SIEMENS

RDB160BNU

Fan coil unit room thermostat with BACnet MS/TP communication

Commissioning Instructions

A6V12045450_en--_b

Smart Infrastructure

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Contents

1 About this document

1.1 Purpose of this document

This document provides information needed for the commissioning of the RDB160BNU thermostat in projects.

For mounting and wiring information, please refer to the Installation instructions (A6V12045441).

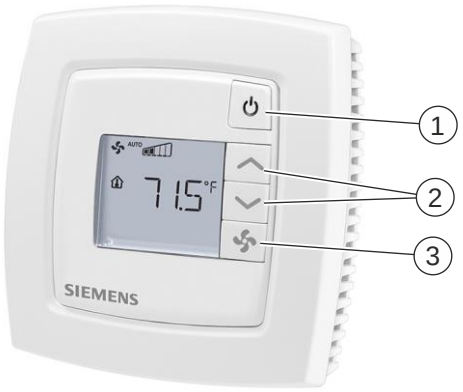
For product information, please refer to the data sheet (A6V12045445).

1.2 Revision history

Edition	Date	Changes	Sections
1.0	2022-04-26	First Edition	
2.0	2022-06-08	Output parameters	Outputs [→ 10]
		Heating/cooling mode	2-pipe fan coil unit with electric heater [→ 26]
		Parameter menu	Parameter menu [→ 31]

2 Operation

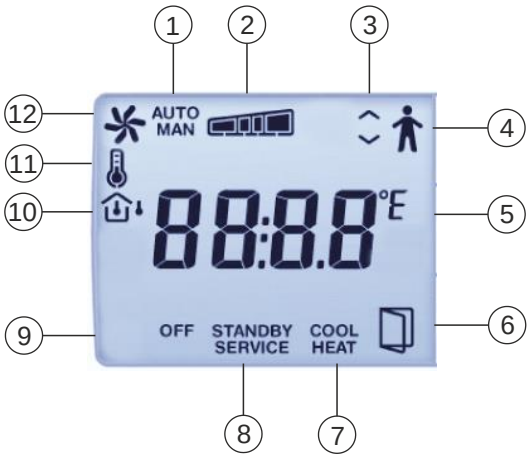
2.1 Buttons



1 On/off
2 Up/down
3 Fan

Button	Use	Action
On/off	Changes operating mode from Comfort to Off and vice versa.	Short press
Up/down	Adjusts comfort temperature setpoints or navigates between parameters (when in Service mode).	Short press
	Enters Service mode (Parameter menu).	1. Press and hold down Up/down buttons together until ˈServiceˈ appears on display. 2. Release Up/down buttons. 3. Short press Up button twice. 4. P01 appears on display i.e., you have accessed the Parameter menu.
Fan	Changes fan speed (low, medium, or high) and mode (manual or automatic).	Short press

2.2 Display



1 ˈAUTO/MANˈ: Automatic or manual mode indication for the fan

2 Current fan speed (Low, Medium, High)

3 Up/Down buttons to adjust setpoints and parameters

4 Occupancy indication

5 Current room temperature or setpoint in °F or °C (one decimal point)

6 Open window

7 ˈCOOL/HEATˈ: Shows the current control mode

8 ˈSTANDBYˈ: Economy mode indication
ˈSERVICEˈ: Commissioning mode (setting parameters)

9 ˈOFFˈ: OFF mode

10 Indoor / outdoor temperature

11 Setpoint temperature

12 Fan status

Backlight

- Pressing any button puts backlight level to high (can be adjusted via P50).
- If no further action is done, the backlight level turns to low after 2 minutes (can be adjusted via P49).
- If the thermostat is switched off, the backlight turns off.

3 Connection terminals

No.	Label	Description
10	G	Supply voltage (AC 24 V~)
11	G0	Supply voltage (AC 24 V⊥)
12	DO1	**D**igital **O**utput 1 (AC 24 V⊥, max. 0.5 A): Fan speed low
13	DO2	**D**igital **O**utput 2 (AC 24 V⊥, max. 0.5 A): Fan speed medium
14	DO3	**D**igital **O**utput 3 (AC 24 V⊥, max. 0.5 A): Fan speed high
20	CDO	**C**ommon (AC 24 V~) for **D**igital **O**utputs: for DOs or UO1 (when configured as DO)
21	MUO	**M**easuring ground for **U**niversal **O**utputs (-DC 0…10 V): for UOs (when configured as AOs)
22	DO4	**D**igital **O**utput 4 (AC 24 V⊥, max. 0.5 A): ● Electric heater (2-pipe FCU with electric heater) ● Cooling valve (4-pipe FCU)
23	UO1	**U**niversal **O**utput 1 (AC 24 V⊥, max. 2.0 A or +DC 0…10 V, max. 5 mA): ● Heating or cooling valve (2-pipe FCU and 2-pipe FCU with electric heater) ● Heating valve (4-pipe FCU)
24	UO2	**U**niversal **O**utput 2 (+DC 0…10 V): ● Fan (all applications with DC fan) ● Cooling valve (4-pipe FCU with 3-speed fan)
30	AI1	**A**nalog **I**nput 1 (PT1000 sensor, 32…122 °F (0…50 °C)): ● External room temperature sensor ● Supply air temperature sensor
31	UI1	**U**niversal **I**nput 1 (PT1000 sensor, 32…212 °F (0…100 °C) or contact): ● Change-over temperature sensor or contact ● Window contact
32	DI1	**D**igital **I**nput 1 (Contact): ● Presence detector ● Window contact
33	M	**M**easuring ground: for AI1 or UI1 (when configured as AI)
40	C	**C**ommon (DC 24 V): for DI1 and UI1 (when configured as DI)
41	REF	BACnet MS/TP Reference
42	-	BACnet MS/TP -
43	+	BACnet MS/TP +

4 Inputs and outputs

4.1 Inputs

The RDB160BNU has three multifunctional inputs:

- Analog input (AI1) configured via P13 as:
  - No function i.e., device works with internal temperature sensor
  - External room temperature or return air temperature sensor (PT1000)
  - Supply air temperature limitation sensor (PT1000)
- Universal input (UI1) configured via P14 as:
  - No function i.e., UI1 is not connected
  - Change-over digital: potential free switch
  - Change-over analog: temperature sensor (PT1000)
  - Window contact: potential free window contact
- Digital input (DI1) configured via P03 as:
  - Presence detector: potential free presence detector
  - Window contact: potential free window contact

DI1 and UI1 can be set to normally open or normally closed via P36 and P37.

4.2 Outputs

The below control outputs are available onboard the RDB160BNU. Their configuration depends on the chosen control application.

- 4 Digital Outputs (DO1…4)
  - DO1 is used for a 1-speed fan. DO1..2 are used for a 2-speed. DO1..3 are used for a 3-speed fan.
  - DO4 is either used for:
  - Valve 1 (3-position close)
  - Electric heater (On/Off)
  - Valve 2 (On/Off or PWM)
- 2 Universal Outputs (UO1 & UO2)
  - UO1 is used either for:
  - Valve 1 as DO (On/Off, PWM or 3-position open)
  - Valve 1 as AO (DC 0…10 V)
  - UO2 is used as AO either for:
  - Fan (DC 0…10 V)
  - Valve 2 (DC 0…10 V)

UO1 and DO4 can be set to normally open or normally closed via P38 and P39.

When configured as AOs, UO1 and UO2 can be set - through P16 and P17 - to the below DC ranges:

- 0…10 V
- 2…10 V
- 10…2 V (inverse signal)
- 10…0 V (inverse signal)

NOTICE	
!	When the fan is set to DC (P77 = 1), UO2 is used to control the fan and P17 is de-activated.

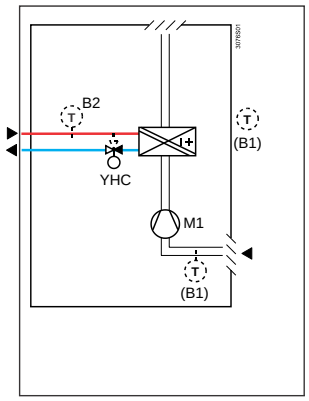
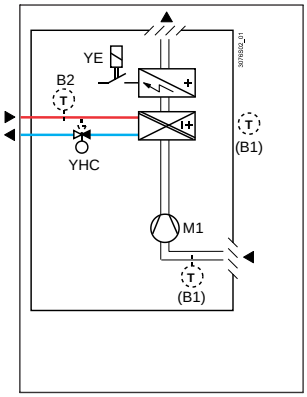
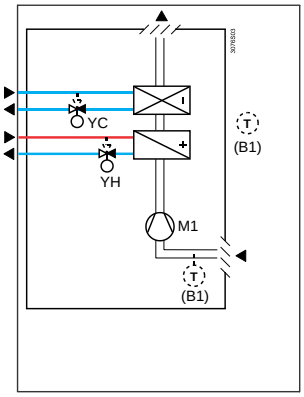
5 Applications

5.1 HVAC applications

The RDB160BNU can control fan coil units of the following types:

- 2-pipe system
- 2-pipe system with electric heater
- 4-pipe system

The appropriate HVAC application can be chosen using P01 or via a BACnet object (Multistate value, 3: AppNr).

HVAC applications		
• 2-pipe fan coil (P01 = 2)	• 2-pipe fan coil with electric heater (P01 = 4)	• 4-pipe fan coil (P01 = 3)
		

YHC	Heating/cooling valve actuator	M1	Fan
YH	Heating valve actuator	B1	Return air temperature sensor or external room temperature sensor (optional)
YC	Cooling valve actuator	B2	Changeover sensor (optional)
YE	Electric heater		

5.2 Control applications

The RDB160BNU can control 29 different FCU control applications with up to 2 DC 0…10 V control outputs i.e., the control of a DC fan, DC cooling valve, and DC heating valve is not possible.

Summary:

	2-pipe		2-pipe with electric heater		4-pipe		
Fan	1/2/3-speed	DC 0…10 V	1/2/3-speed	DC 0…10 V	1/2/3-speed	DC 0…10 V	
Output #1	On/Off, PWM, 3-position, DC 0…10 V		On/Off, PWM, DC 0…10 V		On/Off, PWM, DC 0…10 V	On/Off, PWM	DC 0…10 V
Output #2	N/A		On/Off			On/Off, PWM	

In detail:

Control Applications						Outputs			
No.	**Fan-Coil Unit**	**Fan**	**Valve 1**	**Electric Heater**	**Valve 2**	**DO1..3**	**DO4**	**UO1**	**UO2**
						Fan	**Valve 1 (close), Electric Heater or Valve 2**	**Valve 1**	**Fan or valve 2**
1	2-pipe	3-speed	On/Off	-	-	Fan	-	On/Off	-
2	2-pipe	3-speed	PWM	-	-	Fan	-	PWM	-
3	2-pipe	3-speed	3-position	-	-	Fan	Close	Open	-
4	2-pipe	3-speed	DC valve	-	-	Fan	-	DC valve	-
5	2-pipe	DC fan	On/Off	-	-	-	-	On/Off	Fan
6	2-pipe	DC fan	PWM	-	-	-	-	PWM	Fan
7	2-pipe	DC fan	3-position	-	-	-	Close	Open	Fan
8	2-pipe	DC fan	DC valve	-	-	-	-	DC valve	Fan
9	2-pipe with electric heater	3-speed	On/Off	On/Off	-	Fan	Electric heater	On/Off	-
10	2-pipe with electric heater	3-speed	PWM	On/Off	-	Fan	Electric heater	PWM	-
11	2-pipe with electric heater	3-speed	DC valve	On/Off	-	Fan	Electric heater	DC valve	-
12	2-pipe with electric heater	DC fan	On/Off	On/Off	-	-	Electric heater	On/Off	Fan
13	2-pipe with electric heater	DC fan	PWM	On/Off	-	-	Electric heater	PWM	Fan
14	2-pipe with electric heater	DC fan	DC valve	On/Off	-	-	Electric heater	DC valve	Fan
15	4-pipe	3-speed	On/Off	-	On/Off	Fan	On/Off	On/Off	-
16	4-pipe	3-speed	On/Off	-	PWM	Fan	PWM	On/Off	-
17	4-pipe	3-speed	On/Off	-	DC valve	Fan	-	On/Off	DC valve
18	4-pipe	3-speed	PWM	-	On/Off	Fan	On/Off	PWM	-
19	4-pipe	3-speed	PWM	-	PWM	Fan	PWM	PWM	-
20	4-pipe	3-speed	PWM	-	DC valve	Fan	-	PWM	DC valve
21	4-pipe	3-speed	DC valve	-	On/Off	Fan	On/Off	DC valve	-
22	4-pipe	3-speed	DC valve	-	PWM	Fan	PWM	DC valve	-
23	4-pipe	3-speed	DC valve	-	DC valve	Fan	-	DC valve	DC valve
24	4-pipe	DC fan	On/Off	-	On/Off	-	On/Off	On/Off	Fan
25	4-pipe	DC fan	On/Off	-	PWM	-	PWM	On/Off	Fan

Control Applications						Outputs			
No.	**Fan-Coil Unit**	**Fan**	**Valve 1**	**Electric Heater**	**Valve 2**	**DO1..3**	**DO4**	**UO1**	**UO2**
						Fan	**Valve 1 (close), Electric Heater or Valve 2**	**Valve 1**	**Fan or valve 2**
26	4-pipe	DC fan	PWM	-	On/Off	-	On/Off	PWM	Fan
27	4-pipe	DC fan	PWM	-	PWM	-	PWM	PWM	Fan
28	4-pipe	DC fan	DC valve	-	On/Off	-	On/Off	DC valve	Fan
29	4-pipe	DC fan	DC valve	-	PWM	-	PWM	DC valve	Fan

6 Functions

6.1 Temperature control

The RDB160BNU controls the room temperature with a built-in temperature sensor, or optionally via an external room temperature sensor, or an external return air temperature sensor (e.g. QAP2012.150) connected to AI1 and configured via P13.

It maintains the setpoint temperature by sending control commands to the heating and/or cooling equipment.

The following control outputs are available:

- On/Off control (2-position)
- Modulating PI/P control with 3-position control output (only for 2-pipe applications)
- Modulating PI/P control with PWM output
- Modulating PI/P control with DC 0...10 V control output

Display

The display shows the current room temperature and/or temperature setpoint. The temperature setpoint can be displayed as an absolute value or relative to the basic comfort setpoint (P64).

The display setting is selectable via P24. Factory setting is the display of the room temperature and absolute setpoint.

6.2 Operating modes

The RDB160BNU has 3 operating modes:

Comfort, Standby (Economy) and OFF, which appear on the display as , 'STANDBY' or 'OFF' respectively. In OFF mode all buttons are deactivated, except for the On/Off button.

The operating modes can be changed via the On/Off button, presence detector, window contact or BACnet object (Multistate value, 5: ROpMod). Specific heating and cooling setpoints are assigned to each operating mode.

6.2.1 Comfort mode

In Comfort mode, the thermostat maintains the basic comfort setpoint temperature. This setpoint is defined via P64 or BACnet object (Analog value, 33: CmfSp). The default setting is 72 °F (22 °C).

In Comfort mode, the fan can be set to automatic or manual fan speed: Low, medium, or high.

The Comfort mode change can be delayed. A typical case is when a presence detector is used:

- Delay from Comfort to Standby (Economy) mode is set via P11.
- Delay from Standby (Economy) to Comfort mode is set via P12.

6.2.2 Standby (Economy)

In Standby (Economy) mode, preset setpoints can be defined via P06 (for heating) and P07 (for cooling). The default value is 59 °F (15 °C) and 86 °F (30 °C) respectively.

The RDB160BNU switches to Standby (Economy) mode if:

- The lack of occupancy is detected via a connected presence detector or keycard switch.
- Standby (Economy) is sent via BACnet object (Multistate value, 5: ROpMod).

6.2.3 OFF mode

The thermostat and the fan are switched off, and the thermostat gives no heating or cooling commands.

6.2.4 Mold protection (optional in OFF mode)

When activated via P04, mold protection maintains the low fan speed in OFF mode. This is to reduce moisture due to a lack of air circulation and therefore the chance of mold growing.

Mold protection can also be helpful in warm and humid climates where air circulation is needed in OFF mode.

NOTICE	
!	**No protecting heating or cooling control in OFF mode** Risk of frost or risk of over temperature

6.3 Additional functions

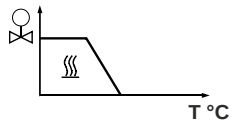
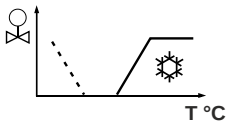
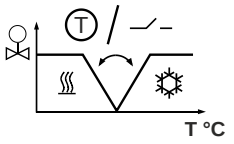
6.3.1 Heating/cooling change-over

Heating / cooling change-over is a function that enables 2-pipe systems to use the same pipe for both heating and cooling control. Heating control is normally required in winter when the outside temperatures are low, while cooling control is normally required in summer when the outside temperatures are high.

The HEAT and COOL symbols indicate if the system is currently heating or cooling. Either heating or cooling is activated at a given time.

Heating/cooling change-over can be set via P02 or a BACnet object (Multistate value, 4: ChoverMod) to:

- Manual control: heating or cooling
- Automatic control: based on water temperature sensor (analog input) or switch (digital input)

Parameter	P02 = 0 (Heating only)	P02 = 1 (Cooling only)	P02 = 2 (Automatic change-over)
Sequence			
		= heating sequence for electric heater	

In case there is no change-over signal, e.g., due to problems with data communication or power failure, then the thermostat operates in the last valid operating mode (heating or cooling).

Automatic change-over via water temperature sensor

Automatic change-over is possible by connecting a PT1000 water temperature sensor (e.g., QAP2012.150) to UI1 and setting P14 to 2. The thermostat changes between heating and cooling mode according to the water temperature:

- If the water temperature is above 82 °F (28 °C), the thermostat changes over to heating mode and stays in heating mode until the temperature falls below 61 °F (16 °C).
- If the water temperature is below 61 °F (16 °C), the thermostat changes over to cooling mode and stays in cooling mode until the temperature rises above 82 °F (28 °C).

The water temperature setpoints can only be changed via BACnet objects:

- (Analog value, 30: TChoverHeat) for heating
- (Analog value, 29: TChoverCool) for cooling

Automatic change-over via switch

Automatic change-over can be done by connecting an external potential-free switch to UI1 and setting P14 to 1. The thermostat switches between heating and cooling modes with the change in switch state.

6.3.2 Supply air temperature limitation function

This function increases the comfort in the room by keeping the supply air temperature between minimum and maximum temperature limits.

To activate this function, a PT1000 air temperature sensor should be connected to AI1 and configured via P13. When configured, the thermostat automatically switches to cascade control.

Cascade control and cascade factor

In cascade control, the room thermostat control loop (controller) works together with the supply air controller to calculate a supply air temperature setpoint and maintain the room temperature setpoint.

The Cascade factor (P74) sets how much faster the supply air controller is than the room thermostat controller. The Cascade factor acts as a divisor to the room thermostat controller values: Proportional band width (P08) and Integral action time (P09).

Example: If the Cascade factor is 3 (default) and the room thermostat controller has a proportional band width of 10 K and an integration time of 300 seconds, then the supply air controller receives a proportional band width of 3 K and an integration time of 100 seconds. In other words, the supply air controller is three times faster than the room thermostat controller.

The minimum and maximum supply air temperature limitation can be set through:

Heating mode		**Cooling mode**	
Min. (P71)	Default: 75 °F (24 °C)	Min. (P73)	Default: 54 °F (12 °C)
Max. (P70)	Default: 95 °F (35 °C)	Max. (P72)	Default: 75 °F 24 °C

Frost protection for supply air

When the supply air temperature limitation is active, a frost protection function is available for the supply air. This function opens the heating valve if the supply air temperature drops below the default 46 °F (8 °C). This value can be changed via P75.

Supply air temperature limitation activation

Supply air temperature limitation can be activated for heating control, cooling control or both. The default setting is cooling control and can be changed via P76.

6.4 Security functions

6.4.1 Lock buttons

The thermostat buttons can be locked from use to room occupants via P65 or a BACnet object.

Lock buttons (P65)	On/Off button active	Up and down buttons active	Fan button active
0	X	X	X
1	✓	X	X
2	X	✓	X
3	✓	✓	X
4	X	X	✓
5	✓	X	✓
6	X	✓	✓
7 (factory setting)	✓	✓	✓

6.4.2 Lock parameter menu access

Access to the parameter menu can be blocked to prevent unpermitted access and changes to the thermostat parameter settings. This does not affect the normal operation, where users can change the temperature setpoint, fan speed, etc. This function can only be activated via a BACnet object (Binary value, 12: LockSettings).

6.4.3 Block device during fire alarms

The RDB160BNU can be completely blocked during fire alarms. This function can only be activated via a BACnet object (Binary value, 9: ShdownState). When activated, it forces the thermostat to OFF mode. The RDB160BNU cannot be re-started from the On/Off button until this function is de-activated i.e. BACnet object is set to 0.

6.4.4 Valve exercising feature

With this feature, the valves are operated from time to time to prevent them from failing after long periods of inactivity. For example, only heating valves are used in winter. Therefore, cooling valves must also be operated from time to time so that they do not get stuck.

The time between two exercises is set via P22 for the heating actuator and P23 for the cooling actuator. The default setting is 23 hours.

No exercises are performed for electric heaters.

6.5 Energy efficiency functions

6.5.1 Setpoint limitation

For energy saving purposes, the permitted setpoint offset can be limited upward (P34) and downward (P35). The reference is the Basic comfort setpoint (P64).

6.5.2 Window state

A potential-free window contact can be connected to DI1 or UI1 and configured via P03 and P14 respectively.

When the window opens, the thermostat switches to OFF mode. In OFF mode, the thermostat stops heating or cooling and the fan switches off - unless mold protection is activated, or cooling of an electric heater is taking place (fan over-run of electric heater).

The window status is available via a BACnet object (Binary input, 0: RWndSta).

6.5.3 Occupancy

A presence detector can be connected to DI1 and configured via P03. When activated, the occupancy function helps save energy by switching between Comfort and Economy (Standby) mode when occupancy is absent. Once the room is occupied, the thermostat switches back from Economy (Standby) to Comfort mode. The presence detector status is available via a BACnet object (Binary input, 2: RPscDet).

7 Fan

7.1 Fan settings

The RDB160BNU controls either a 1-speed, 2-speed, 3-speed, or DC 0…10 V fan.

The type of fan output (DC 0...10 V, 1-, 2- or 3-speed) and number of fan stages (1, 2, or 3-speed) can be selected via thermostat using P77 and P30 or via BACnet objects.

In case a DC fan is chosen in P77, then the P30 setting is no longer relevant and does not affect the thermostat operation.

For 2- and 3-speed fans, only one fan output can be on at a time i.e., either DO1, DO2 or DO3.

7.2 Fan operation

7.2.1 Automatic and manual modes

The fan operates in automatic mode or manual mode with the selected speed: low, medium, and high. The fan mode and speed can be changed via the Fan button on the thermostat or changed and monitored via BACnet objects.

In automatic mode, the fan speed depends on the setpoint and the current room temperature. When the room temperature reaches the setpoint, the control valve closes, and the fan switches off or stays at minimum fan speed.

7.2.2 Fan operation in dead zone (fan kick)

If the thermostat is in automatic fan mode and the room temperature is within the dead zone, the control valve is normally closed, and the fan is at low speed by default. The fan can be switched off when the room temperature is within the dead zone via P31. The factory setting for P31 is 1 (Low speed).

7.2.3 Fan over-run for electric heater

When the electric heater is switched off, the fan overruns for 120 seconds (fixed value) to avoid over-temperature of the electric heater or to prevent the thermal cutout from responding.

⚠ CAUTION	
	**Fan failure** In case of fan failure, the thermostat cannot protect the electric heater against over-temperature. For this reason, the electric heater must feature a separate safety device (thermal cutout).

7.3 Fan blocking functions

7.3.1 Block fan speed control in Auto mode

Fan speed control in Auto mode can be limited to ‘active for cooling only’ or ‘active for heating only’, or even blocked completely via P25. The default value is ‘active for heating and cooling’.

7.3.2 Block fan speed control in Manual mode

The manual fan operation can be locked via P66. If activated, the manual fan operation will follow the same setting as the fan speed control in Auto mode (P25) described above. For example, if P66 is set to 1 (lock manual fan speed: enabled) and P25 is set to 1 (fan speed control in auto mode: active in heating only), then manual fan speed control will only be available in heating mode.

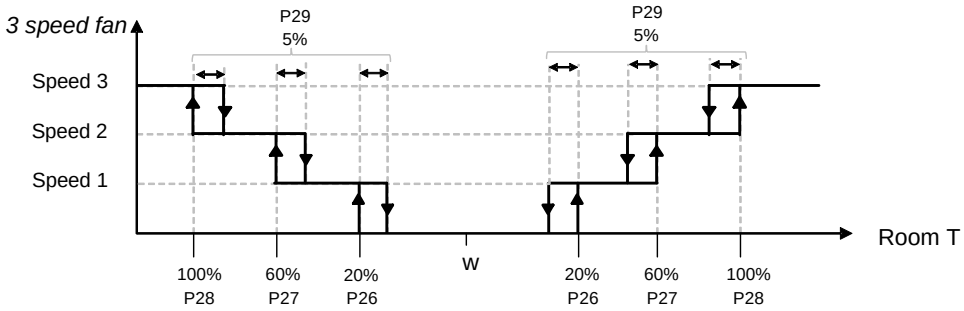
NOTICE	
!	Fan operation in the dead zone (fan kick) must be changed to disable the fan operation.

7.4 Fan control sequences

7.4.1 3-speed fan control

When the fan is in Auto mode, the default setting is that its speed is controlled at both heating and cooling demands. The first step starts when the output signal of the internal controller exceeds 20 %. The second step starts at 60 % and the third at 100 %. When the heating/cooling demand decreases, each fan step has a hysteresis of 5 % for changing over to the slower speed. For example, the fan will change from the third to the second step when the controller output signal falls below 95 %.

The fan speed switching points (low, medium, and high) can be changed via P26, P27 and P28 respectively. The hysteresis can be changed via P29.



When the fan is in manual mode, speed control takes place by activating DO1 (low), DO2 (medium) and DO3 (high).

7.4.2 DC fan control

When a DC fan is used and the fan is in auto mode, the fan control takes place linearly in conjunction with the cooling/heating output. The minimum and maximum speed for the DC fan can set via P67 (default is 10 %) & P68 (default is 100 %).

When the fan is in manual mode, control takes place in three stages, and the level of each stage is set via P26, P27 and P28.

8 Valves and electric heater

8.1 Heating/cooling settings

The heating/cooling control sequence is set via P02. For more details, please check section Heating/cooling change-over [→ 16].

The controlled Application is set via P01. For more details, please check section Applications [→ 11].

8.2 Control sequences

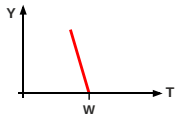
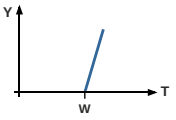
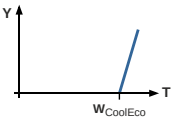
8.2.1 2-pipe fan coil unit

In 2-pipe systems, the thermostat controls a heating or cooling valve (depending on the change-over mode setting).

The thermostat controls the heating valve (heating mode) or cooling valve (cooling mode) using the same setpoint: Basic Comfort setpoint (W) set via P64.

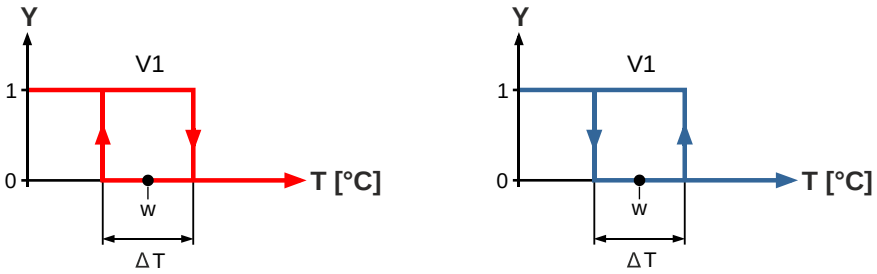
The setpoints for Standby (Economy) mode are below the Basic Comfort setpoint for heating and above the Comfort setpoint for cooling.

In Economy mode, the Economy heating setpoint ($W_{HeatEco}$) controls the heating valve (heating mode), while the Economy cooling setpoint ($W_{CoolEco}$) controls the cooling valve (cooling mode). The Economy heating setpoint ($W_{HeatEco}$) can be set via P06, while the Economy cooling setpoint ($W_{CoolEco}$) can be set via P07.

Application	Comfort mode		Standby (Economy) mode	
	Heating	Cooling	Heating	Cooling
2-pipe				

W	Basic Comfort setpoint (P64)
$W_{HeatEco}$	Economy heating setpoint (P06)
$W_{CoolEco}$	Economy cooling setpoint (P07)

On/Off (2-position) valve control



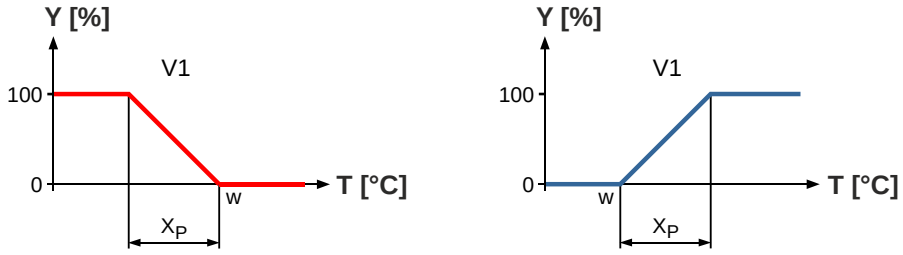
T [°C]	Room temperature	W	Temperature setpoint
V1	Valve control command	ΔT	Hysteresis (P10)

If the measured room temperature is below the setpoint (heating mode) or above the setpoint (cooling mode), the valve receives the 'Open' or 'On' command via UO1. The valve receives the 'Off' command if the measured room temperature is above the setpoint (heating mode) or below the setpoint (cooling mode).

The control hysteresis of On/Off control output can be set via P10. The default setting is 2 °F (1 °C).

Modulating valve control

(PWM, 3-position or DC 0…10 V)



T [°C]	Room temperature	W	Temperature setpoint
V1	Valve control command	Xp	Proportional band width (P08)

For modulating valves, the output is directly proportional to the deviation between the room temperature and setpoint i.e., the larger the deviation, the higher the output signal. This allows more hot or cold water to flow in the heating or cooling valves when the deviation is high, and less water to flow when the deviation is low. Modulating control is a more accurate control method than On/Off control as it lowers the temperature fluctuations in the room.

The proportional band width (Xp) - used in P & PI control - is the same for heating and cooling modes. It has a default value of 18 °F (10 °C) which can be changed via P08.

The integral action time (Tn) - used in PI control - is also the same for heating and cooling modes. It has a default value of 300 seconds which can be changed via P09.

The diagrams only show the PI proportional part of the thermostat.

PWM

Like On/Off control, PWM opens and closes the valves via UO1 (Valve 1) and DO4 (Valve 2). However, the on/off output time (pulse) is varied proportionally, depending on the heating and cooling demand. The larger the deviation between the room temperature and setpoint, the longer the On pulse and shorter the Off pulse and vice versa.

The PWM period (in seconds) is defined as the sum of the times of the on and off pulses. The period for heating and cooling can be changed via P18 and P19 respectively. Their defaults are 60s.

3-position

For 3-position control, two outputs (UO1 and DO4) are used to control one 3-position actuator. Output UO1 provides the 'Open' command, and DO4 the 'Close' command.

The default setting for the actuator's running time is 120 seconds. It can be changed via P20 for heating and P21 for cooling.

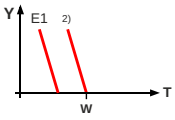
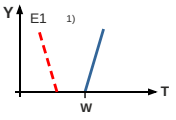
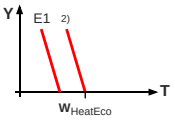
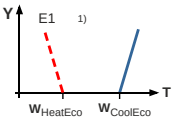
8.2.2 2-pipe fan coil unit with electric heater

In 2-pipe systems with electric heater, the thermostat either controls a heating valve and electric heater, or cooling valve and electric heater (depending on the change-over mode setting).

The thermostat controls the heating valve (heating mode) or cooling valve (cooling mode) using the same setpoint: Basic Comfort setpoint (W) set via P64.

The setpoints for Standby (Economy) mode are below the Basic Comfort setpoint for heating and above the Comfort setpoint for cooling.

In Economy mode, the Economy heating setpoint ($W_{HeatEco}$) controls the heating valve (heating mode) and electric heater (cooling mode), while the Economy cooling setpoint ($W_{CoolEco}$) controls the cooling valve (cooling mode). The Economy heating setpoint ($W_{HeatEco}$) can be set via P06, while the Economy cooling setpoint ($W_{CoolEco}$) can be set via P07.

Application	Comfort mode		Standby (Economy) mode	
	Heating	Cooling	Heating	Cooling
2-pipe & electric heater				

W	Basic Comfort setpoint (P64)
$W_{HeatEco}$	Economy heating setpoint (P06)
$W_{CoolEco}$	Economy cooling setpoint (P07)
E1	Electric heater sequence

On/Off (2-position) valve control

On/Off valve control follows the same concept as 2-pipe fan coil units. For more details, please refer to section 2-pipe fan coil unit [→ 23].

Modulating valve control

(PWM or DC 0…10 V)*

Modulating valve control follows the same concept as 2-pipe fan coil units. For more details, please refer to section2-pipe fan coil unit [→ 23].

*3-position valve control is not possible for 2-pipe with electric heater applications.

Electric heater, in cooling mode

The electric heater receives an 'On' command if the room temperature is below the setpoint temperature minus ½ dead zone (P05) and minus hysteresis (P10).

The electric heater receives an 'Off' command if the room temperature is above the setpoint temperature minus ½ dead zone (P05).

Electric heater, in heating mode

The electric heater is used as an additional heating source when the heating energy controlled by the valve is insufficient.

The electric heater receives an 'On' command if the temperature is below the setpoint temperature minus hysteresis (P10) and the first heating sequence has reached 100 %.

⚠ WARNING	
	Always protect an electric heater by a safety limit thermostat.

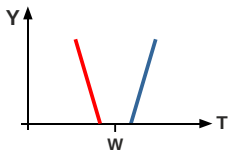
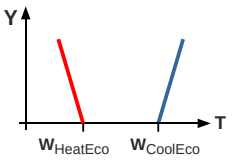
8.2.3 4-pipe fan coil unit

In 4-pipe systems, the thermostat controls one heating valve and one cooling valve.

The thermostat controls the heating valve (heating mode) and cooling valve (cooling mode) using the same setpoint: Basic Comfort setpoint (W) set via P64. The Basic Comfort setpoint (W) is in the middle of the dead zone between the heating and cooling sequences. The comfort dead zone has a default value of 4 °F (2 °C) and can be changed via P05.

The setpoints for Standby (Economy) mode are below the Basic Comfort setpoint for heating and above the Comfort setpoint for cooling.

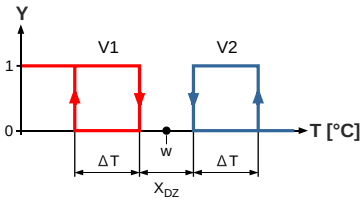
In Economy mode, the Economy heating setpoint ($W_{HeatEco}$) controls the heating valve while the Economy cooling setpoint ($W_{CoolEco}$) controls the cooling valve. The Economy heating setpoint ($W_{HeatEco}$) can be set via P06, while the Economy cooling setpoint ($W_{CoolEco}$) can be set via P07.

Application	Comfort mode	Standby (Economy) mode
	Heating and cooling	Heating and cooling
4-pipe		

W	Basic Comfort setpoint (P64)
$W_{HeatEco}$	Economy heating setpoint (P06)
$W_{CoolEco}$	Economy cooling setpoint (P07)

On/Off (2-position) valve control

Heating and cooling modes



T[°C]	Room temperature
W	Temperature setpoint
V1	Valve control command (H)
V2	Valve control command (C)
ΔT	Hysteresis (P10)
X_{DZ}	Comfort dead zone (P08)

The heating valve receives the following commands via UO1:

- 'Open' or 'On' command when:
  Room temperature = Temperature setpoint – (1/2 X_{DZ} + ΔT)
- ‘Close’ or ‘Off’ command when:
  Room temperature = Temperature setpoint – (1/2 X_{DZ})

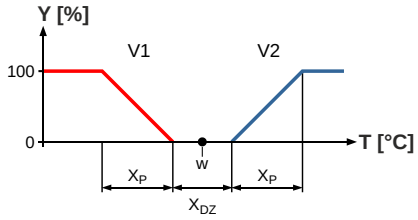
The cooling valve receives the following commands via DO4:

- 'Open' or 'On' command when:
  Room temperature = Temperature setpoint + (1/2 X_{DZ} + ΔT)
- ‘Close’ or ‘Off’ command when:
  Room temperature = Temperature setpoint + (1/2 X_{DZ})

Modulating valve control

(PWM or DC 0…10 V)*

Heating and cooling modes



T[°C]	Room temperature
W	Temperature setpoint
V1	Valve control command 'Valve' (H)
V2	Valve control command 'Valve' (C)
ΔT	Hysteresis (P10)
X_{DZ}	Comfort dead zone (P08)

The diagrams only show the PI proportional part of the thermostat.

Modulating control for the 4-pipe system follows the same concepts as the ones described for the 2-pipe system. The main difference is the dead zone:

- The heating valve starts receiving a command to open:
  Room temperature = Temperature setpoint – 1/2 X_{DZ}
- The cooling valve starts receiving a command to open:
  Room temperature = Temperature setpoint + 1/2 X_{DZ}

The proportional band width (Xp) - used in P & PI control - is the same for heating and cooling modes. It has a default value of 18 °F (10 °C) which can be changed via P08.

The integral action time (Tn) - used in PI control - is also the same for heating and cooling modes. It has a default value of 300 seconds which can be changed via P09.

*3-position valve control is not possible for 4-pipe applications.

9 Parameters

80 parameters are available to set up the thermostat and optimize control performance. The complete parameter menu can be accessed from the thermostat itself. Some parameters can also be changed remotely via BACnet objects.

All parameter settings are retained in the event of power failure.

9.1 Parameter menu via thermostat

9.1.1 Parameter menu access

1. Press and hold down the Up and Down buttons together until 'Service' appears on display.
2. Release Up and Down buttons
3. Press Up button twice.
4. P01 appears on display i.e., you have accessed the Parameter menu.

9.1.2 Parameter change

To change a parameter setting:

1. Navigate through the parameter menu using the Up and Down buttons until you reach the parameter you want to change.
2. Press the On/Off button to select it.
3. Use the Up and Down buttons to change the parameter value.
4. Press the On/Off button to save and go back to the parameter menu.

To exit the parameter menu, either

1. Go to EXIT (last parameter in the Parameter menu) and press the On/Off button.
2. Press the Up and Down buttons simultaneously.

9.2 Parameter menu

Parameter	Name	Range	Factory setting
P01	Application	2 = 2-pipe system 3 = 4-pipe system 4 = 2-pipe system with electric heater	3 = 4-pipe system
P02	Control sequence	0 = Heating control 1 = Cooling control 2 = Automatic change-over based on analog temperature sensor or digital input	2 = Automatic change-over
P03	Digital input 1 (DI1)	0 = Presence detector 1 = Window contact	0 = Economy mode
P04	Mold protection	0 = Not active 1 = Active (the fan never stops, even when in controller OFF mode)	0 = Not active
P05	Comfort dead zone	0…21 °F (0…10 °C)	4 °F (2 °C)
P06	Economy heating setpoint	50…105 °F (10…40 °C)	59 °F (15 °C)
P07	Economy cooling setpoint	25.5…125 °F (10…50 °C)	86 °F (30 °C)
P08	Proportional band width (Xp)	-	18 °F (10 °C)
P09	Integral action time Tn	-	300 s
P10	Hysteresis (ΔT)	-	2 °F (1 °C)
P11	Delay from Comfort to Standby	-	0 min
P12	Delay from Standby to Comfort	-	0 min
P13	Input AI	0 = No function 1 = External room/ return air temperature sensor 11= Supply air temperature limitation sensor	0 = No function
P14	Input UI	0 = no function 1 = Changeover digital 2 = Changeover analog 3 = Window contact	0 = No function
P15	Not in use	-	-

Parameter	Name	Range	Factory setting
P16	Output UO1	0 = 0…10 V 1 = 2…10 V 2 = 10…2 V 3 = 10…0 V	0 = 0…10 V
P17	Output UO2	0 = 0…10 V 1 = 2…10 V 2 = 10…2 V 3 = 10…0 V	0 = 0…10 V
P18	PWM period heating	-	60 s
P19	PWM period cooling	-	60 s
P20	3-position actuator running time heating	-	120 s
P21	3-position actuator running time cooling	-	120 s
P22	Time (in hours) between exercise of heating actuator	-	23 h
P23	Time (in hours) between exercise of cooling actuator	-	23 h
P24	Standard display	0 = Room temperature and absolute setpoint 1 = Room temperature and relative setpoint 2 = Absolute setpoint 3 = Relative setpoint	0 = Room temperature and absolute setpoint
P25	Fan control in auto mode	0 = Not active (auto mode is deactivated) 1 = Active for heating only 2 = Active for cooling only 3 = Active for heating and cooling	3 = Active for heating and cooling
P26	Fan speed switching point low (in % of internal controller output)	0…100 %	20 % When using electric heater: 5 %
P27	Fan speed switching point medium (in % of internal controller output)	0…100 %	60 %
P28	Fan speed switching point high (in % of internal controller output)	0…100 %	100 %
P29	Hysteresis for start/stop of fans (in % of controller output)	0…20 %	5 %
P30	Fan speed stages	1 = 1-speed fan 2 = 2-speed fan 3 = 3-speed fan	3

Parameter	Name	Range	Factory setting
P31	Fan stage in dead zone	0 = Fan turned off 1 = Lower speed	1 = Lower speed
P32	Measured value correction on AI1	-	0 °F (0 °C)
P33	Measured value correction on internal temperature sensor	-	0 °F (0 °C)
P34	Maximum permitted upward setpoint offset	0…23 °F (0…13 °C)	23 °F (13 °C)
P35	Maximum permitted downward setpoint offset	0…31 °F (0…17 °C)	31 °F (17 °C)
P36	Normal position for DI1	0 = Normally Open 1 = Normally Closed	1 = Normally Closed
P37	Normal position for UI1	0 = Normally Open 1 = Normally Closed	0 = Normally Open
P38	Normal position for UO1	0 = Normally Open 1 = Normally Closed	1 = Normally Closed
P39	Normal position for DO4	0 = Normally Open 1 = Normally Closed	1 = Normally Closed
P40	Manual/Auto heating output signal	0 = Off 1 = Manual 2 = Auto	2 = Auto
P41	Manual/Auto cooling output signal	0 = Off 1 = Manual 2 = Auto	2 = Auto
P42	Heating output signal in manual mode	-	0 %
P43	Cooling output signal in manual mode	-	0 %
P44	Model number	-	-
P45	Firmware version	-	-
P46	Firmware version	-	-
P47	Firmware version	-	-
P48	Firmware version	-	-
P49	Display backlit low	0…100 %	10 %
P50	Display backlit high	0…100 %	30 %
P51	Not in use	-	-
P52	Not in use	-	-
P53	Not in use	-	-
P54	Not in use	-	-
P55	Not in use	-	-

Parameter	Name	Range	Factory setting
P56	Not in use	-	-
P57	Communication protocol	0 = No communication 1 = BACnet	1 = BACnet
P58	BACnet MS/TP: MAC address	0…127 Must be unique within an MS/TP network	127
P59	BACnet MS/TP: Device instance number, 4 digits on right-hand side (e.g., 4567 in 1234567)	Please choose a device instance number (P59 & P60) from 0…4194302	0
P60	BACnet MS/TP: Device instance number, 3 digits on left-hand side (e.g., 123 in 1234567)	0…419 Please choose a device instance number (P59 & P60) from 0…4194302	0
P61	BACnet MS/TP: Maximum number of master units	0…127	127
P62	Baud rate	0 = 9600 bps 1 = 19200 bps 2 = 38400 bps 3 = 76800 bps	3 = 76800 bps
P63	Reset communication parameters to factory settings	1 = reset com. parameters	0
P64	Basic comfort setpoint	41…122 °F (5… 50 °C)	72 °F (22 °C)
P65	Lock buttons	0 = No active buttons 1 = Only On/Off button active 2 = Only Up/Down buttons active 3 = On/Off and Up/Down buttons active 4 = Only fan button active 5 = On/Off and fan button active 6 = Up/Down and fan button active 7 = all active	7 = all active
P66	Lock manual fan speed setting according to P25	0 = Disabled 1 = Enabled	0 = Disabled
P67	DC fan: Start switching point	0…100 %	10 %
P68	DC fan: Maximum speed	0…100 %	100 %
P69	Fan start kick time	0…10 seconds	0
P70	Supply air max. limitation for cascade control and heating control	85… 125 °F (30…50 °C)	95 °F (35 °C)

Parameter	Name	Range	Factory setting
P71	Supply air min. limitation for cascade control and heating control	68… 86 °F (20…30 °C)	75 °F (24 °C)
P72	Supply air max. limitation for cascade control and cooling control	59…86 °F (15…30 °C)	75 °F (24 °C)
P73	Supply air min. limitation for cascade control and cooling control	41…68 °F (5…20 °C)	54 °F (12 °C)
P74	Cascade factor between room controller and supply air controller	1…5	3
P75	Frost protection temperature for supply air when supply air temperature limitation is active	-	46 °F (8 °C)
P76	Activate supply air temperature limitation for	0 = Heating control 1 = Cooling control 2 = Both heating and cooling control	1 = Cooling control
P77	Fan output type	0 = 1- /2- or 3-speed fan 1 = DC fan	0 = 1- /2- or 3-speed fan
P78	Valve 1 output type	0 = DC valve 1 = PWM 2 = On/Off 3 = 3-position valve	0 = DC valve
P79	Valve 2 output type (Locked to On/Off when Application is set to 2-pipe with electric heater (P01 =4))	0 = DC valve 1 = PWM 2 = On/Off 3 = 3-position valve	0 = DC valve
P80	Temperature unit Disconnect and reconnect power for change to take effect.	0 = Celsius 1 = Fahrenheit	1 = Fahrenheit

NOTICE	
!	**Data loss** Changing parameter P80 resets all parameters with temperature values to factory setting.

10 BACnet MS/TP communication

10.1 BTL Certificate

The RDB160BNU thermostat supports the BACnet MS/TP communication protocol and is listed as a BTL device.

The BTL certificate of the thermostat can be found at https://www.bacnetlabs.org/.

10.2 Device addressing

The BACnet MS/TP MAC address and device instance number can only be set from the thermostat and not via a BACnet object. They can be changed when the RDB160BNU is first powered on through the Setup Wizard, or later via the parameter menu.

- MAC address has a default of 127 and is changed via P58.
- Device instance number has a default of 0. It should be in the range of 0…4194302 and is changed via 2 parameters:
  - P59 sets the 4 digits on the right-hand side
  - P60 sets the 3 digits on the left-hand side

After setting P58, P59 & P60, it is recommended to write down the settings, as well as the installed location, on the sticker label available on the back of the RDB160BNU.

RDB160BNU MAC: _ _ _ Dev inst: _ _ _ _ _ _ _	Floor: Room:
RDB160BNU MAC: _ _ _ Dev inst: _ _ _ _ _ _ _	Floor: Room:
RDB160BNU MAC: _ _ _ Dev inst: _ _ _ _ _ _ _	Floor: Room:

The MAC address must be unique within the BACnet MS/TP network.
The device instance number must be unique within the project.

10.3 Baud rate

The baud rate is selectable via P62.

Four options are available for the RDB160BNU: 9600, 19200, 38400 and 76800 (default) bps.

10.4 Maximum number of master units

The maximum number of master units can be set from 0 to 127. The default is 127 and can be changed via P61.

NOTICE	
!	Any parameter change, such as change of MAC address, device instance number, baud rate, etc. will only take effect after manually switching the power supply off and then back on again (manual power cycle).

10.5 BACnet objects

10.5.1 Analog inputs

Object name	Object ID	Description	Unit	Writeable
TR	Analog input, 0	Room temperature	°C	No
TChover	Analog input, 1	Change over temperature	°C	No
AI1	Analog input, 2	Analog input	°C	No
UI1	Analog input, 3	-	V	No
Tsu	Analog input, 4	Supply air temperature	°C	No

10.5.2 Analog values

Object name	Object ID	Description	Unit	Writeable
AO1	Analog value, 0	Analog output	V	No
AO2	Analog value, 1	Analog output	V	No
SpTRShft	Analog value, 2	Setpoint shift value	°C	No
SpTR	Analog value, 3	Controller setpoint	°C	No
LoopOut	Analog value, 4	Control output	%	No
HclVlvPos	Analog value, 5	Heating coil valve position	%	No
CclVlvPos	Analog value, 6	Cooling coil valve position	%	No
Not used	Analog value, 7, 8	-	-	No
SpHEco	Analog value, 9	Heating setpoint for Standby (Economy)	°C	Yes
SpCEco	Analog value, 10	Cooling setpoint for Standby (Economy)	°C	Yes
Not used	Analog value, 11	-	-	-
PrSpShft	Analog value, 12	Setpoint displacement during presence	°C	Yes
HclVlvPosMan	Analog value, 13	Manual value heating output	%	Yes
CclVlvPosMan	Analog value, 14	Manual value cooling	%	Yes

Object name	Object ID	Description	Unit	Writeable
		output		
TRRemote	Analog value, 15	Remote control of room temperature	°C	Yes
StbyDBand	Analog value, 16	Dead band for Standby mode	°C	Yes
Not used	Analog value, 17-26	-	-	-
FanVarSpdMin	Analog value, 27	Lowest possible speed for the DC fan	%	Yes
FanVarSpdMax	Analog value, 28	Highest possible speed for the DC fan	%	Yes
TChoverCool	Analog value, 29	Cooling if lower changeover temperature	°C	Yes
TChoverHeat	Analog value, 30	Heating if higher changeover temperature	°C	Yes
RTHyst	Analog value, 31	Room temperature hysteresis	°C	Yes
CmfDBand	Analog value, 32	Dead band for comfort mode	°C	Yes
CmfSp	Analog value, 33	Basic setpoint for the controller	°C	Yes
TSuSpCalc	Analog value, 34	Calculated supply air setpoint	°C	No

10.5.3 Binary inputs

Object name	Object ID	Description	Values	Writeable
RWndSta	Binary input, 0	Room window state	Active / inactive	No
Not used	Binary input, 1	-	-	No
RPscDet	Binary input, 2	Room presence detection	Active / inactive	No
HCChover	Binary input, 3	Indicates changeover from digital input	Active / inactive	No
Not used	Binary input, 4-6	-	-	No

10.5.4 Binary values

Object name	Object ID	Description	Values	Writeable
Not used	Binary value, 0	-	-	No
Outputtype	Binary value, 1	Indicates pulse prop. heating	Active / inactive	No
Outputtype	Binary value, 2	Indicates pulse prop. cooling	Active / inactive	No

Object name	Object ID	Description	Values	Writeable
3-posInc	Binary value, 3	Indicates heating increase	Active / inactive	No
3-posDec	Binary value, 4	Indicates heating decrease	Active / inactive	No
FanType	Binary value, 5	Select fan type: Inactive = 3-speed fan Active = DC fan	Active / inactive	Yes
Not used	Binary value, 6	-	-	-
ChoverStatus	Binary value, 7	Indicates changeover status from both digital and analog input	Active / inactive	No
Not used	Binary value, 8	-	-	-
ShdownState	Binary value, 9	Places the unit in 'OFF' mode and prevents it from being activated again, unless this value is first set to '0'.	Active / inactive	Yes
ShdownSet	Binary value, 10	Places the unit in 'OFF' mode	Active / inactive	Yes
-	Binary value, 11	-	-	-
LockSettings	Binary value, 12	Prevents parameter menu access via display	Active / inactive	Yes

10.5.5 Loop

Object name	Object ID	Description
Controller	Loop, 0	Controller PI information

10.5.6 Multistate inputs

Object name	Object ID	Description	Values	Writeable
Not used	Multistate input, 0	-	-	No
ROpMode	Multistate input, 1	Current running mode	1 = Off 2 = Economy/Standby 3 = Not used 4 = Not used 5 = Comfort	No
HCSta	Multistate input, 2	Current control mode	1 = Off 2 = Heating 3 = Cooling	No
Fan3Spd	Multistate input, 3	Current fan speed	1 = Off 2 = Fan speed 1 3 = Fan speed 2 4 = Fan speed 3	No

10.5.7 Multistate values

Object name	Object ID	Description	Values	Writeable
CclVlvPosMod	Multistate value, 1	Manual/Auto cool output	1 = Off 2 = Manual output 3 = Automatic output	Yes
FanSpdMod	Multistate value, 2	Fan mode select	1 = Off 2 = Manual speed 1 3 = Manual speed 2 4 = Manual speed 3 5 = Auto	Yes
AppNr	Multistate value, 3	Control application	2 = 2-pipe system 3 = 4-pipe system 4 = 2-pipe system with electric heater	Yes
ChoverMod	Multistate value, 4	Manual/Auto change-over	1 = Heating 2 = Cooling 3 = Auto	Yes

Object name	Object ID	Description	Values	Writeable
ROpMod	Multistate value, 5	Room operating mode	1 = Off 2 = Economy/Standby 3 = Not used 4 = Not used 5 = Comfort 6 = No remote control	Yes
BtnCnf	Multistate value, 6	Buttons active	1 = No active buttons 2 = Only On/Off button active 3 = Only Up/Down buttons active 4 = On/Off and Up/Down buttons active 5 = Only fan button active 6 = On/Off and fan button active 7 = Up/Down and fan button active 8 = All buttons active	Yes
Valve 1 setting	Multistate value, 7	Set valve 1 type	1 = DC valve 2 = PWM 3 = On/Off 4 = 3-position valve	Yes
Valve 2 setting	Multistate value, 8	Set valve 2 type	1 = DC valve 2 = PWM 3 = On/Off 4 = 3-position valve	Yes

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