KJM MANDÍK
measurement and control system Climatix

Detailed operating instructions

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ATEX II 2G IIB T4

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This manual is an integral part of the technical conditions TPM 088/12 of MANDIK AC units. The latest versions of the documents are available at www.mandik.cz

1 General information

The following abbreviations are used in this manual:

- M&R - Measurement and control system
- Controller - Siemens Climatix control unit located in the switchboard cabinet of the measurement and control system
- Components - the AC unit assembly consists of the individual components controlled by the M&C.

This manual uses graphics and symbols to highlight specific details. They include:

This symbol indicates a potentially hazardous situation and an imminent health or safety hazard to personnel, AC unit, or its components.

This symbol indicates an important detail related to proper installation, commissioning or maintenance of the unit or its components. It may also indicate a suggestion or a note concerning installation, commissioning, or maintenance.

This manual contains instructions for setting up and operating the M&C of the MANDÍK M, P, S, and T series AC units.

This manual must be read and then followed before starting work on the M&C. Compliance with this manual is a condition for proper operation, function and fulfilment of warranty conditions. The manufacturer is not liable and the user bears all risks for any damage resulting from improper use.

This manual is intended for personnel with valid authorisation and licenses to conduct service work on ventilation and air handlers.

Any arbitrary changes to the M&C switchboards that have not been approved in advance by MANDÍK, a.s. will result in the termination of the warranties provided and the termination of the guarantee of safe use and operation.

It is recommended to switch off the control box with the controller only for a short period of time, because even if the AC unit is switched off, the controller performs some control functions! If the controller is switched off for a long period of time (more than 3 days), time may be lost in the controller and consequently the functioning of the AC unit according to the time program may be disturbed.

This description is valid for M&C with the Climatix controller with software 29.01AHU or higher! The software version is in the *ApplicationInfo* menu on the display home screen.

2 Related documents

The following documents are included with every M&R supplied with the AC unit and should be placed near the AC unit:

- Warranty certificate Certificate of the switchboard test per ČSN EN 61439-1-ED2
- M&C drawings

3 Safety

When using the M&C, the instructions in this regulation must be observed.

The applicable standards, safety regulations, and generally accepted technical rules must be observed when installing, wiring, commissioning, repairing, and maintaining the units.

Only individuals or legal entities with valid authorisation are permitted to conduct assembly of the unit, including electrical wiring, commissioning, repairs, maintenance, and operation.

4 Introduction

To control the Mandík AC units, the Climatix freely programmable PLC controller from Siemens is used, which meets the new requirements arising from technical, technological, ecological, and economic needs. This controller is one of the best rated controllers for air handling units. It ensures comfortable control, safe and energy-saving operation of air handling units and complete adaptability to the final solution according to the customer's requirements. A notable quality is the wide communication possibilities enabling easy control and cooperation with most of the higher-level systems and integration into building technology systems.

The measurement and control system with the Climatix controller offers:

- Excellent price/performance ratio
- Simple installation
- Easy control in several variants
- Local and remote control
- Annual and weekly schedules
- Text display with clear depiction of all data
- Displays come equipped with support for all the European languages (Czech is standard)
- Possibility to select from multiple operating regimes
- Temperature and humidity control in supply or room
- Automatic detection of heating or cooling needs
- Comprehensive precise control of ventilation operation
- Clear listing of alarm messages, including history
- Changes to important parameters after login (multiple levels)
- Connection of all the HVAC components to one control system
- It controls all the standard heating and cooling components
- Uniform marking of connection terminals
- Control from a PC using a web browser (standard delivery) and then from anywhere on the Internet
- Possibility of visualisation superstructure and cooperation with higher-level systems

5 Control description

All the control parameters of the KJ Mandík can only be set on the Climatix controller from the integrated HMI control unit, HMI-DM control unit, HMI-TM control unit, and HMI@Web web interface. A partially limited parameter setting can be made from the POL822 room unit. The other controls are only used to switch on the unit, set the required temperature, set the required fan speed and possibly set a regime or specific function.

5.1 Home screen

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

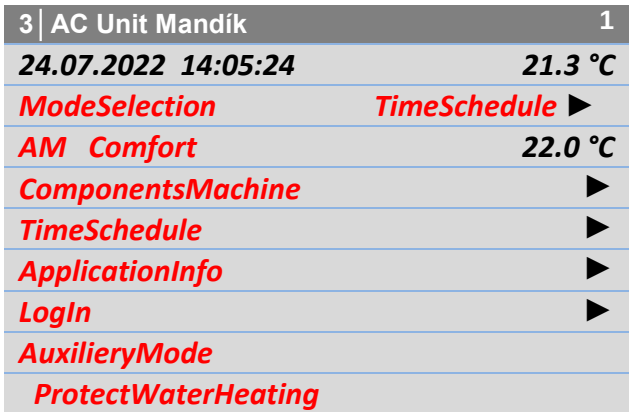


Fig. 1

1. Line – system information about the access level (PIN level), type of AC unit and, if applicable, the number of the selected line on the current screen. For the display integrated in the controller, in case of an alarm, a bell is displayed at the end of the first line.
2. Line – current date, time and temperature according to the configuration (room, supply or exhaust air). The date and time can be changed by entering the service PIN.
3. Line – ***ModeSelection*** allows the user to enter the required regime.
4. Line – The current regime is displayed including the required temperature corresponding to the regime and temperature period. Additional information is the display of the auxiliary regime (the "***AM***" symbol at the beginning of the line) and the switching on of the unit from one of the controllers without communication (the "•" symbol in front of the current regime). If the auxiliary regime symbol is displayed, the setting for the current regime may not be observed. The specific auxiliary regime is then specified on the last line of the home screen under the ***AuxilieryMode*** writing.

The next lines contain menu items for further setting of the AC unit parameters.

The next figures will show the login level required to view them in the top left corner of the screen.

5.2 Operating and auxiliary regimes

The AC unit can operate in four basic operating regimes: ***Off***, ***Tempering***, ***Economy***, and ***Comfort***. Each of these regimes can be set fixed from the display, from the control panel, from external switches, or according to a time program.

The auxiliary regime occurs when the unit cannot meet the requirements of the basic operating regime, for example, when the unit starts up. The auxiliary regime symbol "***AM***" is displayed before the current regime. The specific auxiliary regime is displayed on the last line of the home screen and the device component screen.

5.2.1 Selecting the operating regime

The ***ModeSelection*** line is used to specify the type of operating regime required of the unit. The current operating regime is displayed on the next line of the display, including the required temperature. The user can select from the following operating regimes:

- ***TimeSchedule***, ***Off***, ***Tempering***, ***Economy***, ***Comfort***

The ***Economy*** operating regime usually differs from the ***Comfort*** operating regime by having a lower required temperature, lower fan speed, and lower fresh air quantity. The speeds for the ***Comfort*** and ***Economy*** operations are set in the ***ComponentsMachine*** ⇨ ***Fans***. Temperatures for the operating regimes are set in ***ComponentsMachine*** ⇨ ***TemperatureRegulation***. Fresh air quantity is set in ***ComponentsMachine*** ⇨ ***Dampers***.

5.2.2 Off regime

In this operating regime, the AC unit is turned off. Only safety functions that are designed to protect certain parts of the unit from damage may operate.

5.2.3 Tempering regime

In this operating regime, the AC unit is off by default and is in one of the following additional regimes:

- ***Standby*** – the unit is switched off and only the safety features are operational to protect some parts of the unit from damage.

- ***FrostProtect*** – frost protection of the room occurs if the temperature in the room drops below the required temperature. The unit will start and switch on its heating components. If the unit includes a mixing damper, 100% air circulation will also be used. The unit will shut off when the required room temperature is reached. This additional regime is typically used in the winter when a building is not used for extended periods of time. The start of the additional regime is indicated on the next line below the selected regime by the ***FrostProtect*** sign and required temperature. The fan speed may correspond to the ***Comfort*** or ***Economy*** regime, depending on the last operating regime started. The required temperature is set in the ***ComponentsMachine*** ⇄ ***TemperatureRegulation*** menu through the ***FrostProtect*** ***(5 °C)*** variable.
- ***Freecooling*** – this regime is typically used in the summer to freely ventilate the building at night with cooler outside air based on meeting temperature conditions. Starting the additional regime is indicated on the next line under the selected regime by the ***Freecooling*** sign and required temperature***.*** The fan speeds may correspond to the ***Comfort*** or ***Economy*** regime, depending on the last operating regime. The required temperature is set in the ***ComponentsMachine*** ⇄ ***TemperatureRegulation*** menu via the ***Freecooling*** ***(18 °C)*** variable. Ventilation must be enabled in the ***Configuration*** menu via the variable ***Freecooling*** ***(Yes).*** The other parameters are set in the ***ComponentsMachine*** ⇄ ***Freecooling*** menu and are described in a separate chapter.
- ***Humidity*** **–** this condition occurs when the upper or lower humidity limits are exceeded, and humidity monitoring is enabled in the ***ComponentsMachine*** ⇄ ***HumidityRegulation*** menu, while the unit is off, including setting the menu fan speed to a non-zero value.
- ***AirQuality*** **–** this condition occurs when the air quality limit is reached and at the same time air quality monitoring is enabled in the ***ComponentsMachine*** ⇄ ***AirQuality*** menu with the unit off, including setting the menu fan speed to a non-zero value.

5.2.4 Attenuation regime

In this operating regime, the AC unit is switched on in the so-called Economy regime, where the required fan speed and the required temperature are lower by default compared to the Comfort regime. The required speed and temperature are user adjustable for summer and winter separately. The control controls the individual components (heating, cooling, and humidification)

to achieve the required parameters. This regime of operation is usually used outside dwelling or working hours.

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

5.2.5 Comfort regime

In this operating regime, the AC unit is switched on in a regime where the required fan speed is set to the comfort limit, and the required temperature is set to the comfort value for summer and winter separately. The control controls the individual components (heating, cooling, and humidification) to achieve the required parameters. This operating regime is usually used during dwelling or working hours.

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

5.2.6 Auxiliary regime

Information about the occurrence of an auxiliary regime is displayed with the ***AM*** symbol in front of the current regime. The type of auxiliary regime itself is displayed at the end of the start screen or at the end of the ***ComponentsMachine*** menu. The auxiliary regime occurs when a situation arises that requires a temporary change in the operation of the AC unit, due to too high or low temperature, failure of a component, non-standard operation of a component, protection of the unit, etc. The following auxiliary regimes may occur:

- ***CompenssationSpeed*** – occurs when the supply temperature drops and compensation is enabled for any of the options in the ***ComponentsMachine*** ⇄ ***Fans*** menu:
  - ***MixingCompensation***
  - ***CompensationTemperature***
  - ***CoolError***
  - ***Defrost***
  - ***HeatErr***

- ***Ventilation*** – after the unit has been shut down by the user or since a fault, ventilation is always performed for at least 60 s. Only when a fault occurs from fire sensors or fire dampers, the unit shuts down immediately. If the unit contains gas or electric heating, venting of the heat exchangers shall be carried out until the supply air temperature falls 5 °C below the maximum calculated supply air temperature. However, max. 10 minutes.
- ***Preheat*** – it signals the preheating of the water heating when the unit is started. The fan speed can be adjusted according to the settings in the menu ***ComponentsMachine*** ⇨ ***WaterHeating*** ⇨ ***CompenssationSpeed.***
- ***Boiler*** – the operation of the fans is blocked until there are no heating water requirements in the boiler room.
- ***Start*** – indicates the start-up status of the components when the unit is started, at which point the preheat may be activated, adjusting the start position of the dampers, recuperation and fan speed to ensure that the supply air temperature is optimum and the water heating is protected in winter. The related parameters in the ***ComponentsMachine*** menu are:
    - ***TemperatureRegulation*** ⇨ ***StartDuration***
    - ***Fans*** ⇨ ***StartingSpeed***
    - ***FreshAir*** ⇨ ***StartFreshAir***
    - ***WaterHeating*** ⇨ ***Preheat***
- ***SuperiorBlock*** – operation of the AC unit is blocked from a superior device, usually allowing the AC unit to turn on based on meeting technological or safety conditions, such as a fire alarm.
- ***Test*** – signals that the device is on for testing. Testing is described in a separate chapter.

6 Equipment components

The AC unit consists of individual mechanical components that ensure its required function with the required parameters. Depending on the technical specification, these components are configured in the measuring and control system and then displayed in item ***ComponentsMachine***. The components include, for example, ***Temperatures***, ***TemperatureRegulation***, ***Fans***, ***Burner***, ***ElectricalHeating***, ***WaterHeating***, ***CondensingUnit***, ***Recuperator***, ***Dampers***, ***Filters***, and others. Every component displays its current performance or status. Selecting a component displays more detailed information. Basic component information is available without logging in. These include the following items:

- ***State*** (Off/……..) - informs about the status and required regime of operation. The specific states may vary from component to component and are therefore described in detail for each component.
- ***Power*** (%) – informs about the required output of the device.
- ***OperatingHour*** – may be used as information for service personnel due to wear and tear on the fan or other components.
- ***NumberStarts*** – indicates how the unit is operated. A big number of starts may indicate improper operation of the entire AC unit.

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

- ***PID–Regulation*** ***(BLOCK/OG/UG/REG/Y–NV/UDEF)*** – contains the control parameters that determine the quality and speed of the required output control based on the required and actual values. The values are set by default at the factory and should only be changed by a person knowledgeable in control systems. The standard factory set values are shown for every component. The meaning of the individual control states is as follows:
  - ***BLOCK*** – controller function is not released,
  - ***OG*** – forced maximum output, parameter ***O,***
  - ***UG*** – forced minimum output, parameter ***O,***
  - ***REG*** – controller is active,
  - ***Y–NV*** – invalid setpoint, parameter ***S***,
  - ***UDEF*** – invalid output value, parameter ***O.***

The meaning of the individual control parameters is:

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

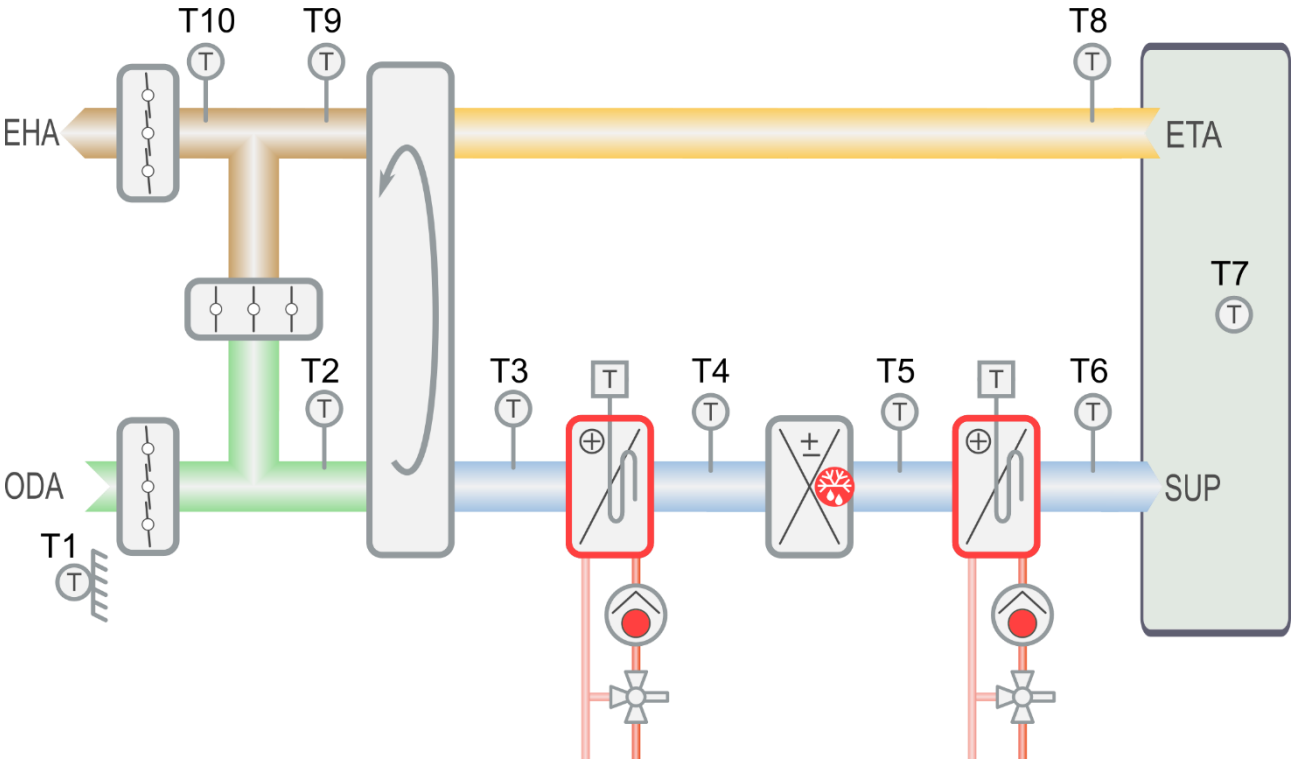
PID–Regulation values are only available for some components.

- ***OrderHeat, OrderCool (--/1/2/3/…)*** – this parameter determines the order of the component in the heating or cooling sequence. Selection -- means that the component will not be included in the sequence. The order used depends on the number of components in every sequence. For example, in the case of three heating components in the order of mixing, recuperation and water heating, the order is set to mixing 1, recuperation 2, and water heating 3. In the case of two cooling components in the order of heat recovery and condensing unit, the heat recovery is set to order 1 and condensing unit to 2. The components may not have the same order in the same sequence.
- ***Control (0–10V/****2–10V/10–0V/10–2V)* – this parameter determines the range of the output control signal for the actuator typically controlling the 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. It applies for glycol only.
- ***TimeOpen (90s)*** – time for the actuator to move from one extreme position to the other. When monitoring the actuator position feedback signal, the difference between the predicted and actual position may indicate a malfunction of a device mechanically connected to the actuator (damper, valve, etc.). If the actuator position feedback signal is not monitored, this value of the assumed damper position is only informative.
- ***Nonsensitive (20%)*** – this parameter is only meaningful when monitoring the damper position feedback signal. If the difference between the predicted and actual damper position is greater

than the non-sensitivity, then a damper failure may be indicated and consequently the component with that damper or the entire AC unit may shut down.

6.1 Temperatures

This menu contains information about the measured temperatures according to the settings in the configuration. The location of the temperature sensors in the air handling unit and air ducts can be seen in Figure 2.



Legend:

T1 – Outdoor (ODA)
T2 – Inlet
T3 – Supply Recuperation
T4 – Preheat – after 1st heating
T5 – Reheat – before 2nd heating
T6 – Supply (SUP)
T7 – Room
T8 – Extract (ETA)
T9 – Extract Recuperation
T10 – Exhaust (EHA)

Fig. 2 - Temperature sensor locations

Following are the descriptions of every temperature sensor, including installation methods and other related settings:

- ***Room*** – if configured, the sensor should be placed in the room that is the target of the air conditioning so that the measured temperature is not affected by any local influences, such as radiators, sunlight through a window, etc. If not configured, it can be replaced by a supply

or exhaust air temperature sensor. Multiple room sensors can be installed and the resulting room temperature is determined by the ***MoreRoomSensors*** parameter.

- ***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 the supply air is required to be preheated and is placed between preheating and reheating or cooling.
- ***Supply*** – in most cases, at least this sensor is configured to measure the supply air temperature. The temperature sensor is placed after the last heating or cooling component before the air enters the room. The maximum duct temperature is set at 50 °C per health and fire regulations.
- ***Flue*** – this sensor must be configured if the unit contains a gas heater as it ensures the proper operation and protection of the gas exchanger, including the emergency function. It is also used to control the gas exchanger bypass damper to mitigate condensation and heat the exchanger faster when the gas heater starts. The temperature sensor is placed in a sump welded above the flue way base. The QAZ21.5120 sensor from Siemens with the NI1000 measuring element is supplied as standard.
- ***Outdoor*** – should also be configured for all the air conditioning units to ensure correct operation of the control system especially when the unit is started up or shut down. The sensor should be located outdoors so that it is protected from weather influences that would improperly affect the M&C. For example, direct sunlight, rain, frost, wind, etc. The outdoor sensor is also used to control air circulation with a mixing damper or to efficiently use the recuperator. This sensor should always be configured as it is often tied to protection and start-up functions.
- ***HeatingWaterDrain*** – if the unit contains a water heater, then a temperature sensor must be configured to measure the heating water temperature. The heating water drain temperature sensor ensures proper operation and protection of the water heat exchanger. It is placed on the water exchanger discharge piping, called the return piping, so that it measures the actual temperature of the discharged water.
- ***HeatingWaterSupplied*** – this sensor is placed on the heating water supply line to measure the actual temperature of the water supplied to the water exchanger. It can be used to signal a heating water requirement to the boiler room.

- ***CoolingWaterDrain*** – this sensor can be configured if the unit contains a water cooler. It is placed on the water exchanger discharge piping, called the return piping, so that it measures the actual temperature of the cooling water. The sensor is for informational purposes only.
- ***CoolingWaterSupplied*** – this sensor is placed on the cooling water supply line to measure the actual temperature of the water supplied to the water exchanger. The sensor is for informational purposes only.
- ***Recuperation***
  - ***Inlet*** – placed upstream of the recuperator on the air inlet.
  - ***Supply*** – located after the recuperator on the air supply. Together with the inlet sensor, it provides information on the current thermal performance of the recuperation
  - ***Extract*** – ensures the correct defrost protection function of the recuperator. The temperature sensor is placed behind the recuperator on the air outlet.
- ***Extract*** – temperature sensor is in many cases configured as a replacement for the room temperature sensor, as it senses the temperature of the exhaust air from the room without being affected by local room influences. It is placed in the exhaust duct.
- ***Exhaust*** – used to measure the temperature of the exhaust air. It is placed at the end of the exhaust duct.
- ***MoreRoomSensors*** ***(Average****/OG/UG/1/2/SummerMin/WinterMin****)*** – with multiple room temperature sensors, determines how the final room temperature is calculated or assigned. When 1, 2 is selected, the final room temperature is given only by the selected sensor, and the other sensors are only informative. For other selections, the final value is calculated as a mathematical average, maximum or minimum. The ***SummerMin*** option selects the lowest measured room temperature in the summer and the highest in the winter. The ***WinterMin*** option selects the lowest measured room temperature in the winter and the highest in the summer.
- ***Display*** ***(Room****/****Extract****/****Supply****/****Preheat****/****Exhaust****)*** – selects the temperature sensor whose value will be displayed on the second line of the Home screen next to the current time. By default, a reference temperature sensor is selected and compared to the required temperature. A room, supply or exhaust air temperature sensor can be selected.

6.2 Temperature control

Temperature control can be direct or cascading and depends on the selection of the required temperature in the ***Configuration*** menu. In the case of the required supply temperature or preheat temperature, it is direct control. For the other options, it is cascade control (***PID–Supply***), which allows better control of the required temperature. Temperature control includes other parameters that affect the operation of the AC unit. Temperature control is accessible only after service login.

- ***State (Off/Ventilate/Heat/Cool)*** – current state of temperature control.
- ***Currently (°C)*** – current temperature on the setpoint sensor.
- ***DesiredSupply (22 °C)*** – current required supply air temperature.
- ***Required (°C)*** – required temperature for all regimes if the unit is controlled from a room unit.
- ***Summer*** – required temperatures for every regime in the summer, if the unit is not controlled from its room unit:
  - ***Comfort (22 °C)*** – required temperature for the ***Comfort*** regime in the summer.
  - ***Economy (18 °C)*** – required temperature for the ***Economy*** regime in the summer.
- ***Winter*** – required temperatures for every regime in the winter if the unit is not controlled from its room unit:
  - ***Comfort (23 °C)*** – required temperature for the ***Comfort*** regime in the winter.
  - ***Economy (19 °C)*** – required temperature for the ***Economy*** regime in the winter.
- ***FrostProtect (5 °C)*** – required heating temperature in the ***Tempering*** regime.
- ***Freecooling (18 °C)*** – required ventilation temperature in the ***Tempering*** regime.
- ***Compensation (0 °C)*** – difference between the outdoor temperature and the setpoint temperature at which the setpoint compensation is activated in the ***Economy*** or ***Comfort*** regime. Setpoint compensation is used at higher outdoor temperatures and consists of shifting the setpoint temperature, depending on the outdoor temperature. At the value of 0°C, the compensation is blocked.

  Example for ***Compensation = 6 °C*** in the ***Comfort*** regime:
  - Outdoor temperature ≤ 28 °C ⇄ required temperature = 22 °C.
  - Outdoor temperature = 32 °C ⇄ required temperature = 26 °C.
- ***DesiredPreheat (0 °C)*** – required temperature for water or electric heating preparing air for another component, usually a condensation unit. For proper operation, the temperature

sensor for preheat must be configured and the preheat must not have a valid order set, ***OrderHeat =---.***

- ***PID–Supply –*** is a cascade control that calculates the required supply temperature based on the required and actual room temperature or discharge temperature. The factory default values are: **TI = 900 s, KP = 10, WPD = 0 °C.** The only apply when configuration ***RequiredTemperature*** features no selected ***Supply*** and ***Preheat*** temperatures. If the ***RequiredTemperature*** configuration features the ***Supply*** or ***Preheat*** temperature, then this PID control is not applied, and the required temperature is equal to the required supply air temperature. The calculated required temperature of the air supplied by the PID is between ***HighLimitSupply*** and ***LowLimitSupply***.
- ***HighLimitSupply (30 °C)*** – current upper limit of the required supply air temperature, which is determined by the ***Fixed*** or ***Shift*** upper limit values.
  - ***Fixed (30 °C)*** – maximum required static supply air temperature. This value applies as the current maximum ***HighLimitSupply*** limit only if the upper limit is subject to ***Shift = 0 °C***.
  - ***Shift (0 °C)*** – non-zero value defines the current maximum required supply air temperature limit ***HighLimitSupply*** as the sum of the required temperature by regime ***(Comfort, Economy, Tempering,)*** and ***Shift***. The maximum required supply air temperature will change dynamically as the required temperature changes.
- ***LowLimitSupply (16 °C)*** – current minimum required supply air temperature limit, which is determined by the ***Fixed*** or ***Shift*** low limit values.
  - ***Fixed (16 °C)*** – maximum required static required supply air temperature. This value applies as the current ***LowLimitSupply*** minimum limit only if ***Shift = 0 °C***.
  - ***Shift (0 °C)*** – non-zero value defines the current minimum limit of the required supply air temperature ***LowLimitSupply*** as the difference between the required temperature per the regime ***(Comfort, Economy, Tempering***, and ***Shift***). The minimum required supply air temperature will change dynamically as the required temperature changes.
- ***CascadeNonSensitive (6 °C)*** – determines when to shut down the heating or cooling components of the unit when the minimum or maximum supply air temperature limit is exceeded:
  - If the supply air temperature exceeds the ***HighLimitSupply + CascadeNonSensitive*** value, then all the heating components of the unit will immediately shut down or cooling components of the unit will turn on.

- If the supply air temperature drops below the ***LowLimitSupply – CascadeNonSensitive*** value, then all the cooling components of the unit will immediately shut down, or the heating components of the unit will turn on.

➢ ***ShiftHC (2 °C)*** – shifts the required supply air temperature calculated by the cascade PID control for the ***Heat*** and ***Cool*** to achieve energy savings:

- ***Heat*** state – supply air temperature setpoint range is between ***HighLimitSupply – (ShiftHC / 2)*** and ***LowLimitSupply – (ShiftHC / 2).***
- ***Cool*** state – supply air temperature range is between ***HighLimitSupply + (ShiftHC / 2)*** and ***LowLimitSupply + (ShiftHC / 2).***

➢ ***HighSplyOff*** ***(***No/***Recuperation***/Heating***)*** – determines how much of the heating section will shut off when the upper limit of supply temperature plus insensitivity is exceeded. This feature is particularly applicable to condensing units with non-standard controls where the recuperation unit shuts down instead of the condensing unit. This will reduce the frequency of condensing unit shutdowns.

➢ ***ClimaTemp*** ***(***Outdoor***/Room/***Supply/Extract/Preheat/Exhaust/Room1/Room2/Season/Contact***)*** – selects a temperature sensor or other condition for the controller to decide whether to heat or cool the unit.

- When either temperature is selected, the required temperature is compared to the selected temperature.
- ***Season*** – the controller heats or cools based on the parameters set in item ***TemperatureSeason***. In the ***Summer*** temperature season, the unit only cools and in the ***Winter***, it only heats.
- ***Contact*** – the climate temperature is replaced by an external contact switching the heating or cooling regimes from the superior system (***AssignmentInputs/Outputs*** ⇨ ***ExternalSwitches*** ⇨ ***Cool/Heat***). By default, the unit is switched to cooling regime when the contact is open and to heating regime when the contact is open.

➢ ***ClimaShift (0 °C) –*** only has meaning if either temperature is selected as ***ClimaTemp***. For example, with the selected outdoor climate temperature, a required room temperature of 23 °C and a climate shift of 2 °C, climate insensitivity of 0 °C will result in an outdoor limit temperature for switching between heating and cooling of 25 °C.

➢ ***ClimaNonSensitive (1 °C) –*** only has meaning if either temperature is selected as ***ClimaTemp***. It is used to specify the limit temperature at which the unit should heat and at which it should

cool. It is the insensitivity band around the required climate temperature in which the temperature control will not change from ***Heat*** to ***Cool*** and vice versa.

- The unit will switch to heating if the selected ***ClimaTemp < RequiredTemperature + ClimaShift – ClimaNonSensitive.***
- The unit switches to Cool if the selected ***ClimaTemp > RequiredTemperature + ClimaShift + ClimaNonSensitive.***

Switching from cooling to heating, with the supply air temperature within the calculated temperature control limits, will only occur if all the cooling components are switched off. The switchover from heating to cooling, at a supply air temperature within the calculated temperature control limits, will only occur if all heating components are switched off. These conditions may not apply in the case of active humidity control.

- ***DeadBandStpt (0 °C) –*** applies when controlling heating or cooling components with step power control. If the current temperature falls into the insensitivity range around the required temperature, then the PID control of the component is interrupted and the component's output is not further changed, although the exact required temperature is not reached. At insensitivity values close to 0 °C, this function is almost inapplicable.
- ***TemperatureSeason (Summer/Winter, 18 °C, 60 min)*** – displays the condition that the controller has diagnosed by comparing the outdoor temperature with the setpoint temperature for the specified period of time. The values of the decision temperature and time are shown on the next line. If the outdoor temperature is less for the specified time, then the ***Winter*** temperature period occurs and if it is greater for the specified time, then the ***Summer***. The temperature period controls, for example, the function of the recuperator, the condensing unit or the water heating at the start of the AC unit. If the outdoor temperature sensor is not configured, the preset temperature period is ***Winter***.
- ***DelayHC (60 s)*** – minimum time interval between switching from heating to cooling or vice versa. During this time the temperature control is in the ***Ventilate*** state. This is to prevent abrupt changes in supply temperature.
- ***DelayOrder (90 s) –*** only relevant for a unit that contains heating or cooling components with non-zero starting power (gas heating, condensing unit or heat pump). After the component starts, PID control is not applied during the delay period, the component runs at minimum output and waits for the supply air temperature to respond to this condition.

- ***StartDuration* *(3min)* –** ensures a smooth temperature start of the unit depending on the unit's mixing damper. During this time, the calculated supply air temperature is equal to the required temperature. The unit start consists of 3 phases:
  1. After the regime selection, the unit switches to ***Start*** and waits with the fan start for the dampers to move to the required position and for the permission from the boiler room, if configured. The heat recovery performance is 100% at start up if the heat recovery temperature conditions allow. Depending on the outside temperature, water preheat will start if necessary.
  2. The fans are then run at start-up output for the duration of the start-up to allow the control to eliminate the outdoor temperature sensor location while acclimating the unit components.
  3. At the end of the start-up period, the fans are started up to the required operating output and the control of the components based on their PID control is also started up.
- ***LTFilter* *(0.02 °C/sec)*** – filters the step changes in the required temperature and the calculated supply air temperature from the PID cascade control. The standard setting for the linear temperature change rate is 2 hundredths of a degree per second.
- ***EnableRunning* (*All*/*Heat+*/*Cool+*/*Heat*/*Cool*)** – here you can restrict the AC unit running to the ***Heat*** or ***Cool*** states:
  - ***All*** – the unit behaves as standard, the fans are on in all three states of ***Ventilate*, *Heat***, and ***Cool***.
  - ***Heat+*** – unit is only operated in the ***Heat*** and ***Ventilate*** states. In the ***Cool*** state, the AC unit is switched off.
  - ***Cool+*** – the unit is operated in the ***Cool and Ventilate*** states. In the ***Heat*** state, the AC unit is switched off.
  - ***Heat*** – the unit behaves as a pure heater, the fans are only switched on in the state of ***Heat.*** In the ***Cool*** state, the AC unit is switched off.
  - ***Cool*** – the unit behaves as pure cooling, the fans only turn on in the state of ***Cool.*** In the ***Heat*** state, the AC unit is switched off.
- ***MaxSupplyTemp* *(50 °C)*** – safety value of supply air temperature. If exceeded, the gas or electric heating will be switched off if configured.

6.3 Humidity control

Humidity control is based on the required and actual humidity in the room or the exhaust or supply air. Humidification is carried out using steam generators. Dehumidification can be done passively or actively. Passive dehumidification of a ventilated room is carried out by ventilation under the condition that the outdoor absolute humidity is less than the required absolute humidity. In passive dehumidification, the amount of outdoor air supplied can be increased by increasing the output of the fans, opening the supply air damper or both simultaneously. Active dehumidification uses a cooling and heating component whereby the supply air is first cooled to remove moisture and then reheated to the required temperature. In the case of the required supply humidity, this is direct control. When controlling for room or exhaust humidity requirements, cascade control (***PID–Supply***) is used, which calculates the required supply humidity based on the difference between the required and actual humidity, allowing better control of the required humidity. Relative humidity sensors with 0-10 V analog output are mainly used for humidity measurement, but sensors with digital output can also be used.

- ***State*** ***(Off***/*OK*/*Low*/*High*/*Outdoor****)*** – current humidity control status relative to the required and actual measured value.
  - State ***Off*** – humidity control is not active.
  - State ***OK*** – current humidity is within the required range ***(Comfort/Economy)*** – ***LowHysteresis*** to ***(Comfort/Economy)*** + ***HighHysteresis.***
  - State ***Low*** – current humidity < required one (***Comfort/Economy***) – ***LowHysteresis.***
  - State ***High*** – current humidity < required one (***Comfort/Economy***) + ***HighHysteresis.***
  - State ***Outdoor*** – passive dehumidification with outdoor air is performed.
- ***Currently*** ***(%)*** – current temperature on the humidity sensor.
- ***DesiredSupply*** ***(%)*** – current required humidity of the supply air.
- ***Required*** ***(%)*** – required humidity for all regimes when the unit is controlled from a room unit and the humidity is measured by a sensor with analog output.
- ***Comfort*** ***(50%)*** – required humidity in the ***Comfort*** regime when humidity is measured by a sensor with analog output and the unit is not controlled from a room unit.
- ***Economy*** ***(50%)*** – required humidity in the ***Economy*** regime if the humidity is measured by a sensor with analog output and the unit is not controlled from a room unit.

- ***Control*** ***(Room/****Extract/Supply****)*** – determines the current humidity sensor used to control humidity.
- ***PID–Regulation*** – the factory default values are: **TI = 240 s, KP = 2, TD = 0 s.**
- ***PID–Supply*** – only applies when ***Setpoint = Room*** or ***Setpoint = Extract*** is set in the humidity control configuration. The factory default values are: **TI = 300 s, KP = 4, WPD =-2%**.
- ***Validity*** ***(Regime/****Always/Tempering****)*** **–** the system will only respond to a change in humidity status if the unit is not in the ***Off*** state. The ***Regime*** has the following options:
  - ***Regime*** **–** system will respond to a change in humidity status only if the AC unit is in the ***Comfort*** or ***Economy*** regime.
  - ***Always*** **–** system will respond to high humidity whenever the AC unit is not in the ***Off*** state. That is, if the unit is in the ***Tempering, Comfort*** or ***Economy*** regime.
  - ***Tempering*** **–** system will only respond to high humidity when the unit is in the regime ***Tempering.***
- ***HighHysteresis*** ***(5%)*** – value that determines the humidity control status. If the actual humidity differs from the required humidity by this value, then it will activate to humidify or dehumidify depending on the direction of the deviation.
  - ***High*** humidity status occurs if: Current humidity > required one (***Comfort/Economy***) + ***HighHysteresis.*** With preset values, dehumidification starts at 55% humidity.
  - ***Low*** humidity state occurs if: Current humidity < required one (***Comfort/Economy***) – ***HighHysteresis.*** With preset values, humidification starts at 45% humidity.
- ***LowHysteresis*** ***(1%)*** – deviation, determining return from low or high humidity state. Its function is as follows:
  - The ***High*** humidity state is terminated if: Current humidity < required one (***Comfort/Economy***) + ***LowHysteresis.*** With preset values, dehumidification is terminated at humidity of 52%.
  - State ***Low*** humidity is terminated if: Current humidity > required one (***Comfort/Economy***) – ***LowHysteresis.*** With preset values, humidification is terminated at humidity of 52%.
- ***HighLimitSupply*** – maximum humidity allowed in the supply air.
- ***LowLimitSupply*** – minimum allowable supply air humidity.
- ***ActiveDehumidification*** ***(No/****Cond/HPump/Water/All****)*** – specifies the cooling component that will dehumidify the supply air. This component is controlled by the output of the PID humidity

control. Active dehumidification is accomplished by cooling and then reheating the supply air to the required temperature. Active dehumidification is not carried out via outside air.

- ***No*** **–** active dehumidification will not be carried out.
- ***Cond*** **–** condensing unit will be used for active dehumidification.
- ***HPump*** **–** heat pump will be used for active dehumidification.
- ***Water*** **–** water cooling will be used for active dehumidification.
- ***All*** **–** all previous components will be used for active dehumidification if configured.

- ***PowerLimitation*** ***(1.00)*** – limits the power of the cooling component in active dehumidification. The power requirement of the cooling component is equal to: ***Output PID–Regulation*** x ***PowerLimitation*****.**
- ***PassiveDehumidification*** ***(No****/Fan/MixDmp/Fire&Smoke****)*** – determines the method of passive dehumidification with outside air. A necessary condition is that the absolute outdoor humidity is less than the absolute actual humidity from the sensor selected in ***Control***.
  - ***No*** **–** passive dehumidification will not be performed.
  - ***Fan*** **–** power of the fans preset for passive dehumidification will be used for passive dehumidification (***ExhaustFan***, ***ExhaustFan***)**.**
  - ***MixDmp*** **–** output of the fans preset for passive ventilation (FreshAir) will be used for passive dehumidification (***FreshAir***)**.**
  - ***Fire&Smoke*** **–** both previous methods will be used for passive dehumidification.
- ***SupplyFan*** ***(%)*** – supply fan speed when humidity is high and ***PassiveDehumidification*** ***(Fan/Fire&Smoke)*** is selected. The standard supply fan speed values for the regimes (***Comfort***, ***Economy***) should be less than this value.
- ***ExhaustFan*** ***(%)*** – fan speed when humidity is high and***PassiveDehumidification*** ***(Fan/Fire&Smoke)*** is selected. The standard exhaust fan speed values for the regimes (***Comfort***, ***Economy***) should be less than this value.
- ***FreshAir*** ***(%)*** – amount of fresh air when humidity is high and ***PassiveDehumidification*** ***(MixDmp/Fire&Smoke)*** is selected. The standard exhaust fan speed values for the regimes (***Comfort***, ***Economy***) should be less than this value. The damper setting is only accepted in the ***Tempering*** operating regime if the fan speed value is non-zero.
- ***Outdoor***, ***Absolute*** ***(%, g/kg)*** – measured outdoor relative humidity value and the absolute humidity value calculated from the relative humidity based on the outdoor temperature.

- ***Supply, Absolute (%, g/kg)*** – measured value of the relative humidity of the supply air and the absolute humidity value calculated from the relative humidity based on the supply air temperature.
- ***Room, Absolute (%, g/kg)*** – measured value of the relative humidity of the room air and the absolute humidity value calculated from the relative humidity based on the room air temperature.
- ***Extract, Absolute (%, g/kg)*** – measured value of the relative humidity of the exhaust air and the absolute humidity value calculated from the relative humidity based on the temperature of the exhaust air.

6.4 Fans

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

In the case of a unit equipped with both supply and exhaust fans, the displayed information can be common for both fans or can be displayed for each fan separately, depending on the settings in the configuration.

- ***Supply, Exhaust (Off/On)*** – displays information about fan on.
- ***2Supply, 2Exhaust (Off/On)*** – displays information about turning on the backup fan, if enabled in the configuration.
  - ***State*** – displays information about how the fan is operated:
    - ***Tempering*** – fan is running as required by the ***Tempering*** regime.
    - ***Economy*** – fan is running as required by the ***Economy*** regime.
    - ***Comfort*** – fan is running as required by the ***Comfort*** regime.
    - ***3xSpeed*** – fan is controlled in three stages by external contacts.
    - ***RoomUnit*** – fan is user controlled from one of the control panels.

- ***SplyTemp*** – fan speed is compensated based on supply air temperature. Or the fans are turned off because the supply air temperature is above the ***HighLimitSupply*** **+** ***OffShift*** limit or below the ***LowLimitSupply*** **–** ***OffShift*** limit.
- ***MixDmp*** – fan speed is compensated based on the selection in ***MixingCompensation***.
- ***Press*** – fan is controlled based on a constant air volume (CAV) or constant pressure (VAV) requirement.
- ***BadAQ*** – fan speed is compensated based on the air quality sensor.
- ***Ventilation*** – fan ventilates the heating components when the unit is switched off. This condition is also indicated as an auxiliary regime.
- ***Start*** – start-up sequence takes place before the fans start. E.g., opening supply and exhaust air dampers, starting the recuperator, preheating the water heater, etc.
- ***Release*** – not all the conditions required to start the AC unit fans based on the selected regime are met.

- ***Power*** (%) – displays the current fan speed.
- ***Summer*** **–** ***Comfort*** ***(100%)*** – supply or exhaust fan speed in the ***Comfort*** regime in the summer. Only if speed control from the room unit is selected (configuration parameter ***TypeControl*** ***= 'POLx'***), ***Comfort*** is the maximum speed value that can be set from the room unit. This value is not displayed if parameter ***TypeControl*** ***= 'Press'.***
- ***Summer*** **–** ***Economy*** ***(80%)*** **–** supply or exhaust fan speed in the ***Economy*** regime in the summer. Only if speed control from the room unit is selected (configuration parameter ***TypeControl*** ***= 'POLx'***), ***Economy*** is the minimum speed value that can be set from the room unit. This value is not displayed if parameter ***TypeControl*** ***= 'Press'.***
- ***Winter*** **–** ***Comfort*** ***(100%)*** – fan speed of the supply or exhaust fan in the ***Comfort*** regime in the winter. Only if speed control from the space instrument is selected (configuration parameter ***TypeControl*** ***= 'POLx'***), ***Comfort*** is the maximum speed value that can be set from the space instrument. This value is not displayed if the corresponding fan parameter ***TypeControl*** ***= 'Press'.***
- ***Winter*** **–** ***Economy*** ***(80%)*** **–** speed of the supply or exhaust fan in the ***Economy*** regime in the winter. Only if speed control from the room unit is selected (configuration parameter ***TypeControl*** ***= 'POLx'***), ***Economy*** is the minimum speed value that can be set from the

room unit. This value is not displayed if the corresponding fan parameter ***TypeControl = 'Press'.***

- ***Comfort, Economy (Pa, m3/h)*** – required duct pressure when controlling the performance of the fans to constant pressure (VAV) or the required amount of air conveyed when controlling the performance of the fans to constant flow (CAV) in the regimes of ***Comfort*** or ***Economy.*** This value is only displayed if the corresponding fan's ***TypeControl = 'Press'.*** The required and actual pressure or flow rate values in % are passed to the ***PID–Regulation*** that controls the fans. The constant pressure (VAV) control of the fans takes precedence over the constant flow (CAV) control. Therefore, for constant flow control to apply, the required pressure must be 0 Pa.
- ***PID–Regulation*** – the factory default values are: **TI = 120 s, KP = 2, TD = 0 s.** Only displayed if the configuration parameter ***TypeControl = 'Press'.***
- ***Press (Pa)*** – displays the current duct pressure based on the analog pressure sensor if the configuration parameter ***TypeControl = 'Press'.***
- ***Flow (m3/h)*** – displays the current air flow in the duct based on the analog pressure sensor if the configuration parameter ***TypeControl = 'Press'.***
- ***RampStart (60 s) –*** time (ramp-up) for the fan speed control signal to reach from 0 V (0% speed) to 10 V (100% speed). The ramp-up value is determined by the fan type and the technical specification of the AC unit. The rump-up of the fan with EC motor is directly controlled by the ramp value. The minimum speed of the EC motor is set in the controller at 18 Hz. In case of fans with frequency converters, the ramp-up value set in the controller is informative, because the fan start-up is determined by the ramp set in the parameters of the frequency converter. Since the actual fan speed is not monitored by default, the ramp-up value entered in the controller is mainly used to display the expected actual fan speed. Therefore, the ramp-up values should be set the same in the frequency converter parameters as in the controller. The minimum speed is also set in the frequency converter parameters.
- ***RampFinish (30s)*** – time (ramp time) for the supply and exhaust fan speed control signal (each separately) to reach from 10 V (100% speed) to 0 V (0% speed). The ramp time has a different value for every fan type. The run-out time of the fans with EC motors is determined by this value. For fans with frequency converters, the ramp value is informative because the run-out time of the fans is determined by the run-out time

specified in the frequency converter parameters. Therefore, the run-out values should be the same.

- ***Speed (%,%,%)*** – speed values for three-stage fan speed control by external contacts. ***ModeSwitches=3xSpeed*** must be set in the configuration.
- ***MinSpeed (36%)*** – used to protect the motor against thermal overload when operating at speeds lower than 18 Hz for long periods of time (36% is for the rated speed of 50 Hz). This applies mainly to frequency converter controlled motors.
- ***MaxSpeed (100%)*** – used to limit the fan power to prevent the individual ***Comfort*** and ***Economy*** regimes from setting fan power in excess of their operating point according to the unit's technical specifications. A bigger amount of supply air can cause, for example, incorrect operation of the manostats (exceeding the pressure drop) of filters, recuperator, etc.
- ***Delay (30 s) –*** delay of the supply fan switching on after the exhaust fan switching on. This function is particularly important in a recuperator configuration where the warm air supplied to the recuperator by the exhaust fan heats the recuperator before the supply fan starts.

➢ ***Release (1 to 31) –*** indication that the conditions for starting the AC unit fans have been met. The value is given by the sum of the weights of all the 5 conditions with weights of 1 to 16. The weights of the conditions needed to start the fans are in Tab. 1.

Condition	Weight	Condition description
1	1	There is no fault blocking the operation of the fans.
2	2	One of the operating regimes is selected (***Comfort, Economy, Tempering***, or ***Freecooling*).**
3	4	Unit operation is not blocked by another component (service switch, boiler room, air flow sensor, etc.).
4	8	Standard operating requirement to turn on the fans (***Heat, Cool*** or ***Ventilate***) that is not blocked by too low or high supply air temperature.
5	16	Forced on fans with a higher priority than the standard operating requirement (unit ventilation, poor air quality or humidity, etc.).

Table 1 - Fan start release

- ***Release < 15 –*** Fans are not running, all the necessary conditions are not met.
- ***Release = 15 –*** Fans are running, all the necessary conditions are met.

- ***Release* > 15 –** Fans are running, the reason is some overriding function.

➢ ***StartingSpeed* (20%)** – specification of the fans speed during the auxiliary ***Start*** regime. If ***MinSpeed*** is higher than ***StartingSpeed***, then ***MinSpeed*** will be used when the unit starts.

➢ ***MixingCompensation*** (***No***/*Supply*/*Extract*/*Both*) – specifies which fan speed will be compensated based on the mixing damper opening. It is primarily used on compact units designed so that when the mixing damper is 100% open, the exhaust fan pushes air into the closed exhaust damper.

➢ ***CompensationTemperature*** (***No***/*Temperature*/*Option*/*Fire&Smoke*) – fan speed compensation used to achieve the required supply air temperature by varying the fan speed level. Compensation can be enabled at will:

- ***Temperature*** – speed compensation is enabled in the heating state when the supply air temperature is low and the heating capacity cannot be increased any further. In the cooling state, it is enabled when the supply air temperature is high and the cooling capacity cannot be increased any further.
- ***Option*** – compensation is enabled if the supply air temperature is low and at the same time any of the ***CoolError***, ***Defrost*** or ***HeatErr*** options is set to ***Compensation***.
- ***Fire&Smoke*** – compensation occurs if any of the previous conditions are met.

The following parameters affect when compensation is triggered:

- ***On* (1 °C)** – specifies by how many degrees the supply air temperature must be below the required value for compensation to be triggered.
- ***Shift* (4 °C)** – shifts the supply air temperature for PID speed control. The shift is positive in the heating regime and negative in the cooling one.
- ***Delay* (60 s)** – time that the supply air temperature must be low and the heating output cannot be increased to enable compensation.
- ***PID–Compensation*** – contains control parameters for the operation of fans controlled to the required supply air temperature, which determine the quality and speed of the control. The values are set by default at the factory and should only be changed by a person knowledgeable in control systems. The factory default values are: ***TI = 60 s, KP = 8, TD = 0 s.***

➢ ***CoolError*** (*Regime*/***Compensation***) – this is where the fan speed is defined when a cooling fault occurs. When ***Regime*** is selected, the speeds stay at the level set by the regime or other

control and when ***Compensation*** is selected, the speeds switch to a speed compensated by the supply air temperature.

- ***Defrost*** **(***Regime*/***Compensation)*** – this defines the fan speed when defrosting the condensing unit, recuperator or glycol circuit exchanger. When ***Regime*** is selected, the speeds stays at the level set by the regime or other control and when ***Compensation*** is selected, the speed switches to a speed compensated per the supply air temperature.
- ***HeatErr*** ***(****Regime*/***Compensation***) – this defines the fan speed during a heating fault. When ***Regime*** is selected, the speed will stay at the level set by the regime or other control and when ***Compensation*** is selected, the speed switches to a speed compensated per the supply air temperature.
- ***OffShift*** ***(10 °C)*** – AC unit shuts down if the supply air temperature exceeds ***HighLimitSupply*** **+** ***OffShift*** or drops below ***LowLimitSupply*** **–** ***OffShift***. The purpose is to protect the ventilated room from becoming too cold or overheating when heating or cooling components fail. This function can be blocked by specifying an unreasonably large offset value, up to max. 100°C.
  - ***Delay*** ***(600 s)*** – delay of the AC unit shutdown due to extremely low or high supply air temperature.

6.5 Fresh air

If the AC unit is equipped with dampers, then information about their status is displayed here. Control of the dampers can be done based on unit operation, external contact or mixing request. By default, mixing can be performed based on the current operating regime, the selected temperature, a user request from the POL822 room unit, or it can be controlled according to the required temperature as part of a heating or cooling sequence. Mixing can also be affected by higher priority functions.

The supply and exhaust dampers are normally controlled by the same signal as the mixing damper, only set in the opposite direction of rotation. For the correct display of damper status and fresh air quantity, it is necessary to observe the correct configuration of the AC unit dampers according to the electrical wiring. In the ***Off*** state of the unit, the supply and exhaust dampers must be fully closed and the mixing damper fully open.

- ***FreshAir*** ***(%)*** – amount of fresh air supplied to the room according to the preset parameters.
  - ***State*** –displays information about the operation of the dampers:

- ***Regime*** – in this state the dampers can be controlled according to the preset parameters for ***Comfort*** and ***Economy*** regimes or from a room unit or external contact.
- ***Humidity*** – dampers are controlled based on the set position for the dehumidification condition.
- ***AirQuality*** – dampers are controlled based on the set position for poor air quality.
- ***Defrost*** – request for a minimum amount of fresh air is sent to the dampers because a heating component is in defrost regime and at the same time the damper response to defrost is enabled, parameter ***Defrost = Yes.***
- ***WaterHeating*** – minimum fresh air request is sent to the dampers because water heating protection has occurred.
- ***Err*** – all the dampers open 100% because one of the dampers is not in the expected position. This is only true if the backward position of the dampers is monitored, and every damper has its own control signal assigned at the control outputs from the controller.

➢ ***Damper (%)*** – required damper position calculated by the controller. The value is displayed separately for every damper enabled in the configuration. This value should correspond to the actual damper position if the damper control output is set correctly according to the wiring diagram and servo drive type.

➢ ***CtrlMixingComfort, MixingEconomy (Fixed/****Linearly/POL/Setpoint/2Setpoint****)*** – assuming the unit includes a mixing damper, this parameter can be used to set the fresh air quantity control to a fixed value, to a linearly varying value based on temperature, to a required supply air temperature, or to a required preheat temperature, as part of a heating or cooling sequence, according to the POL822 room unit, for every regime separately.

➢ ***Fixed*** – dampers are set to a fixed value corresponding to the temperature period and the selected regime.

- ***SummerComfort (80%)*** – fixed position of the supply damper in the ***Comfort*** regime for option ***CtrlMixingComfort='Fixed'.***
- ***SummerEconomy (50%)*** – fixed position of the inlet damper in the ***Comfort*** regime for option ***MixingEconomy='Fixed'.***
- ***WinterKomfort (80%)*** – fixed position of the inlet damper in the ***Economy*** regime for option ***CtrlMixingComfort='Fixed'.***

- ***WinterEconomy* (50%)** – fixed position of the inlet damper in the ***Economy*** regime for option ***MixingEconomy='Fixed'.***

➢ ***Linearly* (*Outdoor*/*Preheat*/*Inlet*/*Room* /*Supply*/*AftRecup*)** – determines the temperature sensor that will linearly control mixing for the ***CtrlMixingComfort='Linearly'*** option or for the ***MixingEconomy='Linearly'*** option.

- ***Temperature* (°C)** – current temperature measured by the sensor selected in ***Linearly.***
- ***MinAiring, MaxAiring* (0 °C**) – temperature limits for linear mixing control for the ***CtrlMixingComfort='Linearly'*** option or option ***MixingEconomy='Linearly. MaxAiring*** determines at what temperature the minimum amount of fresh air will be 100%. ***MinAiring*** determines at what temperature the minimum amount of fresh air will be. Between these cut-off temperatures, the amount of fresh air will vary linearly. These values can be set separately for both states of ***Heat*** and ***Cool.*** In the ***Ventilate*** state, the mixing setting remains the same as in the previous regime.

➢ ***Setpoint*** – with this option, the mixing damper acts as a heating or cooling component and must be assigned a priority for heating or cooling. The amount of fresh air is controlled based on PID control.

- ***PID–Regulation* –** the factory default values are: **TI = 150 s, KP = 8, TD = 0 s.**

➢ ***MinFreshAirComf, MinFreshAirRedu* (0%, 15%)** – minimum hygienic value of supply air damper opening for every regime. This parameter does not apply if the unit is in its ***Off*** regime. The supply and exhaust dampers are always opened to at least this value when the unit is running, if the mixing regime is selected.

➢ ***StartFreshAir* (15%)** – indicates the amount of fresh air when the unit starts. Unit start is signalled as an auxiliary regime.

➢ ***Defrost* (*No*/*Yes*)** – affects the amount of fresh air when defrosting any of the configured components.

- ***No*** – defrost status of a component does not affect the amount of fresh air.
- ***Yes*** – reduces the amount of fresh air to the minimum value when defrosting some component.

6.6 Recuperation

In addition to recovering heat, recuperation can also be used to recover cold. Recuperation can be implemented by a plate recuperator, rotary recuperator or a glycol circuit.

The motor protection of the rotary recuperator is provided by a motor thermocontact connected to a frequency converter, if the motor contains one. If the motor does not contain a thermocontact, it is necessary to connect the appropriate terminals on the frequency converter or change the parameters of the frequency converter so that the frequency converter does not monitor the state of the motor thermocontact. The setting of the frequency converter parameters for a specific job is part of the documentation.

- ***State*** – displays information about the operation of the recuperator.
  - ***Off*** – recuperator is not used.
  - ***Cool*** – recuperator is used for cooling.
  - ***Heat*** – recuperator is used for heating.
  - ***NoCool*** – recuperator cannot cool because the temperature of the exhaust air is higher than the outside air temperature.
  - ***NoHeat*** – recuperator cannot heat because the temperature of the exhaust air is lower than the outside air temperature.
  - ***Defrost*** – recuperator is in its defrost regime.
  - ***Err*** – recuperator is not working properly. The specific fault is listed in the alarm messages.
- ***Power*** (%) – displays the current damper opening of the plate recuperator or the rotary recuperator speed.
- ***MinPower (0%)*** – minimum power of the heat recovery system at power up.
- ***Ramp (60 s)*** – time (ramp-up, ramp-down time) for the recuperator control signal to reach the recuperator speed from 0 V (0% speed) to 10 V (100% speed) and vice versa. The value is only relevant for a rotary recuperator.
- ***FillGlycol (80%)*** – this value determines the pressure limit in the glycol circuit at which the glycol make-up pump will turn on. The pressure in the glycol circuit is measured by a pressure sensor with a 0-10 V output. The required value is calculated as follows: ***FillGlycol*** (%) = Minimum pressure (Pa) * 100 / sensor range.
- ***Inlet (°C)*** – current temperature in front of the recuperator at the air inlet.

- ***AftRecup (°C)*** – current temperature after the recuperator at the air supply.
- ***RecuperatorExhaust (°C)*** – current temperature after the recuperator on the air exhaust.
- ***PID–Regulation*** – the factory default values are: **TI = 300 s, KP = 4, TD = 0 s**.
- ***MaxPower (0%)*** – maximum speed of the rotary recuperator motor.
- ***SpeedMonitoring (240 s)*** – applies only to rotary recuperators equipped with a pulse speed sensor. If the sensor does not detect a rotating recuperator during this time, then a recuperation fault is declared.
- ***Anti–FreezeProtection*** – anti-freezing protection of the recuperator can be provided by a manostat with digital or analog output, monitoring the air pressure before and after the recuperator at the air supply or exhaust. Or it is secured via a temperature sensor located behind the recuperator at the air inlet or outlet. If both temperature sensors are fitted, then only the temperature sensor on the air outlet contributes to frost protection. Both methods can be combined. When the recuperator freezes, the bypass damper of the plate recuperator opens or the rotary recuperator speed is reduced to the minimum value. The mixing damper opens to 100%. At the same time, the fan speed can be adjusted according to the setting of the parameter ***ComponentsMachine ⇄ Fans ⇄ Defrost = „Compensation“***. The parameters of the recuperator frost protection are:
  - ***Press (Pa) –*** current pressure measured by manostat with analog output.
  - ***OG (Pa) –*** pressure value above which the recuperator frost protection is activated.
  - ***Temperature (°C)*** – if the current temperature of any of the temperature sensors behind the recuperator at the supply or exhaust air is less than this value, then the recuperator frost protection will be activated.

6.7 Water heating

Water heating is controlled based on the selected regime and the required temperature in conjunction with the temperature sensors. As standard, a quality control with a three-way valve and an electric water pump are used. Anti-frost protection is provided by an anti-frost thermostat, a temperature sensor for discharge or supply water and a temperature sensor for supply or outside air.

Emergency frost protection is provided via the frost protection thermostat. The frost protection thermostat shall signal a drop in supply air temperature below the thermostat setpoint,

preferably via an open contact. When the emergency frost protection is activated, the fans are switched off, mixing damper is opened to 100%, pump is switched on, three-way valve is opened to 100%, and a fault is signalled.

Operational frost protection is performed based on return water temperature, outdoor temperature, and supply air temperature in the following cases:

1. When the unit is switched on, the heating water temperature drops below´6 °C (***TempWtr***) – pump switches on, and the three-way valve opens to 100%. The frost protection stops if the temperature rises above 7 °C.
2. When the unit is switched on, the supply air temperature falls below 6 °C (***SplyTemp***) – pump switches on, and the three-way valve opens 100%. The frost protection stops if the temperature rises above 7 °C.
3. When the unit is switched off, the heating water temperature falls below 10 °C (***TempWtr***) – pump switches on, and the three-way valve opens. The three-way valve opens fully at 4 °C. Between 4 °C and 10 °C, the valve position is linearly dependent on the temperature of the discharged water. The frost protection stops if the temperature rises above 10 °C.
4. Based on the ***PumpOn*** selection, the pump can be switched on at a low outside air temperature with the unit switched off or on (***TempOut***).

´Frost protection is indicated as ***AuxilieryMode*** – ***ProtectWaterHeating*** on the controller display in the main menu.

Any failure of the water heating will open the three-way valve to 100% and turn on the pump. If the unit is running during a water heating fault, then the fan speed may be reduced when***ComponentsMachine*** ⇨ ***Fans*** ⇨ ***HeatErr*** = ***Compensation*** is set. This condition is indicated as ***AuxilieryMode*** – ***CompenssationSpeed*** on the controller display in the main menu.
Additionally, the water heating fault counts are displayed after user login.

- ***State*** – displays information about the water heater operation.
  - ***Ready*** – water heating is switched off.
  - ***Heat*** – water heater is heating.
  - ***Humidity*** – water heater is heating to reheat dehumidified air.
  - ***TempOut*** – heating water temperature is low, pump is on.
  - ***TempSup*** – supply air temperature low, heater is on.

- ***TempWtr*** – heating water temperature is lower than the set required or low temperature.
- ***Preheat*** – preheating is in progress to ensure the heat exchanger is heated before the fans are started.
- ***Frost*** – thermostatic frost protection of the water exchanger is active, heating is on.
- ***Err*** – specific fault is listed in the alarm messages, heating is on.

➢ ***Pump*** – displays information about the contact controlling the heating pump.

- ***Off*** – water heating pump contact is open.
- ***On*** – water heating pump contact is switched on.

➢ ***Power*** (%) – current opening of the water heating valve.

➢ ***PID–Regulation*** – factory default values are: **TI = 120 s, KP = 6, TD = 0 s**.

➢ ***HeatingWaterSupplied (°C)*** – current heating water temperature before the heat exchanger.

➢ ***HeatingWaterDrain (°C)*** – current temperature of the heating water after the heat exchanger.

➢ ***LowTempWater (12 °C)*** – drain water temperature limit value used as operational protection of the water heating when the unit is switched on (pump on). If the heating water temperature is lower, then the valve opens and fan speed compensation is activated until the temperature rises above the ***NecessaryWaterTemp*** value.

➢ ***NecessaryWaterTemp (20 °C)*** – discharge water temperature limit at which the water heating output will change to the setpoint and and the next heating component will turn on in the order of.

➢ ***Preheat (0%)*** – ensures temperature-friendly 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 preheat starts.
- ***Low (5 °C, 50%) –*** maximum outdoor temperature at which the valve will open to 50% after preheat starts.
- ***On (180s) –*** duration of the first sequence where the fans start, the pump turns on, and a fixed valve opening value is set based on the outdoor temperature and ***UG*** and ***OG*** parameters. Between these cut-off temperatures, the fixed valve opening is set linearly.

- ***Off* (*2%/UG*) –** second sequence where the valve opening calculated by the preheat begins to decrease at the rate given by the ***Off*** parameter while enabling PID control of the valve opening based on the required temperature**.** The actual valve opening corresponds to the bigger of the two.
- ***CompenssationSpeed* (*No/Yes/Only*)** – selection of preheating and fan speed compensation combinations based on supply air temperature. The individual items have the following meanings:
  - ***No*** – no speed compensation is applied during preheating.
  - ***Yes*** – speed compensation is active at the same time as preheating.
  - ***Only*** – only speed compensation is active instead of preheating.

***PumpOn* (*Normally/OnLowTout/Regime/Always*)** – pump switched on outside of standard operation. The individual items have the following meanings:

- ***Normal*** – pump turns on in the heating regime only when a valve is requested to open.
- ***OnLowTout*** – pump turns on if the outside temperature is below 1°C, regardless of the unit status.
- ***Regime*** – pump will turn on if ***TemperatureRegulation*** switches to the ***Heat*** state.
- ***Always*** – pump is permanently switched on in the heating regime.

- ***PumpSpin* (*No/Yes*) –** this parameter enables the pump to spin down once a week to prevent the pump from stalling.
- ***InSummer* (*Block/Enable*)** – allows the water heating to be turned off in the summertime, thus limiting the use of the hot water source if it is only for the HVAC unit.
- ***CoolingProtection* –** protection of the heat exchanger when the cooler is placed in front of the water heating exchanger. A preheating temperature sensor placed in front of the water heating exchanger is a prerequisite to control the required heating output. Up to 8 temperature points of the heating performance curve corresponding to the preheating temperature can be set.
- ***OffProtection* –** protection of the water heating exchanger when the unit is switched off. Exchanger protection when the heat exchanger is placed in front of the water heating exchanger. Similar function to ***CoolingProtection***, but based on the outdoor temperature.

6.8 Electric heating

Electric heating is controlled based on the selected regime and required temperature in conjunction with temperature sensors. The fans are switched on as a condition for switching on the electric heater. The electric heating control is ready for modulating and non-modulating heaters.

Protective functions are provided by the emergency thermostat, which switches off the power supply to the electric heater in case of overheating, and this condition is signalled to the controller, which performs the total cooling of the electric heat exchanger. Do not turn off the power to the AC unit (supply fan) while the electric heater is running! It will overheat!

If the electric heater fails, the fan speed may decrease after the heat exchanger has cooled down when the parameter ***ComponentsMachine*** ⇨ ***Fans*** ⇨ ***HeatErr*** = ***Compensation***. This condition is indicated as ***AuxilieryMode*** – ***CompenssationSpeed*** on the controller display in the main menu.

- ***State*** – displays information about the electric heating operation.
  - ***Ready*** – electric heating is not used.
  - ***Heat*** – electric heating is in the heating regime.
  - ***Err*** – electric heater contactor is open when heating is required, heating is off.
- ***Heating*** – displays information about the contact controlling the heating contactor.
  - ***Off*** – contact for the electric heater contactor is open.
  - ***On*** – contact for the electric heater contactor is open.
- ***Power*** (%) – current electric heater output.
- ***ContactorOn (No/Yes)*** – it is only relevant for modulating electric heaters and enables the contactor to turn on for the duration of the heating regime even if the modulation signal is zero. The purpose is to reduce wear and tear of the contactors.
- ***MaxPower (100%)*** – here the maximum power limit of the electric heater can be set. This function is usually used when the fan power is reduced and the electric heat exchanger is overheating.
- ***PID–Regulation*** – the default factory set values are: **TI = 120 s, KP = 6, TD = 0 s.**
- ***kW/Section (kW)*** – total power input value of the electric heater. It is meaningful only for energy balance.

6.9 Gas heating

The gas heating burner is controlled based on the selected regime and required temperature in conjunction with temperature sensors and the burner bypass damper, if installed. The Monzun burner inserts from Mandík a.s. or burner inserts with burners from other manufacturers can be installed. The burners can be single-stage, two-stage or modulating. The maximum value of 100% modulation burner corresponds to the maximum power of the heat exchanger in kW according to the documentation. The minimum value of the actual output is set when the burner is commissioned and corresponds to the minimum output of 0%. During normal operation, the burner will only turn on if the fans are running. The burner operation is indicated by its indicator light on the control box. In transitional periods (spring and autumn) the number of starts may be bigger than in the winter. However, too frequent burner starts may indicate incorrect operation of the entire AC unit.

Protective functions are provided by an emergency thermostat and temperature sensor in the flue gas. The exhaust gases temperature sensor has the function of an operating thermostat set at 200 °C. When this exhaust gases temperature is reached, the burner is switched off with the fans running. Once the burner has cooled down below 80 °C, it will switch back on again, unless another fault has occurred. The emergency thermostat is located behind the gas exchanger and is fixed at 90 °C. When this temperature is exceeded, the emergency thermostat shuts off power to the burner and operator intervention (thermostat reset) is expected to address the cause of this condition. Turning off the power to the control while the gas heater is running will cause the heater to overheat!

If the gas heater fails, the fan speed may decrease after the heat exchanger has cooled down when parameter ***ComponentsMachine*** ⇨ ***Fans*** ⇨ ***HeatErr*** = ***Compensation***. This condition is indicated as ***AuxilieryMode*** – ***CompenssationSpeed*** on the controller display in the main menu.

- ***State*** – displays information about the gas heater operation.
  - ***Ready*** – gas heating is not used.
  - ***Heat*** – gas heating is in the heating regime.
  - ***TempSup*** – supply air temperature is greater than the maximum allowable duct temperature setting in ***ComponentsMachine*** ⇨ ***TemperatureRegulation*** ⇨ ***MaxSupplyTemp***.

- ***TempFlue*** – the flue gas temperature exceeds the maximum permitted flue gasses temperature ***MaxTempExhaustGases***.
- ***Err*** – gas burner indicates a malfunction or has not ignited.

➢ ***Burner*** – displays information about the contact controlling heating.

- ***Off*** – gas heater contact is open.
- ***On*** – gas heating contact is on.

➢ ***Power*** (%) – current opening of the gas heating valve.

➢ ***MaxTempExhaustGases*** ***(200 °C)*** – emergency limit of exhaust gas temperature. When it is reached, the burner is switched off and a fault is signalled.

➢ ***ExhaustGasesMin*** ***(80 °C)*** – when the flue gas temperature drops below this value, the fan may shut down.

➢ ***TimeRangeBurn*** ***(40 s)*** – time it takes for the burner valve actuator to change the valve from 0% to 100%. This value is required for proper three point control of the actuator.

➢ ***MaxPower*** ***(100%)*** – the maximum power limit of the gas heater can be set here. This feature is usually used when the fan power is reduced, and the gas heat exchanger may overheat.

➢ ***ChangePower*** ***(30 s)*** – control output is sent to the gas heater automation at intervals, allowing rapid changes in power requirements to be filtered out.

➢ ***PID–Regulation*** – the default factory set values are: **TI = 60 s, KP = 5, TD = 0 s.**

➢ ***PID–FlueGas*** – contains values that determine the quality and speed of the gas heating power limit control based on actual and maximum flue gas temperature. The factory default values are: **TI = 60 s, KP = 5, TD = 0 s.**

➢ ***DamperAtHeatExchanger*** – is controlled based on flue gas temperature or pressure to achieve optimum combustion in normal operation. Another function of the bypass damper is to ensure minimal condensation of water vapour in the heat exchanger during cold start.

- ***Required*** ***(140 °C)*** – required flue gas temperature to which the damper position is controlled. Control to this value is only applied when the flue gas temperature reaches 40 °C below the required temperature to allow the heat exchanger to warm up as quickly as possible. If the flue gas temperature exceeds ***MaxTempExhaustGases***, the exchanger damper is closed to cool the exchanger.
- ***Required*** ***(300 Pa)*** – required pressure at the flue gas exchanger at which the damper position is controlled. The purpose is to lead a quantity of air through the heat exchanger

such that optimum heat transfer occurs. The value should correspond to the value in the technical specification of the AC unit.

- ***PID–Damper*** – contains values that determine the quality and speed of the gas heating bypass damper position control based on the pressure or temperature of the flue gas. PID control is not applicable at flue gas temperatures below 80 °C (damper 100% open). The factory default values are: **TI = 60 s, KP = 2, TD = 0 s.**

➢ ***Convector (Off/On)*** – is a device that ensures suitable thermal conditions for burner ignition and protects it from freezing. If an outdoor temperature sensor is not installed, then the flue gas temperature sensor is used for protection, which is placed in the base of the chimney outdoors. A practical implementation is a 230V socket controlled from the controller, which is located in the burner electronics chamber. An electric radiator or heating cable can be connected to the socket. If the power supply to the control cabinet or controller is switched off, this protection will not work! It is mainly used on external AC unit designs.

- ***SetOn (4 °C,*** *BurnOn*/***Always***/*BurnOff****)*** – determines the conditions under which the burner box is to be heated. The first condition is that the outside temperature or flue gas temperature falls below the set limit value. The second condition is set according to:
  - ***BurnOn –*** convector will only be switched on when the gas heating is switched on and the temperature is low.
  - ***Always –*** convector always switches on at low temperature, regardless of the gas heating status.
  - ***BurnOff –*** convector will only switch on when the gas heating is switched off and the temperature is low.
- ***Delay (10 min)*** – parameter for the delay of switching the convector on and off.

6.10 Water cooling

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

If the water cooling fails, the fan speed may be reduced according to parameter ***ComponentsMachine*** ⇨ ***Fans*** ⇨ ***CoolError = Compensation***. This condition is indicated as ***AuxilieryMode*** – ***CompenssationSpeed*** on the controller display in the main menu.

- ***State*** – displays information about the gas heater operation.
  - ***Off*** – water cooling is not used.
  - ***Cool*** – water cooling is active.
  - ***Err*** – water cooling pump is malfunctioning, the valve will close.
- ***Power*** (%) – current opening of the gas heating valve.
- ***Pump*** – displays information about the contact controlling the cooling pump.
  - ***Off*** – water cooling pump contact is open.
  - ***On*** – water cooling pump contact is open.
- ***PID–Regulation*** **–** the factory default values are: **TI = 150 s, KP = 8, TD = 0 s.**
- ***CoolingWaterSupplied*** ***(°C)*** – current cooling water temperature upstream of the heat exchanger.
- ***CoolingWaterDrain*** ***(°C)*** – current temperature of the cooling water after the heat exchanger.

6.11 Condensing units

There are numerous manufacturers of external cooling devices on the market that can be used with air conditioning units. Almost every manufacturer of a cooling or condensing unit has its own control method. This causes a great deal of fragmentation in the way refrigeration or condensing units are controlled, and sometimes it is very difficult to reconcile the control of an air conditioning and condensing unit. Therefore, it is possible to choose the type of control of the condensing unit (chiller) according to the specific control methods of each manufacturer, which is continuously updated. The condensing unit control is prepared to control 6 separate units.

In the event of a failure or defrost of the condensing unit, the fan speed can be reduced to reduce the supply air temperature to achieve the required supply air temperature. The compensation for these conditions must be set in the menu ***ComponentsMachine*** ⇄ ***Fans.*** This condition is indicated on the controller display in the main menu as ***AuxilieryMode*** – ***CompenssationSpeed***.

- ***Unit*** – displays information about the operation of the condensing unit.
  - ***Off*** **–** condensing unit is switched off.
  - ***Cool*** **–** condensing unit is operating in the cooling regime.
  - ***Heat*** – condensing unit is operating in the heating regime.

- ***TempOut*** **–** condensing unit operation is blocked from the outdoor temperature ***MinOutdoorCool*** and ***MinOutdoorHeat*** .
- ***NoCool*** – cooling by the condensing unit is blocked in the winter (***BlockSummerWinter* = *Yes***).
- ***NoHeat*** – heating by the condensing unit is blocked in the summer (***BlockSummerWinter* = *Yes***).
- ***Defrost*** **–** condensing unit is defrosting.
- ***Err*** **–** condensing unit signals a fault.

- ***Power*** (%) – current heating or cooling capacity of the condensing unit.
- ***Compressor*** (*On/Off*) – current compressor demand of the condensing unit.
- ***ControlTemperature*** ***(****Room/Extract/****Supply****/Preheat****)*** – selects the temperature control temperature per which the required heating or cooling capacity will be calculated.
- ***MinPower*** ***(1%)*** – minimum power to turn on the condensing unit. For Mitsubishi units with ***PAC_IF*** control, this value must be set to 18%.
- ***MaxPower*** ***(100%)*** – limitation of the maximum power of the condensing unit. This function can be used, for example, for oversized power or for special condensing unit control modules.
- ***Standby*** ***(1.5V)*** – intended for Mitsubishi units with ***PAC_IF*** control. At this control voltage value, the condensing unit is in its standby regime and has zero power.
- ***StandbyOff*** ***(10 min)*** – intended for Mitsubishi units with ***PAC_IF*** control. It defines the amount of time the condensing unit is in standby regime before it shuts down completely.
- ***MinOutdoorCool*** ***(10 °C)*** – minimum outdoor air temperature at which the condensing unit can still cool effectively. This parameter is usually specified by the manufacturer in the condensing unit documentation.
- ***MinOutdoorHeat*** ***(-10 °C)*** – minimum outdoor air temperature at which the condensing unit can still effectively heat. This parameter is usually specified by the manufacturer in the condensing unit documentation.
- ***BlockSummerWinter*** ***(****No****/Yes****)*** – this parameter blocks heating by the condensing unit in summer and cooling by the condensing unit in the winter. The current temperature period is specified in ***TemperatureRegulation*****.**
- ***DelayOff*** ***(****Normal****/Recup****)*** – this parameter allows the condensing unit to shut down after the recuperation has shut down.

- ***ChangePower* (30 s)** – some manufacturers' condensing units require a power change no more than once per time interval.
- ***DelayOnOff* (60 s)** – Delaying the on and off time of every condensing unit will ensure that the condensing unit compressor does not turn on too often. Combined with the minimum power required to turn on ***PowerOn***, the number of condensing unit starts during transient periods will be reduced. The maximum number of starts of the condensing unit is 6 starts per hour.
- ***FDP3–CoolOn* (6,25 V)** – is relevant for condensing units whose states are controlled by a constant voltage level of 0-10V DC signal (***TypeControl*=FDP3**). The voltage according to the technical specification at which the cooling regime of the condensing unit is switched on is entered.
- ***FDP3–AirOn* (4,75 V)** – is relevant for condensing units whose states are controlled by a constant voltage level of 0-10V DC signal (***TypeControl*=FDP3**). The voltage according to the technical specification at which the ventilation regime of the condensing unit is switched on is entered.
- ***FDP3–HeatOn* (3,25 V)** – is relevant for condensing units whose states are controlled by a constant voltage level of 0-10V DC signal (***TypeControl*=FDP3**). The voltage according to the technical specification at which the heating regime of the condensing unit is switched on is entered.
- ***PID–Regulation*** – the default factory set values are: **TI = 300 s, KP = 5, TD = 0 s.**
- ***Cool*, *Heat* (*Normal*/*Invert*)** – allow to invert the control signals of the condensing unit output.
  - ***Normal*** – output signal 0% = 0 V, 100% = 10 V.
  - ***Invert*** – output signal 0% = 10 V, 100% = 0 V.
- ***ControlModulEKE* –** is important for condensing units with EKE control. Up to 8 points of the condensing unit output curve can be set corresponding to the difference between the required and actual temperature.
- ***ControlModulFDP3*** – is important for condensing units with FDP3 control. Up to 16 points of the condensing unit power curve corresponding to the required temperature can be set.

6.12 Heat pump

The heat pump is a compact part of the Mandík air conditioning unit, if fitted. The heat pump circuit with heating and cooling function can be single or double circuit. It consists of an

exchanger, compressors, electronic expansion valves, pressure sensors, temperature sensors, and autonomous controller for the EVD expansion valves from Carel. A detailed description of the EVD controller set-up, including commissioning, is given in a separate manual supplied by Carel. Heat pump setup and commissioning is usually included with the AC unit manufacturer's delivery. The number before the item name identifies the first or second circuit:

- ***Circuit*** – displays information about the operation of the heat pump.
  - ***Off*** **–** heat pump is switched off.
  - ***Cool*** **–** heat pump is operating in cooling regime.
  - ***Heat*** – heat pump is operating in heating regime.
  - ***NoCool*** **–** heat pump is not cooling because the operating conditions are not met.
  - ***NoHeat*** – heat pump is not heating because the operating conditions are not met.
  - ***Defrost*** **–** heat pump is defrosting.
  - ***Err*** **–** heat pump failed.
  - ***Power*** (%) – current heating or cooling capacity of the heat pump.
- ***PowerOn*** ***(10%)*** – minimum power required to turn on a circuit or compressor.
- ***MaxPower*** ***(100%)*** – here you can set the maximum power limit of both circuits of the heat pump.
- ***DelayOff*** ***(60 s)*** – delay for the compressor to switch off after reaching zero power.
- ***NextStart*** ***(600 s)*** **–** time between switching off and next switching on of each heat pump circuit or compressor. Ensures that the compressors are not switched on and off too frequently. The recommended maximum number of compressor starts is approximately 6 times per hour.
- ***LeftTime*** ***(s)*** – displays the remaining time until the next possible circuit activation.
- ***PID–Regulation*** – factory default values are: ***TI = 240 s, KP = 2, TD = 0 s***.
- ***PowerCompensation*** ***(No/****Yes****)*** – compensates the maximum heat pump power relative to the fan speed to ensure sufficient air is available. Between the ***MinFans*** and ***MaxFans*** fan speed limits, the allowed maximum heat pump power varies linearly.
  - ***MinFans*** ***(90%)*** – if the current fan speed falls below this value, the maximum allowable heat pump output drops to 0% and the heat pump shuts down.
  - ***MaxFans*** ***(100%)*** – at this speed, the heat pump can reach the preset maximum ***MaxPower***.

- ***Anti–FreezeProtection*** – frost protection of the heat pump is provided by a manostat with digital or analog output, monitoring air pressure before and after the heat exchanger at the air outlet. If the heat exchanger freezes, the heat pump control may change. At the same time, the fan speed can be adjusted according to parameter ***ComponentsMachine*** ⇄ ***Fans*** ⇄ ***Defrost = "Compensation***". The parameters of the recuperator frost protection are:
  - ***Press (Pa) –*** current pressure of the manostat with analog output.
  - ***OG (Pa) –*** pressure value at which the heat pump frost protection is activated.
  - ***Control (Reversing/****No****)*** – defines the behaviour of the heat pump during freezing:
    - ***Reversing*** – changes the heating regime to cooling regime.
    - ***No*** – keeps heating regime and expects defrost by compensating fan speed.
  - ***Recuperation (Off/****On****)*** – defines the behaviour of the recuperator during freezing:
    - ***Off*** – recuperator will shut down when the heat pump freezes.
    - ***On*** – recuperator stays on during freezing if it has not been turned off before.
- ***Start (10s) –*** time for which the digital compressor output will be 100% at start-up. The minimum value should be 5 s. For a compressor with FM, this value must be 0 s.
- ***MinPower (25%)*** – minimum output of the digital compressor. If ***Start100% = 0 s***, then this value does not apply.
- ***PWM (20 s)*** – pulse width modulation period to control the digital compressor.
- ***Modbus*** – if **1-MB** or **2-MB** is selected in the configuration for the heat pump, then selecting this item will display the operating values of the EVD drivers to control the expansion valves:
  - ***EVD–Driver*** – values displayed are used to control the operation of the heat pump circuits:
    - ***ValveOpen (%) –*** current expansion valve.
    - ***EvaporatePress (Bar) –*** current evaporating pressure.
    - ***EvaporateTemp (°C) –*** current evaporating temperature.
    - ***SuperHeat (K) –*** current superheat temperature.
    - ***SuctionTemperature (°C) –*** current suction temperature.
    - ***AlarmsEVD –*** sum of the alarms from the EVD.

6.13 Humidifier

The humidifier is used to achieve the required air humidity using steam generators. The steam generators can be controlled continuously or in steps depending on the type used. The starting conditions and the required humidifier output are calculated in ***HumidityRegulation***. If the ***Low*** state occurs in humidity control, the humidifier output is controlled via ***PID–Regulation*** per the required and actual humidity.

- ***State*** – displays information about the operation of the humidifier.
  - ***Off*** – humidifier is off.
  - ***Humidity*** – humidifier is on.
  - ***Err*** – humidifier failed.
- ***Power (%)*** – current humidifier output.
- ***Supply (0%)*** – current humidity of the supply air.
- ***Room (%)*** – current room humidity of the supply air.
- ***Extract (0%)*** – current humidity of the exhaust air.
- ***PowerOn (10%)*** – minimum power required to turn on the humidifier.
- ***DelayOff (10 s)*** – amount of time that the required humidifier output must be equal to 0% for the humidifier to turn off.

6.14 Filters

This item contains information about the status of all the monitored filters. Filter monitoring is performed by one or two manostats or one pressure sensor with 0-10 V analog output. In the case of a unit equipped with several filters, every filter should be monitored separately.

The setting of the pressure sensor is prescribed in the technical report for every AC unit. The filter setting indication is divided into two optional stages. In the first ***Dirty*** stage, filter clogging is only signalled, and in the second ***Clogged*** stage, the unit switches off. In the event of a poor filter condition, it is recommended that the filter be replaced, otherwise the filter may rupture or pressure conditions may change.

Status and operating information is listed for every filter:

- ***Filter…… (Clean/Dirty/Clogged/Sensor)*** – indicates filter condition and analog pressure sensor failure, if any.
  - ***Clean*** – filter is clean.
  - ***Dirty*** – filter is dirty, the AC unit remains running and a message is displayed in the alarm messages. After the filter has been replaced, the message in the alarm messages must be cleared.
  - ***Clogged*** – filter is very dirty, the AC unit has automatically shut down and a message has been displayed in the alarm messages. After the filter has been replaced, the message in the alarm messages must be acknowledged.
  - ***Sensor*** – fault has occurred in the analog air pressure sensor, if configured.
- ***Press (Pa)*** – current filter pressure, if monitored by the analog pressure sensor.
- ***WrongOperatingHrs (0)*** – informs how long the AC unit has been operated with a dirty filter in the state ***Dirty*** or ***Clogged.***

- ***AlarmsStates:***
  - ***Filter (Dirty/****Clogged****)*** – this setting is only valid when monitoring filter clogging by a pressure sensor with an output contact called a manostat, which indicates only two filter states, ***Clean*** or ***Dirty (Clogged)***. It determines the behaviour of the AC unit when the filter is no longer ***Clean***.
  - ***Dirty (200 Pa)*** – specifies the pressure limit at which the filter clogging alarm is raised and the AC unit continues to operate. It can only be set when monitoring filter clogging with a 0-10V analog output manometer.
  - ***Clogged (300 Pa)*** – specifies the pressure limit at which the filter clogging alarm message is displayed and the AC unit shuts down. It can only be set when monitoring filter clogging with a 0-10V analog output manometer.
  - ***Delay (60s)*** – delay of the display of the alarm when the filter is no longer ***Clean***.

6.15 Air quality

Air quality is a parameter that can affect the performance of the fans and the position of the mixing (circulation) damper. Air quality can be monitored by sensors with digital outputs or sensors with 0-10V analog outputs. This chapter covers air quality control by changing the amount of fresh air supplied.

- ***AirQuality*** ***(OK/Bad)*** – current status of the air quality in relation to the required value set directly on the air quality sensor.
  - ***Currently*** ***(ppm)*** – current air pollution.
  - ***WrongOperatingHrs*** – informs about the period of operation for which the air quality was assessed as poor.
- ***Required*** ***(800 ppm)*** – air quality limit value if measured by a sensor or sensors with analog output. At this value, the poor air quality indication will be terminated. The fan speed and mixing will return to their original values.
- ***SetpointShift*** ***(50 ppm)*** – air quality limit if measured by a sensor or sensors with analog output. If it is exceeded, a poor air quality condition is signalled and the fan speed and mixing damper settings are adjusted to the required value for the poor air quality condition according to the ***Validity*** and ***Enable*** parameters. The default values for fan speed (***Comfort***, ***Economy***) and damper opening should be below this value.
- ***SupplyFan*** ***(100%)*** – selection to enable supply fan speed control based on air quality and fan speed when the air quality is poor. The default fan speed values for the (***Comfort***, ***Economy***) regimes should be below these values.
- ***ExhaustFan*** ***(100%)*** – selection to enable supply fan speed control based on air quality and fan speed when the air quality condition is poor. The default fan speed values for the (***Comfort***, ***Economy***) regimes should be below these values.
- ***FreshAir*** ***(100%)*** – selection to enable mixing control according to air quality and the mixing level if the air quality condition is poor. The default mixing values for the (***Comfort***, ***Economy***) regimes should be below these values. The damper setting is only accepted in the ***Tempering*** operating regime if the fan speed value is non-zero.
- ***Validity*** ***(Regime/****Always****/****Tempering****)*** **–** the system will only respond to poor air quality if the unit is not in the ***Off*** state. The ***Regime*** has the following options:
  - ***Regime*** **–** the system will only respond to poor air quality if the unit is in the ***Comfort*** or ***Economy*** regime.
  - ***Always*** **–** system will react to poor air quality whenever the AC unit is not in the ***Off*** state. That is, if the unit is in the ***Tempering***, ***Comfort*** or ***Economy*** regime.
  - ***Tempering*** **–** the system will only react to poor air quality when the unit is in the regime of ***Tempering***.

- ***Enable*** ***(No/****Fan/MixDmp/Fire&Smoke****)*** – enables ventilation when poor air quality is present and specifies how ventilation will occur.
  - ***No*** **–** system will not respond to poor air quality.
  - ***Fan*** **–** only greater power fans 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.
  - ***Fire&Smoke*** **–** both previous options will be used for ventilation.
- ***1Sensor, 2Sensor (ppm) –*** current air quality at every sensor.
- ***MoreSensor*** ***(Average/****OG/UG/1/2****)*** – with multiple sensors, it determines how the final air quality value is calculated or assigned. When 1, 2 is selected, the value is given only by the selected sensor and the other sensors are used only as informative. For other selections, the final value is calculated as a mathematical average, maximum or minimum.

6.16 Fire/Smoke

The Fire/Smoke function allows you to shut down the AC unit in the event of a fire alarm from the fire panel or an alarm from a smoke or fire sensor. A switched contact from both the fire panel and smoke or fire sensors is expected at the controller inputs. An open contact is indicated by an alarm message such as ***Fire*** or ***Smoke***, which immediately shuts down the AC unit. This item can only be accessed after a service login.

- ***FireSignal*** ***(****Fire/OK****)*** – information about the status of a fire panel or fire detector located in a duct or room.
- ***Smoke, 2Smoke*** ***(****Smoke/OK****)*** – status information for up to two smoke detectors located in a duct or room.
  - ***NumberActivations*** – serves as an information value about the number of fire or smoke evaluations.

6.17 Fire dampers

The fire dampers are equipped with two limit switches to indicate the extreme positions of the dampers in the closed state and can be actuated by actuators or manually. Based on the status

of these contacts, the control monitors the status of the fire dampers and decides on the operation of the air conditioning unit. The monitoring of the dampers can also be carried out using the THC24-B electronic relay. Up to 8 fire dampers can be monitored in the standard configuration.

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

If, while the unit is running, the contact indicating an open damper on any fire damper opens (damper closes), then the AC unit will shut down immediately and a failure of that particular fire damper will be indicated.

- ***FireDamper (Undefined/Close/Open/Err)*** – information about the position of the fire damper.
  - ***Undefined*** **–** damper is currently moving between the extreme open and closed positions.
  - ***Close*** **–** damper is in the closed position.
  - ***Open*** **–** damper is in the open position.
  - ***Err*** **–** damper is not in the expected position.
- ***TimeOpen (130 s)*** – time it takes for the motorised fire damper to move from the closed position to the open position. Applies only to configuration options ***Mot1c*** ***and*** ***Mot2c***.
- ***UnitStopFlapClose*** ***(****Open****/Close)*** – determines the position of the damper when the air conditioning unit is off. Only applies to the ***Mot2c*** and ***THC*** configuration options.
  - ***Open*** **–** when the A/C unit is off, the power to the damper actuators is not turned off and the dampers remain open.
  - ***Close*** **–** when the AC unit is off, the power to the damper actuators is turned off and the dampers are closed.

6.18 Freecooling

Freecooling is used to freely ventilate the room and lower the temperature in it, using the coolness of the outside air. It is mainly used at night. Freecooling can be triggered by a custom time program, by an external contact or manually from the controller display. For proper freecooling operation, sensors for outdoor, supply and room temperatures must be configured.

Freecooling can only be started automatically if the AC unit is in its ***Tempering*** regime, and the necessary temperature requirements are met!

- ***State*** ***(Off****/MinTempOut/TOutMax/TSupMin/Err/On****)*** – informs about the status and possible reason that prevents the start of freecooling.
  - ***Off*** – freecooling is not activated.
  - ***MinTempOut*** – freecooling is blocked because the outside temperature is below ***MinTempOut***.
  - ***TOutMax*** – freecooling is blocked because the outdoor temperature is greater than the room temperature minus ***Shift***.
  - ***TSupMin*** – freecooling is blocked if the AC unit includes a water heater and the supply temperature is less than 7 °C.
  - ***Err*** – freecooling is blocked because one of the temperature sensors has malfunctioned.
  - ***On*** – freecooling is active.
- ***Required*** ***(18 °C)*** – required room temperature. If the room temperature is higher, then freecooling is enabled.
- ***Shift*** ***(5 °C)*** – the outside temperature must be at least this much lower than the room temperature for freecooling to be enabled.
- ***MinTempOut*** ***(10 °C)*** – minimum outdoor temperature at which freecooling is no longer allowed because the room could become too cold. At this temperature, freecooling is immediately switched off independently of ***MinOn***.
- ***MinOn*** ***(30 min)*** – freecooling will stop when the room temperature drops below the required value if the set time has elapsed at the same time.
- ***Controlled*** ***(No****/ Contact/Manually/ Scheduler****)*** – informs about the way in which freecooling is currently switched on.
- ***TemperatureCondition*** ***(No****/****Yes****)*** – defines the start of freecooling, depending on the outside temperature.
  - ***No*** – allows freecooling to be switched on without meeting the outside temperature requirements.
  - ***Yes*** – allows freecooling to turn on only when the required conditions for the outside temperature are met.

- ***Manually*** ***(Off/****On****)*** – manual freecooling activation.
- ***TimeSchedule*** – time program of free ventilation for each day for the whole week is valid only if the ***Tempering*** regime is selected. Every day contains six daily time points for selecting the freecooling status. Entering a daily time point consists of entering a start time in the form of ***hh:mm:ss*** and the regime itself (***Off****/On*).

6.19 Boiler room

The ***Boiler*** item contributes to a better water heating function and can eliminate the shortcomings of the boiler room system. It allows the boiler room heating water to be preheated to the required value before the AC unit fans are started. The options for boiler room start-up are many and can be combined with each other depending on the specific conditions of every installation. Only the basic options are listed here and others can be added to the software based on the requirements when installing the AC unit.

- ***State*** ***(Off/On)*** – current state of the boiler room switch-on request.

The following parameters are only accessible after service login:

- ***WaterHeating*** ***(No/****Winter****/****Always****)*** – boiler room switch-on based on water heating switch-on:
  - ***No*** – boiler room switch-on request is not activated.
  - ***Winter*** – boiler room request is activated in the winter season (***TemperatureRegulation*** ⇨ ***TemperatureSeason***) when the water heating switch-on request occurs.
  - ***Always*** – request to the boiler room is activated when a request to switch on water heating occurs.
- ***LowTempWater*** ***(No/****Yes****)*** – when ***Yes*** is selected, a boiler room request is activated when the temperature of the discharged heating water is low. The value of the low temperature discharge water signal is set in ***WaterHeating*****.**
- ***LowOutdoorTemp*** ***(5 °C; No/****Winter****/****Heat****/****Always****)*** – switching on the boiler room based on the outside air temperature:
  - ***No*** – boiler room switch-on request is not activated.
  - ***Winter*** – boiler room request in the winter (***TemperatureRegulation*** ⇨ ***TemperatureSeason***) is activated if the outdoor temperature is below 5 °C.

- ***Heat*** **–** boiler room request is activated if there is a request to switch on the water heating and at the same time the outside temperature is less than 5 °C.
- ***Always*** **–** activates the boiler room request if the outdoor temperature is less than 5 °C.

➢ ***Difference*** ***(50 °C; No/****Winter/Heat/Always****)*** – activates the boiler room based on the difference between the required temperature and the outdoor temperature:

- ***No*** **–** request to switch on the boiler room is not activated.
- ***Winter*** **–** boiler room request in the winter (***TemperatureRegulation*** ⇨ ***TemperatureSeason***) is activated if the difference between the outside temperature and required temperature exceeds 50 °C.
- ***Heat*** **–** boiler room request is activated if there is a request to switch on the water heating and at the same time the difference between the outside temperature and required temperature exceeds 50 °C.
- ***Always*** **–** activates the boiler room request when the difference between the outdoor temperature and required temperature exceeds 50 °C.

➢ ***CondensaingUnit*** ***(70%; No/****Winter/Always****)*** – is relevant in cases where 100% of the condensing unit output is followed by a water heating activation. The options for switching on the boiler room based on the condensing unit output are:

- ***No*** **–** request to switch on the boiler room is not activated.
- ***Winter*** **–** boiler room request is activated in the winter season (***TemperatureRegulation*** ⇨ ***TemperatureSeason***) and the condensing unit output has exceeded 70%.
- ***Always*** **–** activates the boiler room request if the condensing unit output has exceeded 70%.

➢ ***DelayFan*** ***(No/****Winter/Always****; 3 min)*** – delays the request to turn on the fans (start of the unit) after the boiler room request occurs has three options:

- ***No*** – delay of the request to switch on the fans when the unit starts does not occur.
- ***Winter*** **–** delay of the request to turn on the fans when the unit starts occurs in the winter season (***TemperatureRegulation*** ⇨ ***TemperatureSeason***) and simultaneous request to turn on the water heating.

- ***Always*** **–** delay in the request to turn on the fans when the unit starts occurs when there is a request to turn on the water heating.

➢ ***DelayBoiler*** ***(3 min)*** – delay of the boiler room start upon the arrival of either request.

6.20 Others

The ***Others*** item contains unassigned parameters for external regime switches defined by ***Configuration*** ⇄ ***ModeSwitches*** and service signalling.

➢ ***ExternalSwitches*** ***(Off/****On****)*** – disables or enables the operation of the external regime switches.

- ***ModeOff*** ***(Off/****Tempering****)*** – defines the unit's shutdown state when external switches control the regimes:
  - ***Off*** – if no regime is selected by the external switches, then the unit is set to ***Off.***
  - ***Tempering*** – if none of the modes are selected by the external switches, then the unit is set to ***Tempering.***
- ***SwitchType*** ***(Contact/****Button****)*** – defines the type of external regime switch connected:
  - ***Contact*** – controller accepts a permanently closed contact to enable the required regime and a permanently open contact to disable the regime.
  - ***Button*** – controller accepts a short switching of the control contact (pulse) to switch on or off the required regime.

➢ ***QMX3–On*** ***(Economy/****Comfort****)*** – determines the regime to which the unit will switch when turned on from a QMX3 series room unit.

➢ ***QMX3–Off*** ***(Off/****Tempering****)*** – specifies the regime the unit will switch to by turning off from the QMX3 series room unit.

➢ ***ResidencyButton*** ***(60 min)*** – specifies the amount of time the AC unit will run in Comfort regime after the residency button is pressed, unless the unit is previously turned off by pressing the button again.

➢ ***Service*** – defines the service message period and its signalling:

- ***NextServiceRequest*** ***(/****PerOneYear****/****Per6Month****/****Per3Month****/****PerMonth****)*** – used to signal the need for periodic service of the AC unit. After selecting one of the time options, the next line displays the corresponding date at which the ***Service*** alarm message will be

displayed. A service signal may also be indicated on the controller's digital output. It is a prerequisite that the internal time of the controller corresponds to real time.

- ***ServiceLight*** ***(Shines****/Flash/Fire&Smoke****)*** – defines the function of the digital ***Service*** output that can be used to control the light signalling:
  - ***Shines*** – ***Service*** digital output will be permanently switched on in the event of a service signal.
  - ***Flash*** – digital output ***Service*** will switch on with a period of 5 s in case of service signalling.
- ***AlarmLight*** ***(Shines****/Flash****)*** – defines the function of digital fault ***A*** output, which can be used to control the light signalling:
  - ***Shines*** – digital fault ***A*** output will be permanently switched on in the event of a fault signal and will not differentiate between a detected fault and a new fault.
  - ***Flash*** – digital fault ***A*** output will be switched on with a period of 1s in the event of a fault signal and will not discriminate between a detected and a newly generated fault.
  - ***Fire&Smoke*** – digital fault ***A*** output will behave in the same way as the fault indication on the display or HMI controller. In the event of a newly generated fault, the digital output will switch on with a period of 1 s. In the event of a cleared fault, the digital output will be permanently switched on.
- ***DueDate*** – this function enables automatic shutdown of the unit if an invoice is not paid by the agreed date. Detailed instructions can be found in the separate manual “Invoice due date tracking”.
  - ***NumberDays*** – number of days until the invoice is due after which the unit will be shut down is entered. In the factory setting, ***NumberDays*** is zero, and no invoice due date is tracked.
  - ***DaysLeft*** – displays 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 AC unit by monitoring the current specific power consumption of the SFP fans, electricity consumption, consumption of other energies, and recovered energies. These values are archived in cloud storage and can be summarized and viewed retrospectively for selected periods. The function is described in the separate manual *"Energy balance of KJ Mandík"*.

8 Time program

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

The time program item displays the days of the week with six time points for every day:

- ***Actual Day*** – for every day, it shows whether that day of the week is active (***Passive/Active***) and the status of the AC unit if it is active (***Off/Tempering/Economy/Comfort***).
- ***Time Point Input*** – every day contains six time points for selecting the status of the AC unit and consists of entering the time in the form of ***hh:mm:ss*** (hour:minute:second) and the actual regime (***Off/Tempering/Economy/Comfort***) that the unit will switch to at that time. The time input is considered invalid if it is set to 24 hours, 60 minutes or 60 seconds (24:60:60).
- ***OutOffScheduler*** (***Off***/*Tempering*/*Economy*/*Comfort*) – this item defines the regime the AC unit will be in if the time points for the current day are not sufficiently defined:
  - No valid time points are defined for the current day.
  - The first time point of the current day is not defined from the beginning of the day (00:00:00). The AC unit will be in the regime per ***OutOffScheduler*** until the first valid time point.

9 Application information

In the ***ApplicationInfo*** menu, the following information is displayed on every line:

- ***Device*** – device name
- ***Contract*** – contract number or other identification
- ***Firmware*** – version of the software used and the date this version was created
- ***Service*** – phone contact for the service department
- ***Web*** – company's web address
- ***NextServiceRequest*** – date of the next service, if this function is set

10 Configuration

The configuration item defines the components of the AC unit to be controlled by the control. The basic configuration is carried out at the factory or when additional changes are made to the components and should be carried out by authorised personnel. This determines the function of the equipment and subsequently the control method. There is a risk of damage to the equipment or violation of work safety rules if the setting is not carried out in a professional manner. The configuration can only be accessed after a service login. The ***No*** option determines that the item is not included in the unit or that its function is not to be monitored. The ***Yes*** option specifies that the item is contained in the unit once. A number instead of ***Yes*** indicates the number of components that can be populated. Non-standard item options are described separately.

- ***RequiredTemperature*** ***(***-----/*Supply*/***Room***/*Extract*/*Preheat*/*Exhaust****)*** – selects temperature that is compared to the required temperature for the selected regime. If supply temperature or preheat temperature is selected, then this is a direct control and the required heating or cooling capacity is calculated directly from the difference between the required and selected temperature. The cascade control function is only applied if the room, extract or exhaust air temperature is selected. Based on the difference between the required and selected temperature, the required supply air temperature is calculated and the required heating or cooling capacity is calculated from the difference between the required supply temperature and the actual supply temperature, so that the selected required temperature is optimally achieved.

- ***RooumUnit*** ***(No****/POL822/OP41temp/OP41fan/OP70/QMX3****)*** – defines the external room unit or controller used with communication to control the AC unit. The communication parameters for each controller are automatically set to the preset values in the controller.
  - ***POL822*** – is a Siemens room unit with integrated temperature sensor and Process Bus communication.
  - ***OP41temp*** – is an Amit controller with Modbus communication, where the rotary knob is used to control the required temperature.
  - ***OP41fan*** – is an Amit controller with Modbus communication, where the rotary knob is designed to control the fan speed.
  - ***OP70*** – is an Amit touchscreen controller with Modbus communication and an internal temperature sensor.
  - ***QMX3*** – is a range of Siemens KNX communication controllers with programmable button and LED functions.
- ***TemperatureRoom*** ***(****No****/****1****/****2****)*** – 2 room temperature sensors can be used to measure room temperature.
- ***TemperatureSupply*** ***(****No****/****Supply/Preheat/Reheat/Sup+Preh/Sup+Reh/Preh+Reh/All****)*** – temperature sensor can be selected to measure the supply air temperature according to the purpose of the measurement:
  - ***Supply*** – sensor is designed to measure the temperature of the supply air to the room.
  - ***Preheat*** – sensor is designed to measure the temperature after any preheating and is usually placed before both the preheat and supply sensors.
  - ***Reheat*** – sensor is designed to measure the temperature after any reheat and is usually located between the preheat and supply sensors.
- ***TemperaturesRecuperator*** ***(****No****/****Extract/Inlet/Supply/Extract+Inlet/Extract+Supply/Inlet+Supply/All****)*** – temperature sensor can be selected to measure the supply air temperature based on the purpose of the measurement:
  - ***Extract*** – sensor is located behind the recuperator on the air outlet and is used for frost protection of the recuperator or for pool units.
  - ***Inlet*** – sensor is located in front of the recuperator and is relevant for pool units.

- ***Supply*** – sensor is located after the recuperator on the supply air and is applicable for frost protection of the recuperator or for pool units.

➢ ***HeatWaterTemperature*** ***(No****/Extract/Supply/Both****)*** – temperature sensor can be selected to measure the water temperature of the water heater according to the measurement purpose. The meaning of the configuration options is:

- ***Extract*** – sensor is designed to measure the temperature of the water at the drain line, so-called return line.
- ***Supply*** – sensor is designed to measure the temperature of the water on the supply pipe.

➢ ***CoolWaterTemperature*** ***(No****/Extract/Supply/Both****)*** – temperature sensor can be selected to measure the temperature of the cooling water according to the measurement purpose:

- ***Extract*** – sensor is designed to measure the temperature of the water at the drain line, so-called return line.
- ***Supply*** – sensor is designed to measure the temperature of the water on the supply pipe.

➢ ***TemperatureExhaust*** ***(No****/Extract/Exhaust/Both****)*** – temperature sensor can be selected to measure the temperature of the exhaust air according to the measurement purpose:

- ***Extract*** – sensor is designed to measure the temperature of the air exhausted from the room.
- ***Exhaust*** – sensor is designed to measure the temperature of air exhausted to the outside.

➢ ***HumidityRegulation*** ***(No****/DehumRel/HumRel/BothRel/DehumAbs/HumAbs/BothAbs****)*** – defines the humidity control methods:

- ***DehumRel*** – only dehumidification based on relative humidity is performed using one of the cooling components or using fans and mixing dampers.
- ***HumRel*** – only humidification based on relative humidity is performed using a humidifier.
- ***BothRel*** – system dehumidifies and humidifies as needed based on relative humidity.
- ***DehumAbs*** – only dehumidification based on absolute humidity is performed using either of the cooling components or using fans and mixing dampers.

- ***HumAbs*** – only humidification based on absolute humidity is performed using a humidifier.
- ***BothAbs*** – system dehumidifies and humidifies as needed based on absolute humidity.

▪ ***Setpoint*** ***(Room****/Extract/Supply****)*** – first set of humidity sensors:

- ***Room, Extract*** – these selections apply cascading humidity control, where the required supply humidity is calculated based on the difference between the required and actual humidity.
- ***Supply*** – this option involves direct humidity control based on the required and actual supply humidity.

▪ ***Supply*** ***(No****/Supply/Outdoor/Both****)*** – first set of humidity sensors:

- ***Supply*** – supply air humidity sensor for humidity control.
- ***Outdoor*** – outdoor air humidity sensor to enable passive dehumidification.

▪ ***Exhaust*** ***(No****/Room/Extract/Both****)*** – second set of humidity sensors:

- ***Room*** – room humidity sensor for humidity control.
- ***Extract*** – exhaust air humidity sensor for humidity control.

➢ ***AirQuality*** ***(No****/DI/Const/Regul****)*** – one sensor with digital contact output (DI) or two sensors with 0-10V analog output (*Const*/*Regul*) can be selected for air quality measurement.

- ***DI*** – air quality measurement is performed by a sensor with a digital output, when activated, increased constant fresh air ventilation is activated.
- ***Const*** – increased constant fresh air ventilation is activated when the required air quality limit measured by one or two analog sensors is exceeded.
- ***Regul*** – continuous controlled fresh air ventilation is implemented by PID control based on the required air quality value and the actual value measured by one or two analog sensors.

➢ ***SupplyDamper, ExhaustDamper*** ***(No****/Unit/MixFlap/Contact****)*** – selection of damper control methods:

- ***Unit*** – damper opens based on a signal to start the unit.
- ***MixFlap*** – damper will be controlled inversely to the mixing damper. This option is only relevant if the mixing damper is part of the HVAC unit.
- ***Contact*** – damper will be controlled by an external contact.

- ***Position*** ***(No****/AI/DI****)*** – monitoring of the actual position of the dampers:
  - ***AI*** – actual position is monitored based on the 0-10V analog return signal from the actuator.
  - ***DI*** – damper opening is monitored based on the actuator end contact.

➢ ***SupplyFilter, ExhaustFilter, GreaseFilter*** ***(No****/DI/AI/2xDI/2xAI****)*** – manostat with a digital output implemented by a contact or a pressure sensor with a 0-10V analog output can be used to monitor filter clogging as follows:

- ***DI*** – pressure sensor with an output contact called a manostat is used to monitor the condition of one filter, and the signalled level of clogging is set in ***ComponentsMachine*** ⇨ ***Filters***.
- ***2xDI*** – two manostats are used to monitor two clogging levels of one filter or one clogging level of two filters, with the signalled clogging level of every filter set in ***ComponentsMachine*** ⇨ ***Filters.***
- ***AI*** – pressure sensor with an analog output, called a manometer, is used to monitor the condition of one filter, with the signalled clogging levels set in ***ComponentsMachine*** ⇨ ***Filters***.
- ***2xAI*** – for monitoring the status of two filters, pressure sensors with analog output, called manometers, are used and the signalled clogging levels are set in ***ComponentsMachine*** ⇨ ***Filters***.

➢ ***SupplyFan, ExhaustFan*** ***(****No****/****FM****/EC/FC–MB/EC–MB****)*** – fan motor can be controlled by a frequency converter ***(FM)*** or an EC motor ***(EC)*** can be used with the following options:

- ***FM*** – fan frequency converter is controlled via inputs and outputs.
- ***EC*** – EC fan motor is controlled via inputs and outputs.
- ***FC–MB*** – fan frequency converter is controlled via Modbus communication.
- ***EC–MB*** – EC fan motor is controlled by Modbus communication.

- ***TypeControl*** ***(Regime****/Press/Direct/POLv1/POLv2/AMR****)*** – the control signal source for the fans can be:
  - ***Regime*** – fixed speed value in % for the current regime entered on the controller display in ***ComponentsMachine*** ⇨ ***Fans*** is used to control the speed of the fans.

- ***Press*** – used to sense the air pressure and the amount of air in the duct supplied by the fan. The ***AssignmentInputs/Outputs*** ⇨ ***Fans*** displays the assignment of a separate input for the pressure sensor and flow sensor.
- ***Direct*** – fixed voltage value of the required speed 0-10V. The fan speed is set to this value converted to a percentage of 0-100%.
- ***POLv1*** – six-step speed value entered from the POL822 room unit within the range of values for ***MinSpeed*** and ***Comfort*** is used to control the fan speed
- ***POLv2*** – linear % speed value entered from the POL822 room unit within the range of values for ***MinSpeed*** and ***Comfort*** is used to control fan speed.
- ***AMR*** – fan speed control is controlled by a linear % speed value entered from the AMR-OP70 or AMR-OP41 room unit within the range of values for ***MinSpeed*** and ***Comfort***.

➢ ***BackupFans*** ***(No****/Supply/Extract/Both****)*** – activates the backup fans when the main fans fail:

- ***Supply*** – backup supply fan is activated when the supply fan fails.
- ***Extract*** – the exhaust fan fails, the backup exhaust fan is turned on.

➢ ***Recuperation*** ***(No****/Plate/Rotary/Glycol/RotaryFbk****)*** – specifies the type of recuperator used and its characteristics:

- ***Plate*** – plate recuperator with bypass damper without monitoring its position.
- ***Rotary*** – rotary recuperator with frequency converter controlled by digital and analog controller outputs or stepper motor.
- ***Glycol*** – recuperation implemented by a glycol circuit.
- ***RotaryFbk*** – rotary recuperator with a sensor monitoring the recuperator speed.

➢ ***WaterHeating*** ***(No****/1/2****)*** – selection of the number and function of water heating:

- ***1*** – selection of standard water heating or in the preheating function. Temperatures are configured for this water heating in ***HeatWaterTemperature.***
- ***2*** – selection of the water heating in the preheating function. Temperatures are configured for this water heating in ***2HeatWaterTemperature.***

▪ ***Boiler*** ***(No****/Yes****)*** – control of the boiler room to prepare heating water for water heating.

➢ ***ElectricalHeating*** ***(No****/1/2****)*** – selection of the number and function of electric heating:

- ***1*** – selection of standard electric heating or in preheat function.
- ***2*** – selection of electric heating in the preheating function.

- ***GasHeating*** ***(No****/Modulation/1st/2st)* – determines how the gas heating is controlled:
  - ***Modulation*** – installed gas burner is modulating.
  - ***1st*** – installed gas burner is a single stage one.
  - ***2st*** – installed gas burner is a two-stage one.
  - ***DamperAtHeatExchanger*** ***(No****/Temperature/Press)* – bypass damper configuration of the gas exchanger:
    - ***Temperature*** – gas exchanger includes an exchange damper that is controlled based on the temperature of the flue gas.
    - ***Press*** – gas exchanger includes an exchanger damper that is controlled based on the pressure at the exchanger.
- ***WaterCooling*** ***(No****/Separate/WithHeat/2WithHeat)* – determines how the gas water cooling is controlled:
  - ***Separate*** – AC unit has a separate water cooling exchanger.
  - ***WithHeat*** – AC unit has a common water heat exchanger for cooling and heating. The antifreeze thermostat is blocked in the cooling regime.
  - ***2WithHeat*** – AC unit has a common water heat exchanger for cooling and heating. By default, cooling is enabled by an open external contact (***AssignmentInputs/Outputs*** ⇨ ***ExternalSwitches*** ⇨ ***Cool/Heat***), which signals cooling water readiness. The antifreeze thermostat is blocked in the cooling regime.
- ***CondensingUnit*** **–** ***(No****/1CH/2CH/3CH/4CH/5CH/6CH/1C/2C/3C/4C/5C/6C)* – up to 6 condensing units can be selected with both ***HC*** heating and cooling functions or up to 6 condensing units with only ***C*** cooling function.
  - ***TypeControl*** ***(Modulation****/ANL2WIRE/FDP3/EKEQFCB/PAC–IF)* – types of control modules of the individual manufacturers of condensing units are selected here.
    - ***Modulation*** – 0-10V output control signal corresponds to the required 0-100% output in both heating and cooling regimes. The switching of the Cooling/Heating regimes is done by voltage-free contacts.
    - ***ANL2WIRE*** – is designed for controlling some types of Fujitsu condensing units and VRF-kits with 0-10V voltage. At 0V voltage the condensing unit is switched off. At voltage of 0.6 to 10V, the unit is switched on the voltage level corresponds to the

required indoor temperature of +16 °C to +30 °C. Switching of the Cool/Heat regimes is done by voltage-free contacts.

- ***FDP3*** – is designed to control Toshiba condensing units. The required temperature control voltage range of 1.3V to 9.7V corresponds to temperatures of 18 °C to 31 °C. Cool/Heat regime switching is performed by voltage levels.
- ***EKEQFCB*** – is designed to control Daikin condensing units with 0-10V voltage. The 0-10V input signal is divided into 5 levels - 2 levels for power reduction (the first for faster and the second for slower adjustment), 1 level for maintaining current power and 2 levels for increasing power (the first for slower, the second for quicker adjustment).
- ***PAC–IF*** – is designed to control Mitsubishi condensing units with 0-10V voltage. At 0V voltage the condensing unit is switched off. At voltages 1.8V to 10V, the power of the unit is controlled in 7 steps. The switching of the Cooling/Heating modes is done by voltage-free contacts.

➢ ***HeatPump (No/1/2/1–MB/2–MB)*** – specifies the type of heat pump used is its control method:

- ***1*** – single circuit heat pump.
- ***2*** – heat pump with two circuits.
- ***1–MB*** – single circuit heat pump with compressor frequency converter and expansion valve module controlled via bus (Modbus).
- ***2–MB*** – heat pump with two circuits that has compressor frequency converters and expansion valve modules controlled over a bus (Modbus).

➢ ***FireDamper (No/1/ … /24)*** – enables monitoring of up to 24 fire dampers.

▪ ***TypeControl (Mot2c/Man2c/THC/Man1c/Mot1c)*** – selects the method of controlling and monitoring fire dampers:

- ***Mot2c*** – motorized fire damper with limit switches in both extreme positions.
- ***Man2c*** – non-driven fire damper with both limit switches of both end positions.
- ***THC*** – motorised fire damper is connected via the THC24-B control relay, which supplies information about the damper's extreme positions.
- ***Man1c*** – non-powered fire damper with open limit switch.
- ***Mot1c*** – motorized fire damper with open limit switch.

- ***ModeSwitches*** ***(No****/Modes/Modes2/2xPlace/WRF–S/WRF–P/WRF–F/CPM–P/CPM–P/CPM–F/3xSpeed****)*** – selection of the type of operation using external switches. The function options of the external switches are as follows:
  - ***Modes*** – in ***AssignmentInputs/Outputs*** ⇄ ***ExternalSwitches***, there are two digital regime control inputs displayed (***1Switch***, ***2Switch***). The first one has the function of ***Off/On*** of the AC unit, the second one is used to switch the ***Economy/Comfort*** modes when the first contact is switched. ***3Switch*** is designed for potential external activation of the function.
  - ***Modes2*** – in ***AssignmentInputs/Outputs*** ⇄ ***ExternalSwitches***, there are two digital inputs for regime control displayed (***1Switch***, ***2Switch***). The first switches the AC unit into the ***Economy*** regime, and the other one into the regime of ***Comfort***. ***3Switch*** is designed for potential external activation of the function.
  - ***2xPlace*** – in ***AssignmentInputs/Outputs*** ⇄ ***ExternalSwitches***, there two digital inputs (***1Switch***, ***2Switch***) are displayed to switch the unit from two different locations to the ***Economy*** regime. When both contacts are closed, the unit is in the regime of ***Comfort***. ***3Switch*** is designed for potential external activation of the function.
  - ***WRF–S, CPM–S*** – fans are controlled for 0–100% via the WRF04 or CP–M–B controller. In the***Configuration*** menu, there it is necessary to set ***TypeControl=Direct*** for both fans and then in menu ***AssignmentInputs/Outputs*** ⇄ ***Fans*** assign analog inputs to ***SupplySpeed*** and ***ExhaustSpeed***.
  - ***WRF–P, CPM–P*** – fan speed control is in the range of 0-100% from the WRF04 or CP-M-B controller. In the ***Configuration*** menu, there it is necessary to set ***TypeControl=Press*** for both fans and then in the ***AssignmentInputs/Outputs*** ⇄ ***Fans*** menu to assign the analog inputs to ***SupplyPress*** and ***ExhaustPress***.
  - ***WRF–F, CPM–F*** – fan speed control per the required flow from the WRF04 or CP–M–B controller. In the ***Configuration*** menu, there it is necessary to set ***TypeControl=Press*** for both fans and then in the ***AssignmentInputs/Outputs*** ⇄ ***Fans*** menu to assign analog inputs to ***SupplyFlow*** and ***ExhaustFlow***.
  - ***3xSpeed*** – in ***AssignmentInputs/Outputs*** ⇄ ***ModeSwitches***, there three digital inputs for switching fan speeds are displayed, and their specific values can be set in

ComponentsMachine ⇨ ***Fans*** ⇨ ***Speed.*** The unit is turned on by turning on any switch.

- ***Freecooling*** ***(No/Yes)*** – enables the use of the venting function in the ***Tempering*** regime.
- ***EnergyWatch*** ***(No/****ElectricityMeter****/Fan)*** – enables monitoring of energy consumption while the unit is operating. It specifies how the electricity consumption is measured and calculates the other energy consumption based on the temperature difference before and behind the components.
  - ***ElectricityMeter*** – separate electricity meter measures the total electricity consumption of all the devices supplied from the switchboard.
  - ***Fan*** – only the power consumption of fans is measured and the power consumption of the switchboard can only be entered as a constant.
- ***POL945*** ***(No/1/2)*** – allows the number of controller inputs to be expanded by one or two POL945 modules with 8 Inputs/Outputs.
- ***POL955*** ***(No/1/2)*** – allows to expand the number of controller inputs by one or two POL955 modules with 14 Inputs/Outputs.
- ***POL985*** ***(No/1/2)*** – allows the number of controller inputs to be expanded by one or two POL985 modules with 26 Inputs/Outputs.
- ***AfterModificationOfValue RestartRequired!*** ***(/Execute)*** **–** the ***Execute*** option saves the parameters to the controller's backup user memory. At the same time, the controller is restarted to initialize the changes made.
- ***ParametersLoad*** ***(/Restore)*** – the ***Restore*** option loads the parameters from the backup user memory of the controller. At the same time, the controller is restarted to initialize the changes made.
- ***OriginalSettings*** ***(/Restore)*** – the ***Restore*** option is used to restore the original configuration set at the factory. At the same time, the controller is restarted and the production parameters are initialized.

11 Testing

The device testing item is only accessible after a service login. This function is intended for service technicians during commissioning of the AC unit or during service inspections. The device

testing function allows to independently control any component of the AC unit. Testing gets enabled by setting ***EnableTesting=Yes***, and it is indicated as auxiliary ***Test*** regime on the controller display. It allows to turn the fan on and off, set the damper opening angle in %, turn the burner on and off and control its output in %, etc. When testing a device, no protective functions may be operational and therefore, if not handled properly, the device could be damaged or work safety rules could be violated. When testing is complete, set ***EnableTesting=No***! Otherwise, the standard control will not work!

12 Inputs and outputs

The current values of the physical inputs and outputs of the controller are displayed here, including their functional status. If a malfunction or failure is suspected, it is possible to check here that the connected sensors are functioning correctly and the expected values are displayed. Every line contains the input type with a serial number that corresponds to the physical description of the connectors on the controller. This is followed by the value, status information and, for universal inputs, the function type or sensor type that is part of the factory setup. If the sensor type setting does not match the connected sensor, then a configuration fault will be displayed. The marking system of inputs and outputs ***xVy*** corresponds to the markings in the drawing documentation, and its meaning is as follows:

- ***x*** – serial number of the controller's input and output extensions and 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 and 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 be assigned. Several types of resistor, voltage, current and digital sensors can be connected to this input. The universal input can also be configured as a voltage, current or digital output, if required.
- ***B*** – NTC10K temperature input.
- ***D*** – potential-free digital input.
- ***Y*** – analog output with 0-10V range.
- ***Q*** – relay output 230VAC, max. 3A/ 2A (cos 0.6).

➢ ***y*** – is the serial number of the input or output on the controller or on the controller extension.

13 Assignment of inputs and outputs

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

13.1 Assignment of analog inputs

The assignment of the digital and analog inputs is done separately for every component (temperature, humidity, pressure, fan operation or malfunction, water heating, etc.). A prerequisite for the correct function of the assigned input is the setting of the correct type of connected sensor or input function in the ***Inputs/Outputs***. The assignment of digital and analog inputs is carried out according to the following examples:

➢ **Temperature sensor** – in the ***AssignmentInputs/Outputs*** ⇨ ***Temperatures*** menu, there for the selected temperature, select one of the inputs marked according to the syntax described in the previous chapter “Inputs and outputs”, (e.g. for a room temperature sensor connected to 1 universal input of the controller, set ***Room = X1***). In addition to these inputs, the room unit assignment is offered with the POL (POL822) and AMR (AMR-OP70) designations. Another option is to assign a constant temperature via setting the input to ***Set***. The required

value for the required temperature is then set below the ***Correction*** sign. The example of setting the room temperature to the fixed value of 25 °C is done in two steps:

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

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

- ***Correction (0 s, 0 °C)*** – consists of two parameters. The first one is used to smooth the jammed signal from the sensor by specifying filtering in seconds. The other one can be used by the user to change the value given by the sensor and to adjust the temperature deviation caused by, for example, the cable length.
- ***Range (–10 °C, 250 °C)*** – determines the range over which the temperature of the connected sensor can 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 less than -100 °C, then the supply cable has probably shorted or the measuring cell itself has shorted. If the temperature is higher than 250 °C, then the supply cable or the measuring cell itself has probably been broken. In the case of an unstable value, a foreign signal is probably induced in the supply cable. A potential fault is indicated by a bell on the LCD display or a flashing or lit alarm LED and a message in the alarm list.

➢ **Pressure sensor** – by default it refers to the ***AssignmentInputs/Outputs ⇨ Filters ⇨ Fans*** menu. For the selected sensor, one of the inputs labelled according to the syntax described in the previous section “Inputs and Outputs” is selected (e.g. for a supply air filter gauge connected to the 3rd universal input of the second input extension ***SupplyFilterAI = 2X3***). Another option is to set a constant pressure by setting the input to ***Set***. The required value for the required pressure is then set under the ***Correction*** sign. An example of setting the filter pressure to a fixed value of 500 Pa is done in two steps:

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

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

- ***Range (500 °C)*** – this value must match the range set on the connected pressure gauge. Exceeding the limits can be signalled as an alarm. The maximum range is 10,000 Pa.
- ***Correction (10 s, 0 Pa)*** – consists of two parameters. The first one is used to smooth the jammed signal from the sensor by specifying filtering in seconds. The first one is used to smooth the jammed signal from the sensor by specifying filtering in seconds.
- ***Press (Pa)*** – measured value of the current differential pressure from the connected sensor. If the pressure value is below 0 Pa, then the supply cable has probably shorted. If the pressure exceeds 10,000 Pa, then the supply cable has probably been broken. A potential fault is indicated by a bell on the LCD display or a flashing or lit alarm LED and a message in the alarm list.
- ***Flow (m3/h)*** – indicates the current air quantity.
- ***K–factor*** – used to calculate the flow rate from the measured differential pressure.

➢ **Relative humidity sensor** – in the ***AssignmentInputs/Outputs*** ⇨ ***Humidity*** menu, there for the selected humidity, select one of the inputs marked according to the syntax described in the previous chapter "Inputs and Outputs", (e.g. for the humidity of exhaust air connected to the 8th universal input 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 required humidity is then set under the ***Correction*** sign. An example of setting the extracted 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 (10 s, 0 %)*** – consists of two parameters. The first one is used to smooth the jammed signal from the sensor by specifying filtering in seconds. The other one can be used by the user to change the value given by the sensor and make adjustments to the relative humidity deviation according to local conditions.
- ***Value (%)*** – indicates the current relative humidity of the connected sensor. If the relative humidity value is less than 0%, then the supply cable has probably shorted. If the pressure is greater than 100%, then the supply cable has probably been cut. A

potential fault is indicated by a bell on the LCD display or a flashing or lit alarm LED and a message in the alarm list.

- **Air quality sensor** – in the ***AssignmentInputs/Outputs*** ⇨ ***AirQuality*** menu, there for the selected air quality sensor, one of the inputs marked according to the syntax described in the previous chapter "Inputs and Outputs" is selected (e.g. for the first sensor connected to the 5 universal input of the controller set ***Sensor = X5***). Another option is to set constant air quality by setting the input to ***Set***. The required value for the required air quality is then set below the ***Correction*** sign. An example of setting the air quality to a fixed value of 1,000 ppm is done in two steps:

  1. ***Sensor = Set.***
  2. ***Correction = 1,000 ppm.***

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

  - ***Correction (10s, 0ppm)*** – consists of two parameters. The first one is used to smooth the jammed signal from the sensor by specifying filtering in seconds. The other one can be used by the user to change the value given by the sensor and make an adjustment of 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 less than 0 ppm, then the supply cable has probably shorted. If the air quality is greater than 2,000 ppm, then the supply cable has probably been cut. A potential fault is indicated by a bell on the LCD display or a flashing or lit alarm LED and a message in the alarm list.

13.2 Assignment of digital inputs

Digital inputs are used to signal running, fault, icing or other component conditions. Assign a digital input to the selected component by selecting one of the digital inputs marked according to the syntax described in the "Inputs and Outputs" chapter (e.g. for a supply fan status contact connected to 1 digital input of the controller, set ***SupplyState = D1***). Another option is to assign a constant value (***Off/On***) via the option ***Set.*** The required value at the input for the required function is then set using the ***Polarity*** (***Normal/Invert***) item. ***Polarity=Invert*** inverts the signal coming from the selected input. An example of setting the supply fan state to the fixed value of ***On*** is done in two steps:

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

13.3 Assignment of digital outputs

Assigning digital outputs is done in the ***Assignm.DigitalOutput*** menu where the line of the required digital output is assigned to the required component to be controlled by this output (e.g. for a supply fan switched from output Q1 to ***DO.Q1 = FS)***. A list of the component abbreviations used in the digital output assignments is shown in Table 2. The assignment also includes the option to invert 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 the output Q1 permanently On: ***DO.Q1 = Set, Invert.*** The component abbreviations in the table are also given for the previous SW version 28.01.

Device component name	Abbreviation v28.01	Abbreviation v29.01
Supply fan – switch on	FanS	FS
Exhaust fan – switch on	FanE	FE
Mixing damper - open	DmpM	DM
Recuperator – switch on	Rec	Rc
Water heating 2 – switch on	5	WH2
Glycol refill pump - on	AGl	AG
Water heating 1 – switch on	WtH	WH
Water heating 1 – switch on	ElH	EH
Water heating 2 – switch on	ElH2	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 – reduce 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 - 4way valve cool/heat	HPV1	HPV
Class A or B alarm	28	AA
Heat pump 2nd circuit - compressor - switch on	HPC2	HP2C
Heat pump - cool	HPC	HPC
Heat pump – heat	HPH	HPH
Humidifier – switch on	Hum	Hu
Fire dampers power supply - switch on	DmpF	FD
Fire signalling	Fire	Fr
Boiler room – switch on	Boil	Bo
Attenuation regime	Red	Red
Comfort regime	Cmf	Cmf
Filter clogging	FiE	FiA
Unit service	Srv	Srv
Temperature period 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 operation	On	On
Fan operation	FnO	FO
Fan failure	FnE	FA
Heating/Cooling 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 o D alarm		AC
Backup supply fan - switch on		FS2
Backup exhaust fan - switch on		FE2

Table 2 - List of digital output assignment abbreviations

13.4 Analog output assignments

The assignment of analog outputs is done in the ***Assignm.AnalogOutput***, menu where the line of the selected analog output is assigned to the required component to be controlled by this output (e.g. for a plate recuperator damper controlled from output Y1 of the controller, you set ***AO.Y1 = Rc)***. A list of the individual component abbreviations used in the analog output

assignments is given in Table 3. Another option is to assign a constant analog value (0-10V) in % using the option ***Set (1% = 0.1V).*** The required value on this output is then set under the menu ***SettingValues–Set.*** The example setting of 8.5V on analog output Y1 is done in two steps:

1. ***AssigningOutputs:*** ***AO.Y1 = Set.***
2. ***SettingValues–Set:*** ***AO.Y1 = 85%.***

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

Device component name	Abbreviation v28.01	Abbreviation v29.01
Supply fan - speed	FanS	FS
Exhaust fan - speed	FanE	FE
Mixing damper - position	DmpM	DM
Recuperator - output	Rec	Rc
Water heating 2 – output	5	WH2
Water heating – output	WtH	WH
Electric heating 1 – output	ElH	EH
Electric heating 2 – output	ElH2	EH2
Supply air damper - position	DmpS	DS
Exhaust 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
Condensation unit 2 – Heat/Cool (FDP3)	CndCH2	Cd2CH
Condensation 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
Condensation unit 2 – off = 1V, on = 9V	28	Cd2O
Condensation 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 exhaust fan - speed		FE2
Air flow controller 3 - position		AF3
Air flow controller 4 - position		AF4
Air quality – output		AQ

Table 4 - List of analog output assignment abbreviations

13.5 External switches

The external switches are configurable and 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 to switch the modes of the AC unit externally, and the specific function of each is determined by the option in ***Configuration*** ⇨ ***ModeSwitches***. Their function is enabled in ***ComponentsMachine*** ⇨ ***Others.***

- ***1Switch*** – is used depending on the ***ModeSwitches*** configuration:
  - ***Modes*** – has the function of switching the AC unit to the ***Economy*** regime.
  - ***Modes2*** – has the function of switching the AC unit to the regime ***Economy.***
  - ***2xMisto*** – has the function of switching the AC unit to the regime ***Economy.*** When the ***2Switch*** contact is activated, it switches the AC unit from the ***Economy*** regime to ***Comfort***.
  - ***3xSpeed*** – has the function of switching the AC unit to the ***Comfort*** regime at speed stage I.
- ***2Switch*** – is used depending on the ***ModeSwitches*** configuration:
  - ***Modes*** – when the ***1Switch*** contact is activated, it switches the AC unit from the ***Economy*** regime to ***Comfort***. When the ***1Switch*** contact is open, it has no function.
  - ***Modes2*** – switches the AC unit to the ***Comfort*** regime regardless of the status of ***1Switch.***

- ***2xMisto*** – has the function of switching the AC unit to the regime ***Economy.*** When the ***1Switch*** contact is closed, it switches the AC unit from ***Economy*** to ***Comfort***.
- ***WRF04*** – has the function of switching on the AC unit.
- ***CPM*** – has the function of switching the AC unit from ***Economy*** to ***Comfort.***
- ***3xSpeed*** – has the function of switching the AC unit to ***Comfort*** at speed stage II.

➢ ***3Switch*** – is used depending on the ***ModeSwitches*** configuration:

- ***3xSpeed*** – has the function of switching the AC unit to ***Comfort*** at speed stage III.
- ***Others Modes*** – external activation of the function of switches 1 and 2. When closed, it sets ***ComponentsMachine*** ⇨ ***Others*** ⇨ ***ExternalSwitches*** **=** ***On***. If it is open, this value can be set by the user.

13.5.2 Fixed external switches

The fixed external switches are part of the components, so no configuration is done, only setting the digital inputs for their special function relative to the external environment.

➢ ***Cool/Heat*** – this digital input can decide whether the unit should cool or heat, subject to other settings. An open contact is the default request for cooling and an open contact is the default request for heating. There are two possible uses:

- ***TemperatureRegulation*** ⇨ ***ClimaTemp*** **=** ***Contact*** – climate temperature is replaced by an external contact switching the heating or cooling modes from some higher-level system.
- ***Configuration*** ⇨ ***WaterCooling*** **=** ***2WithHeat*** – air conditioning unit has a common water exchanger for cooling and heating. An external contact signals the readiness of water for cooling or heating, and therefore the regime of the unit.

➢ ***ResidencyButton*** – this digital input is used to switch the AC unit on and off to the ***Comfort*** regime with a button without locking. The necessary condition is the setting of ***ComponentsMachine*** ⇨ ***Others*** ⇨ ***ExternalSwitches*** **=** ***On.***

➢ ***BMS*** – this digital input is used to enable the AC unit to run on and off from a higher-level Building Management System (BMS), which is used in conjunction with complex building control and management.

➢ ***AlarmAcknowldge*** – this digital input is used to remotely acknowledge (acknowledge) alarms with an external push button.

14 System parameters

The system parameters item is only accessible after a service login. It is possible to set the time and date, change the HMI language, set communication parameters, change preset logins, etc. In the following, only those options will be described that may be useful to the user:

- ***Restart (/Execute)*** – option to restart the controller.
- ***ApplicationInfo*** – item for setting informative texts about the company and application. The Info3, info4, and Info5 texts can be overwritten with custom information.
  - ***Info3*** – ***KJ Mandík*** – contains the name of the device by default.
  - ***Info4*** – ***www.mandik.cz*** – by default contains the company's web address with information about the device.
  - ***Info5*** – ***+420311706877*** – by default contains the telephone contact for the service department.
  - ***Info6*** – by default this line is used to record the date of the next service. If the service function is not used, then other information can be entered.
- ***Versions*** – this displays information about hardware, firmware and software versions.

14.1 Time setting

The current date and time are displayed on the first line below the line on both the Home screen and the ***SystemObjects*** screen. Changes can be made in either of these locations by entering the service password. If the line with time information is selected, then pressing the OK button enters the date and time entry. Entry will stop automatically after seconds have been entered or can be terminated at any time by pressing the ESC key. Correct date and time entry is important for the correct operation of the AC unit according to the time program. Other time-related items are:

- ***TimeValid (No/Yes)*** – valid time is important for the correct operation of the AC unit according to the time program.
- ***DaylightSav.Time*** – allows to enable or disable the change from daylight saving time to standard time and possibly adjust the preset values of the time change.

14.2 Language selection

The language selection is basically done only during the commissioning of the unit and is used to switch the displayed texts on the HMI to the language required by the user. By default, it allows you to select one of the following languages:

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

14.3 Communication

The controller can generally communicate with other parent or slave devices using its communication protocols. BACnet, LonWorks, Modbus, and TCP/IP protocols can be used to connect to higher-level Building Management System (BMS) systems. The Process bus (KNX) and Modbus protocols can be used to integrate slave components. For higher-level systems, communication tables are created for all the types of communications used, with addresses of variable values that can be read from or written to the controller. These tables are in separate annexes and are not part of this documentation. A quick guide to setting the parameters for every type of communication is provided in the ***"Climatix QuickStartSetup"*** manual and is available for download on the Mandík Company's website.

- ***TCP/IP*** – this method of communication uses the Internet and in this case can be used to connect the controller to a computer network to a higher-level system, to cloud storage or directly to a PC. Changing the standard IP address settings and other properties is done after user login in the menu ***SystemObjects*** ⇨ ***Communication*** ⇨ ***IP–Configuration***. In order for a change to initialize, it must be saved by selecting ***Execute*** in item ***RestartRequired!!*** Connecting the controller to a PC with the possibility of controlling the controller via an internet browser is described in detail in the separate documentation *"KJM Mandík - Control panels".*

The ***MANDÍK Cloud*** storage allowing full remote control of the AC unit is described in detail in the separate manual *"Mandík-Cloud"* including connection methods and Ethernet network parameters. For safety reasons, only trained operators can set the controller's internal parameters for connection to the cloud storage.

- ***Modbus*** – is an open protocol for intercommunication of different devices, which allows data to be transferred over different networks and buses. It works on the ***Master/Slave*** principle, i.e. the principle of message passing between server and client. The ***Slave*** regime is used to communicate with a master control system, and the ***Master*** regime is used to communicate with a slave device. The Climatix controller offers the option of both Modbus RTU and Modbus IP protocols, which can be used simultaneously. The Climatix controller has 3 internal Modbus communication ports. The standard communication parameters are set in the menu ***SystemObjects*** ⇄ ***Communication*** ⇄ ***Modbus*** for every port separately. Changes made must be saved by selecting the ***Execute*** option in item ***RestartRequired!*** These are the ports:
  - ***Local*** – Modbus RTU protocol is enabled on the RS485 port and the physical serial communication connection using RS485 is made with a twisted pair cable, such as Belden 3105A, plugged into the ***T9*** controller terminals labelled ***RS485***.
  - ***Service*** – Modbus RTU protocol can also be used on the service connector marked ***T-HI***. the physical connection of serial communication using RS485 is made with a twisted pair cable, for example Belden 3105A, which must be terminated on the controller side with the RJ45 connector. A specific parameter is the setting of the communication service port function for Modbus ***ModbusRTU_Serv=Yes.*** With this setting, no external control unit can be connected to the service port. Changes made must be saved by selecting the ***Execute*** option in item ***RestartRequired!***
  - ***IP*** – Modbus IP protocol is also enabled on the Ethernet port and the physical connection of the TCP/IP transmission is made with a UTP cable terminated with the RJ45 connector that plugs into the Ethernet connector of the ***T-IP*** controller labelled ***Ethernet***. This option cannot be selected for Climatix POL4xx series controllers.

Modbus can also be implemented using the additional POL902 communication module. The individual options of enabling protocols and communication port selections are made in item ***Configuration*** ⇄ ***ModbusPort.*** A complete list of registers is given in the documentation *"Modbus table"* and can be downloaded from the Mandík website. Further information on

Modbus communication is provided in the system documentation for the Climatix controller from Siemens.

- ***ProcessBus (KNX)*** – the controller is preconfigured as standard for communication with the POL822 or POL895 HMI-DM room unit. The parameters of the POL822 room unit are included in the menu ***SystemObjects*** ⇨ ***Communication*** ⇨ ***ProcessBus*** ⇨ ***RoomUnit***. The setup and control of the room unit is described in the separate manual *"Instructions for controlling the KJ Mandík via the POL822 room unit"*. The room unit features the following communication settings:
  - ***Communication (OK/Err)*** **–** informs about a communication failure between the controller and room unit.
  - ***Address*** – communication parameters are entered here, which correspond to parameters 005, 006, and 007 in the room unit.
  - ***PresenceButton (60 min)*** – specifies the time for which, after briefly pressing the ***PresenceButton*** on the ***POL822*** room unit, the ***Comfort*** operating regime is active. After this time has elapsed or the ***PresenceButton*** is pressed again, the unit returns to its previous operating regime.
  - ***RestartRequired!*** – address change is saved by selecting ***Execute*** in this item.

  The S-Mode variant with the maximum of 100 values is used for the transfer of values between the controller and master system via KNX. A complete list of these values is given in the documentation *"KNX S-mode table"* and can be downloaded from the Mandík website.
- ***LonWorks*** – this protocol is an industrial communication bus that via partially resembles the Internet. This communication is implemented for the Climatix controller using the POL906 add-on communication module. For more information on communication, see the separate system documentation for the Climatix controller from Siemens.

  BACnet – this protocol is the standard communication protocol for building management. It is implemented in the Climatix controller using the additional communication modules POL908 (BACnetIP) or POL904 (BACnetMSTP). The controller can handle the maximum of 300 BACnet objects and a complete list of these objects is given in the documentation *"BACnet table"* and is available for download on the Mandík website. For more information on communication, see the separate system documentation for the Climatix controller from Siemens.

14.4 Login - PIN management

In this item you can log in and log out with a password. Another option is to change the preset user or service password, provided you know the existing password.

Without a PIN entered, only basic data is displayed on the controller display, where only the regime (***Off/Tempering/Economy/Comfort***) can be changed. All the other changes can only be made by entering a user or service PIN. The factory default PINs are set as follows:

- **PIN:** ***User = ‚0000‘*** – access level number 3 appears in the top left corner of the display or a single key in the top right corner of the HMI-TM or HMI-DM controls.
- **PIN:** ***Service = ‚2222‘*** – top left corner of the display will show access level number 2 or two keys in the top right corner of the HMI-TM or HMI-DM controls.
- **PIN:** ***Factory = ‚xxxx‘*** – top left corner of the display will show access level number 0 or three keys in the top right corner of the HMI-TM or HMI-DM controls.

15 Alarm message

The alarm message can be any predefined message such as fault, event, message, etc. It consists of name, status, type (priority) and time of occurrence or extinction. Current alarm listings and alarm history can contain the maximum of 50 items. The alarm messages are described in the separate documentation *“Alarm messages”*.