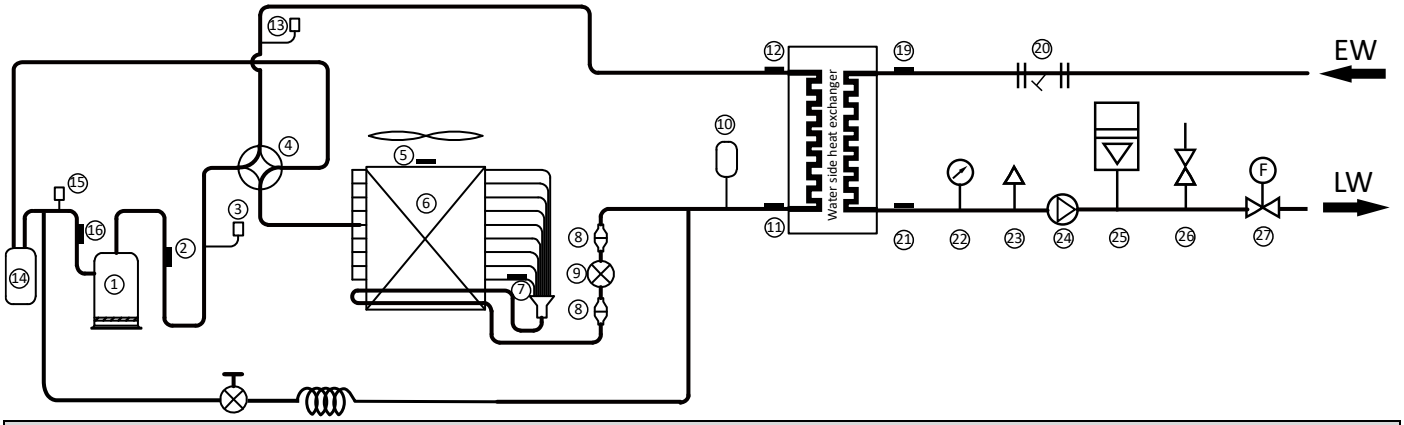


Figure 2-1.2: MHC-V18(22,26,30)W/D2RN8 side view



2 Piping Diagrams

Figure 2-2.1: MHC-V18(22,26,30)W/D2RN8 piping diagram



Legend			
1	Compressor	15	Low pressure switch
2	Discharge temperature sensor	16	Suction temperature sensor
3	High Pressure Switch	17	Single-way electromagnetic valve
4	4-Way Valve	18	Capillary
5	Outdoor temperature sensor	19	Water Inlet temp. sensor
6	Air side heat exchanger	20	Y-shape filter (Accessories)
7	Air side heat exchanger refrigerant outlet temperature sensor(cooling)	21	Water outlet temp. sensor
8	Filter	22	Manometer
9	Electronic expansion valve	23	Safety valve
10	Accumulator	24	Circulating pump
11	Refrigerant temperature sensor (liquid line)	25	Expansion vessel
12	Refrigerant temperature sensor (gas line)	26	Air purge valve
13	Pressure sensor	27	Flow switch
14	Gas-liquid separator		

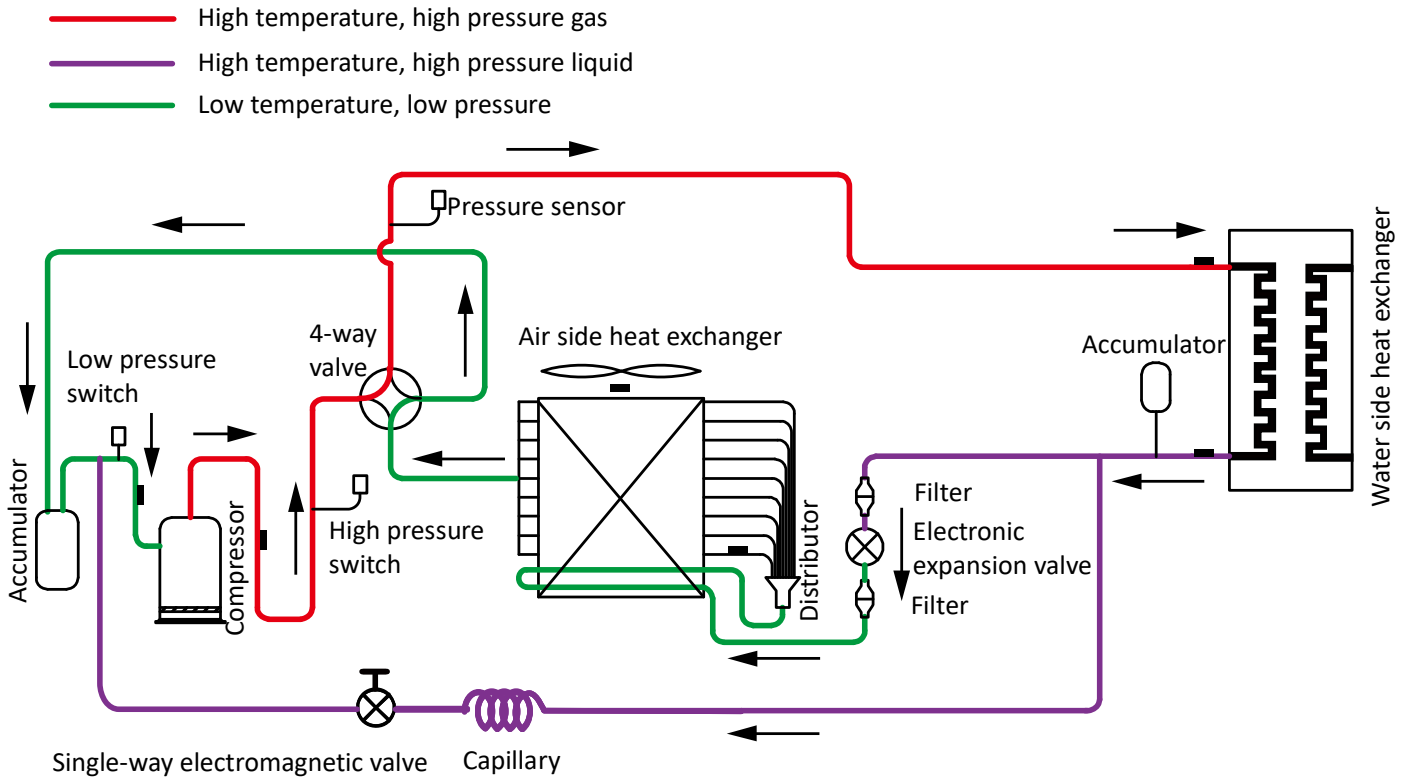
Key components:

1. **Accumulator:**
   Stores liquid refrigerant and oil to protect compressor from liquid hammering.
2. **Electronic expansion valve (EXV):**
   Controls refrigerant flow and reduces refrigerant pressure.
3. **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.
4. **High and low pressure switches:**
   Regulate refrigerant system pressure. When 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.
5. **Air purge valve:**
   Automatically removes air from the water circuit.
6. **Safety valve:**
   Prevents excessive water pressure by opening at 43.5 psi (3 bar) and discharging water from the water circuit.
7. **Expansion vessel:**
   Balances water system pressure. (Expansion vessel volume: 8L in 18/22/26/30kW units)
8. **Water flow switch:**
   Detects water flow rate to protect compressor and water pump in the event of insufficient water flow.
9. **Manometer:**
   Provides water circuit pressure readout.
10. **Water pump:**
    Circulates water in the water circuit.

3 Refrigerant Flow Diagrams

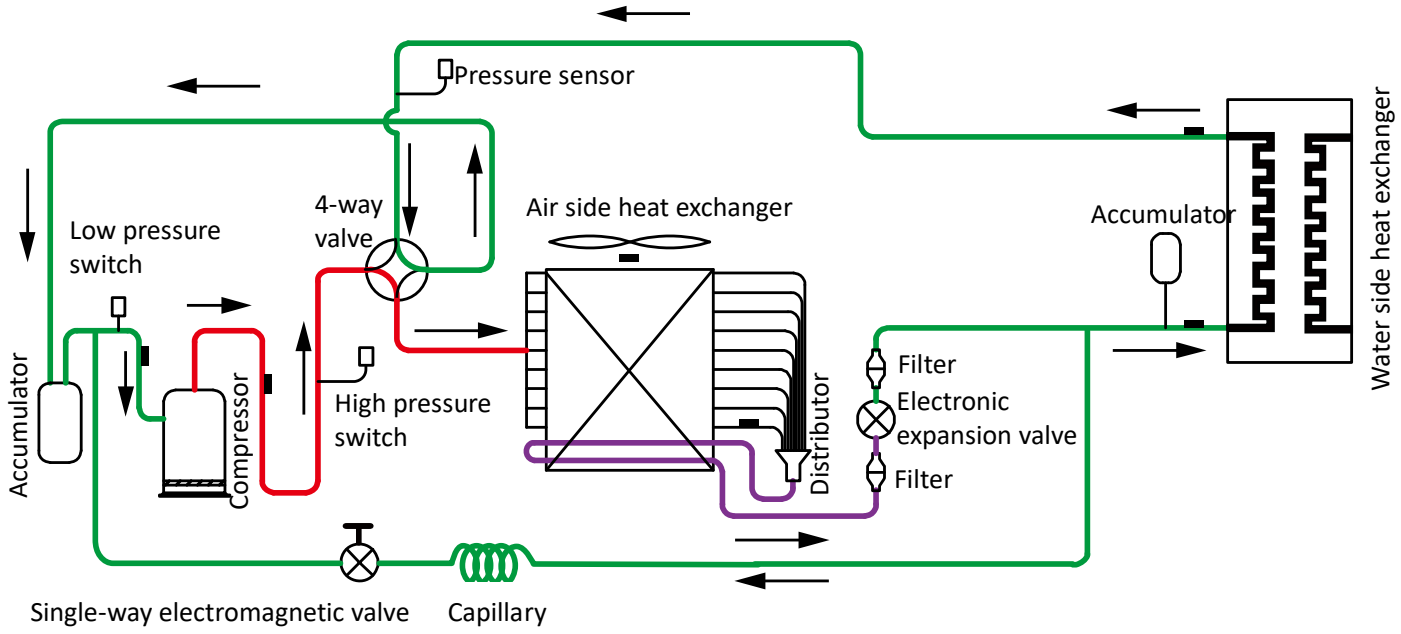
Heating and domestic hot water operation

Figure 2-3.1: Refrigerant flow during heating or domestic hot water operation



Cooling and defrosting operation

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



Part 3

Control

1 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 PCB and on the user interface.
2. The system stops when the set temperature has been reached.

2 Standby Control

2.1 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 outdoor ambient temperature and the compressor on/off state. When the outdoor ambient temperature is above 5°C or the compressor is running, the crankcase heater is off; when the outdoor ambient temperature is at or below 5°C and either the compressor has been stopped for more than 3 hours or the unit has just been powered-on (either manually or when the power has returned following a power outage), the crankcase heater turns on.

2.2 Water Pump Control

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

3 Startup Control

3.1 Compressor Startup Delay Control

In initial startup control and in restart control (except in oil return operation and defrosting operation), compressor startup is delayed such that a minimum of the set re-start delay time has elapsed since the compressor stopped, in order to prevent frequent compressor on/off and to equalize the pressure within the refrigerant system. The compressor re-start delays for cooling and heating modes are set on the user interface. Refer to the M thermal Mono Engineering Data Book Part 3, 7.5 “COOL MODE SETTING Menu” and Part 3, 7.6 “HEAT MODE SETTING Menu”.

3.2 Compressor Startup Program

In initial startup control and in re-start control, compressor startup is controlled according to outdoor ambient temperature. There are two startup programs which both have 60 second stage for compressor to startup. Once the 60 second stage 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.

During compressor startup, the startup platform is determined according to T4 temperature. The compressor must be forcibly operated at 38Hz for 60 seconds. (This platform is a mandatory platform, which is not affected by the restricted frequency. When the target frequency is less than 38Hz, this platform must also be run.)

Compressor start: When Tp is greater than or equal to 15℃ or T4 is greater than 8℃, start in mode 1, otherwise, start in mode 2. Refer to Figures 3-3.1, 3-3.2.

Figure 3-3.1 18-30 kW Compressor startup program mode 1

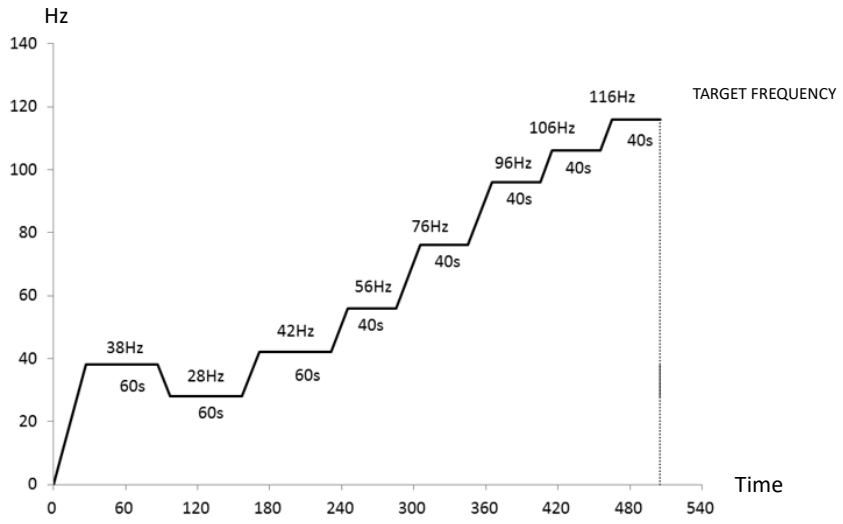
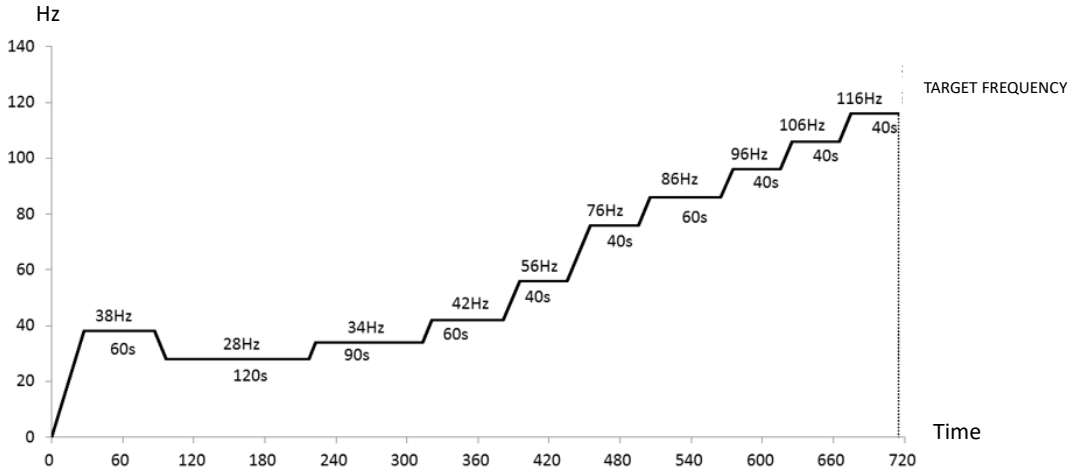


Figure 3-3.2 18-30 kW Compressor startup program mode 2



3.3 Startup Control for Heating and Domestic Hot Water Operation

Table 3-3.1: Component control during startup in heating and domestic hot water modes

Component	Wiring diagram label	18/22/26/30kW	Control functions and states
Inverter compressor	COMP	●	Compressor startup program selected according to ambient temperature and discharge temperature
DC fan motor	FAN_UP / FAN_DOWN	●	Fan runs at higher speed
Electronic expansion valve	EEV1	●	304 steps
Four-way valve	ST	●	On

3.4 Startup Control for Cooling Operation

Table 3-3.2: Component control during startup in cooling mode

Component	Wiring diagram label	18/22/26/30kW	Control functions and states
Inverter compressor	COMP	●	Compressor startup program selected according to ambient temperature and discharge temperature
DC fan motor	FAN_UP / FAN_DOWN	●	Fan runs at higher speed
Electronic expansion valve	EEV1	●	304 steps
Four-way valve	ST	●	Off

4 Normal Operation Control

4.1 Component Control during Normal Operation

Table 3-4.1: Component control during heating and domestic hot water operations

Component	Wiring diagram label	18/22/26/30kW	Control functions and states
Inverter compressor	COMP	●	Controlled according to load requirement from hydronic system
DC fan motor	FAN_UP / FAN_DOWN	●	Controlled according to outdoor heat exchanger pipe temperature, ambient temperature and compressor speed
Electronic expansion valve	EEV1	●	Controlled according to discharge temperature, discharge superheat, suction superheat and compressor speed
Four-way valve	ST	●	On

Table 3-4.2: Component control during cooling operation

Component	Wiring diagram label	18/22/26/30kW	Control functions and states
Inverter compressor	COMP	●	Controlled according to load requirement from hydronic system
DC fan motor	FAN_UP / FAN_DOWN	●	Controlled according to outdoor heat exchanger pipe temperature, ambient temperature and compressor speed
Electronic expansion valve	EEV1	●	Controlled according to discharge temperature, discharge superheat, suction superheat and compressor speed
Four-way valve	ST	●	Off

4.2 Compressor Output Control

The compressor rotation speed is controlled according to the load requirement. Before compressor startup, the M thermal Mono outdoor unit determines the compressor target speed according to outdoor ambient temperature and discharge temperature and then runs the appropriate compressor startup program. Refer to Part 3, 3.2 “Compressor Startup Program”. Once the startup program is complete, the compressor runs at the target rotation speed.

During operation the compressor speed is controlled according to the setting and actual water temperature, the refrigerant system pressure, refrigerant temperature and ambient temperature.

4.3 Compressor Speed Control

The running speed of six-pole compressors (used on all models) 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 per second.

4.4 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/DHW operations. Refer to Figures 2-3.1 and 2-3.2 in Part 2, 3 “Refrigerant Flow Diagrams”.

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

4.5 Electronic Expansion Valve Control

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

- When the outdoor unit is power on:
  - The EXV first closes fully, then moves to the standby position (304 steps). After compressor runs for 60-second, EXV is controlled according to ambient temperature. After a further 180s, EXV is controlled according to different modes.
- When the outdoor unit is in standby:
  - The EXV is at position 304 (steps).
- When the outdoor unit stops:
  - The EXV is fully closed firstly, then moves to the standby position (304 steps).

4.6 Outdoor Fan Control

The speeds of the outdoor unit fans are adjusted in steps, as shown below.

Table 3-4.3: Fan speed index

Fan speed index	Fan speed (rpm)	
	Upper fan	Lower fan
W1	200	180
W2	280	260
W3	340	320
W4	400	380
W5	460	440
W6	520	500
W7	580	560
W8	640	620
W9	700	680
W10	760	740
W11	820	800
W12	880	860
W13	900	900

4.7 Spray liquid cooling control

If the discharge temperature exceeds 105℃, the solenoid valve opens. While the spray liquid cooling control is in progress, the discharge temperature is judged every 20s and the frequency of compressor drops 2Hz until the minimum frequency which differs from every model. When the discharge temperature is below 95℃, the compressor runs at the current frequency and solenoid valve closes.

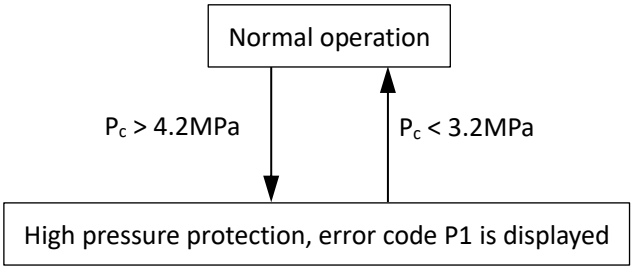
If the discharge temperature exceeds 108℃, the solenoid valve opens. While the spray liquid cooling control is in progress, the discharge temperature is judged every 20s and the frequency of compressor drops 4Hz until the minimum frequency which differs from every model. When the discharge temperature is below 95℃, the compressor runs at the current frequency and solenoid valve closes.

5 Protection Control

5.1 High Pressure Protection Control

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

Figure 3-5.1: High pressure protection control



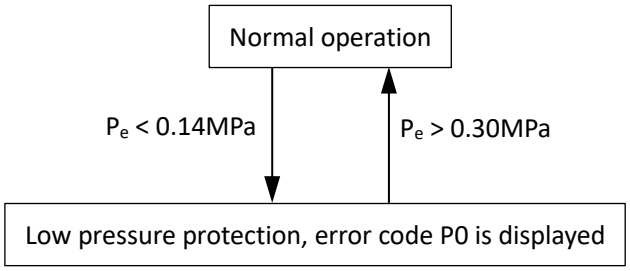
Notes:
1. P_c: Discharge pressure

When the discharge pressure rises above 4.2MPa the system displays P1 protection and the unit stops running. When the discharge pressure drops below 3.2MPa, the compressor enters re-start control.

5.2 Low Pressure Protection Control

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

Figure 3-5.2: Low pressure protection control



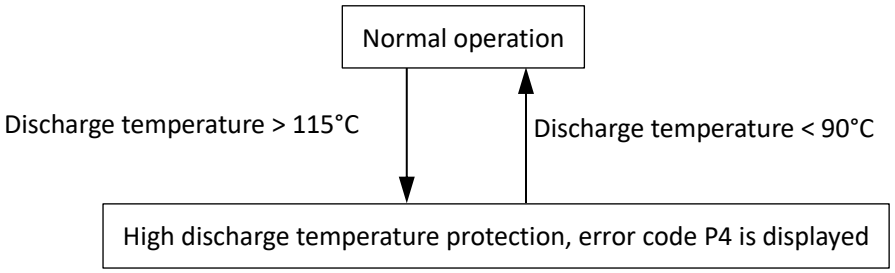
Notes:
1. P_e: Suction pressure

When the suction pressure drops below 0.14MPa the system displays P0 protection and the unit stops running. When the suction pressure rises above 0.3MPa, the compressor enters re-start control.

5.3 Discharge Temperature Protection Control

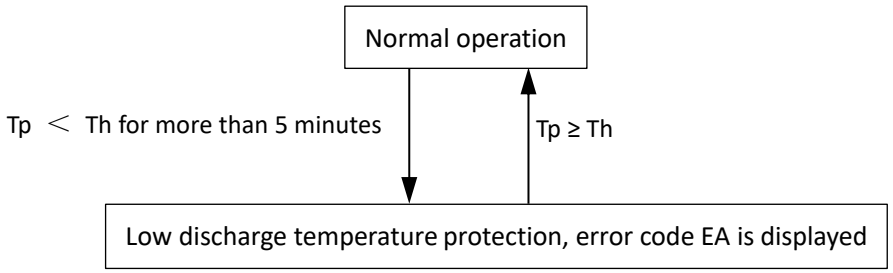
This control protects the compressor from abnormally high temperatures and transient spikes in temperature.

Figure 3-5.3: High discharge temperature protection control



When the discharge temperature rises above 115°C the system displays P4 protection and the unit stops running. When the discharge temperature drops below 90°C, the compressor enters re-start control.

Figure 3-5.4:Low discharge temperature protection control

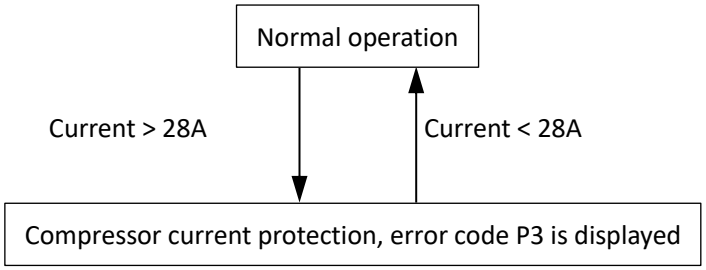


When the discharge temperature is lower than suction temperature for more than 5 minutes, the system displays EA protection and the unit stops running. When the discharge temperature is higher than suction temperature, the compressor enters re-start control.

5.4 Compressor Current Protection Control

This control protects the compressor from abnormally high currents.

Figure 3-5.5: Compressor current protection control

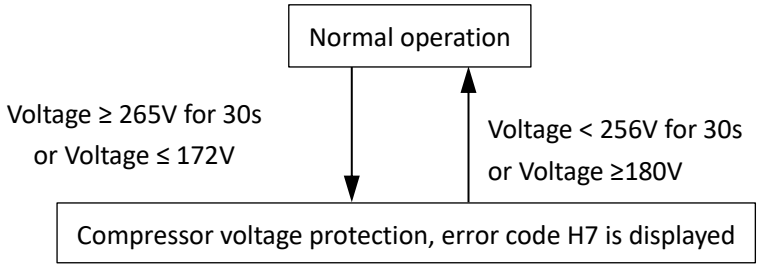


When the compressor current rises above $Current_{max}$ the system displays P3 protection and the unit stops running. When the compressor current drops below $Current_{max}$, the compressor enters re-start control.

5.5 Voltage Protection Control

This control protects the M thermal Mono from abnormally high or abnormally low voltages.

Figure 3-5.6: Compressor voltage protection control



When the phase voltage of AC power supply is at or above 265V for more than 30 seconds, the system displays H7 protection and the unit stops running. When the phase voltage drops below 265V for more than 30 seconds, the refrigerant system restarts once the compressor re-start delay has elapsed. When the phase voltage is at or below 172V, the system displays H7 protection and the unit stops running. When the AC voltage rises to at or more than 180V, the refrigerant system restarts once the compressor re-start delay has elapsed.

5.6 DC Fan Motor Protection Control

This control protects the DC fan motors from strong winds and abnormal power supply. DC fan motor protection occurs when any one of the following three sets of conditions are met:

- Outdoor ambient temperature is at or above 4°C and actual fan speed differs from target fan speed by more than 200rpm for more than 3 minutes.
- Outdoor ambient temperature is below 4°C and actual fan speed differs from target fan speed by more than 300rpm for more than 3 minutes.
- Actual fan speed is less than 150rpm for more than 20 seconds.

When DC fan motor protection control occurs the system displays the H6 error code and the unit stops running. After 3 minutes, the unit restarts automatically. When H6 protection occurs 10 times in 120 minutes, the HH error is displayed. When an HH error occurs, a manual system restart is required before the system can resume operation.

5.7 Anti-freeze Protection Control

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

Conventional effluent mode: T1SCLMIN≥5℃ (set T1SCLMIN on the wire controller)

Low temperature effluent mode: 0℃≤T1SCLMIN < 5℃

Cooling Mode Standby:

Number	Mode	State	The state of anti-freezing mode
1	Conventional effluent mode	Two＜4℃ or Twi＜4℃ or T1＜4℃	After each condition lasts for 5 seconds, the unit enters the anti-freezing protection mode
2	Low temperature effluent mode	Two＜-2℃ or Twi＜-2℃ or T1＜-2℃	After each condition lasts for 5 seconds, the unit enters the anti-freezing protection mode
3	Conventional effluent mode	Two≥8℃ or Twi≥8℃ or T1≥8℃	After each condition lasts for 5 seconds, the unit exits the anti-freezing protection mode
4	Low temperature effluent mode	Two≥5℃ or Twi≥5℃ or T1≥5℃	After each condition lasts for 5 seconds, the unit exits the anti-freezing protection mode

Cooling mode operation status:

In the cooling mode, after the compressor stops running, the anti-freezing is not detected within 2 minutes, the anti-freezing is detected within 2-30 minutes, and the cooling is performed after 30 minutes.

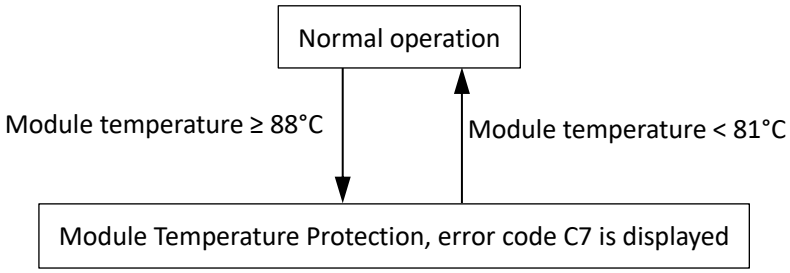
Heating/DWH Mode Standby:

Number	Mode	State 1	State 2	The state of anti-freezing mode
1	Conventional effluent mode	T4＜3℃	Two＜5℃ or Twi＜5℃ or T1＜5℃	After each condition lasts for 5 seconds, the unit enters the anti-freezing protection mode
2	Conventional effluent mode	/	Two＜2℃ or Twi＜2℃ or T1＜2℃	Enter anti-freezing protection mode immediately
3	Low temperature effluent mode	/	Two＜-2℃ or Twi＜-2℃ or T1＜-2℃	After each condition lasts for 5 seconds, the unit enters the anti-freezing protection mode

5.8 Module Temperature Protection Control

This control protects the module from abnormally high temperatures.

Figure 3-5.7: Module Temperature Protection Control



When the module temperature rises at or above 88°C, the system displays C7 protection and the unit stops running. When the module temperature is below 81°C, error disappears and unit runs normally.

6 Special Control

6.1 Oil Return Operation

In order to prevent the compressor from running out of oil, the oil return operation is conducted to recover oil that has flowed out of the compressor and into the refrigerant piping.

Timing of oil return operation:

- When the compressor cumulative operating time with running rotation speed less than 42rps reaches 6 hours.

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

- Oil return operation duration reaches 5 minutes.
- Compressor stops.
- Mode change command is received.

Table 3-6.1: Outdoor unit component control during oil return operation in cooling mode

Component	Wiring diagram label	18/22/26/30kW	Control functions and states
Inverter compressor	COMP	•	Runs at oil return operation rotation speed
DC fan motor	FAN_UP / FAN_DOWN	•	Controlled according to outdoor heat exchanger pipe temperature, ambient temperature, discharge temperature and compressor speed
Electronic expansion valve	EEV1	•	304 (steps)
Four-way valve	ST	•	Off

Table 3-6.2: Outdoor unit component control during oil return operation in heating and DHW modes

Component	Wiring diagram label	18/22/26/30kW	Control functions and states
Inverter compressor	COMP	•	Runs at oil return operation rotation speed
DC fan motor	FAN_UP / FAN_DOWN	•	Controlled according to outdoor heat exchanger pipe temperature, ambient temperature, discharge temperature and compressor speed
Electronic expansion valve	EEV1	•	304 (steps)
Four-way valve	ST	•	On

6.2 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 is above 8°C for more than 10 seconds.
- The air side heat exchanger refrigerant outlet temperature is above 12°C.
- Water side heat exchanger water outlet temperature sensor is less than 10℃ for 5s and air side heat exchanger refrigerant outlet temperature is above 5℃.
- Water side heat exchanger water outlet temperature sensor is less than 7℃ for 5s.

Table 3-6.3: Component control during defrosting operation

Component	Wiring diagram label	18/22/26/30kW	Control functions and states
Inverter compressor	COMP	●	Runs at defrosting operation rotation speed
DC fan motor	FAN_UP / FAN_DOWN	●	Off
Electronic expansion valve	EEV1	●	Fully open
Four-way valve	ST	●	Off

6.3 Fast DHW Operation

Fast DHW operation is used to quickly meet a requirement for domestic hot water when DHW priority has been set on the user interface. Refer to the M thermal Mono Engineering Data Book Part 3, 7.4 “DHW MODE SETTING Menu”.

Domestic hot water demand priority can be ended by changing the switch on controller from "on" to "off".

Table 3-6.4: Component control during fast DHW operation

Component	Wiring diagram label	18/22/26/30kW	Control functions and states
Inverter compressor	COMP	●	Controlled according to load requirement
DC fan motor	FAN_UP / FAN_DOWN	●	Controlled according to outdoor heat exchanger pipe temperature, ambient temperature and compressor speed.
Electronic expansion valve	EEV1	●	Controlled according to pressure, temperature and compressor speed.
Four-way valve	ST	●	On
Tank electric heater(Optional)	TBH	●	On

6.4 Two zones control[1]

Two zones control function is used to control temperature of each zone separately, thus different type radiator will operate at its optimal temperature and water pump cycle time will be reduced to save energy.

- Cooling mode

In two zones control for cooling mode, when the setting temperature of a certain zones is reached, the zone and water pump of this zone will turn off.

- Heating mode

In two zones control for heating mode, the on/off control of zone and water pump is same with cooling mode, but in addition, the mixing valve (3-way valve SV3) control function will be activated to adjust the water temperature of the low temperature zone by control the opening time and closing time of the valve. The mixing valve will only turn on when two

zones control for heating is activated. On other conditions, the mixing valve will keep off. When the valve initially turns on, the opening time and closing time is same and then the time is controlled according to the difference between water pipe temperature and setting water temperature of the controlling zone.

- Hydronic adapter PCB (Optional)

With the help of hydronic adapter PCB, totally 8 thermostats can be used at the same time for maximum 8 rooms to control heat pump.

Note:

1. *M thermal units just have the controlling function, while the mixing valve, water pump of each zone need to be field supplied and connect to M thermal unit.*

6.5 Smart grid control

Unit adjusts the operation according to different electrical signals to realize energy saving.

Free electric energy signal: DHW mode turn on, the setting temperature will be changed to 70℃ automatically, and the TBH operate as below:T5<69℃， the TBH is on；T5 ≥ 70℃, the TBH is off. The unit operates in cooling/heating mode as the normal logic.

Common electric energy signal: unit operates according to users' need.

Expensive electric energy signal: only available for cooling or heating mode and user can set the maximum operating time.

6.6 Balance tank temperature control

Balance tank temperature sensor is used to control on/off of heat pump.

Once the heat pump stops, internal pump stops to save energy and then balance tank provides hot water for space heating. In addition, balance tank temperature control can meet both space heating and domestic hot water needs at the same time. Balance tank can store energy to provide hot water whilst heat pump runs heat mode/cooling, which can reduce the host selection and the initial investment.

6.7 USB data transfer

- Convenient program upgrade

No need to carry any other heavy equipment but only USB can realize program upgrade of indoor unit and outdoor unit.

- Parameter setting transmission between wired controllers

Installer can quickly copy the setting from one controller to another via USB, which save the time of on-site installation.

6.8 Dry contract M1M2 control

M1M2 can be set in the wired controller for heat pump on/off control, TBH control, AHS control.

- For heat pump on/off control

  When dry contract closes for 1s, heat pump stops. When dry contract opens for 5s, heat pump on/off according to wired controller or room thermostat setting.

- For TBH control

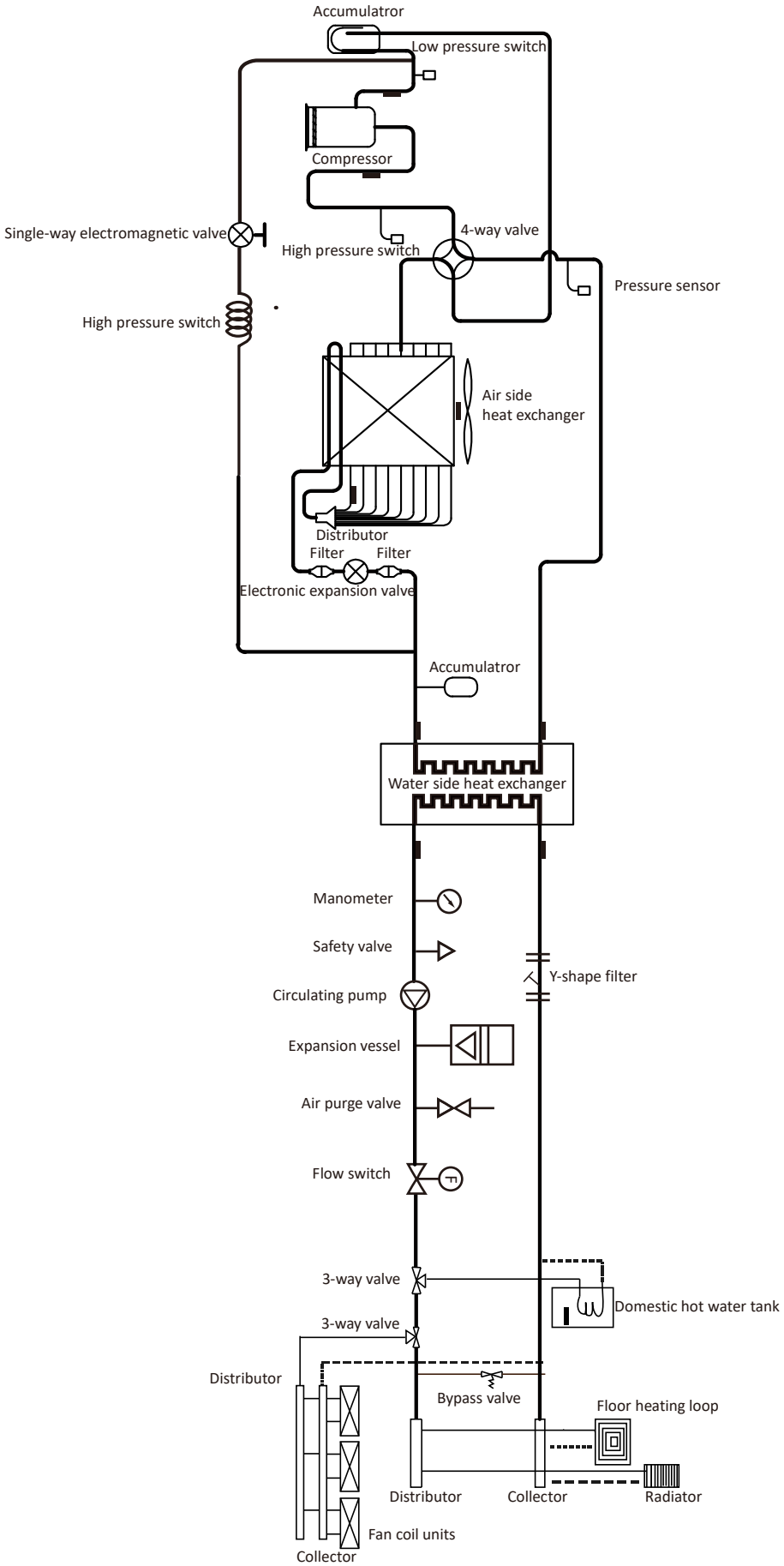
  TBH is only controlled by M1M2. If dry contract closes, T5<65℃ then TBH opens until water tank temperature reaches 70℃.

- For AHS control

  In heating mode， AHS on/off is only controlled by M1M2. In DHW mode, M1M2 control does not affect AHS on/off.

7 Role of Temperature Sensors in Control Functions

Figure 3-7.1: Location of the temperature sensors on 18~30kW unit systems



Notes: The names and functions of the temperature sensors labelled 1 to 12 in this figure are detailed in Table 3-7.1.

Table 3-7.1: Names and functions of the temperature sensors

Number	Sensor name[1]	Sensor code	Mode	Control functions
1	Discharge pipe temperature sensor	Tp	Heating	▪ Electronic expansion valve control[2] ▪ Discharge superheat control
			Cooling	▪ Electronic expansion valve control[2] ▪ Outdoor fan control[3] ▪ Discharge superheat control
2	Outdoor ambient temperature sensor	T4	Heating	▪ Compressor startup control[4] ▪ Compressor output control[5] ▪ Electronic expansion valve control[2] ▪ Defrosting operation control[7] ▪ Low pressure protection control[7] ▪ Crankcase heater control[9]
			Cooling	▪ Compressor startup control[4] ▪ Compressor output control[5] ▪ Electronic expansion valve control[2] ▪ Outdoor fan control[3] ▪ Crankcase heater control[9]
3	Air side heat exchanger refrigerant outlet temperature sensor	T3	Heating	▪ Electronic expansion valve control[2] ▪ Defrosting operation control[7] ▪ Outdoor fan control[3]
			Cooling	▪ Compressor output control[5] ▪ Outdoor fan control[3]
4	Water side heat exchanger refrigerant inlet (liquid pipe) temperature sensor	T2	Heating	▪ Compressor output control[5]
			DHW	
5	Water side heat exchanger refrigerant outlet (gas pipe) temperature sensor	T2B	Heating	▪ Freeze prevention control[10]
6	Suction pipe temperature sensor	Th	Heating	▪ Electronic expansion valve control[2]
			Cooling	
7	Water side heat exchanger water inlet temperature sensor	Tw_in	Heating	▪ Freeze prevention control[10]
			Cooling	
8	Water side heat exchanger water outlet temperature sensor	Tw_out	Heating	▪ Compressor output5 and on/off control[6] ▪ Freeze prevention control[10]
			Cooling	
			DHW	
9	Final water outlet temperature sensor	T1	Heating	▪ Compressor output control[5] ▪ Backup electric heater control ▪ DHW priority control[11] ▪ Auto mode control
			Cooling	▪ Compressor output5 and on/off control[6] ▪ Auto mode control
			DHW	▪ Compressor output control[5] ▪ Backup electric heater control ▪ DHW priority control[11]
10	Domestic hot water tank temperature sensor	T5	DHW	▪ Disinfection operation control ▪ DHW tank immersion heater control ▪ Backup electric heater control ▪ Auxiliary heat source control ▪ Solar energy kit control ▪ Compressor output control[5] ▪ DHW priority control[11]
11	Room temperature sensor (built in wired controller)	Ta	Heating	▪ Auto mode control ▪ Climate related curve ▪ Compressor output control[5]
			Cooling	

Notes:

1. Sensor names in this service manual referring to refrigerant flow is named according refrigerant flow during cooling operation refer to Part 2, 3 “Refrigerant Flow Diagrams”.
2. Refer to Part 3, 4.5 “Electronic Expansion Valve Control”.
3. Refer to Part 3, 4.6 “Outdoor Fan Control”.
4. Refer to Part 3, 2 “Compressor Startup Program”.
5. Refer to Part 3, 4.2 “Compressor Output Control”.
6. Refer to Part 3, 1 “Stop Operation”.
7. Refer to Part 3, 6.2 “Defrosting Operation”.
8. Refer to Part 3, 5.2 “Low Pressure Protection Control”.
9. Refer to Part 3, 2.1 “Crankcase Heater Control”.
10. Refer to Part 3, 5.7“Water Side Heat Exchanger Anti-freeze Protection Control”.
11. Refer to Part 3, 6.3 “Fast DHW Operation”.

Part 4
Diagnosis and Troubleshooting

1 Outdoor Unit Electric Control Box Layout

Figure 4-1.1: Electric control box front view

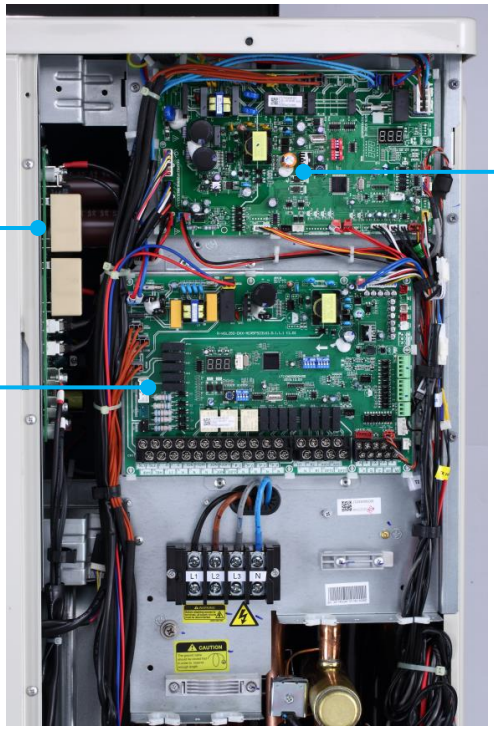
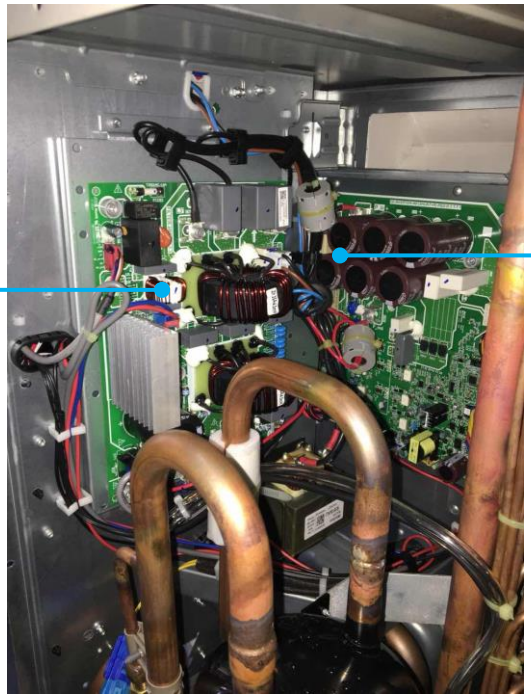


Figure 4-1.2: Electric control box side view



2 Outdoor Unit PCBs

2.1 Types

M thermal Mono outdoor units have two main PCBs – one for the hydronic system and one for the refrigerant system.

In addition to the two main PCBs, all models also have an inverter module and a filter board.

The locations of each PCB in the outdoor unit electric control boxes are shown in Figures 4-1.1 to 4-1.7 in Part 4, 1 “Outdoor Unit Electric Control Box Layout”.

2.2 PCB Instruction

Figure 4-2.1: MHC-V18(22,26,30)W/D2RN8 hydronic system main PCB

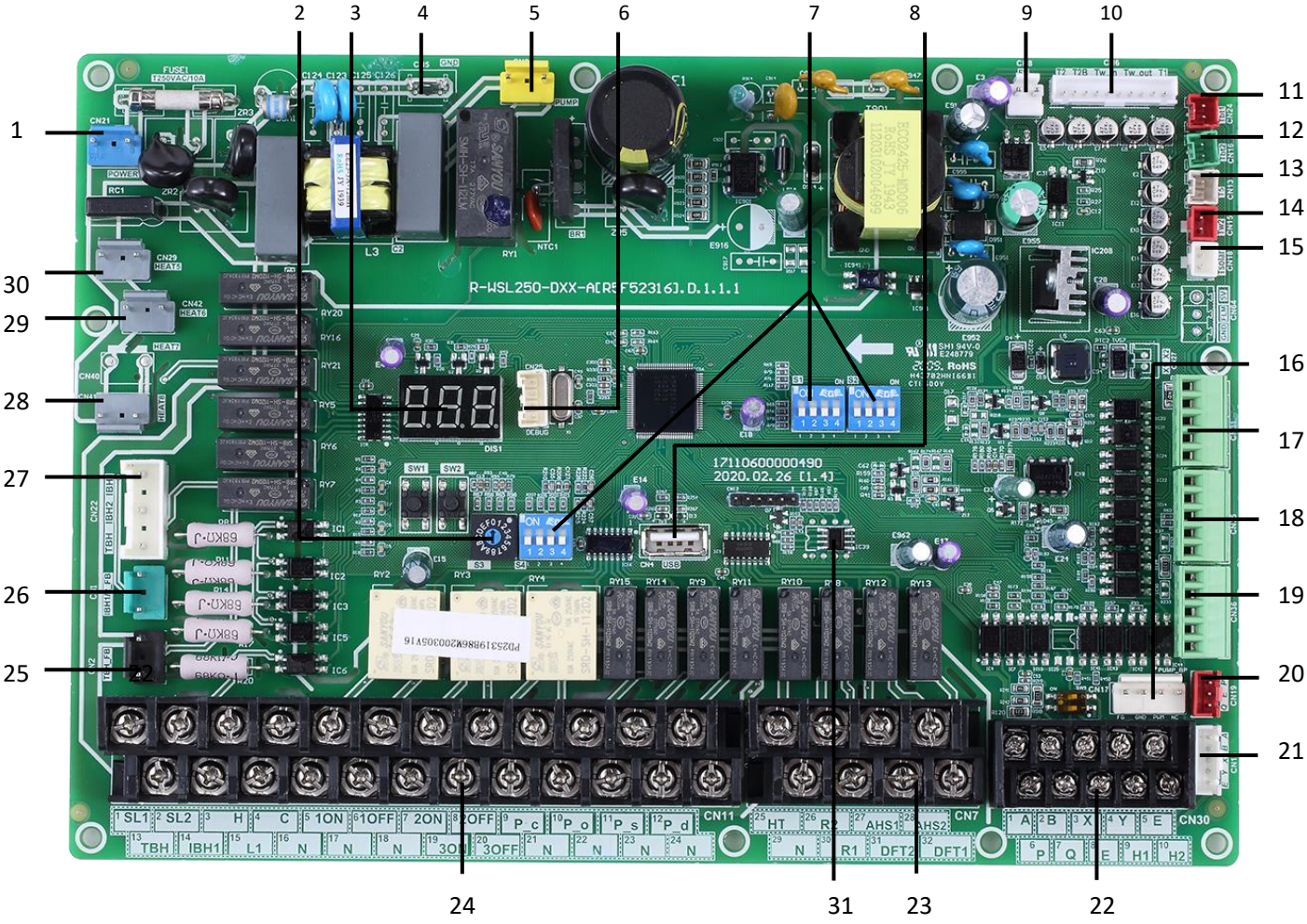


Table 4-2.1: MHC-V18(22,26,30)W/D2RN8 hydronic system main PCB

Label in Figure 4-2.1	Code	Content
1	CN21	Port for power supply
2	S3	Rotary dip switch
3	DIS1	Digital display
4	CN5	Port for ground
5	CN28	Port for variable speed pump power input
6	CN25	Port for IC programming
7	S1,S2,S4	Dip switch
8	CN4	Port for USB programming
9	CN8	Port for Flow switch
10	CN6	Port for temp. sensors (T2,T2B,TW_out,TW_in, T1,)
11	CN24	Port for temp. sensor(Tbt1, The balanced water tank of up temp. sensor)
12	CN16	Port for temp. sensor(Tbt2, The balanced water tank of up temp. sensor)
13	CN13	Port for temp. sensor(T5, domestic hot water tank temp. sensor)
14	CN15	Port for temp. sensor(Tw2, The outlet water for zone 2 temp. sensor)
15	CN18	Port for temp. sensor(Tsolar, Solar panel temp. sensor)
16	CN17	Port for variable speed pump communication
17	CN31	Control port for room thermostat (heating mode)(HT)/Control port for room thermostat (cooling mode)(CL)/Power port for room thermostat(COM)
18	CN35	Port for smart grid (grid signal, photovoltaic signal)
19	CN36	Port for remote switch, temperature board
20	CN19	Communicate port between indoor unit and outdoor unit
21	CN14	Port for communication with the wired controller
22	CN30	Communicate port between indoor unit and outdoor unit, port for communication with the wired controller, internal machine parallel
23	CN7	Port for antifreeze E-heating tape(external), additional heat source, compressor run/defrost run
24	CN11	Control port for tank booster heater, internal backup heater 1, input port for solar energy, Port for room thermostat, SV1(3-way valve), SV2(3-way valve), SV3(3-way valve), zone 2 pump, outside circulation pump, solar energy pump, DHW pipe pump,
25	CN2	Feedback port for external temp. switch(shorted in default)
26	CN1	Feedback port for temperature switch(shorted in default)
27	CN22	Control port for backup heater1/booster heater/Reserved
28	CN41	Port for anti-freeze electric heating tape
29	CN42	Port for anti-freeze electric heating tape
30	CN29	Port for anti-freeze electric heating tape
31	IC39	EEPROM

Figure 4-2.2: MHC-V18(22,26,30)W/D2RN8 outdoor unit main PCB for refrigerant system

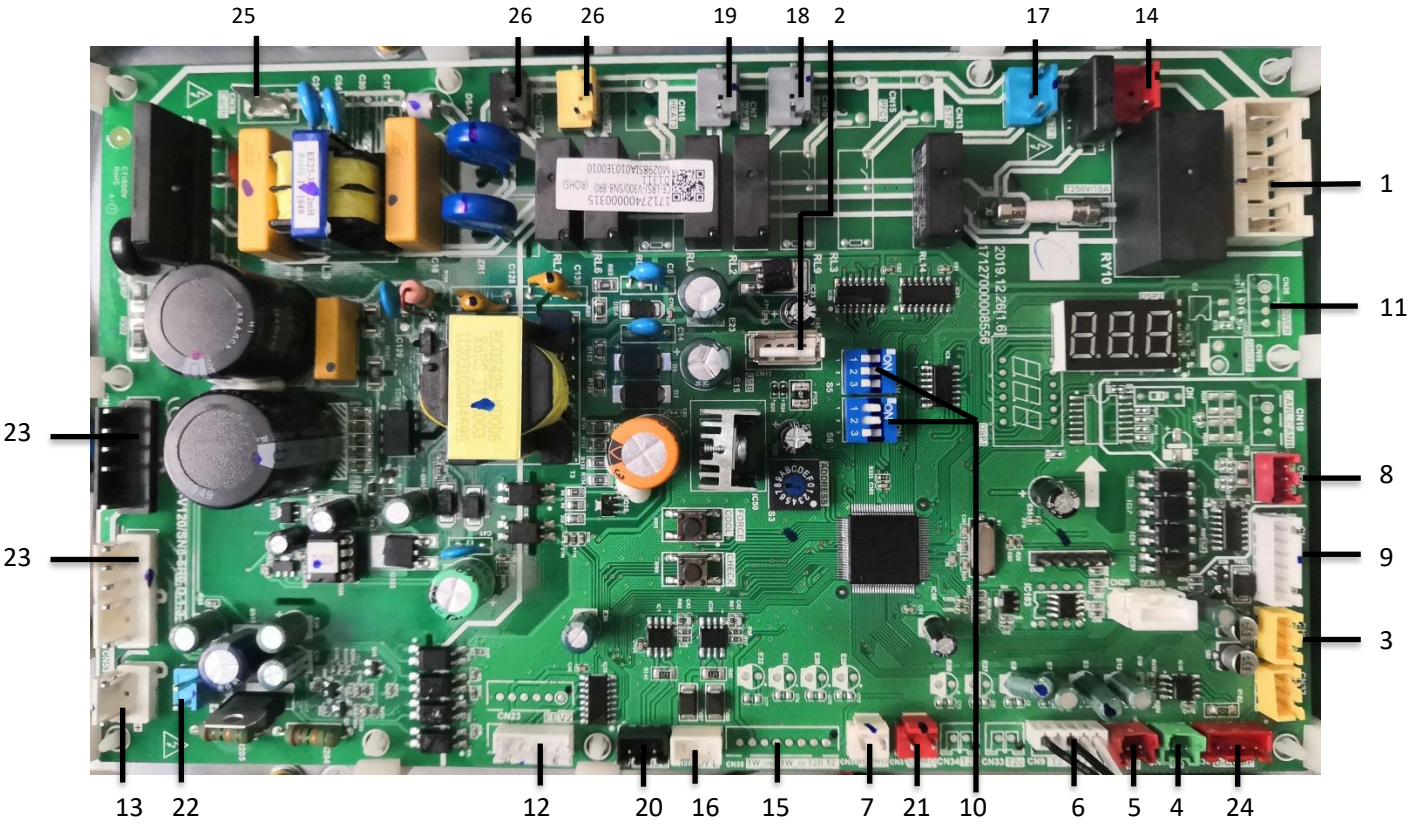


Table 4-2.2: MHC-V18(22,26,30)W/D2RN8 outdoor unit main PCB for refrigerant system

Label in Figure 4-2.2	Code	Content
1	CN41	Power supply port for PCB B
2	CN11	Port for IC programming
3	CN6	Port for pressure sensor
4	CN5	Port for suction temp. sensor
5	CN8	Port for discharge temp. sensor
6	CN9	Port for outdoor ambient temp. sensor and condenser temp. sensor
7	CN29	Port for low pressure switch and quick check
8	CN24	Port for communication with hydro-box control board
9	CN4	Port for communication with PCB C
10	S5, S6	DIP switch
11	CN26	Port for communication with Power Meter
12	CN22	Port for electrical expansion value
13	CN53	Port for fan 310VDC power supply
14	CN21	Power supply port for hydro-box control board
15	CN35	Port for other temp. sensor
16	CN28	Port for communication XYE
17	CN18	Port for 4-way value
18	CN10	Port for electric heating tape1
19	CN7	Port for electric heating tape2
20	CN37	Port for communication D1D2E
21	CN31	Port for high pressure switch and quick check
22	CN30	Port for fan 15VDC power supply
23	CN107/109	Port for fan
24	CN36	Port for communication with PCB A
25	CN38	Port for GND
26	CN20/27	Port for SV

Figure 4-2.3: MHC-V18(22,26,30)W/D2RN8 outdoor unit inverter module

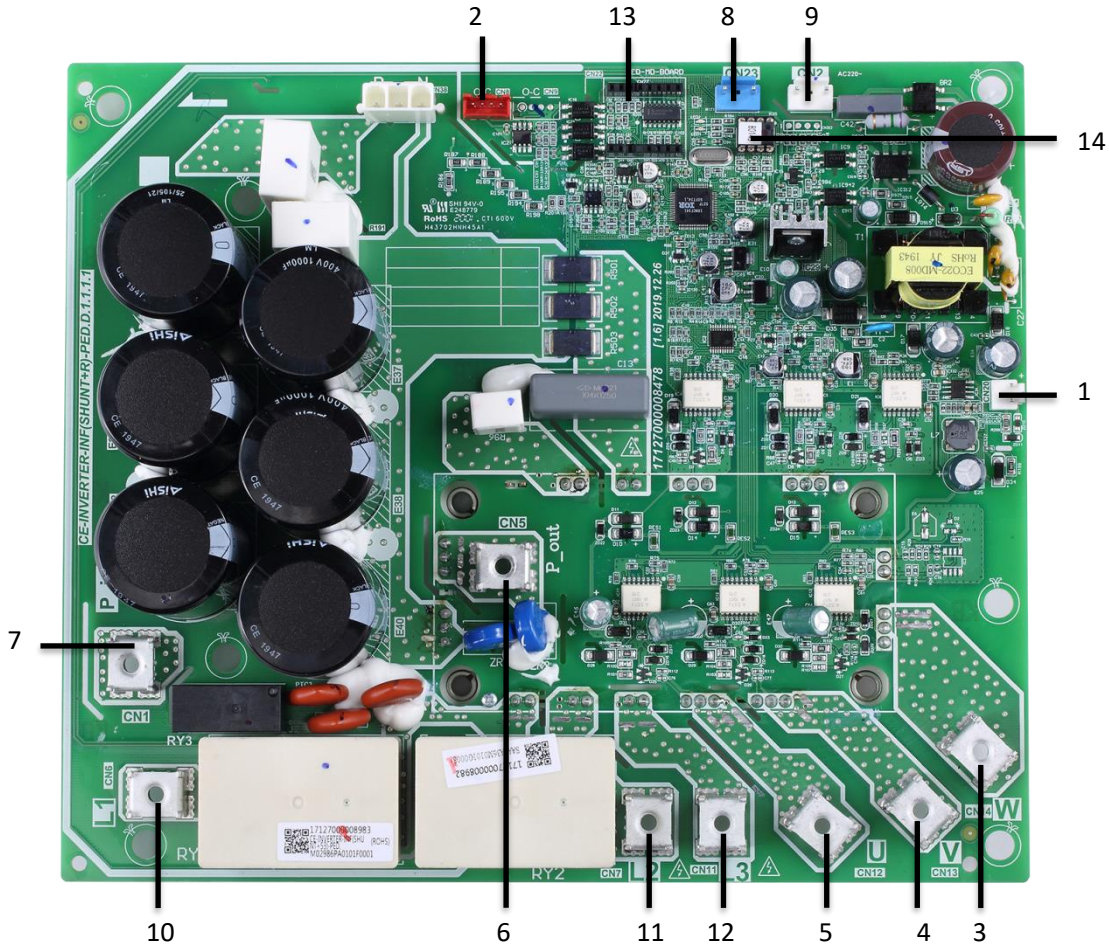


Table 4-2.3: MHC-V18(22,26,30)W/D2RN8 outdoor unit inverter module

Label in Figure 4-2.3	Code	Content
1	CN20	Output port for +15V
2	CN8	Port for communication with PCB B
3	W	Compressor connection port W
4	U	Compressor connection port U
5	V	Compressor connection port V
6	-	Input port P_out for IPM module
7	-	Input port P_in for IPM module
8	CN23	Input port for high pressure switch
9	CN2	Power for switching power supply
10	L1’	Power filtering L1
11	L2’	Power filtering L2
12	L3’	Power filtering L3
13	-	PED board
14	IC25	EEPROM

Figure 4-2.4: MHC-V18(22,26,30)W/D2RN8 outdoor unit filter board

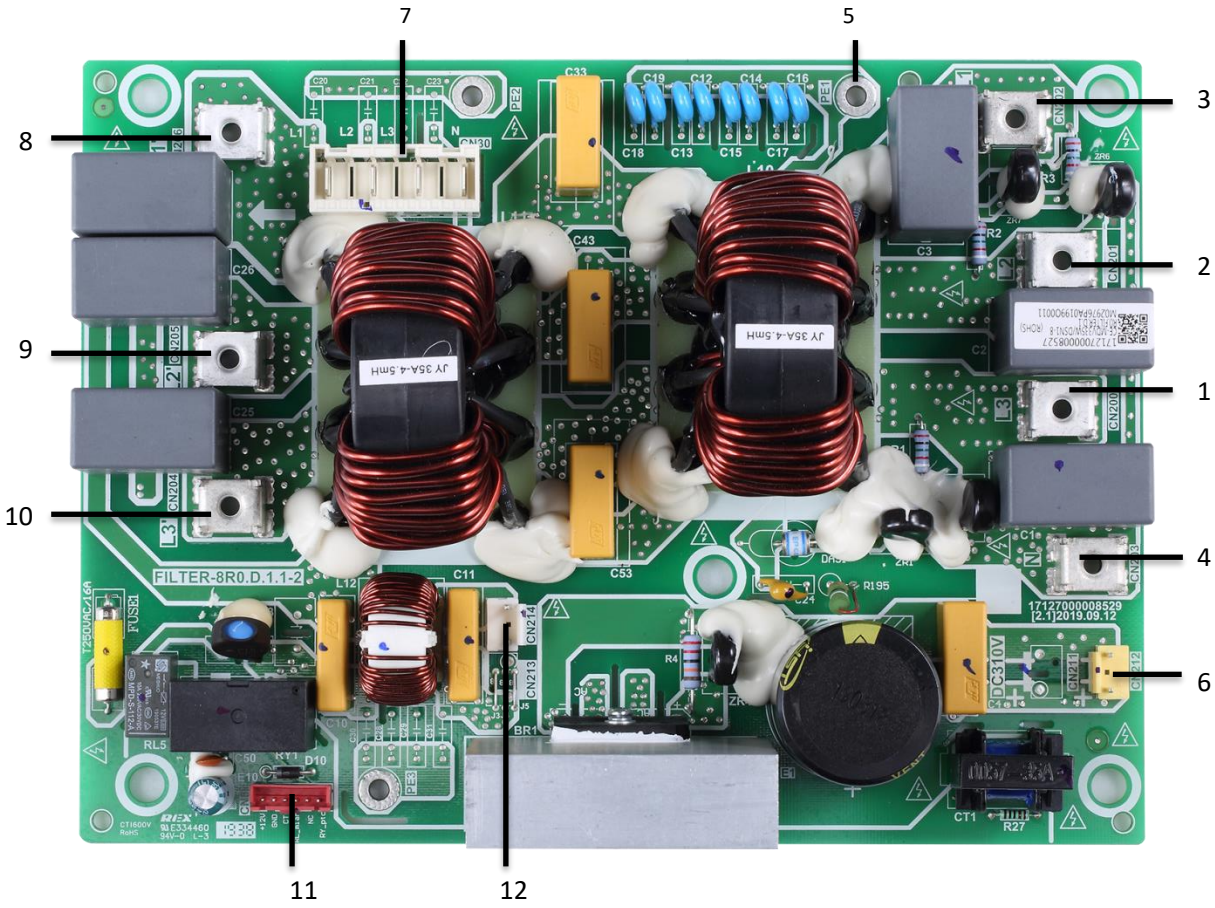


Table 4-2.4: MHC-V18(22,26,30)W/D2RN8 outdoor unit filter board

Label in Figure 4-2.4	Code	Content
1	L3	Power supply L3
2	L2	Power supply L2
3	L1	Power supply L1
4	N	Power supply N
5	PE1	Ground wire
6	CN212	Power supply port for DC fan
7	CN30	Power supply port for main control board
8	L1’	Power filtering L1
9	L2’	Power filtering L2
10	L3’	Power filtering L3
11	CN8	Port for communication with PCB B
12	CN214	Power supply for PCB A switching power supply

2.3 Digital Display Output

Table 4-2.5: Digital display output in different operating states

Outdoor unit state	Parameters displayed on hydronic system DSP1	Parameters displayed on refrigerant system DSP1	
On standby	0	0	
Normal operation	Leaving water temperature (°C)	Running speed of the compressor in rotations per second	
Error or protection	Error or protection code	Error or protection code	

2.4 Modbus Function

Figure 4-2.6: Connection

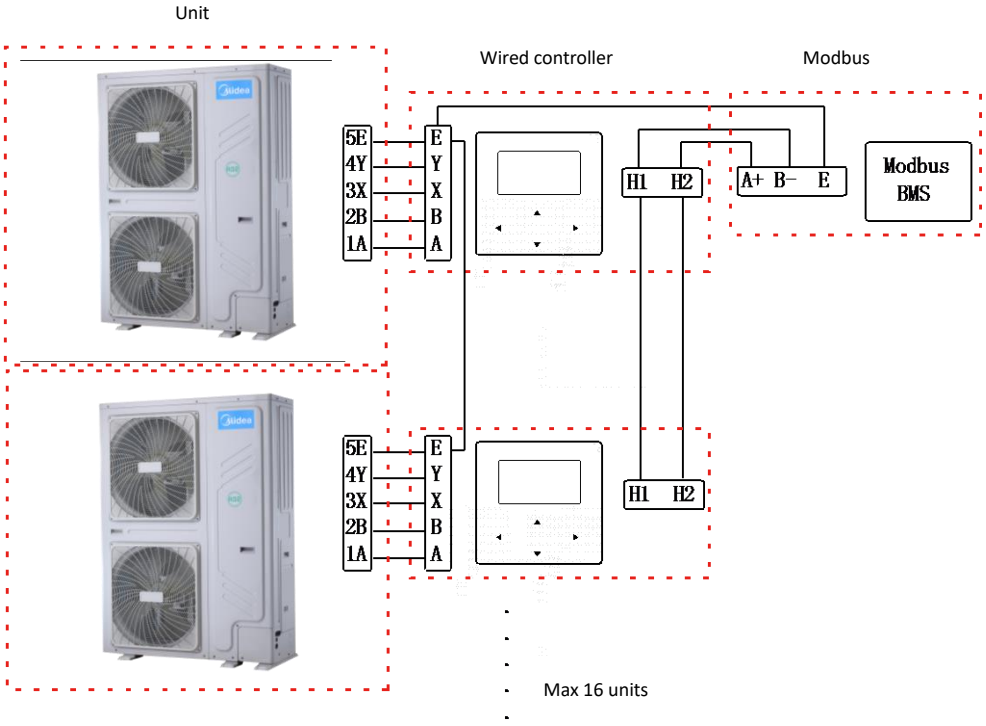
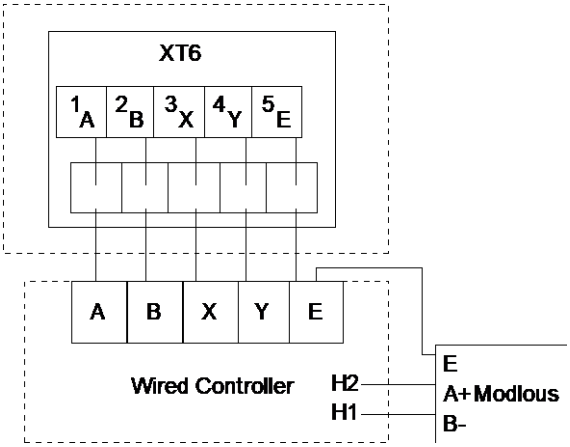
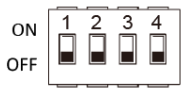
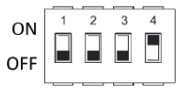
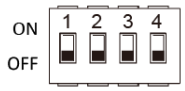


Figure 4-2.7: Wiring

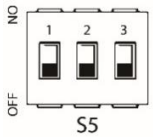
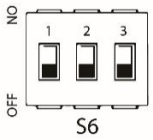


2.5 DIP Switch Settings

DIP switch S1, S2 and S4 are located on the main control hydraulic module board.

Switch		ON=1	OFF=0	
S1 	1/2	Reserved		Set according to unit configuration by factory
	3/4	00=Without IBH and AHS 10=With IBH 01=With AHS for heating mode 11=With AHS for heating mode and DHW		Set according to unit configuration by factory or adjust onsite according to application
S2 	1	Start Pump O after 24 hours will be invalid	Start Pump O after 24 hours will be valid	Refer to electrically controlled wiring diagram
	2	without TBH	with TBH	
	3/4	00=variable speed pump, Max head: 8.5m 01=constant speed pump 10=constant speed pump, Max head: 10.5m 11=constant speed pump, Max head: 9.0m		
S4 	1	Master unit: clear address of all slave units Slave unit: clear its own address	Keep the current address	Refer to electrically controlled wiring diagram
	2	Reserved	Reserved	
	3/4	Reserved		

DIP switch S5 and S6 are located on outdoor unit main PCB for refrigerant system.

	Default factory setting
	0/0/0=18Kw, 1/0/0=22Kw, 0/1/0=26Kw, 1/1/0=30Kw

The rotating coded switch S3(0-F) on the outdoor unit main PCB for refrigerant system Keep factory Settings.

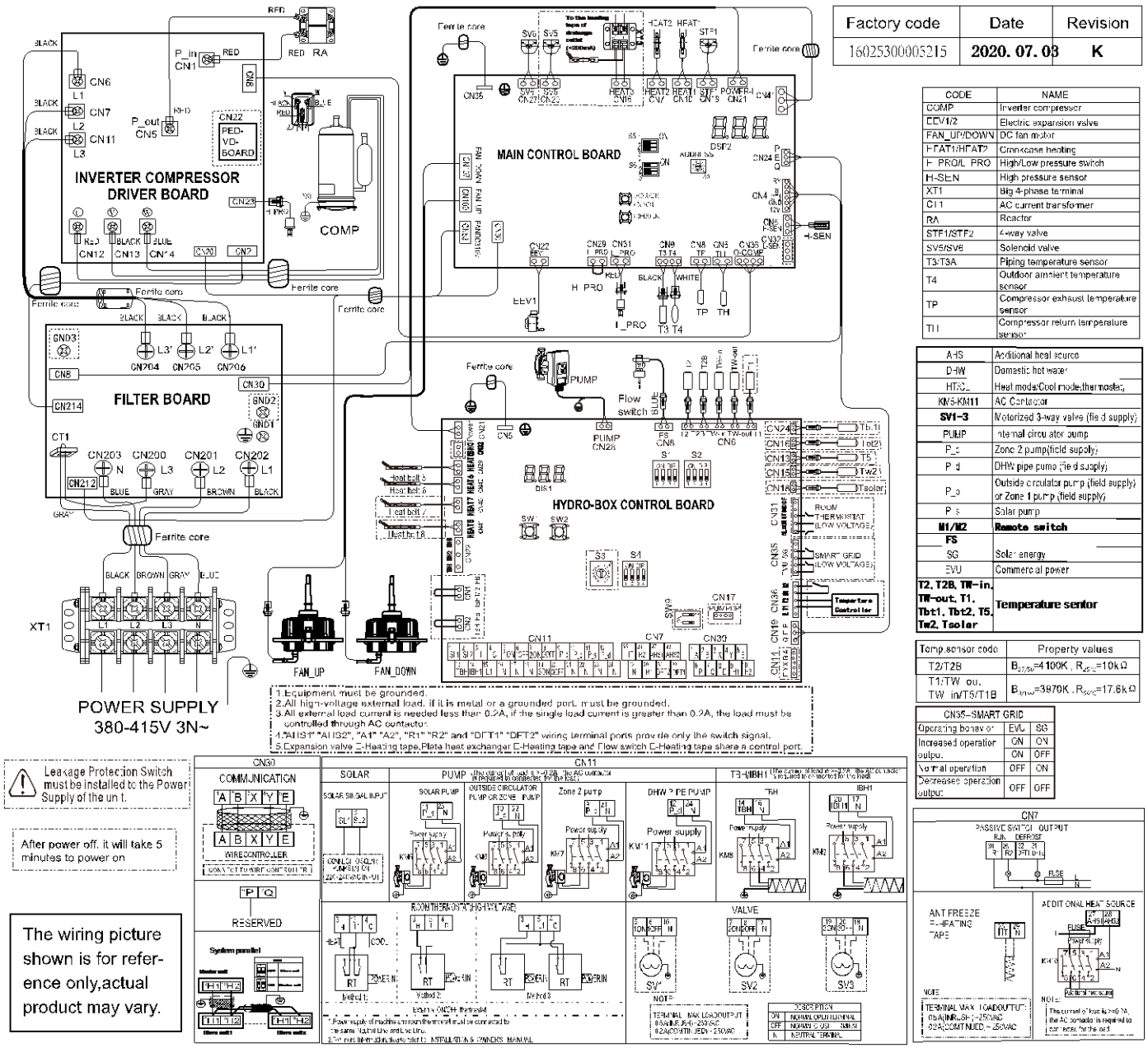
2.6 Point check button

Point check button SW1 and SW2 are located on outdoor unit main PCB for refrigerant system.

Point check button is for the use of research and development personnel, and should not be touched under normal circumstances.

3 Wiring Diagrams

Figure 4-3.1: MHC-V18(22, 26,30)W/D2RN8 wiring diagram



Factory code	Date	Revision
16025300005215	2020. 07. 03	K

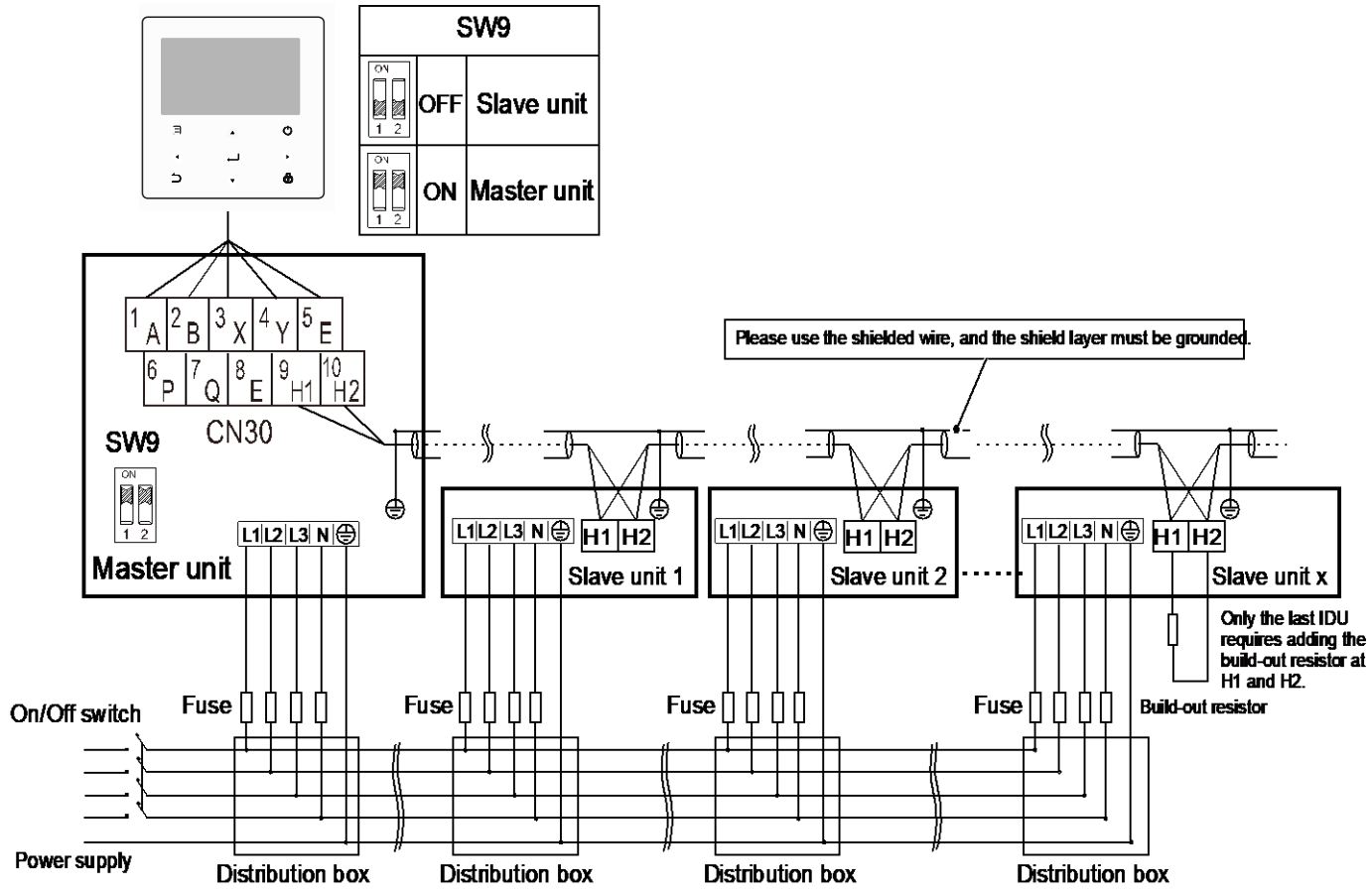
CODE	NAME
COMP	Inverter compressor
EEV1/2	Electric expansion valve
FAN_UP/DOWN	DC fan motor
HEAT1/HEAT2	Crankcase heating
H_PRO/L_PRO	High/Low pressure switch
H-SEN	High pressure sensor
XT1	Big 4-phase terminal
CT1	AC current transformer
RA	Reactor
STF1/STF2	4-way valve
SV5/SV6	Solenoid valve
T3-T3A	Piping temperature sensor
T4	Outdoor ambient temperature sensor
TP	Compressor exhaust temperature sensor
TH	Compressor return temperature sensor

AHS	Additional heat source
DHW	Domestic hot water
HTAC_	Heat mode/Cool mode,thermostat
KM5-KM11	AC Contactor
SV1-3	Motorized 3-way valve (field supply)
PUMP	Internal circulator pump
P_c	Zone 2 pump(field supply)
P_d	DHW pipe pump (field supply)
P_o	Outside circulator pump (field supply) or Zone 1 pump (field supply)
P_s	Solar pump
M1/M2	**Remote switch**
FS	
SG	Solar energy
EVU	Commercial power
T2, T2B, TW_in, TW_out, T1, Tbt1, Tbt2, T5, Tw2, Tsolar	**Temperature sensor**

Temp.sensor code	Property values
T2/T2B	$B_{27/50}$=4100K , $R_{25℃}$=10kΩ
T1/TW_ou, TW_in/T5/T1B	$B_{(VW)}$=3970K , $R_{25℃}$=17.6kΩ

CN35--SMART GRID		
Operating behavior	EVU	SG
Increased operation output	ON	ON
	ON	OFF
Normal operation	OFF	ON
Decreased operation output	OFF	OFF

Figure 4-3.2: MHC-V18(22, 26,30)W/D2RN8 group control system wiring diagram



Notes:

1. Midea recommends 6 units to be controlled by one controller and installed by reversed return water system for better hydraulic equilibrium.
2. In order to ensure the success of automatic addressing, all machines must be connected to the same power supply and powered on uniformly.
3. Only the master unit can connect the controller, and SW9 on hydronic PCB should be switched to “on” for the master unit. The slave units can not connect the controller.
4. Please use the shielded wire and the shield layer must be grounded.
5. When the communication between the unit is unstable, please add a network matching wire between the ports H1 and H2 at the terminal of the communication system
6.When connecting to the power supply terminal, use the circular wiring terminal with the insulation casing (see Figure 4-4.1).
7.Use power cord that conforms to the specifications and connect the power cord firmly. To prevent the cord from being pulled out by external force, make sure it is fixed securely.
8. If circular wiring terminal with the insulation casing cannot be used, please make sure that: Do not connect two power cords with different diameters to the same power supply terminal (may cause overheating of wires due to loose wiring) (See Figure 4-4.2).

Figure 4-4.1

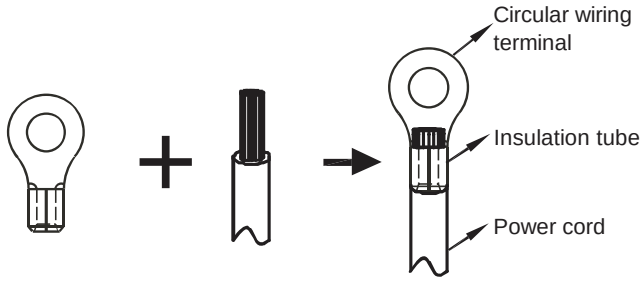
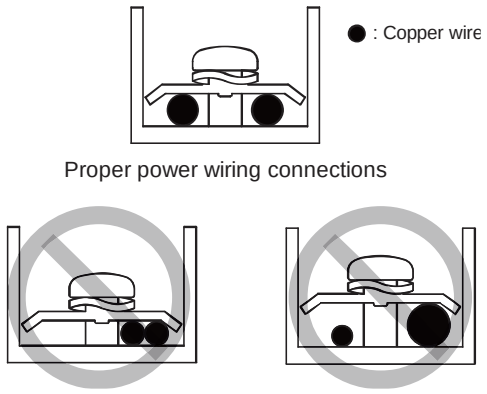
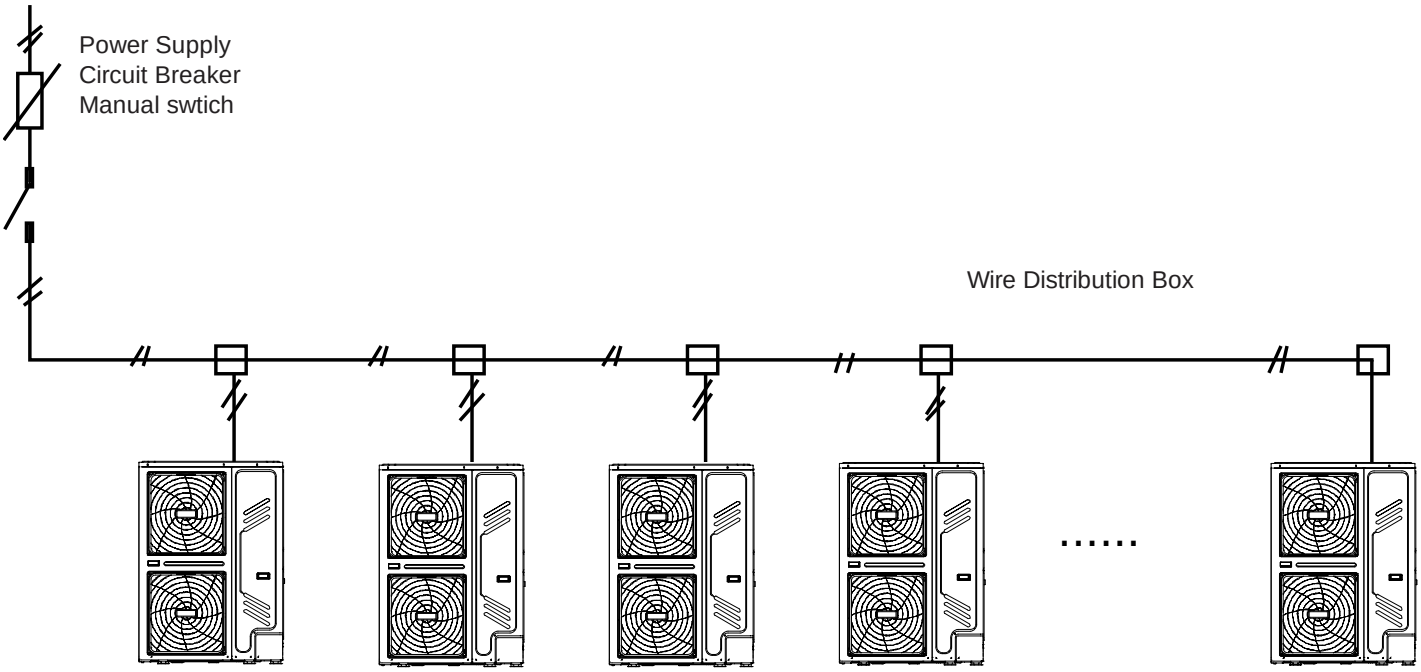


Figure 4-4.2



9. Power Cord Connection of group control system

Use a dedicated power supply for the indoor unit that is different from the power supply for the outdoor unit. Use the same power supply, circuit breaker and leakage protective device for the indoor units connected to the same outdoor unit.



4 Error Code Table

Table 4-4.1: Error code table

Error code	Content
bH	PED PCB fault
C7	High temp. protection of inverter module
E0	Water flow fault (E8 displayed 3 times)
E1	Phase loss or neutral wire and live wire are connected reversely (only for three phase unit)
E2	Communication fault between controller and main control board of hydraulic module
E3	Final outlet water temp. sensor (T1) fault.
E4	Water tank temp. sensor (T5) fault.
E5	The condenser outlet refrigerant temperature sensor (T3) fault
E6	The ambient temperature sensor (T4) fault.
E7	The balance tank up temp. sensor (Tbt1) fault.
E8	Water flow fault.
E9	Compressor suction temp. sensor (Th) fault.
EA	Compressor discharge temp. sensor (Tp) fault
Eb	Solar panel temp.sensor (Tsolar) fault.
Ec	The balance tank low temp.sensor(Tbt2) fault
Ed	The plate exchanger water inlet temp. sensor (Tw_in) fault.
EE.	The main control board of hydraulic module EEPROM fault.
F1	DC bus low voltage protection
H0	Communication fault between main control board of hydraulic module and main control board PCB B(Main control board of unit)
H1	Communication fault between inverter module PCB A(Inverter module) and main control board PCB B(Main control board of unit)
H2	The plate exchanger refrigerant outlet (liquid pipe) temp. sensor (T2) fault.
H3	The plate exchanger refrigerant outlet (gas pipe) temp. sensor (T2B) fault.
H4	Three times P6 protection
H5	Room temp.sensor (Ta) fault
H6	DC fan motor fault.
H7	Main circuit voltage protection fault
H8	Pressure sensor fault.
H9	Zone 2 water flow temp. sensor (Tw2) fault.
HA	The plate heat exchanger water outlet temperature sensor (Tw_out) fault.
Hb	Three times “PP” protection and Tw_out < 7℃
Hd	Communication fault between master unit and slave unit (in parallel)
HE	Communication fault between indoor unit and Ta / room thermostart transfer PCB.
HF	Inverter module board EE PROM fault
HH	H6 displayed 10 times in 120 minutes.
HP	Low pressure protection （Pe<0.6） occured 3 times in 1 hour in cooling mode
P0	Low pressure protection
P1	High pressure protection
P3	Compressor overcurrent protection

Table continued on next page …

Table 4-4.1: Error code table (continued)

P4	Compressor discharge temp. too high protection
P5	High Temperature difference protection between water inlet and water outlet of the plate heat exchanger.
P6	Inverter module protection
Pb	Anti-freeze mode protection
Pd	High temperature protection of refrigerant outlet temp. of condenser
PP	Water inlet temperature is higher than water outlet in heating mode
L0	DC compressor inverter module fault
L1	DC bus low voltage protection (from inverter module mostly when compressor running)
L2	DC bus high voltage protection from DC driver
L4	MCE fault
L5	Zero speed protection
L7	Phase sequence fault
L8	Compressor frequency variation greater than 15Hz within 1 second protection
L9	Actual compressor frequency differs from target frequency by more than 15Hz protection

5 Troubleshooting

5.1 Warning

Warning

- All electrical work must be carried out by competent and suitably qualified, certified and accredited professionals and in accordance with all applicable legislation (all national, local and other laws, standards, codes, rules, regulations and other legislation that apply in a given situation).
- Power-off the outdoor units before connecting or disconnecting any connections or wiring, otherwise electric shock (which can cause physical injury or death) may occur or damage to components may occur.

5.2 E0, E8 Troubleshooting

5.2.1 Digital display output

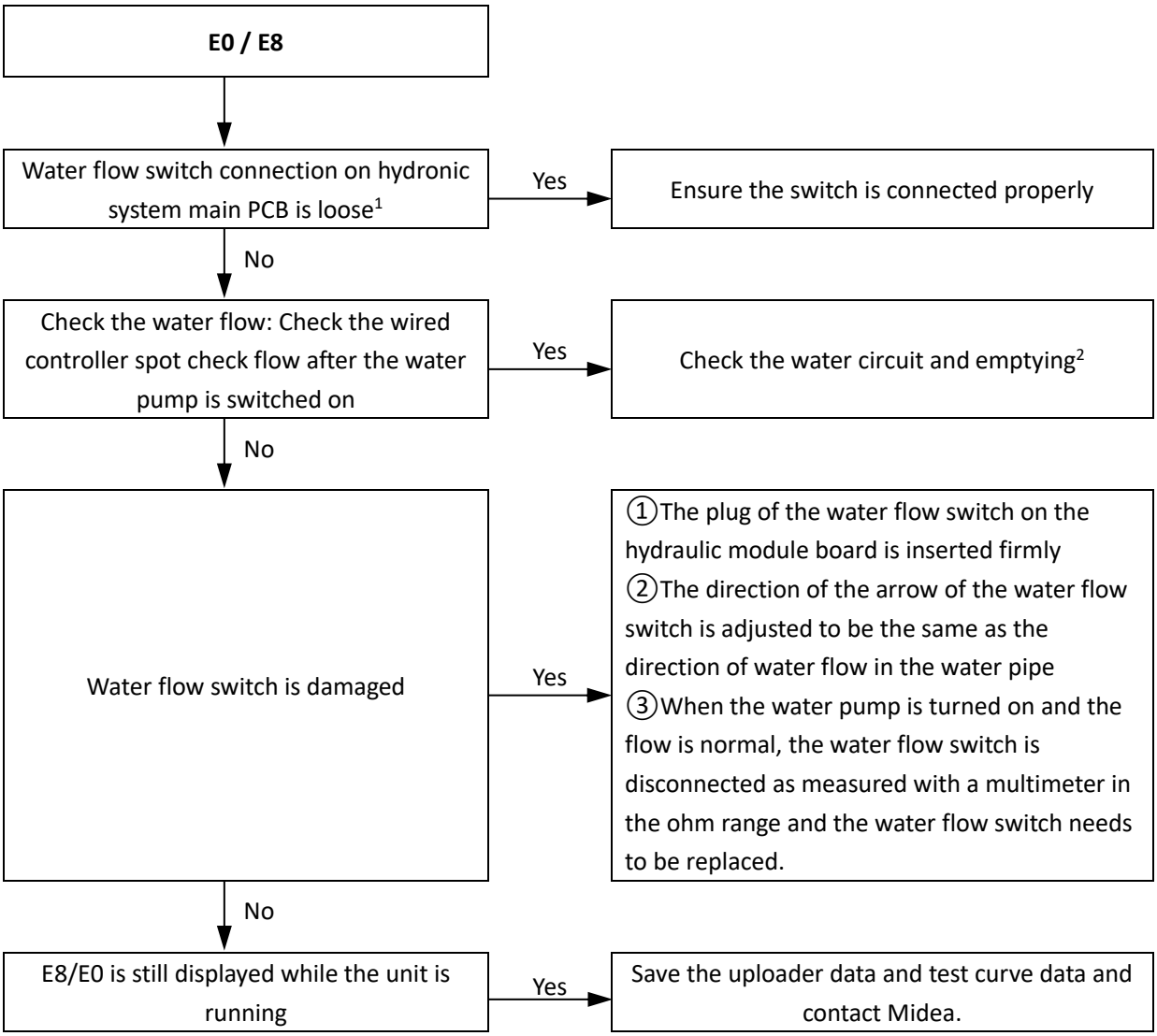

5.2.2 Description

- Water flow failure.
- E0 indicates E8 has displayed 3 times. When an E0 error occurs, a manual system restart is required before the system can resume operation.
- M thermal Mono stops running.
- Error code is displayed on hydronic system main control board for refrigerant system and user interface.

5.2.3 Possible causes

- The wire circuit is short connected or open.
- Water flow rate is too low.
- Water flow switch damaged.
- Water circuit is abnormal or not emptied.

5.2.4 Procedure



Notes:

1. Water flow switch connection is port CN8 on the main PCB for hydronic system (labeled 5 in Figure 4-2.1 in Part 4, 2.2 “Main PCB for Hydronic System”).
2. Methods of Checking the water circuit and emptying: ①Whether the unit connected the water circuit ball valve open; ②Whether the unit inlet and outlet pipes are reversed; ④Whether the unit water circuit replenishment and emptying is completed, if necessary, the unit can be emptied quickly and manually from the pressure relief valve, requiring system water pressure ≥ 1.5 bar; ⑤Whether the pump wires is connected, whether the water pump indicator lights up after the water pump icon is lit on the wired controller

5.3 E1 Troubleshooting

5.3.1 Digital display output

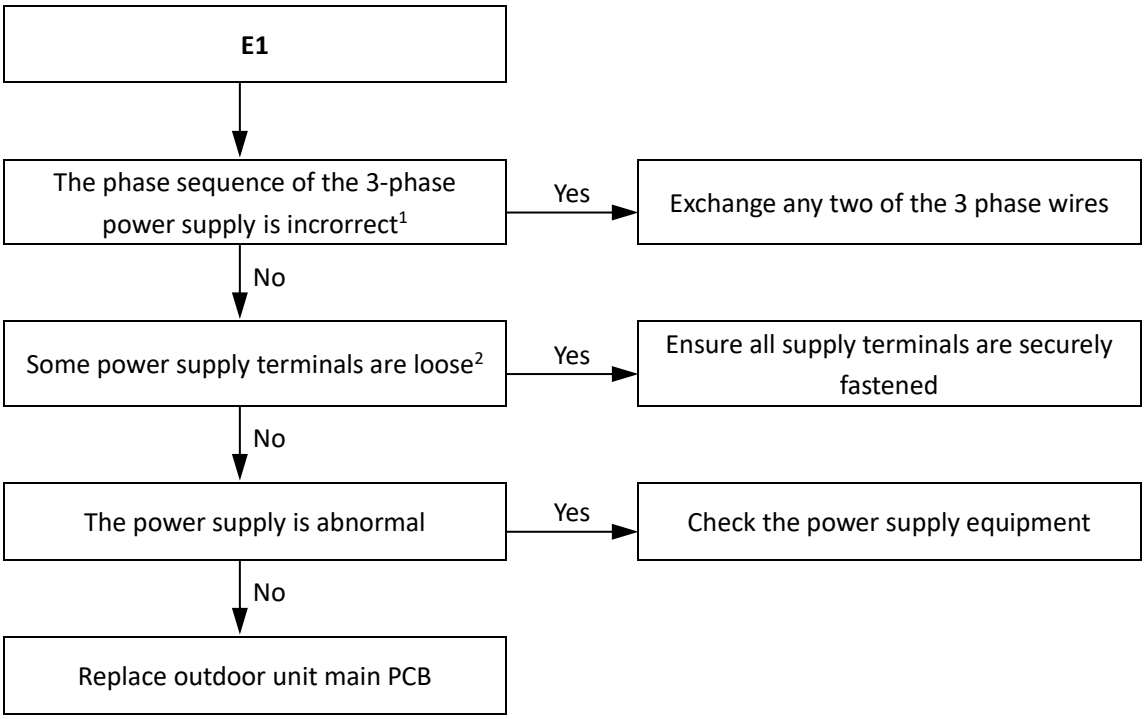
5.3.2 Description

- Phase sequence error.
- M thermal Mono stops running.
- Error code is displayed on outdoor unit main PCB and user interface.

5.3.3 Possible causes

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

5.3.4 Procedure



Notes:

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

5.4 E2 Troubleshooting

5.4.1 Digital display output

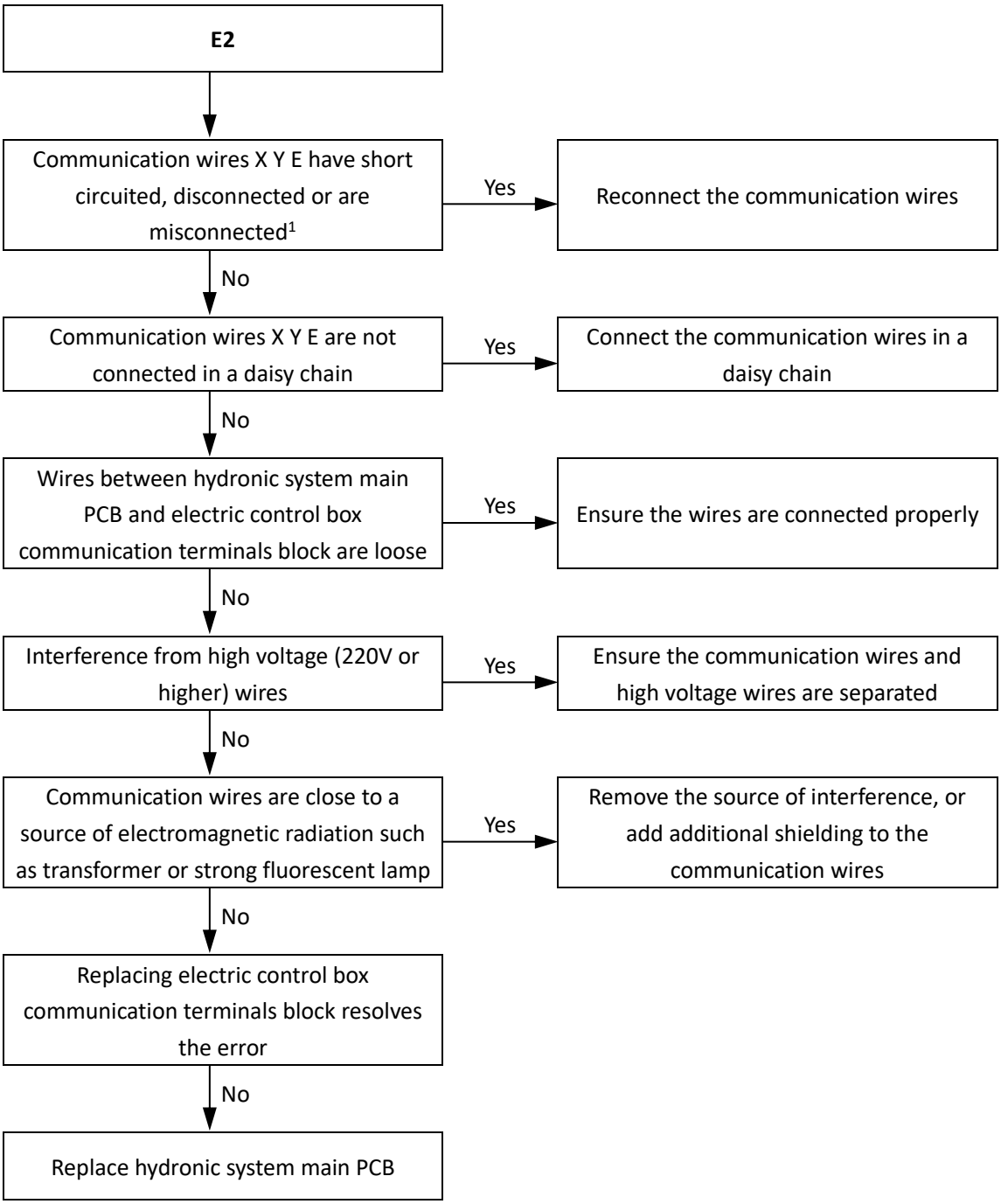
5.4.2 Description

- Communication error between hydronic system and user interface.
- M thermal Mono stops running.
- Error code is displayed on hydronic system main PCB and user interface.

5.4.3 Possible causes

- Communication wires between hydronic system and user interface not connected properly.
- Communication wiring X Y E terminals misconnected.
- Loosened wiring within electric control box.
- Interference from high voltage wires or other sources of electromagnetic radiation.
- Damaged main PCB or electric control box communication terminals block.

5.4.4 Procedure

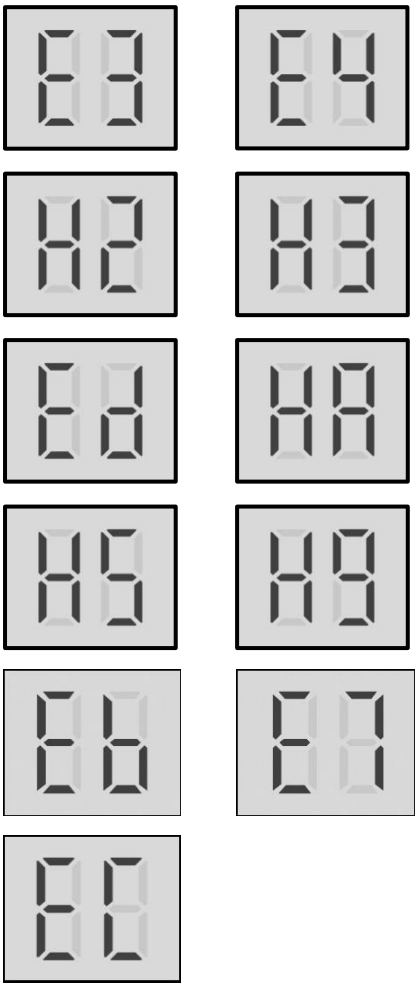


Notes:

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

5.5 E3, E4, H2, H3, Ed, HA, H5, H9, Eb, E7,Ec Troubleshooting

5.5.1 Digital display output



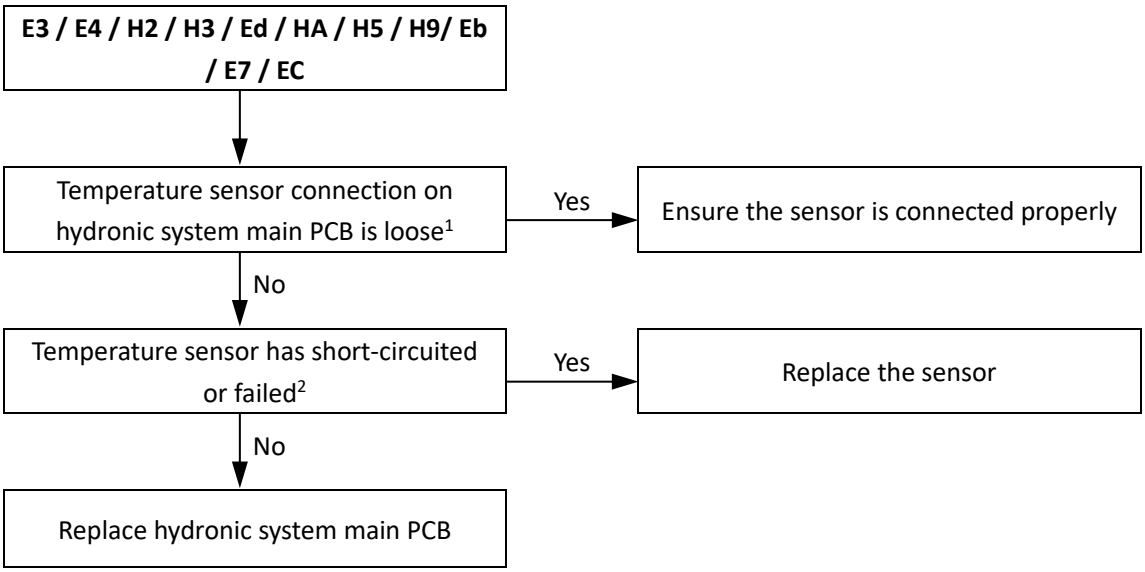
5.5.2 Description

- E3 indicates final outlet water temperature sensor error
- E4 indicates a domestic hot water tank temperature sensor error.
- H2 indicates a water side heat exchanger refrigerant outlet (liquid pipe) temperature sensor error.
- H3 indicates a water side heat exchanger refrigerant inlet (gas pipe) temperature sensor error.
- Ed indicates a water side heat exchanger water inlet temperature sensor error.
- HA indicates a water side heat exchanger water outlet temperature sensor error.
- H5 indicates a room temperature sensor error.
- H9 indicates a circuit 2 water outlet temperature sensor error.
- Eb indicates solar panel temperature sensor error
- E7 indicates balance tank upper temperature sensor error
- EC indicates balance tank nether temperature sensor error
- M thermal Mono stops running.
- Error code is displayed on hydronic system main PCB and user interface.

5.5.3 Possible causes

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

5.5.4 Procedure

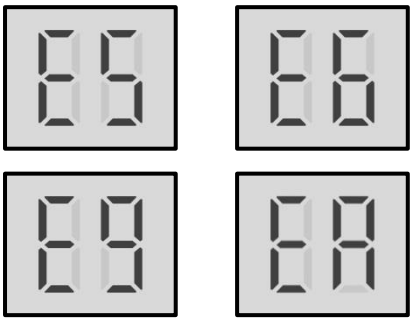


Notes:

1. Final water outlet temperature sensor, water side heat exchanger refrigerant inlet (liquid pipe) temperature sensor, water side heat exchanger refrigerant outlet (gas pipe) temperature sensor, water side heat exchanger water inlet temperature sensor and water side heat exchanger water outlet temperature sensor connections are port CN6 on the hydronic system main PCB (labeled 10 in Figure 4-2.1). Domestic hot water tank temperature sensor connection is port CN13 on the hydronic system main PCB (labeled 13 in Figure 4-2.1). Circuit 2 water outlet temperature sensor connection is port CN15 on the hydronic system main PCB (labeled 14 in Figure 4-2.1). Room temperature sensor connection is port CN11 on the hydronic system main PCB (labeled 24 in Figure 4-2.1). Solar panel temperature sensor connection is port CN18 on the hydronic system main PCB (labeled 15 in Figure 4-2.1). Balance tank upper temperature sensor connection is port CN24 on the hydronic system main PCB (labeled 11 in Figure 4-2.1) Balance tank nether temperature sensor connection is port CN16 on the hydronic system main PCB (labeled 12 in Figure 4-2.1)
2. Set a multi-meter to buzzer mode and test any two terminals of sensor. If the resistance is too low, the buzzer sounds, which means 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 4-7.1 or 4-7.3.

5.6 E5, E6, E9, EA Troubleshooting

5.6.1 Digital display output



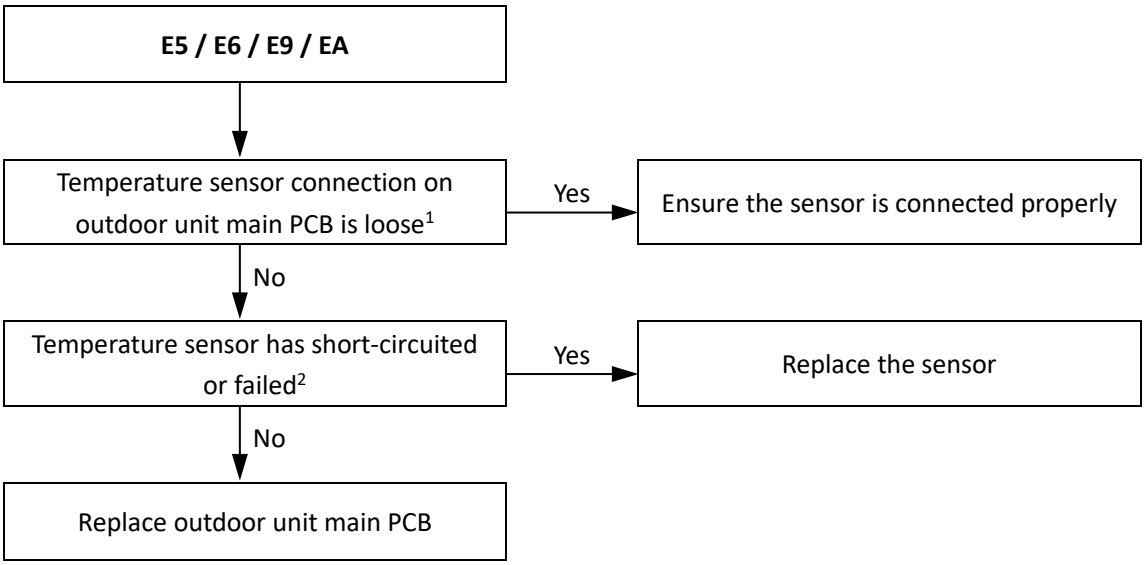
5.6.2 Description

- E5 indicates an air side heat exchanger refrigerant outlet temperature sensor error.
- E6 indicates an outdoor ambient temperature sensor error.
- E9 indicates a suction pipe temperature sensor error.
- EA indicates a discharge temperature sensor error.
- M thermal Mono stops running.
- Error code is displayed on outdoor unit main PCB and user interface.

5.6.3 Possible causes

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

5.6.4 Procedure



Notes:

1. Air side heat exchanger refrigerant outlet temperature sensor and outdoor ambient temperature sensor connections are port CN9 on the outdoor unit refrigerant system main PCB (labeled 6 in Figure 4-2.2). Discharge pipe temperature sensor connection are port CN8 on the outdoor unit refrigerant system main PCB (labeled 5 in Figure 4-2.2). Suction pipe temperature sensor connection are port CN5 on the outdoor unit refrigerant system main PCB (labeled 4 in Figure 4-2.2).
2. Set a multi-meter to buzzer mode and test any two terminals of sensor. If the resistance is too low, the buzzer sounds, which means 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 4-7.1, and Table 4-7.2.

5.7 EE Troubleshooting

5.7.1 Digital display output

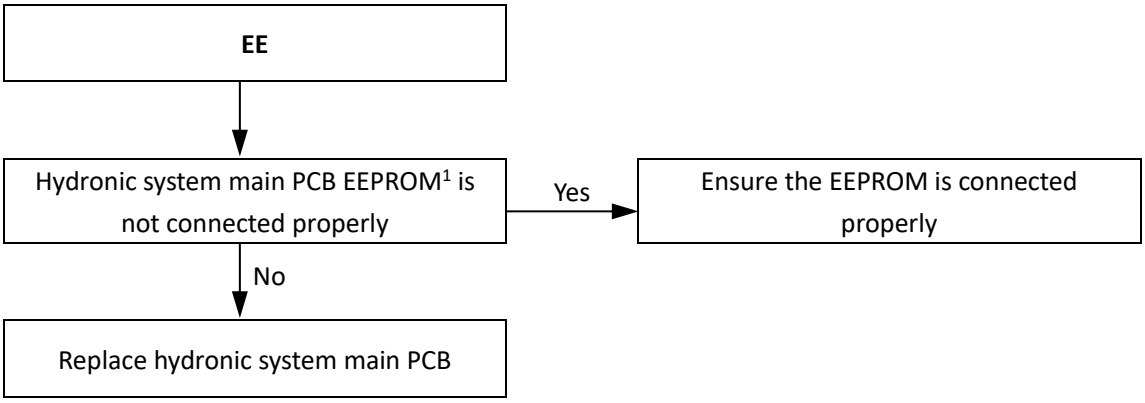
5.7.2 Description

- Hydronic system main PCB EEPROM error.
- M thermal Mono stops running.
- Error code is displayed on hydronic system main PCB and user interface.

5.7.3 Possible causes

- Hydronic system main PCB EEPROM is not connected properly.
- Hydronic system main PCB damaged.

5.7.4 Procedure



Notes:

1. Hydronic system main PCB EEPROM is designated IC39 on the main PCB for hydronic system (labeled 31 in Figure 4-2.1).

5.8 F1 Troubleshooting

5.8.1 Digital display output

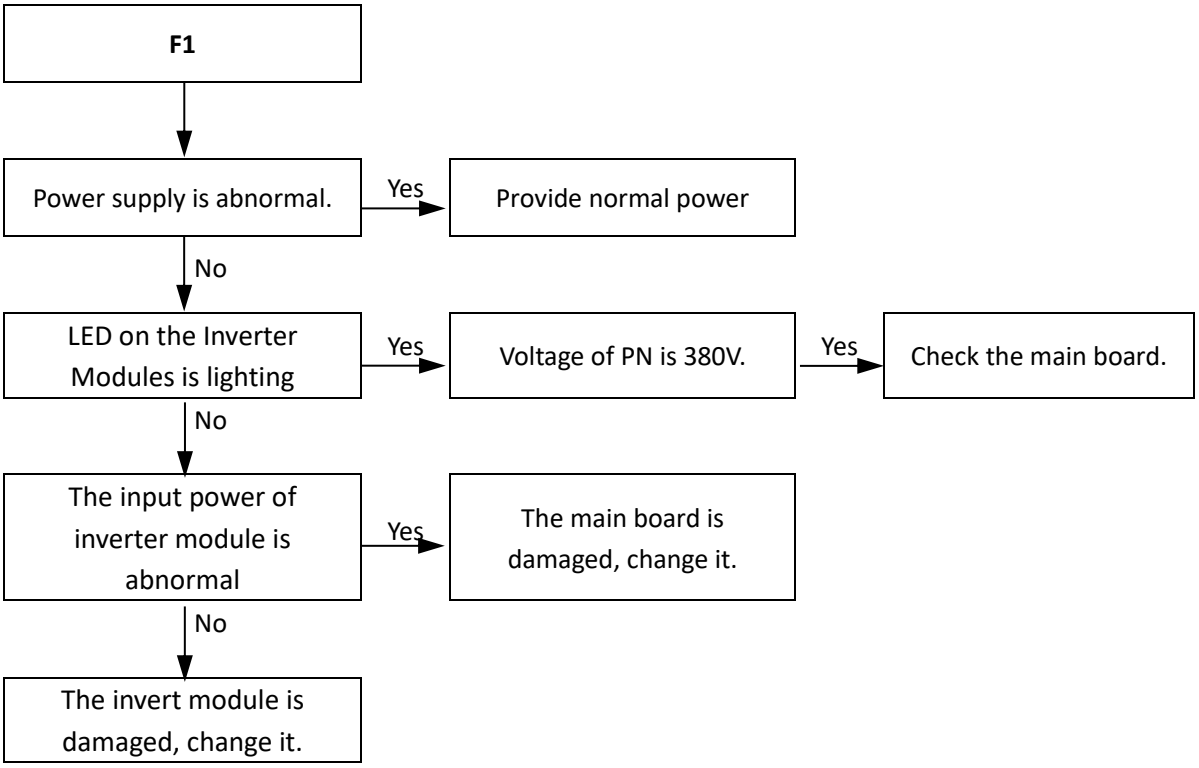
5.8.2 Description

- Low DC generatrix voltage.
- M thermal Mono stops running.
- Error code is displayed on hydronic system main PCB and user interface.

5.8.3 Possible causes

- The DC generatrix voltage is too low.

5.8.4 Procedure



5.9 HF Troubleshooting

5.9.1 Digital display output

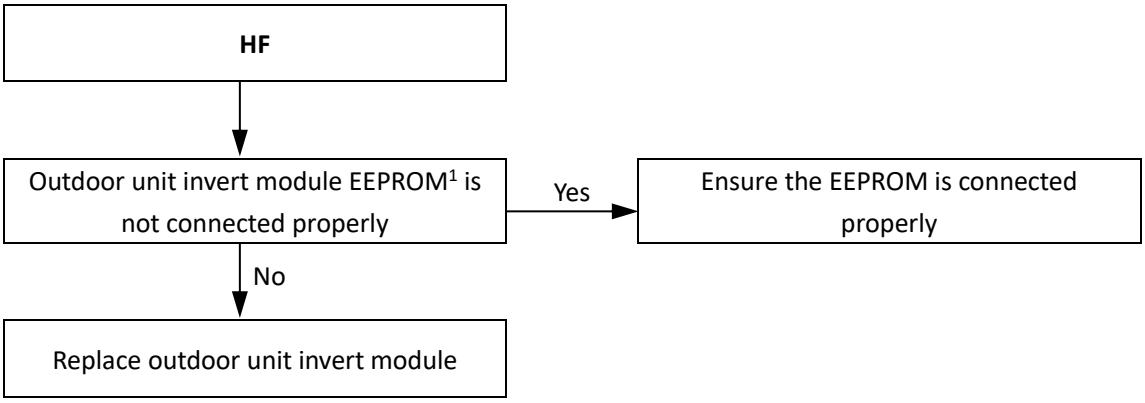
5.9.2 Description

- Outdoor unit inverter module EEPROM error.
- M thermal Mono stops running.
- Error code is displayed on outdoor unit main PCB and user interface.

5.9.3 Possible causes

- Outdoor unit invert module EEPROM is not connected properly.
- Outdoor unit invert module EEPROM damaged.

5.9.4 Procedure



Notes:

1. Outdoor unit invert module EEPROM is designated IC25 on the outdoor unit invert module (labeled 14 in Figure 4-2.3)..

5.10 H0 Troubleshooting

5.10.1 Digital display output

5.10.2 Description

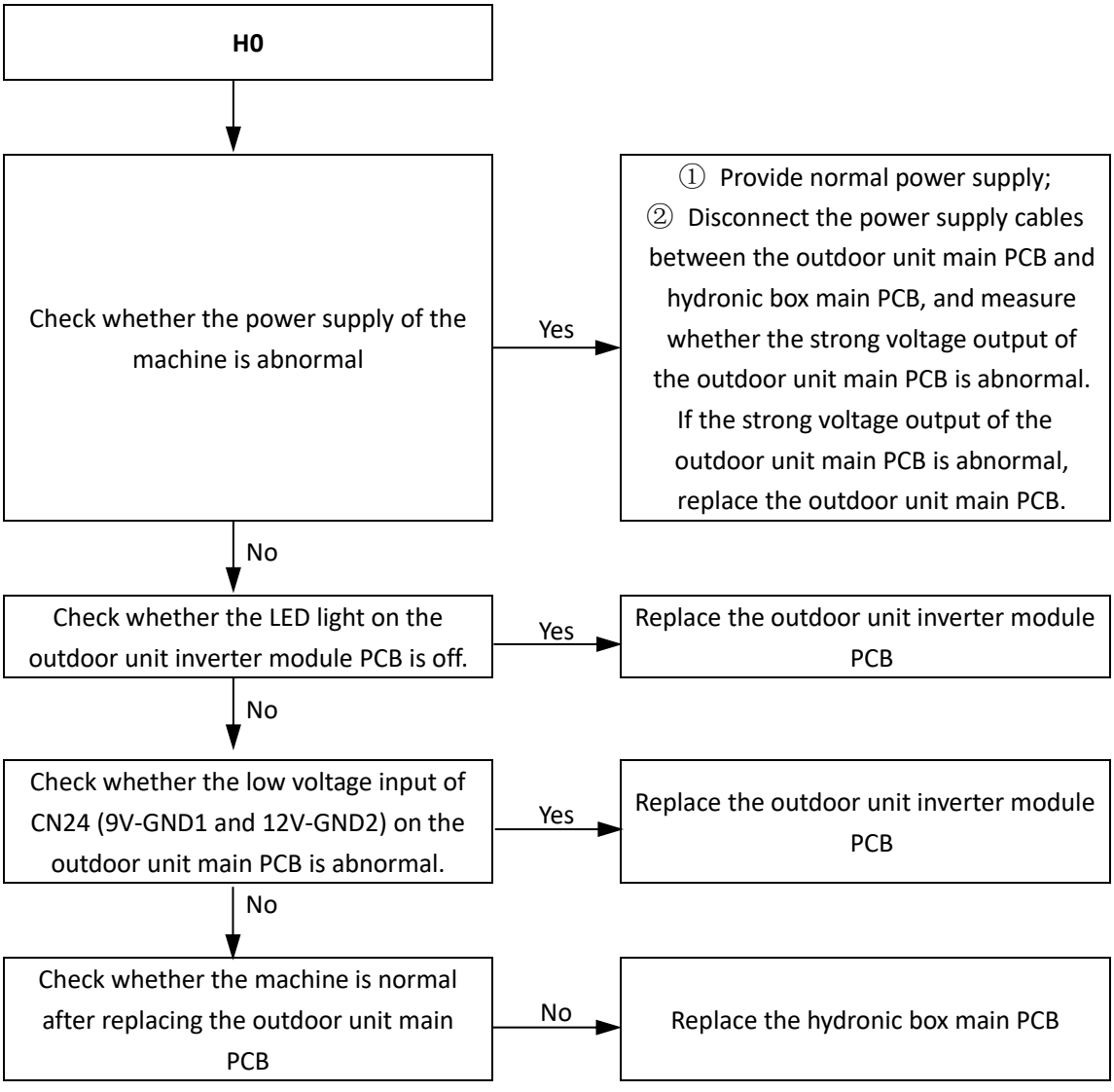
- Communication error between outdoor unit and hydronic system.
- M thermal Mono stops running.
- Error code is displayed on hydronic system main PCB, outdoor unit main PCB and user interface.

5.10.3 Possible causes

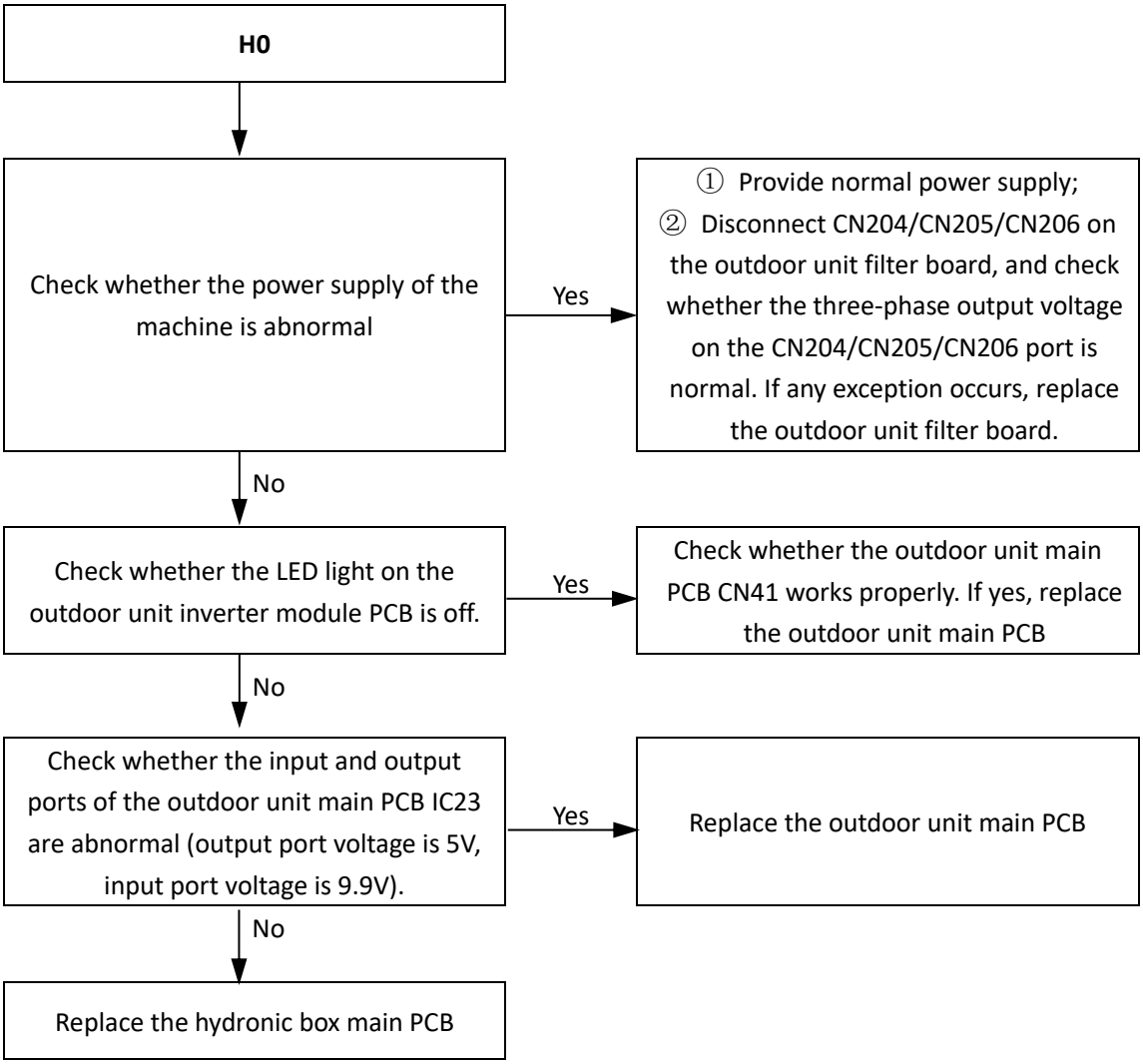
- Power supply abnormal.
- Transformer malfunction.
- Interference from a source of electromagnetic radiation.
- Outdoor unit main PCB or hydronic system main PCB damaged.

5.10.4 Procedure

One-phase model



Three-phase model



5.11 H1 Troubleshooting

5.11.1 Digital display output

5.11.2 Description

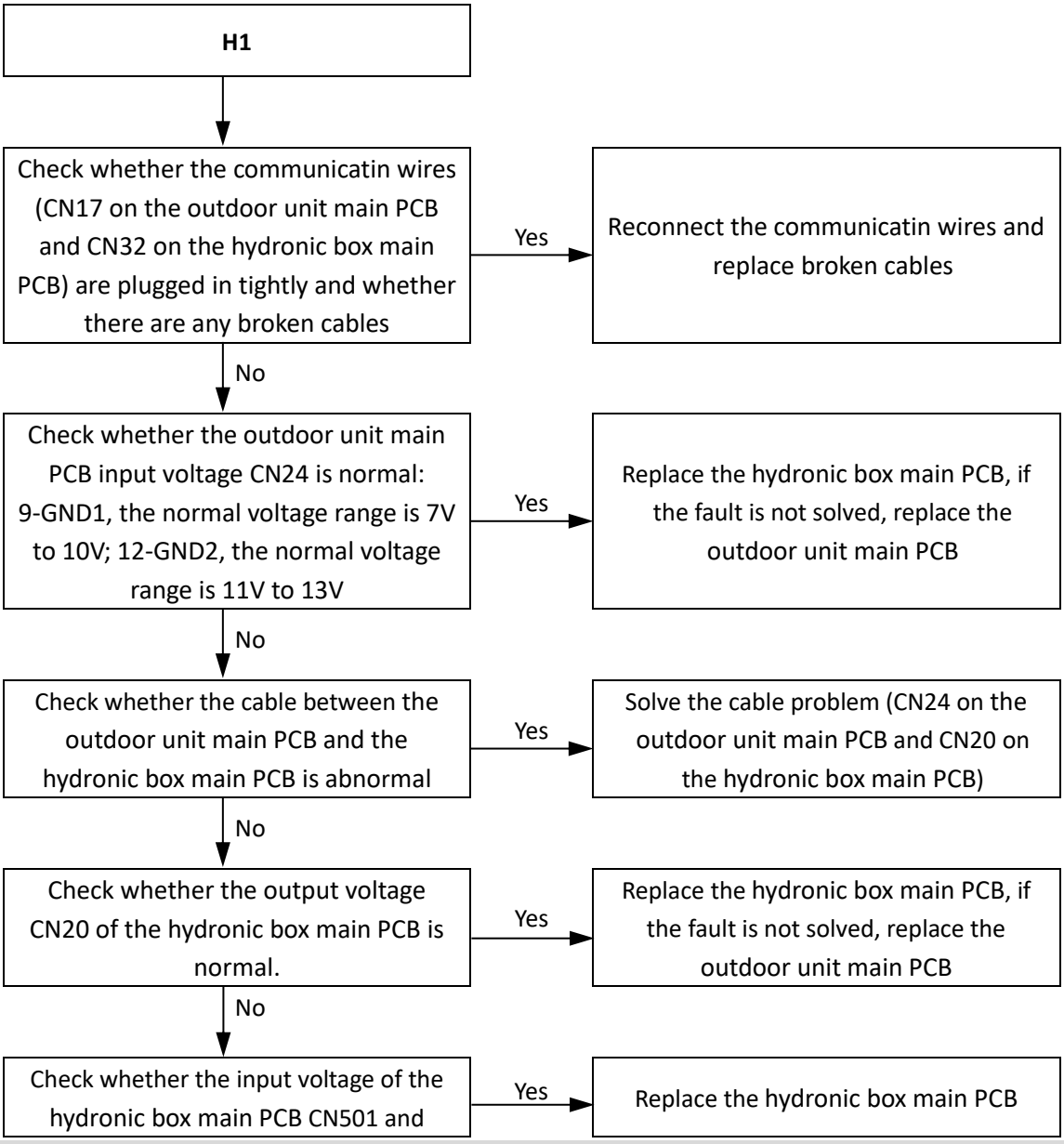
- Communication error between outdoor unit main control board and inverter module.
- M thermal Mono stops running.
- Error code is displayed on outdoor unit main PCB and user interface.

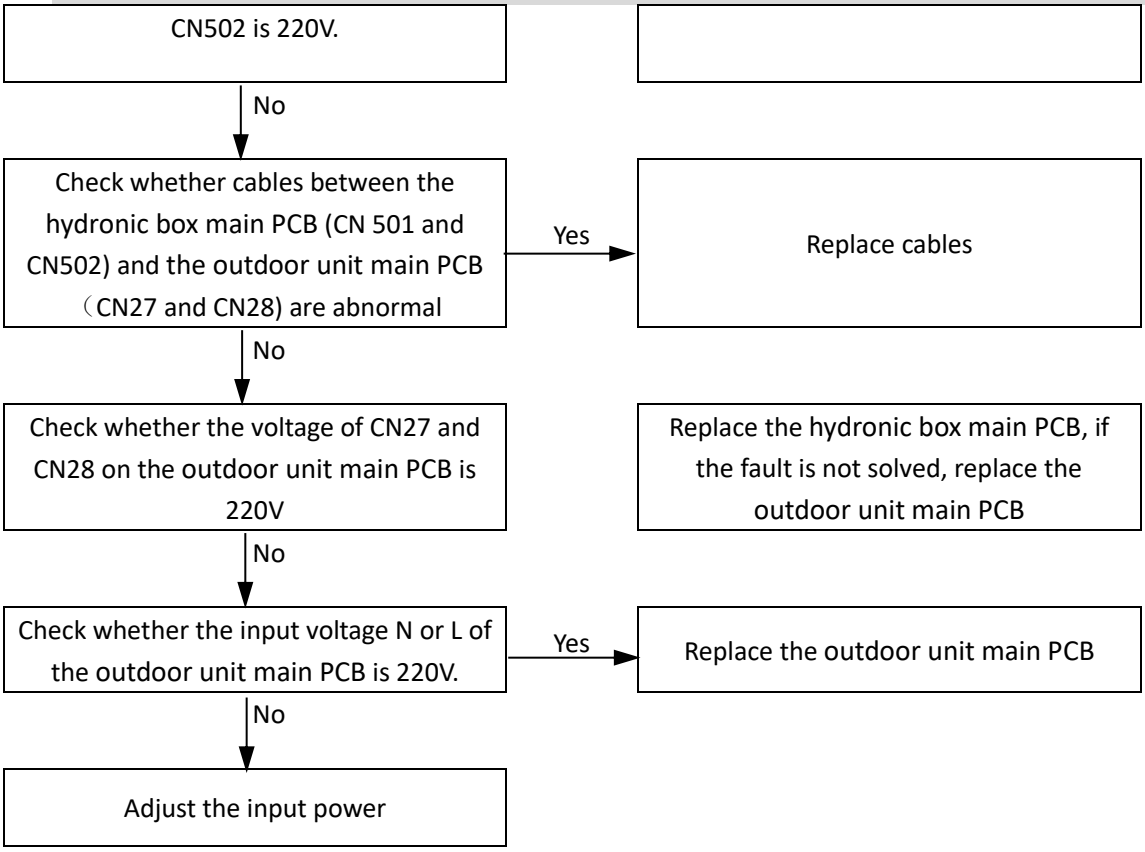
5.11.3 Possible causes

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

5.11.4 Procedure

One-phase model





Notes:

A multimeter measures weak current in DC voltage mode and strong current in AC voltage mode.

5.12 H6, HH Troubleshooting

5.12.1 Digital display output

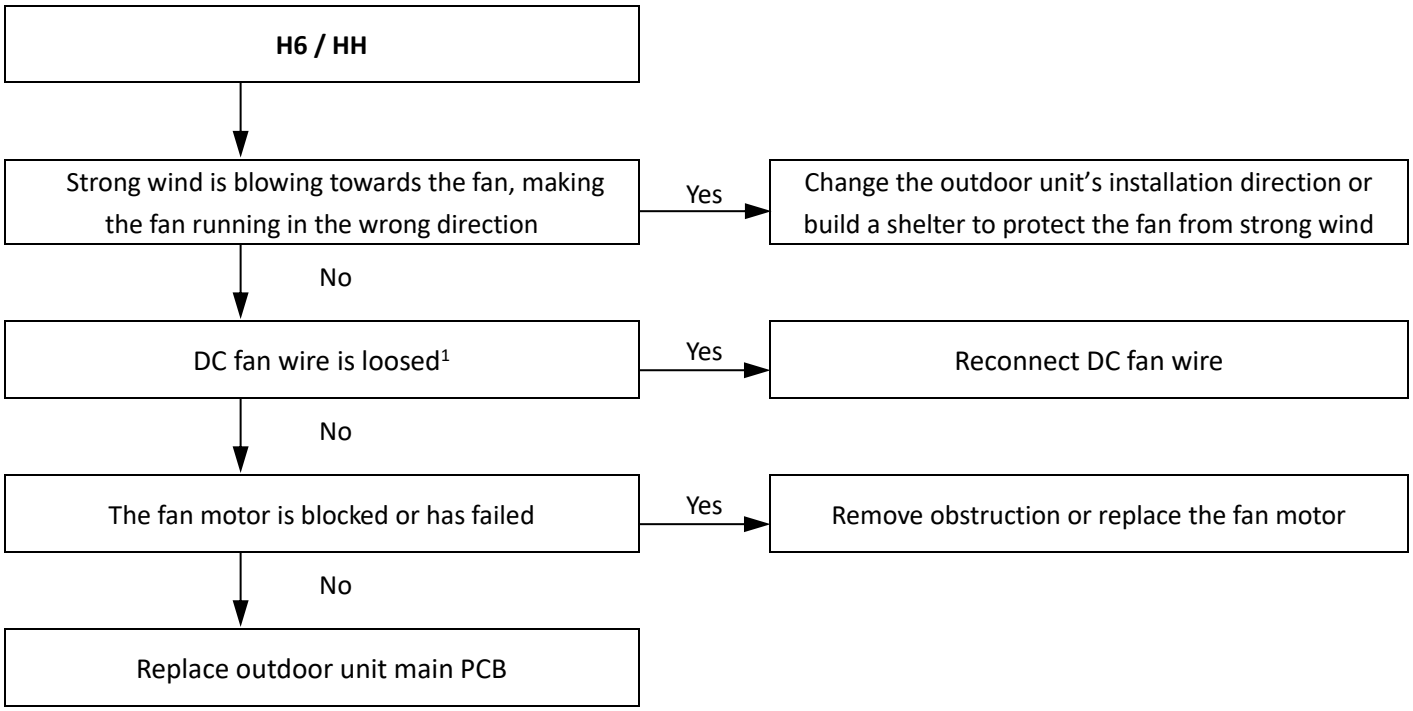
5.12.2 Description

- H6 indicates a DC fan error.
- HH indicates that H6 protection has occurred 10 times in 2 hours. When HH error occurs, a manual system restart is required before the system can resume operation. The cause of HH error should be addressed promptly in order to avoid system damage.
- M thermal Mono stops running.
- Error code is displayed on outdoor unit main PCB and user interface.

5.12.3 Possible causes

- DC fan wire is loosed.
- High wind speed.
- Fan motor blocked or has failed.
- Invert module damaged.
- Main PCB is damaged.

5.12.4 Procedure



Notes:

1. Refer to Figures 4-1.1 to 4-1.2 in "M thermal Mono Service Manual" and to Part 2 "Wiring Diagrams". in M thermal Mono Engineering Data Book,
2. Measure the voltage between the DC fan motor power supply's white and black wires. The normal voltage is 15V when the unit is in standby. If the voltage is significantly different from 15V, the IPM module on the inverter module is damaged. DC fan connection is CN107/109 on the outdoor unit refrigerant system main PCB (labeled 23 in Figure 4-2.2).

5.13 H7 Troubleshooting

5.13.1 Digital display output

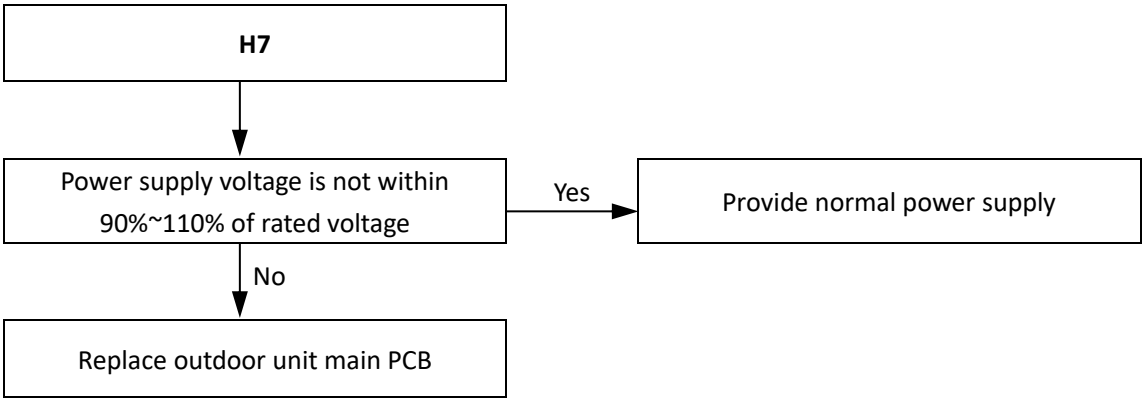
5.13.2 Description

- Abnormal main circuit voltage.
- M thermal Mono stops running.
- Error code is displayed on outdoor unit main PCB and user interface.

5.13.3 Possible causes

- Power supply voltage not within 90%~110% of rated voltage.
- Outdoor unit main PCB is damaged.

5.13.4 Procedure



5.14 H8 Troubleshooting

5.14.1 Digital display output

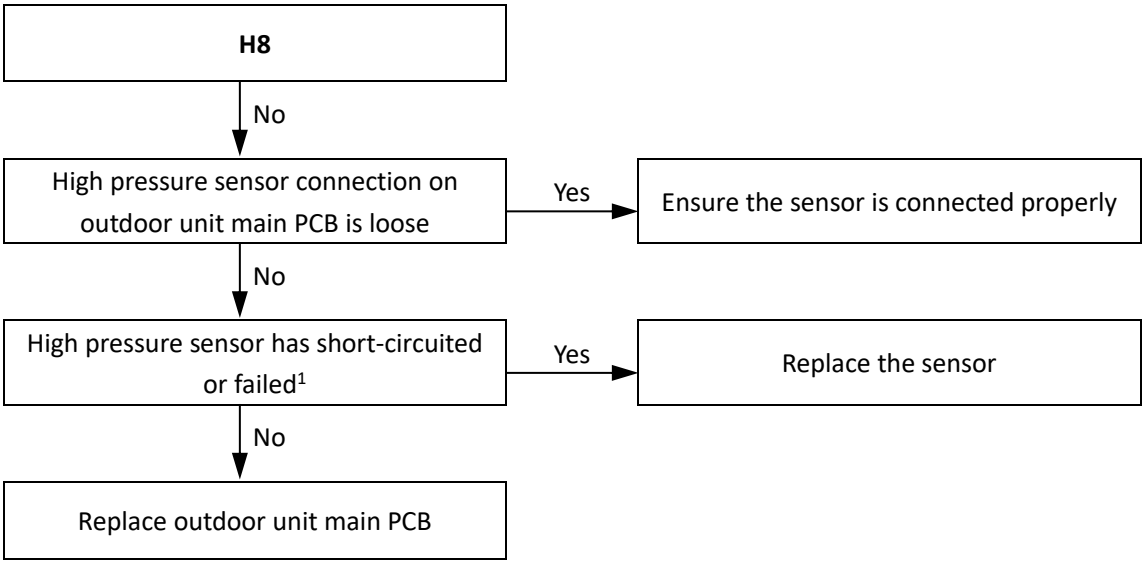
5.14.2 Description

- Pressure sensor error.
- M thermal Mono stops running.
- Error code is displayed on outdoor unit main PCB and user interface.

5.14.3 Possible causes

- Pressure sensor not connected properly or has malfunctioned.
- Outdoor unit main PCB is damaged.

5.14.4 Procedure



Notes:

1. 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. The pressure sensor connection is port CN6 on the outdoor unit refrigerant system main PCB (labeled 3 in Figure 4-2.2).

5.15 P0, HP Troubleshooting

5.15.1 Digital display output

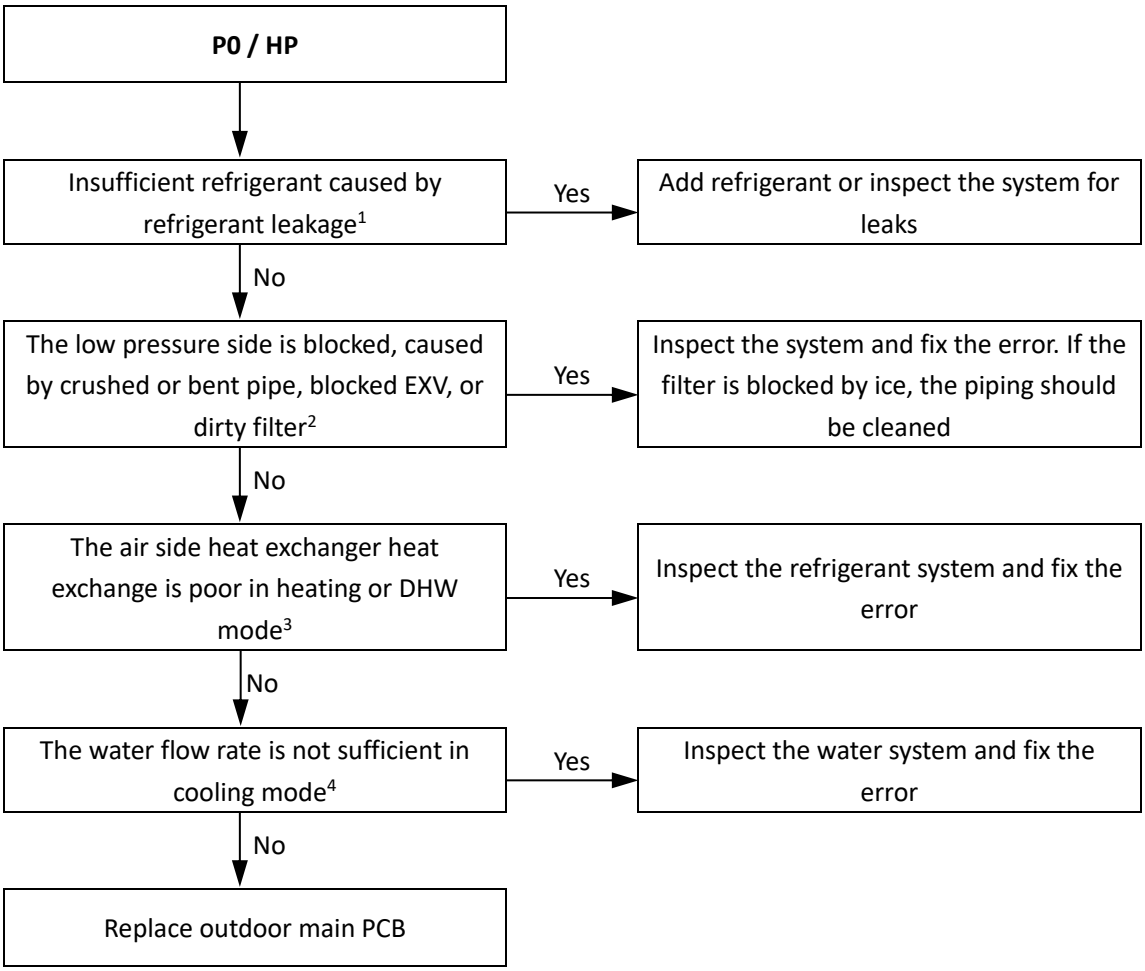
5.15.2 Description

- P0 indicates suction pipe low pressure protection. When the suction pressure falls below 0.14MPa, the system displays P0 protection and M thermal Mono stops running. When the pressure rises above 0.3MPa, P0 is removed and normal operation resumes.
- HP indicates Pe<0.6Mpa occurred 3 times in an hour.
- Error code is displayed on outdoor unit main PCB and user interface.

5.15.3 Possible causes

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

5.15.4 Procedure



Notes:

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

5.16 P1 Troubleshooting

5.16.1 Digital display output

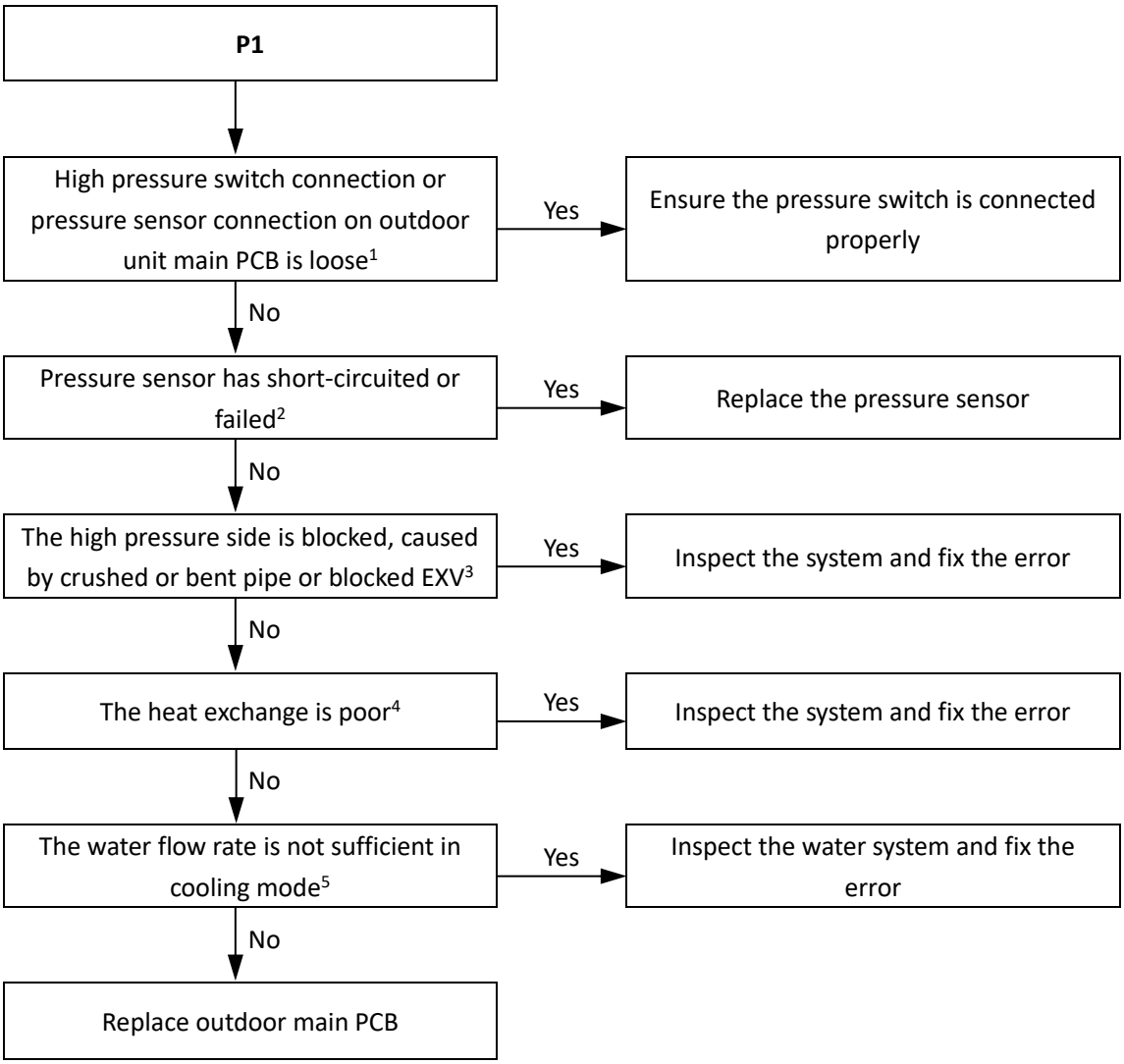
5.16.2 Description

- Discharge pipe high pressure protection. When the discharge pressure rises above 4.2MPa, the system displays P1 protection and M thermal Mono stops running. When the discharge pressure falls below 3.2MPa, P1 is removed and normal operation resumes.
- Error code is displayed on outdoor unit main PCB and user interface.

5.16.3 Possible causes

- Pressure sensor/switch not connected properly or has malfunctioned.
- Excess refrigerant.
- System contains air or nitrogen.
- High pressure side blockage.
- Poor condenser heat exchange.
- Outdoor unit main PCB damaged.

5.16.4 Procedure



Notes:

1. High pressure switch connection is port CN31 on the outdoor unit refrigerant system main PCB (labeled 21 in Figure 4-2.2).
2. Measure the resistance among the three terminals of the pressure sensor. If the resistance is of the order of mega Ohms or infinite, the pressure sensor has failed.
3. High pressure side blockage causes discharge temperature to be higher than normal, discharge pressure to be higher than normal and suction pressure to be lower than normal.
4. In heating mode check water side heat exchanger, water piping, circulator pumps and water flow switch for dirt/blockages. In cooling mode check air side heat exchanger, fan(s) and air outlets for dirt/blockages.
5. Check water pressure on the manometer. If the water pressure is not > 1 bar, water flow is insufficient. Refer to Figure 2-1.1.

5.17 P3 Troubleshooting

5.17.1 Digital display output

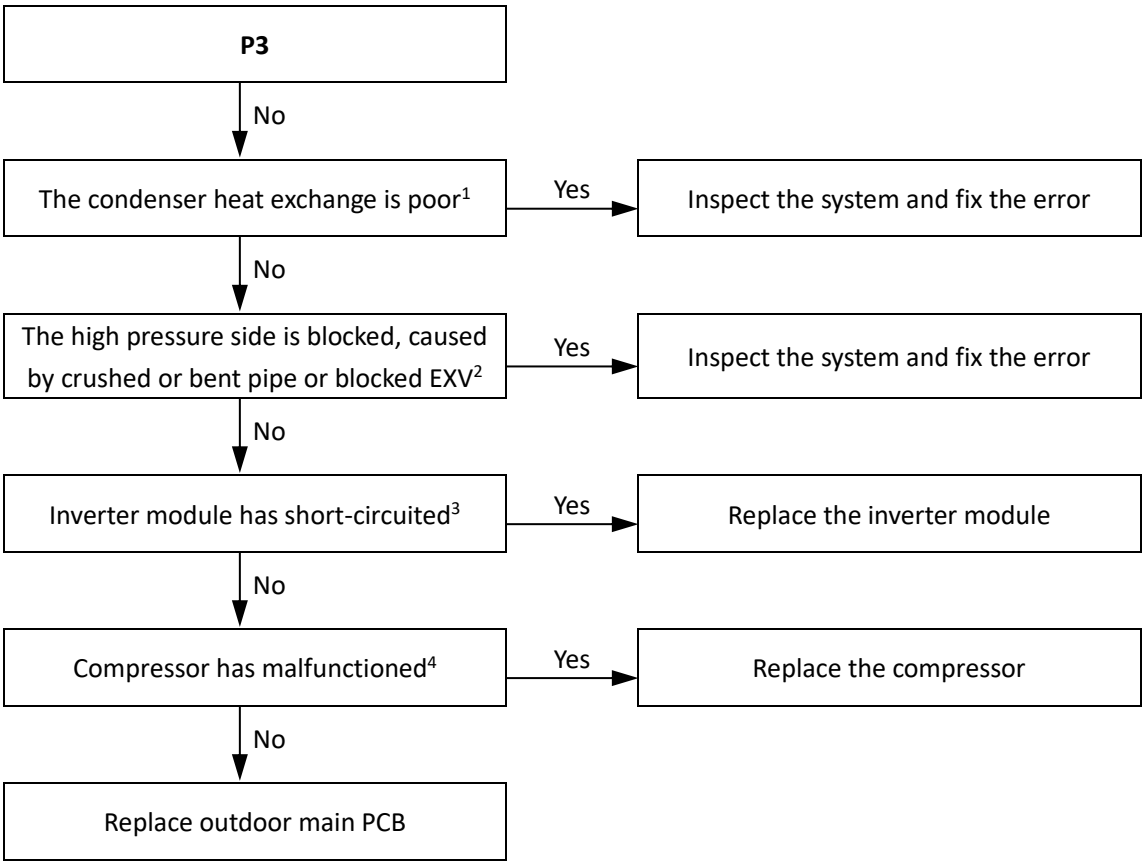
5.17.2 Description

- Compressor current protection.
- When the compressor current rises above the protection value (28A), the system displays P3 protection and M thermal Mono stops running. When the current returns to the normal range, P3 is removed and normal operation resumes.
- Error code is displayed on refrigerant system main PCB and user interface.

5.17.3 Possible causes

- Poor condenser heat exchange.
- High pressure side blockage.
- Inverter module damaged.
- Compressor damaged.
- Outdoor unit main PCB damaged.

5.17.4 Procedure



Notes:

1. In heating mode check water side heat exchanger, water piping, circulator pumps and water flow switch for dirt/blockages. In cooling mode check air side heat exchanger, fan 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.

5.18 P4 Troubleshooting

5.18.1 Digital display output

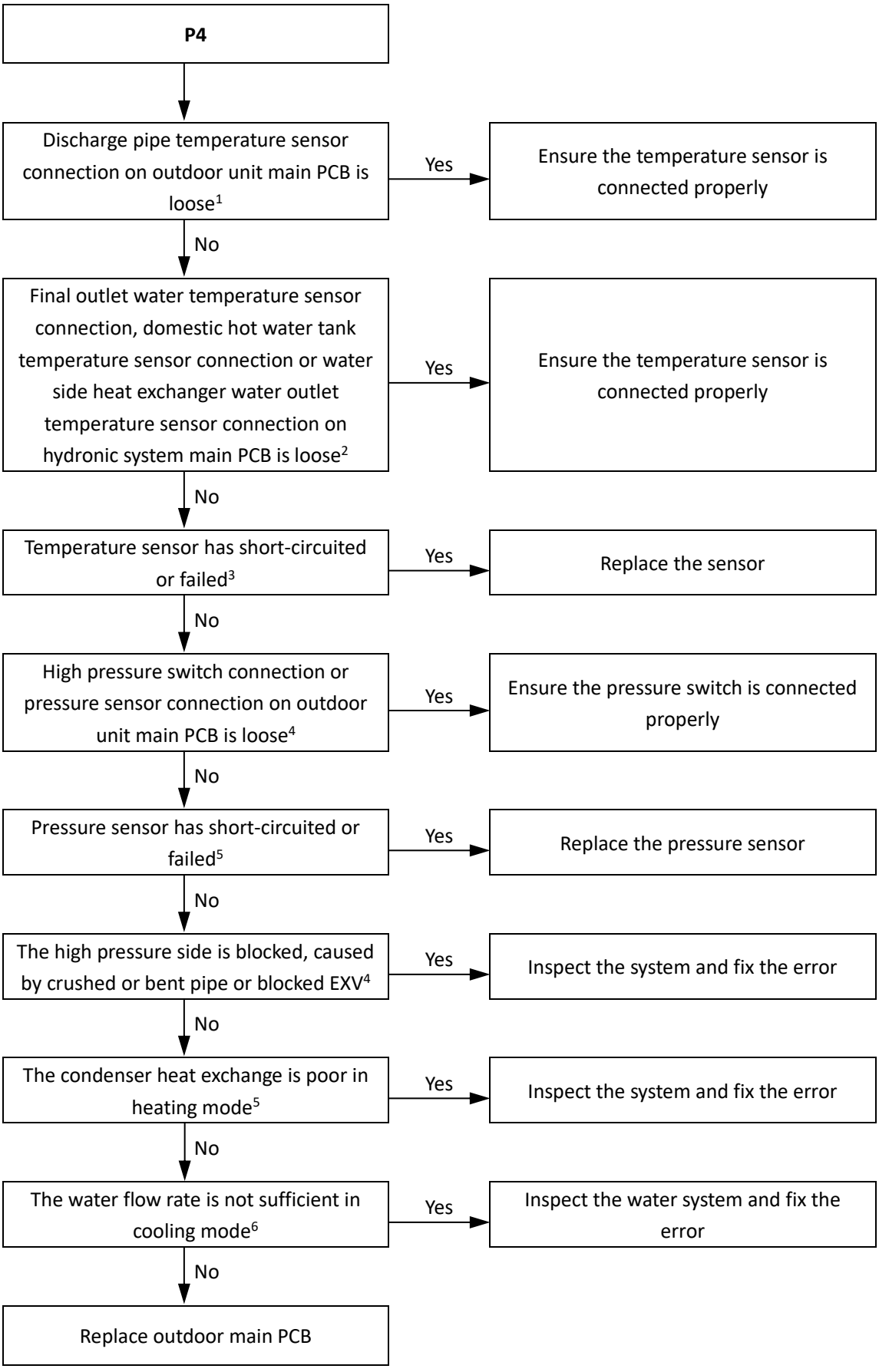
5.18.2 Description

- Discharge temperature protection.
- When the compressor the discharge temperature rises above 115°C, the system displays P4 protection and M thermal Mono stops running. When the discharge temperature falls below 90°C, P4 is removed and normal operation resumes.
- Error code is displayed on refrigerant system main PCB and user interface.

5.18.3 Possible causes

- Temperature sensor error.
- High pressure side blockage.
- Poor condenser heat exchange.
- Outdoor unit main PCB damaged.

5.18.4 Procedure



Notes:

1. Discharge pipe temperature sensor connection is port CN8 on the outdoor unit refrigerant system main PCB (labeled 5 in Figure 4-2.2).
2. Final outlet water temperature sensor and water side heat exchanger water outlet temperature sensor connections are port CN6 on the hydronic system

main PCB (labeled 10 in Figure 4-2.1). Domestic hot water tank temperature sensor connection is port CN13 on hydronic system main PCB (labeled 13 in Figure 4-2.1).

3. Set a multi-meter to buzzer mode and test any two terminals of sensor. If the resistance is too low, the buzzer sounds, which means 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 5-5.1 or 5-5.2 in Part 5, 5.1 "Temperature Sensor Resistance Characteristics".
4. High pressure switch connection is port CN31 on the outdoor unit refrigerant system main PCB (labeled 21 in Figure 4-2.2).
   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.
   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.
5. Check air side heat exchanger, fan and air outlets for dirt/blockages.
6. Check the water side heat exchanger, water piping, circulator pumps and water flow switch for dirt/blockages.

5.19 P5 Troubleshooting

5.19.1 Digital display output

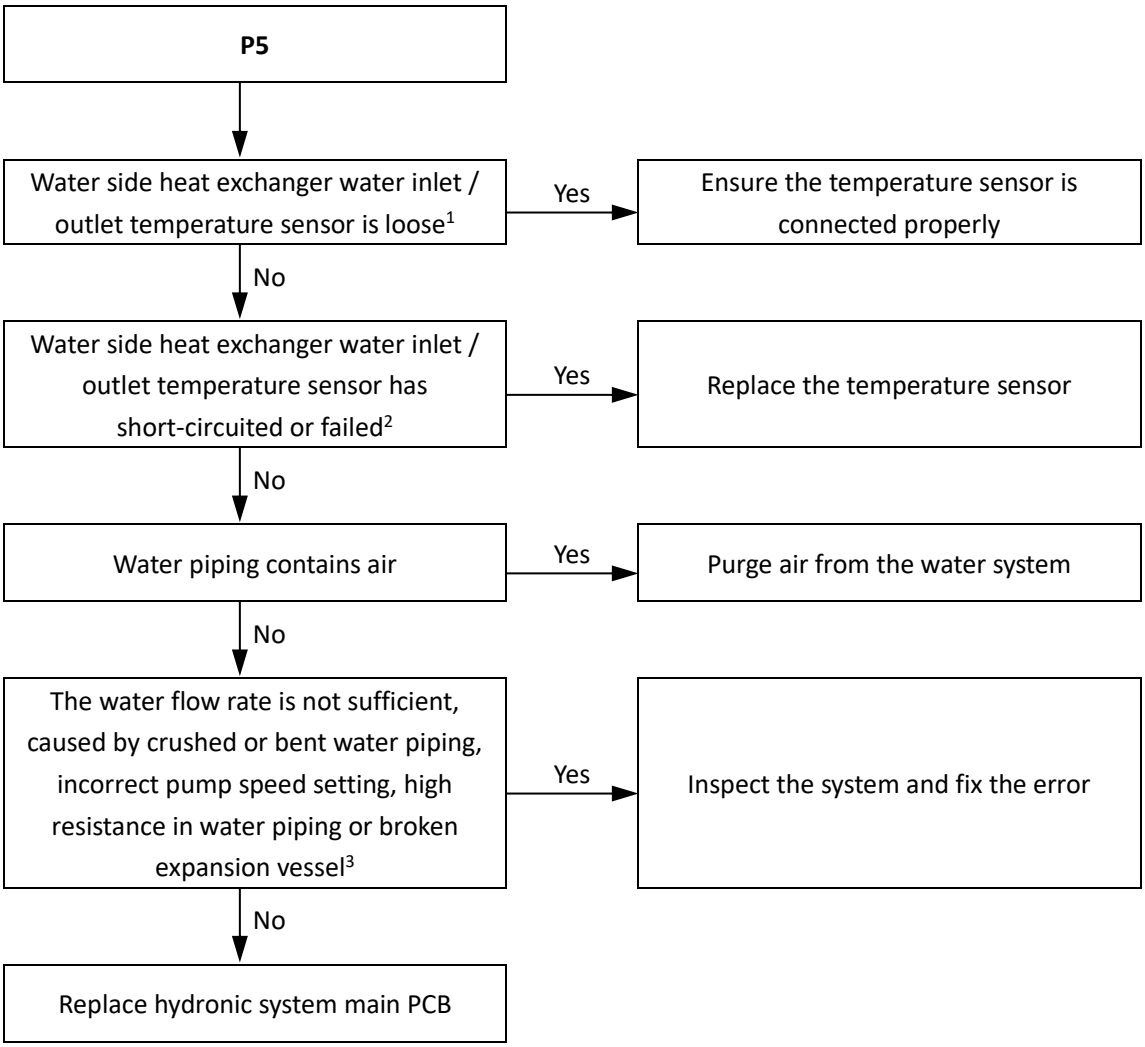
5.19.2 Description

- High temperature difference between water side heat exchanger water inlet and water outlet temperatures protection.
- M thermal Mono stops running.
- Error code is displayed on hydronic system main PCB and user interface.

5.19.3 Possible causes

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

5.19.4 Procedure

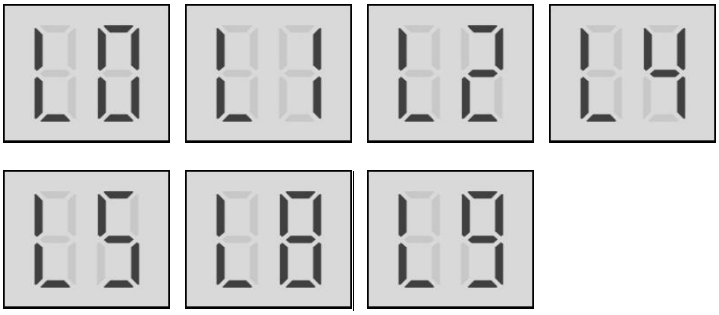


Notes:

1. Water side heat exchanger water inlet temperature sensor and water side heat exchanger water outlet temperature sensor connections are port CN6 on the hydronic system main PCB (labeled10 in Figure 4-2.1).
2. Set a multi-meter to buzzer mode and test any two terminals of sensor. If the resistance is too low, the buzzer sounds, which means the sensor has short-circuited. If the resistance is not consistent with the sensor's resistance characteristics table, the sensor has failed. Refer to Table 5-5.3.
3. Check water pressure on the manometer. If the water pressure is not > 1 bar, water flow is insufficient. Refer to Figures 2-1.1

5.20 Inverter module Troubleshooting

5.20.1 Digital display output



5.20.2 Description

- Inverter module protection or high pressure protection.
- M thermal Mono stops running.
- Specific error code L0, L1, L2, L4, L5, L8 , L9 is displayed on the user interface and the refrigerant system main PCB.

5.20.3 Possible causes

- Inverter module protection.
- DC bus low or high voltage protection.
- MCE error(DC bus low or high voltage protection or software over current protection)
- Zero speed protection.
- Excessive compressor frequency variation.
- Actual compressor frequency differs from target frequency.
- High pressure protection.
- Contactor stuck or 908 self checking fail.

5.20.4 Specific error codes for inverter module protection

Table 4-5.1: Specific error codes

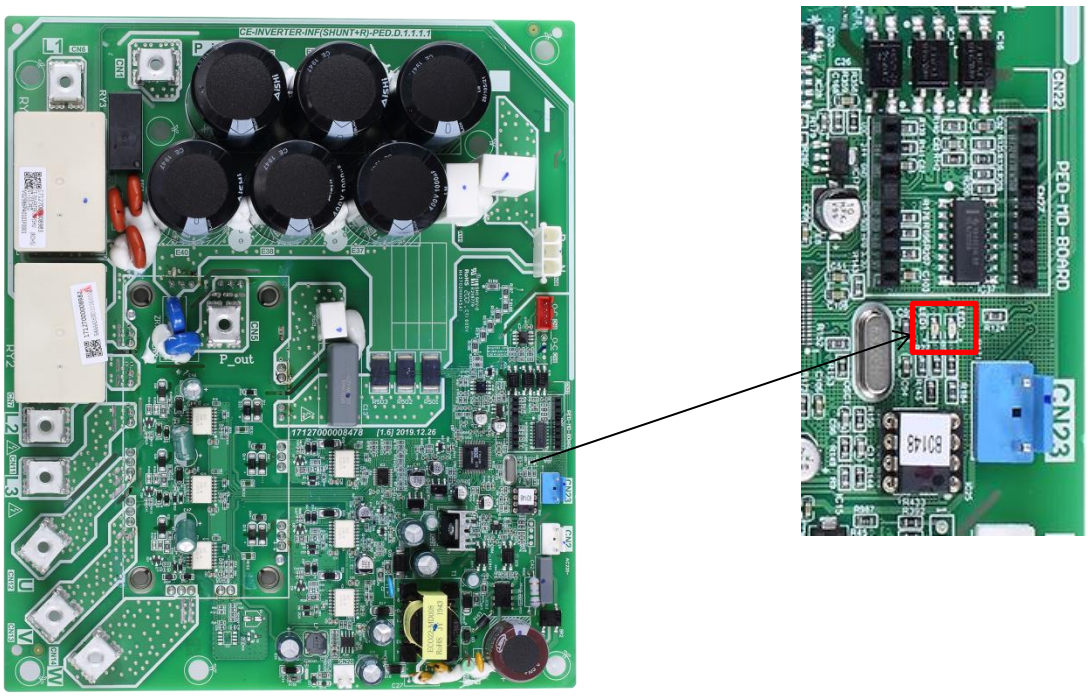
Specific error code	Content
L0	Inverter module protection
L1	DC bus low voltage protection
L2	DC bus high voltage protection
L4	MCE error(DC bus low or high voltage protection or software over current protection)
L5	Zero speed protection
L8	Compressor frequency variation greater than 15Hz within one second protection
L9	Actual compressor frequency differs from target frequency by more than 15Hz protection

The specific error codes can also be obtained from the LED indicators LED1/LED2 on the inverter module.

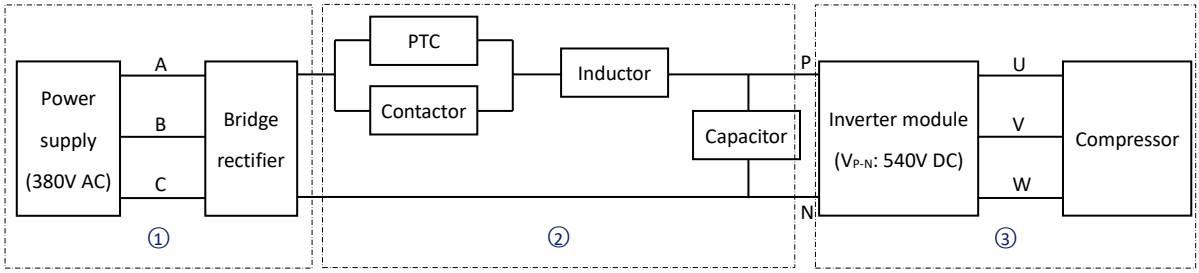
Table 4-5.2: Errors indicated on LED for 18/22/26/30kW unit

LED1/2 flashing pattern	Corresponding error
Flashes 8 times and stops for 1 second, then repeats	L0 - Inverter module protection
Flashes 9 times and stops for 1 second, then repeats	L1 - DC bus low voltage protection
Flashes 10 times and stops for 1 second, then repeats	L2 - DC bus high voltage protection
Flashes 12 times and stops for 1 second, then repeats	L4 - MCE error(DC bus low or high voltage protection or software over current protection)
Flashes 13 times and stops for 1 second, then repeats	L5 - Zero speed protection
Flashes 17 times and stops for 1 second, then repeats	L8 - Compressor frequency variation greater than 15Hz within one second protection L9 - Actual compressor frequency differs from target frequency by more than 15Hz protection
Flashes 3 times and stops for 1 second, then repeats	bH - Contactor stuck or 908 self checking fail
Flashes 5 times and stops for 1 second, then repeats	P1 - High pressure protection

Figure 4-5.1: LED location of inveter module for three-phase 18/22/26/30kW unit



5.20.5 Principle of DC inverter



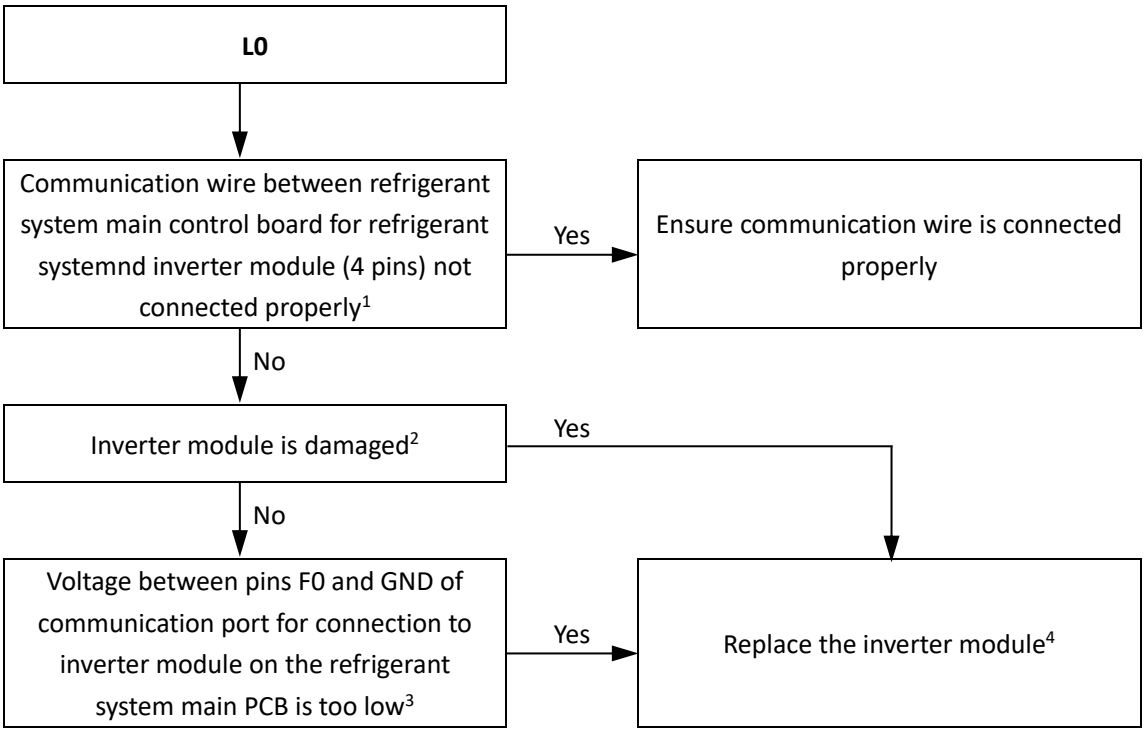
① 380-415V AC power supply change to DC power supply after bridge rectifier.

② Contactor is open the current across the PTC to charge capacitor, after 5 seconds the contactor closed.

③ The capacitor output steady 540V DC power supply for inverter module P N terminals.

5.20.6 L0 troubleshooting

Situation 1: L0 error appears immediately after the outdoor unit is powered-on



Notes:

1. The communication port between refrigerant system main control board for refrigerant system inverter module is port CN36 on refrigerant system main control board for refrigerant system port CN8 on inverter module.
2. Measure the resistance between each of U, V and W and each of P and N on the inverter module. All the resistances should be infinite. If any of them are not infinite, the inverter module is damaged and should be replaced.
3. The normal voltage between F0 and GND is 5V. Refer to Figure 4-5.2.
4. When replacing an inverter module, a layer of thermally conductive silica gel should be painted on the IPM module (on the reverse side of the inverter module PCB). Refer to Figure 4-5.3.

Figure 4-5.2: F0 and GND voltage on IC28-1（F0），IC28-4（GND）

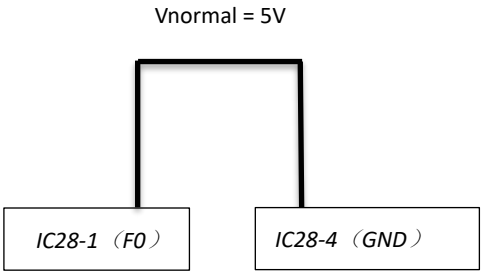
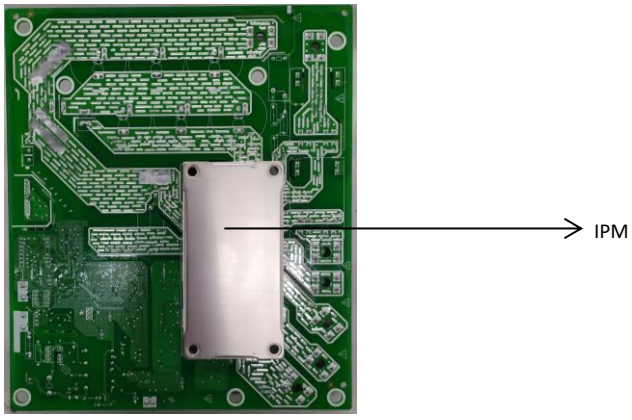
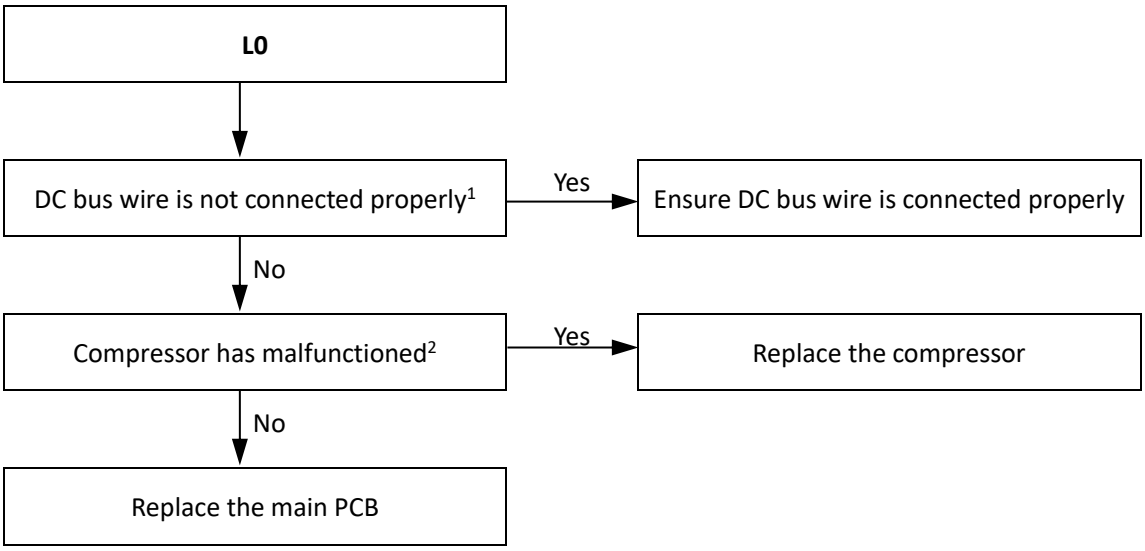


Figure 4-5.3: Replacing an inverter module



Situation 2: L0 error appears immediately after the compressor starts up

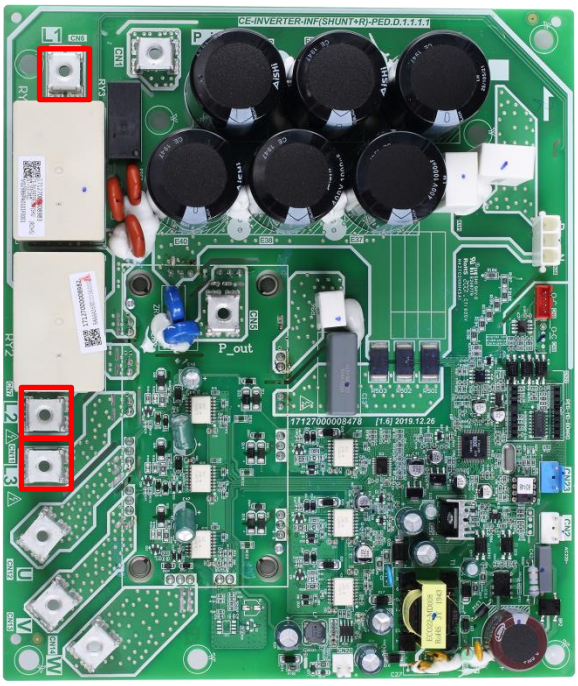


Notes:

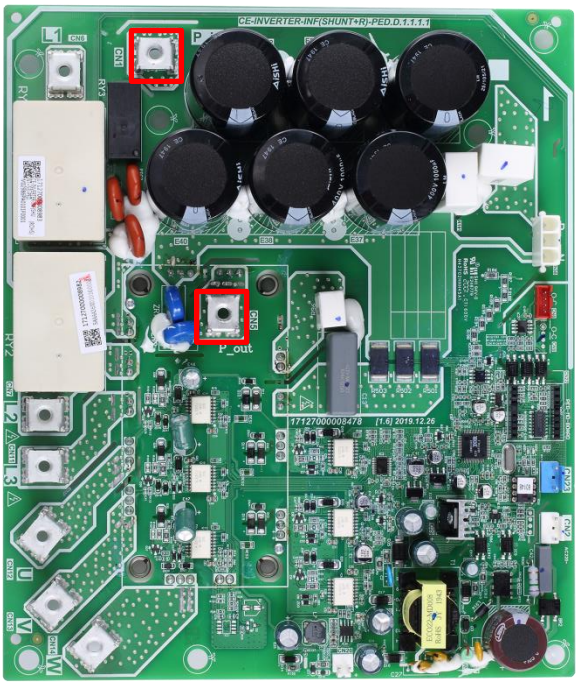
1. The DC bus wire should run from the N terminal on the inverter module, through the current sensor (in the direction indicated by the arrow on the current sensor), and end at the N terminal of capacitor. Refer to Figure 4-5.4.

Figure 4-5.4: DC bus wire connection （L1L2L3,PIN- POUT）

L1，L2，L3

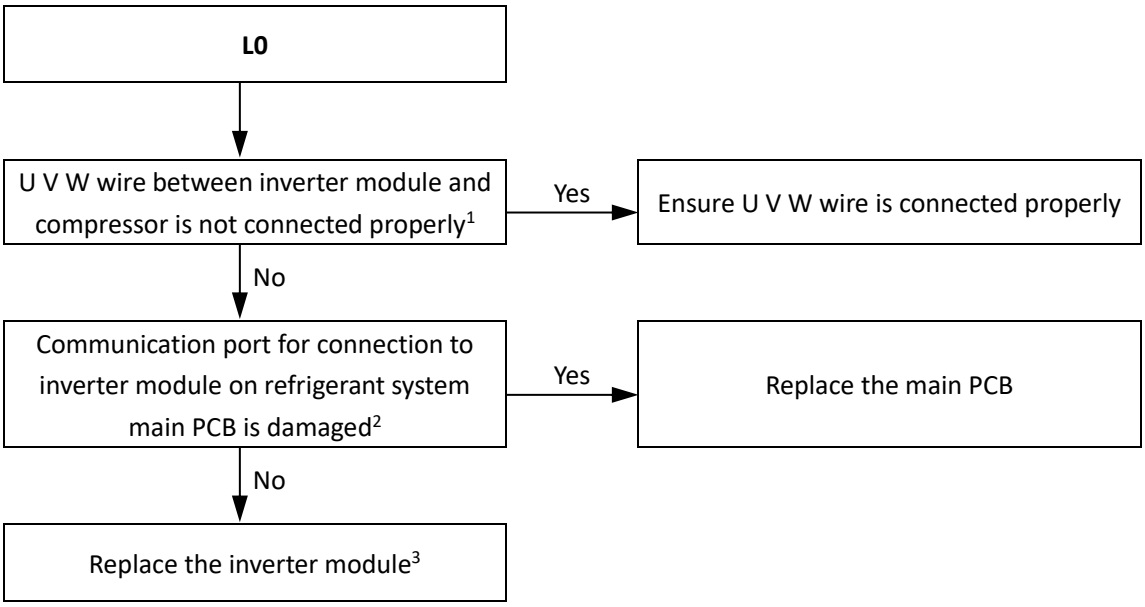


Pin，Pout



2. 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.

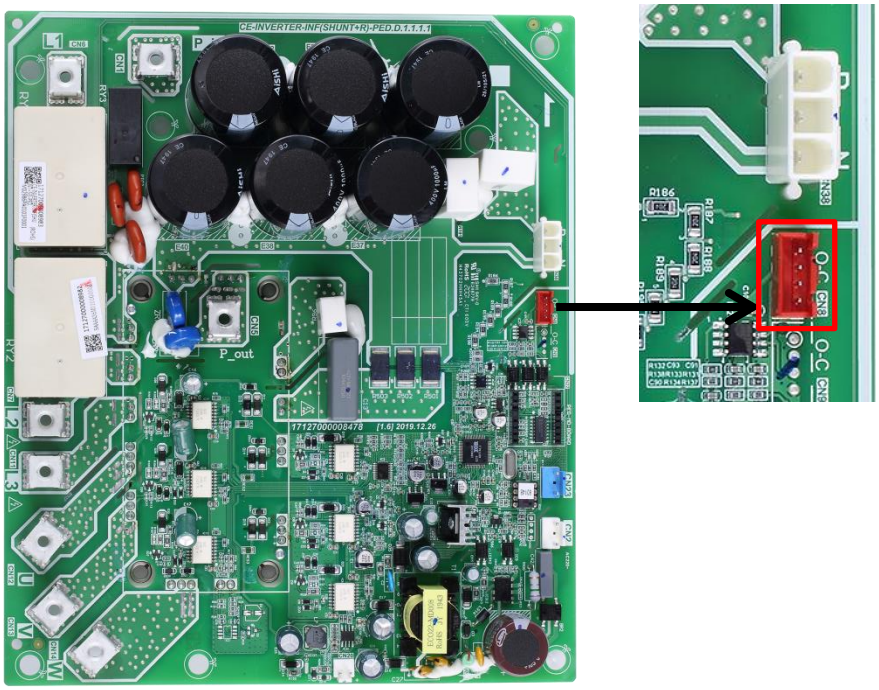
Situation 3: L0 error appears within 2 seconds of compressor start-up



Notes:

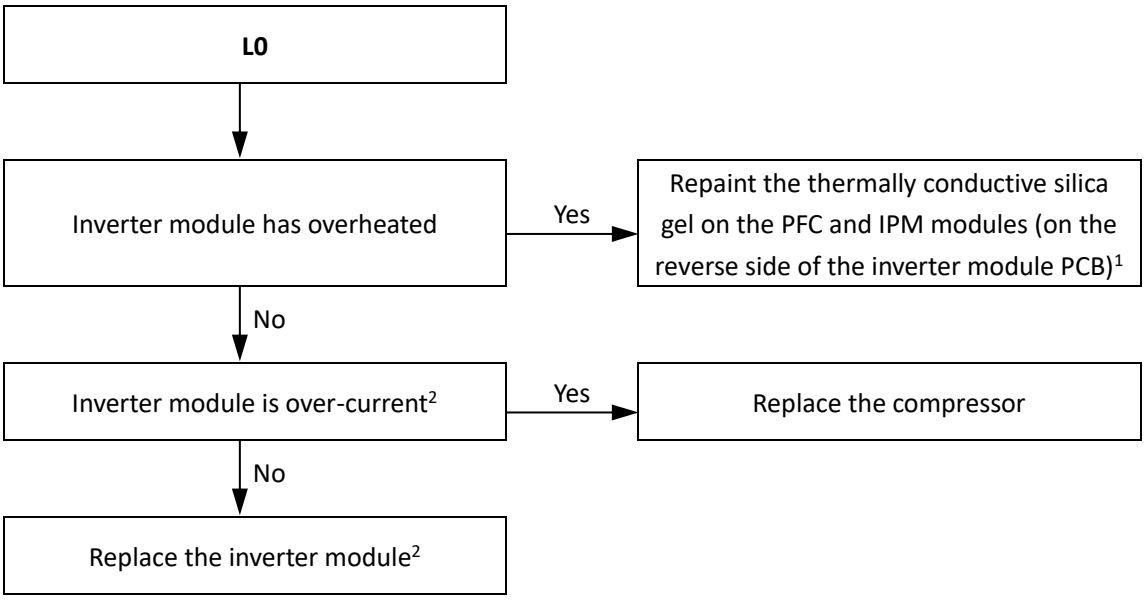
1. Connect the U V W wire from the inverter module to the correct compressor terminals, as indicated by the labels on the compressor.
2. Measure the voltage between each of W-, W+, V-, V+, U-, U+ and GND when the unit is in standby. The normal voltage should be 2.5V-4V and the six voltages should be same, otherwise the communication terminal has failed. Refer to Figure4-5.5.

Figure 4-5.5: Connection port for inverter module



3. When replacing an inverter module, a layer of thermally conductive silica gel should be painted on the IPM module (on the reverse side of the inverter module PCB). Refer to Figure 4-5.3.

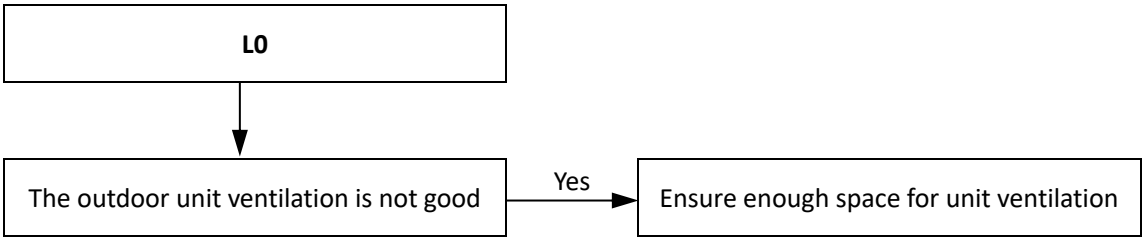
Condition 4: L0 error appears after the compressor has been running for a period of time and the compressor speed is over 60rps



Notes:

1. When replacing an inverter module, a layer of thermally conductive silica gel should be painted on the IPM module (on the reverse side of the inverter module PCB). Refer to Figure 4-5.3.
2. Use clip-on ammeter to measure the compressor current, if the current is normal indicates the inverter module is failed, if the current is abnormal indicates the compressor has failed.

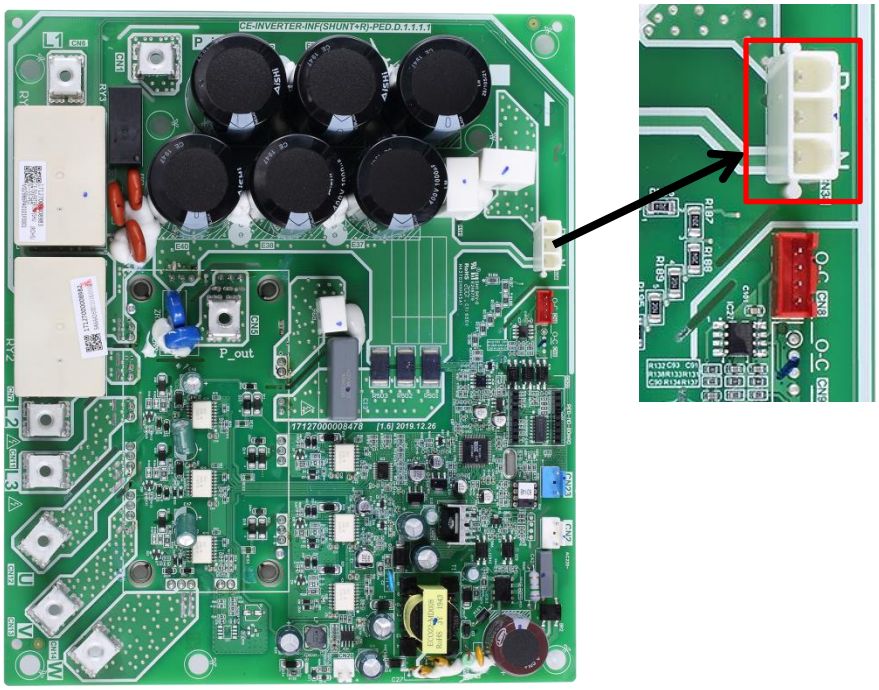
Situation 5: L0 error appears occasionally/irregularly



5.20.7 L1/L2 troubleshooting

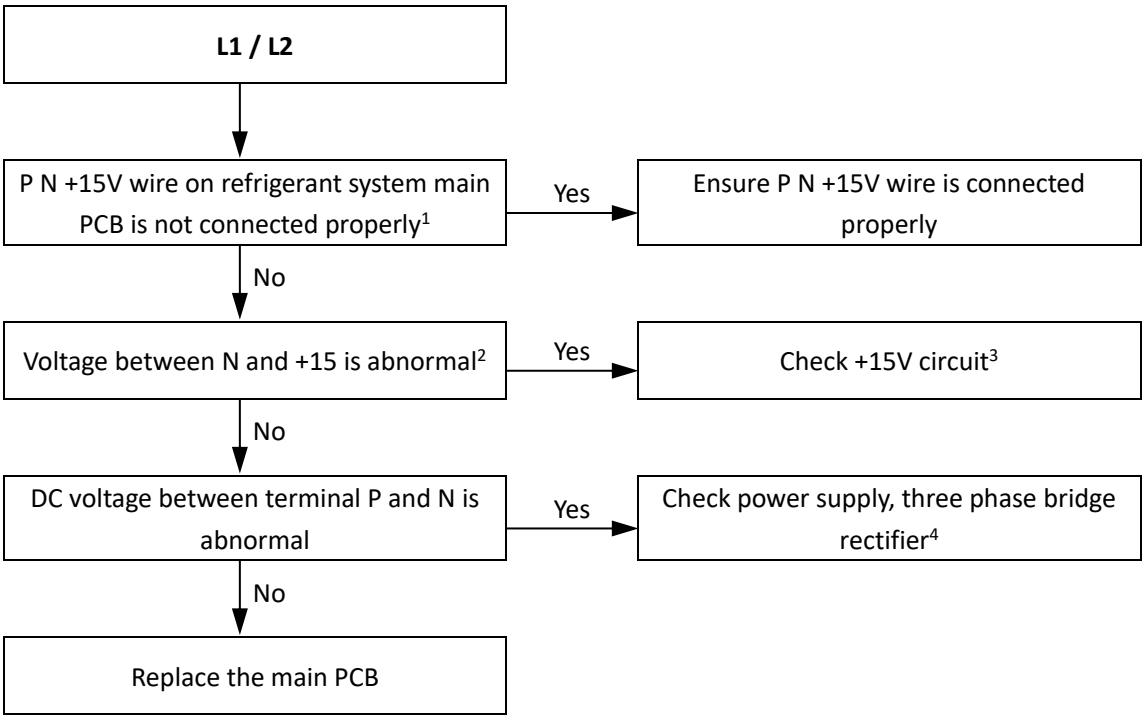
The normal DC voltage between terminals P and N on inverter module is 540V. If the voltage is lower than 300V, the unit displays an L1 error; if the voltage is higher than 830V, the unit displays an L2 error. Refer to Figure4-5.6.

Figure 4-5.6: P, N terminals voltage



V_{normal} = 540V DC

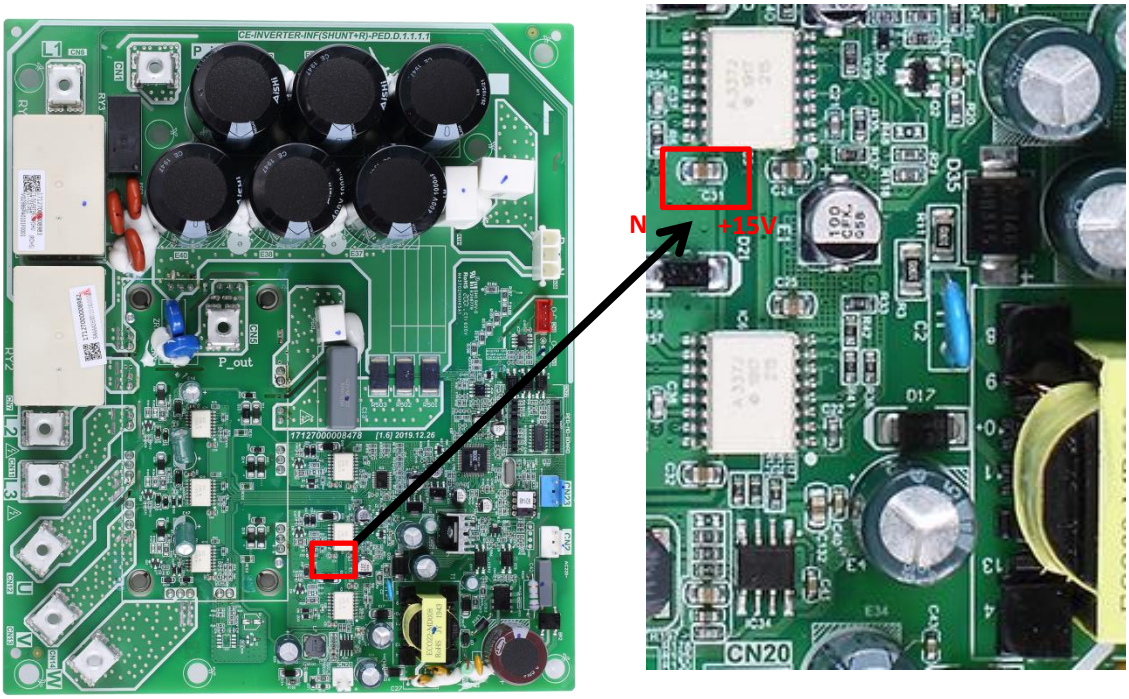
Situation 1: L1 or L2 error appears immediately after the outdoor unit is powered-on



Notes:

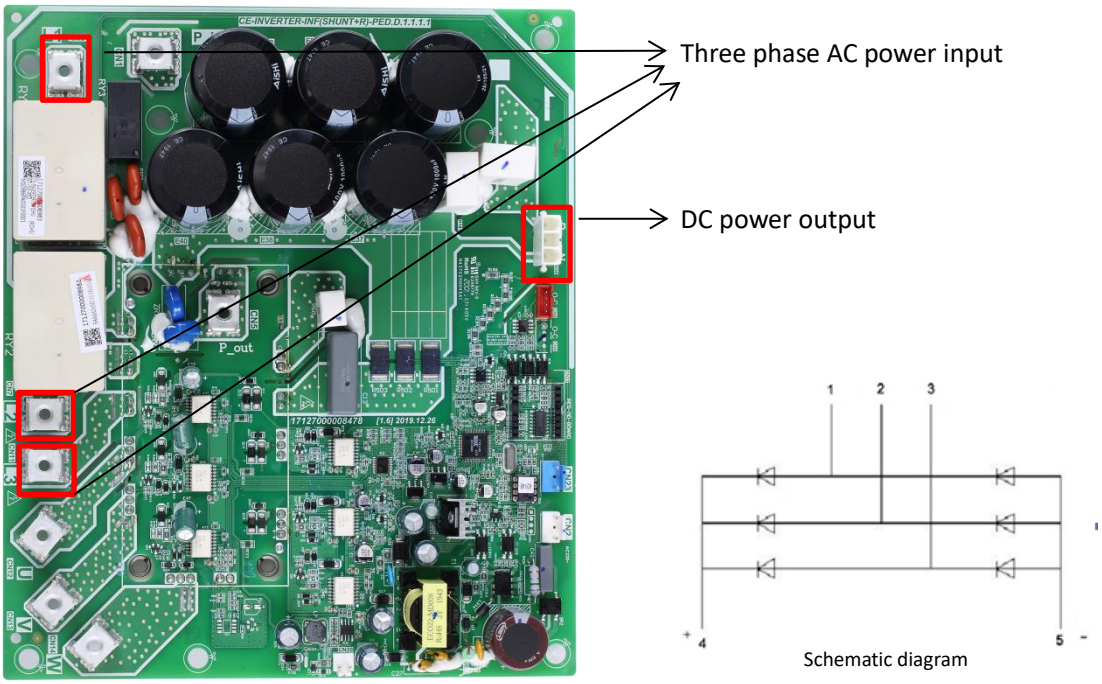
1. P N +15V terminal on refrigerant system main PCB. Refer to Figure4-5.9.
2. Voltage between N and +15. Refer to Figure4-5.7

Figure 4-5.7: P N +15V terminal-+15V（IC4/5/6PIN12）；N-（IC/4/5、6）PIN13



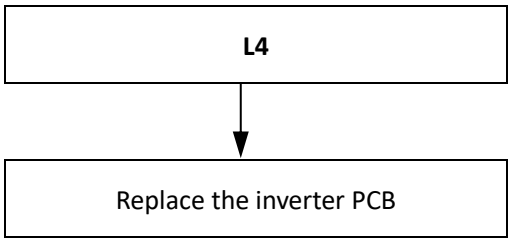
3. Check the +15V circuit according to corresponding wiring diagram. If IC4/5/6PIN12 on inverter module output voltage is not +15V means the inverter module is failed. If voltage output of inverter module is +15V means main PCB is failed.
4. Check the bridge rectifier using one of the following two methods (refer to Figure 4-5.8):
   - Method 1: measure the resistance between any two of the 5 bridge rectifier terminals. If any of the resistances is close to zero, the bridge rectifier has failed.
   - Method 2: dial a multimeter to the diode setting:
     - Put the red probe on the DC power output negative terminal (terminal 5) and put the black probe onto each of the AC power input terminals (terminals 1, 2 and 3) in turn. The voltage between terminal 5 and each of terminals 1, 2 and 3 should be around 0.378V. If the voltage is 0, the bridge rectifier has failed.
     - Put the red probe on the DC power output positive terminal (terminal 4), then put black probe onto each of the AC power input terminals (terminals 1, 2 and 3) in turn. The voltage between terminal 4 and each of terminals 1, 2 and 3 should be infinite. If the voltage is 0, the bridge rectifier has failed.

Figure 4-5.8: Bridge rectifier

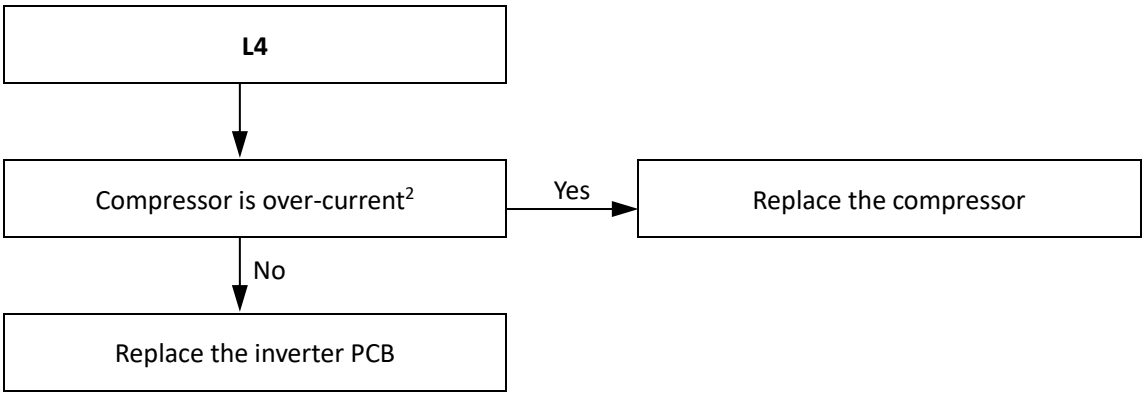


5.20.8 L4 troubleshooting(the same as L1/L2)

Situation 1: L4 error appears immediately after the outdoor unit is powered-on



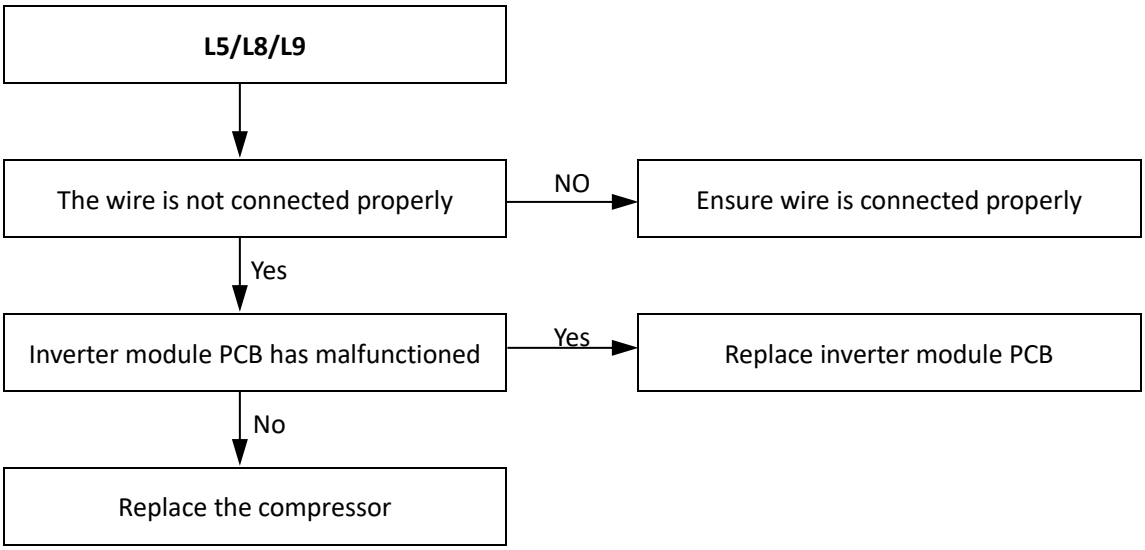
Condition 2: L4 error appears after the compressor has been running for a period of time and the compressor speed is over 60rps



Notes:

1. Re-start the unit, use clip-on ammeter to measure the compressor current, if the current is normal indicates the compressor is failed, if the current is abnormal indicates the inverter PCB is failed..

5.20.9 L5/L8/L9 troubleshooting



5.21 Pd Troubleshooting

5.21.1 Digital display output

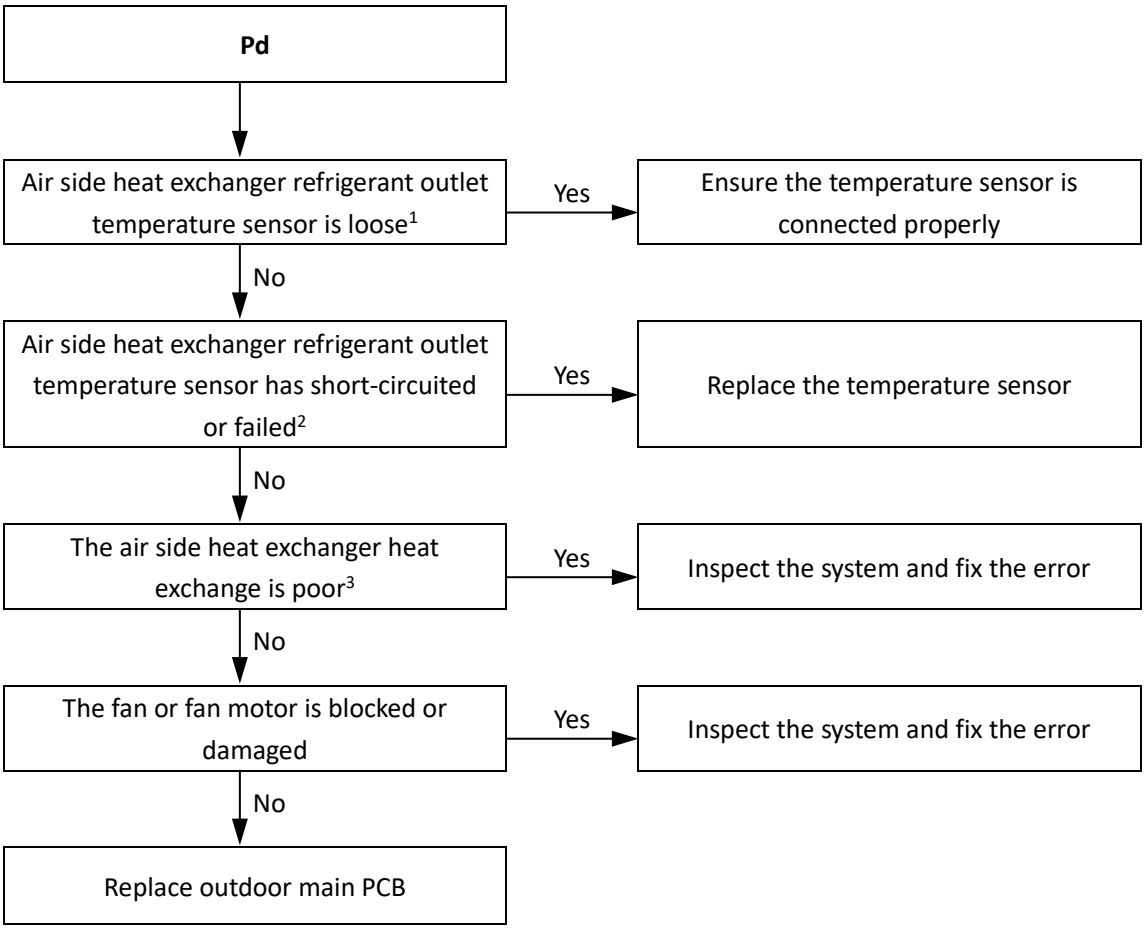
5.21.2 Description

- High temperature protection of air side heat exchanger refrigerant outlet in cooling mode. When the air side heat exchanger refrigerant outlet temperature is higher than 61°C for more than 3 seconds, the system displays Pd protection and M thermal Mono stops running. When the air side heat exchanger refrigerant outlet temperature returns drops below 55°C, Pd is removed and normal operation resumes.
- M thermal Mono stops running.
- Error code is displayed on outdoor unit main PCB and user interface.

5.21.3 Possible causes

- Temperature sensor not connected properly or has malfunctioned.
- Poor condenser heat exchange.
- Fan motor damaged.
- Hydronic system main PCB damaged.

5.21.4 Procedure

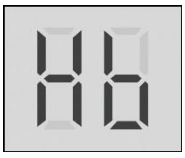


Notes:

1. Air side heat exchanger refrigerant outlet temperature sensor and outdoor ambient temperature sensor connection port are CN9 on the outdoor unit refrigerant system main PCB (labeled 6 in Figure 4-2.2)
2. Set a multi-meter to buzzer mode and test any two terminals of sensor. If the resistance is too low, the buzzer sounds, which means 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 4-7.1.
3. Check air side heat exchanger, fan and air outlets for dirt/blockages.
4. High pressure switch connection is port CN31 on the outdoor unit refrigerant system main PCB (labeled 21 in Figure 4-2.2)

5.22 PP Troubleshooting

5.22.1 Digital display output



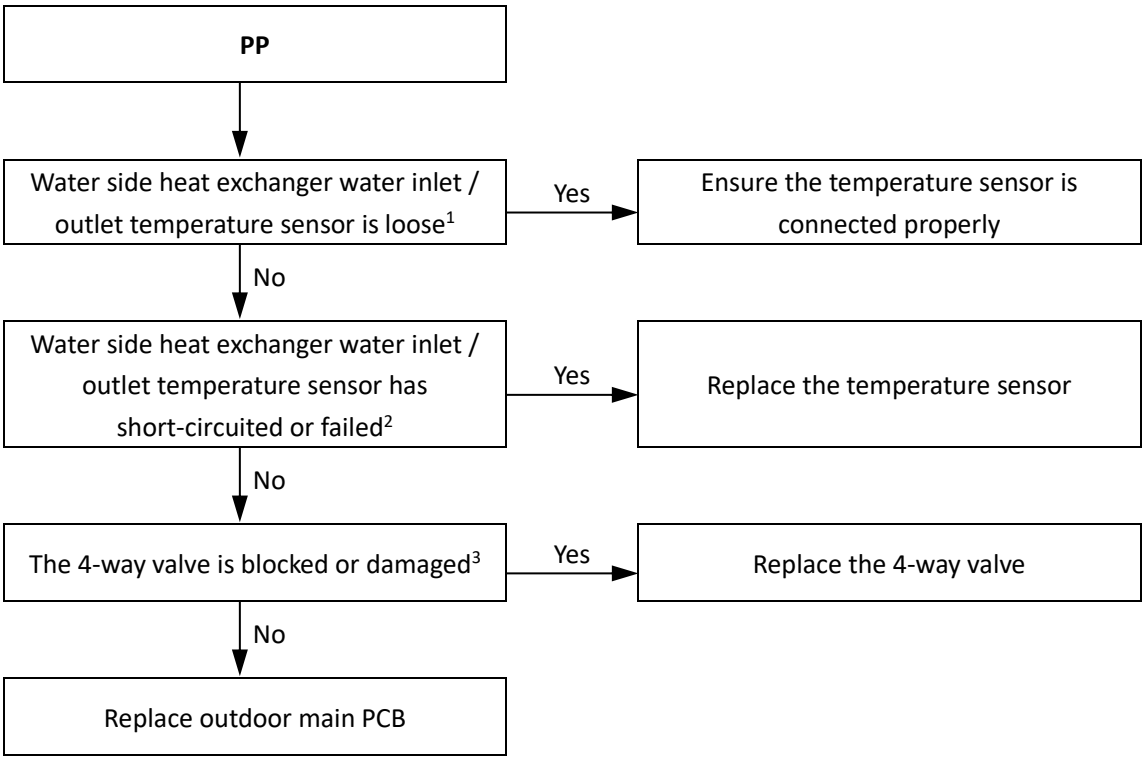
5.22.2 Description

- Water side heat exchanger inlet temperature is higher than outlet temperature in heating mode.
- M thermal Mono stops running.
- Error code is displayed on hydronic system main PCB and user interface.
- Hb indicates PP has displayed 3 times.

5.22.3 Possible causes

- Temperature sensor not connected properly or has malfunctioned.
- 4-way valve is blocked or damaged.
- Hydronic system main PCB damaged.

5.22.4 Procedure

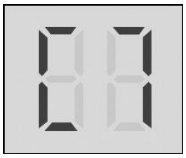


Notes:

1. Water side heat exchanger water inlet temperature sensor and water side heat exchanger water outlet temperature sensor connections are port CN6 on the hydronic system main PCB (labeled 10 in Figure 4-2.1).
2. Set a multi-meter to buzzer mode and test any two terminals of sensor. If the resistance is too low, the buzzer sounds, which means 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 4-7.3
3. Restart the unit in cooling mode to change the refrigerant flow direction. If the unit does not operate normally, the 4-way valve is blocked or damaged.

5.23 C7 Troubleshooting

5.23.1 Digital display output



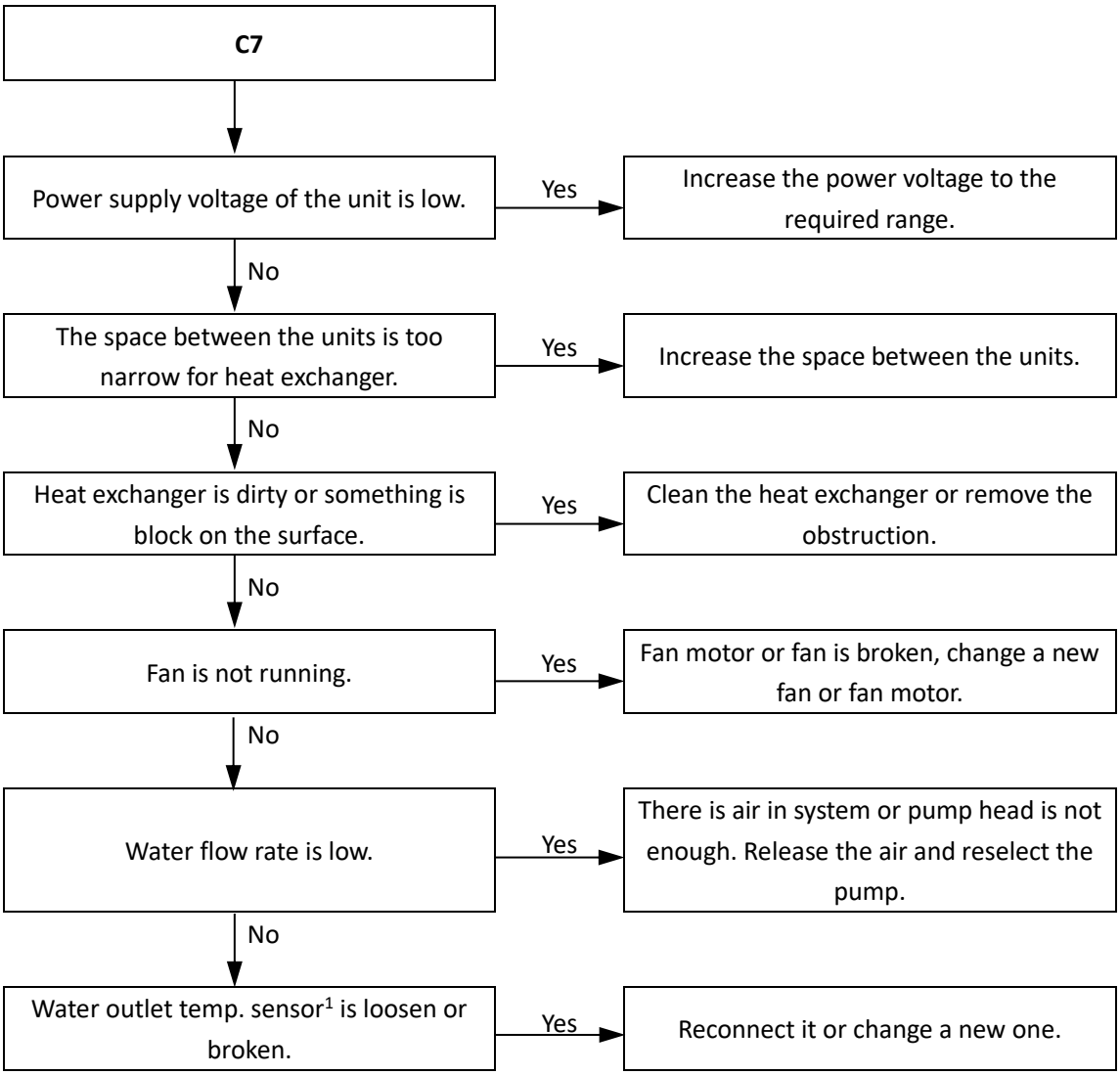
5.23.2 Description

- Transducer module temperature too high protection
- M thermal Mono stops running.
- Error code is displayed on hydronic system main PCB and user interface.

5.23.3 Possible causes

- Power supply voltage of the unit is low.
- The space between the units is too narrow for heat exchanger.
- Heat exchanger is dirty or something is block on the surface.
- Fan is not running.
- Water flow rate is low.
- Water outlet temp. sensor is loosen or broken.

5.23.4 Procedure

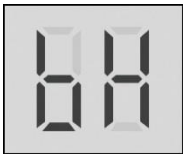


Notes:

1. Water side heat exchanger water inlet temperature sensor and water side heat exchanger water outlet temperature sensor connections are port CN6 on the hydronic system main PCB (labeled 10 in Figure 4-2.1).
2. Set a multi-meter to buzzer mode and test any two terminals of sensor. If the resistance is too low, the buzzer sounds, which means 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 4-7.3.

5.24 bH Troubleshooting

5.24.1 Digital display output



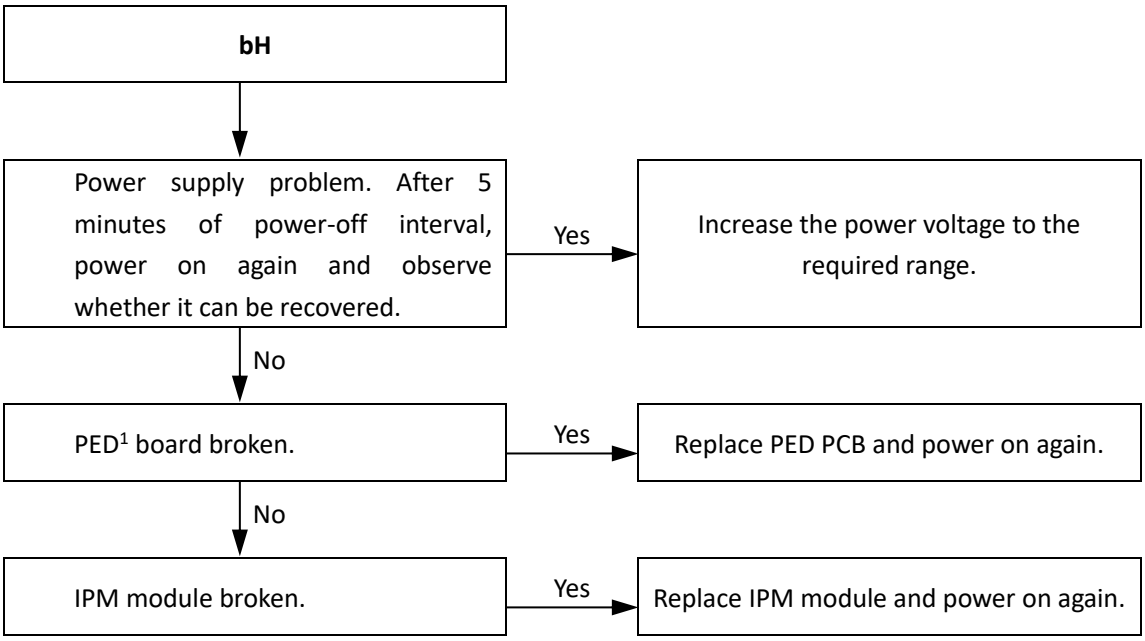
5.24.2 Description

- PED PCB failure
- M thermal Mono stops running.
- Error code is displayed on hydronic system main PCB and user interface.

5.24.3 Possible causes

- Power supply problem.
- PED board broken.
- IPM module broken.

5.24.4 Procedure



Notes:

1. PED is labeled 13 in Figure 4-2.3.

5.25 Pb Troubleshooting

5.25.1 Digital display output

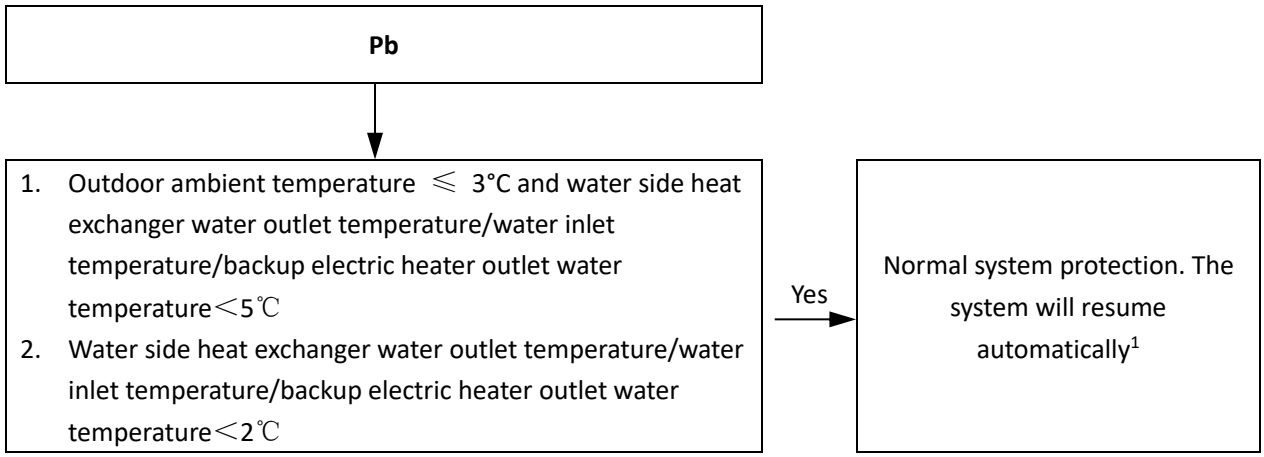
5.25.2 Description

- Water side heat exchanger anti-freeze protection.
- M thermal Mono stops running.
- Pb is displayed on hydronic system main PCB and **ANTI.FREEZE** icon is displayed on user interface.

5.25.3 Possible causes

- Normal system protection.

5.25.4 Procedure



Notes:

1. Refer to Part 3, 5.7 “Water Side Heat Exchanger Anti-freeze Protection Control”.

5.26 HE Troubleshooting

5.26.1 Digital display output

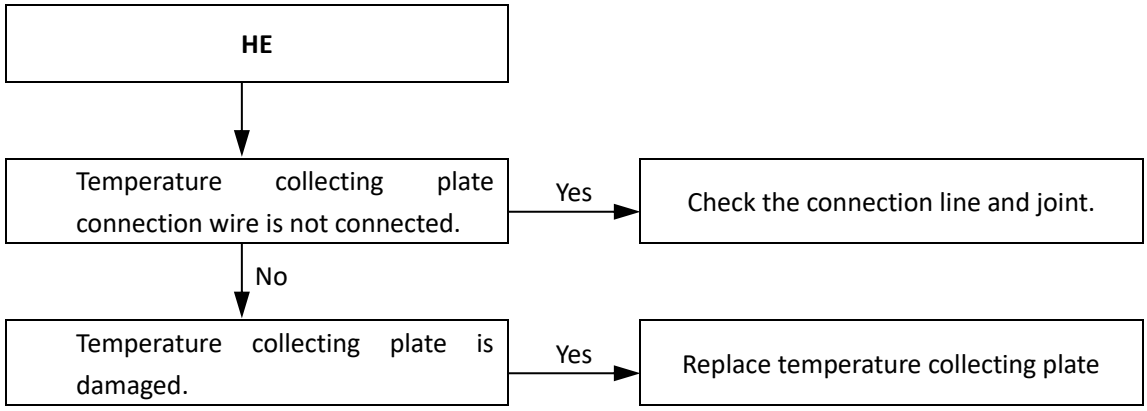
5.26.2 Description

- Communication error between main control board of hydronic module and Ta/room thermostat transfer PCB
- M thermal Mono stops running.
- Error code is displayed on hydronic system main PCB, outdoor unit main PCB and user interface.

5.26.3 Possible causes

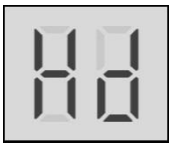
- Temperature collecting plate(Optional) connection wire is not connected.
- Temperature collecting plate(Optional) is damaged.

5.26.4 Procedure



5.27 Hd Troubleshooting

5.27.1 Digital display output



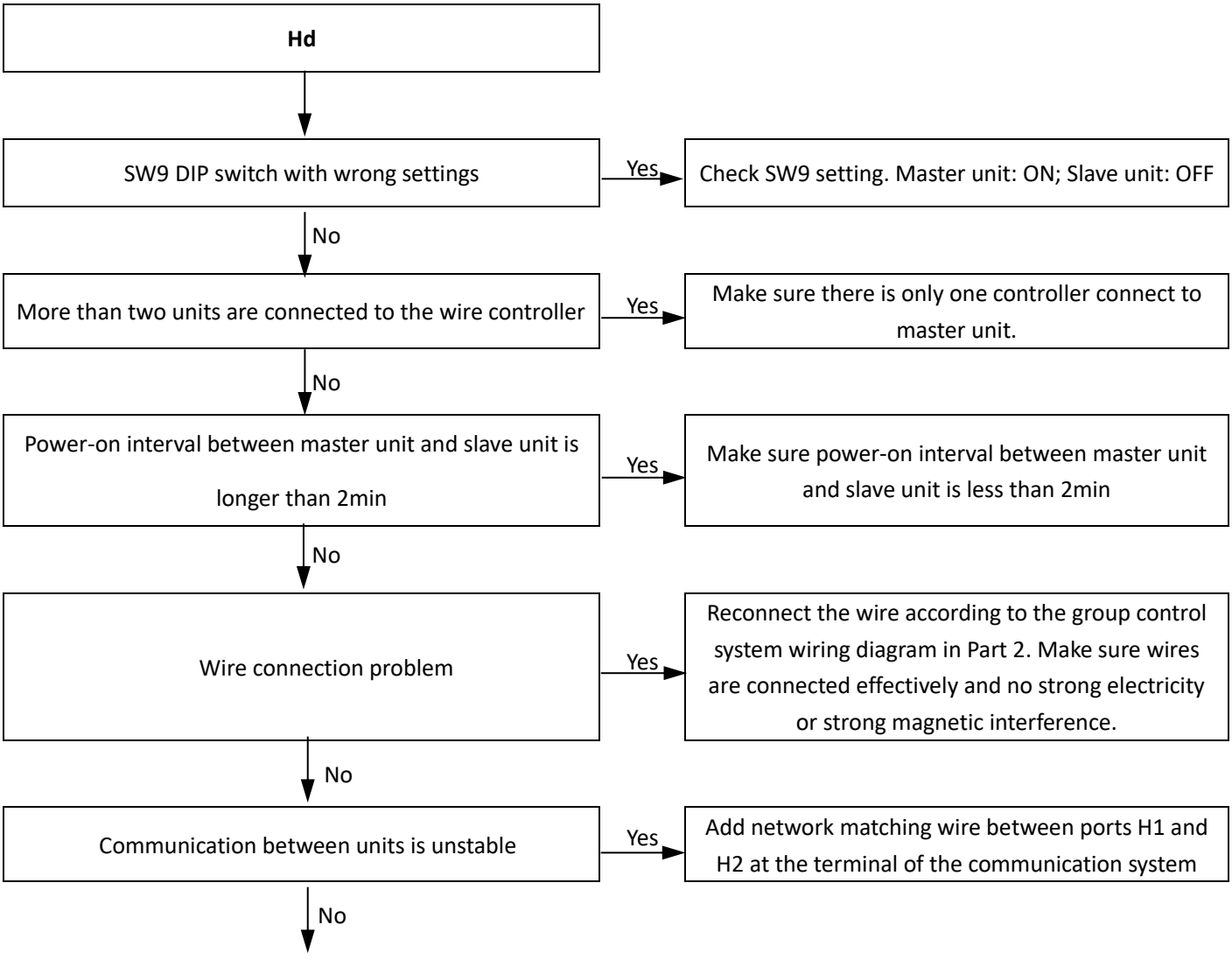
5.27.2 Description

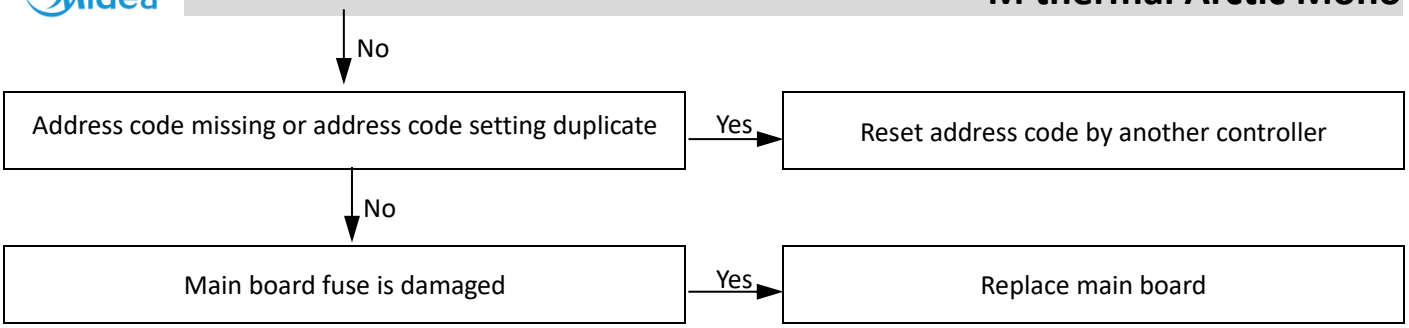
- Communication fault between master unit and slave unit (in parallel)
- M thermal Mono stops running.
- Error code is displayed on hydronic system main PCB, outdoor unit main PCB and user interface.

5.27.3 Possible causes

- SW9 DIP switch with wrong settings
- More than two units are connected to the wire controller
- Power-on interval between master unit and slave unit is longer than 2min
- Wire connection error
- Communication between units is unstable
- Address code missing or address code setting duplicate
- Main board fuse is damaged

5.27.4 Procedure





6 Discharge / Suction pressure and temperature range

The following parameter ranges are used to roughly determine whether the system is running properly:

Discharge temperature(Tp) for heating/DHW mode	
T4＜-10℃	Twout+15＜Tp＜Tw_out+50
-10℃≤T4＜10℃	Twout+10＜Tp＜Tw_out+45
10℃≤T4＜25℃	Twout+10＜Tp＜Tw_out+40
T4≥25℃	Twout+10＜Tp＜Tw_out+35
Note: T4 means ambient temperature Tw_out means leaving water temperature.	

Discharge pressure(P1) for heating/DHW mode									
Tw_out(℃)	25	30	35	40	45	50	55	60	65
P1（kPa）	1750±150	2000±150	2270±150	2560±150	2890±150	3250±150	3630±150	3900±150	4200±150
Note: P1 is absolute pressure.									

Discharge temperature(Tp) for cooling mode				
Tp	Fx＜44Hz	44Hz≤Fx＜62Hz	62Hz≤Fx＜72Hz	Fx≥72Hz
T4＜25℃	52±10	56±10	58±10	62±10
25℃≤T4＜30℃	56±10	62±10	68±10	74±10
30℃≤T4＜35℃	65±10	70±10	75±10	80±10
35℃≤T4＜40℃	70±10	75±10	80±10	85±10
40℃≤T4＜46℃	75±10	80±10	85±10	90±10
T4≥46℃	78±10	80±10	85±10	90±10
Note: Fx means compressor operating frequency.				

Suction pressure(P1) for cooling mode							
Tw_out(℃)	5～7	8～10	11～13	14～16	17～19	20～22	23～25
P1（kPa）	880±100	955±100	1050±100	1150±100	1250±100	1360±100	1500±100
Note: P1 is absolute pressure.							

7 Appendix to Part 4

7.1 Temperature Sensor Resistance Characteristics

Table 4-7.1: Outdoor ambient temperature sensor, water side heat exchanger refrigerant inlet / outlet (liquid / gas pipe) temperature sensor, air side heat exchanger refrigerant out temperature sensor and suction pipe temperature sensor resistance characteristics

Temperature (°C)	Resistance (kΩ)	Temperature (°C)	Resistance (kΩ)	Temperature (°C)	Resistance (kΩ)	Temperature (°C)	Resistance (kΩ)
-25	144.266	**15**	16.079	**55**	2.841	**95**	0.708
-24	135.601	**16**	15.313	**56**	2.734	**96**	0.686
-23	127.507	**17**	14.588	**57**	2.632	**97**	0.666
-22	119.941	**18**	13.902	**58**	2.534	**98**	0.646
-21	112.867	**19**	13.251	**59**	2.44	**99**	0.627
-20	106.732	**20**	12.635	**60**	2.35	**100**	0.609
-19	100.552	**21**	12.05	**61**	2.264	**101**	0.591
-18	94.769	**22**	11.496	**62**	2.181	**102**	0.574
-17	89.353	**23**	10.971	**63**	2.102	**103**	0.558
-16	84.278	**24**	10.473	**64**	2.026	**104**	0.542
-15	79.521	**25**	10	**65**	1.953	**105**	0.527
-14	75.059	**26**	9.551	**66**	1.883		
-13	70.873	**27**	9.125	**67**	1.816		
-12	66.943	**28**	8.721	**68**	1.752		
-11	63.252	**29**	8.337	**69**	1.69		
-10	59.784	**30**	7.972	**70**	1.631		
-9	56.524	**31**	7.625	**71**	1.574		
-8	53.458	**32**	7.296	**72**	1.519		
-7	50.575	**33**	6.982	**73**	1.466		
-6	47.862	**34**	6.684	**74**	1.416		
-5	45.308	**35**	6.401	**75**	1.367		
-4	42.903	**36**	6.131	**76**	1.321		
-3	40.638	**37**	5.874	**77**	1.276		
-2	38.504	**38**	5.63	**78**	1.233		
-1	36.492	**39**	5.397	**79**	1.191		
0	34.596	**40**	5.175	**80**	1.151		
1	32.807	**41**	4.964	**81**	1.113		
2	31.12	**42**	4.763	**82**	1.076		
3	29.528	**43**	4.571	**83**	1.041		
4	28.026	**44**	4.387	**84**	1.007		
5	26.608	**45**	4.213	**85**	0.974		
6	25.268	**46**	4.046	**86**	0.942		
7	24.003	**47**	3.887	**87**	0.912		
8	22.808	**48**	3.735	**88**	0.883		
9	21.678	**49**	3.59	**89**	0.855		
10	20.61	**50**	3.451	**90**	0.828		
11	19.601	**51**	3.318	**91**	0.802		
12	18.646	**52**	3.191	**92**	0.777		
13	17.743	**53**	3.069	**93**	0.753		
14	16.888	**54**	2.952	**94**	0.73		

Table 4-7.2: Compressor discharge pipe temperature sensor resistance characteristics

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

Table 4-7.3: Water side *heat exchanger water inlet / outlet temperature sensor, backup heater exchanger outlet water temperature sensor and DHW temperature sensor resistance characteristics*

Temperature (°C)	Resistance (kΩ)	Temperature (°C)	Resistance (kΩ)	Temperature (°C)	Resistance (kΩ)	Temperature (°C)	Resistance (kΩ)
-30	853.724	**10**	98.227	**50**	17.600	**90**	4.4381
-29	802.986	**11**	93.634	**51**	16.943	**91**	4.3022
-28	755.557	**12**	89.278	**52**	16.315	**92**	4.1711
-27	711.21	**13**	85.146	**53**	15.713	**93**	4.0446
-26	669.728	**14**	81.225	**54**	15.136	**94**	3.9225
-25	630.913	**15**	77.504	**55**	14.583	**95**	3.8046
-24	594.58	**16**	73.972	**56**	14.054	**96**	3.6908
-23	560.556	**17**	70.619	**57**	13.546	**97**	3.5810
-22	528.68	**18**	67.434	**58**	13.059	**98**	3.4748
-21	498．814	**19**	64.409	**59**	12.592	**99**	3.3724
-20	470.812	**20**	61.535	**60**	12.144	**100**	3.2734
-19	444.548	**21**	58.804	**61**	11.715	**101**	3.1777
-18	419.907	**22**	56.209	**62**	11.302	**102**	3.0853
-17	396.779	**23**	53.742	**63**	10.906	**103**	2.9960
-16	375.063	**24**	51.396	**64**	10.526	**104**	2.9096
-15	354.662	**25**	49.165	**65**	10.161	**105**	2.8262
-14	335.492	**26**	47.043	**66**	9.8105		
-13	317.470	**27**	45.025	**67**	9.4736		
-12	300.521	**28**	43.104	**68**	9.1498		
-11	284.576	**29**	41.276	**69**	8.8387		
-10	269.569	**30**	39.535	**70**	8.5396		
-9	255.439	**31**	37.878	**71**	8.2520		
-8	242.131	**32**	36.299	**72**	7.9755		
-7	229.593	**33**	34.796	**73**	7.7094		
-6	217.774	**34**	33.363	**74**	7.4536		
-5	206.630	**35**	31.977	**75**	7.2073		
-4	196.119	**36**	30.695	**76**	6.9704		
-3	186.201	**37**	29.453	**77**	6.7423		
-2	176.840	**38**	28.269	**78**	6.5228		
-1	168.001	**39**	27.139	**79**	6.3114		
0	159.653	**40**	26.061	**80**	6.1078		
1	151.766	**41**	25.031	**81**	5.9117		
2	144.311	**42**	24.048	**82**	5.7228		
3	137.264	**43**	23.109	**83**	5.5409		
4	130.599	**44**	22.212	**84**	5.3655		
5	124.293	**45**	21.355	**85**	5.1965		
6	118.326	**46**	20.536	**86**	5.0336		
7	112.679	**47**	19.752	**87**	4.8765		
8	107.330	**48**	19.003	**88**	4.7251		
9	102.265	**49**	18.286	**89**	4.5790		

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