DC INVERTER AIR TO WATER UNIT

WORKING PROGRAM

Version No. V1.10

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CONTENT

SUMMARY

The controller uses Fuzzy-logic to control the compressor operation frequency and speed. The compressor is Matsushita DC-driven compressor 5RS102XAB。

WORKING CONDITIONS FOR CONTROLLER

1. Applicable voltage: 160V～263V , indoor unit gets the power from room power supply, and then from indoor unit to outdoor unit;
2. Power frequency：50Hz ;
3. Working temperature range :(-20～+55) ℃ ;
4. Working Environment RH：RH30%～RH95% ;
5. Indoor unit equipped with a circulation water pump.
6. Outdoor fan motor is constant speed metal cased motor.
7. wired operation panel (30M) equipped with remote control transmission. Transmission signal receiving distance：5m with ＞120º range, or 8m direct ;
8. Compressor: Matsushita 5RS102XAB

Functions of Controller

1. Wired controller with optional remote controller
2. Digital LCD display
3. Buzzer
4. Water pump controlling
5. Timer ON/OFF function
6. Compressor start-up delay protection
7. Heating mode indoor coil high temp protection
8. Heating Mode defrosting function
9. Heating mode Anti-cold air function
10. Cooling/Dry mode Anti-freezing function
11. Self-diagnosis
12. Unit operation mode change-over: Cooling Operation、Heating operation
13. Water flow switch controlling
14. Pressure switch controlling

15. Water in and Out temperature sensors controlling
16. Compressor/outdoor coil preheat function

UNIT FUNCTIONS

1、Terminology :

Tr：Room temperature

Ti：water in temperature

To: water out temperature

Ts：Set temperature

Tc：outdoor unit coil temperature

Td：compressor gas discharge temperature

Ta：outdoor ambient temperature

Tf: temperature differences

2、Cooling Operation

Choose this cooling operation mode and the set temperature with wired operation panel or optional remote controller. Temperature setting range is 16℃ - 31℃ if you use room temperature as the index, Temperature setting range is 7℃ - 25℃ if you use water temperature as the index (with operation panel only). The set temperature can be selected with the button ” ▲” or “▼”. In this operation mode, reversing valve is always OFF. Other operations in this mode:

a、Compressor speed control is described in Chapter 7.

b、Water pump is always running. If something wrong happens and compressor stops, the pump will keep on running for one more minute before stopping, until problem is removed.

c、Indoor coil anti-Freezing protection temperature setting is ≤ 3℃.

d、In this mode unit has TIMER, Sleep and Auto-restart function;

e、When the conditions for compressor to start are met, unit will start outdoor fan 1 second before the compressor starts. When compressor stops, outdoor fan will keep on working for 30 more seconds.

3、Heating Operation

Choose this heating operation mode and the set temperature with wired operation panel or optional remote controller. Temperature setting range is 16℃ - 31℃ if you use room temperature as the index, Temperature setting range is 26℃ - 60℃ if you use water temperature as the index (with operation panel only). The set temperature can be selected with the button " ▲" or "▼". In this operation mode, reversing valve is always OFF. Other operations in this mode:

A、 Compressor speed control is described in Chapter 7.

B、Reversing valve is always ON. 5 seconds after the reversing valve coil is powered on, compressor can start to work. To turn off the reversing valve, it has to be in 2 minutes after compressor turns off (with the exception for defrosting operation)

C、When the conditions for compressor to start are met, unit will start and run outdoor fan for 1 second, and then run the compressor. When compressor stops, outdoor fan will keep on working for 30 more seconds.

D、If the set water temperature is over 45℃, and it is reached, compressor stops and the water pump keeps on running for 1 more minute before it stops. And then the water pump starts to run for 1 minute every 6 minutes until the compressor starts and pump starts to run continuously. If the set water temperature is below 45℃, water pump runs all the time. If something wrong happens and compressor stops, the pump will keep on running for 1 more minute before stopping, until problem is removed and compressor resumes operation

E、In this mode unit has TIMER, Sleep and Auto-restart function;

F、Defrosting Operation as follows:

a) if the following conditions are met altogether at the same time, defrosting operation starts. The picture of Sun in the operation panel display flashes:

1) Outdoor coil temp. is less than -3℃ and remains so for 3 minutes;

2) Compressor has been working continuously for over 5 minutes;

3) Compressor's accumulated working time is bigger than defrosting interval time (see below for defrosting interval time);

b) Defrosting cycle stops when one of the following conditions is met:

1) Defrosting time is over 9 minutes;

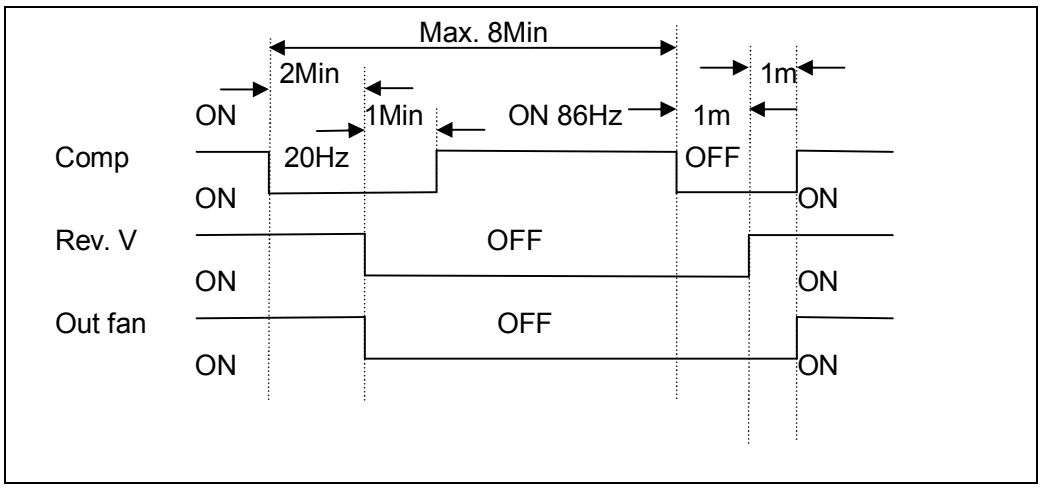
2) Defrosting time is over 10 seconds and the outdoor coil temp. is over 13℃.

c) Defrosting cycle intervals

When unit is powered on first time or changes to heating operation from other modes, the initial interval time between defrosting cycles is 50 minutes.

In heating operation, each time after a defrosting cycle ends, the unit adjusts the interval time between the defrosting cycles by itself. But the interval time between defrosting cycles can not be less than 45 minutes, or over 2 hours.

1) If defrosting operation time is less than 1minute, the interval time of defrosting is 10 minutes longer.
2) If defrosting operation time is less than 3 minutes, the interval time of defrosting is 10 minutes shorter.
3) If defrosting operation time is bigger than 3 minutes, the interval time of defrosting is 20 minutes shorter.



Defrosting Cycles as follows :

4. Sleep Mode

Sleep Mode takes effect in Cooling and Heating operations. Once Sleep mode is entered, Sleep Indication light is ON.

Press "Sleep" button to enter "Sleep" mode.

For Cooling operation, the set temp. rises by 1℃ after one hour operation, and by another 1℃ after another hour of operation (total 2℃). Unit keeps it with 2℃ increments/compensation as set temperature.

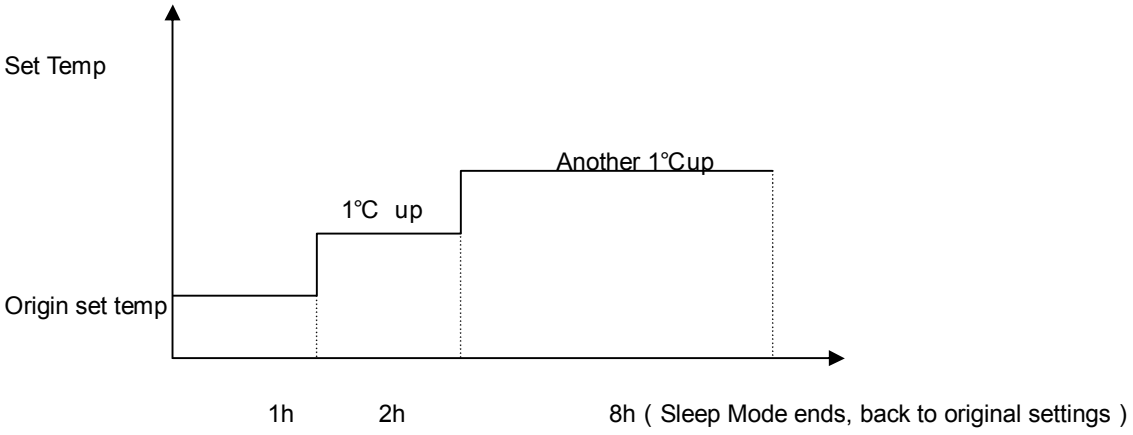
For heating operation, the set temp. drops by 2℃ after one hour operation, and drops by another 2℃ after another hour of operation (total 4℃). Unit keeps it with 4℃ decrements/compensation as set temperature.

SLEEP Mode operation lasts for 8 hours. 8 hours after the Sleep Mode is set, it ends up, and unit resumes the operations set before.

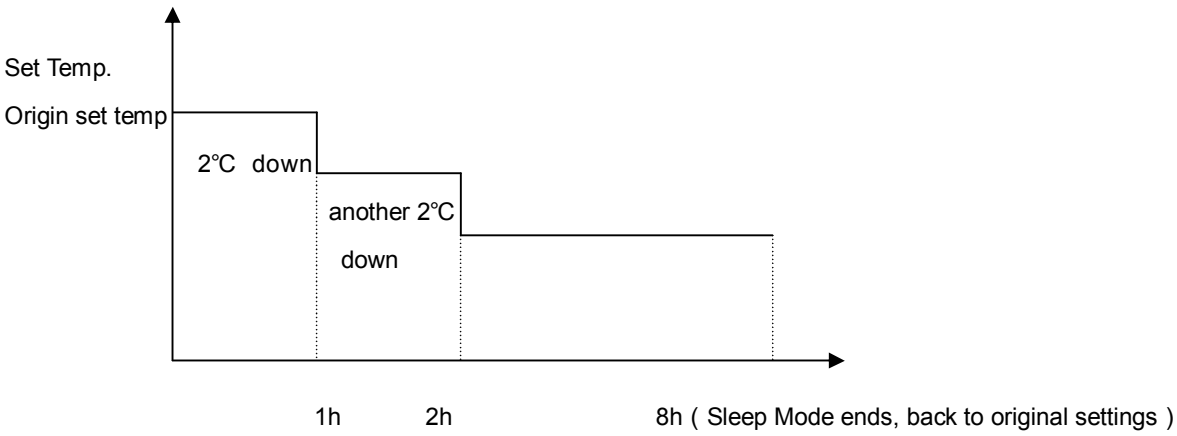
While in SLEEP Mode operation, other mode buttons still remain functional. If other mode button is pressed, SLEEP Mode is cancelled. But if temperature adjusting buttons " ▲" or "▼" are pressed, unit will run with the newly set temp. + Decrements/Increments compensation.

In Sleep Mode, press again "Sleep" button or other Mode button, or Power button, Sleep operation is stopped.

Sleep Mode in Cooling operation:



Sleep Mode in Heating Operation:



5、TIMER Function

Press TIMER button, Timer light is ON. TIMER ON or OFF time is set with wired operation panel or optional remote controller.

6、Self-diagnosis (For factory testing, omitted)

outdoor unit :

a. Reversing valve is powered for 5 seconds, valve indication light is ON. (then it is OFF, self-diagnosis proceeds to next procedure) ;
b. Outdoor fan works for 5 seconds, outdoor fan motor indication light is ON.
c. Compressor works for 30 seconds, compressor indication light is ON.
d. Self-diagnosis ends. Self-diagnosis quits.

In this Self-diagnosis operation, the compressor protection time after turning –off and then turning –on is 30 seconds for cooling operation, and 40 seconds for heating operation.

7、Compressor speed control

The “SW” button on the operation panel is used for switching-over of room temperature “Tr” or water temperature “To” setting. Compressor working speed and target speed is decided by temperature setting.

a) compressor speed VS frequency

Frequency	F0	F1	F2	F3	F4	F5	F6	F7
Comp. Speed in Hertz in Cooling	0	30	37	44	58	65	75	85
Comp. Speed in Hertz in heating	0	30	37	50	60	70	75	85

Compressor speed is decided by the unit. F4 is the optimal speed for rated capacity with highest efficiency.

b) Compressor speed increasing or dropping is by 1Hz/s;

c) When unit is turned on first time, there is 3 seconds delay protection for compressor; When unit is turned on immediately after shutoff, there is 3 minute delay protection for compressor.

d) When unit is turned on, compressor will work at 57Hz and remain so for 50 seconds before it gets to the set frequency described in item h;

e) If compressor target speed is over 72Hz, If compressor has not run at 72Hz for 2 minutes, it will run at 72Hz for 2 minutes, and then toward the set frequencies described in item h;

f) If the compressor works continuously for over two hours at speed less than 57Hz, controller will force the compressor to run at 57Hz for 2 minutes, and then run at a speed decided by the temperatures.

g) set temp differences VS compressor speed

1) If room temperature Tr is used for setting the temperature ,When the compressor starts first time, its initial speed is set according to room and set temperature difference as follows:

TS-TR<1℃ , Compressor speed isF0 ;

TS-TR>1℃ , Compressor speed F2 ;

TS-TR>6℃ , Compressor speed F4 ;

TS-TR>10℃ , Compressor speed F6 ;

After compressor starts, Unit adjusts the compressor speed every 3 minutes according to Room temp and set temp differences and ratio of temp changes. but maximum speed is no more than F7. Adjustment are as per the following chart:

Tf. 变化率	-3	-2	-1	0	1	2	3
-3	0	-1	-2	-3	-4	-5	-6
-2	1	0	-1	-2	-3	-4	-5
-1	2	1	0	-1	-2	-3	-4
0	3	2	1	0	-1	-2	-3
1	4	3	2	1	0	-1	-2
2	5	4	3	2	1	0	-1
3	6	5	4	3	2	1	0

While the compressor works, if the user changes the temperature setting, the unit will choose the compressor working speed from 1).

In heating operation, if the room temperature is 2℃ higher than the set temperature （Tr-Ts≧2℃）

Compressor speed drops to F1; （Tr-Ts≧3℃） compressor stops.

In cooling operation, if the room temperature is 2℃ lower than the set temperature （Ts-Tr≧2℃）

Compressor speed drops to F1; （Ts-Tr≧3℃） compressor stops.

2) If water temperature To is for setting the temperature ,When the compressor starts first time, its initial speed is set at F4.

After the compressor starts, the unit adjusts the compressor speed every 6 minutes according to water temp and set temp differences and ratio of temp changes. But maximum speed is no more than F7.

Tf / 变化率	-3	-2	-1	0	1	2	3
-3	0	-3	-6	-9	-12	-15	-18
-2	3	0	-3	-6	-9	-12	-15
-1	6	3	0	-3	-6	-9	-12
0	9	6	3	0	-3	-6	-9
1	12	9	6	3	0	-3	-6
2	15	12	9	6	3	0	-3
3	18	15	12	9	6	3	0

While the compressor works, if the user changes the temperature setting, the unit will choose the compressor working speed from 2).

In heating operation, if the water out temperature is 2℃ higher than the set temperature （To-Ts≧2℃）

Compressor speed drops to F1; （To-Ts≧3℃） compressor stops.

In cooling operation, if the water out temperature is 2℃ lower than the set temperature （Ts-To≧2℃）

Compressor speed drops to F1; （Ts-To≧3℃） compressor stops.

h) compressor gas discharge temp. VS compressor speed

If the gas discharge temp is between 93℃ and 97℃, compressor speed is maintained as the current speed, without increasing. If the gas discharge temp is between 97℃ and 110℃, compressor speed drops by 1Hz/3s; If the target compressor speed is less than the compressor's lowest allowable speed, compressor stops. If the gas discharge temp is over 110℃, compressor stops.

In this protection, If the gas discharge temp is between 87℃ and 93℃, compressor speed increases by 1Hz/30s.

If gas discharge temp drops below 87℃, protection is cancelled.

i) Ambient temperature VS compressor speed

When outdoor ambient temp. is over 70C, or lower than –25C, compressor stops, Unit enters protection and

indoor unit indicates F2. When outdoor ambient temp. comes back within 50C and –20C, compressor starts to work again.

If ambient temp. is over 70℃, compressor stops; After 3 minutes, if ambient temp. is 50℃, compressor starts to work.

In Cooling operation: if outdoor ambient temperature is over 53℃, compressor speed limit is “Speed Limit 2”; If outdoor ambient temperature is over 47℃, compressor speed limit is “Speed Limit 1”; If outdoor ambient temperature is over 39℃, compressor speed limit is “Speed Limit 0”; If outdoor ambient temperature is below 35℃, compressor speed limit is cancelled; if outdoor ambient temperature is below 15℃, compressor speed limit is “Speed Limit 2”;

In heating operation: If the outdoor temp. is lower than -20℃, compressor speed limit is “Speed Limit 3”; If outdoor ambient temperature is over 23℃, compressor speed limit is “Speed Limit 3”; If outdoor ambient temperature is over 19℃, compressor speed limit is “Speed Limit 2”; If outdoor ambient temperature is over 12℃, compressor speed limit is “Speed Limit 1”; If outdoor ambient temperature is over 0℃, compressor speed limit is “Speed Limit 0”; If outdoor ambient temperature is below 0℃, compressor speed limit is cancelled

	Comp. speed limit 0	Comp. Speed Limit 1	Comp. Speed Limit 2	Comp. Speed limit 3
Cooling	74Hz	52Hz	32Hz	
Heating		70Hz	50Hz	32Hz

j) Pressure VS compressor speed

1) In heating operation: if system pressure makes the Normal-On pressure switche Off , compressor speed drops 1Hz/s until the OFF pressure switch closes again. The memory of the unit keeps tack of the pressure that triggers this protection, and make the current compressor speed minus 5Hz as the maximum allowable compressor speed. This maximum allowable compressor speed stays functional for 2 hours compressor continuous working time.

2) In cooling operation: Pressure has no effect on compressor speed.

K) Over-current protection

In Cooling operation, if the AC current is over 8.9Amp, compressor stops; In heating operation, if the current is

over 9.1Amp, compressors; After 3 minutes, compressor tries to start again.

L) Overpower Protection

In Cooling or heating operation, if the power consumption is over 1500W/1540W, compressor speed is maintained as it is, without increasing. If the power is over 1650W/1620W, compressor speed drops by 3Hz/4 seconds; If the power is over 1750W/1700W, compressor speed drops by 6Hz/4 seconds;

M) Overvoltage Protection

If the volatge is over 270V or below 156V, compressor stops; If the voltage falls back within 260V~175V, this protection is cancelled.

If the voltage is below 180V for 10 seconds, compressor speed restriction is triggered; If the voltage comes back over 190V for 10 seconds, this restiction is cancelled. If the voltage is below 170V, compressor maximum speed is 45Hz; If the voltage is over 170V, compressor maximum speed is 74Hz;

N) Outdoor coil temperature VS compressor speed

It is valid in cooling operation only. If the outdoor coil temp. is over 60℃, compressor speed drops by 1Hz/3s; If it is between 55~60℃, compressor speed is prohibited from increasing. If it is between 50~55℃, compressor speed increases by 1Hz/30s.

O) While the unit is in operation, if any of the protections happens twice within 1 hour, and then keep on happening successively 8 times, outdoor unit stops, and indoor error display shows F7.

P) Temperature sensor fails

8. Water pump

a) When the unit is first powered on and stands by , the water pump starts to run for 10 seconds to check whether there is water in the system. If there is water in the system, it keeps on running, and compressor starts. If there is no water, it gives off warning sginal, and compressor won't start.

9、Led Display

1) Indoor unit

Indoor unit Error Code Display:

Error Code	Errors
E1	wired operation panel failure
E2	communication failure on wired operation panel
E3	Indoor room temperature sensor failure
F8	water pump / flow switch failure
F9	water temperature sensor
Fa	pressure sensor failure
Fb	disabled
Fc	communication failure between indoor unit and outdoor unit

Outdoor unit error code display

Error Code	errors
F1	outdoor ambient temp..sensor failure
F2	Outdoor coil temp sensor failure
F3	compressor gas discharge temp. sensor failure
F4	compressor overheat protection
F5	Outdoor E^2PROM failure
F6	Inverter failure
F7	outdoor power circuit failure

If the unit is turned on for heating operation, the unit does not give heat, and there is no error code in the indoor unit display. Every 3 minutes, the compressor speed pilot lights in the indoor display (the two lights in the middle) is ON and OFF continuously and repeatedly, then the causes can be:

1. Defective indoor temperature sensor: In heating operation, the compressor speed pilot lights in the indoor display (the two lights in the middle) is ON and OFF continuously and repeated. The ON time is around 2-3 seconds. The unit does not have any problem running cooling operation. To solve this problem, change the indoor temperature sensor.

2. Defective IPM: In heating operation, the compressor speed pilot lights in the indoor display (the two lights in the middle) is ON and OFF continuously and repeated. The ON time is around 5-6 seconds. The unit can not run cooling operation either. In cooloing operation, it has the same sympton. To solve this problem, change the outdoor controller.

2) outdoor

D2：Power indication light, always ON when there is power to the unit

Failures	D3	D4	D5
Outdoor coil temp. sensor failure	○	●	●
Communication failure	●	○	●
Compressor overheat	●	●	○
Compressor speed too low	○	○	●
overcurrent protection	○	●	○
PFC failure	●	○	○
Inverter communication failure	¤	●	●
Inverter data error	●	¤	●
Inverter failure	●	●	¤
Overvoltage protection	○	¤	●
Outdoor coil temp sensor failure	○	●	¤
Gas discharge temp. sensor failure	¤	○	●
Overpower protection	¤	●	○
I2C failure	¤	○	○
Compressor start-up failure	¤	¤	¤
outdoor power circuit failure	¤	¤	●
Outdoor protection			
Outdoor ambient temp. protection	¤	¤	○
Outdoor coil temp protection	¤	¤	●
Gas discharge temp. protection	¤	○	¤

When there is no error in the outdoor unit, the displays are as follows:

	D3	D4	D5
Outdoor fan motor	○	●	●
Reversing valve	●	○	●
compressor	●	●	○
Compressor preheat	●	●	○

¤ : means flashing ● : means OFF ○ : means “ON”

10、Auto-restart

When there is a power failure, unit memorizes the status/operations of the unit before the power failure. When power comes back again after the failure, unit will enter the status/operations again automatically set before the power failure.

i. If the unit was off before the power failure, when power comes back again, the unit is ready for any operation to be set with remote controller, with 5 minutes delay protection.

ii. If the unit was in operation before the power failure, when power comes back again, unit resumes the operation mode before the power failure, with compressor 3-minutes delay functional.

11、Outdoor coil heater and compressor preheat

a. When the outdoor ambient temp. is ≤ 0℃, outdoor coil heater turns ON; when it is over 2℃, outdoor coil heater turns OFF.

b. When the unit is first powered on and the compressor is not working, if outdoor ambient temp is lower than 4℃, compressor starts to preheat by itself.

c. After compressor works, 3 hours after it stops, if outdoor ambient temp is lower than 4℃, compressor starts to preheat by itself.

d. When compressor is in preheating, if outdoor ambient temp is over 5℃, or unit needs to start the compressor , compressor preheating stops.