DC INVERTER AIR TO WATER HEAT PUMP

DEFROSTING SYSTEM

INTRODUCTION
GUIDELINE
TROUBLE SHOOTING

Introduction

This document introduces defrosting program and provides suggestions on how to reset the parameters to achieve optimized defrosting system, and general trouble shooting guide.

1. What is defrosting?

When an **Air to Water Heat Pump** working in cold climate for house or sanitary hot water heating, the water vapor in the air can be cooled down to frost when it flows through the air heat exchanger (Aluminum Finned Tube Heat Exchanger).

The frost accumulates on the surface of the fins of air heat exchanger and may turn into ice which eventually blocked air passage. A process of defrosting will be carried out automatically by heat pump, or manually by technician.

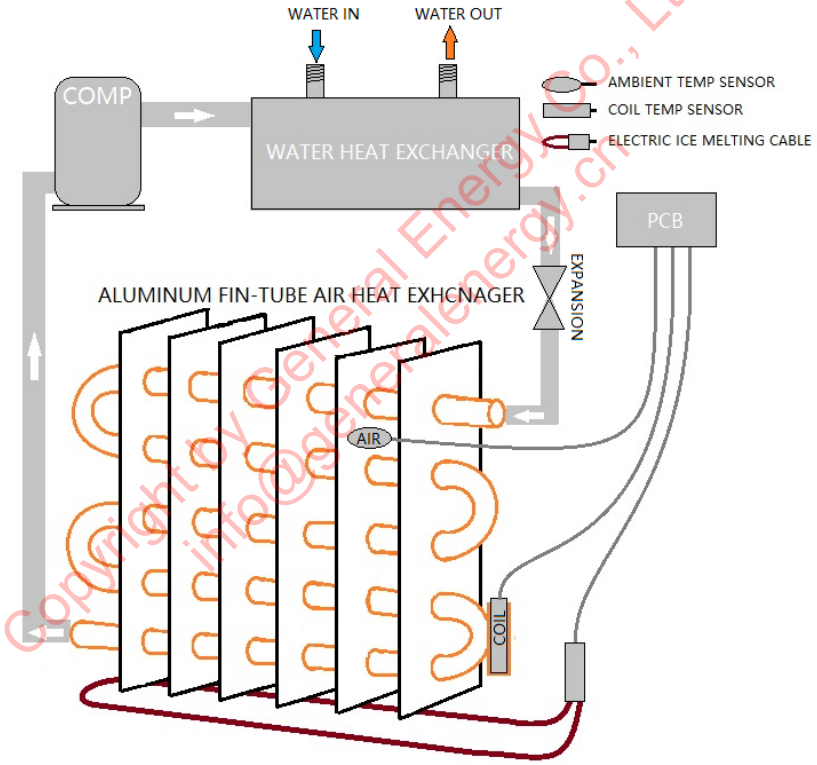
Defrosting is a process of cooling to indoor buffer tank/house and heating to outdoor air heat exchanger for melting the frost/ice. When the frost/ice was removed, heat pump will back to normal working.

2. Defrosting process

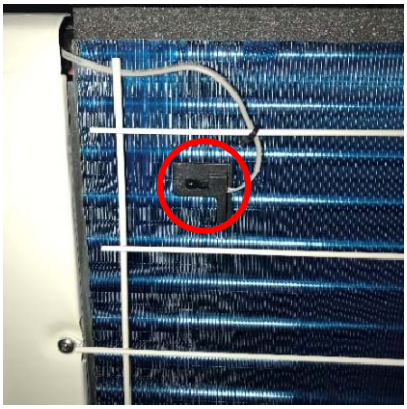
2.1 Action components list:

No.	Name of Component	Socket No. on PCB	Reading code
1	Compressor	CN501,502,503	
2	4-way valve	CN39	
3	Fan motor	CN27,33	
4	Water pump	CN14	
5	Controller PCB		
6	Ambient air temp sensor	socket PO on PCB	d08(refer to 5.2)
7	Coil temperature sensor	socket PG on PCB	d09(refer to 5.2)
8	Electrical ice melting cable	CN38	

2.1.1 Refrigeration System Diagram:



2.1.2 Find Ambient air temperature sensor and Coil temperature sensor



(Amb. Air temp sensor, Plastic seal)

(Coil temp sensor, Copper seal)

2.2 Starting a defrosting process:

- Defrosting will be started when **all 3 Enter-conditions are ready**. If one of them is not ready, heat pump **will not** start defrost.

  - **Enter Condition #1**:
    Compressor has cumulatively operated for ** minutes.
    (** is refer to the setting time of Parameter P15: Defrost interval, refer to 5.1)
    And compressor has continuously operated for 5 minutes.

    Remarks:
    - If Parameter P12 (the method of defrosting) was set 1 (1:SMART), the compressor accumulative operation time will be decided by the defrost program automatically, it doesn't follow the time setting on Parameter P15, and it follows the previous defrost time to decide the current defrost interval time automatically. It means that **the defrost interval cannot controlled by technician.**
    - If Parameter P12 was set 0 (0:AUTO), the accumulative operation time will follow the time setting on Parameter P15.
    - If the compressor has not cumulatively operated for the time of Parameter P15, heat pump **will not** start the defrosting process.

  - **Enter Condition #2**:
    If actual measured Coil temperature (d09) is lower than **°C for at least 5 minutes.
    (** is refer to the setting temperature of Parameter P13, refer to 5.1)

  - **Enter Condition #3**:
    If ambient air temperature (d08) – Coil temperature (d09) > 5°C

- **Action sequence of entering the defrost process:**

① Compressor operating frequency drops down to the lowest for 35 seconds;
② 4-way valve reverses (with refrigeration pressure);
③ Fan motor stops in 5 seconds;
④ Compressor operating frequency goes up to the highest;
⑤ Water pump keep working;
⑥ DHW magnetic 3-way valve (if any) has no action;
⑦ Electric heater (if any) keeps working if water outlet temperature is less than 65°C;
⑧ The defrosting icon displayed on LCD controller panel.

2.3 Conditions of exiting defrosting process:

- Defrosting will be terminated as **one of** the below conditions is ready.

  - **Exit Condition #1**:
    When Coil temperature (d09) is higher than **°C.
    (** is refer to the Parameter P14: Set coil temp. to exit defrosting, refer to 5.1)

  - **Exit Condition #2**:
    Actual defrosting time > ** minutes.
    (** is refer to the Parameter P16: Defrosting time, refer to 5.1)

  No matter which of the Exit-conditions is ready, defrosting will be terminated.

- **Action sequence of exiting the defrost process:**

① Compressor operating frequency drops down to the lowest for 45 seconds;
② Fan motor starts at the same time;
③ 4-way valve reverses back;
④ defrost process will be terminated in 5 seconds;
⑤ Compressor return to normal working frequency;
⑥ The program starts another counting period of defrost interval;
⑦ The defrosting icon disappeared.

3. Controller parameters setting

3.1 Access to setting of parameters on LCD controller

① Unlock the keyboard by keep touching on both and for 3 seconds;
② Enter parameter setting status, touch on or to browse parameter P1 to P21;
③ Select a parameter by touch on and the value of parameter will be flashing;
④ Adjust by or, wait for 2 seconds, auto saved.
⑤ Finally touch on to quit the setting;

3.2 Parameter P12: The methods of defrosting

Setting range: **0 (SMART)** or **1 (AUTO)**.

Update Notice:
Due to incorrect translation in the past, we had updated the description on method of defrost:

Old description:	AUTO (0)	MANUAL (1)
Since January 2020, it is updated and change to below new description ↓		
New description:	**SMART** (0)	AUTO (1)

➢ Difference between **SMART** and **AUTO**:

SMART defrosting is **not following** the setting of Parameter 15 (defrost interval). (Under SMART defrosting mode, the program will decide the defrost interval automatically according to the situation of previous defrosting record, in another word, defrost interval cannot be controlled and Parameter P15 is not valid.)

AUTO defrosting **is following** the setting of Parameter 15.

Tips:
1 (AUTO) defrosting is recommended.

3.3 Parameter P13: Set coil temp. to enter defrost

If coil temperature (d09) ≤ the set temperature P13, defrost **Enter-condition #2** is ready. (At this moment, if both Enter condition #1 and #3 are ready, defrosting process will be started. Otherwise defrosting process will not be started.)

Setting Range:	-15°C<----------↓----------->+2°C
Default Setting:	-4°C
Enter defrost timing:	Late<----------->Early

Tips:
If the heat pump enters defrosting too late (or too early), please increase (or decrease) this setting degree by degree as: -3°C, -2°C, -1°C and etc.

3.4 Parameter P14: Set coil temp. to exit defrost

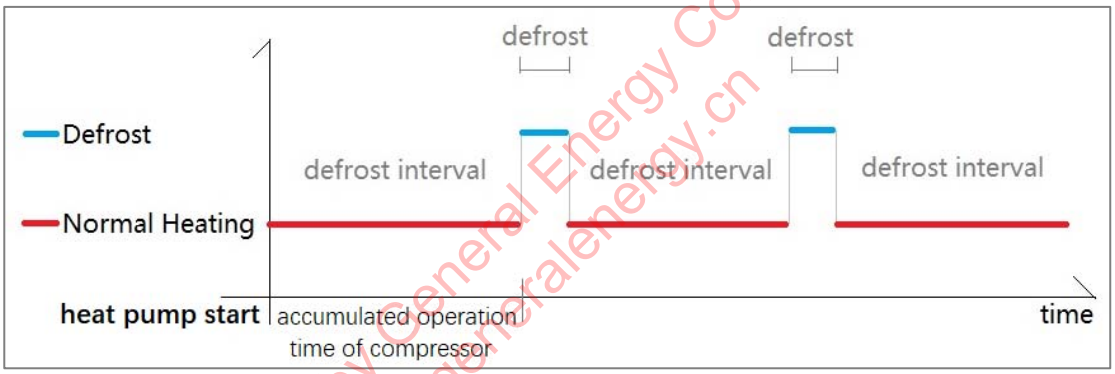
If coil temperature (d09) ≥the set temperature P14, defrost **Exit-condition #1** is ready, regardless Parameter P16 (Defrost time), defrosting will be terminated.

Setting Range:	+8°C<----------↓----------->+20°C
Default Setting:	15°C
Exit defrost timing:	Early<----------->Late

Tips:
If the heat pump exits defrosting too late (or too early), please increase (or decrease) this setting degree by degree as: 15°C, 14°C, 13°C and etc.

3.5 Parameter P15: Defrost interval

It is a time lag between two defrosting process.



It is also an accumulated operation time of compressor related to **Enter Condition #1**.

Setting Range:	25minutes<----------↓----------->70minutes
Default Setting:	40minutes
Defrost frequency:	Frequently<----------->Rarely

When a defrosting process ended, the program starts to count down the accumulated operation time again.

Tips:
If the heat pump doesn't defrost in time (or too many times), please decrease (or increase) this setting minute by minute as: 40mins, 35minus, 30mins, 25mins and etc.

3.6 Parameter P16: Defrost time

It is a time period for defrosting process.

Setting Range:	2minutes<----------↓----------->20minutes
Default Setting:	12minutes
Defrost time:	Short<----------->Long

If time is up, regardless Parameter P14 (Set coil temp. to exit defrost), defrosting will be terminated.

Short defrost time leads to that the frost cannot be cleaned efficiently.

Long defrost time leads to waste of energy, or high-pressure protection on heat pump system.

Tips:
Observe and record the actual situation of each defrosting cycle. According to the record, set a proper defrosting time on Parameter P16.

3.7 Manual defrosting

- **MANUAL** defrosting: A third method of defrost.

  This is the emergency method of defrosting process.
  In case the heat pump is not defrosting automatically.

Follow below steps to active **MANUAL** defrosting process:

① Heat pump is running on heating mode;
② Unlock the keyboard, keep touch on  for 3 seconds;
③ The defrosting process starts and  (defrost icon) displayed on LCD screen;

Remark:

If the defrost icon disappeared in 10 seconds, it means that the actual coil temperature is higher than the setting temperature of parameter P14 (Set coil temp. to exit defrost). The program will terminate the defrosting process immediately.

4. Trouble shooting

Here are some possible troubles that happened to the air to water heat pump, just for reference.

4.1 Ice blocked the whole bottom pan

Description:

On the bottom pan of heat pump, the drain hole was jammed, condensation water cannot be drained out in time, so it would become ice during cold climate days.

Possible Solutions:

1) Melt the ice with boiled hot water.
2) Clean the bottom pan and dredge the drain holes.
3) If electric ice melting cable was burnt, replace it with a new one.
4) If electric ice melting cable was not powerful enough, add one more cable.
5) If no output signal from PCB to electric ice melting cable (CN38), replace it with a new one.

4.3 Part of the air heat exchanger frozen

Description:

Frost was not evenly covered on the whole air heat exchanger, only part of the air heat exchanger was frozen.

Possible Solutions:

1) Move the coil temperature sensor to a proper position.
2) Start manual defrost, refer to 3.7.
3) Reset parameters of defrosting (P14 and P16) and enable a longer time defrosting process.

4.4 Air heat exchanger was fully frozen

Description:

Heat pump does not start defrosting and the air heat exchanger was fully frosted.

Possible Solutions:

1) Set Parameter 12 to 1 (AUTO);
2) Set Parameter P15 to 25 minutes for temporary setting;
3) Replace the failed coil temperature sensor with a new one;
4) Replace the failed ambient air temperature sensor with a new one;
5) Replace the failed PCB with a new one.
6) Refrigeration system was jammed and need repair;
7) Refrigeration system was leak and need repair;
8) Four-way (reverse) valve doesn't swift and need repair.

4.5 Defrosting has not completely cleaned

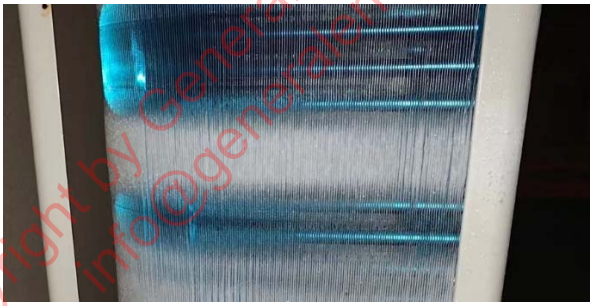

Description:

After defrosting, there is remain frost or ice stay on the air heat exchanger.

Possible solutions:

1) The set temperature of Parameter 14 is too low and it has not defrosted clean, but the defrosting process had been terminated. Set a higher temperature on Parameter P14, to improve the effect of defrosting. Observe and record every defrost cycle, reset the setting of P14 according to the record.
2) Coil temperature sensor was not installed on a proper position. Change the position of Coil temperature sensor to another row of copper coil where has heavily frosted.

4.6 Short defrost / Defrost frequently



Description:

Defrosting process is short.

Heat pump defrosts frequently.

Possible solutions:

1) The air heat exchanger is dirty. Clean the air heat exchanger with cleaner.
2) The air flow is not enough. Fan motor is working abnormally or it is smaller size than the required. It is not capable to provide enough air flow and needs to be replaced with a bigger size.
3) Lack of refrigerant. There may be refrigerant leakage, repair the heat pump.
4) The expansion valve failed. Check the expansion valve, replace with a new one if it is damaged.
5) The air heat exchanger is not big enough. Replace with a bigger size one.

4.6 Frosted heavy

Description:

The frost was very heavy on the air heat exchanger.

Possible solutions:

1) Heat pump defrosting late. The setting temperature of Parameter P13 “Set coil temp. to enter defrost” is low. Increase the setting temperature of Parameter P13.
2) The setting time of Parameter P15 is too long time, heat pump cannot start defrosting process in time. Keep observes on actual defrost situation and set a shorter time setting on P15, in order to make sure defrost interval is proper.
3) The Coil temperature sensor is not installed at a proper position. Change the Coil temperature sensor to another row of copper coil where has heavily frosted.

4.8 Frosted unevenly

Description:

The frost or ice was formed unevenly on the air heat exchanger.

Part of the air heat exchanger has thickly frosted and the other parts has thinly frosted.

Possible solutions:

1) The refrigerant was not distributed evenly into the air heat exchanger, some of the rows has big flow volume and some has small flow volume. Contact with manufacturer for an advice.
2) The size of air heat exchanger was not properly match with the specification of fan motor. The air flow is not even when the air passes through the air heat exchanger.
3) Increase the air flow by using a bigger size of fan motor and blades.

4.9 Low pressure protection occurred during defrosting

Description:

There is low-pressure protection occurred during the defrosting process.

Possible solutions:

1) During the defrosting process, there is no delay setting, or delay time is too short for low pressure protection. Contact with manufacturer for an advice.
2) Expansion valve was jammed. Replace the expansion valve if necessary.

4.10 High pressure protection occurred during defrosting

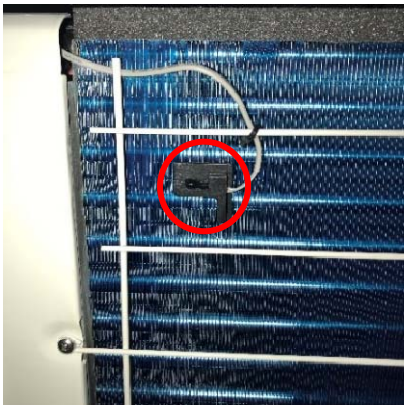
Description:

There is high-pressure protection occurred during the defrosting process.

Possible solutions:

1) The set temperature of Parameter 14 is too high. The heat pump is late to exits the defrosting process, and then lead to high pressure protection.
2) Observe a complete defrost cycle and record the reading of the coil temperature (d09) at the moment of all the frost was cleaned. According to the reading, set Parameter P14 with a proper setting.

4.10 Sensor or PCB damaged



(Amb. Air temp sensor, Plastic seal)

(Coil temp sensor, Copper seal)

Description: Heat pump doesn't defrost

Possible reason:

1) Sensor damaged.

- Find out where the sensors on the heat pump, ambient air temp. sensor and coil temp. sensor.
- Check the displayed temperatures by operates on the temperatures on LCD controller. (Please refer to 5.2 Readings of Operating Status Table) and record them.
- Check the ambient air temperature by temperature probe and infrared thermometer (telemetry) and compare the temperature readings with the records, in order to know if temperature sensor failed.
- Specification of sensor 5K NTC B3470, for detail, please refer to Appendix 5.3

2) Control main PCB damaged. If the sensors are all right, then it may be PCB failed.

Solution: Replace the sensor or the main PCB.

5 Appendix

5.1 Parameter Setting Table

Follow the below steps to access the parameter setting:

① Unlock the keyboard, keep touch on both (Clock/Timer) and for 3 seconds;
② System enters parameter setting status, touch on or to browse parameters;
③ Select parameter by touch on , and the value of parameter will be flashing;
④ Adjust by or, 2 seconds, auto saved. Finally touch on to quit the setting.

No.	Name of Parameter	Default (Range)
P1	Setting desired temperature of water tank (DHW)	55°C (20~60)
P2	Setting desired temperature for AC ROOM HEAT	40°C (15~60)
P3	Setting desired temperature for AC cooling	10°C (5~35)
P4	COMP startup temperature difference for DHW	5°C (3~15)
P5	COMP startup temp. difference for AC (H&C)	3°C (2~15)
P6	Temp. difference for keeping constant water temp.	2 (0~6)
P7	ON/OFF Setting of electric heater at AC (H&C)	0 (0:AUTO/1:OFF)
P8	Desired startup water temp. of electric heater	50°C (30~55)
P9	Electric heater startup delay	30MIN (2~90)
P10	Max. outlet water temp. of AC (H&C)	60°C (25~67)
P11	Lowest HP operating limit of ambient temp.	-30°C (5~35)
P12	Way of defrost	1 (0:SMART/1:AUTO)
P13	Set coil temp. to enter defrost	-4°C (-15~2)
P14	Set coil temp. to exit defrost	15°C (8~20)
P15	Defrost interval	40MIN (25~70)
P16	Defrost time	12 MIN (2~20)
P17	Temp correction for water tank (DHW) temp.	0°C (-5~5)
P18	Temp correction for hot water supply/return	0°C (-5~5)
P19	Control way of water pump in AC ROOM HEAT	0 (0: ON/1: Interval)
P20	Type of heat pump	7 (1/3/5/7)
P21	Manual startup on water pump	0 (0:OFF/1:MANUAL)

5.2 Readings of Operating Status Table

Follow the below steps to access the reading of operating status:

① Unlock the keyboard, keep touch on both and for 3 seconds;
② System enters inquiry to operating status reading;
③ Touch on or to browse parameter d01 to d19, refer to appendix;
④ Finally touch on to quit the setting;

Code	Explanation
d01	Frequency
d02	Current
d03	Return water temperature
d04	Water tank temperature
d05	How water supply temperature
d06	N/A
d07	Exhaust gas temperature (outdoor unit)
d08	Ambient air temperature
d09	Evaporator coil temperature (outdoor unit)
d10	Compressor return gas temperature
d11	Temperature after expansion valve
d12	The open step of expansion valve
d13	Reserved protection code 1: Frequency limitation on compressor because excessive operating current; 2: Frequency limitation on compressor because excessive exhaust gas temperature; 4: Frequency limitation on compressor because excessive coil temperature at cooling mode; 8: Protection of excessive temperature of IPM module;
d14	Heat pump shut down code 01~55: Shut down because of E01 ~ E55 failure code 61: Shut down because of swift operating mode; 62: Shut down because of water heated to desired temperature; 63: Shut down because of defrost;
d15	The time of a latest shut down
d16	The rotating speed of outdoor fan motor
d71	Target frequency
d18	The open step of expansion valve for EVI system (if it is EVI system)
d19	Temperature of IPM module

5.3 NTC Resistance vs Temperature Table (5K, B=3470±1%)

T(℃)	R(KΩ)		T(℃)	R(KΩ)		T(℃)	R(KΩ)
-30	63.7306		14	7.7643		58	1.5636
-29	60.3223		15	7.4506		59	1.5142
-28	57.1180		16	7.1813		60	1.4856
-27	54.1043		17	6.8658		61	1.4206
-26	51.2686		18	6.5934		62	1.3763
-25	48.5994		19	6.3333		63	1.3336
-24	46.0860		20	6.0850		64	1.2923
-23	43.7182		21	5.8479		65	1.2526
-22	41.4868		22	5.6213		66	1.2142
-21	39.3833		23	5.4048		67	1.1771
-20	37.3992		24	5.1978		68	1.1413
-19	35.5274		25	5.0000		69	1.1008
-18	33.7607		26	4.8108		70	1.0734
-17	32.0927		27	4.6298		71	1.0412
-16	30.5172		28	4.4586		72	1.0100
-15	29.0286		29	4.2909		73	0.9800
-14	27.6216		30	4.1323		74	0.9508
-13	26.2913		31	3.9804		75	0.9228
-12	25.0330		32	3.8349		76	0.8957
-11	23.8424		33	3.6955		77	0.8695
-10	22.7155		34	3.5620		78	0.8441
-9	21.6486		35	3.4340		79	0.8196
-8	20.6380		36	3.3119		80	0.7959
-7	19.6806		37	3.1937		81	0.7730
-6	18.7732		38	3.0809		82	0.7508
-5	17.9129		39	2.9727		83	0.7295
-4	17.0970		40	2.8688		84	0.7086
-3	16.3230		41	2.7692		85	0.6885
-2	15.5886		42	2.6735		86	0.6690
-1	14.8713		43	2.5816		87	0.6502
0	14.2293		44	2.4936		88	0.6320
1	13.6017		45	2.4097		89	0.6144
2	13.0057		46	2.3276		90	0.5973
3	12.4390		47	2.2491		91	0.5808
4	11.9011		48	2.1739		92	0.5647
5	11.3894		49	2.1016		93	0.5492
6	10.9028		50	2.0321		94	0.5342
7	10.4399		51	1.9656		95	0.5196
8	9.9995		52	1.9016		96	0.5088
9	9.5802		53	1.8399		97	0.4919
10	9.1810		54	1.7804		98	0.4786
11	8.8008		55	1.7232		99	0.4650
12	8.4395		56	1.6680		100	0.4533
13	8.0934		57	1.6140			