NA8651 Engineering Water Pump Water Heater Controller User Guide (V1.3)

➢ Main Function and Technique Index

The controller is the special controller for engineering heat pump water heater, it contains 4 temperature sensors (water temperature, outdoor temperature, exhaust temperature, general temperature switch sensor), 5 controlling output (compressor, defrost, fan, water compensating valve, general temperature switch), 1 water level signal input (used for showing the water is full) and 1 alarm signal input (used for high and low pressure protection). Its main function is as follows:

- 1. **Temperature Display and Controlling:** It can display water tank temperature and outdoor machine temperature, and it can also control the temperature in water tank at the set temperature.
- 2. **Auto Defrosting Controlling:** It has defrosting controlling logic of heat pump optimization design, and can defrost effectively in order to ensure that the outdoor machine can run normally at low temperature. You can set several kinds of defrost methods: four-way valve defrost, bypass valve defrost or electric heat defrost.
- 3. **Auto compensating water :** Intelligent compensating water program, the controller only uses one water level switch signal to ensure that it doesn't affect the water temperature in the process of compensating water and the water tank contains more hot water, and ensure the unit running steadily in the process of compensating water.
- 4. **Exhaust temperature protection:** When the exhaust temperature is too high, the controller turns off the unit and generates alarm signal, and it can control the outdoor fan according to the exhaust temperature.
- 5. **External alarm:** one external switch valve alarm signal input, it can be set to 3 modes: always open, always closed or forbidden, and you can set the times and time of the auto recovery.
- 6. **General temperature switch:** the controller has a general temperature switch, and contains a temperature sensor and an output signal. The controller can give an output signal according to the temperature controlling, and the temperature point and action way can be set. The typical application is switching the double capillary system, or it can be used in pipe temperature difference cycle controlling.
- 7. **Running in different period of time:** The controller has two modes: "Auto" and "Econ", in "Econ" mode, the controller can set 3 periods of time at most, it can only heat in these periods of time.
- 8. **Others:** Real Time Clock, On-off State Memory When the power is off(Can be set), Direction of four-way valve can be set, Compressor start delay protection, Sensor Error Alarm, High Temperature Alarm, Add Fluorin, Test and so on.

Main Technique Index:

- **▶** Range of Temperature Display: -50~150°C
- **A Range of Temperature Set:** $0 \sim 100^{\circ}$ C, the range can be set.
- **P Power Supply:** 220V±10%
- ▷ Operation Environment: Temperature $-10^{\circ}C \sim 50^{\circ}C$, humidity $\leq 85\%$.
- Dutput Load Capability: Compressor and Defrost 10A/250VAC, Others 2A/250VAC
- **Temperature Sensor Type:** NTC R25=5k Ω ,B(25/50)=3470K
- Decutive standard: Q/320585 XYK 01-2004 (NA8651-HTDX)

Operating Guide

I Display

The controller usually displays the temperature in water tank, press the key " \checkmark " to display the exhaust temperature, press the key " \checkmark " to display the outdoor temperature, press the key " \checkmark " and " \checkmark " at the same time to display the temperature of temp switch sensor.

II On-off

Press" \odot " to turn on and off the controller, the controller displays "HEAT", "Temp Keep", "DEFROST" in the on state, and "OFF" in the off state. The controller will always display current time and water temperature in spite of on or off.

III Water Temperature Set

Press the key "S", and then enter the state of temperature set, the LCD shows "upper limit

temperature". use the key " \checkmark " or " \checkmark " to change the setting value (The key " \checkmark " adds 1°C, the key " \checkmark " minuses 1°C, press and hold them over 0.5 seconds can add or minus rapidly). Press the key of "S" again and then set the lower limit temperature in the same way, in the end, you can press the key of "S" again to exit the setting state.

The controller begins to heat when it detect that the water temperature is below "lower limit temperature", and stop heating when the water temperature is higher than "upper limit temperature", thus the water temperature can be controlled between "lower limit temperature" and "upper limit temperature".

The upper and lower limit temperature range can be set and limited, please refer to the senior set (F13 and F14).

IV Time Set

Press the key " $^{\oplus}$ ", the hour part of the time display is coruscating, and use the key " \checkmark " or" \checkmark " to adjust the hour. Press the key " $^{\oplus}$ " again after adjusting, then you can adjust the minute in the same way, finally you can press the key " $^{\oplus}$ " to exit the state of time setting.

V Run Mode Set

Press the key "M" to select the "Auto Mode" and "Econ Mode". In "Auto Mode", the controller controls the heat pump to heat according to the setting temperature. In "Econ Mode", the controller can only heat in the 3 start periods of time.

VI Set running time of economical mode

Press the key " \oplus " and hold it for 2 seconds, the controller can enter the state of heat period of time setting, you can set 3 heat periods of time in turn according to the display of LCD. (The key " \oplus " switches setting items, the key " \bigstar " or" \checkmark " changes its value)

The controller can be set 3 heat periods of time at most, if you don't need some periods of time, you can set the starting time and ending time which you don't need as "00:00".

In addition, if the ending time is earlier than starting time, the controller considers this ending time is next day. For example, the period of time is "22:00"to"03:30", the controller considers it as 22:00 at night to 03:30 next day.

VII Advanced Set

The controller can adjust some internal parameter to meet all kinds of need. The parameter is supplied for special technologist, and common users don't need to know. Please don't change the internal parameter of the controller casually, lest lead to the abnormity of the controller. Use the code to enter the state of parameter setting, the code is "up-down-up-down-up-up-down", Press the key " \checkmark ", " \checkmark " continuously in the state of showing current temperature, and it must be finished within 3 seconds, if the code is right, you can enter the state of parameter setting, here the nixietube shows "Fxx", there into xx is a number, it means parameter code. Use " \checkmark " or " \checkmark " to select the parameter code, Pressing the key "S" can make it to show the value of the parameter after select the parameter, here you use " \checkmark " or " \checkmark " to set the parameter, then press the key "S" to return to the state of showing parameter code after finishing setting. Internal parameter code is showing below:

Sort	Code	Parameter Name	Range	Factory Setting	Unit	Remark
	F13	Max set temp	0 - 100	60	°C	Used for limiting the range
Temperature	F14	Min set temp	0 - 100	10	°C	of temperature upper and lower limit
	F19	Water temp sensor adjustment	-10 - 10	0	°C	Used for adjusting water temp measure error
Compressor	F21	Compressor delay time	0 – 10	3	Min	
	F31	Defrost start temp	-20 - 20	-2	°C	
	F32	Defrost end temp	0 - 50	10	°C	
	F33	Defrost start time	1 – 999	30	Min	
	F34	Max defrost time	Off 1 – 99	10	Min	Off means no defrost
Defrost	F37	Defrost mode	0 - 3	0	-	0 - four-way valve, open when defrosting 1 - four-way valve, closed when defrosting 2-bypass valve 3-electric heat
Water Compensating	F48	Water compensating alternation time	1 - 999	30	Min	
	F49	Water level switch polarity	0 or 1	0	-	0 - closed when water is full 1 - open when water is full

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	F50	External alarm mode	0 - 2	0	-	0: without external alarm 1: always open, alarm if closed 2: always open, alarm if open		
	F51	External alarm auto resume times *	0-10	1	Times	Refer to the annotation		
Alarm	F52	Reset time of external alarm auto resume times*	0 – 999	60	Min			
	F57	Exhaust temp protect mode	0 - 2	1	-	0-no protection 1-protect when high temp, fan is not controlled 2-protect when high temp, fan is controlled		
	F58	Exhaust protect temp	50 - 125	100	°C			
	F59	Exhaust protect temp difference	0.1-20	5	°C			
	F61	Whether memorize the on/off state or not after power is off	Yes/No	Yes	-	Yes: memorize No : unmemorize		
System setting	F63	Backlight delay	Off 1 – 99 On	30	Sec	Off means backlight is always on. On means backlight is always off. 1-99 means the backlight delay to be off after key operating.		
	F70	Display the temp switch sensor temp	-	-	°C	Temp switch mode:		
General	F71	Temp switch action mode	0 - 2	0	-	1 - 0 when low temp off		
Temp	F72	Temp switch action temp	-45 - 145	0	°C	when high temp		
Switch	F73	Temp switch action temp difference	0.1 – 20	1	°C	2 - off when low temp, on		
	F74	Temp switch action delay	0 – 999	0	Sec	when high temp		
State Display	F81	Showing model and software version						
Test	F97	Check input signal	Used for checking alarm input signal					
	F98	Add fluorin	The controller shows "AdF" after entering this function, an on compressor and fan, four-way valve state is relative to mode (Refer to "Auto defrost principle" for details). Press a to exit or exit automatically after 20 minutes.			vering this function, and turns ve state is relative to defrost le" for details). Press any key inutes.		
	F99	Check output signal	The controller shows "CCC" after entering this function and attracts all relay in turn, used as outdoor machine panel, please don't use it when the controller is running! Press any key to exit or exit automatically after 30 seconds.					
	End	Exit						

*Annotation: "F51 External alarm auto resume times" : It means the times of system becoming normal automatically when external alarm signal becomes normal, if it is above the times, the system can not run even if the external alarm signal becomes normal and it is in the error state, and only can resume by turning off the controller manually.

"F52 Reset time of external alarm auto resume times": If only the time of external alarm signal being normal reaches the set time, the controller will count the auto resume times again when the error occurs next time. For example, F58=1, F59=60, then within 60 minutes, the external alarm signal can resume automatically when the error occurs for the first time, when it occurs for the second time, the system is locked, and it can be resume manually.

VII Alarm Processing

The controller enters the alarm state when the abnormal status below happens:

Abnormal status	bnormal Alarm status indication		Action	Resume way	Explanation
External alarm	Error	A11	Stop heating	Auto or Manual, it can be set (F51, F52)	Manual resume way: turn off the controller then turn on
Water temp sensor error	Error	A21	Stop heating	Auto	
Outdoor sensor error	Error	A22	-	Auto	
Exhaust sensor error	Error	A23	-	Auto	Exhaust temp protect mode (F57) ,no alarm if 0

Temp switch sensor error	Error	A24	-	Auto	Temp switch mode (F71), no alarm if 0
Interrupt with the outdoor panel	Offline		Stop heating	Auto	Temp display""
Exhaust temp too high	High temperature	-	Stop heating	Resume automatically after the exhaust temp fell	
Withinsetdefrosttime,outdoortempcan not go up todefrostendtemp	Defrost failure	-	-	Auto or Manual	Resume automatically when the outdoor temp is above "defrost start temp"

Explanation:

- 1. When the sensor is error, "OPE" means open, and "SHr" means short. You can press the key "▲" "▼" to view the temperature of each sensor.
- 2. "Alarm Code" It displays alternately with temperature.
- 3. "Auto Resume" The controller exits the alarm state when the abnormal state disappears.
- 4. "Manual Resume" When the abnormal state disappears, the controller is still in the alarm state, it can only resume by turning off the controller first then turning on.

✤ Basic Operating Principle

Ger <u>Temperature controlling</u>

Temperature controlling can set according to "Upper limit" and "Lower limit". If "Upper limit" is 55° C, "Lower limit" is 50° C, it begins to heat when the water temperature is lower than 50° C, and it stops heating when the water temperature is higher than 55° C. Thus temperature can be controlled between 50° C and 55° C.

G <u>Compressor Delay Time</u>

The controller contains a "compressor halt calculagraph", and it begins to time when compressor stops, the program first check the calculagraph before booting the compressor next time, the program will immediately boot the compressor if the calculagraph reach 3 minutes ,if the calculagraph doesn't reach 3 minutes ,it will boot again when the calculagraph reaches 3 minutes. The compressor can be protected. (*Annotation: the time of boot delay protection can be adjusted, it sets to 3 minutes above.)

GAuto Defrosting

The controller first detects the temperature of outdoor machine when it begins to heat. If it is lower than "defrost start temperature", the controller will first turn on defrosting, then turn on heating after defrosting ends. In addition, the controller will supervise the temperature of outdoor machine when heating normally, and decide whether need to defrost according to the time of the outdoor machine in the continuous low temperature state. In other words, the defrosting calculagraph begins to time when the outdoor machine temperature is lower than "defrost start temperature", and turns on the defrosting when the value of time reaches "defrost start temperature" when timing, and it begins to time again when the outdoor machine temperature is lower than "defrost start temperature" next time. In other words, the value of defrosting calculagraph shows the continuous low temperature time of the outdoor machine.

The controller can check the defrosting effect through the temperature of outdoor machine, if the temperature of outdoor machine goes up to the "defrost end temperature", the controller will turn off the function of defrosting. If the defrosting time is above "max defrost time", the controller will turn off defrosting forcibly and touch off the defrosting failure alarm.

The process above can only run in heating state, in other words, the controller will not turn on defrosting in non-heating state.

Defrost Mode (F37)	Explanation	State	Compressor Output	Defrost Output	Fan Output		
0	Four-way valve heat pump defrost, four-way valve is off when heating, and on when defrosting	Heat	1	0	1		
		Defrost	1	1	0		
		Add fluorin	1	1	1		

You can set different defrost mode by F37, refer to the table below: (1 means on, 0 means off)

1	Four-way valve heat	Heat	1	1	1
	valve is on when heating, and off when defrosting	Defrost	1	0	0
		Add fluorin	1	0	1
2		Heat	1	0	1
	Bypass Valve Defrost	Defrost	1	1	0
		Add fluorin	1	0	1
3		Heat	1	0	1
	Electric Heat Defrost	Defrost	0	1	0
		Add fluorin	1	0	1

GS <u>Running in different period of time</u>

The controller contains real time clock (RTC), and it can time accurately. In "Economical mode", whether heat or not is not only according to the water temperature, but also according to whether during the set running time, if not in the period of time, the controller will not heat in spite of high or low temperature.

GSAuto water compensating

The intelligent water compensating program of the controller is designed according to the principle below:

- 1. Ensure that it doesn't affect the water temperature in the process of water compensating.
- 2. Ensure that there is as more as hot water in the water tank.
- 3. Ensure that the unit is running steadily in the process of water compensating.
- 4. Use the simplest water level sensor, reduce the error, reduce the cost and construction difficulty.

Based on the principle above, the controller use a simple way to compensate water, and only use one water level switch signal, the water level switch is above the water tank and indicates that water is full. Water compensating logic is as follows:

- 1. When water is not full, the controller will compensate water every other water compensating alternation time(Alternation time is set by F48);
- 2. When water is not full and it is in the compressor running state, the controller begins to compensate water at once when water temperature is higher than "upper limit temperature -2°C", it is in order to keep the compressor running;
- 3. The controller will not stop compensating water until water temperature is lower than "lower limit temperature -2°C", on one hand it ensures that the water temperature is not too low, on the other hand, it make compressor run and begins to heat (When the water temperature is higher than "upper limit temperature 2°C", it begins to compensate water again, and stops when water is full);
- 4. It stops compensating water at once when water is full.

Water full signal is a contact switch signal, and actually it is a water level switch on the top of water tank. Water level switch has 2 forms: one is close when it has water, and open when no water, the other is open when is has water, and close when no water. Please set the F49 accurately when you select different water level switch.

&∕<u>External alarm</u>

The external alarm is a switching value signal, and usually connected to the high and low voltage protection switch, it can be set to forbidden, always open or always closed (F50). "Always open" means that external alarm signal is in the open state, and it generates alarm when closed. "Always closed" is on the contrary, "forbidden" means external alarm signal.

The system will stop when the external alarm occurs, and start to run when the external alarm becomes normal. But if the external alarm occurs 2 times in one hour, the system will be locked in the alarm state, and it will resume by turning off the controller manually. The times and time can be set, please refer to F51 and F52 for details.

GS <u>Exhaust temperature protection</u>

When the exhaust temperature is too high, the controller enters the alarm state and stops heating. The temperature can be set (F58 and F59), and the exhaust temperature protection can be set to fan not controlled mode (F57=1) and fan controlled mode (F57=2).For example, F58=100°C(temperature), F59=5°C(temperature difference):

Fan not controlled mode (F57=1): The controller enters alarm state and stops heating when the exhaust temperature is higher than 105°C.

Resume when the exhaust temperature is lower than 95°C.

Fan controlled mode (F57=2): Turn

Turn off the fan when the exhaust temperature is higher than 100°C. The controller enters alarm state and stops heating when the exhaust temperature is higher than 105°C.

Resume when the exhaust temperature is lower than 95°C.

When F57=0, no exhaust temperature protect function, and no exhaust temperature sensor error alarm.

GS General temperature switch

The controller supplies one general temperature switch, and it contains a temperature sensor and an output signal. The controller can control the output signal according to the temperature (for example, the controller transforms double capillaries system according to the environment temperature, or controls pipe cycle pump according to back water temperature). The action temperature and method can be set (F71– F74), for example, F72=0°C (temperature), F73=1°C (temperature difference), F74=60 (action delay) : On when low temperature (F71=1) : sensor temperature is lower than -1°C for 60 seconds, output is on sensor temperature is higher than 1°C for 60 seconds, output is off

On when high temperature (F71=2) : sensor temperature is higher than 1°C for 60seconds, output is on sensor temperature is lower than -1°C for 60 seconds, output is off

When F71=0, not use the temperature switch function, and no temperature switch sensor error alarm. You can read the sensor temperature in the parameter F70.

Wiring Diagram:



\bigcirc Notice:

- 1. Please set F37 correctly, and it must be accordant with defrost system of heat pump, otherwise the system can not work normally.
- 2. Please set F49 correctly, and it must be accordant with water level switch polarity, otherwise it can not compensate water normally.
- 3. The RTC power of the controller is supplies by super capacitance, and the RTC can run for 72 hours when power cut, if the power cut time is over 3 days, you may adjust the RTC again.
- 4. Water temperature sensor, outdoor sensor and exhaust sensor must be fixed at the right place.
- 5. Please connect the ground of outdoor machine panel and outdoor machine reliably.



NA8651 Function Diagram: