

## Operation control function by the indoor unit control

### Operation mode

#### General

The modes mentioned below can be chosen from the control panel.

Mode	Function
(1) Auto	<ul style="list-style-type: none"> <li>The mode is automatically switched over between (3) Heating mode and (4) Cooling mode. Automatic switching rule is mentioned below.</li> </ul>
(2) Manual	<ul style="list-style-type: none"> <li>In this operating mode, you can select what functions are permitted.</li> <li>You can't deselect "compressor" in manual mode.</li> </ul>
(3) Heating	<ul style="list-style-type: none"> <li>Hot water is supplied for heating.</li> <li>Hot water operation will be made when the tank water temperature lowers.</li> <li>When the outdoor unit can not cover the heat load, electric heater use is allowed and water in the tank is supplied for heating to fulfill the required heat load.</li> </ul>
(4) Cooling (Super Cooling)	<ul style="list-style-type: none"> <li>Cold water is supplied for cooling.</li> <li>Hot water operation will be made when the tank water temperature lowers;</li> </ul>
(5) Add. Heat only	<ul style="list-style-type: none"> <li>Outdoor unit is not allowed to operate.</li> <li>Only electric heater is exclusively used for Heating and Hot water operation.</li> </ul>

Note 1 : The measured value of outdoor air temperature (BT1) which is used for control, is averaged in accordance with the prescribed formula.

Note 2 : Heating/Cooling demand is calculated as numeric DM (Degree Minutes) from the supply water temperature (BT12) and its target temperature in accordance with the prescribed formula.

Note 3 : Electric heater can be replaced with external heat source of the docking feature. See Menu 5.1.12 and 5.3.6 for setting.

Note 4 : Two sets of climate system can be controlled with different heating curve. See Menu 1.9.1 for setting.

## Operation control function by the indoor unit control

Actuator operation according to the operation mode

State	Function	Run status	Outdoor unit side			Indoor unit side			
			Compressor CM	Outdoor fan FMO1	4-way valve 20S	Electric heater EB1	Circulation pump GP12	Reversing valve QN10	Cooling shift valve QN12
Heating Alternating mode	Switching between heating and hot water	Heating	ON/OFF	ON/OFF	ON	OFF	ON	Closed	Closed
		Hot water						Active	
Heating Combined mode	Outdoor unit produces heating and electric heater supports lack of capacity	Heating	ON	ON	ON	ON	ON	Active	Closed
Cooling	Switching between cooling and hot water	Cooling	ON/OFF	ON/OFF	OFF	OFF	ON	Closed	Open
		Hot water			ON			Active	Closed
Add. Heat only	Producing heating and hot water with electric heater	Heating	OFF	OFF	ON/OFF	ON	ON	Closed	Closed
		Hot water						Active	
Defrost	Defrosting outdoor unit heat exchanger	Defrost	ON	OFF	OFF	OFF	ON	Closed	Closed
		Tank defrost				ON		Active	
Shutdown	Only in the event of serious alarms	Stop	OFF	OFF	ON/OFF	OFF	ON/OFF	Closed	Closed

## Operation control function by the indoor unit control

### Mode transition in Auto mode

Change-over of Heating/Cooling operation is controlled by detection with outdoor air temperature sensor (BT1) of the indoor unit. Threshold value depends on setting on Menu 4.9.2.

#### Start cooling

If outdoor air temperature is above setting value on Menu 4.9.2, cooling mode is chosen.

If outdoor air temperature is below setting value on Menu 4.9.2 it switches to heating mode.

Default of setting value is 25°C .

#### Stop heating

If outdoor air temperature is below setting value on Menu 4.9.2, heating mode is chosen.

If outdoor air temperature is above setting value on Menu 4.9.2, it switches to cooling mode.

Default of setting value is 17°C .

### Mode transition in Auto/manual mode to hot water operation

Change-over of Heating or Cooling/Hot water operation is controlled by detection with temperature sensor (BT6) of the tank unit. Threshold value depends on setting on Menu 5.1.1.

#### Setting range start temp. economy/normal/luxury

If tank temperature is below setting value on Menu 5.1.1, hot water mode is chosen.

Default of setting value is the following table.

Hot operation mode	Default value
Economy	42°C
Normal	46°C
Luxury	49°C

#### Setting range stop temp. economy/normal/luxury

If tank temperature is above setting value on Menu 5.1.1, it switches to heating or cooling mode.

Default of setting value is the following table.

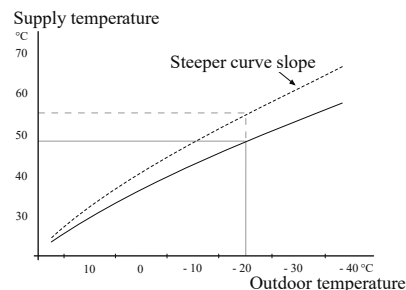
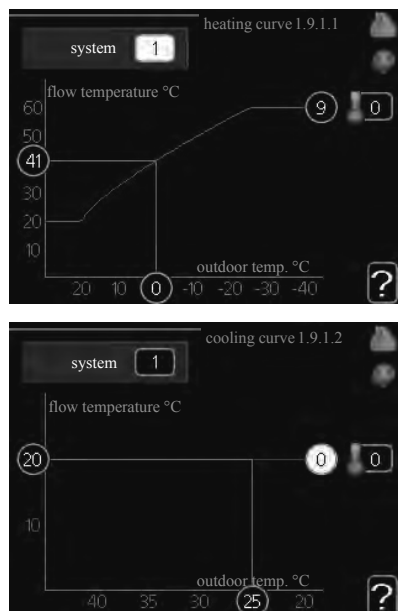
Hot operation mode	Default value
Economy	48°C
Normal	50°C
Luxury	53°C

## Supply water temperature control in heating

Target supply water temperature can be seen in Menu 1.1.

### Heating curve

#### Heating/cooling curve setting



The optimum slope depends on the climate conditions in your location, the type of heating device (radiators or under floor heating) and how well insulated the house is.

The curve is set when the heating installation is installed, but may need adjusting later. Normally, the curve will not need further adjustment.

### CAUTION

*In the event of making fine adjustments of the indoor temperature, the curve must be offset up or down instead, this is done in menu 1.1 "temperature".*

#### heating curve

Setting range: 0 – 15

Default value: 9

#### cooling curve (accessory required)

Setting range: 0 – 9

Default value: 0

The prescribed heating curve for your house can be viewed in the menu "heating curve". The task of the heating curve is to give an even indoor temperature, regardless of the outdoor temperature, and thereby energy efficient operation. From this heating curve, the control module determines the temperature of the water to the heating system, supply temperature, and therefore the indoor temperature. Select the heating curve and read off how the supply temperature changes at different outdoor temperatures here. If there is cooling function, the same settings can be made for the cooling curve.

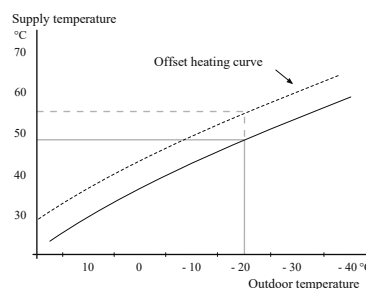
#### Curve coefficient

The heating/cooling curve shows the relation between the target supply temperature and the corresponding outdoor temperature. A steep curve indicates that supply temperature becomes higher at low outdoor air temperature in heating and it becomes lower at high outdoor air temperature in cooling.

#### Curve offset

The target temperature can be offset in parallel over the entire outdoor temperature range by this function. This is offset by 5 °C by adjusting 2 steps.

The target temperature can be parallel offset in the entire outdoor temperature range with this function. It is offset by 5 °C by adjusting 2 steps.



## Flow line temperature – maximum and minimum values

This function is used in order to limit max-min supply temperature. The heating / cooling curve becomes flat beyond max / min target temperature.

### CAUTION

*Underfloor heating systems are normally "max flow line temperature" set between 35 and 45°C. Take care not to cause low temperature burns in case it is set higher than 35°C.*

*Must be restricted with underfloor cooling min. flow line temp. to prevent condensation.*

*Check the max temperature for your floor with your installer/floor supplier.*

### TIP

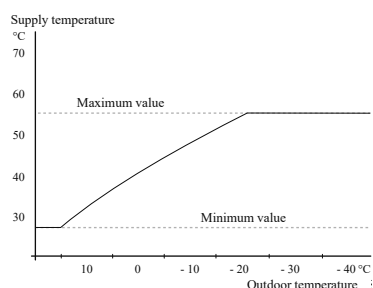
*Wait 24 hours before making a new setting, so that the room temperature has time to stabilise.*

*If it is cold outdoors and the room temperature is too low, increase the curve slope by one increment.*

*If it is cold outdoors and the room temperature is too high, lower the curve slope by one increment.*

*If it is warm outdoors and the room temperature is too low, increase the curve offset by one increment.*

*If it is warm outdoors and the room temperature is too high, lower the curve offset by one increment.*



The figure at the end of the curve indicates the curve number. The figure beside the thermometer icon gives the curve offset. Use the control knob to set a new value.

Confirm the new setting by pressing the OK button.

Curve 0 is an own curve created in menu 1.9.7.

### To select another curve (slope):

1. Press OK button to access the setting mode
2. Select a new curve. The curves are numbered from 0 to 15, and the bigger number curve has steeper slope. Curve 0 means that "own curve" (menu 1.9.7) is used.
3. Press OK button to exit the setting.

### To read off a curve:

1. Turn the control knob so that the ring on the shaft with the outdoor temperature is marked.
2. Press OK button.
3. Follow the grey line up to the curve and out to the left to read off the value for the supply temperature at the selected outdoor temperature.
4. You can now select to take read outs for different outdoor temperatures by turning the control knob to the right or left and read off the corresponding flow temperature.
5. Press OK or Back button to exit read off mode.

**Water temperature control when deviated from the target**

When the DM value is significantly small, supply water temperature must be controlled higher than target temperature to reduce the deficit of DM value. However, too big overshoot of the supply temperature will affect comfort.

In order to control the supply water temperature to avoid fluctuation of room temperature, overshoot limit is set in Menu 5.1.3 (Max diff flow-line temp.). When the current supply temperature deviates from the set value compared to that calculated, the heat pump is forced to stop irrespective of the degree minute value.

If the current supply temperature exceeds the calculated flow temperature plus the set value, the degree minute value is set to 0. The compressor in the heat pump stops when there is only a heating demand.

**Heating thermo-ON / OFF control**

The control by DM value is the basic principle to operate/stop the outdoor unit operation.

**DM (Degree-Minutes) value**

DM value is integrated value of the gap between the target and actual supply water temperature.

Compressor required speed and electric heater ON/OFF are controlled by the DM value.

**Operation state transition according to DM value**

According to the DM value, operating state is changed.

Default of DM start heating value (Menu 4.9.3) is -60.

Default of DM start add. heat value (Menu 4.9.3) is 400.

**Supply water temperature control in cooling**

Principle such as cooling curve, cooling curve offset and upper/lower limit is the same as heating operation.

Target supply water temperature can be checked in Menu 1.9.

Cooling curve can be chosen in Menu 1.9.1.2.

**Cooling curve**

Cooling curve is the basic principle to decide the target supply water temperature for cooling.

The higher the outdoor air temperature (BT1) becomes, the lower the target supply water temperature becomes, and the characteristics can be adjusted in Menu 1.9.1.2.

**Upper/Lower limit of the supply water temperature**

Regardless of the cooling curve setting and the outdoor air temperature, target supply water temperature can not exceed the min/max supply water temperature set in Menu 1.9.3.2 and 5.1.2.

Upper and lower limit is set after various offset correction.

**Water temperature control when deviated from the target**

When the DM value is significantly big, supply water temperature must be controlled lower than target temperature to reduce the surplus of DM value. However, too big overshoot of the supply temperature will affect comfort.

In order to control the supply water temperature to avoid fluctuation of room temperature, overshoot limit is set in Menu 9.6.7 (Max diff flow-line temp.). When the current supply temperature deviates from the set value compared to that calculated, the heat pump is forced to stop irrespective of the degree minute value.

If the current supply temperature exceeds the calculated flow temperature plus the set value, the degree minute value is set to 0. The compressor in the heat pump stops when there is only a heating demand.

**Cooling thermo-ON / OFF control**

Principle of the control such as DM value is the same as heating operation.

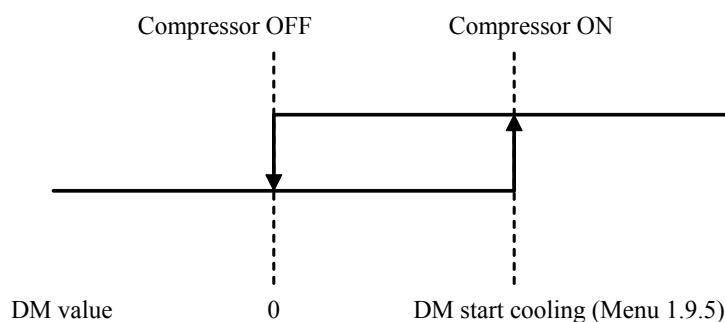
**DM (Degree-Minutes) value**

DM value is limited in Menu 1.9.5 and does not exceed the limit.

**Operation state transition according to DM value**

According to the DM value, operating state is changed.

Default of DM start cooling value (Menu 1.9.5) is +30.

**Exceptional processing of DM value**

Forced outdoor unit operation

In cooling mode, there is no exceptional DM value processing to operate the outdoor unit according to the gap between target and actual supply water temperature.

Forced outdoor unit stop

In case the actual supply water temperature is lower than the target temperature and the gap is bigger than the value set in Menu 5.1.3 when the outdoor unit is operating, the DM value is overwritten to 0, which results in stopping the outdoor unit operation immediately.

## Operation control function by the indoor unit control

### Hot water operation control

#### ON/OFF control

Regardless of the DM value, hot water operation when tank water temperature (BT6) lowers below Start temp HW in Menu 5.1.1. It finishes when the tank water temperature reaches Stop temp HW in Menu 5.1.1.

#### Compressor speed control

During the hot water operation, compressor speed is controlled according to the map linked with the outdoor air temperature. There are two maps. One is high cap map. The other is low cap. These map automatically changed depending on the tank temperature.

#### Charge method

There are two kinds of hot water storage methods. The 2 methods are dt and target temperature charging. They can be chosen in Menu 5.1.1. Dt uses high capacity curve when BT12, BT3 and BT6 allow it and finish the charging with low capacity curve. Target temperature method uses high capacity curve only.

#### Defrost operation

When frost accumulates on the surface of the outdoor heat exchange, defrost operation starts to remove it.  
For detailed operation condition, see outdoor unit control

During defrost operation, indoor unit operates as follows in order to extract heat from the heating system:

- Reversing valve QN10 and QN12 are towards heating system.
- Circulation pump GP12 keeps operation based on general rule.

When at least one of the following conditions is fulfilled, Reversing valve QN12 switches towards hot water to extract heat from the tank.

- Water return temperature < tank defrost temperature level
- Water outlet temperature < 10°C
- Water return temperature – Water outlet temperature > Min Flow Threshold
- Operation of the climate system has been blocked

### Protection control

#### Current protection

Maximum current limit control for the outdoor unit (by indoor unit control)

When the operation current of the outdoor unit comes close to the limit, request compressor speed is retained in order to keep the current.

#### Freeze protection of water heat exchanger

The freeze protection function shall avoid water to freeze inside the heat exchanger during defrost and cooling operation.

##### (1) In cooling mode

Compressor speed is kept when the low pressure (BP4) reaches 0.75MPa, and stopped when it reaches 0.65MPa for 20 seconds. Operation is automatically restarted when it reaches 0.83MPa and the supply water temperature becomes 14°C or higher, but it will permanently stop if the protection is activated for 10 repeated.

##### (2) In defrosting mode

Compressor stops when the low pressure (BP4) reaches threshold value for 10 seconds depending on water temperature.

After stopping, the system automatically restarts with heating mode.

When the above action is repeated for 10 times, the system stops and error code is displayed.

#### Low condenser out

Compressor stops when the supply temperature (BT12) becomes below 5°C and it automatically restarts when the supply temperature (BT12) becomes above 14°C.

#### High water out

Compressor stops when the supply temperature (BT12) becomes above 60°C and it automatically restarts when the supply temperature (BT12) becomes below 58°C.

#### High water in

Compressor stops when the return temperature (BT3) becomes above 55°C and it automatically restarts when the return temperature (BT3) becomes below 53°C.

#### High pressure

Compressor stops when the high pressure (BP4) reaches 4.15MPa and it automatically restarts when the high pressure (BP4) becomes below 3.15MPa.

When the above action is repeated for 5 times within an hour, the system will permanently stop.