

**PANEL INSTRUCTIONS:**

**TYPE 10:**

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 wires.
- 3 . Major Functions:
  - ◆ Cooling ;
  - ◆ Winter Anti-freeze Protection
  - ◆ Heating;
  - ◆ Plate Heat Exchanger Anti Freeze Protection
  - ◆ LCD Display ;
  - ◆ High/Low Pressure Protection ;
  - ◆ Timer Clock ;
  - ◆ Outlet Water Temp Too High Proteciton in Heating
  - ◆ Remote Control
  - ◆ Compressor Safety Startup, Running Protection and Balanced Running;
  - ◆ User Parameter Setting ;
  - ◆ Display of 16 Kinds of Faults & Protections ;
  - ◆ Powerdown Memory ;
  - ◆ Temperature Checkup – Ambient Air, Inlet Water, Outlet Water & Evaporator Coil
  - ◆ 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 Switch, Inlet Water Temperature Sensor, Outlet Water Temperature Sensor.
4. Backup Electricity Heating Element, Fan Motor 1, Fan Motor 2, 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	2 Fan Motors	Single Fan Motor	

JP4		User Regulation not allowed	Backup
JP5	Automatic Unit Startup Allowed When Power Is Restored	Only Manual Unit Startup Allowed When Power Is Restored	
JP6	Interlock Control Valid	Interlock Control Disabled	Backup
JP7	Electricity Element Heating Only	Electricity Element Heating + Heat Pump	
JP8	Cooling Only	Heat Pump	

3. Default Values (D=Disconnected, L= Loop Wired) :

JP1	JP2	JP3	JP4	JP5	JP6	JP7	JP8
D	D	D	D	D	D	L	L

4. 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** BUTTON

When the power is switched on and this button is not pressed, the panel screen only displays the inlet water temperature.

When the power is switched on and this button is pressed, the unit will enter the running mode automatically unless the running mode is selected manually within ten seconds.

Pressing this button while the unit is running will shut down the unit.

### **MODE** BUTTON

Press this button to select the running mode manually.

Mode selection is valid only before the compressor is started.

When the compressor is running, the light “heating” or “cooling” will be on. When the compressor is not

running, the light “heating” or “cooling” will flicker.

#### **RESET** BUTTON

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

#### **▲** BUTTON

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

In clock timer setting, press this button will increase the timer hours by 1 hour.

#### **▼** BUTTON

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

In clock timer setting, press this button will decrease the timer hours by 1 hour.

#### **TIMER** BUTTON ( In hours, range 1- 15 hours )

When the unit is off, press this button to set automatic on time. Press “ ”、“ ” buttons to set the hours.

When the unit is on, press this button to set automatic off time. Press “ ”、“ ” buttons to set the hours.

#### **SET** BUTTON (PARAMETER SETTING)

Press **SET** button directly to check running parameters ( See RUNNING PARAMETER CHECKUP PART)

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

Press **SET** button 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 ambient air temperature, if no mode selection is made manually.

$T_a \geq 25$  , enters cooling mode

$T_a < 25$  , enters heating mode

Where  $T_a$  is the ambient air temperature.

### 2. Cooling Mode

#### ● Compressor On Conditions:

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

Where  $T_i$  is inlet water temperature,  $T_s$  is water temperature setpoint, and  $T_d$  is the set value for water temperature difference between inlet and outlet.

#### ● Compressor Off Conditions:

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

Where  $T_i$  is inlet water temperature and  $T_s$  is water temperature setpoint.

### 3. Heating Mode

#### ● Compressor On Conditions:

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

Where  $T_i$  is inlet water temperature,  $T_s$  is water temperature setpoint, and  $T_d$  is the set value for water temperature difference between inlet and outlet.

#### ● Compressor Off Conditions:

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

Where  $T_i$  is inlet water temperature and  $T_s$  is water temperature setpoint.

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. Backup Electricity Heating Element Control

- Heating Element On Conditions for dual compressor system

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

b.  $T_a \leq T_e$

Where  $T_i$  is inlet water temperature,  $T_s$  is water temperature setpoint,  $T_a$  is ambient air temperature and  $T_e$  is the air temperature setpoint under which the backup heating element can become active.

- Heating Element Off Conditions for dual compressor system

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

d.  $T_a \geq T_e$

Where  $T_i$  is inlet water temperature,  $T_s$  is water temperature setpoint,  $T_a$  is ambient air temperature and  $T_e$  is the air temperature setpoint under which the backup heating element can become active.

- Heating Element On Conditions for single compressor system

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

f.  $T_a \leq T_e$

Where  $T_i$  is inlet water temperature,  $T_s$  is water temperature setpoint,  $T_a$  is ambient air temperature and  $T_e$  is the air temperature setpoint under which the backup heating element can become active.

- Heating Element Off Conditions for single compressor system

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

h.  $T_a \geq T_e$

Where  $T_i$  is inlet water temperature,  $T_s$  is water temperature setpoint,  $T_a$  is ambient air temperature and  $T_e$  is the air temperature setpoint under which the backup heating element will cut in ( if installed).

5. Fan Motor Control

In heating mode, when the air temperature is above  $2$  , only FAN1 will be active. When the air temperature is below  $2$  , only FAN2 will be active. In cooling mode, only FAN2 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 always has yellow wire connected to FAN1 and black wire connected to FAN2. High speed fan means bigger noise but also higher heat transfer efficiency, and vice versa. It is not recommended to change high speed to low speed manually because insufficient air volume in low air temperatures could damage the unit.

6. Defrosting

- Defrost In Condition

In Heating Mode, when the evaporator coil temperature (read by evaporator coil temp sensor) is lower than the set value, the unit begins to count the time. If the count time is equivalent to or bigger than the defrost time delay setting, the corresponding system enters the defrost mode.

When the defrost condition of one system is satisfied, and the count time of the other system is bigger than one half of the defrost time display setting, both systems will enter the defrost model.

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

Defrost Mode: The water and the corresponding compressor continue to work, corresponding fan motor stops, and corresponding 4-way reversing valve de-energizes.

- Defrost Out Condition

The Evaporator Coil Temp is observed to be higher than 15 °C ;

Accumulated defrosting time is longer than set value;

High pressure switch is disconnected.

7. Crankcase Heater

In heating mode, when the ambient air temperature is lower than  $\leq 15$  °C , the heater will turn on (when compressor is off) or turn off (when the compressor is on)

8. Interlock Control

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.

- Note: If this function is not needed, loop wire JP6 to disable it.

9. Timer Clock

Range : 1-15 hours.

When the unit is on, this function enables the unit to shut down in set hours. When the unit is on, this function enables the unit to shut down in set hours

Start or shut down the unit manually after timer clock hours have been set will cancel the setting.

8. 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 if 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 switch JP5 is disconnected). Timer clock settings before the occurrence of powerdown will become void after the power is restored.

9. Unit Protection

Winter Anti-freeze Protection

While the unit is off, or when the 2-way valve is in interlock state, once the ambient air temperature and the inlet water temperature satisfy the conditions of anti-freeze protection ( $T_a \leq 5$  °C , and  $T_i \leq T_w$ , where  $T_a$  is the ambient air temperature,  $T_i$  is the inlet water temperature and  $T_w$  is the winter anti freeze water temperature, in sixty seconds the unit will automatically run in heating mode to protect itself from freezing.

Anti-freeze Protection Process

Display Error Code "E14" → Pump On → 4-way Reversing Valve, Backup Electricity Heating Element, Fan Motor 1 and 2, Compressor 1 and 2 On → Inlet Water Temp > 15 °C → All outputs closed in sequence → Unit back to Off State

Note: When the inlet water temperature is smaller than or equals to

Compressor Running Protection

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

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

Brazed Plated Heat Exchanger Anti Freeze Protection

In cooling mode,

If the outlet water temperature is below the set value ( permissible minimum outlet water temperature in cooling mode), the system begins to count time. If this remains the same after 60 seconds, the

protection will be activated and the compressor will be shut down. After the outlet water temperature is 3 higher than the set value, the systems will withdraw from the protection mode.

When the anti freeze switch “ SET-S ” is disconnected, the compressor will be shut down. When the anti freeze switch is closed, 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 higher than the set value (permissible maximum outlet water temperature in heating mode) , the protection will be activated and the compressor and the backup electricity heating element will be shut down. When the outlet water temperature is 15 lower than the set value, the unit will be restored to the original running mode.

**Temperature Sensor Malfunction Protection**

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

**Insufficient Water Flow Protection**

All outputs will be closed if water flow is insufficient of the water flow switch is malfunctioning. System uses two approaches to check whether the water flow is insufficient.

**Water Flow Switch**

System will check 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 the difference is bigger than the set value, 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.)

**6. Unit Fault and Protection**

	Input Port	Error Description	Code	Results
1	TH1	Inlet Water Temp Sensor Malfunction	E1	Close All Outputs
2	TH2	Outlet Water Temp Sensor Malfunction	E2	Close All Outputs
3	TH3	Ambient Air Temp Sensor Malfunction	E3	Close All Outputs
4	TH4	Evaporator Coil Temp Sensor 1 Malfunction	E4	Close All Outputs
5	TH5	Evaporator Coil Temp Sensor 1 Malfunction	E5	Close All Outputs
6	FLOW	Insufficient Water Flow ( Water Flow Switch Malfunction)	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

*Heating Cooling Air to Water Heat Pump Panel Instruction*

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	OV-P	Water Pump Overload	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-S	Outlet Water Temp Too Low in Cooling	E16	Turn off compressor, turn on pump and backup electricity heating element
17	OV-F	Fan Motor Overload	E17	Close All Outputs
18	///	Communication Error	E19	Close All Outputs

Notes:

When there are more than one protections, the system will handle the protections separately in the following sequence of reduced priority: E19, E7, 48, E9, E10, E1-E16, and E11-E17.

Protections E7-E10, E12, E13 cannot be reset automatically. After the faults are corrected, the LCD screen will still display the Error code. Only after the "RESET" button is pressed will the error code disappear. For other protections, the system can reset automatically.

## 7. Parameter Setting & Display

Item	Parameter Name	Max	Min	Unit	Default
	Inlet Water Temp in Cooling	25	8		12
	Inlet Water Temp in Heating	50	25		45
1	Defrost Delay Time	90	30	min	45
2	Defrost Time	25	3	min	5
3	Defrost In Temp	5	-15		3

*Heating Cooling Air to Water Heat Pump Panel Instruction*

4	Defrost Out Temp	25	3		15
5	Permissible Minimum Outlet Water Temp in Cooling	10	0		5
6	Permissible Maximum Outlet Water Temp in Heating	70	40		65
7	Permissible Water Temp Difference between Inlet and Outlet	20	5		10
8	Winter Anti freeze Water Temp Backup Electricity	5	0		3
9	Heating Element Cut-in Temp ( Ambient Air Temp)	12	0		5
A	Water Temp Difference between Inlet and Outlet	10	1		5

**Running Parameter Checkup**

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	Accumulated Running Time Compressor 1	min
7	Accumulated Running Time	min

*Heating Cooling Air to Water Heat Pump Panel Instruction*

---

	Compressor 2	
8	Defrost Time Compressor 1	min
9	Defrost Time Compressor 2	min