

# **HEAT PUMP WATER HEATER (EEV) CONTROLLER PANALE INSTRUCTION**

**SH-16G2-C-KP  
(V1.0)**

# Installation instructions:

1. **Terminal Block:** When fixing the terminal block, please make sure that the wires and block are tightly connected. Loose connection could lead to arc phenomenon and unnecessary damage/dangerous accident.
2. **Power supply:** please use rated voltage to avoid unnecessary damage to the controller.
3. **Operation environment:** please do not use controller in high temperature, high humidity or high interference environments. Strong electricity and weak electricity wires should be routed separately.

## i. Specifications

**Operation Environment**

**Voltage:** AC220V $\pm$ 20%, 50Hz.

**Operation Temperature Range:** -15 $\sim$ +60 $^{\circ}$ C

**Storage Temperature Range:** -20 $\sim$ +65 $^{\circ}$ C

**Humidity Requirement:** 10 $\sim$ 95%RH, no condensation

## ii. Display Panel Function

1. Applicable to hot water and heating/cooling systems.
2. Operation modes: circulated hot water, instant hot water, and cooling.
3. Operation modes can be selected through **[46]** ( parameter No. 46).
4. Inquiry function available. Displays water temperature and set temperature.
5. Memory storage;
6. ON/OFF TIMER functions.
7. Temp Range: Hot Water (25 $^{\circ}$ C $\sim$ 60 $^{\circ}$ C); Cold Water (10 $^{\circ}$ C $\sim$ 35 $^{\circ}$ C)

## iii. Buttons

### 1. Power-up

After unit is electrified, the panel screen will display the version number for two seconds before it enters normal operation.

### 2. 【ON/OFF】

When unit is running, press button to shut down the unit. Panel screen displays water temperature, timer status and clock time. When the unit is off, press button to start the unit. Panel screen displays operation mode, water temperature, timer status and clock time.

### **3. 【▲】【▼】**

Press button to set parameter values, clock time, on/off timer and water temperature.

In parameter setting state, press button to change setting value;

In clock time setting state, press button to change hours and minutes.

In on/off timer setting state, press button to change on/off timer hours and minutes.

In normal setting state, press button to change set water temperature.

### **4. 【TIME】**

Press button to enter clock time settings. Press 【▲】【▼】 to set clock time, and then press 【TIME】 again to confirm settings and exit.

When setting ON/OFF TIMER, press 【TIME】 to exit setting.

### **5. 【ON TIMER】【OFF TIMER】**

a) Press button to enter ON TIMER or OFF TIMER.

b) Users can set three timer periods. Press 【▲】【▼】 to select TIMER period. Then press 【ON TIMER】【OFF TIMER】to enter timer hour setting. Press 【▲】【▼】 to set timer hours. Press 【ON TIMER】【OFF TIMER】 again to enter timer minute setting. Press 【▲】【▼】 to set timer minutes. Press 【ON TIMER】【OFF TIMER】 to confirm settings and exit.

c) In ON TIMER or OFF TIMER state, press 【CYCLIC TIME】 to cancel current settings.

d) Hold 【ON TIMER】 for 10 seconds to enter forced defrost.

### **6. 【CYCLIC TIME】**

a) Press button to abort ON TIMER or OFF TIMER setting.

b) Hold button for 10 second to restore factory settings.

### **7. 【E-HEAT】**

When the unit runs in hot water mode, press button to start forced electric heating. Press again to exit.

### **8. 【MODE】**

This function is only valid in cooling mode. After the unit is electrified, press button to change between hot water and cooling mode.

### **9. 【INQUIRY】**

Press button to check parameter settings. Set values will be displayed in temp display area. Parameter No. will be displayed in clock time area. Press 【▲】【▼】 to select parameter No. Panel will exit INQUIRY state if no buttons are pressed in 10 seconds.

Table 1

Code	Description	Remarks
1	Outlet Water Temp	
2	Water Tank Temp	
3	Ambient Temp	
4	Evaporator Coil 1 Temp	
5	Evaporator Coil 2 Temp	
6	Compressor 1 Discharge Temp	
7	Compressor 2 Discharge Temp	
8	Input Port No.	
9	Unit Version Number or Unit Protection Code	Error Code ( when value is below 40)
10	Compressor 1 Suction Temp	
11	Compressor 2 Suction Temp	
12	EEV 1 Opening	Actual value = *10
13	EEV 2 Opening	Actual value = *10
14	Communication Status	
15	Network Module IP Add 1	
16	Network Module IP Add 2	
17	Network Module IP Add 3	
18	Network Module IP Add 4	

#### 10. Forced Defrost.

Hold **【ON TIMER】** for 10 seconds to enter forced defrost state.

Unit enters defrost mode. Display screen shows “DEFROST”

Operation conditions: In hot water mode or when unit is off

Press **【ON/OFF】** to exit forced defrost.

#### 11. Parameter Settings

Hold **【INQUIRY】** for 10 seconds to enter parameter setting. Parameter values will be displayed in temp display area. Parameter No. will be displayed in clock time area. Press **【▲】【▼】** to change parameter settings. Press **【INQUIRY】** to confirm setting and move to next parameter. Panel will exit parameter setting state if no buttons are pressed in 10 seconds.

Table 2

Parameter NO.	Description	Default	Range	Remarks
〔1〕	Temp Difference	4℃	2~15	
〔2〕	Hot Water Temp Comp	2℃	—5~15	

	<b>ensation</b>			
〔3〕	<b>Insufficient Water Flow Protection ( Temp Difference too High in Heating)</b>	<b>15℃</b>	<b>5～50</b>	
〔4〕	<b>Defrost Cut-in Evaporator Coil Temp</b>	<b>-2℃</b>	<b>-5～5</b>	
〔5〕	<b>Defrost Cut-out Ambient Temp</b>	<b>13℃</b>	<b>5～25</b>	
〔6〕	<b>Defrost Interval Time</b>	<b>45min</b>	<b>20～60</b>	
〔7〕	<b>Defrost Cut-out Time</b>	<b>6min</b>	<b>3～15</b>	
〔8〕	<b>Replenish Valve Cut-in Temp</b>	<b>42℃</b>	<b>40～60</b>	<b>Not in use</b>
〔9〕	<b>Replenish Temp Diff</b>	<b>4℃</b>	<b>1～15</b>	
〔10〕	<b>Electric Heater Cut-in Ambient Temp</b>	<b>7℃</b>	<b>0～40</b>	
〔11〕	<b>Electric Heater Temp Difference</b>	<b>5℃</b>	<b>2～10</b>	
〔12〕	<b>Compressor Rotation Period</b>	<b>8</b>	<b>3～15</b>	<b>Not in use</b>
〔13〕	<b>Compressor Rotation Time</b>	<b>30</b>	<b>3～60</b>	<b>Not in use</b>
〔14〕	<b>Replenish Interval Time</b>	<b>5min</b>	<b>1～60</b>	<b>Not in use</b>
〔15〕	<b>Defrost Cut-in Ambient Temp</b>	<b>15</b>	<b>0～20</b>	
〔16〕	<b>Electric Heater Exit Water Temp</b>	<b>61℃</b>	<b>25～65</b>	
〔17〕	<b>Compressor Discharge Gas Temp Protection</b>	<b>115℃</b>	<b>101～130</b>	
〔18〕	<b>Reserved</b>	<b>30</b>	<b>20～40</b>	
〔19〕	<b>Reserved</b>	<b>63</b>	<b>60～75</b>	
〔20〕	<b>Water Return Valve On Time</b>	<b>1</b>	<b>1～10</b>	
〔21〕	<b>Water Return Valve Off Time</b>	<b>60</b>	<b>25～65</b>	
〔22〕	<b>Reserved</b>	<b>92</b>	<b>80～99</b>	
〔23〕	<b>Low Pressure Check Delay Time</b>	<b>3min</b>	<b>1～15</b>	
〔24〕	<b>Low Pressure Check Ambient Temp</b>	<b>5℃</b>	<b>-10～20</b>	
〔25〕	<b>Tank Antifreeze Temp</b>	<b>6℃</b>	<b>3～20</b>	
〔26〕	<b>Reserved</b>	<b>98</b>	<b>90～110</b>	
〔27〕	<b>EEV Tuning Frequency</b>	<b>30se</b>	<b>20～90</b>	

		<b>c</b>		
〔28〕	EEV Full Open Pulses	48	46~60	Actual Value= Set Value x 1 0
〔29〕	EEV Min Open Pulses	15	10~20	Actual Value= Set Value x 1 0
〔30〕	EEV Initial Pulses in Heating	35	15~45	Actual Value= Set Value x 1 0
〔31〕	EEV Superheat	2℃	-20~20	
〔32〕	EEV Open Pulses in Defrosting	35	10~45	Actual Value= Set Value x 1 0
〔33〕	EEV Initial Pulses in Cooling	35	10~45	Actual Value= Set Value x 1 0
〔34〕	EEV High Discharge Gas Temp	100℃	90~120	
〔35〕	EEV Secondary Discharge Temp	90℃	80~110	
〔36〕	EEV High Suction Temp	26	15~40	
〔37〕	EEV Secondary Suction Temp	-26	-30~-10	
〔38〕	Temp Difference in 〔35〕, 〔36〕, 〔37〕	2	1~10	
〔39〕	EEV High Superheat	-4	-20~10	
〔40〕	EEV Ambient Temperature	26	15~45	
〔41〕	EEV Water Temperature	52	35~80	
〔42〕	Hot Water Overheat Temperature	75	50~90	Protection aborted if set value is 90
〔43〕	Cold Water Overcold Temperature	5	1~15	
〔44〕	Electric Heater Cut-in Water Temperature in Instant Mode	40	20~80	
〔45〕	Instant/Circulated Conversion Temp	8	4~20	When Set Water Temperature is 60℃
〔46〕	Unit Type	1	1~3	1 Circulated,

				2 Instant, Cooling
〔50〕	EEV Mode	1	0~1	0 [Manual],1 [Auto]
〔51〕	Powerdown Memory	1	0~1	0 [No],1 [Yes]
〔52〕	Reserved	1	0~1	
〔53〕	Electric Heater	1	0~1	0[No], 1[Yes]
〔54〕	Water Flow Switch	1	0~1	0[No],1[Yes]
〔55〕	Low Pressure Protection	1	0~1	0[No],1[Yes]
〔56〕	High Pressure Protection	1	0~1	0 [No],1[Yes]
〔57〕	Water Pump in Heating/Cooling	1	0~1	0:Auto, 1:Normally Open
〔58〕	Back Light	1	0~1	1:[ 15seconds],0 [Always]
〔59〕	Cooling Mode	0	0~1	0[Mandatory], 1[Normal]
〔60〕	Reserved	1	0~1	
〔61〕	Reserved	1	0~1	
〔62〕	Reserved	0	0~1	
〔63〕	Reserved	1	0~1	
〔64〕	Discharge Gas Temperature Sensor	1	0~1	0 [No],1 [Yes]

【Remarks: Press CYCLIC for 10 seconds will restore the unit to factory settings.】


## iv. Error Codes

Item	Error Code	Description	Remarks
1	E01	Water Temp Sensor Malfunction	R 25=5.0KΩ, B 25-50 = 3470K
2	E02	Ambient Temp Sensor Malfunction	R 25=5.0KΩ, B 25-50 = 3470K
3	E03	Evap. Coil Temp Sensor 1 Malfunction	R 25=5.0KΩ, B 25-50 = 3470K
4	E04	Insufficient Water Flow Protection	
5	E05	High Pressure Switch 1 Malfunction	

		Function	
6	E06	Low Pressure Switch 1 Malfunction	
7	E07	Outlet Water Temp Sensor Malfunction	R25=5.0KΩ, B25-50 = 3470K
8	E08	Tank Insufficient Water Protection	
9	E09	Insufficient Water Flow (Temp Diff too Big)	
10	E10	Communication Error	
11	E11	Evap. Coil Temp Sensor 2 Malfunction	R25=5.0KΩ, B25-50 = 3470K
12	E12	High Pressure Switch 2 Malfunction	
13	E13	Low Pressure Switch 2 Malfunction	
14	E14	Compressor Discharge Temp 1 Protection	R25=50KΩ, B25-50 = 3950K
15	E15	Compressor Discharge Temp 2 Protection	R25=50KΩ, B25-50 = 3950K
16	E21	Outlet Water Temp too High in Heating	
17	E22	Outlet Water Temp too Low in Cooling	
18	E39	EEPROM	Factory Settings should be Restored



[Note: Error codes caused by temperature protections can be reset automatically. Other codes must be reset manually after unit is restarted by pressing **【ON/OFF】** .

## v. Display Symbols

1. Circulated Hot Water Mode: Panel screen displays “1”; Instant Hot Water Mode: Panel screen displays “2”; Cooling Mode: Panel screen displays “3”
2. ON TIMER: If ON TIMER has been set, panel screen will display “ON TIMER”;
3. Off Timer: If OFF TIMER has been set, panel screen will display “OFF TIMER”;
4. Compressor: When compressor is running, panel screen will display “”;
5. Circulation Water Pump: When circulation water pump is running, panel



screen will display “”;

6. Electric Heater: When electric heater is activated, panel screen will display “”;
7. Defrost: panel screen will display ”DEFROST” when unit is in defrost state.
8. Network: When the unit is connected to internet, panel screen will display “  ”.

## vi. Mainboard Functions

1. Operation modes : Circulated Hot Water, Instant Hot Water, Heating/cooling.
2. Above three modes can be selected through changing [15] settings.
3. Comprehensive protections;
4. Temp Range: Hot Water (25℃~60℃); Cold Water (10℃~35℃)
5. Temp Precision: 1℃;
6. Control of single/dual compressor operation;
7. Temp Sensor Default Self Checkup;
8. Control Signals of Mainboard:
9. Compressor ×2: (220V, 30A);
10. Fan Motor ×1: (220V);
11. 4 Way Reversing Valve ×1 (220V);
12. Circulation Water Pump×1 (220V);
13. Electric Heater×1 (220V);
14. Replenish Valve ×1 (220V);
15. Water Return Valve ×1 (220V);
16. Crankcase Heater×1 (220V);
17. Electronic Expansion Valve ×2
18. Temperature Sensor×9 (Outlet Water Temp, Tank Water Temp, Ambient Temp, Evaporator Coil Temp 1 ,Evaporator Coil Temp 2,Suction Temp 1,Suction Temp 2,Discharge Temp 1 ,Discharge Temp 2);
19. Display Panel communication;
20. Protection Switch ×8 (High Pressure Protection Switch×2【N/C】 ,Low Pressure Protection Switch×2【N/C】 ,High/Low Water Level Switch ×1【N/C】 ,Water Flow Switch×1【N/C】)、End Equipment Switch×1【N/C】 (only valid in cooling) .

## vii. Function Description

- a) Standby State: Displays time and water temperatures. (no 3 min delay for compressor starts);
- b) Powerdown and restart: Restore to original mode (3 min delay for compressor);
- c) Operation process for Circulated Hot Water: water pump starts——fan

motor starts—compressor starts;

Exit process: compressor stops—fan motor stops—water pump stops

- d) Operation process for Instant Hot water: fan motor starts—replenish valve opens—compressor starts;

Exit process: compressor stops—replenish valve closes—fan motor stops

- e) Operation process for cooling: water pump starts—fan motor starts—4 way reversing valve energizes—compressor starts;

Exit process: compressor stops—fan motor stops—4 way reversing valve de-energizes water pump stops

## 1. Defrost

This function is only valid in hot water mode. Not available in cold water mode.

- a) Defrost Cut-in Conditions:

Ambient temperature is lower than [ 15 ] and evaporator coil temperature is lower than set value in [ 4 ] and

Time counting is bigger than set value in [ 6 ] and

Compressor has been running for at least 10 minutes;

When all above conditions are satisfied, unit enters defrost state and panel screen displays “DEFROST”.

In defrost state, circulation water pump always remains open. If unit is

In instant hot water mode, the inlet water valve will be closed.

- b) Defrost Cut-in Conditions:

(1) Evaporator coil temperature is lower than [ 4 ] or

(2) Time counting is bigger set value in [ 7 ];

When either condition is satisfied, unit exits defrost state. “DEFROST”

On the display screen disappears.

- c) Defrost Process:

Circulation water pump on—compressor off—4 way reversing valve energizes—fan motor off—compressor 1 on—compressor 2 on;

- d) Defrost Exit Process:

Compressor 1 off —Compressor 2 off—fan motor on—4 way reversing valve de-energizes—compressor 1 on—compressor 2 on;

Note: in defrost state, if water temperature is detected to be lower than  $\leq 3^{\circ}\text{C}$  for a continuous 5 seconds, unit will stop and exit defrost state.

## 2. Compressor [×1 (220V) ]

- a) Compressor On/off Conditions

1) Circulated Hot Water Mode

Compressor On Condition

**Tank Water Temperature ≤ Set Water Temperature — [1]**

**Compressor Off Condition**

**Tank Water Temperature ≥ Set Water Temperature**

**2) Instant Hot Water Mode**

**Compressor On Condition: High/low water level switch disconnected.**

**Compressor Off Condition :High/low water level switch connected.**

**3) Cooling Mode**

**Compressor On Condition**

**Tank Water Temperature ≥ Set Water Temperature+ [1]**

**Compressor Off Condition**

**Tank Water Temperature ≤ Set Water Temperature**

- b) Compressor will not stop in the first three minutes of operation no matter how water temperature changes.**
- c) c ) Restart of compressor is subject to 3minutes time delay ( exceptional in defrost state).**
- d) d ) In dual compressor system, the compressors will operate independently.**

**3. 4 Way Reversing Valve [×1 (220V) ]**

- a) In Hot Water Mode , 4 way reversing valve remains de-energized. It energizes when the unit enters defrost mode.**
- b) In Cooling Mode, 4 way reversing valve energizes before compressor starts, and de-energizes after compressor stops.**

**4. Circulation Water Pump [×1 (220V) ]**

- a) Circulation water pump starts before compressor starts and stops after compressor stops.**
- b) Circulation water pump starts when unit enters defrost state**
- c) In instant hot water mode, the water return valve opens and the circulation water pump closes.**
- d) 5) Cooling mode: Circulation water pump control mode can be selected through [57]. If the value is set as “1”, the water pump will run as long as the end equipment valve is closed. If the valve is open, the water pump and compressor will stop no matter whether set water temperature is reached. If value in [57] is set as “0”, the unit will not check the status of end equipment valve. The control of water pump is subject to whether set water temperature is reached.**

**5. Electric Heater[×1 (220V) ]**

- a) When ambient temperature is ≤ [10], and when inlet water temperature is < set water temperature — [11] ,electric heater starts.  
When inlet water temperature is ≥ set water temperature, electric heater exits ;**
- b) Press 【E-HEAT】 will start electric heater without considering ambient temperature.**

- When ambient temperature is  $\leq [10]$ , and when inlet water temperature is  $< \text{set water temperature} - [11]$ , electric heater starts.
- When inlet water temperature is  $\geq$  set water temperature, electric heater exits ;
- c) When tank water temperature is  $\geq [16]$ , electric heater exits.
  - d) When high/low water level switch is disconnected, electric heater exits forcibly.
6. Water Return Valve [ $\times 1$  (220V) ]  
after unit starts, every  $[21]$  minutes the water return valve will be energized and run for  $[21]$  minutes.
7. Replenish Valve
- a) 1. Circulated Hot Water Mode  
When both high and low water level switches are closed, the unit will not check water temperature and the replenish valve will not de-energized.  
When both high and low water level switches are open, the unit will not check water temperature, the replenish valve will be energized and the unit will top. After the low water level switch is closed, will the circulation water pump, fan motor and compressor be allowed to start.  
When one water level switch is open and the other is closed, if water temperature is detected to be  $\geq$  set water temperature -  $[09]$ , the replenish valve will be energized.  
When one water level switch is open and the other is closed, if water temperature is detected to be  $\leq$  set water temperature -  $[09] - 4^{\circ}\text{C}$ , the replenish valve will be de-energized.
  - b) Instant Hot Water Mode  
When both high and low water level switches are open, unit enters instant hot water mode and the the replenish valve will be energized.  
When both high and low water level switches are closed, if water temperature is detected to be  $\leq$  set water temperature -  $[45]$  ( If set water temperature is not  $60^{\circ}\text{C}$ , actual  $[45]$  value will be tuned proportionally. But the minimum actual value will be  $22^{\circ}\text{C}$ ), the unit enters circulated hot water mode.
  - c) Cooling Mode  
In cooling mode, replenish valve and high/low water level switches are not in use.
8. Crankcase Heater  
When power is on, it starts when ambient temperature is  $\leq 2^{\circ}\text{C}$ , and exits when ambient temperature is  $\geq 5^{\circ}\text{C}$ .
9. Electronic Expansion Valve
- a) After compressor stops, EEV fully opens (Adjustable. Setting Range: 45~60. Default: 48. Actual number of pulses: Set value multiplied by

10).

- b) After compressor starts, EEV is tuned to initial number of pulses. (Adjustable. Setting Range: 15~45. Default: 35. Actual number of pulses: Set value multiplied by 10).
- c) If full close pulse is 0, the full open pulse will be = maximum pulse -2.
- d) After compressor is on, unit will check the temperature difference between evaporator coil and suction pipe. The EEV will be tuned automatically according to the formula below. In tuning the maximum open pulse is  $\llbracket 28 \rrbracket -2$ , and the minimum open pulse is  $\llbracket 29 \rrbracket$ . The tuning frequency is once every  $\llbracket 27 \rrbracket$  seconds.

$$P_n = P_{n-1} + K * \Delta P$$

Whereas:  $P_n$  is EEV actual open pulse;

$P_{n-1}$  last EEV actual open pulse;

K is coefficient, the default value of which is 1;

$\Delta P$  = Suction temperature – evaporator coil temperature -

$\llbracket 31 \rrbracket$

In circulated hot water mode, if both the ambient temperature and tank water temperature are high,

$\Delta P$  = Suction temperature – evaporator coil temperature -  $\llbracket 39 \rrbracket$

e) Rules for EEV Tuning:

- 1) When compressor discharge gas temperature is  $\geq \llbracket 34 \rrbracket$ , the open pulse increases by 8pulses every tuning until it reaches maximum pulses allowed. When compressor discharge gas temperature is  $\leq \llbracket 35 \rrbracket - \llbracket 38 \rrbracket$ , EEV is tuned normally.
- 2) When compressor discharge gas temperature is  $\geq \llbracket 35 \rrbracket$ , the open pulse increases by 8pulses every tuning until it reaches maximum pulses allowed. When compressor discharge gas temperature is  $\leq \llbracket 35 \rrbracket - \llbracket 38 \rrbracket$ , EEV is tuned normally.
- 3) When suction temperature is  $\geq \llbracket 36 \rrbracket$ , the open pulse increases by 8pulses every tuning until it reaches maximum pulses allowed. When compressor discharge gas temperature is  $\leq \llbracket 36 \rrbracket - \llbracket 38 \rrbracket$ , EEV is tuned normally.
- 4) When suction temperature is  $\leq \llbracket 37 \rrbracket$ , the open pulse decreases by 8pulses every tuning until it reaches minimum pulses allowed. When compressor suction temperature is  $\geq \llbracket 37 \rrbracket + \llbracket 38 \rrbracket$ , EEV is tuned normally.

10. High Pressure Switch [N/C]

- a) after the unit is powered up, when the high pressure switch is detected to be disconnected by a continuous 5 seconds, the unit stops automatically. After the high pressure switch is connected ( high pressure restored to normal), the unit starts (subject to 3 min time delay of compressor).

- b) when the high pressure switch is detected to be disconnected for 3 times in one hour or for a continuous 10 min, the unit stops permanently until manually restored, and the control panel displays corresponding error code.
- c) in parameter setting, the user can select whether to activate high pressure protection function (by default the function is activated). When this function is inactivated, the system does not detect the status of the high pressure switch.

#### **11. Low Pressure Switch[N/C]**

- a) after the unit is powered up, when the low pressure switch is detected to be disconnected by a continuous 10 seconds, the unit will stop automatically. After the low pressure switch is connected ( low pressure restored to normal), the unit will start (subject to 3 min time delay of compressor).
- b) when the low pressure switch is detected to be disconnected for 2 times in one hour or for a continuous 30 min, the unit will stop permanently until manually restored, with panel screen displaying corresponding Error code.
- c) in 3 min ( parameter value adjustable) after the compressor starts, and in defrost mode, the system does not detect the status of the low pressure switch.
- d) in parameter setting, the user can select whether to activate low pressure protection function (by default the function is activated). When this function is inactivated, the system does not detect the status of the low pressure switch.

#### **12. Water Flow Switch[N/C]**

- a) 30 seconds after the water pump starts, the will check the status of the water flow switch. If it is detected to be disconnected for a continuous 5 seconds, the unit will stop with display screen showing error code E04.
- b) in parameter setting, the user can select whether to activate water flow switch protection function (by default the function is activated). When this function is inactivated, the unit will not check the status of water flow switch.

#### **13. Insufficient Water Flow ( Water Temp Diff too Big)**

- a) In circulated hot water mode, 60 seconds after the water pump starts, the unit will check outlet water temperature against tank water temperature. If the temperature difference is  $\geq \llbracket 3 \rrbracket$  for a continuous 10 seconds, the unit will stop.
- b) If the protection occurs 3 times in one hour, the unit will stop

permanently to protect itself with display screen showing error code E09.

#### **14. Outlet Water Temp too High Protection**

- a) In hot water mode, after compressor is on, if outlet water temperature is  $\geq [42]$  for a continuous 5 seconds, the unit will stop. Circulation water pump will run for 30 seconds. After outlet water temperature is  $\leq [42] - 12^{\circ}\text{C}$  for a continuous 20 seconds, the unit will exit protection and restart.
- b) If the protection occurs 3 times in one hour, the unit will stop permanently to protect itself with display screen showing error code E21.

#### **15. Outlet Water Temp too Low Protection**

- a) In cooling mode, after compressor is on, if outlet water temperature is  $\leq [43]$  for a continuous 5 seconds, the unit will stop. After outlet water temperature is  $\leq [43] + 4^{\circ}\text{C}$  for a continuous 20 seconds, the unit will exit from protection and restart.
- b) If the protection occurs 3 times in one hour, the unit will stop permanently to protect itself with display screen showing error code E22.

#### **16. Compressor Discharge Temp Protection**

- a) When compressor discharge temp is detected to be  $\geq [42]$  for a continuous 5 seconds, the unit will stop.
- b) If the protection occurs 3 times in one hour, the unit will stop permanently to protect itself with display screen showing error code E14/E15.

#### **17. Pipe Anti Freeze Protection**

When outlet water temperature is detected to be lower than  $3^{\circ}\text{C}$ , and ambient temperature is detected to be lower than  $3^{\circ}\text{C}$  (both for a continuous 10 seconds), and water pump has been stopped for over 30min, the water pump will start. If the water temperature is detected to be over  $4^{\circ}\text{C}$  for a continuous 10 seconds, the unit will exit pipe anti freeze protection and the water pump will stop.

#### **18. Water Tank Anti Freeze Protection**

When the unit is off, if water temperature is detected to be  $\leq 10^{\circ}\text{C}$  and ambient temperature is  $\leq 3^{\circ}\text{C}$  for a continuous 10 seconds, unit starts in hot water heating mode.

Exit conditions:

- 1) Operation Time  $\geq 3\text{min}$ ;
- 2) Water temperature is  $\geq 15^{\circ}\text{C}$  for a continuous 10 seconds.

**When both above conditions are satisfied, unit exits.**

**19. Unit Anti Freeze Protection**

**When unit has entered Pipe Anti Freeze Protection for over one hour, class II anti freeze protection will be activated. Unit will start hot water heating mode to protect itself from water freezing.**

**Exit Conditions:**

**2) Operation Time  $\geq 3\text{min}$ ;**

**3) Water Temperature  $\geq 10^{\circ}\text{C}$  for a continuous 20 seconds.**

**When both conditions are satisfied, unit exit anti freezing and restore to standby state.**