












Single/Dual System SHCW814G Controller of Air Source Heat Pump Water Heater Installation Manual

Before installing the controller, please read the instructions in detail.

【Safety precautions】

Symbol description	Danger 	When used incorrectly, it may cause dangerous situations, personal injury or casualties.
	Caution 	When used incorrectly, it may cause dangerous situations, which may lead to equipment damage or accelerated damage.
Installation		Please install it on the non-combustible plate such as metal, and fix it firmly to avoid falling due to vibration.
		<p>Please eliminate static electricity before installation. Live installation and damage to components are prohibited.</p> <p>The main board should not be exposed to direct sunlight, rainwater and complex magnetic interference environment.</p> <p>Do not expose to corrosive or contaminated gases, such as sulphide gases and salt spray.</p> <p>Make sure that the temperature of the electric box is between - 20 ~-50°C, and add exhaust fan if necessary.</p>
Wiring		<p>Make sure that the power input is in the OFF state.</p> <p>The electrical staff should connect the wires following safety instructions.</p> <p>The input terminal is passive switching signal. Do not connect to the power supply.</p> <p>Attention should be paid to lightning protection. Make sure that the water tank and the machine are well grounded during roof installation.</p>
		<p>Please observe the principle of isolating strong and weak signals.</p> <p>Use wires that meet the required specifications.</p> <p>Please use parallel grounding mode. The thickness of the grounding wire should meet the requirements.</p> <p>When connecting terminals or inserts, please tighten them to prevent gap arcing and device damage.</p>
Parameter Settings		<p>Set relevant parameters according to machine configuration to ensure the normal operation of the machine.</p> <p>Set relevant jumper/decoder switch according to machine configuration to ensure the normal operation of the machine.</p>
Operation		<p>Input the power supply after confirming that the wiring is correct.</p> <p>Ensure that environmental conditions and power supply voltage are within permissible conditions before starting operation.</p>


		<p>When the machine is running, do not check the signal.</p> <p>When the machine is running, do not change the parameter settings at will.</p> <p>When the machine is running, do not get too close to the machine.</p>
Maintenance & inspection	 	<p>If a repair job is necessary, please contact the equipment manufacturer. Do not repair by yourself.</p> <p>Do not pull or twist power cord, communication line or probe line to avoid serious malfunction.</p> <p>Do not touch the main board components directly with your hands, so as to avoid conducting static electricity to damage the components.</p> <p>The display screen of the wire controller is made of glass. Attention should be paid to the protection to avoid breakage and damage.</p>
Others		<p>In the desktop simulation debugging motherboard, there is the risk of electric shock and injury, pay attention to safe operation.</p> <p>If the wire controller is a touch screen, please touch it with your finger. Do not press it or hit it with a hard object.</p>

1. Product Introduction

1.1 Overview

- This product is suitable for single compressor and double compressor system. Single-phase 220V or three-phase 380V is optional.
- The operation modes of the product are: hot water mode; heating / cooling mode; modular machine (8 modules).
- This product has the functions of power-off memory, timing on/off, forced defrosting, anti-freezing protection, three-phase protection, current overload protection and so on.
- Through RS485 communication, the product can be jointly controlled by remote equipment.

1.2 【Technical Specifications】

		
Operation Voltage	AC220V±10%, 50Hz±1Hz。	
Display Range	-30℃~90℃	
Control Accuracy	±1℃@25℃	
Working Environment	-25℃~70℃,≤85%RH	
Storage Environment	-30℃~85℃,≤85%RH	
Switch Output	Single Compressor Normal Temp Type: 8 way relay Low Temp Type: 10 way relay Double Compressor Normal Temp Type: 9 way relay Low Temp Type: 11 way relay	Single relay load < 200W (current 1A) (inductive load); Total load of relay at the same common terminal ≤ 1kW (current ≈ 5A)
Switch Input	Single compressor Normal Temp Type : 8 passive digital inputs Low Temp: 8 passive digital inputs Double compressors Normal Temp Type : 10 passive digital inputs Low Temp Type: 10 passive digital inputs	Do not connect to power supply, external load resistance ≤ 2K Ω
Electronic Expansion Valve	Single compressor Normal Temp Type: 1 Electronic Expansion Valve Low Temp Type : 2 Electronic Expansion Valve Double compressors Normal Temp Type: 2 Electronic	12V power supply, load coil current ≤ 0.4A

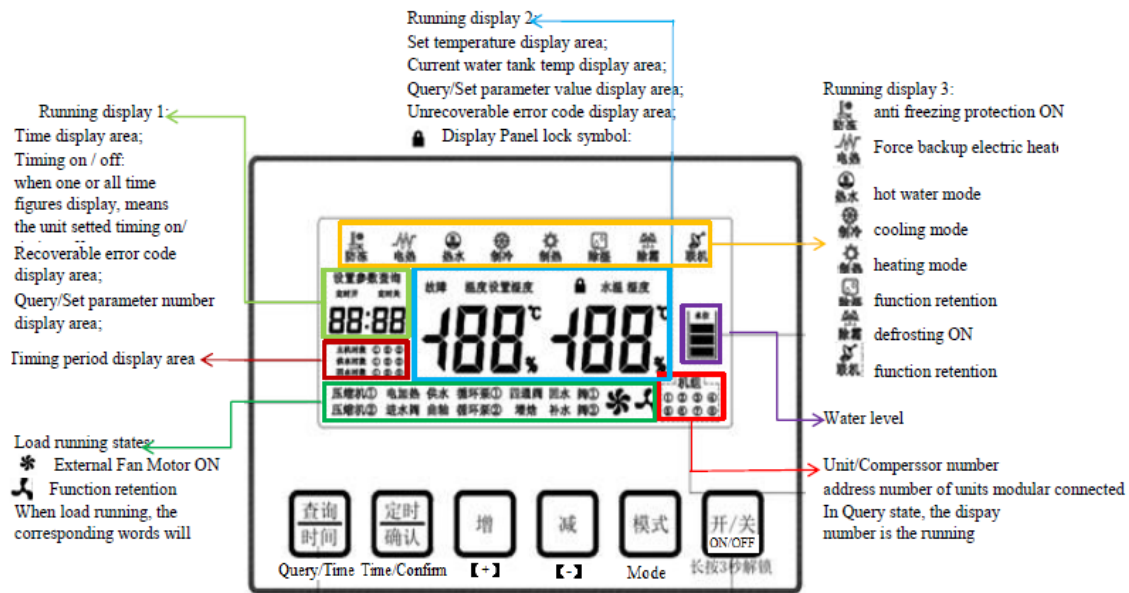
	Expansion Valve Low Temp Type : 4 Electronic Expansion Valve	
Analog input	Single compressor Normal Temp Type: 8 NTC Temp Sensor Low Temp Type : 8 NTC Temp Sensor	Discharge gas temperature sensor 50K 3950. Others 5K 3470
	Double compressors Normal Temp Type: 12 NTC Temp Sensor Low Temp Type : 8 NTC Temp Sensor	
	Single Compressor : 1 current detection interface	
	Double Compressors : 2 current detection interface	

1.3 【Spare Parts List】

Sequence No.	Name	Model No.	Pcs	Description
1	PCB	SHXK814G1	1	Low Temp Single Compressor System
2	PCB	SHXK814G2	1	Low Temp Double Compressor System
3	PCB	SHCW814G1	1	Normal Temp Single Compressor System
4	PCB	SHCW814G2	1	Normal Temp Double Compressor System
5	Display	SHXK814	1	Touch Screen, 12V DC
6	Commu nication Line	4 core 7M	1	Communication line connecting PCB and touch screen
7	Transfor mer	DB48-105-08100	1	
8	Temp sensor	2core 5K 3470		Configuration as required
9	Current Transfor mer	SH-D-C-A	1\2	1 for single compressor 2 for double compressor system
Optional				
1	GPRS Module			

2. Wire Controller Display Description, Parameter Query and Fault Table

2.1 Wire Controller Display Description (model: SHXK814)



Note: When the unit working, corresponding graphic symbol will display when controller has output, if it's External devices but didn't install, there will don't have the function even the graphic symbol display.

After the first power-on, the LCD screen displays the version number of the line controller for 2 seconds, and then the full screen displays, and it enters the normal working state.

【ON/OFF】

In the boot state, press this key to enter the shutdown state, displaying water temperature, timing state and clock, etc.

In the shutdown state, press this key to enter the boot state, displaying the operation mode, setting temperature, water temperature, unit, timing state and clock, etc.

After the first power-on, if there is no key-press operation for more than 60 seconds, the controller automatically enters the state of key-lock, and the "🔒" symbol is displayed. Press this key for 3 seconds to release the lock key status and the "🔒" symbol disappears.

When setting clock, timing, parameter query and parameter setting, press this key to exit the setting state.

【+】 【-】

This key can be used for parameter query, parameter setting, clock adjustment, timing adjustment and temperature setting.

Press **【+】** to increase the temperature setting value and press **【-】** to decrease the temperature setting value.

【Query/Time】

Press this key to enter the clock setting state. The "HOUR" of the clock flickers. Adjust the "HOUR" by pressing **【+】** **【-】**. Press **【Query/Time】** again to enter the "MINUTE" setting, the "MINUTE" of the clock flickers. Adjust the "MINUTE" by pressing **【+】** **【-】**, and then press **【Query/Time】** to confirm the clock setting and exit the clock setting.

Press this key to cancel the timed turn-on/turn-off in the setting state.

In the state of parameter query, pressing this key can clear the unrecoverable fault.

Press **【Query/Time】** for 3 seconds and enter the parameter query state.

[timing / confirm] key

Press this key to enter the timing on / off setting.

In the non clock setting state, press this key to enter the timing period selection of the unit. There are 3 periods in total. Press **【+】 【-】** keys to select the period, press this key to confirm the period. Press **【+】 【-】** keys to select timing on or timing off, and then press this key to confirm. At this time, the hour digit will flash, and press **【+】 【-】** keys to adjust the hour time, then press this key to confirm the set hour digit. Then the minute digit will flash, press **【+】 【-】** keys to adjust the minute time, then press the this key to confirm the set minute digit and exit the timing setting state.

Cancel timer

In the timing period selection, press **【+】 【-】** keys to select the period to be cancelled, and then press "time" key to cancel the timing on and timing off settings of this period.

Forced defrost

When the system starts up and enters the unit parameter query state, press and hold the [query / time] and [timing / confirmation] keys for more than 5 seconds, and the buzzer drips once.

A. when the system enters defrost mode, the LCD screen will display [defrosting];

B. when the exit conditions are met, the system will exit defrost automatically.

C. operating conditions: hot water mode or heating mode.

【mode】 key

In "hot water" or "heating" mode, press and hold this key for 3 seconds to turn on or cancel forced electric heating;

Heating/Cooling models: in the startup state, press the [mode] key to switch the operation mode between "cooling" and "heating" modes;

General parameter query

Query parameter method: press and hold the [query / time] key for 3 seconds to enter the parameter query status.

Display add 1 (add: for unit address, 1: for unit 1). Press the **【+】 【-】** key to select the unit number to query. For example, when "add 1" is displayed, press the [mode] key to enter the parameter query of unit 1. At this time, D01 is displayed. Press **【+】 【-】** key to change the parameter query item. Other unit queries are the same.

Exit -- press the "on / off" key or no operation key for more than 120 seconds to exit the parameter query.

2.2General Parameter Query Table 1

Code	Representation	Remarks
Add	Unit Address	Add 1 represents unit 1, press 【+】 and 【-】 to select the unit address, and press [mode] to confirm.
d01	Non Recoverable Error Code	
d02	Recoverable Error Code	
d03	Tank water temperature	
d04	Inlet water temperature	
d05	Outlet water temperature	
d06	Ambient temperature	
d07	Evaporator coil temp 1	
d08	Suction temp 1	
d09	Discharge gas temp 1	
d10	After valve temp 1 in cooling /Return Water Temp	After valve temp in cooling and Return water temp in hot water mode
d11	Evaporator coil temp 2	
d12	Suction temp 2	

d13	Discharge gas temp 2	
d14	After valve temp 2 in cooling	
d15	Compressor current 1	
d16	Compressor current 2	
d17	Compressor Current Set Value	
d18	Main Circuit EEV opening 1	
d19	Main Circuit EEV opening 2	
d20	Auxiliary Circuit EEV opening 1	
d21	Auxiliary Circuit EEV opening 2	
d22	External Version 1	
d23	External Version 2	
d24	Low Water Level Sensitivity	Valid in Hot Water Mode, not valid in heating/cooling Mode
d25	Medium Water Level Sensitivity	Valid in Hot Water Mode, not valid in heating/cooling Mode
d26	High Water Level Sensitivity	Valid in Hot Water Mode, not valid in heating/cooling Mode
d27	Protection Switch Status 1	
d28	Protection Switch Status 2	
d29	Output 1 Status	
d30	Output 2 Status	
d31	Output 3 Status	
d32	External machine model code	
d33	Communication status 1	A digital jump indicates normal communication
d34	Communication status 2	A digital jump indicates normal communication
d35	Weeks of Limited Use	
d36	Historical Fault 1 (Latest)	
d37	Historical Fault 2	
d38	Historical Fault 3	
d39	Historical Fault 4	
d40	Historical Fault 5	
d41	Historical Fault 6 (Oldest)	
d42	Evaporator coil temp 3	Reserved
d43	Evaporator coil temp 4	Reserved
d44	Suction Temp 3	Reserved
d45	Suction Temp 4	Reserved
d46	After Valve temp 3	Valid in Heating/Cooling Mode, Reserved
d47	After Valve temp 4	Valid in Heating/Cooling Mode, Reserved
d48	Discharge gas temp 3	Reserved
d49	Discharge gas temp 4	Reserved
d50	Compressor 3 Current	Reserved
d51	Compressor 4 Current	Reserved
d52	Main EEV 3	Reserved
d53	Main EEV 4	Reserved
d54	Auxiliary EEV 3	Reserved
d55	Auxiliary EEV 4	Reserved

2.3 System Fault Table 2

COD	Protection	Cause of Failure	Entry Condition	Fault Handling
E01	System Shutdown	Wrong Phase	Wrong Phase	Check whether the three-phase wiring of power supply is correct

E02	System Shutdown	Phase Loss	Phase Loss	Check whether the three-phase wiring of power supply is correct
E03	System Shutdown	Water Flow Switch 1 Protection	Water Flow Switch 1 open for 3 times in 1 hour	Check Water Flow Switch , water pump and water pipe
E05	System Shutdown	High Pressure Switch 1 Protection	High Pressure Switch 1 open for 3 times in 1 hour	Check manometers, heat exchangers, water pump and water pipe
E06	System Shutdown	Low Pressure Switch 1 Protection	Low Pressure Switch 1 open for 3 times in 1 hour	Check refrigerant, heat exchangers, and fan motors
E07	System Shutdown	High Pressure Switch 2 Protection	High Pressure Switch 2 open for 3 times in 1 hour	Check manometers, heat exchangers, water pump and water pipe
E08	System Shutdown	Low Pressure Switch 2 Protection	Low Pressure Switch 2 open for 3 times in 1 hour	Check refrigerant, heat exchangers, and fan motors
E09	System Shutdown	Communication Error	Communication failure between mainboard and display panel	Check communication wire sequence, connector and type
E10	System Shutdown	Insufficient Water Protection	Low Water Level Switch open for 10 minutes	Check low water level switch, water pump and water level in the tank
E11	System Shutdown	Time Limitation Protection	Consult the manufacturer when the probation period expires	Enter the correct password to unlock
E12	System Shutdown	Discharge gas temp 1 protection	Discharge gas temperature 1 exceeds the setting	Check if discharge gas temperature exceeds the setting
E13	System Shutdown	Discharge gas temp 2 protection	Discharge gas temperature 2 exceeds the setting	Check if discharge gas temperature exceeds the setting
E15	System Shutdown	Water tank temp sensor failure	Sensor short or open	Secure connector or replace sensor
E16	Failure report	Evaporator coil temp sensor 1 failure	Sensor short or open	Secure connector or replace sensor
E17	Failure report	Evaporator coil temp sensor 2 failure	Sensor short or open	Secure connector or replace sensor
E18	Failure report	Discharge gas temp sensor 1 failure	Sensor short or open	Secure connector or replace sensor
E19	Failure report	Discharge gas temp sensor 2 failure	Sensor short or open	Secure connector or replace sensor
E21	Failure report	Ambient temp sensor failure	Sensor short or open	Secure connector or replace sensor
E22	Failure report	Return water temp sensor failure	Sensor short or open	Secure connector or replace sensor
E23	Failure report	Inlet water temp sensor failure	Sensor short or open	Secure connector or replace sensor
E25	System Shutdown	Water level switch failure	Water level switches misplaced	Place the switches in the correct positions
E26	System Shutdown	Outlet water over temperature protection	Outlet water temperature exceeds setting	Check pipeline filter, valve and water pump head
E27	Failure report	Outlet water temp sensor failure	Sensor short or open	Secure connector or replace sensor
E28	System Shutdown	Insufficient water flow	Differential temp inlet/outlet exceeds setting	Check water flow, water circuit and water pump head
E29	Failure report	Suction temp sensor 1 failure	Sensor short or open	Secure connector or replace sensor

E30	Failure report	Suction temp sensor 1 failure	Sensor short or open	Secure connector or replace sensor
E32	System Shutdown	Low outlet water temp protection	Outlet water temp lower than setting	Check pipeline filter, valve and water pump head
E35	System Shutdown	Compressor 1 overcurrent	Compressor 1 current exceeds setting	Check compressor current
E36	System Shutdown	Compressor 2 overcurrent	Compressor 2 current exceeds setting	Check compressor current
E39	Failure report	EEPROM error		Restore to factory settings
E50				
E51				
E52				
E53				
E54	Failure report	Heating/cooling: after valve sensor 1 failure Hot water: Inlet water temp sensor failure	Sensor short or open	Secure connector or replace sensor
E55	Failure report	Heating/Cooling : after valve sensor 2 failure Hot water: N/A	Sensor short or open	Secure connector or replace sensor
E56				
E57				
E63				
E65				
E66				
E67				
E68				
E72				
E73				
E76				
E77				
E78				

E79				
E89				
E90				
E95				
E96				

Note: 1. The temperature fault protection can be recovered automatically, and other fault protection must be restarted by pressing 【ON/OFF】 key.

2. In case of module fault, the number in front of E indicates the unit number in fault. For example, when 2E09 is displayed, E09 communication fault occurs in unit 2.

3. Main board wiring diagram and dial code description

3.1 Model selection SW1 dial code setting description

SET ITEM	DIP1	DIP2	DIP3	DIP4	RESULT	REMARKS
Power Supply	OFF				1PH 220V	
	ON				3PH 380V	Check whether the three-phase is in phase loss or out of phase
Spare		OFF				
		ON				
Main Circuit EEV			OFF		Regular	Do not detect suction temperature and the temperature after the valve
			ON		Superheat	Detect suction temperature and the temperature after the valve
Model Selection				OFF	Heating/cooling	Do not detect water level. Make up valve and return valve not valid.
				ON	Hot water	Detect water level. Make up valve and return valve valid.

Note:1) the dip switch is off on the digital side and on on the "ON" side;

2) when single-phase 220V is selected, three-phase protection will not be detected;

3) the DIP switch is only detected when the unit is powered on, and will not be detected after the unit is powered on.

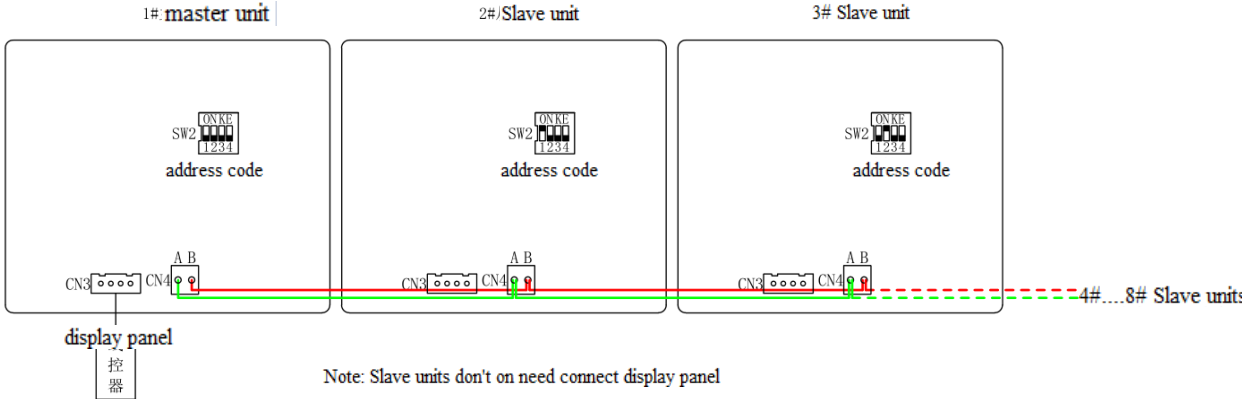
3.2 Module address SW2 dial code setting description

SET ITEM	DIP1	DIP2	DIP3	DIP4	Result	Remarks
Module address setting (SW2)	OFF	OFF	OFF	OFF	1#Module	Master
	ON	OFF	OFF	OFF	2#Module	Slave 2
	OFF	ON	OFF	OFF	3#Module	Slave 3
	ON	ON	OFF	OFF	4#Module	Slave 4
	OFF	OFF	ON	OFF	5#Module	Slave 5
	ON	OFF	ON	OFF	6#Module	Slave 6
	OFF	ON	ON	OFF	7#Module	Slave 7
	ON	ON	ON	OFF	8#Module	Slave 8

Note: 1) the DIP switch is OFF on the digital side and ON on the "ON" side;

- 2) the address code of the unit must be set before the unit is powered on. Ensure that the address codes of each unit are different; after power on, the dial switch will not be detected.
- 3) modular mode: 1 # the module is the master unit, which controls the water tank, water level, end switch and circulating water pump; the slave machine does not connect to the display panel, otherwise the connected display panel will report "E09" fault; the slave units does not detect the water tank, water level and end switch.
- 4) singular mode: the address code of the main board shall be set as 1 #, otherwise the communication failure of "E09" will be reported.

3.3 Wiring diagram of main boards of modular units



3.3.1 description of unit free combination

All units are connected through the module interface communication bus, and the control board on the network is connected in parallel. Each control panel can work independently or in combination with multiple control panels, and can control up to 8 unit modules. The addresses of the units must be unique (i.e. different), and one unit address must be set to 1 (i.e. master) and the others are slave. Each control board has the same function. The master and slave can be set by dialing the module address on the control board. When the address dial code is set to 1, the unit is specified as the master, and the rest addresses are all slaves.

In addition to the functions of the slave, the master also include the control functions of devices with [※] (table below). The slave does not output or detect the above components. Therefore, the master is equivalent to the slave plus additional control functions. The additional control functions are independent. If the master is shut down in case of failure, the additional control functions will not be affected. That is to say, the master which is shutdown because of its own failure will not affect the operation of the water heater system. Each module controller can be set as a master module or a slave module. Only one controller is allowed to be set as the master module in a system, and the controllers set as the slave modules can be added to the system at any time for operation, or can be detached from the system for maintenance or inspection at any time.

The setting parameters of the modular units are shared.

No.	Digital Input	Digital Output	Analog Input	Analog Output	Special Interface
1	End switch ※	Enthalpy Valve	Ambient Temp	1#Main EEV	Display Panel interface 485
2	Water Flow Switch	1#Compressor	Outlet Temp	2#Main EEV	Modular Interface485
3	2#High Pressure	2#Compressor	Water Tank Temp※	1#Auxiliary EEV	Transformer primary
4	2#Low Pressure	External Fan Motor	Inlet Temp	2# Auxiliary EEV	Transformer secondary
5	1#High Pressure	4-way valve	1#Compressor Discharge		RS485 Interface 1
6	1#Low Pressure	Circulation Pump※	2#Compressor Discharge		RS485 Interface 2
7	Three Phase Detect	Electric	1# After Valve Temp (only in cooling)		
8	Three Phase Detect	Crankcase	2#After Valve Temp		
9	Three Phase Detect	Water Replenish Valve	1#Sutction Temp		
10		Backwater Valve	2#Sutction Temp		
11		Chasis Heating	2#Evaporator Coil Temp		
12			2#Evaporator Coil Temp		
13			1#Compressor Current		
14			2#Compressor Current		
15			High Water Level Signal※		
16			Medium Water Level Signal※		
17			Low Water Level Signal※		
18			Return Water Temp (hot water only)		

3.3.2 Modular Unit Energy Regulation Description

Energy regulation is determined by two factors:

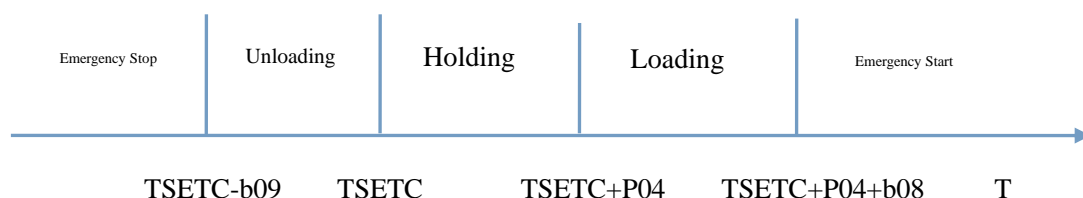
- Control temperature: water tank temperature
- Control cycle;

The energy is regulated by the temperature area, and there are five areas in total: emergency start, loading, holding, unloading and emergency stop.

When the control temperature is in the emergency start area, an energy level is loaded after every [control cycle B10] time; when the control temperature is in the energy loading area, an energy level is loaded after every [control cycle B11] time until all the energy is loaded; when the control temperature is in the energy holding area, the current energy level is maintained without action; In the energy unloading area, unload one energy level every [control cycle B11] time until all the energy is unloaded; when the control temperature is in the emergency stop area, unload one energy level every [control cycle B10] time. The energy level is the units of the modular machines.

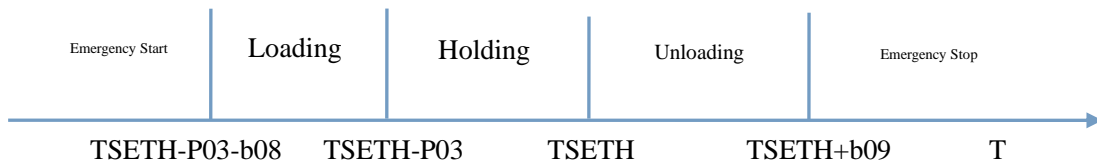
Note: when the modular machine or water heater is selected, the start and stop of the compressor is controlled by the water tank temperature, and the current water temperature is the water tank temperature;

3.3.3 Division of cooling energy regulation area



Graph 1

3.3.4 Division of heating energy regulation area



Graph 2

Note: TSETC: setting temperature in cooling; TSETH: setting temperature in heating;

P03 (parameter setting item): differential temperature in heating;

P04: differential temperature in cooling;

B08: differential temperature for return water in emergency start;

B09: differential temperature for return water in emergency stop;

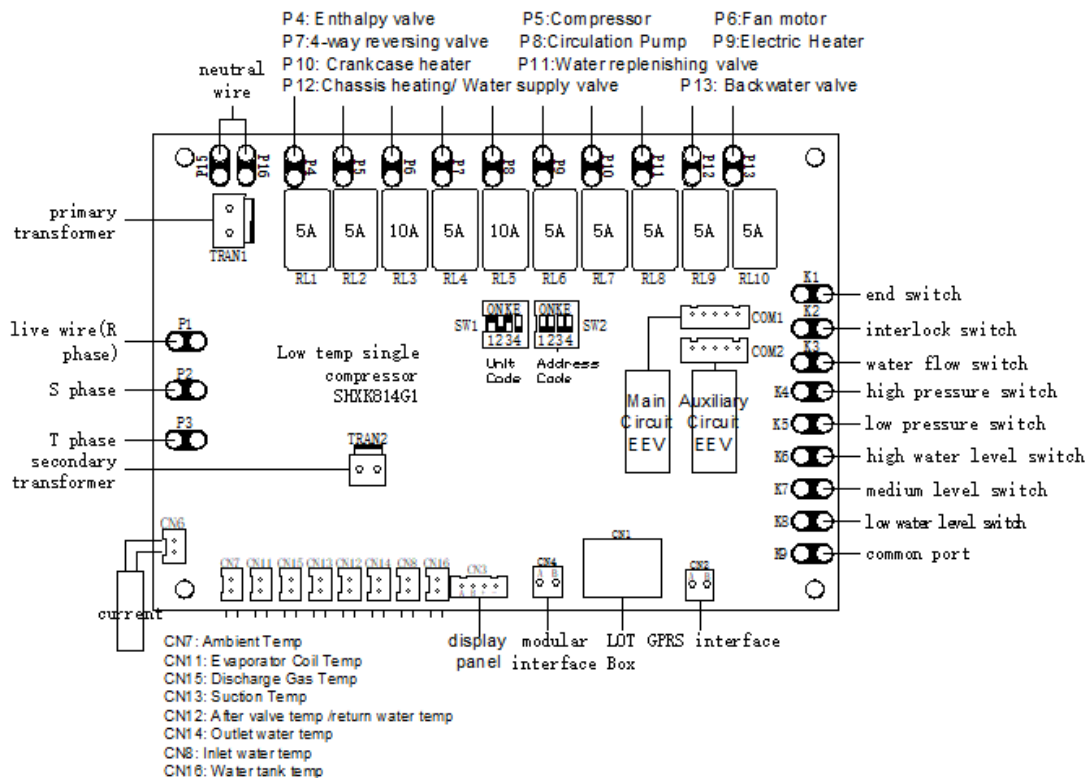
B10: emergency start / stop control cycle (unit: Second);

B11: load / unload control cycle (unit: minute)

3.4 The connection method of GPRS module in modular units

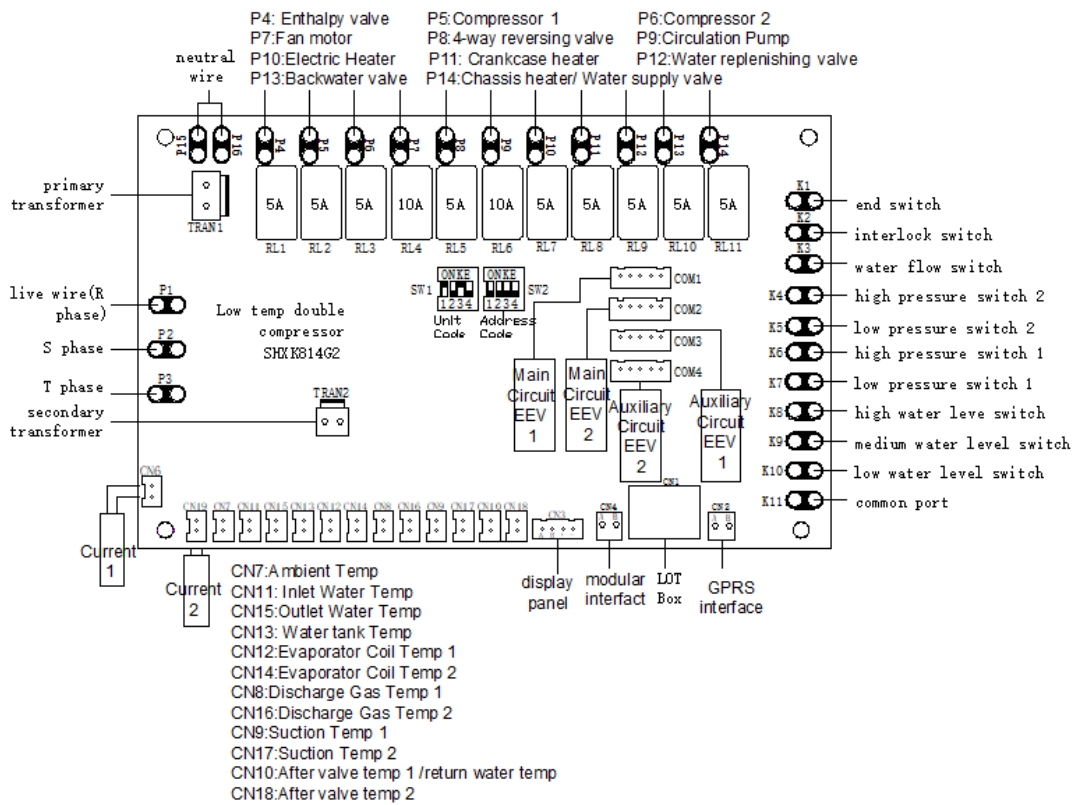
A and B of the GPRS module interface of the master are respectively connected with A and B of the GPRS module interface of the slave. The mode of connection with the main board of the module is similar. The GPRS module is connected to the master. See the wiring diagram for the location of GPRS module interface.

3.5 SHXK814G1 wiring diagram of single system of low temperature unit



Note: For heating/cooling model, CN12 is After valve sensor, P12 is Chassis heating. The water level switches K6, K7, and K8 are invalid; For hot water model, CN 12 is Return water temp sensor, P12 is Water supply valve, the water level switches K6, K7, and K8 are effective.

3.6 SHXK814G2 wiring diagram of dual system of low temperature unit



Note: For heating/cooling model, CN 10 is After valve sensor 1, CN18 is After valve sensor 2. P14 is Chassis heating. The water level switches K8, K9, and K10 are invalid; For hot water model, CN 10 is Return water temp sensor, CN18 is invalid, P14 is Water supply valve, the water level switches K8, K9, and K10 are effective.

4. Output description of replays

4.1 Compressor (220V/5A)

- 1) the compressor will not stop running due to energy load reduction within 3 minutes after starting, except in the emergency stop area of energy regulation and fault protection;
- 2) the delay of 3 minutes (minimum standby time) must be met when the compressor is turned off and then turned on.

4.2 Fan Motor (220V/10A)

- 1) Turn on the fan motor before starting the compressor;
- 2) Turn off the fan motor after the compressor shuts down;
- 3) In defrost mode, the fan motor is controlled according to the defrosting logic;

Fan-off unloading function: in the hot water mode, when the discharge gas temperature is \geq P15, (default 105 °C) and the ambient temperature is \geq 25 °C, the fan turns off; when the discharge gas temperature is $<$ p15-5 °C or the ambient temperature is \leq 23 °C, the fan turns. When the parameter setting value for P15 is set as 130, cancel this function.

4.3 4-way Reversing Valve (220V/5A)

- 1) the 4-way valve starts 10 seconds before the compressor starts (only in cooling mode);
- 2) the 4-way valve closes 2 minutes after the compressor shuts down.

4.4 Circulation Pump (220V/10A)

In hot water mode, the circulating pump operates as below.

- 1) before the compressor starts, the circulating pump starts in advance;

2) after the compressor shuts down, the circulating pump is delayed to shut down.

3) when the temperature of the inlet water is too low and the pipeline is protected against freezing, the circulating pump is forced to start.

4) in defrost mode, the circulating pump is forced to start.

In Heating and cooling mode: when the end switch is invalid, the circulating pump operates as the above. When the end switch is effective, if the end switch opens, both the compressor and circulating pump are forced to stop. When the end switch closes, if the water temperature reaches the set temperature and the parameter value in A09 is set to 0, the circulating pump runs continuously when the unit is started, otherwise the circulating pump will run for A10 minutes after it stops for A09 minutes

4.5 make up water valve (220V / 5A) (valid in hot water mode)

1) when the the high, middle and low water level switches are all disconnected, and the make-up valve is forced to open. After 10 minutes, if the high, middle and low water level switches are still disconnected, the water shortage protection is reported.

2) after the low water level switch is closed, the forced water replenishment is cancelled and the unit switches to the temperature control water replenishment. When the water tank temperature is \geq setting temperature - P06 (when the setting temperature is $< 51\text{ }^{\circ}\text{C}$, P06 is halved), the make-up valve is opened; when the water tank temperature is \leq setting temperature - P06 (when the setting temperature is $< 51\text{ }^{\circ}\text{C}$, P06 is halved) - P07, the make-up valve is closed.

3) when the high, middle and low water level switches are closed, the make-up valve is forced to close. Only when the high and middle water level switches are disconnected, can it be switched to temperature control water supply again.

4) when the high water level switch is closed and the low water level switch is disconnected for 10 seconds, the water level switch fault will be reported.

4.6 return valve (220V / 5A) (valid in hot water mode)

4.6.1 regular return water

1) in the hot water mode, when the return water temperature \leq parameter p08-5 $^{\circ}\text{C}$ and the water tank temperature is \geq parameter P08 + 5 $^{\circ}\text{C}$, turn on the return water function, when the return water temperature \geq parameter P08, turn off the return water function.

2) the return valve will be opened only when the remote terminal has the function of timed return water and the current time is within the set time range and the return water function is turned on.

4.6.2 temperature control return water

1) when the main board does not communicate with GPRS module for 10 minutes, turn on the temperature control return function.

2) in the hot water mode, when the return water temperature \leq parameter p08-5 $^{\circ}\text{C}$, turn on the return water function, when the return water temperature \geq parameter P08, turn off the return water function.

3) when the return water function is turned on, the temperature of the water tank must be higher than the parameter item P08 + 5 $^{\circ}\text{C}$ before the return valve is turned on.

4.7 Electric Heater (220V/5A)

1) when the ambient temperature is \leq p09, the controller will check if the condition of electric heater is met. When the ambient temperature is \geq p09 + 2 $^{\circ}\text{C}$, the electric heater is turned off

When the water temperature is \leq the set temperature - P10 (default 7 $^{\circ}\text{C}$), the electric heater is turned on;

When the water temperature is \geq the set temperature, the electric heater is turned off;

2) press and hold the [mode] key for 3 seconds to forced start the electric heater; (ambient temperature conditions unnecessary to be met)

When the water temperature is \geq the set temperature, the electric heating is turned off;

When the water temperature is \leq the set temperature - P10 (default 7 °C), the electric heater is turned on;

3) when the master unit defrosts, the electric heater starts. When the unit enters the secondary anti freezing or water tank anti freezing, the electric heater is turned on.

4) electric heater does not start in cooling mode.

4.8 enthalpy increasing valve (220V / 5A)

1) when the ambient temperature is \leq P11, the enthalpy increasing valve opens. When the ambient temperature is \geq P11 + 2 °C, the enthalpy increasing valve is forced to close.

2) the enthalpy increasing valve can be opened only after the compressor is started for 12 seconds. When the compressor is closed, the enthalpy increasing valve is forced to close.

3) In cooling mode or defrost mode, the enthalpy increasing valve is forced to close.

As long as one system of the double system unit meets the requirements of opening the enthalpy increasing valve, the enthalpy increasing valve will be opened.

4.9 Crankcase heater for compressor (220V / 5A)

1) when the ambient temperature is \leq 5 °C, the crankcase heater is turned on; when the ambient temperature is \geq 8 °C, the crankcase heater is turned off.

4.10 chassis heating (220V / 5A)

1) when the ambient temperature is \leq P14, and the compressor is turned in defrost, the chassis heating is turned on.

2) when the ambient temperature is \geq P14 + 2 °C or when it is in cooling mode, the chassis heating is turned off.

4.11 water supply valve (220V / 5A) (effective in hot water mode)

1) when the display temperature is \geq parameter P08 + 2 °C, the water supply function is activated.

2) after the water supply function is activated, if the remote end has turned on the timed water supply function and the current time is within the set timed time range, the water supply valve is turned on.

3) if the display temperature is lower than the parameter item P08 -2 °C, or the remote end does not turn on the timed water supply function, or the timed water supply is turned on, but the current time is not within the set time range, the water supply valve is closed.

4) when the low water level is disconnected, the water supply valve is closed.

5. Electronic expansion valve control logic

5.1 main circuit electronic expansion valve

1) after the compressor stops, the electronic expansion valve opens to the full open state, i.e. the maximum number of pulses (parameter setting item L3) (settable, range: 230-254, default is 240, and the actual number of pulses is the set value \times 2);

2) 30 seconds after the compressor is started, in cooling mode the electronic expansion valve is opened to the corresponding initial value L09, and the initial value in hot water / heating mode for electronic expansion valve is L08;

3) when the electronic expansion valve is fully closed, it is 0 pulse, and when it is fully opened, it is the maximum pulse;

The basic principle of opening the main circuit electronic expansion valve is as follows:

After the compressor is started, in hot water/ heating mode the system will detect the difference between suction temperature and the coil temperature, and in cooling mode the system will detect the difference between the suction temperature and the after valve temperature. Adjustments will be made according to the following rules.

The maximum opening during the adjustment process is L3, the minimum opening in cooling mode is L07, and the

minimum opening in hot water or heating mode is L22 ~ L26. The adjustment interval time is L04 seconds. The electronic expansion valve of each system works and adjusts independently;

Hot water / heating mode: $\Delta P = \text{suction temperature} - \text{coil temperature} - L22 \sim L26$

Cooling mode: $\Delta P = \text{suction temperature} - \text{temperature after refrigeration valve} - L05$

In hot water or heating mode, when the ambient temperature is not less than L14 and the water temperature is not less than L15, $\Delta P = \text{suction temperature} - \text{coil temperature} - L13$;

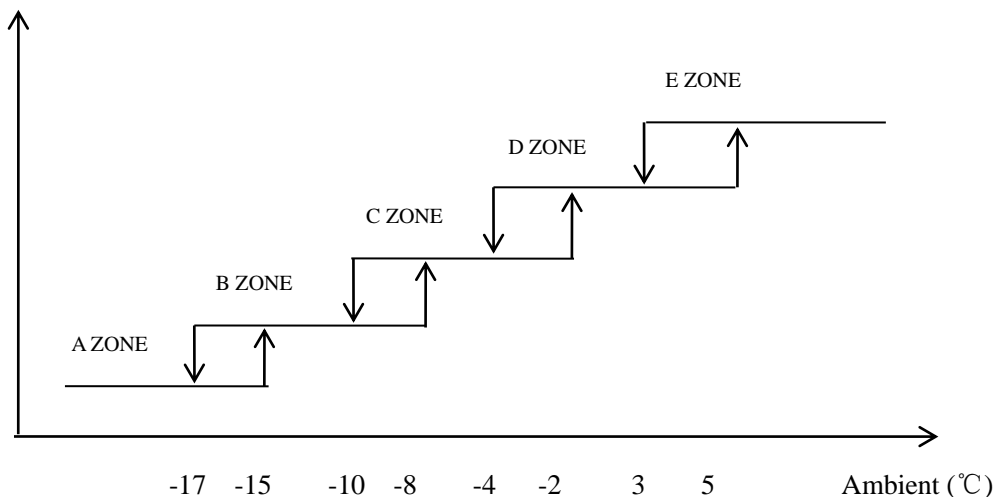
Restrictions on opening of main circuit electronic expansion valve:

① when the suction temperature is higher than L12, the value of the electronic valve increases gradually with 8 pulses, and it can reach the maximum value; when the suction temperature is lower than $L12 - 2 \text{ }^\circ\text{C}$, it enters normal regulation;

② when the discharge gas temperature of the compressor is $\geq L10$, the value of the electronic valve increases gradually with 8 pulses, and it can reach the maximum value; when the discharge gas temperature of the compressor is $\leq L10 \text{ }^\circ\text{C}$, it exits this regulation;

③ when the discharge gas temperature is higher than L11, the value of the electronic valve increases gradually with 8 pulses, and it can reach the maximum value; when the discharge gas temperature is lower than $L11 - 2 \text{ }^\circ\text{C}$, it enters normal regulation;

Note: the superheat and the minimum opening of the electronic expansion valve of the main circuit are divided into 5 areas according to the table below.



5.2 auxiliary electronic expansion valve

1) after the enthalpy increasing valve closes, the electronic expansion valve of the auxiliary circuit will fully close;

2) after the enthalpy increasing valve opens, the auxiliary electronic expansion valve will open to the initial opening set in parameter L16. After the compressor starts for 2 minutes, If inlet water temperature and discharge gas temperature are detected, the opening of the EEV will be adjusted according to the following rules. The maximum opening is 60 and the minimum opening is L17. The adjustment interval time is L4 seconds;

$\Delta P = \text{discharge gas temperature} - \text{inlet water temperature} - 35 \text{ }^\circ\text{C} - L18$;

When $|\Delta p| = 2$, the electronic expansion valve of the auxiliary circuit maintains the current opening.

6. Logic of defrost control

This function is only valid in hot water mode or heating mode;

6.1 conditions for defrosting

1) when the ambient temperature is $\geq H08$ (default - $6 \text{ }^\circ\text{C}$) + $1 \text{ }^\circ\text{C}$, coil temperature is $\leq H02$ (default -

3 °C), ambient temperature is \leq H01 (default 15 °C), and the compressor is running, time counting starts, when timing is \geq H04 (default 60 minutes);

2) when the ambient temperature is \leq H08, the cumulative operation time of the compressor is \geq H12 (default 90 minutes) ;

3) ambient temperature - coil temperature is \geq H09;

4) the compressor runs continuously for 6 minutes;

If any system meets the above conditions of 1, 3, 4 or 2, 3 and 4 at the same time, both systems will enter defrost at the same time, and the display panel will display defrost icon.

6.2 defrost exit conditions

1) coil temperature \geq H03 (default 16 °C) for 30 seconds;

2) defrost operation time \geq H05 (default 8 minutes);

3) high pressure protection;

4) compressor current \geq B01 for 5 seconds;

5) the outlet water temperature is less than 5 °C for 10 seconds;

If one system meets any of the above conditions, the compressor stops, and if both systems meet any of the above conditions, the unit will exit defrost.

6.3 defrost operation process

Enter defrost - compressor off - external fan off, 4-way valve on - compressor on;

6.4 defrost exit process:

Defrost exit conditions satisfied - compressor off - external fan on - 4-way valve off - compressor on, defrost icon on display panel removed (only valid when querying this unit).

6.5 forced defrost

Enter the parameter query state, select the address of the unit to be forced defrosted, and in the query unit state, press and hold the [query / time] + [timing / confirmation] key for 5 seconds. This unit enters into forced defrost operation, and defrosting symbol flickers.

1) when the system enters defrost, the panel displays [defrosting];

2) operation conditions: in hot water/heating mode only;

Note: during defrosting, there is no need for coordination between modules. As long as defrosting conditions are met, the module unit will enter defrost; for modules entering defrost, two systems will enter defrost synchronously.

When H07 is set to - 5, the unit defrosts according to the default conditions.

When H07 is not set to - 5, and the ambient temperature \leq H07, the unit does not defrost.

7. System Protections

7.1 phase loss and reverse phase protection

1) when the three-phase input is out of phase or of wrong phase, it will enter the unit protection state. When the three-phase input is normal, the unit will exit the protection state and enter the normal operation state.

2) the phase loss and wrong phase protection can be selected, which can be turned on or cancelled through the dial switch SW1-1 on the main board.

7.2 high pressure protection

1) when the high pressure switch is detected to be open for 5 seconds, the unit will stop and display the fault code. When the high pressure switch is detected to be closed, the unit will start (the compressor must meet the requirement of 3 minute delay).

2) when the high pressure switch is detected to be open for three times within one hour or for a continuous 30 minutes, the unit will enter protection and display the corresponding fault code.

7.3 low pressure protection

- 1) when the low pressure switch is detected to be open for a continuous 10 seconds, the unit will stop. When the low pressure switch is detected to be closed, the unit will start (the compressor must meet the requirements of 3 minute delay).
- 2) when the low pressure switch is detected to be open for three times within one hour or for a continuous 30 minutes, the unit will enter the unit protection and display the corresponding fault code.
- 3) however, in the delay time (default is 5 minutes) of P16 after the compressor is started, and in defrost mode, the system will not detect low pressure switch.

7.4 water flow switch protection

- 1) after the circulating pump runs for 60 seconds, the system starts to check the water flow switch status. If it is detected to be disconnected for a continuous 5 seconds, the unit will shut down and enter the protection state, displaying the fault. After 3 minutes, the unit exits the protection can be restarted;
- 2) if the protection occurs three times in 1 hour, the unit will be shut down and locked, displaying failure code.

7.5 linkage protection function of end switch (effective in heating/cooling mode)

When parameter A05 is set to "1", the end switch is invalid: the circulating pump starts and stops following the compressor.

When parameter A05 is set to "0", the end switch is effective.

A. If the end switch is closed, the circulating pump is running continuously, and the compressor starts/stops according to water temperature conditions.

B. If the end switch is open, both the circulating pump and the compressor will stop.

If the end switch is open, the unit stops and the "unit" symbol on the display flickers.

7.6 temperature difference protection for insufficient water flow

- 1) in cooling mode, after the circulating pump is started for 60 seconds, if inlet water temperature – outlet water temperature is \geq B03 (default is 15 °C) for a continuous 10 seconds, the unit will shut down and enter the protection state, displaying the fault;
- 2) in the hot water / heating mode, after the circulating pump is started for 60 seconds, if outlet water temperature - inlet water temperature is \geq B03 for a continuous 10 seconds, the unit will stop and enter the protection state, displaying the fault;
- 3) if there are three times of insufficient water flow temperature difference protection within one hour, the unit will be shut down and locked, indicating failure.

7.7 outlet water over temperature protection

- 1) in hot water / heating mode, 60 seconds after the circulating pump is started, if the outlet water temperature is \geq B04 (default is 70 °C) for a continuous 5 seconds, the unit will stop. When the outlet water temperature is \leq B04 - 10 °C for a continuous 30 seconds, the unit will exit protection and can be started again;
- 2) if the protection occurs three times in 1 hour, the unit will stop and enter the protection state, displaying the fault;

7.8 low outlet temperature protection

In cooling mode, 50 seconds after the circulating pump starts, if the outlet water temperature is \leq B05 (default is 5 °C) and lasts for 5 seconds, the unit will stop. When the outlet water temperature is \geq B05 + 4 °C and for a continuous 30 seconds, the unit will exit protection and can be started again;

7.9 pipeline level I anti freezing protection

When the outlet water temperature or water inlet temperature is \leq 5 °C for a continuous 10 seconds, the unit enters the pipeline antifreeze protection. After the circulating pump runs for 1 minute, if the outlet water temperature is \geq 7 °C for a continuous 10 seconds, the unit exits the pipeline level I antifreeze protection. Any unit failure does not affect the antifreeze protection (except for the three-phase protection).

7.10 pipeline level II anti freezing protection (heating/cooling mode)

In the shutdown state, if the pipeline level I antifreeze protection lasts for more than 10 minutes, the unit enters level II antifreeze protection. The system starts the heating mode and automatically starts the electric heater, 3 minutes later, if the water inlet temperature is $\geq 20\text{ }^{\circ}\text{C}$ for a continuous 10 seconds, the unit exits pipeline II antifreeze protection. Any unit failure does not affect the antifreeze protection (except for the three-phase protection).

7.11 pipeline level III anti freezing protection (ambient temperature pipeline anti freezing protection)

When the ambient temperature is less than or equal to $5\text{ }^{\circ}\text{C}$ (parameter B06) for a continuous 10 seconds and the water pump stops for more than 25 minutes, the unit enters pipeline level III anti freezing protection, and the water pump is forced to start for 2 minutes. When the ambient temperature drops, the corresponding water pump interval time will also be shortened.

This function is optional. When parameter B06 is set to 21, this function is cancelled.

7.12 anti freezing protection of water tank (hot water mode)

In the shutdown state, if the water tank temperature is $\leq 15\text{ }^{\circ}\text{C}$ and lasts for more than 10 seconds, the unit enters the water tank anti freezing protection. The system runs in heating mode and automatically starts the electric heating. After 3 minutes, if the water tank temperature is $\geq 25\text{ }^{\circ}\text{C}$ and lasts for 10 seconds, the unit exits the water tank anti freezing protection. Any unit failure does not affect the antifreeze protection (except for the three-phase protection).

7.13 discharge gas temperature protection

- 1) when the discharge gas temperature is \geq B02 (default $115\text{ }^{\circ}\text{C}$, range $80\text{ }^{\circ}\text{C} \sim 130\text{ }^{\circ}\text{C}$), and lasts for more than 5 seconds, the unit will stop and display the fault code;
- 2) if the discharge gas temperature protection occurs three times in 1 hour, the unit will enter the unit protection status and display the corresponding fault code.
- 3) parameter A04 is for discharge gas temperature protection. When "0" is selected, the discharge gas temperature protection will be cancelled.

7.14 compressor overcurrent protection

After the compressor is started, if the current of the compressor is \geq the current setting value B01 (set to be less than or equal to 0 to cancel the protection), the system will stop and restart after 3 minutes. If the overcurrent protection occurs 3 times in an hour, the protection will be locked and the compressor will not start anymore.

8. System parameter setting

- enter --- press and hold the **【mode】** and **【-】** keys for 5 seconds
- Change: the setting parameter is displayed above the clock area, the parameter item is displayed in the clock area, and the parameter value is displayed in the water temperature area. Press **【+】** or **【-】** to change the serial number of the displayed parameter item. Press [timing / confirm] to enter parameter setting, and the parameter value will flicker. Press **【+】** or **【-】** to change the parameter value, and then press [timing / confirm] to save the parameter value and exit the parameter modification status. If the operation is successful, the buzzer will "drip" twice.
- Exit: press the **【ON/OFF】** key or no key operation for more than 60 seconds to exit parameter setting.
- Restore factory settings: press and hold **【mode】** and **【time/confirm】** keys successively for more than 5 seconds to restore factory settings.

Advanced Parameter Table 3

Item	Implication	Default	Range	Remarks
Regular Parameter Setting				
P01	Range of Minimum Temp in Cooli	10°C	5~20	

	ng Mode			
P02	Range of Maximum Temp In Hot Water Mode Range of Maximum Temp in Heating Mode	60°C 55°C	30~85 25~80	Valid in Hot water Mode Valid in Heating/Cooling Mode
P03	Differential Temp in Hot Water / Heating Mode	5°C	1~20	
P04	Differential Temp in Cooling Mode	5°C	1~20	
P05	Temp compensation	2°C	-5~15	
P06	Differential Temp for make up water	8°C	0~30	Valid in hot water mode only
P07	Differential temp for stop make up water	4°C	1~15	Valid in hot water mode only
P08	Set temp for return water	40°C	10~50	
P09	Ambient temp for electric heater on	7°C	-30~40	When it is set as 7°C, the actual value is -20°C, When it is set not as 7°C, the actual value is set value -10°C
P10	Differential temp for electric heater	7°C	2~30	
P11	Enthalpy increasing valve on ambient temp	10°C	-9~60	
P12	Discharge temp to turn on injection valve	110°C	10~125	
P13	Differential temp for injection valve	15°C	0~50	
P14	Chassis heating on ambient temperature	5°C	-9~21	Set to -9 to cancel this function
P15	Temperature for discharge pressure relief and fan shutdown	105°C	10~130	Set to 130 to cancel this function
P16	Low pressure detection delay time	5min	1~15	
P17	Medium pressure switch protection delay time	3min	1~15	
P18	Chassis heating delay off time	20min	2~60	
P19	Water level switch adjustment sensitivity	10	1~84	The higher the value is, the more sensitive the water level switch is.
Protection parameter setting				
B01	Compressor overcurrent protection	0 安	-20 ~45	Set to less than or equal to 0 to cancel this function
B02	Discharge gas temperature protection	115°C	80~130	
B03	Temperature difference-insufficient water flow	15°C	5~50	
B04	Outlet water temperature too high	70°C	50~90	

	in heating			
B05	Outlet water temperature too low in cooling or opening time of return valve	5°C / min	-19~15	When the unit is a hot water heater, this parameter is the opening time of the return valve. This parameter is the protection value of outlet water temperature too low when it is a heating/cooling unit.
B06	Ambient temperature for antifreeze protection	5°C	0~21	Set to 21 to cancel this function
B07	Reserved	0	0~15	
B08	Energy regulation: Emergency start return water differential temperature	4°C	0~15	
B09	Energy regulation: Emergency stop return water differential temperature	2°C	0~6	
b10	Energy regulation: Emergency start/stop cycle	30sec	10~90	
b11	Energy regulation: Normal start/stop cycle	3min	1~15	
Parameter setting for defrost				
H01	Cut-in Ambient Temp	15°C	0~25	
H02	Cut-in Evaporator Coil Temp	-3°C	-19~5	
H03	Cut-out Evaporator Coil Temp	16°C	5~25	18
H04	Accumulated Time – Ambient Temp	60min	20~120	
H05	Run Time	8min	3~15	
H06	EEV Opening	240	10~250	Value*2=number of pulses
H07	No Defrost Low Ambient Temp	-5°C	-30~-5	Set to -5 to cancel this function
H08	Cut-in Low Ambient Temp	-6°C	-30~30	
H09	Difference between ambient and evaporator coil temp 1	0°C	0~30	
H10	Difference between ambient and evaporator coil temp 2 (Low)	0°C	0~30	
H11	Temperature condition for low ambient defrost	-10°C	-30~0	
H12	Accumulated Time -Low Ambient Temp	90min	10~250	
Parameter setting of electronic expansion valve				
L01	Mode selection of main circuit electronic expansion valve	1	0~1	0 [Manual], 1 [Auto]
L02	Mode selection of auxiliary circuit electronic expansion valve	1	0~1	0 [Manual], 1 [Auto]
L03	Total steps of electronic expansion valve	240	230~254	(Value*2) The maximum steps of EEV, please set according to the actual valve used

L04	Action interval of electronic expansion valve	30sec	5~90	20
L05	Superheat value in cooling mode	0	-20~60	
L06	Reserved	0	-20~60	
L07	Minimum openings of EEV in cooling mode	64	10~250	Value*2=number of pulses
L08	Initial openings of main EEV in heating	160	10~250	Value*2=number of pulses
L09	Initial openings of main EEV in cooling	160	10~250	Value*2=number of pulses
L10	EEV High Discharge Gas Temperature	100℃	80~120	
L11	EEV Secondary Discharge Gas Temperature	90℃	70~110	
L12	EEV High Suction Temperature	28℃	10~60	
L13	EEV High Temperature Superheat	-4	-20~60	
L14	EEV High Ambient Temperature	26℃	0~60	
L15	EEV High Water Temperature	52℃	5~80	
L16	Auxiliary EEV Initial Opening	32	10~250	Value*2=number of pulses
L17	Auxiliary EEV Minimum Opening	8	8~250	Value*2=number of pulses
L18	Auxiliary EEV Superheat	0	-20~60	
L19	High Temperature Overheat of Auxiliary Circuit	0	-20~60	
L20	Interval Time for Auxiliary EEV Adjustment	30 秒	5~90	
L21	Discharge Gas Temp to Open Auxiliary EEV	95℃	20~110	Set to 110 to cancel this function
L22	A Zone Main Circuit Superheat	8	-20~60	Hot Water/Heating only
L23	B Zone Main Circuit Superheat	8	-20~60	Hot Water/Heating only
L24	C Zone Main Circuit Superheat	7	-20~60	Hot Water/Heating only
L25	D Zone Main Circuit Superheat	5	-20~60	Hot Water/Heating only
L26	E Zone Main Circuit Superheat	3	-20~60	Hot Water/Heating only
L27	A Zone Minimum Opening	44	10~250	Hot Water/Heating only, Value*2=number of pulses
L28	B Zone Minimum Opening	44	10~250	Hot Water/Heating only, Value*2=number of pulses
L29	C Zone Minimum Opening	52	10~250	Hot Water/Heating only, Value*2=number of pulses
L30	D Zone Minimum Opening	60	10~250	Hot Water/Heating only, Value*2=number of pulses
L31	E Zone Minimum Opening	80	10~250	Hot Water/Heating only, Value*2=number of pulses
L32	Reserved	5	1~30	
L33	Reserved	32	10~250	
L34	Auxiliary EEV maximum opening	240	0~250	
L35	Reserved	0	0~250	
Switch on / off setting				
A01	High pressure switch protection	15	0~15	0[no], 1[yes]

A02	Low pressure switch protection	15	0~15	0[no], 1[yes]
A03	Medium pressure switch protection	15	0~15	0[no], 1[yes]
A04	Discharge gas temperature	15	0~15	0[no], 1[yes]
A05	End switch	0	0~3	0[yes], 1[no]
A06	Waterflow switch protection	1	0~1	0[no], 1[yes]
A07	powerdown memory function	1	0~1	0[no], 1[yes]
A08	Reserved	0	0~15	
A09	Interval stop time of water pump	0	0~60	When the end switch is effective, it is set as 0 water pump normally open.
A10	Action interval of water pump	3	1~60	
A11	Reserved	0	0~1	
A12	Main Board MODBUS address	1	1~16	Address always is 1

Instructions for manually adjusting the electronic expansion valve:

1. When the default value of L01 and L02 is set to 0, item L08 is the manual adjustment value of the opening of the electronic expansion valve in the main circuit of system 1, and item L09 is the manual adjustment value of the opening of the electronic expansion valve in the main circuit of system 2.
2. When the default value of L02 is set to 0, L16 is the manual adjustment value of the opening of system 1 and 2 auxiliary electronic expansion valves.

Meaning of A01~A04:

Set Value	System 4	System 3	System 2	System 1
0	0	0	0	0
1	0	0	0	1
2	0	0	1	0
3	0	0	1	1
4	0	1	0	0
5	0	1	0	1
6	0	1	1	0
7	0	1	1	1
8	1	0	0	0
9	1	0	0	1
10	1	0	1	0
11	1	0	1	1
12	1	1	0	0
13	1	1	0	1
14	1	1	1	0
15	1	1	1	1

Note: 0 means there is no such function, 1 means there is such function.