RYMASKON® **200-Modbus**
Modbus Slave User Manual

User Manual
for Room Control Units

RYMASKON® **211-Modbus**
RYMASKON® **212-Modbus**

RYMASKON® **221-Modbus**
RYMASKON® **222-Modbus**

RYMASKON® **231-Modbus**
RYMASKON® **232-Modbus**

RYMASKON® **241-Modbus**
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RYMASKON® **262-Modbus**

Abbreviations

ASCII	American Standard Code for Information Interchange
IR	Infrarot
LCD	Liquid Crystal Display
NDEF	NFC Data Exchange Format
NFC	Near Field Communication
RGB	Red, Green, Blue
URI	Uniform Resource Identifier
URL	Uniform Resource Locator
EU	End User
SA	System Administrator
DSEU	Display Source for End User
DSSA	Display Source for System Administrator

Table of Content

1. Introduction

1.1. Overview

The RYMASKON 200 is a room control unit with a modern, minimalistic look that fits any interior design. It is designed to be directly connected to a controller with a Modbus interface.

Up to 16 RYMASKON 200 devices can be connected to a single Modbus segment. RYMASKON 200 is equipped with a segmented LCD display featuring an RGB backlight with adjustable color, offering a neat way to make the RYMASKON 200 match the interior color concept of an office building. Eight capacitive touch buttons are used to cycle through sensor values, display parameters, and adjust setpoints. Up to four external buttons can be accessed and processed using Modbus interface.

The RYMASKON 200's internal sensors measure temperature, humidity and dew point. Sensor values can be displayed in SI or US units. Additionally, the date and time as well as the current level of eco-friendliness are also displayed on the LCD display. Parameters controlled by the Modbus Masters's logic can be overridden on the RYMASKON 200, such as for occupancy, air conditioning, and ventilation. A direct access mode is available to quickly adjust the most important setpoints e.g. for temperature and ventilation control.

A buzzer provides acoustic feedback for the touch buttons and can also be used to indicate alarms and error states. To prevent unauthorized modifications, two access levels (end user, system integrator) are used, which are secured via 4-digit pin codes. Device replacement and RYMASKON 200's configuration are performed with very little effort through the Modbus controller. The RYMASKON 200 is represented in the controller by a simple data point interface, which can be directly connected to the IEC 61131 or IEC 61499 logic application and offers all common functions for data points such as alarming, scheduling, trending, math functions, etc.

Using an NFC tag, the RYMASKON 200 transmits the URL to mobile devices. Last but not least, the RYMASKON 200 comes with a built-in infrared receiver for comfortable remote control.

1.2. Key Features

The different RYMASKON 200 models and their features are documented in Table 1.

CONTROL	Typ 210	Typ 220	Typ 230	Typ 240	Typ 250	Typ 260
Temperature up/down	✓	✓	✓	✓	✓	✓
Fan speed up/down	–	✓	✓	–	✓	✓
Light on/off	–	–	✓	✓	–	✓
Sun protection up/down	–	–	–	✓	✓	✓
Room occupancy	✓	✓	✓	✓	✓	–
Menu	✓	✓	✓	✓	✓	✓

Table 1: Key Features

Not only the model type but also the enclosure color as well as the touch button layout is defined with the order code. See Table 2 for possible order codes.

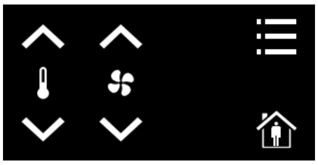
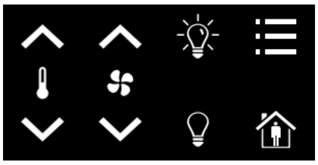
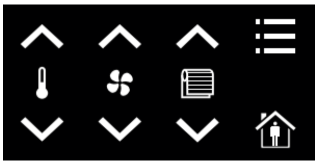
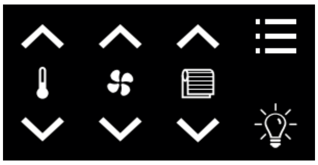
Nomenclature of Order Codes				
Enclosure color:	xx**1** = black xx**2** = white			
Button layout:	**21**x		**22**x	
	23x		**24**x	
	25x		**26**x	

Table 2: Possible Order Codes

1.3. LCD Segments

The following Figure 1 shows the LCD of the device with all possible segments.

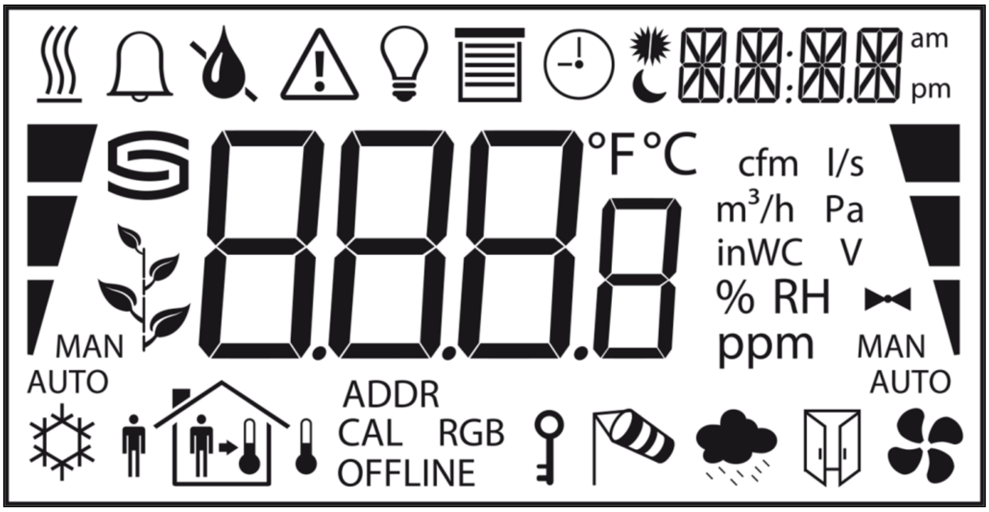


Figure 1: LCD Segments available on RYMASKON 200 displays

The following Table gives an overview of all available segments of the RYMASKON 200 with its defined names. The Table also shows which symbols are directly accessible via Modbus registers (see Table 12 on Page 23).

Segment	Name	Deskription	Direct Access
	heat	Heating symbol	✓
	alarm_bell	Alarm bell symbol	✓
	drop	Drop symbol	✓
	drop_not	Cross out for drop symbol	✓
	alarm	Alarm symbol	✓
	light	Light bulb symbol	✓
	blinds	Sun blinds symbol	✓
	clock	Clock symbol	✓

Segment	Name	Deskription	Direct Access
	sun_left	Left half of sun symbol	✓
	sun_right	Right half of sun symbol	✓
	moon	Moon symbol	✓
	colon	The colon symbol of the secondary display will only be available if the secondary_display_direct_access_string register at address 200 (see Table 22 Page 30) is not empty.	✓
	secondary_display	The secondary display is used to show time, date and/or a short text depending on the semantic meaning of a display value or set point. It can also be directly accessed via the Modbus register: secondary_display_direct_access_string (see Table 22 on Page 30).	✓
am pm	am_pm_symbols	These symbols are not directly accessible but are shown along with the time when 12h time format has been selected.	-
	cool	Cooling symbol	✓
	man_out	Man outside the house (no occupancy)	✓
	man_in	Man inside the house (occupancy)	✓
	arrow	Arrow symbol (to represent a set point)	✓
	temp_in	Temperature inside	✓
	temp_out	Tempareture outside	✓
	house	House symbol	✓
ADDR CAL RGB OFFLINE	text_symbols	The text symbols are not accessible via Modbus but are shown at certain modes or events.	-
	key	The key symbol is primarily used to show that a set point is pincode protected but it can also be accessed via the symbol direct access registers.	✓

Segment	Name	Deskription	Direct Access
	wind	Wind alarm symbol	✓
	rain	Rain alarm symbol	✓
	window	Window open alarm symbol	✓
	fan	Fan symbol	✓
	valve	Valve symbol	✓
	green_leaf_3	The green leaf symbols can be used to display the level of eco-friendliness or to visualize environmental conditions.	✓
	green_leaf_2		✓
	green_leaf_1		✓
	green_leaf_0		✓
	bar_left_2	The left bar graph symbols can be used to display a heating or cooling stage in automatic or manual mode.	✓
	bar_left_1		✓
	bar_left_0		✓
	manual_left		✓
	auto_left		✓
	bar_right_2	The right bar graph symbols can be used to display a fan stage or valve position in automatic or manual mode.	✓
	bar_right_1		✓
	bar_right_0		✓
	manual_right		✓
	auto_right		✓

Segment	Name	Deskription	Direct Access
8.8.8.8	main_display	The main display is primarily used to show certain values. It is not accessible directly.	-
°F	unit_F	All unit symbols are not directly accessible but are displayed along with a display value or set point if the unit is set in the corresponding configuration register. See Table 27 on Page 35 for display value configuration and Table 28 on Page 37 for set point configuration.	-
°C	unit_C		-
cfm	unit_cfm		-
l/s	unit_l/s		-
m^3/h	unit_m^3/h		-
Pa	unit_Pa		-
inWC	unit_inWC		-
V	unit_V		-
%	unit_%		-
% RH	unit_%RH		-
ppm	unit_ppm		-

Table 3: LCD Segments Overview

2. Quick-Start Guide

2.1. Hardware Installation

Please refer to the RYMASKON 200 installation sheet for further information on dimensions, mounting and wiring.

Figure 2 shows the back view of the device with the connection terminals for Modbus, 24 V DC-Supply and external buttons. The four external buttons share a common GND connection which is internally connected to the negative 24 V input terminal.

The external button terminal EB3 is also capable of sensing a NTC-10k temperature sensor. The temperature value of the sensor will be provided on Modbus register address 49 (see Table 10 on Page 21). The cable length for connecting the temperature sensor must not exceed 150m for 0.5mm² or 70m for 0.25mm² to guarantee a temperature error less than 0.1% at 25°C.

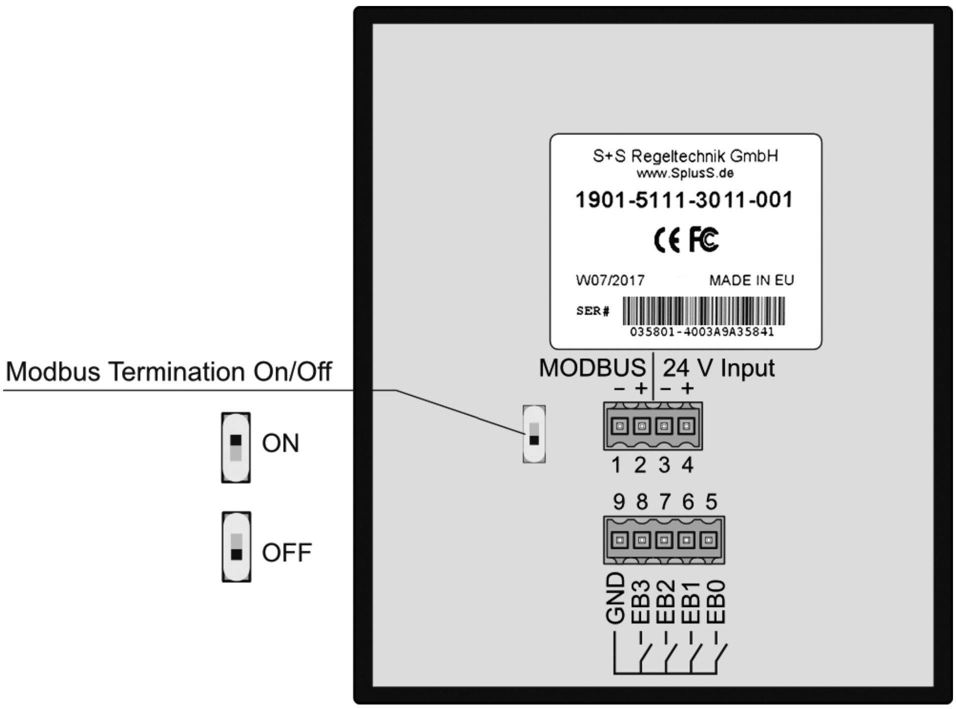


Figure 2: Back View RYMASKON 200

2.2. User Interface

2.2.1. General Description

The user interface consists of the LCD for displaying any desired value and up to eight touch buttons which are used to adjust set points and change settings. Additionally up to four external push-buttons can be connected to the device.

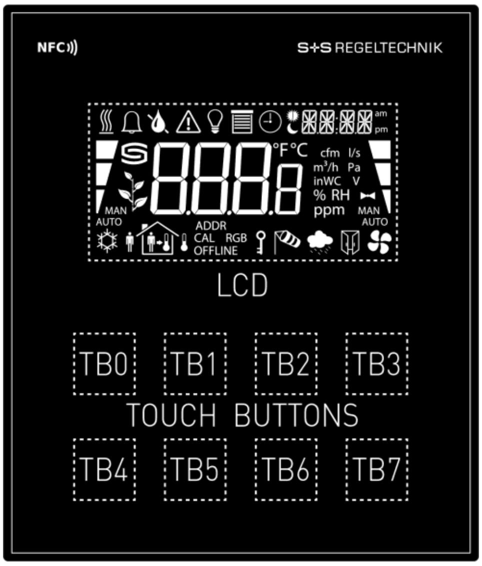
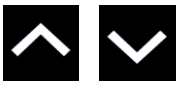


Figure 3: Front View RYMASKON 200

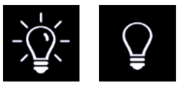
Each button can be configured individually via a Modbus register for its function (see Table 23 on Page 31). The following listing gives you an overview which functionality can be associated with the buttons.

UP **DOWN**



change set point or device setting in EDIT-mode
directly access a set point in DISPLAY-mode

ON **OFF**

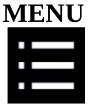


no specific function, the button state can be requested to control lighting

OCCUPANCY

no specific function, the button state can be requested to set occupancy state

MENU



short press <3s: cycle through display values, set points or device settings
long press ~3s: switch between DISPLAY-mode and EDIT-mode
long press >6s: switch to CLEANING-mode

2.2.2 Operating Modes

In Figure 4 the operating modes of RYMASKON 200 are depicted. Each operating mode gives access to certain Modbus registers that can either be viewed or edited depending on the mode. The following data is available:

display values: Are used to visualize data provided by the Modbus master or values of internal sensors. It is viewed in DISPLAY-mode. For the display value registers see Table 11 on Page 22 and Table 27 on Page 35 for the corresponding display value configuration.

set points: Are used to visualize data that is provided by the Modbus master and that can be edited by the user. It is shown in DISPLAY-mode and it can be edited in EDIT-mode. For the set point registers see Table 31 on Page 41 and Table 28 on Page 37 for set point configuration. The range in which a set point can be altered is defined by minimum and maximum values that have to be written by the Modbus master. Please refer to Table 32 on Page 42 and Table 33 on Page 43.

device settings: These values define some basic settings of the device itself. Please refer to Table 4 on Page 15 for a listing of all device settings and to Table 18, Table 19 and Table 20 on Page 27 f. for the corresponding Modbus registers. Device Settings can only be edited by the system administrator in administration-mode.

offset values: Are used to add a certain offset to a display value. This functionality can be used to calibrate sensor values. Offset values can be editet by the system administrator in CALIBRATION-mode directly at the device or over Modbus. Please see Table 34 on Page 44 for the offset value register.

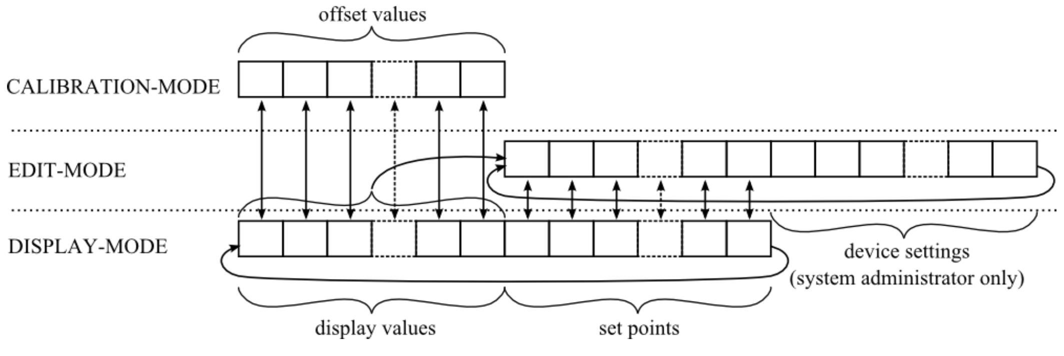


Figure 4: RYMASKON 200 Operating Modes

When the device powers up, it enters DISPLAY-mode and it will display the first display value. When pressing the MENU-button the next value will be shown. First all active display values and then all active set points are displayed. After the last set point, the display will show the first display value again.

EDIT-mode is entered by pressing the MENU-button for more than 3 seconds. To enter the administration-mode as system administrator two additionally defined buttons (TB0 and TB4) need to be pressed along with the MENU-button for more than 3 seconds. Also in EDIT-Mode a short press on the MENU-button is used to go to the next value. Any other button that has no specific function can be used in EDIT-mode to cycle the values in the opposite direction. EDIT-mode is left when pressing the MENU-button for more than 3 seconds.
It is possible to edit the device settings in administration-mode.

CALIBRATION-mode will be entered for any display value when pressing one UP- and one DOWN-button simultaneously for more than 3 seconds to adjust the offset. This mode is secured by the system administrator password. CALIBRATION-mode is left when pressing the MENU-button for more than 3 second or after a timeout of 1 minute.

An overview of all possible operating modes is given in Table 4 below. The operating mode can also be defined by the Modbus master by writing the user interface direct access register (see Table 13 on page 23).

Order of Operating Modes	Description
0 DISPLAY-Mode / display values	Display values are shown.
1 DISPLAY-Mode / set points	Set points are shown.
2 EDIT-Mode / set points	Set points can be edited.
3 administration-Mode / device settings	Device settings can be edited. This mode is only accessible for the system admi-nistrator.
4 CALIBRATION-Mode / offset values	Offset values can be edited
5 PINCODE-ENTRY / end user	The pincode for the end user has to be entered to show and/or edit the requested value.
6 PINCODE-ENTRY / system administrator	The pincode for the system administator has to be entered to show and/or edit the requested value.
7 DIRECT_ACCESS-Mode / set points	A defined set point can be accessed and edited without entering EDIT-mode. It can be entered by pressing a defined button (see Table 23 on page 31). In contrast to EDIT-mode only predefined set points can be edited. The DIRECT_ACCESS-mode can be left by pressing any button that has no direct access capability.
10 CLEANING-Mode	This mode is used to clean the surface of the device without any response of the touch buttons and hence any unwanted changes. This mode is entered by pressing the MENU-button for at least 6 seconds. After 10 seconds with no interaction the device will switch back to DISPLAY-mode automatically.

Table 4: Operating Modes

2.2.3 Access Levels

There are two access levels (end user & system administrator) with configurable rights to display and edit values. Each access level is secured by a four digit pincode that will be requested if EDIT-mode or DIRECT_ACCESS-mode is entered and the desired value is pincode protected.

Per default the pincode for end user and system administrator access level is disabled (0000). Otherwise the pincode can be entered as described in Figure 5.

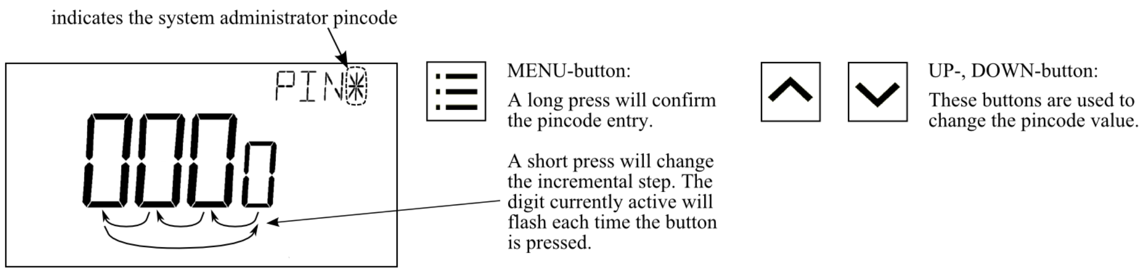


Figure 5: Pincode Entry

2.2.4 Device Settings

The following Table gives an overview of the device settings accessible through the button interface as well as via Modbus. For the corresponding Modbus registers please refer to Table 18, Table 19 and Table 20 on Page 27 and following.

Parameter	**Value**	**Default**	**Your Setting**
Modbus Parity	Odd / Even / None	None	
Modbus Baudrate	1.2kB / 2.4kB / 4.8kB / 9.6kB / 19.2kB / 38.4kB / 57.6kB / 115.2kB	57,6kB	
Modbus Address	1 - 247	1	
Pincode System Administrator	0000 – 9999 (if 0000 the pincode is disabled)	0000	
Pincode End User	0000 – 9999 (if 0000 the pincode is disabled)	0000	
Color Setting LCD Backlight Red	0% - 100%	100%	
Color Setting LCD Backlight Green	0% - 100%	100%	
Color Setting LCD Backlight Blue	0% - 100%	100%	
Brightness LCD Backlight	0% - 100%	100%	
LCD Contrast	0% - 100%	100%	
LCD Color Scheme	0 – user (as defined above) 1 – white 2 – red 3 – green 4 – blue 5 – orange 6 – magenta 7 – cyan	0	
Time Format	24h / 12h	24h	
Show Date	on / off	off	
Show Time	on / off	off	
Acoustic Feedback (for Touch Buttons)	on / off	on	
Goto First Display Value (the first display value will be displayed after 1 minute without inter-action)	on / off	on	
Display Auto Shuffle	on / off	off	
Display Auto Dim (lcd brightness will be dimmed after 2 minutes with no interaction)	off / 50% / 10% / 0%	off	
Unit System	SI / US	SI	
Device Restart	off – if a DOWN-button is pressed the device will be rebooted manually	-	

Table 5: Device settings

2.2.5 Factory Default

The factory default configuration for display values and set points depends on the specific RYMASKON 200 model. The following Table shows the factory default values for each model. See Table 27 on page 35 for display value configuration and Table 28 on Page 37 for set point configuration.

Register Name	Inhalt
display_value_0	Internal Temperature
display_value_1	Relative Humidity
display_value_2	Dew Point
display_value_3	-
display_value_4	Supply Voltage
display_value_5	External Temperature
display_value_6 to display_value_15	-
set_point_0	Internal Temperature Set Point
set_point_1	Fan Stage
set_point_2 to set_point_15	-

Table 6: Factory Default for RYMASKON 200

3. Modbus

3.1. Introduction

The device operates as a Modbus slave in Modbus RTU mode. The default baudrate is set to 57600, the default parity is set to 'none' and the default address is set to 1. The communication with a Modbus master device will work with Modbus function code 0x03 (Read Holding Registers) and Modbus function code 0x06 (Preset Single Register). Section 3.4 shows all available Modbus registers.

3.2. Modbus Network

Figure 6 illustrates a typical Modbus network setup with a linear bus topology used to connect several slave devices to a master device. The transmission line has to be terminated at both ends. At the master device this can be done by connecting a termination resistor.
Each RYMASKON 200 is equipped with a built-in 120Ω termination resistor. Set the termination switch to OFF except on the last device on the bus where the termination switch must be turned ON. Per default each device has the Modbus address set to 1. Because each address can only be used once it has to be configured at the device settings in administration-mode.
For further information please see Section 2.2.

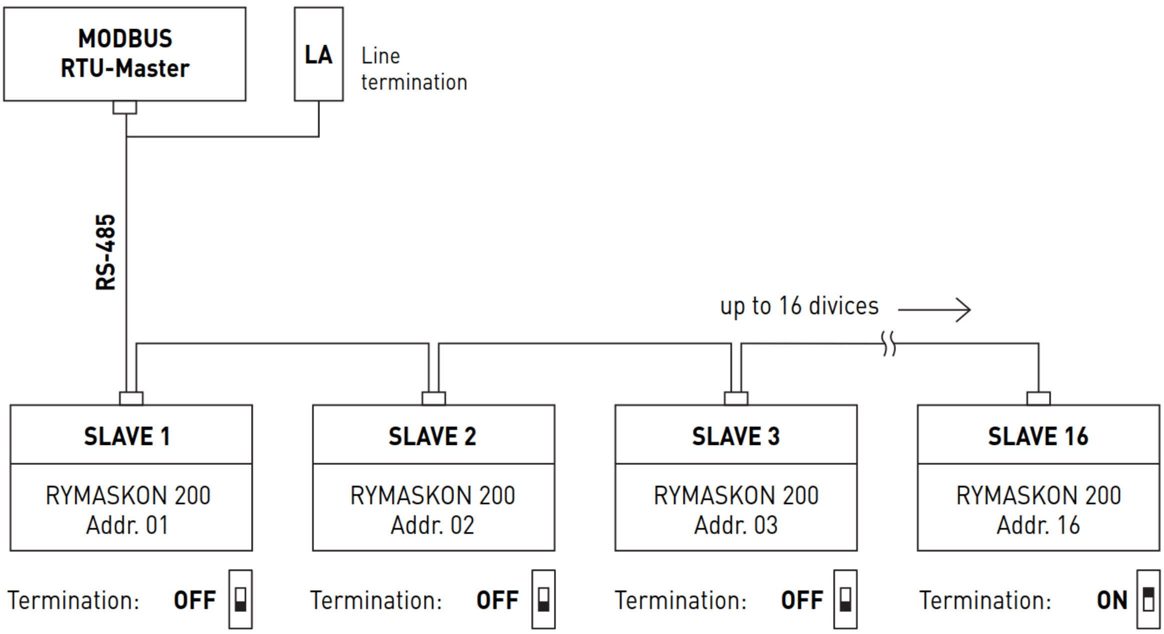


Figure 6: Modbus Network

3.3. Modbus Register Usage for Value Display

The following Figure 7 shows, which Modbus registers have influence on a displayed value, unit, text on the secondary display or symbols.
Depending on settings in configuration registers different combinations are possible to achieve the desired result.

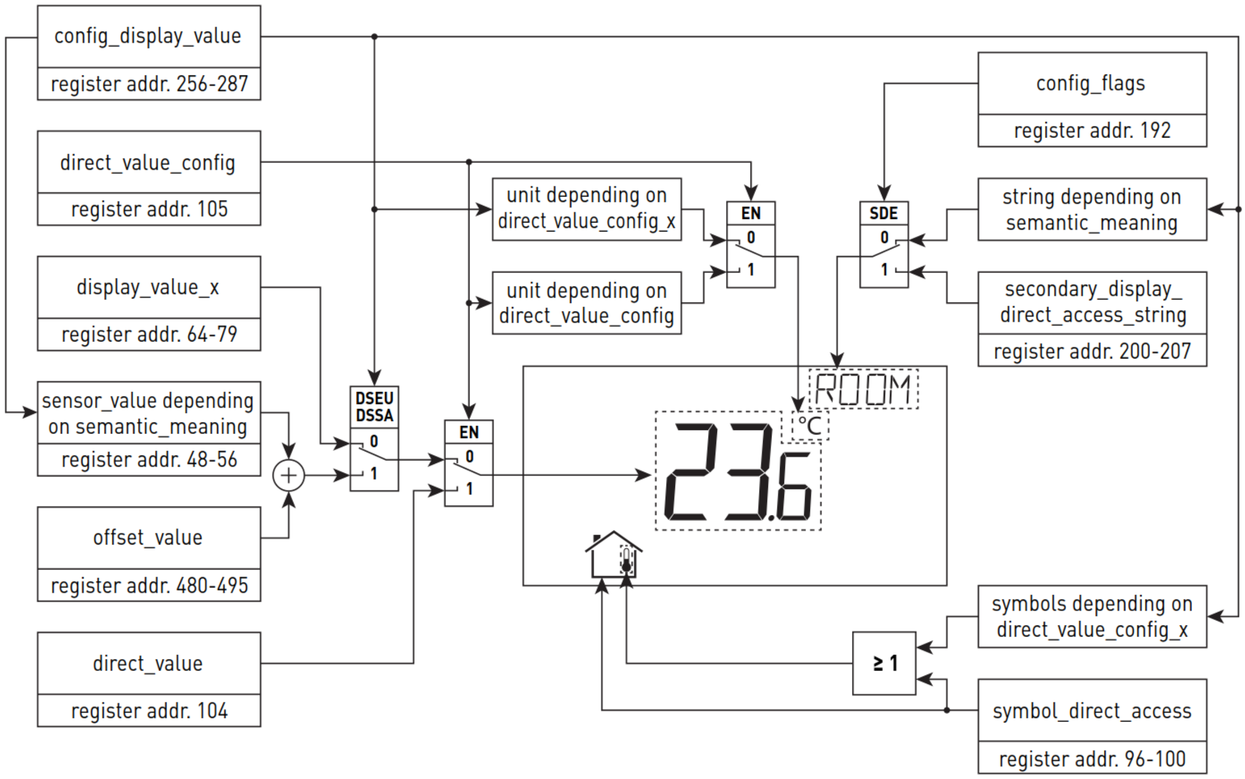


Figure 7: Modbus Register Usage for Value Display

3.4. Modbusregister Description

In the following sections the RYMASKON 200 Modbusregister.
Modbus registers are described. Abbrevations are explained at the end of each table. ‘R’ indicates that this value is not used by now and that it is reserved for future use. Square brackets ‘[]’ indicate that this is the initial value. Numbers with the prefix ‘0x’ are hexadecimal values. Values with no prefix indicate decimal values.

3.4.1 Data Registers

These registers contain data that is changing frequently. This data is not stored persistent in the device and will be lost after a reboot.

<table>
<tr><th rowspan="2">Register Name</th><th rowspan="2">Register Address</th><th colspan="16">Bit Position</th></tr>
<tr><th>15</th><th>14</th><th>13</th><th>12</th><th>11</th><th>10</th><th>9</th><th>8</th><th>7</th><th>6</th><th>5</th><th>4</th><th>3</th><th>2</th><th>1</th><th>0</th></tr>
<tr><td>present_state</td><td>0
0x0000</td><td>R
[0]</td><td>R
[0]</td><td>R
[0]</td><td>R
[0]]</td><td rowspan="3">EB3 [0]</td><td rowspan="3">EB2 [0]</td><td rowspan="3">EB1 [0]</td><td rowspan="3">EB0 [0]</td><td rowspan="3">TB7 [0]</td><td rowspan="3">TB6 [0]</td><td rowspan="3">TB5 [0]</td><td rowspan="3">TB4 [0]</td><td rowspan="3">TB3 [0]</td><td rowspan="3">TB2 [0]</td><td rowspan="3">TB1 [0]</td><td rowspan="3">TB0 [0]</td></tr>
<tr><td>short_pressed</td><td>1
0x0001</td><td>IRC
[0]</td><td>NFC
[0]</td><td>R
[0]</td><td>R
[0]</td></tr>
<tr><td>long_pressed</td><td>2
0x0002</td><td>R
[0]</td><td>ERR
[0]</td><td>DOC
[0]</td><td>SPC
[0]</td></tr>
</table>

The present_state register always represents the actual state of the buttons.
The short_pressed and long_pressed states will remain set until the flags are cleared by the Modbus master by writing a logical ‘1’ to the specific flag The long_pressed state of a button will remain set as long as the button is pressed.

Bits 0-11 indicate the states of the buttons (**TBx**-touch button, **EBx**-external button)

NFC: NFC flag, is set if an NFC field was detected. This gives the information that a user is reading the NFC tag memory with an NFC enabled mobile device. For more information see Chapter 4.

IRC: infrared remote control flag, is set when an infrared remote control code was received. The received code can be read via the ir_remote_control_command register at register address 32 (see Table 9 on page 20).

SPC: Set point changed flag, is set when a set point was changed.
Each set point has an individual change flag at register address 3 (see Table 8 on page 20).

DOC: device setting or offset value changed flag, is set when a device setting or offset value was changed. he specific change flags can be read via the registers at address 4 and 5 (see Table 8 on page 20).

ERR: error flag, is set when an internal error has occurred.

!!! Button states and flags can have the following binary values:
1 – pressed, set
0 – released, cleared

!!! The present_state register is only updated in DISPLAY- and DIRECT_ACCESS-mode!
(For a list of possible modes see Table 4 on page 13)

Table 7: Button States and Flags

Register Name	Register Address	Bit Position															
		15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
change_flags_ set_points	3 0x0003	SP15 [0]	SP14 [0]	SP13 [0]	SP12 [0]	SP11 [0]	SP10 [0]	SP9 [0]	SP8 [0]	SP7 [0]	SP6 [0]	SP5 [0]	SP4 [0]	SP3 [0]	SP2 [0]	SP1 [0]	SP0 [0]
change_flags_ device_settings	4 0x0004	R [0]	R [0]	R [0]	R [0]	R [0]	R [0]	R [0]	DS8 [0]	DS7 [0]	DS6 [0]	DS5 [0]	DS4 [0]	DS3 [0]	DS2 [0]	DS1 [0]	DS0 [0]
change_flags_ offset_values	5 0x0005	OV15 [0]	OV14 [0]	OV13 [0]	OV12 [0]	OV11 [0]	OV10 [0]	OV9 [0]	OV8 [0]	OV7 [0]	OV6 [0]	OV5 [0]	OV4 [0]	OV3 [0]	OV2 [0]	OV1 [0]	OV0 [0]

The change flag register states will remain true until the flags are cleared by the Modbus master by writing a logical '1' to the specific flag.

SP0 to **SP15:** change flags for set_point_0 to set_point_15 (see Table 31 on page 41)

DS0: change flag for modbus_parameter on register address 176 (see Table 18 on page 27)

DS1: change flag for pincode_system_administrator on register address 177 (see Table 19 on page 27)

DS2: change flag for pincode_end_user on register address 178 (see Table 19 on page 27)

DS3: change flag for lcd_color_red on register address 179 (see Table 20 on page 28)

DS4: change flag for lcd_color_green on register address 180 (see Table 20 on page 28)

DS5: change flag for lcd_color_blue on register address 181 (see Table 20 on page 28)

DS6: change flag for lcd_brightness_contrast on register address 182 (see Table 20 on page 28)

DS7: change flag for user_interface_settings on register address 183 (see Table 20 on page 28)

DS8: change flag for display_unit on register address 192 (see Table 21 on page 29)

OV0 to **OV15:** change flags for offset_value_0 to offset_value_15 (see Table 34 on page 44)

!!! Change flags can have the following binary values:
1 – true / 0 – false

!!! If a set point, device setting or offset value is changed by the user the corresponding flag will be set and it has to be cleared by the Modbus master.

Table 8: Change Flags

Register Name	Register Adresse	Bit Position															
		15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ir_remote_control_ command	32 0x0020	button_code [0x00]								remote_id [0x00]							

This register provides the button_code and remote_id of a valid command received via the infrared receiver. See Chapter 5 for detailed information.

!!! Whenever a command was received the ir_remote_control_command register is updated and the IRC flag of the short_pressed register at address 1 is set (see Table 7 on Page 19).

Table 9: IR Remote Control Command

The following Table gives an overview of the internal sensor values. These registers can be read over Modbus and can be used as source for a display value if configured. As described in Section 2.2.2 on page 11 there are up to 16 display values used to visualize data.

Each display value has two 16 bit configuration registers to specify the values displayed. Display values (register address 64 to 79) are read- and writable over Modbus.

Register Name	Register Address	Bit Position															
		15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
sensor_value_0	48 0x0030	internal temperature															
sensor_value_1	49 0x0031	external temperature															
sensor_value_2	50 0x0032	relative humidity															
sensor_value_3	51 0x0033	dew point															
sensor_value_4	52 0x0034	reserved															
sensor_value_5	53 0x0035	reserved															
sensor_value_6	54 0x0036	supply voltage															
sensor_value_7	55 0x0037	CPU temperature															
sensor_value_8	56 0x0038	CPU voltage															

!!! A sensor value can be used as source for a display value. Therefor the DSSA or DSEU bit as well as the semantic meaning at the corresponding display value configuration at address 256 to 286 has to be set (see Table 27 on page 35). If the DSSA or DSEU bit is set this specifies that a sensor value is used instead of a display value. The semantic meaning specifies which sensor value is used as source for displaying. For an overview on this topic please see Figure 7 on page 18.

!!! Sensor_value_0, sensor_value_1 and sensor_value_3 are 16 Bit signed values. All other sensor values are defined as 16 Bit unsigned since there are no negative values to expect. The values are scaled as described in Table 38 on page 49.

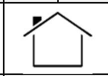
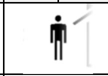
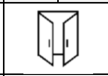
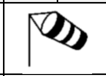
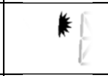
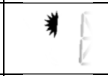
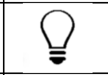
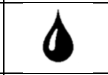
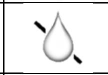
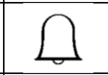
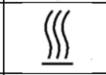
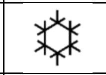
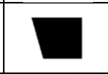
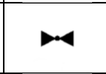
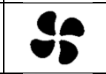
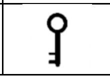
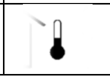
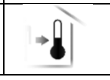
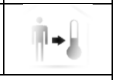
Table 10: Sensor Values

If an external temperature sensor is connected to the EB3 terminal and GND the value of this sensor will be provided as sensor_value_1. It is advised to disable the button function at the button configuration register at address 227 (Table 24 on page 32) when used as temperature sensor input.

<table>
<tr><th rowspan="2">Register Name</th><th rowspan="2">Register Address</th><th colspan="16">Bit Position</th></tr>
<tr><th>15</th><th>14</th><th>13</th><th>12</th><th>11</th><th>10</th><th>9</th><th>8</th><th>7</th><th>6</th><th>5</th><th>4</th><th>3</th><th>2</th><th>1</th><th>0</th></tr>
<tr><td>display_value_0</td><td>64
0x0040</td><td colspan="16">[0x0000]</td></tr>
<tr><td>display_value_1</td><td>65
0x0041</td><td colspan="16">[0x0000]</td></tr>
<tr><td>display_value_2</td><td>66
0x0042</td><td colspan="16">[0x0000]</td></tr>
<tr><td>display_value_3</td><td>67
0x0043</td><td colspan="16">[0x0000]</td></tr>
<tr><td>display_value_4</td><td>68
0x0044</td><td colspan="16">[0x0000]</td></tr>
<tr><td>display_value_5</td><td>69
0x0045</td><td colspan="16">[0x0000]</td></tr>
<tr><td>display_value_6</td><td>70
0x0046</td><td colspan="16">[0x0000]</td></tr>
<tr><td>display_value_7</td><td>71
0x0047</td><td colspan="16">[0x0000]</td></tr>
<tr><td>display_value_8</td><td>72
0x0048</td><td colspan="16">[0x0000]</td></tr>
<tr><td>display_value_9</td><td>73
0x0049</td><td colspan="16">[0x0000]</td></tr>
<tr><td>display_value_10</td><td>74
0x004A</td><td colspan="16">[0x0000]</td></tr>
<tr><td>display_value_11</td><td>75
0x004B</td><td colspan="16">[0x0000]</td></tr>
<tr><td>display_value_12</td><td>76
0x004C</td><td colspan="16">[0x0000]</td></tr>
<tr><td>display_value_13</td><td>77
0x004D</td><td colspan="16">[0x0000]</td></tr>
<tr><td>display_value_14</td><td>78
0x004E</td><td colspan="16">[0x0000]</td></tr>
<tr><td>display_value_15</td><td>79
0x004F</td><td colspan="16">[0x0000]</td></tr>
<tr><td colspan="18">!!! The DSSA or DSEU bit at the corresponding display value configuration at address 256 to 286 has to be cleared to display the content of a display value register (see Table 27 on Page 35). If the DSSA or DSEU bit is cleared this specifies that a display value is used instead of a sensor value. The semantic meaning specifies which text is displayed along with the specific display value. For an overview on this topic please see Figure 7 on Page 18.

!!! All registers are 16 Bit signed values. Depending on the modbus_unit specified with the corresponding display value configuration register at address 256 to 287 (Table 27 at Page 35) the value needs to be scaled as described in Table 38 at Page 49 to achieve the desired result.</td></tr>
</table>

Table 11: Display Values

Register Name	Register Address	Bit Position															
		15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
symbol_direct_access_0	96 0x0060	R [00]															
symbol_direct_access_1	97 0x0061																
symbol_direct_access_2	98 0x0062																
symbol_direct_access_3	99 0x0063																
symbol_direct_access_4	100 0x0064	MAN AUTO		MAN AUTO		MAN AUTO		MAN AUTO									

Symbols of the LCD can be directly set by writing these registers. For an overview of all LCD segments please see Table 3 on Page 9.

2 bits are reserved per symbol indicating the state that can have the following values:

00 – disabled, symbol is not visible

01 – enabled, symbol is visible

10 – blinking slow (1Hz)

11 – blinking fast (2Hz)

!!! For the house symbol the initial value is set to ‘01’ per default.
The initial value of the other symbols is ‘00’.

!!! The colon symbol of the secondary display will only be available if the secondary_display_direct_access_string register at address 200 (see Table 22 Page 30) is not empty.

Table 12: Symbol-Direct Access

Register Name	Register Address	Bit Position															
		15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
user_interface_direct_access	101 0x0065	EU/ SA [0]	ui_mode [0x00]							ui_index [0x00]							

This register can be read to get information of which value is currently displayed. It can also be written to determine the displayed value.

EU/SA: defines the current access level (0 – end user, 1 – system administrator)

ui_mode: defines the user interface mode the device is currently operating in.
For a listing of all RYMASKON 200 operating modes see 2.2.2 on Page 12.

ui_index: defines the index within each mode of the value currently displayed

Please see the following examples:

0x0001 – This means that display_value_1 is currently displayed in DISPLAY-mode for the end user.

0x8200 – This means that set_point_0 is currently edited in administration-mode

Table 13: User Interface Direct Access

Register Name	Register Address	Bit Position															
		15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
buzzer_direct_access_0	102 0x0066	BE [0]	R [0]	R [0]	R [0]	R [0]	R [0]	R [0]	R [0]	buzzer_duration [0x00]							
buzzer_direct_access_1	103 0x0067	buzzer_mode [0x00]								buzzer_tone [0x00]							

These registers are used to provide direct access of the piezo buzzer primarily used to give acoustic feedback for the touch buttons.

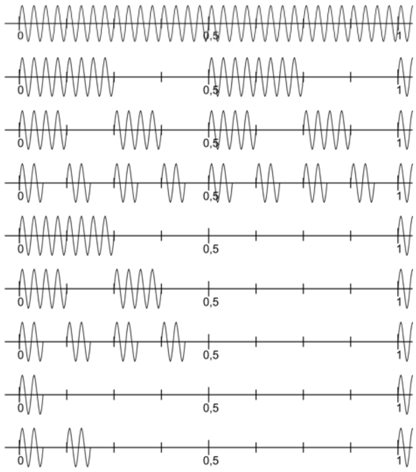
BE: Buzzer Enable Bit (1 – enabled/ 0 – disabled)

buzzer_duration: 0x00 infinite, 0x01 - 0xFF duration in seconds

buzzer_mode: defines specific alarm sound patterns

mode:	description:
0	continuous
1	alarm 1
2	alarm 2
3	alarm 3
4	alarm 4
5	alarm 5
6	alarm 6
7	alarm 7
8	alarm 8

< 1s pattern >



buzzer_tone: 0x00 - 100 Hz, 0xFF - 1375 Hz (step-width = 5 Hz)

Table 14: Buzzer Direct Access

Register Name	Register Address	Bit Position															
		15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
direct_value	104 0x0068	[0x0000]															
direct_value_config	105 0x0069	EN [0]	R [0]	R [0]	R [0]	R [0]	R [0]	R [0]	R [0]	R [0]	R [0]	unit [0x0]				exp [00]	

These registers are used to display specific values instead of display_values or set_points. For an overview on how to setup the configuration please refer to Figure 7 on Page 18.

direct_value: 16 bit signed integer to be displayed

EN: direct value enable bit (1 – enabled, 0 – disabled)

unit: defines a unit symbol to be displayed, following values are possible:

0x0	0x1	0x2	0x3	0x4	0x5	0x6	0x7	0x8	0x9	0xA	0xB
no unit	°C	°F	cfm	l/s	m³/h	Pa	inWC	V	%	%RH	ppm

exp: exponent, defines the number of decimal places:

00 – no decimal point
01 – one decimal place
10 – two decimal places
11 – three deciml places

!!! If disabled, the last viewed value will be visible again as defined with the user_interface_direct_access register at adderss 101 (Table 13 on Page 23).

Table 15: Direct Value

Register Name	Register Address	Bit Position															
		15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
system_time	112 0x0070	system_time_0 [0x0000]															
	113 0x0071	system_time_1 [0x0000]															

system_time represent a 32 bit timestamp in seconds since JAN-01-1970. The timestamp has to be initially set by the Modbus master because the device has no back-up battery and so it would start at 0 (00:00:00 JAN-01-1970) after a reboot.
The timestamp is incremented by the device but anyway it has to be set by the master at defined intervals to prevent time offsets.

Table 16: System Time

Register Name	Register Address	Bit Position 15–0
modbus_time_cleared	128 0x0080	modbus_time_cleared_0 [0x0000]
	129 0x0081	modbus_time_cleared_1 [0x0000]
modbus_rx_packets	130 0x0082	modbus_rx_packets_0 [0x0000]
	131 0x0083	modbus_rx_packets_1 [0x0000]
modbus_rx_bytes	132 0x0084	modbus_rx_bytes_0 [0x0000]
	133 0x0085	modbus_rx_bytes_1 [0x0000]
modbus_tx_packets	134 0x0086	modbus_tx_packets_0 [0x0000]
	135 0x0087	modbus_tx_packets_1 [0x0000]
modbus_tx_bytes	136 0x0088	modbus_tx_bytes_0 [0x0000]
	137 0x0089	modbus_tx_bytes_1 [0x0000]
modbus_timeout_errors	138 0x008A	modbus_timeout_errors_0 [0x0000]
	139 0x008B	modbus_timeout_errors_1 [0x0000]
modbus_checksum_errors	140 0x008C	modbus_checksum_errors_0 [0x0000]
	141 0x008D	modbus_checksum_errors_1 [0x0000]

Modbus_time_cleared_0 and **modbus_time_cleared_1** represent a 32 bit timestamp in seconds since JAN-01-1970 that is set by the RYMASKON 200 after the statistics have been cleared by the master device.

All other values are 32 bit counters incremented by the device.
These values are not permanently stored and will be lost after a reboot.

!!! The statistics can be cleared by setting the MSC bit at the config_flags register at address 192 (see Table 21 on Page 29).

Table 17: Modbus Statistics

3.4.2 Device Settings

The device settings contain data to configure the device and the user interface. This registers are also accessible through the button interface in administration-mode. The data is stored persistently and will be preserved during power loss.

Register Name	Register Address	Bit Position															
		15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
modbus_parameter	176 0x00B0	R [0]	R [0]	PAR [0x2]		modbus_baud [0x6]				device_addr [0x01]							

This register contains the configuration for the Modbus port of the Rymaskon 200.

PAR: defines the parity bit used for Modbus communication. Valid are:
0x0 – odd (odd parity bit, 1 stop bit)
0x1 – even (even parity bit, 1 stop bit)
0x2 – none (no parity bit, 2 stop bits)

modbus_baud: defines the Modbus baudrate, following values are valid:
0x0 – 1200
0x1 – 2400
0x2 – 4800
0x3 – 9600
0x4 – 19200
0x5 – 38400
0x6 – 57600
0x7 – 115200

device_addr: defines the Modbus slave address.
Valid addresses are 1(0x01) to 247 (0xF7).

!!! Compare Table 4 on Page 15 for device settings editable via the user interface.

Table 18: Modbus Parameter

Register Name	Register Adresse	Bit Position															
		15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
pincode_ system_administrator	177 0x00B1	R [0]	R [0]	[0x0000]													
pincode_ end_user	178 0x00B2	R [0]	R [0]	[0x0000]													

pincode_system_administrator defines the pincode for the system administrator.
If set to 0000 the pincode is disabled. Possible values are 0000 (0x0000) to 9999 (0x270F).

pincode_end_user defines the pincode for the end user.
If set to 0000 the pincode is disabled. Possible values are 0000 (0x0000) to 9999 (0x270F).

!!! Compare Table 4 on Page 15 for device settings editable via the user interface.

Table 19: Pincodes

<table>
<tr><th rowspan="2">Register Name</th><th rowspan="2">Register Address</th><th colspan="16">Bit Position</th></tr>
<tr><th>15</th><th>14</th><th>13</th><th>12</th><th>11</th><th>10</th><th>9</th><th>8</th><th>7</th><th>6</th><th>5</th><th>4</th><th>3</th><th>2</th><th>1</th><th>0</th></tr>
<tr><td>lcd_color_red</td><td>179
0x00B3</td><td colspan="8">reserved
[0x00]</td><td colspan="8">color_brightness
[0x64]</td></tr>
<tr><td>lcd_color_green</td><td>180
0x00B4</td><td colspan="8">reserved
[0x00]</td><td colspan="8">color_brightness
[0x64]</td></tr>
<tr><td>lcd_color_blue</td><td>181
0x00B5</td><td colspan="8">reserved
[0x00]</td><td colspan="8">color_brightness
[0x64]</td></tr>
<tr><td>lcd_brightness_contrast</td><td>182
0x00B6</td><td colspan="8">lcd_contrast
[0x64]</td><td colspan="8">lcd_brightness
[0x64]</td></tr>
<tr><td>user_interface_settings</td><td>183
0x00B7</td><td colspan="3">DAD
[0x0]</td><td>GFV
[1]</td><td>AF
[1]</td><td>Time
[1]</td><td>Date
[0]</td><td>TF
[1]</td><td>DAS
[0]</td><td>R
[0]</td><td colspan="6">lcd_color_scheme
[0x0]</td></tr>
</table>

These registers are used to configure basic features of the display and the button interface.

color_brightness: defines the brightness of a specific backlight color.
Values from 0x00 – 0% to 0x64 – 100% are valid.

lcd_brightness: defines the overall brightness of the LCD backlight.
Values from 0x00 – 0% to 0x64 – 100% are valid.

lcd_contrast: defines the contrast setting of the LCD.
Values from 0x00 – 0% to 0x64 – 100% are valid.

lcd_color_scheme: sets a predefined color setting, possible values are:
0x0 – user (as defined with the above values)
0x1 – white
0x2 – red
0x3 – green
0x4 – blue
0x5 – orange
0x6 – magenta
0x7 – cyan

DAS: display auto shuffle mode (0 – off, 1 – on), display values and set points will be shuffled after a defined timeout of 1 minute, each value is shown for 5 seconds

TF: time format (0 – 12h, 1 – 24h), if TF is set to 12h the date format will also be set to MM/DD instead of DD/MM

Date: show date in secondary display (0 – off, 1 – on)

Time: show time in secondary display (0 – off, 1 – on)

AF: acoustic feedback for touch buttons (0 – off, 1 – on)

GFV: goto first value after a defined timeout of 1 minute (0 – off, 1 – on)

DAD: display auto dim, dim display brightness after 2 minutes to following defined values:
0x0 – off (disabled)
0x1 – 50% lcd_brightness
0x2 – 10% lcd_brightness
0x3 – 0% lcd_brightness
0x4 – 0% lcd_brightness

!!! Compare Table 4 on Page 15 for device settings editable via the user interface.

Table 20: User Interface Settings

3.4.3 Configuration Registers

The configuration registers contain data for configuring fundamental functions of the device as well as configurations for display values and set points. The data is stored persistent and will be preserved after reboot

Register Name	Register Address	Bit Position															
		15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
config_flags	192 0x00C0	R [0]	SDSV [0]	MSC [0]	IRCP [0]	DU [0x1]		MU [0x1]		VIE [0]	VOL [1]	AIE [0]	AOL [0]	PESA [1]	PEEU [1]	SDE [0]	RST [0]

RST: reset_device flag, set to ‘1’ the device will reboot.

SDE: secondary_display_direct_access_enabled flag, set to ‘1’ the device displays the content of the secondary_display_direct_access_string register at address 200 (see Table 22 on Page 30)

PEEU: pincode_enabled_for_end_user flag, if set to ‘1’ the pincode for the end user can be edited by the end user

PESA: pincode_enabled_for_system_administrator flag, if set to ‘1’ the pincode for the end user and the system administrator can be edited by the system administrator

AOL: acoustic_alarm_when_offline flag, if set to ‘1’ a buzzer tone will be generated while the device is offline

AIE: acoustic_alarm_on_internal_error flag, if set to ‘1’ a buzzer tone will be generated if an internal error occurred

VOL: visual_alarm_when_offline flag, if set to ‘1’ the offline text symbol (OFFLINE) will be displayed while the device is offline

VIE: visual_alarm_on_internal_error flag, if set to ‘1’ the alarm symbol (⚠) will be displayed if an internal error occurred

MU: modbus_unit, defines which unit system is used for values on Modbus. The following values are possible:

0x0 – K
0x1 – °C (SI)
0x2 – °F (US)

DU: display_unit, defines which unit system is used to display values on the Rymaskon 200. The following values are possible:

0x0 – access prohibited via the user interface
0x1 – °C (SI)
0x2 – °F (US)

The display_unit can also be changed via the user interface in the device settings (see Table 4 an Page 15). If the value is set to ‘00’ the access to this device setting via the user interface is prohibited.

IRCP: ir_remote_control_pairing flag. This flag is set when a remote control is paired with the Rymaskon 200. Clear this flag to remove the pairing.

MSC: modbus_statistics_clear flag. When set to ‘1’ all Modbus statistics will be reseted.

SDSV: secondary_display_direct_access_string_volatile flag, if set to ‘1’ the content of secondary_display_direct_access_string (Table 22 on Page 30) is not kept persistent. This should be considered when the content of this register is changed frequently because of the limited write cycles of persistent memory.

Table 21: Configuration Flags

Please note that a change of display_unit or modbus_unit at the config_flags register will change the configuration registers for display values at address 256 to 289 and set points at address 320 to 351 to match the selected units system. Please see Table 27 on Page 35 for display value configuration and Table 28 on Page 37 for set point configuration.

If the direct value registers at adderss 104 and 105 (see Table 15 on Page 25) are used to display certain values there is no need to set the SDE flag at the config_flags register (see Table 21 on Page 29) to show a text along with the value. If the direct value enable bit is set to ‘1’ the content of sec_display_direct_access_string will be checked by the device. If the string is empty time and/or date will be displayed if enabled at user_interface_settings at addresse 183 (Table 20 on Page 28). Otherwise the content of the string will be displayed automatically.
If it is desired to don´t show anything at the secondary display a space character (0x20) needs to be inserted.

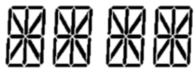
<table>
<tr><th rowspan="2">Register Name</th><th rowspan="2">Register Address</th><th colspan="16">Bit Position</th></tr>
<tr><th>15</th><th>14</th><th>13</th><th>12</th><th>11</th><th>10</th><th>9</th><th>8</th><th>7</th><th>6</th><th>5</th><th>4</th><th>3</th><th>2</th><th>1</th><th>0</th></tr>
<tr><td>secondary_display_ direct_access_string</td><td>200
0x00C8
–
207
0x00CF</td><td colspan="16">sec_display_direct_access_string</td></tr>
<tr><td></td><td colspan="17">The string will be displayed with the 4x16 segment digits of the secondary display. 
The string will be updated if the secondary_display_direct_access_enabled flag at the config_flags register at address 192 (Table 21 on Page 29) is set.
!!! Up to 16 ASCII character (limited to characters from 0x20 to 0x5F) can be displayed. A string terminator (0x00) will determine the length of the string. If a string is longer than 4 characters the secondary display will work as a ticker.</td></tr>
</table>

Table 22: Secondary Display Direct Access String

Register Name	Register Adresse	Bit Position															
		15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
config_touch_button_0	208 0x00D0	DA [1]	ED [0]	EU [1]	DAD [0]	DAU [1]	MF [0]	R [0]	EN [1]	set_point_index [0x00]							
config_touch_button_1	209 0x00D1	DA [1]	ED [0]	EU [1]	DAD [0]	DAU [1]	MF [0]	R [0]	EN [1]	set_point_index [0x01]							
config_touch_button_2	210 0x00D2	DA [0]	ED [0]	EU [0]	DAD [0]	DAU [0]	MF [0]	R [0]	EN [1]	set_point_index [0x00]							
config_touch_button_3	211 0x00D3	DA [0]	ED [0]	EU [0]	DAD [0]	DAU [0]	MF [1]	R [0]	EN [1]	set_point_index [0x00]							
config_touch_button_4	212 0x00D4	DA [1]	ED [1]	EU [0]	DAD [1]	DAU [0]	MF [0]	R [0]	EN [1]	set_point_index [0x00]							
config_touch_button_5	213 0x00D5	DA [1]	ED [1]	EU [0]	DAD [1]	DAU [0]	MF [0]	R [0]	EN [1]	set_point_index [0x01]							
config_touch_button_6	214 0x00D6	DA [0]	ED [0]	EU [0]	DAD [0]	DAU [0]	MF [0]	R [0]	EN [1]	set_point_index [0x00]							
config_touch_button_7	215 0x00D7	DA [0]	ED [0]	EU [0]	DAD [0]	DAU [0]	MF [0]	R [0]	EN [1]	set_point_index [0x00]							

With these registers the functionality of the touch buttons is defined.

set_point_index: defines a set point register that can be edited in DIRECT_ACCESS-mode if the DA bit is set

EN: if set to '1' the defined button is enabled and its state will be updated in the present state, short pressed and long pressed register at Table 7 on Page 19

MF: if set to '1' the button is defined as MENU-button

DAU: if set to '1' the button is defined as UP-button in DIRECT_ACCESS-mode

DAD: if set to '1' the button is defined as DOWN-button in DIRECT_ACCESS-mode

EU: if set to '1' the button is defined as UP-button in EDIT-mode

ED: if set to '1' the button is defined as DOWN-button in EDIT-mode

DA: if set to '1' and the button gets pressed a set point defined by the set_point_index will be displayed in DIRECT_ACCESS-mode

!!! See Table 25 on Page 33 for example configurations.

Table 23: Touch Button Configuration

Register Name	Register Adresse	Bit Position															
		15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
config_external_button_0	224 0x00E0	DA [0]	ED [0]	EU [0]	DAD [0]	DAU [0]	MF [0]	R [0]	EN [1]	set_point_index [0x00]							
config_external_button_1	225 0x00E1	DA [0]	ED [0]	EU [0]	DAD [0]	DAU [0]	MF [0]	R [0]	EN [1]	set_point_index [0x00]							
config_external_button_2	226 0x00E2	DA [0]	ED [0]	EU [0]	DAD [0]	DAU [0]	MF [0]	R [0]	EN [1]	set_point_index [0x00]							
config_external_button_3	227 0x00E3	DA [0]	ED [0]	EU [0]	DAD [0]	DAU [0]	MF [0]	R [0]	EN [1]	set_point_index [0x00]							

With these registers the functionality of the external buttons is defined.

set_point_index: defines a set point register that can be edited in DIRECT_ACCESS-mode if the DA bit is set.

EN: if set to ‘1’ the defined button is enabled and its state will be updated in the present state, short pressed and long pressed register at Table 7 on Page 19.

MF: if set to ‘1’ the button is defined as MENU-button

DAU: if set to ‘1’ the button is defined as UP-button in DIRECT_ACCESS-mode

DAD: if set to ‘1’ the button is defined as DOWN-button in DIRECT_ACCESS-mode

EU: if set to ‘1’ the button is defined as UP-button in EDIT-mode

ED: if set to ‘1’ the button is defined as DOWN-button in EDIT-mode

DA: if set to ‘1’ and the button gets pressed a set point defined by the set_point_index will be displayed in DIRECT_ACCESS-mode

!!! See Table 25 on Page 33 for example configurations.

Table 24: External Button Configuration

Description	Bit Position															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
no special function	0	0	0	0	0	0	0	1	0							
➔	The button is enabled but has no special function (e.g. OCCUPANCY-button). The set point index has no influence in this case.															
MENU-button	0	0	0	0	0	1	0	1	0							
➔	This combination can be used to determine the MENU-button. The set point index has no influence in this case.															
UP-button	0	0	1	0	1	0	0	1	0							
➔	This button will increment a set point in EDIT- or DIRECT_ACCESS-mode when pressed. The set point index has no influence in this case.															
DOWN-button with direct access	1	1	0	1	0	0	0	1	0							
➔	This button will decrement a set point in EDIT- or DIRECT_ACCESS-mode when pressed. Additionally a setpoint defined with the set_point_index is displayed when pressed and can be edited in DIRECT_ACCESS-mode.															

Table 25: Button Example Configuration

Register Name	Register Address	Bit Position															
		15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
config_bar_graph_left	240 0x00F0	R [0]	R [0]	R [0]	R [0]	R [0]	R [0]	R [0]	EN [0]	set_point_index [0x00]							
config_bar_graph_right	241 0x00F1	R [0]	R [0]	R [0]	R [0]	R [0]	R [0]	R [0]	EN [1]	set_point_index [0x01]							

These registers are used to associate a set point as source for the bar graph on the left and on the right side of the LCD. If enabled the bar graph is updated corresponding to the value of the set point defined with the set_point_index.
The bar graph segments can also be set manually by writing the symbol_direct_access registers at address 99 and 100 (Table 12 on Page 23)

set_point_index: defines a set point register that is used as source for the bar graph.

EN: if set to '1' the corresponding bar-graph will be updated to visualize the value of a set point with the defined set_point_index.

Table 26: Bar Graph Configuration

Register Name	Register Address	Bit Position															
		15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
config_display_value_0	256 0x0100	unit_modbus [0x1]				unit [0x1]				CAL [1]	semantic_meaning [0x01]						
	257 0x0101	VSA [1]	VEU [1]	DSSA [1]	DSEU [1]	[0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]	[1]	[0]
config_display_value_1	258 0x0102	unit_modbus [0xA]				unit [0xA]				CAL [1]	semantic_meaning [0x04]						
	259 0x0103	VSA [1]	VEU [1]	DSSA [1]	DSEU [1]	[0]	[0]	[0]	[0]	[1]	[0]	[0]	[0]	[0]	[0]	[0]	[0]
config_display_value_2	260 0x0104	unit_modbus [0x1]				unit [0x1]				CAL [1]	semantic_meaning [0x05]						
	261 0x0105	VSA [1]	VEU [1]	DSSA [1]	DSEU [1]	[0]	[0]	[0]	[0]	[1]	[0]	[0]	[0]	[0]	[0]	[1]	[0]
config_display_value_3	262 0x0106	unit_modbus [0xB]				unit [0xB]				CAL [1]	semantic_meaning [0x07]						
	263 0x0107	VSA [0]	VEU [0]	DSSA [0]	DSEU [0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]
config_display_value_4	264 0x0108	unit_modbus [0x8]				unit [0x8]				CAL [1]	semantic_meaning [0x0E]						
	265 0x0109	VSA [1]	VEU [1]	DSSA [1]	DSEU [1]	[0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]
config_display_value_5	266 0x010A	unit_modbus [0x1]				unit [0x1]				CAL [1]	semantic_meaning [0x03]						
	267 0x010B	VSA [1]	VEU [1]	DSSA [1]	DSEU [1]	[0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]	[1]	[0]	[0]
config_display_value_6	268 0x010C	unit_modbus [0x0]				unit [0x0]				CAL [0]	semantic_meaning [0x00]						
	269 0x010D	VSA [0]	VEU [0]	DSSA [0]	DSEU [0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]
config_display_value_7	270 0x010E	unit_modbus [0x0]				unit [0x0]				CAL [0]	semantic_meaning [0x00]						
	271 0x010F	VSA [0]	VEU [0]	DSSA [0]	DSEU [0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]
config_display_value_8	272 0x0110	unit_modbus [0x0]				unit [0x0]				CAL [0]	semantic_meaning [0x00]						
	273 0x0111	VSA [0]	VEU [0]	DSSA [0]	DSEU [0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]
config_display_value_9	274 0x0112	unit_modbus [0x0]				unit [0x0]				CAL [0]	semantic_meaning [0x00]						
	275 0x0113	VSA [0]	VEU [0]	DSSA [0]	DSEU [0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]
config_display_value_10	276 0x0114	unit_modbus [0x0]				unit [0x0]				CAL [0]	semantic_meaning [0x00]						
	277 0x0115	VSA [0]	VEU [0]	DSSA [0]	DSEU [0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]
config_display_value_11	278 0x0116	unit_modbus [0x0]				unit [0x0]				CAL [0]	semantic_meaning [0x00]						
	279 0x0117	VSA [0]	VEU [0]	DSSA [0]	DSEU [0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]
config_display_value_12	280 0x0118	unit_modbus [0x0]				unit [0x0]				CAL [0]	semantic_meaning [0x00]						
	281 0x0119	VSA [0]	VEU [0]	DSSA [0]	DSEU [0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]

Register Name	Register Address	Bit Position															
		15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
config_display_value_13	282 0x011A	unit_modbus [0x0]				unit [0x0]				CAL [0]	semantic_meaning [0x00]						
	283 0x011B	VSA [0]	VEU [0]	DSSA [0]	DSEU [0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]
config_display_value_14	284 0x011C	unit_modbus [0x0]				unit [0x0]				CAL [0]	semantic_meaning [0x00]						
	285 0x011D	VSA [0]	VEU [0]	DSSA [0]	DSEU [0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]
config_display_value_15	286 0x011E	unit_modbus [0x0]				unit [0x0]				CAL [0]	semantic_meaning [0x00]						
	287 0x011F	VSA [0]	VEU [0]	DSSA [0]	DSEU [0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]

These registers hold the configuration of the 16 display values.

semantic_meaning: is used to provide information about the semantic meaning and the source of the value. For further information please see Table 29 on Page 38.

CAL: if set to ‘1’ the corresponding offset_value can be edited in CALIBRATION-mode (only capable if DSEU or DSSA is set to ‘1’)

unit: defines a unit with which the corresponding display value appears on the LCD

unit_modbus: defines a unit that the corresponding display value register appeare on Modbus

!!! For both, unit and unit_modbus the following values are possible:

0x0	0x1	0x2	0x3	0x4	0x5	0x6	0x7	0x8	0x9	0xA	0xB	0xC
no unit	°C	°F	cfm	l/s	m³/h	Pa	inWC	V	%	%RH	ppm	°F dec.

Bits 0-11 of the higher address of each configuration register indicate the symbols that are displayed along with the corresponding display value.

DSEU: Display Source for End User

DSSA: Diplay Source for System Administrator

These two bits define if the value displayed is taken from a display_value register at address 64 to 79 (see Table 11 on Page 22) or from a sensor_value register at address 48 to 56 (see Table 10 on Page 21). The following states are valid:

0 – defines that the value is taken from a display_value register that has to be set via modbus.

1 – defines that the value is taken from a sensor_value (+ offset_value) register that is automatically updated with the current sensor value.

VEU: Visible for End User

VSA: Visible for System Administrator

These two bits define if the display value is visible for the end user and/or the system administrator. If set to ‘1’ the value will be visible.

!!! See Table 30 on Page 40 for example configurations of display values or set points.

Table 27: Display Value Configuration

Register Name	Register Adresse	Bit Position															
		15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
config_set_point_0	320 0x0140	unit_modbus [0x1]				unit [0x1]				PIN [0]	semantic_meaning [0x01]						
	321 0x0141	VSA [1]	VEU [1]	ESA [1]	EEU [1]	[0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]	[1]	[1]
config_set_point _1	322 0x0142	unit_modbus [0x0]				unit [0x0]				PIN [0]	semantic_meaning [0x0B]						
	323 0x0143	VSA [1]	VEU [1]	ESA [1]	EEU [1]	[0]	[0]	[0]	[0]	[0]	[0]	[1]	[0]	[0]	[0]	[0]	[0]
config_set_point _2	324 0x0144	unit_modbus [0x0]				unit [0x0]				PIN [0]	semantic_meaning [0x00]						
	325 0x0145	VSA [0]	VEU [0]	ESA [0]	EEU [0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]
config_set_point _3	326 0x0146	unit_modbus [0x0]				unit [0x0]				PIN [0]	semantic_meaning [0x00]						
	327 0x0147	VSA [0]	VEU [0]	ESA [0]	EEU [0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]
config_set_point _4	328 0x0148	unit_modbus [0x0]				unit [0x0]				PIN [0]	semantic_meaning [0x00]						
	329 0x0149	VSA [0]	VEU [0]	ESA [0]	EEU [0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]
config_set_point _5	330 0x014A	unit_modbus [0x0]				unit [0x0]				PIN [0]	semantic_meaning [0x00]						
	331 0x014B	VSA [0]	VEU [0]	ESA [0]	EEU [0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]
config_set_point _6	332 0x014C	unit_modbus [0x0]				unit [0x0]				PIN [0]	semantic_meaning [0x00]						
	333 0x014D	VSA [0]	VEU [0]	ESA [0]	EEU [0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]
config_set_point _7	334 0x014E	unit_modbus [0x0]				unit [0x0]				PIN [0]	semantic_meaning [0x00]						
	335 0x014F	VSA [0]	VEU [0]	ESA [0]	EEU [0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]
config_set_point _8	336 0x0150	unit_modbus [0x0]				unit [0x0]				PIN [0]	semantic_meaning [0x00]						
	337 0x0151	VSA [0]	VEU [0]	ESA [0]	EEU [0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]
config_set_point _9	338 0x0152	unit_modbus [0x0]				unit [0x0]				PIN [0]	semantic_meaning [0x00]						
	339 0x0153	VSA [0]	VEU [0]	ESA [0]	EEU [0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]
config_set_point _10	340 0x0154	unit_modbus [0x0]				unit [0x0]				PIN [0]	semantic_meaning [0x00]						
	341 0x0155	VSA [0]	VEU [0]	ESA [0]	EEU [0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]
config_set_point _11	342 0x0156	unit_modbus [0x0]				unit [0x0]				PIN [0]	semantic_meaning [0x00]						
	343 0x0157	VSA [0]	VEU [0]	ESA [0]	EEU [0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]

Register Name	Register Adresse	Bit Position															
		15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
config_set_ point _12	344 0x0158	unit_modbus [0x0]				unit [0x0]				PIN [0]	semantic_meaning [0x00]						
	345 0x0159	VSA [0]	VEU [0]	ESA [0]	EEU [0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]
config_set_ point _13	346 0x015A	unit_modbus [0x0]				unit [0x0]				PIN [0]	semantic_meaning [0x00]						
	347 0x015B	VSA [0]	VEU [0]	ESA [0]	EEU [0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]
config_set_ point _14	348 0x015C	unit_modbus [0x0]				unit [0x0]				PIN [0]	semantic_meaning [0x00]						
	349 0x015D	VSA [0]	VEU [0]	ESA [0]	EEU [0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]
config_set_ point _15	350 0x015E	unit_modbus [0x0]				unit [0x0]				PIN [0]	semantic_meaning [0x00]						
	351 0x015F	VSA [0]	VEU [0]	ESA [0]	EEU [0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]

These registers hold the configuration for the 16 set point.

semantic_meaning: is used to provide information about the semantic meaning of the set point. For further information please see Table 29 on Page 38.

PIN: if set to '1' the the corresponding set point is pincode protected and can only be changed in EDIT-mode if the correct pincode has been entered before.

unit: defines a unit with which the corresponding set point appears on the LCD

unit_modbus: defines a unit that the corresponding set point register appears on Modbus

!!! For both, unit and unit_modbus the following values are possible:

0x0	0x1	0x2	0x3	0x4	0x5	0x6	0x7	0x8	0x9	0xA	0xB	0xC
no unit	°C	°F	cfm	l/s	m³/h	Pa	inWC	V	%	%RH	ppm	°F dec.

Bits 0-11 of the higher address of each configuration register indicate the symbols that are displayed along with the corresponding display value.

EEU: Editable for End User

ESA: Editable for Aystem Administrator

These two bits define if the set point is editable for the end user and/or the system administrator. The following states are valid:

0 – defines that the set point is not editable.

1 – editable for system administrator.

VEU: Visible for End User

VSA: Visible for System Administrator

These two bits define if the set point is visible for the end user and/or the system administrator. If set to '1' the set point will be visible.

!!! See Table 30 on Page 40 for example configurations of display values or set points.

Table 28: Set Point Configuration

Table 29 below shows possible values for the semantic meaning used in the configuration for display values (Table 27 on Page 35) and set points (Table 28 on Page 37).

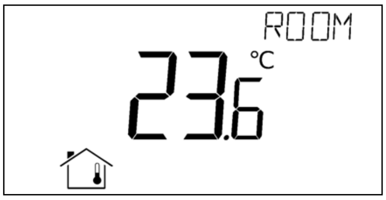
Primarily the semantic meaning field defines a text that is displayed along with a display value or a set point. Additionally for display values it defines the internal sensor_value that is displayed when the DSEU or DSSA bit is set. For examples on how to use the semantic meaning field in the configuration registers please see Table 30 on Page 40.

semantic_meaning	Beschreibung	Text im Zweitdisplay
0x00	None (unconfigured)	
0x01	Internal Temperature abs.	R O O M
0x02	Internal Temperature rel.	Δ S P T
0x03	External Temperature	O U T
0x04	Relative Humidity	H U M
0x05	Dew Point	D E W
0x06	Luminance (lx)	L U X
0x07	Amount CO_2	C O 2
0x08	Differential Pressure	P R E S
0x09	Flow	F L O W
0x0A	Valve Position	V A L V
0x0B	Fan Stage	F A N
0x0C	Heat/Cool Stage	H & C
0x0D	Brightness (%)	B R %
0x0E	Supply Voltage	2 4 V
0x0F	CPU voltage	C P U
0x10	CPU temperature	C P U
0x11	Room ID	R O O M
0x12	Damper Position (%)	D A M P
0x13	Reheat (%)	H E A T
0x14	Discharge Temperature	D I S

Table 29: Semantic Meaning

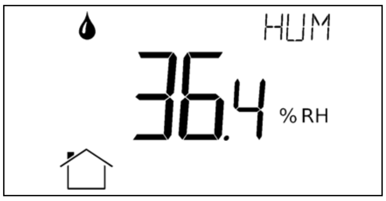
Description	Bit Position															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
config_display_value_x internal temperature (from built in sensor)	0x1				0x1				1	0x01						
	1	1	1	1	0	0	0	0	0	0	0	0	0	0	1	0

The value of the built in temperature sensor will be displayed with the internal temperature symbol in °C. It will be visible for the end user and system administrator. See the following example for how the display would look like:



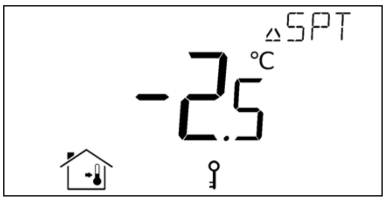
Description	Bit Position															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
config_display_value_x relative humidity (value supplied over Modbus)	0xA				0xA				0	0x04						
	1	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0

This is an example of a relative humidity display value. Because the DSEU and DSSA bit is set to '0' the content of the corresponding display_value_register will be displayed. It will be visible for the end user and system administrator. See the following example for how the display would look like:



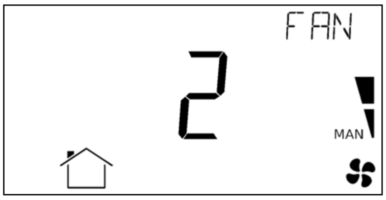
Description	Bit Position															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
config_set_point_x relative temperature	0x1				0x1				1	0x02						
	1	1	1	1	0	0	0	0	0	0	0	0	0	0	1	1

This is an example of a relative temperature set point in °C. The internal temperature symbol as well as the arrow symbol will be displayed. Since the set point is pincode protected also the key symbol will be displayed. See the following example for how the display would look like:



Description	Bit Position															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
config_set_point_x fan stage	0x0				0x0				0	0x0B						
	1	1	1	1	0	0	0	0	0	0	1	0	0	0	0	0

This is an example of a fan stage set point. The fan symbol and the actual stage will be displayed. The bar graph showing the actual stage of the fan is not displayed automatically but can be enabled via the corresponding bar graph configuration register at address 240-241 (see Table 26 on Page 33).
See the following example for how the display would look like:



For a stage set point the following semantic meanings are possible:

0x0A …Valve Position

0x0B …Fan Stage

0x0C …Heat/Cool Stage

The user can adjust the set point in manual mode within the limits defined by the set point max and min values (see Table 32 and Table 33). The automatic mode can be displayed by writing defined values to the specific set point register (see Table 31).
The following values are possible:

0x0000 … Stufe 0 Manual

0x0001… Stufe 1 Manual

0x0002 … Stufe 2 Manual

0x0003 … Stufe 3 Manual

0x8000 … Stufe 0 Auto

0x8001 … Stufe 1 Auto

0x8002 … Stufe 2 Auto

0x8003 … Stufe 3 Auto

If the set point min value is set to any automatic stage the user will have the opportunity to switch between manual and automatic mode. In this case, if the set point max value is set to “Stage 3 Manual” for example, the user can select the following values:

Stage 3 Manual

Stage 2 Manual

Stage 1 Manual

Stage 0 Manual

Stage 0 Auto

Table 30: Display Value and Set Point Example Configuration

<table>
<tr><th rowspan="2">Register Name</th><th rowspan="2">Register Address</th><th colspan="16">Bit Position</th></tr>
<tr><th>15</th><th>14</th><th>13</th><th>12</th><th>11</th><th>10</th><th>9</th><th>8</th><th>7</th><th>6</th><th>5</th><th>4</th><th>3</th><th>2</th><th>1</th><th>0</th></tr>
<tr><td>set_point_0</td><td>384
0x0180</td><td colspan="16">[0x00DC]</td></tr>
<tr><td>set_point_1</td><td>385
0x0181</td><td colspan="16">[0x0000]</td></tr>
<tr><td>set_point_2</td><td>386
0x0182</td><td colspan="16">[0x0000]</td></tr>
<tr><td>set_point_3</td><td>387
0x0183</td><td colspan="16">[0x0000]</td></tr>
<tr><td>set_point_4</td><td>388
0x0184</td><td colspan="16">[0x0000]</td></tr>
<tr><td>set_point_5</td><td>389
0x0185</td><td colspan="16">[0x0000]</td></tr>
<tr><td>set_point_6</td><td>390
0x0186</td><td colspan="16">[0x0000]</td></tr>
<tr><td>set_point_7</td><td>391
0x0187</td><td colspan="16">[0x0000]</td></tr>
<tr><td>set_point_8</td><td>392
0x0188</td><td colspan="16">[0x0000]</td></tr>
<tr><td>set_point_9</td><td>393
0x0189</td><td colspan="16">[0x0000]</td></tr>
<tr><td>set_point_10</td><td>394
0x018A</td><td colspan="16">[0x0000]</td></tr>
<tr><td>set_point_11</td><td>395
0x018B</td><td colspan="16">[0x0000]</td></tr>
<tr><td>set_point_12</td><td>396
0x018C</td><td colspan="16">[0x0000]</td></tr>
<tr><td>set_point_13</td><td>397
0x018D</td><td colspan="16">[0x0000]</td></tr>
<tr><td>set_point_14</td><td>398
0x018E</td><td colspan="16">[0x0000]</td></tr>
<tr><td>set_point_15</td><td>399
0x018F</td><td colspan="16">[0x0000]</td></tr>
<tr><td></td><td colspan="17">These registers contain the values of up to 16 set points.
All registers are 16 Bit signed values. Depending on the modbus_unit specified with the corresponding set point configuration register at address 320 to 351 (Table 28 on Page 37) the value needs to be scaled as described in Table 38 on Page 49 to achieve the desired result..</td></tr>
</table>

Table 31: Set Points

Register Name	Register Address	Bit Position															
		15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
set_point_max_0	416 0x01A0	[0x012C]															
set_point_max_1	417 0x01A1	[0x0003]															
set_point_max_2	418 0x01A2	[0x0000]															
set_point_max_3	419 0x01A3	[0x0000]															
set_point_max_4	420 0x01A4	[0x0000]															
set_point_max_5	421 0x01A5	[0x0000]															
set_point_max_6	422 0x01A6	[0x0000]															
set_point_max_7	423 0x01A7	[0x0000]															
set_point_max_8	424 0x01A8	[0x0000]															
set_point_max_9	425 0x01A9	[0x0000]															
set_point_max_10	426 0x01AA	[0x0000]															
set_point_max_11	427 0x01AB	[0x0000]															
set_point_max_12	428 0x01AC	[0x0000]															
set_point_max_13	429 0x01AD	[0x0000]															
set_point_max_14	430 0x01AE	[0x0000]															
set_point_max_15	431 0x01AF	[0x0000]															
	These registers are used to allow set point changes for the end user or system administrator only within limits defined with a set_point_max value of this Table and a set_point_min value of Table 33. All registers are 16 Bit signed values. Depending on the modbus_unit specified with the corresponding set point configuration register at address 320 to 351 (Table 28 at Page 37) the value needs to be scaled as described in Table 38 at Page 49 to achieve the desired result..																

Table 32: Set Point max. Values

Register Name	Register Address	Bit Position															
		15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
set_point_min_0	448 0x01C0	[0x0096]															
set_point_min_1	449 0x01C1	[0x0000]															
set_point_min_2	450 0x01C2	[0x0000]															
set_point_min_3	451 0x01C3	[0x0000]															
set_point_min_4	452 0x01C4	[0x0000]															
set_point_min_5	453 0x01C5	[0x0000]															
set_point_min_6	454 0x01C6	[0x0000]															
set_point_min_7	455 0x01C7	[0x0000]															
set_point_min_8	456 0x01C8	[0x0000]															
set_point_min_9	457 0x01C9	[0x0000]															
set_point_min_10	458 0x01CA	[0x0000]															
set_point_min_11	459 0x01CB	[0x0000]															
set_point_min_12	460 0x01CC	[0x0000]															
set_point_min_13	461 0x01CD	[0x0000]															
set_point_min_14	462 0x01CE	[0x0000]															
set_point_min_15	463 0x01CF	[0x0000]															

These registers are used to allow set point changes for the end user or system administrator only within limits defined with a set_point_max value of Table 32 and a set_point_min value of this Table.

All registers are 16 Bit signed values. Depending on the modbus_unit specified with the corresponding set point configuration register at address 320 to 351 (Table 28 at Page 37) the value needs to be scaled as described in Table 38 at Page 49 to achieve the desired result..

Table 33: Set Point min. Values

Register Name	Register Address	Bit Position															
		15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
offset_value_0	480 0x01E0	[0x0000]															
offset_value_1	481 0x01E1	[0x0000]															
offset_value_2	482 0x01E2	[0x0000]															
offset_value_3	483 0x01E3	[0x0000]															
offset_value_4	484 0x01E4	[0x0000]															
offset_value_5	485 0x01E5	[0x0000]															
offset_value_6	486 0x01E6	[0x0000]															
offset_value_7	487 0x01E7	[0x0000]															
offset_value_8	488 0x01E8	[0x0000]															
offset_value_9	489 0x01E9	[0x0000]															
offset_value_10	490 0x01EA	[0x0000]															
offset_value_11	491 0x01EB	[0x0000]															
offset_value_12	492 0x01EC	[0x0000]															
offset_value_13	493 0x01ED	[0x0000]															
offset_value_14	494 0x01EE	[0x0000]															
offset_value_15	495 0x01EF	[0x0000]															
	These registers are used to define offsets for display values when displaying a value from a built in sensor. These registers can either be written via Modbus or can be edited in CALIBRATION-mode by the system administrator. All registers are 16 Bit signed values. Depending on the modbus_unit specified with the corresponding display value configuration register at address 256 to 287 (Table 27 on Page 35) the value needs to be scaled the same as the corresponding display value as described in Table 38 on Page 49.																

Table 34: Offset Values

3.4.4 Model Information Registers (read only)

These registers are set at production time and contain specific information about the specific model and the default button print layout.

		Buttonlayout / Default Values					
Register Name	**Register Address**	**Type 210**	**Type 220**	**Type 230**	**Type 240**	**Type 250**	**Type 260**
default_print_touch_button_0	528 0x0210	[0x0004]	[0x0004]	[0x0004]	[0x0004]	[0x0004]	[0x0004]
default_print_touch_button_1	529 0x0211	[0x0000]	[0x0006]	[0x0006]	[0x000A]	[0x0006]	[0x0006]
default_print_touch_button_2	530 0x0212	[0x0000]	[0x0000]	[0x0008]	[0x0008]	[0x000A]	[0x000A]
default_print_touch_button_3	531 0x0213	[0x0001]	[0x0001]	[0x0001]	[0x0001]	[0x0001]	[0x0001]
default_print_touch_button_4	532 0x0214	[0x0005]	[0x0005]	[0x0005]	[0x0005]	[0x0005]	[0x0005]
default_print_touch_button_5	533 0x0215	[0x0000]	[0x0007]	[0x0007]	[0x000B]	[0x0007]	[0x0007]
default_print_touch_button_6	534 0x0216	[0x0000]	[0x0000]	[0x0009]	[0x0009]	[0x000B]	[0x000B]
default_print_touch_button_7	535 0x0217	[0x0002]	[0x0002]	[0x0002]	[0x0002]	[0x0002]	[0x0008]
default_print_external_button_0	539 0x0218	[0x0000]					
default_print_external_button_1	539 0x0219	[0x0000]					
default_print_external_button_2	539 0x021A	[0x0000]					
default_print_external_button_3	539 0x021B	[0x0000]					

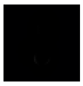
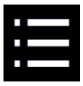
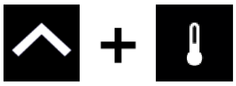
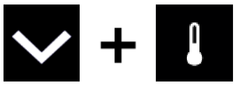
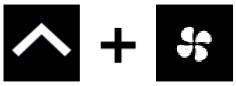
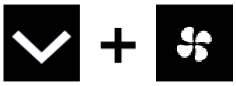
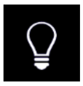
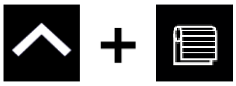
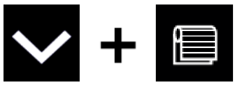
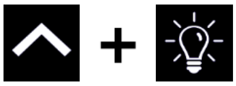
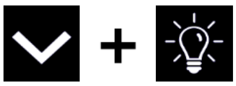
		Buttonlayout / Default Values					
Register Name	**Register Address**	**Type 210**	**Type 220**	**Type 230**	**Type 240**	**Type 250**	**Type 260**
		Button Print Layout – describes which symbols are printed on the front panel and on the external buttons by default. The following symbols are defined: 0x0000 – none  0x0001 – menu  0x0002 – occupancy  0x0003 – reserviert 0x0004 – temp_up  0x0005 – temp_down  0x0006 – fan_up  0x0007 – fan_down  0x0008 – light_on  0x0009 – light_off  0x000A – blinds_up  0x000B – blinds_down  0x000C – light_up  0x000D – light_down 					

Table 35: Model Information Registers

3.4.5 Device Information Registers (read only)

The registers shown in Table 36 are set at production and contain specific information about the device.

Register Name	Register Address	Bit Position															
		15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
product_code_string	560 0x0230 – 569 0x0239	product_code_string															
serial_number_ string	576 0x0240 – 585 0x0249	serial_number_string															
firmware_version_ string	592 0x0250 – 595 0x0253	firmware_version_string															
firmware_date	596 0x0254	firmware_date_0															
	597 0x0255	firmware_date_1															
bootloader_version_ string	608 0x0260 – 611 0x0263	bootloader_version_string															
bootloader_date	612 0x0264	bootloader_date_0															
	613 0x0265	bootloader_date_1															
!!! firmware_date_0 and firmware_date_1 as well as bootloader_date_0 and bootloader_date_1 represent a 32 bit timestamp in seconds since JAN-01-1970 indicating the build time.																	

Table 36: Device Information Registers

3.4.6 NFC Registers

These registers provide an URL that can be accessed by NFC enabled devices such as smart phones to get additional information and control of the room automation.

Register Name	Register Address	Bit Position															
		15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
url_string	1024 0x0400 – 1148 0x047C	[https://spluss.de]															
!!! Up to 248 ASCII character including a string terminator (0x00) can be used. The string will be converted to a NDEF URI record that is saved on the NFC tag. For further information on the NFC interface see Chapter 4.																	

Table 37: NFC Registers

3.4.7 Value Scaling and Stepwidth

The following Table 38 gives an overview of how Modbus register datapoints (display values, set points, min., max. and offset values) need to be scaled to achieve the desired result at the display. It also shows which stepwidth is defined for set points.

Physical Value	Unit	Modbus Scaling A*10^B*(raw + C)			Set Point Stepwidth	Example	
		A	B	C		raw value	displayed value
No Unit	-	1	0	0	1	100	100.0
Temperature	(K)	1	-1	-2740	0,5	2975	023.5 °C
	°C	1	-1	0	0,5	235	023.5 °C
	°F	1	-1	0	1,0	743	074.0 °F
	°F dec.	1	-1	0	0,5	743	074.5 °F
Flow	m^3/h	1	0	0	1	150	150.0 m^3/h
	l/s	1	-1	0	0,1	417	041.7 l/s
	cfm	1	0	0	1	88	088.0 cfm
Pressure	Pa	1	0	0	1	200	200.0 Pa
	inWC	1	-3	0	0,01	803	0.803 inWC
Voltage	V	1	-1	0	0,1	240	024.0 V
Percentage	%	5	-3	0	1	9000	045.0 %
Humidity	%RH	5	-3	0	1	9000	045.0 %RH
Amount CO_2	ppm	1	0	0	1	550	550.0 ppm

Note that though a display value or a set point would accept values from 0 to 65535 if unsigned or -32768 to 32767 if signed the value that is displayed is limited to a range from -999 to 9999 because of the 4 digit display.

!!! When a fixed-point number reaches a certain limit where an overflow occurs the decimal point is shifted rightwards (e.g. 999.9 → 1000).

!!! Whole number values are preferably displayed with the bigger digits. If an overflow occurs the number is shifted rightwards (e.g. 999 → 1000).

Table 38: Value Scaling and Stepwidth

4. NFC

The NFC interface of the RYMASKON 200 device can be used to get additional information and configuration options for room automation. The RYMASKON 200 will behave like an NFC tag that can be read by an NFC enabled device. The antenna is located behind the LCD and best performance is achieved by putting the NFC enabled device right on the front panel glass. Depending on where the antenna of the mobile device is located the optimal position will be found by moving the device slowly over the front panel. Best performance can be achieved by positioning the device in a more or less horizontal position covering the LCD as shown in Figure 8.

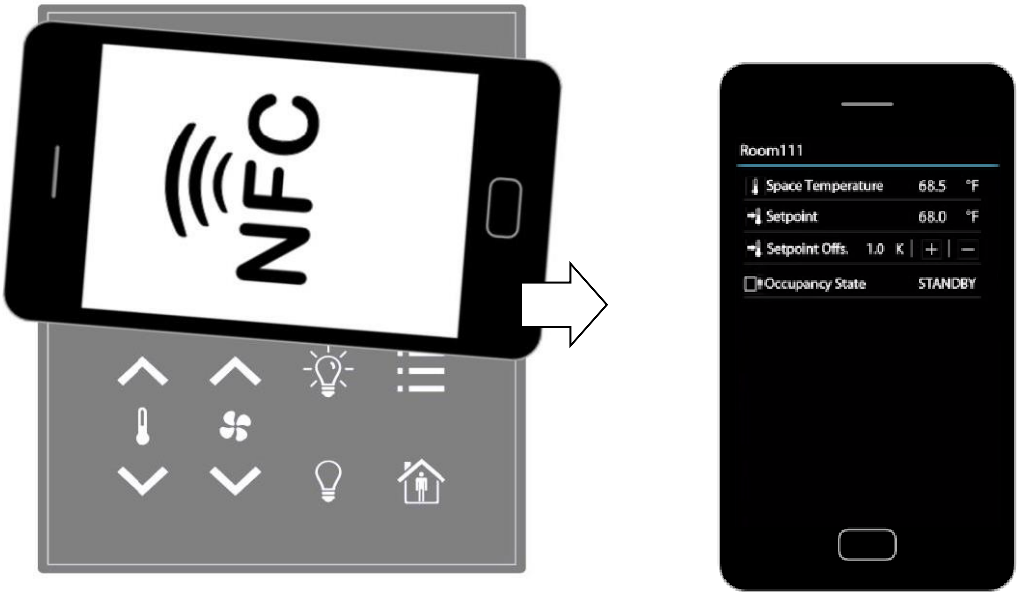


Figure 8: NFC Device Positioning

If the connection is established the NFC field detection bit at the short_pressed Modbus register at address 1 (Table 7 on Page 19) will be set. In the meantime the NFC enabled device will read the memory of the tag and will perform an appropriate action.

Since a NDEF URI record is saved at the tags memory the device will ask to open the defined URL in the browser of the NFC enabled device.

5. IR-Remote Control Operation

5.1. General Description

The IR receiver is located behind the front panel glass above the LCD.
The RYMASKON 200 device implements the NEC IR protocol compatible with the Apple remote control as displayed in Figure 9.

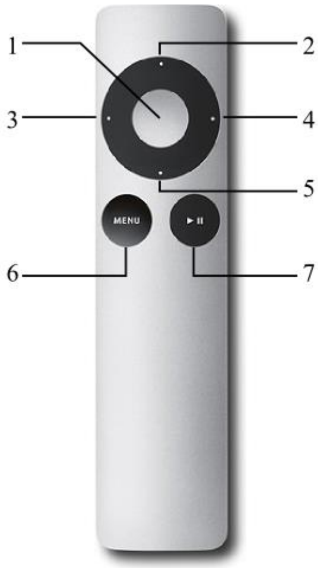


Figure 9: Apple Remote Control

Whenever a command gets received the IRC bit at the short_pressed Modbus register at address 1 (Table 7 on Page 19) is set.
The received button code as well as the remote ID can be read from the ir_remote_control_command register at address 32 (Table 9 on Page 20).

Button Number	Description	Button Code
1	Center	46
2	Up	5
3	Left	4
4	Right	3
5	Down	6
6	Menu	1
7	Play/Pause	47

Table 39: Apple Remote Button Codes

5.2. Remote Control Pairing

Each remote control has an ID that is transmitted along with the button code. This ID can be used to pair a certain remote control with a certain RYMASKON 200 - device. The ID of the Apple remote control can be changed by pressing Menu and Center button for at least 6s. This will increment the ID by one.

The ID of your remote control can be checked by pressing any button while watching the ir_remote_control_command register.

If a RYMASKON 200 device gets paired with a certain remote control it will only update the ir_remote_control_command register and the IRC bit at the short_pressed register when receiving a command from this remote control.

Pairing can be achieved by pressing Menu and Right button at the remote control for at least 6s while pointing towards the RYMASKON 200 device. If pairing worked the secondary display will shortly show ‘IRP’ (IR pairing). The remote ID will be saved internally and the IRCP flag of the config_flags register at address 192 (Table 21 on Page 29) will be set.

The pairing can be canceled by either clearing the IRCP flag or by pressing Menu and Left button for at least 6s. If the secondary display shows ‘IRUP’ (IR unpairing) shortly the pairing is suspended.

6. Troubleshooting

6.1. Technical Support

S+S Regeltechnik GmbH
Piraner Str. 20
D-90411 Nürnberg
Germany / Europe

E-Mail :	mail@SplusS.de
Web :	http://www. SplusS.de
Tel :	+49 (0) 911 / 5 19 47-0
Fax :	+49 (0) 911 / 5 19 47-70

7. Specifications

7.1. Physical Specifications

Operating Voltage	24 V DC (±10 %)
Power Consumption	max. 0.8 W
In rush current	up to 4A (at 24 V DC)
Operating range, temperature	0....+50°C
Operating range, humidity	10... 90 % r.H. (without dew formation)
Dimensions	94.5 x 110 x 19.5mm
Protection type	IP 30 (according to EN 60529)
Installation	using a plastic mounting plate, on in-wall flush box, Ø 55 mm

Following Table 40 should provide support for dimensioning of an installation and the power supply. For each device type there is a listing for up to 16 devices of the maximum possible cable length and the resulting power loss on the cable for different supply voltage levels. Together with the power consumption of the devices one can calculate the required power of the power supply.

Conditions of the Installation				Number of Devices															
				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
RYMASKON200		maximum power consumption of devices	[W]	0,8	1,6	2,4	3,2	4,0	4,8	5,6	6,4	7,2	8,0	8,8	9,6	10,4	11,2	12,0	12,8
RYMASKON200	24V DC	max. Cable length [m]	for 0,5mm^2	1.620	810	540	400	320	270	230	200	180	160	140	130	120	110	100	100
RYMASKON200	24V DC	max. Cable length [m]	for 1,0mm^2	3.250	1.620	1.080	810	650	540	460	400	360	320	290	270	250	230	210	200
RYMASKON200	24V DC	max. Power loss on cable	[W]	0,2	0,4	0,6	0,9	1,1	1,3	1,5	1,7	1,9	2,1	2,3	2,6	2,8	3,0	3,2	3,4

Table 40: Cable Length and Power Loss on Cable

7.2. Sensor Specifications

Ambient Temperature Sensor	
Type:	CMOS
Measuring range, temperature:	–40....+125 °C
Resolution:	0.1 °C
Deviation of temperature:	± 0.5 °C (+5...+60 °C)
Relative Humidity Sensor	
Type:	capacitive
Measuring range, humidity:	0...100 % r.H.
Resolution:	0.1 % r.H.
Deviation of humidity:	±2 % r.H. (at +25 °C, 20...80 % r.H.)
	±3 % r.H. (at +25 °C, 0... 20 % r.H. and 80...100 % r.H.)
Infrared Receiver	
Protocol:	NEC
Carrier:	38 kHz @ 950 nm
	Apple remote control compatible