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Functional Description:

AHU equipped with OJ-Air2 Controller

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Functional Description

AHU equipped with OJ-Air2 Controller

Revision	Initials	Date	Item	Changes/Updates
01	JBA	28-05-2020	All	First version
22-09-20	RWT	22-09-2020	2.2.6	Control sequence Cooling - Free Coling + Cooling 1- kommentar

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Functional Description

AHU equipped with OJ-Air2 Controller

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Functional Description

AHU equipped with OJ-Air2 Controller

1. Introduction to OJ-Air2

1.1. A pre-programmed and configurable AHU control solution

The OJ-Air2 system is a complete control solution for an Air Handling Unit (AHU), pre-programmed and configurable. More than a billion different operation modes and configurations are supported and ready for use. Available features in a specific AHU depends on the installed components and actual configuration.

1.2. This documents scope

The goal for this document is to provide a short high-level description of the most frequently used functions in a standard AHU. The descriptions can be used as basis for:

- Text for tenders
- Functional description in sales documentation
- Technical information to Sales support
- Technical information for Commissioning engineers
- Technical information for Service crews.

1.3. Other documents

Detailed information for each standard component in the OJ-Air2 system are available in the corresponding instructions and documentation at https://www.ojelectronics.com. Further detailed information is available at OJ Electronics Customer log-in.

1.4. Selection of applicable text

Since an AHU can be designed with different hardware and options, great care shall be taken when selecting applicable texts for a specific AHU. It is strongly recommended to perform a review by the Engineering department before publishing any extracts from this document.

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2. Functional Description

2.1. Fan control loops

Depending on the installed hardware the AHU fans are controlled on/off by relays or by variable speed drives. The variable speed drives are controlled by either 0-10V signal or Modbus RS485.
Some fan control loops requires pressure transmitters in the ventilation ducts and at the fan inlet cones.

2.1.1. Constant Pressure

The Supply and Extract fan speeds are individually controlled to maintain duct air pressure according to the setpoints (Pa). The duct pressure is maintained even in case of Variable Air Volume (VAV) dampers in ducts.

- The Supply and Extract duct pressure shall be measured by pressure transmitters.

Setpoint range: 0 - 5.000 Pa depending on Pressure transmitter type.

2.1.2. Constant airflow

The Supply and Extract fan speeds are individually controlled to maintain duct air volume according to the setpoints (m3/h, l/s, CFM). Increased internal pressure drops due to filter clogging are automatically compensated.

- The Inlet cone pressure in both fans shall be measured by pressure transmitters

Setpoint range: 0 - 300.000 m3/h, l/s, CFM depending on Max. Airflow settings.

2.1.3. Extract air slave

The Supply fan speed is controlled to maintain duct air pressure according to the setpoint (Pa). The Extract fan speed are controlled to maintain the same Extract air volume as measured in the Supply air duct with an optional offsett up to +/-50%. Balanced ventilation is maintained even in case of Variable Air Volume (VAV) dampers in the supply duct and none in the extract duct.

- The Supply duct pressure shall be measured by a pressure transmitter.
- The Inlet cone pressure in both fans shall be measured by pressure transmitters.

2.1.4. Supply air slave

The Extract fan speed is controlled to maintain duct air pressure according to the setpoint (Pa). The Supply fan speed are controlled to maintain the same Supply air volume as measured in the Extract air duct with an optional offset up to +/-50%. Balanced ventilation is maintained even in case of Variable Air Volume (VAV) dampers in the extract duct and none in the supply duct.

- The Extract duct pressure shall be measured by a pressure transmitter.
- The Inlet cone pressure in both fans shall be measured by pressure transmitters.

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2.1.5. Constant VOC/CO_2

The Extract fan speed is controlled to maintain Extract air quality according to the setpoint (ppm). The air volume decreases to the Min. airflow setpoint in case of low VOC/CO_2
The Supply fan speed are controlled to maintain the same Supply air volume as measured in the Extract air duct with an optional offset up to +/-50%. Balanced ventilation is maintained in all operation points.

- The Inlet cone pressure in both fans shall be measured by pressure transmitters.
- The Extract duct or room Air Quality shall be measured by a VOC or CO_2 transmitter.

Setpoint range: 0 - 10.000 ppm depending on used transmitter.

2.1.6. Fan optimiser

The Supply and Extract fan speeds are individually controlled to maintain duct air volume according to the Fan optimiser 0-10V input signals. Increased internal pressure drops due to filter soiling are automatically compensated.

- The Inlet cone pressure in both fans shall be measured by pressure transmitters.
- The air volume setpoints shall be controlled by a 0-10V signal, e.g. from Belimo COU24-A-MP.

2.1.7. Fan optimiser slave

The Supply fan speed is controlled to maintain duct air volume according to the Fan optimiser 0-10V input signal. The Extract fan speed are controlled to maintain the same Extract air volume as measured in the Supply air duct with an optional offset up to +/-50%. Balanced ventilation is maintained even in case of Variable Air Volume (VAV) dampers in the supply duct and none in the extract duct.

- The Inlet cone pressure in both fans shall be measured by pressure transmitters.
- The Supply air volume setpoint shall be controlled by a 0-10V sinal, e.g. from Belimo COU24-A-MP

2.1.8. GreenZone

The Supply and Extract fan speeds are individually controlled to maintain optimised duct air pressure according to setpoints from an OJ-ZoneMaster in an advanced dual duct VAV system.

- The OJ ZoneMaster is a part of an OJ Electronics GreenZone system.
- Fan setpoints are communicated by Modbus RS485 between OJ-Air2Master and OJ-ZoneMaster

2.1.9. GreenZone slave

The Supply fan speed are controlled to maintain optimised duct air pressure according to setpoints from an OJ-ZoneMaster in a VAV system. The Extract fan speed are controlled to maintain the same Extract air volume as measured in the Supply air duct with an optional offset up to +/-50%. Balanced ventilation is maintained even in case of Variable Air Volume (VAV) dampers in the supply duct and none in the extract duct.

- The Inlet cone pressure in both fans shall be measured by pressure transmitters.
- The OJ ZoneMaster is a part of an OJ Electronics GreenZone system.

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- Fan setpoints are communicated by Modbus RS485 between OJ-Air2Master and OJ-ZoneMaster

2.1.10. Constant motor speed %

The Supply and Extract fan speeds are individually controlled by fixed setpoints.
Duct pressure and air volume are unregulated and depends on actual loads and internal pressure drops e.g. in filters.

- No sensors required.

Setpoint range: 1 - 100%.

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2.2. Temperature control loops

Depending on the installed hardware a range of different coils and heat recovery devices can be used for heating. Some temperature control loops requires additional temperature sensors.

2.2.1. Constant Supply air

The available heating sources are controlled to maintain the Supply air temperature at the set-point (ºC, ºF). This control loop is used when the AHU shall supply ventilation air.
Other systems shall control the temperature in the building.

- The Supply air temperature shall be measured by a duct temperature sensor (PT-1000).

Setpoint range: 0 – 60 ºC

2.2.2. Constant Extract air

The available heating sources are controlled to maintain the Extract air temperature at the set-point (ºC, ºF). The Supply air temperature is kept within minimum and maximum limit setpoints. This control loop is used when the AHU shall control the average temperature in a building.

- The Supply and Extract air temperature shall be measured by duct temperature sensors (PT-1000).

Setpoint range: 0 – 60 ºC, Supply air limit setpoints 0 – 70 ºC.

2.2.3. Constant room

The available heating sources are controlled to maintain the Room air temperature at the setpoint (ºC, ºF). The Supply air temperature is kept within minimum and maximum limit setpoints. This control loop is used when the AHU shall control the temperature in a specific room.

- The Supply air temperature shall be measured by a duct temperature sensors (PT-1000).
- The room temperature shall be measured by a room temperature sensor (PT-1000, OJ-Air2-HMI-20T, TTH-6040-W)

Setpoint range: 0 – 60 ºC, Supply air limit setpoints 0 – 70 ºC.

2.2.4. Constant supply air/extract air difference

The available heating sources are controlled to maintain the Supply temperature at the current Extract temperature subtracted the temperature setpoint. (ºC, ºF).
This control loop is used for Displacement ventilation.

- The Supply and Extract air temperature shall be measured by duct temperature sensors (PT-1000).

Setpoint range: 0 – 60 ºC.

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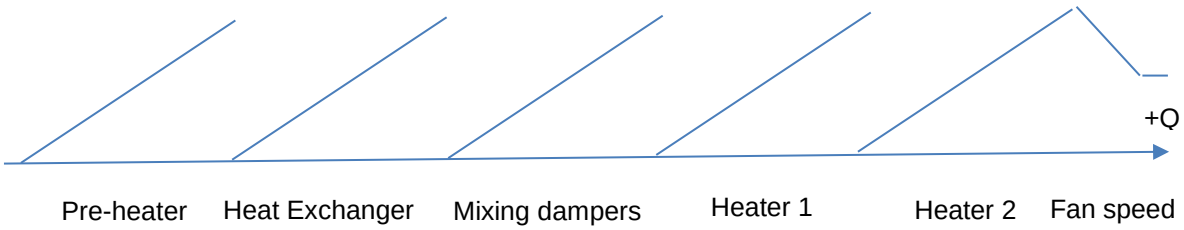
2.2.5. Control sequence heating

The heating control sequence uses the installed heating sources in this sequence.
Sources not installed in the AHU are skipped by the control loop.

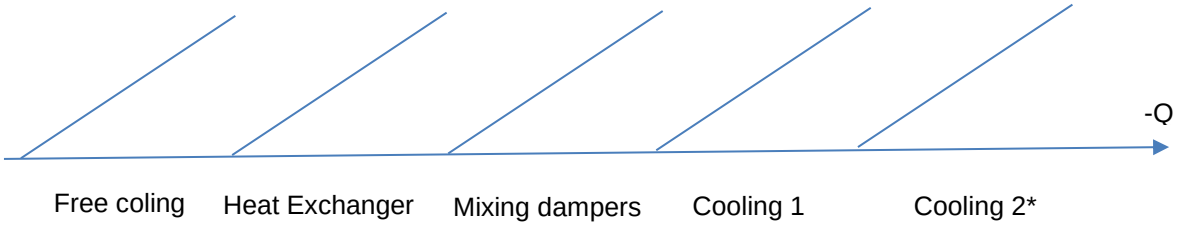


The Pre-heater is only active at temperatures below the Pre-heater setpoint.

2.2.6. Control sequence Cooling

The heating control sequence uses the installed heating sources in this sequence.

Sources not installed in the AHU are skipped by the control loop.



*) Cooling 2 is only available in Combi coils.

Vedr. Free coling:

Modulerende omluftspjæld 0-10V

Vedr. Cooling 1:

køle 1 med Digital udgang. OBS regulatorens P-bånd og I tid skal stilles så On/Off ikke sker flere gange i minuttet. Det vil slide relæerne op.

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2.3. Heat recovery

Depending on the installed hardware Heat recovery are controlled on/off by relays or by a modulating actuator. Modulating actuators are controlled by 0-10V signals or Modbus RS485.
Some frost and ice protection control loops requires a temperature sensor or pressure transmitters.

2.3.1. Cross flow heat exchanger (Plate Exchanger)

The heat recovery is controlled by a set of modulating by-pass dampers splitting the freshair between the Cross flow heat exchanger and the by-pass duct to the supply air.

- Outdoor Air, Supply Air and Extract Air temperatures shall be measured by duct temperature sensors (PT-1000).

Modbus Actuator
If the by-pass damper is controlled by Modbus additional benefits are available

A. **Position monitoring**
The current by-pass damper position is displayed in the webserver.

B. **Malfunction alarm**
A malfunction alarm is released in case of wrong damper position, which prevents excessive energy consumption and poor indoor climate.

- A Belimo Direct Modbus actuator shall be used.

Ice protection
The principle for protection against ice build-up in the Exhaust channel depends on the installed hardware.

A. **Exhaust temperature**
If the Exhaust temperature drops below the ice protection setpoint, then the by-pass damper is overridden to increase the by-passes air volume

- The Exhaust temperature shall be measured by a duct temperature sensor (PT-1000).

B. **Static Pressure drop**
If the heat exchanger pressure drop from Extract to Exhaust increases above the ice protection setpoint, then the by-pass damper is overridden to max. by-pass air volume during a de-icing cycle This principle increases the heat recovered at low temperatures if the Extract air humidity is low and the air volume is fixed.

- The Heat Exchanger pressure drop shall be measured by a pressure transmitter.

A. **Dynamic Pressure drop**
If the heat exchanger pressure drop from Extract to Exhaust increases above a flow dependent ice protection setpoint, then the by-pass damper is overridden to max. by-passed air volume during a de-icing cycle. This principle increases the heat recovered at low temperatures if the Extract air humidity is low and the air volume is variable.

- The Heat Exchanger pressure drop shall be measured by a pressure transmitter
- The Inlet cone pressure in both fans shall be measured by pressure transmitters

2.3.2. Double crossflow heat exchanger (Plate Exchanger)

See section 2.3.1 Cross flow heat exchanger.

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2.3.3. Rotary heat exchanger (Energy wheel)

The heat recovery is controlled by adjusting the rotation speed of the heat recovery wheel.

- Outdoor Air, Supply Air and Extract Air temperatures shall be measured by duct temperature sensors (PT-1000).

Rotation speed

The principle for controlling the rotation speed depends on the installed hardware.

A. **Fixed speed**. The heat recovery are controlled On/Off. This might be OK in a large room having high ceilings where the supply air temperature not is important.

- The rotor shall be controlled by a motor having fixed speed

B. **Variable speed**
The supply temperature are controlled precisely at low outdoor temperatures and operate On/Off at medium outdoor temperatures. In a building having low ceilings there can be some complaints due to fluctuations in the supply temperature, which inhibits the Coanda effect and occasionally results in cold draft.

- The rotor shall be controlled by at variable speed drive with 1:10 speed ratio.

C. **Variable speed Stepper motor**
The supply temperature are controlled precisely at all outdoor temperatures.
This is the correct solution for buildings having low ceilings.

- The rotor shall be controlled by at variable speed drive and a stepper motor with 1:100 speed ratio. E.g. the DRHX rotor drive.

2.3.4. Liquid connected (Run around coils)

The heat recovery is controlled by a valve modulating the water flow in the Run around coils.

- Outdoor Air, Supply Air and Extract Air temperatures shall be measured by duct temperature sensors (PT-1000)

Modbus Actuator

If the by-pass damper is controlled by Modbus additional benefits are available

A. **Position monitoring**
The current valve position is displayed in the webserver.

B. **Malfunction alarm**
A malfunction alarm is released in case of wrong valve position, which prevents excessive energy consumption and poor indoor climate.

- A Belimo Direct Modbus actuator shall be used.

Frost protection

The modulating valve is overridden to increase the heat recovery if the Supply air coil return water temperature drops below the frost protection setpoint.

- Supply air coil return water temperature shall be measured by a pipe/water temperature sensor (PT-1000).

Circulator pump

The principle for controlling the circulator pump depends on the installed hardware and settings.

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A. **Constant**
The circulator pump is always On.

B. **Auto**
The circulator pump is On when there is a heat recovery demand.

- The pump shall be controlled by a digital output.

C. **Outdoor air temp.**
The circulator pump is On when the outdoor temperature is below “Pump start” setpoint or there is a recovery demand.

- The pump shall be controlled by a digital output.
- Outdoor air temperature shall be measured by a duct/Outdoor temperature sensor (PT-1000).

2.3.5. Counter flow heat exchanger

See section 2.3.1 Cross flow heat exchanger.

2.4. Heating coils

Depending on the installed hardware heating is controlled on/off by relays or by a modulating valve actuator. Modulating valves are controlled by either 0-10V/2-10V signal or Modbus RS485.
Some heating coils requires an additional temperature sensor for frost protection.

2.4.1. Electric heating coils

The principle for controlling the Electrical heating depends on the installed hardware.

A. 0-10V: The electrical heating power is modulated

- The 0-10V output signal shall be used to modulate the output from e.g. a triac power controller

B. 1 step: The electrical heating power is controlled in two steps

- Heating coil section 1 shall be turned on at heating demand
- Heating coil section 2 shall be turned on at heating demand above 50%

The electrical heating power is modulated seamless in the complete range if

- Heating coil section 1 is modulated using the 0-10V output
- Heating coil section 2 is turned on at heating demand above 50%
- The heating coil sections has equal heating power size.

C. 2 step: The electrical heating power is modulated seamless in the complete range

- Heating coil section 1 shall be modulated using the 0-10V output
- Heating coil section 2 shall be turned on at heating demand above 33%
- Heating coil section 3 shall be turned on at heating demand above 66%
- The heating coil sections shall have equal heating power size.

D. Binary: The electrical heating power is controlled in three steps

- Heating coil section 1 shall be turned on at heating demand in range 25 to 50% and again in range 75 to 100%.

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- Heating coil section 2 shall be turned on at heating demand above 50%
- The heating coil section 2 shall have double power size.

The electrical heating power is modulated seamless in the complete range if

- Heating coil section 1 is modulated using the 0-10V output
- Heating coil section 2 shall be turned on at heating demand in range 25 to 50% and again in range 75 to 100%.
- Heating coil section 3 shall be turned on at heating demand above 50%
- The heating coil sections 1 and 2 shall have equal heating power size. Heating coil section 3 has double power size.

Min. Airflow

The electrical heater coils is protected against overheating by a flow dependent output power limit.

- The Inlet cone pressure in the supply fan shall be measured by a pressure transmitter.

2.4.2. Water heating coils

The water heating coils is controlled by a modulating heating valve controlling the hot water flow.

Frost protection

The modulating valve is overridden to increase the heat if the heating coil return water temperature drops below the frost protection setpoint.

- Heating coil return water temperature shall be measured by a pipe/water temperature sensor (PT-1000).

Modbus Actuator

If the modulating valve is controlled by Modbus additional benefits are available

A. **Position monitoring**
   The current valve position is displayed in the webserver.

B. **Malfunction alarm**
   A malfunction alarm is released in case of wrong valve position, which prevents excessive energy consumption and poor indoor climate.

- A Belimo Direct Modbus actuator shall be used.

Standby heating

The modulating valve is controlled to maintain return water temperature according to the Standby heating setpoint when the AHU is stopped.

Circulator pump

The principle for controlling the circulator pump depends on the installed hardware and settings.

A. **Constant**
   The circulator pump is always On.

B. **Auto**
   The circulator pump is On when there is a heating demand.

- The pump shall be controlled by a digital output.

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C. **Outdoor air temp.**
The circulator pump is On when the outdoor temperature is below “Pump start” setpoint or there is a heating demand.

- The pump shall be controlled by a digital output.
- Outdoor air temperature shall be measured by a duct/Outdoor temperature sensor (PT-1000).

2.4.3. Gas Heating coils

The Gas heating coils is controlled by a modulating gas valve.

Min. Airflow
The Gas heater coils is protected against overheating by a flow dependent output power limit.

- The Inlet cone pressure in the supply fan shall be measured by a pressure transmitter.

2.5. Cooling recovery

2.5.1.Cross flow heat exchanger (Plate Exchanger)

The cooling recovery is controlled by a set of modulating by-pass dampers splitting the freshair between the Cross flow heat exchanger and the by-pass duct to the supply air.

- Outdoor Air, Supply Air and Extract Air temperatures shall be measured by duct temperature sensors (PT-1000).

Modbus Actuator
If the by-pass valve is controlled by Modbus additional benefits are available

- **Position monitoring**
  The current by-pass damper position is displayed in the webserver.
- **Malfunction alarm**
  A malfunction alarm is released in case of wrong damper position, which prevents excessive energy consumption and poor indoor climate.
- A Belimo Direct Modbus actuator shall be used.

2.5.2. Double crossflow heat exchanger (Plate Exchanger)

See section 2.5.1 Cross flow heat exchanger.

2.5.3. Rotary heat exchanger (Energy wheel)

The cooling recovery is controlled by adjusting the rotation speed of the heat recovery wheel.

- Outdoor Air, Supply Air and Extract Air temperatures shall be measured by duct temperature sensors (PT-1000).

2.5.4. Liquid connected (Run around coils)

The cooling recovery is controlled by a valve modulating the water flow in the Run around coils.

- Outdoor Air, Supply Air and Extract Air temperatures shall be measured by duct temperature sensors (PT-1000)

Modbus Actuator
If the by-pass damper is controlled by Modbus additional benefits are available

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A. **Position monitoring**
The current by-pass damper position is displayed in the webserver.

B. **Malfunction alarm**
A malfunction alarm is released in case of wrong damper position, which prevents excessive energy consumption and poor indoor climate.

- A Belimo Direct Modbus actuator shall be used.

2.5.5. Counter flow heat exchanger

See section 2.5.1 Cross flow heat exchanger.

2.6. Free cooling

Basic Free cooling requires only temperature sensors. If Mixing dampers are installed please see section “Dampers”.

2.6.1. Free cooling

Cold outside air is utilised for energy effective cooling.

- Outdoor Air and Supply Air temperatures shall be measured by duct temperature sensors (PT-1000).

2.7. Summer night cooling

The Summer night cooling functionality depends on the installed temperature sensors.

2.7.1. Summer night cooling: Standard sensors

Cold outside air during the night is utilised for energy effective cooling and increased comfort.
Summer night cooling starts a 10 minutes temperature test run once every night if the other conditions are met.

- Outdoor Air, Supply Air and Extract Air temperatures shall be measured by duct temperature sensors (PT-1000)

2.7.2. Summer night cooling: Additional sensors

Cold outside air during the night is utilised for energy effective cooling and increased comfort.
Summer night cooling starts and restarts anytime during the night if the conditions are met.

- Supply Air temperatures shall be measured by duct temperature sensors (PT-1000)
- Outdoor Air shall be measured by a dedicated Outdoor temperature sensor outside the ducts. (PT-1000 or TTH-6040-O)
- Room temperature shall be measured by a dedicated room temperature sensor outside the ducts. (PT-1000 or TTH6040-W)

2.7.3. Summer night cooling: Conditions

The Summer night cooling only starts when:

- ”Weekly programme” or “Scheduler” is selected under ”User” AND the AHU is in status ”Stop”.

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- There was less than 60 minutes heating demand between 12.00 noon and 23.59, during the latest operation period
- The room temperature is above the set “Start room temperature”
- The Outdoor temperature is min. 2 ºC below the Room/Extract temperature.
- The Outdoor temperature is above the set “ Outdoor temperature stop”
- The set “Start time” has been passed.

The Summer night cooling will stop when:

- ”Weekly programme” or “Scheduler” sets the AHU is in status ”Low speed”, “Medium speed” or “High speed”.
- Operation mode is changed to “Stop” ”Low speed”, “Medium speed” or “High speed”.
- The room temperature is below the set “Stop room temperature”
- The Outdoor temperature not is below the Room/Extract temperature.
- The Outdoor temperature is below the set “ Outdoor temperature stop”
- The set “Stop time” has been passed.
- The Supply Air temperature is below the set “Min. supply”.

2.8. Cooling coils

Depending on the installed hardware cooling is controlled on/off by relays or by a modulating valve actuator. Modulating valves are controlled by either 0-10V/2-10V signal or Modbus RS485.

2.8.1. Water cooling coils

The water cooling coils is controlled by a modulating heating valve controlling the chilled water flow.

Modbus Actuator

If the modulating valve is controlled by Modbus additional benefits are available

A. **Position monitoring**
The current valve position is displayed in the webserver.

B. **Malfunction alarm**
A malfunction alarm is released in case of wrong valve position, which prevents excessive energy consumption and poor indoor climate.

- A Belimo Direct Modbus actuator shall be used.

Circulator pump

The principle for controlling the circulator pump depends on the installed hardware and settings.

A. **Constant**
The circulator pump is always On.

B. **Auto**
The circulator pump is On when there is a cooling demand.

- The pump shall be controlled by a digital output.

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C. **Outdoor air temp.**
The circulator pump is On when the outdoor temperature is above “Pump start” setpoint or there is a cooling demand.

- The pump shall be controlled by a digital output.
- Outdoor air temperature shall be measured by a duct/Outdoor temperature sensor (PT-1000).

2.8.2. Combi coil

The Combi coil is controlled by a modulating valve controlling the water or refrigirant flow.
The valve opens at heat demand if heating is available and opens at cooling demand if cooling is available.

Central Heating/cooling production
Digital inputs or the Modbus/BACnet interface shall be used to signal heating or cooling is available for the Combi coil.

Local Heating/cooling production
Digital outputs shall be used to start production of either heating or cooling for the Combi coil.

Standby heating
The modulating valve is controlled to maintain return water temperature according to the Standby heating setpoint when the AHU is stopped.

Circulator pump
The principle for controlling the circulator pump depends on the installed hardware and settings.

A. **Constant**
The circulator pump is always On.

B. **Auto**
The circulator pump is On when there is a Heating or Cooling demand.

- The pump shall be controlled by a digital output.

C. **Outdoor air temp.**
The circulator pump is On when the outdoor temperature is below “Pump start heating” setpoint or above “Pump start cooling” setpoint or there is a Heating/Cooling demand.

- The pump shall be controlled by a digital output.
- Outdoor air temperature shall be measured by a duct/Outdoor temperature sensor (PT-1000)

Cooling 2 (Combi coil)
A second cooling coil can be controlled by a 0-10V modulating valve as Combi coil cooling stage two.

- “Analogue cooling output sequential” shall be selected
- Analogue output ”Cooling 2 (combi-coil)” shall be used.
  Digital udgang for Cooling 2 kan benyttes til on/off styring

2.8.3. DX coils

The principle for controlling the DX coils depends on the installed hardware. Two separate DX cooling circuits can be controlled, each cooling circuit having two DX compressors.

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Functional Description

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A. 2 step: The DX cooling power is controlled in two steps in one cooling circuit.
   - DX compressor 1 shall be turned on at cooling demand.
   - DX compressor 2 shall be turned on at cooling demand above 50%

B. 3 step Bin: The DX cooling power is controlled in three steps in one cooling circuit
   - DX compressor 1 shall be turned on at cooling demand in range 0 to 33% and again in range 67 to 100%.
   - DX compressor 2 shall be turned on at heating demand above 33%
   - DX compressor 2 shall have the double power size of DX compressor 1

C. 4 step: The DX cooling power is controlled in four steps in two cooling circuits
   - DX compressor 1 shall be turned on at cooling demand.
   - DX compressor 2 shall be turned on at heating demand above 25%
   - DX compressor 3 shall be turned on at heating demand above 50%
   - DX compressor 4 shall be turned on at heating demand above 75%

D. 15 step Bin: The DX cooling power is controlled in 15 steps in two cooling circuits
   - DX compressor 1 shall be turned on at cooling demand in range 0 to 6,7%, 13,3 to 20%, 26,7 to 33,3%, 40 to 46,7%, 53,3 to 60%, 66,7 to 73,3, 80 to 86,7% and 93,3 to 100%.
   - DX compressor 2 shall be turned on at heating demand in range 6,7 to 20%, 33,3 to 46,6%, 60 to 73,3% and 86,7 to 100%
   - DX compressor 3 shall be turned on at heating demand in range 20 to 46,7% and 73,3 to 100%
   - DX compressor 4 shall be turned on at heating demand above 46,7%
   - DX compressor 2 shall have the double power size of DX compressor 1
   - DX compressor 3 shall have four times the power size of DX compressor 1
   - DX compressor 4 shall have eight times the power size of DX compressor 1

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2.9. Filters

Depending on the installed hardware are the Outdoor air filter, Supply air filter, Extract air filter 1 and Extract air filter 2 monitored by different methods

2.9.1. Filter clogging: Timer.

The filter is monitored by a timer. An alarm is released when it expires and the filter needs replacement.
OBS: Only allowed in dedicated domestic ventilation units up to 1000m3/h according to EU 1253

Setpoint range: 0 - 8800 hours

2.9.2. Filter clogging: Pressure switch

- An alarm is released when the filter pressure drop reach the switching setpoint and the filter needs replacement. The current filter status OK/NOK is displayed in the Touch panel and webserver.Filter pressure drop shall be measured by a Pressure switch

Setpoint range: Depends on installed Pressure switch.

2.9.3. Filter clogging: Static Pressure drop

- An alarm is released when the filter pressure drop reach the alarm setpoint and the filter needs replacement. The current filter pressure drop is displayed in the Touch panel and webserver.Filter pressure drop shall be measured by a Pressure transmitter.

Setpoint range: 10 – 500 Pa.

2.9.4. Filter clogging: Dynamic Pressure drop

An alarm is released when the filter pressure drop reach the dynamic alarm setpoint and the filter needs replacement. The dynamic alarm setpoint is flow corrected and detects filter clogging even when the AHU not is operating at max. airvolume.
The current filter pressure drop is displayed in the Touch panel and webserver.

- Filter pressure drop shall be measured by a Pressure transmitter.
- The Inlet cone pressure in the corresponding fan shall be measured by a pressure transmitter.

Setpoint range: +10 – +100 % deviation from reference pressure drop.

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2.10. Dampers

Depending on the installed hardware dampers is controlled on/off by relays or by a modulating valve actuator. Modulating valves are controlled by either 0-10V/2-10V signal or Modbus RS485.

2.10.1. OA, SA, RA, EA dampers

The Outdoor Air damper, Supply Air damper, Room Air damper and Exhaust Air damper are closed when the AHU operation stops. This protects the ductwork against bad weather conditions.

2.10.2. Night heat Recirculation damper

The AHU starts and Room air is recirculated and heated if the room temperature drops.

During recirculation are the Outdoor Air damper and Exhaust Air damper closed.
The Supply Air damper, Room Air damper and Recirculation damper are open.

- The room temperature shall be measured by a room temperature sensor (PT-1000, OJ-Air2-HMI-20T, TTH-6040-W)
- Supply Air temperatures shall be measured by duct temperature sensors (PT-1000).
- Recirculation Air, Outdoor Air and Exhaust Air dampers shall be On/Off.

Setpoint range: 5 - 40 ºC

2.10.3. Night heat Mixing dampers

The AHU starts and Room air is recirculated and heated if the room temperature drops.

During recirculation are the Outdoor Air damper and Exhaust Air damper closed.
The Supply Air damper, Room Air damper and Recirculation damper are open.

- The room temperature shall be measured by a room temperature sensor (PT-1000, OJ-Air2-HMI-20T, TTH-6040-W)
- Supply Air temperatures shall be measured by duct temperature sensors (PT-1000).
- Recirculation Air, Outdoor Air and Exhaust Air On/Off dampers shall be modulated.

Setpoint range: 5 - 40 ºC

Modbus Actuator
If the modulating damper is controlled by Modbus additional benefits are available

A. **Position monitoring**
   The current damper position is displayed in the webserver.

B. **Malfunction alarm**
   A malfunction alarm is released in case of wrong damper position, which prevents excessive energy consumption and poor indoor climate.

- A Belimo Direct Modbus actuator shall be used.

2.10.4. Mixing dampers temperature

The Mixing dampers recirculates some of the extract air in order to save heating/cooling energy. The damper positions are controlled to min. fresh air if the current outdoor temperature not can be used for heating/cooling.

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AHU equipped with OJ-Air2 Controller

- Outdoor Air, Supply Air and Extract Air temperatures shall be measured by duct temperature sensors (PT-1000).
- The Recircualtion Air, Outdoor Air and Exhaust Air damper shall be modulated.

Min. Fresh air mixing setpoint range: 0 - 100%

Max. Fresh air mixing setpoint range: 30 - 100%

Modbus Actuator
If the modulating damper is controlled by Modbus additional benefits are available

C. **Position monitoring**
The current damper position is displayed in the webserver.

D. **Malfunction alarm**
A malfunction alarm is released in case of wrong damper position, which prevents excessive energy consumption and poor indoor climate.

- A Belimo Direct Modbus actuator shall be used.

2.10.5. Mixing dampers VOC/CO_2

The Mixing dampers recirculates some of the extract air in order to save heating/cooling energy and increases the fresh air amount if the VOC/CO_2 level in the building is to high.
The dampers positions are controlled to min. fresh air if the current outdoor temperature not can be used for heating/cooling and the VOC/CO_2 level is below setpoint.

- The VOC/CO_2 level shall be measured by a sensor installed in the Extract air duct or room.
- Outdoor Air, Supply Air and Extract Air temperatures shall be measured by duct temperature sensors (PT-1000).
- The Recircualtion Air, Outdoor Air and Exhaust Air damper shall be modulated.

Setpoint range: 0 - 10.000 ppm

Min. Fresh air mixing setpoint range: 0 - 100%

Max. Fresh air mixing setpoint range: 30 - 100%

Modbus Actuator
If the modulating damper is controlled by Modbus additional benefits are available

E. **Position monitoring**
The current damper position is displayed in the webserver.

F. **Malfunction alarm**
A malfunction alarm is released in case of wrong damper position, which prevents excessive energy consumption and poor indoor climate.

- A Belimo Direct Modbus actuator shall be used.

2.10.6. Mixing dampers Enthalpy

The Mixing dampers recirculates some of the extract air based on Enthalpy levels in order to save heating/cooling energy. The dampers positions are controlled to min. fresh air if the current outdoor Enthalpy level not can be used for energy efficient heating/cooling.

Taking Enthalpy in consideration is efficient if the building has additional cooling systems not included in the AHU.

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AHU equipped with OJ-Air2 Controller

- Mixed Air and Extract Air temperature/Humidity shall be measured by duct temperature/Humidtiy sensors (HTH-620x).
- Outdoor Air and Supply Air temperatures shall be measured by duct temperature sensors (PT-1000).
- The Recircualtion Air, Outdoor Air and Exhaust Air damper shall be modulated.

Min. Fresh air mixing setpoint range: 0 - 100%

Max. Fresh air mixing setpoint range: 30 - 100%

Modbus Actuator

If the modulating damper is controlled by Modbus additional benefits are available

G. **Position monitoring**
The current damper position is displayed in the webserver.

H. **Malfunction alarm**
A malfunction alarm is released in case of wrong damper position, which prevents excessive energy consumption and poor indoor climate.

- A Belimo Direct Modbus actuator shall be used.

2.11. Humidification

A steam humidifier is controlled by 0-10V signal.

2.11.1. Supply Air Humidification

A humidifier is activated if the Supply Air relative humidity is below the setpoint. (%RH)

- Supply Air temperature/Humidity shall be measured by a duct temperature/Humidity sensor (HTH-620x).

Setpoint range: 0 - 100 %RH

2.11.2. Extract Air Humidification

A humidifier is activated if the Extract Air relative humidity is below the setpoint. (%RH)

- Extract Air and Supply Air temperature/Humidity shall be measured by duct temperature/Humidtiy sensors (HTH-620x).

Setpoint range: 10 - 100 %RH, Supply air limit setpoints 0 – 100 %RH.

2.12. Dehumidification

Depending on the installed hardware is the cooling coil used to

2.12.1. Dewpoint Dehumidification

The cooling coil is dewpoint controlled to remove humidity from the supply air in order to maintain the Extract air relative humidity at the setpoint (%RH). The supply air temperature is controlled by an after heater coil.

- Mixed Air, Extract Air and Supply Air temperature/Humidity shall be measured by duct temperature/Humidtiy sensors (HTH-620x).

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- Dewpoint temperature and Supply Air temperatures shall be measured by duct temperature sensors (PT-1000).

Setpoint range: 0 - 100 %RH, Supply air limit setpoints 0 – 100 %RH.

2.12.2. Fixed cooling Dehumidification

The cooling coil is active at a fixed setpoint to remove humidity from the supply air in order to maintain the Extract air relative humidity at the setpoint (%RH). The supply air temperature is controlled by an after heater coil.

- Mixed Air, Extract Air and Supply Air temperature/Humidity shall be measured by duct temperature/Humidtiy sensors (HTH-620x).
- Supply Air temperature shall be measured by duct temperature sensors (PT-1000).

Setpoint range: 0 - 100 %RH, Supply air limit setpoints 0 – 100 %RH.

2.13. Scheduler and Calendar

The built-in scheduler can automatically change the fan set point 6 times a day with individual settings each day of the week. Exceptions like e.g. vacation periods and holidays are set in the calendar function, which can handle 10 different time periods or repetitions.

2.14. PIR input

A PIR sensor can automatically start or increase ventilation to the high speed setpoint when there are people present.

- A PIR sensor shall be connected to a digital input

2.15. Start input

The AHU can be started manually with a switch.

- A switch shall be connected to a digital input

2.16. Summer/Winter changeover

During the summer period is the temperature control loop set to room temperature allowing the AHU to cool the room. In the winter period is the temperature control loop set to Supply Air temperature so the ventilation system works well in combination with Radiators or Floor heating.
The changeover are done automatically by Outdoor temperature or calendar dates.

Setpoint range: Summer start 1st of January to the 31th of June.
Winter start 1st of July to the 31th of December

Summer start: Outdoor temperature above -10 to +40ºC
Winter start: Outdoor temperature above -30 to +40ºC

2.17. Smoke

The fans can be stopped by a smoke detector in the duct system.

- A Smoke detector shall be connected to a digital input.

2.18. Fire

The fans are individually controlled to a pre-installed set point in case of fire.

- A Fire detector shall be connected to a digital input.

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Setpoint range: 0 to 100%.

2.19. Connectivity

2.19.1. BACnet TCP/IP

A BTL listed BACnet server is included in the AHU controller. The device profile is BACnet Advanced Application Controller (B-AAC) for easy BMS integration.

2.19.2. Modbus TCP/IP

A modbus TCP/IP server is included in the AHU controller for easy BMS integration using TCP/IP.

2.19.3. Modbus RTU

A Modbus RTU server is included in the AHU controller for easy BMS integration using RS485.

2.19.4. WEB server

A webserver is included in the AHU controller for easy visualization, operation and maintenance.

2.19.5. Cloud

A secure cloud connection is included the AHU controller for easy connection to OJ Air Cloud. The OJ Air Cloud service offers easy visualization, operation and maintenance.

- The AHU controller shall have access to the internet through the TCP/IP connector.
- The client shall create an account in the OJ Air Cloud

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