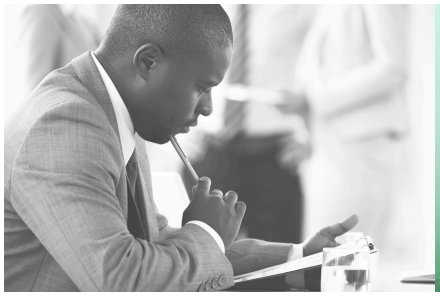

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MANUAL

RCFD-230C

REGIN
THE CHALLENGER

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Rev. A, 2019-10-01

REGIN
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1 Introduction

RCFD-230C 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 unit can operate in standalone mode or through Modbus, which makes it possible to integrate with other systems such as SCADA or DDC. 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.

Special text formats used in the manual:

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

2 Control functions

2.1 Control modes

The thermostat can be used both for 4-pipe systems and 2-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:

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

2.1.1 Four pipe system

In the four 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.

2.1.2 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 change-over 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*.

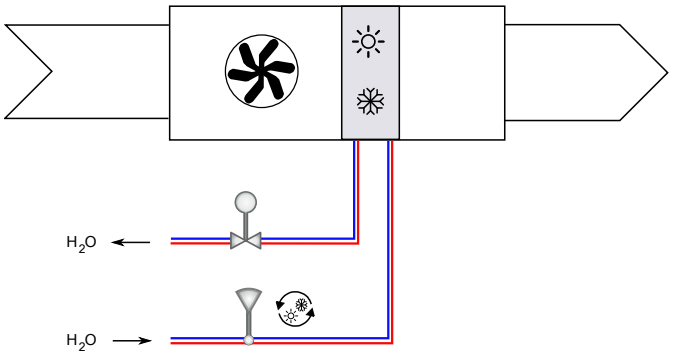


Figure 2-1 A two pipe system

2.1.3 Control mode settings

Parameter	Description
8	Control mode 0 = 2-pipe system 1= 4-pipe system

Modbus register	Modbus addess	Description
Holding register	5	Control mode 0 = 2-pipe system 1= 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*.

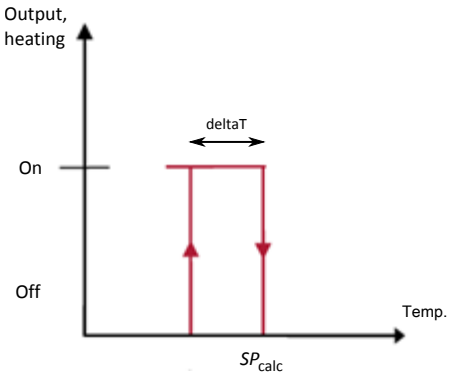


Figure 2-2 Heating function

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*.

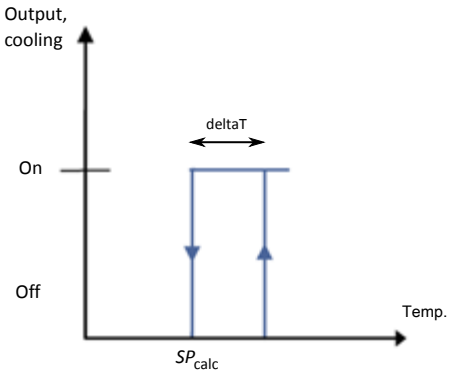


Figure 2-3 Cooling function

2.2.2 Heating/Cooling function settings

Parameter	Description
1	Basic setpoint (SP_{basic})
2	Hysteresis used for setpoint calculation at *Occupied* state (heating and cooling)
3	Hysteresis used for setpoint calculation at *Standby* state (heating and cooling)
7	DeltaT, temperature span for On/Off control

Modbus register	Modbus address	Description
Holding register	1	Basic setpoint (SP_{basic})
Holding register	2	Hysteresis used for setpoint calculation at *Occupied* state (heating and cooling)
Holding register	3	Hysteresis used for setpoint calculation at *Standby* state (heating and cooling)
Holding register	4	DeltaT, temperature span for On/Off control

2.3 Change-over

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 an cooling unit
- ✓ Change-over, manual/automatic
  The thermostat works as a heating or cooling unit depending on the change-over state. The change-over may be set manually, by communication or by the temperature sensor on AI *Temp* or switch on DI.

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

2.3.2 Change-over detection

Change-over detection is performed either by using a PT1000 sensor that is connected to an analog input, or by using a potential-free contact that is connected to a digital input. The PT1000 sensor is mounted so that it senses the pipe media temperature.

When using a PT1000 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 (default setting) higher than the room temperature. The thermostat shifts the change-over state to *cooling* when the pipe media temperature is 3 °C (default setting) lower than the room temperature. The valve has to be at least 20 % open to run calculation to ensure that the media temperature is correct.

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 9 or Holding Register 12 is set to 0, 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. This is the only configuration where the change-over button will be showed in the display.

2.3.4 Change-over settings

Parameter	Description
9	The change-over mode 0 = Manual setting in display 1 = Manual Heat 2 = Manual Cool 3 = Automatic via analogue or digital input
10	Temperature difference between the room temperature and the water temperature to switch to heating
11	Temperature difference between the room temperature and the water temperature to switch to cooling
12	Sensor/detector connected to DI1 0 = No sensor connected 1-2 = *Not used* 3 = Presence detector (activate *Occupied* state) 4 = Change-over sensor
15	DI1 Normally closed (NC) / Normally open (NO) 0 = NO 1 = NC
17	Sensor connected to AI 0 = No sensor connected (Internal NTC sensor is used) 1 = Room temperature sensor 2 = Change-over temperature sensor

Modbus register	Modbus address	Description
Coils register	10	DI1 Normally closed (NC) / Normally open (NO) 0 = NO 1 = NC
Holding register	12	The change-over mode 0 = Manual setting in display 1 = Manual Heat 2 = Manual Cool 3 = Automatic via AI1/DI1
Holding register	13	Temperature difference between the room temperature and the water temperature to switch to heating
Holding register	14	Temperature difference between the room temperature and the water temperature to switch to cooling
Discrete input register	4	Change-over state: 0 = heating 1 = cooling Active if change-over sensor is configured at DI1, otherwise = 0
Input register	11	Current change-over temp. Shows NaN! if no sensor is connected.
Input register	22	Value from the external change-over temperature sensor. Shows a value if a change-over sensor is configured for AI1, else NaN!

2.4 Fan control

2.4.1 Three speed fan

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

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

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

For the end user, the manual control of the fans is done with the fan button in the lower right corner.

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

Auto -> Manual speed 0 (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 of 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 2-6 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
16	Mould protection 0 = Not active 1 = Active
20	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
21	Number of fan speeds used 1 = 1 fan speed is used 2 = 2 fan speeds are used 3 = 3 fan speeds are used

Modbus register	Modbus address	Description
Holding register	34	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.
Coils register	1	Minimum fan speed. The fan runs at least at speed 1, except in *Off* state. 0 = Not Active 1 = Active
Coils register	2	Mould protection 0 = Not active 1 = Active
Discrete register	5	0 = Fan speed 1 is *not* active 1 = Fan speed 1 is active
Discrete register	6	0 = Fan speed 2 is *not* active 1 = Fan speed 2 is active
Discrete register	7	0 = Fan speed 3 is *not* active 1 = Fan speed 3 is active

2.5 Actuator control

2.5.1 Heating/Cooling valves

The unit has two digital outputs for heating and cooling thermal actuator control, i.e. terminals *Heat* and *Cool*. For thermal actuators *Heat* is always configured for heating valve and *Cool* for cooling valve. If heating is needed, *Heat* is On and *Cool* is Off, and if cooling is needed *Cool* is On and *Heat* is Off.

2.5.2 Actuator control settings

Parameter	Description
31	DO *Heat*Normally closed (NC) / Normally open (NO) 0 = NO 1 = NC
32	DO *Cool* Normally closed (NC) / Normally open (NO) 0 = NO 1 = NC

Modbus register	Modbus address	Description
Coil register	15	DO *Heat* Normally closed (NC) / Normally open (NO) 0 = NO 1 = NC
Coil register	16	DO *Cool* Normally closed (NC) / Normally open (NO) 0 = NO 1 = NC

2.6 Controller states

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 hystereses. 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.

All segments in the display are dimmed down, except the On/Off button (see chapter3.3). The thermostat cannot exit the *Off* state due to presence. Only a press on the On/Off button or a remote control command can trigger the exit.

2.6.2 Standby

The thermostat works around the calculated *Standby* setpoint (see chapter see *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. This is also the normal state at power up.

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

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.

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 2-7* to get a better understanding of how the thermostat moves between the different states.

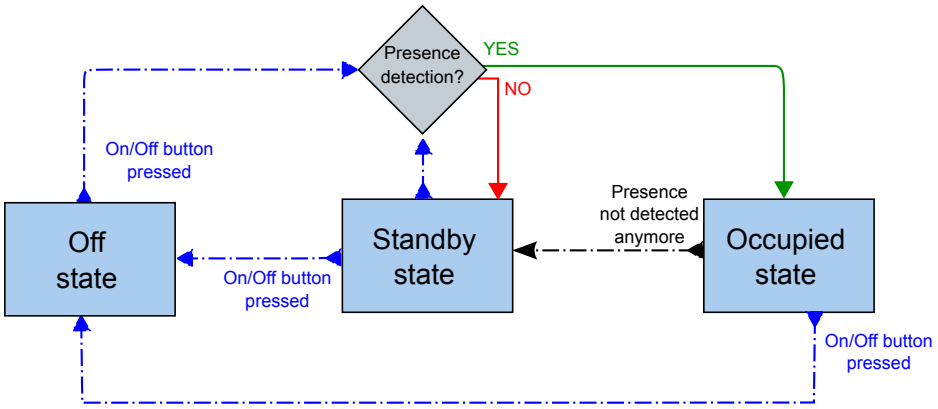


Figure 2-7 Changing controller states (no remote control)

2.6.5 Remote control

Remote control is a way to make the controller enter a specific controller state via Modbus communication. It may enter the states *Off*, *Standby* and *Occupied*. However, the remote control does not lock the state so an external event from e.g. a presence sensor may move it out of the state set remotely.

Example: The controller is currently in *Occupied* state. Via remote control the unit is set to *Standby* state. The controller then enters *Standby* state and stays there. The connected presence detector indicates presence, which makes the controller enter *Occupied* state again. It stays in that state until either there is no more presence or a new state is set remotely.

2.6.6 Controller state settings

Modbus register	Modbus address	Description
Input register	9	Current controller state 0 = Off 1 = *Not used* 2 = Standby 3 = *Not used* 4 = Occupied
Holdig register	17	Remote setting of the current controller state 0 = Off 1 = *Not used* 2 = Standby 3 = *Not used* 4 = Occupied 5 = 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 DI1 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.

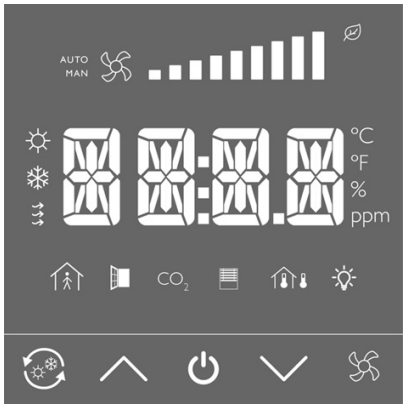
2.7.3 Presence settings

Parameter	Description
12	Sensor/detector connected to DI 0 = No sensor connected 1-2 = *Not used* 3 = Presence detection (activate *Occupied* state) 4 = Change-over sensor
13	Switch on delay for DI, in minutes
14	Switch off delay for DI, in minutes
15	DI1 Normally closed (NC) / Normally open (NO) 0 = NO 1 = NC

Modbus register	Modbus address	Description
Discrete input register	3	Presence detected 0 = No presence detector is configured 1 = Presence detector is configure on DI
Holdig register	15	Switch on delay for DI, in minutes
Holding register	16	Switch off delay for DI, in minutes
Holding register	48	Sensor/detector connected to DI1 0 = No sensor connected 1-2 = *Not used* 3 = Presence detector 4 = Change-over sensor
Coils register	10	DI1 Normally closed (NC) / Normally open (NO)

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:

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

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})

✓ The current user defined setpoint adjustment (SP_{adj})

3.2.5 View mode settings

Parameter	Description
44	Inactive delay Delay for the display to dim down and enter *Idle* mode. If set to 0 the display never dims down.
45	Display setting for *Idle* mode 0 = Show the calculated setpoint (SP_{calc}) 1 = Show the room temperature
46	Display setting for the *Setpoint* mode 0 = Show the calculated setpoint (SP_{calc}) 1 = Show the user defined setpoint adjustment (SP_{adj})
47	Positive setpoint adjustment. The maximum allowed user defined setpoint adjustment (SP_{adj}) increase.
48	Negative setpoint adjustment. The maximum allowed user defiined setpoint adjustment (SP_{adj}) decrease.
49	Brightness of segment at *Active* and *Setpoint* mode as well as in the parameter list

Modbus register	Modbus address	Description
Holding register	37	User defined setpoint adjustment (SP_{adj}) set by using the arrows Can be reset remotely. 0 = No current setpoint adjustment made
Holding register	38	Positive user defined setpoint adjustment. The maximum allowed setpoint adjustment (SP_{adj}) increase.
Holding register	39	Negative user defined setpoint adjustment. The maximum allowed setpoint adjustment (SP_{adj}) decrease.
Holding register	53	Display inactive delay Delay for the display to dim down to *Idle* mode. If set to 0 the display never dims down.
Holding register	57	Display setting for *Idle mode* 0 = Show the calculated setpoint (SP_{calc}) 1 = Show the room temperature
Holding register	58	Display setting for the *Setpoint mode* 0 = Show the calculated setpoint (SP_{calc}) 1 = Show the user defined setpoint adjustment (SP_{adj})
Holding register	59	Intensity or "brightness" of display when in *Active* and *Setpoint mode*
Holding register	60	Intensity or "brightness" of display when in *Idle mode*

3.3 Buttons

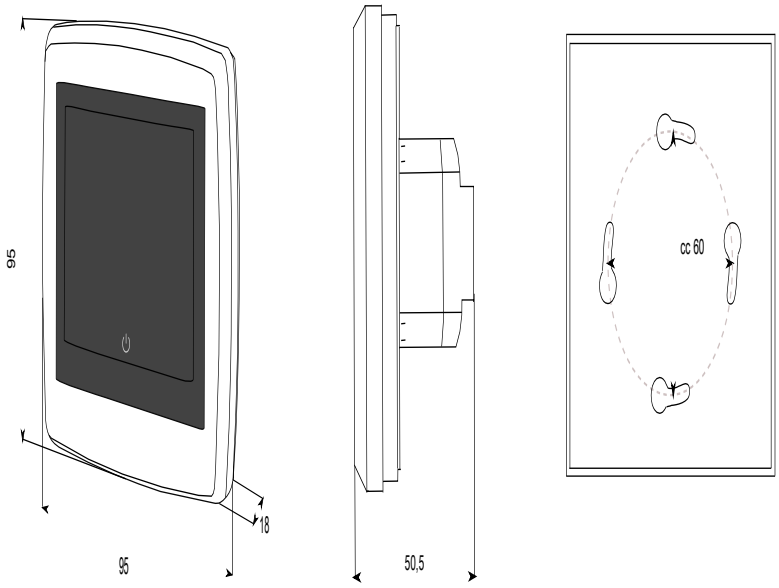
Symbol	Description
	Changeover button This is a combination of two segments, the outer arrows and the inner sun/ snowflake. These two segments are controlled individually.
	Arrow up/Increase button
	On/Off button
	Arrow down/Decrease button
	Fan button

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

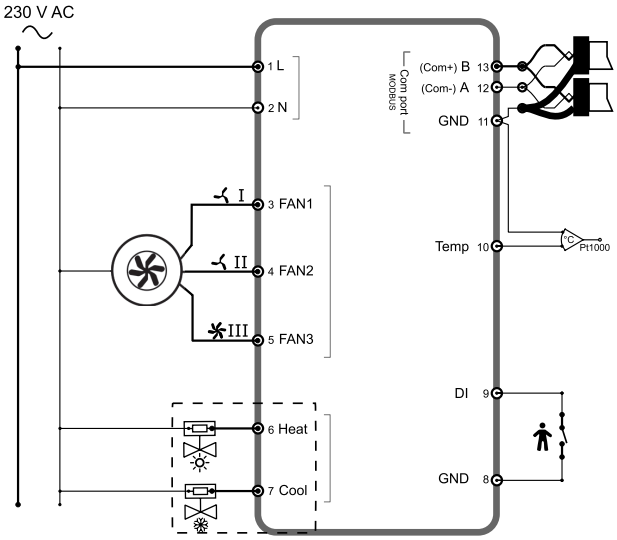


Figure 4-1 4-pipe wiring

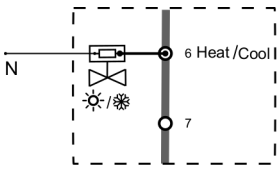


Figure 4-2 2-pipe wiring

Terminal	Description
L	Supply voltage
N	Supply voltage
FAN1	230 V AC Relay 1
FAN2	230 V AC Relay 2
FAN3	230 V AC Relay 3
Heat	230 V AC Relay 4
Cool	230 V AC Relay 5
GND	GND (for DI)
DI	Digital input for presence detection, hotel key card etc
Temp	Analogue input for external PT1000 sensor, change-over
GND	Agnd for terminal *Temp* Serial communication port, Com N
A	Serial communication port, Com A
B	Serial communication port, Com B

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
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 (AI)	1 x PT1000
Change-over function	Automatic
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 mm^2 (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 (5 s), else the display will revert to *Idle mode*
- ✓ P001 is shown in the display (parameter 1)
- ✓ 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 5 seconds without any activity (buttons pressed), the controller will exit the parameter menu and revert to *Idle mode*.

Parameter Number	Description	Default value	Min Value	Max Value
1	Basic setpoint (SP_{basic})	22 °C	5	50
2	Hysteresis used for setpoint calculation at *Occupied* state (heating and cooling)	2 °C	1	10
3	Hysteresis used for setpoint calculation at *Standby* state (heating and cooling)	14 K	1	30
4-6	*Not used*	0	0	0
7	DeltaT, temperature span for On/Off control	1 K	0	30
8	Controller mode 0 = 2-pipe systems 1 = 4-pipe systems	0	0	1
9	The change-over mode 0 = Manual setting in display 1 = Manual Heat 2 = Manual Cool 3 = Automatic via analogue or digital input	0	0	3
10	Temperature difference between the room temperature and the water temperature to switch to heating	3 °C	1	25
11	Temperature difference between the room temperature and the water temperature to switch to cooling	3 °C	1	25

Parameter Number	Description	Default value	Min Value	Max Value
12	Operating mode for DI1 0 = No sensor connected 1-2 = *Not used* 3 = Presence detection (activate *Occupied* state) 4 = Change-over sensor	3	0	4
13	Switch on delay for DI	0 min	0	120
14	Switch off delay for DI	0 min	0	120
15	DI1 Normally closed (NC) / Normally open (NO) 0 = NO 1 = NC	0	0	1
16	Mould protection 0 = Not active 1 = Active	0	0	1
17	Sensor connected to AI 0 = No sensor connected (Internal NTC sensor is used) 1 = Room temperature sensor 2 = Change-over temperature sensor	0	0	2
18	Temperature compensation AI1	0 K	-10	10
19	Temperature compensation internal NTC sensor	0 K	-10	10
20	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
21	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
22-29	*Not used*			
31	DO *Heat* Normally closed (NC) / Normally open (NO) 0 = NO 1 = NC	0	0	1
32	DO *Cool* Normally closed (NC) / Normally open (NO) 0 = NO 1 = NC	0	0	1
33-38	*Not used*			
39	Heat valve exercise hour, 0 - 23	23	0	23
40	Cool valve exercise hour, 0 - 23	23	0	23
41	Heat valve control 0 = Manual Off 1 = Manual On 2 = Auto	2	0	2
42	Cool valve control 0 = Manual Off 1 = Manual On 2 = Auto	2	0	2
43	*Not used*			
44	Inactive delay Delay for the display to dim down and enter *Idle* mode. If set to 0 the display never dims down.	30 s	0	600
45	Display setting *Idle* mode 0 = Show current controller setpoint 1 = Show current room temperature	1	0	1

Parameter Number	Description	Default value	Min Value	Max Value
46	Display setting for the *Setpoint* mode 0 = Show the calculated setpoint (SP_{calc}) 1 = Show the user defined setpoint adjustment (SP_{adj})	1	0	1
47	Maximum setpoint increase min = 0, max = 20	3 K	0	20
48	Maximum setpoint decrease min = 0, max = 20	3 K	0	20
49	Brightness of segment at *Active* and *Setpoint* mode as well as in the parameter list	70 %	0	100
50	Modbus address	Factory set	1	254
51	Modbus Speed 0 = 4800 bps 1 = 9600 bps 2 = 19200 bps 3 = 38400 bps	1	0	3
52	Modbus parity and stop bit 0 = 8N2 1 = 8O1 2 = 8E1 3 = 8N1	2	0	3
53	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
54	Modbus Answer delay	5 ms	5	1000
55	Version number	Version dependent	-	-

Appendix C Modbus variable list

C.1 Introduction

The Modbus protocol is a general-purpose protocol for data exchange between for instance control units, SCADA 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

Modbus address	Description
1	*Not used*
2	*Not used*
3	Presence detected 0 = Presence **not** detected 1 = Presence detected Active if presence sensor 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*

Modbus address	Description
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

Modbus 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

Modbus address	Description	Scale
1	Regin Model number (=1751)	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 internal or external sensor	10
11	Change-over temperature The current change-over temp. Shows NaN! if no sensor is connected.	10
12-19	*Not used*	
20	Room temperature (internal) The value from the internal NTC sensor	10
21	Room temperature (external) The value from the external temperature sensor. Shows a value if a temperature sensor is configured for AI1, 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 AI1, 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

Modbus adress	Description	Unit	Default value	Scale	Min value	Max value
1	Basic setpoint (SP_{basic})	°C	220	10	50	500
2	Hysteresis to calculate Heating and Cooling setpoint at *Occupied* state	°C	20	10	10	400

Modbus adress	Description	Unit	Default value	Scale	Min value	Max value
3	Hysteresis to calculate Heating and Cooling setpoint at *Standby* state	K	140	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 = Manual setting in display 1 = Manual Heat 2 = Manual Cool 3 = Automatic via AI1/DI1	-	20	1	0	3
13	Temperature difference to change to heating (control mode change-over)	°C	30	10	10	250
14	Temperature difference to change to cooling (control mode change-over)	°C	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*					
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	°C	0	10	-200	200

Modbus adress	Description	Unit	Default value	Scale	Min value	Max value
38	Positive user defined setpoint adjustment. The maximum allowed setpoint adjustment (SP_{adj}) increase.	°C	30	10	0	200
39	Negative user defined setpoint adjustment. The maximum allowed setpoint adjustment (SP_{adj}) decrease.	°C	30	10	0	200
40-43	*Not used*					
44	Heat valve exercise hour, 0 - 23	-	23	1	0	23
45	Cool valve exercise hour, 0 - 23	-	23	1	0	23
46	Sensor connected to AI *Temp* 0 = No sensor connected (Internal NTC sensor is used) 1 = Room temperature sensor 2 = Change-over temperature sensor	-	0	1	0	2
47	*Not used*					
48	Sensor/detector connected to the terminal *DI* 0 = No sensor connected 1-2 = *Not used* 3 = Presence detector (activate *Occupied* state) 4 = Change-over sensor	-	3	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	30	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 *Idle 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})	-	10	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	-	Set at factory	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

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