

PANEL INSTRUCTIONS:

TYPE 15:

FOR:

HEATING/COOLING AIR TO WATER HEAT PUMP

(THREE SPEED FAN MOTORS)

1. Introduction

- 1 . This controller is applicable to heating/cooling air to water heat pumps, single compressor or dual compressors.
- 2 . This controller is composed of mainboard, control panel and connecting cables.
- 3 . Major Functions:
 - ◆ Cooling ;
 - ◆ Modular Control (maximum 10 units)
 - ◆ Heating;
 - ◆ Winter Anti-freeze Protection
 - ◆ LCD Display ;
 - ◆ Plate Heat Exchanger Anti Freeze Protection
 - ◆ Timer Clock ;
 - ◆ High/Low Pressure Protection ;
 - ◆ Remote Control
 - ◆ Outlet Water Temp Too High Protection in Heating
 - ◆ User Parameter Setting ;
 - ◆ Compressor Safety Startup, Running Protection and Balanced Running;
 - ◆ Powerdown Memory ;
 - ◆ Temperature Checkup – Ambient Air, Inlet Water, Outlet Water & Evaporator Coil, Discharge Gas
 - ◆ Backup Electricity Element Heating ;
 - ◆ User Function Selection ;
 - ◆ Insufficient Water Flow Protection ;
 - ◆ 2-way Valve Interlock Control;
 - ◆ Running Parameter Display

2. System Configuration

1. System 1: Compressor 1, 4-way Reversing Valve 1, Evaporator Coil Temp Sensor 1 , Compressor 1 High/Low Pressure Switch & Compressor 1 Overload.
2. System 2: Compressor 2, 4-way Reversing Valve 2, Evaporator Coil Temp Sensor 2 , Compressor 2 High/Low Pressure Switch & Compressor 2 Overload.
- 3 . Water circulating system: Pump, Water Flow Switch, Anti Freeze Thermo Switch, Inlet Water Temperature Sensor, Outlet Water Temperature Sensor, Water Pump Overload.
4. Backup Electricity Heating Element, Fan Motor Low Speed, Fan Motor High Speed, 2-way Valve Interlock Signal & Fan Motor Overload

3. System Settings

- 1 Multiple functions are available for selection by users(through switching between disconnected and loop wired state)
- 2 Function List (JP1, JP2, JP3,JP4,JP5,JP6,JP7,JP8 Settings) :

State Function Switch	Disconnected	Loop Wired	Remarks
JP1	Equipments Self-checkup. User regulation not allowed.		
JP2	Both Systems Valid	System 1 Valid Only	
JP3			Backup

Heating Cooling Air to Water Heat Pump Panel Instruction

JP4			Backup
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Settings Modular Control

JP8	JP7	JP6	JP5	Unit
0	0	0	0	No. 1 (Duty)
0	0	0	1	No. 2 (Assist)
0	0	1	0	No. 3 (Assist)
0	0	1	1	No. 4 (Assist)
0	1	0	0	No. 5 (Assist)
0	1	0	1	No. 6 (Assist)
0	1	1	0	No. 7 (Assist)
0	1	1	1	No. 8 (Assist)
1	0	0	0	No. 9 (Assist)
1	0	0	1	No. 10 (Assist)
X	X	X	X	Invalid

For valid function selection, setting should be made while the mainboard is powered off. Restore the power sixty seconds later after the setting is finished.

4. Panel Regulation & Parameter Setting

1. Panel Buttons



2 . Panel Regulation

ON/OFF

Press **ON/OFF** to switch on/off the unit.

MODE

Press **MODE** to select the running mode.

Mode selection is valid only when the compressor is off.

Cooling Mode: the unit will cool the water till the water temperature reaches the set point (hot water heating function is available if hot water heating mode is activated).

Heating Mode: the unit will heat the water till the water temperature reached the set point (hot water heating function is available if hot water heating mode is activated)

Auto Mode: the unit will cool the water till the water temperature reaches the set point, and automatically heat the water till the water temperature reaches the set point (hot water heating function is available if hot water heating mode is activated).

Note: Hot water heating mode can only be activated in parameter setting.

RESET

When an error code is displayed on the screen, press **RESET**. If the error is rectified, the error code will disappear. If the error is not rectified, the error code will remain on the screen.



Press to set the parameter value upwards by 1 degree or 1 min.



Press to set the parameter value downwards by 1 degree or 1 min.

When the unit is off, the user can press for 5 seconds to enter forced defrost mode even if the defrost cut-in conditions are not satisfied.

Note: to set water temperature for heating/cooling, switch on the control panel (**ON/OFF**), and then press or to adjust the set water temperature.

TIMER (24hours/7days)

Press **TIMER** and then to set unit automatic on/off time.

First Press: set HOUR digit for unit automatic on;

Second Press: set MINUTE digit for unit automatic on;

Third Press: set HOUR digit for unit automatic off;

Fourth Press: set MINUTE digit for unit automatic off.

Fifth Press: exit Timer state.

Note: when the set times are the same, the timer setting will become invalid.

Press Timer Button for five seconds to set clock time.

First Press: set HOUR digit of the clock time.

Second Press: set MINUTE digit clock time.

Third Press: exit clock time setting.

Note: if no action is made in five seconds, the controller will exit setting state.

When both unit automatic on and automatic off times are set, every day the unit will run according to this setting

UNIT

Press this button to select the Unit Number for running parameters checkup (if multiple units are installed in one project and modular control function is in use).

SET (PARAMETER SETTING)

Press **SET** button directly to check running parameters. If the unit No. shown on the display is “ 1 ”, the displayed parameters are from the duty unit. Otherwise the displayed parameters are from the assist unit (depending on the Unit Number set on **UNIT**).

Keep **SET** pressed for 10 seconds to enter parameter setting.

Press **SET** again to select the parameter item in sequence.

The first two digits stand for the parameter item number and the last two digits stand for the parameter value.

5. Function Description

1. Automatic Mode

The unit will select heating or cooling mode automatically depending on the current inlet water temperature.

When $T_i \geq T_s + P15$, the unit enters cooling mode;

When $T_i \leq T_s - P16$, the unit enters heating mode;

Where T_i is inlet water temperature read by CN3, T_s is the set water temperature, P15 is the parameter value set in P15, and P16 is the parameter value set in P16.

2. Cooling Mode

● Compressor On Conditions:

When $T_i \geq T_s + P14$, the compressor(s) is (are) on;

● Compressor Off Conditions:

When $T_i \leq T_s$, the compressor(s) is (are) off;

Where P14 is the parameter value as set in P14.

3. Heating Mode

● Compressor On Conditions:

When $T_i \leq T_s - P14$, the compressor(s) is (are) on;

● Compressor Off Conditions:

When $T_i \geq T_s$, the compressor(s) is (are) off;

Note: The ON/OFF sequence of compressors is subject to the accumulated running times of each compressor. The compressor with shorter accumulated running time will be started first, and the compressor with longer accumulated running time will be shut down last. The ON/OFF sequences of fan motors and 4-way reversing valves are also determined by the ON/OFF sequence of the corresponding compressors.

In systems with dual compressors, there is a delay of thirty seconds between the two compressors' starts/shutdowns.

4. Hot Water Heating Mode

Hot water heating mode is only a submode in Cooling or Heating Mode. When the unit is installed for house heating or house cooling and at the same time domestic hot water heating is needed, this function is needed. When the unit is installed only for domestic hot water heating (without house

heating and house cooling), do not activate hot water heating mode. Use heating mode to control hot water heating.

Hot Water Heating Function Cut-in Condition

Water temperature (ready by CN8) \leq P1- P14

When above condition is satisfied, the three way valve will energize to direct the water from the condenser to the hot water tank. Unit will be switched from cooling or heating mode to hot water heating mode.

Hot water Heating Function Cut-out Condition

Water temperature (ready by CN8) \geq P1

When the above condition is satisfied, the three way valve will de-energize to direct the water back to house heating equipments.

5. Backup Electricity Heater Control

- Heater On Conditions for dual compressor system (required conditions)

- a. $T_i \leq T_s - 6$, and

- b. $T_a \leq P7$

- c. The compressor has run for at least 60 seconds in heating mode.

Where T_i is inlet water temperature read by CN3, T_s is set water temperature, T_a is ambient air temperature read by CN5, and P7 is the parameter value set in P7.

- Heater Off Conditions for dual compressor system (sufficient conditions)

- d. $T_i \geq T_s - 2$, or

- e. $T_a \geq P7$

- Heating Element On Conditions for single compressor system

- f. $T_i \leq T_s - 4$, and

- g. $T_a \leq P7$

- Heater Off Conditions for single compressor system

- h. $T_i \geq T_s - 2$, or

- i. $T_a \geq P7$

6. Fan Motor Control

In cooling mode, only high speed fan (FAN2) will be active.

In heating mode,

When the ambient temperature \geq P22, only FAN1(low speed) will be active.

When the air temperature $<$ P22, only FAN2 (high speed) will be active.

The fan motor has three speeds, with low speed in yellow color, medium speed in blue color and high speed in black color. A factory set unit has yellow wire connected to FAN1 and black wire connected to FAN2. It is not recommended to change high speed to low speed manually because insufficient air volume in low air temperatures could damage the unit.

The fan motor will be off when the unit is in defrost mode.

7. Defrost

- Defrost Cut-in Condition

In Heating or Hot Water Heating Mode, when the evaporator coil temperature (read by CN6/CN7) is lower than P4, the unit begins to count the time. If the count time is equivalent to or bigger than P2, the corresponding system enters defrost mode.

When the defrost cut-in conditions of System 1 (2) are satisfied, and the count time of System 2 (1) is bigger than a half of P2, both systems will enter defrost mode. Otherwise only System 1 (2) will enter defrost mode and System 2 (1) will be shutdown.

Note: During time counting period, if the evaporator coil temperature is observed to be higher than P4, the count time will be restored to zero.

In defrost mode, the water pump and the corresponding compressor continue to work, corresponding fan motor stops, and corresponding 4-way reversing valve energizes.

- Defrost Cut-out Conditions (Sufficient)

- a. The Evaporator Coil Temp \geq P5;

- b. Defrost time \geq P3;

When any of the above conditions are satisfied, defrost mode will be terminated.

8. Crankcase Heater

In heating mode, when the ambient air temperature is lower than ≤ 10 , the heater will turn on when compressor is off and turn off when the compressor is on.

When the ambient air temperature is above 15 , the crankcase heater will turn off.

9. Control of 4-way Reversing Valve

The 4-way reversing valve will be activated when the unit is in cooling or defrost mode. In heating mode the 4-way reversing valve will not be activated.

10. Interlock Control (valid in cooling function only)

The control board will keep checking the state of interlock. If it is from on to off, the unit will be started. If it is from off to on, the unit will be shut down.

- When one or more than one 2-way valves in the fan coil units are open, the interlock is off. When all the 2-way valves in the fan coil units are closed, the interlock is on.

11. Power Down Memory

The parameter settings will not be lost on powerdown occasions; If control panel is disconnected by accident, the system will remain working as normal.

No matter the powerdown occurs while the unit is on or off, once the power is restored the unit will be restored to the state prior to the occurrence of powerdown (if parameter value for P23 is set as 1).

Note: If hot water heating function is activated, after the power is restored, the unit will run in hot water heating mode first before it goes back to the original mode.

12. Defrost Heating Cable Control

In heating mode, when ambient temp is lower than P6 set value, the defrost heating cable will turn on to help defrost the ice accumulated in the base pan of the heat pump.

6. Unit Protection

Winter Anti-freeze Protection

While the unit is off, or when the 2-way valve is in interlock state,

When $T_a \leq 5$, and $T_i \leq P13$

where T_a is the ambient air temperature, T_i is the inlet water temperature and P13 is the parameter value set as in P13,

in sixty seconds the unit will automatically run in heating mode to protect water from freezing.

Anti-freeze Protection Process

Display Error Code "E14" \longrightarrow Pump On \longrightarrow Backup Electricity Heating Element, Fan Motor 1 and 2, Compressor 1 and 2 On \longrightarrow Inlet Water Temp > 15 \longrightarrow All outputs closed in sequence \longrightarrow Unit back to Off State

When $T_a \leq 5$, and $T_i \leq P13 + 3$

The water pump will run for 5 min every 30 min (if water pump is controlled by this controller).

Compressor Running Protection

Time Delay from Compressor On to Compressor Off: 60 seconds.

Time Delay from Compressor Off to Compressor On: 180 seconds.

Brazed Plated Heat Exchanger Anti Freeze Protection

In cooling mode,

If the outlet temperature remains below P10 for 60 seconds continuously, the protection will be activated. The compressor will be shut down but the water pump will continue to work. After the outlet water temperature is 3 higher than P10, the unit will be restored to the original running mode in 3 minutes.

When the anti freeze port “ SET ” is disconnected, the compressor will be shut down. When the anti freeze port is connected, the unit will be restored to the original running mode.

Outlet Water Temperature in Heating Too High

In heating, if the outlet water temperature is P11, the protection will be activated. The compressor and the backup electricity heater (if installed) will be shut down. When the outlet water temperature is 15 lower than P11, the unit will be restored to the original running mode.

Temperature Sensor Malfunction Protection

Malfunction with any of Inlet Water, Outlet Water, Ambient Air, Hot Water or Evaporator Coil Temperature Sensors will close all outputs.

Insufficient Water Flow Protection

All outputs will be closed if water flow is insufficient or the water flow switch is malfunctioning.

System uses two approaches to check whether the water flow is insufficient.

Water Flow Switch

System will check the state of Water Flow Switch one minute after the water pump is on. Insufficient water flow protection will be activated if the switch is observed to be disconnected for a continuous 10 seconds.

Water Temp Difference between Inlet and Outlet

When inlet/outlet water temperature difference is bigger than P12, insufficient water flow protection will be activated.

High/Low Pressure Protection

High Pressure Protection : If the High Pressure Switch is observed to be disconnected, High Pressure Protection will be activated and the corresponding compressor will be shut down.

Low Pressure Protection: When the Low Pressure Switch is observed to be disconnected for a continuous 10 seconds, the corresponding compressor will be shut down.

(Low Pressure Protection will be disabled in the first three minutes in heating mode, in the first 30 seconds in cooling mode and in defrosting state.)

7. Unit Fault and Protection

	Input Port	Error Description	Code	Results
1		Inlet Water Temp Sensor Malfunction	E1	Close All Outputs
2		Outlet Water Temp Sensor Malfunction	E2	Close All Outputs
3		Ambient Air Temp Sensor Malfunction	E3	Close All Outputs
4		Evaporator Coil Temp Sensor 1 Malfunction	E4	Close All Outputs
5		Evaporator Coil Temp Sensor 1 Malfunction	E5	Close All Outputs

Heating Cooling Air to Water Heat Pump Panel Instruction

6	FLOW	Insufficient Water Flow (Water Flow Switch Malfunction or Water Temp Diff too Big)	E6	Close All Outputs
7	HP1	High Pressure Protection Compressor 1	E7	Shut Down Compressor 1
8	LP1	Low Pressure Protection Compressor 1	E8	Shut Down Compressor 1
9	HP2	High Pressure Protection Compressor 2	E9	Shut Down Compressor 2
10	LP2	Low Pressure Protection Compressor 2	E10	Shut Down Compressor 2
11		Hot Water Temp Sensor Malfunction	E11	Close All Outputs
12	OV1	Compressor 1 Overload	E12	Shutdown Compressor 1
13	OV2	Compressor 2 Overload	E13	Shutdown Compressor 2
14		Winter Anti Freeze Protection	E14	Turn on backup electricity heating element and run in heating mode
15		Outlet Water Temp Too High in Heating	E15	Shutdown Compressor and Backup Electricity Heating Element
16	SET	Outlet Water Temp Too Low in Cooling	E16	Turn off compressor, turn on pump and backup electricity heating element
17		Discharge Gas Temp Sensor 1 Malfunction	E17	Close All Outputs
18		Discharge Gas Temp Sensor 2 Malfunction	E18	Close All Outputs
19		Communication Error	E19	Close All Outputs
20		Discharge Gas Temp 1 too High	E20	Shutdown Compressor 1
21		Discharge Gas Temp 2 too High	E21	Shutdown Compressor 2
22	BUS	Comprehensive Error	E22	Close All Outputs

8. Parameter Setting & Display

Item	Parameter Name	Max	Min	Unit	Default	Remarks
1	Hot Water Temp	60	25		50	Only valid when P25 value is set as 1.

Heating Cooling Air to Water Heat Pump Panel Instruction

2	Defrost Delay Time	90	30	min	30	
3	Defrost Cut-out Time	25	3	min	8	
4	Defrost Cut-in Temp	5	-9		-3	
5	Defrost Cut-out Temp	25	3		15	
6	Defrost Heating Cable Cut-in Time	10	-10		0	Only valid when heating cable (to help defrost ice) is installed
7	Backup Electricity Heater Cut-in Temp (Ambient Air Temp)	12	-10		6	Only valid when backup electricity heater is installed
8	E20/E21 Cut-in Discharge Gas Temp	120	70		95	
9	E20/E21 Cut-out Discharge Gas Temp	120	70		75	
10	E16 Cut-in Outlet Water Temp	10	0		5	
11	E15 Cut-in Outlet Water Temp	70	40		65	
12	E6 Cut-in Inlet/Outlet Water Temp Diff	50	5		30	
13	E14 Cut-in Inlet Water Temp	5	0		3	
14	Water Temperature Diff	10	1		5	
15	Up Limit	10	1		5	Only valid when unit is in Auto Mode
16	Down Limit	10	1		5	
17	Unit Type Selection	2	0		1	2=heating only,1=heating & cooling, 0=cooling only
18	Quantity of Heat Pump Units	10	1		1	
19	Type of Water Temperature Control in Heating Mode	1	0		0	1=Water temperature setting is determined automatically by ambient temperature,0=Water temperature setting is determined by manually set water temperature
20	Compensation Temperature in Heating	30	0		20	Only valid when P19 value is set as 1. Automatically set water temperautre = 20+P21*(P20 – ambient temperature).
21	Compensation Coefficient in Heating	3	0.1		1	The display value for PD will be 10 times set value
22	Ambient Temp to Change Fan Motor Speed	20	0		5	Only valid in heating & domestic hot water heating mode
23	Automatic On Allowed after Power is Restored?	1	0		1	1=yes;0=no
24	Interlock Function Valid?	1	0		1	1=yes;0=no
25	Hot Water Heating Function Activated	1	0		0	1=yes;0=no
	Water Temperature In Cooling Mode	25	8		12	Switch on the control panel and then press Up or Down button to change

Heating Cooling Air to Water Heat Pump Panel Instruction

Water Temperature In Heating Mode	60	25	40	the set water temperature in cooling, heating and auto mode. The ranges of water temperatures are different in different modes.
Water Temperature in Auto Mode	50	10	30	

9. Running Parameter Checkup

Duty Unit

Item	Parameter Name	Unit
1	Inlet Water Temp	
2	Outlet Water Temp	
3	Ambient Air Temp	
4	Evaporator Coil Temp 1	
5	Evaporator Coil Temp 2	
6	Hot Water Temp	
7	Discharge Gas Temp Compressor 1	
8	Discharge Gas Temp Compressor 2	

Assist Unit

Item	Parameter Discription	Unit
1	Evaporator Coil Temp 1	
2	Evaporator Coil Temp 2	
3	Discharge Gas Temp Compressor 1	
4	Discharge Gas Temp Compressor 2	
5	Error?	Code

10. Wiring Description

- CN1** : Transformer's Secondary Coil (Blue)
- CN 2**: Transformer's Secondary Coil (White)
- CN3** : Inlet Water Temperature Sensor
- CN4** : Outlet Water Temperature Sensor
- CN5** : Ambient Temperature Sensor
- CN6** : Evaporator Coil Temperature 1 Sensor
- CN7** : Evaporator Coil Temperature 2 Sensor
- CN8** : Hot Water Temperature Sensor
- CN9** : Gas Discharge Temperature 1 Sensor
- CN10**: Gas Discharge Temperature 2 Sensor
- CN11**: Control Panel Communication Port
- CN12**: Assist Unit Communication Port
- CN13** : Transformer's Primary Coil (Red)

COM: Common Port

EN : Interlock Signal

HP1 : High Pressure Switch 1

LP1 :Low Pressure Switch 1

HP2 : High Pressure Switch 2

LP2 : Low Pressure Switch 2
OV1: Compressor Overload 1
OV2: Compressor Overload 2
FLOW: Water Flow Switch
SET: Freezing Point Protection
BUS: Comprehensive Protection

L : Live
N : Neutral
COMP1: Compressor 1
COMP2: Compressor 2
4WV1 : 4-way Reversing Valve 1
4WV2 : 4-way Reversing Valve 1
FAN1: Fan Motor Low Speed
FAN2: Fan Motor High Speed
PUMP: Water Pump
HOT: Backup Electricity Heater
A-HOT: Crankcase Heater
P-W: Solenoid for Hot Water
S-F: Solenoid for Heating Cable
ERR: Error Code