MUNDOCLIMA®

R32

MINI CHILLER

MUENR-H12

Service Manual

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CL25640 to CL25648

CONTENTS

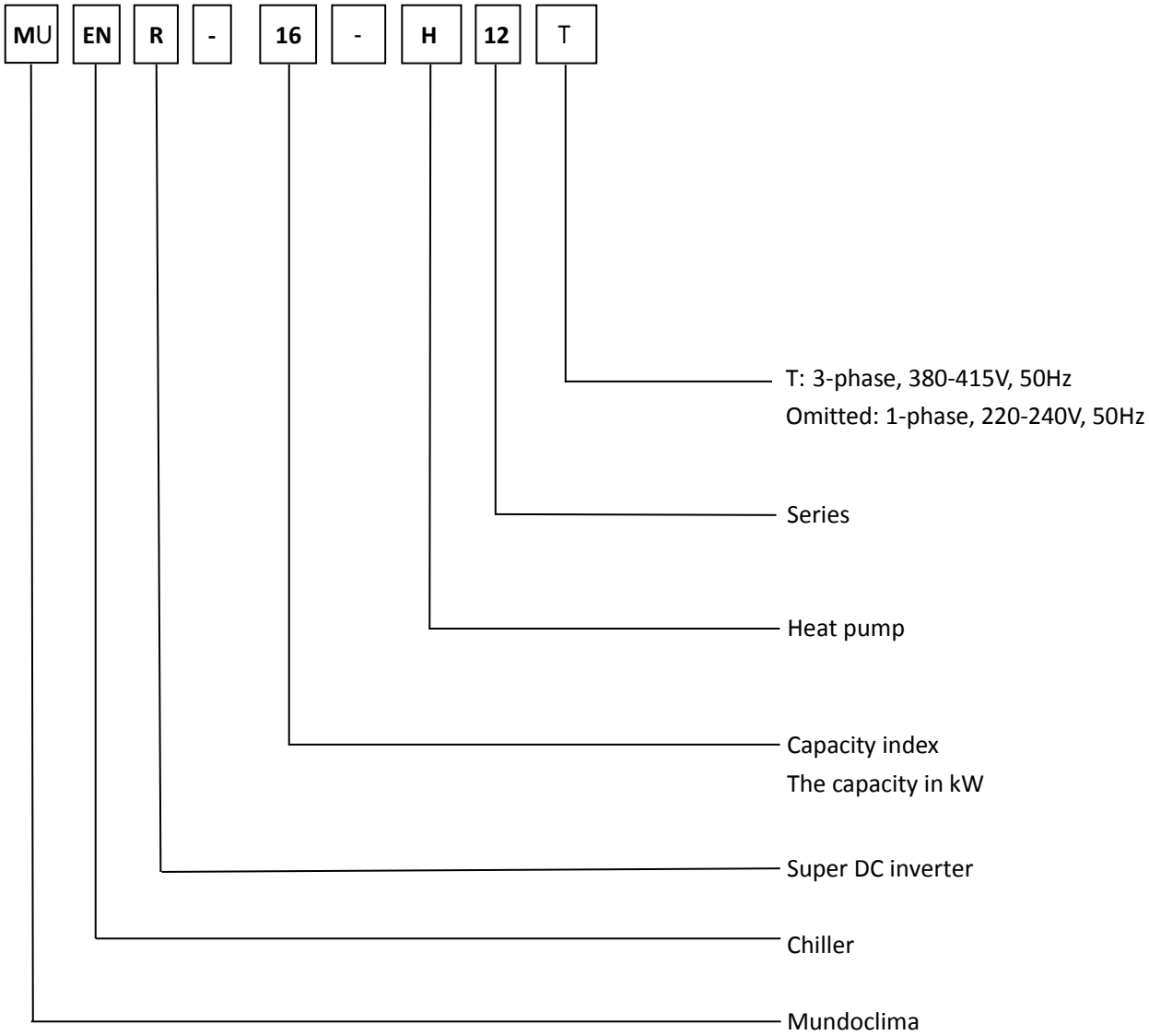
Part 1

General Information

1 Product lineup

Model	Power supply(V/Ph/Hz)	Refrigerant	Appearance
MUENR-05-H12	220-240/1 /50	R32	
MUENR-07-H12	220-240/1 /50	R32	
MUENR-09-H12	220-240/1 /50	R32	
MUENR-12-H12	220-240/1 /50	R32	
MUENR-14-H12	220-240/1 /50	R32	
MUENR-16-H12	220-240/1 /50	R32	
MUENR-12-H12T	380-415/3/50	R32	
MUENR-14-H12T	380-415/3/50	R32	
MUENR-16-H12T	380-415/3/50	R32	

2 Nomenclature

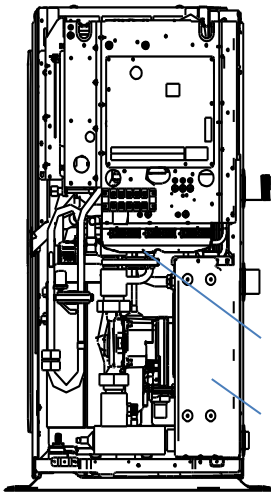


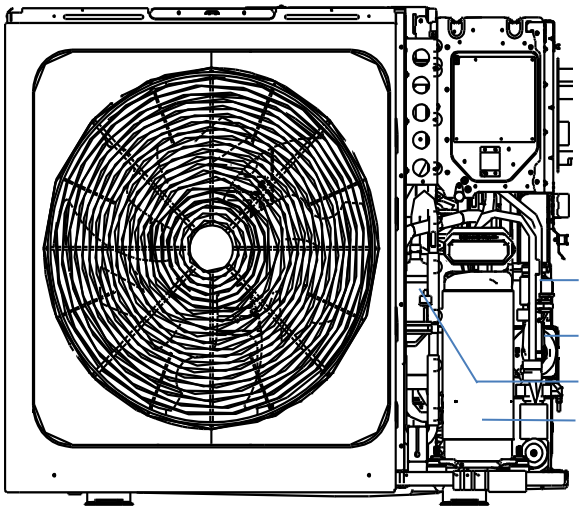
Part 2

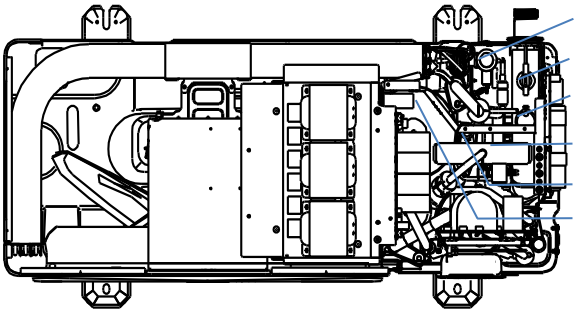
Component Layout and Refrigerant Circuits

1 Layout of Functional Components

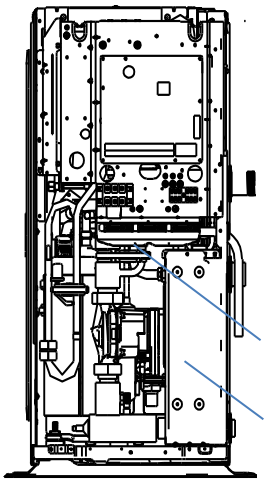
MUENR-05-H12 / MUENR-07-H12 / MUENR-09-H12

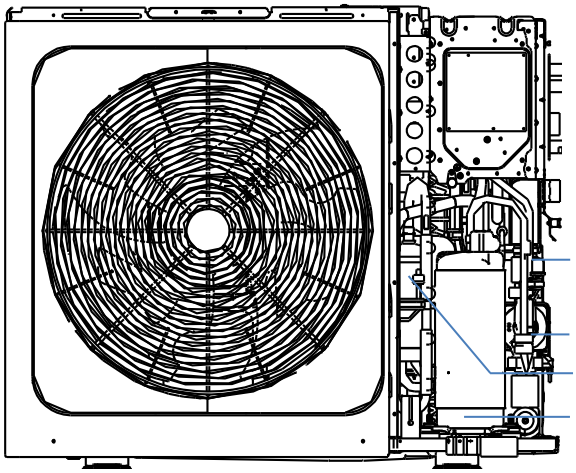


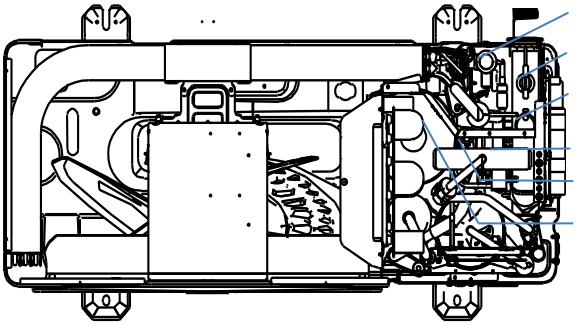




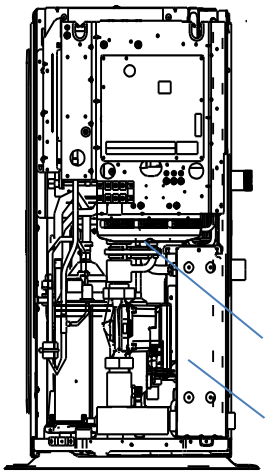
MUENR-12-H12 / MUENR-14-H12 / MUENR-16-H12

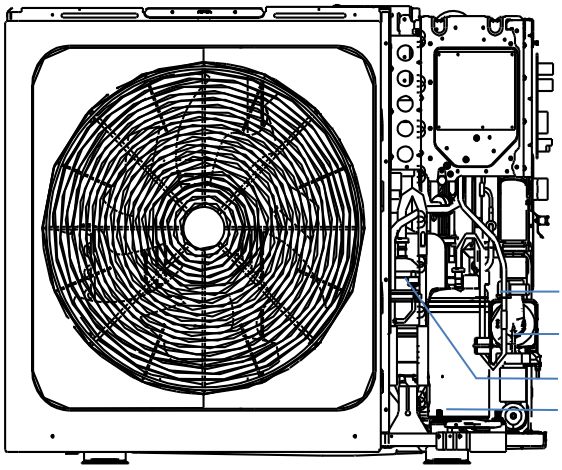


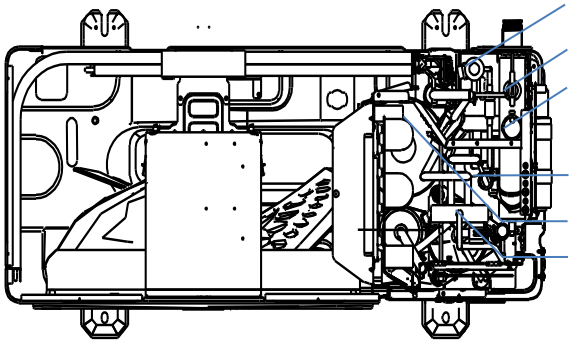




MUENR-12-H12T /MUENR-14-H12T / MUENR-16-H12T





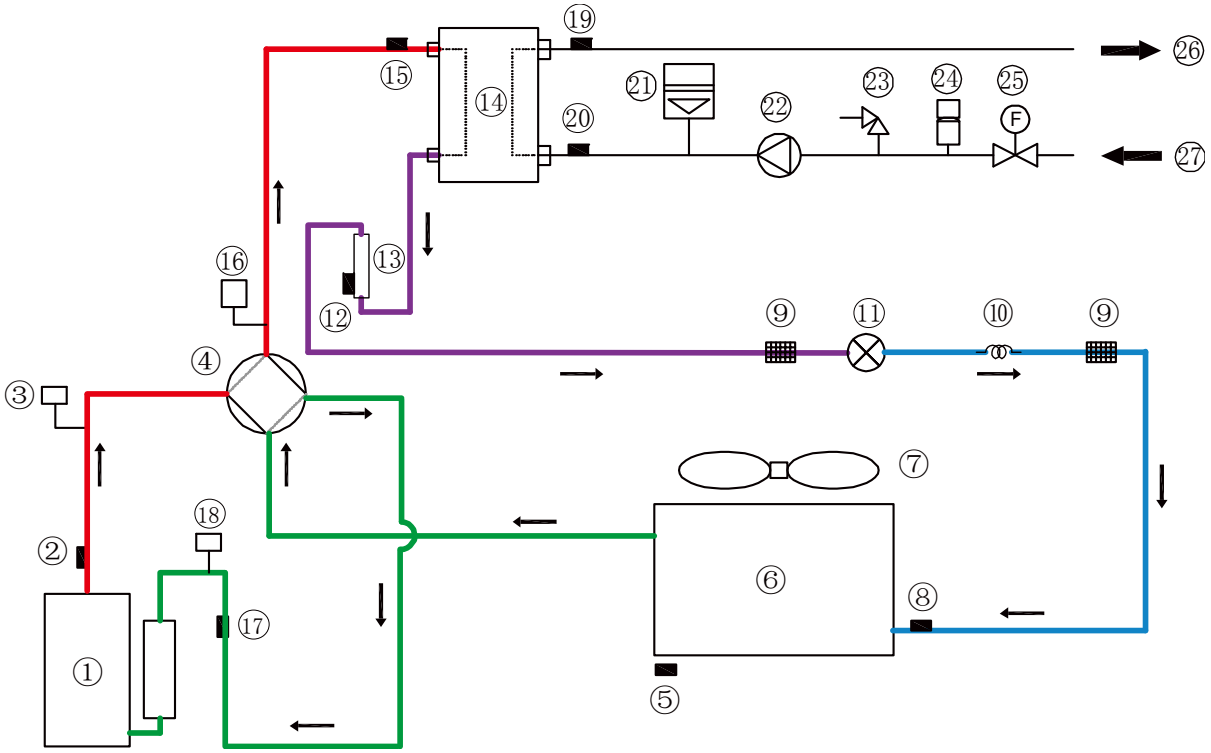


2 Piping Diagrams

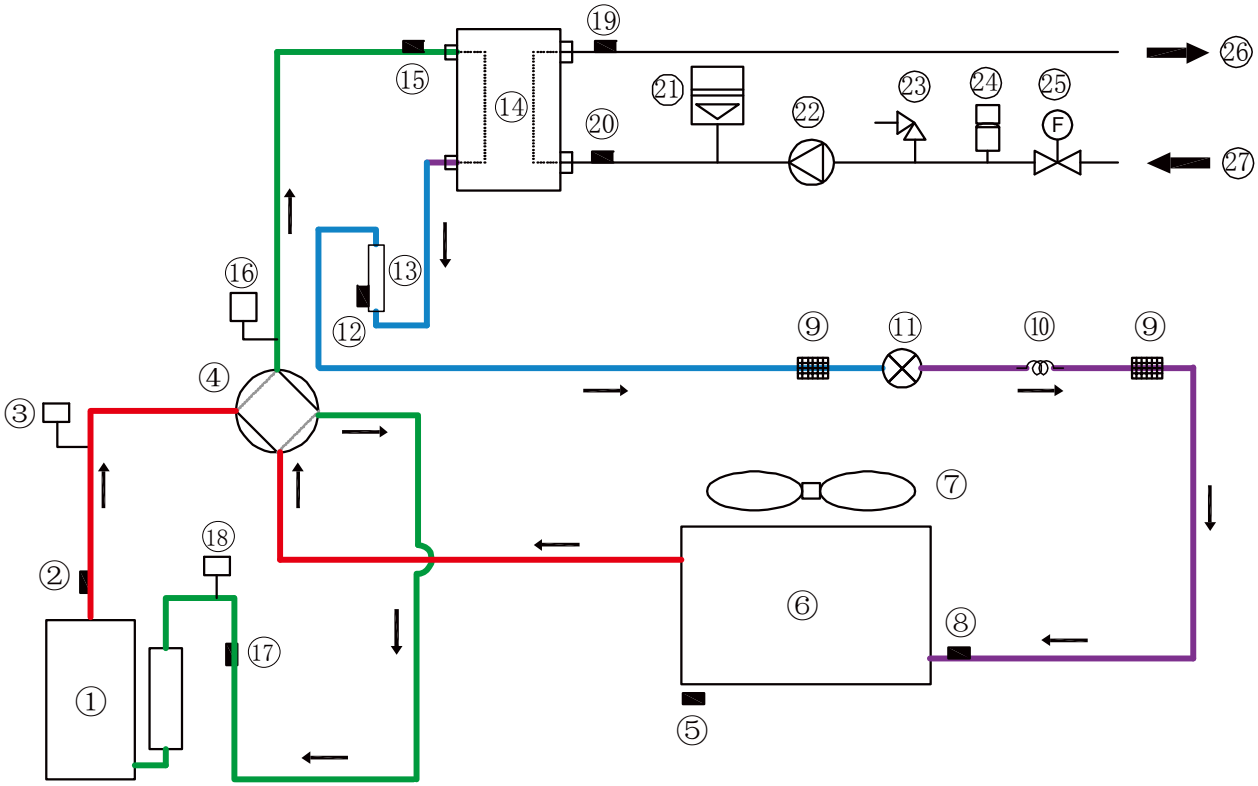
Refrigerant piping graphic example:

- High temperature, high pressure gas
- High temperature, high pressure liquid
- Low temperature, low pressure gas
- Low temperature, low pressure gas liquid mixture

Heating and DHW mode



Cooling mode



Legend			
1	Compressor	15	Refrigerant gas pipe temperature sensor(T2B)
2	Discharge temperature sensor(Tp)	16	Pressure sensor
3	High pressure switch	17	Suction temperature sensor(Th)
4	4-way valve	18	Low pressure switch
5	Ambient temperature sensor(T4)	19	Water outlet temperature sensor(Tw_out)
6	Air side heat exchanger	20	Water inlet temperature sensor(Tw_in)
7	Fan	21	Expansion vessel
8	Air side heat exchanger temperature sensor(T3)	22	Pump
9	Strainer	23	Pressure relief valve
10	Capillary	24	Air purge valve
11	Electronic expansion valve	25	Water flow switch
12	Refrigerant liquid pipe temperature sensor(T2)	26	Water outlet
13	Accumulator cylinder	27	Water inlet
14	Plate heat exchanger		

Key components:

1. **Accumulator cylinder:**
   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. **Pressure relief 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: 5L)
8. **Water flow switch:**
   Detects water flow rate to protect compressor and water pump in the event of insufficient water flow.
9. **Water pump:**
   Circulates water in the water circuit.

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 digital displays 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 8°C or the compressor is running, the crankcase heater is off; when the outdoor ambient temperature is at or below 8°C and either the compressor has been stopped for more than 3 hours or the unit has just been powered-on (either manually or when the power has returned following a power outage), the crankcase heater turns on.

2.2 Water pump control

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

3 Startup control

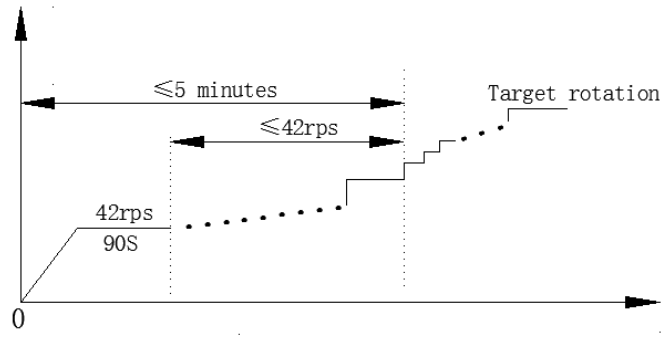
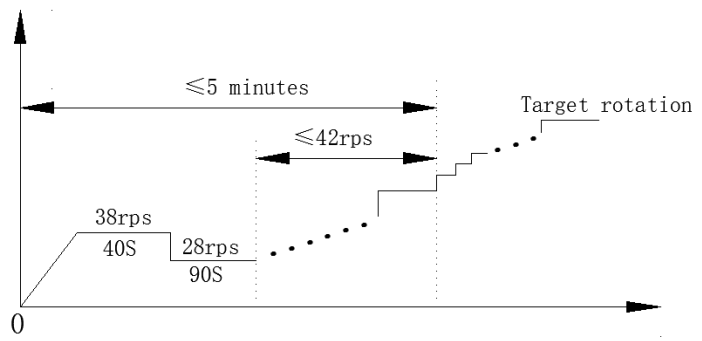
3.1 Compressor sdtartup delay control

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, heating modes are set on the user interface.

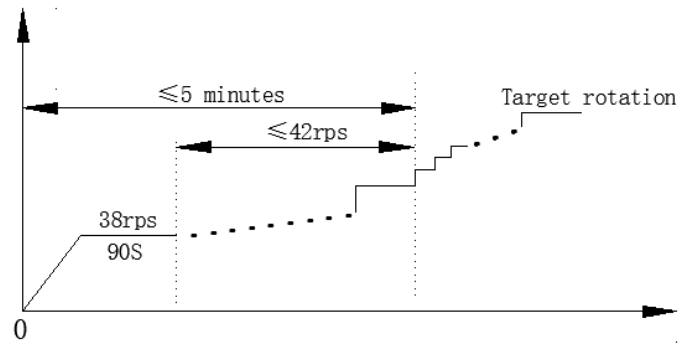
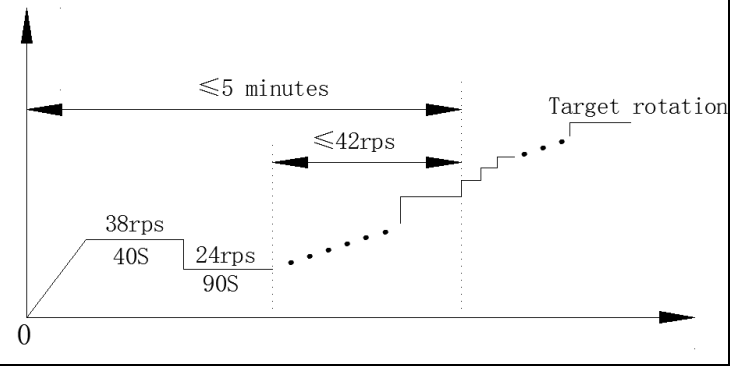
3.2 Compressor startup program

In initial startup control and in re-start control, compressor startup is controlled according to outdoor ambient temperature. Compressor startup follows one of two startup programs until the target rotation speed is reached.

MUENR-05-H12 / MUENR-07-H12 / MUENR-09-H12

Ambient temperature is above 12°C for cooling mode Ambient temperature is above 0°C for heating mode	Ambient temperature is below 12°C for cooling mode Ambient temperature is below 0°C for heating mode
	

MUENR-12-H12 /MUENR-14-H12 / MUENR-16-H12
MUENR-12-H12T / MUENR-14-H12T / MUENR-16-H12T

Ambient temperature is above 12°C for cooling mode Ambient temperature is above 0°C for heating mode	Ambient temperature is below 12°C for cooling mode Ambient temperature is below 0°C for heating mode
	

3.3 Startup control for heating operation

Component	Wiring diagram label	5~16kW	Control functions and states
Inverter compressor	COMP	•	Compressor startup program selected according to ambient temperature
DC fan motor	FAN	•	Fan runs at maximum speed
Electronic expansion valve	EXV	•	Position (steps) from 0 (fully closed) to 480 (fully open), controlled according to outdoor ambient temperature, discharge temperature, suction superheat, compressor speed and refrigerant system pressure
Four-way valve	4-WAY	•	On

3.4 Startup control for cooling operation

Component	Wiring diagram label	5~16kW	Control functions and states
Inverter compressor	COMP	•	Compressor startup program selected according to ambient temperature
DC fan motor	FAN	•	Fan run at maximum speed
Electronic expansion valve	EXV	•	Position (steps) from 0 (fully closed) to 480 (fully open), controlled according to outdoor ambient temperature, discharge temperature, suction superheat, compressor speed and refrigerant system pressure
Four-way valve	4-WAY	•	Off

4 Normal operation control

4.1 Normal operation control for heating operation

Component	Wiring diagram label	5~16kW	Control functions and states
Inverter compressor	COMP	•	Controlled according to load requirement from temperature set and outlet water temperature
DC fan motor	FAN	•	Controlled according to outdoor heat exchanger pipe temperature
Electronic expansion valve	EXV	•	Position (steps) from 0 (fully closed) to 480 (fully open), controlled according to outdoor ambient temperature, discharge temperature, suction superheat, compressor speed, refrigerant system pressure and temperature
Four-way valve	4-WAY	•	On

4.2 Normal operation control for cooling operation

Component	Wiring diagram label	5~16kW	Control functions and states
Inverter compressor	COMP	•	Controlled according to load requirement from temperature set and outlet water temperature
DC fan motor	FAN	•	Controlled according to outdoor heat exchanger pipe temperature
Electronic expansion valve	EXV	•	Position (steps) from 0 (fully closed) to 480 (fully open), controlled according to outdoor ambient temperature, discharge temperature, suction superheat, compressor speed, refrigerant system pressure and temperature
Four-way valve	4-WAY	•	Off

4.3 Compressor output control

The compressor rotation speed is controlled according to the load requirement. Before compressor startup, heat pump determines the compressor target speed according to outdoor ambient temperature, leaving water set temperature and actual leaving water temperature and then runs the appropriate 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 rate of change of water temperature, the refrigerant system pressure and temperature.

4.4 Compressor step control

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

4.5 Four-way valve control

The four-way valve is used to change the direction of refrigerant flow through the water side heat exchanger in order to switch between cooling and heating operations.

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

4.6 Electronic expansion valve control

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

- At power-on:
  - The EXV first closes fully, then moves to the standby position.
  - After the compressor runs, the EXV is controlled according to suction superheat, discharge temperature, pressure and compressor speed.

- When the outdoor unit is in standby:
  - The EXV is at standby position.

- When the outdoor unit stops:
  - The EXV first opens fully and remains for 30 seconds, then closes fully, then moves to the standby position.

4.7 Outdoor fan control

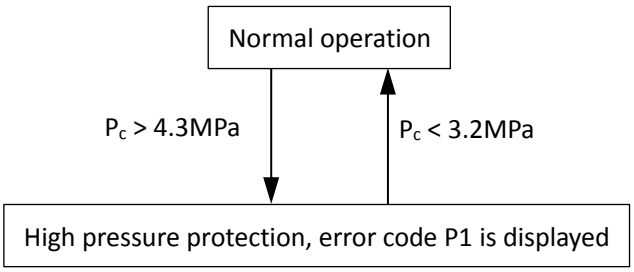
The speed of the outdoor unit fan is adjusted in steps, as shown below

Fan speed index	Fan speed (rpm)					
	5kW	7kW	9kW	12kW	14kW	16kW
W1	200	200	200	200	200	200
W2	250	250	250	250	250	250
W3	300	300	300	300	300	300
W4	350	350	350	350	350	350
W5	400	400	400	400	400	400
W6	450	450	450	450	450	450
W7	470	470	470	530	530	530
W8	530	530	530	600	600	600
W9	550	550	550	650	650	650
W10	/	590	590	730	730	730
W11	/	650	650	780	780	780
W12	/	/	/	/	820	820

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.

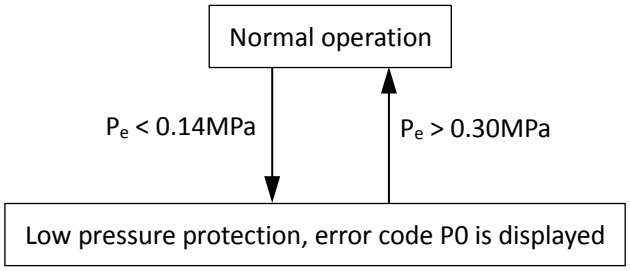


Notes:
1. P_c: Discharge pressure

When the discharge pressure rises above 4.3MPa 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.



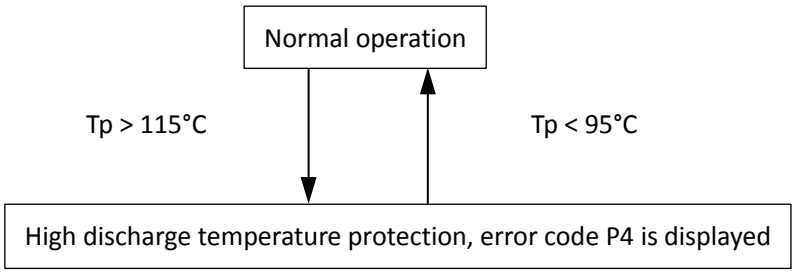
Notes:
1. P_e: Suction pressure

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.

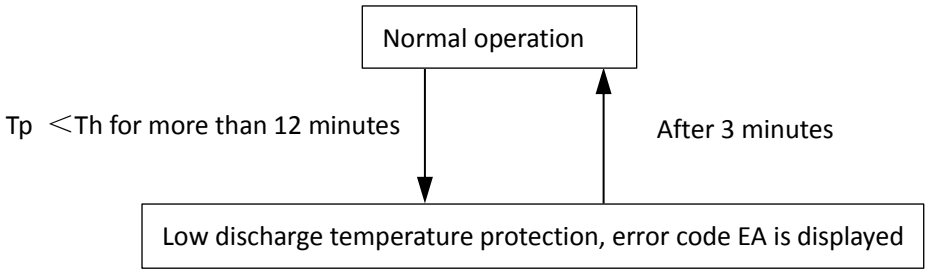
When P0 protection occurs 3 times in 60 minutes, the HP error is displayed. When an HP error occurs, a manual system restart is required before the system can resume operation.

5.3 Discharge temperature protection control

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



When the discharge temperature rises above 115°C the system displays P4 protection and the unit stops running. When the discharge temperature drops below 95°C, the compressor enters re-start control.



Notes:

T_p: Discharge temperature

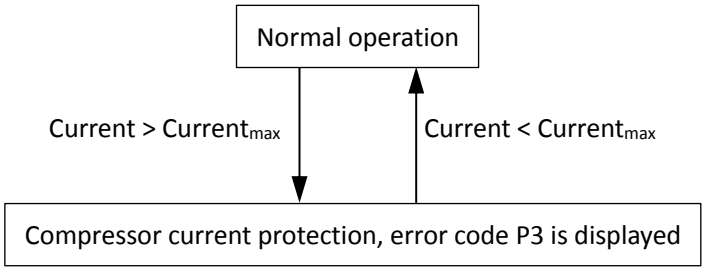
T_h: Suction temperature

When the discharge temperature is lower than suction temperature for more than 12 minutes after compressor runs, the system displays EA protection and heat pump stops running. After 3 minutes, the compressor enters re-start control automatically.

If EA protection occurs 3 times within 2 hours, heat pump cannot be restarted unless it is powered on again.

5.4 Compressor current protection control

This control protects the compressor from abnormally high currents.



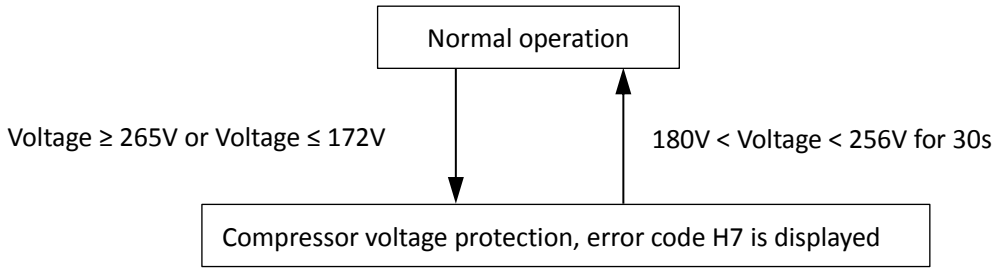
Current limitation for heat pump

Model name	MUENR-5(7,9)H12	MUENR-12(14,16)H12	MUENR-12(14,16)H12T
Current$_{max}$	18A	30A	14A

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

5.5 Voltage protection control

This control protects the heat pump from abnormally high or abnormally low voltages.



When the phase voltage of AC power supply is at or above 265V, 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 conditions are met:

- Fan speed is less than 50rpm for more than 40s after fan operates.
- Fan speed is lower than 50rpm for 3S,during normal operation

When DC fan motor protection control occurs the system displays the H6 error code and the unit stops running. After 3 seconds, 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 Water side heat exchanger anti-freeze protection control

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

The water side heat exchanger electric heater is controlled according to outdoor ambient temperature, water side heat exchanger water inlet temperature and outlet temperature.

In cooling mode, if inlet water temperature or leaving water temperature or auxiliary heat source leaving water temperature is below 4°C, heat pump stops and water pump keeps running for 30min. If water temperature is still below 4°C, heat pump turns to heating mode. the anti-freeze protection actions.

In heating standby mode, if ambient temperature is below 3°C and inlet water temperature or leaving water temperature or auxiliary heat source leaving water temperature is below 5°C, heat pump stops and water pump keeps running for 30min. If ambient temperature is still below 3°C and water temperature is still below 5°C, heat pump turns to heating mode. the anti-freeze protection actions; if leaving water temperature is below 2°C, the anti-freeze protection actions.

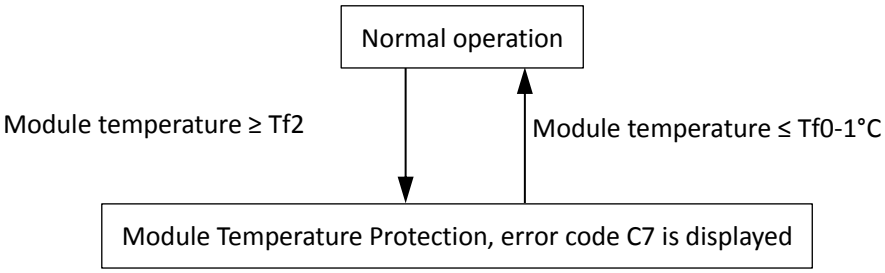
In heating standby mode, if leaving water temperature is below 2°C, heat pump stops and water pump keeps running for 30min. If water temperature is still below 2°C heat pump turns to heating mode to protect from anti-freezing.

When water side heat exchanger anti-freeze protection occurs the system displays error code Pb and the unit stops running.

5.8 Module temperature protection control

This control protects the module from abnormally high temperatures.

Module Temperature Protection Control



When the module temperature rises at or above Tf2 the system displays C7 protection and the unit stops running. When the module temperature drops at or below Tf0-1, the compressor enters re-start control.

	5-9kW	12-16kW 1ph	12-16kW 3ph
Tf2	81	100	84
Tf0	75	94	78

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. When the oil return operation is being conducted, the refrigerant system main PCB displays code d0.

The oil return operation starts when the following condition occurs:

- 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 conditions occurs:

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

Component control during oil return operation in cooling mode.

Component	Wiring diagram label	5~16kW	Control functions and states
Inverter compressor	COMP	●	Runs at oil return operation rotation speed
DC fan motor	FAN	●	Controlled according to cooling mode
Electronic expansion valve	EXV	●	304 (steps)
Four-way valve	4-WAY	●	Off

Component control during oil return operation in heating mode.

Component	Wiring diagram label	5~16kW	Control functions and states
Inverter compressor	COMP	●	Runs at oil return operation rotation speed
DC fan motor	FAN	●	Controlled according to heating mode
Electronic expansion valve	EXV	●	304 (steps)
Four-way valve	4-WAY	●	On

6.2 Defrosting operation

In order to recover heating capacity, the defrosting operation is conducted when the 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.

Component control during defrosting operation

Component	Wiring diagram label	5~16kW	Control functions and states
Inverter compressor	COMP	•	Runs at defrosting operation rotation speed
DC fan motor	FAN	•	Off
Electronic expansion valve	EXV	•	Fully open
Four-way valve	4-WAY	•	Off

6.3 Force cooling operation

The force cooling operation helps the refrigerant recovering before removal the water side heat exchanger.

The force cool mode can be ended by pushing the button on the outdoor refrigerant system PCB named “force-Bool” for 5s or this mode will be ended automatic if the system has operated force cool mode for more than 30 minutes.

Component control during force cool operation

Component	Wiring diagram label	5-16kW	Control functions and states
Inverter compressor	COMP	•	Runs at force cooling operation rotation speed
DC fan motor	FAN	•	Runs at force cooling operation speed
Electronic expansion valve	EXV	•	304 (steps)
Four-way valve	4-WAY	•	Off

6.4 Two zones control[1]

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

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.

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 temperature and setting water temperature of the controlling zone.

Note:

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

6.5 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.

6.6 Dry contract M1M2 control

M1M2 can be set in the wired controller for heat pump on/off 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.

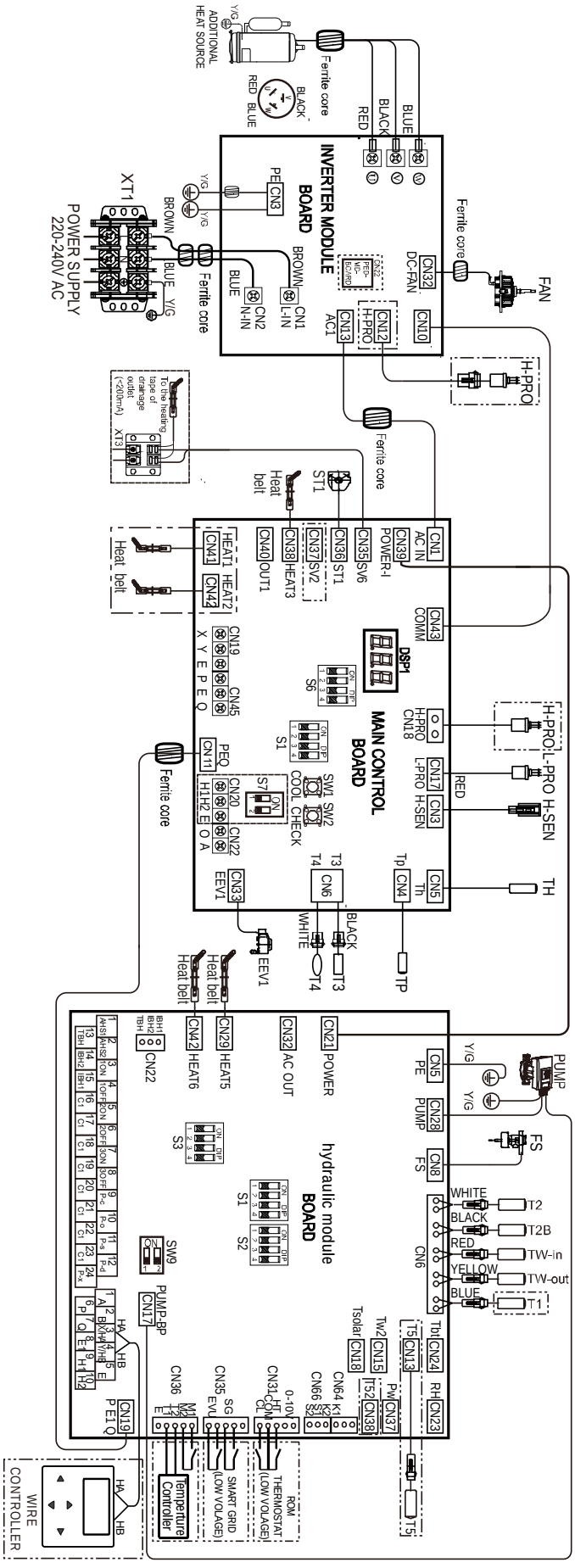
- For AHS control

In heating mode， AHS on/off is only controlled by M1M2.

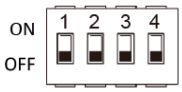
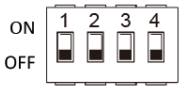
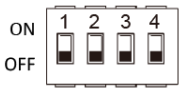
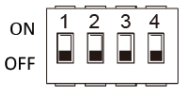
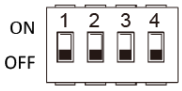
Part 4 Diagnosis and Troubleshooting

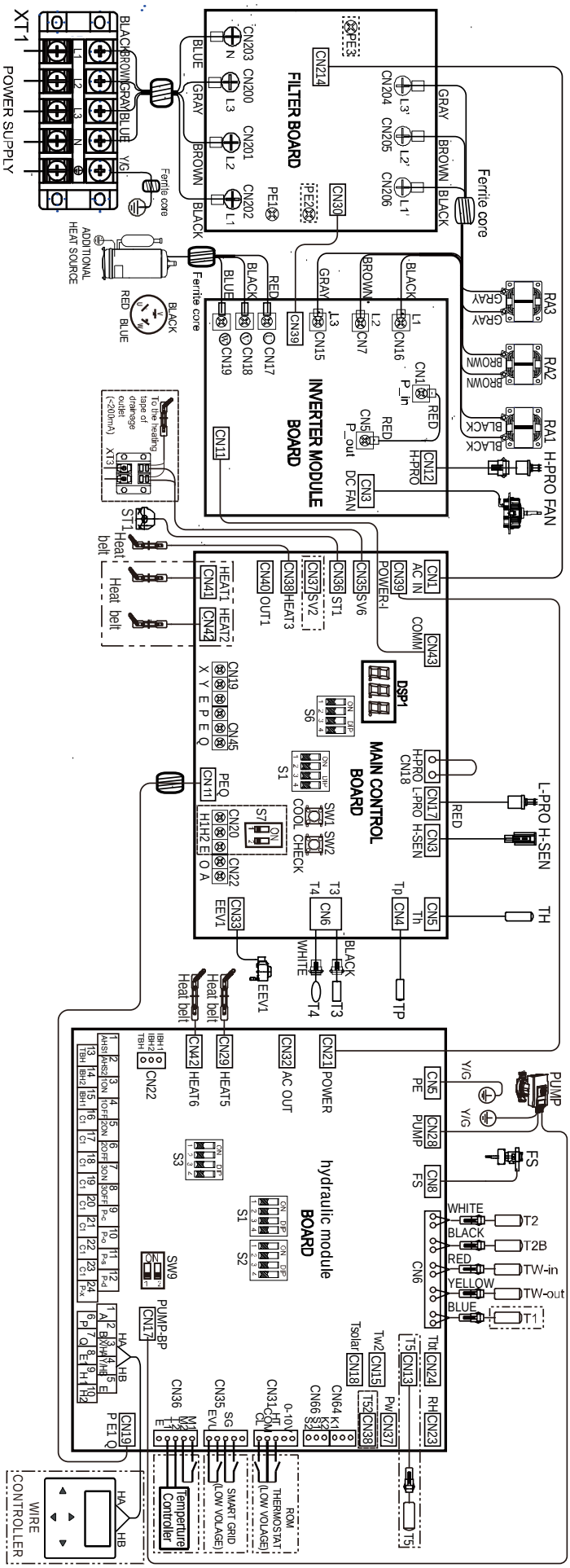
1 Electric wiring diagram

MUENR-05-H12 / MUENR-07-H12 / MUENR-09-H12
MUENR-12-H12 / MUENR-14-H12 / MUENR-16-H12



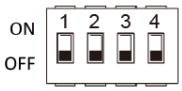
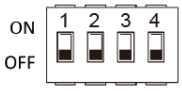
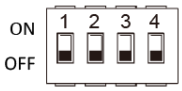
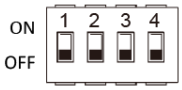
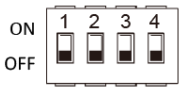
DIP switch settings

PCB	Switch		ON=1 OFF=0	Default factory setting
Hydro system	**S1** 	1/2	0/0=Model 1 1/0=Model 2 0/1=Model 3 1/1=Model 4	00
		3/4	0/0=Without backup heater 0/1=With backup heater(One step control) 1/0= With backup heater(Two step control) 1/1= With backup heater(Three step control)	00
	S2 	1/2	Reserved	00
		3/4	0/0=variable speed pump 1 0/1=variable speed pump 2 1/1=variable speed pump 3 1/0=constant speed pump	00
	S3 	1/2/3	0/0/0=address 0#(master units) 1/0/0=address 1#(slave units) 0/1/0=address 2#(slave units) 0/0/1=address 3#(slave units) 1/1/0=address 4#(slave units) 1/0/1=address 5#(slave units) 1/0/0=address 6#(slave units) 0/1/0=address 7#(slave units) 1/1/1=address 8#(slave units)	000
		4	Reserved	0
Refrigerant system	**S1** 	1/2/3/4	0/0/0/0=5kW model 0/0/0/1=7kW model 0/0/1/0=9kW model 0/0/1/1=12kW model(Single phase) 0/1/0/0=14kW model(Single phase) 0/1/0/1=16kW model(Single phase)	-
	S6 	1/2/3/4	All the combination=Reserved	0000


XT1
POWER SUPPLY
380-415V 3N~
FILTER BOARD
INVERTER MODULE BOARD
MAIN CONTROL BOARD
hydraulic module BOARD
Ferrite core
ADDITIONAL HEAT SOURCE
Heat belt
EEV1
PUMP
FS
WHITE
BLACK
RED
YELLOW
BLUE
T2
T2B
TW-in
TW-out
T1
TH
TP
T5
L-PRO
H-SEN
H-PRO FAN
RA1
RA2
RA3
SMART GRID
(LOW VOLAGE)
THERMOSTAT
(LOW VOLAGE)
Temperture Controller
WIRE CONTROLLER

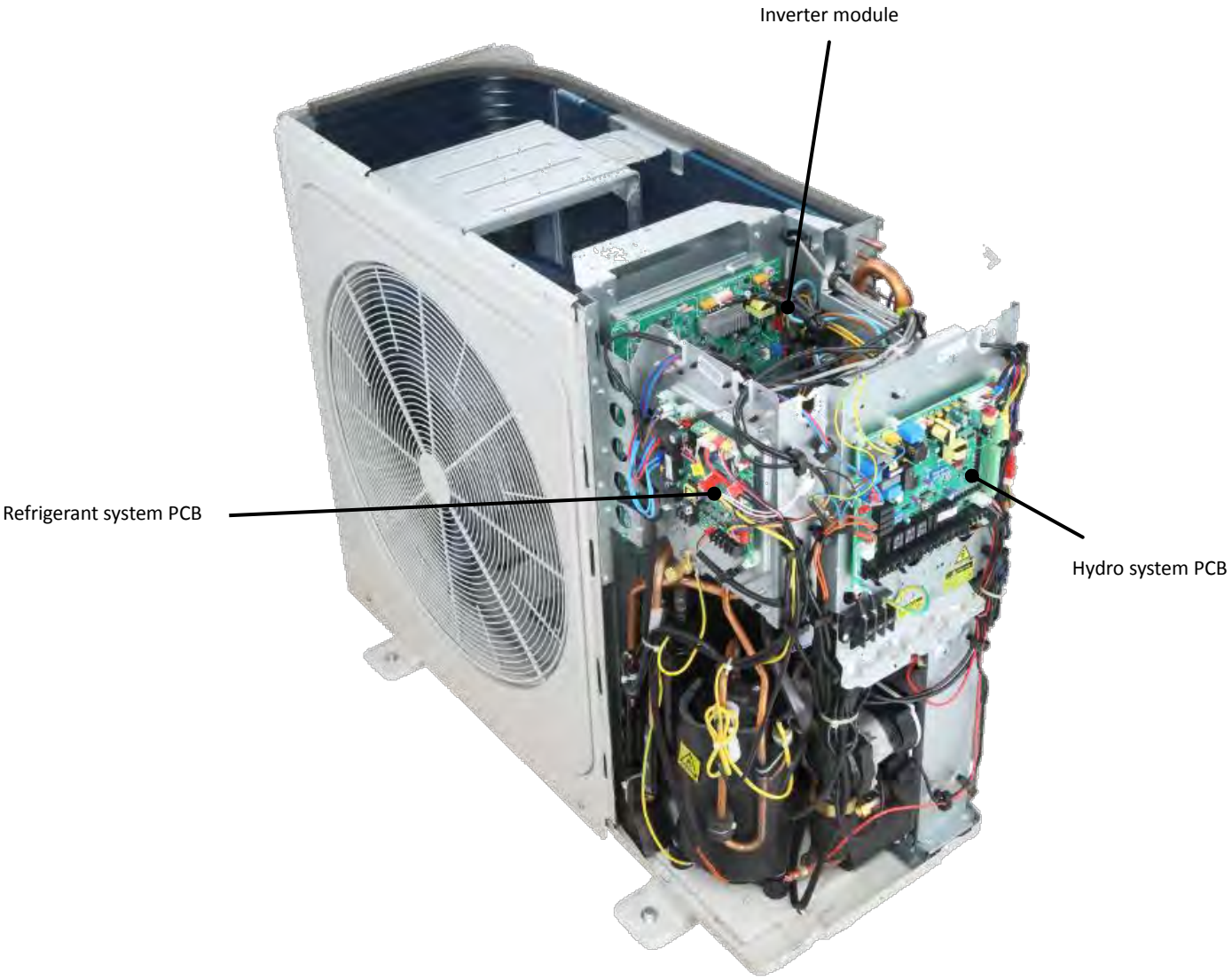
Version: D

DIP switch settings

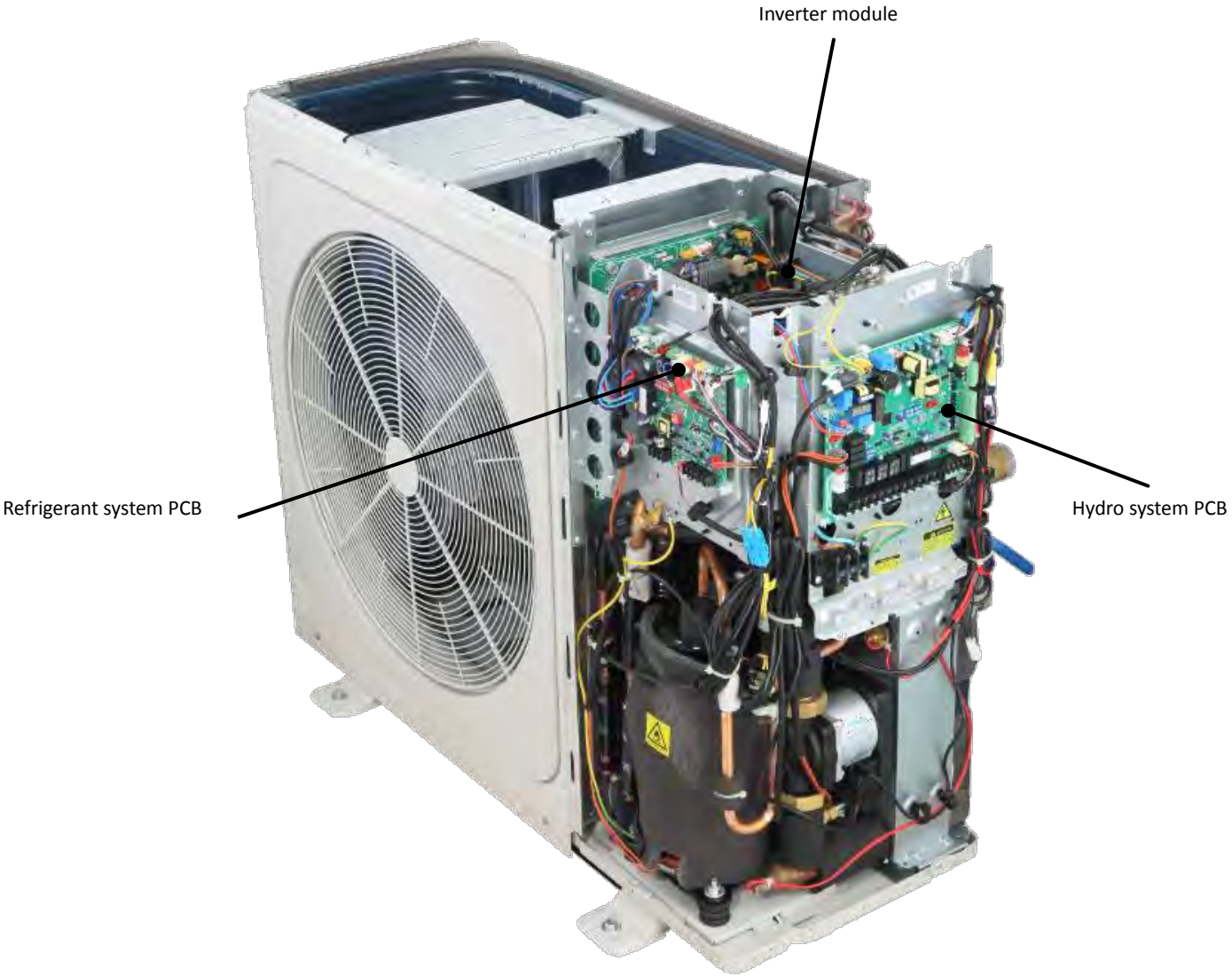
PCB	Switch		ON=1 OFF=0	Default factory setting
Hydro system	**S1** 	1/2	0/0=Model 1 1/0=Model 2 0/1=Model 3 1/1=Model 4	00
		3/4	0/0=Without backup heater 0/1=With backup heater(One step control) 1/0= With backup heater(Two step control) 1/1= With backup heater(Three step control)	00
	S2 	1/2	Reserved	00
		3/4	0/0=variable speed pump 1 0/1=variable speed pump 2 1/1=variable speed pump 3 1/0=constant speed pump	00
	S3 	1/2/3	0/0/0=address 0#(master units) 1/0/0=address 1#(slave units) 0/1/0=address 2#(slave units) 0/0/1=address 3#(slave units) 1/1/0=address 4#(slave units) 1/0/1=address 5#(slave units) 1/0/0=address 6#(slave units) 0/1/0=address 7#(slave units) 1/1/1=address 8#(slave units)	000
		4	Reserved	0
Refrigerant system	**S1** 	1/2/3/4	1/0/1/1=12kW model(Three phase) 1/1/0/0=14kW model(Three phase) 1/1/0/1=16kW model(Three phase)	-
	S6 	1/2/3/4	All the combination=Reserved	0000

2 Electric Control Box Layout

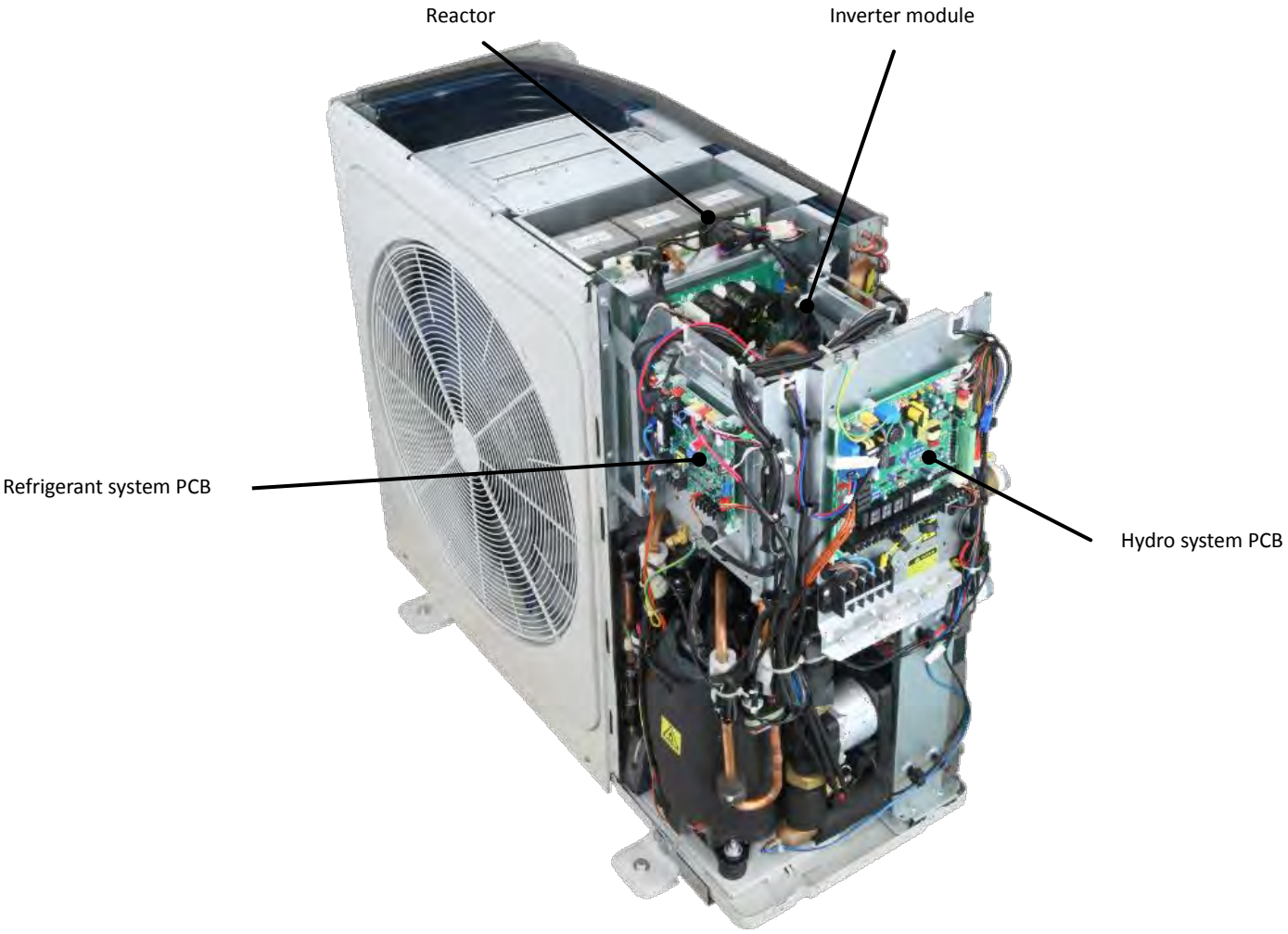
MUENR-05-H12 / MUENR-07-H12 / MUENR-09-H12

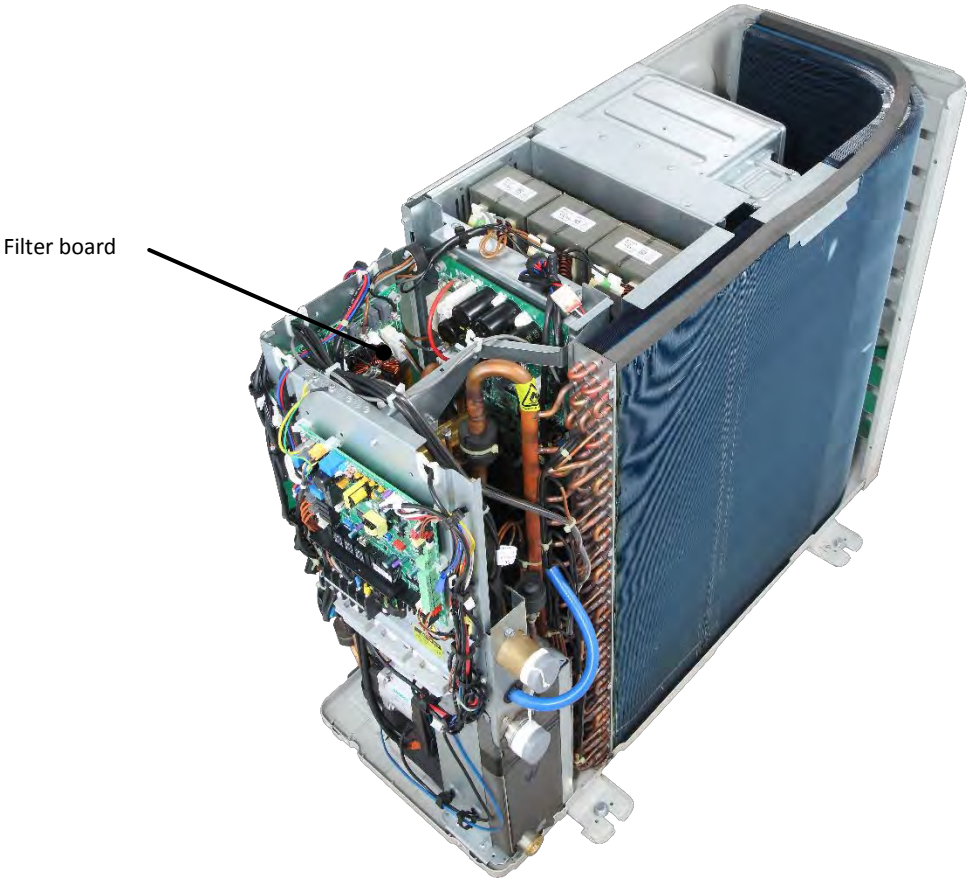


MUENR-12-H12 / MUENR-14-H12 / MUENR-16-H12



MUENR-12-H12T / MUENR-14-H12T / MUENR-16-H12T





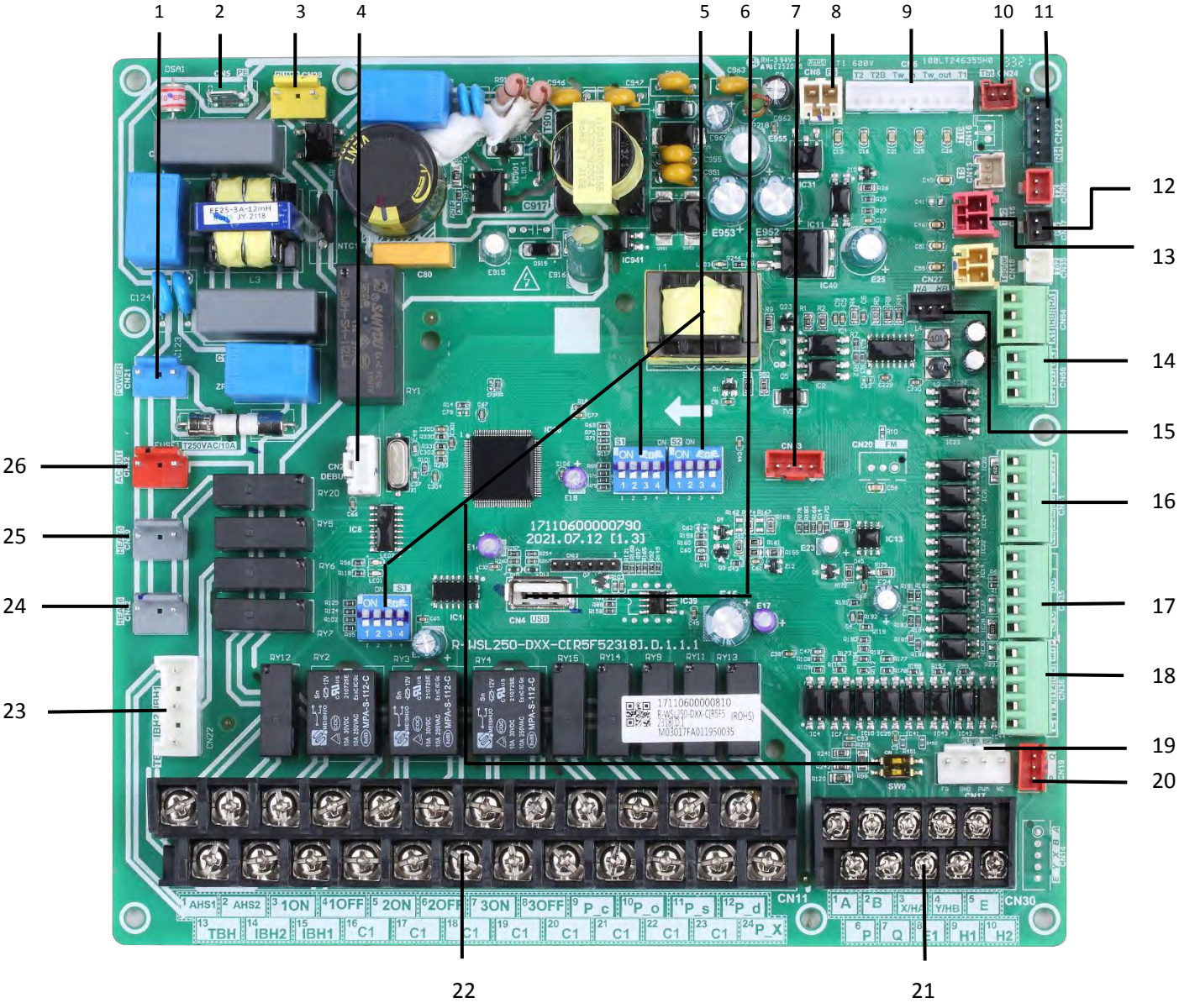
3 PCB

3.1 Hydro system PCB

MUENR-05-H12 / MUENR-07-H12 / MUENR-09-H12

MUENR-12-H12 / MUENR-14-H12 /MUENR-16-H12

MUENR-12-H12T / MUENR-14-H12T /MUENR-16-H12T



Label	Port	Code	Content	Voltage(V)
1	CN21	POWER	Port for power supply	220VAC
2	CN5	GND	Port for ground	-
3	CN28	PUMP	Port for variable speed pump power input	220VAC
4	CN25	DEBUG	Port for IC programming	5VDC
5	S1 ,S2,S3,SW9	/	Dip switch	5VDC
6	CN4	USB	Port for USB programming	5VDC
7	CN33	/	Port for breathing light	5VDC
8	CN8	FS	Port for flow switch	12VDC
9	CN6	T2	Port for refrigerant liquid side temperature(heating mode)	5VDC
		T2B	Port for temperature sensors of refrigerant gas side temperature (cooling mode)	5VDC

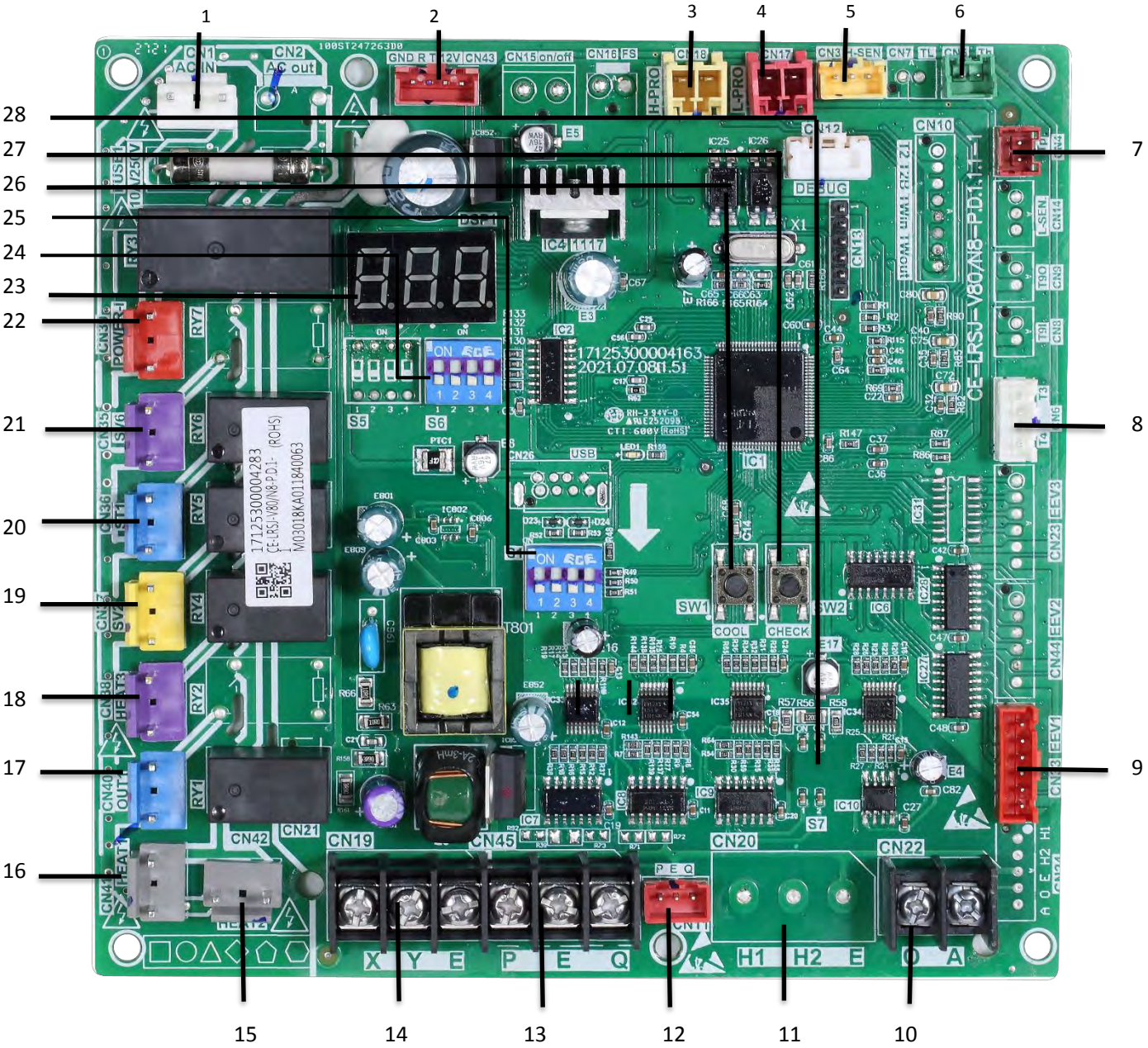
9	CN6	TW_in	Port for temperature sensors of inlet water temperature of plate heat exchanger	5VDC
		TW_out	Port for temperature sensors of outlet water temperature of plate heat exchanger	5VDC
		T1	Port for temperature sensors of final outlet water temperature	5VDC
10	CN24	Tbt	Port for temperature sensor of balance tank	5VDC
11	CN23	RH	Port for humidity sensor	5VDC
12	CN37	Pw	Port for temperature sensor of water pressure	5VDC
13	CN15	Tw2	Port for outlet water for zone 2 temp. sensor	5VDC
14	CN66	K1 K2	Input port (Reserved)	12VDC
		S1 S2	Reserved	12VDC
15	CN27	HA/HB	Port for communication with the HOME BUS wired controller (Reserved)	18VDC
16	CN31	10V GND	Output port for 0-10V	10VDC
		HT	Control port for room thermostat (heating mode)	-
		COM	Power port for room thermostat	12VDC
		CL	Control port for room thermostat (cooling mode)	-
17	CN35	SG	Port for smart grid (grid signal)	12VDC
		EVU	Port for smart grid (photovoltaic signal)	12VDC
18	CN36	M1 M2	Port for remote switch	12VDC
		T1 T2	Port for thermostat transfer board	5VDC
19	CN17	PUMP_BP	Port for variable speed pump communication	5VDC
20	CN19	P Q	Communicate port between indoor unit and outdoor unit	5VDC
21	CN30	3 4	Port for communication with the wired controller	18VDC
		6 7	Communicate port between hydro module board and main control board	5VDC
		9 10	Port for Internal machine Cascade	5VDC
22	CN 11	1 2	Port for additional heat source	-
		3 4 17	Reserved	220VAC
		5 6 18	Port for SV2(3-way valve)	220VAC
		7 8 19	Port for SV3(3-way valve)	220VAC
		9 20	Port for zone 2 pump	220VAC
		10 21	Port for outside circulation pump	220VAC
		11 22	Reserved	220VAC
		12 23	Reserved	220VAC
		13 16	Reserved	220VAC
		14 16	Control port for internal backup heater 1	220VAC
		15 17	Control port for internal backup heater 2	220VAC
		24 23	Output port for alarm/Defrost run	220VAC
23	CN22	IBH1	Control port for internal backup heater 1	220VAC
		IBH2	Control port for internal backup heater 2	220VAC
		TBH	Reserved	220VAC
24	CN42	HEAT6	Port for anti-freeze electric heating tape(internal)	220VAC
25	CN29	HEAT5	Port for anti-freeze electric heating tape(internal)	220VAC
26	CN32	AC OUT	Port for backup heater	220VAC

3.2 Refrigerant system PCB

MUENR-05-H12/MUENR-07-H12/MUENR-09-H12

MUENR-12-H12/MUENR-14-H12/MUENR-16-H12

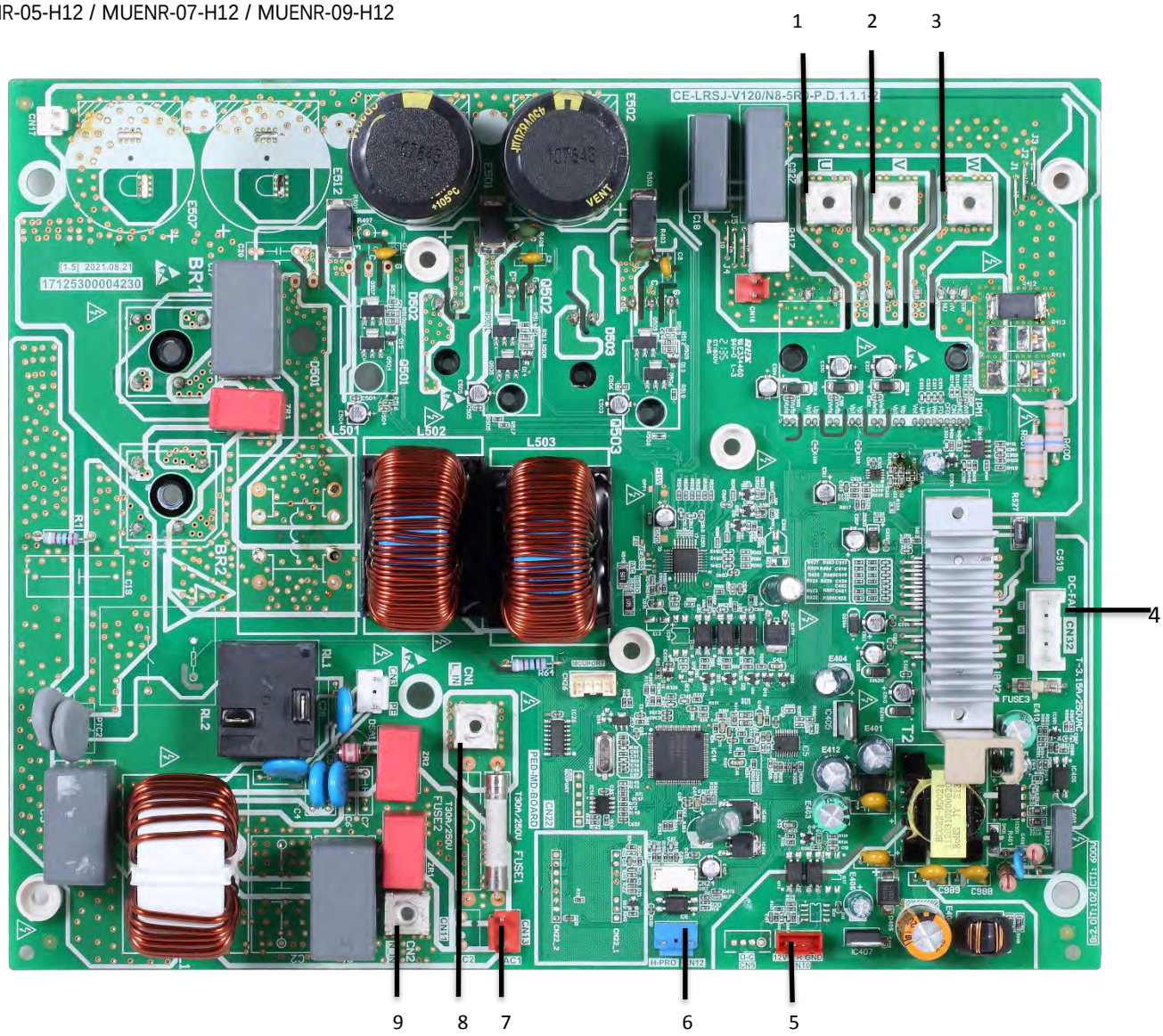
MUENR-12-H12T/MUENR-14-H12T/MUENR-16-H12



Label	Port	Content	Voltage(V)
1	CN1	Power input port from main control board	220VAC
2	CN43	Port for communication with Inverter module	12VDC/5VDC
3	CN18	Port for high pressure switch	3.3VDC
4	CN17	Port for low pressure switch	3.3VDC
5	CN3	Port for high pressure sensor	5VDC
6	CN5	Port for TH temperature sensor	3.3VDC
7	CN4	Port for TP temperature sensor	3.3VDC
8	CN6	Port for T3,T4 temperature sensor	3.3VDC
9	CN33	Port for electrical expansion valve1	12VDC
10	CN22	Port for communication with ammeter	5VDC
11	CN20	Port for communication with outdoor unit (Reserved)	5VDC
12	CN11	Port for communication with hydro-box control board PQE	5VDC
13	CN45	Port for communication with hydro-box control board PQE	5VDC
14	CN19	Port for communication with indoor monitor XYE	5VDC
15	CN42	Reserved	220VAC
16	CN41	Reserved	220VAC
17	CN40	OUT1	220VAC
18	CN38	Port for crankcase heating tape	220VAC
19	CN37	SV2(Reserved)	220VAC
20	CN36	Port for 4-way valve	220VAC
21	CN35	Port for the heating tape of drainage outlet	220VAC
22	CN39	Power output port to hydraulic module board	220VAC
23	DSP1	Digital display	3.3VDC
24	S6	Dip switch	3.3VDC
25	S1	Dip switch	3.3VDC
26	SW1	Port for Forced cooling	3.3VDC
27	SW2	Port for point check	3.3VDC
28	S7	Dip switch(Reserved)	3.3VDC

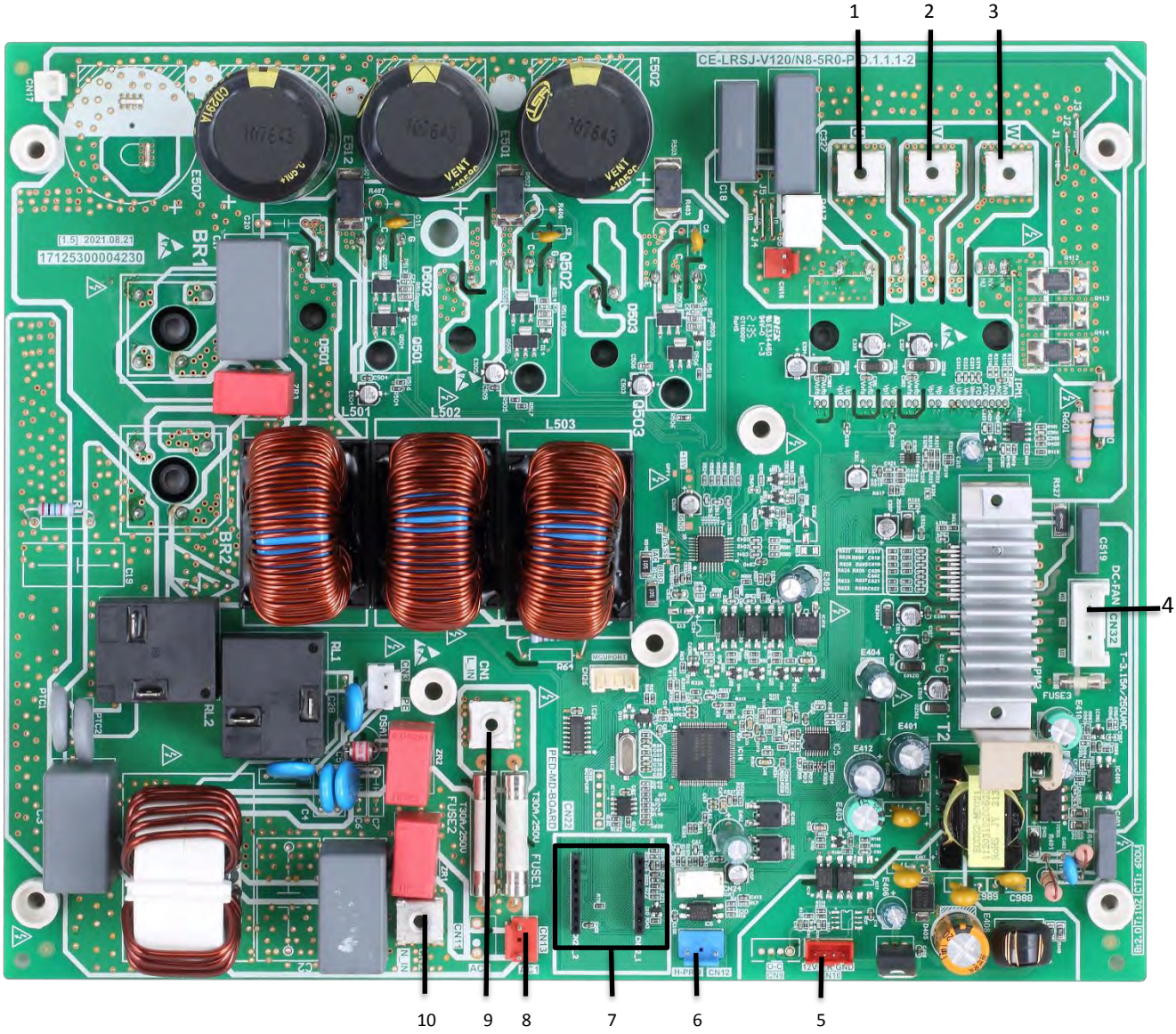
3.3 Inverter Module

MUENR-05-H12 / MUENR-07-H12 / MUENR-09-H12



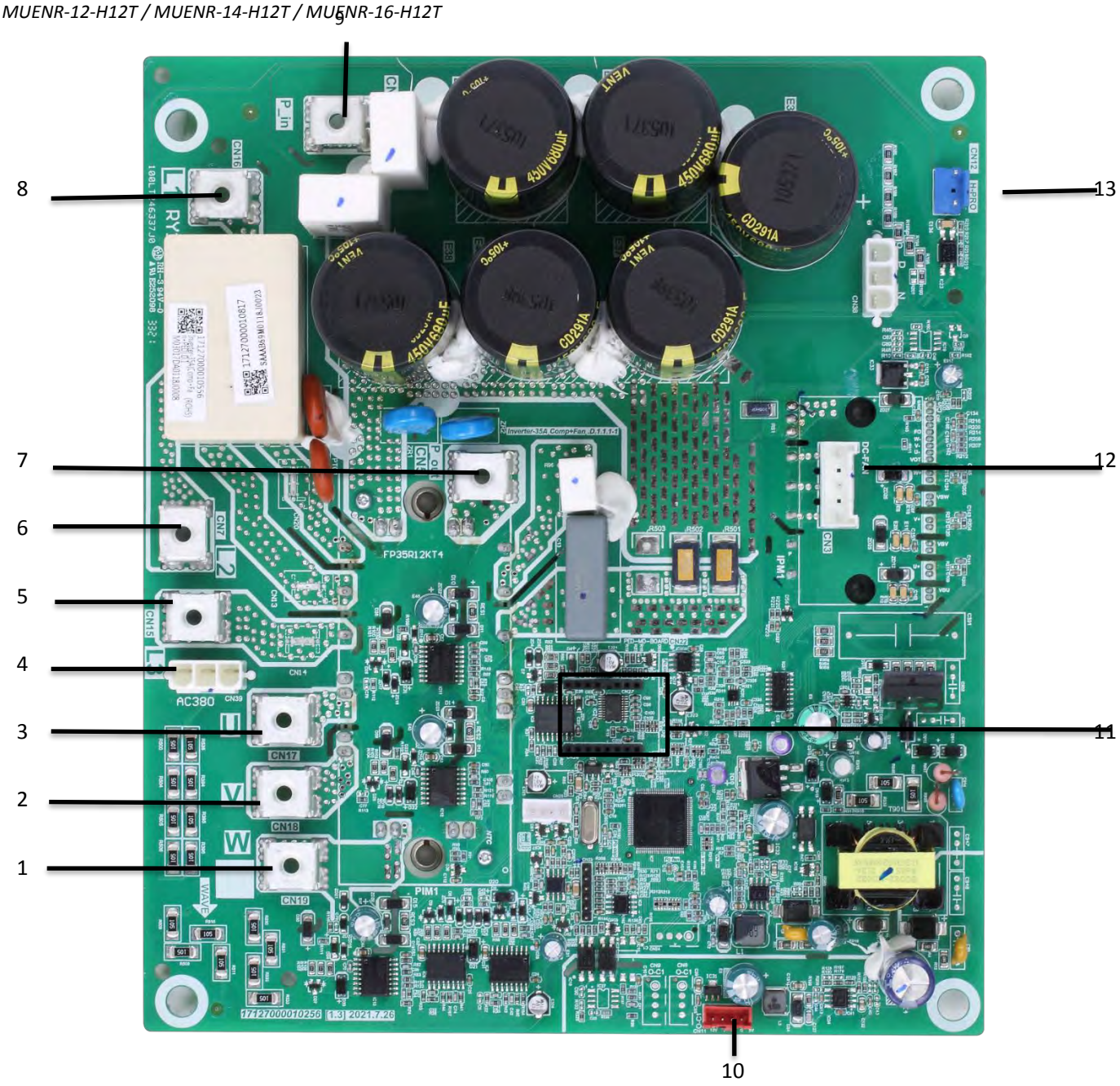
Label	Port	Content	Voltage(V)
1	U	Compressor connection port U	380VAC
2	V	Compressor connection port V	380VAC
3	W	Compressor connection port W	380VAC
4	CN32	Port for fan	380VAC
5	CN10	Port for communication with main control board	12VDC
6	CN12	Reserved	12VDC
7	CN13	Port for power supply	220VAC
8	CN1	Input port L for rectifier bridge	220VAC
9	CN2	Input port N for rectifier bridge	220VAC

MUENR-12-H12 / MUENR-14-H12 / MUENR-16-H12



Label	Port	Content	Voltage(V)
1	U	Compressor connection port U	380VAC
2	V	Compressor connection port V	380VAC
3	W	Compressor connection port W	380VAC
4	CN32	Port for fan	380VAC
5	CN10	Port for communication with main control board	12VDC
6	CN12	Port for high pressure switch	12VDC
7	CN22	PED board	5VDC
8	CN13	Port for power supply	220VAC
9	CN501	Input port L for rectifier bridge	220VAC
10	CN502	Input port N for rectifier bridge	220VAC

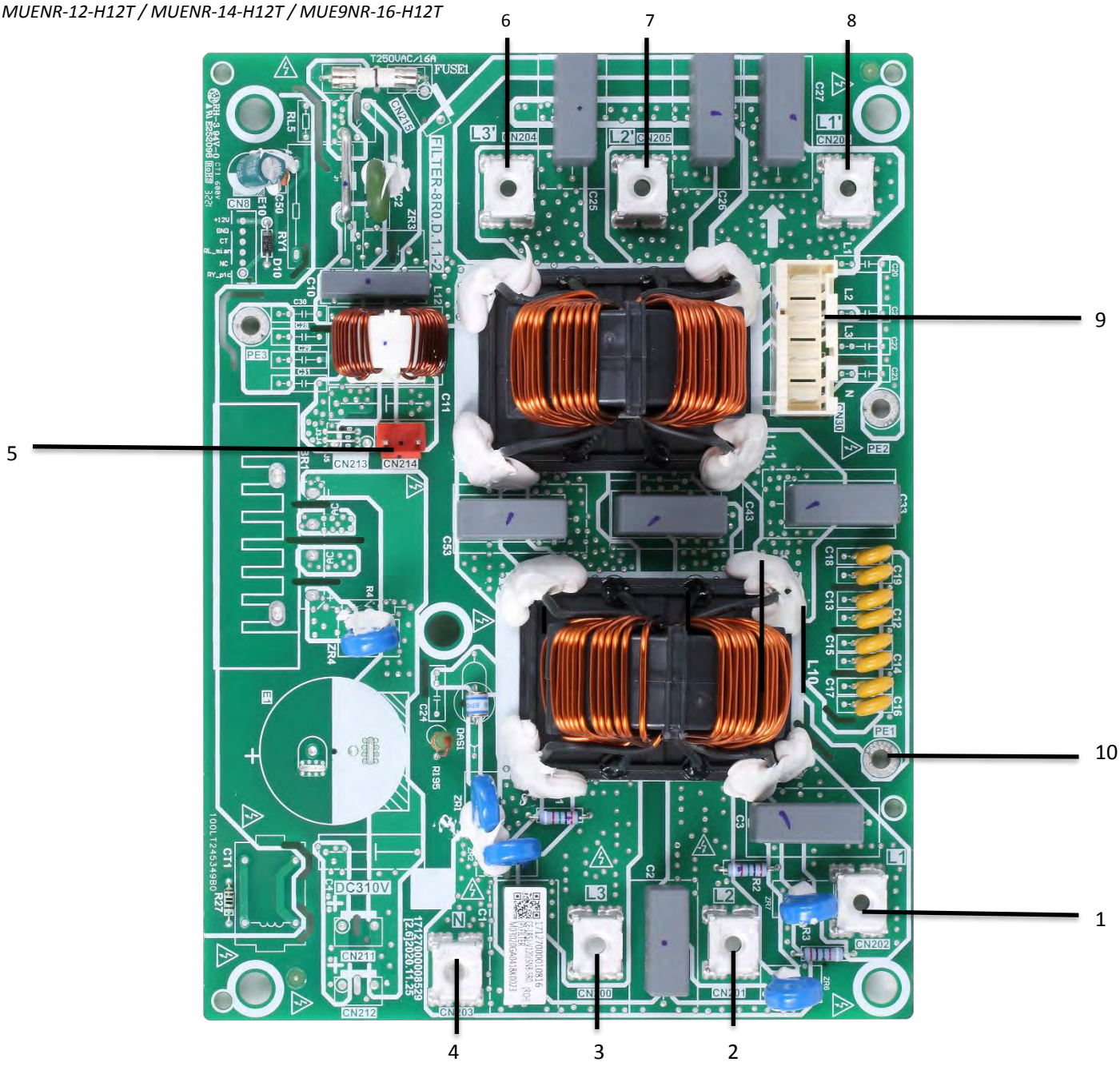
MUENR-12-H12T / MUENR-14-H12T / MUENR-16-H12T



Label	Port	Content	Voltage(V)
1	W	Compressor connection port W	380VAC
2	V	Compressor connection port V	380VAC
3	U	Compressor connection port U	380VAC
4	CN39	Port for voltage detection	380VAC
5	CN15	Power Input port L3	380VAC
6	CN7	Power Input port L2	380VAC
7	CN5	Input port P_out for IPM module	540VDC
8	CN16	Power Input port L1	380VAC
9	CN1	Input port P_in for IPM module	540VDC
10	CN43	Port for communication with main control board	12VDC
11	CN22	PED board	5VDC
12	CN3	Port for communication with DC FAN	380VAC
13	CN12	Port for high pressure switch	10VDC

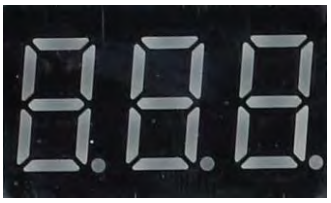
3.4 Filter board

MUENR-12-H12T / MUENR-14-H12T / MUE9NR-16-H12T



Label	Port	Content	Voltage(V)
1	CN202	Power supply L1	380VAC
2	CN201	Power supply L2	380VAC
3	CN200	Power supply L3	380VAC
4	CN203	Power supply N	/
5	CN214	Power supply port for main control board	220VAC
6	CN204	Power filtering output L3’	380VAC
7	CN205	Power filtering output L2’	380VAC
8	CN206	Power filtering output L1’	380VAC
9	CN30	Power for voltage detection	380VAC
10	PE1	Port for ground wire	/

3.5 Digital Display Output

Outdoor unit state	Parameters displayed on refrigerant system DSP1	
On standby	0	
Normal operation	Running speed of the compressor in rotations per second	
Error or protection	Error or protection code	

4 Error Code Table

Error code	Serial number	Content[1]
bA	106	T4 sensor out of operation range
C7	65	High temperature protection of inverter module
E0	1	Water flow malfunction(after 3 times E8)
E1	2	Phase loss or neutral wire and live wire are connected reversely
E2	3	Communication malfunction between controller and hydraulic module
E3	4	Total outlet water temperature sensor(T1) malfunction
E5	6	Air side heat exchanger temperature sensor (T3) malfunction
E6	7	Outdoor ambient temperature sensor malfunction
E7	8	Buffer tank upper temperature sensor(Tbt) malfunction
E8	9	Water flow malfunction
E9	10	Suction temperature sensor(Th) malfunction
EA	11	Discharge temperature sensor(Tp) malfunction
Eb	12	Solar temperature sensor(Tsolar) malfunction
Ed	14	Inlet water temperature sensor (Tw_in) malfunction
EE	15	Hydraulic module EEprom malfunction
F1	116	DC bus low voltage protection
F6	121	EXV1 fault
H0	39	Communication malfunction between main control board and hydraulic module board
H1	40	Communication malfunction between main control board and inverter board
H2	41	Liquid refrigerant temperature sensor(T2) malfunction
H3	42	Gas refrigerant temperature sensor(T2B) malfunction
H4	43	Three times L0 protection
H5	44	Room temperature sensor(Ta) malfunction
H6	45	DC fan malfunction
H7	46	Voltage protection
H8	47	Pressure sensor malfunction
H9	48	Outlet water for zone 2 temperature sensor (Tw2) malfunction
HA	49	Outlet water temperature sensor (Tw_out) malfunction
Hb	50	Three times PP protection and Tw_out below 7 ℃
Hd	52	Communication malfunction between master unit and slave unit
HF	54	Inverter module board EE prom malfunction
HH	55	10 times H6 in 2 hours
HP	57	Low pressure protection in cooling mode
P0	20	Low pressure switch protection
P1	21	High pressure switch protection

P3	23	Compressor overcurrent protection
P4	24	Compressor discharge temperature too high protection
P5	25	|Tw_out-Tw_in| value too big protection
Pb	31	Anti-freeze mode
Pd	33	High temperature protection of air side heat exchanger temperature(T3).
PP	38	| Tw_out-Tw_in | abnormal protection
L0	134	Inverter or compressor protection
L1	135	DC bus low voltage protection
L2	136	DC bus high voltage protection
L3	137	Current sampling error of PFC circuit
L4	138	Rotating stall protection
L5	139	Zero speed protection
L7	141	Phase loss protection of compressor

5 Troubleshooting

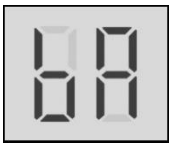
5.1 Warning

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 bA Troubleshooting

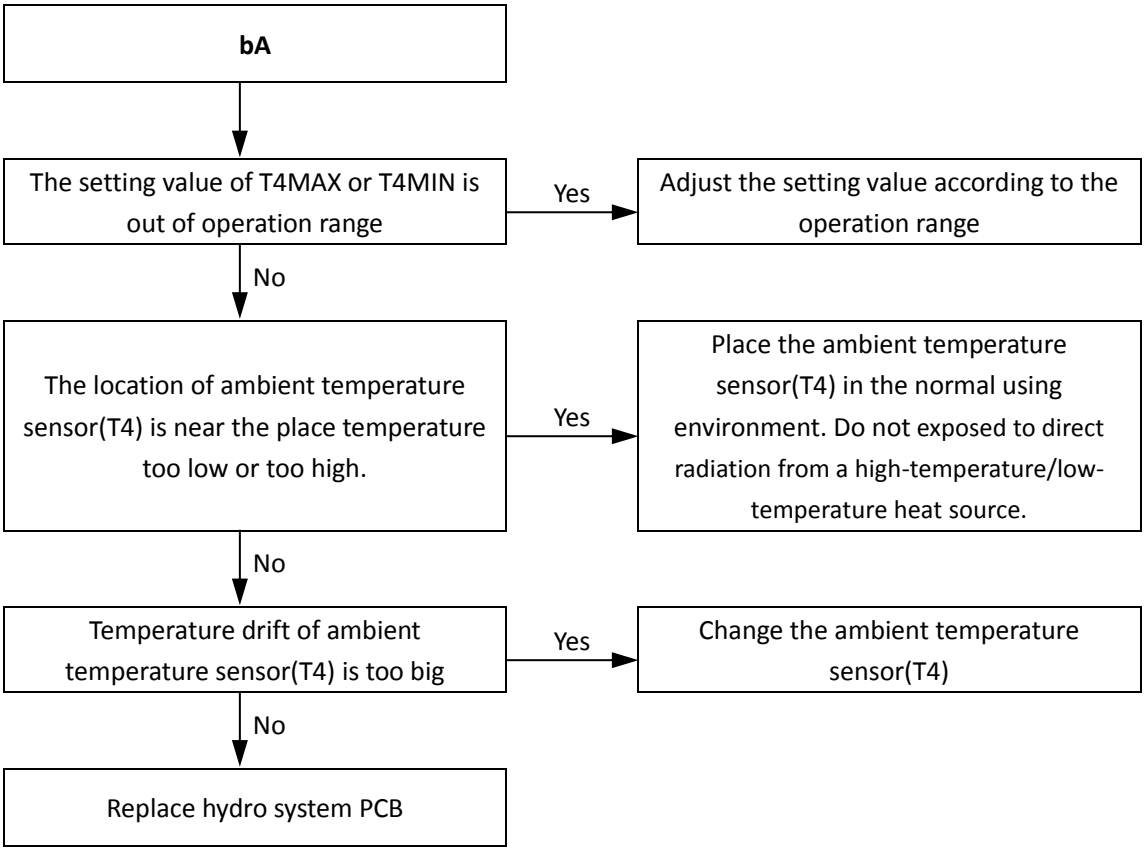
5.2.1 Digital display output



5.2.2 Description

- Outdoor temperature exceeds the operation temperature range
- Heat pump stops running.
- Error code is displayed on the refrigerant system PCB digital tube and user interface.

5.2.3 Procedure



Notes:

1. Ambient temperature sensor(T4) connection is port CN6 on the refrigerant system PCB

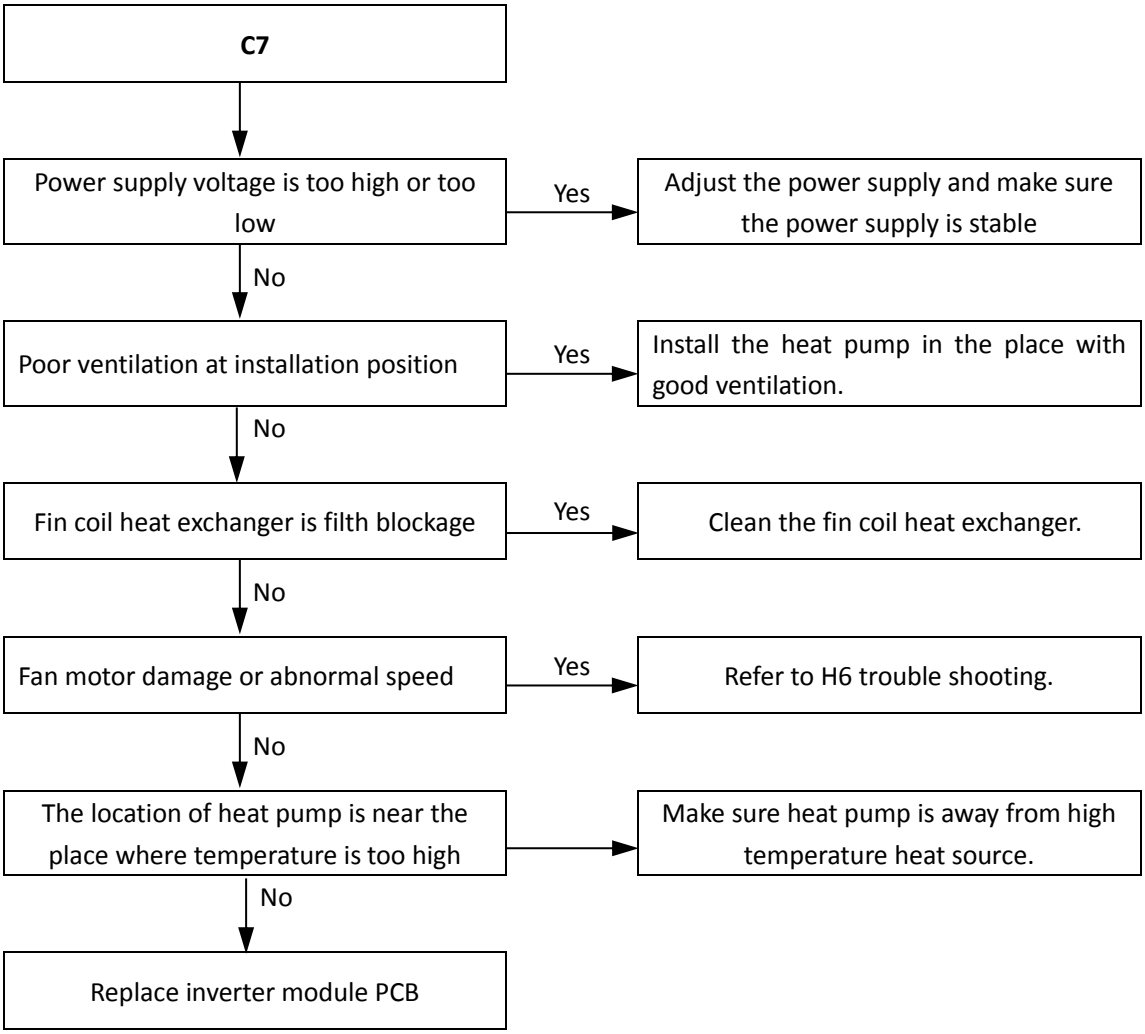
5.3 C7 Troubleshooting

5.3.1 Digital display output

5.3.2 Description

- High temperature protection of inverter module
- Heat pump stops running.
- Error code is displayed on the refrigerant system PCB digital tube and user interface.

5.3.3 Procedure



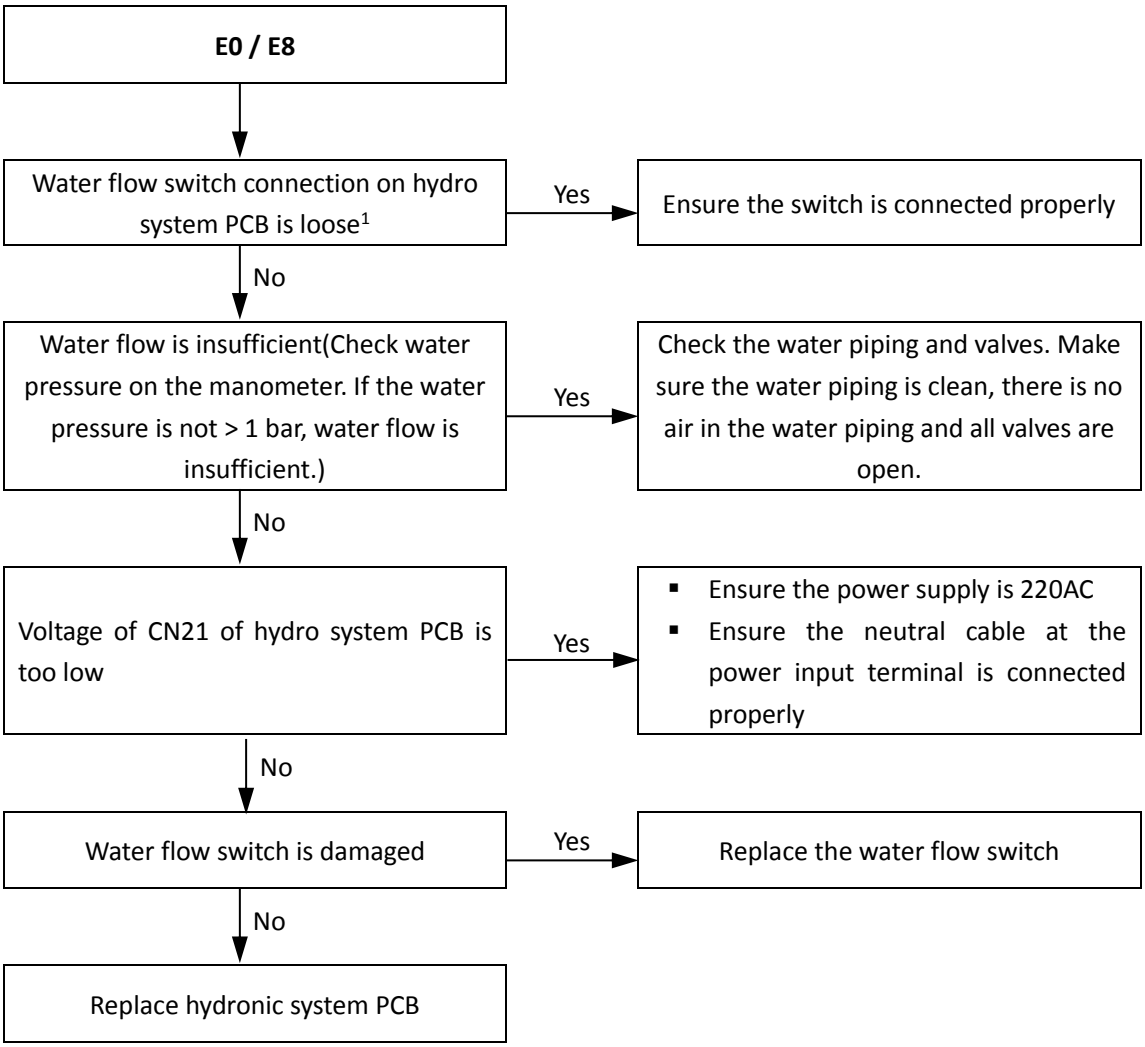
5.4 E0, E8 Troubleshooting

5.4.1 Digital display output


5.4.2 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.
- Heat pump stops running.
- Error code is displayed on the refrigerant system PCB digital tube and user interface.

5.4.3 Procedure



Notes:

1. Water flow switch connection is port CN8 on the hydro system PCB.

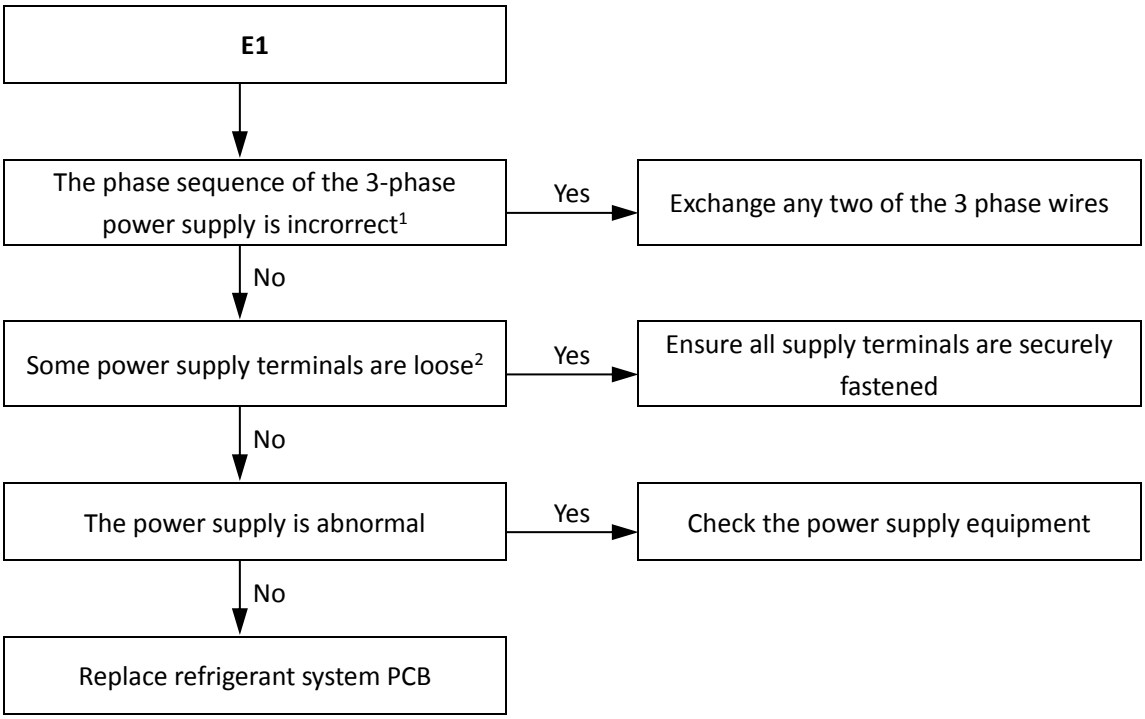
5.5 E1 Troubleshooting

5.5.1 Digital display output

5.5.2 Description

- Phase sequence error.(Only applies to 3-phase models)
- Heat pump stops running.
- Error code is displayed on the refrigerant system PCB digital tube and user interface..

5.5.3 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.

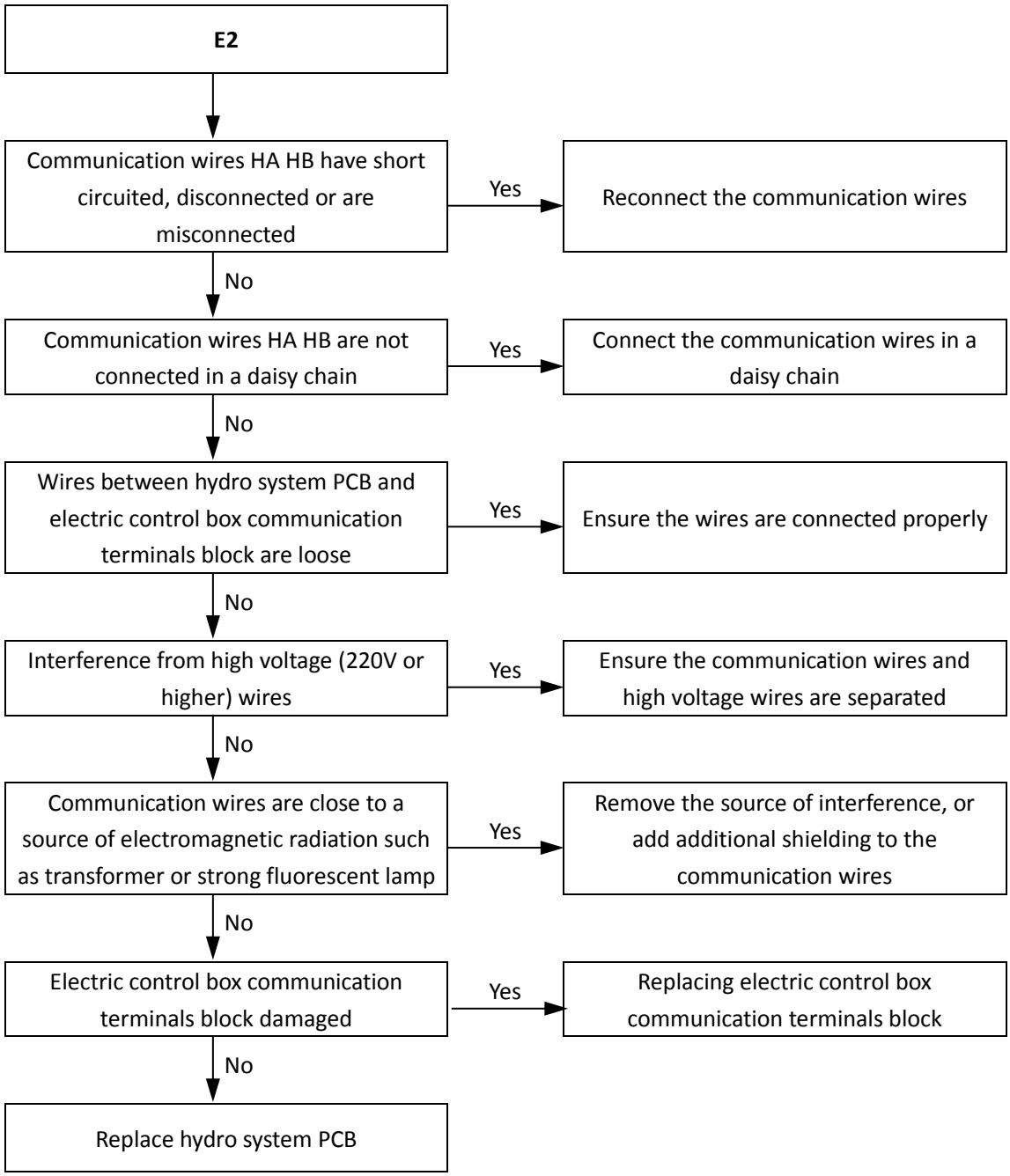
5.6 E2 Troubleshooting

5.6.1 Digital display output

5.6.2 Description

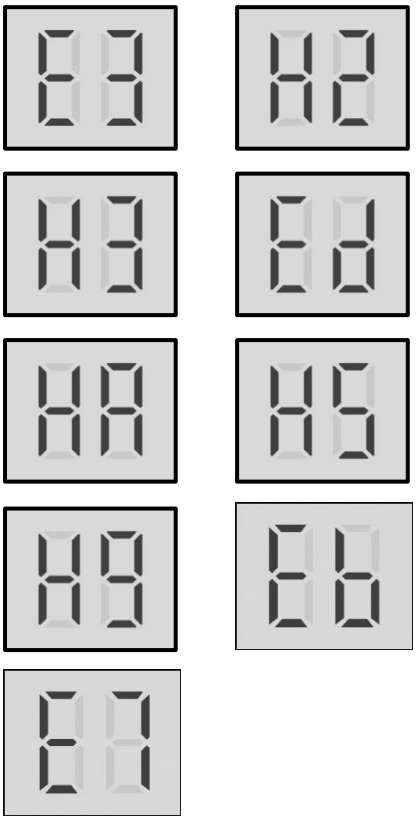
- Communication error between hydro system PCB and user interface.
- Heat pump stops running.
- Error code is displayed on the refrigerant system PCB digital tube and user interface.

5.6.3 Procedure



5.7 E3, H2, H3, Ed, HA, H5, H9 Troubleshooting

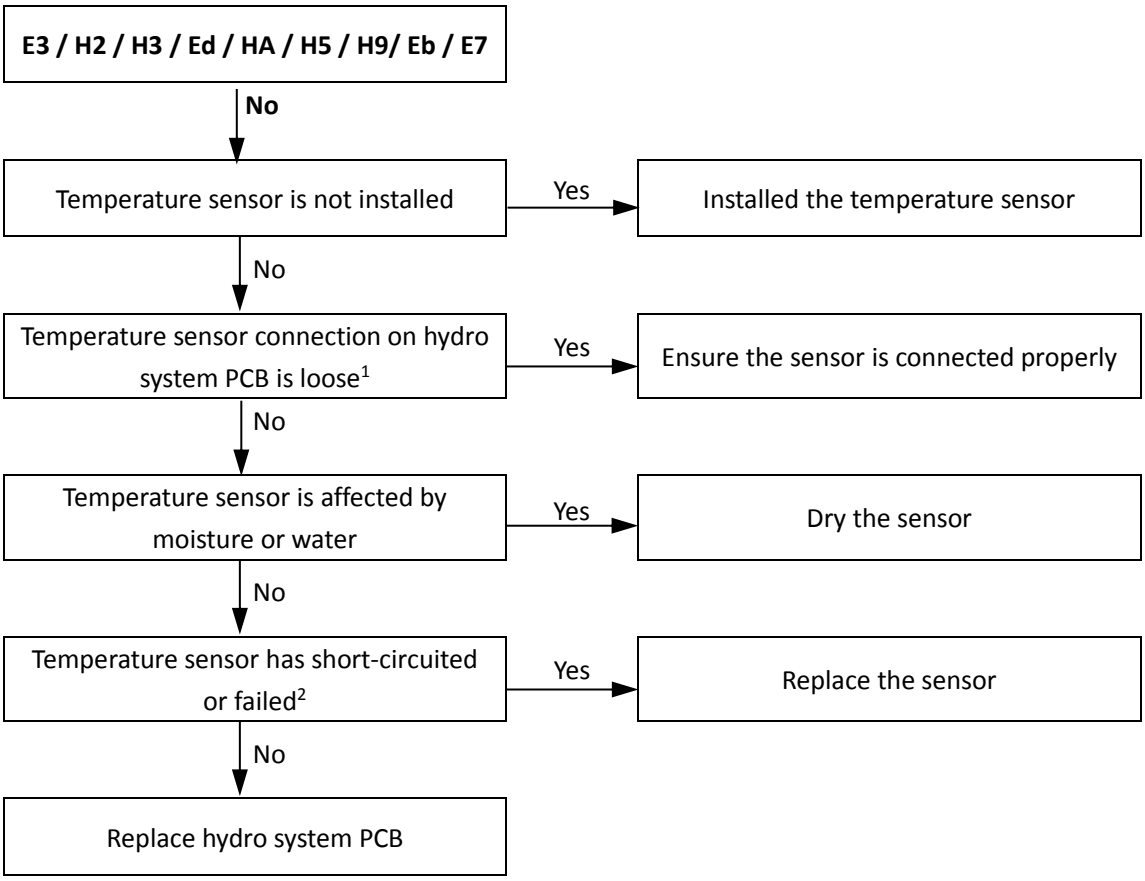
5.7.1 Digital display output



5.7.2 Description

- E3 indicates total outlet water temperature sensor(T1) malfunction
- H2 indicates liquid refrigerant temperature sensor(T2) malfunction
- H3 indicates gas refrigerant temperature sensor(T2B) malfunction
- Ed indicates inlet water temperature sensor (Tw_in) malfunction
- HA indicates outlet water temperature sensor (Tw_out) malfunction
- H5 indicates room temperature sensor(Ta) malfunction
- H9 indicates outlet water for zone 2 temperature sensor (Tw2) malfunction.
- Eb indicates solar temperature sensor(Tsolar) malfunction
- E7 indicates buffer tank upper temperature sensor(Tbt) malfunction
- Heat pump stops running.
- Error code is displayed on the refrigerant system PCB digital tube and user interface.

5.7.3 Procedure

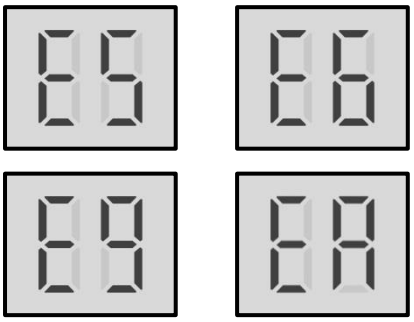


Notes:

1. Total outlet water temperature sensor(T1), liquid refrigerant temperature sensor(T2), gas refrigerant temperature sensor(T2B), inlet water temperature sensor (Tw_in), outlet water temperature sensor (Tw_out) connection is port CN6 on the hydro system PCB.
   Room temperature sensor(Ta)
   Outlet water for zone 2 temperature sensor (Tw2) connection is port CN15 on the hydro system PCB.
   Buffer tank upper temperature sensor(Tbt) connection is port CN24 on the hydro system PCB.
2. Measure sensor resistance. If the resistance is too low, the sensor has short-circuited. If the resistance is not consistent with the sensor's resistance characteristics table, the sensor has failed.

5.8 E5, E6, E9, EA Troubleshooting

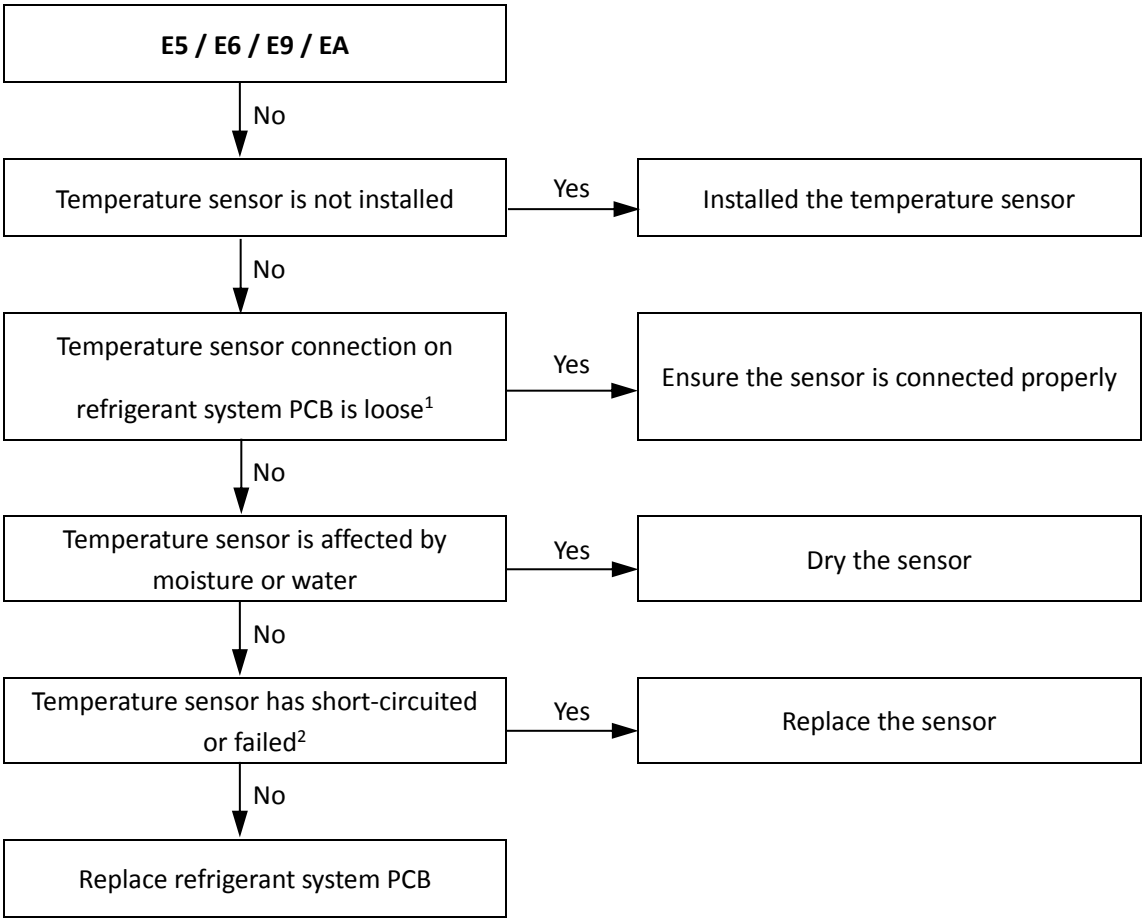
5.8.1 Digital display output



5.8.2 Description

- E5 indicates air side heat exchanger temperature sensor (T3)malfunction
- E6 indicates outdoor ambient temperature sensor error
- E9 indicates suction temperature sensor(Th) malfunction
- EA indicates discharge temperature sensor(Tp) malfunction
- Heat pump stops running.
- Error code is displayed on the refrigerant system PCB digital tube and user interface..

5.8.3 Procedure



Notes:

1. Air side heat exchanger temperature sensor (T3), outdoor ambient temperature sensor(T4) connection is port CN6 on the refrigerant system PCB.
   Suction temperature sensor (Th) connection is port CN5 on the refrigerant system PCB.
   Discharge temperature sensor (Tp) connection is port CN4 on the refrigerant system PCB.
2. Measure sensor resistance. If the resistance is too low, the sensor has short-circuited. If the resistance is not consistent with the sensor's resistance characteristics table, the sensor has failed.

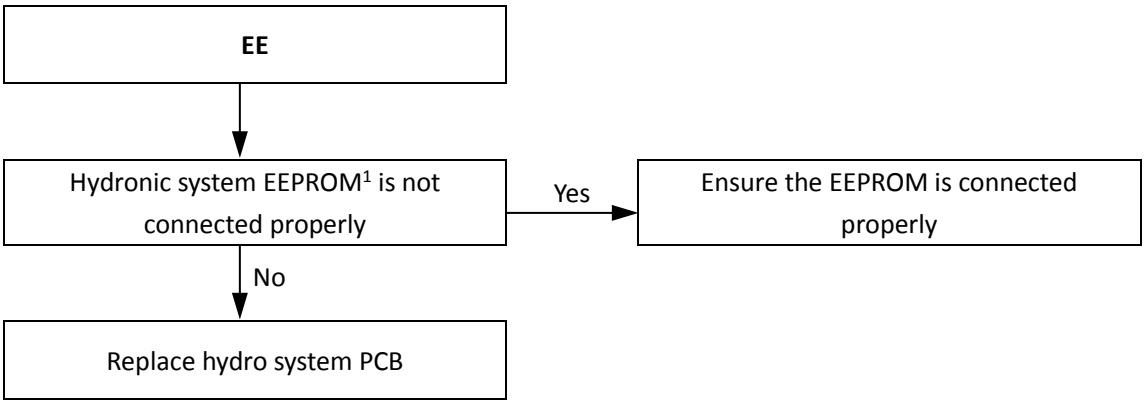
5.9 EE Troubleshooting

5.9.1 Digital display output

5.9.2 Description

- Hydronic system EEPROM error.
- Heat pump stops running.
- Error code is displayed on the refrigerant system PCB digital tube and user interface.

5.9.3 Procedure



Notes:

1. Hydro system PCB EEPROM is designated IC18 on the hydro system PCB (labeled 29 in Figure 4-2.1 in Part 4, 2.2 “Main PCB for Hydronic System”).

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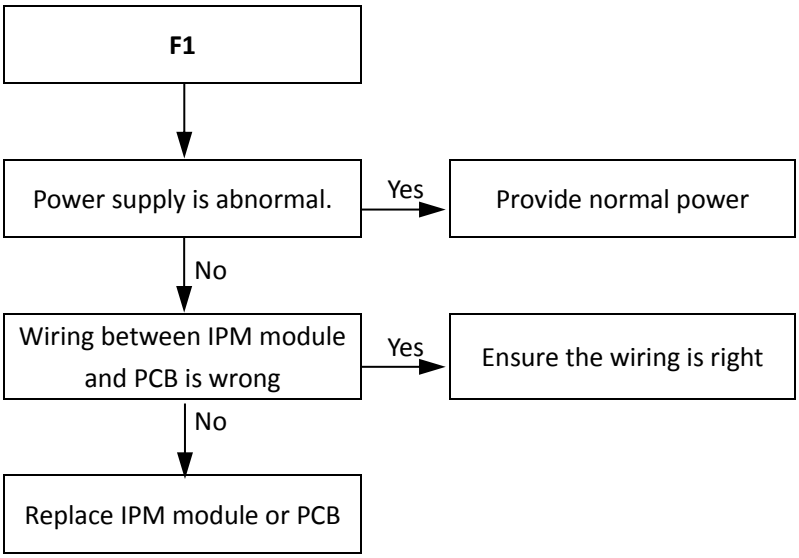
5.10 F1 Troubleshooting

5.10.1 Digital display output

5.10.2 Description

- DC bus low voltage protection
- Heat pump stops running.
- Error code is displayed on the refrigerant system PCB digital tube and user interface.

5.10.3 Procedure



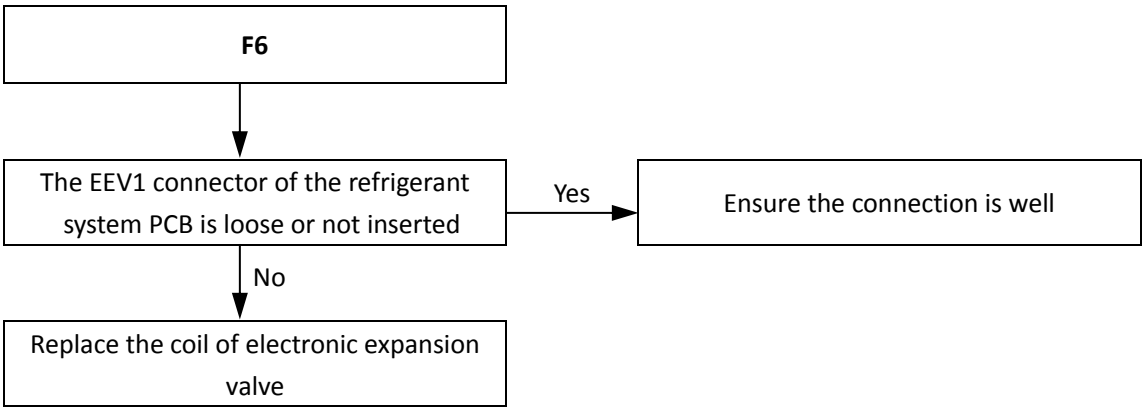
5.11 F6 Troubleshooting

5.11.1 Digital display output

5.11.2 Description

- EXV1 fault
- Heat pump stops running.
- Error code is displayed on the refrigerant system PCB digital tube and user interface.

5.11.3 Procedure



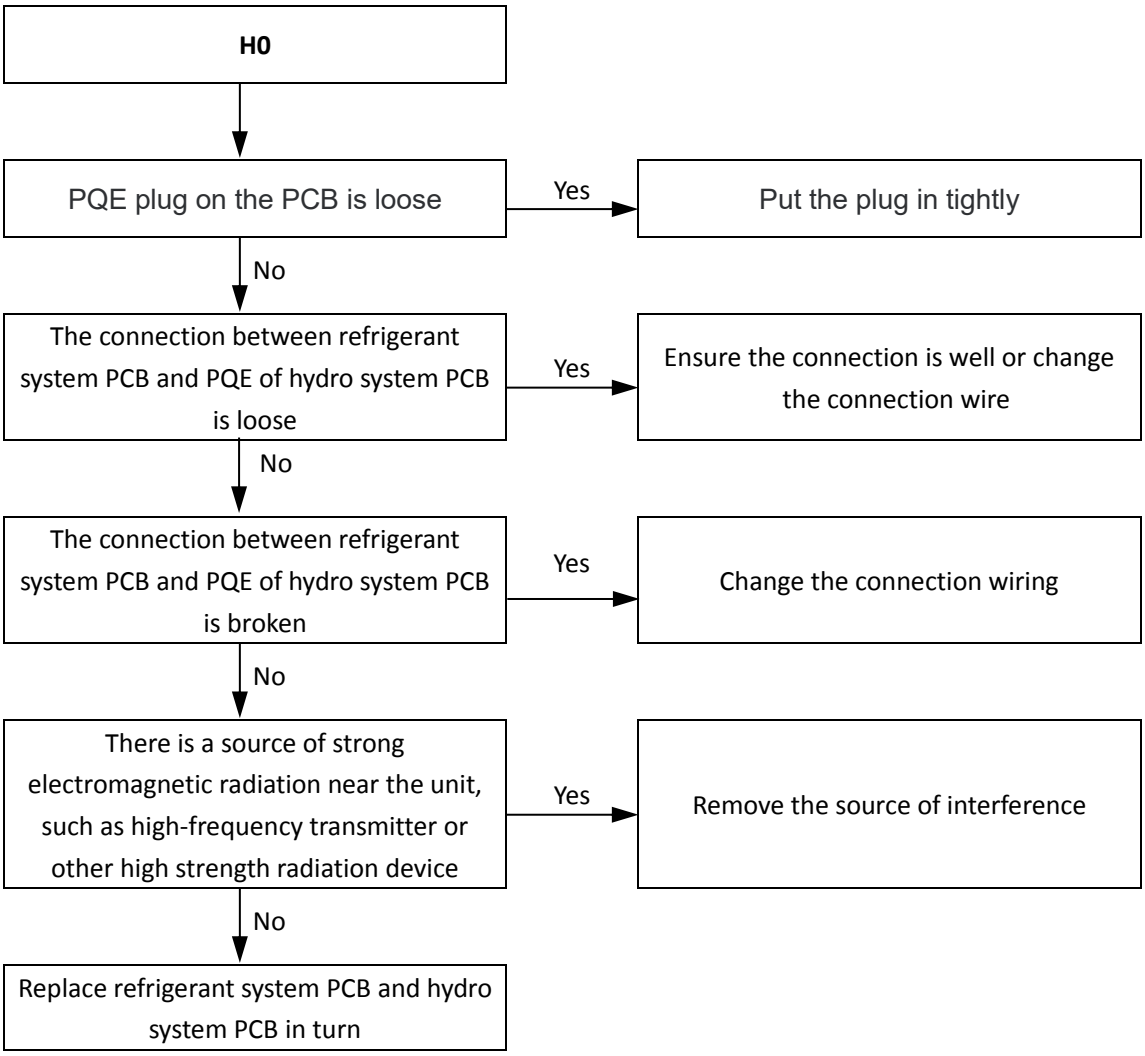
5.12 H0 Troubleshooting

5.12.1 Digital display output

5.12.2 Description

- Communication malfunction between main control board and hydraulic module board
- Heat pump stops running.
- Error code is displayed on the refrigerant system PCB digital tube and user interface.

5.12.3 Procedure



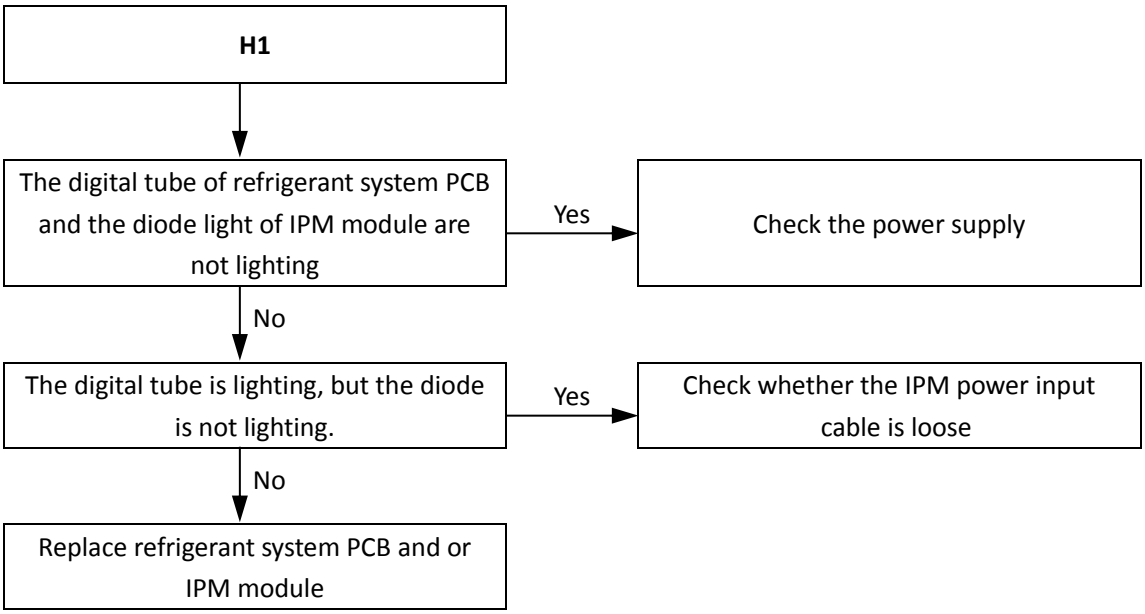
5.13 H1 Troubleshooting

5.13.1 Digital display output

5.13.2 Description

- Communication malfunction between main control board and inverter board
- Heat pump stops running.
- Error code is displayed on the refrigerant system PCB digital tube and user interface..
-

5.13.3 Procedure



5.14 H4 Troubleshooting

5.14.1 Digital display output

5.14.2 Description

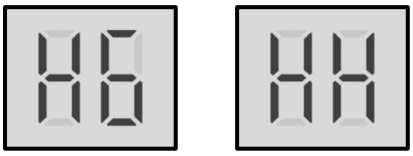
- H4 indicates three times L0 protection in one hour
- Heat pump stops running.
- Error code is displayed on the refrigerant system PCB digital tube and user interface..

5.14.3 Procedure

Refer to P6 trouble shooting.

5.15 H6, HH Troubleshooting

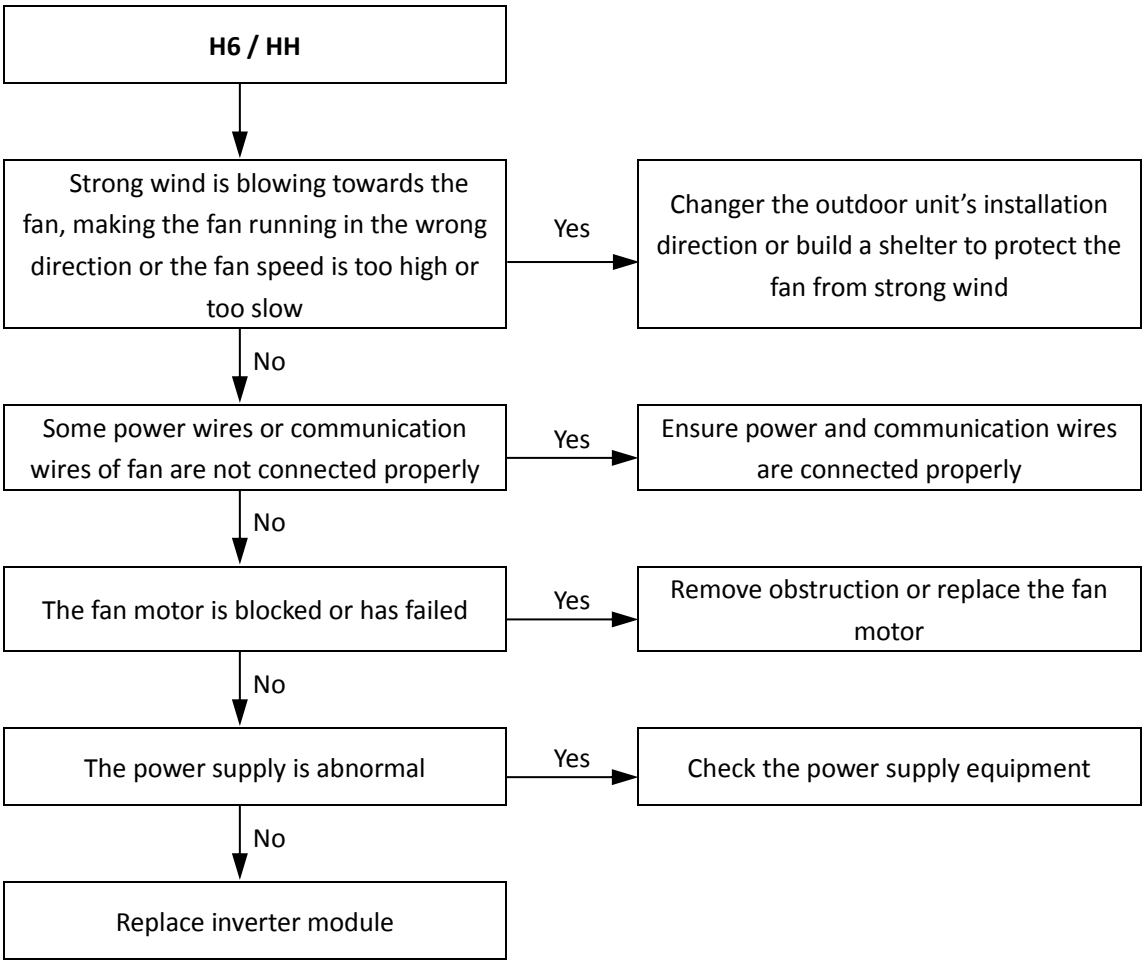
5.15.1 Digital display output



5.15.2 Description

- H6 indicates a DC fan error.
- HH indicates that H6 protection has occurred 10 times in 2 hours. When an HH error occurs, a manual system restart is required before the system can resume operation.
- Heat pump stops running.
- Error code is displayed on the refrigerant system PCB digital tube and user interface..

5.15.3 Procedure



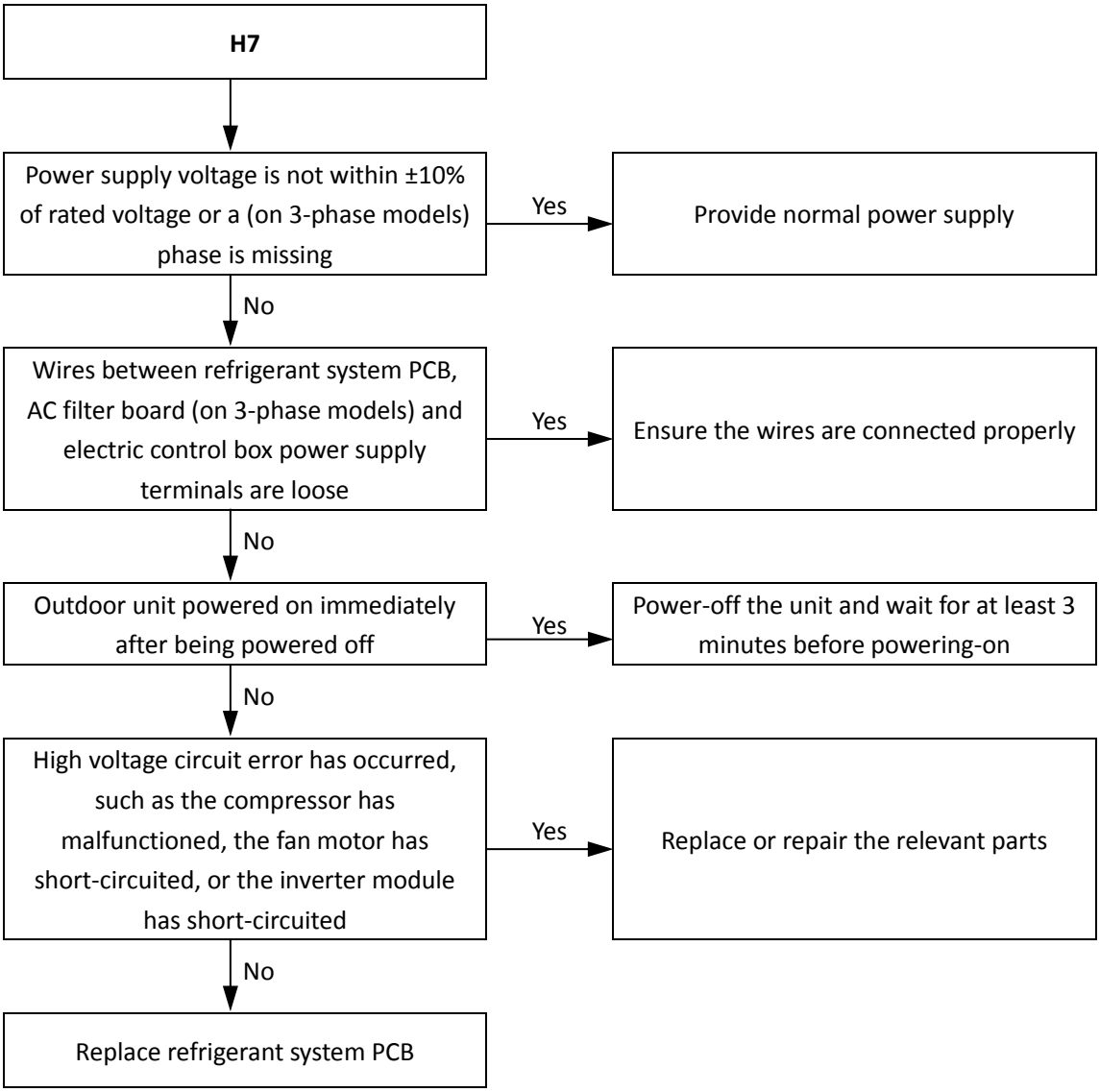
5.16 H7 Troubleshooting

5.16.1 Digital display output

5.16.2 Description

- H7 indicates Voltage protection
- Heat pump stops running.
- Error code is displayed on the refrigerant system PCB digital tube and user interface..

5.16.3 Procedure



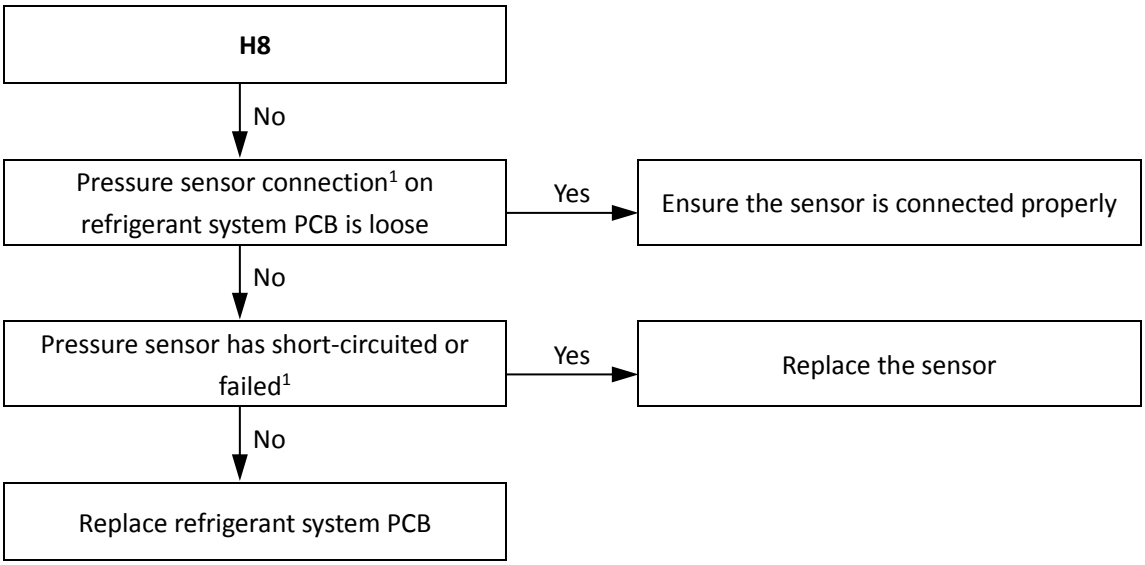
5.17 H8 Troubleshooting

5.17.1 Digital display output

5.17.2 Description

- H8 indicates pressure sensor malfunction
- Heat pump stops running.
- Error code is displayed on the refrigerant system PCB digital tube and user interface..

5.17.3 Procedure

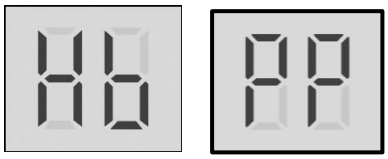


Notes:

1. Pressure sensor connection is port CN3 on the refrigerant system PCB.

5.18 Hb/PP Troubleshooting

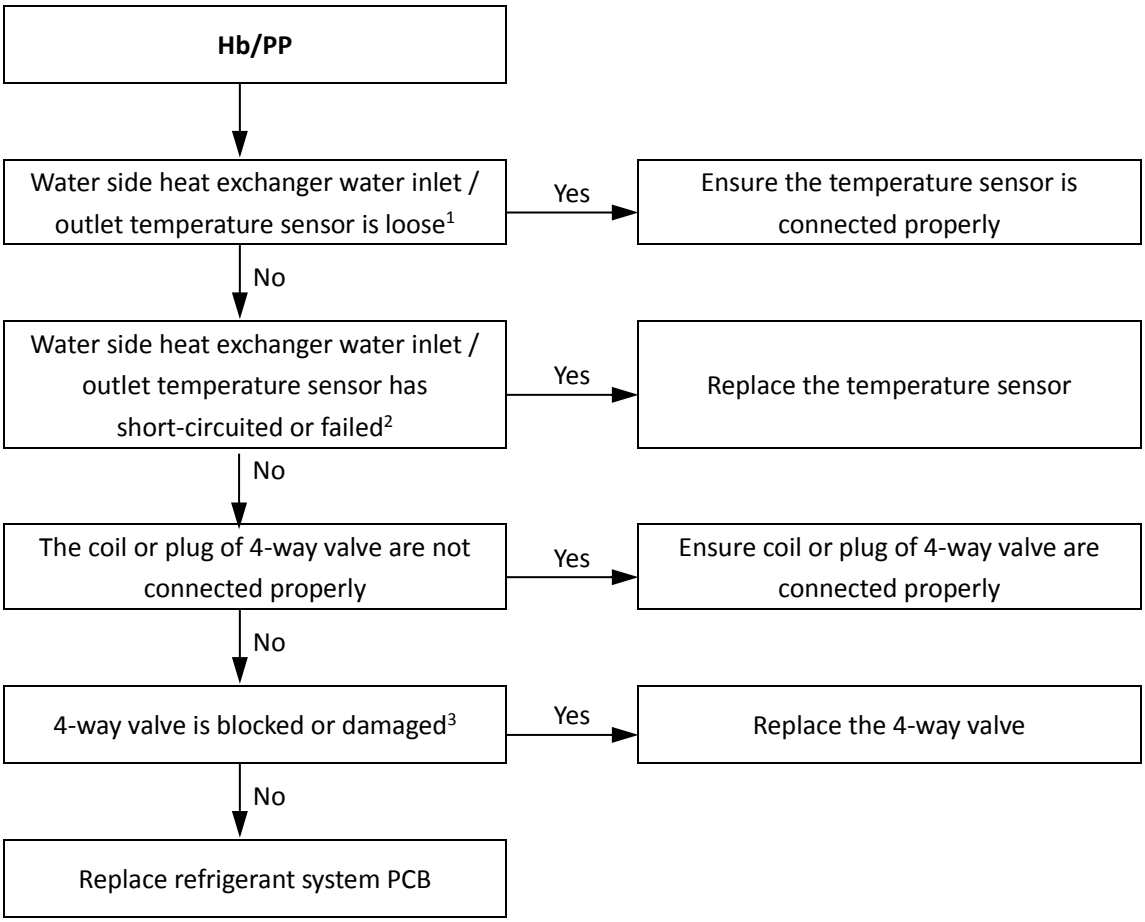
5.18.1 Digital display output



5.18.2 Description

- PP indicates | Tw_out-Tw_in | abnormal protection.
- Hb indicate three times PP protection and Tw_out below 7 ℃
- Heat pump stops running.
- Error code is displayed on the refrigerant system PCB digital tube and user interface.

5.18.3 Procedure

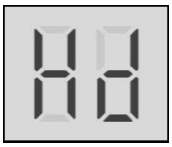


Notes:

1. Inlet water temperature sensor(TW_in), outlet water temperature sensor(TW_out) connection are port CN6 on the hydro system PCB.
2. Measure sensor resistance. If the resistance is too low, the sensor has short-circuited. If the resistance is not consistent with the sensor's resistance characteristics table, the sensor has failed.
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.

5.19 Hd Troubleshooting

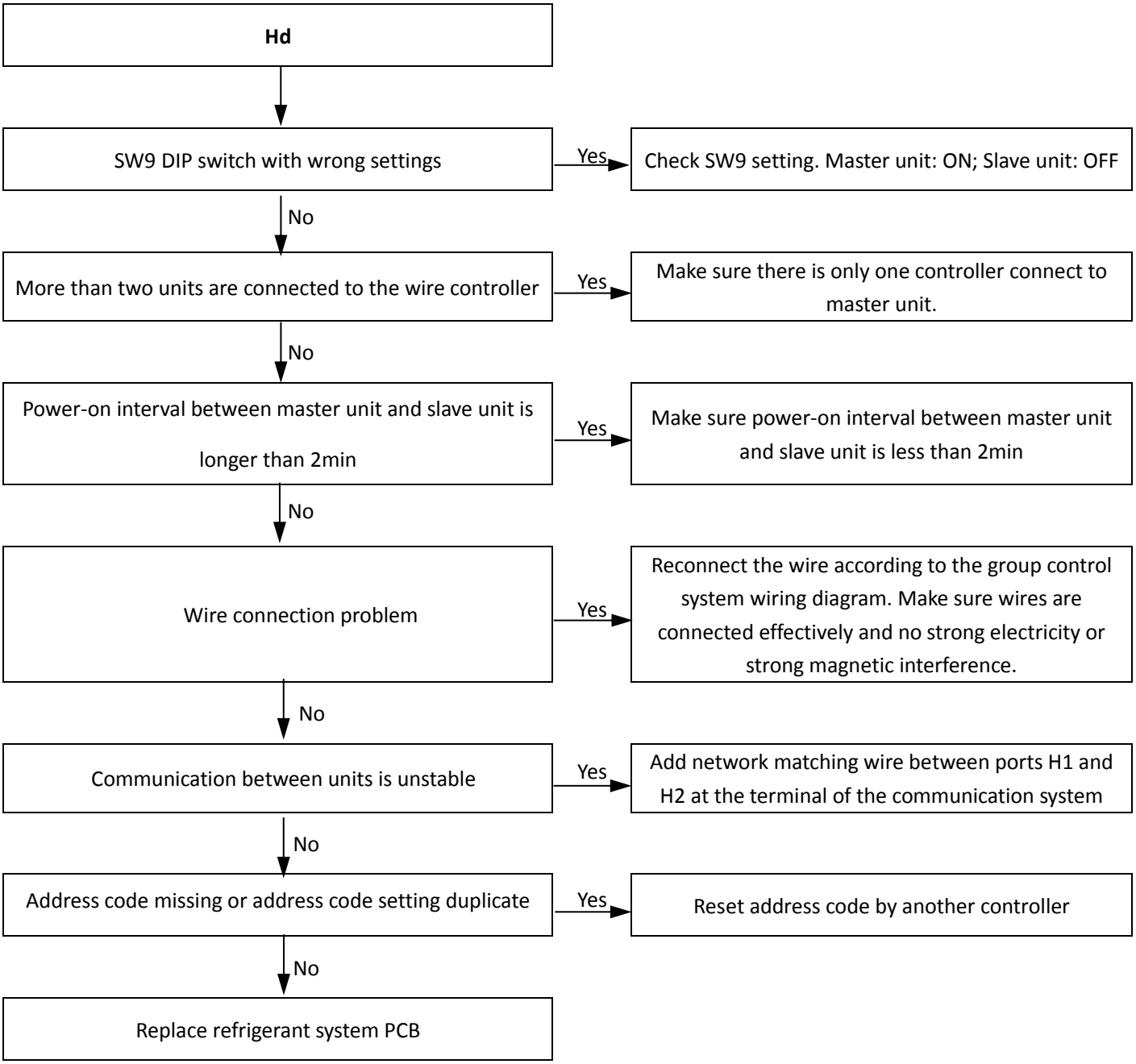
5.19.1 Digital display output



5.19.2 Description

- Hd indicates communication malfunction between master unit and slave unit(Only apply for cascade application)
- Heat pump stops running.
- Error code is displayed on the refrigerant system PCB digital tube and user interface..

5.19.3 Procedure



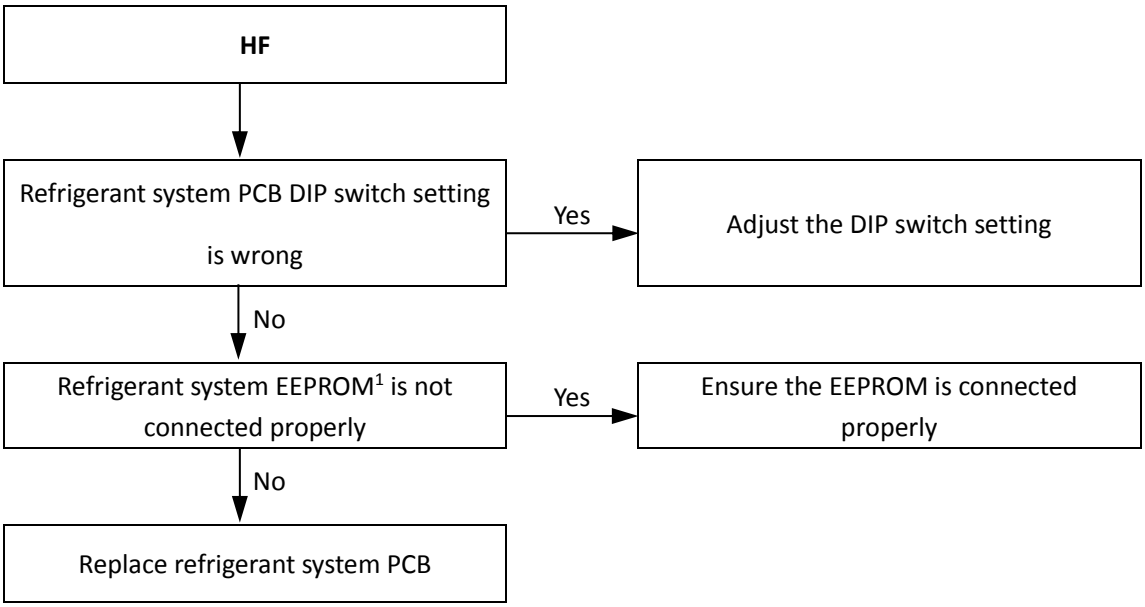
5.20 HF Troubleshooting

5.20.1 Digital display output

5.20.2 Description

- Inverter module board EE prom malfunction
- Heat pump stops running.
- Error code is displayed on the refrigerant system PCB digital tube and user interface.

5.20.3 Procedure



Notes:

1. Refrigerant system PCB EEPROM is designated IC23 on the refrigerant system PCBs (labeled 29 in Figure 4-2.2 in Part 4, 2.3 “Main PCBs for Refrigerant System, Inverter Modules and Filter Boards”), designed IC13 on the refrigerant system PCBs (labeled 19 in Figure 4-2.4 in Part 4, 2.2 “Main PCBs for Refrigerant System, Inverter Modules and Filter Boards”), designed IC23 on the refrigerant system PCBs (labeled 26 in Figure 4-2.6 in Part 4, 2.2 “Main PCBs for Refrigerant System, Inverter Modules and Filter Boards”).

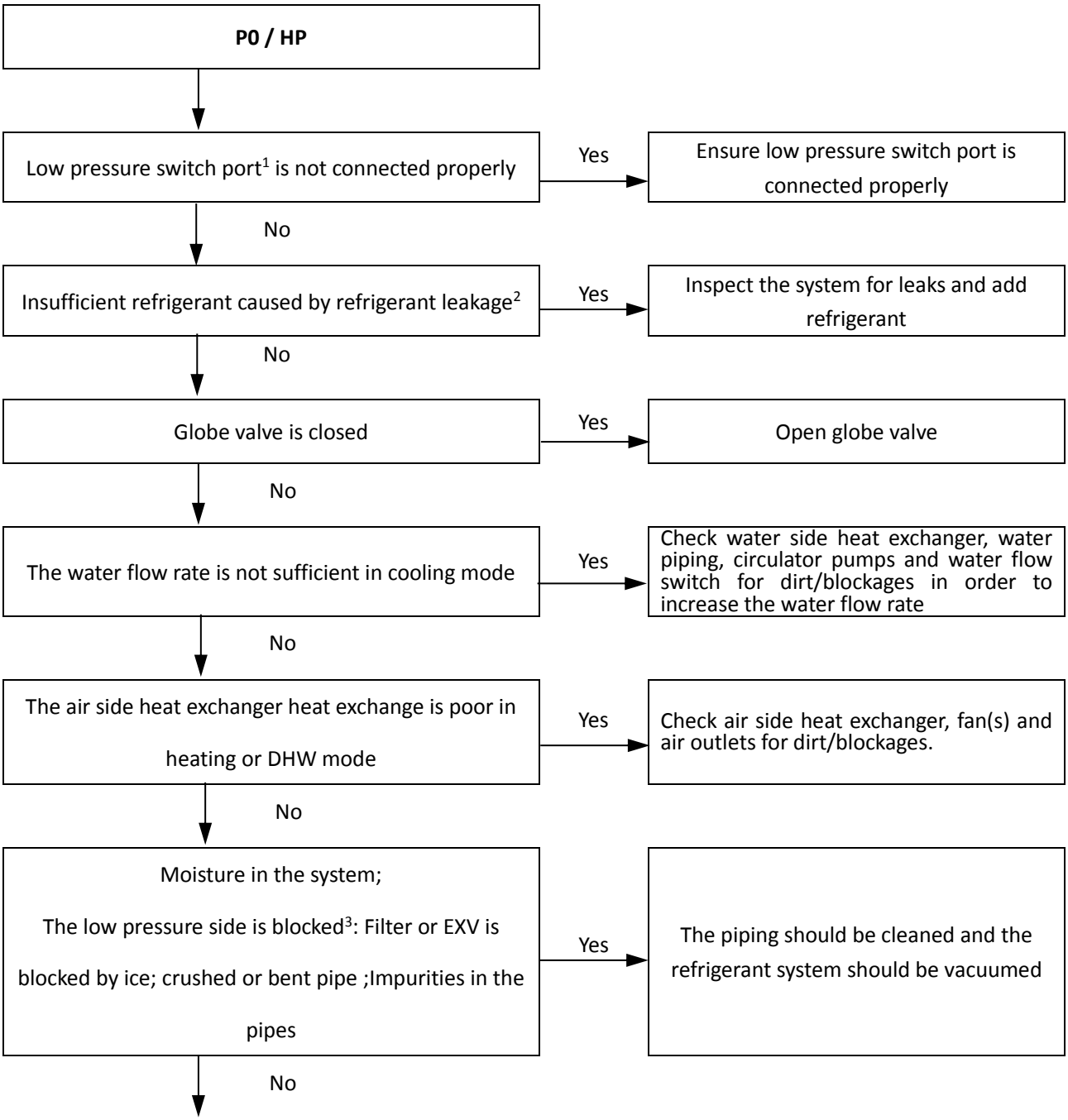
5.21 P0, HP Troubleshooting

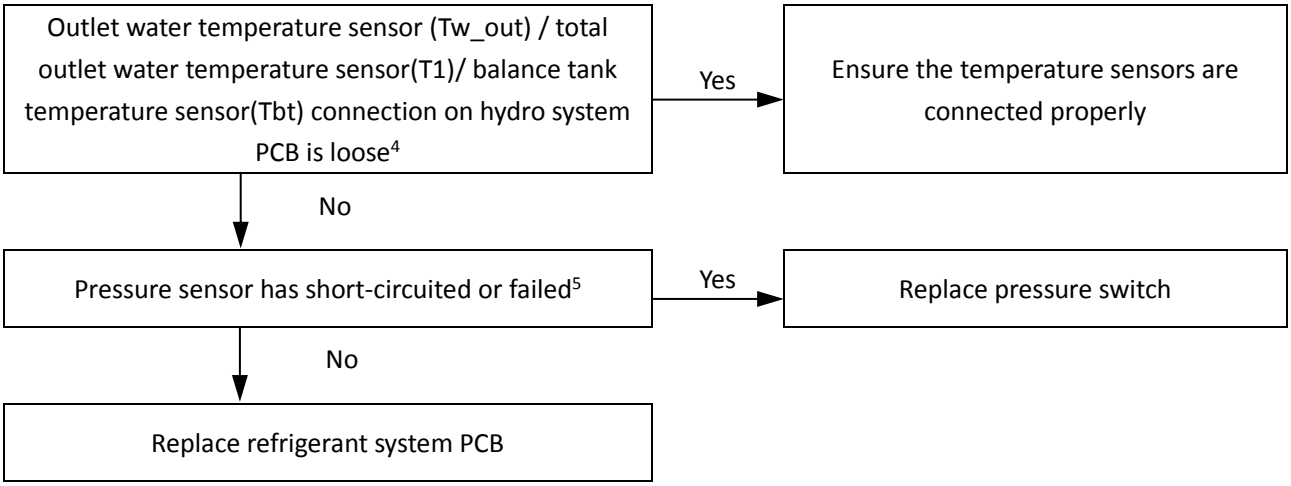
5.21.1 Digital display output

5.21.2 Description

- P0 indicates Low pressure switch protection.
- HP indicates Low pressure protection in cooling mode. When an HP error occurs, a manual system restart is required before the system can resume operation.
- Error code is displayed on the refrigerant system PCB digital tube and user interface..

5.21.3 Procedure





Notes:

1. Low pressure switch connection is port CN17 on the refrigerant system PCB.
2. 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.
3. 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.
4. Outlet water temperature sensor (Tw_out), total outlet water temperature sensor(T1), balance tank temperature sensor(Tbt) connection is port CN6 on the hydro system PCB.
5. 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.

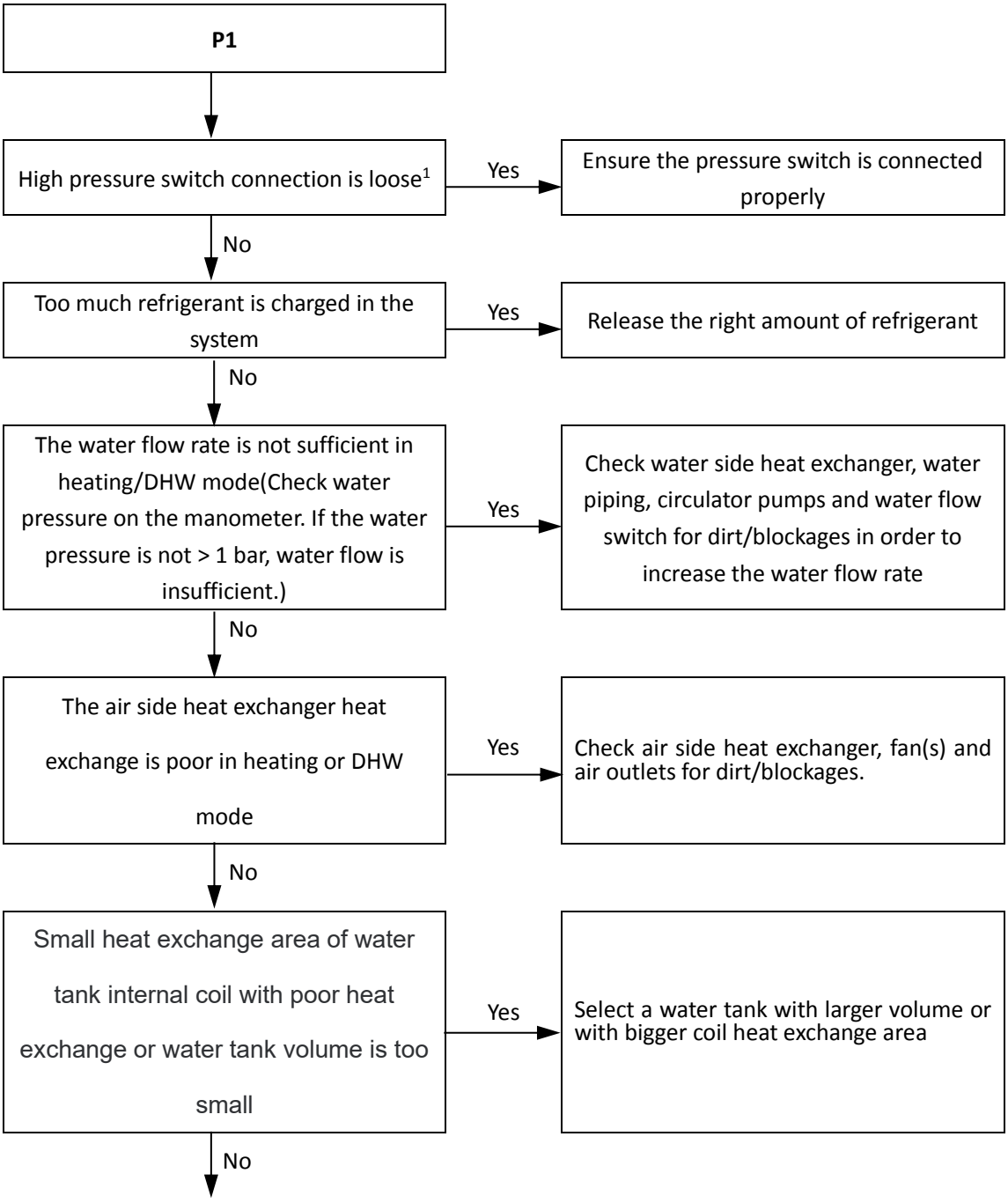
5.22 P1 Troubleshooting

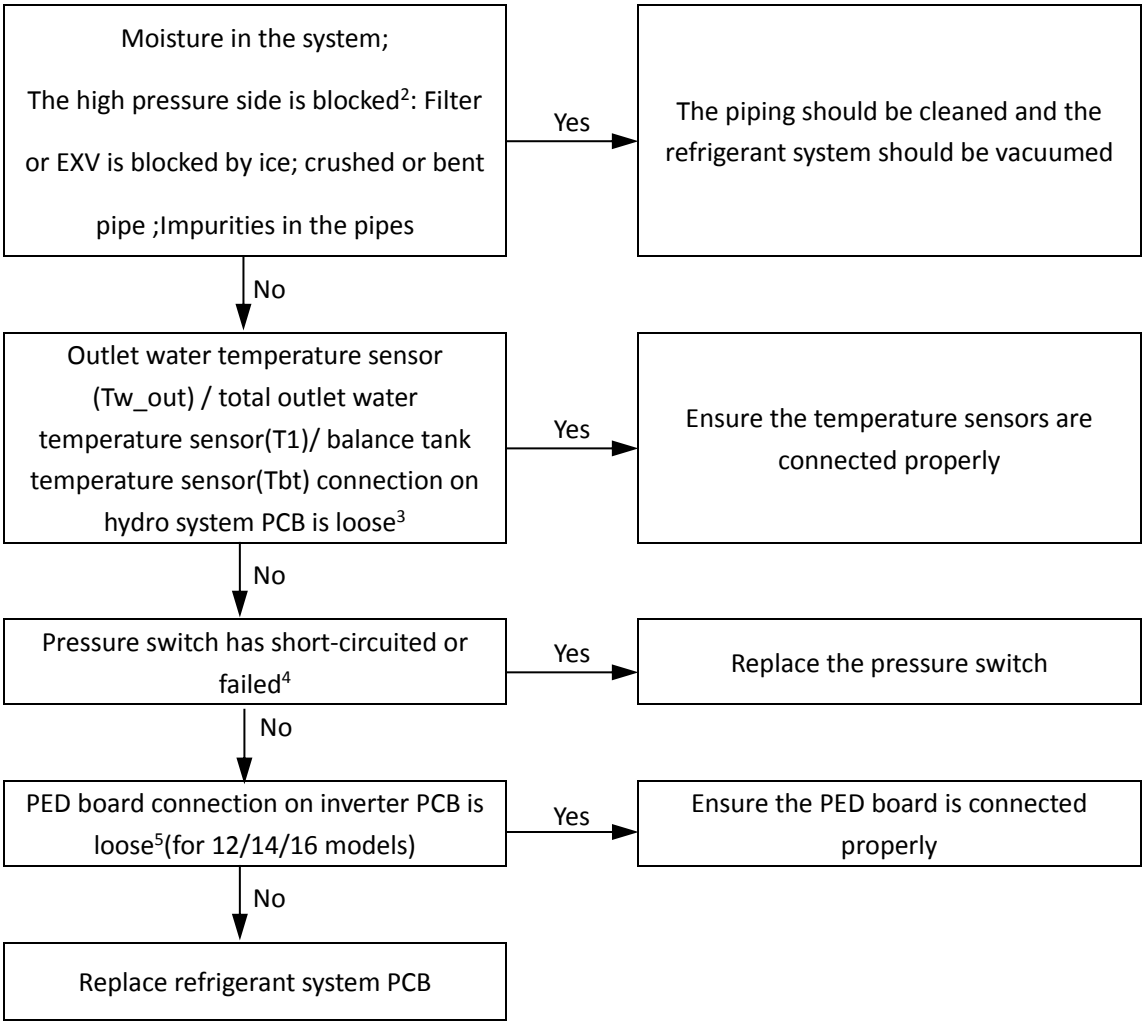
5.22.1 Digital display output

5.22.2 Description

- High pressure switch protection
- Error code is displayed on the refrigerant system PCB digital tube and user interface..

5.22.3 Procedure





Notes:

1. High pressure switch connection is port CN18 on the refrigerant system PCB.
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. Total outlet water temperature sensor(T1), outlet water temperature sensor (Tw_out) connection is port CN6 on the hydro system PCB.

   Buffer tank upper temperature sensor(Tbt) connection is port CN24 on the hydro system PCB.
4. Measure the resistance among the terminals of the pressure switch. If the resistance is of the order of mega Ohms or infinite, the pressure switch has failed.
5. PED board connection is port CN22 on the inverter module of 12/14/16kW unit.

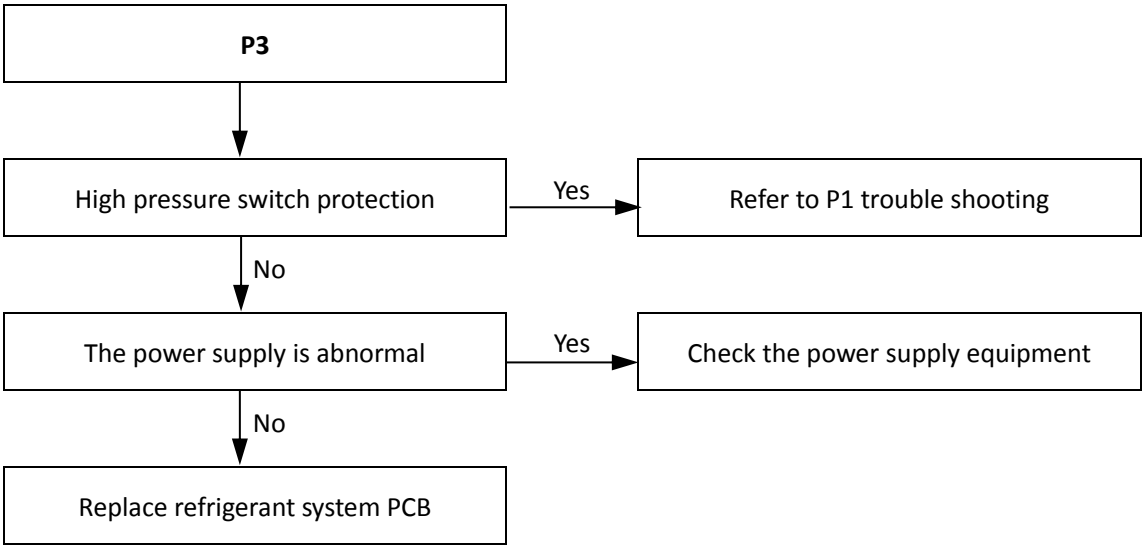
5.23 P3 Troubleshooting

5.23.1 Digital display output

5.23.2 Description

- Compressor current protection.
- Error code is displayed on the refrigerant system PCB digital tube and user interface..

5.23.3 Procedure



Notes:

1. 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.
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.

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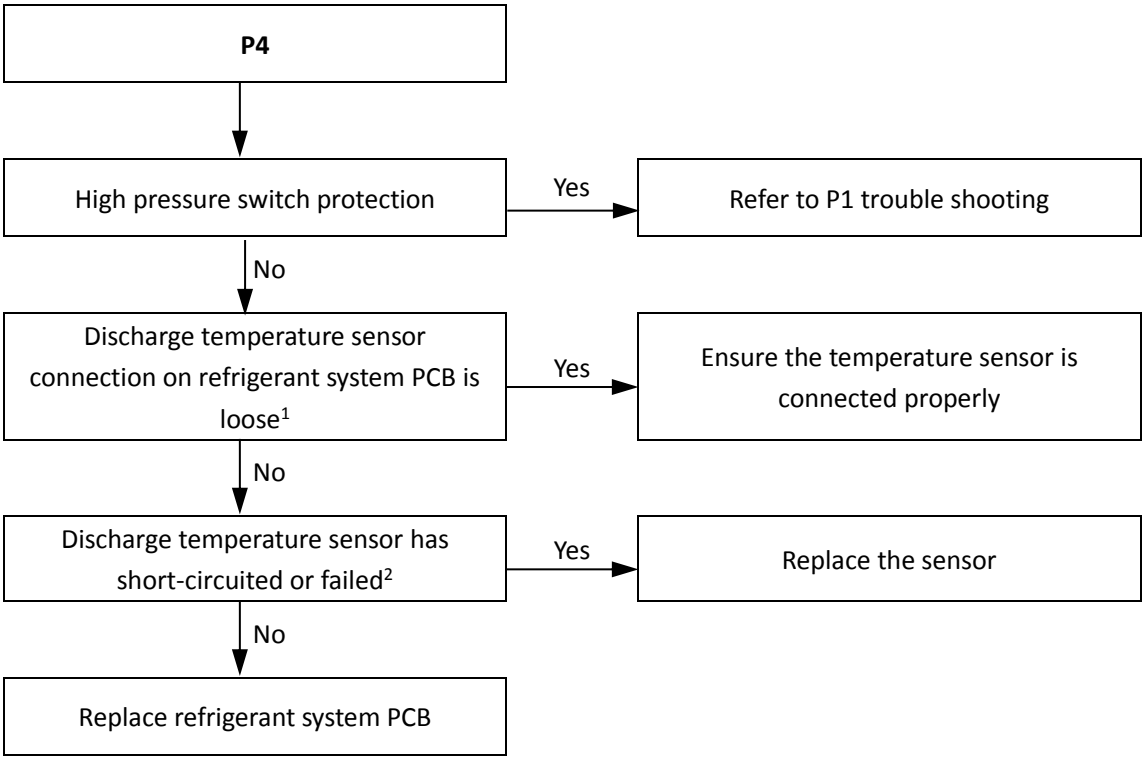
5.24 P4 Troubleshooting

5.24.1 Digital display output

5.24.2 Description

- Compressor discharge temperature too high protection
- Error code is displayed on the refrigerant system PCB digital tube and user interface..

5.24.3 Procedure



Notes:

1. Discharge temperature sensor (Tp) connection is port CN4 on the refrigerant system PCB.
2. Measure sensor resistance. If the resistance is too low, the sensor has short-circuited. If the resistance is not consistent with the sensor's resistance characteristics table, the sensor has failed.

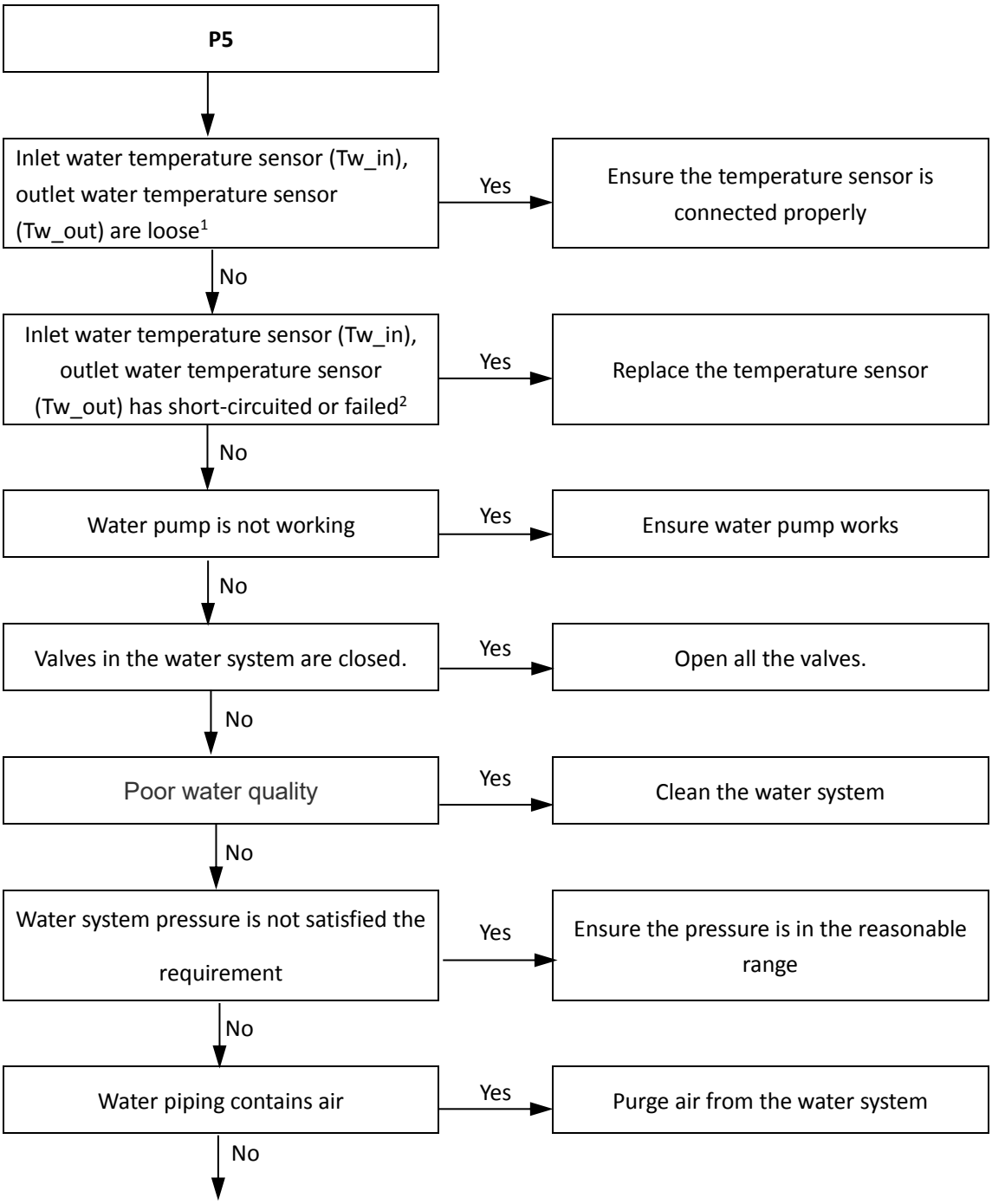
5.25 P5 Troubleshooting

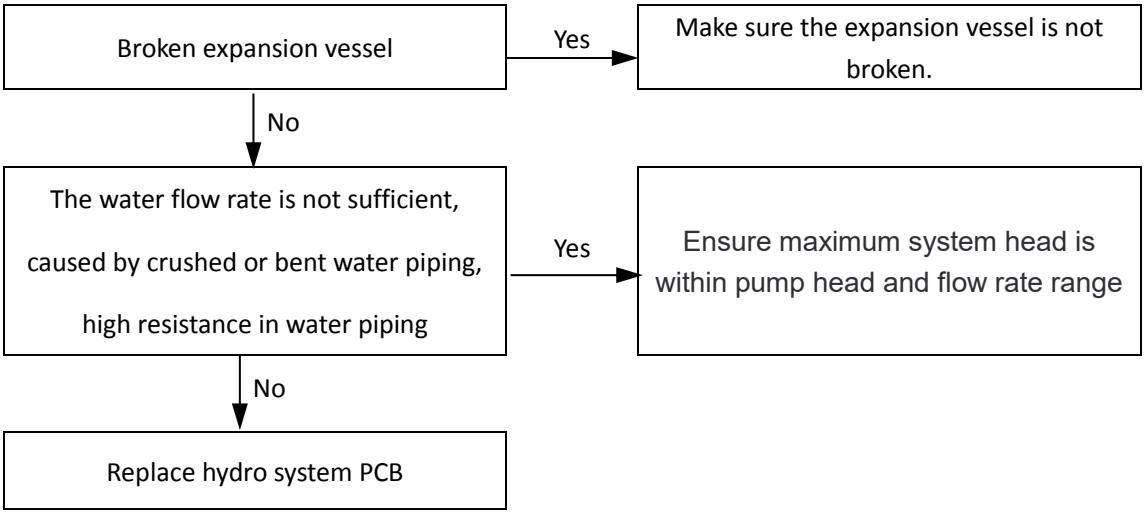
5.25.1 Digital display output

5.25.2 Description

- |Tw_out-Tw_in| value too big protection
- Heat pump stops running.
- Error code is displayed on the refrigerant system PCB digital tube and user interface.

5.25.3 Procedure





Notes:

1. Inlet water temperature sensor (Tw_in) connection, outlet water temperature sensor (Tw_out) connection is port CN6 on the hydro system PCB.
2. Measure sensor resistance. If the resistance is too low, the sensor has short-circuited. If the resistance is not consistent with the sensor's resistance characteristics table, the sensor has failed.

5.26 Pb Troubleshooting

5.26.1 Digital display output

5.26.2 Description

- Anti-freeze mode protection.
- Code is displayed on refrigerant system PCB and **ANTI.FREEZE** icon is displayed on user interface.

5.26.3 Procedure

Anti-freeze is used to protect the water system from cracking during winter. It is normal protection operation and heat pump will return to the normal operation automatically.

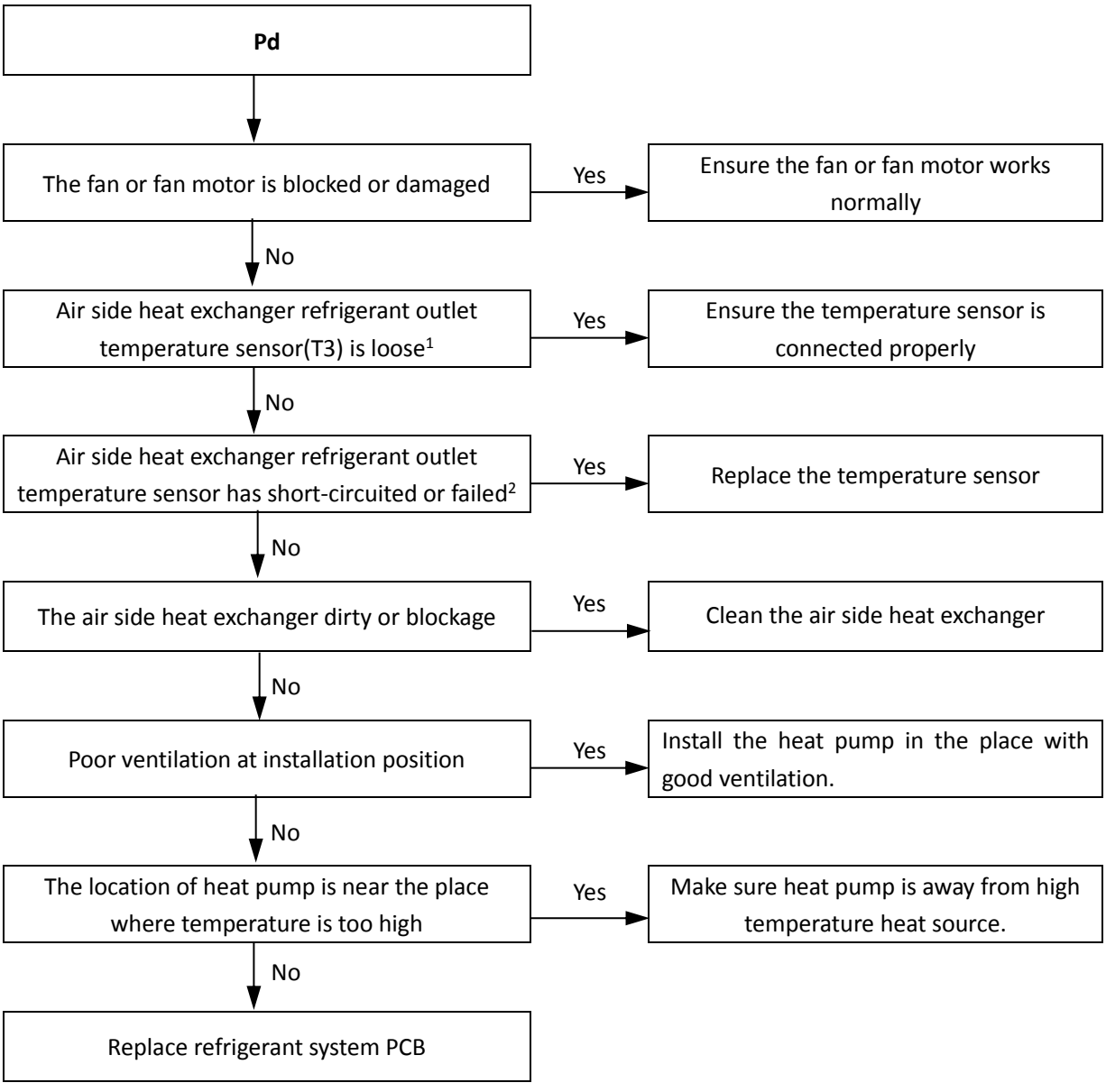
5.27 Pd Troubleshooting

5.27.1 Digital display output

5.27.2 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 heat pump stops running. When the air side heat exchanger refrigerant outlet temperature returns drops below 55°C, Pd is removed and normal operation resumes.
- Heat pump stops running.
- Error code is displayed on the refrigerant system PCB digital tube and user interface..

5.27.3 Procedure

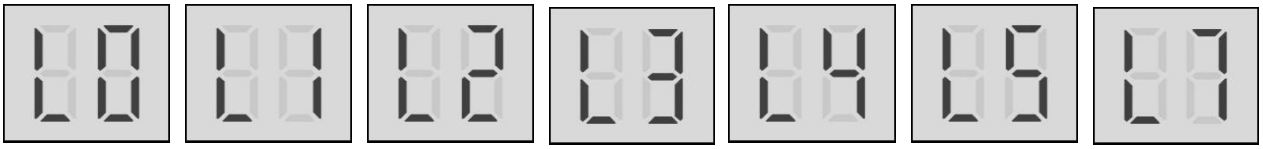


Notes:

1. Air side heat exchanger temperature sensor (T3) connection is port CN6 on the refrigerant system PCB.
2. Measure sensor resistance. If the resistance is too low, the sensor has short-circuited. If the resistance is not consistent with the sensor's resistance characteristics table, the sensor has failed.

5.28 Inverter module Troubleshooting for single-phase models

5.28.1 Digital display output



5.28.2 Description

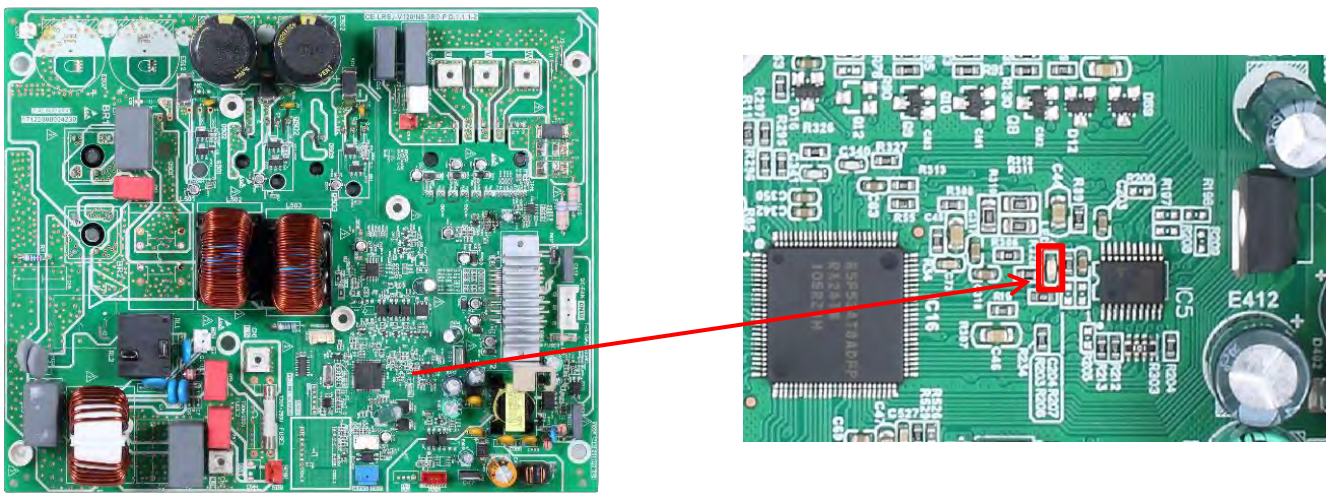
- L0 indicates Inverter or compressor protection
  L1 indicates DC bus low voltage protection
  L2 indicates DC bus high voltage protection
  L3 indicates current sampling error of PFC circuit
  L4 indicates rotating stall protection
  L5 indicates zero speed protection
  L7 indicates phase loss protection of compressor
- Heat pump stops running.
- Specific error code L0, L1, L2, L3, L4, L5, L7 are displayed on the user interface and the main control board of refrigerant system.

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

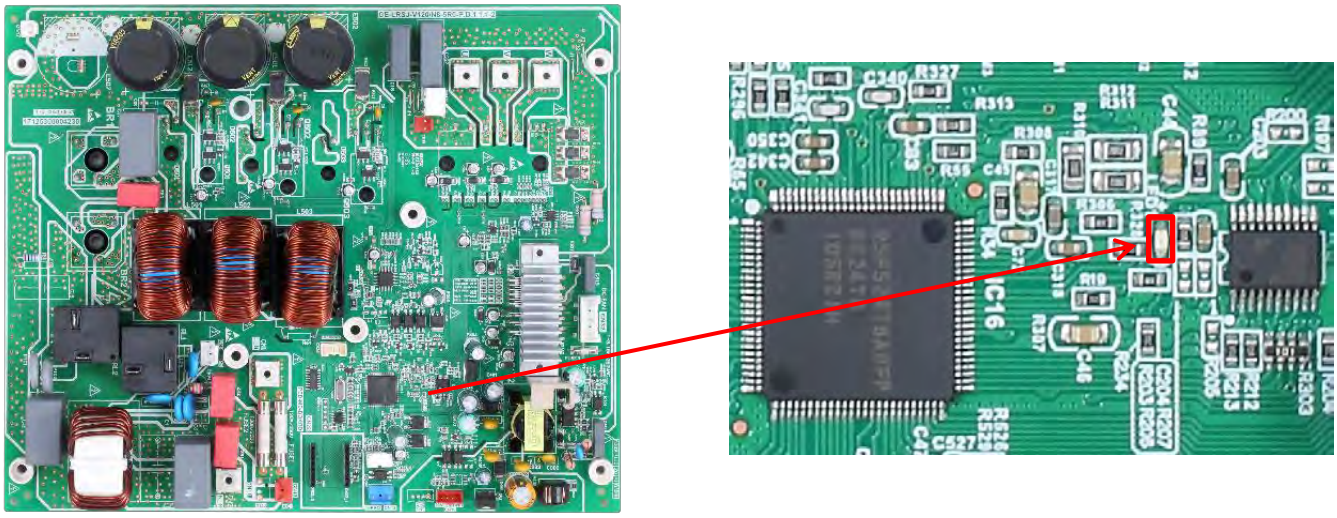
LED1 flashing pattern (RED)	Corresponding error
Flashes 1 times and stops for 0.4s, then repeats	L0 indicates Inverter or compressor protection(overcurrent)
Flashes 2 times and stops for 0.4s, then repeats	L0 indicates Inverter or compressor protection(overheated)
Flashes 3 times and stops for 0.4s, then repeats	L1 indicates DC bus low voltage protection
Flashes 3 times and stops for 0.4s, then repeats	L2 indicates DC bus high voltage protection
Flashes 4 times and stops for 0.4s, then repeats	L3 indicates current sampling error of PFC circuit
Flashes 5 times and stops for 0.4s, then repeats	L4 indicates rotating stall protection
Flashes 5 times and stops for 0.4s, then repeats	L5 indicates zero speed protection
Flashes 6 times and stops for 0.4s, then repeats	L7 indicates phase loss protection of compressor

LED location of inverter module

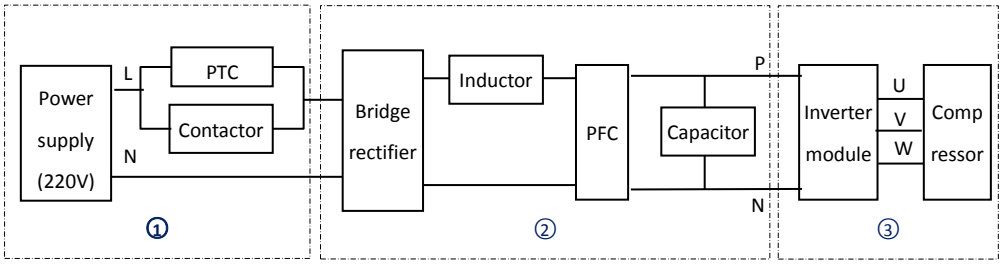
Inverter Module(5-9KW): LED1



Inverter Module(12-16KW): LED1



5.28.3 Principle of DC inverter



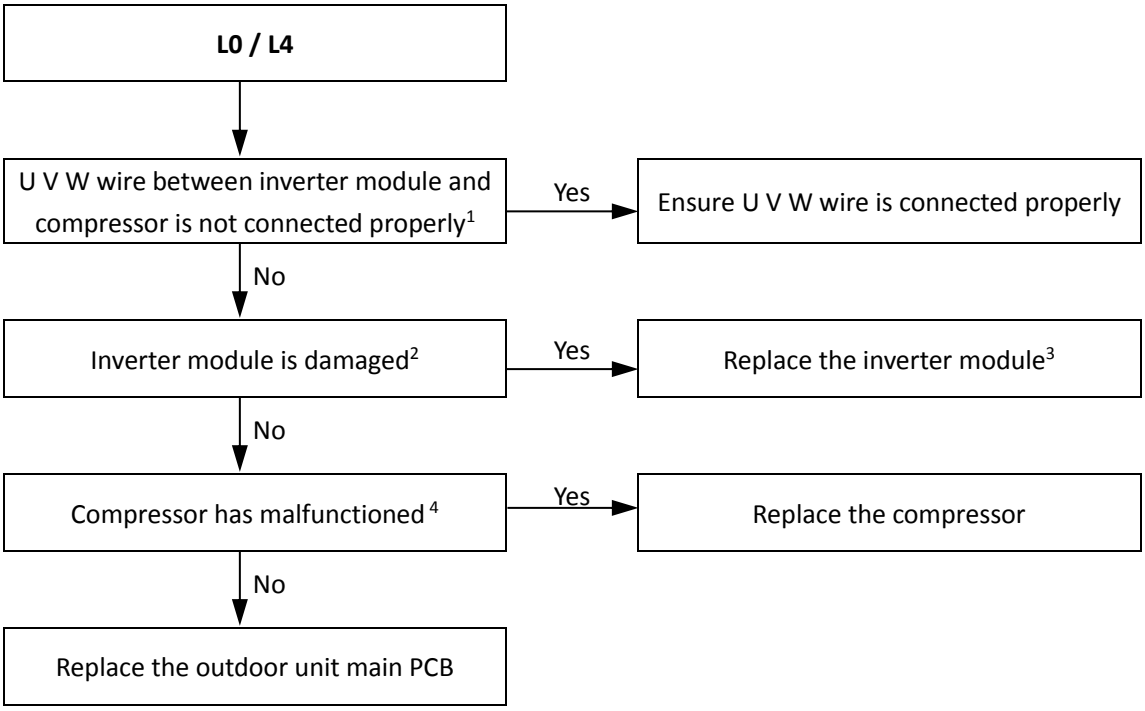
①Contactor is open, the current across the PTC to charge capacitor. After 5 seconds, the contactor closed.

②220-240V AC power supply change to DC power supply after bridge rectifier.

③The capacitor output steady power supply for inverter module P N terminals. In standby the voltage between P and N terminal on inverter module is 1.4 time of AC power supply. When the fan motor is running, the voltage is 380V DC.

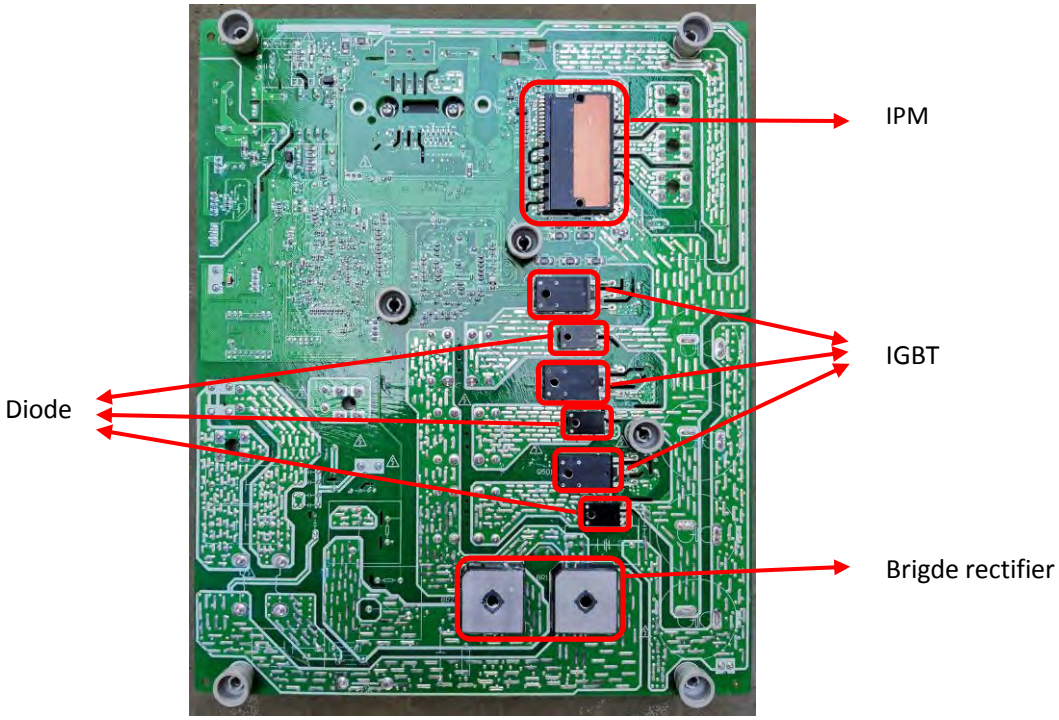
5.28.4 L0/L4 troubleshooting

Situation 1: L0 or L4 error appears immediately after the compressor starts up



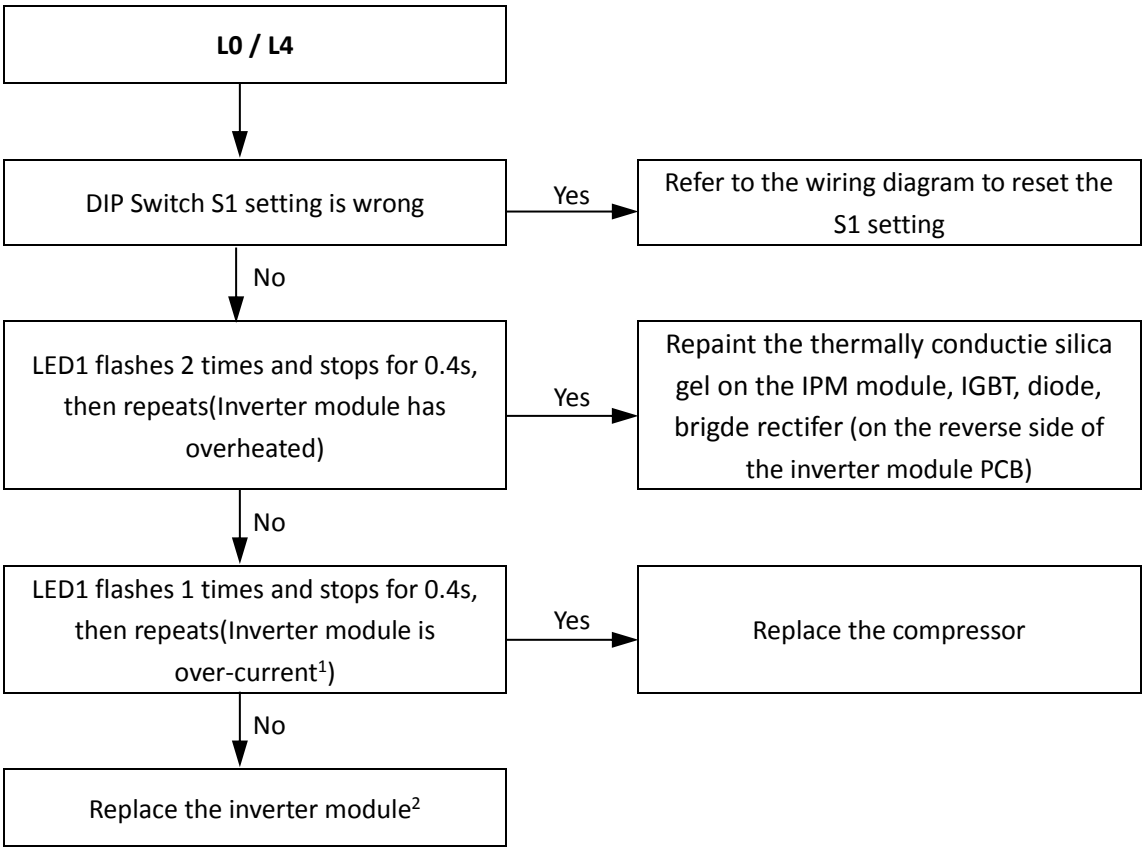
Notes:

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 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. When replacing an inverter module, a layer of thermally conductive silica gel should be painted on the IPM module, IGBT, diode brigde rectifer (on the reverse side of the inverter module PCB).



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.

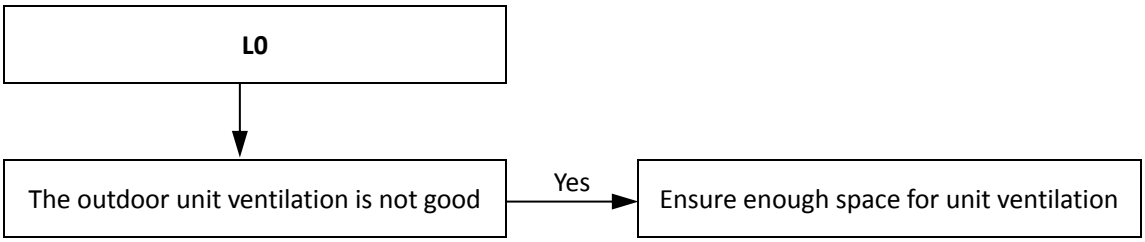
Situation 2: L0 or L4 error appears after the compressor has been running for a period of time and the compressor speed is over 60rps



Notes:

1. 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 is failed.
2. When replacing an inverter module, a layer of thermally conductive silica gel should be painted on the PFC and IPM modules (on the reverse side of the inverter module PCB).

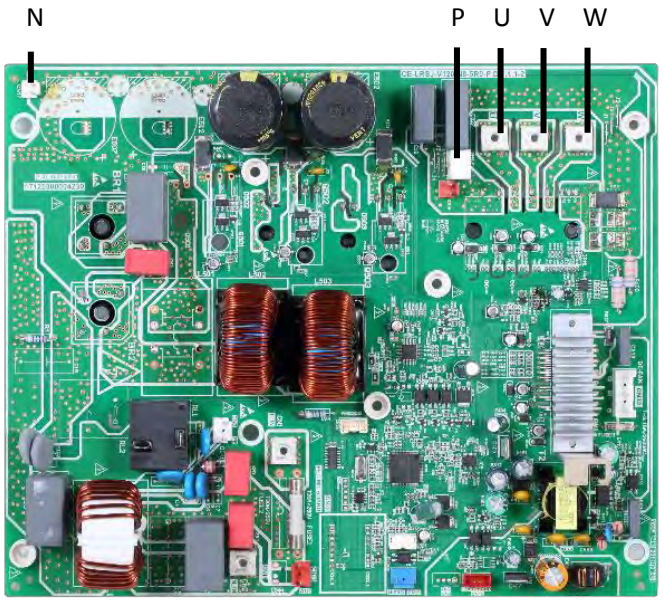
Situation 3: L0 error appears occasionally/irregularly



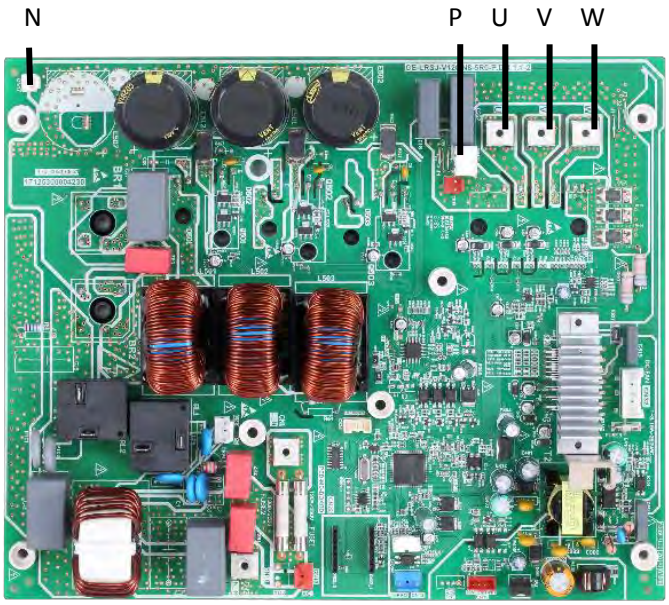
5.28.5 L1/L2 troubleshooting

The normal DC voltage between terminals P and N on inverter module is 1.4 time of AC power supply in standby , the DC voltage is 377V when the fan motor is running. If the voltage is lower than 135V, the unit displays L1. If the voltage is higher than 500V, the unit display L2.

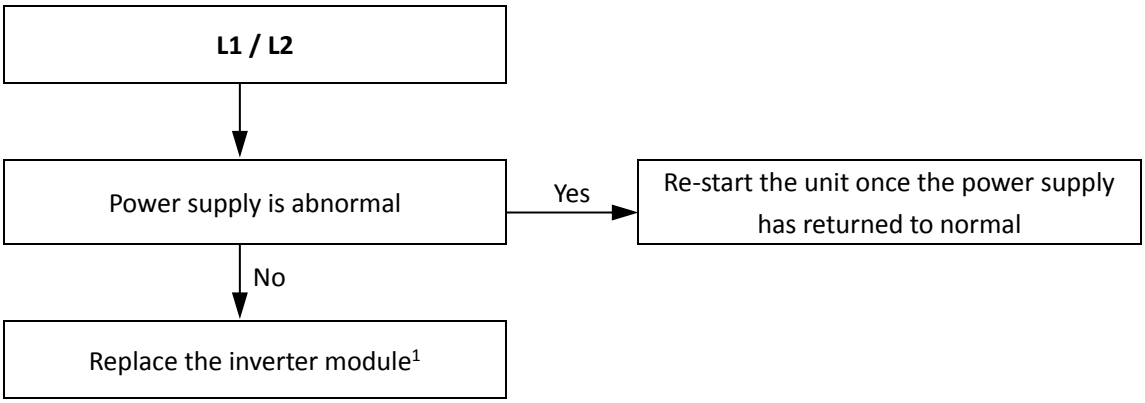
Inverter module terminals (5-9KW)



Inverter module terminals (12-16KW)



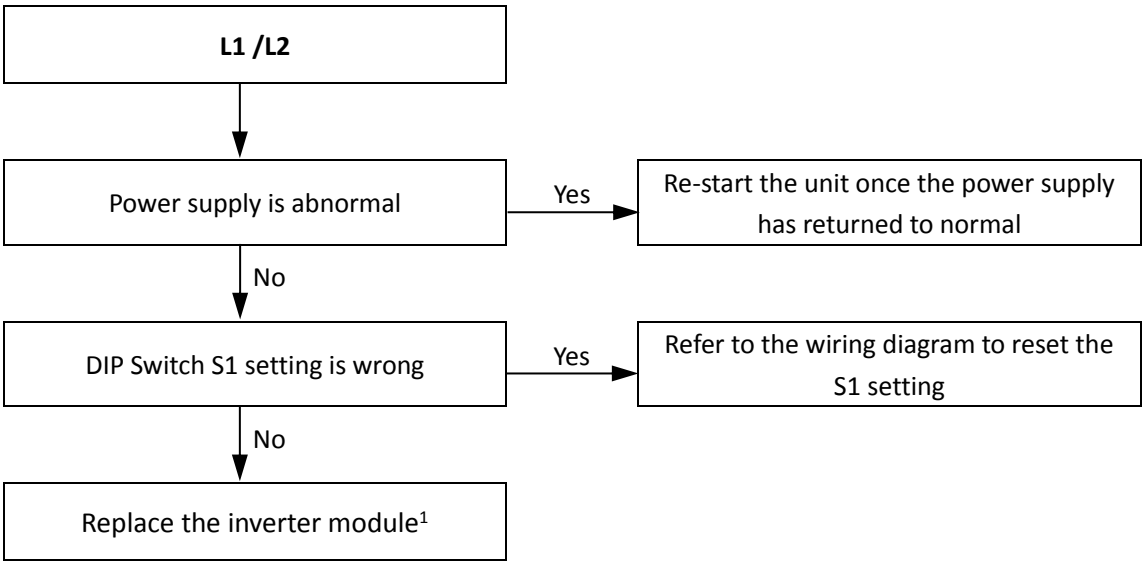
Situation 1: L1 or L2 error appears immediately after the outdoor unit is powered-on



Notes:

1. When replacing an inverter module, a layer of thermally conductive silica gel should be painted on the IPM module, IGBT, diode, brigde rectifer (on the reverse side of the inverter module PCB).

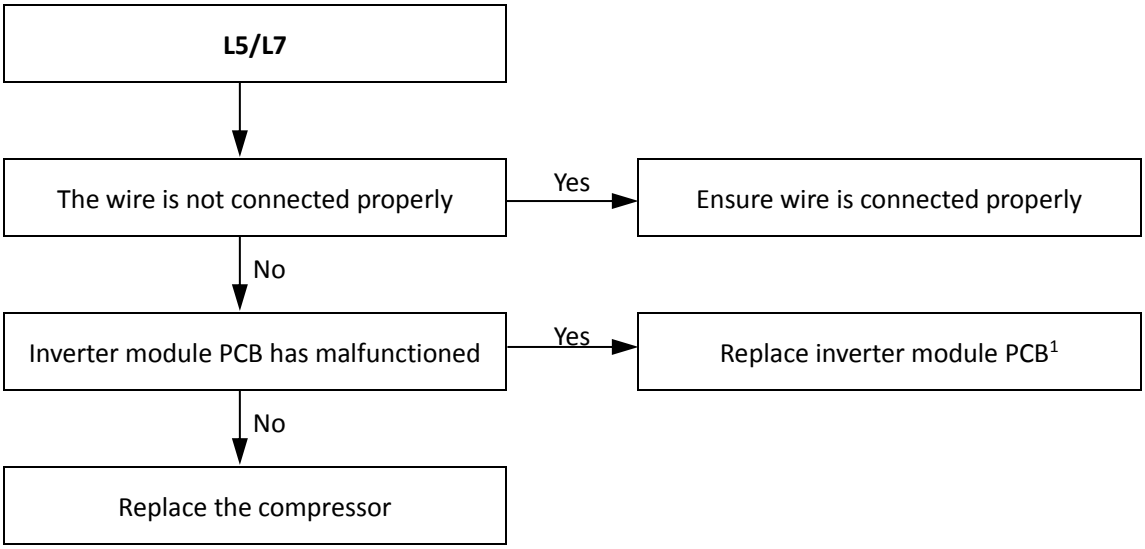
Situation 2: L1 or L2 error appears after the compressor has been running for a period of time and the compressor speed is over 20rps



Notes:

1. When replacing an inverter module, a layer of thermally conductive silica gel should be painted on IPM module (on the reverse side of the inverter module PCB).

5.28.6 L5/L7 troubleshooting



Note：

1. When replacing an inverter module, a layer of thermally conductive silica gel should be painted on IPM module (on the reverse side of the inverter module PCB).

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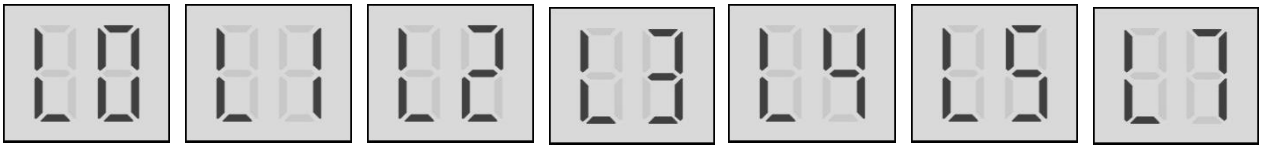
5.29 Inverter module Troubleshooting for three-phase models

5.29.1 Digital display output



5.29.2 Description

- L0 indicates Inverter or compressor protection
  L1 indicates DC bus low voltage protection
  L2 indicates DC bus high voltage protection
  L3 indicates current sampling error of PFC circuit
  L4 indicates rotating stall protection
  L5 indicates zero speed protection
  L7 indicates phase loss protection of compressor
- Heat pump stops running.
- Specific error code L0, L1, L2, L3, L4, L5, L7 is displayed on the user interface and the refrigerant system PCB.

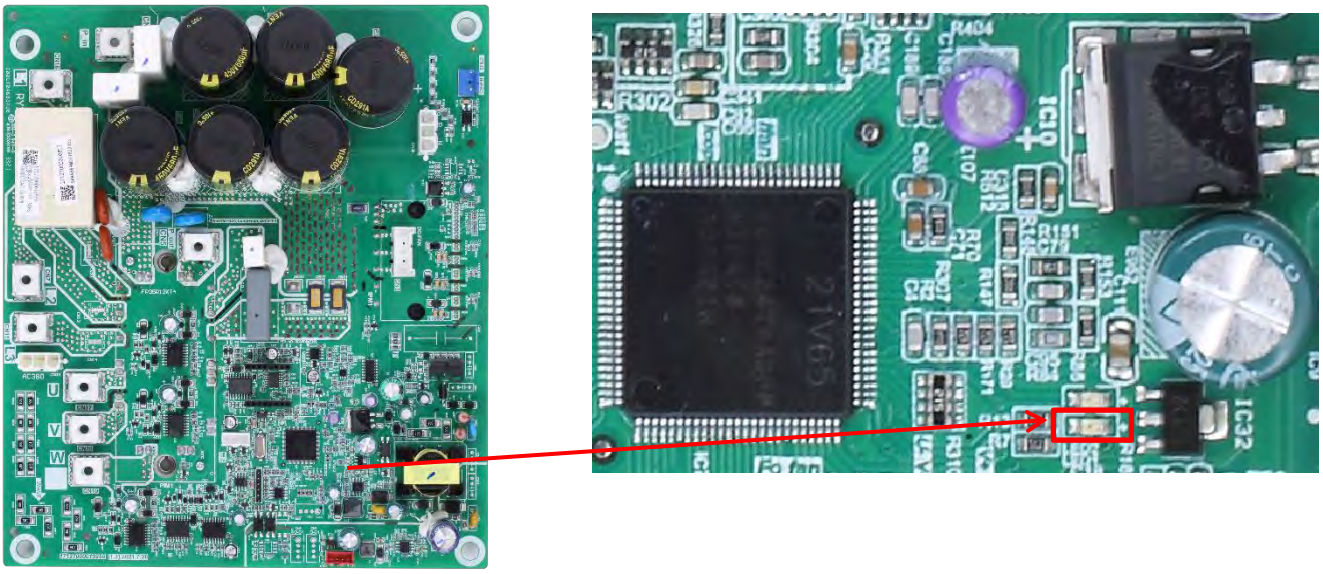
5.29.3 Possible causes

- 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.

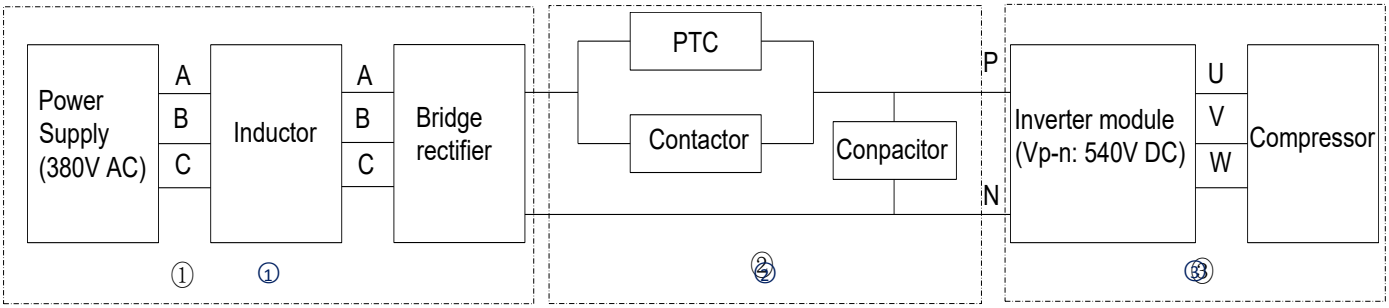
The specific error codes can also be obtained from the LED indicators on the inverter module.

LED1 flashing pattern (RED)	Corresponding error
Flashes 1 times and stops for 0.4s, then repeats	L0 indicates Inverter or compressor protection
Flashes 2 times and stops for 0.4s, then repeats	L0 indicates Inverter or compressor protection(overheated)
Flashes 3 times and stops for 0.4s, then repeats	L1 indicates DC bus low voltage protection
Flashes 3 times and stops for 0.4s, then repeats	L2 indicates DC bus high voltage protection
Flashes 4 times and stops for 0.4s, then repeats	L3 indicates current sampling error of PFC circuit
Flashes 5 times and stops for 0.4s, then repeats	L4 indicates rotating stall protection
Flashes 5 times and stops for 0.4s, then repeats	L5 indicates zero speed protection
Flashes 6 times and stops for 0.4s, then repeats	L7 indicates phase loss protection of compressor

LED location of inveter module for three-phase 12~16kW unit



5.29.4 Principle of DC inverter



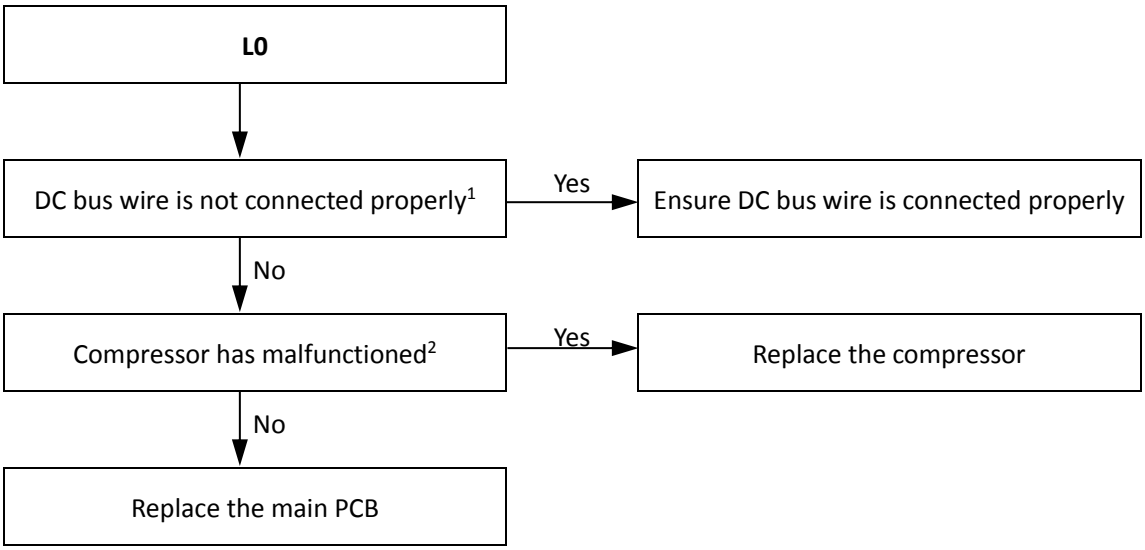
① 380-415V AC power supply change to DC power supply after bridge rectifier.

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.

5.29.5 L0 troubleshooting

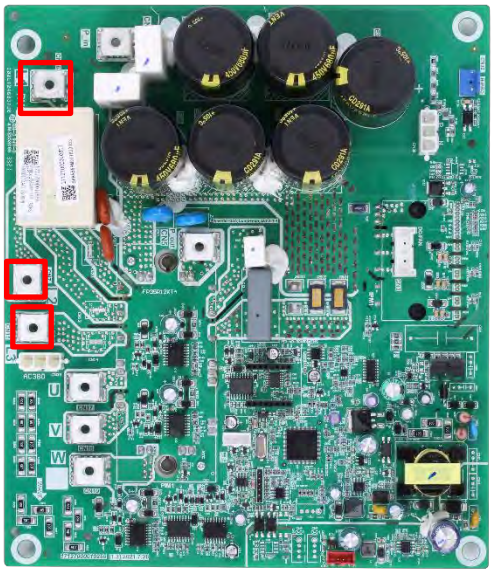
Situation 1: L0 error appears immediately after the compressor starts up



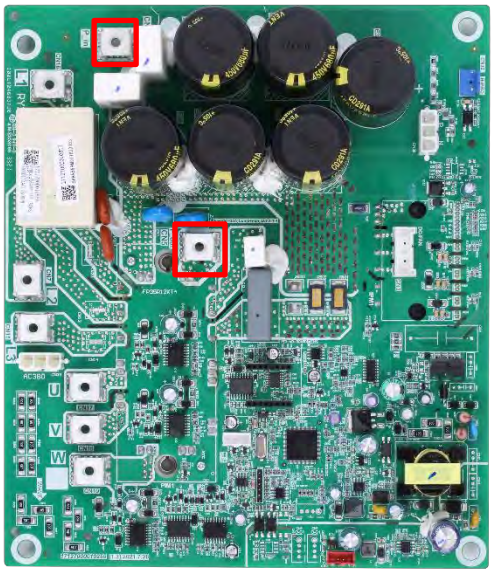
Notes:

1. *DC bus wire connection（L1L2L3,PIN- POUT）*

L1，L2，L3

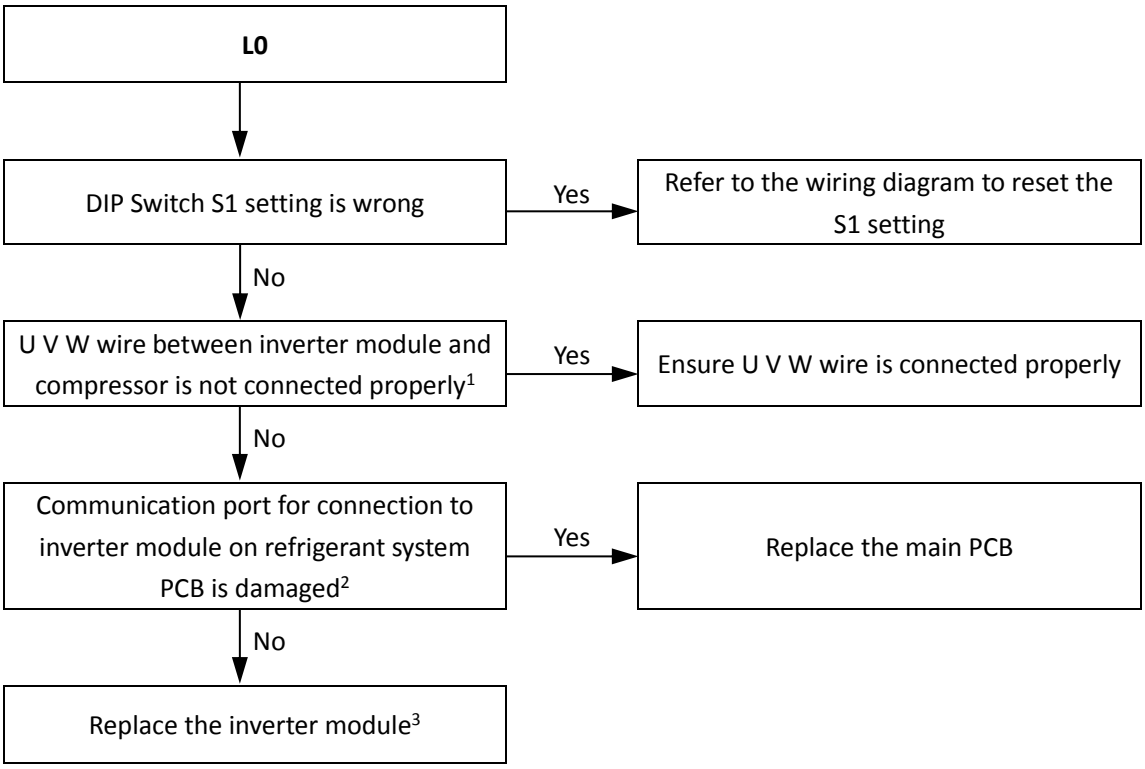


Pin，Pout



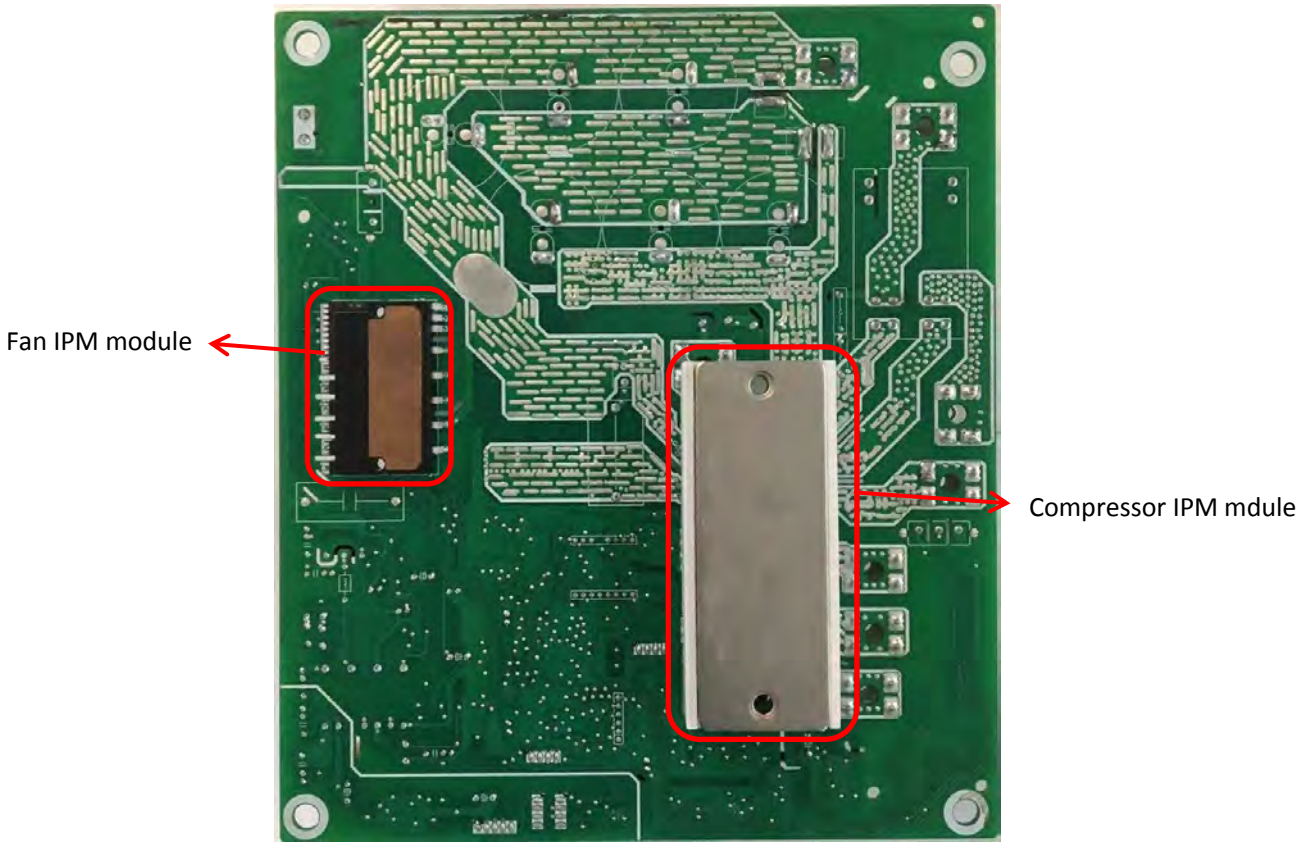
2. The normal resistances of the inverter compressor are 0.7-1.5Ω among U V W and infinite between each of U V W and ground. If any of the resistances differ from these specifications, the compressor has malfunctioned.

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

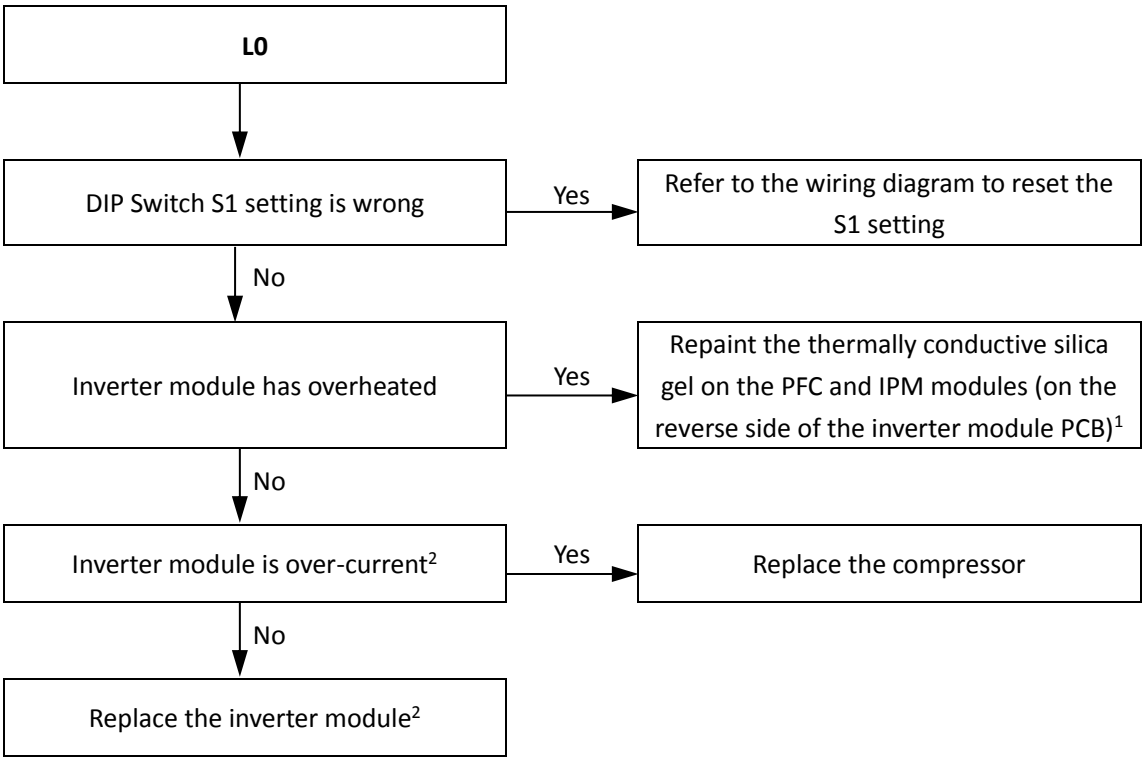


Notes:

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.
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).



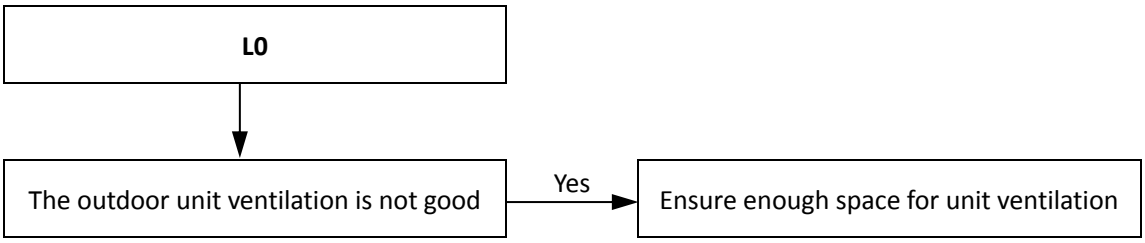
Condition 3: L0 error appears after the compressor has been running for a period of time and the compressor speed is over 60rps



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).
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.

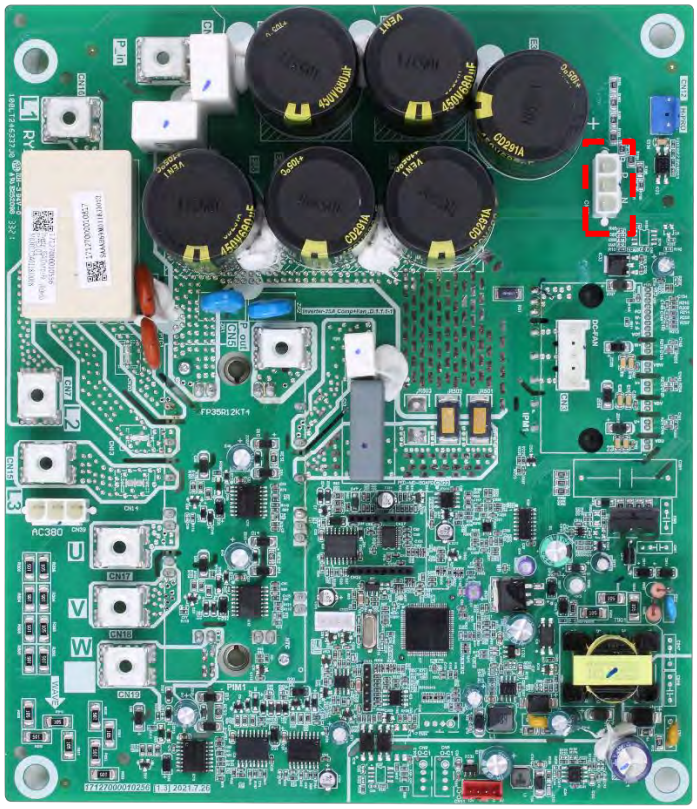
Situation 4: L0 error appears occasionally/irregularly



5.29.6 L1/L2 troubleshooting

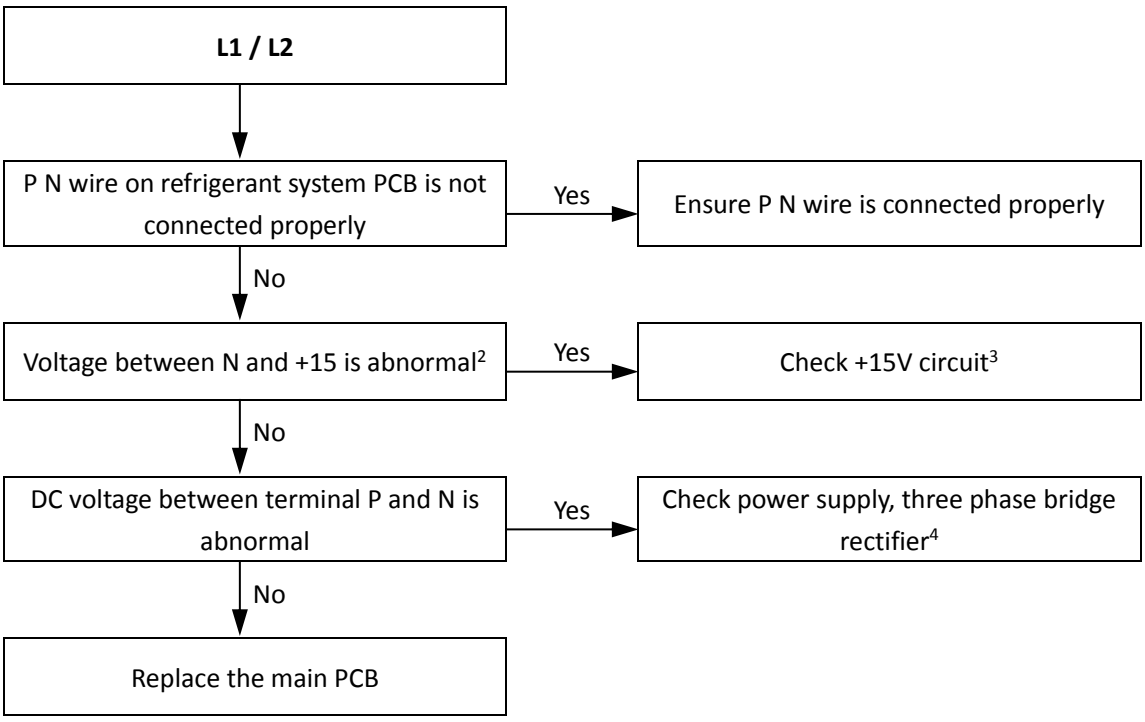
The normal DC voltage between terminals P and N on inverter module is 540V. If the voltage is lower than 250V, the unit displays an L1 error; if the voltage is higher than 720V, the unit displays an L2 error.

P, N terminals voltage



V_{normal} = 540V DC

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



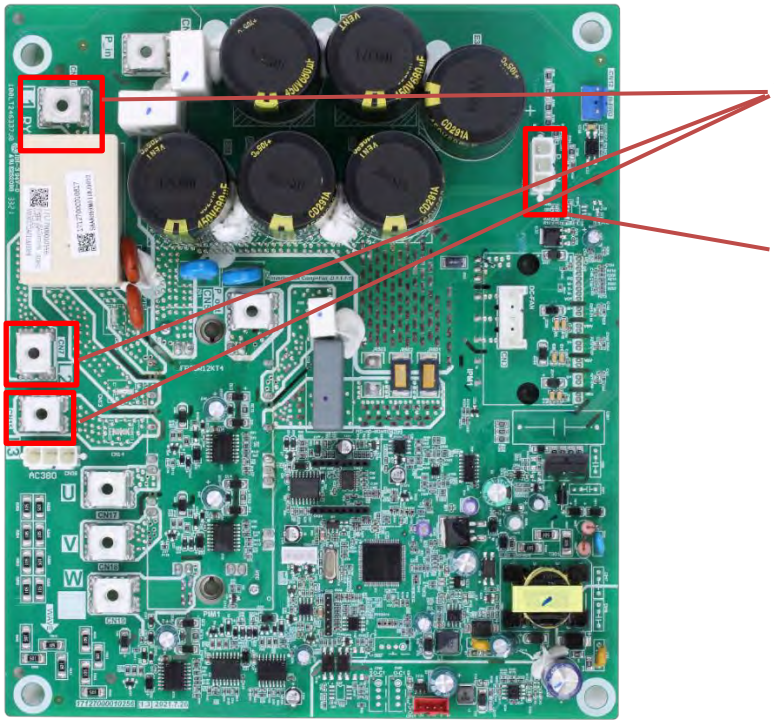
Notes:

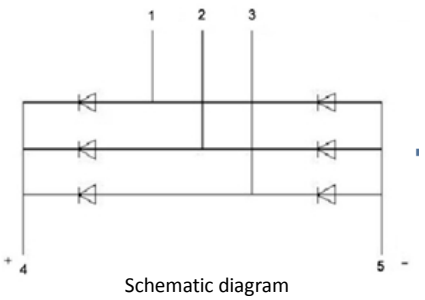
1. Voltage between N and +15.

P N +15V terminal-+15V（IC8/5/6PIN5）；N-（IC/8/5、6）PIN3

2. Check the +15V circuit according to corresponding wiring diagram. If IC8/5/6PIN5 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.
3. Check the bridge rectifier using one of the following two methods
   - 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.

Bridge rectifier

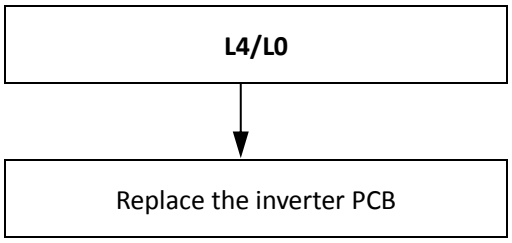




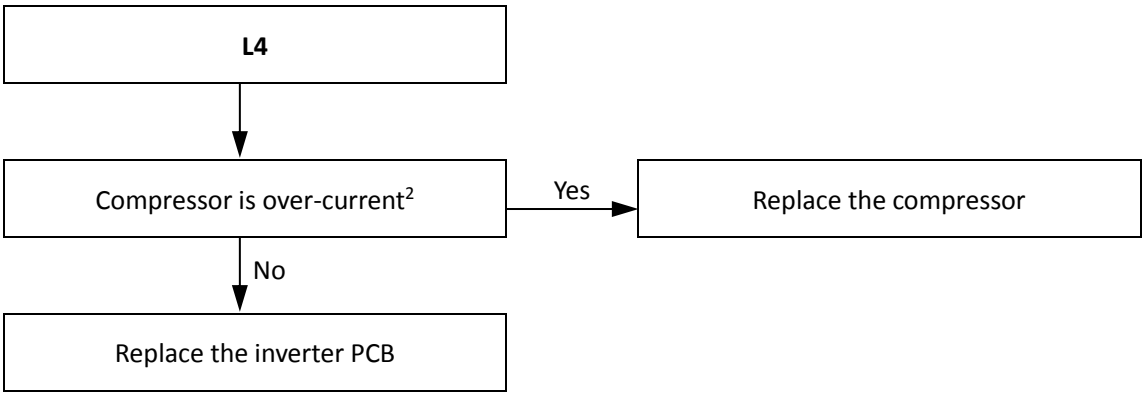
Schematic diagram

5.29.7 L4 troubleshooting

Situation 1: L4/L0 error appears immediately after the outdoor unit is powered-on



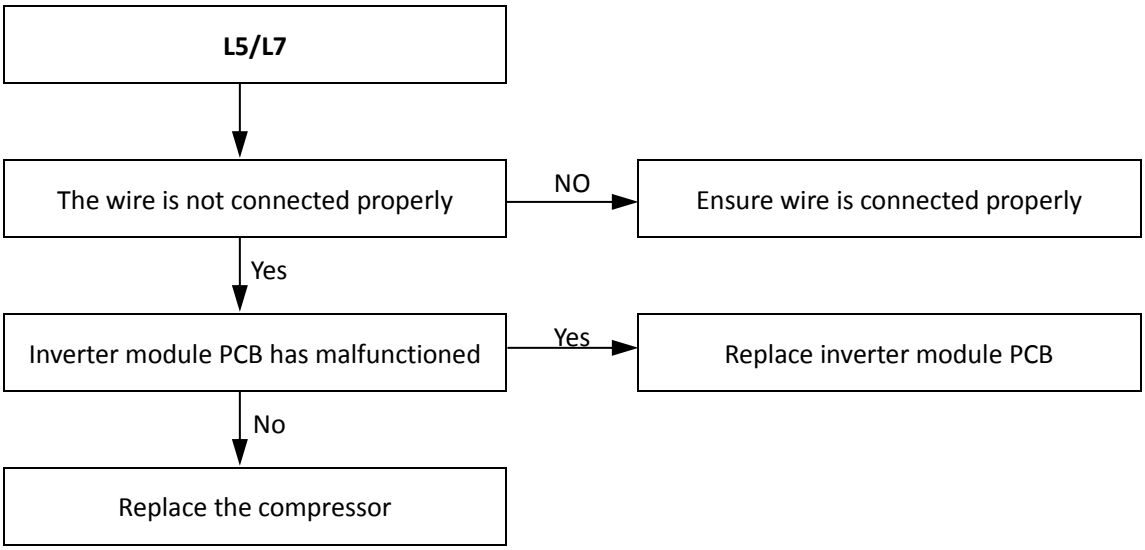
Condition 2: L4 error appears after the compressor has been running for a period of time and the compressor speed is over 60rps



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.

5.29.8 L5/L7 troubleshooting



6 USB data transfer

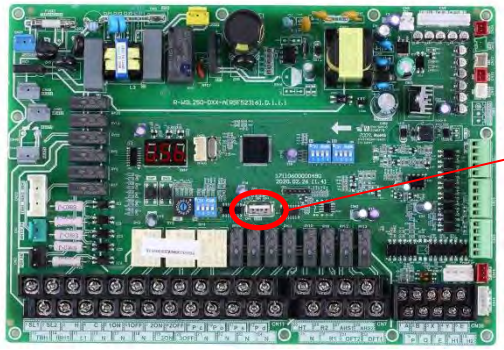
6.1 Parameters setting transfer between wired controllers

Installer can quickly copy the wired controller parameter settings from unit A to unit B via USB disk, which save the time of on-site installation. Steps are as follows:

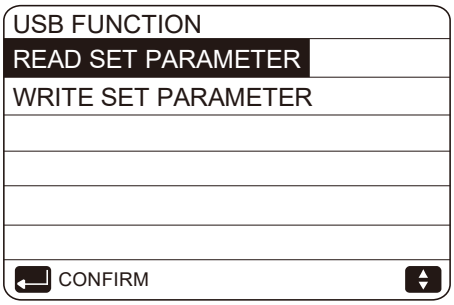
Step 1:

Plug U disk into the port of hydro PCB of A unit.

"USb" appears on digital display



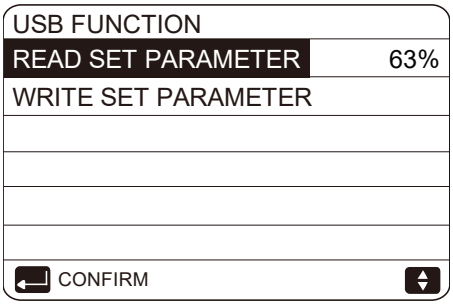
Wired controller interface automatically changes



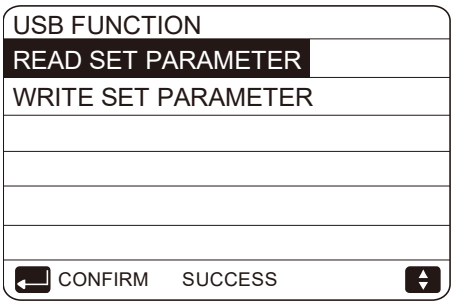
Step 2:

Select "READ SET PARAMETER" and press "OK" button then rate of progress will appear. When the process is finished, "SUCCESS" appears below and an EXCEL file which can not be seen in the wired controller interface but users can find it on computer will be generated inside the USB disk.

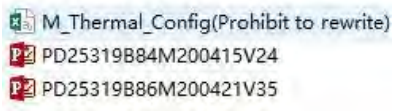
Select "READ SET PARAMETER"



Finished



EXCEL generated

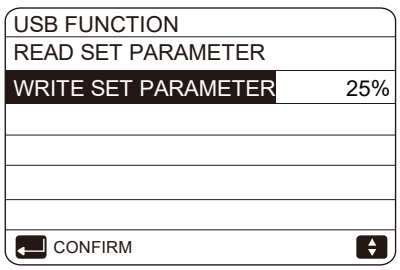


After that, if parameter correction is needed, please connect the USB with computer and open the EXCEL file to change parameters and then save it. Please do not change the file name or format. Parameters are not allowed for non-professionals to change and Mundoclima recommends to use the wired controller to change the parameters.

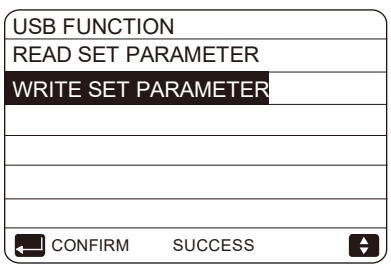
Step 3:

Plug USB disk into the port of hydro PCB of B unit and select "WRITE SET PARAMETER" then rate of progress will appear. When the process is finished, "SUCCESS" appears below.

Select "WRITE SET PARAMETER"



Finished



6.2 Convenient program upgrade for unit

There is no need to carry any heavy equipment but only USB disk can realize program upgrade. Steps are as follows:

Step 1:

Copy new program in U disk root directory where other files in bin format are not allowed in

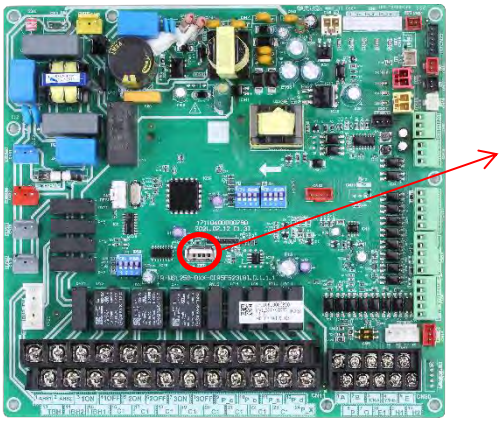
Step 2:

Power on and make sure communication is normal.

Step 3:

Plug U disk into the port of hydro PCB.

"USb" appears on digital display



Wired controller interface automatically changes

USB FUNCTION
RATED SET PARAMETER
WRITE SET PARAMETER
PD25319B84M200415V24.bin
PD25319B86M200415V24.bin
CONFIRM

Step 4:

Please distinguish between programs for main control PCB and hydro PCB. Select one of them and press "OK" button then rate of progress appears. When the process is finished, "SUCCESS" appears below. For upgrading outdoor unit, the process normally lasts for several minutes while only few seconds is needed for indoor unit.

Select program

USB FUNCTION	
RATED SET PARAMETER	
WRITE SET PARAMETER	
PD25319B84M200415V24.bin	51%
PD25319B86M200415V24.bin	
CONFIRM	

Finished

USB FUNCTION
RATED SET PARAMETER
WRITE SET PARAMETER
PD25319B84M200415V24.bin
PD25319B86M200415V24.bin
CONFIRM

Step 5:

Pull out U disk and power on again to finish upgrading program. Check the program version to make sure upgrade is successful.

Check IDU & ODU software version

OPPERATION PARAMETER	#00
IHB2 TOTAL RUN TIME	0 Hrs
THB TOTAL RUN TIME	- - Hrs
AHS TOTAL RUN TIME	0 Hrs
IDU SOFTWARE	29-09-2021V15
ODU SOFTWARE	28-09-2021V25
HMI SOFTWARE	16-10-2021V19
ADDRESS	10/10

7 Network Configuration Guidelines

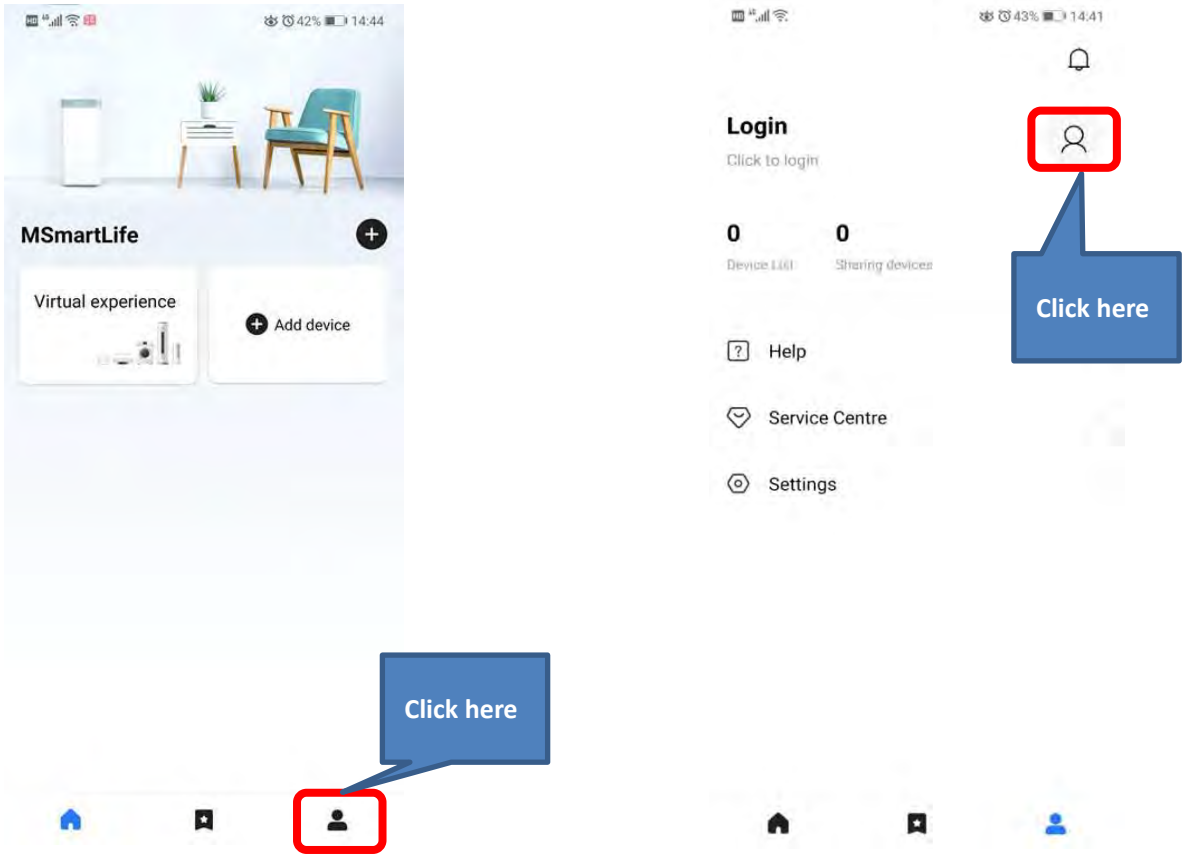
The wired controller realizes intelligent control with a built-in WIFI module, which receives control signal from the APP. Before connecting the WLAN, please check for it if the router in your environment is active and make sure that the wired controller is well-connected to the wireless signal. When the product is connected to the network, please make sure that the phone is as close as possible to the product. Mundoclima only supports 2.4GHz band routers at present. Special characters (punctuation, spaces, etc.) are not recommended as part of the WLAN name. It is recommended that you connect no more than 10 devices to a single router lest home appliances are affected by weak or unstable network signal. If the password of the router or WLAN is changed, clear all settings and reset the appliance. APP interface changes from time to time as APP is updated and may change slightly vary from those in this document.

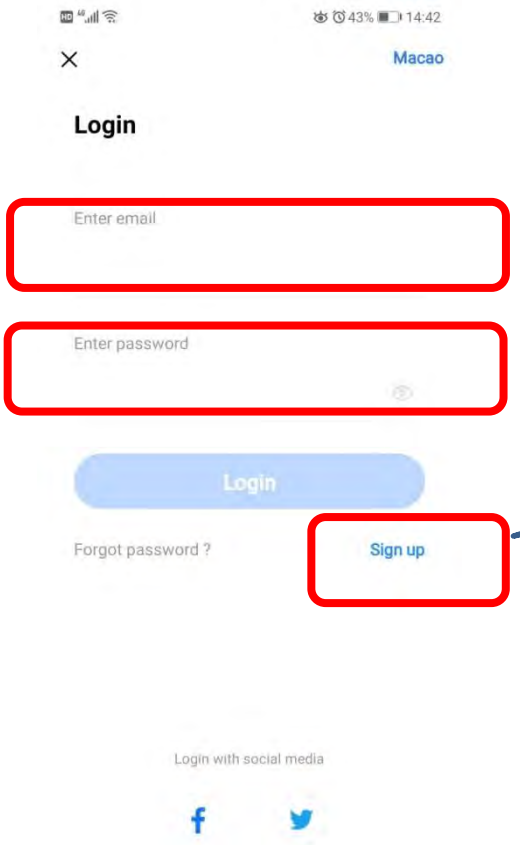
7.1 Install APP

Scan the following QR code or research "MSmartLife" in APP STORE or GOOGLE PLAY to install the APP.

7.2 Sign in

After installation, open the APP and login.



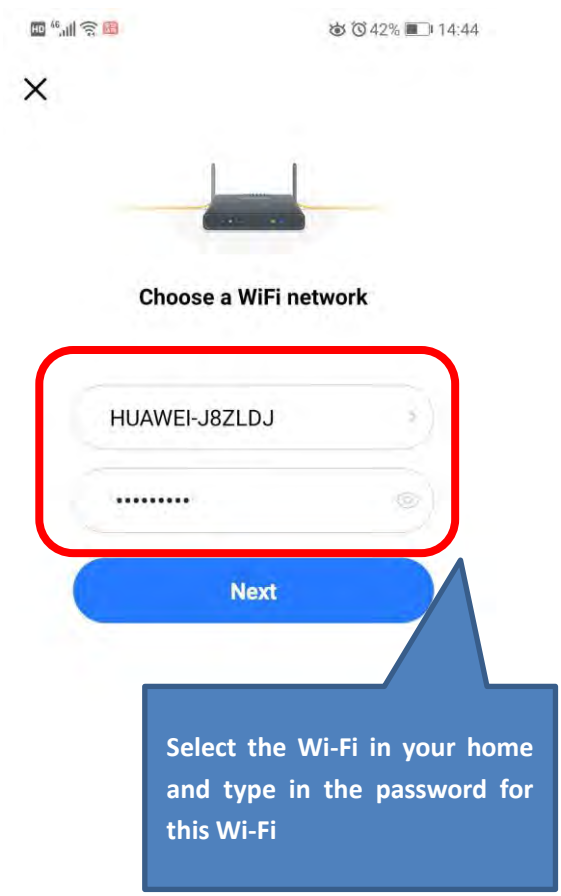


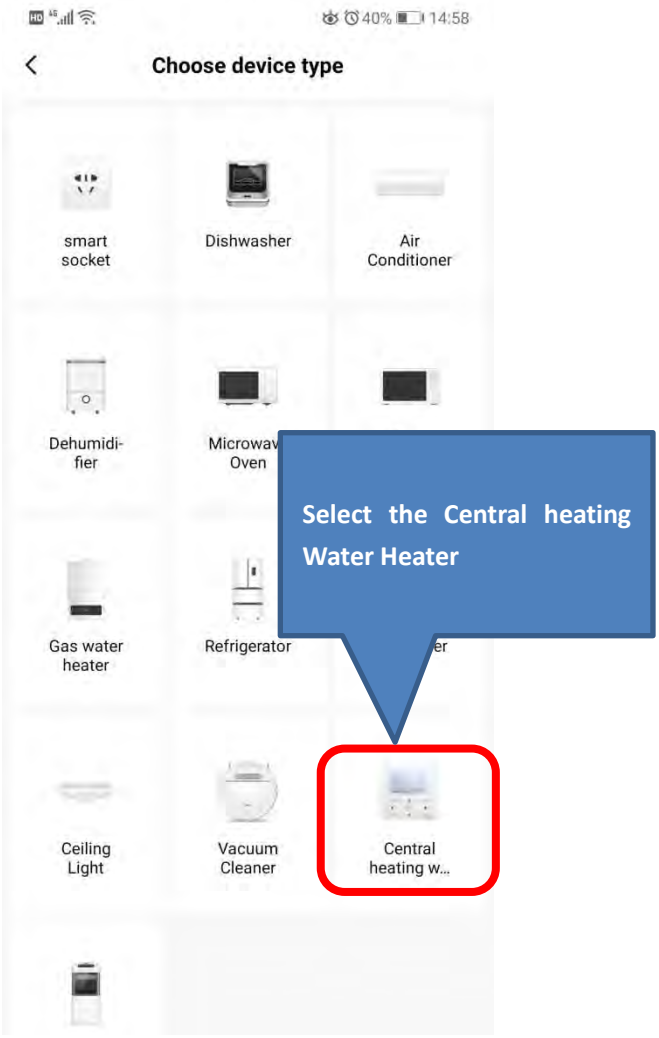
Click on Sign Up and create a new account if you have never created an account of MSmartLife before . If you have already created an account before, login with the email and password.

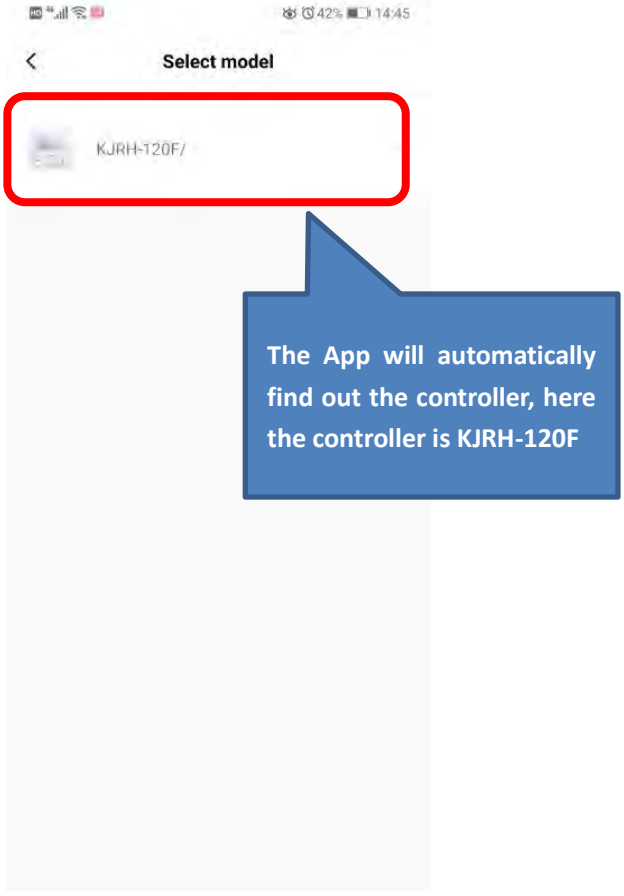
7.3 Add device and login to home Wi-Fi

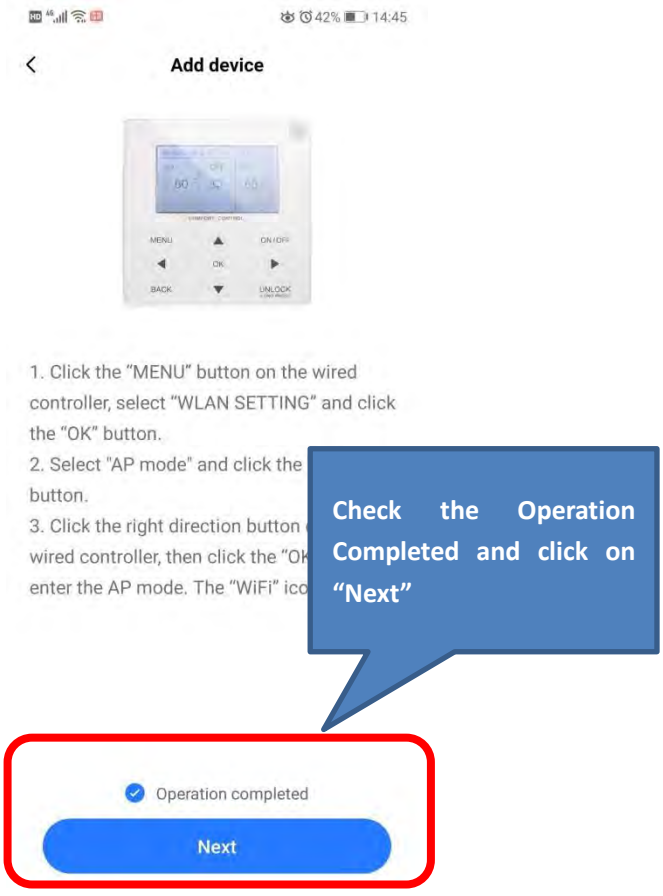
Click on Add Device to add your Heat Pump Water Heater

This page would be displayed. Click on “Ready” . You must have the password of the Wi-Fi


42% 14:44
Choose a WiFi network
HUAWEI-J8ZLDJ
Next
Select the Wi-Fi in your home and type in the password for this Wi-Fi

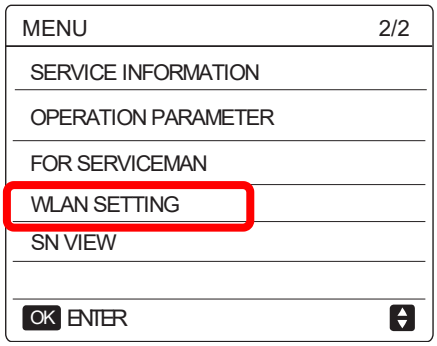

40% 14:58
Choose device type
smart socket
Dishwasher
Air Conditioner
Dehumidifier
Microwav Oven
Gas water heater
Refrigerator
Ceiling Light
Vacuum Cleaner
Central heating w...
Select the Central heating Water Heater

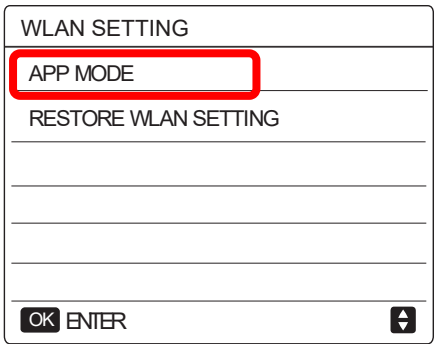

42% 14:45
Select model
KJRH-120F/
The App will automatically find out the controller, here the controller is KJRH-120F

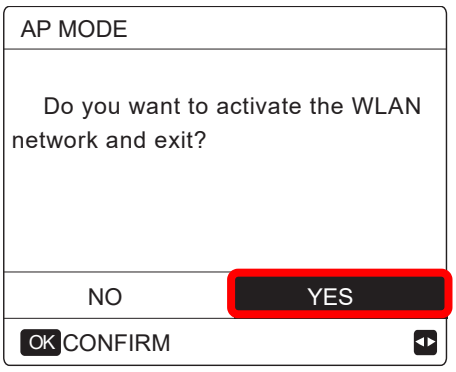

42% 14:45
Add device
1. Click the "MENU" button on the wired controller, select "WLAN SETTING" and click the "OK" button.
2. Select "AP mode" and click the button.
3. Click the right direction button wired controller, then click the "OK enter the AP mode. The "WiFi" ico
Check the Operation Completed and click on "Next"
Operation completed
Next

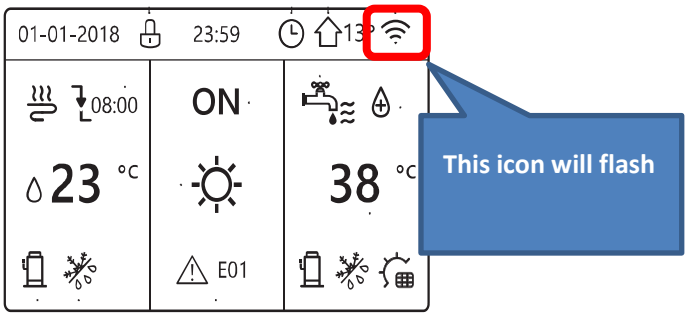
7.4 Wired Controller Setting

Go to "**MENU**"> "**WLAN SETTING**"> "**AP MODE**". Press "**OK**" to activate the WLAN, refer to Figure 3-8.1. Select **YES**, press **OK** to select AP mode. Select **AP Mode** correspondingly on the mobile device and continue the follow-up settings according to the APP prompts. During the Wireless distribution process, the LCD icon "" flashes to indicate that the network is being deployed. After the process is completed, the icon "" will be constantly on.

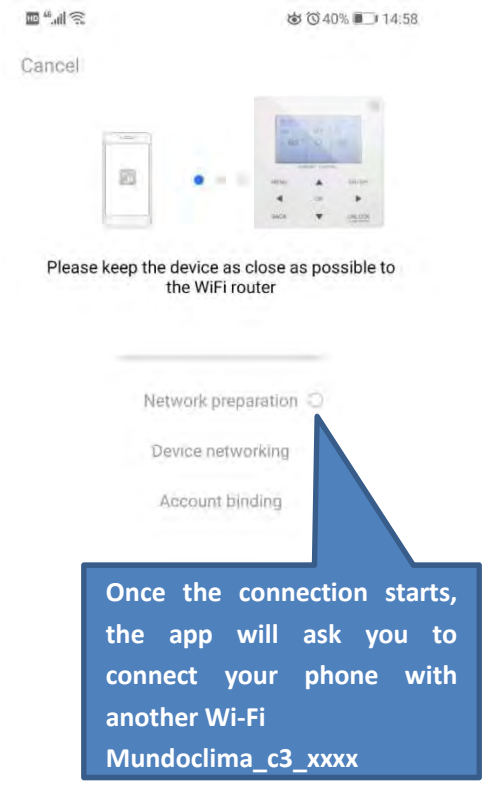


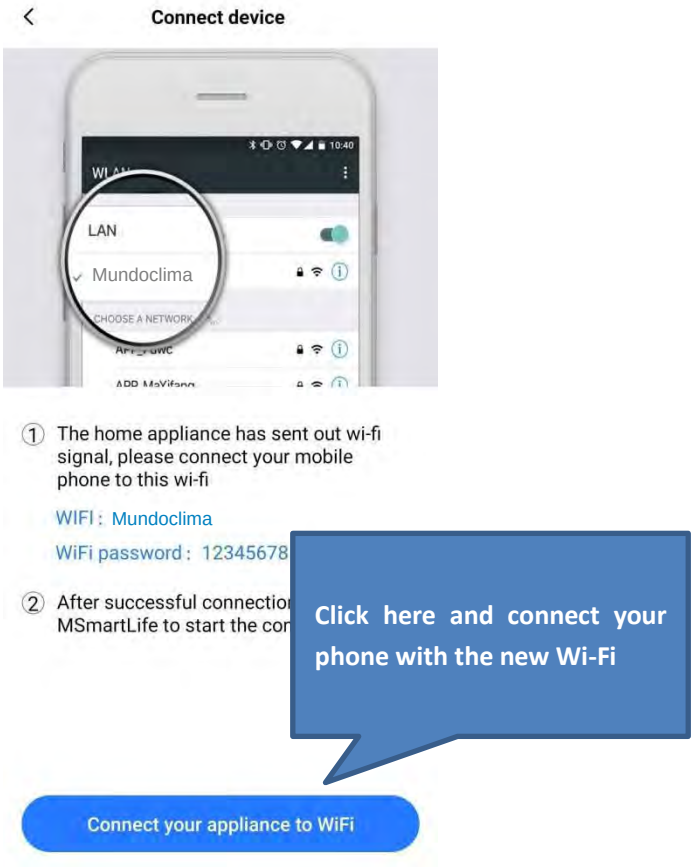


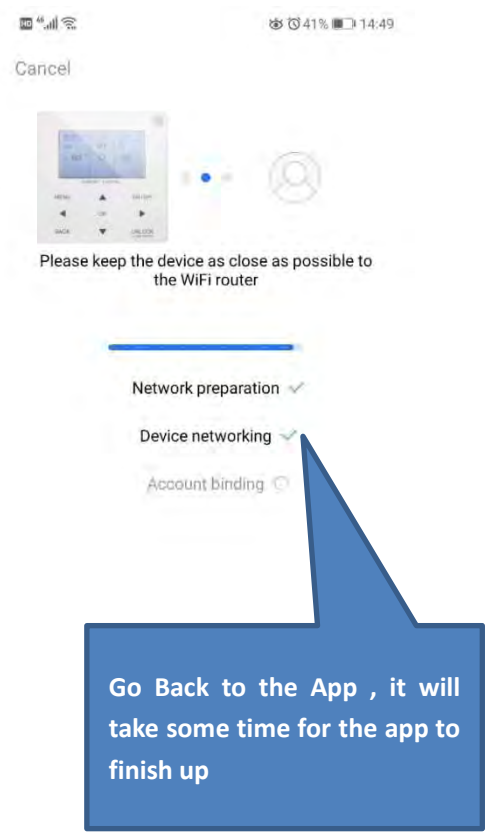


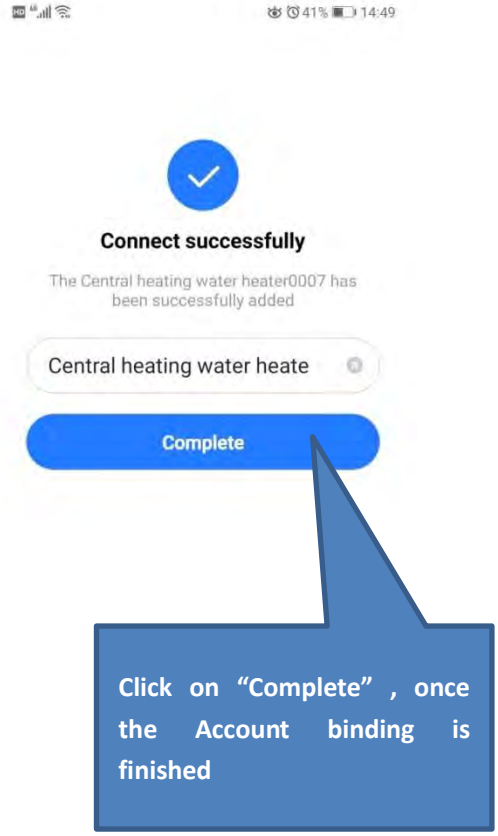


7.4.1 Connect to new Wi-Fi

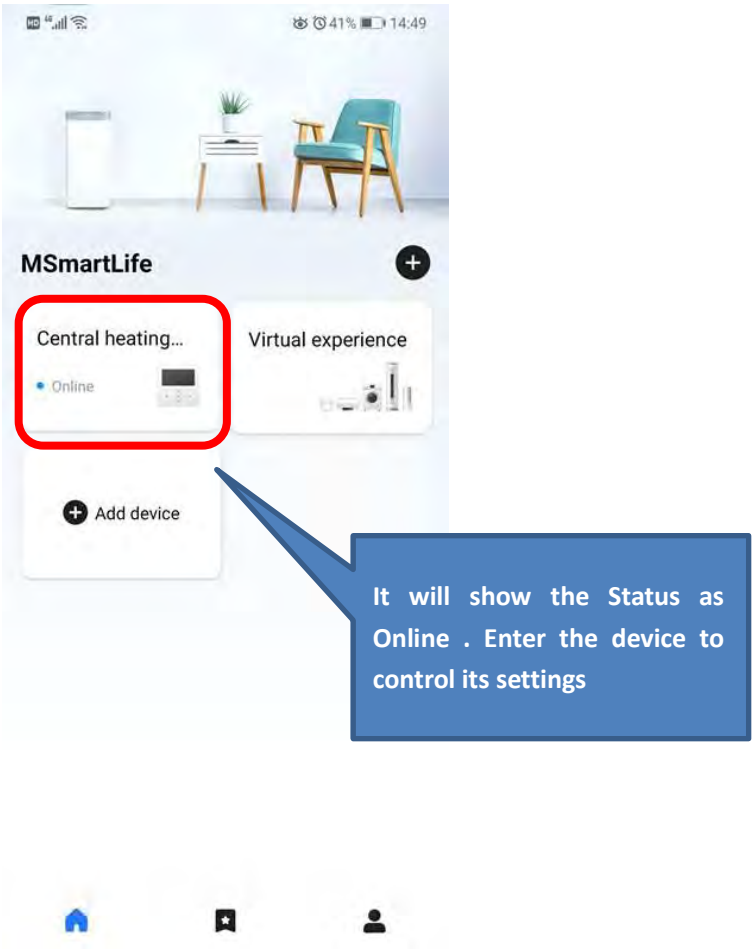








7.4.2 Finishing up


41% 14:49
MSmartLife
Central heating...
Online
Virtual experience
Add device
It will show the Status as Online . Enter the device to control its settings

8 Temperature Sensor Resistance Characteristics

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		

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		

Water side *heat exchanger water inlet / outlet temperature sensor, final 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	867.29	**10**	98.227	**50**	17.600	**90**	4.4381
-29	815.80	**11**	93.634	**51**	16.943	**91**	4.3022
-28	767.68	**12**	89.278	**52**	16.315	**92**	4.1711
-27	722.68	**13**	85.146	**53**	15.713	**93**	4.0446
-26	680.54	**14**	81.225	**54**	15.136	**94**	3.9225
-25	641.07	**15**	77.504	**55**	14.583	**95**	3.8046
-24	604.08	**16**	73.972	**56**	14.054	**96**	3.6908
-23	569.39	**17**	70.619	**57**	13.546	**97**	3.5810
-22	536.85	**18**	67.434	**58**	13.059	**98**	3.4748
-21	506.33	**19**	64.409	**59**	12.592	**99**	3.3724
-20	477.69	**20**	61.535	**60**	12.144	**100**	3.2734
-19	450.81	**21**	58.804	**61**	11.715	**101**	3.1777
-18	425.59	**22**	56.209	**62**	11.302	**102**	3.0853
-17	401.91	**23**	53.742	**63**	10.906	**103**	2.9960
-16	379.69	**24**	51.396	**64**	10.526	**104**	2.9096
-15	358.83	**25**	49.165	**65**	10.161	**105**	2.8262
-14	339.24	**26**	47.043	**66**	9.8105		
-13	320.85	**27**	45.025	**67**	9.4736		
-12	303.56	**28**	43.104	**68**	9.1498		
-11	287.33	**29**	41.276	**69**	8.8387		
-10	272.06	**30**	39.535	**70**	8.5396		
-9	257.71	**31**	37.878	**71**	8.2520		
-8	244.21	**32**	36.299	**72**	7.9755		
-7	231.51	**33**	34.796	**73**	7.7094		
-6	219.55	**34**	33.363	**74**	7.4536		
-5	208.28	**35**	31.977	**75**	7.2073		
-4	197.67	**36**	30.695	**76**	6.9704		
-3	187.66	**37**	29.453	**77**	6.7423		
-2	178.22	**38**	28.269	**78**	6.5228		
-1	168.31	**39**	27.139	**79**	6.3114		
0	160.90	**40**	26.061	**80**	6.1078		
1	152.96	**41**	25.031	**81**	5.9117		
2	145.45	**42**	24.048	**82**	5.7228		
3	138.35	**43**	23.109	**83**	5.5409		
4	131.64	**44**	22.212	**84**	5.3655		
5	125.28	**45**	21.355	**85**	5.1965		
6	119.27	**46**	20.536	**86**	5.0336		
7	113.58	**47**	19.752	**87**	4.8765		
8	108.18	**48**	19.003	**88**	4.7251		
9	103.07	**49**	18.286	**89**	4.5790		

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