PAW-FC-RC1

Fan Coil – Room Controller (FC-RC)

Manual for

Software, Hardware, Handling and Modbus

Notes:

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Original version (English)

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Table of contents

1 Introduction

PAW-FC-RC1 is a 230 V AC electronic fan-coil thermostat for room temperature control. It is suitable for every kind of building where reduced energy consumption and high comfort need to be met. The ability to switch between control modes depending on occupancy, makes it particularly suitable for public spaces, such as hotel rooms, offices, schools, hospitals, etc. The modular design makes it easy to install and the flush mounting gives the unit a discreet appearance.

This manual provides descriptions of the thermostat functions, as well as hardware-related information concerning thermostat connections, wiring, mounting, maintenance and service, and so on.

The unit can operate in standalone mode or through Modbus, which makes it possible to integrate with other systems such as main controller or building management system.

Special text formats used in the manual:

Note! This box and symbol are used to show useful tips and tricks.

2 Control functions

2.1 Control modes

The thermostat can be used both for 2-pipe systems (standard) and 4-pipe systems. The control mode function enables the thermostat to support control of various room HVAC systems, that is, different combinations of heating and cooling devices that are part of a room. The thermostat can be set to one of the following two control modes:

- ✓ Two pipe system: Heating or Cooling (change-over)
- ✓ Four pipe system: Heating and Cooling

2.1.1 Two pipe system

This control mode is suitable for room HVAC systems that use a 2-pipe fan coil as heating and cooling device (see *Figure 2-1*). A change-over function makes it possible to use the thermostat in a 2-pipe changeover system, where warm or cold media flow in the same pipes and one valve is used to regulate both heating and cooling distribution. The thermostat is either in heating or cooling mode and switches between the modes according to the change-over function settings. The change-over function is further described in chapter *2.3*.

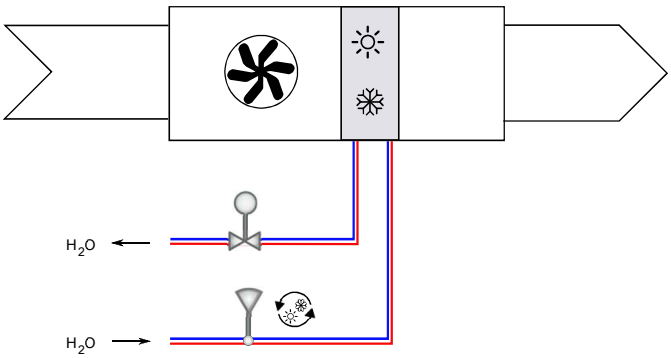


Figure 2-1 A two pipe system

2.1.2 Four pipe system

In the 4-pipe system, the thermostat automatically switches between being a heat thermostat and a cool thermostat. This control mode is suitable for room HVAC systems that use a fan coil as heating or cooling device.

The thermostat works as a heat thermostat when the room temperature is lower than a specified temperature and as a cool thermostat when the room temperature is higher than a specified temperature.

2.1.3 Control mode settings

Parameter	Description
P008	Control mode 00 = 2-pipe system 01 = 4-pipe system

2.2 Control principles

2.2.1 Heating and cooling functions

The thermostat uses a calculated setpoint for heating and cooling (SP_{calc}). Since the user can increase or decrease the basic setpoint, the calculated setpoint takes into consideration both the hysteresis and the user defined setpoint adjustment (SP_{adj}).

- ✓ Heating: $SP_{calc} = SP_{basic} + SP_{adj} - (Hysteresis / 2)$
- ✓ Cooling: $SP_{calc} = SP_{basic} + SP_{adj} + (Hysteresis / 2)$

Note! The hysteresis depends on the current controller state.
Therefore, the calculated setpoint will be different when in *Occupied* state compared to *Standby* state.

The heating function is activated when the room temperature is lower than SP_{calc} minus a defined temperature span (deltaT). The heating output closes when the calculated setpoint is reached (see *Figure 2-2*).

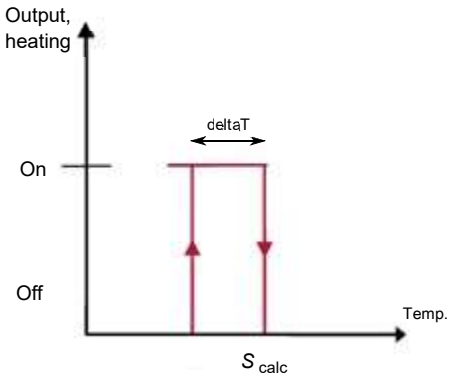


Figure 2-2 Heating function

The cooling function is activated when the room temperature is higher than SP_{calc} plus a defined temperature span (deltaT). The cooling output closes when the calculated setpoint is reached (see *Figure 2-3*).

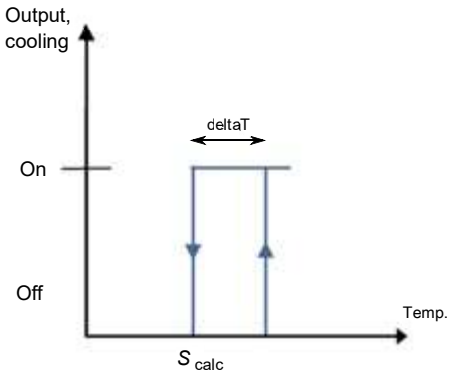


Figure 2-3 Cooling function

2.2.2 Heating/Cooling function settings

Parameter	Description
P001	Basic setpoint (SP_{basic})
P002	Hysteresis used for setpoint calculation at *Occupied* state (heating and cooling)
P003	Hysteresis used for setpoint calculation at *Standby* state (heating and cooling)
P007	DeltaT, temperature span for On/Off control

2.3 Change-over and fan release function (Panasonic)

2.3.1 General

Change-over is a control function that enables the thermostat to provide either a heating or a cooling signal on the same output. This is achieved by shifting the change-over state from *heating* to *cooling*, and vice versa. The change-over function makes it possible to use the thermostat in a 2-pipe change-over HVAC system, where warm or cold media flow in the same pipes and one valve is used to regulate both heating and cooling distribution.

The change-over state can be set to either *heating* or *cooling*.

The change-over state is managed with one of the available change-over modes:

- ✓ Manually heat
  The thermostat works solely as a heating unit
- ✓ Manually cool
  The thermostat works solely as a cooling unit
- ✓ Change-over, manual/automatic
  The thermostat works as a heating or cooling unit depending on the change-over state. The changeover may be set manually in the display (standard), by a switch contact (e.g. heat pump in COOL mode) on the digital input *DI*, by a temperature sensor on the analog input *Temp* or by Modbus communication.

The heat or cool symbol is shown in the display depending on the current change-over state (heating or cooling).

Figure 2-4 Heating symbol in the display at change-over state heating

Figure 2-5 Cooling symbol in the display at change-over state cooling

Additionally, the thermostat has the option to lock and unlock / release the fan, depending on the currently active control mode (heating or cooling) and the temperature at the supply pipeline from the heat pump (heat and cool energy producer), which is connected to the analog input *Temp*. This function prevents that the fan runs, if the water temperature is not warm enough for heating up the room or not cold enough for cooling down the room.

2.3.2 Change-over detection

Change-over detection is performed either by using a potential-free contact that is connected to the digital input *DI*, or by using a temperature sensor that is connected to the analog input *Temp*. As a digital change-over signal can be used the output “heat pump is in COOL mode” (via a relay: potential-free made). The PT1000 temperature sensor is mounted so, that it senses the supply pipe media temperature.

When using a sensor for change-over detection, the shift in change-over state is triggered based on the difference between the pipe media temperature and the room temperature. The thermostat shifts the change-over state to heating when the pipe media temperature is 3 °C (standard) higher than the room temperature. The thermostat shifts the change-over state to cooling when the pipe media temperature is 3 °C (standard) lower than the room temperature. The valve must be at least 20 % open to run calculation to ensure that the media temperature is correct. Alternatively, the sensor can be mounted on the main supply pipeline, in which the media circulates, despite the valve being closed.

When using a potential-free contact for change-over detection, the thermostat shifts the change-over state to cooling when the contact is closed. The thermostat shifts the change-over state to heating when the contact is open. This assumes that the digital input is set to **Normally opened**.

2.3.3 Change-over via display

If Parameter P009 is set to 04 (standard) or 00 (without fan release function), then the change-over function is set by actions from the display. Switching from Heating to Cooling mode and vice versa, is then done by pressing the change-over button (see *Figure 2-6*). This is the only configuration where the change-over button will be showed in the display.

*Figure 2-6 C*hange-over button

2.3.4 Fan release function (Panasonic)

The fan release function is working, if Parameter P009 is set to 04 (standard: heating or cooling selectable via change-over button in the display), 05 (only heating), 06 (only cooling) or 07 (change-over vie digital input). The fan starts only then, if the temperature at the supply pipeline from the heat pump (heat and cool energy producer), which is connected to the analog input *Temp*, is warm enough for heating (*Temp* > current room temperature + P010) or cold enough for cooling (*Temp* < current room temperature - P011). With 1K switching difference, the fan stops when it was already running.

if Parameter P009 is set between 04 and 07, the change-over detection via the analog input Temp are not usable and do not work.

2.3.5 Change-over and fan release settings

Parameter	Description
P009	Change-over mode and Fan release function (Panasonic) 00 = Manual setting in display 04 = Manual setting in display + FAN off dep. on input T*emp* 01 = Manual Heat 05 = Manual Heat + FAN off depending on input *Temp* 02 = Manual Cool 06 = Manual Cool + FAN off depending on input *Temp* 03 = Auto via input *DI* or *Temp* 07 = Auto via input *DI* + FAN off depending on input *Temp*
P010	Temperature difference between the room temperature and the water temperature to switch to heating mode (P009 = 03) or release the fan in heating mode (P009 = 04,05,07)
P011	Temperature difference between the room temperature and the water temperature to switch to cooling mode (P009 = 03) or release the fan in cooling mode (P009 = 04,06,07)
P012	Detector/contact connected to DI 00 = Nothing connected 03 = Presence detector (activate *Occupied* state) 04 = Change-over contact
P015	DI Normally closed (NC) / Normally open (NO) 00 = NO 01 = NC
P017	Sensor connected to AI 00 = No sensor connected (Internal sensor is used for room temperature measurement) 01 = Room temperature sensor 02 = on supply pipeline installed temperature sensor, for change-over or fan release function

2.4 Fan speed control

2.4.1 Three speed fan

The unit handles 3 fan speed with relays.
The fan speed can be configured in one of the following 4 ways:

1. The fan speed does not follow neither heating or cooling and can only be set manually.
2. The fan speed only follows the heating demand.
3. The fan speed only follows the cooling demand.
4. The fan speed follows both heating and cooling demand.

The fan speed is controlled by the deviation from the room temperature and the calculated setpoint (SP_{calc}) (see chapter *2.2.1*). Fan 1 starts when the temperature deviation is 1°C (standard) from the calculated setpoint. Fan 2 starts when the deviation is 2°C (standard) from the calculated setpoint and Fan 3 starts when the temperature deviation is 3°C (standard) from the calculated setpoint. The fan speed then decreases, when the deviation decreases.

For the end user, the manual control of the fan speeds is done with the fan button in the lower right corner (see *Figure 2-7)*.

Figure 2-7 Fan button

The user steps through the following steps by pressing the fan button:

Auto -> Manual fan stop -> Manual speed 1 -> Manual speed 2 -> Manual speed 3 -> Auto

The fan symbol in the upper part of the display will spin if speed is set (automatically or manually) and will be at standstill otherwise. Symbol “Man” will lit up as long as the Manual speed 0 – Manual speed 3 is selected and be turned off otherwise. Auto will be lit up when Auto speed is selected and be turned off otherwise. The bars for fan speed will correspond to the current speed set, either Manually or Automatically.

Figure 2-8 Fan speed bars

Via Modbus it is possible to force the fan to run with at least one fan speed. This is valid in all states except the *Off* state where the fan will be turned off.

2.4.2 Mould protection

In order to minimise the risk of mould growth in the fan-coil unit it is possible to activate the mould protection. When activated, the fan will run with at least one fan speed in all states to circulate air in the room and minimise the risk of mould growth in the fan-coil unit.

Note! With activated mould protection the fan also runs in *Off* state.

2.4.3 Fan control settings

Parameter	Description
P016	Mould protection 00 = Not active 01 = Active
P020	Fan control 00 = No fan control 01 = Fan is controlled by heat command 02 = Fan is controlled by cool command 03 = Fan is controlled by both heat and cool command
P021	Number of fan speeds used 01 = 1 fan speed is used 02 = 2 fan speeds are used 03 = 3 fan speeds are used

2.5 Actuator control

2.5.1 Heating/Cooling valves

The unit has two digital outputs for heating and cooling thermal actuator control, see terminals *Heat* and *Cool*. For the thermal actuator on the heating valve, the output *Heat* is always configured. Depending on the selected control mode (P008), the output for the cooling sequence is also the terminal *Heat* (in a 2-pipe system) or the terminal *Cool* (in a 4-pipe system). Only according to the demand (Heat or Cool), the corresponding output is switched on. Heat and Cool terminals can only be on at the same time, during manual control.

2.5.2 Actuator control settings

Parameter	Description
P031	DO *Heat* Normally closed (NC) / Normally open (NO) 00 = NO 01 = NC
P032	DO *Cool* Normally closed (NC) / Normally open (NO) 00 = NO 01 = NC

2.6 Controller state

Controller state is a function that makes it possible for the room HVAC system to operate with priority on comfort or energy saving.

The following controller states are available for use and the thermostat always operates in one of them:

- ✓ Off
- ✓ Standby
- ✓ Occupied

Note! The calculated setpoint is different when the thermostat is in *Occupied* state compared to *Standby* state due to different hysteresis. See chapter *2.2.1* for more information.

Table 2-1 Controller state overview

Controller state	Description	User experience	Display behaviour
Off	This state is typically used when no one is present in the room for an extended period of time, for example, during holidays or long weekends.	Energy saving	The background lighting is not lit. On/Off button is shown.
Standby	This state is typically used when no one is present in the room, temporarily or for shorter periods of time, such as during evenings, nights, or weekends.	Energy saving	The background lighting is lit (dimmed). The current room temperature or user defined setpoint adjustment is shown (depending on the configuration).
Occupied	This state is typically used when someone is present in the room.	Comfort	The background lighting is lit (dimmed). The current room temperature or user defined setpoint adjustment is shown (depending on the configuration).

2.6.1 Off

The thermostat neither heats nor cools and the fan is at a standstill, unless mould protection has been selected in which case the fan is still running. This is also the normal state at power up.

All segments in the display are dimmed down, except the On/Off button (see chapter 3.3). The thermostat cannot exit the Off state due to presence. Only a press on the On/Off button or a remote control command via Modbus can trigger the exit.

2.6.2 Standby

The thermostat works around the calculated Standby setpoint (see chapter 2.2.1)

This is the controller state, that the thermostat will enter into, when it has no input from the I/O, the display or the communication.

At Standby, the unoccupied segment is shown in the display.

Figure 2-9 Unoccupied segment

2.6.3 Occupied

A presence detector can be connected to DI1 in order to switch between the *Occupied* and *Standby* state. Switching between *Occupied* and *Off* can also be performed via the occupancy button, or via communication. The thermostat works around the calculated *Occupied* setpoint (see *2.2.1*).

At *Occupied* state the occupied segment is shown in the display.

Figure 2-10 Occupied segment

2.6.4 Flow chart controller states

The basic state of the thermostat is *Standby* state. If there is no external influence it will return to this state. See *Figure 2-11* to get a better understanding of how the thermostat moves between the different states.

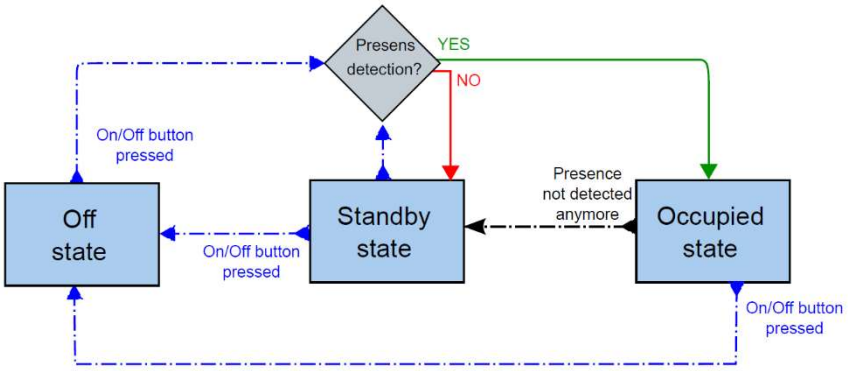


Figure 2-11 Changing controller states (no remote control)

2.7 Presence detection

2.7.1 Function

Presence detection is a control function that makes it possible for the controller to automatically switch between controller states based on if someone is present in the room. A presence detector or hotel key card sensor is connected to DI in order to choose between the controller states *Occupied* and *Standby*.

The controller checks for presence continuously when the controller has been set in the Operating mode (DI) *Presence detection*.

2.7.2 On/Off delay

When the DI is configured as presence sensor, there is an On/Off delay that may be configured. The On delay makes the presence detection wait for the configured amount of time before *presence* is determined. The Off delay makes the presence detection stick for the configured amount of time before returning to *no presence*.

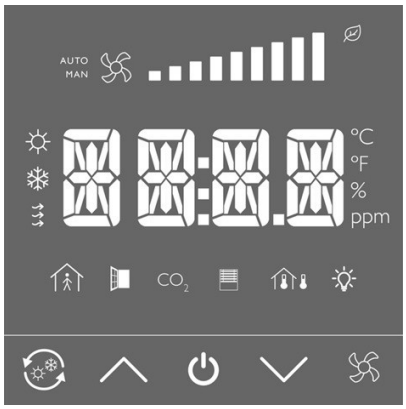
The default values are 0 which means that the presence is on or off instantly.

2.7.3 Presence settings

Parameter	Description
P012	Detector/contact connected to DI1 00 = Nothing connected 03 = Presence detector (activate *Occupied* state) 04 = Change-over contact
P013	Switch on delay for DI, in minutes
P014	Switch off delay for DI, in minutes
P015	DI Normally closed (NC) / Normally open (NO) 00 = NO 01 = NC

3 Display layout

3.1 The display



3.2 Display modes

3.2.1 General

The display has three different modes that it operates in when in *Standby* and *Occupied* state:

- ✓ Active mode
- ✓ Idle mode
- ✓ Setpoint mode

3.2.2 Idle mode

When the display has been inactive during a defined time span, it goes into *Idle* mode. In this mode all buttons and segments, except the two arrows, are dimmed down in the display. The time it takes before the display is put into *Idle* mode is set with the parameter *Inactive delay*. If this delay is set to 0 the display never dims down.

3.2.3 Active mode

The *Active* mode is the mode the user sees when activating the display, without entering any value. In this mode it is possible to show one of the following two values in the display:

- ✓ The current room temperature (standard),
  measured either by the internal (standard) or the external sensor
- ✓ The calculated setpoint (SP_{calc})

The symbol for indoor temperature is always lit in this mode, as there will always be measurements of the indoor temperature.

3.2.4 Setpoint mode

The *Setpoint* mode is what the user sees when adjusting the room temperature via the display. This mode is activated if the user presses either the *Arrow up* or *Arrow down* arrow when in *Active mode*. The display can be set to show two different values in this mode:

- ✓ The calculated setpoint (SP_{calc}) (standard)
- ✓ The current user defined setpoint adjustment (SP_{adj})

3.2.5 View mode settings

Parameter	Description
P044	Inactive delay Delay for the display to dim down and enter *Idle* mode. If set to 0 the display never dims down.
P045	Display setting for *Active* mode 00 = Show the calculated setpoint (SP_{calc}) 01 = Show the room temperature (standard)
P046	Display setting for the *Setpoint* mode 00 = Show the calculated setpoint (SP_{calc}) (standard) 01 = Show the user defined setpoint adjustment (SP_{adj})
P047	Positive setpoint adjustment. The maximum allowed user defined setpoint adjustment (SP_{adj}) increase.
P048	Negative setpoint adjustment. The maximum allowed user defined setpoint adjustment (SP_{adj}) decrease.
P049	Brightness of segment at *Active* and *Setpoint* mode as well as in the parameter list.

3.3 Buttons

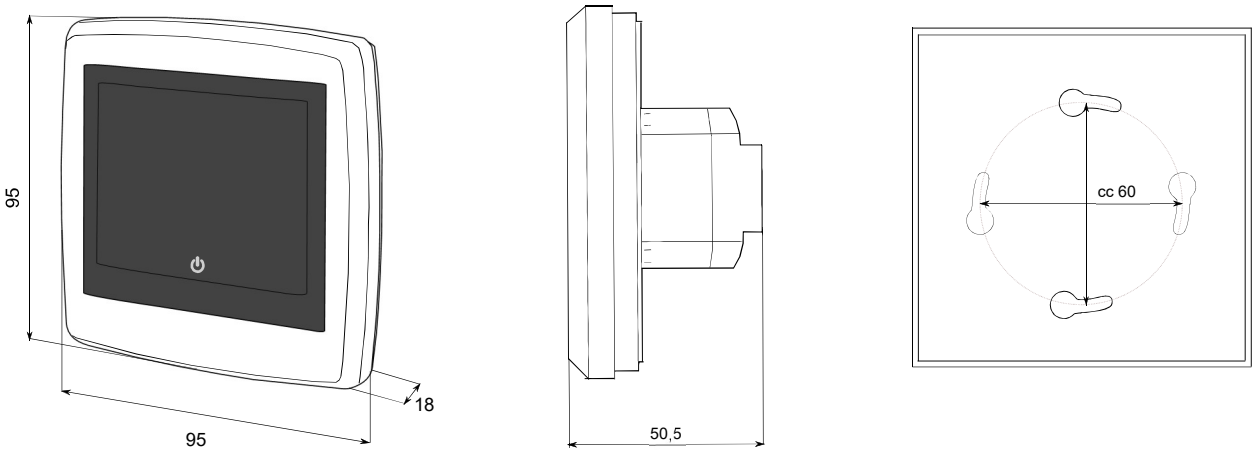
Symbol	Description	
	On/Off button	
	Arrow up = increase button for setpoint adjustment +	for start the parameter list: press both arrow buttons together until the display shows 0000, then press short the Arrow up button to show P001 = Parameter 001
	Arrow down = decrease button for setpoint adjustment -	
	Changeover button to switch between heating and cooling via the display This is a combination of two segments, the outer arrows and the inner sun / snowflake. These two segments are controlled individually.	
	Fan button to regulate the fan speed via the display between AUTO / MAN (off/1/2/3)	

3.4 Segments

Segment	Description
	Four 16-segments LCD blocks for numeric feedback All segments are individually controllable, i.e. the digits, the ":" and the two "."
	Unit °C
 	Fan symbols Two 4 blade fans are combined. When the fan is running the fan symbols alters between showing all 8 fan blades and showing only 4, creating an illusion of fan spinning.
	Auto mode Normally used in conjunction with the fan symbol, to show that the fan is in Auto mode.
	Manual mode Normally used in conjunction with the fan symbol, to show that the fan is in Manual mode.
	Fan speed Every bar is a separate segment and may be used individually. 10 different fan speeds can be shown.
	Occupancy The man and the house are two separate segments that can be controlled individually.
	No presence Used in combination with the segment Occupancy.
	Shows that the controller is in cool mode
	Shows that the controller is in heat mode

4 Hardware

4.1 Dimensions



4.2 Connection diagram

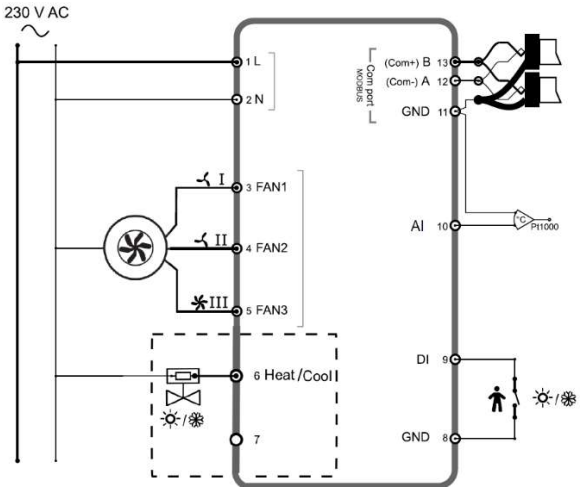


Figure 4-1 2-pipe wiring (standard)

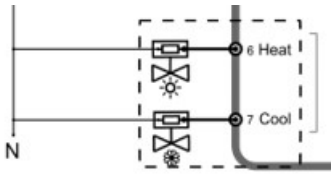


Figure 4-2 4-pipe wiring

Terminal	Description
L	Supply voltage 230V AC Phase
N	Supply voltage 230V AC Neutral
FAN1	Fan speed 1, digital output relay contact normally open
FAN2	Fan speed 2, digital output relay contact normally open
FAN3	Fan speed 2, digital output relay contact normally open
Heat	Heating and Cooling valve actuator at 2-pipe installation, Heating valve actuator at 4-pipe installation, digital output relay contact normally open changeable to normally closed
Cool	Cooling valve actuator at 4-pipe installation, digital output digital output relay contact normally open changeable to normally closed
Temp / AI	Analog input for external temperature sensor PT1000 (fan release function, change-over, room temperature alternative to the internal room sensor)
DI	Digital input, for an external potential-free contact (presence detection, hotel vex card, change-over)
GND	Ground / Agnd / reference potential for Temp / AI, DI and Modbus Com N
A	Serial communication port Com A, Modbus RTU
B	Serial communication port Com B, Modbus RTU

Appendix A Technical data

Supply voltage	230 V ~ (207…253 V ~ 50/60 Hz)
Power consumption	< 2 VA
Protection class	IP30
Ambient humidity	10…90 %RH (non-condensing)
Ambient temperature	0…50 °C
Measuring range, temperature	0…50 °C, external sensor at Temp / AI: 0…80°C
Sensor element, temperature	NTC
Accuracy, temperature	±0.5 K
Display	Built-in
Display type	LED-backlit LCD
Output signal, temperature	NTC
Setpoint adjustment	5…35 °C
Mounting	Room (flush-mounted with screw distance cc 60 mm)
Installation	Fan-coils, 2- or 4-pipe
Digital inputs (DI)	1 x Closing potential-free contact
Digital outputs (DO)	3 x Relay outputs for 3-step fan control, 230 V AC, Max. 5 A 2 x Relay outputs for On/Off valve actuators, 230 V AC, Max. 5 A
Analogue inputs (Temp / AI)	1 x PT1000 (standard: for the clamp-on sensor to install at the heat pump supply pipeline or for other functions)
Change-over function	Manual or automatically via DI or Temp / AI
Communication port	1
Internal serial port, type	RS485
Internal serial port, built-in protocol	Modbus (RTU)
Internal serial port, communication speed	9600 bps (4800…38400 bps)
Internal serial port, parity	Even (Even, Odd, None)
Internal serial port, stop bit	1 (1 or 2)
Cable connection	Screw terminals max. 1.5 mm2 (AWG 16)
Dimensions, external (WxHxD)	95 x 95 x 50.5 mm
Weight, incl. packaging	0.24 kg
Material, housing and base	Polycarbonate, PC
Material, fire resistance	UL 94 V-0
Colour, housing and base	Signal white RAL 9003

Appendix B Parameter list

The parameter list is used to make basic configurations for the controller. It is intended for quick configurations for installers.

The parameter list is entered by tapping a special sequence with the buttons on the controller:

- ✓ Press the *Arrow up* and *Arrow down* buttons simultaneously for five seconds
- ✓ 0000 is shown in the display
- ✓ Release the two arrow buttons
- ✓ Push the *Arrow up* button twice while 0000 is still shown in the display (10 s), else the display will revert to *Idle mode*
- ✓ P001 = Parameter 1 is shown in the display
- ✓ Use the *Arrow up* or *Arrow down* to step through the parameter list

The display looks as in *Figure B-1* when inside the parameter list.

Figure B-1 Display when inside the parameter list

If the display is left in Parameter menu for more than 10 seconds without any activity (buttons pressed), the controller will exit automatically the parameter menu and revert to *Idle mode*. The parameter menu can also be left, with the selection of "EXIT" and confirm with On/Off.

Par.- No.	Description	Standard	Min	Max
P001	Basic setpoint (SP_{basic})	20 °C	5	50
P002	Hysteresis used for setpoint calculation at *Occupied* state (heating and cooling)	1 K	1	10
P003	Hysteresis used for setpoint calculation at *Standby* state (heating and cooling)	5 K	1	30
P007	DeltaT, temperature span for On/Off control	1 K	0	30
P008	Controller mode 0 = 2-pipe systems 1 = 4-pipe systems	0	0	1
P009	Change-over mode (0-3) and fan release function (4-7) via heat pump supply sensor 0 = Manual setting in display 1 = Manual Heat 2 = Manual Cool 3 = Automatic via analog or digital input 4 = manual setting in the display via button 5 = Manual Heat 6 = Manual Cool 7 = Automatic via digital input DI	4	0	7

Par.- No.	Description	Standard	Min	Max
P010	Temperature difference between the room temperature and the water temperature to switch to heating (P009 = 3) or to release the fan at heat mode (P009 = 7)	3 K	1	50
P011	Temperature difference between the room temperature and the water temperature to switch to cooling (P009 = 3) or to release the fan at cool mode (P009 = 7)	3 K	1	50
P012	Operating mode for DI 0 = No contact connected 1-2 = *Not used* 3 = Presence detector connected (switches between *Standby* and *Occupied* state) 4 = Change-over contact connected (e. g. heat pump in COOL mode)	0	0	4
P013	Switch on delay for DI	0 min	0	120
P014	Switch off delay for DI	0 min	0	120
P015	DI Normally closed (NC) / Normally open (NO) 0 = NO 1 = NC	0	0	1
P016	Mould protection 0 = Not active 1 = Active	0	0	1
P017	Sensor connected to Temp / AI 0 = No sensor connected (internal room temperature sensor is used) 1 = Room temperature sensor 2 = Temperature sensor for change-over or fan release function	2	0	2
P018	Temperature compensation for Temp / AI	0 K	-10	10
P019	Temperature compensation for the internal room temperature sensor	0 K	-10	10
P020	Fan control 0 = No fan control 1 = Fan is controlled by heat command 2 = Fan is controlled by cool demand 3 = Fan is controlled by both heat and cool demand	3	0	3
P021	Number of fan speeds used 1 = 1 fan speed is used 2 = 2 fan speeds are used 3 = 3 fan speeds are used	3	1	3
P031	DO *Heat* Normally closed (NC) / Normally open (NO) 0 = NO 1 = NC	0	0	1
P032	DO *Cool* Normally closed (NC) / Normally open (NO) 0 = NO 1 = NC	0	0	1
P039	Heat valve exercise hour, 0 – 23 h	23 h	0	23
P040	Cool valve exercise hour, 0 – 23 h	23 h	0	23
P041	Heat valve control 0 = Manual Off 1 = Manual On 2 = Auto	2	0	2
P042	Cool valve control 0 = Manual Off 1 = Manual On 2 = Auto	2	0	2
P044	Inactive delay, delay for the display to dim down and enter *Idle* mode. If set to 0 the display never dims down.	0 s	0	600
P045	Display setting *Active* mode 0 = Show current controller setpoint 1 = Show current room temperature	1	0	1
P046	Display setting for the *Setpoint* mode 0 = Show the calculated setpoint (SP_{calc}) 1 = Show the user defined setpoint adjustment (SP_{adj})	0	0	1
P047	Maximum setpoint adjustment increase	3 K	0	20
P048	Maximum setpoint adjustment decrease	3 K	0	20
P049	Brightness of segment at *Active* and *Setpoint* mode as well as in the parameter list	100 %	0	100

Par.- No.	Description	Standard	Min	Max
P050	Modbus address	1	1	254
P051	Modbus Speed 0 = 4800 bps 1 = 9600 bps 2 = 19200 bps 3 = 38400 bps	1	0	3
P052	Modbus parity and stop bit 0= 8N2 8 bits parity None 2 stop bits 1 = 8O1 8 bits parity Odd 1 stop bit 2 = 8E1 8 bits parity Even 1 stop bit 3 = 8N1 8 bits parity None 1 stop bit	2	0	3
P053	Modbus Char timeout Timeout should be at least 1.5 times a character, i.e. at least 2 ms (@9 600 baud)	2 ms	2	1000
P054	Modbus Answer delay	5 ms	5	1000
P055	Version number	11	11	-
EXIT	leave the parameter menu, confirm with On/Off			

Appendix C Modbus variable list

C.1 Introduction

The Modbus protocol is a general-purpose protocol for data exchange between for instance control units, Building Management Systems, instruments and electricity meters. It's an asynchronous, serial Master Slave protocol. It's widely used, well documented and simple to understand.

A Modbus master can communicate with up to 247 slave units with the device ID 1-247. A protocol like Modbus consists of several layers (OSI-model). The bottom layer is always the physical layer; the number of wires and signal levels. The next layer describes the communication digits (number of data bits, stop-bits, parity etc.). Next are the layers describing the Modbus-specific functions (number of digits per message, the meaning of different messages, etc.).

C.2 Modbus register types

1. Discrete Input Register
2. Coils Register
3. Input Register
4. Holding Register

Supported Modbus functions:

- ✓ 0x01 Read Coils
- ✓ 0x02 Read Discrete Inputs
- ✓ 0x03 Read Holding Registers
- ✓ 0x04 Read Input Registers
- ✓ 0x05 Write Single Coil
- ✓ 0x06 Write Single Register
- ✓ 0x0F Write Multiple Coils
- ✓ 0x10 Write Multiple Registers
- ✓ 0x17 Read/Write Multiple Registers

C.3 Discrete Input Register

Variable address	Description
1	*Not used*
2	*Not used*
3	Presence detected 0 = Presence **not** detected 1 = Presence detected Active if presence detector is configured at terminal *DI*.
4	Change-over heating/cooling 0 = Change-over heating 1 = Change-over cooling Active if Change-over sensor is configured at terminal *DI*.
5	Fan speed 1 0 = Fan speed 1 is **not** active on DO *FAN1* 1 = Fan speed 1 is active on DO *FAN1*
6	Fan speed 2 0 = Fan speed 2 is **not** active on DO *FAN2* 1 = Fan speed 2 is active on DO *FAN2*
7	Fan speed 3 0 = Fan speed 3 is **not** active on DO *FAN3* 1 = Fan speed 3 is active on DO *FAN3*
8	Heat valve 0 = Heat valve is **not** active on DO *Heat* 1 = Heat valve is active on DO *Heat*
9	Cool valve 0 = Cool valve is **not** active on DO *Cool* 1 = Cool valve is active on DO *Cool*
10	Indicates the current change-over state of the controller 0 = Heating 1 = Cooling This value may be set by either *DI* or *Temp* change-over control
11-19	*Not used*
20	Actual value on *DI*, before filters such as NC/NO
21	*Not used*
22	Actual value on DO *FAN1*, after filters such as NC/NO
23	Actual value on DO *FAN2*, after filters such as NC/NO
24	Actual value on DO *FAN3*, after filters such as NC/NO
25	Actual value on DO *Heat*, after filters such as NC/NO
26	Actual value on DO *Cool*, after filters such as NC/NO

C.4 Coils Register

Variable address	Description
1	Minimum fan speed. The fan runs at least at speed 1, except in *Off* state. 0 = Not Active 1 = Active
2	Mould protection 0 = Not Active 1 = Active
3-9	*Not used*
10	NC/NO for terminal *DI* 0 = NO 1 = NC
11-14	*Not used*
15	NC/NO for terminal *Heat* 0 = NO 1 = NC
16	NC/NO for terminal *Cool* 0 = NO 1 = NC

C.5 Input Register

Variable address	Description	Scale
1	Regin Model number (= 1715)	1
2-3	*Not used*	
4	Status 0 = Beta status 1 = Released version	1
5-7	*Not used*	
8	Heating/cooling mode 0 = *Not used* 1 = Heating 2 = Cooling	1
9	Controller state 0 = Off 1 = *Not used* 2 = Standby 3 = *Not used* 4 = Occupied	1
10	Room temperature The current room temp, from the internal or the external sensor.	10
11	Change-over temperature or fan release temperature The current change-over temperature. Shows NaN! if no sensor is connected.	10
12-19	*Not used*	
20	Room temperature (internal) The value from the internal temperature sensor.	10
21	Room temperature (external) The value from the external temperature sensor. Shows a value if a temperature sensor is configured for *Temp/AI*, NaN! otherwise.	10
22	Change-over temperature The value from the external change-over temperature sensor. Shows a value if a change-over sensor is configured for *Temp/AI*, NaN! otherwise.	10
23-24	*Not used*	
25	AI *Temp* Raw Raw value of the terminal (before any filters). Shows NaN! if no sensor is connected.	10
26	*Not used*	
27	AI *Temp* Value of the Analog input after filters and scaling. Shows NaN! if no sensor is connected.	10
28	*Not used*	
29	Calculated setpoint The setpoint for the controller (SP_{calc}), calculated from the basic setpoint, setpoint adjustment and hysteresis.	10
30-32	*Not used*	

C.6 Holding Register

Variable address	Description	Unit	Default value	Scale	Min value	Max value
1	Basic setpoint (SP_{basic})	°C	200	10	50	500
2	Hysteresis to calculate Heating and Cooling setpoint at *Occupied* state	°C	10	10	10	400
3	Hysteresis to calculate Heating and Cooling setpoint at *Standby* state	K	50	10	10	400
4	DeltaT, temperature span for On/Off control	K	10	10	5	100
5	Controller mode 0 = 2-pipe 1 = 4-pipe	-	0	1	0	1
6	Fan control 0 = No fan control 1 = Fan is controlled by heat command 2 = Fan is controlled by cool demand 3 = Fan is controlled by both heat and cool demand	-	3	1	0	3
7-10	*Not used*					
11	Number of fan speed used 1 = 1 fan speed is used 2 = 2 fan speeds are used 3 = 3 fan speeds are used	-	3	1	1	3
12	Change-over mode (0-3) and fan release function (4-7) via heat pump supply sensor 0 = Manual setting in display 1 = Manual Heat 2 = Manual Cool 3 = Automatic via analog or digital input 4 = manual setting in the display via button 5 = Manual Heat 6 = Manual Cool 7 = Automatic via digital input DI	-	4	1	0	7
13	Temperature difference between the room temperature and the water temperature to switch to heating (P009 = 3) or to release the fan at heat mode (P009 = 7)	K	30	10	10	250
14	Temperature difference between the room temperature and the water temperature to switch to cooling (P009 = 3) or to release the fan at cool mode (P009 = 7)	K	30	10	10	250
15	Switch on delay for terminal *DI*	min	0	1	0	120
16	Switch off delay for terminal *DI*	min	0	1	0	120
17	Remote setting of the current controller state 0 = Off 1 = No Action 2 = Standby 3 = No Action 4 = Occupied 5 = No remote control	-	5	1	0	5
18-29	*Not used*					
30	Manual or Auto control of output for Heat valve (terminal *Heat*) 0 = Manual Off 1 = Manual On 2 = Auto (output is controlled by the heat demand)	-	2	1	0	2
31	Manual or Auto control of output for Cool valve (terminal *Cool*) 0 = Manual Off 1 = Manual On 2 = Auto (output is controlled by the cool demand)	-	2	1	0	2
32-33	*Not used*					

Variable address	Description	Unit	Default value	Scale	Min value	Max value
34	Manual/Auto Fan control, 3-speed fan 0 = No fan speed active 1 = Fan speed 1 is active on DO *FAN1* 2 = Fan speed 2 is active on DO *FAN2* 3 = Fan speed 3 is active on DO *FAN3* 4 = Auto. Fan speed follows heat or cool demand according to the application.	-	4	1	0	4
35-36	*Not used*					
37	User defined setpoint adjustment (SP_{adj}) set by using the buttons on the front. Can be reset remotely. 0 = No current setpoint adjustment made.	K	0	10	-200	200
38	Positive user defined setpoint adjustment. The maximum allowed setpoint adjustment (SP_{adj}) increase.	K	30	10	0	200
39	Negative user defined setpoint adjustment. The maximum allowed setpoint adjustment (SP_{adj}) decrease.	K	30	10	0	200
40-43	*Not used*					
44	Heat valve exercise hour, 0 – 23h	h	23	1	0	23
45	Cool valve exercise hour, 0 – 23h	h	23	1	0	23
46	Sensor connected to AI *Temp* 0 = No sensor connected (Internal room sensor is used) 1 = Room temperature sensor 2 = Change-over temperature sensor or fan release function	-	2	1	0	2
47	*Not used*					
48	Contact/detector connected to the terminal *DI* 0 = No contact connected 1-2 = *Not used* 3 = Presence detector (activate *Occupied* state) 4 = Change-over contact	-	0	1	0	4
49-52	*Not used*					
53	Display inactive delay Delay for the display to dim down to *Idle* mode. If set to 0 the display never dims down.	s	0	30	0	600
54	Calibration of the external temperature sensor (terminal *Temp*) Is used to eliminate cable resistance for the temperature measuring and thus correct the temperature reading from *Temp* if needed.	-	0	10	-100	100
55	Filter factor for temperature on analog input *Temp* Low pass filter to avoid temperature spikes and flickering.	%	20	1	0	100
56	Calibration of the internal temperature sensor Is used to correct the internal temperature reading if necessary.	-	0	10	-100	100
57	Display setting for *Active* mode 0 = Show the calculated setpoint (SP_{calc}) 1 = Show the room temperature	-	1	1	0	1
58	Display setting for the *Setpoint* mode 0 = Show the calculated setpoint (SP_{calc}) 1 = Show the user defined setpoint adjustment (SP_{adj})	-	0	1	0	1
59	Intensity or "brightness" of display when in *Active* or *Setpoint* mode	%	70	1	0	100
60	Intensity or "brightness" of display when in *Idle* mode	%	25	1	0	100
61	The Modbus address the controller uses	-	1	1	1	254
62	Modbus stop bits and parity 0 = 8N2 1 = 8O1 2 = 8E1 3 = 8N1	-	2	1	0	3
63	Timeout should be at least 1.5 times a character, i.e. at least 2 ms (@9 600 baud)	ms	3	1	1	500
64	Answer delay should be at least 3.5 times a character, i.e. at least 5 ms (@9 600 baud)	ms	5	1	1	500
65	0 = 4800 bps 1 = 9600 bps 2 = 19200 bps 3 = 38400 bps	-	1	1	0	3

Notes: