

MANDÍK AHU control system (MaR) Climatix

Detailed Operating Manual

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MANDÍK®



ATEX II 2G IIB T4

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This manual is an integral part of the technical specifications TPM 088/12 for MANDÍK air handling units. The current versions of the documents are available at www.mandik.cz

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1 General

The following abbreviations are used in this manual:

- ❖ MaR – measurement and control system
- ❖ Controller – Siemens Climatix control unit located in the control panel of the measurement and control system
- ❖ Components – the air handling unit assembly consists of individual components controlled by the MaR.



This manual uses graphic symbols that draw attention to particular facts. They are:

Symbol warning of a potentially dangerous situation that poses an immediate threat to life or may cause damage to the unit or a part of it.



Symbol drawing attention to important facts related to the correct installation, commissioning or maintenance of the unit or a part of it. It may also indicate a suggestion or note concerning installation, commissioning or maintenance.

This manual contains instructions for setting up and operating the MaR of MANDÍK air handling units of the M, P, S and T series.



Before starting any work on the MaR, this manual must be studied and subsequently followed. Compliance with this manual is a precondition for correct operation, function and fulfilment of the warranty conditions. The manufacturer is not liable for any damage caused by improper use, and the user bears all the risk.

This manual is intended for persons holding a valid authorisation for servicing air handling and air conditioning units.



Any unauthorised modifications to the MaR control panels that have not been approved in advance by MANDÍK, a.s. will void the warranties provided and the guarantee of safe use and operation.



Switching off the control cabinet with the controller is recommended only for short periods, because the controller performs certain monitoring functions even when the air handling unit is switched off! If switched off for a long period (more than 3 days), the time in the controller may be lost, subsequently disrupting the operation of the air handling unit according to the time schedule.



This description applies to MaR with a Climatix controller running software AHU35.01 or higher! The software version can be found in the *ApplicationInfo* menu on the home screen of the display.

2 Related documents

Each MaR supplied with an air handling unit is accompanied by the following documents, which should be kept near the air handling unit:

- ❖ Warranty certificate Control panel test certificate according to ČSN EN 61439-1-ED2
- ❖ MaR drawing documentation

3 Safety

When using the MaR, the instructions in this document must be observed.



During assembly, electrical connection, commissioning, repair and maintenance of the units, the applicable standards, safety regulations and generally accepted technical rules must be observed.



Assembly of the units, including the electrical connection, commissioning, repair, maintenance and operation, may only be carried out by a natural or legal person holding a valid authorisation.

4 Introduction

Mandík air handling units are controlled by the freely programmable Climatix PLC controller from Siemens, which meets new requirements arising from technical, technological, environmental and economic needs. This controller is among the most highly rated controllers designed for controlling air handling units. It provides comfortable control, safe and energy-efficient operation of air handling equipment and complete adaptability of the final solution to customer requirements. A significant advantage is its wide range of communication options, enabling easy operation, cooperation with most superior systems and integration into building management systems.

The measurement and control system with the Climatix controller offers:

- ❖ Excellent price/performance ratio
- ❖ Simple installation
- ❖ Simple operation in several variants
- ❖ Local and remote control
- ❖ Annual and weekly time schedule
- ❖ Text display with a clear presentation of all data
- ❖ Choice of display language from any European language (Czech by default)
- ❖ Choice of several operating modes
- ❖ Temperature and humidity control in the supply air or room
- ❖ Automatic detection of heating or cooling demand
- ❖ Comprehensive, precise control of air handling operation
- ❖ Clear listing of alarm messages including history
- ❖ Changes to important parameters only after login (several levels)
- ❖ Connection of all air handling components into a single control system
- ❖ Controls all standard heating and cooling components
- ❖ Uniform marking of connection terminals
- ❖ Control from a PC via a web browser (standard supply) and consequently from any location on the internet
- ❖ Option of a visualisation add-on and cooperation with superior systems

5 Description of operation

All control parameters of Mandík AHUs can be set on the Climatix controller only from the integrated HMI control unit, the HMI-DM control unit, the HMI-TM control unit and the HMI@Web web interface. The other controllers are used to switch the unit on, set the required temperature, set the required fan speed and, where applicable, set the mode or a specific function. All controllers are described in detail in the relevant documentation on the website of Mandík a.s.

5.1 Home screen

The basic home screen of the controller after user login is shown in the figure (Fig. 1) with the following information:

1. line – system information on the access level (PIN level), the type of air handling unit and, where applicable, the number of the selected line on the current screen. the display integrated in the controller, bell is shown at the end of the first line the event of an alarm.

3 AHU Mandík	1
24.07.2022 14:05:24	21.3 °C
ModeSelection	TimeSchedule ▶
▶PR Comfort	22.0 °C
UnitComponents	▶ of
TimeSchedule	▶ On
ApplicationInfo	▶ a
Login	▶ in
AuxiliaryMode	
▶ WaterHeatingProtection	

Fig. 1

2. line – current date, time and temperature according to the configuration (room, supply or extract air). The date and time can be changed after entering the service PIN.
3. line – **ModeSelection** allows the user to enter the required mode.
4. line – shows the current mode including the required temperature corresponding to the mode and temperature season. Additional information shown is the auxiliary mode (symbol “PR” at the beginning of the line) and the unit being switched on from a controller without communication (symbol “•” before the current mode). If the auxiliary mode symbol is displayed, the settings for the current mode may not be maintained. The specific auxiliary mode is then specified on the last line of the home screen under the heading **AuxiliaryMode**.

The following lines contain menu items for further setting of the air handling unit parameters.

In the following figures, the login level required to display them is shown in the top left corner of the screen.

5.2 Operating and auxiliary modes

The air handling unit can operate in four basic operating modes: **Off**, **Standby**, **Economy** and **Comfort**. Each of these modes can be set as fixed from the display, from the control panel, from external switches or according to the time schedule.

The auxiliary mode occurs when the unit cannot meet the requirements of the basic operating mode, for example when the unit starts. The auxiliary mode symbol “**PR**” is displayed before the current mode. The specific auxiliary mode is shown on the last line of the home screen and of the unit components screen.

5.2.1 Operating mode selection

The **ModeSelection** line is used to enter the type of operating mode required from the unit. The current operating mode is shown on the next line of the display, including the required temperature. The user can choose from the following operating modes:

➤ **TimeSchedule, Off, Standby, Economy, Comfort**

The economical operating mode **Economy** usually differs from the comfort operating mode **Comfort** by a lower required temperature, lower fan speeds and a lower amount of fresh air. The speeds for **Comfort** and **Economy** operation are set in **UnitComponents** → **Fans**. The temperatures for the operating modes are set in **UnitComponents** → **TemperatureControl**. The amount of fresh air is set in **UnitComponents** → **Dampers**.

5.2.2 Off mode

In this operating mode, the air handling unit is switched off. Only safety functions intended to protect certain parts of the unit from damage may be active.

5.2.3 Standby mode

In this operating mode, the air handling unit is normally switched off and is in one of the following supplementary modes:

➤ **Ready** – the unit is switched off and ready to switch automatically to one of the supplementary modes described below when the necessary conditions are met.

- **FrostProtection** – frost protection of the room occurs if the room temperature drops below the setpoint temperature. The unit starts and switches on the heating components. If the unit contains a mixing damper, 100% air recirculation is also used. The unit switches off when the required room temperature is reached. This supplementary mode is usually used in winter when the building is not used for a longer period. Activation of the supplementary mode is indicated on the next line below the selected mode by the text **FrostProtection** and the required temperature. The fan speeds may correspond to the **Comfort** or **Economy** mode, depending on the last started operating mode. The required temperature is set in the menu **UnitComponents** → **TemperatureControl** in the variable **FrostProtection (5 °C)**.
- **Freecooling** – this mode is usually used in summer for free night-time ventilation of the building with cooler outdoor air, provided the temperature conditions are met. Activation of the supplementary mode is indicated on the next line below the selected mode by the text **Freecooling** and the required temperature. The fan speeds may correspond to the **Comfort** or **Economy** mode, depending on the last operating mode. The required temperature is set in the menu **UnitComponents** → **TemperatureControl** in the variable **Freecooling (18 °C)**. Freecooling must be enabled in the menu **Configuration** in the variable **Freecooling (Yes)**. Further parameters are set in the menu **UnitComponents** → **Freecooling** and are described in a separate chapter.
- **Humidity** – this state occurs if the upper or lower humidity limits are exceeded.
- **AirQuality** – this state occurs if the air quality limit value is reached.
- **Testing** – equipment testing state. Testing is described in a separate chapter.

5.2.4 Economy mode

In this operating mode, the air handling unit is switched on in the so-called economy mode, in which the required fan speeds and the required temperature are normally lower than in Comfort mode. The required speeds and temperature can be set by the user separately for the summer and winter seasons. The control system operates the individual components (heating, cooling, humidification) so that the required parameters are achieved. This operating mode is usually used outside occupancy or working hours.

The fan speeds are set in the menu **UnitComponents** → **Fans** in the variable **Economy (80%)** separately for the supply and extract fans. The required temperature is set in the menu **UnitComponents** → **Temperatures** in the variable **Economy (18 °C)**.

5.2.5 Comfort mode

In this operating mode, the air handling unit is switched on in a mode in which the required fan speeds are set to the comfort level and the required temperature to the comfort value separately for the summer and winter seasons. The control system operates the individual components (heating, cooling, humidification) so that the required parameters are achieved. This operating mode is usually used during occupancy or working hours.

The fan speeds are set in the menu **UnitComponents** → **Fans** in the variable **Comfort (100%)** separately for the supply and extract fans. The required temperature is set in the menu **UnitComponents** → **Temperatures** in the variable **Comfort (22 °C)**.

5.2.6 Auxiliary mode

The occurrence of an auxiliary mode is indicated by the symbol **PR** before the current mode. The type of auxiliary mode itself is shown at the end of the home screen or at the end of the **UnitComponents** menu. An auxiliary mode occurs when a situation arises that requires a temporary change in the operation of the air handling unit due to excessively high or low temperature, a fault of a component, non-standard operation of a component, unit protection, etc. The following auxiliary modes may occur:

- **SpeedCompensation** – occurs if the supply temperature drops and, in the menu **UnitComponents** → **Fans** → **Compensation** compensation is enabled for one of the options:
 - **Mixing**
 - **CoolingFault**
 - **Defrost**
 - **HeatingFault**
- **Purge** – after the unit is switched off by the user or due to a fault, purging is always carried out for at least 60 s. Only in the event of a fault from the fire sensors or fire dampers is the unit switched off immediately. If the unit contains gas or electric heating, purging of the heat

exchangers is carried out until the supply air temperature drops 5 °C below the maximum calculated supply air temperature, but for no longer than 10 minutes.

- **WaterHeatingProtection** – water heating protection is indicated. The fan speeds can be adjusted according to the settings in the menu **UnitComponents** → **WaterHeating** → **SpeedCompensation**.
- **BoilerRoom** – fan operation is blocked until there are requirements for heating water preparation in the boiler room.
- **Start** – indicates the start-up state of the components when the unit starts, during which the preheating may be activated and the start-up position of the dampers, heat recovery and fan speeds set so that the supply air temperature is optimal and the water heater is protected in winter. The related parameters in the menu **UnitComponents** are:
 - **TemperatureControl** → **StartDuration**
 - **Fans** → **StartSpeed**
 - **FreshAir** → **FreshAirStart**
 - **WaterHeating** → **Preheat**
- **SuperiorBlocking** – operation of the air handling unit is blocked by a superior device, which usually enables the air handling unit to be switched on once technological or safety conditions are met, e.g. fire alarm signalling.

6 Unit components

The air handling unit consists of individual mechanical components that provide its required function with the required parameters. Depending on the technical specification, these components are configured in the measurement and control system and then displayed under the item **UnitComponents**. The components include, for example, **Temperatures**, **TemperatureControl**, **Fans**, **Burner**, **ElectricHeating**, **WaterHeating**, **CondensingUnit**, **HeatRecoveryExchanger**, **Dampers**, **Filters** and others. The current output or status is shown for each component. Selecting a component displays more detailed information. Basic information about the components is accessible without login. It includes the following items:

- **Status** (Off/.....) – provides information on the status and the required mode of operation. The specific states may differ between components and are therefore described in detail for each of them. The following four states are the same for all components:

- **Ready** – the component is switched off and ready for further operation.
 - **Heating** – the component is working correctly and heating.
 - **Cooling** – the component is working correctly and cooling.
 - **Fault** – the component is not working correctly. The specific fault is listed in the alarm messages.
- **Output (%)** – provides information on the current required output of the respective component.
- **OperatingHours** – can serve as information for service personnel with regard to wear of the fan or other components.
- **NumberOfStarts** – indicates the way the unit is operated. A large number of starts may indicate incorrect operation of the entire air handling unit.

The following describes parameters that apply to most components and have the same function, so they do not need to be described separately for each component. These parameters are accessible only after service login:

- **PID-Control (Block/Max/Min/Ctrl/NotCtrl/NotDef)** – contains the control parameters that determine the quality and speed of control of the required output value based on the setpoint and the actual value. The values are set as standard at the factory and should only be changed by a person familiar with control systems. The standard factory settings are given for the individual components. The meaning of the individual control states is as follows:
- **Block** – the controller function is not enabled,
 - **Max** – forced maximum output, parameter **O**,
 - **Min** – forced minimum output, parameter **O**,
 - **Ctrl** – the controller is active,
 - **NotCtrl** – invalid setpoint, parameter **S**,
 - **NotDef** – invalid output value, parameter **O**.

The meaning of the individual control parameters is:

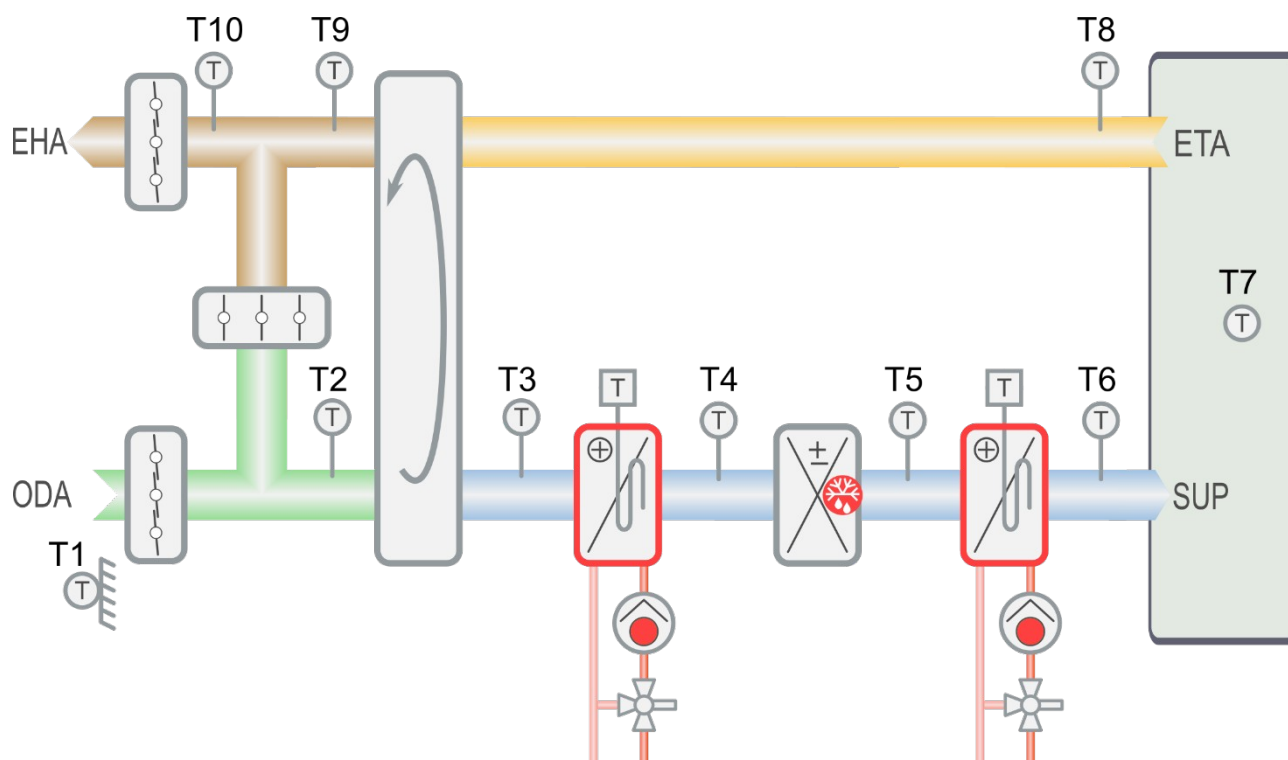
- **S (% or °C)** – setpoint.
- **P (% or °C)** – actual value.
- **O (% or °C)** – PID controller output.
- **TI (s)** – integral component.
- **KP** – proportional constant.
- **TD (s)** – derivative component.

The **PID-Control** values are accessible only for some components.

- **SequenceHeat, SequenceCool (--/1/2/3/...)** – this parameter determines the order of the component in the heating or cooling sequence. The option -- means that the component will not be included in the sequence. The use of the order depends on the number of components in the individual sequences. For example, with three heating components in the order mixing, heat recovery and water heating, mixing is set to order 1, the heat recovery exchanger to 2 and the water heater to 3. With two cooling components in the order heat recovery and condensing unit, the heat recovery exchanger is set to order 1 and the condensing unit to 2. Components must not have the same order within one sequence.
- **Control (0-10V/2-10V/10-0V/10-2V)** – the parameter determines the range of the output control signal for the actuator, usually operating a valve or damper. This value is selected according to the type of actuator used.
 - **0-10V** – output signal 0% = 0V, 100% = 10V.
 - **2-10V** – output signal 0% = 2V, 100% = 10V.
 - **10-0V** – output signal 0% = 10V, 100% = 0V.
 - **10-2V** – output signal 0% = 10V, 100% = 2V.
 - **0-5V** – output signal 0% = 0V, 100% = 5V. Applies to glycol only.
- **Opening (90s)** – the time it takes the actuator to move from one end position to the other. When the actuator position feedback signal is monitored, a fault of the device mechanically connected to the actuator (damper, valve, etc.) may be signalled based on the difference between the expected and the actual position. If the actuator position feedback signal is not monitored, this expected damper position value is for information only.
- **Deadband (20%)** – this parameter is relevant only when the damper position feedback signal is monitored. If the difference between the expected and the actual damper position is greater than the deadband, a damper fault may be signalled, and the component with this damper or the entire air handling unit may subsequently be switched off.
- **OffAlways (0%)** – position of the component when the unit is switched off.

6.1 Temperatures

This menu contains information on the measured temperatures according to the configuration settings. The location of the temperature sensors in the air handling unit and air ducts is shown in Figure 2.



Legend:

T1 - Outdoor (ODA)	T4 - Preheat - after 1st heater	T7 - Room
T2 - Inlet	T5 - Reheat - before 2nd heater	T8 - Extract (ETA)
T3 - Heat recovery supply	T6 - Supply (SUP)	T9 - Heat recovery
extract		
T10 - Exhaust (EHA)		

Fig. 2 - Location of temperature sensors

The following are descriptions of the individual temperature sensors, including installation methods and other related settings:

- **Room** - if the sensor is configured, it should be located in the space that is the target of the air conditioning, so that the measured temperature is not affected by local influences such as radiators, sunlight through a window, etc. If it is not configured, it can be substituted by the supply or extract air temperature sensor. Several room sensors can be installed, and the resulting room temperature is determined by the parameter **MultipleRoomSensors**.
- **RoomUnit** - temperature of the sensor located in the room unit. The room unit must be configured to display this temperature.
- **Preheat** - this sensor is used when preheating of the supply air is required and is located between the preheater and the reheater or cooler.

- **Supply** – in most cases, at least this sensor is configured to measure the temperature of the air supplied to the room. The temperature sensor is located after the last heating or cooling component, before the air enters the room. For hygiene and fire safety reasons, the maximum temperature in the duct is set at 50 °C.
- **FlueGas** – this sensor must be configured if the unit contains a gas heater, as it ensures the correct function and protection of the gas heat exchanger, including the emergency function. It is also used to control the bypass damper of the gas heat exchanger to reduce condensation and to heat up the exchanger faster when the gas heating starts. The temperature sensor is installed in a thermowell welded above the base of the flue. As standard, a Siemens QAZ21.5120 sensor with an NI1000 measuring element is supplied.
- **Outdoor** – should also be configured for all air handling units to ensure the correct function of the control system, especially during unit start-up or shutdown. The sensor should be located outdoors so that it is protected from weather influences that would incorrectly affect the MaR, for example direct sunlight, rain, icing, wind, etc. The outdoor sensor is also used to control air recirculation via the mixing damper or for efficient use of the heat recovery exchanger. This sensor should always be configured, as it is often linked to protective and start-up functions.
- **HeatingWaterReturn** – if the unit contains a water heater, a temperature sensor for measuring the heating water temperature must be configured. The heating water return temperature sensor ensures correct operation and protection of the water heat exchanger. It is installed on the outlet pipe of the water heat exchanger (the return pipe) so that it measures the actual temperature of the return water.
- **HeatingWaterFlow** – this sensor is installed on the heating water flow pipe so that it measures the actual temperature of the water supplied to the water heat exchanger. It can be used to signal a demand for heating water preparation to the boiler room.
- **ChilledWaterReturn** – this sensor can be configured if the unit contains a water cooler. It is installed on the outlet pipe of the water heat exchanger (the return pipe) so that it measures the actual temperature of the chilled water return. The sensor is for information only.
- **ChilledWaterFlow** – this sensor is installed on the chilled water flow pipe so that it measures the actual temperature of the water supplied to the water heat exchanger. The sensor is for information only.
- **Heat recovery**
 - **Inlet** – installed upstream of the heat recovery exchanger on the supply air side.

- **Supply** – installed downstream of the heat recovery exchanger on the supply air side. Together with the inlet sensor, it provides information on the current thermal efficiency of the heat recovery
- **Extract** – ensures the correct protective defrosting function of the heat recovery exchanger. The temperature sensor is installed downstream of the heat recovery exchanger on the extract air side.
- **Extract** – in many cases this temperature sensor is configured as a substitute for the room temperature sensor, because it measures the temperature of the air extracted from the room without being affected by local conditions in the room. It is installed in the extract duct.
- **Exhaust** – used to measure the exhaust air temperature. It is installed at the end of the exhaust duct.
- **MultipleRoomSensors**
(**Average/Max/Min/1stSensor/2ndSensor/3rdSensor/SummerMin/WinterMin**) – when several room temperature sensors are used, this determines how the final room temperature is calculated or assigned. With option 1, 2 or 3, the final room temperature is given solely by the selected sensor and the other sensors are for information only. With the other options, the resulting value is calculated as the arithmetic mean, maximum or minimum. The **SummerMin** option selects the lowest measured room temperature in summer and the highest in winter. The **WinterMin** option selects the lowest measured room temperature in winter and the highest in summer.
- **Display (Room/Extract/Supply/Preheat/Exhaust)** – selects the temperature sensor whose value is shown on the second line of the home screen next to the current time. Normally the reference temperature sensor, which is compared with the setpoint temperature, is selected. The room, supply air or extract air temperature sensor can be selected.

6.2 Temperature control

Temperature control can be direct or cascade and depends on the temperature setpoint selection in the **Configuration** menu. With a supply temperature or preheat temperature setpoint, the control is direct. With the other options, the control is cascade (**PID-Supply**), which allows better control of the required temperature. Temperature control also includes further parameters

affecting the operation of the air handling unit. Temperature control is accessible only after service login.

- **Status (Off/Ventilate/Heat/Cool)** – current status of temperature control.
- **Current (°C)** – current temperature at the setpoint temperature sensor.
- **SupplySetpoint (22 °C)** – current required supply air temperature.
- **Required (°C)** – required temperature according to the current mode or from the room unit.
- **Summer** – required temperatures for individual modes in summer, if the unit is not controlled from the room unit:
 - **Comfort (22 °C)** – required temperature for **Comfort** mode in summer.
 - **Economy (18 °C)** – required temperature for **Economy** mode in summer.
- **Winter** – required temperatures for individual modes in winter, if the unit is not controlled from the room unit:
 - **Comfort (23 °C)** – required temperature for **Comfort** mode in winter.
 - **Economy (19 °C)** – required temperature for **Economy** mode in winter.
- **FrostProtection (5 °C)** – required heating temperature in **Standby** mode.
- **Freecooling (18 °C)** – required ventilation temperature in **Standby** mode.
- **Compensation (0 °C)** – difference between the outdoor and the required temperature at which compensation of the required temperature is activated in **Economy** or **Comfort** mode. Compensation of the required temperature is used at higher outdoor temperatures and consists of shifting the required temperature depending on the outdoor temperature. With a value of 0 K, compensation is blocked.

Example for **Compensation = 6 °C** in **Comfort** mode:

- Outdoor temperature $\leq 28\text{ °C}$ → required temperature = 22 °C.
- Outdoor temperature = 32 °C → required temperature = 26 °C.
- **PreheatSetpoint (0 °C)** – required temperature for the water or electric heater preparing the air for the next component, usually for the condensing unit. For correct operation, the preheat temperature sensor must be configured and the heater must not have a valid sequence set, **SequenceHeat = --**.
- **PID-Supply** – is a cascade control which calculates the required supply temperature on the basis of the required and actual room or extract temperature. The factory default values are: **TI = 900s**, **KP = 10**, **WPD = 0 °C**. It applies only if, in the configuration under **TemperatureSetpoint**, neither the **Supply** nor the **Preheat** temperature is selected. If, in the configuration under

TemperatureSetpoint, the temperature **Supply** or **Preheat** is selected, this PID control does not apply and the required temperature is equal to the required supply air temperature. The required supply air temperature calculated by the PID control ranges between the values **SupplyUpperLimit** and **SupplyLowerLimit**.

- **SupplyUpperLimit (30 °C)** – current upper limit of the required supply air temperature, determined on the basis of the **Fixed** or **Offset** values for the upper limit.
 - **Fixed (30 °C)** – maximum static required supply air temperature. This value is valid as the current maximum limit **SupplyUpperLimit** only if, for the upper limit, **Offset = 0 °C**.
 - **Offset (0 °C)** – a non-zero value determines the current maximum limit of the required supply air temperature **SupplyUpperLimit** as the sum of the setpoint temperature according to the mode (**Comfort**, **Economy**, **FrostProtection**, **Freecooling**) and **Offset**. The maximum required supply air temperature will change dynamically as the setpoint temperature changes.
- **SupplyLowerLimit (16 °C)** – current minimum limit of the required supply air temperature, determined on the basis of the **Fixed** or **Offset** values for the lower limit.
 - **Fixed (16 °C)** – minimum static required supply air temperature. This value is valid as the current minimum limit **SupplyLowerLimit** only if, for the lower limit, **Offset = 0 °C**.
 - **Offset (0 °C)** – a non-zero value determines the current minimum limit of the required supply air temperature **SupplyLowerLimit** as the difference between the setpoint temperature according to the mode (**Comfort**, **Economy**, **FrostProtection**, **Freecooling**) and **Offset**. The minimum required supply air temperature will change dynamically as the setpoint temperature changes.
- **DeadbandLimit (6 °C)** – determines when the heating or cooling components of the unit are to be switched off when the minimum or maximum supply air temperature limit is exceeded:
 - If the supply air temperature exceeds the value **SupplyUpperLimit + DeadbandLimit**, all heating components of the unit are switched off immediately, or the cooling components of the unit are switched on.
 - If the supply air temperature falls below the value **SupplyLowerLimit - DeadbandLimit**, all cooling components of the unit are switched off immediately, or the heating components of the unit are switched on.
- **OffsetTCh (2 °C)** – offset of the required supply air temperature calculated by the cascade PID control for the control states **Heat** and **Cool**, resulting in energy savings:

- State **Heat** – the range of the required supply air temperature is between the values **SupplyUpperLimit** – (**OffsetTCh** / 2) and **SupplyLowerLimit** – (**OffsetTCh** / 2).
- State **Cool** – the range of the required supply air temperature is between the values **SupplyUpperLimit** + (**OffsetTCh** / 2) and **SupplyLowerLimit** + (**OffsetTCh** / 2).
- **HighSupplyShutsDown** (No/**HeatRecovery**/Heating) – determines how much of the heating section is switched off when the upper supply temperature limit plus deadband is exceeded. This function is used mainly for condensing units with non-standard control, where the heat recovery is switched off instead of the condensing unit. This reduces the switching frequency of the condensing units.
- **ClimaTemperature** – selects the temperature sensor or other state on the basis of which the controller decides whether the unit is to heat or cool.
 - If one of the temperatures is selected, the required temperature is compared with the selected temperature.
 - **Season** – the control heats or cools on the basis of the parameters set in the **TemperatureSeason** item. In the **Summer** temperature season the unit only cools, and in the **Winter** season it only heats.
 - **Contact** – the clima temperature is replaced by an external contact from a superior system switching between heat and cool modes (**InputAssignment/Output** → **ExternalSwitches** → **Cool/Heat**). By default, the unit is switched to cool mode when the contact is open and to heat mode when the contact is closed.
- **ClimaShift** (0 °C) – is relevant only if one of the temperatures is selected as **ClimaTemperature**. For example, with outdoor clima temperature selected, a required room temperature of 23 °C, a clima shift of 2 °C and a clima deadband of 0 °C, the limit outdoor temperature for switching between heating and cooling will be 25 °C.
- **ClimaDeadband** (1 °C) – is relevant only if one of the temperatures is selected as **ClimaTemperature**. It is used to determine the temperature limit at which the unit is to heat and at which it is to cool. It is a deadband around the required clima temperature within which temperature control does not change from the **Heat** state to the **Cool** state and vice versa.
 - The unit switches to heating if the selected **ClimaTemperature** < **TemperatureSetpoint** + **ClimaShift** – **ClimaDeadband**.
 - The unit switches to cooling if the selected **ClimaTemperature** > **TemperatureSetpoint** + **ClimaShift** + **ClimaDeadband**.

With the supply air temperature within the calculated temperature control limits, switching from cooling to heating takes place only once all cooling components are switched off. With the supply air temperature within the calculated temperature control limits, switching from heating to cooling takes place only once all heating components are switched off. These conditions may not apply when humidity control is active.

- **SetpointDeadband (0.2 °C)** – applies when controlling heating or cooling components with stepped output control. If the current temperature falls within the deadband around the setpoint temperature, the PID control of the component is interrupted and its output no longer changes, even though the exact required temperature has not been reached. With deadband values close to 0 °C, this function has almost no effect.
- **TemperatureSeason (Summer/Winter, 18 °C, 60min)** – shows the state diagnosed by the controller on the basis of comparing the outdoor temperature with the changeover temperature over the specified time. The changeover temperature and time values are given on the next line. If the outdoor temperature is lower for the specified time, the **Winter** temperature season begins, and if it is higher for the specified time, the **Summer** temperature season begins. The temperature season governs, for example, the function of the heat recovery exchanger, the condensing unit or the water heater when the air handling unit starts. If no outdoor temperature sensor is configured, the default is temperature season **Winter**.
- **DelayTCh (60s)** – minimum time interval between switching from heating to cooling or vice versa. During this time, temperature control is in the **Ventilate** state. This prevents sudden changes in the supply temperature.
- **SequenceDelay (90s)** – is relevant only for a unit containing heating or cooling components with a non-zero start output (gas heating, condensing unit or heat pump). After a component starts, PID control does not apply for the duration of the delay; the component runs at minimum output while waiting for the supply air temperature to respond to this state.
- **StartDuration (3min)** – ensures a smooth temperature start of the unit depending on whether the unit is fitted with a mixing damper. During this time, the calculated required supply air temperature is equal to the required temperature. The unit start consists of 3 phases:
 1. After a mode is selected, the unit switches to the **Start** state and the fan start is delayed until the dampers have moved to the required position and the boiler room has given its release, if configured. The heat recovery output is 100% at start-up, if the heat recovery

temperature conditions allow it. Depending on the outdoor temperature, preheating of the water heater may be started.

2. The fans then start at the start output for the start duration, so that the control can eliminate the effect of the outdoor temperature sensor location and the unit components can acclimatise.
 3. At the end of the start time, the fans ramp up to the required operating output, and control of the components on the basis of their PID controls also starts.
- **LTFiltr (0.02 °C/sec)** – filters step changes in the required temperature and in the supply air temperature calculated by the PID cascade control. The default linear rate of temperature change is 2 hundredths of a degree per second.
- **RunEnable (All/Heat+/Cool+/Heat/Cool)** – here the operation of the air handling unit can be restricted to the **Heat** or **Cool** states only:
- **All** – the unit behaves normally; the fans run in all three states, **Ventilate**, **Heat** and **Cool**.
 - **Heat+** – the unit operates only in the **Heat** and **Ventilate** states. In the **Cool** state the air handling unit is switched off.
 - **Cool+** – the unit operates in the **Cool** and **Ventilate** states. In the **Heat** state the air handling unit is switched off.
 - **Heat** – the unit behaves as pure heating; the fans run only in the **Heat** state. In the **Cool** state the air handling unit is switched off.
 - **Cool** – the unit behaves as pure cooling; the fans run only in the **Cool** state. In the **Heat** state the air handling unit is switched off.
- **MaxSupply (50 °C)** – safety value of the supply air temperature. If it is exceeded, the gas or electric heating is switched off, if configured.

6.3 Humidities

This menu contains information on the measured humidities according to the configuration settings. The location of the sensors in the air ducts complies with the standards.

- **Outdoor, Absolute (% , g/kg)** – measured value of the relative outdoor humidity and the absolute humidity calculated from the relative humidity on the basis of the outdoor temperature.

- **Supply, Absolute** (% , g/kg) – measured value of the relative humidity of the supply air and the absolute humidity calculated from the relative humidity on the basis of the supply air temperature.
- **Room, Absolute** (% , g/kg) – measured value of the relative humidity of the room air and the absolute humidity calculated from the relative humidity on the basis of the room air temperature.
- **Extract, Absolute** (% , g/kg) – measured value of the relative humidity of the extract air and the absolute humidity calculated from the relative humidity on the basis of the extract air temperature.
- **MultipleRoomSensors (Average/Max/Min/1stSensor/2ndSensor/3rdSensor)** – when several room humidity sensors are used, this determines how the resulting room humidity for control is calculated or assigned. With option 1, 2 or 3, the resulting room humidity is given solely by the selected sensor and the other sensors are for information only. With the other options, the resulting value is calculated as the arithmetic mean, maximum or minimum.

6.4 Humidity control

Humidity is controlled on the basis of the required and actual humidity in the room or in the extract or supply air. Humidification is performed by steam generators. Dehumidification can be passive or active. Passive dehumidification of the ventilated space is performed by ventilation, provided that the outdoor absolute humidity is lower than the required absolute humidity. In passive dehumidification, the amount of outdoor air supplied can be increased by increasing the fan output, by opening the supply air damper, or by both methods at once. Active dehumidification uses a cooling and a heating component: the supply air is first cooled to remove moisture and then reheated to the required temperature. With a supply humidity setpoint, the control is direct. When controlling to a required room or extract humidity, cascade control is used (**PID-Supply**), which calculates the required supply air humidity on the basis of the difference between the required and actual humidity; this allows better control of the required humidity. Humidity is measured mainly with relative humidity sensors with a 0–10V analogue output, but sensors with a digital output can also be used.

- **Status** – current status of humidity control with respect to the required and the currently measured value.

- **Good** – the current humidity is within the required range given by the hystereses.
 - **Low** – the current humidity is below the lower hysteresis of the required humidity.
 - **High** – the current humidity is above the upper hysteresis of the required humidity.
 - **Outdoor** – passive dehumidification with outdoor air is not possible because its humidity is not low enough.
- **Current (%)** – current humidity at the setpoint humidity sensor.
- **SupplySetpoint (%)** – current required supply air humidity.
- **Required (%)** – required humidity according to the current mode or from the room unit.
- **Comfort (50%), Economy (50%)** – required humidity in **Comfort** or **Economy mode**, if the humidity is measured by a sensor with an analogue output and the required value is not entered from the room unit.
- **PID-Control** – the factory default values are: **TI = 240s, KP = 2, TD = 0s**.
- **PID-Supply** – is a cascade control which calculates the required supply humidity on the basis of the required and actual room or extract humidity. It applies only if the humidity control configuration is set to **Setpoint = Room** or **Setpoint = Extract**. The factory default values are: **TI = 300s, KP = 4, WPD = -2%**.
- **Validity (No/Mode/Comfort/Economy/Always/Standby/StandbyEconomy/StandbyComfort)** – the system will respond to a change in air humidity only if the unit is not in the **Off** state. The **Validity** option has the following settings:
- **No** – the system will not respond.
 - **Mode** – the system will respond only if the air handling unit is in **Comfort** or **Economy** mode.
 - **Comfort** – the system will respond only if the air handling unit is in **Comfort** mode.
 - **Economy** – the system will respond only if the air handling unit is in **Economy** mode.
 - **Always** – the system will always respond when the air handling unit is not in the **Off** state, i.e. when the unit is in **Standby, Comfort** or **Economy** mode.
 - **Standby** – the system will respond only if the air handling unit is in **Standby** mode.
 - **StandbyEconomy** – the system will respond only if the air handling unit is in **Standby** mode. The fan output and the amount of fresh air will correspond to **Economy** mode.
 - **StandbyComfort** – the system will respond only if the air handling unit is in **Standby** mode. The fan output and the amount of fresh air will correspond to **Comfort** mode.
- **Priority (Low/High)** – resolves the situation where demands for both humidity control and air quality control are active at the same time:

- **Low** – air quality control takes priority over humidity control.
- **High** – humidity control takes priority over air quality control.
- **UpperHysteresis (5%)** – if the current humidity is higher than the required humidity plus the upper hysteresis, high humidity is signalled and dehumidification starts. Dehumidification ends when the current humidity returns to the required value and the dehumidification output drops to 0%.
- **LowerHysteresis (-5%)** – if the current humidity is lower than the required humidity plus the lower hysteresis, low humidity is signalled and humidification starts. Humidification ends when the current humidity returns to the required value and the humidification output drops to 0%.
- **SupplyUpperLimit** – maximum permitted supply air humidity.
- **SupplyLowerLimit** – minimum permitted supply air humidity.
- **ActiveDehumidification (No/Condens/HeatPump/Water/All)** – determines the cooling component that will be used to dehumidify the supply air. This component is controlled by the output of the humidity PID control. Active dehumidification is achieved by cooling the supply air and then reheating it to the required temperature. Active dehumidification is not performed with outdoor air.
 - **No** – active dehumidification will not be performed.
 - **Condens** – the condensing unit will be used for active dehumidification.
 - **HeatPump** – the heat pump will be used for active dehumidification.
 - **Water** – water cooling will be used for active dehumidification.
 - **All** – all the above components will be used for active dehumidification, if configured.
- **OutputLimitation (1.00)** – limits the output of the cooling component in active dehumidification. The output demand of the cooling component is equal to: **PID-Control output x OutputLimitation**.
- **PassiveDehumidification (No/Fan/Mixing/Both)** – determines the method of passive dehumidification with outdoor air. A necessary condition is that the outdoor humidity is lower than the current humidity from the sensor selected in **Control**.
 - **No** – passive dehumidification will not be performed.
 - **Fan** – the fan output preset for passive ventilation will be used for passive dehumidification (**SupplyFan, ExtractFan**).
 - **Mixing** – the fresh air amount preset for passive ventilation will be used for passive dehumidification (**FreshAir**).

- **Both** – both of the above methods will be used for passive dehumidification.
- **SupplyFan (100%), ExtractFan (100%)** – fan speeds when the air humidity is high and **PassiveDehumidification (Fan/Both)** is selected. The standard supply fan speed values for the modes (**Comfort, Economy**) should be lower than this value.
- **FreshAir (100%)** – amount of fresh air when the air humidity is high and **PassiveDehumidification (Mixing/Both)** is selected. The standard fresh air values for the modes (**Comfort, Economy**) should be lower than this value. In the **FrostProtection, Freecooling** operating modes, the damper setting is accepted only if the fan speed value is non-zero.

6.5 Fans

The **Fans** item contains information on how the fans operate. The fans are normally driven by motors with frequency converters or by EC motors. In this case, motor protection is provided by the thermal contact of the frequency converter or EC motor. The frequency converter parameters are set at the factory according to the technical specification of the specific air handling unit. The speed of fans with frequency converters is controlled by the controller in the range from (0Hz, 0%) up to the maximum (xHz, 100%) set in the frequency converter. For EC motors, the speed is controlled by the controller in the range from (0Hz, 0%) up to the maximum (50Hz, 100%) speed.

For a unit fitted with both a supply and an extract fan, the information displayed may be common to both fans or may be shown separately for each fan, depending on the configuration settings.

- **Supply, Extract (Off/On)** – shows whether the fan is switched on.
- **2Supply, 2Extract (Off/On)** – shows whether the backup fan is switched on, if enabled in the configuration.
- **Status** – shows information on the fan's mode of operation:
 - **Economy** – the fan is running as required by the **Economy** mode.
 - **Comfort** – the fan is running as required by the **Comfort** mode.
 - **HeatPump** – the heat pump has forced an increase in fan speed.
 - **3xSpeed** – the fan is controlled in three stages by external contacts.
 - **Controller** – the fan is controlled by the user from one of the control panels.
 - **Compensation** – the fan speed is compensated on the basis of the supply air temperature.

Alternatively, the fans are switched off because the supply air temperature is above the

limit **SupplyUpperLimit + ShutdownOffset** or below the limit **SupplyLowerLimit - ShutdownOffset**.

- **Mixing** – the fan speed is compensated on the basis of the selection in **MixingCompensation**.
- **Pressure** – the fan is controlled on the basis of a demand for a constant air volume (CAV) or a constant pressure (VAV).
- **AirQual** – the fan speed is compensated according to the air quality sensor.
- **Purge** – the fan purges the heating components after the unit has been switched off. This state is also indicated as an auxiliary mode.
- **Start** – the start-up sequence is in progress before the fans are started, e.g. opening of the supply and extract air dampers, start-up of the heat recovery exchanger, preheating of the water heater, etc.
- **Release** – not all conditions required to start the air handling unit fans in the selected mode are met.
- **Summer – Comfort (100%)** – supply or extract fan speed in Comfort mode in the summer season. Only if fan speed control from the room unit is selected (configuration parameter **ControlType**), **Comfort** is the maximum fan speed that can be set from the room unit. This value is not displayed if the parameter **ControlType = 'Pressure'**.
- **Summer – Economy (80%)** – supply or extract fan speed in Economy mode in the summer season. Only if fan speed control from the room unit is selected (configuration parameter **ControlType**), **Economy** is the minimum fan speed that can be set from the room unit. This value is not displayed if the parameter **ControlType = 'Pressure'**.
- **Winter – Comfort (100%)** – supply or extract fan speed in Comfort mode in the winter season. Only if fan speed control from the room unit is selected (configuration parameter **ControlType**), **Comfort** is the maximum fan speed that can be set from the room unit. This value is not displayed if the parameter of the respective fan is **ControlType = 'Pressure'**.
- **Winter – Economy (80%)** – supply or extract fan speed in Economy mode in the winter season. Only if fan speed control from the room unit is selected (configuration parameter **ControlType**), **Economy** is the minimum fan speed that can be set from the room unit. This value is not displayed if the parameter of the respective fan is **ControlType = 'Pressure'**.
- **Comfort, Economy (Pa, m3/h)** – setpoints for fan output control to constant pressure (VAV), or the required volume of conveyed air for fan output control to constant flow (CAV), in

Comfort or **Economy** mode. This value is displayed only if the parameter of the respective fan is set in the configuration to **ControlType = 'Pressure'**. The setpoint and actual value of pressure or flow in % are passed to the PID control, which controls the fans. Fan control to constant pressure (VAV) takes priority over control to constant flow (CAV). For control to constant flow to take effect, the pressure setpoint must therefore be 0Pa.

- **PID-Control** – the standard factory-set values are: **TI = 120s**, **KP = 2**, **TD = 0s**. Displayed only if the configuration parameter is **ControlType = 'Pressure'**.
- **Pressure (Pa)** – shows the current air pressure in the duct, based on the analogue pressure sensor, if the configuration parameter is **ControlType = 'Pressure'**.
- **Flow (m3/h)** – shows the current air flow in the duct, based on the analogue pressure sensor, if the configuration parameter is **ControlType = 'Pressure'**.
- **RampUp (60s)** – the time (ramp-up) in which the fan speed control signal rises from 0V (0% speed) to 10V (100% speed). The ramp-up value depends on the fan type and the technical specification of the air handling unit. The start-up of a fan with an EC motor is governed directly by the ramp value. The minimum speed of the EC motor is set in the controller to 18Hz. For fans with frequency converters, the ramp entered in the controller is for information only, because the fan start-up is determined by the ramp-up entered in the frequency converter parameters. As the actual fan speed is not normally monitored, the ramp entered in the controller serves mainly to display the estimated actual fan speed. The ramp-up values should therefore be set identically in the frequency converter parameters and in the controller. The minimum speed is also entered in the frequency converter parameters.
- **RampDown (30s)** – the time (ramp-down) in which the speed control signal of the supply and extract fans (each separately) falls from 10V (100% speed) to 0V (0% speed). The ramp-down has a different value for each fan type. The run-down of fans with EC motors is determined by this value. For fans with frequency converters, the ramp is for information only, because the fan run-down is determined by the ramp-down entered in the frequency converter parameters. The ramp-down values should therefore be identical.
- **HeatPump (0%)** – the speed required for efficient operation of the heat pump. The fans switch to this speed when the heat pump starts operating. The heat pump speed values must be higher than the speeds for the standard modes.

- **Speed (%,%,%)** – speed values for three-stage fan speed control by external contacts. The configuration must be set to **ModeSwitches=3xSpeed**.
- **MinSpeed (36%)** – limits the minimum fan output so that it is not possible to enter, for the individual Comfort and Economy modes, a fan output that would cause other components of the air handling unit to malfunction.
- **MaxSpeed (100%)** – limits the fan output so that it is not possible to enter, for the individual Comfort and Economy modes, a higher fan output exceeding the fans' operating point according to the technical specification of the unit. A larger volume of conveyed air may cause, for example, malfunction of the pressure switches (pressure drop exceeded) of filters, the heat recovery exchanger, etc.
- **MinFM (36%)** – protects a motor controlled by a frequency converter against thermal overload during prolonged operation at speeds below 18Hz (36% applies to a rated speed of 50Hz). The value should correspond to the value entered in the frequency converter parameters.
- **Delay (30s)** – delay in switching on the supply fan after the extract fan has been switched on. This function is mainly relevant in a configuration with a heat recovery exchanger, where the warm air conveyed to the exchanger by the extract fan warms the exchanger up before the supply fan starts.
- **StartSpeed (36%)** – specifies the fan speed for the duration of the auxiliary mode Start. If **MinSpeed** is higher than **StartSpeed**, then **MinSpeed** will be used at unit start-up.
- **Compensation** – this menu contains the fan speed compensation parameters:
 - **Mixing (No/Supply/Extract/Both)** – determines for which fan the speed will be compensated based on the opening of the mixing damper. It is used mainly in compact units designed in such a way that, with the mixing damper open to 100%, the extract fan pushes air against the closed extract damper.
 - **Source)** – compensation of fan speed to achieve the required supply air temperature by changing the speed level. Compensation can be enabled according to the selected source:
 - **Temperature** – in the heating state, speed compensation is enabled if the supply air temperature is low and the heating output can no longer be increased. In the cooling state, it is enabled if the supply air temperature is high and the cooling output can no longer be increased.

- **Selection** – compensation is enabled if the supply air temperature is low and, at the same time, one of the options **CoolingFault**, **Defrost** or **HeatingFault** is set to **Compensation**.
- **Both** – compensation takes place if any of the above conditions is met.

The following parameters affect the activation of compensation:

- **On (1 °C)** – specifies by how many degrees the supply air temperature must be lower than the setpoint for compensation to be activated.
- **Offset (4 °C)** – offset of the supply air temperature for PID speed control. In heating mode the offset is positive and in cooling mode it is negative.
- **Delay (60s)** – the time for which the supply air temperature must remain low with the heating output no longer able to be increased before compensation can be enabled.
- **Temperature (Supply/Extract)** – selects the control temperature for speed compensation.
- **PID-Compensation** – contains the control parameters for operation of fans controlled to the required supply air temperature, which determine the quality and speed of control. The values are set as standard at the factory and should only be changed by a person familiar with control systems. The standard factory-set values are: **TI = 60s, KP = 8, TD = 0s**.
- **CoolingFault (Mode/Compensation)** – defines the fan speed in the event of a cooling fault. With the value Mode selected, the speed remains at the level determined by the mode or by other control; with the value Compensation, the fans switch to the speed compensated according to the supply air temperature.
- **Defrost (Mode/2Compensation/1Compensation)** – defines the fan speed during defrosting of the condensing unit, the heat recovery exchanger or the glycol circuit exchanger.
 - **Mode** – the speed remains at the level determined by the mode or by other control.
 - **2Compensation** – the speed switches to the speed compensated according to the supply air temperature *for both fans*.
 - **1Compensation** – the speed switches to the compensated speed for the supply fan only.
- **HeatingFault (Mode/Compensation)** – defines the fan speed in the event of a heating fault. With the value Mode selected, the speed remains at the level determined by the mode or by other control; with the value Compensation, the fans switch to the speed compensated according to the supply air temperature.
- **ShutdownOffset (10 °C)** – the air handling unit switches off if the supply air temperature is higher than **SupplyUpperLimit + ShutdownOffset** or lower than **SupplyLowerLimit - ShutdownOffset**. The purpose is to protect the ventilated space against excessive cooling or

overheating in the event of a fault in the heating or cooling components. This function can be blocked by entering an unrealistically large offset value, up to a maximum of 100 °C.

- **Delay (600s)** – delay in switching off the air handling unit due to excessively low or high supply air temperature.

6.6 Fresh air

If the air handling unit is fitted with dampers, information on their status is displayed here. The dampers can be controlled on the basis of unit operation or a mixing demand. .

The supply and extract dampers are usually controlled by the same signal as the mixing damper, only with the opposite direction of rotation set. For correct display of the damper status and fresh air volume, the damper configuration of the air handling unit must correspond to the electrical wiring. Damper position feedback can be monitored by assigning the corresponding inputs and outputs in **InputAssignment/Output** → **FreshAir**. In the unit state **Off**, the supply and extract dampers must be fully closed and the mixing damper fully open.

- **FreshAir (%)** – the volume of fresh air supplied to the space according to the preset parameters.
- **Status** – shows information on damper operation:
 - **Selection** – the damper is controlled according to the selection **MixingComfort** or **MixingEconomy** other than the option **Auto**.
 - **Humidity** – the dampers are controlled on the basis of the position set for the dehumidification state.
 - **Quality** – the dampers are controlled on the basis of the position set for poor air quality.
 - **Defrost** – a demand for the minimum fresh air volume is sent to the dampers because one of the heating components is in defrost mode and the damper response to defrosting is enabled, parameter **Defrost = Yes**.
 - **SupplyTemp** – a demand for the minimum fresh air volume is sent to the dampers because the supply air temperature is too low.
 - **WaterHeating** – a demand for the minimum fresh air volume is sent to the dampers because the water heating protection has been activated.
 - **Start** – the unit is starting and the supply and extract dampers are in the **FreshAirStart** position.

- **Damper (%)** – the required damper position calculated by the controller. The value is displayed separately for each damper enabled in the configuration. The actual damper position should correspond to this value if its control output is set correctly according to the wiring diagram and the actuator type.
- **MixingComfort, MixingEconomy** – provided the unit includes a mixing damper, this parameter can be used to set the fresh air volume control to a fixed value or to a value varying with temperature, separately for each of the **Comfort** and **Economy** modes.
- **Fixed-Setting** – the dampers are set to a fixed value corresponding to the temperature season and the selected mode.
 - **SummerComfort (80%)** – fixed position of the supply damper in the summer season for **Comfort** mode.
 - **SummerEconomy (50%)** – fixed position of the supply damper in the summer season for **Comfort** mode.
 - **WinterComfort (80%)** – fixed position of the supply damper in the winter season for **Economy** mode.
 - **WinterEconomy (50%)** – fixed position of the supply damper in the winter season for mode .
- **Linear-Setting** – the fresh air volume will vary linearly between the limit values of the selected temperature.
 - **Temperature** – specifies the temperature sensor used for mixing control.
 - **Current (°C)** – the current temperature measured by the sensor selected in the item **Temperature**.
 - **MinVentilate, MaxVentilate (0 °C)** – temperature limits for linear mixing control . **MaxVentilate** specifies the temperature at which the fresh air volume will be 100%. **MinVentilate** specifies the temperature at which the fresh air volume will be at its minimum. Between these limit temperatures, the fresh air volume will vary linearly. These values can be set separately for the **Heat** and **Cool** states. In the **Ventilate** state, the mixing setting remains the same as in the previous state.
- **Control-Setting** – with this option, the mixing damper behaves as a heating or cooling component that differs in its control setpoint temperature and can be assigned a priority for heating or cooling. With the option **Control**, control is to the setpoint temperature of the current mode. With the option **2Control**, control is to the preheat setpoint temperature. The fresh air volume is controlled by PID control.

- *PID-Control* – the standard factory-set values are: **TI = 150s**, **KP = 8**, **TD = 0s**.
- **Auto** – with this option, the system sets the mixing damper, on the basis of the outdoor and extract temperatures, to the end position that better supports the current **Heat** or **Cool** state.
- **MinFreshAirComfort, MinFreshAirEconomy (0%, 15%)** – the minimum hygienic opening of the supply air damper for the individual modes. This parameter does not apply when the unit is in **Off** mode. While the unit is running, the supply and extract dampers are always open to at least this value.
- **FreshAirStart (15%)** – specifies the fresh air volume at unit start-up. Unit start-up is indicated as an auxiliary mode.
- **Defrost (No/Yes)** – affects the fresh air volume during defrosting of any of the configured components.
 - **No** – the defrost state of a component has no effect on the fresh air volume.
 - **Yes** – during defrosting of any component, the fresh air volume is reduced to the minimum value.

6.7 Heat recovery

In addition to heat recovery, the heat recovery system can also be used for cooling recovery. Heat recovery can be provided by a plate heat exchanger, a rotary heat exchanger or a glycol circuit.

The rotary heat exchanger motor is protected by the motor thermal contact connected to the frequency converter, if the motor has one. If the motor has no thermal contact, the appropriate terminals on the frequency converter must be bridged, or the frequency converter parameters must be changed so that the frequency converter does not monitor the motor thermal contact status.

When the unit is off, the rotary heat exchanger is protected against seizing by being turned every 30min for 10s.

The frequency converter parameter settings for a specific order are part of the documentation.

- **Status** – shows information on heat recovery exchanger operation.
 - **Humidity** – the heat recovery exchanger assists with dehumidification (cools), if the temperature conditions allow.
 - **SupplyTemp** – the heat recovery exchanger heats when the supply air temperature is low, if the temperature conditions allow.

- **Preheat** – at unit start-up, the heat recovery exchanger assists with preheating (heats), if the temperature conditions allow.
 - **NotCooling** – the heat recovery exchanger cannot cool because the extract air temperature is higher than the outdoor air temperature.
 - **NotHeating** – the heat recovery exchanger cannot heat because the extract air temperature is lower than the outdoor air temperature.
 - **Defrost** – the heat recovery exchanger is in defrost mode.
- **MinOutput (0%)** – the minimum heat recovery output when switched on.
- **Ramp (60s)** – the time (ramp-up, ramp-down) in which the heat recovery exchanger speed control signal rises from 0V (0% speed) to 10V (100% speed) and vice versa. The value is relevant only for a rotary heat exchanger.
- **AllowGlycol (80%)** – this value determines the pressure limit in the glycol circuit below which the glycol top-up pump is switched on. The pressure in the glycol circuit is measured by a pressure sensor with a 0–10V output. The setpoint is calculated as follows: **AllowGlycol (%)** = Minimum pressure (Pa) * 100 / sensor range.
- **Inlet (°C)** – the current temperature upstream of the heat recovery exchanger on the supply air side.
- **AfterHeatRecovery (°C)** – the current temperature downstream of the heat recovery exchanger on the supply air side.
- **HeatRecoveryExhaust (°C)** – the current temperature downstream of the heat recovery exchanger on the extract air side.
- **PID-Control** – the standard factory-set values are: **TI = 300s, KP = 4, TD = 0s.**
- **MaxOutput (0%)** – the maximum motor speed of the rotary heat exchanger.
- **SpeedMonitoring (240s)** – applies only to rotary heat exchangers fitted with a pulse speed sensor. If the sensor does not detect the heat exchanger rotating within this time, a heat recovery fault is signalled.
- **AntiFrostProtection** – protection of the heat recovery exchanger against icing can be provided by a pressure switch with a digital or analogue output that monitors the air pressure upstream and downstream of the exchanger on the supply or extract air side. Alternatively, it is provided by a temperature sensor located downstream of the exchanger on the supply or extract air side. If both temperature sensors are fitted, only the extract air temperature sensor is used for anti-frost protection. Both methods can be combined. When the heat recovery exchanger ices up,

the bypass damper of the plate heat exchanger opens or the speed of the rotary heat exchanger is reduced to the minimum value. The mixing damper opens to 100%. At the same time, the fan speed may be adjusted according to the parameter setting **UnitComponents → Fans → Defrost = „Compensation“**. The heat recovery anti-icing protection parameters are:

- **Pressure (Pa)** – the current pressure measured by the pressure switch with analogue output.
- **Max (Pa)** – the pressure value above which the heat recovery anti-frost protection is activated.
- **Temperature (°C)** – if the current temperature of any of the temperature sensors downstream of the heat recovery exchanger on the supply or extract air side is lower than this value, the heat recovery anti-frost protection is activated.

6.8 Water heating

Water heating is controlled on the basis of the selected mode and the setpoint temperature, in conjunction with the temperature sensors. As standard, qualitative control with a three-way valve and an electric water pump is used. Anti-frost protection is provided by a frost protection thermostat, a return or flow water temperature sensor, and a supply or outdoor air temperature sensor.

Emergency anti-frost protection is provided by the frost protection thermostat. The frost protection thermostat signals a drop in the supply air temperature below the value set on the thermostat, preferably by an opened contact. When emergency anti-frost protection is activated, the fans are switched off, the mixing damper opens to 100%, the pump is switched on, the three-way valve opens to 100% and a fault is signalled.

Operational anti-frost protection is provided on the basis of the return water temperature, the outdoor temperature and the supply air temperature in the following cases:

1. With the unit switched on, the heating water temperature drops below 6 °C (**WaterTemp**) – the pump is switched on and the three-way valve opens to 100%. Anti-frost protection ends when the temperature rises above 7 °C.
2. With the unit switched on, the supply air temperature drops below 6 °C (**SupplyTemp**) – the pump is switched on and the three-way valve opens to 100%. Anti-frost protection ends when the temperature rises above 7 °C.

3. With the unit switched off, the heating water temperature drops below 10 °C (**WaterTemp**) – the pump is switched on and the three-way valve starts to open. The three-way valve opens fully at 4 °C. Between 4 °C and 10 °C, the valve position depends linearly on the return water temperature. Anti-frost protection ends when the temperature rises above 10 °C.
4. Depending on the **PumpOn** option, the pump can be switched on at low outdoor air temperature with the unit switched off or on (**OutdoorTemp**).

Anti-frost protection is indicated as **AuxiliaryMode – WaterHeatingProtection** on the controller display in the main menu.

In the event of any water heating fault, the three-way valve opens to 100% and the pump is switched on. If the unit is running during a water heating fault, the fan speed may be reduced with the setting **UnitComponents → Fans → HeatingFault = Compensation**. This state is indicated as **AuxiliaryMode – SpeedCompensation** on the controller display in the main menu.

After user login, the number of water heating faults is also displayed.

- **Status** – shows information on water heating operation.
 - **Humidity** – the water heater heats to reheat the dehumidified air.
 - **OutdoorTemp** – low heating water temperature, the pump is switched on.
 - **SupplyTemp** – low supply air temperature, heating is switched on.
 - **WaterTemp** – the heating water temperature is lower than the set required or low temperature.
 - **Preheat** – preheating is in progress, warming up the heat exchanger before the fans are started.
 - **NotHeating** – heating is blocked by the temperature season or by an external contact signalling heating water readiness.
 - **Defrosting** – frost protection of the water heat exchanger by the thermostat is active, heating is switched on.
- **Pump** – shows **information on the contact controlling the heating pump**.
 - **Off** – the water heating pump contact is open.
 - **On** – the water heating pump contact is closed.
- **PID-Control** – the standard factory-set values are: **TI = 120s, KP = 6, TD = 0s**.
- **HeatingWaterFlow (°C)** – the current heating water temperature upstream of the heat exchanger.

- **HeatingWaterReturn (°C)** – the current heating water temperature downstream of the heat exchanger.
- **LowWaterTemperature (12 °C)** – the return water temperature limit serves as operational protection of the water heating with the unit switched on. If the heating water temperature remains lower for 5 minutes while the water heating is active, fan speed compensation is activated until the temperature rises above **RequiredWaterTemp**.
- **RequiredWaterTemp (20 °C)** – limit temperature of the return water at which the water heating output changes to the set value and the next heating component in the sequence is switched on.
- **Preheat (0%)** – ensures a thermally gentle start-up of the unit in cold periods. The current output calculated by the preheat function is displayed. It consists of two sequences with the following parameters:
 - **High (-10 °C, 100%)** – minimum outdoor temperature at which the valve opens to 100% after the preheat starts.
 - **Low (5 °C, 50%)** – maximum outdoor temperature at which the valve opens to 50% after the preheat starts.
 - **On (180s)** – duration of the first sequence, during which the fans start, the pump switches on and a fixed valve opening is set based on the outdoor temperature and the parameters **Low** and **High**. Between these limit temperatures the fixed valve opening is set linearly. This preheat sequence ends earlier if the supply temperature upper limit set in **TemperatureControl** is reached.
 - **Off (10%/min)** – second sequence, during which the valve opening calculated by the preheat starts to decrease at the rate given by the parameter **Off** and at the same time PID control of the valve opening based on the required temperature is enabled. The actual valve opening corresponds to the greater of the two.
 - **MinValvePosition (20%)** – selection of combinations of preheat and fan speed compensation
 - **SpeedCompensation (No/Yes/Only)** – selection of combinations of preheat and fan speed compensation based on the supply air temperature. The individual items have the following meaning:
 - **No** – speed compensation is not applied during preheat.
 - **Yes** – speed compensation is active simultaneously with preheat.
 - **Only** – only speed compensation is active instead of preheat.

- **MinValvePosition (20%)** – minimum valve opening for cases where, for example, the heating water flow is no longer sufficient at 15%.
- **OffWinter (20%)** – valve opening when the unit is switched off in the winter period.
- **AntiFrostProtection (-18°C)** – outdoor temperature limit at which frost protection by thermostat is activated for water heaters with glycol.
- **PumpOn (Normal/LowOutdoorTemp/Mode/Winter/Always)** – switching on the pump outside standard operation. The individual items have the following meaning:
 - **Normal** – in heating mode the pump switches on only when there is a demand to open the valve.
 - **LowOutdoorTemp** – the pump switches on if the outdoor temperature is below 1 °C, regardless of the unit status.
 - **Mode** – the pump switches on when **TemperatureControl** switches to the Heat state.
 - **Winter** – the pump switches on in the winter period.
 - **Always** – the pump is permanently on in heating mode.
- **PumpKick (No/Yes)** – this parameter enables the pump to be run once a week to prevent it from seizing.
- **SummerOperation (Block/Allow)** – allows the water heating to be switched off in the summer period, thereby limiting the use of the hot water source if it is intended only for the AHU.
- **CoolingProtection** – protection of the exchanger when the cooler is located upstream of the water heating exchanger. A prerequisite is a preheat temperature sensor located upstream of the water heating exchanger, on the basis of which the required heating output is controlled. Up to 8 temperature points of the heating output curve corresponding to the preheat temperature can be set.
- **OffProtection** – protection of the water heating exchanger when the unit is switched off. Similar function to **CoolingProtection**, but based on the outdoor temperature.
- **Protection** – information on the current status of the water heating protection:
 - **Cooling** – exchanger protection is active based on the settings in **CoolingProtection**.
 - **Preheat** – preheat is in progress during unit start-up.
 - **OffTwater** – exchanger protection is active when the unit is switched off, based on the settings in **OffProtection**.
 - **Twater** – the heating water temperature is lower than the preset operating **LowWaterTemperature**.

- **Kick** – the pump is being run as protection against seizing during a long shutdown. The exchanger must not be empty!
- **Toutdoor** – pump switched on due to low outdoor temperature ($<1^{\circ}\text{C}$).
- **FrostWater** – the heating water temperature is lower than 6°C .
- **FrostSupply** – the supply air temperature is lower than 6°C .
- **FrostThermostat** – unit operation is blocked by the frost protection thermostat.

6.9 Electric heating

Electric heating is controlled based on the selected mode and the required temperature in conjunction with the temperature sensors. A prerequisite for switching on the electric heater is that the fans are running. Electric heating control is prepared for both modulated and non-modulated heaters.

Protective functions are provided by a safety thermostat which, in the event of overheating, disconnects the power supply to the electric heating; this state is signalled to the controller, which then performs complete cooling of the electric heat exchanger. Do not switch off the power supply to the air handling unit (supply fan) while the electric heating is in operation! It will overheat!

In the event of an electric heating fault, the fan speed may be reduced after the exchanger has cooled down if the parameter **UnitComponents** → **Fans** → **HeatingFault = Compensation** is set. This state is signalled as **AuxiliaryMode – SpeedCompensation** on the controller display in the main menu.

- **Status** – displays information on the operation of the electric heating.
 - **SupplyTemp** – heating is blocked because the supply temperature has exceeded the set maximum value of 50°C .
 - **NoHeat** – heating is blocked by the temperature season.
- **Heating** – displays information on the contact controlling the heating contactor.
 - **Off** – the electric heating contactor contact is open.
 - **On** – the electric heating contactor contact is closed.
- .
- **ContactorOn (No/Yes)** – applies only to modulated electric heaters and allows the contactor to remain switched on for the entire duration of heating mode even when the modulation signal is zero. The purpose is to reduce contactor wear.

- **MaxOutput (100%)** – here the maximum output of the electric heater can be limited. This function is mostly used with reduced fan output, when the electric heat exchanger overheats.
- **PID-Control** – the standard factory-set values are: **TI = 120s, KP = 6, TD = 0s.**
- **SummerOperation (Block/Allow)** – allows the electric heating to be switched off in the summer period, thereby reducing the energy consumption of the equipment.
- **FilterClogged (Block/Allow)** – allows operation of the electric heating to be blocked when the supply air filter is clogged, to prevent shutdown by the safety thermostat due to insufficient supply air.

6.10 Gas heating

The gas heating burner is controlled based on the selected mode and the required temperature in conjunction with the temperature sensors and the burner bypass damper, if installed. Monzun burner modules from Mandík a.s. or burner modules with burners from other manufacturers may be installed. Burners may be single-stage, two-stage or modulating. The maximum value of 100% of a modulating burner corresponds to the maximum output of the heat exchanger in kW according to the documentation. The minimum value of the actual output is set during burner commissioning and corresponds to the minimum output of 0%. In normal operation, the burner switches on only if the fans are running. Burner operation is indicated by a pilot light on the control cabinet. In transitional periods (spring and autumn), the number of starts may be higher than in winter. However, excessively frequent burner starts may indicate incorrect operation of the entire air handling unit.

Protective functions are provided by a safety thermostat and a flue gas temperature sensor. The flue gas temperature sensor acts as an operating thermostat set to 200 °C. When this flue gas temperature is reached, the burner is switched off while the fans keep running. After cooling below 80 °C, the burner switches on again unless another fault has occurred. The safety thermostat is located downstream of the gas heat exchanger and permanently set to 90 °C. If this temperature is exceeded, the safety thermostat switches off the burner power supply and operator intervention (thermostat reset) is required; the operator should investigate the cause of this condition. Switching off the control system power supply while the gas heating is in operation will cause it to overheat!

In the event of a gas heating fault, the fan speed may be reduced after the exchanger has cooled down if the parameter **UnitComponents → Fans → HeatingFault = Compensation** is set. This state is signalled as **AuxiliaryMode – SpeedCompensation** on the controller display in the main menu.

- **Status** – displays information on the operation of the gas heating.
 - **SupplyTemp** – the supply air temperature is higher than the maximum permitted duct temperature set in UnitComponents → TemperatureControl → MaxSupply.
 - **FlueGasTemp** – the flue gas temperature is higher than the maximum permitted flue gas temperature FlueGasMax.
 - **NoHeat** – heating may be blocked by the temperature season.
- **Burner** – displays information on the contact controlling the heating.
 - **Off** – the gas heating contact is open.
 - **On** – the gas heating contact is closed.
- **FlueGasMax (200 °C)** – emergency flue gas temperature limit. When it is reached, the burner is switched off and a fault is signalled.
- **FlueGasMin (80 °C)** – when the flue gas temperature drops below this value, the fan is allowed to switch off.
- **ValveTime (40s)** – time in which the burner valve actuator can move the valve from 0% to 100%. This value is needed for correct three-point control of the actuator.
- **MaxOutput (100%)** – here the maximum output of the gas heater can be limited. This function is mostly used with reduced fan output, when the gas heat exchanger may overheat.
- **OutputChange (30s)** – the control output is sent to the gas heating automatic controls at intervals, which allows rapid changes in output demand to be filtered.
- **PID-Control** – the standard factory-set values are: **TI = 60s, KP = 5, TD = 0s**.
- **PID-FlueGas** – contains values that determine the quality and speed of the gas heating output limitation control based on the actual and maximum flue gas temperature. The standard factory-set values are: **TI = 60s, KP = 5, TD = 0s**.
- **SummerOperation (Block/Allow)** – allows the electric heating to be switched off in the summer period, thereby reducing the energy consumption of the equipment.
- **FilterClogged (Block/Allow)** – allows operation of the gas heating to be blocked when the supply air filter is clogged, to prevent shutdown by the safety thermostat due to insufficient supply air.

- **ExchangerDamper** – is controlled based on the flue gas temperature or pressure so that optimum combustion is achieved in normal operation. A further function of the bypass damper is to ensure minimum condensation of water vapour in the heat exchanger during a cold start.
 - **Setpoint (140°C)** – required flue gas temperature to which the damper position is controlled. Control to this value starts to apply only once the flue gas temperature has reached 40 °C below the setpoint, so that the heat exchanger can warm up as quickly as possible. If the flue gas temperature is higher than **FlueGasMax**, the exchanger damper is closed so that the heat exchanger cools down.
 - **Setpoint (300Pa)** – required pressure across the flue gas heat exchanger to which the damper position is controlled. The purpose is to pass such a quantity of air through the heat exchanger that optimum heat transfer takes place. The value should correspond to the value in the technical specification of the air handling unit.
 - **PID-Damper** – contains values that determine the quality and speed of the gas heating bypass damper position control based on the pressure or flue gas temperature. PID control is not applied at flue gas temperatures below 80 °C (damper open to 100%). The standard factory-set values are: **TI = 60s, KP = 2, TD = 0s**.
- **Convector (Off/On)** – a device that ensures suitable thermal conditions for burner ignition and protects it against freezing. If no outdoor temperature sensor is installed, the flue gas temperature sensor, which is placed at the base of the chimney outdoors, is used for protection. In practice it is a 230V socket controlled by the controller, located in the burner electronics compartment. An electric radiator or heating cable can be connected to the socket. This protection will not work when the power supply to the control cabinet or controller is switched off! It is used mainly for outdoor versions of air handling units.
 - **SwitchOn (4 °C)** – determines the conditions under which the burner cabinet is to be temperature-maintained. The first condition is a drop in the outdoor temperature or flue gas temperature below the set limit value. The second condition is set according to:
 - **BurnerOn** – the convector switches on only when the gas heating is on and the outdoor temperature is low.
 - **Always** – the convector always switches on at low temperature, regardless of the gas heating status.
 - **BurnerOff** – the convector switches on only when the gas heating is off and the outdoor temperature is low.

- **Delay (10min)** – convector switch-on and switch-off delay parameter.

6.11 Water cooling

Water cooling is controlled based on the selected mode and the required temperature in conjunction with the temperature sensors. As standard, qualitative control with a three-way valve and an electric water pump is used.

In the event of a water cooling fault, the fan speed may be reduced according to the setting of the parameter **UnitComponents** → **Fans** → **CoolingFault = Compensation**. This state is signalled as **AuxiliaryMode – SpeedCompensation** on the controller display in the main menu.

- **Status** – displays information on the operation of the water cooling.
 - **NoCool** – cooling is blocked by the temperature season.
- **Pump** – displays information on the contact controlling the cooling pump.
 - **Off** – the water cooling pump contact is open.
 - **On** – the water cooling pump contact is closed.
- **PID-Control** – the standard factory-set values are: **TI = 150s, KP = 8, TD = 0s**.
- **ChilledWaterFlow (°C)** – current chilled water temperature upstream of the exchanger.
- **ChilledWaterReturn (°C)** – current chilled water temperature downstream of the exchanger.
- **WinterOperation (Block/Allow)** – allows the water cooling to be switched off in the winter period, thereby reducing the energy consumption of the equipment.

6.12 Condensing units

There are many manufacturers of external cooling equipment that can be used with air handling units. Almost every manufacturer of chillers or condensing units has its own control method. This results in great fragmentation in the way chillers and condensing units are controlled, and it is sometimes very difficult to coordinate the control of the air handling unit and the condensing unit. It is therefore possible to select the condensing unit (chiller) control type according to the specific control methods of individual manufacturers, which are continuously being added. Condensing unit control is prepared for controlling 6 separate units. The condensing units alternate cyclically after each switch-on of heating or cooling.

In the event of a fault or defrosting of the condensing unit, the fan speed may be reduced owing to the drop in supply air temperature, so that the required supply air temperature is achieved. A prerequisite is that compensation for these states is set in the menu **UnitComponents** → **Fans**. This state is signalled on the controller display in the main menu as **AuxiliaryMode – SpeedCompensation**.

- **Unit** – displays information on the operation of the condensing unit.
 - **Humidity** – the condensing unit assists with dehumidification.
 - **OutdoorTemp** – condensing unit operation is blocked by the outdoor temperature limits **MinOutdoorCool** and **MinOutdoorHeat**.
 - **NoCool** – cooling by the condensing unit is blocked in the winter period (**BlockSummerWinter** = Yes).
 - **NoHeat** – heating by the condensing unit is blocked in the summer period (**BlockSummerWinter** = Yes).
 - **Defrost** – the condensing unit is defrosting.
- **Compressor (Off/On)** – current demand for the condensing unit compressor.
- **ControlTemperature (Room/Extract/Supply/Preheat)** – selects the temperature used for temperature control, on the basis of which the required heating or cooling output is calculated.
- **MinOutput (1%)** – minimum output for switching on the condensing unit. For Mitsubishi units with PAC_IF control, this value must be set to 18%.
- **MaxOutput (100%)** – limitation of the maximum output of the condensing unit. This function can be used, for example, with oversized output or with special condensing unit control modules.
- **Ready (1.5V)** – intended for Mitsubishi units with PAC_IF control. At this control voltage value, the condensing unit is in standby mode and has zero output.
- **ReadyOff (10min)** – intended for Mitsubishi units with PAC_IF control. Defines the time for which the condensing unit remains in standby mode before switching off completely.
- **MinOutdoorCool (10 °C)** – minimum outdoor air temperature at which the condensing unit can still cool effectively. This parameter is usually stated by the manufacturer in the condensing unit documentation.
- **MinOutdoorHeat (-30 °C)** – minimum outdoor air temperature at which the condensing unit can still heat effectively. This parameter is usually stated by the manufacturer in the condensing unit documentation.

- **BlockSummerWinter (No/Yes)** – this parameter blocks heating by the condensing unit in the summer period and cooling by the condensing unit in the winter period. The current temperature season is specified in **TemperatureControl**.
- **OffDelay (Normal/HeatRec)** – this parameter allows the condensing unit to switch off only after the heat recovery has switched off.
- **OutputChange (30s)** – condensing units from some manufacturers require output changes no more than once per time interval.
- **OnOffDelay (60s)** – the switch-on and switch-off delay of each condensing unit prevents excessively frequent switching on of the condensing unit compressor. In combination with the minimum output required for switch-on **SwitchOnOutput**, the number of condensing unit starts in transitional periods is reduced. The maximum number of condensing unit starts is 6 starts per hour.
- **FDP3-CoolOn (6.25V)** – applies to condensing units whose states are controlled by a constant voltage level of a DC signal 0–10V (**ControlType=FDP3**). Enter the voltage according to the technical specification at which the cooling mode of the condensing unit is switched on.
- **FDP3-VentilateOn (4.75V)** – applies to condensing units whose states are controlled by a constant voltage level of a DC signal 0–10V (**ControlType=FDP3**). Enter the voltage according to the technical specification at which the ventilation mode of the condensing unit is switched on.
- **FDP3-HeatOn (3.25V)** – applies to condensing units whose states are controlled by a constant voltage level of a DC signal 0–10V (**ControlType=FDP3**). Enter the voltage according to the technical specification at which the heating mode of the condensing unit is switched on.
- **PID-Control** – the standard factory-set values are: TI = 300s, KP = 5, TD = 0s.
- **Cool, Heat (Normal/Invert)** – allow the condensing unit output control signals to be inverted.
 - **Normal** – output signal 0% = 0V, 100% = 10V.
 - **Invert** – output signal 0% = 10V, 100% = 0V.
- **ControlModuleEKE** – applies to condensing units with EKE control. Up to 8 points of the condensing unit output curve corresponding to the difference between the setpoint and the actual temperature can be set.
- **ControlModuleFDP3** – applies to condensing units with FDP3 control. Up to 16 points of the condensing unit output curve corresponding to the required temperature can be set.

6.13 Heat pump

The heat pump is an integral part of the Mandík air handling unit, if fitted. The heat pump circuit with heating and cooling function may be single-circuit or dual-circuit. It consists of a heat exchanger, compressors, electronic expansion valves, pressure sensors, temperature sensors and an autonomous EVD expansion valve controller from Carel. A detailed description of the EVD controller settings, including commissioning, is given in a separate manual supplied by the manufacturer, Carel. Setting up and commissioning the heat pump is usually part of the air handling unit manufacturer's scope of supply. The heat pumps (circuits) alternate cyclically after each switch-on of heating or cooling. The number in front of the item name identifies the first or second heat pump (circuit):

- **Circuit** – displays information on the operation of the heat pump.
 - **Humidity** – the heat pump assists with dehumidification.
 - **NoCool** – the heat pump is not cooling because the operating conditions are not met.
 - **NoHeat** – the heat pump is not heating because the operating conditions are not met.
 - **Defrost** – the heat pump is defrosting.
- **Compressor (%)** – current heating or cooling output of the heat pump.
- **SwitchOnOutput (10%)** – minimum output required to switch on the circuit or compressor.
- **MaxOutput (100%)** – here the maximum output of both heat pump circuits can be limited.
- **OffDelay (60s)** – compressor switch-off delay after reaching zero output.
- **NextStart (600s)** – time between switching off and the next switching on of each heat pump circuit or compressor. It prevents excessively frequent switching on and off of the compressors. The recommended maximum number of compressor starts is approximately 6 per hour.
- **TimeRemaining (s)** – displays the time remaining until the next possible switch-on of the circuit.
- **BlockSummerWinter (No/Yes)** – this parameter blocks heating in the summer period and cooling in the winter period. The current temperature season is specified in **TemperatureControl**.
- **PID-Control** – the standard factory-set values are: **TI = 240s**, **KP = 2**, **TD = 0s**.
- **ForcedDefrost (No/Yes)** – enables forced periodic defrosting based on the outdoor temperature.
 - **OutdoorTemperature (5°C)** – when the outdoor temperature drops below this value, automatic defrosting is enabled.

- **Period (300min)** – activation cycle if spontaneous defrosting has not occurred.
- **Duration (10min)** – duration of one cycle.
- **OutputCompensation** – compensation of the heat pump or fan output to ensure proper operation of the heat pump.
 - **HeatPump** – the maximum permitted heat pump output changes linearly between the fan speed limit values **MinFans** and **MaxFan**.
 - **MinFans (90%)** – if the current fan speed drops below this value, the maximum permitted heat pump output drops to 0% and the heat pump switches off.
 - **MaxFans (100%)** – at this speed the heat pump can reach the preset maximum output **MaxOutput**.
 - **Fan** – when the heat pump switches on, the fan speed increases to the values set for heat pump operation in the **Fans** menu.
- **AntiFrostProtection** – protection of the heat pump against icing is provided by a pressure switch with a digital or analogue output, monitoring the air pressure upstream and downstream of the exchanger on the extract air side. When the exchanger ices up, the heat pump control may change. At the same time, the fan speed may be adjusted according to the setting of the parameter **UnitComponents** → **Fans** → **Defrost** = “**Compensation**”. The heat recovery exchanger icing protection parameters are:
 - **Pressure (Pa)** – current pressure of the pressure switch with analogue output.
 - **Max (Pa)** – pressure value above which the heat pump frost protection is activated.
 - **ControlType (Reversal)** – defines the behaviour of the heat pump when icing occurs:
 - **Reversal** – switches heating mode to cooling mode.
 - **No** – keeps heating mode and expects defrosting by fan speed compensation.
 - **HeatRecovery (Off)** – defines the behaviour of the heat recovery exchanger when icing occurs:
 - **Off** – the heat recovery exchanger switches off when the heat pump ices up.
 - **On** – the heat recovery exchanger remains on when icing occurs, unless it was already switched off previously.
- **DigitalCompressor** – defines the parameters for a heat pump with a digital compressor:
 - **Start (10s)** – time for which the digital compressor output will be 100% at start-up. Minimum value

- **MinOutput (25%)** – minimum output of the digital compressor. If Start100% = 0s, this value is not applied.
- **PWM (20s)** – pulse-width modulation period for controlling the digital compressor.
- **Modbus** – if **1-MB** or **2-MB** is selected in the heat pump configuration, selecting this item displays the operating values of the EVD drivers controlling the expansion valves:
 - **EVD-Driver** – the displayed values are used to check the operation of the heat pump circuits:
 - **ValveOpening (%)** – current opening of the expansion valve.
 - **EvaporatingPressure (Bar)** – current evaporating pressure.
 - **EvaporatingTemperature (°C)** – current evaporating temperature.
 - **Superheat (K)** – current superheat temperature.
 - **SuctionTemperature (°C)** – current suction temperature.
 - **AlarmsEVD** – summary value of the alarms from the EVD.

6.14 Humidifier

The humidifier is used to achieve the required air humidity by means of steam generators. Depending on the type used, the steam generators can be controlled continuously or in steps. The start conditions and the required humidifier output are calculated in **HumidityControl**. If the humidity control enters the **Low** humidity state, the humidifier output is controlled by the **PID-Control**, based on the required and actual humidity.

- **Status** – displays information on humidifier operation.
 - **Humidity** – the humidifier is on.
- **SwitchOnOutput (10%)** – minimum output required to switch the humidifier on.
- **OffDelay (10s)** – time for which the required humidifier output must be 0% before the humidifier can be switched off.

6.15 Filters

This item contains information on the status of all monitored filters. A filter is monitored by one or two differential pressure switches or by one pressure sensor with a 0–10V analogue output. If the unit is fitted with several filters, each filter should be monitored separately.

The pressure sensor setting is specified in the technical report for each air handling unit. Filter status signalling is divided into two selectable levels. At the first level, **Dirty**, filter clogging is only signalled; at the second level, **Clogged**, the unit is switched off. If the filter is in poor condition, it is recommended to replace it, otherwise the filter may rupture or the pressure conditions may change.

Status and operating information is listed for each filter:

- **Filter.....** – indication of the filter status and of any fault of the analogue pressure sensor.
 - **Clean** – the filter is clean.
 - **Dirty** – the filter is dirty, the air handling unit remains in operation and a message is displayed in the alarm messages. After the filter has been replaced, the message in the alarm messages must be acknowledged.
 - **Clogged** – the filter is very dirty, the air handling unit has switched off automatically and a message is displayed in the alarm messages. After the filter has been replaced, the message in the alarm messages must be acknowledged.
 - **Sensor** – a fault of the analogue air pressure sensor has occurred, if configured.
 - **Pressure (Pa)** – current pressure across the filter, if monitored by an analogue pressure sensor.
 - **BadHours (0)** – indicates how long the air handling unit has been operated with a contaminated filter in the **Dirty** or **Clogged** state.
- **AlarmSettings:**
 - **Filter (Dirty/Clogged)** – this setting applies only when filter clogging is monitored by a pressure sensor with an output contact, i.e. a differential pressure switch, which signals only two filter states, Clean or Dirty (Clogged). It determines the behaviour of the air handling unit when the filter is no longer Clean.
 - **Dirty (200Pa)** – specifies the pressure limit at which an alarm message on filter clogging is displayed and the air handling unit continues in operation. It can be set only when filter clogging is monitored by a pressure gauge with a 0–10V analogue output.
 - **Clogged (300Pa)** – specifies the pressure limit at which an alarm message on filter clogging is displayed and the air handling unit is switched off. It can be set only when filter clogging is monitored by a pressure gauge with a 0–10V analogue output.
 - **Delay (60s, 0s)** – delay on alarm activation and clearance.

6.16 Air quality

Air quality is a parameter that can influence the fan output and the position of the mixing (recirculation) damper. Air quality can be monitored by sensors with a digital output or by sensors with 0–10V analogue outputs. This chapter deals with air quality control by changing the amount of fresh air supplied.

- **Quality (Good/Poor)** – current air quality status relative to the setpoint set directly on the air quality sensor.
 - **Current (ppm)** – current air pollution level.
 - **BadHours** – indicates the operating time during which the air quality was evaluated as poor.
- **Required (800ppm)** – air quality limit value, if measured by a sensor or sensors with an analogue output. At this value, signalling of poor air quality ends. The fan speeds and mixing return to their original values.
- **Comfort (900ppm), Economy (1000ppm)** – required air quality in **Comfort** or **Economy** mode, if measured by a sensor with an analogue output and the setpoint is not entered from the room unit.
- **SupplyFan (100%), ExtractFan (100%)** – enables control of the supply fan speed according to air quality and sets the fan speed when air quality is poor. The standard fan speed values for the modes (**Comfort, Economy**) should be lower than these values.
- **FreshAir (100%)** – enables mixing control according to air quality and sets the mixing level when air quality is poor. The standard mixing values for the modes (**Comfort, Economy**) should be lower than this value. In the **FrostProtection, Freecooling** operating modes, the damper setting is accepted only if the fan speed value is non-zero.
- **Validity** – the system will respond to a change in air quality status only if the unit is not in the **Off** state. The **Validity** option has the following settings:
 - **No** – the system will not respond.
 - **Mode** – the system will respond only if the air handling unit is in **Comfort** or **Economy** mode.
 - **Comfort** – the system will respond only if the air handling unit is in **Comfort** mode.
 - **Economy** – the system will respond only if the air handling unit is in **Economy** mode.
 - **Always** – the system will always respond when the air handling unit is not in the **Off** state, i.e. when the unit is in **Standby, Comfort** or **Economy** mode.

- **Standby** – the system will respond only if the air handling unit is in **Standby** mode.
 - **StandbyEconomy** – the system will respond only if the air handling unit is in **Standby** mode.
The fan output and the amount of fresh air will correspond to **Economy** mode.
 - **StandbyComfort** – the system will respond only if the air handling unit is in **Standby** mode.
The fan output and the amount of fresh air will correspond to **Comfort** mode.
- **Enable** – enables ventilation in the event of poor air quality and specifies how ventilation will be performed.
- **No** – the system will not respond to poor air quality.
 - **Fan** – only a higher fan output will be used for ventilation, without changing the amount of fresh air.
 - **FreshAir** – only damper mixing will be used for ventilation, without changing the fan output.
 - **Both** – both of the above options will be used for ventilation.
- **1Sensor, 2Sensor, 3 sensor (ppm)** – current air quality at the individual sensors.
- MultipleSensors (Average/Max/Min/1/2/3)** – with several sensors, determines how the final air quality value is calculated or assigned. With option 1 or 2, the value is given only by the selected sensor and the other sensors are for information only. With the other options, the resulting value is calculated as the arithmetic mean, maximum or minimum.

6.17 Flow controllers

These are variable air volume (VAV) controllers designed to regulate a variable airflow in the ductwork, resulting in more economical operation of the air handling system. Each controller is equipped with a pressure probe in the airflow and an actuator. Each flow controller has its own assigned room sensor for temperature, humidity and air quality. The operation of the individual airflow controllers can be controlled according to the following parameters:

- **FlowController (%)** – current airflow setpoint.
- **RegulationType** – selects the control method of the airflow controller.
- **Mode** – in **Comfort** mode, the controller will be controlled to the **High** flow value. In **Economy** mode it will be controlled to the **Low** value.
 - **AirQual** – if the required air quality is exceeded, the controller will be controlled to the **High** flow value. Otherwise it will be controlled to the **Low** value.

- **Heat** – if, in the **Heat** state, the supply air temperature is higher than the required temperature, the controller will be controlled to the flow value. Otherwise it will be controlled to the **Low** value.
 - **Cool** – if, in the **Cool** state, the supply air temperature is lower than the required temperature, the controller will be controlled to the **High** flow value. Otherwise it will be controlled to the **Low** value.
 - **Humidity** – if the required room air humidity is exceeded, the controller will be controlled to the **High** flow value. Otherwise it will be controlled to the **Low** value.
 - **Contact** – when the relevant contact is closed, the controller will be controlled to the **High** flow value. Otherwise it will be controlled to the **Low** value.
 - **Fixed (%)** – the controller will be permanently controlled to the **Fixed** value.
 - **TempControl** – the controller will be continuously controlled by PID control based on the difference between the required temperature and the room temperature, within the limits **High** and **Low**.
 - **HumControl** – the controller will be continuously controlled by PID control based on the difference between the required humidity and the room humidity, within the limits **High** and **Low**.
- **Fixed, High, Low (%)** – user-adjustable values for control according to the regulation type.
- **Control-Settings** – setting of the PID control parameters for each controller separately. Applies only when the control type **TempControl** or **HumControl** is selected.

6.18 Fire/Smoke

The Fire/Smoke function allows the air handling unit to be shut down in the event of a fire signal from the fire alarm control panel or a signal from a smoke or fire detector. A closed contact from the fire alarm control panel and from the smoke or fire detectors is expected at the controller inputs. An open contact is signalled by an alarm message, **Fire** or **Smoke**, which immediately switches off the air handling unit. This item is accessible only after service login.

- **FireAlarm (Fire/OK)** – information on the status of the fire alarm control panel or of the fire detector located in the duct or in the room.
- **Smoke, 2Smoke (Smoke/OK)** – information on the status of up to two smoke detectors located in the duct or in the room.

- **NumberOfActivations** – information value showing the number of fire or smoke detections.

6.19 Fire dampers

Fire dampers are fitted with two limit switches which, when closed, signal the end positions of the dampers; the dampers can be operated by actuators or manually. Based on the state of these contacts, the control system monitors the status of the fire dampers and decides on the operation of the air handling unit. The dampers can also be monitored by means of a THC24-B electronic relay. In the standard configuration, up to 32 fire dampers can be monitored.

The monitoring method and the fire damper type are determined in the configuration. For motorised dampers, the open position contact is monitored during both unit start-up and operation. At unit start-up the damper must be closed (contact open) and after the **Opening** time has elapsed the damper must be open (contact closed).

➤ **FireDampers** – global information on the start screen about the status of the fire dampers:

- **Ready** – the air handling unit is switched off.
- **OK** – the unit is switched on and all fire dampers are open.
- **Start** – the air handling unit is starting and the dampers are in an undefined position.

If, during unit operation, the contact signalling an open damper opens at any fire damper (the damper is closing), the air handling unit is immediately switched off and a fault of that particular fire damper is signalled.

➤ **FireDamper** – information on the fire damper position.

- **Undefined** – the damper is currently moving between the open and closed end positions.
- **Closed** – the damper is in the closed position.
- **Open** – the damper is in the open position.

➤ **Opening (130s)** – time taken for a motorised fire damper to move from the closed to the open position. Applies only to the configuration options **Mot1k** and **Mot2k**.

➤ **ModeOff** – determines the damper position when the air handling unit is switched off. Applies only to the configuration options **Mot2k** and **THC**.

- **Open** – when the air handling unit is switched off, the power supply to the damper actuators is not disconnected and the dampers remain open.
- **Close** – when the air handling unit is switched off, the power supply to the damper actuators is disconnected and the dampers close.

6.20 Night ventilation (Freecooling)

Freecooling is used for free ventilation of the room and for lowering its temperature, using the cool outdoor air. It is used mainly at night. Freecooling can be started by its own time schedule, by an external contact or manually from the controller display. For freecooling to work correctly, the outdoor, supply and room temperature sensors must be configured. Freecooling can be started automatically only if the air handling unit is in **Standby** mode and the necessary temperature conditions are met!

- **Status** – indicates the status and any reason preventing freecooling from starting.
 - **MinOutdoor** – freecooling is blocked because the outdoor temperature is lower than **MinOutdoor**.
 - **MaxOutdoor** – freecooling is blocked because the outdoor temperature is higher than the room temperature minus **Offset**.
 - **MinSupply** – freecooling is blocked if the air handling unit includes water heating and the supply temperature is lower than 7 °C.
 - **On** – freecooling is active.
- **Required (18 °C)** – required room temperature. If the room temperature is higher, freecooling is enabled.
- **Offset (5 °C)** – the outdoor temperature must be lower than the room temperature by at least this value for freecooling to be enabled.
- **MinOutdoor (10 °C)** – minimum outdoor temperature at which freecooling is no longer enabled, as the room could be overcooled. At this temperature freecooling is switched off immediately, regardless of **MinOn**.
- **MinOn (30min)** – freecooling ends when the room temperature falls below the setpoint, provided that the set time has also elapsed.
- **ControlledBy (No/ Contact/Manual/ TimeSched)** – indicates how freecooling is currently switched on.
- **TemperatureCondition (No/Yes)** – defines the start of freecooling depending on the outdoor temperature.
 - **No** – allows freecooling to be switched on without meeting the outdoor temperature conditions.

- **Yes** – allows freecooling to be switched on only when the necessary outdoor temperature conditions are met.
- **Manual (Off/On)** – manual switching on of freecooling.
- **TimeSchedule** – the freecooling time schedule for the individual days of the whole week is valid only if **Standby** mode is selected manually or from the mode time schedule. Each day contains six daily time points for selecting the freecooling state. A daily time point is entered by specifying the start time in the format **hh:mm:ss** and the mode itself (**Off/On**).

6.21 Boiler room

The **Boiler room** item contributes to better water heating performance and can eliminate shortcomings of the boiler room system. It allows the heating water from the boiler room to be preheated to the required value in advance, before the air handling unit fans are started. There are many options for switching on the boiler room, and they can be combined with each other according to the specific conditions of each installation. Only the basic options are given here; others can be added to the software based on requirements during installation of the air handling unit.

- **Status (Off/On)** – current status of the boiler room switch-on request.
- **WaterHeating** – switching on the boiler room based on water heating being switched on:
 - **No** – the boiler room switch-on request is not activated.
 - **Winter** – the boiler room request is activated in the winter season (**TemperatureControl** → **TemperatureSeason**) when a request to switch on water heating arises.
 - **Always** – the boiler room request is activated when a request to switch on water heating arises.
- **LowWaterTemperature (No/Yes)** – if **Yes** is selected, the boiler room switch-on request is activated when the heating water return temperature is low. The low return water temperature signalling value is set in the **WaterHeating** item.
- **LowOutdoor (5 °C; No)** – switching on the boiler room based on the outdoor air temperature:
 - **No** – the boiler room switch-on request is not activated.
 - **Winter** – the boiler room request is activated in the winter season (**TemperatureControl** → **TemperatureSeason**) if the outdoor temperature is lower than 5 °C.
 - **Heat** – the boiler room request is activated if there is a request to switch on water heating and at the same time the outdoor temperature is lower than 5 °C.

- **Always** – activates the boiler room request if the outdoor temperature is lower than 5 °C.
- **Difference (50 °C; No)** – switching on the boiler room based on the difference between the setpoint and the outdoor temperature:
 - **No** – the boiler room switch-on request is not activated.
 - **Winter** – the boiler room request is activated in the winter season (**TemperatureControl** → **TemperatureSeason**) if the difference between the outdoor temperature and the setpoint is greater than 50 °C.
 - **Heat** – the boiler room request is activated if there is a request to switch on water heating and at the same time the difference between the outdoor temperature and the setpoint is greater than 50 °C.
 - **Always** – activates the boiler room request if the difference between the outdoor temperature and the setpoint is greater than 50 °C.
- **CondUnit (70%; No)** – relevant in cases where water heating is switched on after the condensing unit reaches 100% output. The options for switching on the boiler room based on the condensing unit output are:
 - **No** – the boiler room switch-on request is not activated.
 - **Winter** – the boiler room request is activated in the winter season (**TemperatureControl** → **TemperatureSeason**) and the condensing unit output has exceeded 70%.
 - **Always** – activates the boiler room request if the condensing unit output has exceeded 70%.
- **FanDelay (No; 3min)** – the delay of the fan switch-on request (unit start) after the boiler room switch-on request arises has three options:
 - **No** – there is no delay of the fan switch-on request at unit start.
 - **Winter** – the fan switch-on request at unit start is delayed in the winter season (**TemperatureControl** → **TemperatureSeason**) when there is a simultaneous request to switch on water heating.
 - **Always** – the fan switch-on request at unit start is delayed when a request to switch on water heating arises.
- **BoilerRoomDelay (3min)** – delay in switching on the boiler room after any of the requests is received.

6.22 Other

The **Other** item contains miscellaneous parameters for the external mode switches defined in **Configuration** → **ModeSwitches** and for service signalling.

- **ModeEnable** – specifies the permitted operating states of the unit:
 - **All** – unit operation is not restricted in any way.
 - **Heat+** – the unit only heats, and ventilates instead of cooling.
 - **Cool+** – the unit only cools, and ventilates instead of heating.
 - **Heat** – the unit only heats. Otherwise it is switched off.
 - **Cool** – the unit only cools. Otherwise it is switched off.
 - **Season** – the unit cools in the summer season and heats in the winter season.
 - **Ventilate** – the unit only ventilates.
 - **HeatRecovery (No/Heat/Cool/Always)** – specifies the behaviour of heat recovery if **ModeEnable** is not set to **All**.
- **ExternalSwitches (Off/On)** – disables or enables the function of the external mode switches.
 - **StateOFF** – defines the unit switch-off state when the modes are controlled by external switches:
 - **Off** – if none of the modes is selected by the external switches, the unit is set to Off mode.
 - **Standby** – if none of the modes is selected by the external switches, the unit is set to **Standby mode**.
 - **SwitchType** – defines the type of the connected external mode switch:
 - **Contact** – the controller accepts a permanently closed contact to switch on the required mode and a permanently open contact to switch the mode off.
 - **Button** – the controller accepts a short closure of the control contact (pulse) to switch the required mode on or off.
- **QMX3-Off (Off/ Standby)** – determines the mode to which the unit switches when switched off from a QMX3 series room unit.
- **PresenceButton (60min)** – determines the running time of the air handling unit in Comfort mode after the presence button is pressed, unless the unit is switched off earlier by pressing the button again.
- **Service** – defines the service message period and its signalling:

- **NextService** (*Select/PerYear/Per6Months/Per3Months/PerMonth*) – used to signal the need for a regular service inspection of the air handling unit. After one of the time options has been selected, the next line shows the corresponding date on which the warning alarm message **Service** will be displayed. Service can also be signalled on a digital output of the controller. A necessary condition is that the internal time of the controller corresponds to real time.
- **LightService** – defines the function of the **Service** digital output, which can be used to control a signal light:
 - **Lit** – when service is signalled, the Service digital output will be permanently closed.
 - **Flashing** – when service is signalled, the Service digital output will switch with a period of 5s.
- **LightFault** – defines the function of the fault digital output **A**, which can be used to control a signal light:
 - **Lit** – when a fault is signalled, fault digital output **A** will be permanently closed and will not distinguish between an acknowledged and a newly occurred fault.
 - **Flashing** – when a fault is signalled, fault digital output **A** will switch with a period of 1s and will not distinguish between an acknowledged and a newly occurred fault.
 - **Both** – fault digital output **A** will behave in the same way as the fault signalling on the display or the HMI controller. In the case of a newly occurred fault, the digital output will switch with a period of 1s. In the case of an acknowledged fault, the digital output will be permanently closed.
- **PaymentDue** – this function allows the unit to be shut down automatically if an invoice has not been paid by the agreed due date. Detailed instructions are given in the separate manual “Invoice Due Date Monitoring”.
 - **NumberOfDays** – enter the number of days until the invoice due date, after which the unit will be shut down. In the factory setting, NumberOfDays is zero and the invoice due date is not monitored.
 - **DaysRemaining** – shows the number of days until the unit is shut down due to non-payment of the invoice.

7 Energy balance

This function qualifies the energy efficiency of the air handling unit by monitoring the current specific fan power SFP, electrical energy consumption, consumption of other energy sources and recovered energy. These values are archived in cloud storage and can subsequently be summarised and viewed for selected periods. The function is described in the relevant documentation on the Mandík a.s. website.

8 Time schedule

The air handling unit will be operated according to the time schedule only if the start screen is set to **ModeSelection = "TimeSchedule"** and the controller time corresponds to real time. When entering the unit start time, it is advisable to switch the unit on approx. 20 minutes before people start to occupy the room. The reason is to allow the supply air temperature to stabilise, especially at very low or high outdoor air temperatures.

The time schedule item displays the individual days of the week with six time points for each day:

- **Current day** – for each day it is shown whether that day of the week is active (**Passive/Active**) and the status of the air handling unit if the day is active (**Off/ Standby /Economy/Comfort**).
- **Time point entry** – each day contains six time points for selecting the air handling unit status; each entry consists of the time in the format **hh:mm:ss** (hour:minute:second) and the mode itself (**Off/ Standby /Economy/Comfort**) to which the unit switches at that time. A time entry is considered invalid if it is set to 24 hours, 60 minutes or 60 seconds (24:60:60).
- **OffSchedule (Off/ Standby /Economy/Comfort)** – this item defines the mode in which the air handling unit will be if the time points for the current day are not sufficiently defined:
 - not a single valid time point is defined for the current day.
 - the first time point of the current day is not defined from the start of the day (00:00:00). The air handling unit will be in the mode set in **OffSchedule** until the first valid time point.

9 Application information

The **ApplicationInfo** menu displays the following information on individual lines:

- **Unit** – name of the unit
- **Order** – order number or other identification
- **Firmware** – version of the software used and the date this version was created
- **ServiceDepartment** – telephone and e-mail contact for the service department
- **Web** – company website address
- **NextService** – date of the next service, if this function is set

10 Configuration

The configuration item defines the components of the air handling unit that are to be controlled by the control system. The basic configuration is performed at the factory or when components are subsequently changed, and should be carried out by an authorised person. It determines the functions of the unit and, consequently, the control method. Incorrect settings may result in damage to the equipment or a breach of occupational safety rules. The configuration is accessible only after service login. The option **No** means that the item is not included in the unit or that its function is not to be monitored. The option **Yes** means that the item is included in the unit once. A number instead of **Yes** indicates the number of components that may be fitted. Non-standard item options are described separately.

- **TemperatureSetpoint** (-----/Supply/Room/Extract/Preheat/Exhaust) – selects the temperature that is compared with the required temperature for the selected mode. If the supply temperature or the preheat temperature is selected, direct control is applied and the required heating or cooling output is calculated directly from the difference between the setpoint and the selected temperature. The cascade control function applies only if the room temperature, extract air temperature or exhaust air temperature is selected. Based on the difference between the setpoint and the selected temperature, the supply air temperature setpoint is calculated, and the required heating or cooling output is calculated from the difference between the supply setpoint and the actual supply temperature, so that the selected required temperature is reached optimally.
- **RoomUnit** – defines the external room unit or controller with communication used to operate the air handling unit. The communication parameters for the individual controllers are set automatically in the controller to preset values:

- **POL822** – a Siemens room unit with an integrated temperature sensor and ProcessBus communication.
 - **OP41tepl** – an Amit controller with Modbus communication, where the rotary knob is used to control the required temperature.
 - **OP41vent** – an Amit controller with Modbus communication, where the rotary knob is used to control the fan speed.
 - **OP70** – an Amit touch controller with Modbus communication and an internal temperature sensor.
 - **QMX3** – a range of Siemens controllers with KNX communication and programmable button and LED functions.
 - **QMX1** – a simple Siemens controller with Modbus communication and an LCD display.
 - **POL824** – *a comfort room controller with an LCD touch display and Modbus communication. Integrated temperature and relative humidity sensors.*
- **RoomTemperature** – up to 3 room temperature sensors can be used to measure the room temperature.
- **SupplyTemperature** – a temperature sensor can be selected for measuring the supply air temperature according to the purpose of the measurement:
- **Supply** – the sensor is intended to measure the temperature of the air supplied to the room.
 - **Preheat** – the sensor is intended to measure the temperature downstream of any preheater and is usually located upstream of the reheat and supply sensors.
 - **Reheat** – the sensor is intended to measure the temperature downstream of any reheater and is usually located between the preheat and supply sensors.
- **HeatRecoveryTemperatures** – a temperature sensor can be selected for measuring the supply air temperature according to the purpose of the measurement:
- **Extract** – the sensor is located downstream of the heat recovery exchanger on the extract air side and is used for anti-frost protection of the heat recovery exchanger or in pool units.
 - **Inlet** – the sensor is located upstream of the heat recovery exchanger and is relevant for pool units.
 - **Supply** – the sensor is located downstream of the heat recovery exchanger on the supply air side and is used for anti-frost protection of the heat recovery exchanger or in pool units.

- **HeatingWaterTemp** – a temperature sensor can be selected for measuring the water temperature of the water heater according to the purpose of the measurement. The configuration options mean:
 - **Extract** – the sensor is intended to measure the water temperature in the return pipe.
 - **Supply** – the sensor is intended to measure the water temperature in the flow pipe.
- **ChilledWaterTemp** – a temperature sensor can be selected for measuring the water temperature of the water cooler according to the purpose of the measurement:
 - **Extract** – the sensor is intended to measure the water temperature in the return pipe.
 - **Supply** – the sensor is intended to measure the water temperature in the flow pipe.
- **ExtractTemperature** – a temperature sensor can be selected for measuring the extract air temperature according to the purpose of the measurement:
 - **Extract** – the sensor is intended to measure the temperature of the air extracted from the room.
 - **Exhaust** – the sensor is intended to measure the temperature of the air discharged to the outside.
- **HumidityControl** – defines the humidity control methods:
 - **DehumRel** – only dehumidification is performed, based on relative humidity, using one of the cooling components or using the fans and mixing dampers.
 - **HumidRel** – only humidification is performed, based on relative humidity, using a humidifier.
 - **BothRel** – the system dehumidifies and humidifies as required, based on relative humidity.
 - **DehumAbs** – only dehumidification is performed, based on absolute humidity, using one of the cooling components or using the fans and mixing dampers.
 - **HumidAbs** – only humidification is performed, based on absolute humidity, using a humidifier.
 - **BothAbs** – the system dehumidifies and
- selects the humidity that is compared with the required humidity for the selected mode.
 - **Room, Extract** – with these options, so-called cascade humidity control is applied, where the required supply humidity is calculated from the difference between the setpoint and the actual humidity.
 - **Supply** – with this option, direct humidity control is applied, based on the required and actual supply humidity.

- **>Dehumidification** selects the humidity that is compared with the required humidity for the selected mode.
 - **Passive** – dehumidification will be performed by means of the quantity and humidity of the supply air.
 - **Active** – dehumidification will be performed by cooling and reheating the supply air.
- **>Room** – up to 3 room humidity sensors can be used to measure the room humidity.
- **>Other** – the following sensors or their combinations can be used to monitor humidity:
 - **Supply** – humidity sensor for the air supplied to the room.
 - **Outdoor** – outdoor air humidity sensor.
 - **Extract** – humidity sensor for the air extracted from the room.
 - **Sup+Out** – supply and outdoor air humidity sensors.
 - **Sup+Ext** – supply and extract air humidity sensors.
 - **Out+Ext** – outdoor and extract air humidity sensors.
 - **All** – outdoor, supply and extract air humidity sensors.
 - **DI** – instead of analogue sensors, only a sensor with a contact signalling that the required humidity has been exceeded will be used.
- **AirQuality** – for measuring air quality, either one sensor with a digital contact output (**DI**) or three sensors with an analogue 0–10V output can be selected for **Const** or **Reg** control:
 - **DI** – air quality is measured by a sensor with a digital output; when it closes, increased constant ventilation with fresh air is activated.
 - **Const** – increased constant ventilation with fresh air is activated when the required air quality limit, measured by one or two analogue sensors, is exceeded.
 - **Reg** – continuously controlled ventilation with fresh air is performed by PID control based on the required air quality value and the actual value measured by one or two analogue sensors.
- **SupplyDamper, ExtractDamper** – selection of damper control methods:
 - **Yes** – the damper opens on the unit start signal.
 - **Mix** – the damper will be controlled inversely to the mixing damper. This option is relevant only if the AHU includes a mixing damper.
- **SupplyFilter, ExtractFilter, GreaseFilter** – to monitor filter clogging, a differential pressure switch with a digital contact output or a pressure sensor with an analogue 0–10V output can be used as follows:

- **DI** – a pressure sensor with an output contact (a so-called differential pressure switch) is used to monitor the condition of one filter; the signalled clogging level is set in **UnitComponents → Filters**.
- **2xDI** – two differential pressure switches are used to monitor two clogging levels of one filter or one clogging level of two filters; the signalled clogging level of each is set in **UnitComponents → Filters**.
- **AI** – a pressure sensor with an analogue output (a so-called pressure gauge) is used to monitor the condition of one filter; the signalled clogging levels are set in **UnitComponents → Filters**.
- **2xAI** – pressure sensors with an analogue output (so-called pressure gauges) are used to monitor the condition of two filters; the signalled clogging levels are set in **UnitComponents → Filters**.
- **SupplyFan, ExtractFan** – the fan motor can be controlled by a frequency converter (**FM**) or an EC motor (**EC**) can be used, with the following options:
 - **FM** – the fan frequency converter is controlled via inputs and outputs.
 - **EC** – the fan EC motor is controlled via inputs and outputs.
 - **FM-MB** – the fan frequency converter is controlled via Modbus communication.
 - **EC-MB** – the fan EC motor is controlled via Modbus communication.
- **ControlType** – the source of the control signal for the fans can be:
 - **Mode** – the fan speed is controlled by a fixed speed value in % for the current mode, entered on the controller display in **UnitComponents → Fans**.
 - **Pressure** – used to sense the air pressure and the air flow rate delivered by the fan in the duct. In **InputAssignment/Output → Fans**, the assignment of a separate input for the pressure sensor and the flow sensor is displayed.
 - **Direct** – a fixed voltage value of the required speed, 0–10V. The fan speed is set to this value converted to a percentage, 0–100%.
 - **POLv1** – the fan speed is controlled by a six-step speed value entered from the POL822 room unit within the range of values between **MinSpeed** and **Comfort**.
 - **POLv2** – the fan speed is controlled by a linear speed value in % entered from the POL822 room unit within the range of values between **MinSpeed** and **Comfort**.
 - **AMR** – the fan speed is controlled by a linear speed value in % entered from the AMR-OP70 or AMR-OP41 room unit within the range of values between **MinSpeed** and **Comfort**.

- **BackupFans** – activates the backup fans in the event of a main fan failure:
 - **Supply** – if the supply fan fails, the backup supply fan is switched on.
 - **Extract** – if the extract fan fails, the backup extract fan is switched on.
- **HeatRecovery** – specifies the type of heat recovery exchanger used and its properties:
 - **Plate** – plate heat recovery exchanger with a bypass damper without position monitoring.
 - **Rotary** – rotary heat recovery exchanger with a frequency converter controlled by the digital and analogue outputs of the controller, or with a stepper motor.
 - **Glycol** – heat recovery by means of a glycol circuit.
 - **RotaryHRX** – rotary heat recovery exchanger with a rotation speed monitoring sensor.
- **WaterHeating** – selection of the number and function of water heaters:
 - **1** – selection of a standard water heater or one acting as a preheater. For this water heater, the temperatures are configured in **HeatingWaterTemp**.
 - **2** – selection of a water heater acting as a reheater. For this water heater, the temperatures are configured in **2HeatingWaterTemp**.
 - **1G** – the same function as option **1**, but the heating medium of the exchanger contains glycol, and the protective functions are therefore limited.
 - **2G** – the same function as option **2**, but the heating medium of the exchanger contains glycol, so the protective functions are limited.
 - **BoilerRoom (No/Yes)** – control of the boiler room that prepares heating water for the water heater.
- **ElectricHeating** – selection of the number and function of electric heaters:
 - **1** – selection of a standard electric heater or one acting as a preheater.
 - **2** – selection of an electric heater acting as a reheater.
- **GasHeating** – determines the control method of the gas heater:
 - **Modulating** – the installed gas burner is modulating.
 - **1st** – the installed gas burner is single-stage.
 - **2st** – the installed gas burner is two-stage.
- **ExchangerDamper** – configuration of the gas heat exchanger bypass damper:
 - **Temperature** – the gas heat exchanger includes an exchanger damper controlled on the basis of the flue gas temperature.
 - **Pressure** – the gas heat exchanger includes an exchanger damper controlled on the basis of the pressure across the exchanger.

- **WaterCooling** – determines the control method of the water cooling:
 - **Separate** – the air handling unit has a separate water cooling coil.
 - **withHeating** – the air handling unit has a common water coil for both cooling and heating. The frost protection thermostat is blocked in cooling mode.
 - **2withHeating** – the air handling unit has a common water coil for both cooling and heating. By default, cooling is enabled by an open external contact (**InputAssignment/Output** → **ExternalSwitches** → **Cool/Heat**), which signals that chilled water is available. The frost protection thermostat is blocked in cooling mode.
- **CondensingUnit** – up to 6 condensing units with both heating and cooling functions **TCh** or up to 6 condensing units with cooling function only **Ch** can be selected.
 - **ControlType** – here the types of control modules of the individual condensing unit manufacturers are selected directly.
 - **Modulation** – the 0–10V output control signal corresponds to the required output of 0–100% in both heating and cooling mode. Switching between Cool/Heat modes is performed by volt-free contacts.
 - **ANL2WIRE** – intended for controlling certain types of Fujitsu condensing units and VRF kits with a 0–10V voltage signal. At 0V the condensing unit is switched off. At 0.6 to 10V the unit is switched on and the voltage level corresponds to the required indoor temperature of +16 °C to +30 °C. Switching between Cool/Heat modes is performed by volt-free contacts.
 - **FDP3** – intended for controlling Toshiba condensing units. The setpoint control voltage in the range 1.3V to 9.7V corresponds to temperatures of 18 °C to 31 °C. Switching between Cool/Heat modes is performed by voltage levels.
 - **EKEQFCB** – intended for controlling Daikin condensing units with a 0–10V voltage signal. The 0–10V input signal is divided into 5 levels – 2 levels for reducing output (the first for faster and the second for slower adjustment), 1 level for maintaining the current output and 2 levels for increasing output (the first for slower and the second for faster adjustment).
 - **PAC-IF** – intended for controlling Mitsubishi condensing units with a 0–10V voltage signal. At 0V the condensing unit is switched off. At 1.8V to 10V the unit output is controlled in 7 steps. Switching between Cool/Heat modes is performed by volt-free contacts.
- **HeatPump** – specifies the type of heat pump used and its control method:

- **1** – heat pump with one circuit.
 - **2** – heat pump with two circuits.
 - **1-MB** – heat pump with one circuit whose compressor frequency converter and expansion valve module are controlled via a bus (Modbus).
 - **2-MB** – heat pump with two circuits whose compressor frequency converters and expansion valve modules are controlled via a bus (Modbus).
- **FireDamper** – enables monitoring of up to 24 fire dampers.
- **ControlType** – selects the control and monitoring method of the fire dampers:
- **Mot2k** – motorised fire damper with limit switches for both end positions.
 - **Man2k** – fire damper without actuator, with limit switches for both end positions.
 - **THC** – motorised fire damper connected via a THC24-B control relay, which provides information on the end positions of the damper.
 - **Man1k** – fire damper without actuator, with a limit switch for the open end position.
 - **Mot1k** – motorised fire damper with a limit switch for the open end position.
- **ModeSwitches** – selection of the operating mode by means of external switches. The possible functions of the external switches are as follows:
- **Modes** – in **InputAssignment/Output → ExternalSwitches**, two digital inputs for mode control are displayed (**1Switch**, **2Switch**). The first has the function **Off/On** of the air handling unit; the second is used to switch between **Economy/Comfort** modes when the first contact is closed. **3Switch** is intended for optional external activation of a function.
 - **Modes2** – in **InputAssignment/Output → ExternalSwitches**, two digital inputs for mode control are displayed (**1Switch**, **2Switch**). The first switches the air handling unit on in **Economy** mode and the second switches it on in **Comfort** mode. **3Switch** is intended for optional external activation of a function.
 - **2xPlace** – in **InputAssignment/Output → ExternalSwitches**, two digital inputs are displayed (**1Switch**, **2Switch**) for switching the unit on from two different places in **Economy** mode. When both contacts are closed, the unit is in **Comfort** mode. **3Switch** is intended for optional external activation of a function.
 - **WRF-S**, **CPM-S** – fan speed control in the range 0–100% from the **WRF04** or **CP-M-B** controller. In the Configuration menu, it is necessary to set **ControlType=Direct** for both fans and then, in the **InputAssignment/Output → Fans** menu, assign analogue inputs to **SupplySpeed** and **ExtractSpeed**.

- **WRF-P, CPM-P** – fan speed control based on the required pressure from the **WRF04** or **CP-M-B** controller. In the Configuration menu, it is necessary to set **ControlType=Pressure** for both fans and then, in the **InputAssignment/Output → Fans** menu, assign analogue inputs to **SupplyPressure** and **ExtractPressure**.
 - **WRF-F, CPM-F** – fan speed control based on the required flow rate from the **WRF04** or **CP-M-B** controller. In the Configuration menu, it is necessary to set **ControlType=Pressure** for both fans and then, in the **InputAssignment/Output → Fans** menu, assign analogue inputs to **SupplyFlow** and **ExtractFlow**.
 - **3xSpeed** – in **InputAssignment/Output → ModeSwitches**, three digital inputs for switching the fan speed are displayed; their specific values can be set in **UnitComponents → Fans → Speed**. The unit is switched on by closing any of the switches.
 - **Comfort** – option to force Comfort mode from Economy mode via an external input (**1Switch**).
- **Purge (No/Yes)** – enables use of the purge function in **Standby** mode.
- **EnergyBalance** – enables monitoring of energy consumption during unit operation. The method of measuring electrical energy consumption is specified, and the consumption of other energies is calculated from the temperature difference upstream and downstream of the components.
- **ElectricityMeter** – a separate electricity meter measures the total electrical energy consumption of all equipment supplied from the control panel.
 - **Fan** – only the electrical energy consumption of the fans is measured, and the consumption of the control panel can only be entered as a constant.
- **POL945** – enables the number of controller inputs to be extended by one or two POL945 modules with 8 inputs/outputs.
- **POL955** – enables the number of controller inputs to be extended by one or two POL955 modules with 14 inputs/outputs.
- **POL985** – enables the number of controller inputs to be extended by one or two POL985 modules with 26 inputs/outputs.
- **Restart required after value change!** (/Execute) – the Execute option saves the parameters to the backup user memory of the controller. At the same time, the controller is restarted, which initialises the changes made.
- **Parameters** – options for managing the user and factory parameters of the controller:
- **Save (/Execute)** – saves the controller parameters.

- **Restore (/Execute)** – restores the controller parameters to their state before the changes were made.

11 Testing

The equipment testing item is accessible only after service login. This function is intended for service technicians when commissioning the air handling unit or during service inspections. The equipment testing function allows any component of the air handling unit to be controlled individually. Testing is enabled by setting **EnableTesting=Yes** and is indicated as the auxiliary mode **Test** on the controller display. It allows the fan to be switched on and off, the damper opening angle to be set in percent, the burner to be switched on and off and its output to be controlled in %, etc. During equipment testing, protective functions may not be active, and incorrect handling could therefore result in damage to the equipment or a breach of occupational safety rules. When testing is finished, set **EnableTesting=No**! Otherwise, standard control will not work!

12 Inputs and outputs

The current values at the physical inputs and outputs of the controller are displayed here, including their functional status. If a malfunction or fault is suspected, it is possible to check here whether the connected sensors are working correctly and displaying the expected values. Each line contains the input type with a sequence number corresponding to the physical labelling of the connectors on the controller. This is followed by the value, status information and, for universal inputs, the type of function or sensor type, which is part of the factory settings. If the sensor type setting does not match the connected sensor, a configuration fault will be displayed. The input and output designation system is **xVy** and corresponds to the designation in the drawing documentation with the following meaning:

- **x** – the sequence number of the controller input/output extension, which can take the following values:
 - No number – inputs and outputs of the POL638 controller itself.
 - 1 – inputs and outputs of the first POL945 extension.

- 2 – inputs and outputs of the first POL955 extension
- 3 – inputs and outputs of the first POL985 extension
- 4 – inputs and outputs of the second POL945 extension
- 5 – inputs and outputs of the second POL955 extension
- 6 – inputs and outputs of the second POL985 extension.

The individual input/output extensions must be enabled in the configuration.

- **V** – specifies the type of inputs or outputs according to the following syntax:
- **X** – universal input, to which an input function can also be assigned. Several types of resistive, voltage, current and digital sensors can be connected to this input. If necessary, the universal input can also be configured as a voltage, current or digital output.
 - **B** – NTC10K temperature input.
 - **D** – volt-free digital input.
 - **Y** – analogue output with a range of 0–10V.
 - **Q** – relay output 230VAC, max. 3A/ 2A (cos 0.6).
- **y** – is the sequence number of the input or output on the controller or on the controller extension.

13 Input and output assignment

The input and output assignment item is accessible only after service login. Here, the controller inputs and outputs are assigned to temperature sensors, fans, filters, electric heaters, etc., according to the electrical drawings of the actual wiring. The settings are made at the factory and may only be changed by a person familiar with the subject, as incorrect settings may result in damage to the equipment or injury to the operator.

13.1 Analogue input assignment

Analogue inputs are assigned separately for each component (temperature, humidity, pressure, fan operation or fault, water heater, etc.). A prerequisite for the correct function of the assigned input is setting the correct type of connected sensor or input function in the

Inputs/Outputs menu. Digital and analogue inputs are assigned according to the following examples:

- **Temperature sensor** – in the **InputAssignment/Output** → **Temperatures** menu, one of the inputs designated according to the syntax described in the previous chapter “Inputs and outputs” is selected for the chosen temperature, (e.g. for a room temperature sensor connected to universal input 1 of the controller, set **Room = X1**). In addition to these inputs, assignment to room units designated POL (POL822) and AMR (AMR-OP70) is offered. Another option is to assign a constant temperature by setting the input to **Set**. The required value for the required temperature is then set under the label **Correction**. For example, the room temperature is set to a fixed value of 25 °C in two steps:

1. **Room = Set.**
2. **Correction = 25 °C.**

Further parameters that can be set for any temperature sensor are:

- **Correction (0s, 0 °C)** – consists of two parameters. The first is used to smooth a noisy sensor signal by entering filtering in seconds. The second can be used by the user to change the value given by the sensor and to adjust a temperature deviation caused, for example, by the cable length.
 - **Range (-10 °C, 250 °C)** – specifies the range within which the temperature of the connected sensor may vary. Exceeding the limits can be signalled as an alarm. The maximum range is -100 °C to 250 °C.
 - **Value (°C)** – indicates the temperature at the sensor location. If the temperature value is lower than -100 °C, the supply cable or the measuring element itself has probably been short-circuited. If the temperature is higher than 250 °C, the supply cable or the measuring element itself has probably been interrupted. If the value is unstable, an external signal is probably being induced into the supply cable. Any fault is signalled by a bell symbol on the LCD display or by a flashing or lit alarm LED, and by a message in the alarm list.
- **Pressure sensor** – as standard, this relates to the menu **InputAssignment/Output** → **Filters** → **Fans**. For the selected sensor, one of the inputs designated according to the syntax described in the previous chapter “Inputs and outputs” is selected (e.g. for the supply air filter pressure gauge connected to universal input 3 of the second input extension, set **SupplyAI = 2X3**).

Another option is to set a constant pressure by setting the input to **Set**. The required value for the desired pressure is then set under the item **Correction**. For example, setting the filter pressure to a fixed value of 500Pa is done in two steps:

1. **SupplyAI = Set.**
2. **Correction = 500Pa.**

Other parameters that can be set for any pressure sensor are:

- **Range (500 °C)** – this value must correspond to the range set on the connected pressure gauge. Exceeding the limits can be signalled as an alarm. The maximum range is 10000Pa.
 - **Correction (10s, 0Pa)** – consists of two parameters. The first is used to smooth a noisy sensor signal by entering a filtering time in seconds. The second can be used by the user to change the value given by the sensor and adjust the pressure deviation according to local conditions.
 - **Pressure (Pa)** – measured value of the current differential pressure from the connected sensor. If the pressure value is lower than 0Pa, the supply cable has probably been short-circuited. If the pressure is higher than 10000Pa, the supply cable has probably been interrupted. Any fault is signalled by a bell symbol on the LCD display or by a flashing or lit alarm LED, and by a message in the alarm list.
 - **Flow (m3/h)** – indicates the current air volume.
 - **K-factor** – is used to calculate the flow rate from the measured differential pressure.
- **Relative humidity sensor** – in the menu **InputAssignment/Output** → **Humidity**, for the selected humidity, one of the inputs designated according to the syntax described in the previous chapter “Inputs and outputs” is selected, (e.g. for the extract air humidity connected to universal input 8 of the fifth input extension, set **Extract = 5X8**). Another option is to set the humidity by setting the input to **Set**. The required value for the desired humidity is then set under the item **Correction**. For example, setting the extract humidity to a fixed value of 50% is done in two steps:

1. **Extract = Set.**
2. **Correction = 50%.**

Other parameters that can be set for any relative humidity sensor are:

- **Correction (10s, 0%)** – consists of two parameters. The first is used to smooth a noisy sensor signal by entering a filtering time in seconds. The second can be used by the user

to change the value given by the sensor and adjust the relative humidity deviation according to local conditions.

- **Value (%)** – indicates the current relative humidity of the connected sensor. If the relative humidity value is lower than 0%, the supply cable has probably been short-circuited. If the value is higher than 100%, the supply cable has probably been interrupted. Any fault is signalled by a bell symbol on the LCD display or by a flashing or lit alarm LED, and by a message in the alarm list.
- **Air quality sensor** – in the menu **InputAssignment/Output** → **AirQuality**, for the selected air quality sensor, one of the inputs designated according to the syntax described in the previous chapter “Inputs and outputs” is selected (e.g. for the first sensor connected to universal input 5 of the controller, set **Sensor = X5**). Another option is to set a constant air quality by setting the input to **Set**. The required value for the desired air quality is then set under the item **Correction**. For example, setting the air quality to a fixed value of 1000ppm is done in two steps:

1. **Sensor = Set.**
2. **Correction = 1000ppm.**

Other parameters that can be set for any air quality sensor:

- **Correction (10s, 0ppm)** – consists of two parameters. The first is used to smooth a noisy sensor signal by entering a filtering time in seconds. The second can be used by the user to change the value given by the sensor and adjust the air quality deviation according to local conditions.
- **Value (ppm)** – indicates the current air quality from the connected sensor. If the air quality value is lower than 0ppm, the supply cable has probably been short-circuited. If the air quality is higher than 2000ppm, the supply cable has probably been interrupted. Any fault is signalled by a bell symbol on the LCD display or by a flashing or lit alarm LED, and by a message in the alarm list.

13.2 Digital input assignment

Digital inputs are used to signal operation, faults, icing or other states of components. A digital input is assigned to the selected component by selecting one of the digital inputs designated according to the syntax described in the chapter “Inputs and outputs” (e.g. for the supply fan status contact connected to digital input 1 of the controller, set **SupplyStatus = D1**). **Polarity=Invert** inverts

the signal coming from the selected input. For example, setting the supply fan status to a fixed value of **On** is done in two steps:

1. **SupplyStatus = Set.**
2. **Polarity = Invert.**

13.3 Digital output assignment

Digital outputs are assigned in the menu **DigitalOutputAssignment**, where the required component to be controlled by this output is assigned on the line of the required digital output (e.g. for the supply fan switched on from output Q1, set **DO.Q1 = FS**). A list of abbreviations of the individual components used in the digital output assignment is given in Table 2. The assignment also includes the option of inverting the output state (**Normal/Invert**). Another option is to assign a constant value (**Off/On**) to the selected output by setting the output to **Set**. Example of setting output Q1 to permanently on: **DO.Q1 = Set, Invert**. The component abbreviations in the table are also given for the previous software version 28.01.

Unit component name	Abbreviation v28.01	Abbreviation v29.01
Supply fan – switch on	FanS	FS
Extract fan – switch on	FanE	FE
Mixing damper – open	DmpM	DM
Heat recovery exchanger – switch on	Rec	Rc
Water heating 2 – switch on	5	WH2
Glycol top-up pump – switch on	AGI	AG
Water heating 1 – switch on	WtH	WH
Electric heating 1 – switch on	EIH	EH
Electric heating 2 – switch on	EIH2	EH2
Heat pump 1 – digital compressor – switch on	HPwm1	HPM
Heat pump 2 – digital compressor – switch on	HPwm2	HP2M
Gas heating – switch on	Gs	G
Gas heating – increase output	GsM	GM
Gas heating – decrease output	GsL	GL
Water cooling – switch on	WtC	WC
Condensing unit – switch on globally	Cnd	Cd
Condensing unit 1 – cool	CndC	CdC
Condensing unit 1 – heat	CndH	CdH
Condensing unit 2 – cool	Cnd2C	Cd2C
Condensing unit 2 – heat	Cnd2H	Cd2H

Condensing unit 3 – cool	Cnd3C	Cd3C
Condensing unit 3 – heat	Cnd3H	Cd3H
Condensing unit 1 – switch on	Cnd1O	CdO
Condensing unit 2 – switch on	Cnd2O	Cd2O
Condensing unit 3 – switch on	Cnd3O	Cd3O
Heat pump circuit 1 – compressor – switch on	HPC1	HP1C
Heat pump – 4-way valve cool/heat	HPV1	HPV
Class A or B alarm	28	AA
Heat pump circuit 2 – compressor – switch on	HPC2	HP2C
Heat pump – cool	HPC	HPC
Heat pump – heat	HPH	HPH
Humidifier – switch on	Hum	Hu
Fire damper power supply – switch on	DmpF	FD
Fire alarm signalling	Fire	Fr
Boiler room – switch on	Boil	Bo
Economy mode	Red	Red
Comfort mode	Cmf	Cmf
Filter clogging	FiE	FiA
Unit service	Srv	Srv
Temperature season Summer/Winter	40	S/W
Gas heating convector – switch on	CnvG	CvG
Unit fault	Err	A
Condensing unit 4 – cool	Cnd4C	Cd4C
Condensing unit 4 – heat	Cnd4H	Cd4H
Unit running	On	On
Fans running	FnO	FO
Fan fault	FnE	FA
Heat/Cool status	H/C	H/C
Condensing unit 4 – switch on	Cnd4O	Cd4O
Condensing unit 5 – switch on		Cd5O
Condensing unit 6 – switch on		Cd6O
Condensing unit 5 – cool		Cd5C
Condensing unit 6 – cool		Cd6C
Condensing unit 5 – heat		Cd5H
Condensing unit 6 – heat		Cd6H
Class C or D alarm		AC
Backup supply fan – switch on		FS2
Backup extract fan – switch on		FE2
Unit start completed. Intended for enabling OptimVent control.		StE

Tab. 2 – List of abbreviations for digital output assignment

13.4 Analogue output assignment

Analogue outputs are assigned in the menu **AnalogOutputAssignment**, where the required component to be controlled by this output is assigned on the line of the selected analogue output (e.g. for the plate heat recovery exchanger damper controlled from controller output Y1, set **AO.Y1 = Rc**). A list of abbreviations of the individual components used in the analogue output assignment is given in Table 3. Another option is to assign a constant analogue value (0–10V) in % using the option **Set (1% = 0.1V)**. The required value at this output is then set in the menu **SetValues-Set**. For example, setting 8.5V at analogue output Y1 is done in two steps:

1. **OutputAssignment:** **AO.Y1 = Set.**
2. **SetValues-Set:** **AO.Y1 = 85%.**

The component abbreviations in the table are also given for the previous software version 28.01.

Unit component name	Abbreviation v28.01	Abbreviation v29.01
Supply fan – speed	FanS	FS
Extract fan – speed	FanE	FE
Mixing damper – position	DmpM	DM
Heat recovery exchanger – output	Rec	Rc
Water heating 2 – output	5	WH2
Water heating – output	WtH	WH
Electric heating 1 – output	EIH	EH
Electric heating 2 – output	EIH2	EH2
Supply air damper – position	DmpS	DS
Extract air damper – position	DmpE	DE
Gas heating – output	GasH	G
Gas heating bypass damper – position	DmpG	DG
Water cooling – output	WtC	WC
Condensing unit 1 – output	CndU1	Cd1U
Condensing unit 2 – output	CndU2	Cd2U
Condensing unit 3 – output	CndU3	Cd3U
Condensing unit 4 – output	CndU4	Cd4U
Heat pump circuit 1 – output	HPmp	HP
Heat pump circuit 2 – output	HPmp2	HP2
Humidifier – output	Hum	Hu
Condensing unit 1 – Heat/Cool (FDP3)	CndCH1	Cd1CH
Condensing unit 2 – Heat/Cool (FDP3)	CndCH2	Cd2CH
Condensing unit 3 – Heat/Cool (FDP3)	CndCH3	Cd3CH
Condensing unit 4 – Heat/Cool (FDP3)	CndCH4	Cd4CH
Condensing unit 1 – off = 1V, on = 9V	CndOn	Cd1O
Air flow controller 1 – position	AirFl1	AF1

Air flow controller 2 – position	AirFl2	AF2
Condensing unit 2 – off = 1V, on = 9V	28	Cd2O
Condensing unit 3 – off = 1V, on = 9V	29	Cd3O
Condensing unit 4 – off = 1V, on = 9V	30	Cd4O
Condensing unit 5 – off = 1V, on = 9V		Cd5O
Condensing unit 6 – off = 1V, on = 9V		Cd6O
Condensing unit 5 – output		Cd5U
Condensing unit 6 – output		Cd6U
Condensing unit 5 – Heat/Cool (FDP3)		Cd5CH
Condensing unit 6 – Heat/Cool (FDP3)		Cd6CH
Backup supply fan – speed		FS2
Backup extract fan – speed		FE2
Air flow controller 3 – position		AF3
Air flow controller 4 – position		AF4
Air quality – output		AQ

Tab. 4 – List of abbreviations for analogue output assignment

13.5 External switches

External switches are either configurable or fixed. Their assignment is the same as for other digital inputs and is described in the chapter “Inputs and outputs”.

13.5.1 Configurable external switches

These switches are used for external switching of the air handling unit modes, and the specific function of each of them is determined by the selection in **Configuration** → **ModeSwitches**. Their function is enabled in **UnitComponents** → **Other**.

- **1Switch** – is used depending on the configuration of **ModeSwitches**:
 - **Modes** – switches the air handling unit on in **Economy** mode.
 - **Modes2** – switches the air handling unit on in **Economy mode**.
 - **2xPlace** – switches the air handling unit on in **Economy mode**. When the contact **2Switch** is closed, it switches the air handling unit from **Economy** mode to **Comfort** mode.
 - **3xSpeed** – switches the air handling unit on in **Comfort** mode at speed stage I.
 - **Comfort** – forces a switchover from **Economy** mode to **Comfort** mode.
- **2Switch** – is used depending on the configuration of **ModeSwitches**:

- **Modes** – when the contact **1Switch** is closed, it switches the air handling unit from **Economy** mode to **Comfort** mode. When the contact **1Switch** is open, it has no function.
 - **Modes2** – switches the air handling unit on in **Comfort** mode regardless of the state of the contact **1Switch**.
 - **2xPlace** – switches the air handling unit on in **Economy mode**. When the contact **1Switch** is closed, it switches the air handling unit from **Economy** mode to **Comfort** mode.
 - **WRF04** – switches the air handling unit on.
 - **CPM** – switches the air handling unit from **Economy** mode to **Comfort mode**.
 - **3xSpeed** – switches the air handling unit on in **Comfort** mode at speed stage II.
- **3Switch** – is used depending on the configuration of **ModeSwitches**:
- **3xSpeed** – switches the air handling unit on in **Comfort** mode at speed stage III.
 - **Other modes** – external activation of the function of switches 1 and 2. When closed, it sets the value **UnitComponents** → **Other** → **ExternalSwitches** = **On**. When it is open, this value can be set by the user.

13.5.2 Fixed external switches

Fixed external switches are part of the components, so they are not configured; only the digital inputs are set for their special function with respect to the external environment.

- **Summer/Winter** – this digital input can determine (force) the temperature season independently of the outdoor temperature sensor.
- **Cool/Heat** – this digital input can decide whether the unit is to cool or heat, subject to other settings. An open contact is by default a request for cooling and a closed contact is by default a request for heating. There are two ways of using it:
- **TemperatureControl** → **ClimaTemperature** = **Contact** – the clima temperature is replaced by an external contact switching between heat and cool modes from a superior system.
 - **Configuration** → **WaterCooling** = **2withHeating** – the air handling unit has a common water coil for both cooling and heating. The external contact signals that water is ready for cooling or heating, and therefore also the unit mode.
- **PresenceButton** – this digital input is used to switch the air handling unit on and off in **Comfort** mode with a non-latching push button. A necessary condition is the setting **UnitComponents** → **Other** → **ExternalSwitches** = **On**.

- **BMS** – this digital input is used to enable switching the air handling unit on and off from a superior BMS (Building Management System), which is used in conjunction with integrated building control and management.
- **AlarmAcknowledge** – this digital input is intended for remote acknowledgement of alarms using an external push button. This input must not be permanently closed!

14 System objects

The item **SystemObjects** is accessible only after service login. Here you can set the time and date, change the HMI language, set communication parameters, change the preset logins, etc. Only the parameters that may be useful to the user are described below.

14.1 Time setting

The current date and time are displayed on the first line below the divider on the **SystemObjects** screen. If the line with the time information is selected, confirming it opens the date and time entry. Correct entry of the date and time is important for the correct operation of the air handling unit according to the time schedule. Other time-related items are:

- **TimeValid (No/Yes)** – a valid time is important for the correct operation of the air handling unit according to the time schedule.
- **WinterTime** – allows the changeover between summer and winter time to be enabled or disabled and, if necessary, the preset time change values to be adjusted.
- **TimeSynchronisation** – allows time synchronisation from the SNTP server 0.siemens.pool.ntp.org to be enabled or disabled, including the synchronisation interval and deviation.

14.2 Language selection

Language selection is generally performed only during commissioning of the unit and is used to switch the texts displayed on the HMI to the language required by the user. As standard, one of the following languages can be selected:

- **English.**

- **German.**
- **Czech.**
- **Russian.**
- **French.**
- **Finnish.**
- **Polish.**
- **Dutch.**

14.3 Communication

In general, the controller can communicate with other superior or subordinate devices using communication protocols. The BACnet, LonWorks, Modbus and TCP/IP protocols can be used for connection to superior BMS (Building Management System) systems. The Process bus (KNX) and Modbus protocols can be used for the integration of subordinate components. For superior systems, communication tables with the addresses of variable values that can be read from or written to the controller have been created for all types of communication used. These tables are provided in separate appendices and are not part of this documentation. A quick guide to setting the parameters of the individual types of communication is given in the manual “*Climatix QuickStartSetup*” on the Mandík a.s. website.

- – this method of communication uses the internet and in this case can be used to connect the controller to a computer network, to a superior system, to cloud storage or directly to a PC. The standard IP address setting and other properties are changed after user login in the menu **SystemObjects → Communication → IP-Configuration**.
- **WLAN** – the POL903.00/100 Wi-Fi access point enables configuration and control of the controller using a smartphone or tablet. It is intended for both service and user operation. Instructions for setting the parameters are given in a separate manual on the Mandík a.s. website.
- **Cloud** – cloud storage enables full remote management of the air handling unit, and its operation is described in detail in a separate manual on the Mandík a.s. website, including connection methods and Ethernet network parameters.
- **Modbus** – is an open protocol for communication between different devices, which allows data to be transmitted over various networks and buses. It works on the **Master/Slave** principle, i.e.

on the principle of passing messages between a server and a client. **Slave** mode is used for communication with a superior control system, and **Master** mode is used for communication with a subordinate device. The Climatix controller offers both Modbus RTU and Modbus IP protocols, which can be used simultaneously. The Climatix controller has 4 internal Modbus communication ports. Standard communication parameters are set in the menu **SystemObjects → Communication → Modbus** for each port separately. These are the ports:

- **Local, Local2** – two ports for the Modbus RTU protocol are located on the connectors marked T6 and T14 (galvanically isolated). The physical connection of the serial communication via RS485 is made with a shielded twisted-pair cable, for example Belden 3105A.
- **Service** – the Modbus RTU protocol can also be used on the service connector marked T-HI. The physical connection of the serial communication via RS485 is made with a shielded twisted-pair cable, for example Belden 3105A, which must be terminated with an RJ45 connector on the controller side. A specific parameter is the setting of the service port function for communication **Modbus ModbusRTU_Serv=Yes**. With this setting, an external control unit cannot be connected to the service port.
- **IP** – the Modbus IP protocol is also enabled on the Ethernet port, and the physical TCP/IP connection is made with a UTP cable terminated with an RJ45 connector, which is plugged into the controller Ethernet connector **T-IP** marked **Ethernet**.

Modbus can also be implemented using the additional communication module POL902. The individual options for enabling the protocol and selecting the communication ports are made by selection in the item **Configuration → ModbusPort**. The complete list of registers is given in the documentation “Modbus table” and can be downloaded from the Mandík a.s. website. Further information on Modbus communication is given in the Siemens system documentation for the Climatix controller.

- **ProcessBus (KNX)** – as standard, the controller is preset for communication with a room unit of the QMX3 series, POL822 or HMI-DM POL895. The parameters of the POL822 room unit are part of the menu **SystemObjects → Communication → ProcessBus → RoomUnit**. Operation from the room unit is described in a separate manual on the Mandík a.s. website. The room unit has the following communication settings:

- **Communication (OK/Fault)** – reports a communication fault between the controller and the room unit.

- **Address** – the communication parameters corresponding to parameters 005, 006 and 007 in the room unit are entered here.
- **PresenceButton (60min)** – specifies the time for which the Comfort operating mode is active after a short press of the **PresenceButton** button on the **POL822** room unit. After this time has elapsed or after another short press of the **PresenceButton** button, the unit returns to the previous operating mode.

For the transfer of values between the controller and a superior system via KNX, the S-Mode variant with a maximum of 100 values is used. The complete list of these values is given in the documentation “KNX S-mode table” and can be downloaded from the Mandík a.s. website.

- **LonWorks** – this protocol is an industrial communication bus which in some respects resembles the Internet. For the Climatix controller, this communication is implemented using the additional communication module POL906. Further information on communication is given in the separate Siemens system documentation for the Climatix controller.
- **BACnet** – this protocol is a standard communication protocol for building automation. In the Climatix controller, it is implemented using the additional communication modules POL908 (BACnetIP) or POL904 (BACnetMSTP). The controller can handle a maximum of 300 BACnet objects, and the complete list of these objects is given in the documentation “BACnet table” and can be downloaded from the Mandík a.s. website. Further information on communication is given in the separate Siemens system documentation for the Climatix controller.

14.4 Login – PIN management

This item is used to log in and log out with a password. It is also possible to change the preset user or service password, provided the existing passwords are known.

Without an entered PIN, only basic data are shown on the controller display, and only the mode can be changed (**Off/ Standby /Economy/Comfort**). All other changes can be made only after entering the user or service PIN. The factory default PINs are as follows:

- **PIN: User = ‘0000’** – access level number 3 is shown in the upper left corner of the display, or one key in the upper right corner of the HMI-TM or HMI-DM controllers.
- **PIN: Service = ‘2222’** – access level number 2 is shown in the upper left corner of the display, or two keys in the upper right corner of the HMI-TM or HMI-DM controllers.

- **PIN: Factory = 'xxxx'** – access level number 0 is shown in the upper left corner of the display, or three keys in the upper right corner of the HMI-TM or HMI-DM controllers.

15 Alarm messages

An alarm message can be any predefined message such as a fault, event, notification, etc. It consists of a name, status, type (priority) and the time of occurrence or clearance. The lists of current alarms and the alarm history can contain a maximum of 50 entries. Alarm messages are described in separate documentation on the Mandík a.s. website.