

Description of functions

komfovent[®]

C3 controller

Table of Contents

1.	Temperature control	3
1.1.	Maintenance of the supply air temperature.....	3
1.2.	Maintenance of the exhaust air temperature (Room).....	3
1.3.	Automatic selection of temperature maintenance.....	3
1.4.	Seasons	3
1.5.	Recirculation.....	3
1.6.	Temperature correction.....	4
1.7.	Correction of ventilation intensity in winter time **	4
1.8.	Summer night cooling **	4
2.	Ventilation intensity control	5
2.1.	Three speed control.....	5
2.2.	Air flow control.....	5
2.2.1.	CAV – constant air volume control	5
2.2.2.	VAV – variable air volume control	5
2.2.2.1.	VAV. Master – Slave	5
2.3.	Supply air flow control	5
2.4.	Air quality function (AQ).....	5
2.5.	Exhaust air flow correction	5
2.6.	Remote unit control	6
2.6.1.	Remote unit switching on or off **	6
2.6.2.	Remote unit intensity control (OVR function) **	6
2.7.	Priorities for the fan control	6
3.	Heat exchanger control	6
3.1.	Rotary heat exchanger control.....	6
3.2.	Plate heat exchanger control	6
4.	Heater control	7
4.1.	Water heater control.....	7
4.2.	Electric heater control	8
4.3.	Heating control sequence.....	9
5.	Cooler control	9
5.1.	Water cooling control.....	9
5.2.	DX cooling control.....	9
5.3.	Control of water and DX coolers.....	9
6.	Weekly filter check	10
7.	Start-up and shut down of the unit	10
7.1.	Unit start-up and shut down methods:.....	10
7.2.	Emergency shutdown of the unit	10

1. Temperature control

C3 controller can maintenance the temperature of the supply air or extract air (Room). If the temperature is lower than the temperature set-point, this leads to the demand for heating, if the temperature is higher – to the demand for cooling. At the temperature within the insensitivity zone $\pm 0.1^{\circ}\text{C}$, the control of heat exchanger, heaters and coolers is suspended. Temperature maintenance modes are chosen in the control panel or PC configuration program.

1.1. Maintenance of the supply air temperature

In case of the heating demand first starts operate the heat exchanger (if conditions are suited). When the heat exchanger control signal reaches a maximum, its control is suspended by leaving the maximal value at the output, and if the “Winter” season is set, after 1 sec.* the water heater is started, or after 30 sec.* the electric heater is started. When there is no longer heating demand, the control takes place in the reverse order.

In case of the cooling demand first starts operate the heat exchanger (if conditions are suited). When the heat exchanger control signal reaches a maximum, its control is suspended by leaving the maximal value at the output, and if the “Summer” season is set, after 1 sec.* the water cooler is started, or after 30 sec.* the DX cooler is started. When there is no longer cooling demand, the control takes place in the reverse order.

1.2. Maintenance of the exhaust air temperature (Room)

The controls are similar to the support of supply air temperature. The exhaust air temperature is maintained by increasing or reducing the supply air temperature. Supply air temperature can be regulated automatically within the range of $15\dots 30^{\circ}\text{C}^*$.

1.3. Automatic selection of temperature maintenance

The controller can automatically select the temperature maintenance mode according to the outdoor air temperature. If within 10 min. outdoor air temperature stays higher than 17°C^* , the extract air (room) temperature maintenance mode is activated. If within 10 min. outdoor air temperature stays less than 17°C^* , the supply air temperature maintenance mode is activated.

1.4. Seasons

In the summer season heating signals are blocked, and the cooling signals are allowed. In the winter season heating signals are allowed, and in the cooling signals are blocked.

Automatic selection of the season is possible. If the outdoor air temperature is 1°C below the set temperature (t_{set}), the winter season is activated, and if it is 1°C higher, the summer season is activated. Season selection is possible from control panel or PC software.

1.5. Recirculation

Recirculation is used when supply of fresh air is unnecessary. During the recirculation, fresh air and exhaust air damper is closed and the recirculation damper is opened. During recirculation the exhaust air fan* and/or rotor* can also be stopped.

* - configured

Activation of recirculation is possible when the power of water heater is insufficient to achieve the necessary temperature. The return water temperature is measured, and when it drops below the set value, the fresh air dampers are closed and the recirculation damper is opened*. Configuration is made in the Settings window of PC configuration program.

1.6. Temperature correction

There is a possibility to increase or reduce the temperature of supply or exhaust air by 9°C for the desired time period. This is made in the control panel or PC configuration program.

1.7. Correction of ventilation intensity in winter time **

In the winter season, if supply air temperature is 4°C below the required temperature, and heating operates at maximum capacity, and outdoor air temperature stays below 5°C for 15 min., the ventilation intensity is reduced. The reduction increment depends on the fan control method. In the three-speed mode (with autotransformer) reduction is made one speed at a time, until the first speed is reached. In the air flow control mode (CAV or VAV), it is carried out every 10% from the air flow set value, up to 20% (the lower limit). Ventilation is reduced until supply air temperature will reach set-point. After, if above described conditions will return to normal state, ventilation intensity step by step will back to previous mode.

1.8. Summer night cooling **

It is possible to cool the premises at night in summertime with outside air. In this case, the operation of the rotor, the heater and the cooler is blocked. The function will be activated if at 00:15 am unit operates at the 1st or 2nd speed and all of these conditions are present:

$$\begin{aligned} 12^{\circ}\text{C} < T_{\text{outdoor}} < T_{\text{set}}; \\ T_{\text{exhaust}} > T_{\text{set}} + 5^{\circ}\text{C}; \end{aligned}$$

The function will stop operating if at least one of the following conditions is met:

$$\begin{aligned} T_{\text{exhaust}} < T_{\text{set}}; \\ 12^{\circ}\text{C} > T_{\text{outdoor}}, \text{ or } T_{\text{outdoor}} > T_{\text{set}}; \\ \text{Coming at 06:00 am}; \\ \text{Exhaust correction is activated}; \\ 4^{\text{th}} \text{ speed is activated (OVR function)}; \\ 3^{\text{rd}} \text{ speed is activated by scheduling program}; \\ \text{any speed in manual mode is activated.} \end{aligned}$$

* - configured

** - at one time possible only one of the mentioned functions

2. Ventilation intensity control

2.1. Three speed control

Fans are controlled by using the autotransformer. Delay is included when switching the speeds. When increasing the speed, the delay is 2 sec., when reducing the speed, it is 5 sec. Each of the three speeds is fixed.

2.2. Air flow control

Fans are controlled by maintaining a constant air volume – CAV, or constant pressure in the ventilation system – VAV.

2.2.1. CAV – constant air volume control

The set air volume is maintained by regulation of the fan speed. Fan pressure is measured with sensors U1 and U2 and the air volume is calculated according to the formula: $Q_{MAX} = k \cdot \sqrt{\Delta p}$. The k factor is adjusted depending on type of used in the PC configuration program.

2.2.2. VAV – variable air volume control

Variable air volume mode is used for the maintenance of constant air pressure in the ventilation duct system. Two additional duct pressure sensors are needed. After the installation of the ventilation system, the calibration of this function has to be carried out. It is carried out in the PC configuration program by pressing the *Start* button or from control panel. During the calibration, the fans are run for 3 min. at maximum capacity and upon reaching the maximum volume of air flow. After measuring of the voltage value, which corresponds to the maximum air pressure in the duct, pressure will be saved by controller.

2.2.2.1. VAV. Master – Slave

Variable air volume control mode (VAV) by using only one pressure sensor. Control takes place according to a pressure sensor installed in one of the ducts, in supply air or exhaust, and another air flow is controlled according to the data of the latter. In other words, one air flow is the Master flow and the other is Slave flow.

2.3. Supply air flow control

The controls are analogous to air flow control, but the exhaust fan control signal is switched off. Control method is used only for air supply units.

2.4. Air quality function (AQ)

Ventilation intensity control function according to the external sensor signal. After activating AQ function, the ventilation intensity can be regulated depending on the air quality sensor readings. If actual air quality value varies from the setpoint then ventilation intensity will increase otherwise – decrease. AQ function may be set depending on the sensor type (VOC, CO₂ and Humidity) therefore the intensity of the unit will be regulated accordingly. User can activate this function anytime according to the demand and can also observe the premise's air quality on the panel or from PC software.

2.5. Exhaust air flow correction

It allows increasing or decreasing the ventilation intensity of the exhaust air flow (from -50% till +50%) for specified periods. For example, it can be used to create

overpressure when there is a fireplace. The function is not available with 3 speed fan control. Correction may be set from the control panel or PC software.

2.6. Remote unit control

2.6.1. Remote unit switching on or off **

If the unit is not operating according to programmed week schedule, by connecting (short-circuit) contacts unit will be switched on and will operate with the set intensity level. Disconnecting contacts unit operation will return to previous mode.

2.6.2. Remote unit intensity control (OVR function) **

Designed for running the additional, the fourth, speed with an external contact. It is possible to choose the speed intensity for every fan (from 20% to 120%). Remote unit intensity control has the highest priority and operates in every mode, even the unit is switched off. The function is not available with 3 speed fan control.

2.7. Priorities for the fan control

If the fans are operating and their speed corrections are made, the control shall take place in accordance with the following priorities:

1. Additional speed (OVR).
2. Exhaust flow correction.
3. Summer night cooling / correction of ventilation in wintertime.
4. Air quality control.

** - at one time possible only one of the mentioned functions

3. Heat exchanger control

3.1. Rotary heat exchanger control

Rotary heat exchanger can be controlled by 0...10 V signal or relay output. In case of the heating demand, if the exhaust air temperature is 2°C higher than outdoor air temperature, the heat exchanger is started and unit operates with heat recovery function. In case of the cooling demand, if the outdoor air temperature is 2°C higher than the exhaust air temperature, the heat exchanger also started unit operates with cooling energy recovery function.

The rotor rotation is monitored by the controller through a rotation sensor. If the controller receives no signal from the rotation sensor within 3 minutes, the "Rotor Stopping" fault is indicated during the summer season, and same is during the winter season but additionally the unit is stopped. With control signal less than 2 V, the rotor fault is not indicated, and the unit is not stopped.

3.2. Plate heat exchanger control

Air bypass channel actuator is also controlled by 0...10 V signal or relay output. In case of the heating demand, if the exhaust air temperature is 2°C higher than outdoor air

temperature, the by-pass air damper is closed and unit operates with heat recovery function. In case of the cooling demand, if the outdoor air temperature is 2°C higher than the exhaust air temperature the bypass air damper also closed and unit operates with cooling energy recovery function.

Since the plate heat exchanger can have or not have the air-bypass valve, there is different frost protection. If there is air-bypass, and the temperature of the anti-frost sensor (B4) drops below the set temperature*, the damper is opened (the control signal is 0 V). If, within 20 minutes, the anti-frost sensor temperature does not rise, the unit is stopped and the “Frost Possibility” alarm is activated.

If there is no air-bypass, after activation of frost protection, the air supply fan is stopped. However, with the condition that the supply fan has been operating for at least 10 minutes (see Table 1).

Table 1. Supply air fan control

	Condition 1	Condition 2	Supply air fan
1	Unit is off	B4 temp. any	Stopped
2	Unit is on	B4 > Anti-freezing	Operates
3	Unit is on	B4 < Anti-freezing	Stopped
4	Unit is on	B4 > Anti-freezing	Operates
5	Unit is on but 10 minutes have not expired after the last start of the supply air fan	B4 < Anti-freezing	Operates
6	Unit is on but 10 minutes have expired after the last start of the supply air fan	B4 < Anti-freezing	Stopped

4. Heater control

4.1. Water heater control

Water heater actuator is controlled with the analog 0...10 V output, and the water circulation pump with the 230 VAC relay output. Heater control is only available in winter season. The pump is always running in the winter season and is turned on in summer season only when the outdoor air temperature drops below 5°C.

In winter season, after unit start-up, for three minutes the mixing valve is fully opened (a 10 V signal for actuator is turned on). If the unit is turned off or stopped with a fault, mixing valve actuator is controlled depending on the return water temperature.

* - configured

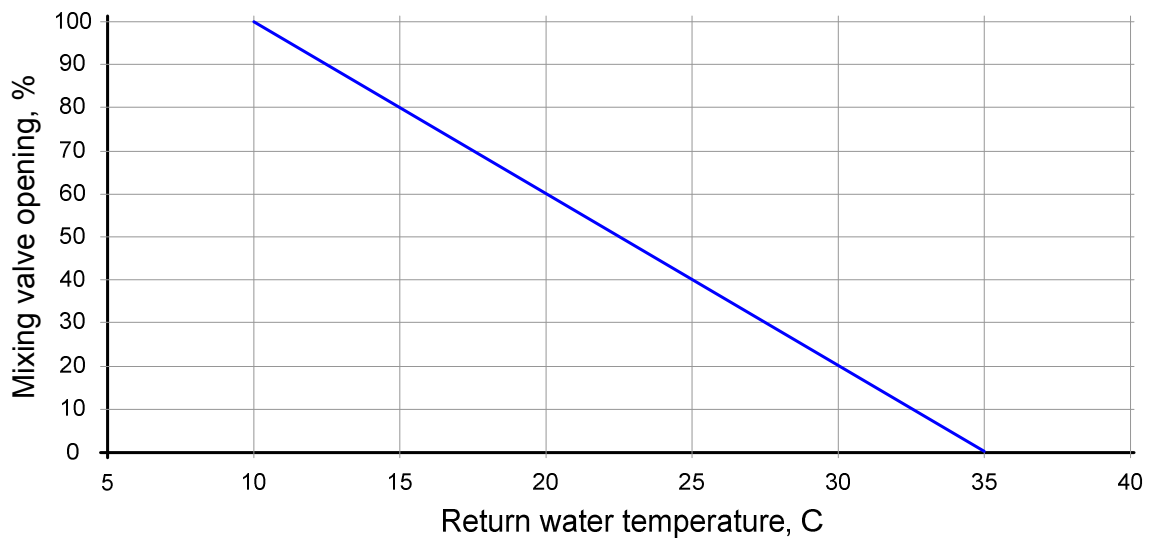


Fig. 1. Mixing valve control according to the return water temperature

4.2. Electric heater control

Electric heater control can be up to three steps. The steps can be controlled by activating them consecutively one after the other, or simultaneously. The controls are carried out by using the pulse width modulation (PWM) signal.

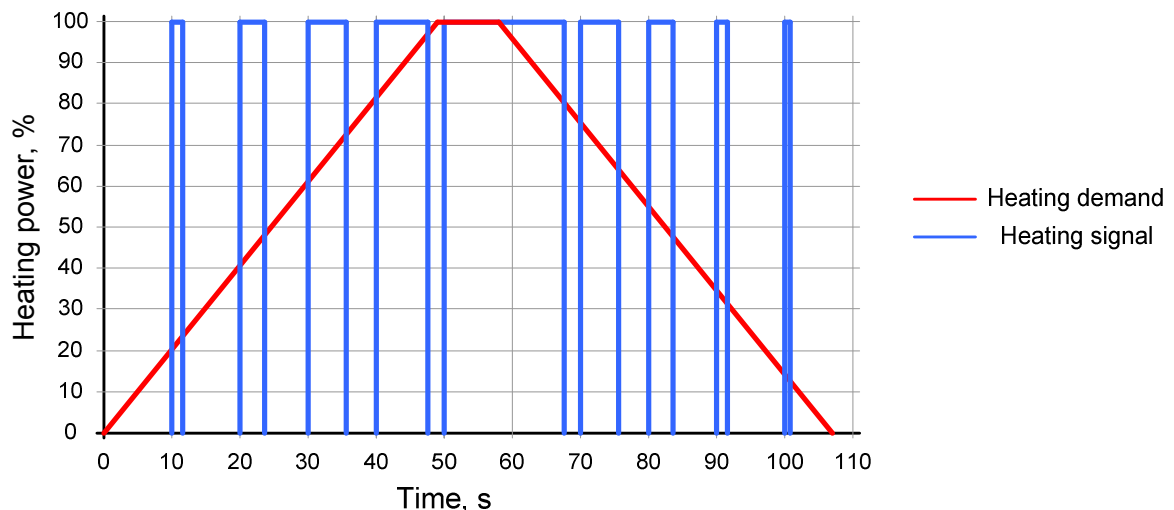


Fig. 2. PWM control dependence of the heating demand

There are two thermal contacts (80°C and 120°C) to protect the heater from overheating. If the 80°C thermal contact is tripped, the heater control signal is interrupted and the "Heater Off" alarm is activated. If the 120°C thermal contact is tripped, the heater supply voltage is interrupted, the unit is stopped and the "Electric Heater Overheating" alarm is activated. When the heater cools down, the 80°C thermal contact is restored automatically, and the 120°C thermal contact has to be restored manually.

If heater is on, and user will turn off the unit (except emergency cases), the fans still operate at 50% capacity for another 2 minutes to cool down heating elements.

4.3. Heating control sequence

There is the possibility to control two heaters: water + electric. In this case in the PC configuration program is possible to set the heating sequences. Example, first – water, second – electric. When the water heater control signal reaches a maximum, but the heating demand does not decrease, electric heater control (if provided) is turned on after 30 sec.* When the heating demand decreases or there is no demand, the electric heater steps are switched off one after the other, and then the water heater control signal is reduced.

5. Cooler control

5.1. Water cooling control

For the water cooling control is intended analog 0 ...10 V signal. Control is only possible in summer season.

5.2. DX cooling control

Up to two steps of the DX cooler can be controlled. 5 min delay after activation is provided for the deactivation of the step. Steps control is described in Tables 1 and 2.

Table 1. One step control

Temperature condition	Elapsed time, min.	Step
$T_{\text{supply}} > T_{\text{set}} + 1^{\circ}\text{C}$	0	1
$T_{\text{supply}} < T_{\text{set}} - 2^{\circ}\text{C}$	<5 min.	1
$T_{\text{supply}} < T_{\text{set}} - 2^{\circ}\text{C}$	>5 min.	0

Table 2. Two steps control

Temperature condition	Elapsed time, min.	Step
$T_{\text{supply}} > T_{\text{set}} + 1^{\circ}\text{C}$	0	1
$T_{\text{supply}} > T_{\text{set}} + 1^{\circ}\text{C}$	>5 min.	1+2
$T_{\text{supply}} < T_{\text{set}} - 2^{\circ}\text{C}$	<5+5 min.	1+2
$T_{\text{supply}} < T_{\text{set}} - 2^{\circ}\text{C}$	>5+5 min.	1
Not important	Additional 5 min. delay	1
$T_{\text{supply}} < T_{\text{set}} - 2^{\circ}\text{C}$, or $T_{\text{supply}} > T_{\text{set}} + 1^{\circ}\text{C}$		0 or 1+2

5.3. Control of water and DX coolers

First start to operate water cooler. When the water cooler control signal reaches a maximum, but the cooling demand does not decrease, the DX cooler control (if provided) is turned on after 30 sec.* When the cooling demand decreases or there is no demand at all, the DX cooler steps are switched off one after the other, and then the water cooler control signal is reduced.

* - configured

6. Weekly filter check

Controller is equipped with automatic filter check function. If ventilation unit is on and fans are operating not by maximal intensity, every week on the Wednesday at 15:00h controller will switch ventilation to maximum intensity for 3 minutes to check condition of the filters. If filter is clogged and pressure switch give signal to the controller, then “Change supply air filter” or “Change exhaust air filter” message appears. After restart of the unit, message disappears. Function is activated by default, but it can be disabled using PC configuration program.

7. Start-up and shut down of the unit

7.1. Unit start-up and shut down methods:

- With an ON-OFF button on the control panel or the PC program;
- According to the weekly schedule;
- Emergency shutdown of the unit;
- Shutdown with 2 min delay of fan control (except in emergency shutdown), where the electric heater has been active;
- Shutdown with an external contact, if the unit operates according to a weekly schedule; Start, in the unit was stopped.
- Start-up of 4 intensity level (OVR) by external contact.

7.2. Emergency shutdown of the unit

When the alarm is activated, the unit is stopped, i.e. the fans, the rotor, the heaters are stopped, and air dampers are closed. When the fault is repaired, the unit can be activated in one of the above ways. Possible alarms:

- Supply air fan overheating;
- Exhaust air fan overheating;
- Rotor stopping in winter season;
- Electric heater overheating after tripping of 120°C thermal contact;
- Frost possibility of plate heat exchanger;
- Fire alarm;
- Temperature sensor failure;
- Water heater frost protection if return water temperature drops below 10°C;
- Supply air overheating if air temperature is above 45°C for 10 minutes;
- To low supply air temperature if temperature is below 5°C for 10 minutes.