



en

MANUAL

REGIO RCX SERIES





PART OF
REGIN GROUP 

THANK YOU FOR CHOOSING REGIN!

Regin provides comprehensive solutions for building automation, including intuitive BMS-solutions, freely programmable and pre-programmed controllers, field devices and more.

Regin's offer, in combination with DEOS and Industrietechnik, empower system integrators, installers, and property owners with a powerful toolbox, setting them in a position to create building automation solutions that save both energy and engineering time. Today, versatile building management, optimized room control, and effective workflows have become the pillars for leading property owners in realizing significant energy savings in properties. Regin shares the clear goal of the group; to make this challenge easier on the way towards a sustainable future.

DISCLAIMER

The information in this manual has been carefully checked and is believed to be correct. Regin makes no warranties about the contents of this manual and users are requested to report errors and discrepancies to Regin, so that corrections may be made in future editions. The information in this document is subject to change without prior notification.

Some product names mentioned in this document are used for identification purposes only and may be the registered trademarks of their respective companies.

© AB Regin. All rights reserved.

Rev. A, 2024-05-06

PART OF
REGIN GROUP 

1	Introduction.....	5
1.1	About this manual.....	5
1.2	More information.....	5
2	Information for the end user.....	6
2.1	Regio zone controllers	6
2.1.1	Applications.....	6
2.1.2	Mounting.....	6
2.2	Regio RCX.....	7
2.2.1	Communication	7
2.3	Display, LEDs and buttons.....	7
2.3.1	User interface description, for models with display.....	7
2.3.2	User interface description, for models without display.....	9
2.3.3	RGB LED functions.....	9
2.4	Navigation - controller menu.....	10
2.4.1	Controllers with display	10
2.4.2	Controllers without display.....	13
2.5	Detection sensor - PIR	14
2.5.1	Range	14
2.5.2	Detection pattern	14
2.6	CO ₂ sensor	15
2.6.1	CO ₂ sensor range.....	15
2.7	Changing values.....	15
2.7.1	Controllers with display	15
2.8	Configuration	15
3	Information for the specialist.....	16
3.1	Regin:GO app	16
3.1.1	Language	16
3.1.2	Introduction Regin:GO app.....	16
3.1.3	Accessing, operation, and settings in the Regin:GO app.....	19
3.1.4	Bluetooth® activation	20
3.2	Application tool.....	21
3.2.1	Open Application tool	21
3.3	Set up, Import, and Export configurations	23
3.4	Function overview.....	23
3.4.1	Control functions.....	23
3.4.2	Controller state	24
3.4.3	Control sequences	28
3.4.4	Control function descriptions.....	46
3.4.5	Inputs/Outputs	54
3.4.6	Fan control.....	58
3.4.7	Display and menus.....	63
3.4.8	Manual/Auto	65
3.5	Navigation - Menus	67
3.5.1	Menu - Dashboard tab.....	67
3.5.2	Menu - Configuration tab	70
3.5.3	Manual/Auto - Menu tab.....	81
3.6	Control function examples - Regio RCX series.....	87
3.6.1	Hotel 1 - Heating (actuator radiator)+ VAV and Extra Zone (control of bathroom w. floor heating)	87
3.6.2	Hotel 2 - Heating (battery) + Cooling (battery) + Fan Control (EC-Fan)	89
3.6.3	Office - Heating/Cooling (change-over) + Fan Control.....	92
3.6.4	Conference - Heating (actuator radiator) + Cooling (chilled ceiling) + VAV (CO ₂).....	95
3.7	External sensors	98
3.7.1	Sensor values via communication	98
3.8	Special functions.....	99

3.8.1	Condensation sensor	99
3.8.2	Window contact	99
3.9	Factory reset	99
4	Information for the installer	101
4.1	Installation	101
4.1.1	Installation preparations	101
4.1.2	Using labels	101
4.1.3	Mounting	102
4.1.4	Wiring	103
4.1.5	Wiring - Control function examples	105
4.1.6	Troubleshooting	108
5	Conformity	109
Appendix A	Technical data	110
A.1	General data	110
A.2	Communication	110
A.3	Inputs & outputs	111
Appendix B	Model overview	112
Appendix C	Alarm list	113
C.1	Alarms	113
Appendix D	Terminal list	114
D.1	Wiring - Terminal list	114
Appendix E	Licenses	115
E.1	Cube MX	115
E.2	FreeRTOS	115
E.3	Fonts	116
E.4	JSMN	116

1 Introduction

1.1 About this manual

Special text formats used in the manual:



Note! This box, text, and symbol are used to highlight useful tips and tricks.



Caution! This box, text, and symbol are used to highlight cautions.



Warning! This box, text, and symbol are used to highlight warnings.

This box is used to show formulas and mathematical calculations

This box is used to
represent the display
window on the
controller

1.2 More information

- ✓ Regio RCX series Product sheet
- ✓ Regio RCX series Instruction
- ✓ Regio RCX series Variable list
- ✓ Regio RCX series Manual (this document)

All the above documents are available for download from Regin's website, www.regincontrols.com.



Note! All settings and configurations of the Regio RCX room controllers should be done with the Regio:GO app or Application tool.

2 Information for the end user

2.1 Regio zone controllers

The Regio RCX series comprises a wide range of room controllers that handle everything from heating, cooling, and ventilation to humidity and CO₂ monitoring. Regio RCX can be used to create anything from stand-alone systems for managing functions in a single room to being part of large, integrated systems with a comprehensive SCADA system.

2.1.1 Applications

The Regio RCX controllers have a discrete design and are easy to use, with an intuitive graphical LED matrix front and stylized touch buttons (depending on the model). They are suitable in buildings where you want optimal comfort and low energy consumption, such as offices, schools, shopping centres, airports, hotels, and hospitals.

In a room, the Regio RCX controller can measure and detect, for example:

- ✓ Temperature
- ✓ CO₂ level
- ✓ Relative humidity level
- ✓ Presence of condensation
- ✓ Motion of a user
- ✓ Air quality (VOC)
- ✓ If a window is open

2.1.2 Mounting

The modular design with a separate wall mount for wiring, available in several models, makes the whole Regio RCX series easy to install and commission. The controllers are mounted directly on a wall or in a wall box.

For more information, see *Table B-2 Wall mount assembly models* in *Appendix B Model overview*.

For more information about mounting, see the RCX-... Instruction, to be found at www.regincontrols.com. Or see detailed information in *chapter 4.1 Installation*.

2.2 Regio RCX

2.2.1 Communication

RS485

The controllers can be connected to a central SCADA-system via RS485 (EXOline, Modbus, or BACnet), and configured for a particular application using the Application tool, which can be downloaded free of charge from Regin's home page www.regincontrols.com. For more information, see section 3.2 *Application tool*.

The Arrigo template is adapted to support the Regio RCX series models (RCX-...).

Bluetooth® Low Energy

Communication is also supported by Bluetooth® (Regin protocol compatible with the Regin:GO app).

The controllers can be connected to the Regin:GO app (iOS/Android) and a cloud back end via Bluetooth® Low Energy.

For Regin:GO default access level passwords, see section 3.1.3 *Accessing, operation, and settings in the Regin:GO app*.

For more information, see section 3.1 *Regin:GO app*.

2.3 Display, LEDs and buttons

2.3.1 User interface description, for models with display

The user interface consists of three (3) touch sensitive buttons, and a display made up of a matrix of LEDs (25x11 pixels), in a plastic casing. The display can be seen through the plastic material, and the buttons can be pressed by touching the icons printed on the front cover.



Note! LED display and buttons are not available on all models. For more information, see *Table B-1 Controller models* in section *Appendix B Model overview*.

If no interaction has taken place with the room controller for a while, the display can emit light with full intensity as usual, be dimmed to emit a lower light intensity, or completely be shut off depending on the settings made by the administrator. If you set the display to be dimmed, or to be shut off when inactive, the room controller blends in with the room and is then not likely to disturb the end user. The dimmed mode is preferable for situations where you not want to be distracted by the light emitted by the room controller. Such as, at a hotel, where guests sleep in the room where the room controller is mounted, or in an office, where employees do not want to be distracted by a bright display. It is up to the administrator and the installer of the room controller to configure when the product should be dimmed, or lit.

The Regio RCX controller user interface is shown in *Figure 2-1 Regio RCX controller model with display*.

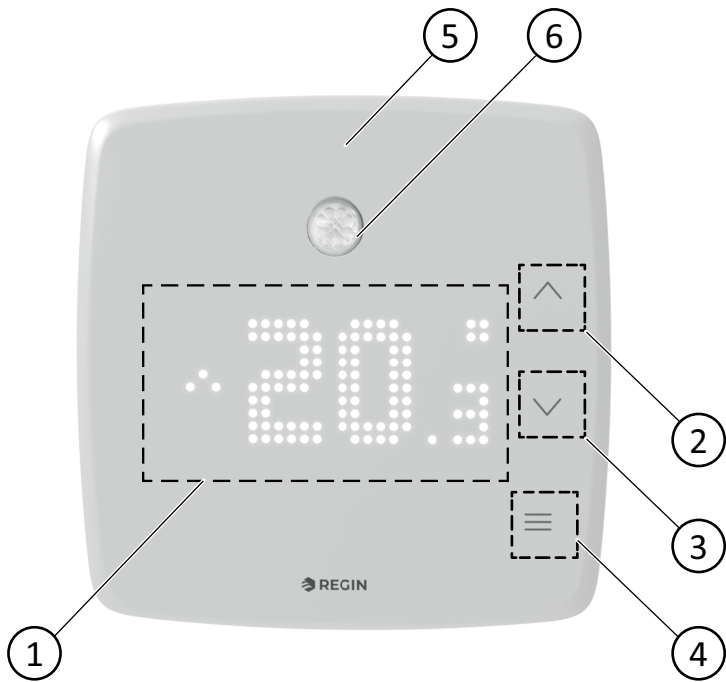


Figure 2-1 Regio RCX controller model with display

- ① LED matrix
- ② **[Down]** arrow button
- ③ **[Up]** arrow button
- ④ **[Menu]** button
- ⑤ RGB LED light (for controllers with/without display)
- ⑥ PIR sensor (on selected models)

Table 2-1 describes the buttons and LED matrix available on Regio RCX controllers with and without display.

Table 2-1 Button and LED descriptions for Regio RCX controllers with display.

Controllers with display	
№	Description
1	LED matrix with the current mode or value displayed
2	[Down] arrow button ▼. Used for toggling values downwards.
3	[Up] arrow button ▲. Used for toggling values upwards.
4	[Menu] button ≡. Used for navigation in menu.
5	RGB LED light. Used for Bluetooth® and CO ₂ level indications. See section 2.3.3 RGB LED functions.

Idle LED display

When no button is pressed, the LED display will return to idle mode after a time-out. After a configurable time delay, the LED display will first dim and then be turned off (by default).

The value shown in idle mode is configurable:

- ✓ Actual temperature
- ✓ Actual setpoint + adjustment
- ✓ Heat setpoint
- ✓ Cool setpoint
- ✓ Average value of heating and cooling setpoint
- ✓ Setpoint adjustment
- ✓ CO₂ level
- ✓ Heat setpoint + adjustment
- ✓ Cool setpoint + adjustment
- ✓ Average setpoint + adjustment
- ✓ Calculated air flow

2.3.2 User interface description, for models without display

For controllers without display (and then also without buttons) all configurations are made via the Regi:GO app or Application tool).

2.3.3 RGB LED functions

An RGB LED is present above the LED display (in upper front area for models without display). With these LEDs you will be notified if and when the Bluetooth® is activated or not, and when the CO₂ sensor indicates CO₂ levels if these functions are activated. The RGB LED can be configured to show the CO₂ level in green, yellow and red for low, medium and high CO₂ level respectively. The indication can be off, active always, or active only when the CO₂ value is shown in the display. See *Table 2-2 RGB LED functionality table*.

The RGB LED setting can be configured individually.

Table 2-2 RGB LED functionality table

Colour	Pattern	Description
Blue	Steady	Bluetooth® activated - device connected, or Identify pressed.
Blue	Blinking off 500ms, on 500ms	Bluetooth® temporarily activated - no device connected. If Bluetooth® is set to Always on the led does not blink.
Red	Steady	Indicating CO ₂ high level
Yellow	Steady	Indicating CO ₂ medium level
Green	Steady	Indicating CO ₂ low level

2.4 Navigation - controller menu

2.4.1 Controllers with display

Organized menu structures enable users to navigate through different configuration options and access various features efficiently, ensuring a logical and user-friendly interface.



Figure 2-2 Controller model with display

Menu button

The **[Menu]** button cycles through all available set *menu* options. Which options are available depends on the model, set configuration, and the connected sensors.

Up/Down buttons

In idle mode, the up/down buttons will initiate setting of the setpoint adjustment. Such as, when the fan control page is selected with the **[Menu]** button, the **[Up]** & **[Down]** buttons will increase/decrease the fan speed.

Display indications

When no button is pressed, the LED display will return to idle mode after a time out. After a configurable time delay the display will first be dimmed, then turned off. The display settings can be customized. See *Menu level reference 161* in section 3.5.2 *Menu - Configuration tab*.

The display indications are shown in *Figure 2-3 Indications in the controller display 1* and *Figure 2-4 Indications in the controller display 2*.

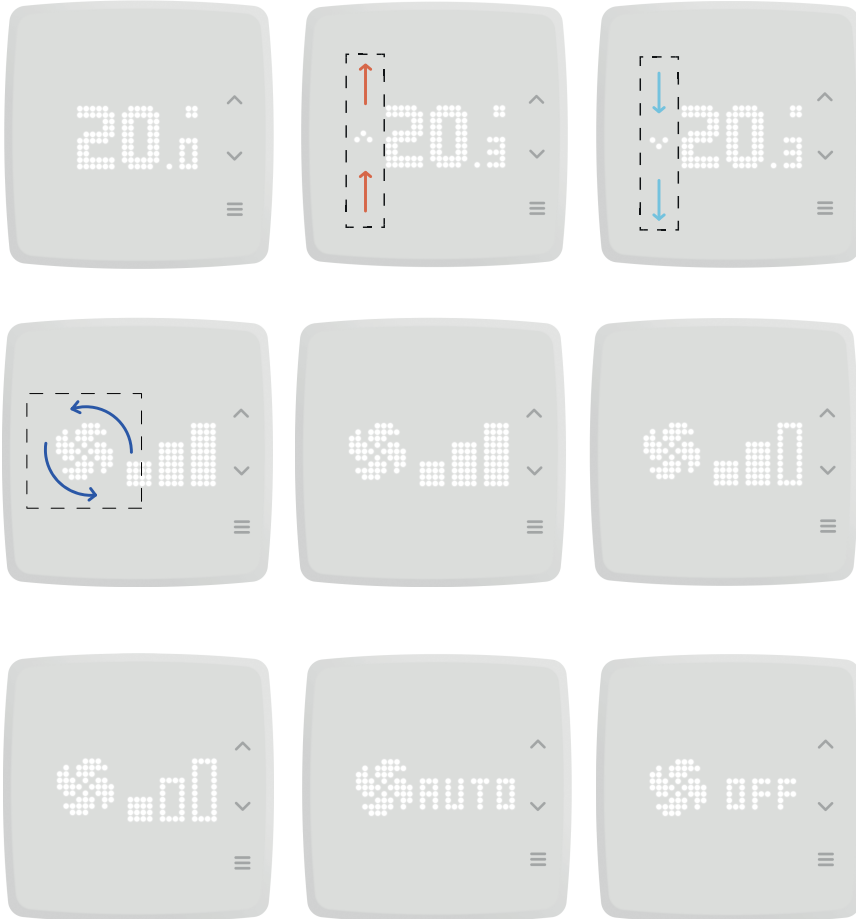


Figure 2-3 Indications in the controller display 1

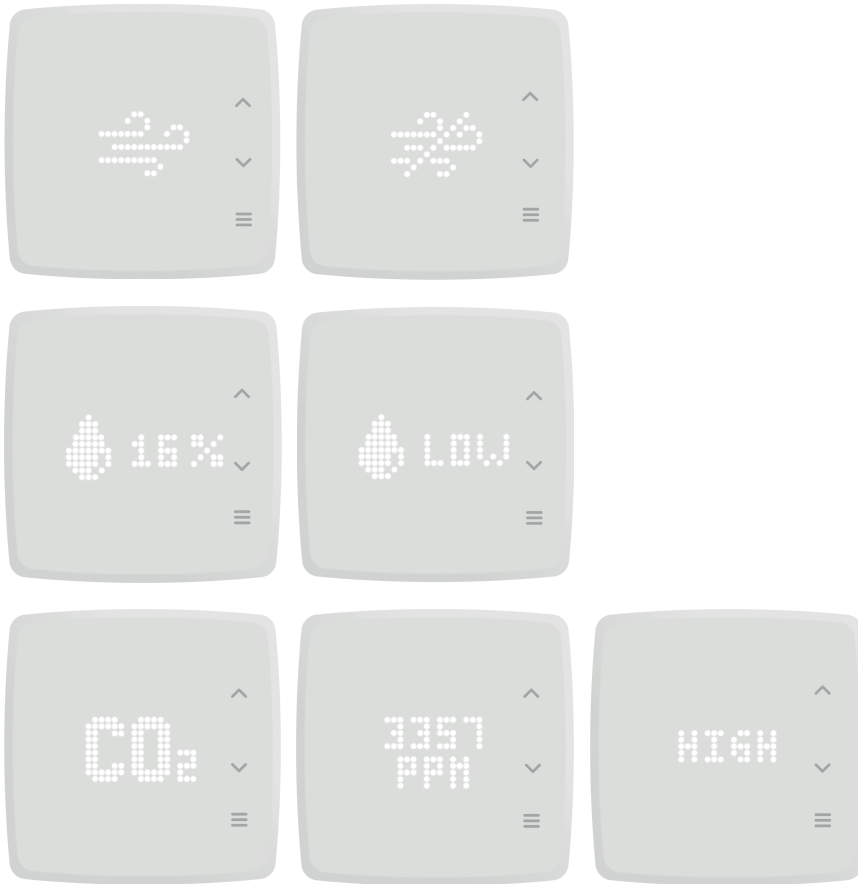


Figure 2-4 Indications in the controller display 2

When setting the setpoint adjustment, the value shown on the display is configurable:

- ✓ Setpoint adjustment
- ✓ Actual setpoint
- ✓ Heating setpoint
- ✓ Cooling setpoint
- ✓ Heating setpoint Occupied + adjustment
- ✓ Cooling setpoint Occupied + adjustment
- ✓ Average cooling/heating setpoint
- ✓ Setpoint adjustment
- ✓ Actual setpoint
- ✓ Heating setpoint

The display and function indications are described in *Table 2-3* and *Table 2-4*.

Table 2-3 Display indication descriptions.

Indication	Description
Actual temperature	When you press the [Up] arrow button, the temperature setpoint is increased, and when you press the [Down] arrow button, the temperature setpoint is decreased. The increment of each button press is 0.5 °C. The range of the temperature is normally between 18 to 24 °C and can be adjusted only by the administrator of the room controller. For the temperature setting to take effect, the user must wait 10 seconds (s) without pressing any buttons. The display then returns to the current default view. When the user presses one of the arrow buttons, the temperature setpoint is shown and the LED display flashes between the dimmed mode and full intensity mode.
Actual fan speed	When you press the [Up] arrow button, the fan speed setpoint is increased and when you press the [Down] arrow button, the fan speed setpoint is decreased. The fan can be set in three (3) levels, 1, 2, and 3. For the fan speed setting to take effect, the user must wait 10 seconds (s) without pressing any buttons. The display then returns to the current default view.

In *Table 2-4* you find descriptions of the functions in the menu and their indications, available when you press the **[Menu]** button.

Table 2-4 Function indication descriptions

Indication	Description
Fan speed	The fan symbol rotates at different speeds when the user cycles the speeds with the arrow buttons. The fan can rotate with three different speeds, visualized with three bars on the display. The fastest fan speed is reached by pressing the up arrow repeatedly and pressing the down arrow repeatedly slows the fan down in increments until it turns the fan to OFF, and the animated fan stops spinning.
Fan Auto	The fan speed Auto mode simply adjust the fan speed automatically, depending on the need.
Fan Off	The fan speed is set to Off. The fan is disengaged.
Forced ventilation On	The setting Forced ventilation On lets in fresh air, as it enables a damper to open so that new, fresh air from the duct flows into the room. The benefit of forced ventilation is that even though the fresh air is brought into a room, the current temperature is not changed.
Forced ventilation Off	The forced ventilation setting is disabled by default (visualized with a breeze of air that is crossed over).
Relative humidity level	The relative humidity level of the room is presented as a percentage along with a drop symbol. An additional aid in understanding the value and to take the consideration of user resources into account, the words "LOW", "OK", and "HIGH" are displayed, after a brief delay, depending on what the measured relative humidity is. This is only indoor climate information, and no action can be taken to adjust the levels. “
CO ₂ level	The system measures the amount of CO ₂ in the room. The value is displayed in the unit parts per million, ppm.
VOC level	The system measures the AQI level in the room. The value is displayed in the AQI scale. See section <i>VOC Control (Volatile Organic Compounds)</i> . The VOC screen switches after a brief delay. This is only indoor climate information, and no action can be taken to adjust the levels.

2.4.2 Controllers without display

Controllers without a display have the same functionality, with either the built-in sensors (varies for different models) or with external sensors. No button or display interaction can be made, apart from RGB LED indications. For more information, see section *2.3.3 RGB LED functions*.

2.5 Detection sensor - PIR

2.5.1 Range

The detection range of the detection sensor (PIR sensor) is dependent on the difference between the object and the room temperature, and cannot be adjusted.

2.5.2 Detection pattern

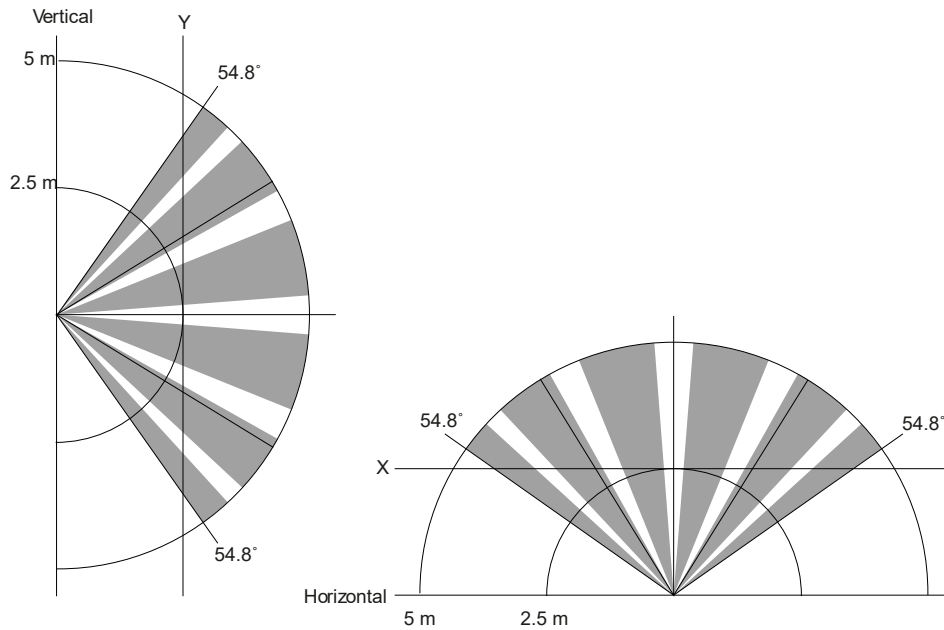


Figure 2-5 Detection pattern range PIR sensor - Vertical and Horizontal.

2.6 CO₂ sensor

2.6.1 CO₂ sensor range

CO₂ control can be used if either a built-in or an external CO₂ sensor is present. The built-in sensor has a range of 0...2000 ppm.

2.7 Changing values

Below you find examples of how to change setpoints directly on the controller.



Note! Valid only for controllers with display. For more information, see section *Display indications* and *Table 2-3 Display indication descriptions*.

2.7.1 Controllers with display

Performing a setpoint adjustment

For controllers with display, a setpoint adjustment of temperature and fan speed settings can be performed when the controller is in *Forced ventilation*, in *Occupied* or *Standby* state.

To perform a setpoint adjustment:

1. Press the **[Menu]** button until the desired function is shown.
2. Press the **[Up]** or **[Down]** button to increase or decrease the setpoint.



Note! The new set setpoint is valid instantly and need no confirmation. When you have changed a setpoint, the controller automatically returns to the previous menu state after 10 seconds.

Controllers without display

Controllers without a display serves only as sensors, with either the built-in sensors (different for different models) or with external sensors. No button or display interaction can be made, apart from RGB LED indications.

For more information, see section *2.3.3 RGB LED functions*.

2.8 Configuration

You use the Regin:GO app and the Application tool as two ways to configure the Regio RCX series controllers. It is a matter of choice which application you use, with the important difference that with Application tool you can configure several devices. With the Regin:GO app you can only configure one device at the time.

See the sections *3.1 Regin:GO app* and *3.2 Application tool*.

3 Information for the specialist

3.1 Regin:GO app

The Regio RCX series controllers are Bluetooth® compatible, and can be connected via the **Regin:GO** app. The Regin:GO app is available on Android and iOS. It is used to upgrade, configure, and commission one or several Regio RCX series controllers. The Regin:GO app can also be used to upgrade the firmware. Get the Regin:GO app from *App store* (iPhone and iPad) or *Google play* (Android).

3.1.1 Language

The language setting is inherited from the handheld device settings.

3.1.2 Introduction Regin:GO app

Below follows screenshots and a short description of some of the basic functions of the menu pages in the Regin:GO app.

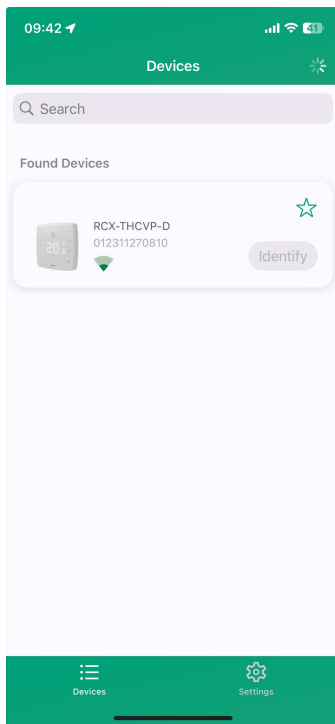
For a complete and more detailed menu structure, and available settings, see section 3.5 *Navigation - Menus*.



Note! Depending on your configuration, you will have different setting options.

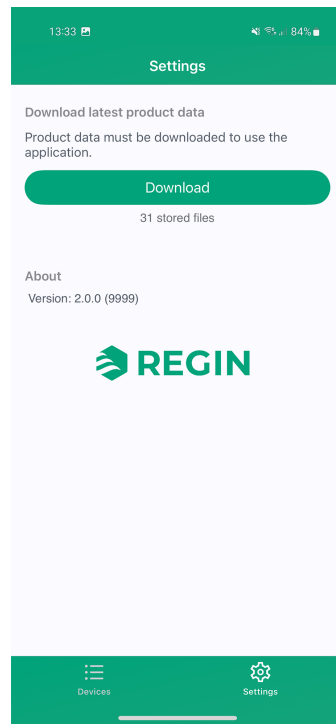


Note! The language setting is inherited from the handheld device. This will be asked for automatically the first time the app starts, but it must be updated periodically to get the latest firmware and settings.



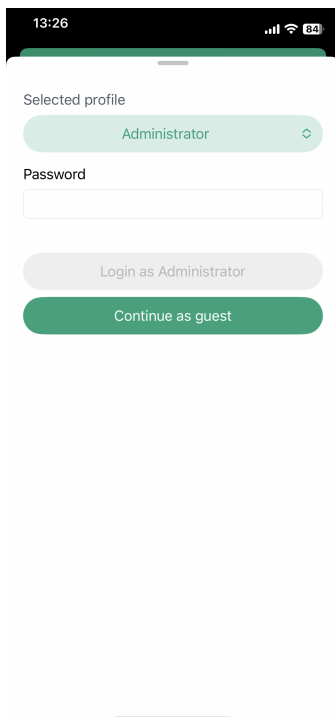
Devices page

This is the first page after the logo page. The Devices page lists all units found, with the possibility to identify new units and create favourites in a long list of units. The list presents a unit's name and serial number. When the **Identify** button is tapped in the Regin:GO app, the unit connection symbol is lit in blue for a few seconds and then turns blinking yellow to indicate which unit is selected.



Settings page

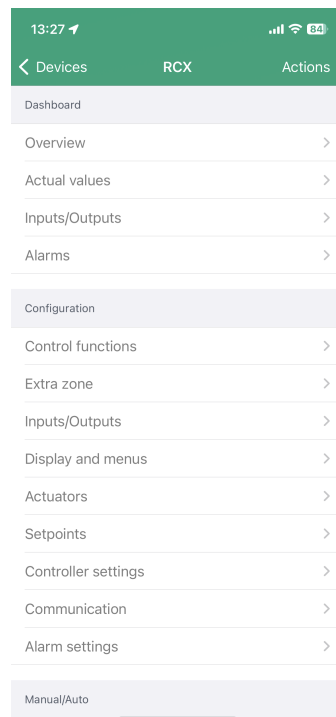
In this page it is possible to download the needed product data files. Tap **[Download]**.



Login pop up window

In this page you can choose the user login type, or to *Continue as guest*.

You need to be logged in as *Administrator* to change the unit name and address, backup and restore settings, as well as doing firmware updates.



Menu page

This page is a menu page to navigate to other sub-menus, such as Overview, Configuration, and Manual/Auto etc.

System	
Controller	RCX-THCVP-D
PLA	254
ELA	30
Sum alarm	Occupied
Room	
Controller state	Occupied
Mode	Heating
Room temperature	19.58
Room setpoint	21.5
Setpoint adjustment	-0.5
Heating demand	13
Cooling demand	0
CO2 level	0
Presence detection	RCX-THCVP-D

Overview page

This page is an overview page where you can see the actual values of *System* and *Room* settings.

Room Control Sequence	
Sequence 1	Heat
Sequence 2	Cool
Sequence 3	VAV
Actual values	
Mode	Heating
Room temperature	19.49
Room setpoint	21.5
Setpoint adjustment	-0.5
Heating demand	15
Cooling demand	0
Heating output	15
Cooling output	0
VAV output	20

Actual values page

This page is an *Actual values* page where you can see actual values.

Universal inputs	
UI1-	Disabled
UI2-	Disabled
Universal outputs	
UO1-	Disabled
UO2- 6-way valve	0
Analog outputs	
AO1-	Disabled
AO2/CI-	Disabled
Internal sensors	
Room temperature	19.5
CO2 sensor	0
RH sensor	52.71
VOC sensor	19.92

Input/Outputs page

This page is an *Inputs* and *Outputs* overview page, where you can view the actual values of all the I/O:s and the built-in sensors.

Alarms	
Sum alarm	Active
Sensor error	Not active
High room temperature	Not active
Low room temperature	Active
High CO2 level	Not active
Output in manual mode	Not active

Alarms page

This page is an overview page of all alarms.

3.1.3 Accessing, operation, and settings in the Regin:GO app

To access and enable operations and settings in the Regin:GO app, a valid password is required. See the list of access rights below.

Administrator - password: Admin

- ✓ Update firmware
- ✓ Reset to default values
- ✓ Save and import local configuration
- ✓ Change password
- ✓ Read and write all values that are possible to change, including all settings and configurations



Note! Make sure to change the default password after the first *Admin* login.

Guest - password: N/A

- ✓ Read values decided by Regin:GO app.

Connecting to a Regio RCX controller, with the Regin:GO app

To connect to a Regio RCX controller with the Regin:GO app:

1. Open the Regin:GO app on your mobile device.
2. In the **Search** field, in the **Devices** page (opens per default), type a controller serial number or wait until the Regin:GO app populates the controller by automatic detection.
3. Tap the **Controller** area on the desired identified controller to connect.
4. In the **Log In** dialogue, tap the **Selected profile** list and select the desired profile type. Then tap and type the corresponding password in the **Password** field.
5. Tap the **[Login as...]** button.
6. The Regin:GO app is now connecting to the device.

You can now navigate the menu in the Regin:GO app to view values or make configuration changes. For more information, see sections [3.1 Regin:GO app](#) or [3.5 Navigation - Menus](#).

3.1.4 Bluetooth® activation

There are two settings that control the activation of Bluetooth®. The configuration of the Bluetooth® functions and the turn off after an activation, as described below.

Bluetooth® function

In *Table 3-1 Bluetooth® functions* the four (4) different activation functions are described, with the corresponding activation procedure.

Table 3-1 Bluetooth® functions

Function	Description
Off	Bluetooth® is disabled. Only serial line communication is possible.
Always On	Bluetooth® is always activated. LED indication is off.
On after start up	Bluetooth® is activated after power on for a configurable time. LED indication is On.
Activated by button (default)	Bluetooth® is activated by pressing the [Menu] button (the lower right corner, if no [Menu] button) of the controller for five (5) seconds. LED indication is On.

When Bluetooth® is temporarily activated (valid for the functions *On after startup* or *Activated by button*), this is indicated with a blue LED flash every five (5) seconds. The Bluetooth® is activated in two (2) minutes per default.

Turn off after activation

Turn off after activation is only applicable for the Bluetooth® function options *On after startup* and *Activated by button*, meaning the time in seconds that Bluetooth® should be activated. The permissible range for the setting value lies between 10 and 3600 seconds (default 600 s).

3.2 Application tool

The Application tool is a PC-based configuration software tool. It is used to upgrade, configure, and commission one or several Regio RCX series controllers.



Warning! Always disconnect the control unit from the power supply before connecting or disconnecting any connectors on the control unit.

3.2.1 Open Application tool

The Application tool opens a dialogue at startup where you can create an offline project, open an existing project, or connect to a Regio RCX controller via an RS485 serial connection.

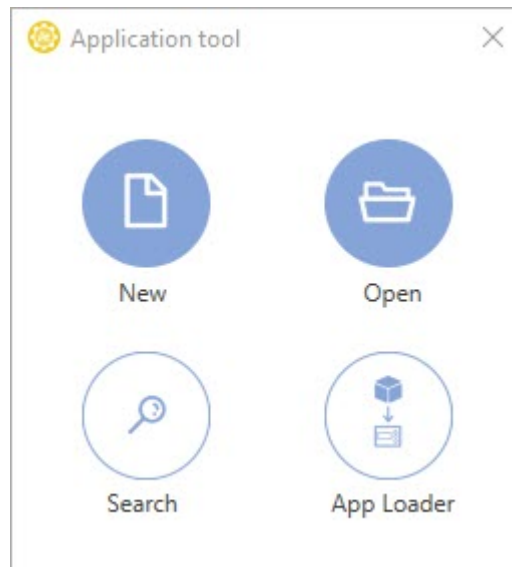


Figure 3-1 Application tool start dialogue

To create and open a new offline project, click the **[New]** button.

To open an already existing project, click the **[Open]** button.

To search and connect to a controller, click the **[Search]** button.

The *App Loader* function can be used when you just want to upload the application to the controller. It is then not possible to configure the settings in the controller. Just send the application to the controller. Click the **[App Loader]** button, and upload the application to the controller.

Serial search

The **Search** window can also be opened by pressing **[F7]** on your keyboard, or from the **Tools** menu, via **Search**. Select **Search** serial and choose the serial port to be used.

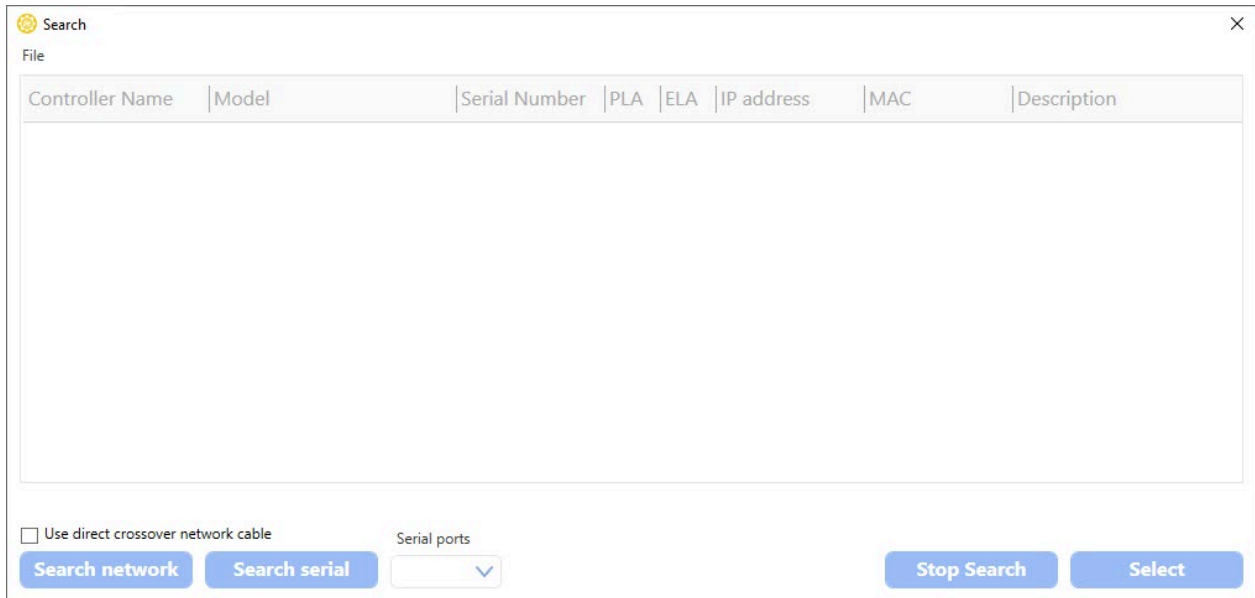


Figure 3-2 The Application tool Search window

3.3 Set up, Import, and Export configurations

You can create configurations offline and online in both Application tool and the Regin:GO app, and then export and import them in both tools when needed.

3.4 Function overview

3.4.1 Control functions

Room Control Sequence function

The *Room Control Sequence* function enables the controller to support control of various room HVAC systems, that is, different combinations of heating, cooling, and variable air volume (VAV) devices that are part of a room. This function is used for setting up a regulation case.

Based on the selected controller sequences, the controller outputs one or multiple control signal sequences, denoted *Sequence 1*, *Sequence 2*, and *Sequence 3*. The signal sequences control the heating, cooling, and VAV devices in the room, and are assigned to the different controller outputs via configuration.

Figure 3-3 shows the drop down that is used to select a control sequence in Application tool.

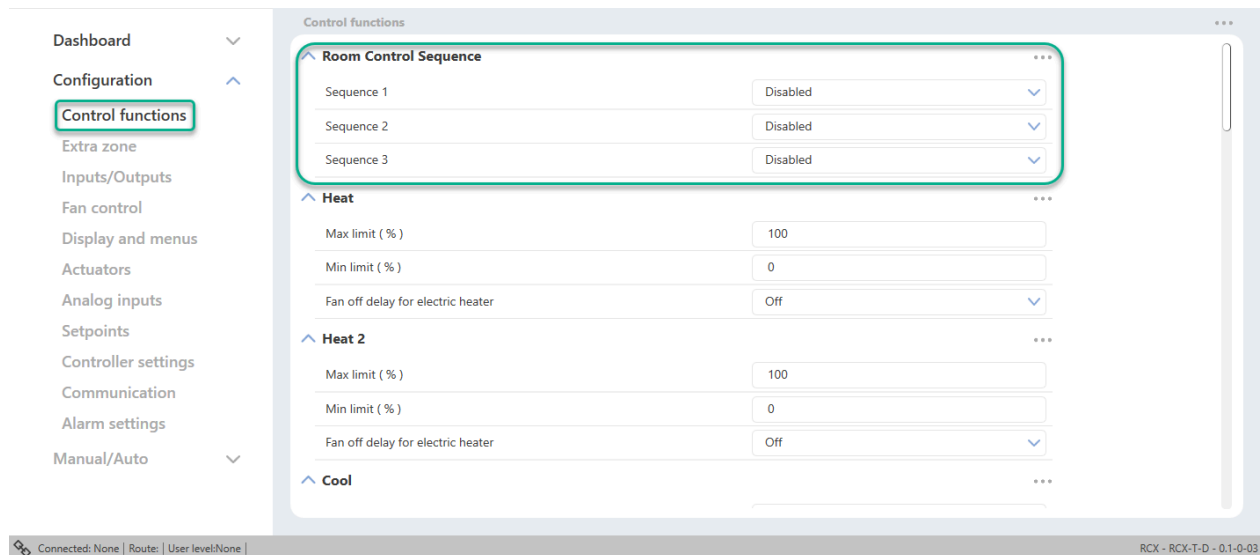


Figure 3-3 Room control sequence selection in Application tool.

3.4.2 Controller state

Controller state is a control 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 controller always operates in one of them:

- ✓ Off
- ✓ Unoccupied
- ✓ Standby
- ✓ Occupied
- ✓ Forced ventilation

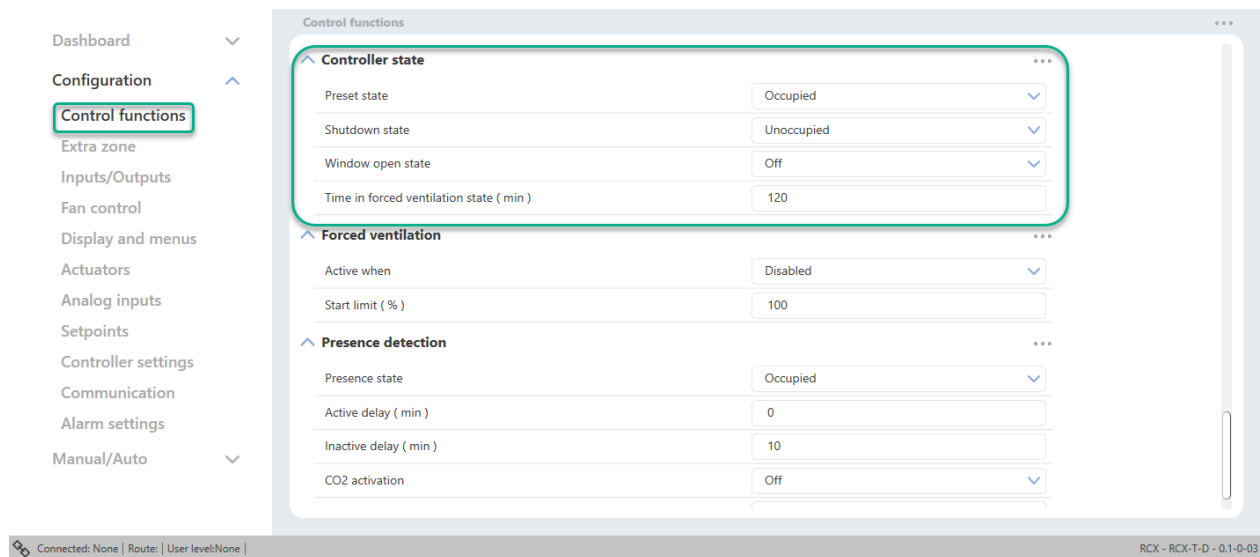


Figure 3-4 Controller state configuration settings in Application tool.

The different controller states make use of various setpoint and deadband settings to regulate the heating and cooling distribution, as described in section *Control behaviour*.

The controller state configuration settings are described in section *Configuration settings*, and controller state changes are described in section *State changes*.

An overview of the controller states is provided in *Table 3-2*.

Table 3-2 Controller state overview.

Controller state	Description	Priority	LED indication in controllers with/without display
Off	This state is typically used for when the room is not in use for an extended period of time, for example, during holidays or long weekends. In this state, the controller only provides heating control for frost protection, which keeps the room temperature above 8 °C.	Energy saving and frost protection	✓ Off
Unoccupied	This state is typically used for when the room is not in use for an extended period of time, for example, during holidays or long weekends.	Energy saving	✓ Off
Standby	This state is typically used for when the room is not in use, temporarily or for shorter periods of time, such as during evenings, nights, or weekends.	Energy saving	✓ Blinking

Table 3-2 Controller state overview. (continued)

Controller state	Description	Priority	LED indication in controllers with/without display
Occupied	This state is typically used for when the room is in use.	Comfort	✓ Solid
Forced ventilation	This state is typically used for when the room is in use, and when a temporary maximum flow of fresh air is needed. For example, when the room needs an extra boost of fresh air prior to a scheduled meeting that is going to fill up the room with a large amount of people, or due to a high CO ₂ level. The increase in airflow is achieved by using the forced ventilation function, see section <i>Forced ventilation</i> .	Comfort and improved air quality	✓ Blinking slowly

Control behaviour

This section describes the control behaviour for the different controller states when the controller regulates based on heating and cooling demand.

Off

In this state, the controller does not regulate based on the configured occupied heating and cooling setpoints. Instead, the controller only provides heating control based on the configured frost protection setpoint. Setpoint adjustment is not active in this controller state.

Active setpoint: The configured frost protection setpoint.

Figure 3-5 illustrates the control behaviour when no maximum or minimum limits are set for the output signal.

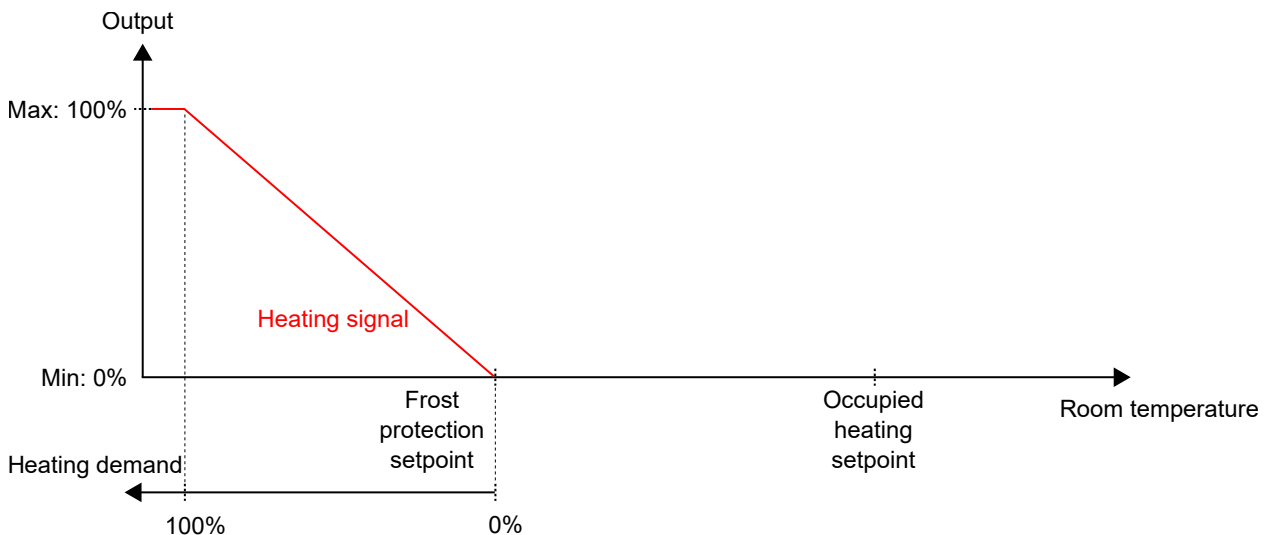


Figure 3-5 Control behaviour for the off controller state.

Unoccupied

In this state, the controller does not regulate based on the configured occupied heating and cooling setpoints. Instead, the controller provides heating and cooling control based on the configured unoccupied heating and cooling setpoints. Setpoint adjustment is not active in this controller state.

Active setpoints: The configured unoccupied heating and cooling setpoints.

Figure 3-6 illustrates the control behaviour when no maximum or minimum limits are set for the output signals.

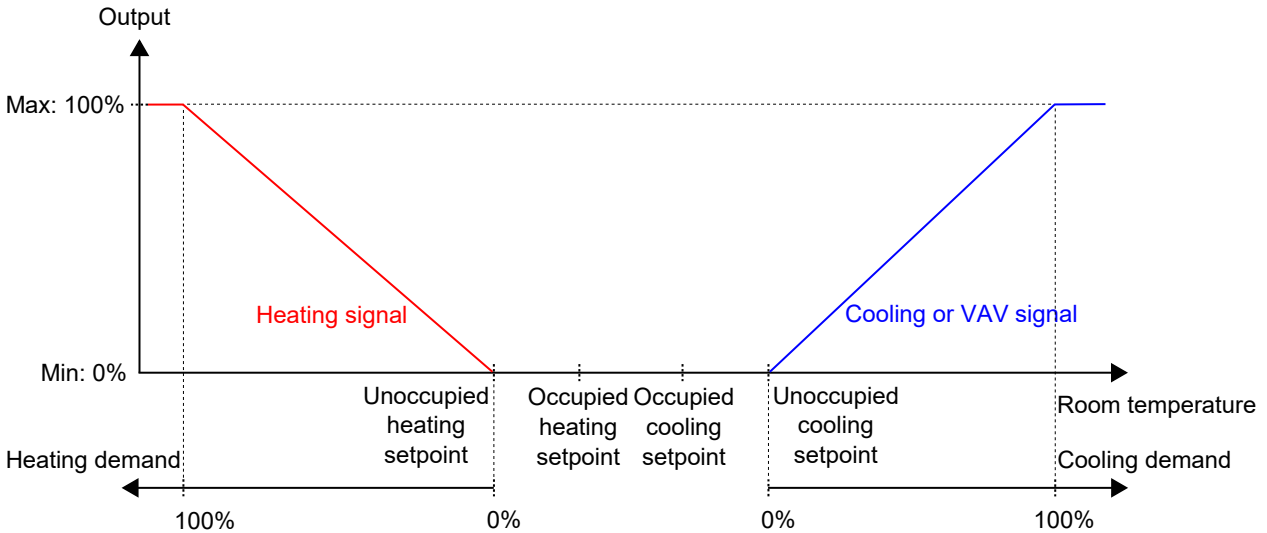


Figure 3-6 Control behaviour for the unoccupied controller state.

Standby

In this state, the controller regulates based on the configured occupied heating and cooling setpoints, in combination with the configured *standby deadband* setting. Setpoint adjustment is active in this controller state.

Active setpoints: The configured occupied heating and cooling setpoints, combined with the configured *standby deadband* setting and any applied setpoint adjustment.

Figure 3-7 illustrates the control behaviour when no maximum or minimum limits are set for the output signals.

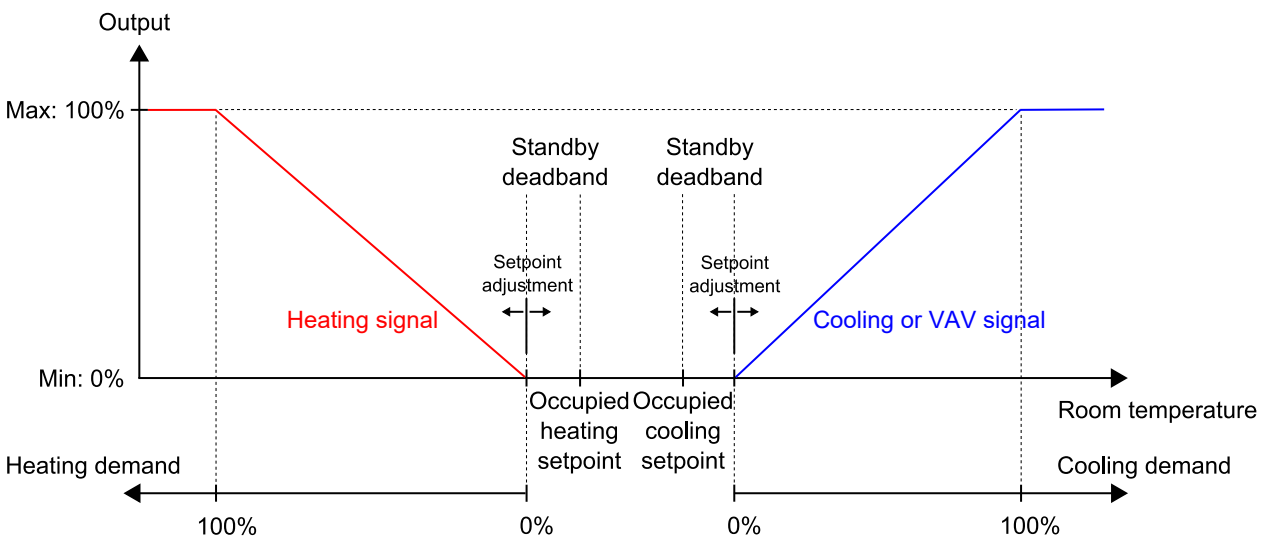


Figure 3-7 Control behaviour for the standby controller state.

Occupied and Forced ventilation

In these states, the controller regulates based on the configured occupied heating and cooling setpoints. Setpoint adjustment is active in these controller states.

The forced ventilation function can be used when the controller changes to *Forced ventilation* state. For information about the *Forced ventilation* function, see section *Forced ventilation*.

Active setpoints: The configured occupied heating and cooling setpoints, combined with any applied setpoint adjustment.

Figure 3-8 illustrates the control behaviour when no maximum or minimum limits are set for the output signals.

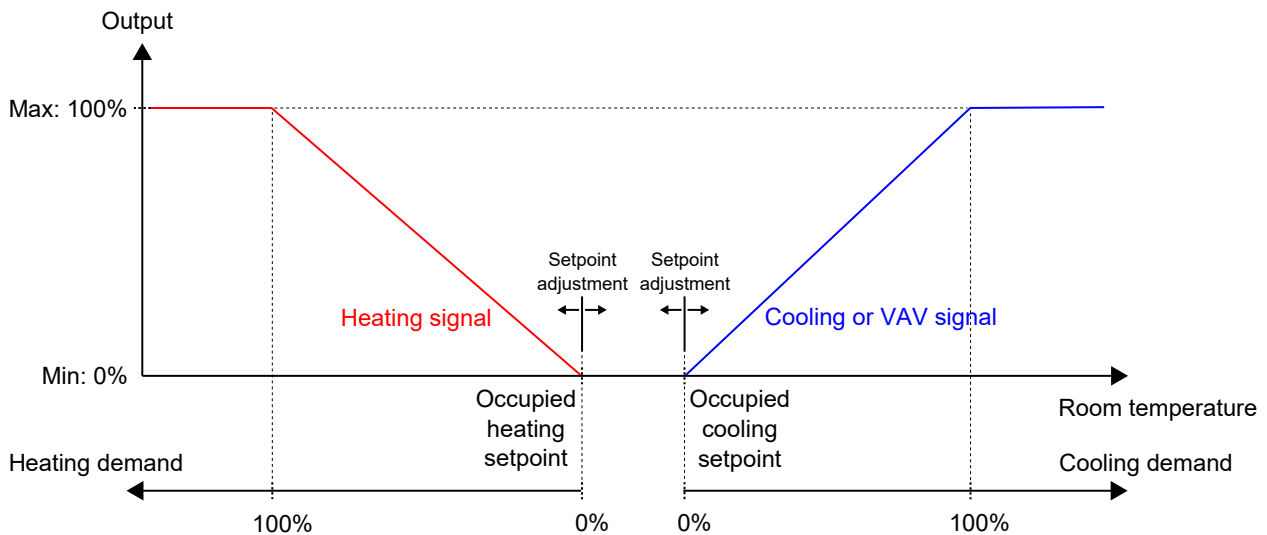


Figure 3-8 Control behaviour for the occupied and Forced ventilation controller state.

Configuration settings

The controller state configuration settings are described in Table 3-3.

Table 3-3 Controller state configuration settings.

Configuration setting	Description
Preset controller state	One of the following controller states is configured as the preset controller state: ✓ Off ✓ Unoccupied ✓ Standby ✓ Occupied (default setting)
Shutdown controller state	One of the following controller states is configured as the shutdown controller state: ✓ Off ✓ Unoccupied (default setting) ✓ Standby ✓ Occupied
Time in Forced ventilation state (min)	The period of time (in minutes) that the controller is in <i>Forced ventilation</i> state before the controller changes state to the configured preset controller state. If time is set to 0, the <i>Forced ventilation</i> never switches back automatically. It will need an activating trigger to leave the <i>Forced ventilation</i> state, see section <i>State changes</i> .

State changes

The controller changes state when one of the following events occur:

- ✓ Presence is detected,
 - ✓ via a presence detector, for example a motion detector, which is connected to the controller, or
 - ✓ due to a high CO₂ level that is detected via a CO₂ sensor, which is connected to the controller.
- See section *Presence detection* for information about the presence detection function and presence detection configuration settings.
- ✓ The Forced ventilation state time out expires.
 - ✓ Presence is not detected anymore.
 - ✓ A central command is issued via communication, for example, from a SCADA system.

3.4.3 Control sequences

The control sequences are set in three (3) freely selectable sequence steps.

There are three (3) sequence steps to be chosen and configured in Application tool. Each step can be set to one (1) of the following functions:

- ✓ Unused
- ✓ Heat
- ✓ Heat 2
- ✓ Cool
- ✓ Cool 2
- ✓ VAV
- ✓ VAV 2
- ✓ Change-Over
- ✓ Change-Over VAV
- ✓ 6-way valve

Excluded from the sequences are overall outputs like *Fan-control* and *Forced ventilation*. The sequence settings are also not dependent on the actuator (valve) type, which will be selected at a later stage.



Note! Depending on the function selected, there are additional parameters to be set for each sequence.

For each sequence either an analogue or digital output can be used to control a valve/damper actuator.

Order of sequence steps

The sequences will always be utilized in order, from one (1) to three (3). When the controller is in heating mode, cooling sequences will be skipped and vice versa. A *6-way valve* sequence is both a heating and cooling sequence. A *Change-over* sequence will be considered a heating or cooling sequence depending on its mode, see section *Change-over*.

Allowed sequence combinations

Not all control sequence combinations are possible. As a general rule, the faulty sequence step will be ignored and considered unused.

Some examples of illegal control sequence combinations:

- ✓ Every function can be used only once in the three (3) chosen sequences. If any duplicates are found, such as two *Heat 1* sequences, the first one found will be used and the second will be ignored.
- ✓ The *Heat 2*, *Cool 2*, and *VAV2* cannot be used without the *Heat 1*, *Cool1*, and *VAV1* sequences respectively. If they are used without each other, they will be ignored.

Sequence Functions

Disabled

If one sequence is unused, **Disabled**, this will always be ignored.

Heating (Heat, Heat 2)

Up to two (2) heating sequences can be configured, *Heat 1* and *Heat 2*.

The following settings can be made:

- ✓ **Max limit (%)**
- ✓ **Min limit (%)**
- ✓ **Fan off delay for electric heater**

This sequence mode is suitable in applications where you want to control a heating source, such as a radiator.

The controller acts as a heating controller and regulates based on the heating setpoint and the current room temperature.

The controller is always in heating mode and outputs a heating signal, **Heating output (%)**, that is configured on the controller outputs by using the configuration values listed in *Table 3-4*.

Maximum and minimum limits for the output signal can be set, see section *Minimum limit for heating output*.

Table 3-4 Controller output configuration values and controller output types.

Output signal	Controller output configuration value	Controller output type
Heating output (%)	Heating	Analog
Heating 2 output (%)	Heating valve, thermal (PWM, Pulse Width Modulation, or use of thermostat function)	Digital

Figure 3-9 illustrates the control behaviour for this controller mode when no maximum or minimum limits are set.

The heating demand increases as the room temperature falls. When the room temperature falls below the heating setpoint, **Heating output (%)** increases to respond to the heating demand. At 100% heating demand, **Heating output (%)** reaches its maximum.

When the room temperature is higher than the heating setpoint and no heating demand exists, **Heating output (%)** is at its minimum.

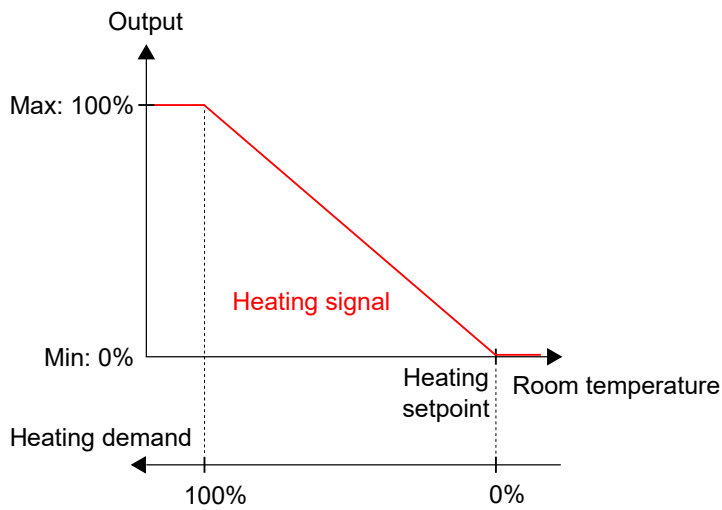


Figure 3-9 Control behaviour for the Heating sequence mode.

Minimum limit for heating output

A minimum limit for the heating output sequence can be set. *Figure 3-10* illustrates the control behaviour for the controller mode when maximum or minimum limits are set for the heating output.

The heating output limits are active when the controller is in heating mode, and inactive when the controller is not in heating mode. Whether the controller is in heating mode or not is defined by the used controller mode, see section *Room Control Sequence function*.

Figure 3-10 illustrates how the control behaviour is affected when limits are set for the heating output. For example, when a 20% minimum limit is set, *Heating signal* is always 20% as long as the controller is in heating mode.

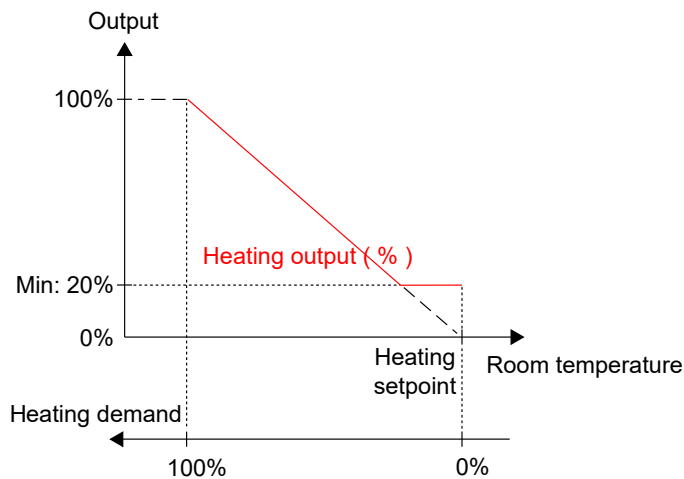


Figure 3-10 Control behaviour when maximum and minimum limits are set for the heating output.

Cooling (Cool, Cool 2)

Up to two (2) cooling sequences can be configured, *Cool* and *Cool 2*.

The following settings can be made:

- ✓ Max limit (%)
- ✓ Min limit (%)
- ✓ Set to max at forced ventilation state

It is suitable to use the cooling sequence(s) when a cooling source should be controlled, such as chilled beams.

Table 3-5 Controller output configuration values and controller output types.

Output signal	Controller output configuration value	Controller output type
Cooling output (%)	Cooling	Analog
Cooling 2 output (%)	Cooling valve, thermal (PWM, Pulse Width Modulation, or use of thermostat function)	Digital

Figure 3-11 illustrates the control behaviour for this controller mode when no maximum or minimum limits are set.

The cooling demand increases as the room temperature rises. When the room temperature rises above the cooling setpoint, the **Cooling output (%)** signal increases to respond to the cooling demand. At a cooling demand of 100%, the **Cooling output (%)** signal reaches its maximum.

When the room temperature is lower than the cooling setpoint and no cooling demand exists **Cooling output (%)** signal is at its minimum.

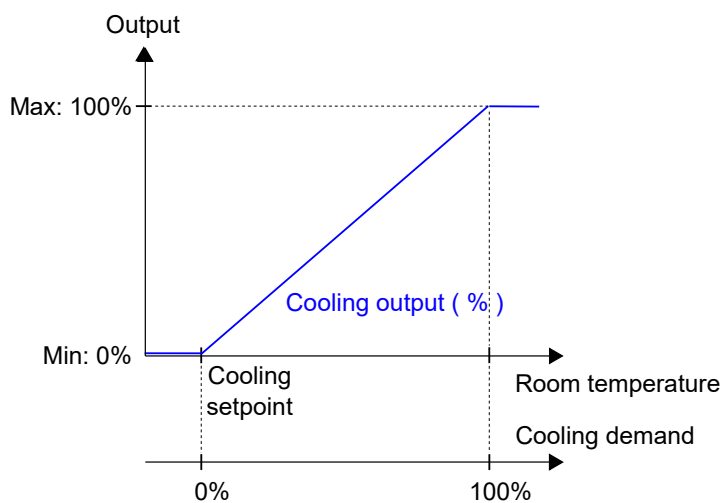


Figure 3-11 Control behaviour for the Cooling controller mode.

VAV (VAV, VAV 2)

Up to two (2) VAV sequences can be configured, VAV 1 and VAV 2.

The following settings can be made:

- ✓ Max limit (%)
- ✓ Min limit, off (%)
- ✓ Min limit, unoccupied (%)
- ✓ Min limit standby (%)
- ✓ Min limit, occupied (%)
- ✓ Min limit, forced ventilation (%)
- ✓ Set to max at forced ventilation state (on, off)
- ✓ Max limit when heating (%)
- ✓ Minimum Limit for VAV Output

This function is intended to put a minimum flow in VAV systems. As such the function puts a minimum output on the VAV output regardless if the controller is in heating or cooling mode.

✓ Maximum Output Limit when Heating

This setting is used to open the VAV-damper at *Heating* mode. The purpose is to increase the airflow into the room at *Heating* mode if the heater is placed in the duct.

When the function is active, the VAV output follows the heat output between the configured minimum limit and the configured maximum limit. No scaling of the output is used, the VAV has the same value as the heat output.

The minimum and maximum VAV limits have precedence. When used together with the minimum and maximum VAV limits, the VAV signal is never lower than the minimum VAV limit and never higher than the maximum VAV limit, regardless of the configuration of this function.

This controller mode is suitable for room HVAC systems that use low supply air temperature that is distributed into the room via a diffuser damper to provide cooling and fresh air. The air must be pretreated and cooled since the diffuser damper itself does not have any cooling capacity.

The controller acts as a cooling controller and regulates based on the cooling setpoint and the current room temperature. In addition, the controller can be set to regulate based on fresh air demand instead of cooling demand, or based on cooling demand and fresh air demand simultaneously, see section *VAV control source*. The controller regulates based on fresh air demand by using CO₂ control, see section *CO₂ control*.

The controller is always in cooling mode and outputs a VAV signal, **VAV output (%)**, that is configured on the controller outputs by using the configuration value listed in *Table 3-6*.

Maximum and minimum limits for the VAV output signal are set via the VAV control function. For more information, see section *VAV control source*.

Table 3-6 Controller output configuration value and controller output type.

Output signal	Controller output configuration value	Controller output type
VAV output (%)	VAV	Analog

Figure 3-12 illustrates the control behaviour when the controller regulates based on cooling demand, and when a minimum limit is set for the VAV output signal.

The cooling demand increases as the room temperature rises. When the room temperature rises above the cooling setpoint, **VAV output (%)** increases to respond to the cooling demand. At a cooling demand of 100%, **VAV output (%)** reaches its maximum.

When the room temperature is lower than the cooling setpoint and no cooling demand exists, **VAV output (%)** is at its minimum.

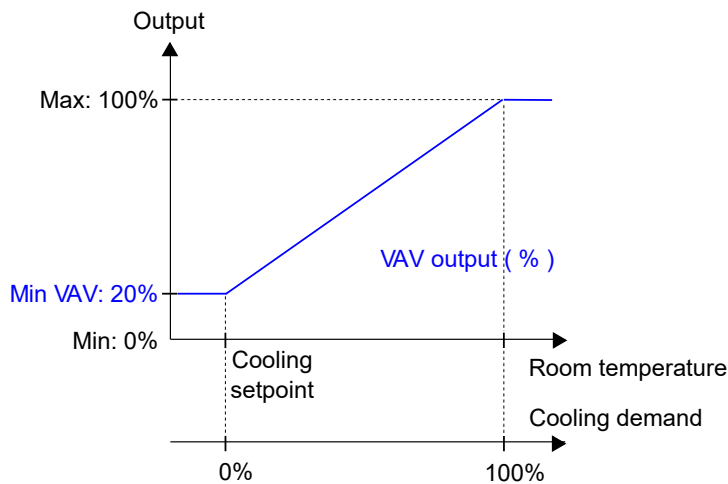


Figure 3-12 Control behaviour for the VAV controller mode when the controller regulates based on cooling demand.

VAV control source

The VAV output can be controlled by cooling demand (or heating demand, see below), CO₂ level, and/or humidity. If more than one function is selected, the highest output value will be used. If no function is selected, the output will be set to the minimum value for the current controller state.

The following settings can be made:

- ✓ Cooling demand (On/Off)
- ✓ CO₂ (On/Off)
- ✓ Humidity (Off/humidify/dehumidify)

The variable air volume (VAV) control function is used to manage the behaviour for a damper that is controlled by the analogue VAV output signal.

The VAV control function enables the controller to regulate based on:

- ✓ Both cooling and fresh air demand simultaneously
 - The highest demand determines if the VAV output signal currently is controlled based on the cooling setpoint and the room temperature, or the CO₂ setpoint and the CO₂ level in the room.

For information about CO₂ control, see section *CO₂ control*.

The maximum damper airflow can be controlled by setting a maximum limit on the VAV output signal. The minimum airflow that applies for each controller state can also be controlled by setting minimum limits on the VAV output signal.

The damper can also be controlled based on heating demand. This is useful when the heating device that provides the room with heat is located in the supply air duct and behind the damper that regulates the airflow into the room. When this function is active and the heating demand increases, the damper opens correspondingly and the distribution of heat into the room is boosted. This function is active when the *Max limit when heating* configuration setting is greater than zero.

Normally for cooling

The VAV control function is enabled, and the VAV control configuration settings in the Regio:GO app or the Application tool are shown when the VAV sequence is selected:

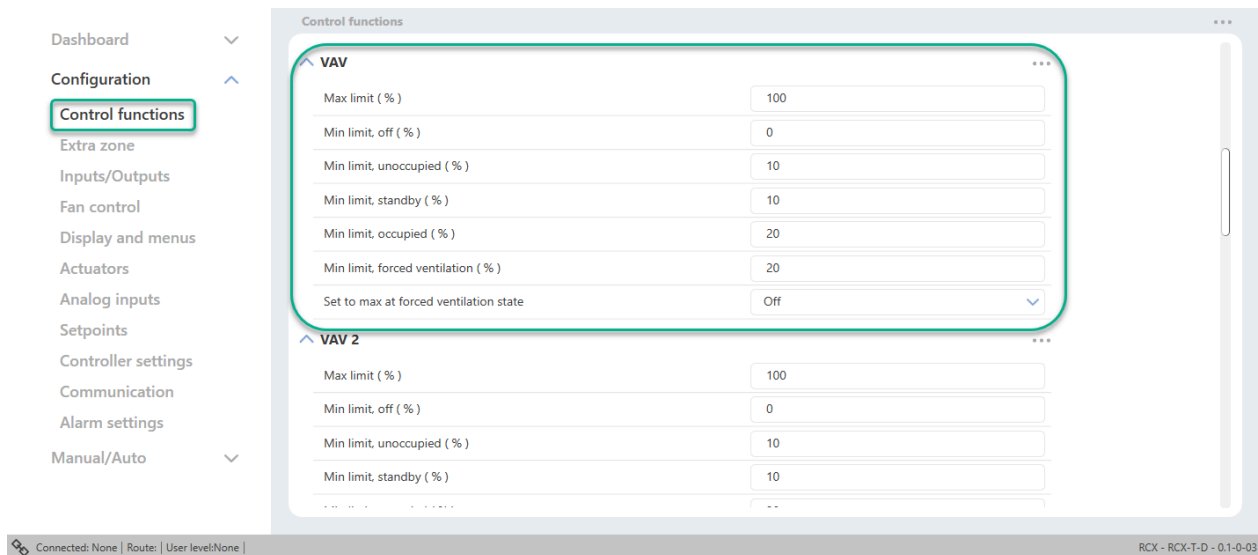


Figure 3-13 VAV control configuration settings in Application tool.

The VAV control configuration settings are described in Table 3-7.

Table 3-7 VAV control configuration settings.

Configuration setting	Description
Max. limit (%)	Specifies the maximum limit for the VAV output signal for all controller states.
Min. limit, off (%)	Specifies the minimum limit for the VAV output signal when the controller is in the <i>Controller off</i> state.
Min. limit, unoccupied (%)	Specifies the minimum limit for the VAV output signal when the controller is in the <i>Unoccupied controller</i> state.
Min. limit, standby (%)	Specifies the minimum limit for the VAV output signal when the controller is in the <i>Standby controller</i> state.
Min. limit occupied (%)	Specifies the minimum limit for the VAV output signal when the controller is in the <i>Occupied controller</i> state.
Min. limit, forced ventilation (%)	Specifies the minimum limit for the VAV output signal when the controller is in the <i>Forced ventilation</i> state.
Set to max. at forced ventilation state	When the controller is in <i>Forced ventilation</i> state the output will be set to the maximum limit value.

Figure 3-14 illustrates the control behaviour for the Heating + VAV controller mode when VAV control is performed based on cooling demand, a maximum limit is set, and minimum limits for the *Occupied* and *Unoccupied* controller states are set.

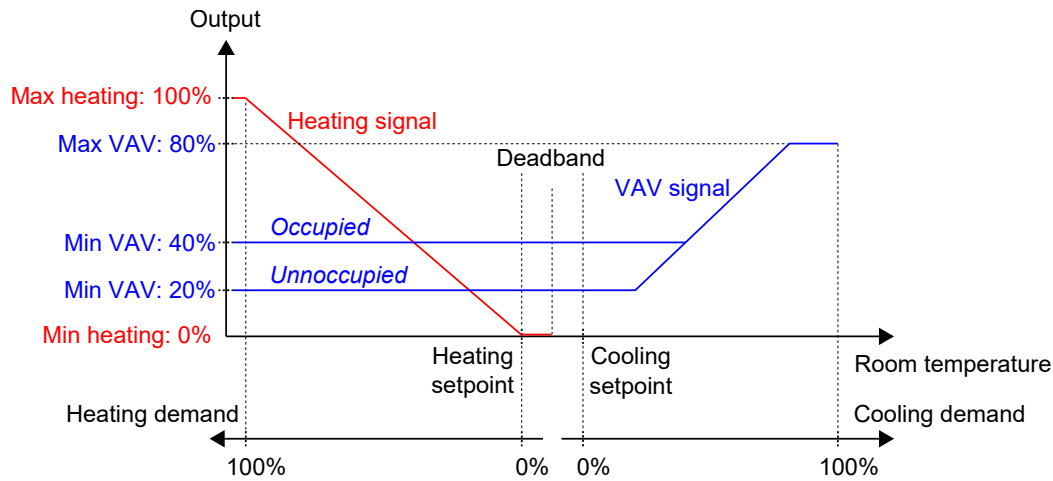


Figure 3-14 VAV control behaviour based on cooling demand when a maximum limit is set, and minimum limits for the occupied and unoccupied controller states are set.

Figure 3-15 illustrates the control behaviour for the Heating + VAV controller mode when the *limit for VAV output at heating demand* setting is applied. For example, when a 50% maximum is set, the VAV signal follows the heating signal as the heating demand increases but never exceeds 50% of its practical maximum (100%).

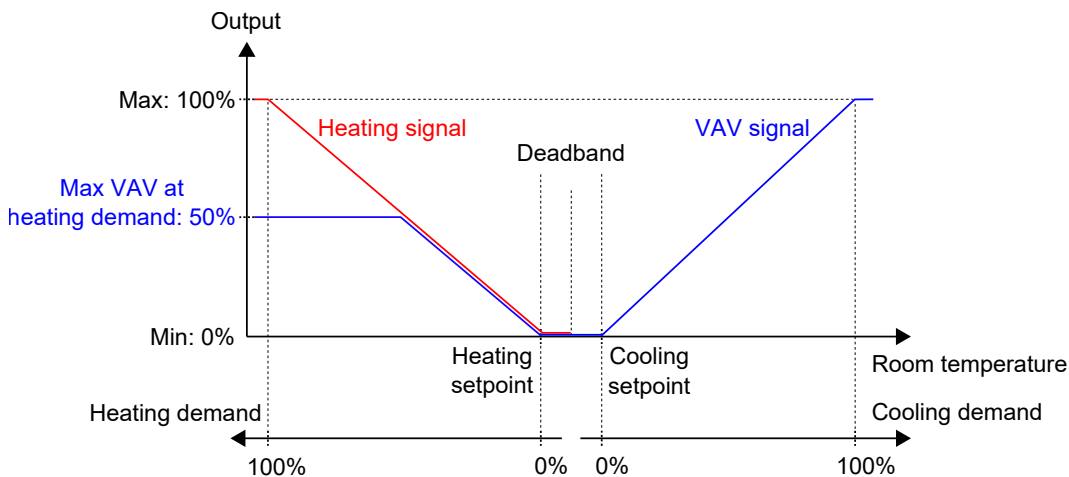


Figure 3-15 Control behaviour for the Heating + VAV controller mode when the maximum VAV output on heating demand setting is applied.

Change-over

Change-over is a control function that enables the controller to provide both a heating or a cooling signal on the same controller output. This is achieved by shifting the controller change-over state from heating to cooling, and vice versa. The change-over function makes it possible to use the controller 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 following settings can be made:

- ✓ **Max limit (%)**
- ✓ **Min limit (%)**
- ✓ **Mode** (Always heating/Always cooling/Digital input/Media temperature, simple/Media temperature, advanced)
- ✓ **Change-over temperature (°C)**
- ✓ **Heating hysteresis (°C)**
- ✓ **Cooling hysteresis (°C)**
- ✓ **Valve delay time (s)**

Heating/Cooling via Change Over is used when a heating/cooling system uses the same water pipes for heating and cooling. Heat or cool water is produced centrally and distributed in the pipes to the battery. To detect whether there is warm or cool water in the pipes, the controller measures the temperature of the pipes or a digital input is used to select heating or cooling.

Mode Change:

The change between heating and cooling mode can be controlled in different ways:

- ✓ Manual control via communication
- ✓ Digital input
- ✓ Measuring the temperature of the heating/cooling medium and compare it to either a fixed value or the room temperature.

When the valve is closed, the measurement of the media temperature may not be reliable. Therefore, when the output value is less than 20%, the valve is opened fully at regular intervals and kept open for a defined time before the temperature is measured.

For more information, see section *Change-over*.

6-way valve

The 6-way valve is a valve that makes it possible to use a 2-pipe beam in a 4-pipe system. The valve is closed at centre position (5 V), runs heat water from 5 - 0 V and cool water from 5 - 10 V. The *6-way valve* sequence can be combined with additional heating or cooling sequences.

The following settings can be made:

- ✓ **Seq 1 fully open (V)**
- ✓ **Seq 1 start opening (V)**
- ✓ **Seq 2 fully open (V)**
- ✓ **Seq 2 start opening (V)**
- ✓ **Center point (V)**
- ✓ **Center point hysteresis (%)**
- ✓ **Sequence order** (Heating 1st sequence/Heating 2nd sequence)

The 6-way valve is a valve that makes it possible to use a 2-pipe beam in a 4-pipe system. The valve is closed at centre position (5 V), runs heat water from 5 - 0 V, and cool water from 5 - 10 V. A hysteresis is present in the centre.

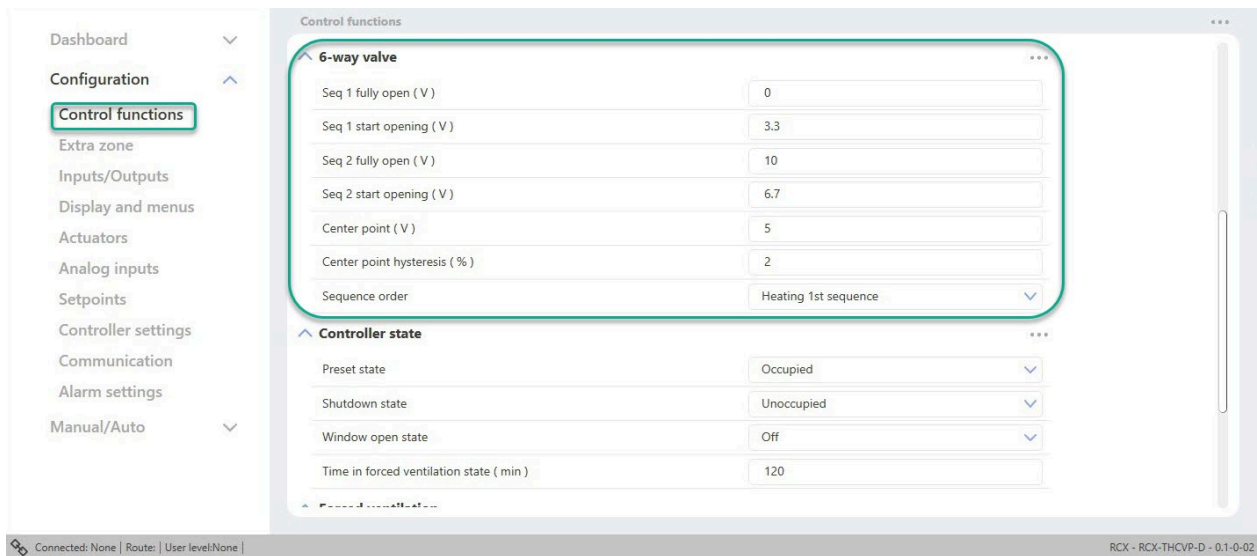


Figure 3-16 6-way valve configuration settings in Application tool.

At *Heat* sequence the PI-controller output is scaled between the heat water start open and heat water fully open values. Hence, at default settings, the 0 - 100% PI-controller output is scaled from 3.3 V (0% + hysteresis) to 0 V (100%). At *Cool* state the PI-controller output is scaled between the cool water start open and cool water fully open values. Hence, at default settings, the 0 - 100% PI-controller output is scaled from 6.7 V (0% + hysteresis) to 10 V (100%).

Around the centre point there will be a small hysteresis, default ± 0.5 V, but configurable (0 - 2 V). This is to avoid the valve to flicker at small controller outputs. When the PI-control output has passed the hysteresis, the value will immediately go up to the start level and start controlling from PI-controller output + hysteresis. The output is set back to the centre point value when the PI-controller reaches 0% output. This functionality can be set by using the value listed in

The sequence of the output could be reversed by configuration so that the *Heat* sequence corresponds to high output levels and vice versa.

The 6-way valve menu group provides a specific setting, listed in *Table 3-8 6-way valve configuration setting*, that is only applicable for the controller modes that include a 6-way valve sequence. This setting is located in the *Configuration* ► *Control functions* ► *6-way valve* menu group in the Regi:GO app or the Application tool, and is shown when an applicable room control sequence is selected.

Table 3-8 6-way valve configuration setting

Configuration setting	Description
Seq 1 fully open (V)	Voltage for fully open at sequence 1
Seq 1 start opening (V)	Voltage to start open at sequence 1
Seq 2 fully open (V)	Voltage for fully open at sequence 2
Seq 2 start opening (V)	Voltage to start open at sequence 2
Center point (V)	Voltage for centre point, both sequences closed
Center point hysteresis (%)	Minimum output to activate the valve
Sequence order	0: Cool 1st Sequence 1: Heat 1st Sequence

Cascade Control

A supply air sensor can be configured on any analogue input, AI. It limits the supply air between a set Min/Max limitation. The supply air limitation works as a cascade controller with the Primary/Outer loop controlling the room temperature and the Secondary/Inner loop controlling the supply air temperature. The limits of the supply air that is possible to configure for the supply air temperature controller will act as limits for the setpoint of the supply air temperature controller.

The following settings can be made:

- ✓ **Control active** (Disabled/Heating/Cooling/Both Heating and Cooling)
- ✓ **Cascade factor**
- ✓ **Max heating temperature (°C)**
- ✓ **Min heating temperature (°C)**
- ✓ **Max cooling temperature (°C)**
- ✓ **Min cooling temperature (°C)**
- ✓ **Frost protection temperature (°C)**

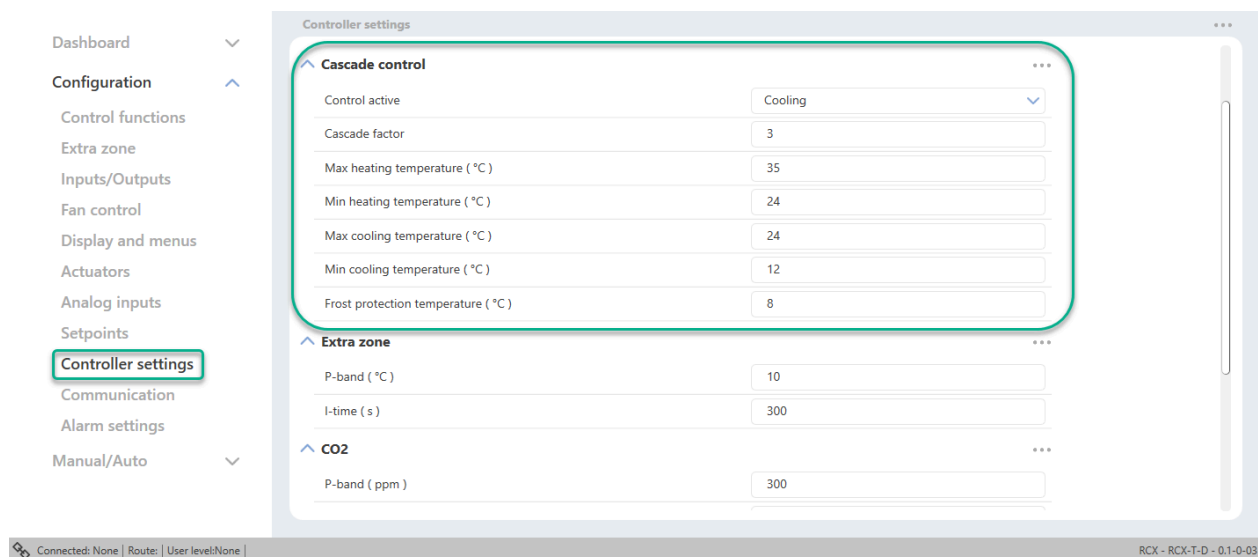


Figure 3-17 Cascade control configuration settings in Application tool.

Control active - Heating

At heating mode, the room controller works as a standard heat controller trying to keep the heat setpoint of the room. It feeds its control signal to the supply air temperature controller with the formula:

$$\text{Setpoint}_{\text{sup.air}} = \text{HeatMin}_{\text{sup.air}} + (\text{HeatMax}_{\text{sup.air}} - \text{HeatMin}_{\text{sup.air}}) \times \text{Output}_{\text{roomctrl}}$$

The supply air temperature controller works as a heat controller trying to keep the setpoint that is provided by the room controller.

Control active - Cooling

At cool mode the room controller works as a standard cool controller trying to keep the cool setpoint of the room. It feeds the reverse of its control signal to the supply air temperature controller with the formula:

$$\text{Setpoint}_{\text{sup.air}} = \text{CoolMax}_{\text{sup.air}} - (\text{CoolMax}_{\text{sup.air}} - \text{CoolMin}_{\text{sup.air}}) \times \text{Output}_{\text{roomctrl}}$$

The supply air temperature controller works as a cool controller trying to keep the setpoint that is provided by the room controller.

Cascade factor

For the system to perform properly, the secondary/inner controller has to be faster than the primary/outer controller, meaning the supply air temperature controller has to respond to changes much faster than the room controller. For this reason, and for ease of tuning, a cascade factor is implemented. This cascade factor defines how much faster the secondary/inner controller is compared to the primary/outer controller. If the factor is set to two, the secondary controller is twice as fast as the primary. The factor affects both the P-band and the I-time of the secondary controller. This means that P-band and I-time are only configurable for the primary controller and the P-band and I-time for the secondary are calculated with regard to the cascade factor.

Example: P-band = 10 °C and I-time = 300 seconds for the primary controller. A cascade factor of 3 => P-band = 3 °C and I-time = 100 seconds for the secondary controller.

The default value for the cascade factor is 3.

Frost protection temperature

In addition to the frost protection of the room, there is also a frost protection of the supply air. In contrary to the frost protection of the room, this is always active as long as the controller is in cooling mode. It works in a way that when the controller enters cooling mode, the heat setpoint for the secondary controller is set to 8 °C (the configured value). When the supply air falls below the minimum limit and continues to fall, the secondary controller switches to frost protection mode and becomes a heat controller. The switch is made in the same way as when the room controller switches between heat and cool mode, i.e. the switch is made roughly in the middle between the minimum limit and the frost protection temperatures, when all valves are closed. When switched to the frost protection mode the secondary controller tries to keep the frost protection setpoint with the heat output.

As the frost protection setpoint has to be lower than the minimum limit of the supply air controller for the switch to frost protection mode to work, a check is made when configuring the frost protection setpoint and minimum limit for the supply air temperature. If the minimum supply air temperature is set below the current frost protection setpoint, the active frost protection setpoint is set to 1 °C lower than the supply air limit.

This function is active in all controller states (Forced ventilation, Occupied, ...).

In frost protection, the fan runs at the speed configured for lowest allowed speed (EC-fan). If the room calls for higher fan speed, this has precedence.

Valid control modes

The Supply air limitation function is valid in all control modes. If used with VAV control, the minimum limit of the cascade controller has precedence over the normal minimum limits for VAV control. The cascade control is not very well suited for VAV control, and the recommendation is that cascade control is used only for heating in those cases.

Fan control

The fan is running with regards to the output of the primary controller, except when the controller has entered frost protection mode. The fan runs dependent on the highest output of the room temperature controller and the supply air temperature controller.

Heat/cool select

The function can be set to run the fan in heat mode, cool mode and both heat and cool mode.

Extra zone

A secondary control loop that works independently of the main sequence, but with only one sequence step.

This function allows for more precise control and customization to meet particular comfort or operational requirements. The integration of an *Extra zone* function provides flexibility, adaptability, and efficiency in managing the environment to meet the diverse needs and preferences of occupants in different parts of a room(s). A typical application is heating of a bathroom in a hotel room.

The *Extra zone* function is intended to control the under-floor heating in an extra zone, such as a bathroom, in parallel to the controlling main room. This means that the extra zone control runs with the same presence triggers as the main room (presence sensor, key card switch, remote state, etc.), meaning it always listens to the main room's control state and acts accordingly.

The *Extra zone* control is activated when the main zone controller state is the same or higher than the selection in *Table 3-11*.

The *Extra zone* function acts as a heating or cooling controller and regulates based on its own heating or cooling setpoint and the *Extra zone* temperature sensor.

The Digital output *Extra zone* active signal is corresponding to the *Activate Extra zone* setting and does not require any *Extra zone temperature sensor* to work. It only indicates if the main room is in a selected control mode or higher.

The Regio RCX Extra zone function can be set to one of the following functions:

- ✓ Disabled
- ✓ Heating
- ✓ Cooling

In **Configuration ▶ Controller settings** you can set the following:

- ✓ P-band (°C)
- ✓ I-time (s)

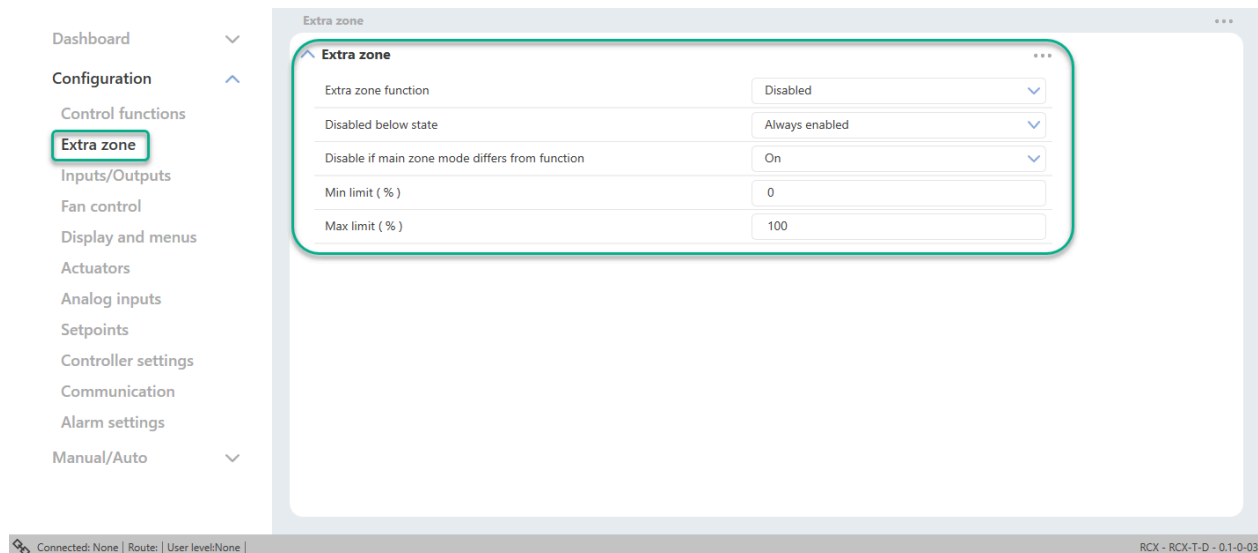


Figure 3-18 Extra zone configuration settings in Application tool.

The *Extra zone* configuration settings are described in *Table 3-11* and in section 3.5.2 *Menu - Configuration tab*.

Table 3-9

Input signal	Controller input type
Extra zone temperature	Analogue

Table 3-10

Output signal	Controller output type
Heating valve Extra zone, thermal (PWM, Pulse Width Modulation)	Analogue
Heating valve Extra zone 0...10 V	Analogue
Extra zone active signal	Digital

Table 3-11 Extra zone configuration settings.

Configuration setting	Description
Extra zone function	One of the following controller states can be configured: ✓ Disabled (default setting) ✓ Heating ✓ Cooling
Disabled below state	One of the following controller states is configured as active when presence is detected: ✓ Always enabled (default setting) ✓ Unoccupied ✓ Standby ✓ Occupied ✓ Forced ventilation
Disable if main zone mode differs from function	If the main zone sequence differs in function, the Extra zone can be set separately to: ✓ On ✓ Off
Min limit (%)	The Extra zone output minimum limit (in percentage).
Max limit (%)	The Extra zone output maximum limit (in percentage).

Minimum unit state

The *Extra zone* function will turn off if the unit state is lower than this setting.

Disable if main zone mode differs from function

If the *Disable if main zone mode differs from function* is enabled and set to on, the *Extra zone* will turn off if the function is set to heating and the main controller is set to cooling, or vice versa.

CO₂ control

An extra control loop that is controlled by the room CO₂ level. It can work independently of the main sequence or in combination with the VAV function. In that case the highest output level takes precedence.

The measurement of CO₂ is typically expressed in parts per million (ppm) or as a percentage (%). Elevated levels of CO₂ can indicate inadequate ventilation, which may lead to discomfort, drowsiness, impaired cognitive function, and can even impact overall productivity and well-being.

Common indoor air CO₂ levels are :

- ✓ Typical indoor air: 400-1,000 ppm
- ✓ Elevated indoor air: >1,000 ppm

Levels significantly higher can be a cause for concern, especially for occupant health and well-being.

External CO₂ sensors

Any type of external CO₂ sensor can be connected to Regio RCX controllers, as long as they have a 0...10 V output.

CO₂ control is a function that enables the controller to regulate based on fresh air demand. CO₂ control is performed by connecting a CO₂ sensor, and by letting the controller control the VAV output signal based on the CO₂ setpoint and the current CO₂ level in the room.

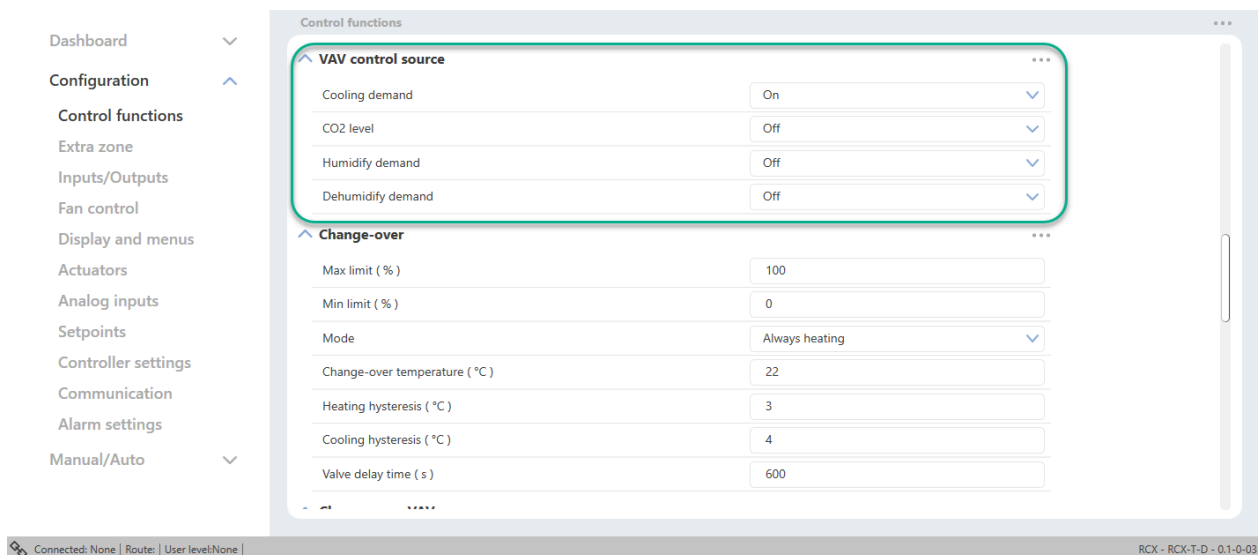


Figure 3-19 CO₂ configuration settings in Application tool.

CO₂ control is managed via the VAV control function, by applying the VAV control configuration setting, see section VAV control source.

The CO₂ sensor is connected to and configured on an analogue controller input by using the value listed in Table 3-12. Regin's RCX-TCD, RCX-THCVPD, and RCX-THCVP controllers have a built-in CO₂ sensor. When either of these units is used, the controller recognizes the built-in CO₂ sensor automatically, and no configuration is needed.

Table 3-12 CO₂ control configuration value and controller input type.

Configuration value	Controller input type
CO ₂ sensor	Analogue

CO₂ control provides a specific setting, listed in Table 3-13, that is only applicable for the controller modes that include a VAV sequence. This setting is located in the Configuration ► Control functions ► VAV control

source menu group in the Regin:GO app or the Application tool, and is shown when an applicable room control sequence is selected.

Table 3-13 CO₂ control configuration setting

Configuration setting	Description
CO ₂ level	The VAV output signal is controlled by the CO ₂ level.

Figure 3-20 illustrates the control behaviour for CO₂ control when a minimum limit is set for the VAV output signal.

The demand for fresh air increases as the CO₂ level in the room rises. When the CO₂ level rises above the CO₂ setpoint, the VAV signal increases to respond to the fresh air demand. At a fresh air demand of 100%, the VAV signal reaches its maximum.

When the CO₂ level in the room is lower than the CO₂ setpoint and no fresh air demand exists, the VAV signal is at its minimum.

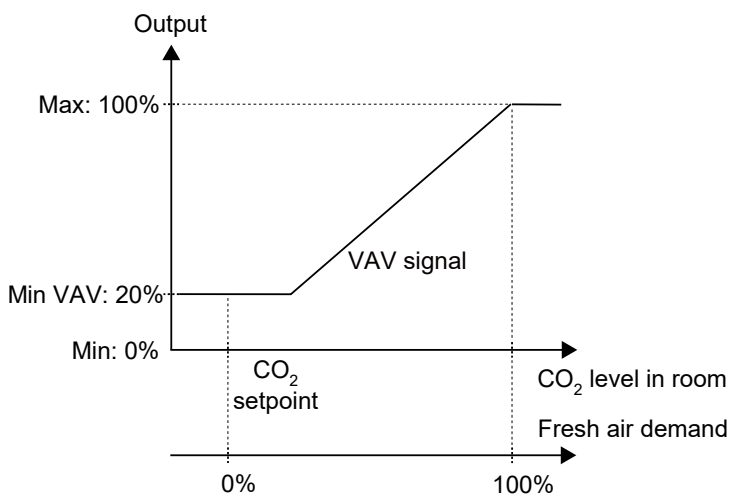


Figure 3-20 CO₂ control behaviour.

Humidity control

An extra control loop that is controlled by a humidity input. It can work independently of the main sequence or in combination with the *VAV* function. In that case, the highest output level takes precedence.

The humidity control helps to maintain an optimal indoor environment. The controller uses the information from the humidity sensor to regulate the HVAC system, ensuring that the relative humidity is within a desired range for comfort and health.

For example, during colder seasons, heating systems can dry out the indoor air, leading to low humidity levels. The humidity sensor detects this and signals the HVAC system to add moisture to the air if needed, maintaining a comfortable humidity level.

Integration with a room controller allows for automated and precise control over the humidity level in a room, contributing to occupant comfort, preventing issues like mold growth, and optimising energy usage by the HVAC system.

External Humidity sensors

Any type of external Humidity sensor can be connected to Regio RCX controllers, as long as they have a 0...10 V output.

VOC Control (Volatile Organic Compounds)

An extra control loop that is controlled by the room VOC level. It can work independently of the main sequence or in combination with the *VAV* function. In that case, the highest output level takes precedence.

VOCs (Volatile Organic Compounds) are measured using specialized devices known as VOC monitors or VOC detectors. VOC detectors are designed to quantify the concentration of VOCs in the air, for RCX controllers expressed in an index number, Air Quality Index (AQI).

The AQI range is:

- ✓ **0-50 (Good)**: Air quality is considered satisfactory, and air pollution poses little or no risk.
- ✓ **51-100 (Moderate)**: Air quality is acceptable; however, there may be concerns for certain sensitive individuals who are unusually sensitive to air pollution.
- ✓ **101-150 (Unhealthy for Sensitive Groups)**: Members of sensitive groups (e.g., children, elderly, individuals with respiratory or heart conditions) may experience health effects. The general public is not likely to be affected.
- ✓ **151-200 (Unhealthy)**: Everyone may begin to experience health effects; members of sensitive groups may experience more serious health effects.
- ✓ **201-300 (Very Unhealthy)**: Health alert - everyone may experience more serious health effects.
- ✓ **301-500 (Hazardous)**: Health warnings of emergency conditions; the entire population is more likely to be affected.

When the AQI indicates poor air quality, individuals may be advised to limit outdoor activities, especially for sensitive groups, or take other precautionary measures to reduce exposure to pollutants.

VOC monitoring is crucial in various settings, including indoor environments (homes, offices, schools) to assess indoor air quality, industrial facilities to monitor emissions and comply with regulations, and environmental monitoring to understand outdoor air quality and potential health impacts on communities. Regular monitoring and control of VOC levels help ensure a safe and healthy environment for both humans and ecosystems.

The VOC sensor used in Regio RCX controllers is a MOx based gas sensor for indoor air quality measurement.

External VOC sensors

Any type of external VOC sensor can be connected to Regio RCX controllers, as long as they have a 0...10 V output.

3.4.4 Control function descriptions

This section contains descriptions of and configuration information for the controller's basic control functions.

Sequence outputs

If more than one heating or cooling sequence are selected, the controller output will be split between the sequence steps. When the first step has reached its maximum value, the second step will start increasing according to the tables and graphs in the sections *One Heat/Cool sequence*, *Two Heat/Cool sequences*, and *Three Heat/Cool sequences*.

One Heat/Cool sequence

Table 3-14 One Heat/Cool sequence

Heat/Cool demand	Output 1
0%	0%
100%	100%

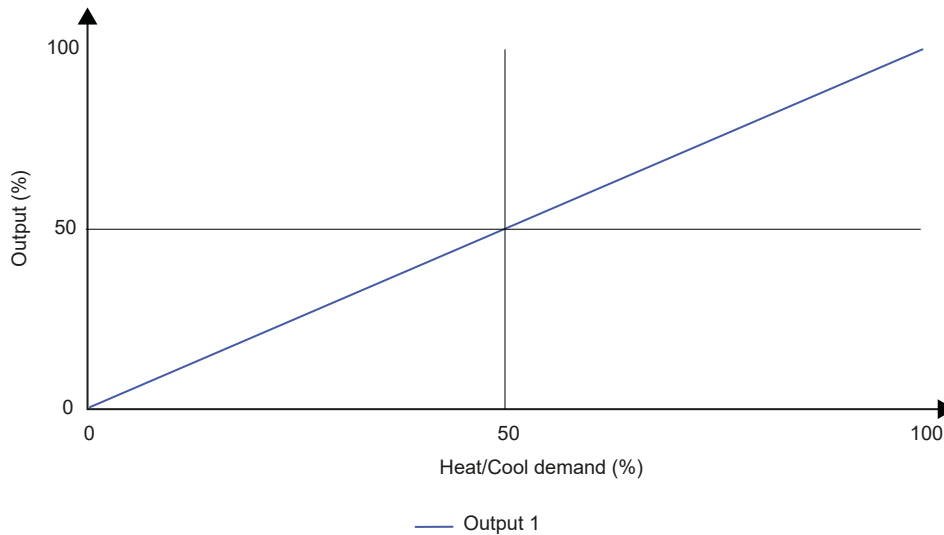


Figure 3-21 One Heat/Cool sequence behaviour

Two Heat/Cool sequences

Table 3-15 Two Heat/Cool sequences

Heat/Cool demand	Output 1	Output 2
0%	0%	0%
49%	100%	0%
51%	100%	0%
100%	100%	100%

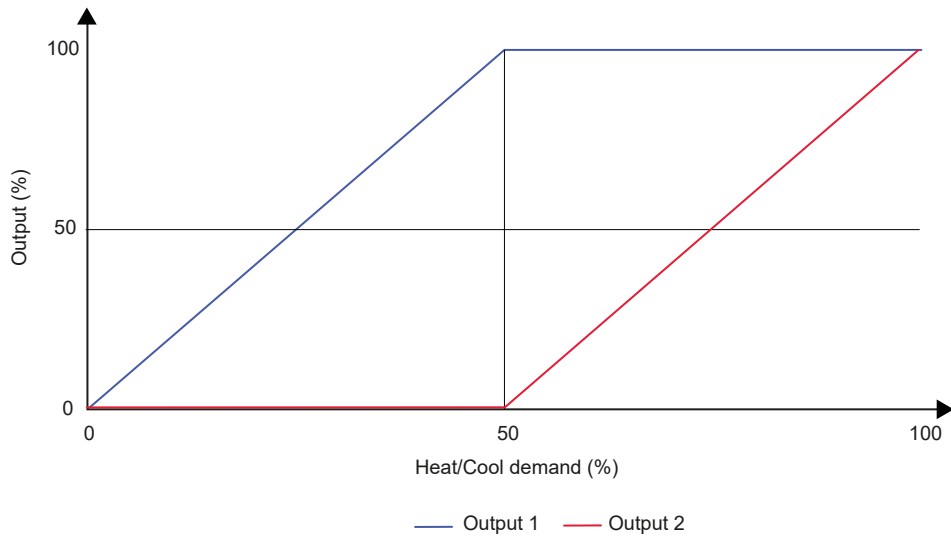


Figure 3-22 Two Heat/Cool sequences behaviour

Three Heat/Cool sequences

Table 3-16 Three Heat/Cool sequences

Heat/Cool demand	Output 1	Output 2	Output 3
0%	0%	0%	0%
32%	100%	0%	0%
34%	100%	0%	0%
66%	100%	100%	0%
68%	100%	100%	0%
100%	100%	100%	100%

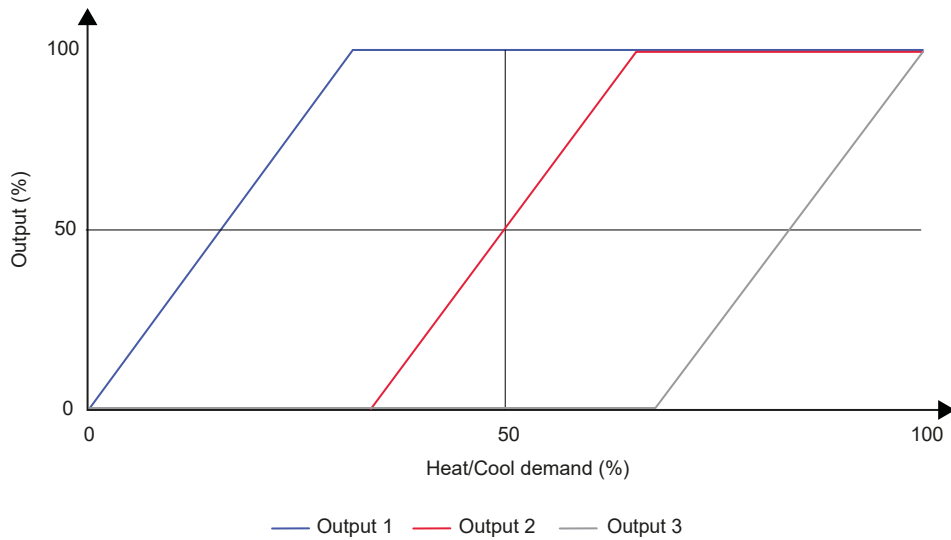


Figure 3-23 Three Heat/Cool sequences behaviour

Change-over

Change-over is a control function that enables the controller to provide both a heating or a cooling signal on the same controller output. This is achieved by shifting the controller change-over state from *heating* to *cooling*, and vice versa. The change-over function makes it possible to use the controller 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 controller change-over state is either *heating* or *cooling*, and is managed automatically via change-over detection, see section *Change-over detection*. The controller change-over state can also be set manually via the *Manual/Auto* settings, or via communication. See section 3.4.8 *Manual/Auto*.

The change-over function is enabled and the configuration settings for change-over detection are shown in Application tool when the *Change-over* sequence is selected.

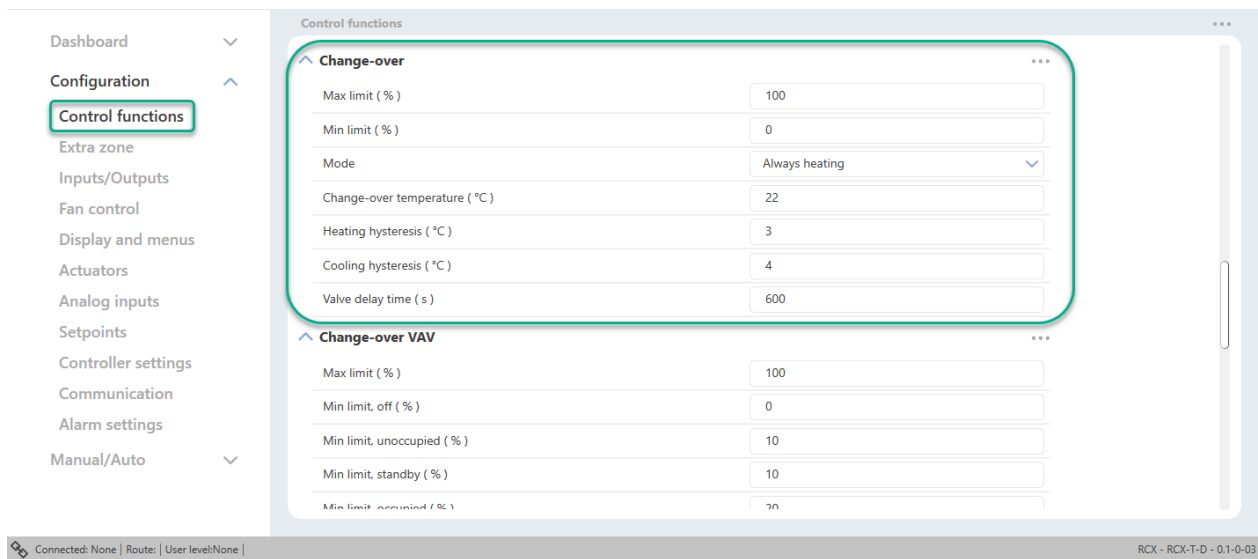


Figure 3-24 Change-over detection configuration settings in Application tool.

Change-over detection

Change-over detection is performed either by using a PT1000 sensor that is connected to an analogue 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 medium temperature.

When using a PT1000 sensor for change-over detection, the shift in controller change-over state is triggered based on the difference between the pipe medium temperature and the room temperature. The controller shifts the change-over state to *heating* when the pipe medium temperature is 3°C (default setting) higher than the room temperature. The controller shifts the change-over state to *cooling* when the pipe medium temperature is 4°C (default setting) lower than the room temperature.

When using a potential-free contact for change-over detection, the controller shifts the controller change-over state to *cooling* when the contact is closed. The controller shifts the controller change-over state to *heating* when the contact is open. This assumes that the digital input is set to **Normally opened**, see the *Configuration -> Inputs / Outputs* page/pane in Application tool or in Regin:GO.

Change-over detection is configured on the controller inputs by using the values listed in *Table 3-17*.

Table 3-17 Change-over detection configuration values and controller input types.

Controller input configuration value	Controller input type
Change-over temperature	Analogue
Change-over	Digital

The configuration settings for change-over detection are described in *Table 3-18*.

Table 3-18 Change-over detection configuration settings.

Configuration setting	Description
Mode	<p>Always heating: Change-over state is always heating.</p> <p>Always cooling: Change-over state is always cooling.</p> <p>Digital input: Change-over state is controlled by a digital input.</p> <p>Media temperature, simple: The media temperature is compared to the Change-over temperature setting.</p> <p>Media temperature, advanced: The media temperature is compared to the room temperature.</p> <p>The change-over state is set to cooling when the media temperature goes below the reference temperature (setting or room) minus the Cooling hysteresis value.</p> <p>The state is set to heating when the media temperature goes above the reference temperature plus the Heating hysteresis value.</p> <p>The valve must be more than 20% open for the time specified in Valve delay time before the media temperature is measured.</p>
Change-over temperature	The change-over media temperature. Only applicable in Media temperature, simple mode.
Heating hysteresis	The hysteresis value that is added to the reference temperature when switching to heating state.
Cooling hysteresis	The hysteresis value that is subtracted from the reference temperature when switching to cooling state.
Valve delay time	The time (in seconds) that the valve is open before the media temperature is measured and compared to the reference temperature. If set to 0, the function is disabled and the valve state is ignored.

Forced ventilation

Forced ventilation is a control function that is used to improve the air quality in a room through increased airflow. This is achieved by fully opening the damper that regulates the airflow into the room, which provides an additional amount of fresh air and decreases the CO₂ level. The forced ventilation function can also be used to boost the heating or cooling distribution when the heating, cooling, or VAV output signal has reached its maximum.

The forced ventilation function can be used in all controller modes, and is enabled by setting the *Forced ventilation* configuration setting to anything other than **Disabled**.

The forced ventilation function is activated when the controller changes to *Forced ventilation* state and the conditions specified by the *Forced ventilation* setting. For information about *Forced ventilation* state, see section 3.4.2 *Controller state*.

When the forced ventilation function is active, a digital controller output that is configured with the **Forced ventilation** value is active, and the analogue VAV output signal is set to its maximum for the controller modes that include a VAV sequence. Optionally, for the Heating + Cooling + VAV controller mode, the cooling output signal can be configured to also be set to its maximum when the forced ventilation is active.

The forced ventilation configuration settings in Application tool are shown in *Figure 3-25*.

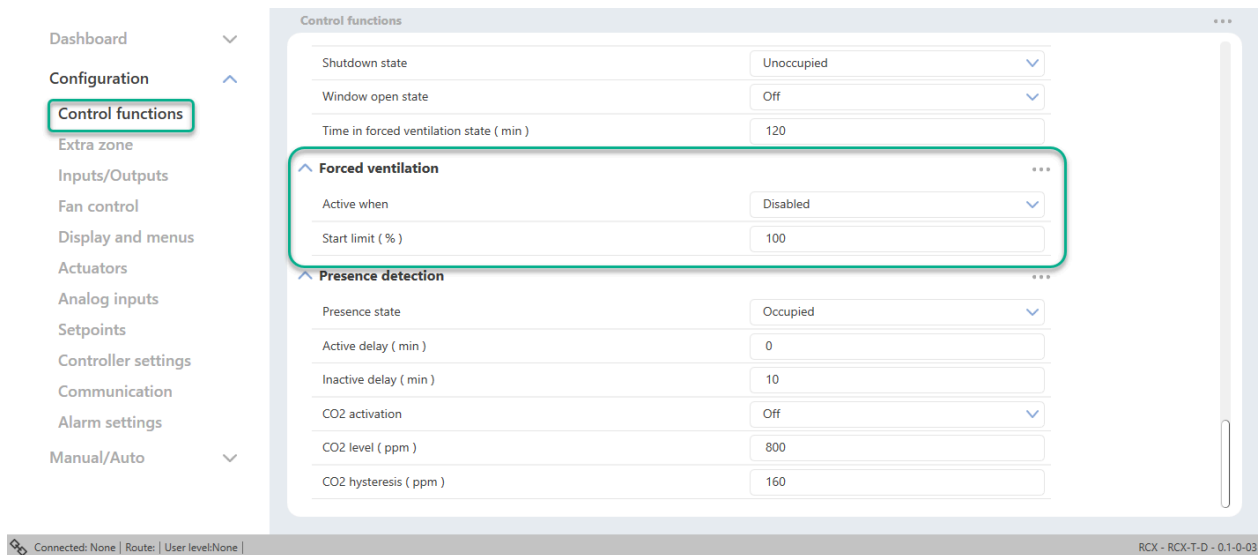


Figure 3-25 Forced ventilation configuration settings in Application tool.

The forced ventilation configuration settings are described in Table 3-19.

Table 3-19 Forced ventilation configuration settings.

Configuration setting	Description
Active when	This setting is used to select if forced ventilation should be activated when the controller is in heating or cooling mode, or in both modes. This is useful for providing an additional amount of fresh air into the room and for decreasing the CO ₂ level. Disabled: Forced ventilation is not activated (default setting). Cooling or heating demand over limit: Forced ventilation is activated when the heating or cooling output signal is above the start limit. Cooling demand over limit: Forced ventilation is activated when the cooling output signal is above the start limit.
Start limit (%)	0-100

Figure 3-26 illustrates digital output signal behaviour for the Heating + VAV controller mode when no maximum or minimum limits are set for the output signals, the controller is in *Forced ventilation* state, and the following configuration setting are applied:

- ✓ Forced ventilation *Active when*: **Cooling or heating demand above limit**

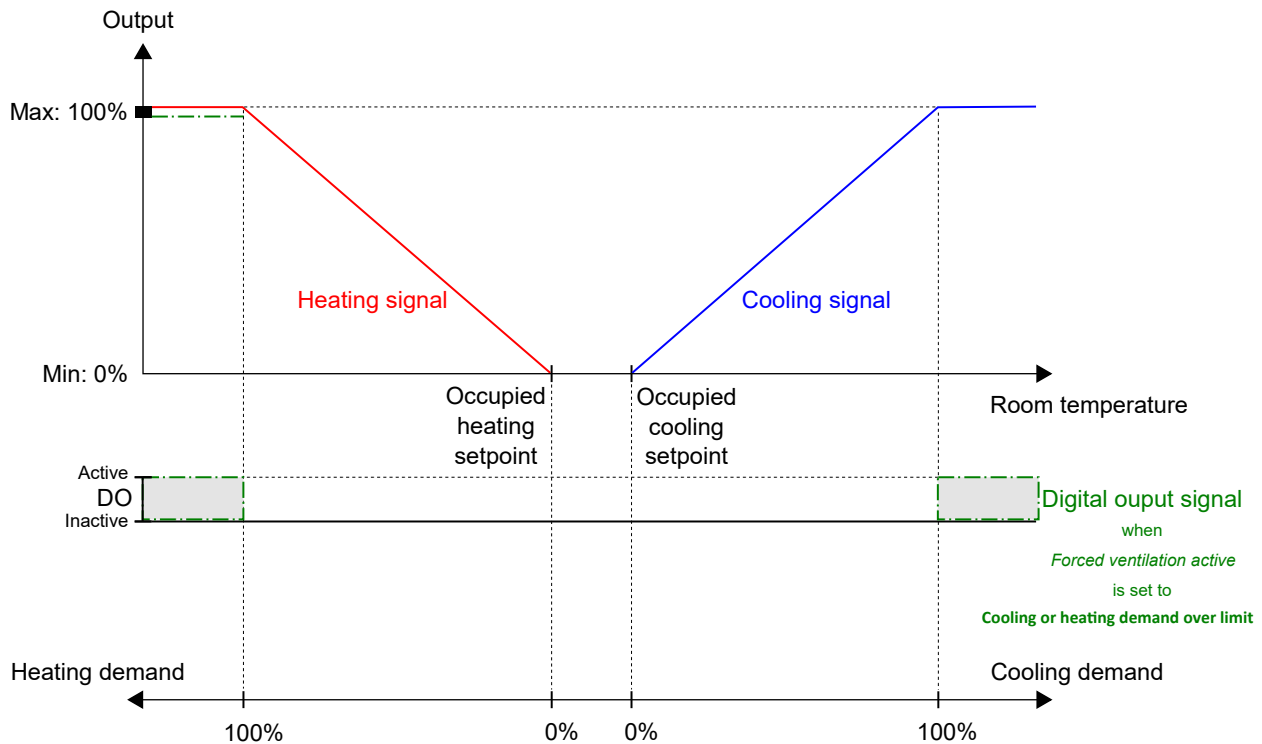


Figure 3-26 Example of forced ventilation control behaviour for the Heating + VAV controller mode when the controller is in the Forced ventilation state.

≤

Presence detection

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, or if the CO₂ level in the room is too high. Regin's RCX-THCVP-D and RCX-THCVP controllers have a built-in motion detector. See section 3.4.2 *Controller state* for information about controller states, and controller state changes when using presence detection.

Presence detection is performed by using a presence detector, for example, a motion detector, that is connected to and configured on a digital input. Presence can also be detected by using a CO₂ sensor that measures the CO₂ level in the room, and is connected to and configured on an analogue controller input. Regin's RCX-TC-D, RCX-THCVP-D, RCX-TC, and RCX-THCVP controllers have a built-in CO₂ sensor. When either of these units are used, the controller recognizes the built-in CO₂ sensor automatically, and no configuration is needed.

The controller checks for presence continuously when the controller is in the state specified by the *Presence state* setting. See Figure 3-27.

The presence detection function is enabled and the presence detection configuration settings are shown in the Regin:GO app or the Application tool when any of the configuration values listed in Table 3-20 are configured on a controller input.

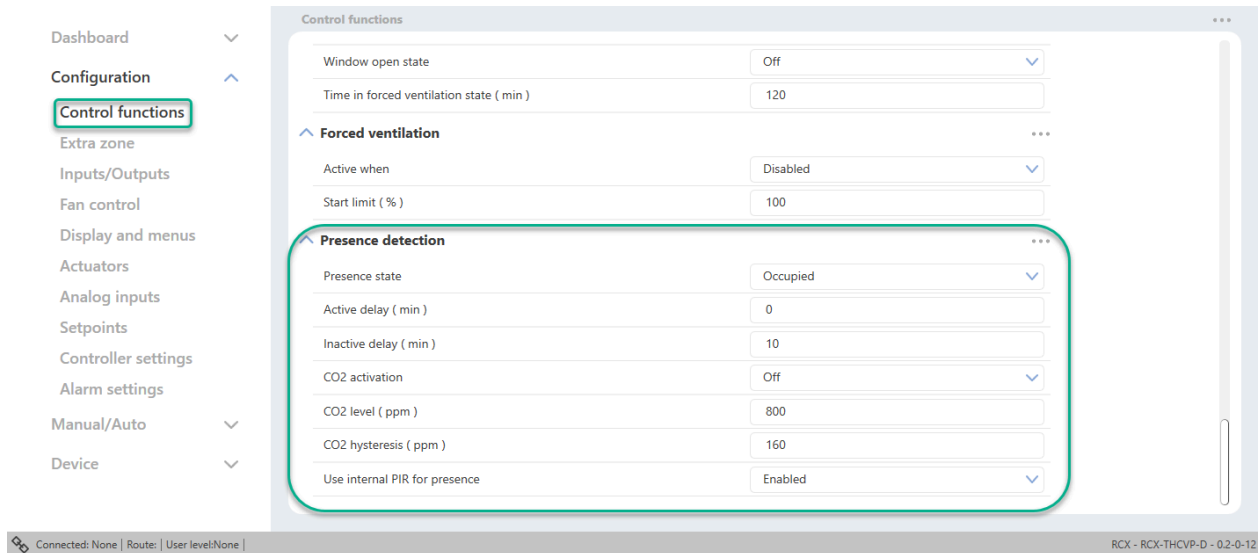


Figure 3-27 Presence detection configuration settings in Application tool.

Table 3-20 Presence detection configuration values and controller input types.

Controller input configuration value	Controller input type
CO ₂ sensor	Analogue
Presence state	Digital

The presence detection configuration settings are described in Table 3-21.

Table 3-21 Presence detection configuration settings.

Configuration setting	Description
Presence state	One of the following controller states is configured as active when presence is detected: ✓ Occupied (default setting) ✓ Forced ventilation
Active delay (min)	The controller checks for presence continuously when the controller is in the state specified by the <i>Preset controller state</i> setting. When presence is detected, a timer starts and the controller waits this delay time (in minutes) before changing to the state specified by the <i>Controller state when presence detected</i> setting. If presence is not detected continuously during this delay time, for example, if a person leaves the room before the delay time has passed, the controller does not change to the presence detected controller state, and the timer is stopped and reset.
Inactive delay (min)	The controller checks for presence continuously when the controller is in the presence detected controller state. When no presence is detected anymore, a timer starts and the controller waits this delay time (in minutes) before changing to the state specified by the <i>Preset controller state</i> setting. If presence is detected again during this delay time, for example, if a person re-enters the room before the delay time has passed, the controller stays in the presence detected controller state, and the timer is stopped and reset.
CO ₂ level (ppm)	Presence is detected via the CO ₂ sensor when the measured CO ₂ level exceeds this value.
CO ₂ hysteresis (ppm)	Specifies the hysteresis for when presence is not detected via the CO ₂ sensor anymore. For example, if presence has been detected at 800 ppm and this setting is 160 ppm, the controller stops detecting presence at 800-160 = 640 ppm.
Use internal PIR for presence	You can choose to activate or deactivate the internal PIR sensor (if available for the model): ✓ Enabled ✓ Disabled (default setting)

3.4.5 Inputs/Outputs

Universal inputs

In *Universal inputs* you can set the UI1 and the UI2 settings, depending on your system configuration needs.

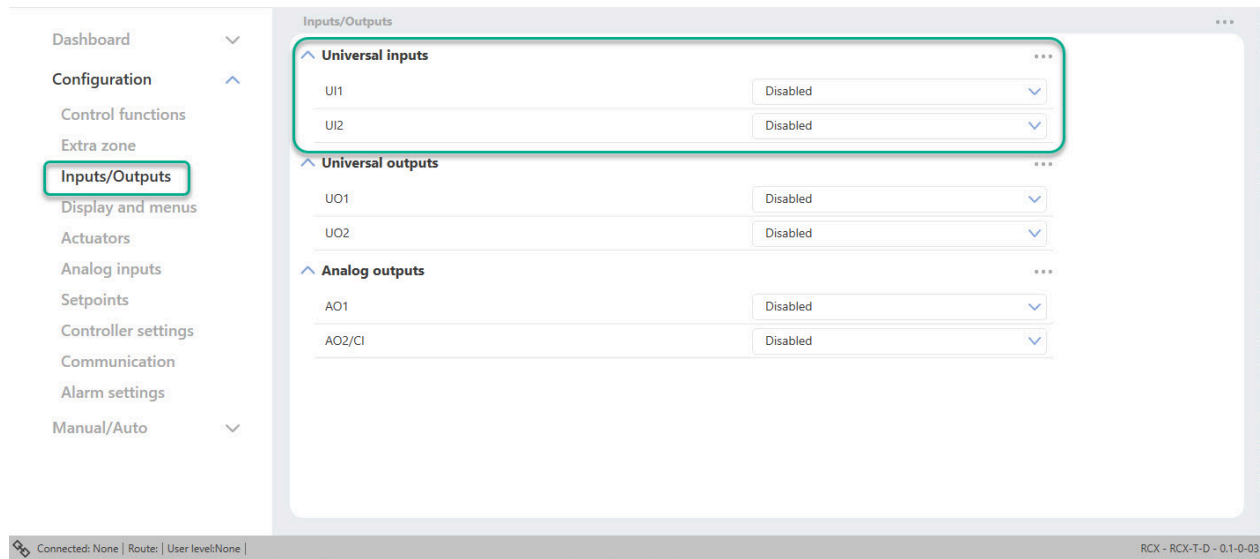


Table 3-22 UI1 settings

Setting	Description
Disabled (default value)	No use of UI1
External room temperature	Use of External room temperature sensor, sub-settings available
Change-over temperature	Use of Change-over room temperature sensor, sub-settings available
Extra zone temperature	Use of Extra zone room temperature sensor, sub-settings available
Supply air temperature	Use of Supply air temperature sensor, sub-settings available
Extract temperature	Use of Extract temperature sensor, sub-settings available
Change-over VAV temperature	Use of Change-over VAV temperature sensor, sub-settings available
Presence detector	Use of Presence detector, sub-settings available
Open window	Use of Open window sensor, sub-settings available
Change-over	Use of Change-over switch, sub-settings available
Change-over VAV	Use of Change-over VAV switch, sub-settings available

Table 3-23 UI2 settings

Setting	Description
Disabled (default value)	No use of UI2
CO2 sensor	Use of CO ₂ sensor, sub-settings available
Flow sensor	Use of Flow sensor, sub-settings available
RH sensor	Use of RH sensor, sub-settings available
External room temperature 0...10V	Use of External room temperature sensor- (0...10V), sub-settings available
VOC sensor	Use of VOC sensor, sub-settings available
Presence detector	Use of Presence detector, sub-settings available
Open window	Use of Open window sensor, sub-settings available
Change-over	Use of Change-over switch, sub-settings available
Change.over VAV	Use of VAV Change-over switch, sub-settings available

Universal outputs

In *Universal inputs* you can set the UO1 and the UO2 settings, depending on your system configuration needs. The universal outputs can also serve for digital outputs.

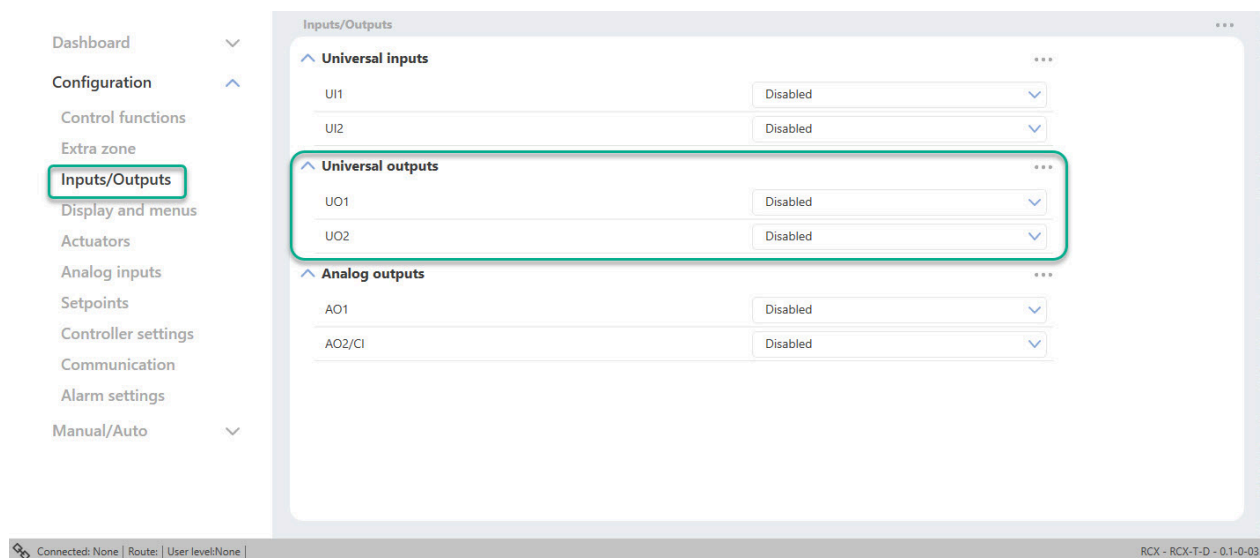


Table 3-24 UO1 settings

Setting	Description
Disabled (default value)	No use of UO1
EC fan	Use of EC fan, sub-settings available
CO2 control	Use of CO ₂ control, sub-settings available
Humidifier	Use of Humidifier, sub-settings available
Dehumidifier	Use of Dehumidifier, sub-settings available
VOC control	Use of VOC control, sub-settings available
Forced ventilation	Use of Forced ventilation, sub-settings available
Sum alarm	Use of Sum alarm, sub-settings available

Table 3-25 UO2 settings

Setting	Description
EC fan	Use of EC fan, sub-settings available
CO2 control	Use of CO ₂ control, sub-settings available
Humidifier	Use of Humidifier, sub-settings available
Dehumidifier	Use of Dehumidifier, sub-settings available
VOC control	Use of VOC control, sub-settings available
Forced ventilation	Use of Forced ventilation, sub-settings available
Sum alarm	Use of Sum alarm, sub-settings available

Analogue outputs

In *Universal inputs* you can set the AO1 and the AO2/CI settings, depending on your system configuration needs.



Note! The analogue outputs can not be used for digital output.

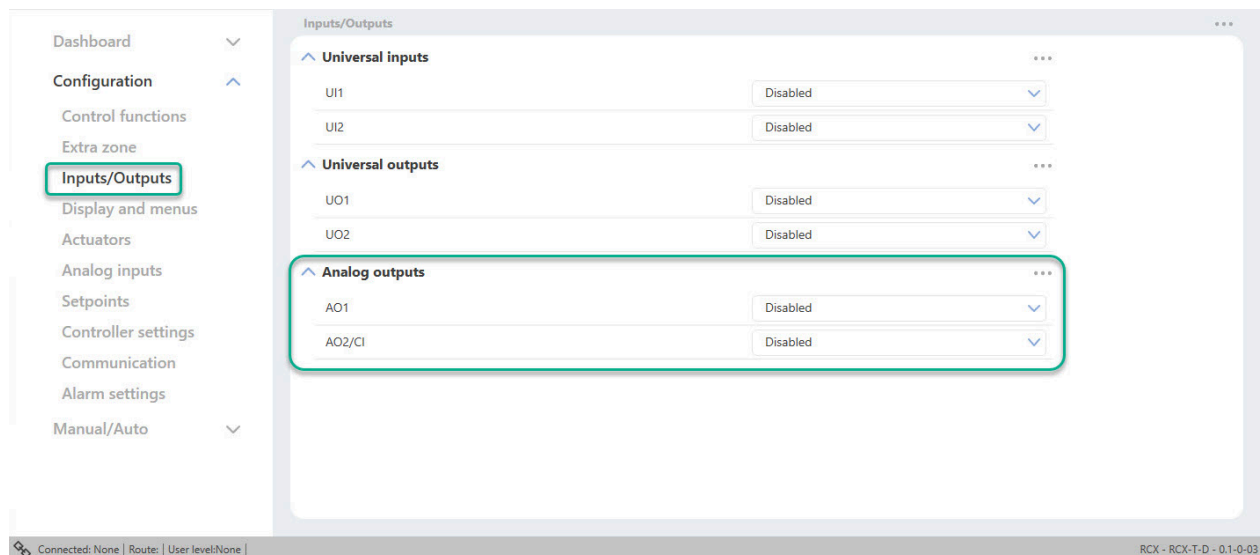


Table 3-26 AO1 settings

Setting	Description
EC fan	Use of EC fan, sub-settings available
CO2 control	Use of CO ₂ control, sub-settings available
Humidifier	Use of Humidifier, sub-settings available
Dehumidifier	Use of Dehumidifier, sub-settings available
VOC control	Use of VOC control, sub-settings available

Table 3-27 AO2 settings

Setting	Description
EC fan	Use of EC fan, sub-settings available
CO2 control	Use of CO ₂ control, sub-settings available
Humidifier	Use of Humidifier, sub-settings available
Dehumidifier	Use of Dehumidifier, sub-settings available
VOC control	Use of VOC control, sub-settings available
CI driver	Use of CI driver, sub-settings available

3.4.6 Fan control

The *Fan control* function is enabled and the EC-fan control configuration settings are shown in the Regin:GO app or the Application tool when the configuration value listed in *Table 3-28* is configured on a controller output.

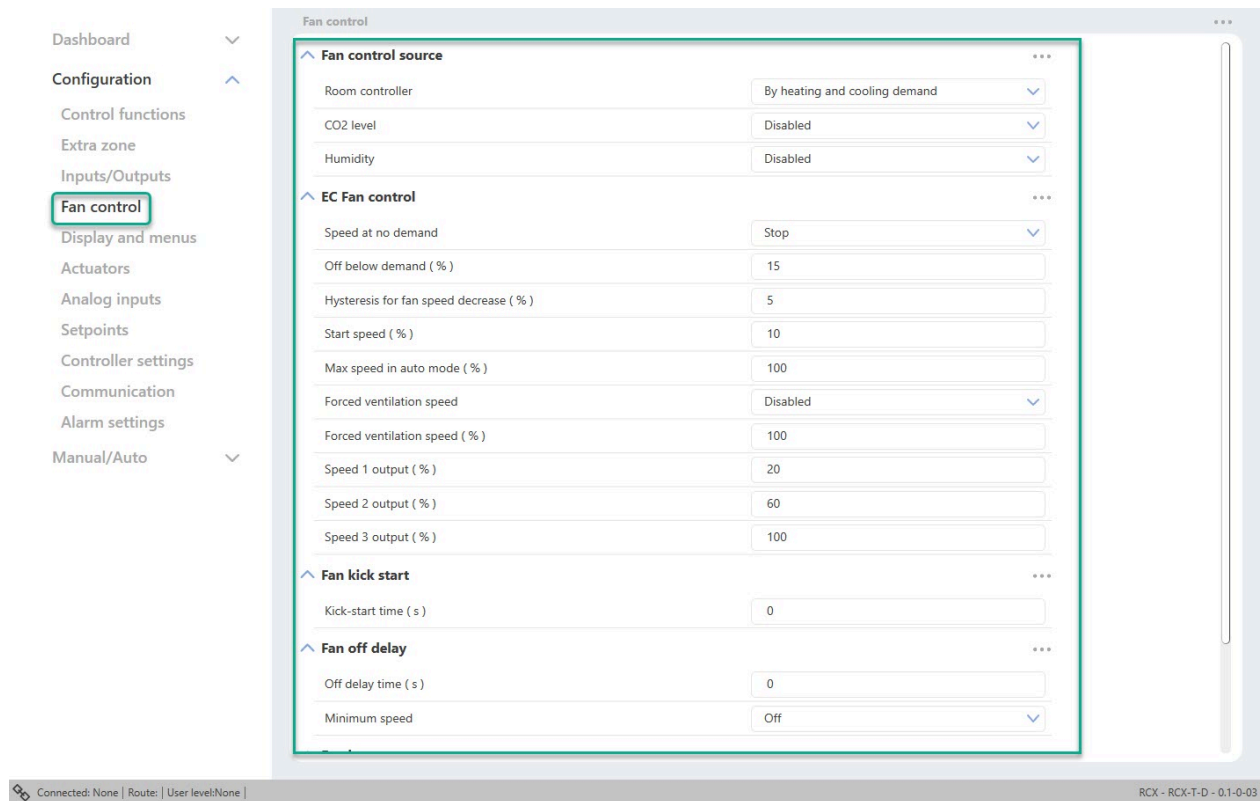


Figure 3-28 Fan control configuration settings in Application tool.

The controller outputs a fan speed signal, **EC Fan speed (%)**, that is configured on a controller output by using the value in *Table 3-28*.

In auto mode, the **EC Fan speed (%)** signal corresponds to the current heating or cooling demand, as illustrated in *Figure 3-29*.

In manual mode, the **EC Fan speed (%)** signal is independent of the current heating or cooling demand. Instead, the fan speed 1, 2, and 3 signals are defined by a number of equal thirds relative to the *Limit maximum EC fan speed to (%)* configuration setting, as illustrated in *Figure 3-30*. For example, the fan speed 1 signal is equal to 0.33 times the set maximum fan speed value, and the fan speed 2 signal is equal to 0.67 times the set maximum fan speed value.

Table 3-28 EC-fan control configuration value and controller input type.

Output signal	Controller output configuration value	Controller output type
EC Fan speed (%)	EC fan	Analog

The *Fan control* configuration settings are described in *Table 3-29*.

Table 3-29 EC fan control configuration settings.

Configuration setting	Fan mode applicability	Description
Fan control source	Room controller	Disabled: Fan control in auto mode is disabled (default setting). By heating demand: Fan control in auto mode is active at heating demand. By cooling demand: Fan control in auto mode is active at cooling demand. By heating and cooling demand: Fan control in auto mode is active both at heating and cooling demand.
	CO2 level: Fan is controlled by CO2 output	Disabled: Fan not controlled by CO2 output. Enabled: Fan is controlled by CO2 output.
	Humidity: Fan is controlled by humidity output	Disabled: Fan <u>not</u> controlled by humidity output. Enabled: Fan is controlled by humidity output.
EC Fan control	Auto and manual	Speed at no demand: Fan never stops in auto mode Off below demand (%): Min EC fan speed in % Hysteresis for fan speed decrease (%): Hysteresis for fan speed outputs Start speed (%): Min EC fan speed in % Max speed in auto mode (%): Max EC fan speed in % Forced ventilation speed: Fan runs at RC_ECFanSpeed-Forced when forced ventilation is active Forced ventilation speed (%): Forced ventilation EC fan speed Speed 1 output (%): EC fan speed for manual speed 1 Speed 2 output (%): EC fan speed for manual speed 2 Speed 3 output (%): EC fan speed for manual speed 3
Fan kick start	Auto and manual	Kick-start time (s): Fan kick start time
Fan off delay	Auto and manual	Off delay time (s): Fan afterblow run time. 0 = Not active Minimum speed: Fan afterblow min speed.
Fan boost	Mode: Fan start boost heat cool select. 0=heat, 1=cool, 2=both	Disabled: By heating demand: By cooling demand: By cooling demand:
	Auto and manual	Boost time (s): Fan boost run time. 0 = Not active
	Auto and manual	P-band: Fan boost P band

Figure 3-29 illustrates the EC fan control behaviour in auto mode when a 90% maximum limit is set for the fan speed output signal, and a 10% heating and cooling demand threshold value for when the fan should start is set.

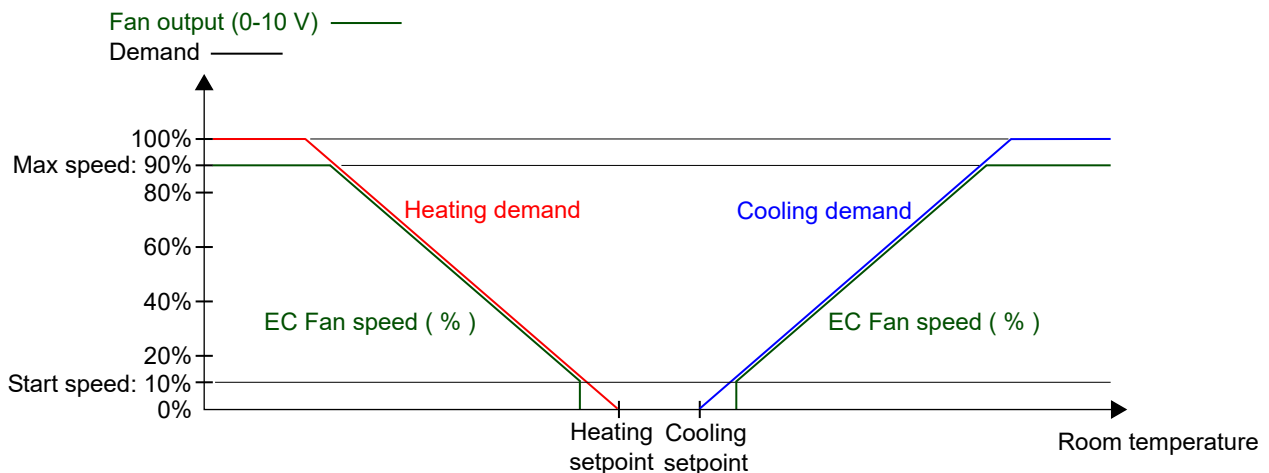


Figure 3-29 EC fan control behaviour in auto mode.

Figure 3-30 illustrates the EC fan control behaviour in manual mode when a 90% maximum limit is set for the fan speed output signal.

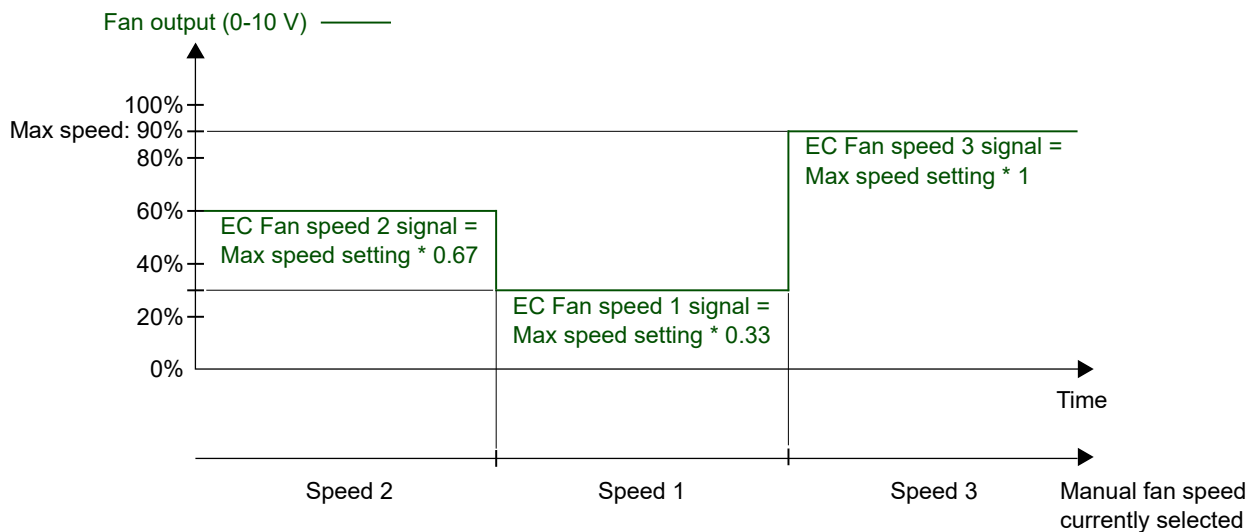


Figure 3-30 EC fan control behaviour in manual mode (fan speed 1, 2, or 3)

Fan boost

Fan boost is a control function that can be used to acknowledge to the person in the room that the fan is started when the occupancy (on/off) button in the controller is pressed, or when the controller detects presence. This is useful when the initial heating or cooling demand is low (the difference between the room temperature and setpoint is small), since the fan then typically runs at a low speed.

Another use case for the fan boost function is to temporarily run the fan at an increased speed to provide a perceived cooling effect, until the cooling distribution from the cooling valve establishes.

The fan boost is achieved by the use of a separate fan boost controller that operates in parallel with the temperature controller, and temporarily increases the fan speed for a configured period of time (the fan boost time). P-band and I-time settings for the different controllers are located in the *Configuration ▶ Controller settings* menu page in the Regio:GO app or the Application tool.

The fan boost function is enabled by configuring the *Fan boost time* setting to a value that is greater than zero.

The fan boost function is activated when presence is detected, see section *Presence detection*, or when the controller changes to Forced ventilation state, see section 3.4.2 *Controller state*. The fan boost time is independent of the *Time in Forced ventilation state* configuration setting.

When the fan boost function is active, the fan runs at maximum speed for the first 10 seconds of the fan boost time. For the remainder of the fan boost time, the fan speed output signal corresponds to whichever of the fan boost or temperature control signal that has the greatest value.

After the fan boost time has expired, the fan speed output signal corresponds to the temperature control signal, regardless if the fan boost control signal is greater than the temperature control signal. That is, the controller reverts to normal fan control, which is either auto or manual mode.

The fan boost configuration settings are described in *Table 3-30*.

Table 3-30 Fan boost configuration settings.

Configuration setting	Description
Fan boost mode	Disabled: Fan boost is disabled. By cooling demand: Fan boost is active at cooling demand. By heating demand: Fan boost is active at heating demand. By heating and cooling demand: Fan boost is active at both heating and cooling demand (default setting).
Boost time (s)	The period of time (in seconds) that the fan boost function is active.
P-band	Fan boost P band Default value: 5°C For more information, see the RCX-... Variable list.

Figure 3-31 illustrates how the fan boost function can be used to provide a perceived cooling effect until the cooling distribution from the cooling valve is established.

In this example, the control behaviour for an EC fan in auto mode is described. It is assumed that the room temperature is 28°C and the cooling setpoint is 24°C at 0 seconds, resulting in an error value of 4, and that the error value is reduced to 0 at 300 seconds. The fan boost time is set to 90 seconds. The P-band for the fan boost controller is set to 5°C, and the P-band and I-time for the temperature controller is set to 10°C and 300 seconds, respectively.

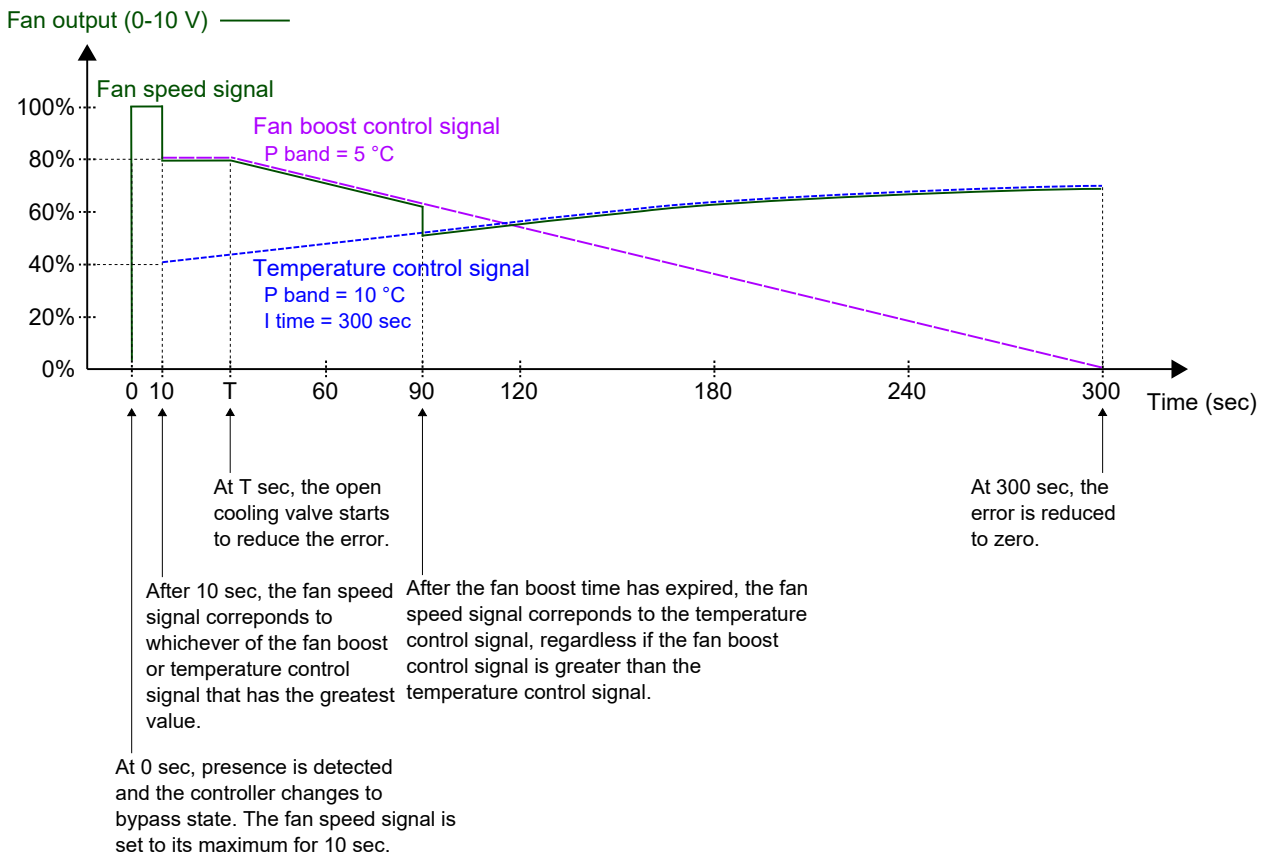


Figure 3-31 An example of fan boost control behaviour for an EC fan in auto mode, which provides a perceived cooling effect until the cooling distribution from the cooling valve establishes. The P-band for the fan boost controller has a lower value (higher gain) than the P-band for the temperature controller.

Fan kick-start

Fan kick-start is a control function that can be used to ensure that the EC fan starts even when the controller outputs a low-voltage control signal.

When using today's energy-saving EC fans, there is always a risk that the fan does not start due to a too low control voltage that prevents the fan from exceeding its starting torque. The fan then remains at a standstill while power still flows through it, which may damage to the fan. The fan kick-start function ensures that the fan output is at its maximum for a set period of time, thereby making sure that the starting torque is exceeded.

The fan kick-start function is enabled by configuring the *Fan kick-start time* setting to a value that is greater than zero.

The fan kick-start function is activated when the fan starts from standstill in manual- or auto-mode.

When the fan kick-start function is active, the controller sets the fan speed output signal to its maximum for the period of time specified by the *Fan kick-start time* configuration setting.

After the fan kick-start time has expired, the controller reverts to normal fan control, that is, manual- or auto-mode.

The fan kick-start configuration settings are described in *Table 3-31*.

Table 3-31 Fan kick-start configuration settings.

Configuration setting	Description
Fan kick-start time (s)	The period of time (in seconds) that the fan kick-start function is active.

Mould protection

Mould protection is a control function that can be used to ensure that the EC fan will always run at least at Fan start speed.

When set, the fan is completely independent from state, Auto-, or Manual-modes, or even Open window- or Presence-signals.

The minimum speed should be adjusted case by case. It is the installer's responsibility to ensure that the minimum speed is adequate to properly ventilate the room and prevent mould to appear and grow.

The mould protection function is enabled by setting *Mould protection* to *On*.

3.4.7 Display and menus

Display

In *Display* you can set the default display settings in terms of the default shown view, alternating view of temperature and CO₂ value, the setpoint mode, round off of CO₂ value, display brightness, dim functions, and light time outs.

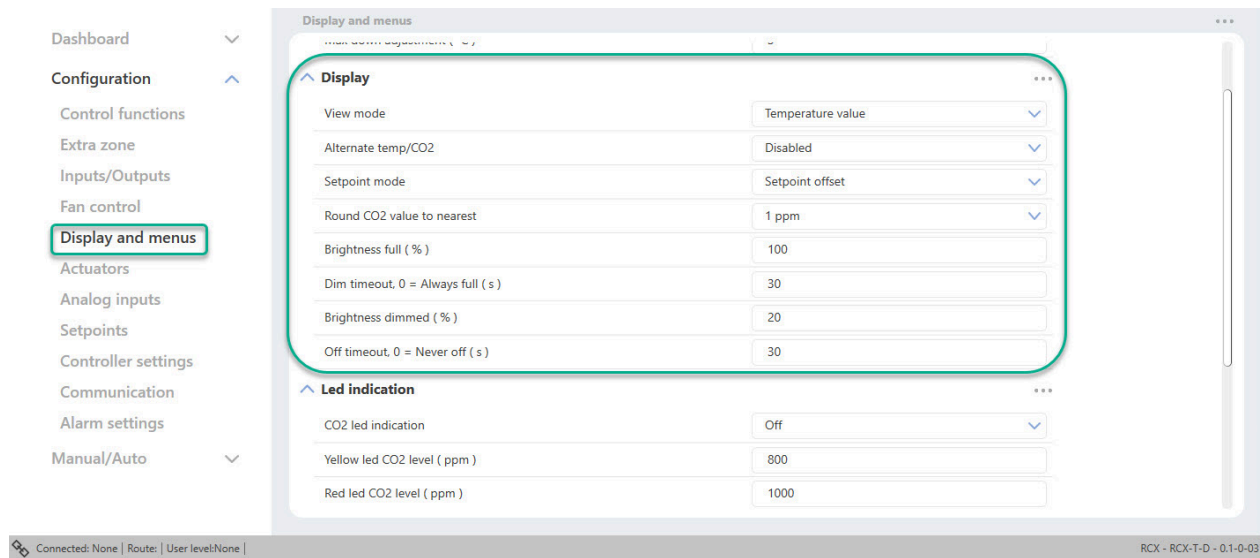


Table 3-32 Display View modes

Mode setting	Description
Actual setpoint	Actual setpoint value shown on the display.
Heating setpoint	Actual heating setpoint value shown on the display.
Cooling setpoint	Actual cooling setpoint value shown on the display.
Average cooling/heating setpoint	When setting the setpoint adjustment, the value shown on the display is configurable with [Up] -arrow button or [Down] arrow button.
Setpoint offset only	When setting the setpoint adjustment, the value shown on the display is configurable with [Up] -arrow button or [Down] arrow button.
CO2 level	Actual CO ₂ level value shown on the display.
Heating setpoint + offset	When setting the setpoint adjustment, the value shown on the display is configurable with [Up] -arrow button or [Down] arrow button.
Cooling setpoint + offset	When setting the setpoint adjustment, the value shown on the display is configurable with [Up] -arrow button or [Down] arrow button.
Average setpoint + offset	When setting the setpoint adjustment, the value shown on the display is configurable with [Up] -arrow button or [Down] arrow button.
Calculated flow in the duct in l/s	When an air flow sensor is connected, this mode shows the air flow value on the display.

Table 3-33 Alternate temp/CO₂ setting

Setting	Description
Alternate temp/CO ₂	You can set the display to alternate between showing the temperature value and the CO ₂ level value.

Table 3-34 Other settings

Setting	Description
Round CO ₂ value to nearest	Setting the CO ₂ value to be rounded of in set range. 1, 50, or 100 ppm (default value = 1)
Brightness full (%)	Setting of the brightness (in %) 0-100 (default value = 100)
Dim timeout (s)	Setting of time (in seconds) Free value, 0 = Always full (s), (default value = 30)
Brightness dimmed	Setting of the dimmed brightness (in %) 0-100, (default value = 20)
Off timeout, 0 = never off (s)	Setting of the LED brightness timeout (in seconds) Free value, 0 = never off (s), (default value = 30)

LED indication

In the Regi:GO app or Application tool you can set the RGB LED indication configuration for the CO₂ level.

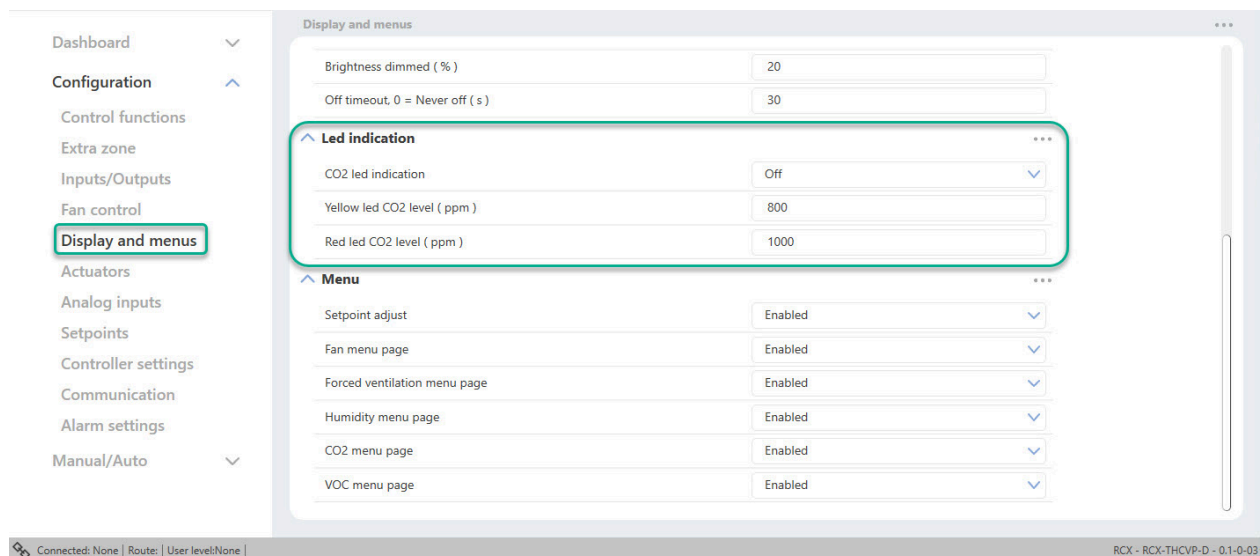


Table 3-35 Led indication settings

Setting	Description
CO ₂ led indication	Set Off/On for CO ₂ led indication function, (default value - Off)
Yellow led CO ₂ level (ppm)	Free value threshold for yellow led warning, (default value - 800 ppm)
Red led CO ₂ level (ppm)	Free value threshold for yellow led warning, (default value - 1000 ppm)

3.4.8 Manual/Auto

Manual output settings

All outputs offer the possibility to be set manually, overriding any application layer. This to handle special functions from, for example, a SCADA system.

There are two ways to manually control the outputs: Controlling the output function or directly control the physical output hardware.

Output function control

When controlling an output function, such as *Heat 2*, the corresponding value variable will be affected as well as any output configured to this function.

The **ManSelect** variables have three allowed values:

- ✓ **0: Off** - The output is off. Valve exercise is disabled.
- ✓ **1: Manual** - The output value is taken from the corresponding Manual variable. Valve exercise is enabled.
- ✓ **2: Auto** - Normal function. The output value is taken from the corresponding value variable.

Output hardware control

When controlling the output hardware the physical output is controlled directly, regardless of which function is configured for the output. This overrides any other control of the output, including valve exercise.

Remote input values

If the controller is part of a bigger system, sensor values can be written from a master controller or a SCADA system over the communication bus, using Modbus, BACnet or EXOline. If the sensor value is set in remote mode, it overrides all local sensors.

The following values can be set remotely:

- ✓
 - ✓ Room temperature
 - ✓ Supply air temperature
 - ✓ Extra zone temperature
 - ✓ Change-over temperature
 - ✓ Change-over VAV temperature
 - ✓ CO₂ level
 - ✓ Room humidity
 - ✓ Air flow
 - ✓ VOC input
 - ✓ Digital inputs
 - ✓ Presence detection
 - ✓ Open window
 - ✓ Condensation active
 - ✓ External alarm (DI)

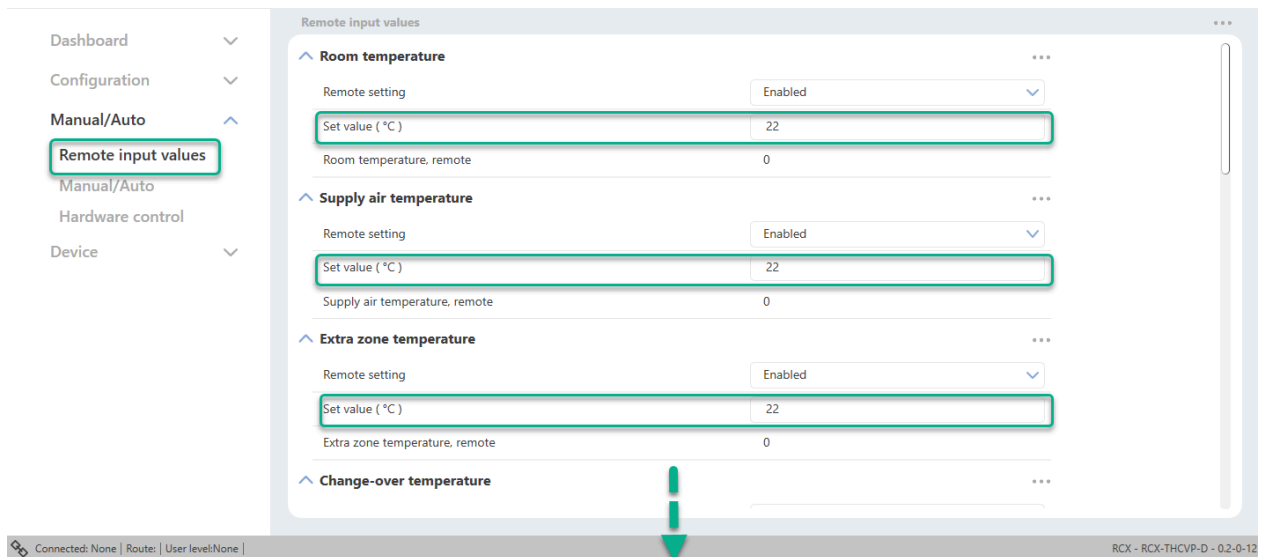


Figure 3-32 Remote input values settings in Application tool.

See also 3.7.1 Sensor values via communication.

3.5 Navigation - Menus

In the configuration tool (Regin:GO app or Application tool), you find a menu presenting an overview and the actual controller values, settings, and any alarms. The menu has the levels - **Tab**, **Menu page**, **Menu group**, **Menu item**.

3.5.1 Menu - Dashboard tab

The table states all levels in the **Dashboard** tab, with a description and reference to variable (where applicable).

Table 3-36 Dashboard tab levels

Menu level, reference	Tab (Level 1)	Menu page (Level 2)	Menu group (Level 3)	Menu item (Level 4)	Description (Variable reference)
1	Dashboard	Overview	System	Controller	Model number (<i>QSystem.Model</i>)
2				PLA	PLA address (<i>QSystem.PLA</i>)
3				ELA	ELA address (<i>QSystem.ELA</i>)
4				Sum alarm	Sum alarm (<i>RC_SumAlarm</i>)
5			Room	Controller state	Defines a control state for the main room controller, i.e. Standby, Occupied etc. (<i>RC_ControllerState</i>)
6				Mode	Current controller mode (<i>RC_ControllerMode</i>)
7				Room temperature (°C)	Room temperature (<i>RC_RoomTemp</i>)
8				Room setpoint (°C)	Active room control setpoint (<i>RC_RoomActiveSetpoint</i>)
9				Setpoint adjustment (°C)	Setpoint adjustment. Effective in Standby state or higher. (<i>RC_RoomSetpointOffset</i>)
10				EC fan speed (%)	Current EC fan speed (<i>RC_ECFanSpeed</i>)
11				Heating demand (%)	Room PID heat output (<i>RC_PIDHeatDemand</i>)
12				Cooling demand (%)	Room PID cool output (<i>RC_PIDCoolDemand</i>)
13				CO2 level (ppm)	Rounded room CO2 level (<i>RC_CO2LevelRounded</i>)
14				Presence detection	Presence indication (<i>RC_Presence</i>)
15			Extra zone	Extra zone temperature (°C)	Extra Zone temperature (<i>RC_ExtraZoneTemp</i>)
16				Extra zone setpoint (°C)	Setpoint for Extra Zone (<i>RC_ExtraZoneSetpoint</i>)
17		Actual values	Room Control Sequence	Sequence 1	Room sequence step 1 function (<i>RC_RoomSeq1Function</i>)
18				Sequence 2	Room sequence step 2 function (<i>RC_RoomSeq2Function</i>)

Table 3-36 Dashboard tab levels (continued)

19		Sequence 3	Room sequence step 3 function (RC_RoomSeq3Function)
20		Actual values	Mode Current controller mode (RC_ControllerMode)
21		Room temperature (°C)	Room temperature (RC_RoomTemp)
22		Room setpoint (°C)	Active room control setpoint (RC_RoomActiveSetpoint)
23		Setpoint adjustment (°C)	Setpoint adjustment. Effective in Standby state or higher. (RC_RoomSetpointOffset)
24		Heating demand (%)	Room PID heat output (RC_PIDHeatDemand)
25		Cooling demand (%)	Room PID cool output (RC_PIDCoolDemand)
26		Heating output (%)	Room control Heat1 output analogue (RC_RoomHeat1OutputAO)
27		Heating 2 output (%)	Room control Heat2 output analogue (RC_RoomHeat2OutputAO)
28		Cooling output (%)	Room control Cool1 output analogue (RC_RoomCool1OutputAO)
29		Cooling 2 output (%)	Room control Cool2 output analogue (RC_RoomCool2OutputAO)
30		VAV output (%)	Room control VAV1 output analogue (RC_RoomVAV1OutputAO)
31		VAV 2 output (%)	Room control VAV2 output analogue (RC_RoomVAV2OutputAO)
32		Change-over output (%)	(RC_RoomChangeOverOutputAO)
33		Change-over VAV output (%)	Room control Change over output analogue (RC_RoomChangeOverVAVOutputAO)
34		6-way valve output (%)	Room control 6-way valve output analogue (RC_Room6WayValveOutputAO)
35	Inputs/outputs	Universal inputs	UI1 - Disabled Filtered value from sensor (IoAnaIn_1_value)
36			UI1 - Disabled Filtered value from sensor (IoDiIn_1_value)
37			UI2 - Disabled Filtered value from sensor (IoAnaIn_2_value)
38			UI2 - Disabled Filtered value from sensor (IoDiIn_2_value)
39			CI Filtered value from sensor (IoDiIn_3_value)

Table 3-36 Dashboard tab levels (continued)

40		Universal outputs	UO1 - Disabled	Value converted to SI units from % (IoAnaOut_1_converted)
41			UO1 - Disabled	Value set for output (IoDo_1_value)
42			UO2 - Disabled	Value converted to SI units from % (IoAnaOut_2_converted)
43			UO2 - Disabled	Value set for output (IoDo_2_value)
44		Analog outputs	AO1 - Disabled	Value converted to SI units from % (IoAnaOut_3_converted)
45			AO2/CI1 - Disabled	Value converted to SI units from % (IoAnaOut_4_converted)
46		Internal sensors	Room temperature (°C)	Filtered value from sensor (IoAnaln_5_value)
47	Alarms	Alarms	Sum alarm	Sum Alarm (RC_SumAlarm)
48			Sensor error	Sensor error alarm (RC_AlarmSensorError)
49			High room temperature	High room temp alarm (RC_AlarmRoomTempHigh)
50			Low room temperature	Low room temp alarm (RC_AlarmRoomTempLow)
51			High CO2 level	High CO2 alarm (RC_AlarmCO2High)

3.5.2 Menu - Configuration tab

The table states all levels in the **Configuration** tab, with a description and reference to a variable (where applicable).

Table 3-37 Configuration tab levels

Menu level, reference	Tab (Level 1)	Menu page (Level 2)	Menu group (Level 3)	Menu item (Level 4)	Description (Variable reference)
52	Configuration	Control functions	Room Control Sequence	Sequence 1	Room sequence step 1 function (RC_RoomSeq1Function)
53				Sequence 2	Room sequence step 2 function (RC_RoomSeq2Function)
54				Sequence 3	Room sequence step 3 function (RC_RoomSeq3Function)
55			Heat	Max limit (%)	Heat1 maximum output for all controller states. (RC_Heat1OutputMax)
56				Min limit (%)	Heat1 minimum output for all controller states. (RC_Heat1OutputMin)
57				Fan off delay for electric heater	Heat1 enable afterblow function (RC_Heat1Afterblow)
58			Heat 2	Max limit (%)	Heat2 maximum output for all controller states. (RC_Heat2OutputMax)
59				Min limit (%)	Heat1 minimum output for all controller states. (RC_Heat2OutputMin)
60				Fan off delay for electric heater	Heat1 enable afterblow function (RC_Heat2Afterblow)
61			Cool	Max limit (%)	Cool1 maximum output for all controller states. (RC_Cool2OutputMax)
62				Min limit (%)	Cool1 minimum output for all controller states. (RC_Cool2OutputMin)
63				Fan off delay for electric heater	Set Cool1 output to max value when forced ventilation is active (RC_Cool2OutputMaxWhenForced)
64			Cool 2	Max limit (%)	Cool2 maximum output for all controller states. (RC_Cool2OutputMax)
65				Min limit (%)	Cool2 minimum output for all controller states. (RC_Cool2OutputMin)
66				Fan off delay for electric heater	Set Cool2 output to max value when forced ventilation is active. (RC_Cool2OutputMaxWhenForced)
67			VAV	Max limit (%)	VAV1 maximum output for all controller states. (RC_VAV1OutputMax)
68				Min limit, off (%)	VAV1 minimum output in Off state. (RC_VAV1OutputMinOff)

Table 3-37 Configuration tab levels (continued)

69		Min limit, unoccupied (%)	VAV1 minimum output in Unoccupied state. (RC_VAV1OutputMinUnoccupied)
70		Min limit, standby (%)	VAV1 minimum output in Standby state. (RC_VAV1OutputMinStandby)
71		Min limit, occupied (%)	VAV1 minimum output in Occupied state. (RC_VAV1OutputMinOccupied)
72		Min limit, forced ventilation (%)	VAV1 minimum output in Bypass state. (RC_VAV1OutputMinBypass)
73		Set to max at forced ventilation state	Set VAV1 output to max value when forced ventilation is active (RC_VAV1OutputMaxWhenForced)
74	VAV 2	Max limit (%)	VAV2 maximum output for all controller states. (RC_VAV2OutputMax)
75		Min limit, off (%)	VAV2 minimum output in Off state. (RC_VAV2OutputMinOff)
76		Min limit, unoccupied (%)	VAV2 minimum output in Unoccupied state. (RC_VAV2OutputMinUnoccupied)
77		Min limit, standby (%)	VAV2 minimum output in Standby state. (RC_VAV2OutputMinStandby)
78		Min limit, occupied (%)	VAV2 minimum output in Occupied state. (RC_VAV2OutputMinOccupied)
79		Min limit, forced ventilation (%)	VAV2 minimum output in Bypass state. (RC_VAV2OutputMinBypass)
80		Set to max at forced ventilation state	Set VAV2 output to max value when forced ventilation is active. (RC_VAV2OutputMaxWhenForced)
81	VAV control source	Cooling demand	VAV is controlled by cooling output. (RC_VAVControlCooling)
82		CO2 level	VAV is controlled by CO2 output. (RC_VAVControlCO2)
83		Humidify demand	VAV is controlled by humidify output. (RC_VAVControlHumidify)
84		Dehumidify demand	VAV is controlled by dehumidify output. (RC_VAVControlDehumidify)
85	Change-over	Max limit (%)	Changeover maximum output for all controller states. (RC_ChangeOverOutputMax)
86		Min limit, off (%)	Changeover minimum output for all controller states. (RC_ChangeOverOutputMin)

Table 3-37 Configuration tab levels (continued)

87		Mode	Type of detection to control change-over. (RC_ChangeOverSelect)
88		Change-over temperature (°C)	The reference temperature to use in simple mode, in advanced mode the room temperature is used. (RC_ChangeOverTemperature)
89		Heating hysteresis (°C)	adjustment subtracted from the reference temperature when heating. (RC_ChangeOverTempHystHeat)
90		Cooling hysteresis (°C)	Offset added to the reference temperature when cooling. (RC_ChangeOverTempHystCool)
91		Valve delay time (s)	The period of time (in seconds) that the valve is open before the pipe medium temperature is measured. (RC_ChangeOverValveTime)
92	Change-over VAV	Max limit (%)	ChangeOverVAV maximum output for all controller states. (RC_ChangeOverVAVOutputMax)
93		Min limit, off (%)	ChangeOverVAV minimum output in Off state. (RC_ChangeOverVAVOutputMinOff)
94		Min limit, unoccupied (%)	ChangeOverVAV minimum output in Unoccupied state. (RC_ChangeOverVAVOutputMinUnoccupied)
95		Min limit, standby (%)	ChangeOverVAV minimum output in Standby state. (RC_ChangeOverVAVOutputMinStandby)
96		Min limit, occupied (%)	ChangeOverVAV minimum output in Occupied state. (RC_ChangeOverVAVOutputMinOccupied)
97		Min limit, forced ventilation (%)	ChangeOverVAV minimum output in Bypass state. (RC_ChangeOverVAVOutputMinBypass)
98		Set to max at forced ventilation state	Set ChangeOverVAV output to max value when forced ventilation is active. (RC_ChangeOverVAVOutputMaxWhenForced)
99		Mode	Type of detection to control change-over VAV. (RC_ChangeOverVAVSelect)
100		Change-over temperature (°C)	The reference temperature to use in simple mode, in advanced mode the room temperature is used. (RC_ChangeOverVAVTemperature)

Table 3-37 Configuration tab levels (continued)

101		Heating hysteresis (°C)	adjustment added to the reference temperature when switching to heat mode. (RC_ChangeOverVAVTempHystHeat)
102		Cooling hysteresis (°C)	(RC_ChangeOverVAVTempHystCool)
103		Valve delay time (s)	The period of time (in seconds) that the valve is open before the pipe medium temperature is measured. (RC_ChangeOverVAVValveTime)
104	6-way valve	Seq 1 fully open (V)	Voltage applied to 6 way valve for fully open at sequence 1. (RC_SixWayValveFirstSeqFullyOpen)
105		Seq 1 start opening (V)	Voltage applied to 6 way valve to start open at sequence 1. (RC_SixWayValveFirstSeqStartOpen)
106		Seq 2 fully open (V)	Voltage applied to 6 way valve for fully open at sequence 2. (RC_SixWayValveSecondSeqFullyOpen)
107		Seq 2 start opening (V)	Voltage applied to 6 way valve to start open at sequence 2. (RC_SixWayValveSecondSeqStartOpen)
108		Center point (V)	Voltage applied to 6 way valve for center point, closed both sequences. (RC_SixWayValveCenterPoint)
109		Center point hysteresis (V)	Center point Hysteresis. (RC_SixWayValveCenterPointHyst)
110		Sequence order	Sequence order 0=Cool 1st Sequence 1=Heat 1st Sequence. (RC_SixWayValveSequenceOrder)
111		Controller state	Preset state
112	Shutdown state		The state to enter when shutdown mode is set. (RC_ControllerStateShutdown)
113	Window open state		(RC_ControllerStateWindow)
114		Time in forced ventilation state (min)	Bypass time (minutes). (RC_BypassTime)
115	Forced ventilation	Active when	Forced ventilation function. (RC_ForcedVentMode)
116		Start limit (%)	Forced ventilation start limit (RC_ForcedVentStartLimit)
117	Presence detection	Presence state	The state to enter when presence is detected. (RC_ControllerStatePresence)
118		Active delay (min)	Delay for presence on (min) (RC_PresenceDelayOn)

Table 3-37 Configuration tab levels (continued)

119		Inactive delay (min)	Delay for presence off (min). (<i>RC_PresenceDelayOff</i>)
120		CO2 activation	Enable CO2 presence detection. (<i>RC_PresenceCO2Enable</i>)
121		CO2 level (ppm)	CO2 presence limit. (<i>RC_PresenceCO2Limit</i>)
122		CO2 hysteresis (ppm)	CO2 presence limit hysteresis. (<i>RC_PresenceCO2Hyst</i>)
123	Extra zone	Extra zone	Extra zone function Extra Zone function. (<i>RC_ExtraZoneControlFunction</i>)
124		Disabled below state	Disable Extra Zone control below this controller state. (<i>RC_ExtraZoneMinControllerState</i>)
125		Disable if main zone mode differs from function	Disable Extra Zone if mode differs from room PID mode. (<i>RC_ExtraZoneDisableIfWrongMode</i>)
126		Min limit, off (%)	Minimum output for Extra Zone. (<i>RC_ExtraZoneOutputMin</i>)
127		Max limit (%)	Maximum output for Extra Zone. (<i>RC_ExtraZoneOutputMax</i>)
128	Input/Outputs	Universal inputs	UI1 UI1 Input function. (<i>RC_UI1Func</i>)
129			UI2 UI2 Input function (<i>RC_UI2Func</i>)
130		Universal outputs	UO2 UO2 Output function. (<i>RC_UO2Func</i>)
131		UO1 period thermal valve (s)	(<i>InAnaOut_1_pulse_period</i>)
132		UO1 NC/NO	Set to 1 to invert output. (<i>IoDo_1_invert</i>)
133		UO1 control signal	(<i>InAnaOut_1_unit</i>)
134		UO2	UO2 Output function. (<i>RC_UO2Func</i>)
135		UO2 period thermal valve (s)	(<i>InAnaOut_2_pulse_period</i>)
136		UO2 NC/NO	Set to 1 to invert output. (<i>IoDo_2_invert</i>)
137		UO2 control signal	(<i>InAnaOut_2_unit</i>)
138		Analog outputs	AO1 UO3 Output function. (<i>RC_UO3Func</i>)
139		AO1 control signal	(<i>InAnaOut_3_unit</i>)
140		AO2/CI	UO4 Output function. (<i>RC_UO4Func</i>)
141		AO2 control signal	(<i>InAnaOut_4_unit</i>)
142	Fan control	Fan control source	Room controller Select fan control mode. (<i>RC_FanControlMode</i>)
143		CO2 level	Fan is controlled by CO2 output. (<i>RC_FanCO2Control</i>)

Table 3-37 Configuration tab levels (continued)

144			Humidity	Fan is controlled by humidity output. (RC_FanHumidityControl)
145		EC Fan control	Speed at no demand	Fan never stops in auto mode. (RC_FanSpeedMin)
146			Off below demand (%)	Min EC fan speed in % (RC_ECFanSpeedStartLimit)
147			Hysteresis for fan speed decrease (%)	Hysteresis for fan speed outputs. (RC_FanSpeedHyst)
148			Start speed (%)	Min EC fan speed in % (RC_ECFanSpeedMin)
149			Max speed in auto mode (%)	Max EC fan speed in % (RC_ECFanSpeedMax)
150			Forced ventilation speed	Fan runs at RC_ECFanSpeed-Forced when forced ventilation is active. (RC_FanForcedVentilation)
151			Forced ventilation speed (%)	Forced ventilation EC fan speed. (RC_ECFanSpeedForced)
152			Speed 1 output (%)	EC fan speed for manual speed 1. (RC_ECFanManualSpeed1)
153			Speed 2 output (%)	EC fan speed for manual speed 2. (RC_ECFanManualSpeed2)
154			Speed 3 output (%)	EC fan speed for manual speed 3. (RC_ECFanManualSpeed3)
155		Fan kick start	Kick-start time (s)	Fan kick start time. (RC_FanKickStartTime)
156		Fan off delay	Off delay time (s)	Fan afterblow run time. 0 = Not active (RC_FanAfterblowTime)
157			Minimum speed	Fan afterblow min speed. (RC_FanAfterblowMinSpeed)
158		Fan boost	Mode	Fan start boost heat cool select. 0=heat, 1=cool, 2=both (RC_FanBoostMode)
159			Boost time (s)	Fan boost run time. 0 = Not active (RC_FanBoostRunTime)
160			P-band	Fan boost P band. (RC_FanBoostPBand)
161	Display and menus	Setpoint adjustment	Max up adjustment (°C)	Maximum positive setpoint adjustment. (RC_RoomSetpointOffsetMaxPos)
162			Max down adjustment (°C)	Maximum negative setpoint adjustment. (RC_RoomSetpointOffsetMaxNeg)
163		Display	View mode	Select value to be shown in the display. (RC_DisplayViewMode)

Table 3-37 Configuration tab levels (continued)

164		Alternate temp/CO2	Alternate temperature/CO ₂ display. (RC_TemperatureCO2)
165		Setpoint mode	Select setpoint display at setpoint adjustment. (RC_DisplaySetpointMode)
166		Round CO2 value to nearest	Min step for CO ₂ value. (RC_CO2Step)
167		Brightness full (%)	Display brightness, full (%). (Disp_BrightnessFull)
168		Dim timeout, 0 = Always full (s)	Display time in full mode. 0 = Never dim. (Disp_TimeFull)
169		Brightness dimmed (%)	Display brightness, dimmed (%). (Disp_BrightnessDim)
170		Off timeout, 0 = Never off (s)	Display time in dimmed mode. 0 = Never off. (Disp_TimeDim)
171	Led indication	CO2 led indication	Setpoint for CO ₂ control. (RC_CO2Setpoint)
172		Yellow led CO2 level (ppm)	CO ₂ level for yellow led. (RC_CO2LevelYellow)
173		Red led CO2 level (ppm)	CO ₂ level for red led. (RC_CO2LevelRed)
174	Menu	Setpoint adjust	Enable setpoint setting from display. (App_EnableSetpoint)
175		Fan menu page	Enable Fan menu page. (App_EnableMenuFan)
176		Forced ventilation menu page	Enable Forced ventilation menu page. (App_EnableMenuForcedVent)
177		Humidity menu page	Enable Humidity menu page. (App_EnableMenuHumidity)
178		CO2 menu page	Enable CO ₂ menu page. (App_EnableMenuCO2)
179		VOC menu page	Enable VOC menu page. (App_EnableMenuVOC)
180	Actuators	Valve exercise	Exercise valves (RC_ValveExerciseFunction)
181		Heat interval (h)	Heat valve 1 exercise interval (hours) (RC_ValveExerciseIntervalHeat1)
182		Heat 2 interval (h)	Heat valve 2 exercise interval (hours) (RC_ValveExerciseIntervalHeat2)
183		Cool interval (h)	Cool valve 1 exercise interval (hours) (RC_ValveExerciseIntervalCool1)
184		Cool 2 interval (h)	Cool valve 2 exercise interval (hours) (RC_ValveExerciseIntervalCool2)

Table 3-37 Configuration tab levels (continued)

185		Change-over interval (h)	Change-over valve exercise interval (hours) (RC_ValveExerciseIntervalChangeOver)
186		6-way valve interval (h)	6-way valve exercise interval (hours) (RC_ValveExerciseInterval6Way)
187		Heat duration (s)	Heat valve 1 runtime (seconds) (RC_ValveRuntimeHeat1)
188		Heat 2 duration (s)	Heat valve 2 runtime (seconds) (RC_ValveRuntimeHeat2)
189		Cool duration (s)	Cool valve 1 runtime (seconds) (RC_ValveRuntimeCool1)
190		Cool 2 duration (s)	Cool valve 2 runtime (seconds) (RC_ValveRuntimeCool2)
191		Change-over duration (s)	Change-over valve runtime (seconds) (RC_ValveRuntimeChangeOver)
192		6-way valve duration (s)	6-way valve runtime (seconds) (RC_ValveRuntime6Way)
193	Analog inputs	CO2 input	Value at 0 V (ppm) VOC index at 0 Volt input (RC_VOC_0V)
194			Value at 10 V (ppm) VOC index at 10 Volt input (RC_VOC_10V)
195			Filter time (s) CO2 filter time (0 to 17200 seconds) (RC_CO2FilterTime)
196		Humidity input	Value at 0 V (%) RH at 0 Volt input (RC_RH_0V)
197			Value at 10 V (%) RH at 10 Volt input (RC_RH_10V)
198			Filter time (s) RH filter time (0 to 17200 seconds) (RC_RHFilterTime)
199		Temperature input 0...10 V	Value at 0 V (°C) Room temperature at 0 Volt input. (RC_RoomTemp_0V)
200			Value at 10 V (°C) Room temperature at 10 Volt input. (RC_RoomTemp_10V)
201			Filter time (s) Temperature filter time (0 to 17200 seconds) (RC_TempFilterTime)
202		Flow input	Value at 0 V Air flow at 0 Volt input. (RC_Flow_0V)
203			Value at 10 V Air flow at 10 Volt input. (RC_Flow_10V)
204			Filter time (s) Air flow filter time (0 to 17200 seconds) (RC_FlowFilterTime)
205		VOC input	Value at 0 V VOC index at 0 Volt input. (RC_VOC_0V)
206			Value at 10 V VOC index at 10 Volt input. (RC_VOC_10V)

Table 3-37 Configuration tab levels (continued)

207		Filter time (s)	VOC index filter time (0 to 17200 seconds) (RC_VOCFilterTime)
208	Setpoints	Room setpoints	Heating, occupied (°C) Heating setpoint in Occupied state. (RC_RoomSetpointHeatOccupied)
209		Cooling, occupied (°C)	Cooling setpoint in Occupied state. (RC_RoomSetpointCoolOccupied)
210		Heating, standby (°C)	Heating setpoint in Standby state. (RC_RoomSetpointHeatStandby)
211		Cooling, standby (°C)	Cooling setpoint in Standby state. (RC_RoomSetpointCoolStandby)
212		Heating, unoccupied (°C)	Heating setpoint in Unoccupied state. (RC_RoomSetpointHeatUnoccupied)
213		Cooling, unoccupied (°C)	Cooling setpoint in Unoccupied state. (RC_RoomSetpointCoolUnoccupied)
214		Frost protection (°C)	Heating setpoint in Off state (frost protection). (RC_RoomSetpointHeatOff)
215		Setpoint adjustment (°C)	Setpoint offset. Effective in Standby state or higher. (RC_RoomSetpointOffset)
216		Extra zone	Extra zone setpoint (°C) Setpoint for Extra Zone (RC_ExtraZoneSetpoint)
217		CO2	CO2 setpoint (ppm) Setpoint for CO2 control (RC_CO2Setpoint)
218		Humidity	Humidity setpoint (°C) Setpoint Humidity control (RC_HumiditySetpoint)
219		VOC	VOC setpoint Setpoint for VOC control (RC_VOCSetpoint)
220	Controller settings	Room	P-band (°C) P-band for room PID controller. (RC_RoomPIDPband)
221			I-time (°C) I-time for room PID controller. (RC_RoomPIDItime)
222		Cascade control	Control active Function of supply air limitation. (RC_SupplyAirFunction)
223			Cascade factor Conversion factor for cascade PI parameters. (RC_SupplyAirCascadeFactor)
224			Max heating temperature (°C) Max supply air temperature when heating. (RC_SupplyAirHeatMax)
225			Min heating temperature (°C) Min supply air temperature when heating. (RC_SupplyAirHeatMin)
226			Max cooling temperature (°C) Max supply air temperature when cooling. (RC_SupplyAirCoolMax)

Table 3-37 Configuration tab levels (continued)

227		Min cooling temperature (°C)	Min supply air temperature when cooling. (<i>RC_SupplyAirCoolMin</i>)
228		Frost protection temperature (°C)	Min supply air temperature in frost protect. (<i>RC_SupplyAirFrostProtect</i>)
229	Extra zone	P-band (°C)	P-band for Extra Zone PID controller. (<i>RC_ExtraZonePIDPband</i>)
230		I-time (s)	I-time for Extra Zone PID controller. (<i>RC_ExtraZonePIDItime</i>)
231	CO2	P-band (ppm)	P-band for CO2 PID controller. (<i>RC_CO2PIDPband</i>)
232		I-time (s)	I-time for CO2 PID controller. (<i>RC_CO2PIDItime</i>)
233	Humidity	P-band (%)	P-band for Humidity PID controller. (<i>RC_HumidityPIDPband</i>)
234		I-time (s)	I-time for Humidity PID controller. (<i>RC_HumidityPIDItime</i>)
235	VOC	P-band	P-band for VOC PID controller. (<i>RC_VOCPIDPband</i>)
236		I-time (s)	I-time for VOC PID controller. (<i>RC_VOCPIDItime</i>)
237	Communication	Port settings	Port 1 function Comm. protocol Port 1 (RS485) (<i>RC_Port1Mode</i>)
238			Port 1 baudrate Comm. speed Port 1 (RS485) (<i>RC_Port1Baud</i>)
239			Port 1 parity Comm. format Port 1 (RS485) (<i>RC_Port1Format</i>)
240			Commit settings Commit communication settings. (<i>RC_CommSettingsCommit</i>)
241		Modbus	Modbus address Active Modbus unit ID (<i>QServices.ModbusUnitID</i>)
242		BACnet	BACnet MSTP address BACnet MSTP address (<i>QServices.BACnetMstpMAC_Port_1</i>)
243			MSTP max master address MSTP max master address (<i>QServices.BACnetMstpMaxMasterAddr_Port_1</i>)
244			BACnet device ID BACnet device ID (<i>QServices.BACnetDeviceID</i>)
245			BACnet device object name BACnet device object name. (<i>QServices.BACnetDeviceObjectName</i>)
246		Bluetooth®	Bluetooth® function Function for Bluetooth® Low Energy button. (<i>BleButtonMode</i>)
247			Turn off after (s) Timeout when Bluetooth® Low Energy is started with the button. (<i>BleButtonTimeout</i>)
248		Communication fail	Fail action Offline function (<i>RC_OfflineFunction</i>)

Table 3-37 Configuration tab levels (continued)

249			Timeout (s)	Offline timeout in seconds. External application must write to HEARTBEAT_OFFLINE_TRIGGER within this time to keep regulator in normal mode. (RC_OfflineTimeout)
250			Fallback state	State to set during communication faults. (RC_ControllerStateFail)
251			Status	Heartbeat function indicates if the device is offline or not. (RC_Offline)
252	Alarm settings	Room temperature alarm	High limit (°C)	High room temp alarm limit. (RC_AlarmRoomTempLimitHigh)
253			Low limit (°C)	Low room temp alarm limit. (RC_AlarmRoomTempLimitLow)
254		CO2 level alarm	High limit (°C)	High CO2 alarm limit. (RC_AlarmCO2LimitHigh)

3.5.3 Manual/Auto - Menu tab

The table states all levels in the **Manual/Auto** tab, with a description and reference to variable (where applicable).

Table 3-38 Manual/Auto tab levels

Menu level, reference	Tab (Level 1)	Menu page (Level 2)	Menu group (Level 3)	Menu item (Level 4)	Description (Variable reference)	
255	Manual/Auto	Remote input values	Room temperature	Remote setting	Enable remote setting of room temperature (RC_RoomTempRemoteSelect)	
256				Set value (°C)	Remote setting of room temperature (RC_RoomTempRemote)	
257				Room temperature	Room temperature (RC_RoomTemp)	
258			Supply air temperature	Remote setting	Enable remote setting of supply air temperature (RC_SupplyAirTempRemoteSelect)	
259				Set value (°C)	Remote setting of supply air temperature (RC_SupplyAirTempRemote)	
260				Supply air temperature	Supply air temperature (RC_SupplyAirTemp)	
261			Extra zone temperature	Remote setting	Extra Zone temperature (RC_ExtraZoneTemp)	
262				Set value (°C)	Remote setting of extra zone temperature (RC_ExtraZoneTempRemote)	
263				Extra zone temperature	Extra Zone temperature (RC_ExtraZoneTemp)	
264			Change-over temperature	Remote setting	Enable remote setting of change-over temperature (RC_ChangeOverTempRemoteSelect)	
265				Set value (°C)	Remote setting of changeover temperature (RC_ChangeOverTempRemote)	
266				Change-over temperature	Changeover temperature (RC_ChangeOverTemp)	
267			Change-over VAV temperature	Remote setting	Enable remote setting of change-over VAV temperature (RC_ChangeOverVAVTempRemoteSelect)	
268				Set value (°C)	Remote setting of changeover VAV temperature (RC_ChangeOverVAVTempRemote)	
269				Change-over VAV temperature	Changeover VAV temperature (RC_ChangeOverVAVTemp)	
270				CO2 level	Remote setting	Enable remote setting of room CO2 level (RC_CO2LevelRemoteSelect)

Table 3-38 Manual/Auto tab levels (continued)

271		Set value (ppm)	Remote setting of room CO2 level (RC_CO2LevelRemote)
272		CO2 level	Room CO2 level (RC_CO2Level)
273	Room humidity	Remote setting	Enable remote setting of relative humidity (RC_HumidityRemoteSelect)
274		Set value (°C)	Remote setting of relative humidity (RC_HumidityRemote)
275		Room humidity	Relative humidity (RC_Humidity)
276	Air flow	Remote setting	Enable remote setting of air flow (RC_AirFlowRemoteSelect)
277		Set value (°C)	Remote setting of air flow (RC_AirFlowRemote)
278		Air flow	Air flow (RC_AirFlow)
279	VOC input	Remote setting	Enable remote setting of VOC index (RC_VOCRemoteSelect)
280		Set value (°C)	Remote setting of VOC index (RC_VOCRemote)
281		VOC input	VOC index (RC_VOC)
282	Manual/Auto	Controller state	Controller state Current state (RC_ControllerState)
283		Remote state settings	Sets the state directly via communication. (RC_RemoteControllerState)
284		Shutdown	Set controller in the state indicated by RC_ControllerStateShutdown (RC_ControllerStateSetShutdown)
285		Forced ventilation	Set controller in Bypass state (RC_ControllerStateSetBypass)
286		Fan control source	Fan control source Fan speed setting (RC_FanSelect)
287		Heating output	Mode Manual/auto select for RoomHeat1Output (RC_RoomHeat1OutputManSelect)
288		Set value (%)	Manual setting of RoomHeat1Output (RC_RoomHeat1OutputManual)
289		Heating output	Room control Heat1 output analogue (RC_RoomHeat1OutputAO)
290		Heating 2 output	Mode Manual/auto select for RoomHeat2Output (RC_RoomHeat2OutputManSelect)

Table 3-38 Manual/Auto tab levels (continued)

291		Set value (%)	Manual setting of RoomHeat2Output (RC_RoomHeat2OutputManual)
292		Heating output	Room control Heat2 output analogue (RC_RoomHeat2OutputAO)
293	Cooling output	Mode	Manual/auto select for RoomCool1Output (RC_RoomCool1OutputManSelect)
294		Set value (%)	Manual setting of RoomCool1Output (RC_RoomCool1OutputManual)
295		Cooling output	Room control Cool1 output analogue (RC_RoomCool1OutputAO)
296	Cooling 2 output	Mode	Manual/auto select for RoomCool2Output (RC_RoomCool2OutputManSelect)
297		Set value (%)	Manual setting of RoomCool2Output (RC_RoomCool2OutputManual)
298		Cooling 2 output	Room control Cool2 output analogue (RC_RoomCool2OutputAO)
299	VAV output	Mode	Manual/auto select for RoomVAV1Output (RC_RoomVAV1OutputManSelect)
300		Set value (%)	Manual setting of RoomVAV1Output (RC_RoomVAV1OutputManual)
301		VAV output	Room control VAV1 output analogue (RC_RoomVAV1OutputAO)
302	VAV 2 output	Mode	Manual/auto select for RoomVAV2Output (RC_RoomVAV2OutputManSelect)
303		Set value (%)	Manual setting of RoomVAV2Output (RC_RoomVAV2OutputManual)
304		VAV 2 output	Room control VAV2 output analogue (RC_RoomVAV2OutputAO)
305	Change-over output	Mode	Manual/auto select for RoomChangeOverOutput (RC_RoomChangeOverOutput-ManSelect)
306		Set value (%)	Manual setting of RoomChangeOverOutput (RC_RoomChangeOverOutput-Manual)
307		Change-over output	Room control Change over output analogue (RC_RoomChangeOverOutputAO)

Table 3-38 Manual/Auto tab levels (continued)

308		Change-over VAV output	Mode	Manual/auto select for RoomChangeOverVAVOutput (RC_RoomChangeOverVAVOutputManSelect)
309			Set value (%)	Manual setting of RoomChangeOverVAVOutput (RC_RoomChangeOverVAVOutputManual)
310			Change-over VAV output	Room control Change over VAV output analogue (RC_RoomChangeOverVAVOutputAO)
311		6-way valve output	Mode	Manual/auto select for Room6WayValveOutput (RC_Room6WayValveOutputManSelect)
312			Set value (%)	Manual setting of Room6WayValveOutput (RC_Room6WayValveOutputManual)
313			6-way valve output	Room control 6-way valve output analogue (RC_Room6WayValveOutputAO)
314		Extra zone output	Mode	Manual/auto select for ExtraZoneOutput (RC_ExtraZoneOutputManSelect)
315			Set value (%)	Manual setting of ExtraZoneOutput (RC_ExtraZoneOutputManual)
316			Extra zone output	Extra Zone output analogue (RC_ExtraZoneOutputAO)
317		EC Fan control	Mode	Manual/auto select for ECFanSpeed (RC_ECFanSpeedManSelect)
318			Set value (%)	Manual setting of ECFanSpeed (RC_ECFanSpeedManual)
319			EC Fan control	Current EC fan speed (RC_ECFanSpeed)
320		CO2 control output	Mode	Manual/auto select for CO2Control (RC_CO2ControlManSelect)
321			Set value (%)	Manual setting of CO2Control (RC_CO2ControlManual)
322			CO2 control output	CO2 control analogue out (RC_CO2ControlAO)
323		Humidify control output	Mode	Manual/auto select for HumidifyOutput (RC_HumidifyOutputManSelect)
324			Set value (%)	Manual setting of HumidifyOutput (RC_HumidifyOutputManual)
325			Humidify control output	Humidify analogue out (RC_HumidifyOutputAO)

Table 3-38 Manual/Auto tab levels (continued)

326		Dehumidify control output	Mode	Manual/auto select for DehumidifyOutput (<i>RC_DehumidifyOutputManSelect</i>)
327			Set value (%)	Manual setting of DehumidifyOutput (<i>RC_DehumidifyOutputManual</i>)
328			Dehumidify control output	Dehumidify analogue out (<i>RC_DehumidifyOutputAO</i>)
329		VOC control output	Mode	Manual/auto select for VOCControl (<i>RC_VOCControlManSelect</i>)
330			Set value (%)	Manual setting of VOCControl (<i>RC_VOCControlManual</i>)
331			VOC control output	VOC control analogue out (<i>RC_VOCControlAO</i>)
332	Hardware control	UO1	UO1 - Disabled	Value converted to SI units from % (<i>IoAnaOut_1_converted</i>)
333			Mode	Set to 1 to enable override (<i>IoAnaOut_1_override_en</i>)
334			Set value (V)	Set to 1 to enable override (<i>IoAnaOut_1_override</i>)
335			UO1 - Disabled	Value set for output (<i>IoDo_1_value</i>)
336			Mode	Set to 1 to enable override (<i>IoDo_1_override_en</i>)
337			Set value	Override value (<i>IoDo_1_override</i>)
338		UO2	UO1 - Disabled	Value converted to SI units from % (<i>IoAnaOut_2_converted</i>)
339			Mode	Set to 1 to enable override (<i>IoAnaOut_2_override_en</i>)
340			Set value (V)	Set to 1 to enable override (<i>IoAnaOut_2_override</i>)
341			UO1 - Disabled	Value set for output (<i>IoDo_2_value</i>)
342			Mode	Set to 1 to enable override (<i>IoDo_2_override_en</i>)
343			Set value	Override value (<i>IoDo_2_override</i>)
344		AO1	UO1 - Disabled	Value converted to SI units from % (<i>IoAnaOut_3_converted</i>)
345			Mode	Set to 1 to enable override (<i>IoAnaOut_3_override_en</i>)
346			Set value (V)	Override value (<i>IoAnaOut_3_override</i>)
347		AO2	UO1 - Disabled	Value converted to SI units from % (<i>IoAnaOut_4_converted</i>)

Table 3-38 Manual/Auto tab levels (continued)

348		Mode	Set to 1 to enable override (IoAnaOut_4_override_en)
349		Set value (V)	Override value (IoAnaOut_4_override)

3.6 Control function examples - Regio RCX series

3.6.1 Hotel 1 - Heating (actuator radiator)+ VAV and Extra Zone (control of bathroom w. floor heating)

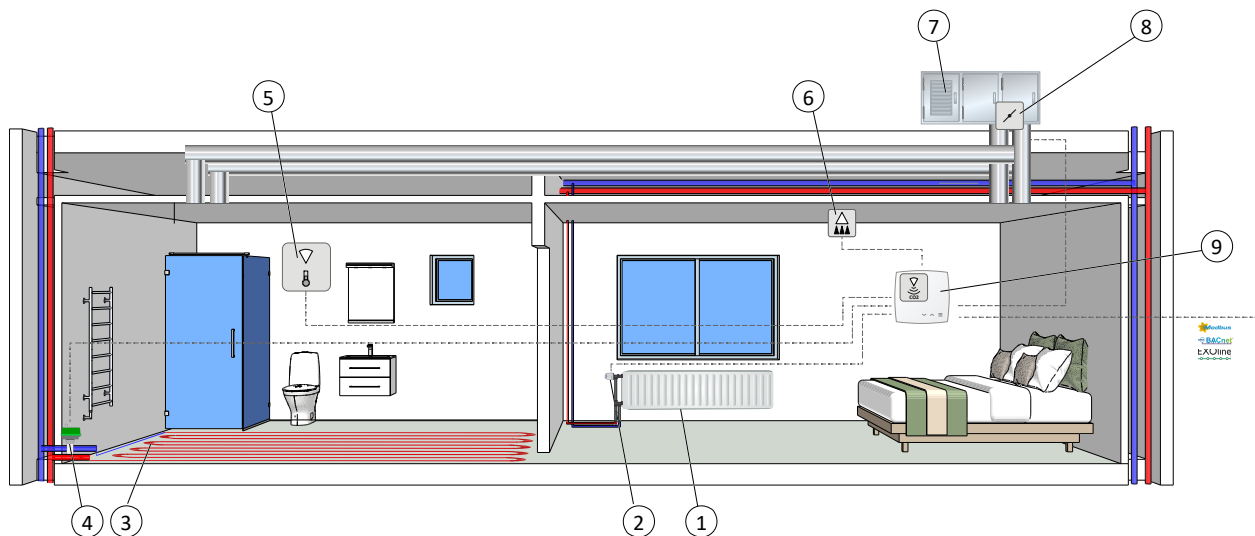


Figure 3-33 Illustration of application example - Hotel 1

- ① Radiator
- ② Thermal actuator
- ③ Floor heating
- ④ Actuator
- ⑤ Temperature sensor, for Extra zone
- ⑥ Presence detector
- ⑦ AHU
- ⑧ Damper / damper actuator
- ⑨ RCX controller, w. temperature and CO₂ sensor

This control mode is suitable for room HVAC systems that use a radiator as a heating device, and low supply air temperature that is distributed into the room via a diffuser to provide cooling and fresh air. The air must be pretreated in the AHU.

The desired room temperature is achieved by controlling the thermal actuator (2) and the VAV damper (8). In addition, the VAV damper can be opened via the CO₂ function to increase the fresh air in the room, see section CO₂ control.

If the temperature drops below the setpoint (heating), the controller will go into heating mode and open the valve to the actuator to increase the temperature in the room.

If the temperature rises above the setpoint (cooling), the controller will go into cooling mode and open the damper to lower the temperature in the room.

Table 3-39 Controller output configuration values and controller output types.

Output signal	Controller output configuration value	Controller output type
Heating signal	Heating	Analog
	Heating valve, thermal (PWM, Pulse Width Modulation, Pulse Width Modulation)	Digital
VAV signal	VAV	Analog

Figure 3-34 illustrates the control behaviour when the controller regulates based on the heating and cooling demand, when no maximum or minimum limits are set for the heating output signal.

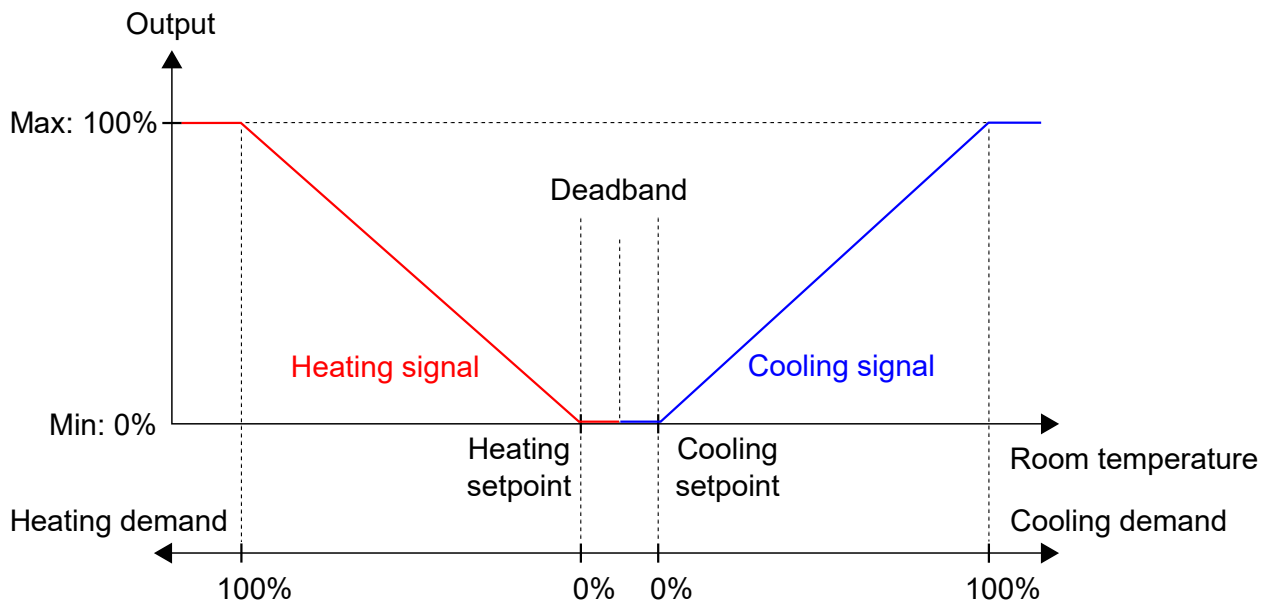


Figure 3-34 Control behaviour for the Heating + Cooling controller mode.

See section 4.1.5 *Wiring - Control function examples* for specific wiring examples based on the application examples in section 3.6 *Control function examples - Regio RCX series*.

Extra zone

In this example, the extra zone function is used to control the under floor heating in a bathroom. For more information, see section *Extra zone*.

3.6.2 Hotel 2 - Heating (battery) + Cooling (battery) + Fan Control (EC-Fan)

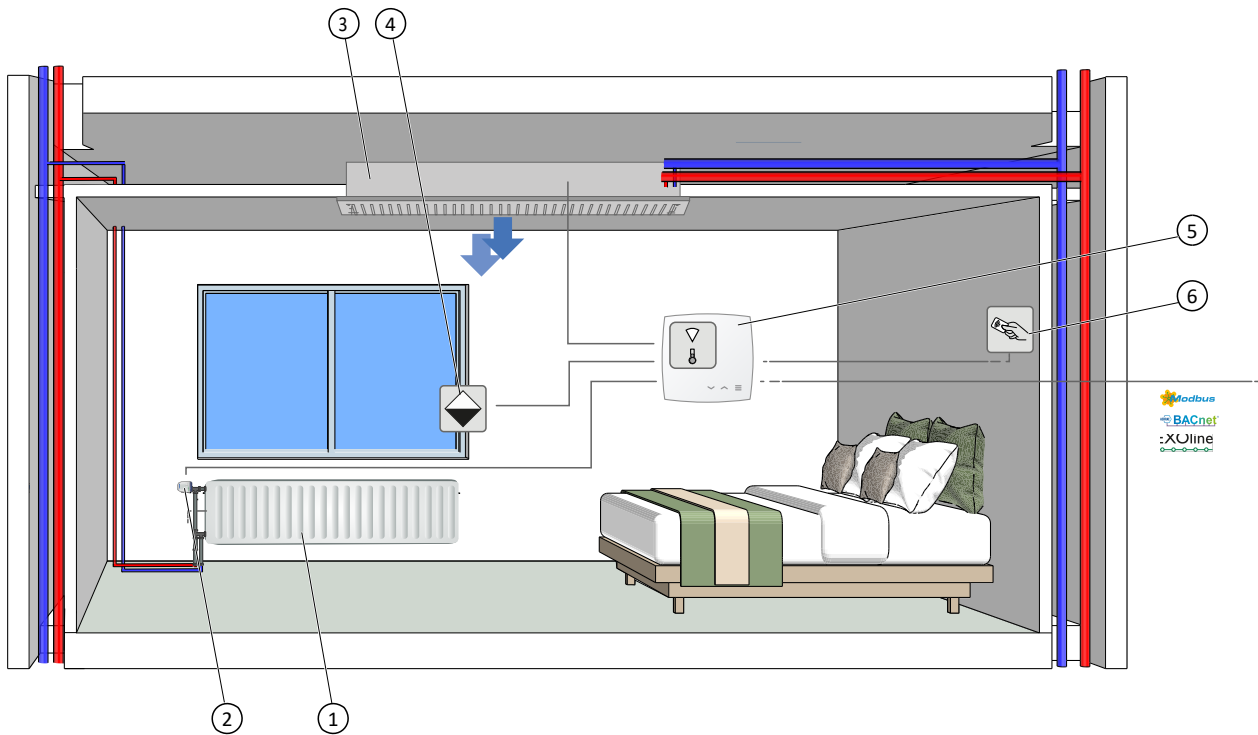


Figure 3-35 Illustration of application example - Hotel 2

- ① Radiator
- ② Thermal actuator
- ③ Fan coil cooling
- ④ Window contact
- ⑤ RCX controller, temperature sensor
- ⑥ Key card switch

This controller mode is suitable for room HVAC systems that use a radiator or fan coil unit as a heating device, and a fan coil unit as a cooling device.

The controller acts as a heating and cooling controller and regulates based on the heating setpoint, cooling setpoint, and the current room temperature.

The temperature range between the heating and cooling setpoints is defined as the deadband. The controller is in heating mode when the room temperature is lower than heating setpoint plus half the deadband, and in cooling mode when the room temperature is higher than [cooling setpoint minus half the deadband].

When in heating mode, the controller outputs a heating signal, *Heating signal*, that is configured on the controller outputs by using the values listed in *Table 3-40*.

When in cooling mode, the controller outputs a cooling signal, *Cooling signal*, that is configured on the controller outputs by using the values listed in *Table 3-40*.

Table 3-40 Controller output configuration values and controller output types.

Output signal	Controller output configuration value	Controller output type
Heating signal	Heating	Analog
	Heating valve, thermal (PWM, Pulse Width Modulation, Pulse Width Modulation)	Digital
Cooling signal	Cooling	Analog
	Cooling valve, thermal (PWM, Pulse Width Modulation, Pulse Width Modulation)	Digital

Table 3-40 Controller output configuration values and controller output types. (continued)

Output signal	Controller output configuration value	Controller output type
6-way valve signal	6-way valve	Analog

Figure 3-36 illustrates the control behaviour for this controller mode when no maximum or minimum limits are set.

The heating demand increases as the room temperature falls. When the room temperature falls below the heating setpoint, *Heat* sequence increases to respond to the heating demand. At a heating demand of 100%, *Heat* sequence reaches its maximum. When the room temperature is in the range between the heating setpoint and the deadband centre and no heating demand exists, *Heat* sequence is at its minimum.

The cooling demand increases as the room temperature rises. When the room temperature rises above the cooling setpoint, *Cool* sequence increases to respond to the cooling demand. At a cooling demand of 100%, *Cool* sequence reaches its maximum. When the room temperature is in the range between the cooling setpoint and the deadband centre and no cooling demand exists, *Cool* sequence is at its minimum.

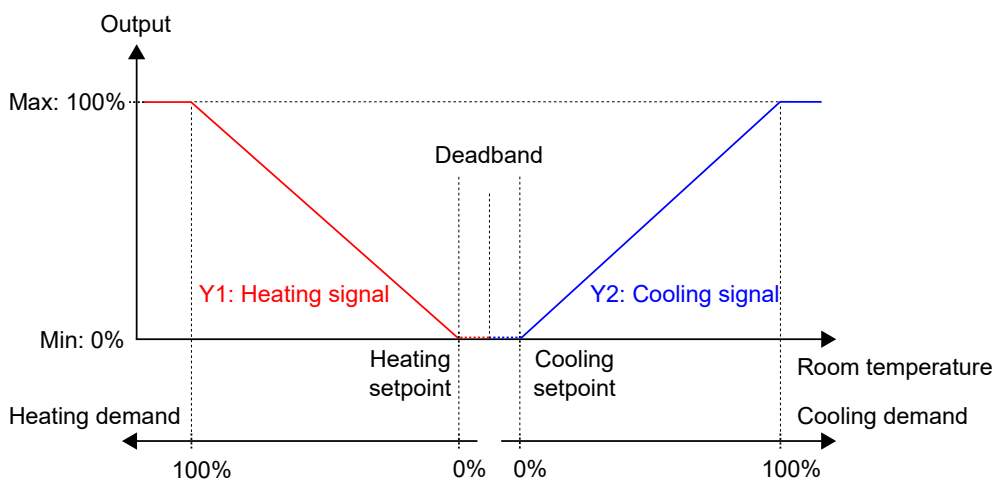


Figure 3-36 Control behaviour for the Heating + Cooling controller mode.

See section 4.1.5 *Wiring - Control function examples* for specific wiring examples based on the application examples in section 3.6 *Control function examples - Regio RCX series*.

Fan Control

The controller outputs a fan speed signal, Fan speed output, that is configured on a controller output by using the value in Table 3-41.

In auto mode, the Fan speed output signal corresponds to the current heating or cooling demand, as illustrated in Figure 3-29.

In manual mode, the Fan speed output signal is independent of the current heating or cooling demand. Instead, the fan speed 1, 2, and 3 signals are defined by a number of equal thirds relative to the *Limit maximum EC fan speed to (%)* configuration setting, as illustrated in Figure 3-30. For example, the fan speed 1 signal is equal to 0.33 times the set maximum fan speed value, and the fan speed 2 signal is equal to 0.67 times the set maximum fan speed value.

Table 3-41 EC fan control configuration value and controller input type.

Output signal	Controller output configuration value	Controller output type
Fan speed output	EC fan	Analogue

The *Fan control* configuration settings are described in Table 3-29.

See section *4.1.5 Wiring - Control function examples* for specific wiring examples based on the application examples in section *3.6 Control function examples - Regio RCX series*.

3.6.3 Office - Heating/Cooling (change-over) + Fan Control

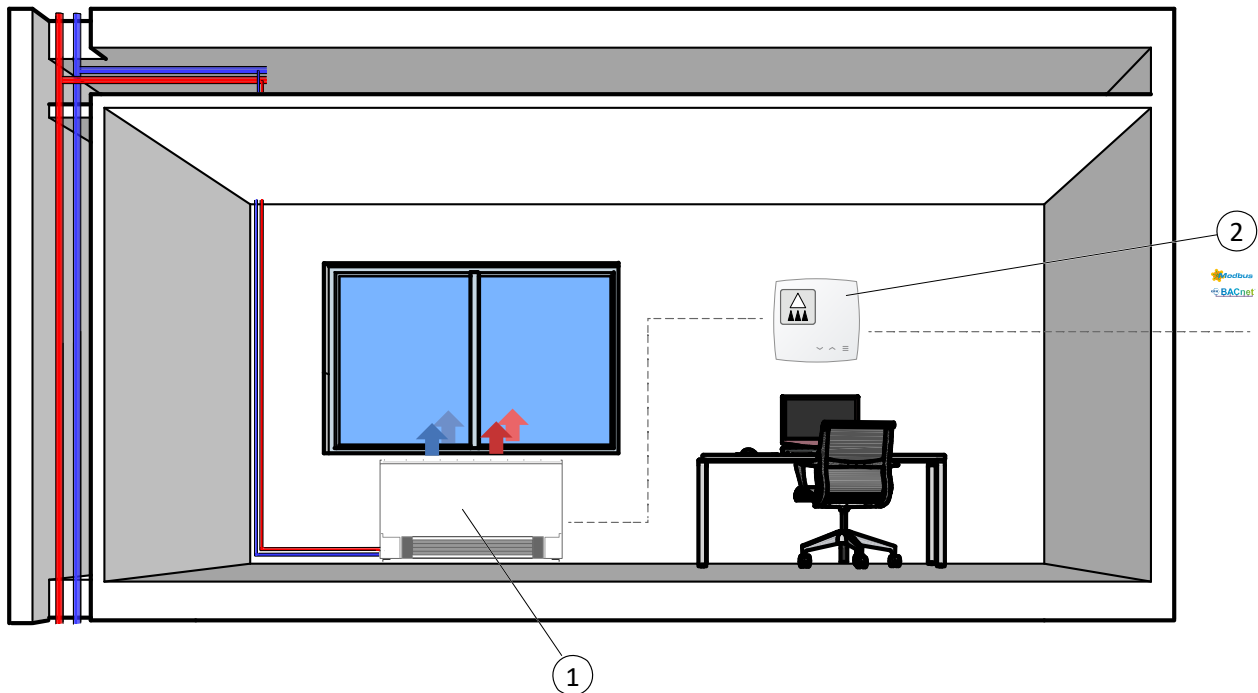


Figure 3-37 Illustration of application example - Office

① 2-pipe fan coil (heating/cooling)

② RCX controller, presence detector

This control mode is suitable for room HVAC systems that use a 2-pipe fan coil as a heating and cooling device. The change-over function makes it possible to use the controller 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 controller acts as a heating or cooling controller and regulates based on the heating setpoint, cooling setpoint, and the current room temperature.

The controller is either in heating or cooling mode, and switches between the modes according to its current change-over state.

For more information, see section *Change-over*.

When the controller is in heating or cooling mode, the controller outputs a heating or cooling signal, that is configured on the controller outputs by using the configuration values listed in *Table 3-42*.

Maximum and minimum limits for the output signal can be set.

Table 3-42 Controller output configuration values and controller output types.

Output signal	Controller output configuration value	Controller output type
Change-over valve (heating or cooling mode) signal	Change-over valve	Analog
	Change-over valve, thermal (PWM, Pulse Width Modulation, Pulse Width Modulation)	Digital

Figure 3-38 illustrates the control behaviour in heating mode, and when no maximum or minimum limits are set.

The heating demand increases as the room temperature falls. When the room temperature falls below the heating setpoint, *Change-over (heating mode) signal* increases to respond to the heating demand. At 100% heating demand: *Change-over (heating mode) signal* reaches its maximum.

When the room temperature is higher than the heating setpoint and no heating demand exists: *Change-over (heating mode) signal* is at its minimum.

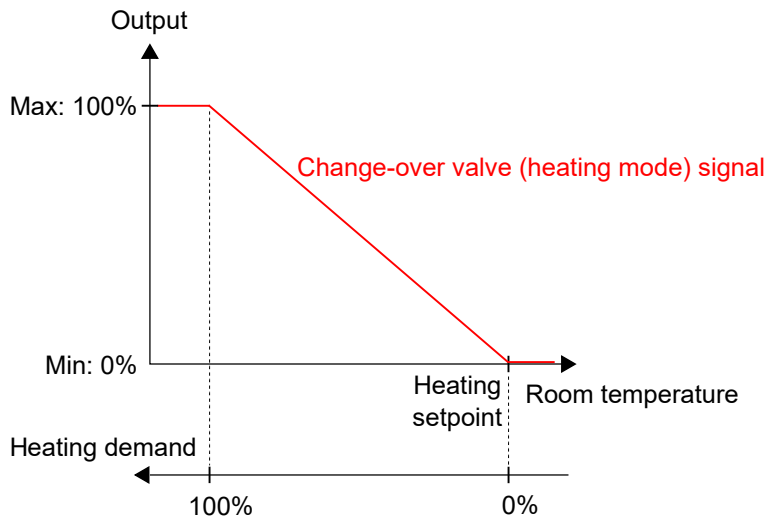


Figure 3-38 Control behaviour for the Heating/Cooling (change-over) controller mode when the controller is in heating mode.

Figure 3-39 illustrates the control behaviour in cooling mode, and when no maximum or minimum limits are set.

The cooling demand increases as the room temperature rises. When the room temperature rises above the cooling setpoint, the *Change-over (cooling mode) signal* increases to respond to the cooling demand. At 100% cooling demand, the *Change-over (cooling mode) signal* reaches its maximum.

When the room temperature is lower than the cooling setpoint and no cooling demand exists, the *Change-over (cooling mode) signal* is at its minimum.

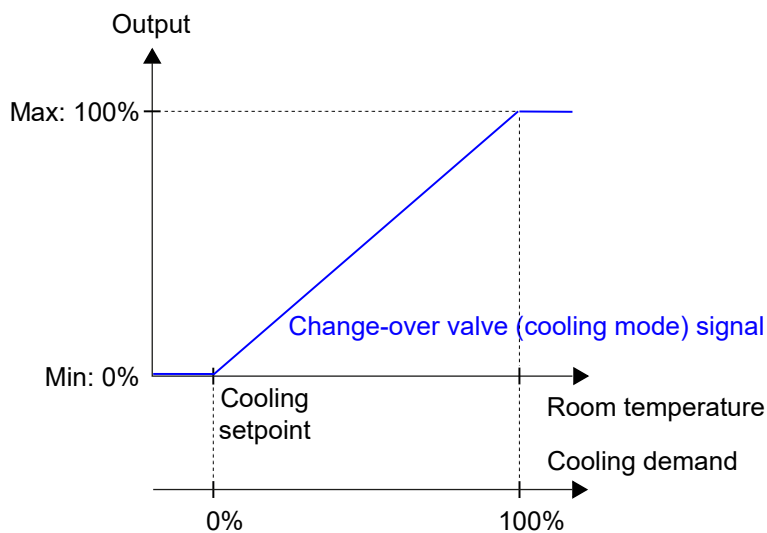


Figure 3-39 Control behaviour for the Heating/Cooling (change-over) controller mode when the controller is in cooling mode.

See section 4.1.5 *Wiring - Control function examples* for specific wiring examples based on the application examples in section 3.6 *Control function examples - Regio RCX series*.

Fan Control (façade unit)

The controller outputs a fan speed signal, that is configured on a controller output by using the value in *Table 3-41*.

In auto mode, the signal corresponds to the current heating or cooling demand, as illustrated in *Figure 3-29*.

In manual mode, the signal is independent of the current heating or cooling demand. Instead, the fan speed 1, 2, and 3 signals are defined by a number of equal thirds relative to the *Limit maximum EC fan speed to (%)* configuration setting, as illustrated in *Figure 3-30*. For example, the fan speed 1 signal is equal to 0.33 times the set maximum fan speed value, and the fan speed 2 signal is equal to 0.67 times the set maximum fan speed value.

The *Fan control* configuration settings are described in *Table 3-29*.

See section *4.1.5 Wiring - Control function examples* for specific wiring examples based on the application examples in section *3.6 Control function examples - Regio RCX series*.

3.6.4 Conference - Heating (actuator radiator) + Cooling (chilled ceiling) + VAV (CO₂)

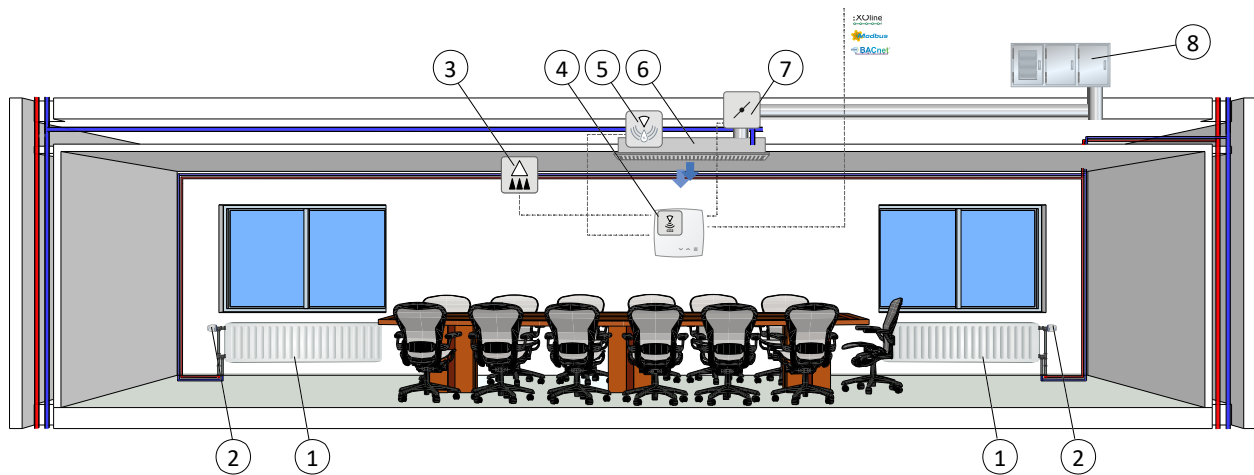


Figure 3-40 Illustration of application example - Conference

- | | |
|---|---------------------------|
| ① Radiator | ⑤ Condensation sensor |
| ② Thermal actuator | ⑥ Chilled beam |
| ③ Presence detector | ⑦ Damper, damper actuator |
| ④ RCX controller, with CO ₂ sensor | ⑧ AHU |

The room control sequences Sequence 1 - Heat, Sequence 2 - Cool, and Sequence 3 - VAV are suitable for room HVAC systems that use a radiator as a heating device and a chilled beam as a cooling device, where the beam contains a cooling valve and a damper that regulates low supply air temperature that is distributed into the room to provide cooling and fresh air. The air must be pretreated and cooled since the damper itself does not have any cooling capacity.

The controller acts as a heating and cooling controller and regulates based on the heating setpoint, cooling setpoint, and the current room temperature. In addition, the controller can be set to also regulate based on fresh air demand, or based on the cooling demand and fresh air demand simultaneously, see section *VAV control source*. The controller regulates based on the fresh air demand by using CO₂ control, see section *CO₂ control*.

The temperature range between the heating and cooling setpoints is defined as the deadband. The controller is in heating mode when the room temperature is lower than heating setpoint plus half the deadband, and in cooling mode when the room temperature is higher than cooling setpoint minus half the deadband.

When in **Heat** sequence, the controller outputs both a heating signal and a VAV signal. These are configured on the controller outputs by using the values listed in *Table 3-43*.

When in cooling mode, the controller outputs a cooling signal and a VAV signal, in sequence, that are configured on the controller outputs by using the configuration values listed in *Table 3-43*.

The signal sequence order is configurable.

Maximum and minimum limits for the heating and cooling output signals can be set. Maximum and minimum limits for the VAV output signal are set via the VAV sequence, see section *VAV control source*.

Table 3-43 Controller output configuration values and controller output types.

Output signal	Controller output configuration value	Controller output type
Heating signal	Heating	Analog
	Heating valve, thermal (PWM, Pulse Width Modulation, Pulse Width Modulation)	Digital
Cooling signal	Cooling	Analog
	Cooling valve, thermal (PWM, Pulse Width Modulation, Pulse Width Modulation)	Digital
Heating signal+ Cooling signal	6-way valve	Analog
VAV signal	VAV	Analog

Figure 3-41 illustrates the control behaviour when the controller regulates based on heating and cooling demand, when no maximum or minimum limits are set for the heating or cooling output signals, and when a minimum limit is set for the VAV output signal.

The heating demand increases as the room temperature falls. When the room temperature falls below the heating setpoint, *Heating signal* increases to respond to the heating demand. At a heating demand of 100%, the *Heating signal* reaches its minimum. When the room temperature is in the range between the heating setpoint and the deadband centre, and no heating demand exists, *Heating signal* is at its minimum.

The cooling demand increases as the room temperature rises. When the room temperature rises above the cooling setpoint, the *Cooling signal* increases to respond to the cooling demand. At a cooling demand of 49%, the *Cooling signal* reaches its maximum. When the room temperature rises further and the cooling demand exceeds 51%, the *VAV signal* increases while the *Cooling signal* stays at its maximum. At a cooling demand of 100%, the *VAV signal* reaches its maximum. When the room temperature is in the range between the cooling setpoint and the deadband centre, and no cooling demand exists, both the *Cooling signal* and the *VAV signal* are at their minimum.

The *VAV signal* never goes below its set minimum limit.

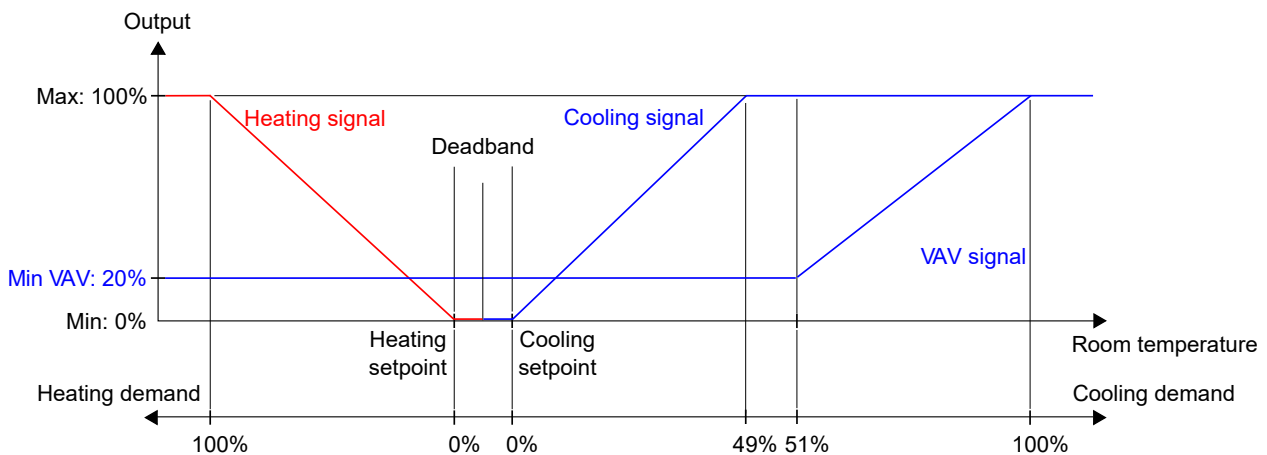


Figure 3-41 Control behaviour for the Heating + Cooling + VAV controller mode when the controller regulates based on heating and cooling demand.

See section 4.1.5 *Wiring - Control function examples* for specific wiring examples based on the application examples in section 3.6 *Control function examples - Regio RCX series*.

CO₂

CO₂ control is a function that enables the controller to regulate based on fresh air demand. CO₂ control is performed by connecting a CO₂ sensor, and by letting the controller control the VAV output signal based on the CO₂ setpoint and the current CO₂ level in the room.

CO₂ control is managed via the VAV control function, by applying the *VAV control* configuration setting, see section *VAV control source*.

The CO₂ sensor is connected to and configured on an analogue controller input by using the value listed in *Table 3-44*. Regin's RCX-TCD, RCX-THCVPD, and RCX-THCVP controllers have a built-in CO₂ sensor. When either of these units is used, the controller recognizes the built-in CO₂ sensor automatically, and no configuration is needed.

Table 3-44 CO₂ control configuration value and controller input type.

Configuration value	Controller input type
CO ₂ sensor	Analogue

CO₂ control provides a specific setting, listed in *Table 3-45*, that is only applicable for the controller modes that include a VAV sequence. This setting is located in the *Configuration ▶ Control functions ▶ Controller mode* pane in the Regin:GO app or the Application tool, and is shown when an applicable controller mode is selected.

Table 3-45 CO₂ control configuration setting.

Configuration setting	Description
VAV sequence controlled by	The VAV output signal is controlled by the Cooling demand or CO ₂ level, the highest demand controls the output.

Figure 3-42 illustrates the control behaviour for CO₂ control when a minimum limit is set for the VAV output signal.

The demand for fresh air increases as the CO₂ level in the room rises. When the CO₂ level rises above the CO₂ setpoint, *VAV signal* increases to respond to the fresh air demand. At 100% fresh air demand, *VAV signal* reaches its maximum.

When the CO₂ level in the room is lower than the CO₂ setpoint and no fresh air demand exists, *VAV signal* is at its minimum.

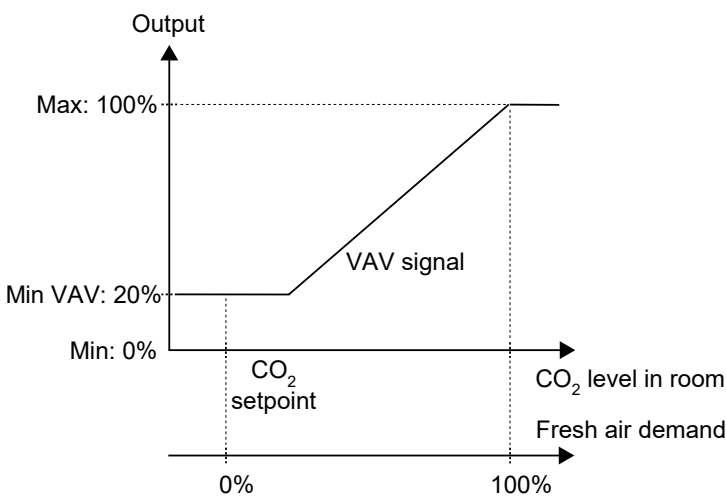


Figure 3-42 CO₂ control behaviour.

See section 4.1.5 *Wiring - Control function examples* for specific wiring examples based on the application examples in section 3.6 *Control function examples - Regio RCX series*.

3.7 External sensors

The following external sensors can be connected to an AI. A connected external sensor will replace the internal sensor if one of those are available. PT1000 sensors must be connected to UI1, and 0...10 V sensors to UI1 or UI2.

All 0...10 V sensor inputs are scalable, 0V = XX: 10V= YY to get it in the correct unit.

Table 3-46 Sensor types and variables

Sensor	Type	Value variable
Room sensor ₁	PT1000	RC_RoomTemp
Change-over media temperature	PT1000	RC_ChangeOverTemp
Change-over VAV media temperature	PT1000	RC_ChangeOverVAVTemp
Extra zone temperature	PT1000	RC_ExtraZoneTemp
Supply air temperature	PT1000	RC_SupplyAirTemp
Room Sensor ¹	0...10 V	RC_RoomTemp
CO ₂ sensor ₁	0...10 V	RC_CO2Level
Humidity sensor ₁	0...10 V	RC_Humidity
VOC sensor ₁	0...10 V	RC_VOC
Air Volume	0...10 V	RC_AirFlow

1. Replace the internal sensor, if one of those are available.

3.7.1 Sensor values via communication

If the controller is part of a bigger system, sensor values can be written from a master controller or a SCADA system over the communication bus, using Modbus, BACnet or EXOline. If the sensor value is set in remote mode, it overrides all local sensors.

The following sensor values can be set remotely:

- ✓ Room temperature (°C)
- ✓ CO₂ (ppm)
- ✓ Air flow
- ✓ Change-over temperature (°C)
- ✓ Extra zone temperature (°C)
- ✓ Supply air temperature (°C)
- ✓ Relative humidity (%)
- ✓ VOC (Volatile Organic Compounds), (AQI, range 0-500)

See also chapter 3.4.8 *Manual/Auto*.

3.8 Special functions

3.8.1 Condensation sensor

You can use the analogue input connection (AO2) as a condensation sensor input (*CI input*) on all Regio RCX controllers. This input is intended for Regin's condensation sensor, KG-A/1, and function as a digital input for condensation or no condensation detection internally. For more information, see section 4.1.4 *Wiring*.

When the condensation sensor is activated, the cooling control is blocked and the controller is set in neutral position. When condensation ceases, the controller will start controlling from the neutral position.

3.8.2 Window contact

When *Window contact* has been configured, the controller is set to normal mode on *Closed window*. On *Open window*, the controller is set to off mode and the frost protection function is activated.

3.9 Factory reset

You can reset the device to factory settings with use of the touch buttons (available also for devices without visible buttons). To reset the device with the touch buttons, follow the below procedure **within the first 60 seconds after starting the device**:

1. Make sure that the device has been turned off.
2. Start the device.
3. Press and hold on the upper right part of the device (keep active during the full sequence), within the first 60 seconds after starting the device.
4. Press and hold the lower right part of the device ([Menu] button) for approximately 10 seconds. During this time the indication will be green, when done it will change to red.
5. Release the lower right part of the device ([Menu] button).
6. Press (and release) the lower right part of the device ([Menu] button) three (3) times in 10 seconds.
7. The LED flashes in green for a short time to confirm a successful factory reset, and the device restarts with default settings.

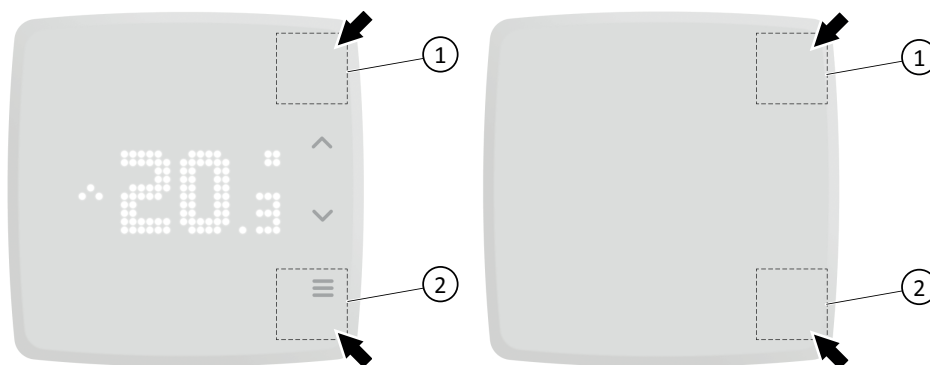


Figure 3-43 Factory reset press areas (with/without display)

① Upper right part of the device

② Lower right part of the device, [Menu] button

If you have not succeeded in pressing the lower right part of the device (2) ([Menu] button) three (3) times during ten (10) seconds in step 6., or you release the upper right part of the device (1), the reset operation is

interrupted and the LED returns to what it showed before. Start with step 3. anew, if you still want to make a factory reset.

4 Information for the installer

4.1 Installation

4.1.1 Installation preparations

See the RCX-... Instruction, to be found at www.regincontrols.com.

4.1.2 Using labels

On the back of the electronics cassette, there is a set of labels which make it easier to install a large number of Regio RCX controllers. By using the labels as carriers of information for the installation engineer, much time will be saved and you can keep wiring errors at a minimum.

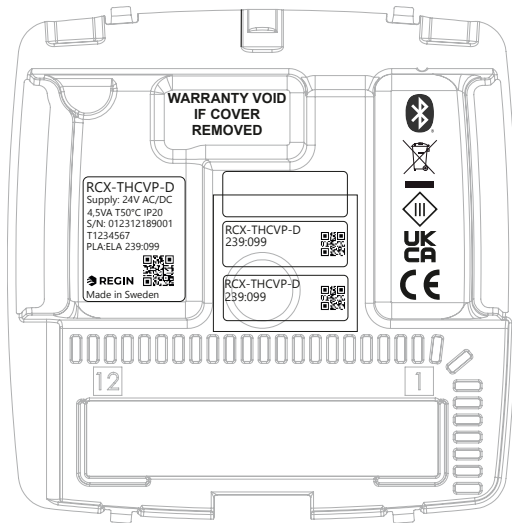


Figure 4-1 Labels on the back of the controller (example label illustrated, may vary).

The three-piece label can be split and the two smaller label parts to the right can be fastened to the installation drawing and the wall mount of the controller. The labels carry information on the communication address etc., and have QR codes and a note area where you can enter a reference number to the connection diagram.

4.1.3 Mounting



Caution! If the unit is mounted over electrical installation pipes, it is important that the airflow is not obstructed. If there is a risk for this, you need to plug the pipe.

1. With surface-mounted cabling, break out suitable holes from the marks in the plastic.
See the Regio RCX-... Instruction, to be found at www.regincontrols.com.
2. Find a location that has a temperature representative for the room. A suitable location is approximately 1.6 m above floor level in a place with unobstructed air circulation.
3. Select suitable holes and mount the wall mount onto the wall or a connection box with fastening screws, so that the arrows on the wall mount point upwards.
The wall mount has several fixing hole combinations.



Note! Do not tighten the fastening screws too hard.

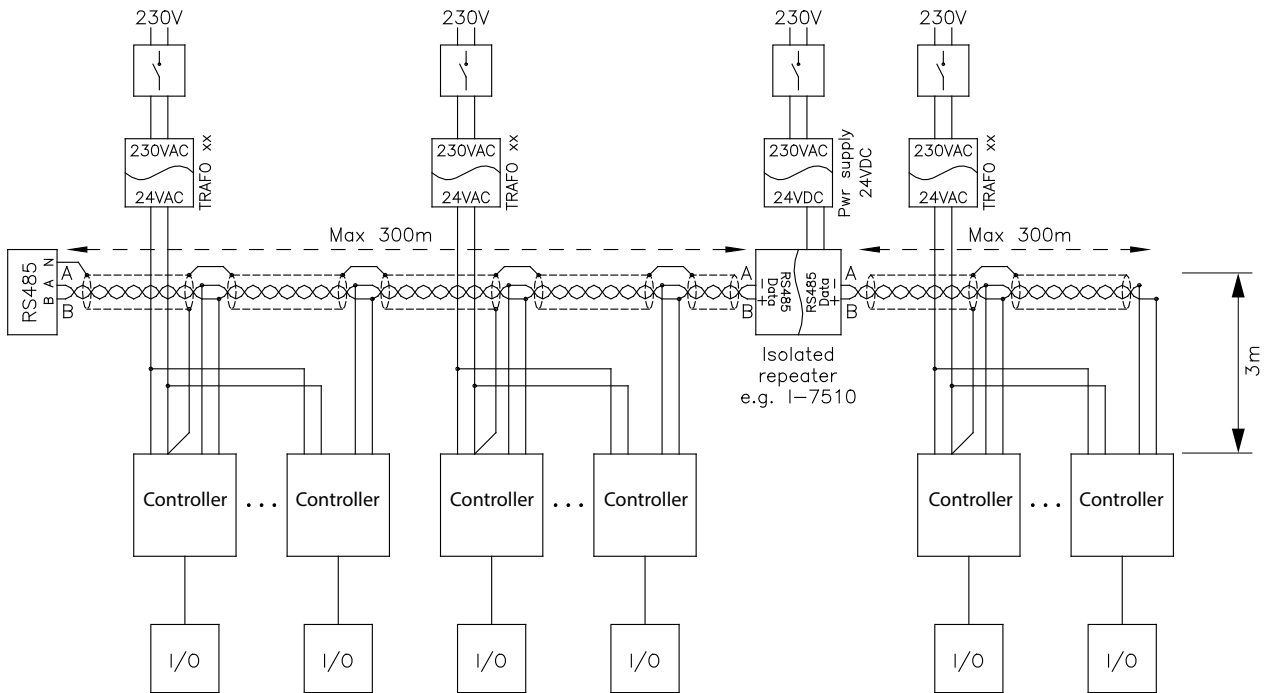
4. Place the terminal in the sliding slots on the wall mount.
 5. Connect the cables needed to the terminal, according to the terminal list.
- For more information, see the RCX-... Instruction, to be found at www.regincontrols.com.

4.1.4 Wiring

All units that share the same transformer and communication loop must use the same transformer-pole for G (terminal 1) and G0 (terminal 2). On the communication loop, the A-terminal (terminal 3) should only be connected to another A-terminal, and the B-terminal (terminal 4) to another B-terminal. Otherwise, the communication will not work.

The communication cable must be a screened twisted pair cable. The shield must be connected to G0 on one (and only one) controller in each separate power supply loop with 24 V AC. If the length of the loop exceeds 300 m, a repeater is required. See figure below.

See *Figure 4-2 Example of terminal locations* which shows an example of the location of the terminals.



Caution! In installations with wires entering the device from the side, the wires must be firmly attached to the surrounding wall to relieve the wires from strain and twisting, as there are no internal strain relief.

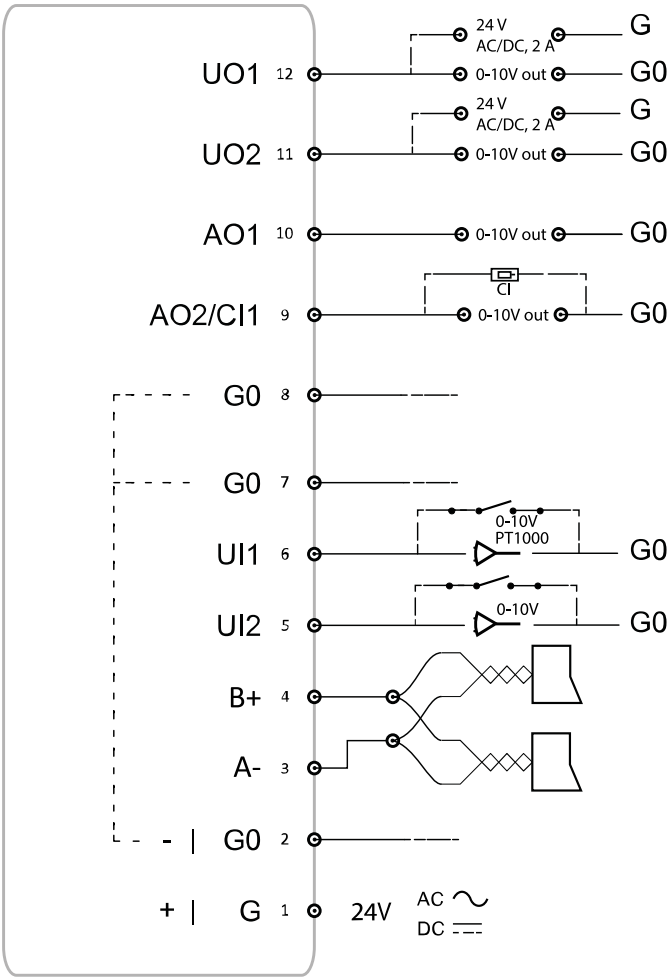


Figure 4-2 Example of terminal locations

4.1.5 Wiring - Control function examples

Below you find wiring examples based on the application examples in section 3.6 *Control function examples - Regio RCX series*.

Wiring - Hotel 1

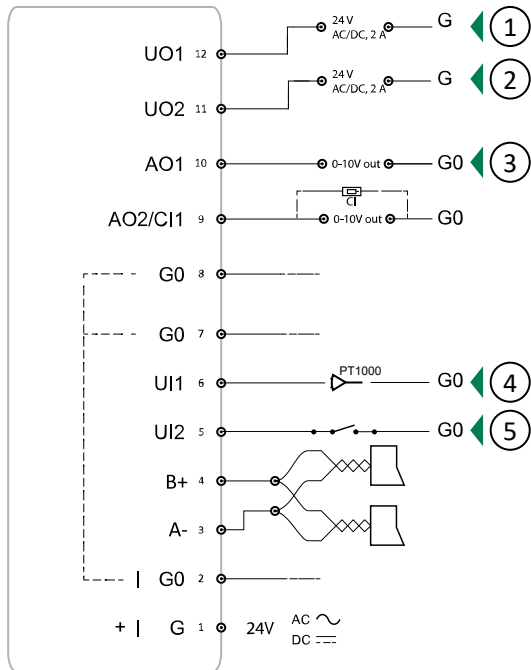


Figure 4-3 Wiring example - for application example Hotel 1

- ① Heating valve, thermal (PWM)
- ② Extra zone valve, thermal (PWM)
- ③ VAV
- ④ External room temperature
- ⑤ Presence detector

See section 3.6.1 *Hotel 1 - Heating (actuator radiator)+ VAV and Extra Zone (control of bathroom w. floor heating)*.

Wiring - Hotel 2

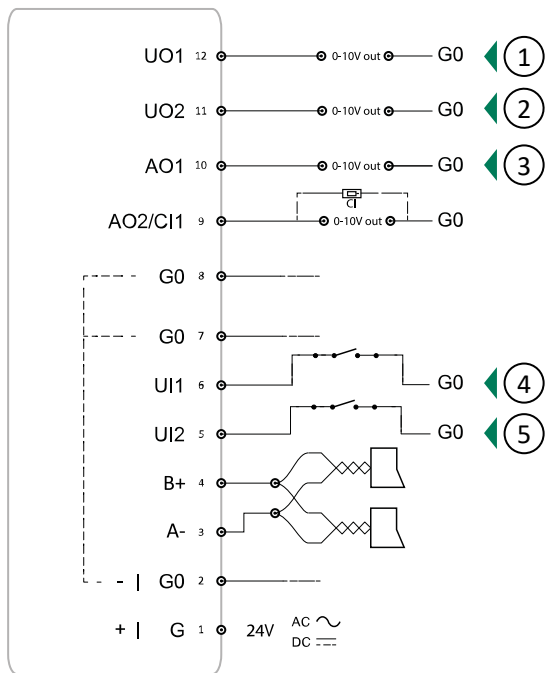


Figure 4-4 Wiring example - for application example Hotel 2

- ① Heating
- ② Cooling
- ③ EC Fan
- ④ Open window
- ⑤ Presence detector

See section 3.6.2 Hotel 2 - Heating (battery) + Cooling (battery) + Fan Control (EC-Fan).

Wiring - Office

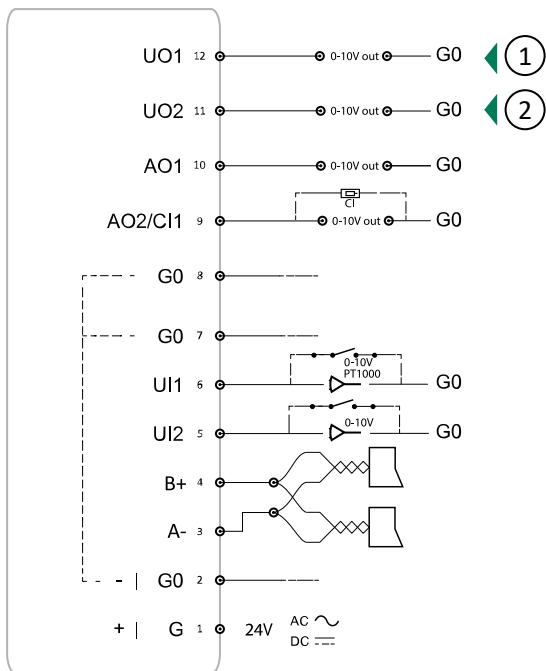


Figure 4-5 Wiring example - for application example Office

① Change-over cooling

② EC Fan

See section 3.6.3 Office - Heating/Cooling (change-over) + Fan Control.

Wiring - Conference

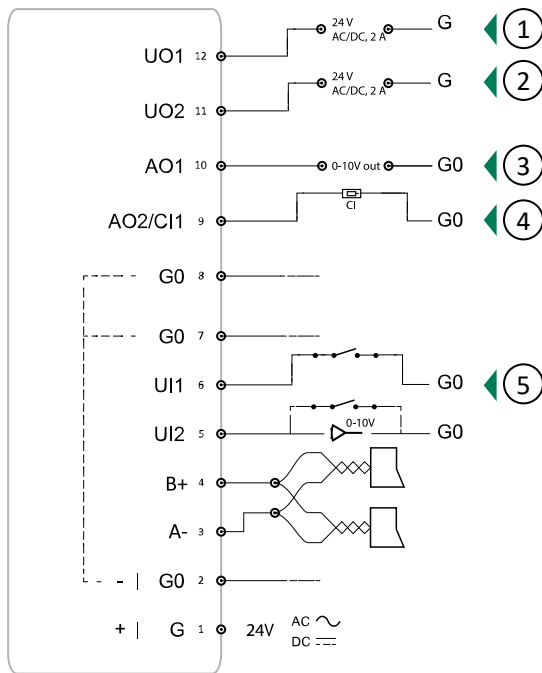


Figure 4-6 Wiring example - for application example Conference

- ① Heating valve, thermal (PWM)
- ② Cooling valve, thermal (PWM)
- ③ VAV
- ④ CI driver
- ⑤ Presence detector

See section 3.6.4 Conference - Heating (actuator radiator) + Cooling (chilled ceiling) + VAV (CO₂).

4.1.6 Troubleshooting

It is possible to detach the terminal from the wall mount when troubleshooting, and perform measurements on the terminal while the controller is connected.

5 Conformity

Hereby, Regin declares that the radio equipment type Regio RCX series is in compliance with Directive 2014/53/EU.

Regio RCX series complies with EN IEC 60730-1, as a class A control.


This radio equipment device is approved for use in all countries within the European union.



This product carries the CE-mark. More information is available at www.regincontrols.com.

Appendix A Technical data

A.1 General data

Supply voltage	24 V AC (50 - 60 Hz) or DC
Display	25 x 11 pixels
Power consumption	2.5 VA
Ambient temperature	0...50 °C
Ambient humidity	Max. 90 % RH
Storage temperature	-20...+70 °C
Terminal blocks	Lift type for cable cross-section 2.1 mm ²
Protection class	IP20
Material casing	Polycarbonate (PC)
Colour	Cover: RAL9003 (signal white) Wall-mount assembly: RAL9003 (signal white)
Modbus RTU	8 bits, 1 or 2 stop bits. Odd, even or no parity.
Communication speed	9600, 19200, 38400, or 76800 bps (for all protocols)
Measuring range, temperature	0...50 °C
Temperature accuracy	±0.5 °C at 15...30 °C ¹
Humidity sensor accuracy	Typical: 2 % RH (10-90 %), 3 % RH (<10 or >90), Max: 3.5 % RH (10-90), 5 % RH (<10 or >90)
CO₂ sensor	0...2000 ppm Update frequency: 5 s
CO₂ sensor accuracy	±50 ppm + 5% (measured value, MV) @400-2000 ppm
PIR sensor, detection range	Detection angle 110°, distance 5 m at 8 °C temp. difference between object and room temp. = up to 7 m at 4 °C temp. difference between object and room temp. = up to 5 m (Target conditions: movement 1.9 m/s, object size approx. 700x250 mm) <div style="display: flex; align-items: center;">  <p>Note! Depending on the temperature difference between the target and the surroundings, detection range will change.</p> </div>
VOC sensor	AQI; range 0-500 (Air Quality Index)
Mounting	Room/Wall
Weight	115 g
Dimensions	Low (RCX-BL) wall mount assembly: 94.6 x 94.6 x 21 mm Medium (RCX-BM) wall mount assembly: 94.6 x 94.6 x 31 mm



¹ 0.5 K is valid if current on UO1 and UO2 is lower than 1.5 A, for currents between 1.5 A and 2 A the accuracy is 0.6 K.

A.2 Communication

RS485	For EXOline (with automatic detection), Modbus (with automatic detection), or BACnet.
Communication cable length, maximum	1200 m, with repeater
Bluetooth® Low Energy	Bluetooth® communication.

A.3 Inputs & outputs

All controllers have the possibility of two (2) universal inputs (UI), two (2) universal outputs (UO), and two (2) analogue outputs (AO).

Universal Output 1	AO: 0...10 V, 2 mA DO: 24 V /max 2 A (switches to G0)  Note! The maximum current is 2 A in total for output 1 and output 2.
Universal Output 2	AO: 0...10 V, 2 mA DO: 24 V /max 2 A (switches to G0)  Note! The maximum current is 2 A in total for output 1 and output 2.
Analogue Output 1	0...10 V out, 2 mA
Analogue Output 2 / Condensation Input 1	0...10 V out, 2 mA Condensation input (same pin as analogue output)
Universal Input 1	0...10 V PT1000 (0...50 °C) DI: Closing potential free contact
Universal Input 2	0...10 V DI: Closing potential free contact

Appendix B Model overview

Table B-1 Controller models

Article	Display	Buttons	Temperature sensor	Humidity sensor	CO ₂ sensor	VOC sensor	PIR sensor
RCX-T	-	-	X	-	-	-	-
RCX-TC	-	-	X	-	X	-	-
RCX-THCVP	-	-	X	X	X	X	X
RCX-T-D	X	X	X	-	-	-	-
RCX-TH-D	X	X	X	X	-	-	-
RCX-TC-D	X	X	X	-	X	-	-
RCX-THCVP-D	X	X	X	X	X	X	X

Table B-2 Wall mount assembly models

Article	Comments
RCX-BL	Wall mount Low, white
RCX-BM	Wall mount Medium, white

Appendix C Alarm list

There is a simple alarm function for the Regio RCX series controllers. There are a number of logic variables that can be read from a SCADA system, and in addition a sum alarm that is set when any of the other alarms are active.

C.1 Alarms

Alarm name	Description
<i>RC_SumAlarm</i>	Active if any of the other alarms are active.
<i>RC_AlarmRoomTempHigh</i>	Room temperature is over the high alarm limit.
<i>RC_AlarmRoomTempLow</i>	Room temperature is under the low alarm limit.
<i>RC_AlarmCO2High</i>	CO ₂ level is over the high alarm limit.
<i>RC_AlarmSensorError</i>	An internal or external sensor is not working properly.
<i>RC_AlarmDI</i>	A DI set up as an alarm input is active.
<i>RC_AlarmManualOutput</i>	An output is controlled manually.

Appendix D Terminal list

D.1 Wiring - Terminal list

See section 4.1.4 *Wiring*.

Terminal	I/O
1	Power supply G+
2	Power supply G0-
3	Communication A-
4	Communication B+
5	Universal input 2
6	Universal input 1
7	G0
8	G0
9	Analogue output 2 / Condensation input 1
10	Analogue output 1
11	Universal output 2
12	Universal output 1

Appendix E Licenses

E.1 Cube MX

COPYRIGHT(c) 2017 STMicroelectronics

Redistribution and use in source and binary forms, with or without modification, are permitted provided that the following conditions are met:

1. Redistributions of source code must retain the above copyright notice, this list of conditions and the following disclaimer.
2. Redistributions in binary form must reproduce the above copyright notice, this list of conditions and the following disclaimer in the documentation and/or other materials provided with the distribution.
3. Neither the name of STMicroelectronics nor the names of its contributors may be used to endorse or promote products derived from this software without specific prior written permission.

THIS SOFTWARE IS PROVIDED BY THE COPYRIGHT HOLDERS AND CONTRIBUTORS "AS IS" AND ANY EXPRESS OR IMPLIED WARRANTIES, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE DISCLAIMED. IN NO EVENT SHALL THE COPYRIGHT HOLDER OR CONTRIBUTORS BE LIABLE FOR ANY DIRECT, INDIRECT, INCIDENTAL, SPECIAL, EXEMPLARY, OR CONSEQUENTIAL DAMAGES (INCLUDING, BUT NOT LIMITED TO, PROCUREMENT OF SUBSTITUTE GOODS OR SERVICES; LOSS OF USE, DATA, OR PROFITS; OR BUSINESS INTERRUPTION) HOWEVER CAUSED AND ON ANY THEORY OF LIABILITY, WHETHER IN CONTRACT, STRICT LIABILITY, OR TORT (INCLUDING NEGLIGENCE OR OTHERWISE) ARISING IN ANY WAY OUT OF THE USE OF THIS SOFTWARE, EVEN IF ADVISED OF THE POSSIBILITY OF SUCH DAMAGE.

E.2 FreeRTOS

The FreeRTOS kernel is released under the MIT open source license, the text of which is provided below.

This license covers the FreeRTOS kernel source files, which are located in the /FreeRTOS/Source directory of the official FreeRTOS kernel download. It also covers most of the source files in the demo application projects, which are located in the /FreeRTOS/Demo directory of the official FreeRTOS download. The demo projects may also include third party software that is not part of FreeRTOS and is licensed separately to FreeRTOS. Examples of third party software includes header files provided by chip or tools vendors, linker scripts, peripheral drivers, etc. All the software in subdirectories of the /FreeRTOS directory is either open source or distributed with permission, and is free for use. For the avoidance of doubt, refer to the comments at the top of each source file.

License text:

Copyright (C) 2017 Amazon.com, Inc. or its affiliates. All Rights Reserved. Permission is hereby granted, free of charge, to any person obtaining a copy of this software and associated documentation files (the "Software"), to deal in the Software without restriction, including without limitation the rights to use, copy, modify, merge, publish, distribute, sublicense, and/or sell copies of the Software, and to permit persons to whom the Software is furnished to do so, subject to the following conditions:

- ✓ The above copyright notice and this permission notice shall be included in all copies or substantial portions of the Software.

THE SOFTWARE IS PROVIDED "AS IS", WITHOUT WARRANTY OF ANY KIND, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO THE WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE AND NONINFRINGEMENT. IN NO EVENT SHALL THE AUTHORS OR COPYRIGHT HOLDERS BE LIABLE FOR ANY CLAIM, DAMAGES OR OTHER LIABILITY, WHETHER IN AN ACTION OF CONTRACT, TORT OR OTHERWISE, ARISING FROM,

OUT OF OR IN CONNECTION WITH THE SOFTWARE OR THE USE OR OTHER DEALINGS IN THE SOFTWARE.

E.3 Fonts

The tom-thumb.bdf (used for Font_4x3.c/.h) font can be licensed under MIT or CC0 or CC-BY 3.0 More information in this thread: <https://robey.lag.net/2010/01/23/tiny-monospace-font.html>

Fonts from uw-ttyp0-1.3 (used for Font_12x6.c/.h) are licensed with:

THE TTYPO LICENSE

Permission is hereby granted, free of charge, to any person obtaining a copy of this font software and associated files (the "Software"), to deal in the Software without restriction, including without limitation the rights to use, copy, modify, merge, publish, distribute, embed, sublicense, and/or sell copies of the Software, and to permit persons to whom the Software is furnished to do so, subject to the following conditions:

1. The above copyright notice, this permission notice, and the disclaimer below shall be included in all copies or substantial portions of the Software.
2. If the design of any glyphs in the fonts that are contained in the Software or generated during the installation process is modified or if additional glyphs are added to the fonts, the fonts must be renamed. The new names may not contain the word "UW", irrespective of capitalisation; the new names may contain the word "ttyp0", irrespective of capitalisation, only if preceded by a foundry name different from "UW".

THE SOFTWARE IS PROVIDED "AS IS", WITHOUT WARRANTY OF ANY KIND, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO THE WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE AND NONINFRINGEMENT. IN NO EVENT SHALL THE AUTHORS OR COPYRIGHT HOLDERS BE LIABLE FOR ANY CLAIM, DAMAGES OR OTHER LIABILITY, WHETHER IN AN ACTION OF CONTRACT, TORT OR OTHERWISE, ARISING FROM, OUT OF OR IN CONNECTION WITH THE SOFTWARE OR THE USE OR OTHER DEALINGS IN THE SOFTWARE.

E.4 JSMN

Copyright (c) 2010 Serge A. Zaitsev

Permission is hereby granted, free of charge, to any person obtaining a copy of this software and associated documentation files (the "Software"), to deal in the Software without restriction, including without limitation the rights to use, copy, modify, merge, publish, distribute, sublicense, and/or sell copies of the Software, and to permit persons to whom the Software is furnished to do so, subject to the following conditions:

- ✓ The above copyright notice and this permission notice shall be included in all copies or substantial portions of the Software.

THE SOFTWARE IS PROVIDED "AS IS", WITHOUT WARRANTY OF ANY KIND, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO THE WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE AND NONINFRINGEMENT. IN NO EVENT SHALL THE AUTHORS OR COPYRIGHT HOLDERS BE LIABLE FOR ANY CLAIM, DAMAGES OR OTHER LIABILITY, WHETHER IN AN ACTION OF CONTRACT, TORT OR OTHERWISE, ARISING FROM, OUT OF OR IN CONNECTION WITH THE SOFTWARE OR THE USE OR OTHER DEALINGS IN THE SOFTWARE.



HEAD OFFICE AB Regin, Box 116, SE-428 22 Kållerød · Visiting address: Bangårdsvägen 35, SE-428 36 Kållerød
Phone: +46 (0)31 720 02 00 · Fax: +46 (0)31 720 02 50 · info@regincontrols.com · www.regincontrols.com