

FCR010

Communicative fancoil controller



Summary

FCR010 is a communicative fan coil controller (up to 3 fan stages, heating and cooling valves). It may either work autonomously, or be connected to a primary controller (markPLC) or SCADA. As a room unit, UC010 is used.

Application

- Individual room control for systems with 4 pipe fancoils
- Individual room control for systems with 2 pipe fancoils
- Individual room control for cooling fancoils and radiators
- Individual room control for heating convectors and cooling panels

Function

The controller communicates with a room unit on a dedicated bus (K2+, K2-). The room unit reads room temperature, setpoint correction by a knob, and operating status, which is selected by a short push of the button or in the menu. Measured temperature range is 0 to +50 °C. Read and entered values are processed in a PI control algorithm. On the output there are PWM modulating sequences for triacs to control the thermic valves.

The controllers operate in a non-aggressive environment. No maintenance is necessary. They are mounted with two screws on any flat surface, e.g. fan coil body, or installation board. The holds can be removed and controller could be fixed on DIN rail. (See Installation below.)

The controller incorporates real time clock with weekly scheduler (6 events per day). It switches between the Comfort, Precomfort, and Off operation modes. There are two digital inputs on the controller for presence sensor (access card reader, PIR sensor etc.) and for window contact or dew point sensor (switches to the Off mode). Both NO and NC contact may be used, the selection follows in the configuration software.

The fan stages are either controlled automatically (with control deviation, or rather PID controller output) or manually (if this function is enabled). Three LEDs indicate correct function: green (PWR) – power OK, red (TX1) – transmit data to the building bus, and red (TX2) – transmit data to the room unit. On the top there are four DIP switches: K1 bus end, and INIT switch to set factory defaults.

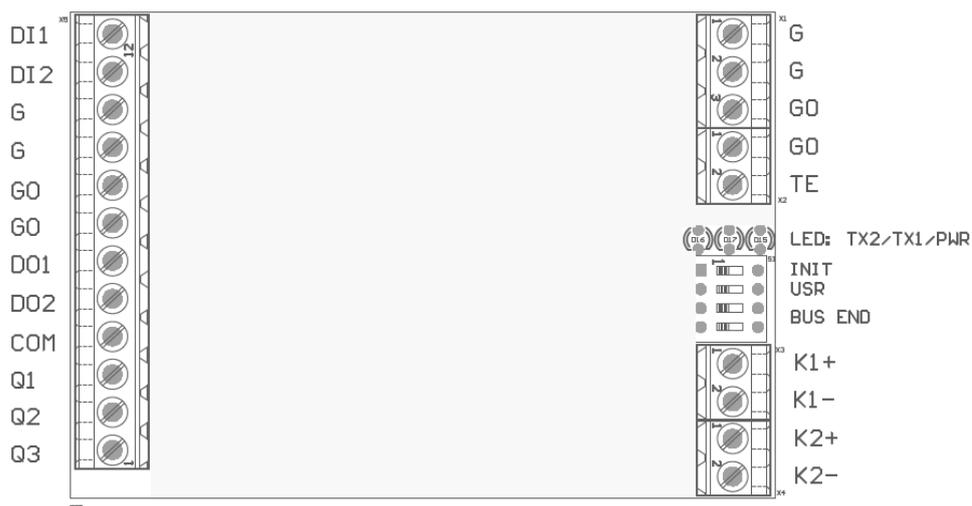
The controller communicates with the management system over RS485 bus with Modbus RTU and therefore can be used in many control systems. See the variable list (Modbus table) in a separate document *Room unit and controllers*. (<http://domat-int.com/en/downloads/technical-documentation/modbus-tables>) Another bus, K2, communicates with the room unit. To configure and commission the unit use ModComTool, which is free to download at <http://domat-int.com/en/downloads/software>.

Technical data

Power	24 V AC $\pm 10\%$; max 1,8 W
Communication	
RS485 – Modbus RTU (slave) - to BMS	RS485 (K1+, K1-) baud rates 300 ... 115 200 bit/s, parity and bits are set over Modbus RTU default 9600, N, 8, 1 maximal bus length 1200 m maximum number of modules depends on requested response time – up to 255 addresses, for common HVAC applications use about 300...400 physical data points on the bus
RS485 – Modbus RTU (master) - to room unit	RS485 (K2+, K2-) default 9600, N, 8, 1 (do not change) both RS485 interfaces are galvanically insulated from other module parts, insulating voltage 1 kV (note: there is no galvanic insulation between K1 and K2 RS485 interfaces)
3x LED	PWR, Tx1, Tx2
Digital inputs	
	2x DI for a dry contact, 24 V AC, 15 mA
Digital outputs	
	2x solid state relay for AC load, zero switching, 24 V AC, max. current 0,4A. Recommended actuators are STA71 (Siemens), TWA (24V types, Danfoss). 3x relay 230V / 5A
SW	ModComTool
Housing	Polycarbonate box (certification UL94V0)

Protection degree	IP20 (EN 60529)
Recommended wire cross-section	0,35 – 1,5 mm ²
Ambient temperature	5 – 40 °C; 5 – 85 % relative humidity; non-condensing gases and chemically non-aggressive conditions (according EN 60721-3-3 climatic class 3K3)
Standards conformity	EMC EN 61000-6-2 ed.3:2005, EN 55022 ed.3:2010 EN 60950-1 ed.2:2006 + A11:2009 + A12:2011 + A1:2010 + A2:2014 EN 50581:2012

Terminals



Terminals and connectors:

G	power
G0	power - common
TE	technical ground - shielding
K1+	serial line RS485 +, BMS communication
K1-	serial line RS485 -, BMS communication
K2+	serial line RS485 +, room unit communication
K2-	serial line RS485 -, room unit communication
DI1	presence input (switches Comfort - Precomfort) against G0
DI2	window contact input (switches Comfort/Precomfort – Off) against G0
G	power supply of outputs and inputs (internally connected to G in the upper terminal row)
G0	power supply of outputs and inputs - reference point (internally connected to G0 in the upper terminal row)
DO1	heating valve output (G, against G0)
DO2	cooling valve output (G, against G0)
COM	common terminal for Q1, Q2, Q3
Q1	fan coil relay stage 1
Q2	fan coil relay stage 2
Q3	fan coil relay stage 3

LED indication:

PWR	green LED – power (ON: power OK; OFF: no power applied, weak or damaged power supply, ...)
Tx1	red LED – RS485 transmitting data to the building bus (flashing: transmitting data; OFF: no data traffic)
Tx2	red LED – RS485 transmitting data to the room unit (flashing: transmitting data; OFF: no data traffic)

DIP switches:

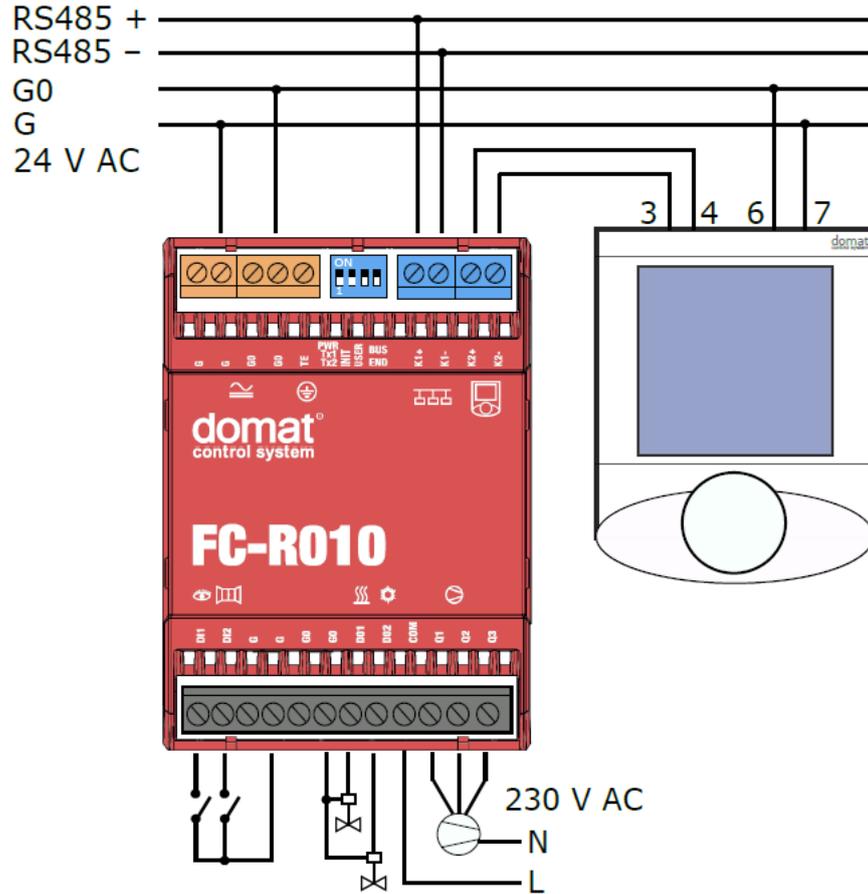
INIT	INIT (DIP 1) - if ON at power-up, configuration parameters are brought to defaults (address 1, communication parameters 9600/8/N/1)
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Another function of the INIT switch is to bring EEPROM into default factory settings. To init the EEPROM, proceed as follows:

- connect the device over RS485 to a PC with ModComTool (Modbus Configuration Tool)
- set INIT to ON
- apply power
- find the controller in the tool (Scan)
- set INIT to OFF
- in the ModComTool, open the controller window
- click the INIT button in the tool
- remove and apply power.

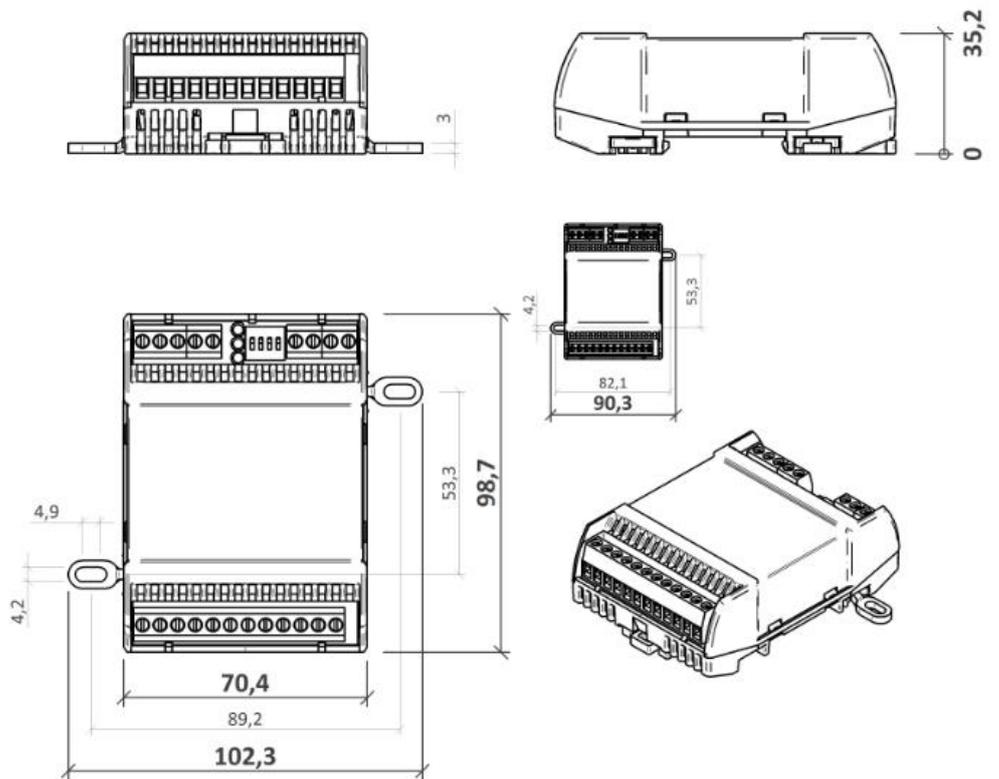
USER	(DIP2) not used
BUS END	DIP3 and DIP4 both ON = bus end RS485 K1 for BMS; the first and last devices on bus should have bus end ON

Connection



Power supply G and G0 terminals are internally connected with G and G0 terminals on the input/output terminals block.

Dimensions

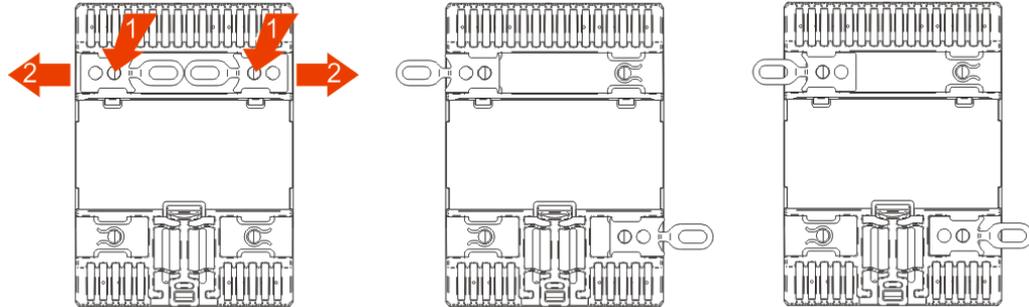


Dimensions are in *mm*.

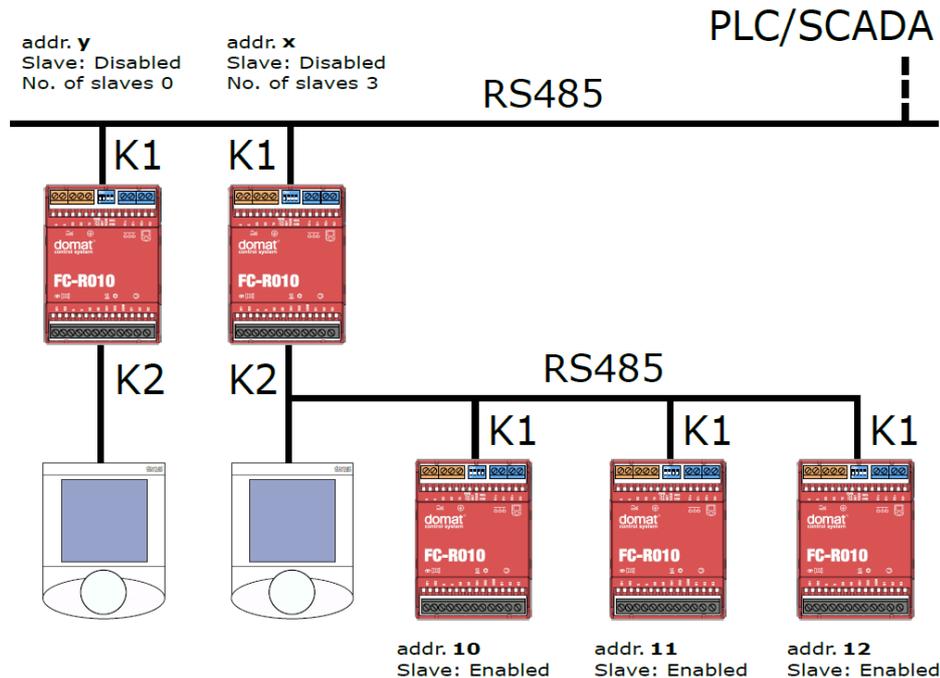
Installation

The module is mounted on a standard DIN rail or fixed by screws in mounting clips (see below).

Mounting clips are fixed on the back of the module. To eject mounting clips, push the fixing point inside the circular hole. To fix module by the clips, slip in the clips with oval hole facing outside of the module. It is possible to choose from two positions.



Master - slave



In this connection, controllers with addresses x, 10, 11, and 12 are in one zone and all of them are controlled by one room unit. The controller addressed x is a master. Outputs of controllers addressed 10, 11, and 12 are controlled by the same signals as the master controller addressed x.

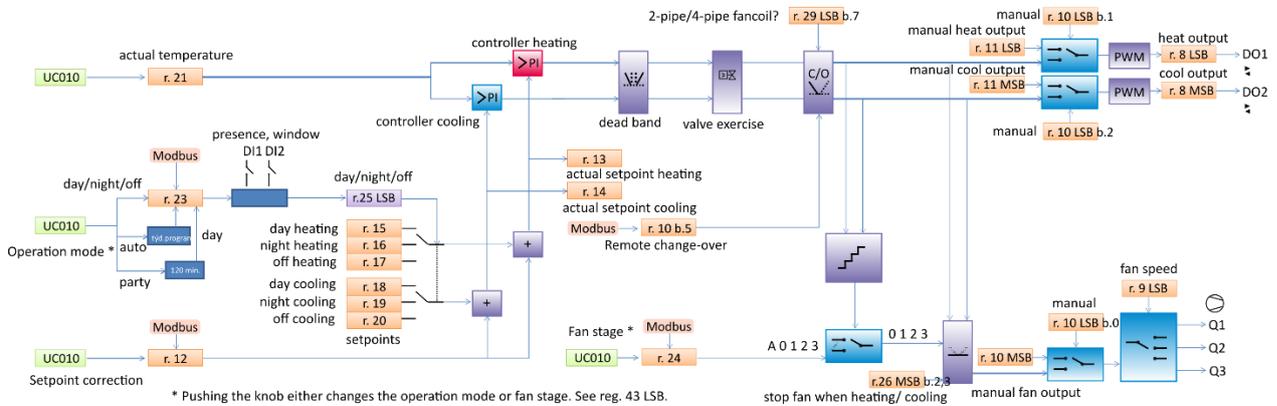
The Slave controllers are connected to the room unit bus (K2+, K2-). They must be addressed starting with 10 and all the other controllers belonging to one zone (on the same K2bus) must be addressed 10, 11, 12, 13, 14... etc, with no gaps. Maximum number of slave controllers is not limited (or, is limited only by the upper Modbus addressing range, which is 250), however, the technology and room layout should be considered.

There may be more slave groups in the same system, each starting with address 10. The addressing of master controllers at the building bus (K1+, K1-), however, must be unique.

Parameters Slave (Enabled / Disabled), No. of slaves (integer 0..240) and controller address are set in the configuration software **ModComTool**.

Function description

The register numbers in the text below refer to the FCR010 Modbus table which is supplied as a separate document and is part of this function description.



Operation mode

The main selector of heating and cooling setpoints is the operation mode, which is one of the following states:

- Comfort (Day)
- Standby (Night)
- Off.

The operating mode is determined by those events:

- push of the UC010 button if the controller is set up so as to change the operation mode
- states of the digital inputs DI1 and DI2
- Modbus setting in **register 23**.

In the register, either the operating mode can be set directly, or a time-dependent state Party or Time schedule. The last written value applies. If Time schedule (the clock symbol) is set, the operating mode is determined by the setting of the internal time scheduler. After the controller is set to Party, it goes to Comfort for another 2 hours, and then sets back to the previous state.

The sets Comfort, Standby, Off, and Day, Night, Off have only this difference: if Residential mode (Day, Night, Off) is selected, it is possible to use the time scheduler. The Hotel mode (Comfort, Standby, Off) does not allow the time scheduler function.

The operation mode is also controlled by the digital inputs for window contact (switches between Off and the two other modes), and presence sensor or card reader (switches between Comfort (Day) and Standby (Night)). The inputs must be enabled (**reg. 26**). The inputs have higher priority than all events described above (pushbutton, Modbus, weekly scheduler). The resulting operation mode is in **Register 25 LSB**.

Setpoints

Based on the operation mode (Comfort, Standby, Off), a pair of basic setpoints for heating and cooling is selected (**registers 15 to 20**). A setpoint correction is added to the setpoints. The correction influences all three pairs of setpoints.

The user correction is available in **register 12**. The same register can be written over Modbus. The setpoint correction thus may be changed by two ways: after the value is set over Modbus, the user is allowed to set it back to a value from allowed range. The last written value is active.

Display of setpoint value

The setpoint correction is determined by the UC010 knob. The setpoint displays either as absolute or as relative value.

Relative display: a deviation against the basic setpoints, like „-3.5 ... +3.5“ (default values)

Absolute display: The correction is added to the basic setpoint, and the result is displayed as the current calculated setpoint in °C. The current setpoint depends on the controller mode – if it is heating or in the dead zone between the heating and cooling setpoint, and the last energy used was heating (then the heating setpoint + correction is displayed), or if the controller is cooling or in the dead zone, and the last energy used was cooling (then the cooling setpoint + correction is displayed). It may thus happen that e.g. for the heating setpoint of 21 °C and cooling setpoint 24 °C the user sets correction of -1.5 K and the controller is heating. The display shows $21 - 1.5 = 19.5$ °C when setting. Then, without any control intervention, the heat gains in the room increase, temperature increases to 24 °C (which is above the current cooling setpoint of $24 - 1.5 = 22.5$ °C) and the controller starts cooling. As soon as the user turns the knob, the actual cooling setpoint displays, which is 22.5 °C. This also is the value to be changed (of course, the heating setpoint shifts as well). The current cooling setpoint is displayed until the controller starts heating again – then the display shows the current heating setpoint. The user may suppose that the setpoint changed automatically from 19.5 to 22.5 °C. This is not correct: the controller mode changed from heating to cooling, and the current setpoint changed from the heating setpoint to the cooling setpoint. The values of both setpoints remain unchanged.

Measured temperature

The measured temperature is read by the room unit UC010.

Control functions

In the following text, the functions below have higher priorities, i.e. the signals are processed in the order as described in the text.

PI controllers

Current setpoint incl. correction and measured room temperature are sent to a pair of PI controllers. These controllers calculate the output signal once per second. If the P or I constants are changed during the operation, the controllers are reset, and old integrated I-parts are deleted and the integration starts at 0.

Dead zone

If the difference between actual temperature and actual setpoint is less than 0.5 K, both outputs of the PI controllers are set to 0. This function prevents the controller from frequent switching between the heating and cooling mode, and defines the dead zone.

Valve exercise

If this function is enabled, the valves are opened and closed once per week regardless of the heating and cooling demands to prevent seizing.

The resulting values are available in **register 8**, PID output heat and PID output cool.

Change-over (C/O)

If the controller is configured as two-pipe, the next step is to calculate the change-over logic. The change-over signal informs the controller that there is cold water in the piping rather than hot water, and the valve should open on cooling demand rather than on heating demand. The change-over state can be set over the bus, using **register 10 bit 5**.

After the C/O changes, there is a safety time gap of 30 minutes (configurable in **reg. 43**) between the stop of heating and the start of cooling (and vice versa), so that the water in the piping is not mixed.

The resulting sequences are used for control of analogue outputs AO1 and AO2, triac PWM outputs DO4 and DO5, and three fan relays.

Control of PWM valve outputs

The heating and cooling signals on the output of the C/O function are brought to the PWM modulating blocks with 60 s period. **Register 26 bit 7** defines if the valves are NC (normally closed, default setting) or NO (normally open). In case of NO configuration, the PWM signal is inverted. The resulting PWM signals are brought to DO1 (heating) and DO2 (cooling) to control valves with thermic actuators. The triac outputs can be overridden manually. The manual override is enabled in **reg. 10 bits 1 to 2** and if the respective bit is active, the PWM sequence is controlled by analogue values from **registers 11 MSB and 11 LSB** rather than from the heating and cooling sequences.

Fan control

The resulting sequences are also used for control of the fan stages. At first, it is specified if a sequence shall influence the fan stage control (**register 26, bits 2 and 3**):

- bit 2: Stop fan when heating, i.e. for cooling fancoils. The heating output can be used e.g. for radiator valve control.
- bit 3: Stop fan when cooling, i.e. for heating convectors. The cooling output can be used e.g. for cooling panel valve control.

Stop fan when heating / cooling works with any operation mode set by writing over Modbus into **register 24** or by setting by user over short push of the UC010 knob, the last written value is active. This means that user is not able to manually override the fan motor at a cooling fancoil in case the controller needs to heat.

If the fan is blocked by Stop fan when heating / cooling parameters, it can be overridden only by manual override directly at the outputs.

If the fan is set to Auto, the fan stage is derived from the control sequence output. Based on the number of fan stages entered in **reg. 26, bits 4 and 5**, the sequence is recalculated among the number of stages. The three-stage control is set as follows:

Stage 1: On 8 %, Off 0 %

Stage 2: On 40 %, Off 25 %

Stage 3: On 80 %, Off 65 %.

When on Auto, there is a short time delay between the switching of the stages to prevent the motor from shocks.

The fan relays can be overridden at any time, regardless of manual or automatic fan stage control, by enabling manual override in **reg. 10 LSB bit 0** and setting of **reg. 10 MSB, bits 0 to 3**.

RoHS notice The device contains a non-rechargeable battery which backups the real-time clock and part of the memory. After the device is not operable, please return it to the manufacturer or dispose of it in compliance with local regulations.

Safety note The device is designed for monitoring and control of heating, ventilation, and air conditioning systems. It must not be used for protection of persons against health risks or death, as a safety element, or in applications where its failure could lead to physical or property damage or environmental damage. All risks related to device operation must be considered together with design, installation, and operation of the entire control system which the device is part of.

**Changes
in versions**

01/2017 – First datasheet version.

01/2017 – Terminals schema correction (COM, Q1, Q2 and Q3).

01/2017 – Terminals schema correction (COM, Q1, Q2 and Q3) changes reversion.

12/2017 – Power description changed, connection and master-slave schemes changed, safety note added.

08/2018 – Function schema changed.