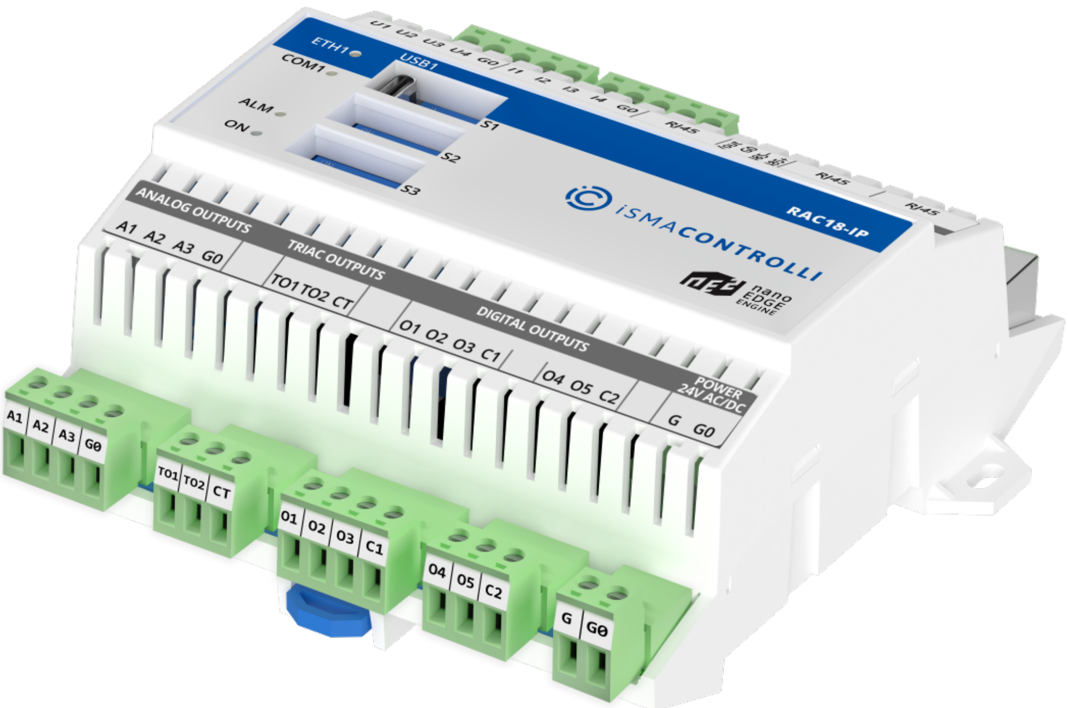
RAC18-IP

User Manual

Universal FCU Application



iSMA CONTROLLI S.p.A. - Via Carlo Levi 52, 16010 Sant'Olcese (GE) - Italy | support@ismacontrolli.com

Table of Contents

1 Introduction

This user manual outlines the configuration steps of the universal FCU application designed for the RAC18-IP controller. The application is based on the nano EDGE ENGINE components and is fit for most types of fan coil units.

The application covers the following modes of FCU operation:

- pipe mode;
- 2-stage heating;
- 2-stage cooling;
- heating/cooling control mode;
- CV temperature source;
- fan type.

The application works with the following types of dedicated panels:

- LP room panel;
- SP room panel;
- FP room panel;
- Touch Point series panels.

Configuration is carried out with an 8-position DIP switch.

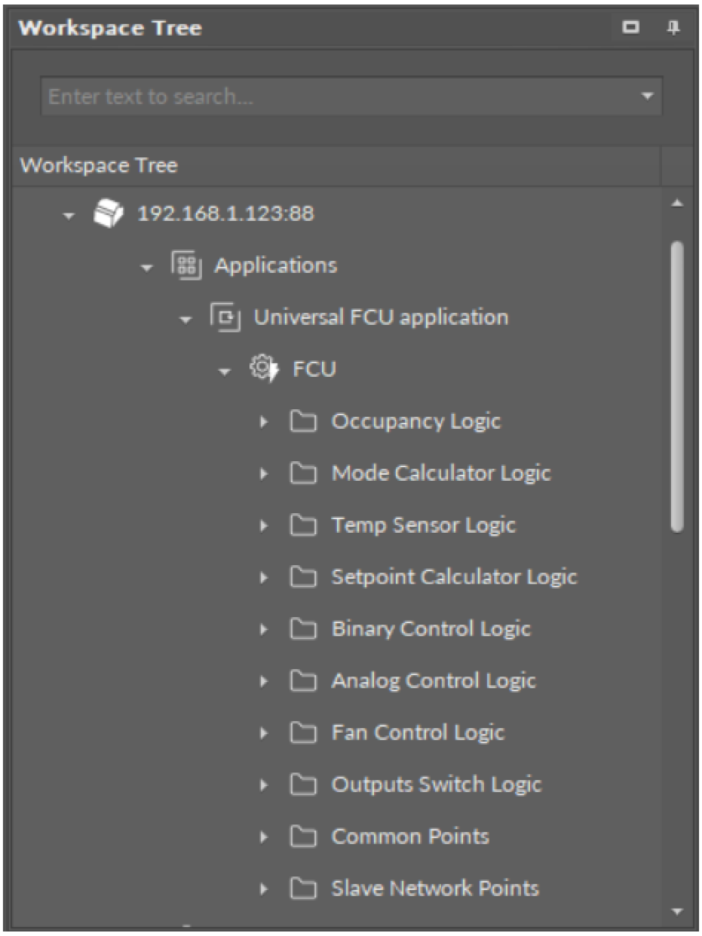


Figure 1. Universal FCU application in the iC Tool

1.1 Revision History

Date	Rev.	Description
18 Jul 2024	1.0	First edition

Table 1. Revision history

2 Inputs and Outputs

This section describes using all inputs and outputs with default application loaded on the RAC18-IP device.

2.1 Universal Inputs

The RAC18-IP device has four universal inputs. In the default application, dedicated temperature sensors and/or potentiometer have to be connected to each input. The figure below presents the way all universal inputs are connected.

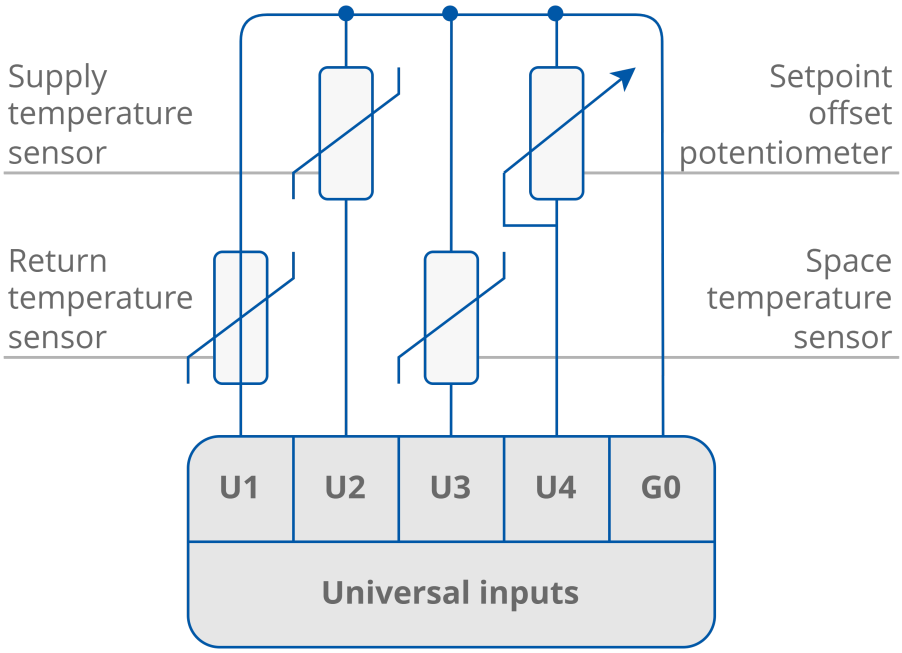


Figure 2. Universal inputs connection

2.2 Digital Inputs

The RAC18-IP device is equipped with four digital inputs. The way of connecting all signals to the inputs is presented in the figure below. Digital inputs I1 to I3 can be inverted, depending on the type of sensors connected to the device.

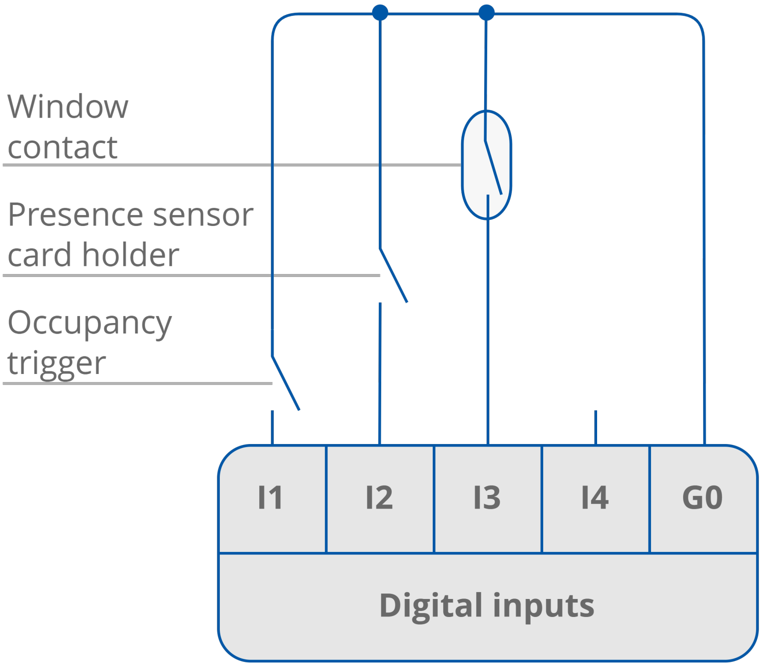


Figure 3. Digital inputs connection

2.3 Triac Outputs

The RAC18-IP device has two triac outputs to connect the actuators of heating and cooling valves. Both can work as typical binary outputs (for binary temperature control) or with the PWM. In the PWM mode, the output works in the period when two states are used (low state 0 V and high 230 V AC). The periods are defined by the PWM_Heating_Period network variable for the TO1 output and PWM_Cooling_Period network variable for the TO2 output (both are set to 300 seconds by default). The control signal defines the output of high state in working period (in percentage).

The way of connecting the actuators to the triac outputs in 4-pipe application is presented in the figures below.

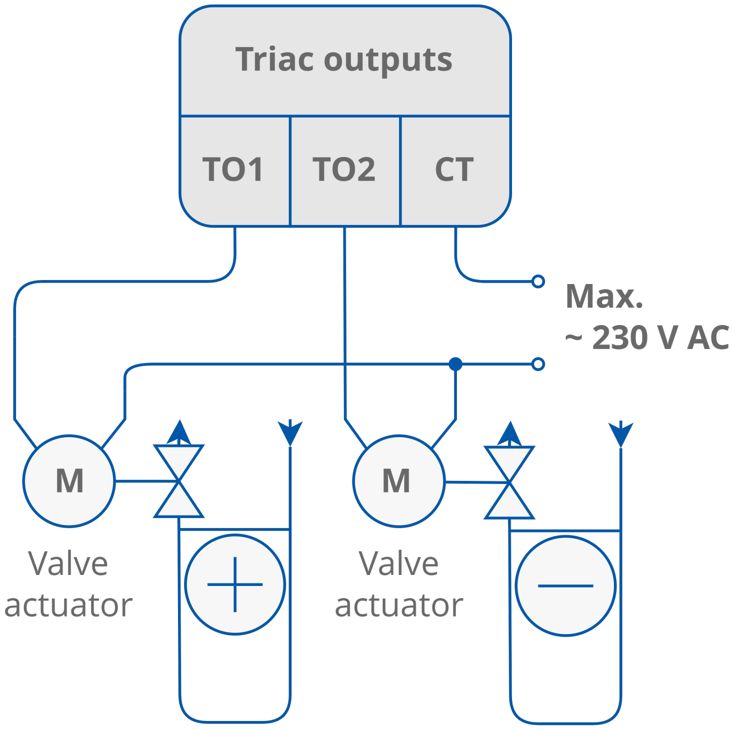


Figure 4. Triac outputs connection

2.4 Digital Outputs

2.4.1 Fan Outputs

The RAC18-IP device is equipped with three relay outputs designed for connecting with the fan. The way of connecting the fan (depending on the number of speeds) is presented in the figure below. These outputs have internal connection to the power supply terminal and are protected by a built-in 6 A fuse. The total load for digital outputs O1, O3, O5, and triac cannot extend 6 A.

WARNING! Please note that the inductive load of the relays is limited to 75 VA.

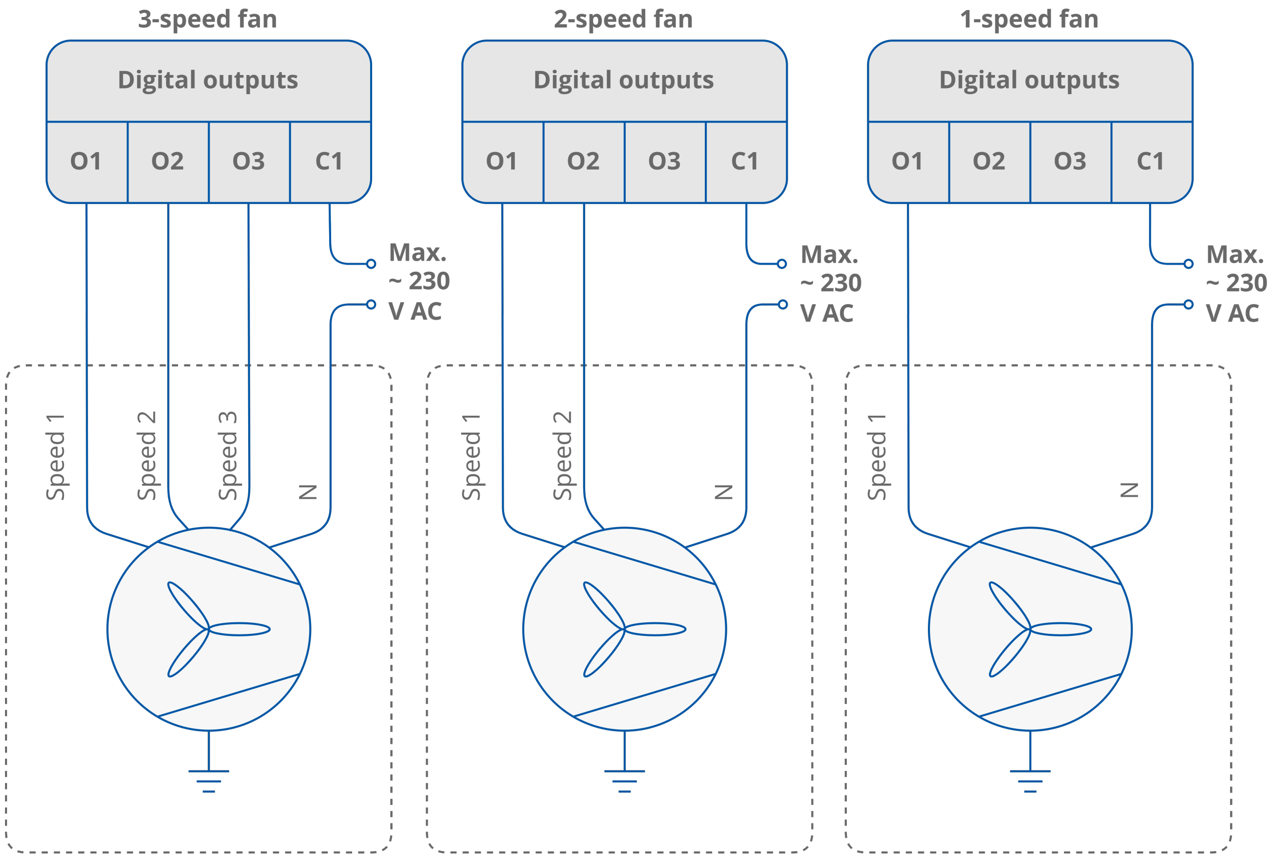


Figure 5. Fan connections

2.4.2 Electrical Heater (O4)

The RAC18-IP device is equipped with a relay output for connecting the electrical heater. This output can be used for 1st or 2nd stage heating, depending on the S3 DIP switch configuration. This output is not internally connected to the power supply, therefore it is necessary to use external supply. Relay current cannot exceed 3 A for resistance load at 230 V AC power supply. The way of connecting the electric heater to O4 is presented in the figure below.

Note: The O4 relay voltage is always limited to 230 V AC, irrespectively of the controller's power supply.

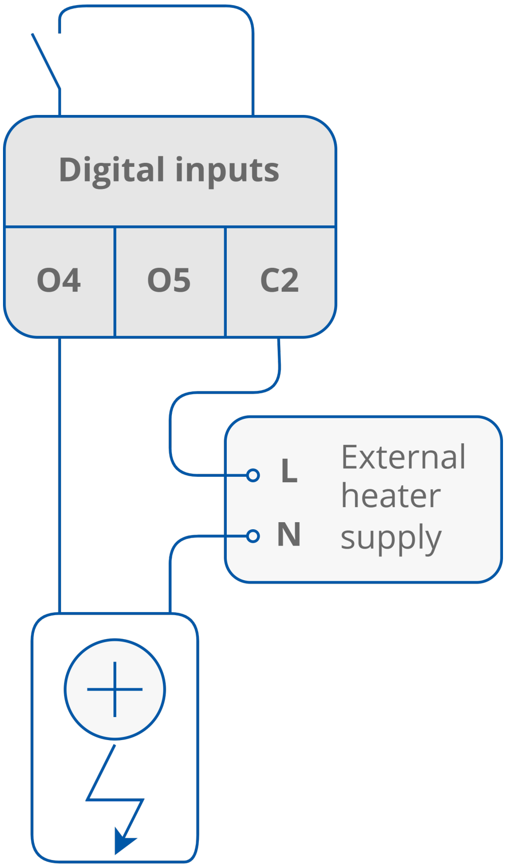


Figure 6. Electrical heater connections

2.4.3 Electrical Cooler (O5)

The RAC18-IP device is equipped with a relay output for connecting the electrical cooler. This output can be used as 1st or 2nd stage cooling, depending on the S3 DIP switch configuration. The relay output is connected with the power supply internally, therefore it is not necessary to connect an external supply. The way of connecting the electric cooler to O5 is presented in the figure below.

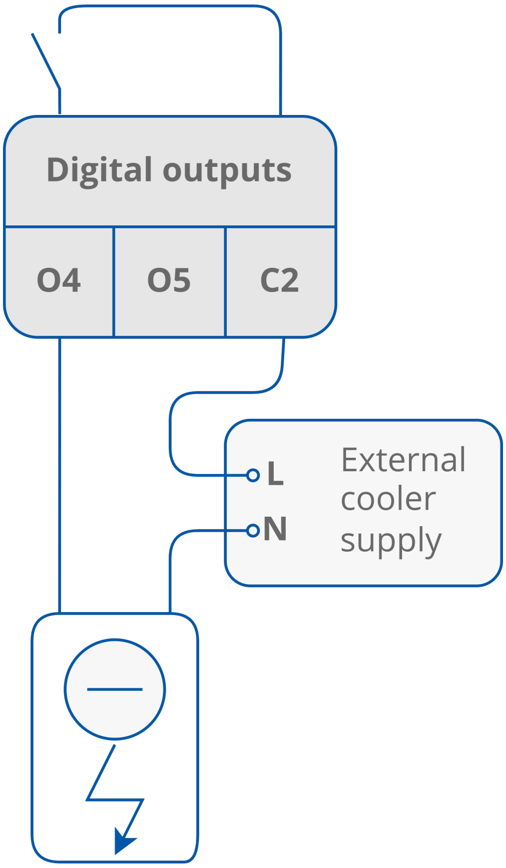


Figure 7. Electrical cooler connection

2.5 Analog Outputs

The RAC18-IP device has 3 analog outputs 0-10 V DC, which can be used for controlling the following fan coil unit devices:

- A1, analog heating valve actuator control;
- A2, analog cooling valve actuator control;
- A3, analog fan speed control.

The way of connecting all analog outputs is presented in the figures below.

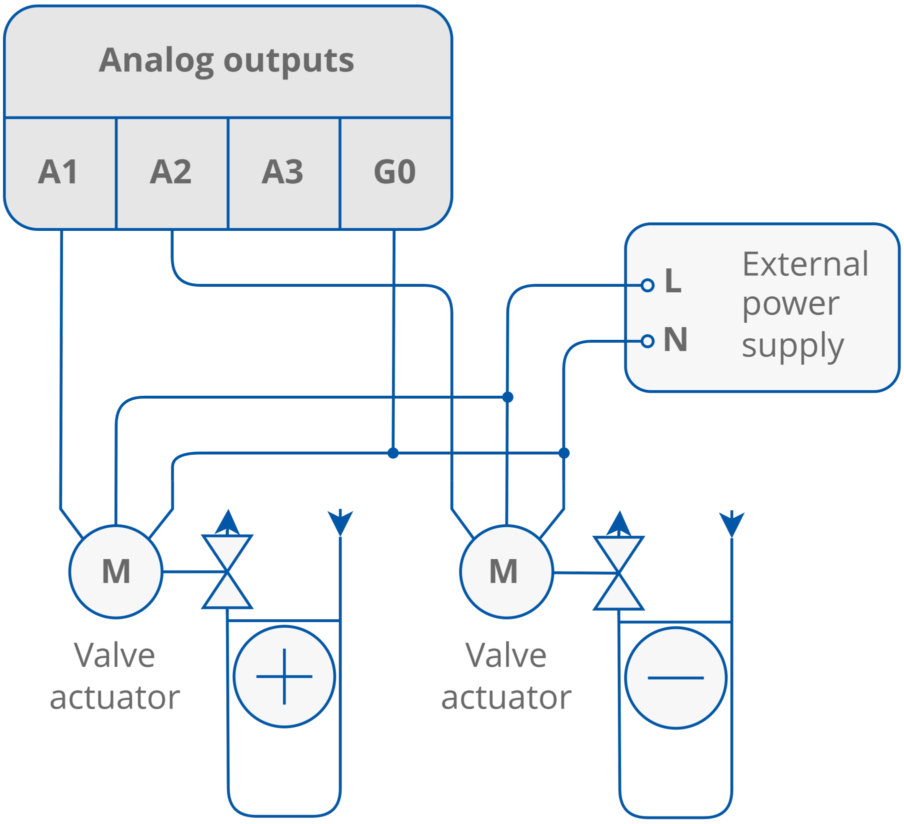


Figure 8. Connection of analog valve actuators

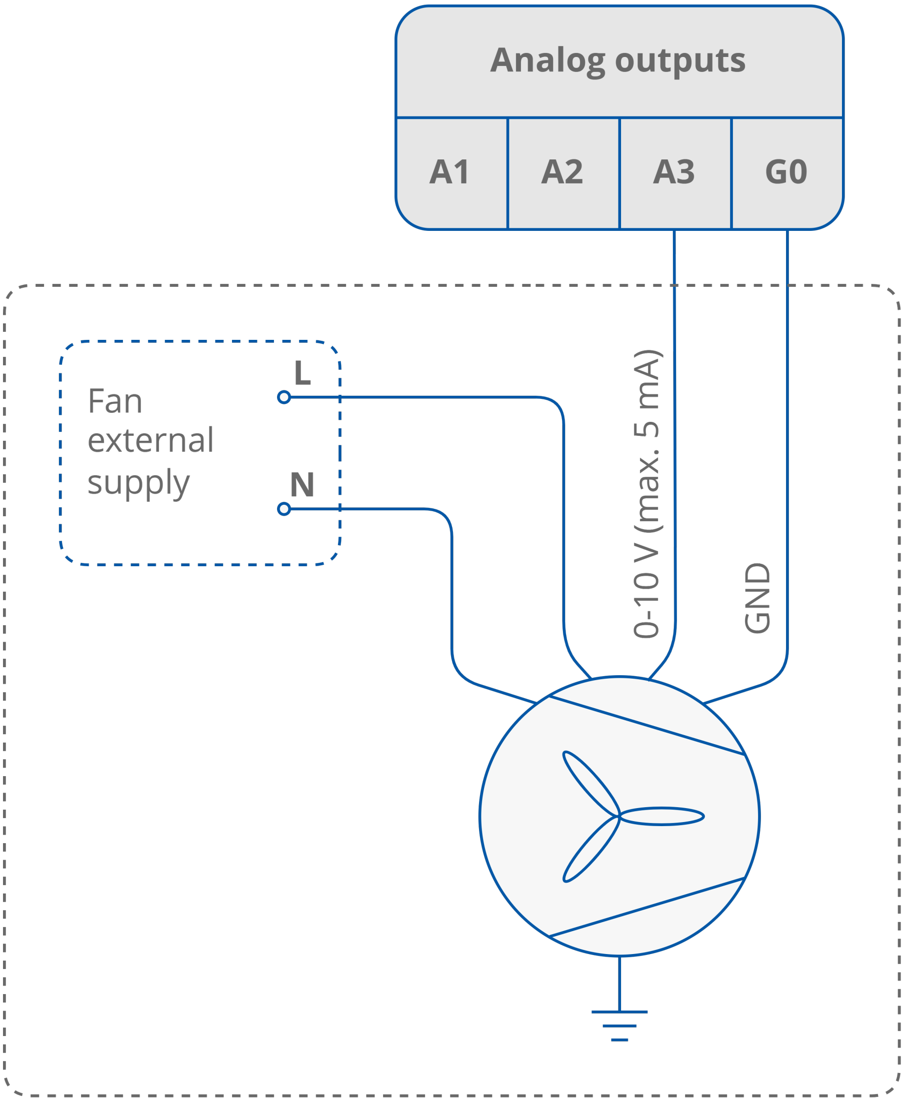


Figure 9. Connection of analog fan control

2.6 Simple Panel Connection

The iSMA-B-SP Simple Panel is a device designed to work with room temperature controllers. The device is fully passive and does not require any power supply. The panel consists of the following parts:

- temperature sensor (10K3A1);
- resistance potentiometer (0-10 kΩ);
- push button (NO, max. 50 mA);
- LED diode (blue, max. 5 mA).

The iSMA-B-SP panel internal connection and the connection with the RAC18-IP controller are presented in the figures below.

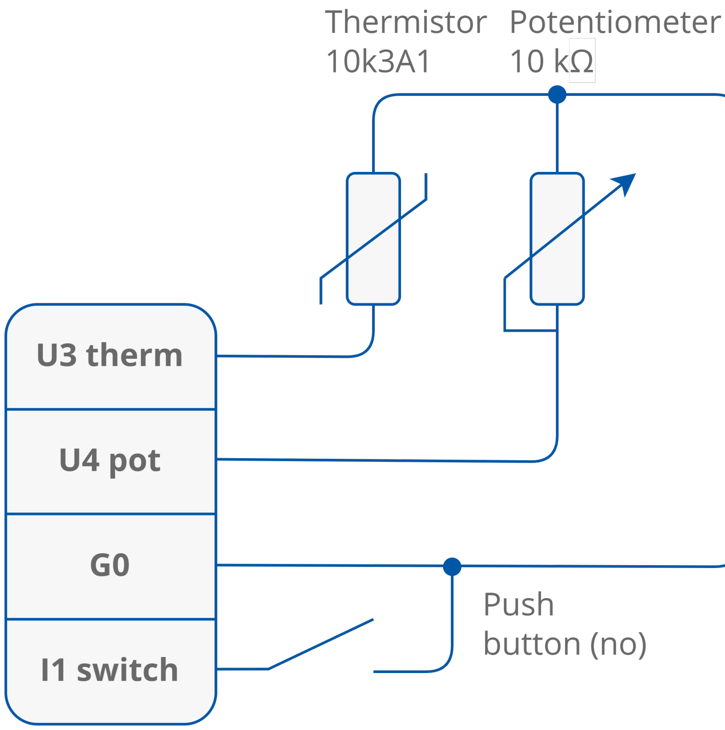


Figure 10. Diagram of internal connections of the simple panel

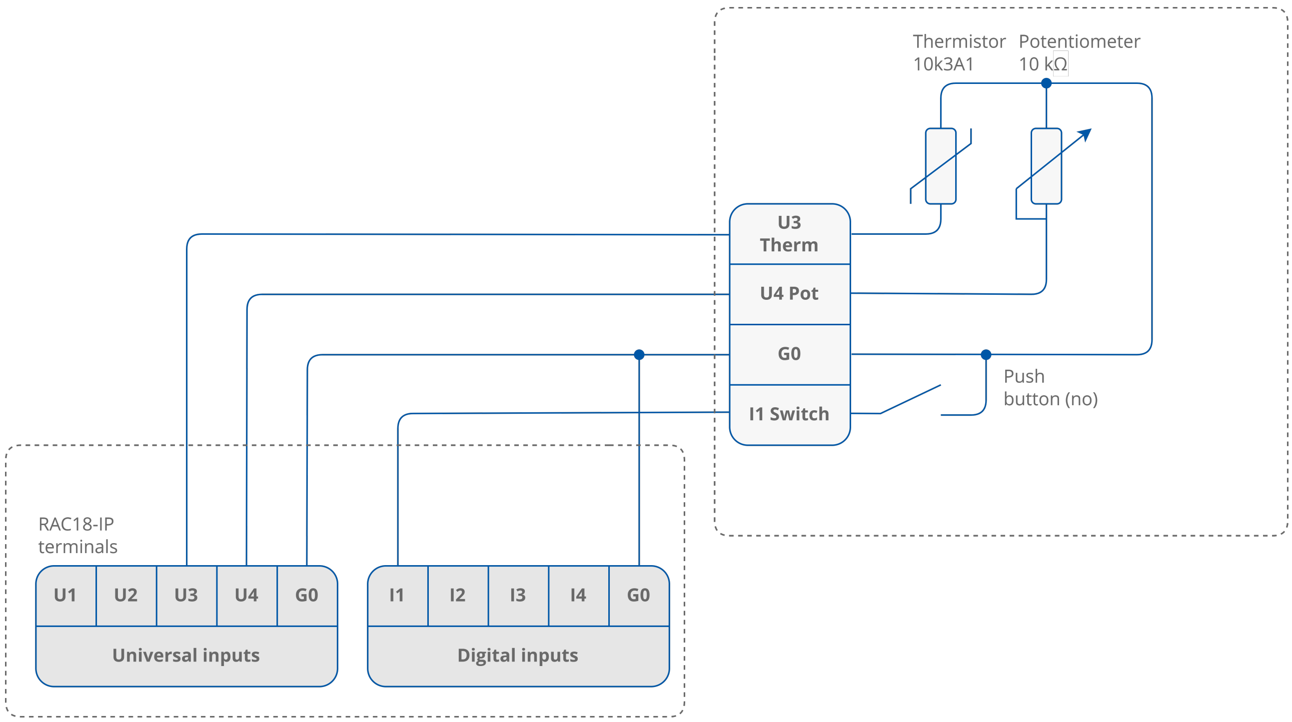


Figure 11. Connection diagram of the iSMA-B-FCU controller

3 DIP Switch Configuration

3.1 Controller Overview

This section describes steps required to properly configure the controller with the universal FCU application. For further information, please see the RAC18-IP Software and Hardware user manuals.

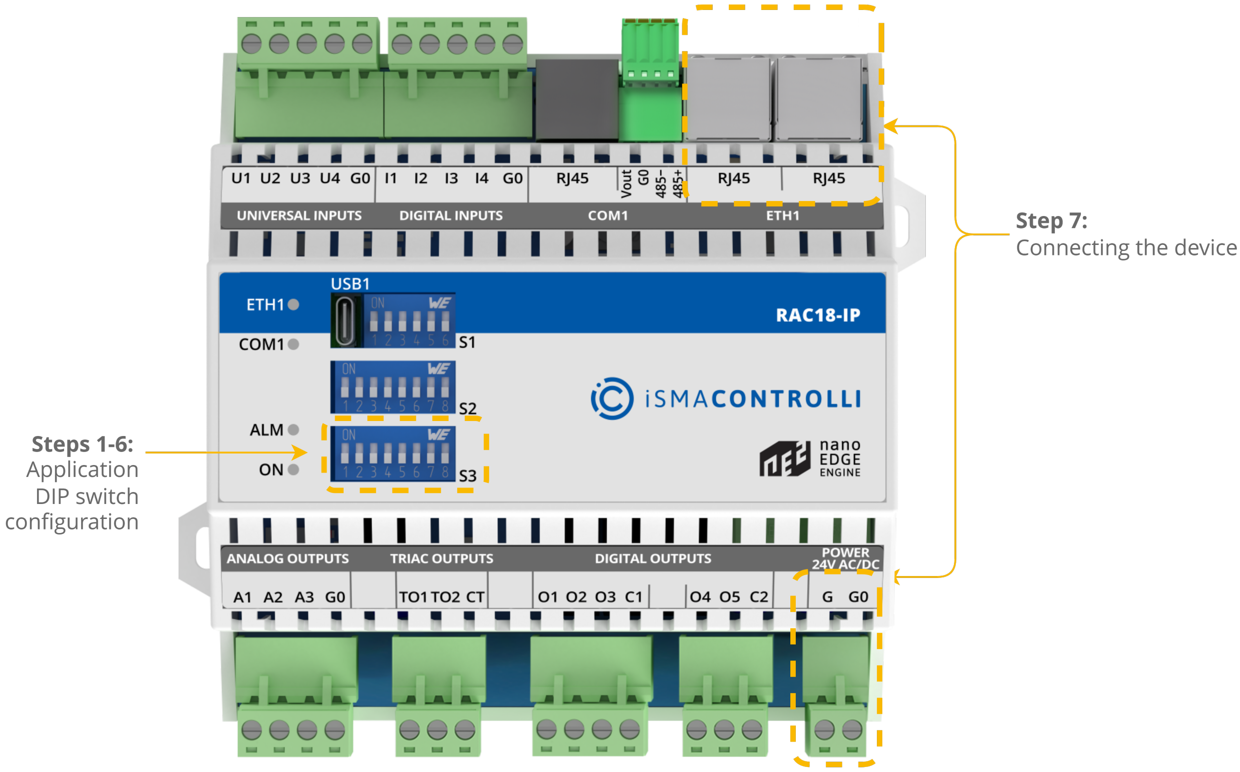


Figure 12. RAC18-IP controller

The S3 DIP switch is responsible for configuring the application.

The configuration of the RAC18-IP controller with the universal FCU application is described step by step in the section of the manual:

Step 1: selecting the FCU pipe type;

Step 2: selecting 1 or 2 stages of heating;

Step 3: selecting 1 or 2 stages of cooling;

Step 4: selecting the type of control the FCU valves require, and heating and cooling actuators connection details;

Step 5: selecting the temperature control value source;

Step 6: selecting the type of fan used within the project.

Steps 1-6 describe configuration of the S3 DIP switch. Their overview with default positioning is presented in the table below.

No.	Name	On	Off	Default
1	Pipe mode	2-pipe	4-pipe	4-pipe
2	Heating 2nd stage	Enable	Disable	Disable
3	Cooling 2nd stage	Enable	Disable	Disable
4	Heating/cooling control mode	Analog	Digital	Digital

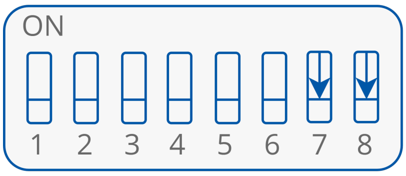
Table 2. The S3 DIP switch configuration

WARNING! Before attempting to configure the controller, make sure to have acquainted with all the required documentation, or have a good knowledge of the fan coil unit application–this will make configuration of the controller easy and trouble-free.

3.2 Step 6: Selecting Type of Fan Used Within the Project and its Connection Details

There are many fan types the RAC18-IP supports, and it can be configured for the fan coil unit used in the project.

3.2.1 Analog Controlled Fan Connection



S3

Analog controlled fan

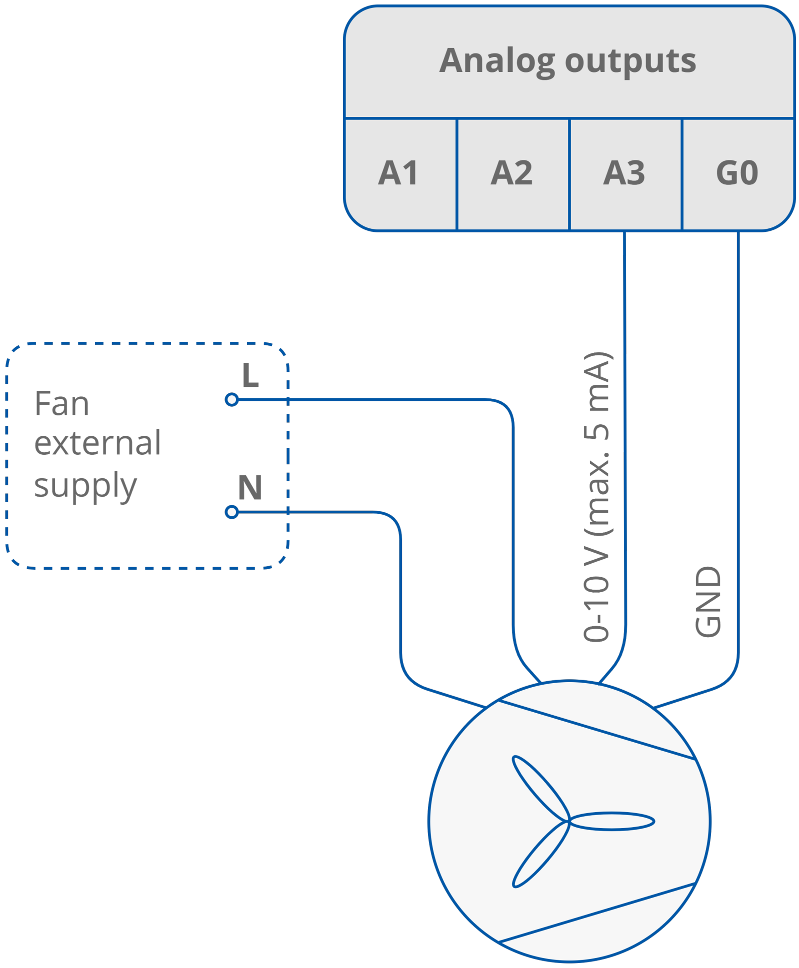
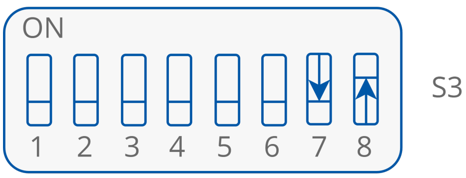


Figure 13. Analog controlled fan connection

3.2.2 1-speed Fan Connection



1-speed fan

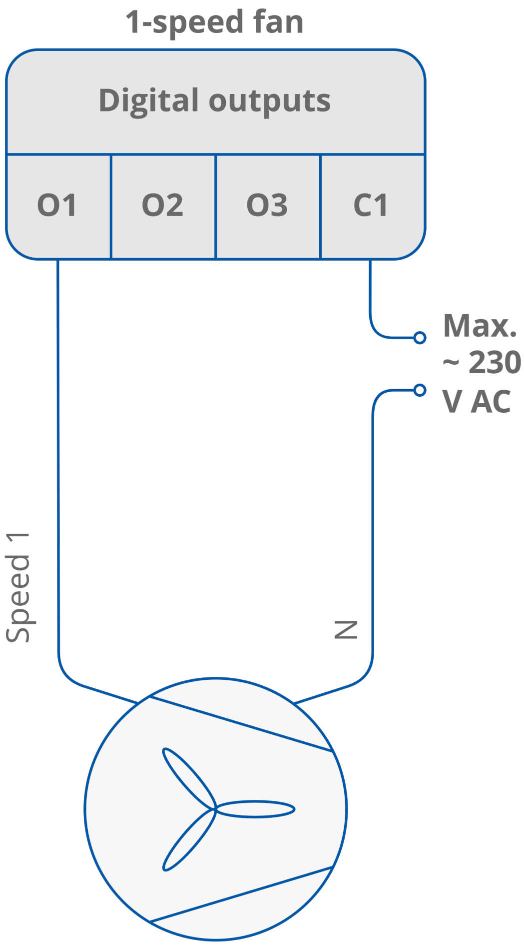
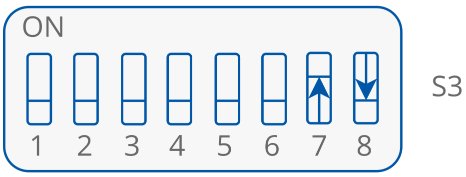


Figure 14. 1-speed fan connection

3.2.3 2-speed Fan Connection



2-speed fan

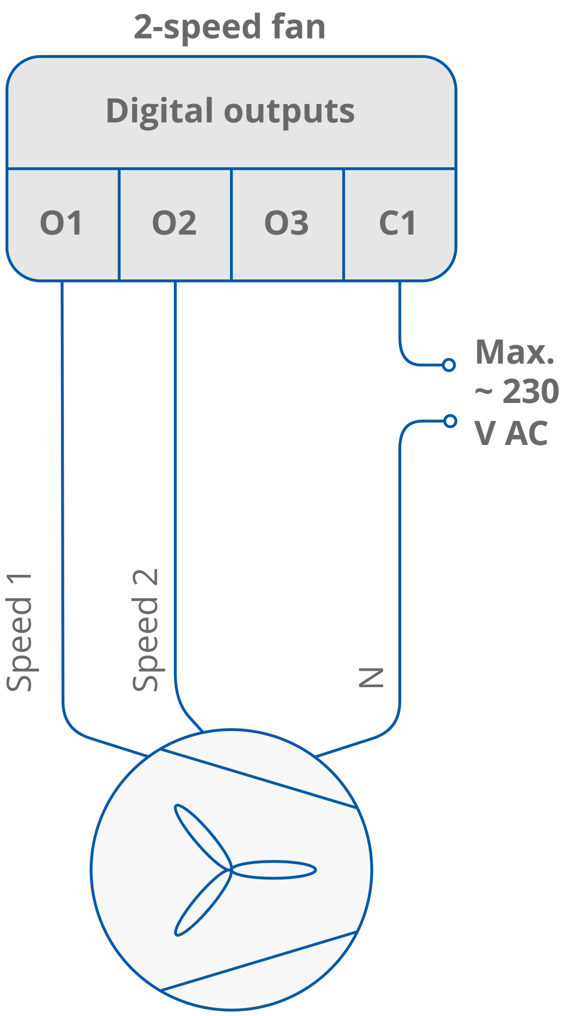
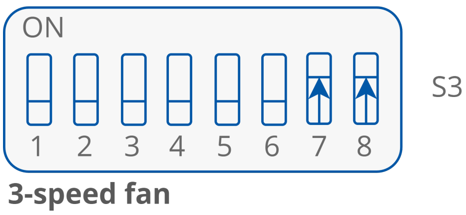


Figure 15. 2-speed fan connection

3.2.4 3-speed Fan Connection



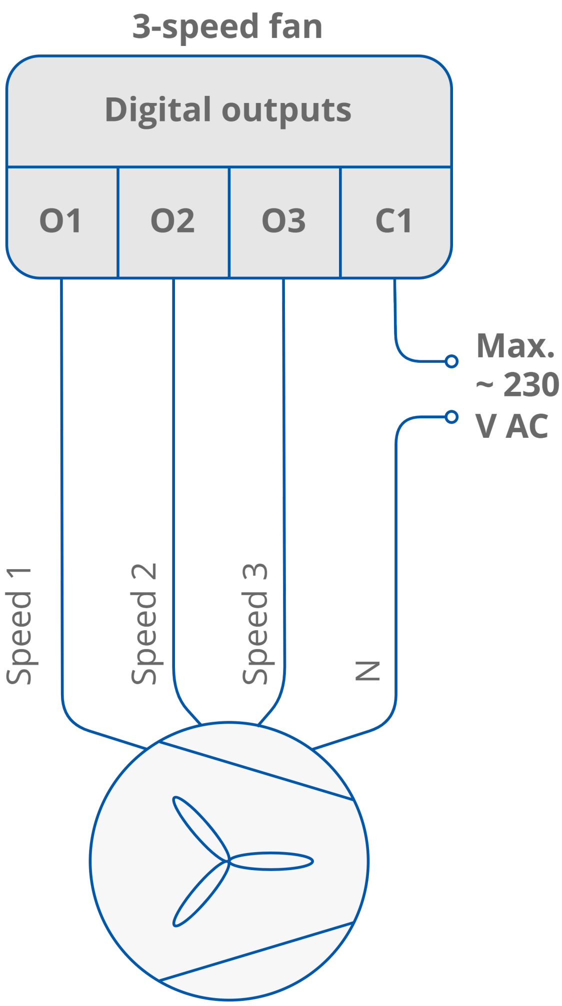
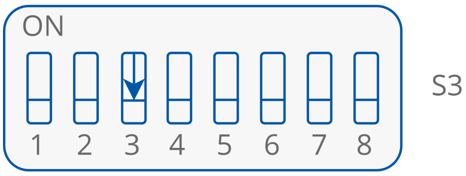


Figure 16. 3-speed fan connection

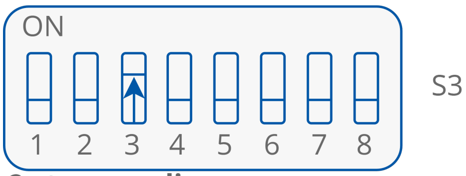
3.3 Step 3: Switching Between 1 Cooling Stage and 2 Cooling Stages Modes

The fan coil unit can operate with one cooling device or with two cooling devices. It is configured with the 3rd DIP switch S3.

3.3.1 2 Stages of Cooling in 4-Pipe Fan Coil Unit



1 stage cooling = 1 cooling device



2 stage cooling =
2 separate cooling devices

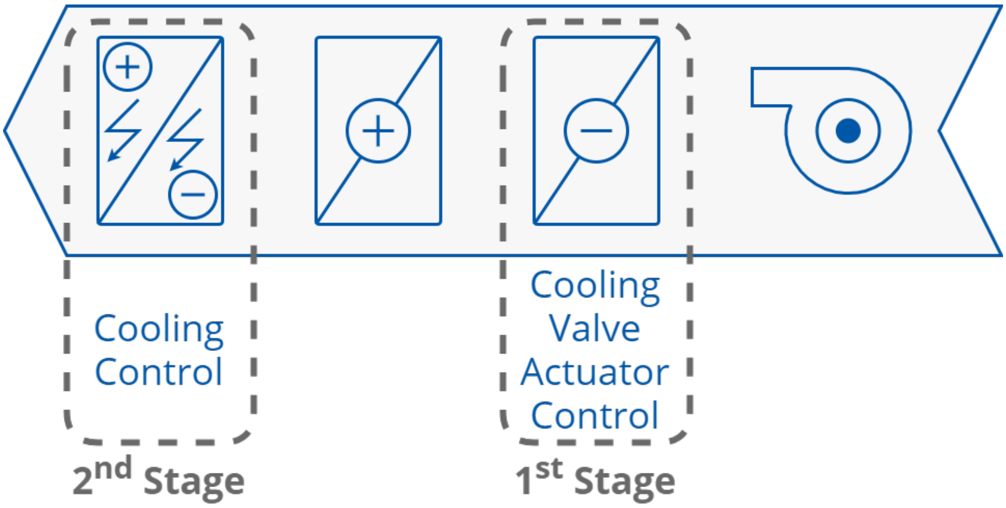
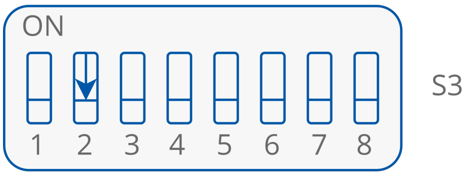


Figure 17. 2 stages of cooling in 2-pipe FCU installation

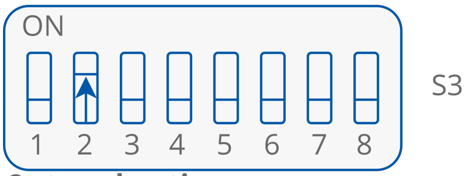
3.4 Step 2: Switching Between 1 Heating Stage and 2 Heating Stages Modes

The fan coil unit can operate with one heating device or with two heating devices. It is configured with the 2nd section of the S3 DIP switch.

3.4.1 2 Stages of Heating in 4-Pipe Fan Coil Unit



1 stage heating = 1 heating device



**2 stage heating =
2 separate heating devices**

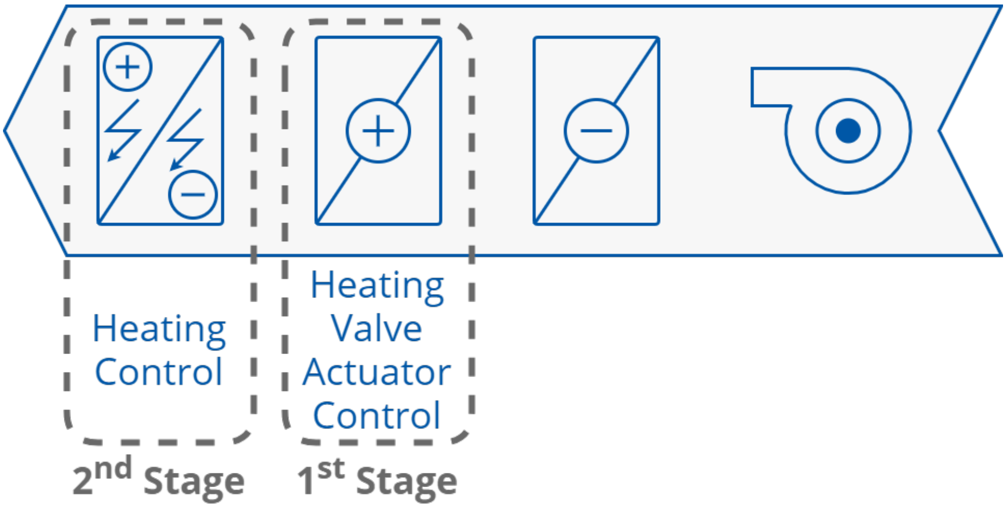


Figure 18. 2 stages of heating in 4-pipe FCU installation

3.5 Step 5: Selecting the Temperature Control Value Source and its Connection Details

The temperature control value source has to be specified with the DIP switches 5 and 6. By default, the sensor's type, served by the controller's inputs U1 and U3, is the 10K3A1 NTC.

The temperature sensor type can be changed using the iC Tool software.

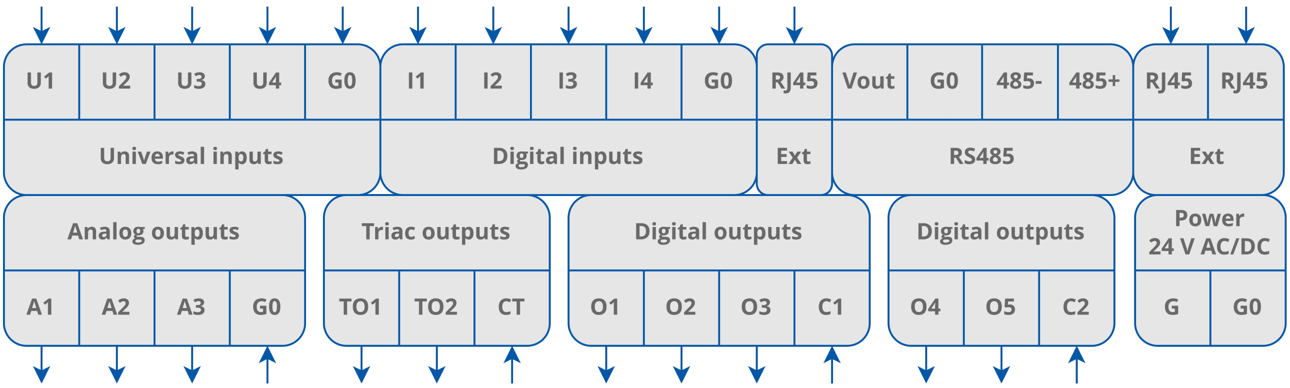
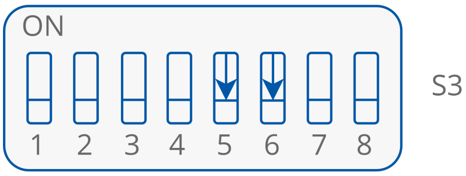


Figure 19. RAC18-IP connectors

3.5.1 Temperature Source: Touch Point/LP/FP Room Panel



LP/Touch Point room panel

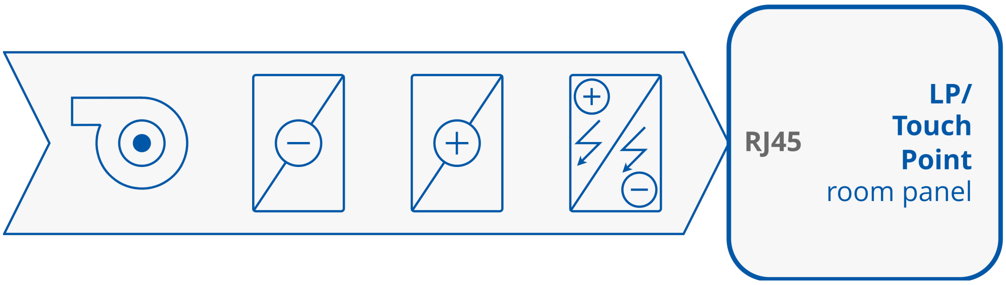
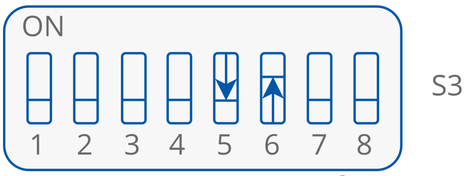


Figure 20. LP/Touch Point room panel set as a temperature source

3.5.2 Temperature Source Connected to U3



Room sensor connected to U3 (space temperature sensor)

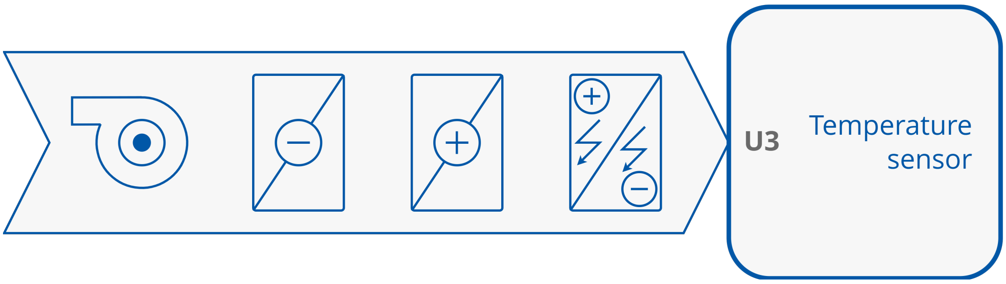
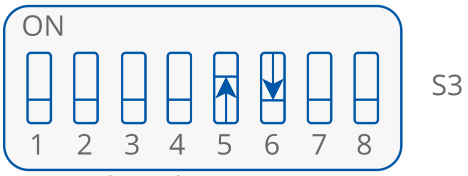


Figure 21. Temperature sensor connected to S3 as a temperature control value source

3.5.3 Temperature Source Connected to U1



Returning air temperature sensor connected to U1

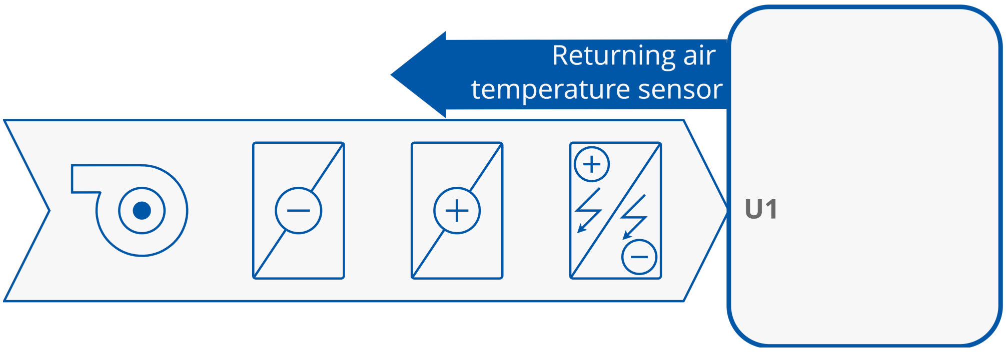
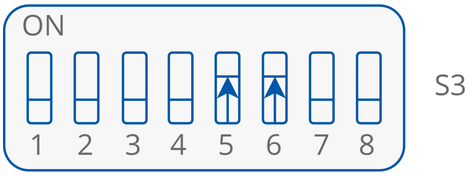


Figure 22. Returning air temperature sensor connected to S1

3.5.4 Temperature Source Connected to RS485 Network



Temperature received from the Modbus TCP network (holding register 106) or BACnet IP network (AV 6)

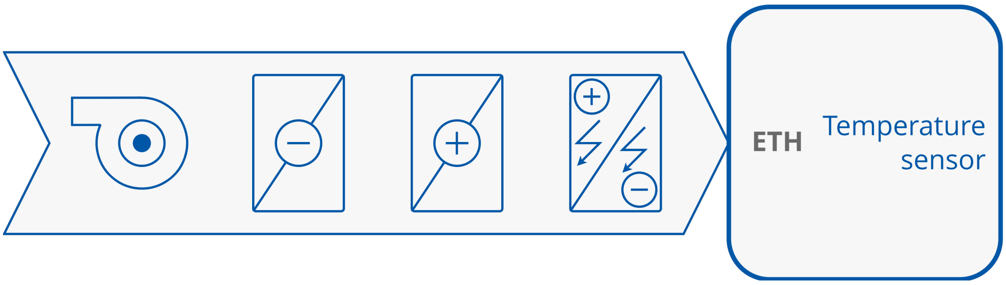
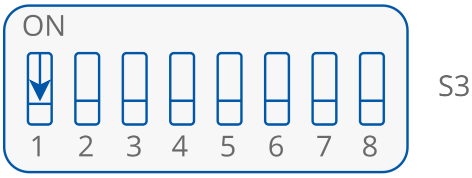


Figure 23. Temperature control value source set to the Ethernet network

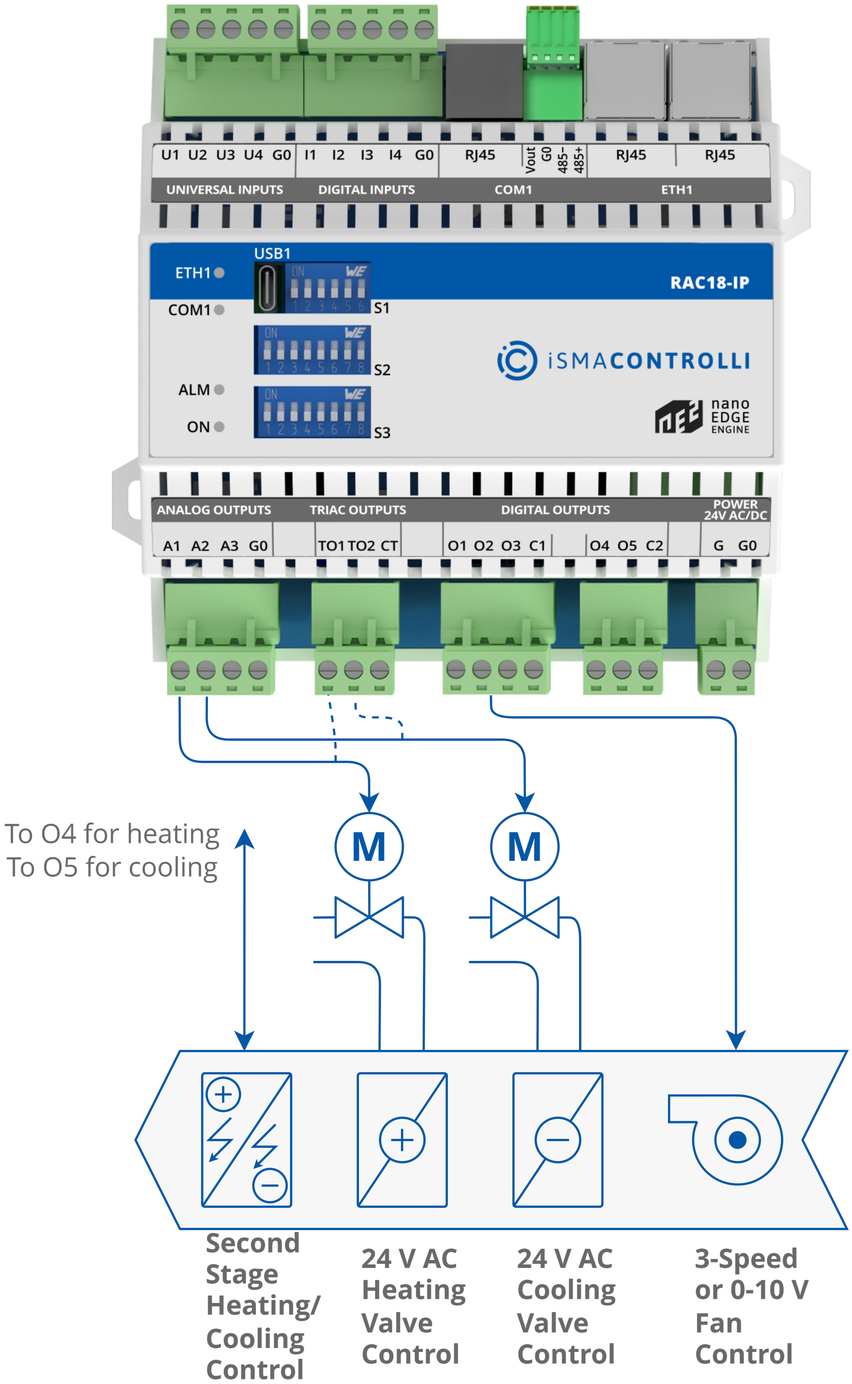
3.6 Step 1: Choosing the FCU Pipe Type

The RAC18-IP can be used in 4-pipe installations as well as in 2-pipe installations. In order for the controller to operate correctly in the application, it is necessary to know the fan coil pipe type and set the S3 DIP switch to the corresponding settings as described below.

3.6.1 4-Pipe Heating and Cooling



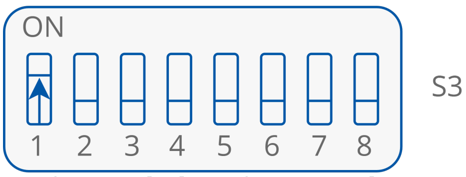
4-pipe–heating and cooling



RAC18-IP

Figure 24. RAC18-IP controller

3.6.2 2-Pipe Only Heating or Only Cooling



2-pipe–only heating or only cooling

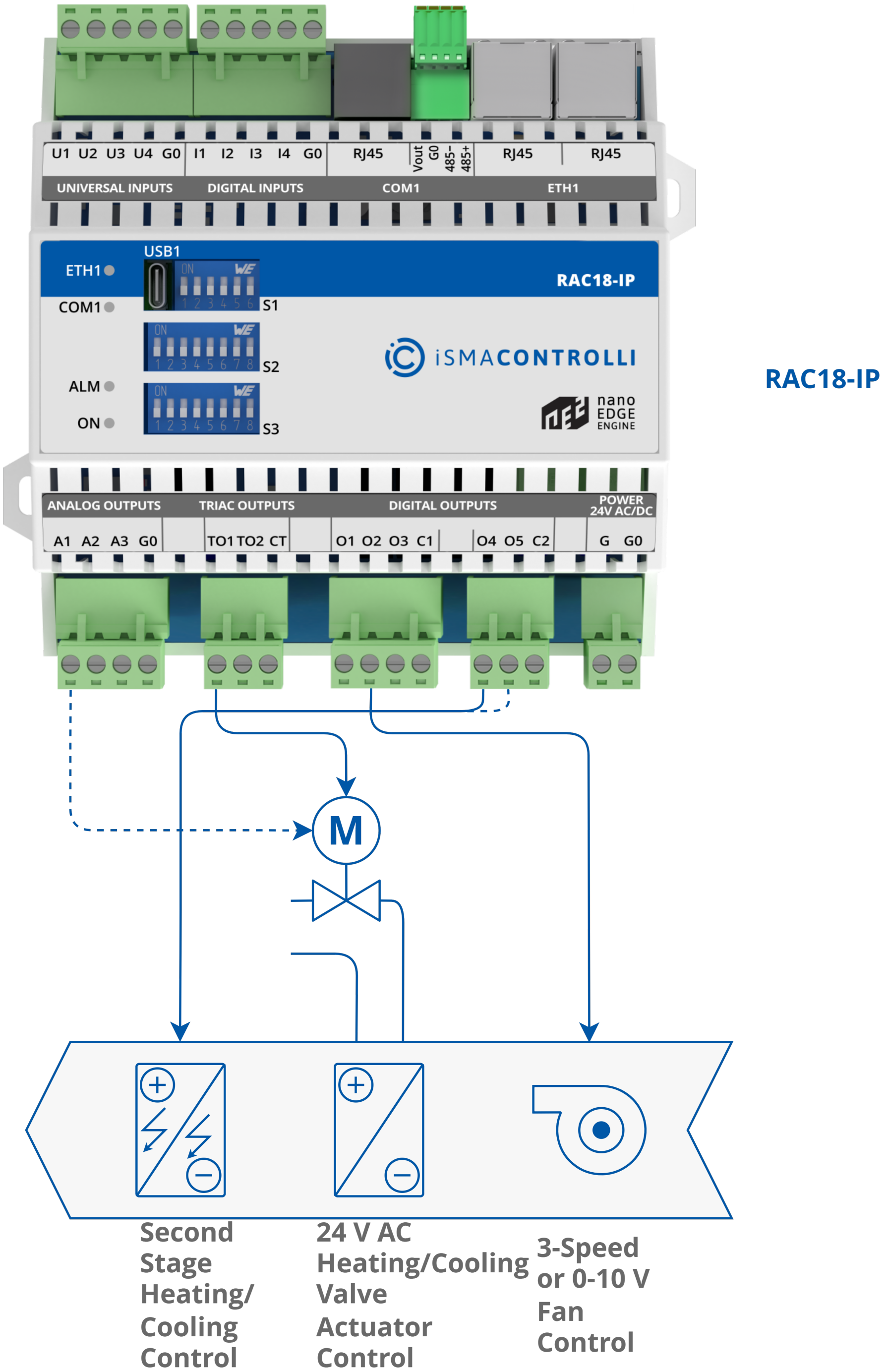
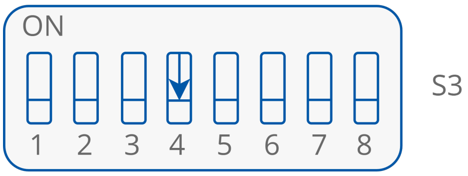


Figure 25. 2-pipe FCU installation

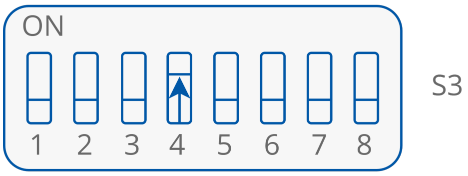
For connection details go to steps 4, 5, and 6.

3.7 Step 4: Selecting Type of Control Required by the FCU Valves and Connection Details

The controller's outputs can operate in digital or analog mode. Depending on the fan coil unit actuators control type, the corresponding DIP switch has to be set to a desired position.



Digital–works only as 2 state valve (open-close)



Analog–PWM or 0-10 V

The figure below pictures the connection of heating actuators:

- A1 for analog 0-10 V control;
- TO1 for analog PWM or digital ON-OFF control;
- O4 for digital ON-OFF control.

Note that, when using the second stage heating, the additional second stage heater can be controlled only by the O4 output, leaving the A1 or TO1 for the first stage. Otherwise, when using only the first stage heating, the O4 output can be used for digital control of the first stage heating actuator.

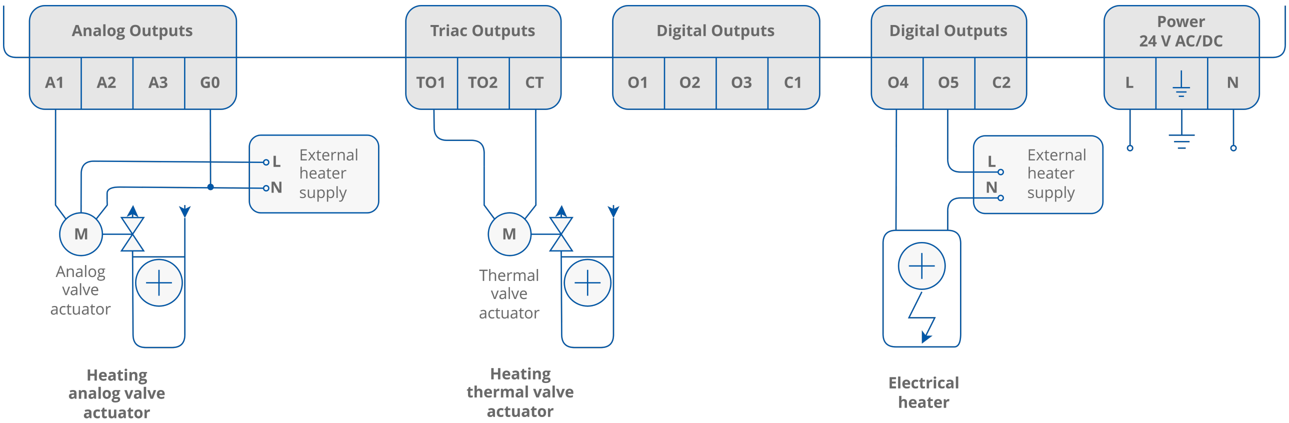


Figure 26. Heating actuators connection

The figure below pictures the connection of cooling actuators:

- A1 for analog 0-10 V control while operating in 2-pipe mode;
- A2 for analog 0-10 V control while operating in 4-pipe mode;
- TO1 for analog PWM or digital ON-OFF control while operating in 2-pipe mode;
- TO2 for analog PWM or digital ON-OFF control while operating in 4-pipe mode;
- O5 for digital ON-OFF control.

Note that, when using the second stage cooling, the additional second stage cooler can be controlled only by the O5 output, leaving the A1, A2, TO1, or TO2 for the first stage. Otherwise, when using only the first stage cooling, the O5 output can be used for digital control of the first stage cooling actuator.

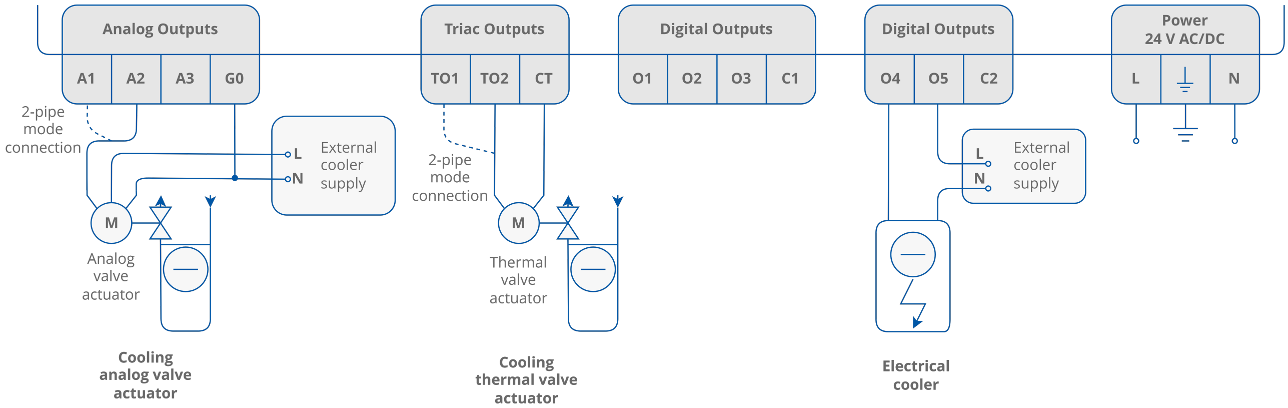


Figure 27. Cooling actuators connection

4 Control Algorithm

The default application has been designed to service a wide range of typical fan coil units. The application allows to work with typical fan coil units equipped with heating and/or cooling devices and wide range of fans. The main function of the default application is designed to control room temperature.

4.1 Occupancy Modes

To allow maximum comfort and energy saving as default, the application has 4 operating modes implemented. These modes are used to switch between user temperature if the space is occupied, and energy saving if the space is unoccupied/standby. There are 4 different modes:

- occupied mode;
- unoccupied mode;
- standby mode;
- forced occupied.

Each mode can be set by the following sources:

- room panel or digital inputs (occupancy button, presence sensor, card holder) for setting the 'Forced Occupied' mode only;
- BMS using the Occupancy Mode network variable for setting any mode. The mode is changed immediately after changing the value of variable. The Occupancy Mode values and corresponding functions are presented in the table below.

The FCU occupancy modes and status with corresponding values are presented in the table below.

Name	BACnet ID	Modbus Address	Value	Function
Occupancy Mode	0	100	0	Unoccupied
			1	Occupied
			2	Standby
Occupancy Status	101	201	0	Unoccupied
			1	Occupied
			2	Standby
			3	Forced Occupied

Table 3. Description of Occupancy Mode and Occupancy Status network parameters

4.1.1 Occupancy Mode

In this mode, the controller is operating to keep room temperature set by the user.

Occupied Effective Setpoint

The Effective Setpoint is calculated based on 2 parameters, Setpoint and Offset. The Setpoint parameter defines real user room temperature value. The Setpoint Offset parameter defines the value, which user can add or subtract to the setpoint. The Offset range is limited by the Offset_Range network variable, by default to 3, therefore the user can add or subtract max. 3 degrees to Setpoint value.

Occupied Fan Control

In the occupied mode, the fan can operate with an auto algorithm or with a user manual value. By setting the fan to the Off mode, the user can switch off device.

Occupied Heating / Cooling FCU Mode Switching

In this mode (if the FCU_Mode network variable is set to auto), the application can automatically switch between heating and cooling. The switching point is based on the Effective Setpoint and CV with Diff parameters, defined in the Heating_Cooling_Switching_Diff.

4.1.2 Unoccupied Mode

Unoccupied Effective Setpoint

The Effective Setpoint is calculated based on 3 parameters: Setpoint, Setpoint_Offset, and Unoccupied_Offset. In this mode, the Setpoint_Offset parameter can be disabled in Effective Setpoint calculation by Offset_In_Occupied_Only network variable. The Effective Setpoint calculation according to the FCU mode and settings is shown in table below.

Occupancy Mode	FCU Status	Offset_In_Occupied_Only	Calculation
0 (Unoccupied)	Heating	False	Effective_Setpoint = Setpoint + Setpoint_Offset – Unnocupied_Offset
0 (Unoccupied)	Cooling	False	Effective_Setpoint = Setpoint + Setpoint_Offset + Unnocupied_Offset
0 (Unoccupied)	Heating	True	Effective_Setpoint = Setpoint – Unnocupied_Offset
0 (Unoccupied)	Cooling	True	Effective_Setpoint = Setpoint + Unnocupied_Offset

Table 4. Effective Setpoint in unoccupied mode calculation table

Unoccupied Fan Control

In the unoccupied mode, the fan operates in the Auto Mode, the value of which is calculated by the application. (See section 3.6.1 Fan control algorithm). In this mode, the Fan Manual Modes are disabled, and the user cannot switch off or define fan speed. If the unoccupied mode changes to occupied, the Fan Mode is switched to previous mode (Auto or user settings).

Occupied Heating / Cooling FCU Mode Switching

In this mode (if the FCU_Mode network variable is set in Auto), the application remains in the last running mode (heating or cooling) in the occupied mode. The control algorithm does not change and depends of the CFG DIP switch configuration.

4.1.3 Standby Mode

This mode is designed to change temperature setpoint level with a higher value in the unoccupied mode if the space is not in use for a longer time, for example, weekends or holidays. It allows to reduce energy consumption. Energy saving is done by changing the Effective Setpoint (lower for heating, increase for cooling). The Standby_Offset is bigger than Unoccupied_Offset.

Standby Effective Setpoint

The Effective Setpoint is calculated based on 3 parameters Setpoint, Setpoint_Offset and Unoccupied_Offset. In this mode, the Setpoint_Offset parameter can be disabled in Effective Setpoint calculation by Offset_In_Occupied_Only network parameter. The Effective Setpoint calculation according to FCU mode and settings is presented in the table below.

Occupancy Mode	FCU Status	Offset_In_Occupied_Only	Calculation
2 (Standby)	Heating	False	Effective_Setpoint = Setpoint + Setpoint_Offset – Standby_Offset
2 (Standby)	Cooling	False	Effective_Setpoint = Setpoint + Setpoint_Offset + Standby_Offset
2 (Standby)	Heating	True	Effective_Setpoint = Setpoint – Standby_Offset
2 (Standby)	Cooling	True	Effective_Setpoint = Setpoint + Standby_Offset

Table 5. Effective Setpoint in standby mode calculation table

Unoccupied Fan Control

In the unoccupied mode, the fan is automatically switched to Auto mode and can run only with value calculated in the application. (See section 3.6.1 Fan control algorithm). In this mode, the FCU manual mode is disabled, and the user cannot switch off or define fan speed. If the unoccupied mode is changed to occupied, the Fan Mode is switched to previous mode (Auto or user settings).

Occupied Heating / Cooling FCU Mode Switching

In this mode (if the FCU_Mode network variable is set in Auto), the application stays in the last running mode (heating or cooling) in the occupied mode. The control algorithm does not change, and it depends on the CFG DIP switch configuration.

4.1.4 Forced Occupied

This mode is called by external devices connected to FCU digital inputs or from the room panel. This mode operates for the time defined in network parameters. The Forced Occupied behavior is the same as the occupied mode.

Switching to Forced Occupancy Mode by Occupancy Button I1

The I1 digital input is dedicated to connect presence button or sensor, which remotely runs the forced occupancy mode. This input is active only in the unoccupied or standby modes (in the occupied mode this input is inactive). If the application detects rising edge on the I1 input, it switches to the forced occupied mode. If the application detects falling edge on the I1 input, it starts counting down the time defined in the Occupancy_Time_Remote_Trigger network variable. During that time, the application is in the forced occupied mode, and the user cannot switch it off before the time elapses. After the defined time elapses, the application returns to the previous mode, unoccupied or standby. By changing the I1_Remote_Occ_Trigger_Invert network variable, the application can be connected to the devices with normal open NO or normal close NC outputs. The function time chart is presented in the figure below.

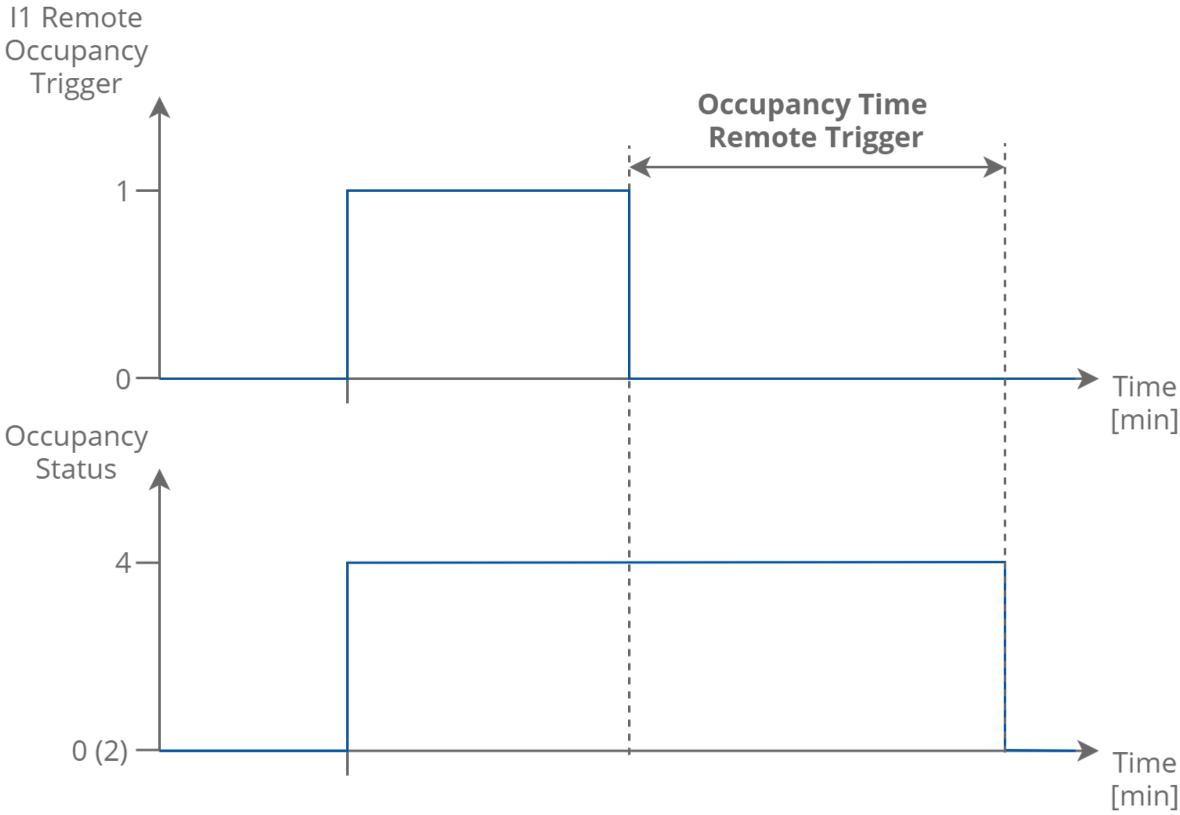


Figure 28. Occupancy trigger time function

Switching to Forced Occupancy Mode with Digital Input I2

The I2 digital input is dedicated to connect the presence button or card holder, which remotely run forced occupancy mode. This input is active only in the unoccupied or standby modes (in the occupied mode this input is inactive). If the application detects rising edge on the I2 input, it switches to the forced occupied mode. If the application detects falling edge on the I2 input, it starts counting down the time defined in the Occupancy_Time_Presence_Sensor network variable. During that time, the application is in the forced occupied mode, and the user cannot switch it off before the time elapses. After defined time elapsed, the application returns to the previous mode, unoccupied or standby. By changing the I2_Presence_Sensor_Invert network variable the application can be connected to the devices with normal open NO or normal close NC outputs. The function time chart is presented in the figure below.

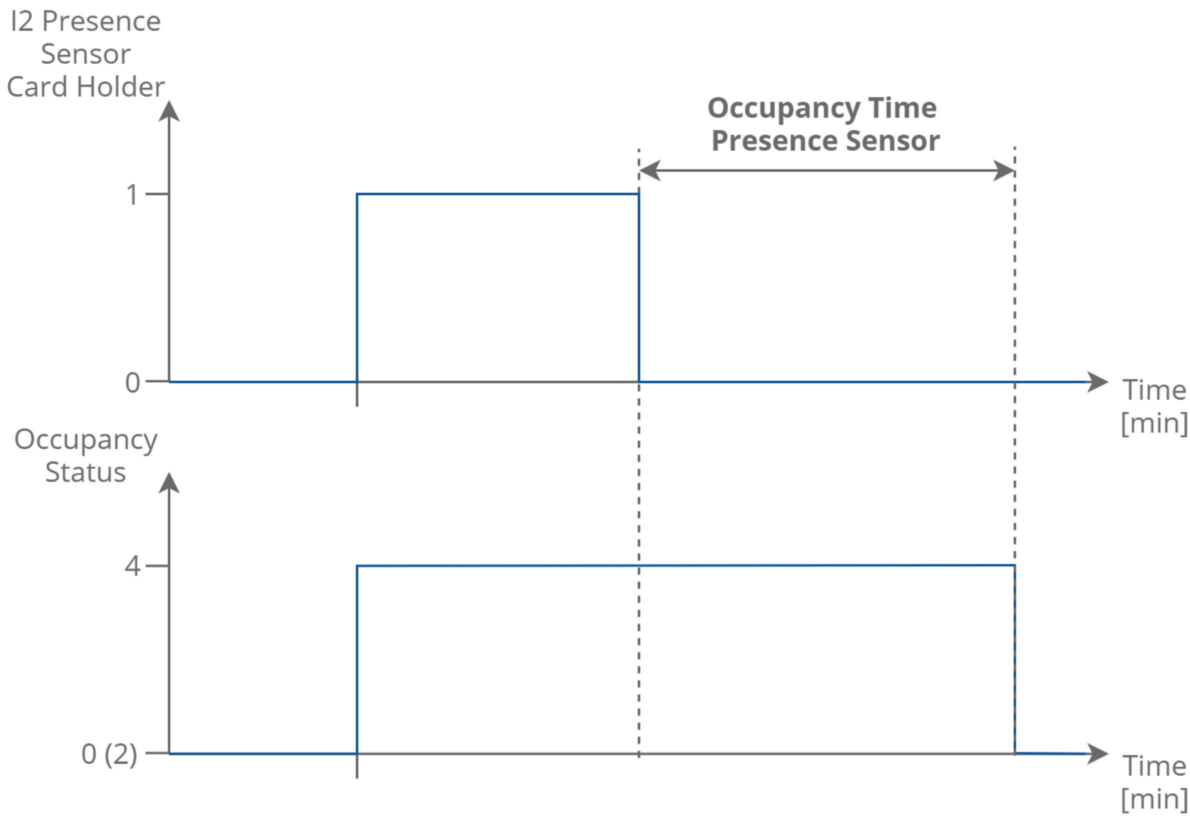


Figure 29. Presence sensor or card holder function time

Switching to Forced Occupancy by Room Panel (LP/Touch Point/FP)

The FCU default application is designed to work with the LP, Touch Point, and FP room panels. In the panel menu, user can switch from the unoccupied or standby mode to forced occupied for the time defined in the Occupancy_Time_Remote_Trigger network parameter. The forced occupied mode is shown as a flashing occupied icon. From the room panel, the user can switch off the forced occupied and come back to the previous mode.

4.2 FCU Modes

The FCU mode is a parameter defining how the FCU controller is operating. This parameter can have the following states:

- OFF: in this mode, the FCU controller software is off, only the anti-frost procreation can start the FCU controller;
- Auto: in this mode, the FCU controller switches between cooling or heating function based on the measurement temperature and effective setpoint temperature;
- Heating Only: in this mode, the FCU controller can perform only heating function (dedicated for 2-pipe mode or if the cooling medium is not available: winter mode);
- Cooling Only: in this mode, the FCU controller can perform only cooling function (dedicated for 2-pipe mode or if the heating medium is not available: summer mode);

- **Fan Only:** in this mode, the FCU controller can perform only ventilation, heating and cooling functions are disabled.

For the remote mode control, the default application has the FCU_Mode network variable.

Name	BACnet ID	Modbus Address	Value	Function
FCU Mode	0	104	0	Off
			1	Auto
			2	Heating Only
			3	Cooling Only
			4	Fan Only

Table 6. FCU mode network variable values description

4.2.1 OFF Mode

In this mode, the fan is switched off, all heating and cooling devices are disabled. This mode can be set from BMS (by writing 0 value to the FCU_Mode network variable). This mode is called if the Open Window signal is detected. In this mode, the anti-frost function is active.

4.2.2 Auto Mode

In this mode fan outputs, heating/cooling valves actuators and HTG/CLG relays are active and work with application algorithm. The cooling or heating algorithm is chosen based on current temperature and effective temperature setpoint with switching dead band defined in Switching_Cooling_Heating_Diff network variable. Switching between heating/ cooling can be done only in Occupancy Mode. In Unoccupied or Standby mode FCU controller remembers and stays in previous function. If the controller comes back to the Occupancy mode, algorithm will calculate in which function it should work.

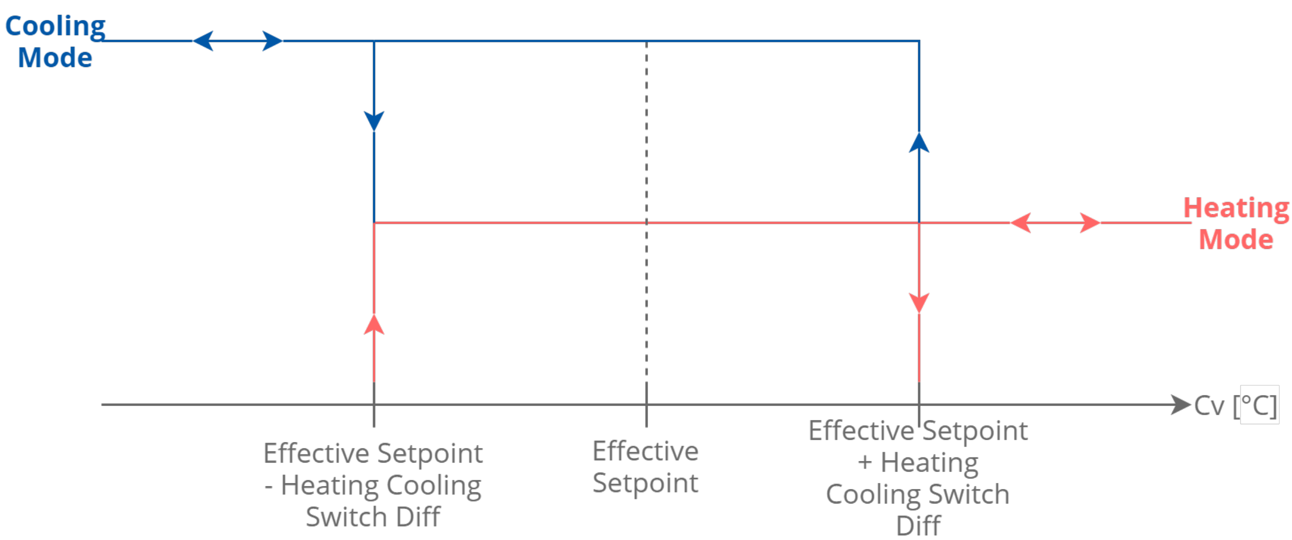


Figure 30. Switching between heating/cooling chart

4.2.3 Heating Only Mode

In the Heating Only mode, the application is running only with the heating algorithm. The fan outputs, heating valve actuator outputs, and HTG relay are enabled, while the cooling valve actuator outputs and CLG relay are disabled. This mode is dedicated for the 2-pipe system during winter mode or the 4-pipe system if the cooling medium is not available.

4.2.4 Cooling Only Mode

In the Cooling Only mode, the application runs only with the cooling algorithm. The fan outputs, cooling valve actuator outputs, and CLG relay are enabled, while the heating valve actuator outputs and HTG relay are disabled. This mode is dedicated for the 2-pipe system during summer mode or the 4-pipe if the heating medium is not available.

4.2.5 Fan Only Mode

In the Fan Only mode, only fan outputs are enabled, while heating and cooling valves actuators outputs and HTG/CLG relays are disabled. The fan is operated with the application algorithm.

4.3 Additional Features

4.3.1 Open Window (I3)

The I3 digital input is dedicated to connect window contraction, which checks if the window is open or closed. If the input detects the open window status (rising edge on the I3 input), it starts counting down the time defined in the Window_Status_Delay network variable (60 seconds by default). After the time elapses, if the window is still open, the application calls the FCU Off mode (for more information, please see the FCU Modes, OFF Mode section). If the input detects the closed window, the application resets the counter and continues normal operation. If the input detects the closed window before the time elapses, the application also resets the counter and continues normal operation. If the window is open, only the anti-frost protection can start. By changing the I3_Window_Contact_Invert network variable, the application can be connected to the devices with normal open NO or normal close NC outputs.

4.3.2 Anti-frost Protection

This function is designed to protect room equipment, which can be damaged in low temperatures. If the application detects a temperature drop below 6°C, it starts the fan and activates all actuators of the heating valves (including 2nd stage, if it is active) with maximum defined value. This action is continued until the room temperature reaches above 8°C. The anti-frost function is always active even if the user switches off the device from BMS or local panel. To prevent unnecessary start after sensor fault, there is a built-in algorithm, which detects a sensor brake. If the temperature value from all available sensors is incorrect (out of the range from -100°C to 100°C), the anti-frost function is disabled.

4.3.3 Return Temperature Sensor Control

The default application can control room temperature based on the air return temperature sensor, SI1. To prevent an incorrect temperature value if the fan is off, the CV temperature is taken from the room sensor. The built-in algorithm checks, which sensor is available (from the room panel, SI1 room sensor, or from the network variable if the FCU is working as slave). After the fan start, the algorithm waits for time defined in the Return_To_Space_Time network variable (by default 30 s) to blow the ducts and switch the CV to the SI1air return sensor. To activate this function, the Return_To_Space_Enable network variable must be set to true.

4.3.4 Supply Air Temperature Limitation

In order to maintain room conditions comfortable for the user, the supply air can have a temperature limitation. This function is available only if the supply air sensor is connected and works correctly. The supply air temperature can have a high limit defined by the Supply Temperature High Limit slot (default value 40°C), and a low limit defined by the Supply Temperature Low Limit slot (default value 10°C). The range between the Supply Temperature Low Limit and Supply Temperature High Limit values is called a comfort range.

Supply Air Temperature limitation in the 1st stage, binary control

If the supply air temperature value is exceeds the comfort range, the default application disables heating (if the temperature value is above the SupplyTemperatureHighLimit), or cooling (if the temperature value is above the SupplyTemperatureLowLimit). If the supply air temperature value returns to the comfort range, the FCU application resets the delay counter and returns to normal operation.

Supply Air Temperature limitation in the 2nd stage, binary control

If the supply air temperature value exceeds the comfort range, the default application disables the 2nd stage and starts counting 30 seconds delay time. After 1 minute, if the supply air temperature value is still out of the comfort range, the FCU application disables heating (if the temperature value is above the SupplyTemperatureHighLimit) or cooling (if the temperature value is above the SupplyTemperatureLowLimit). If the supply air temperature value returns to the comfort range, the FCU application resets the delay counter, enables the 2nd stage, and returns to normal operation.

Supply Air Temperature limitation in the 1st stage, analog control

In the analog control, if the supply air temperature approaches 1°C to the comfort range limit, the FCU application starts a built-in algorithm, which reduces the air temperature (if the temperature value is close or above the SupplyTemperatureHighLimit) or increase the air temperature (if the temperature value is close or below the SupplyTemperatureLowLimit). If the supply air temperature value returns to the comfort range ±1°C, the default application resets the delay counter and returns to normal operation.

Supply Air Temperature limitation in the 2nd (with external heater/cooler), analog control

In the analog control, if the supply air temperature approaches 1°C to the comfort range limit, the FCU application disables 2nd stage and starts counting 30 seconds delay time. After 1 minute, if the supply air temperature value approaches 1°C to the comfort range limit, the default application starts a built-in algorithm, which reduces the air temperature (if the temperature value is close or above the SupplyTemperatureHighLimit) or increase the air temperature (if the temperature value is close or below the SupplyTemperatureLowLimit). If the supply air temperature value returns to the comfort range ±1°C, the default applications resets delay counter, enables 2nd stage, and returns to normal operation.

4.3.5 FCU Test Mode

This mode was implemented to conduct a quick heating/cooling test. In this mode, the FCU application starts the fan and heating or cooling actuators with 100% value. Depending on the FCU_Test_Mode network variable value, the test mode activates heating or cooling function. Network variable values and corresponding test functions are presented in the table below.

Name	BACnet AV ID	Modbus Register	Default Value	FCU_Test_ Mode Value	Fan Value	Heating Value	Cooling Value	Descript ion
FCU_Test_ Mode	37	137	0	0	Auto	Auto	Auto	Normal working
				1	100%	100%	0%	Heating test
				2	100%	0%	100%	Cooling test

Table 7. FCU Test_Mode network variable values description

4.3.6 FCU Controller Outputs Manual Override

This function allows to override the FCU controller outputs control signals by the user values. Each control signal has 2 network parameters: first–for the output value, and second–for the switch between auto and manual control. The control value depends on the output working mode. In the analog control mode, network parameters are working in the range from 0 to 100%. In the binary control mode, the fan works in the range from 0 to 3 and valve actuators outputs (triacs) work in the range from 0 to 1. During the manual override fan and valve actuators status network parameters show real value. By default, all outputs are working in the auto mode.

5 RAC18-IP Panel Connection and Configuration

The RAC18-IP controller works with three types of dedicated panels:

- Touch Point panel;
- LP panel with LCD display;
- SP panel without display, fully passive;
- FP panel.

The default application allows the user to select, which temperature sensor source is chosen to control algorithm.

The sensor is selected by the S3 DIP switches number 5 and 6.

No.	Name	Switches Configuration		Function
5	CV temperature source	5-Off	6-Off	LCD panel
		5-Off	6-On	Room sensor SI3
6		5-On	6-Off	Air return temp SI1
		5-On	6-On	Slave

Table 8. Sensor selection with the CFG DIP switch

5.1 Touch Point

The Touch Point panel is connected to the RAC18-IP controller's RJ45 socket. This connection provides panel power supply and communication.

If the panel is connected, the user can decide, which temperature sensor to control the algorithm, from the panel or from universal input. The temperature source is chosen by the S3 DIP switches number 5 and 6, according to the table above. Using the Touch Point panel, the user can set and display many RAC18-IP controller's parameters, such as fan speed, setpoint, offset, occupancy status, etc. If using the Touch Point device, the configuration and user parameters are synchronized with the BMS, the last change from the BMS or panel is the most current.

Communication settings

Please note that communication settings for a proper controller-panel connection are required as follows:

- protocol: Modbus RTU;
- address: 1.

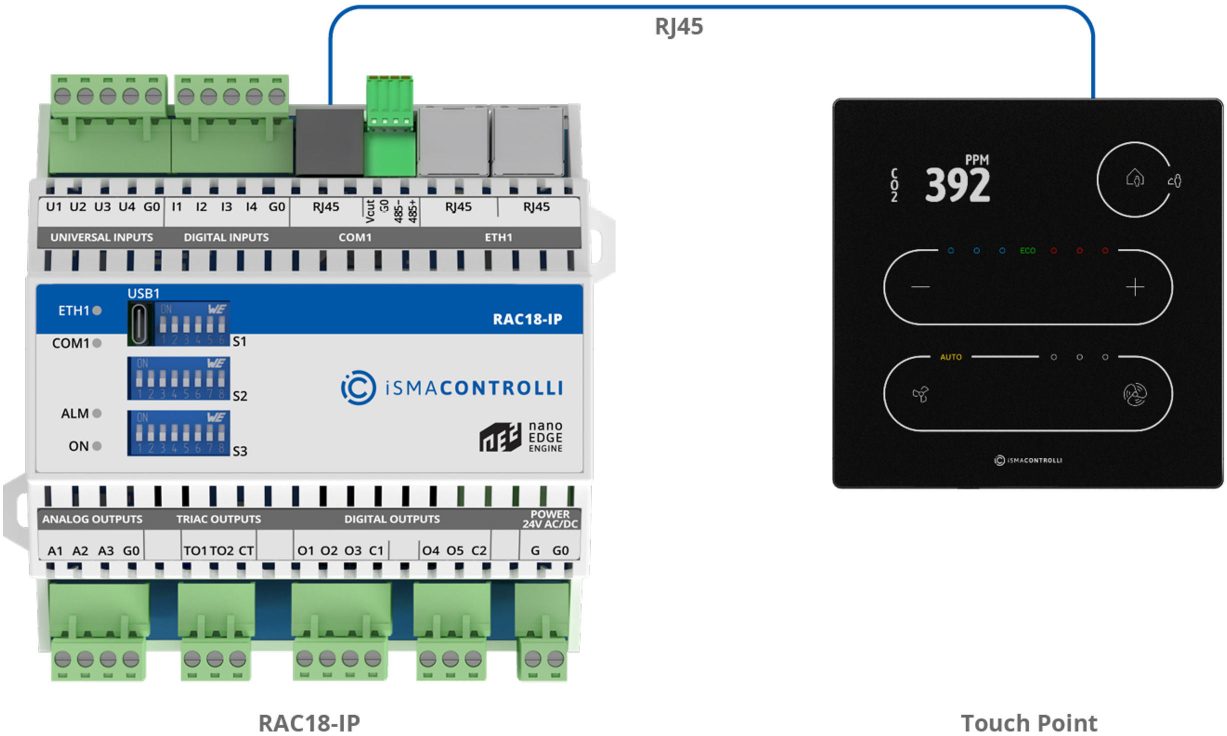


Figure 31. RAC18-IP connection to Touch Point panel

5.2 LP Panel

The LP room panel is connected to the RAC18-IP controller's RJ45 socket. This connection provides panel power supply and communication.

If the room panel is connected, the user can decide, which temperature sensor to control the algorithm, from the panel or from universal input. The temperature source is chosen by the S3 DIP switches number 5 and 6, according to the table above. Using LP, the user can set and display many RAC18-IP controller parameters, such as fan speed, setpoint, offset, occupancy status, etc. If using the LP device, the configuration and user parameters are synchronized with the BMS, the last change from the BMS or panel is the most current.

Communication settings

Please note that communication settings for a proper controller-panel connection are required as follows:

- protocol: Modbus RTU;
- address: 1.

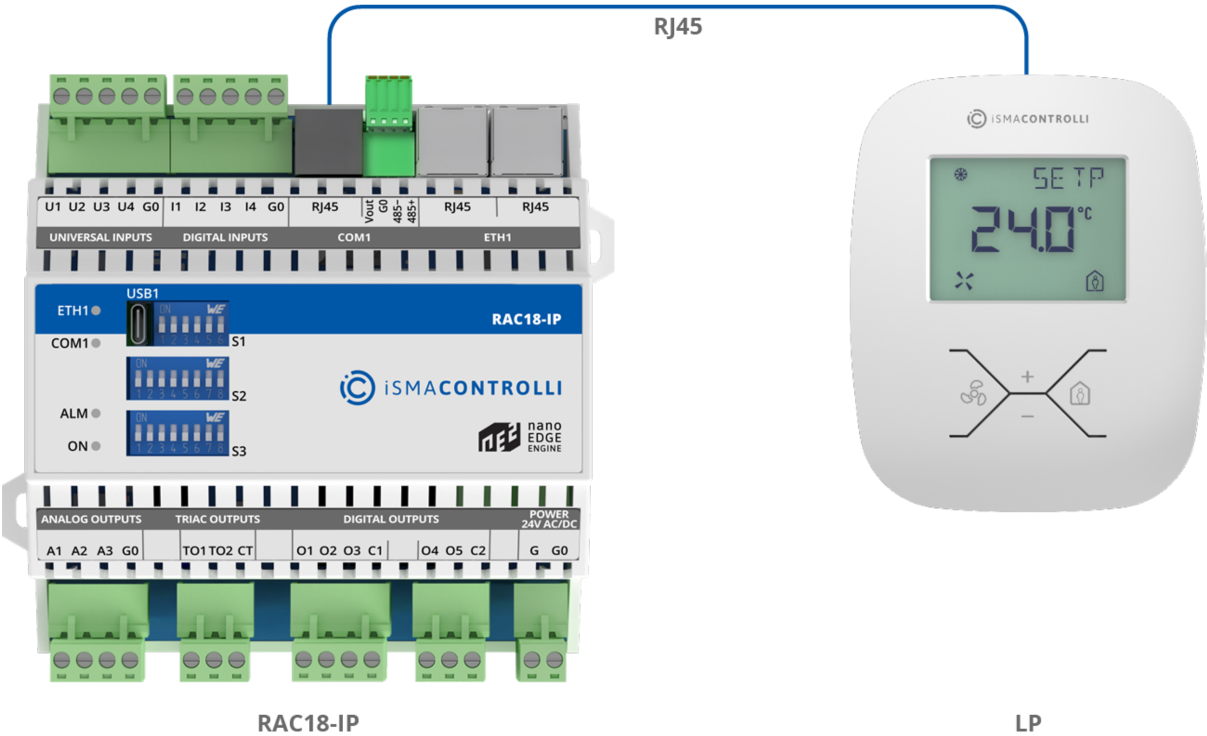


Figure 32. RAC18-IP connection to the LP pane

5.3 SP Panel

Using the SP simple panel, the user can only adjust setpoint offset and force occupation mode. The setpoint offset is automatically overridden by the value from the simple panel. For proper operation of the panel, the temperature sensor source must be taken from the U3 input. The sensor is chosen by the S3 DIP switches number 5 and 6, in accordance with the table above. If using the simple panel, the RAC18-IP controller works as an external sensor connected directly to the U3 input (switches number 5 off and 6 on). The temperature effective setpoint is set by changing the Setpoint_Offset value. The Setpoint_Offset cannot be overridden by the BMS; from the BMS, the Effective setpoint can by changed only by the Setpoint value. The effective setpoint pattern is shown below:

Effective_Setpoint = Setpoint + Setpoint_Offset

Communication settings

Please note that communication settings for a proper controller-panel connection are required as follows:

- protocol: Modbus RTU;
- address: 1.

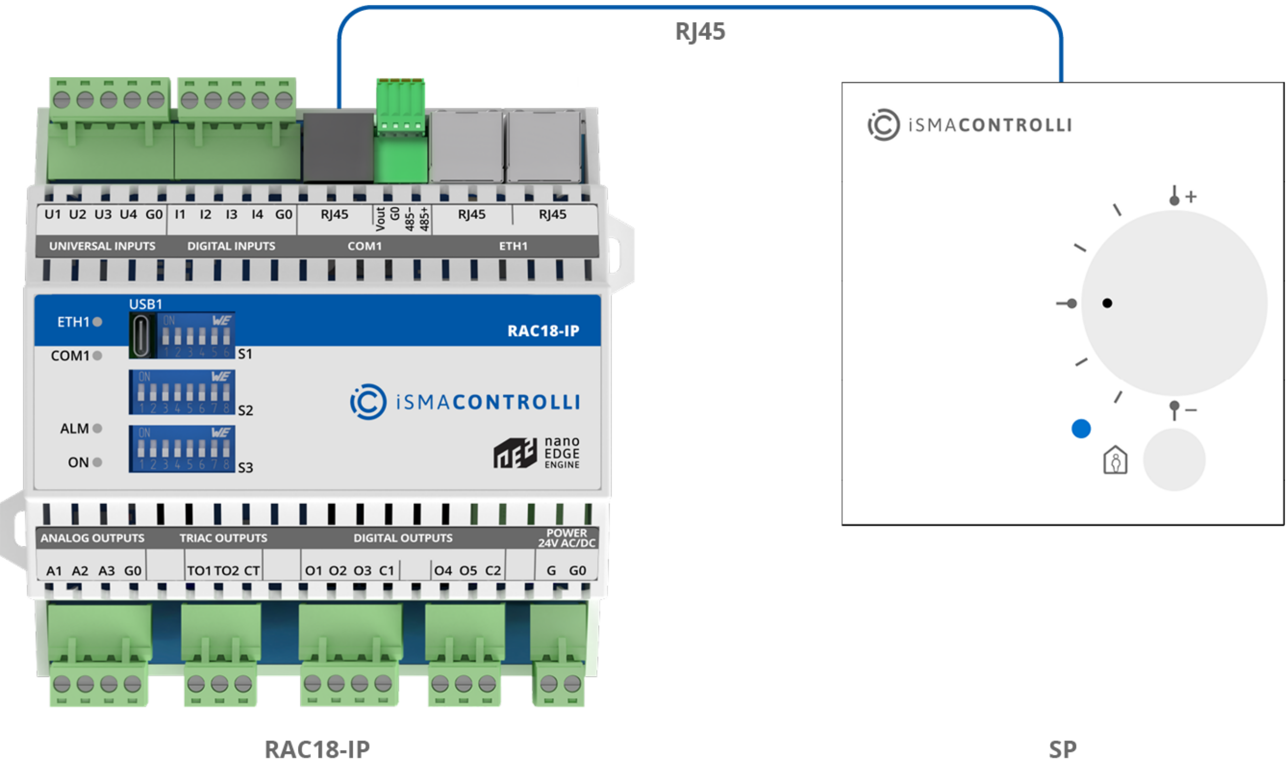


Figure 33. RAC18-IP connection to SP panel

5.4 FP Panel

The FP panel is connected to the RAC18-IP controller's RJ45 socket. This connection provides panel power supply and communication.

If the FP room panel is connected, the user can decide, which temperature sensor to control the algorithm, from the panel or from universal input. The temperature source is chosen by the S3 DIP switches number 5 and 6, according to the table above. Using the FP panel, the user can set and display many RAC18-IP controller parameters, such as fan speed, setpoint, offset, occupancy status, etc. If using the FP device, the configuration and user parameters are synchronized with the BMS, the last change from the BMS or panel is the most current.

Communication settings

Please note that communication settings for a proper controller-panel connection are required as follows:
- protocol: Modbus RTU;
- address: 1.

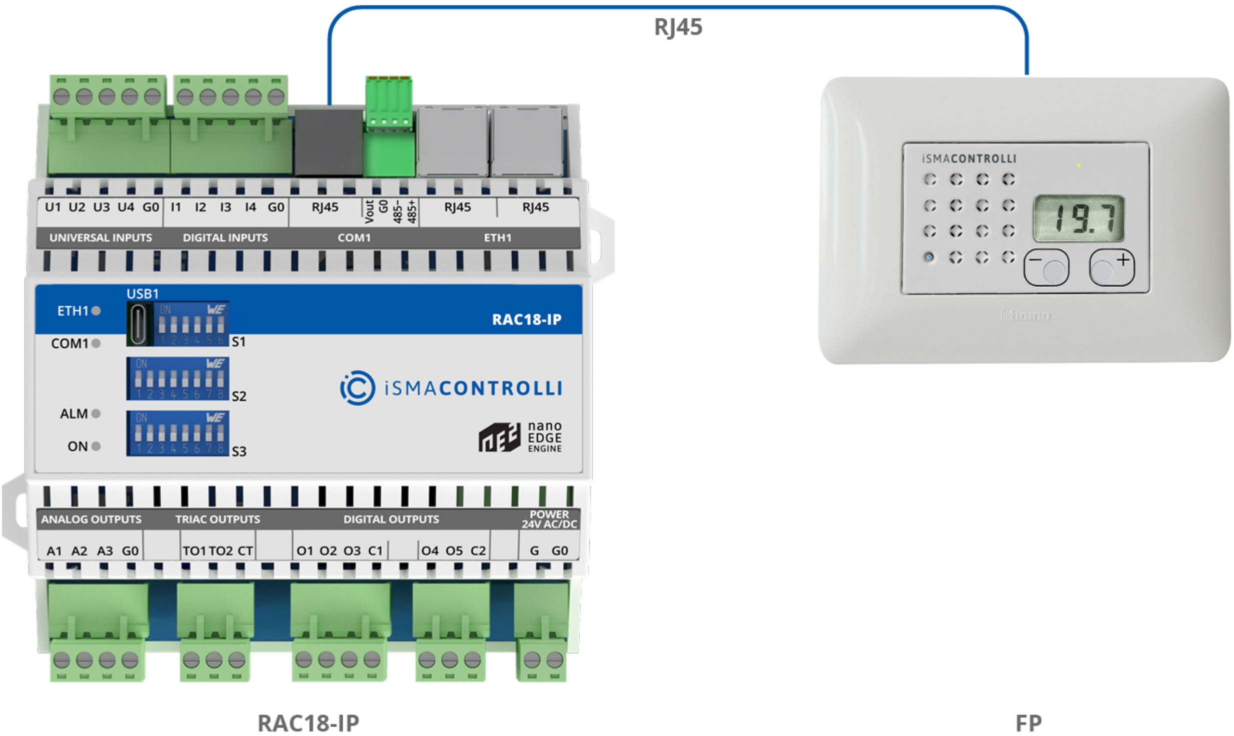


Figure 34. RAC18-IP connection to FP panel

6 BACnet IP Client-Server Configuration

The RAC18-IP controller can work in networks, where one device is a client device and the remaining devices are server devices. This function is useful if there are more than one devices working in a single room. In this case, only the master device can work with the room panel and control from the BMS. All other devices in the room follow the master parameters creating the network. In the default application the master-slave grouping is activated automatically if the master and slaves have been set with the right BACnet Device ID. A single network can contain up to 6 devices, 1 master and up to 5 slaves.

WARNING!

This function is available only in the BACnet protocol, and it works without a supervisor. In the Modbus protocol, master-slave function must be provided by supervisor.

6.1 MAC Addressing and ID

The MAC address and ID need to be set using the iC Tool or Supervisor system.

6.2 Auto Binding Addressing

The default application allows for automatic calculation of the BACnet Device Id of slave devices in the BACnet Master Slave Network, depending on the BACnet Device ID of master devices. This function is called auto-binding. The table below presents the values of master BACnet Device Id and corresponding BACnet Device Id of slave devices for auto-binding function:

Master Id	Slave 1 ID	Slave 2 ID	Slave 3 ID	Slave 4 ID	Slave 5 ID
826101	826001	826002	826003	826004	826005
826102	826006	826007	826008	826009	826010
826103	826011	826012	826013	826014	826015
826104	826016	826017	826018	826019	826020
826105	826021	826022	826023	826024	826025
826106	826026	826027	826028	826029	826030
826107	826031	826032	826033	826034	826035
826108	826036	826037	826038	826039	826040
826109	826041	826042	826043	826044	826045
826110	826046	826047	826048	826049	826050
826111	826051	826052	826053	826054	826055
826112	826056	826057	826058	826059	826060

Master Id	Slave 1 ID	Slave 2 ID	Slave 3 ID	Slave 4 ID	Slave 5 ID
826113	826061	826062	826063	826064	826065
826114	826066	826067	826068	826069	826070
826115	826071	826072	826073	826074	826075
826116	826076	826077	826078	826079	826080
826117	826081	826082	826083	826084	826085
826118	826086	826087	826088	826089	826090
826119	826091	826092	826093	826094	826095
826120	826096	826097	826098	826099	826100
Other	0	0	0	0	0

Table 9. Master Slave Id - Auto Binding function

The auto-binding function can be disabled (by setting the true value to the Local Remote Auto Binding network variable). In this case, Id of slave devices have to be set by the user (in network parameters: Remote Slave 1 Device Id-Remote Slave 5 Device Id).

6.3 Master-Slave Sharing Parameters

If the master device detects that it can communicate with a slave device, it sends/receives the following network parameters:

Network Variable Name	Units	Access	BACnet BV ID	BACnet AV ID	Modbus Coil	Modbus Register	Default Value	Direction
Net_Temperature	°C	RW	-	6	-	106	21	To slave
Setpoint	°C	RW	-	1	-	101	21	To slave
Occupancy_Mode	N/A	RW	-	0	-	100	1	To slave
Fcu_Mode	N/A	RW	-	4	-	104	1	To slave
Fan_Mode	N/A	RW	-	3	-	103	0	To slave
Slave_Window_Status	Bool	RW	69	-	1269	-	true	To master

Table 10. Master-slave sharing parameters

In the auto-binding function the sharing parameters have the following properties:

- Net_Temperature: sends the room temperature from the master device to slave devices. The slave devices can work without connected temperature sensor (CGF DIP switches number 5 and 6 in on position);

- Setpoint: the setpoint for slave devices, based on the master device's setpoint and the Setpoint_Offset value. This parameter does not include the Unoccupied_Offset and Standby_Offset, Effective Setpoint is calculated in the slave device according to the FCU mode;
- Occupancy_Mode: the occupancy mode for slave devices, based on the master device Occupancy_Status value;
- Fcu_Mode: the FCU_Mode for slave devices, based on the master device's FCU_Mode value;
- Fan_Mode: the Fan_Mode for slave devices, based on the master device's Fan_Mode value;
- Slave_Window_Status: every 1 minute the master device checks the slave device's open window status. If the master device detects that the window is open (their own or one of the devices in group), it runs the open window function (waits the time defined in the Window_Status_Delay network variable, and if the window is still open, switches off the whole group).

Name	Units	Access	BACnet BV ID	BACnet AV ID	Modbus Coil	Modbus Register	Default Value
Local_Remote_Auto_Binding	Bool	RW	9	-	1209		False
Remote_Slave1_Device_ID	N/A	RW	-	54	-	154	0
Remote_Slave2_Device_ID	N/A	RW	-	56	-	156	0
Remote_Slave3_Device_ID	N/A	RW	-	58	-	158	0
Remote_Slave4_Device_ID	N/A	RW	-	60	-	160	0
Remote_Slave5_Device_ID	N/A	RW	-	62	-	162	0
Slave1_Active	Bool	RO	96	-	1296	-	N/A
Slave2_Active	Bool	RO	97	-	1297	-	N/A
Slave3_Active	Bool	RO	98	-	1298	-	N/A
Slave4_Active	Bool	RO	99	-	1299	-	N/A
Slave5_Active	Bool	RO	100	-	1300	-	N/A

Table 11. Master device network parameters dedicated to master-slave function

6.4 Application Status

In order to give the user possibility to troubleshoot and diagnose application's operation, the App_status network variable was added. The information is represented as a multistate value available in the Modbus register 99 and the BACnet Device object property 5002. This network variable allows to understand, what is causing a problem if the application is not working, or which fault it has gone into. It also shows transitional states such as yield, restart, and hibernate.

7 Examples: Connecting Actuators and Sensors to the Controller

7.1 Connections Overview

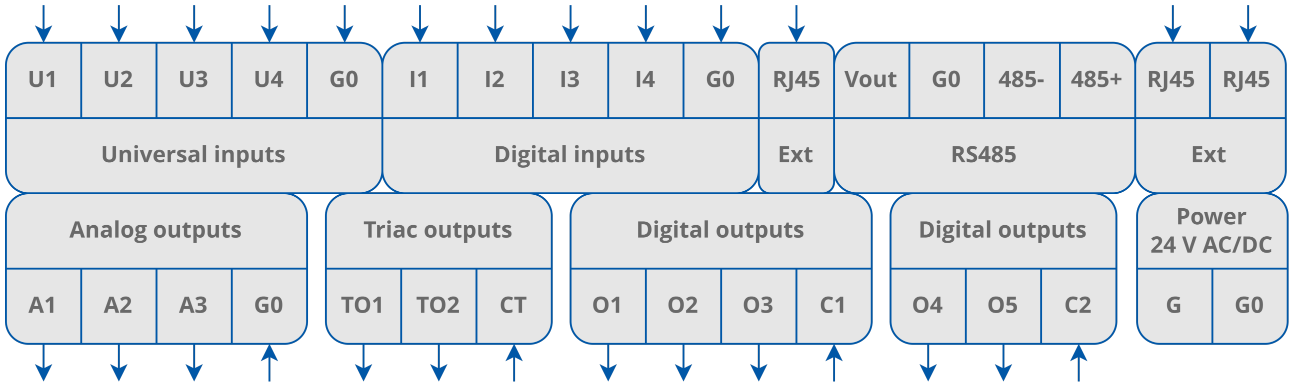


Figure 35. Inputs and outputs overview

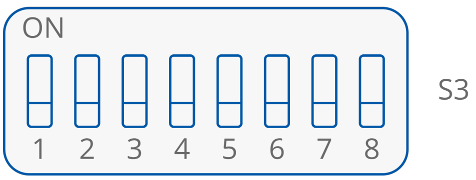
7.2 Connection Examples

The examples below do not include selection of the temperature control value source. Connecting the temperature control value source is described in Step 7 of this manual. In examples, DIP switch sections 5 and 6 are set to OFF.

The 24 V power source for heater and cooler actuators can be taken from L2/N2 connectors.

If 2nd stages of heating or cooling is used, check Step 6 for connection information.

7.2.1 4-pipe Installation with 1-stage Digital Controlled Heating and Cooling and Analog Controlled Fan



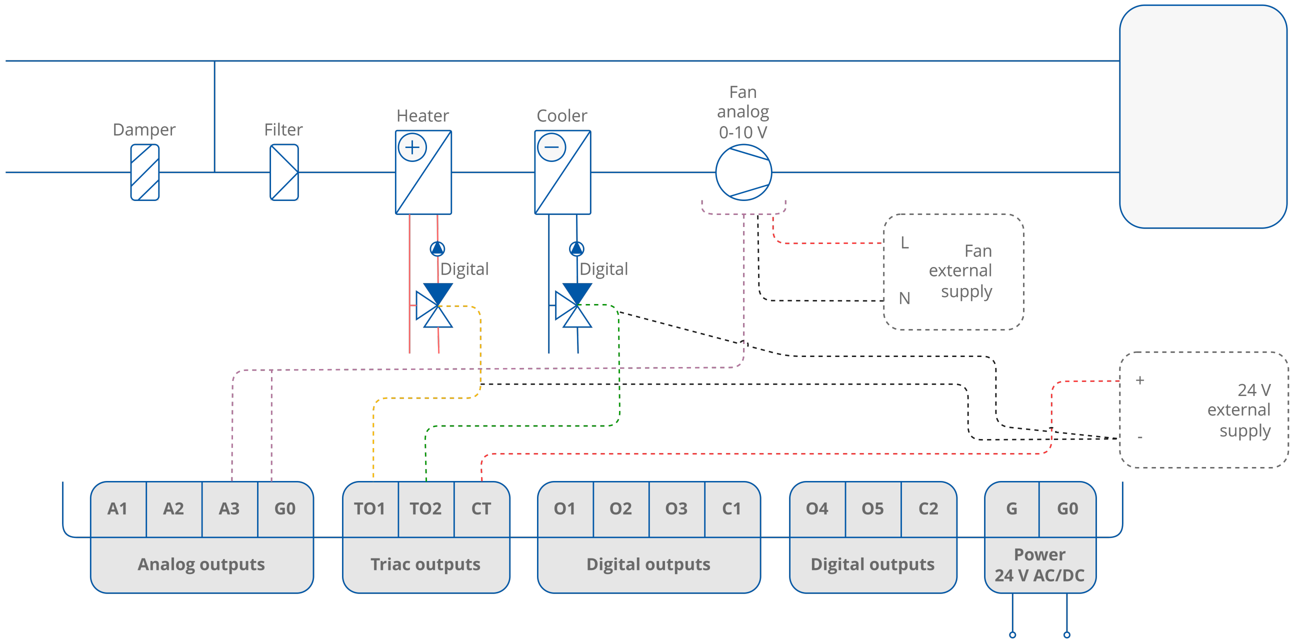
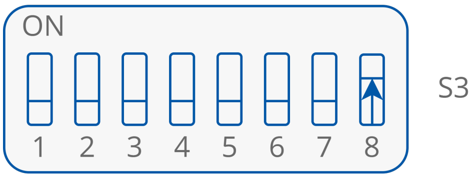


Figure 36. 4-pipe installation with 1-stage digital controlled heating and cooling and analog controlled fan

7.2.2 4-pipe Installation with 1-stage Digital Controlled Heating and Cooling and 1-speed Fan



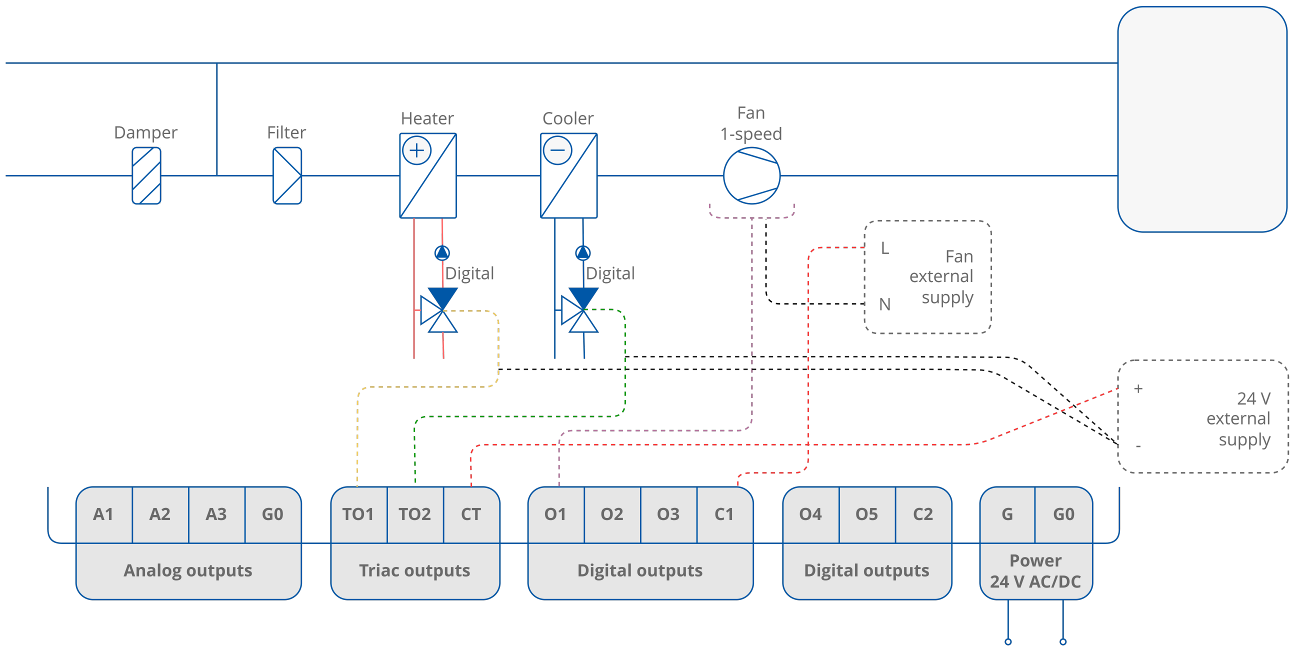
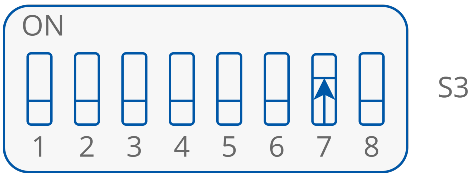


Figure 37. 4-pipe installation with 1-stage digital controlled heating and cooling and 1-speed fan

7.2.3 4-pipe Installation with 1-stage Digital Controlled Heating and Cooling and 2-speed Fan



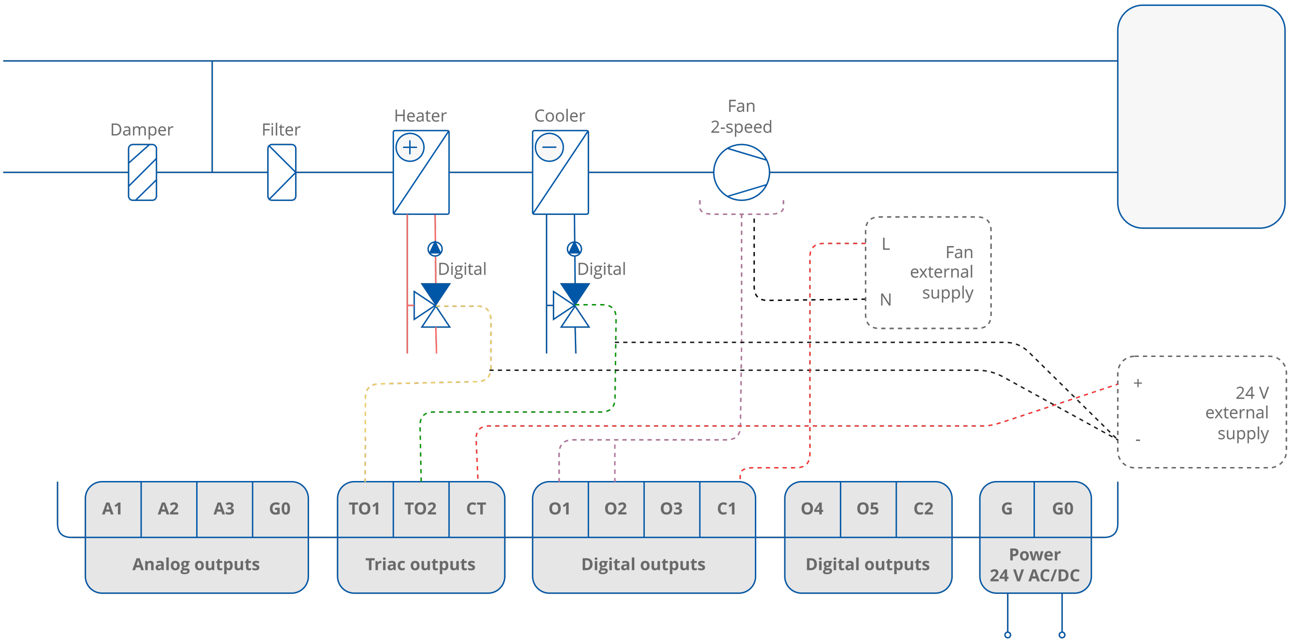
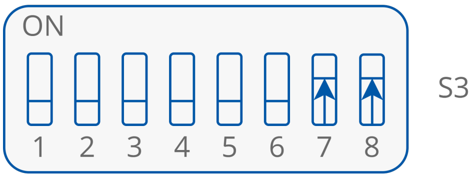


Figure 38. 4-pipe installation with 1-stage digital controlled heating and cooling and 2-speed fan

7.2.4 4-pipe Installation with 1-stage Digital Controlled Heating and Cooling and 3-speed Fan



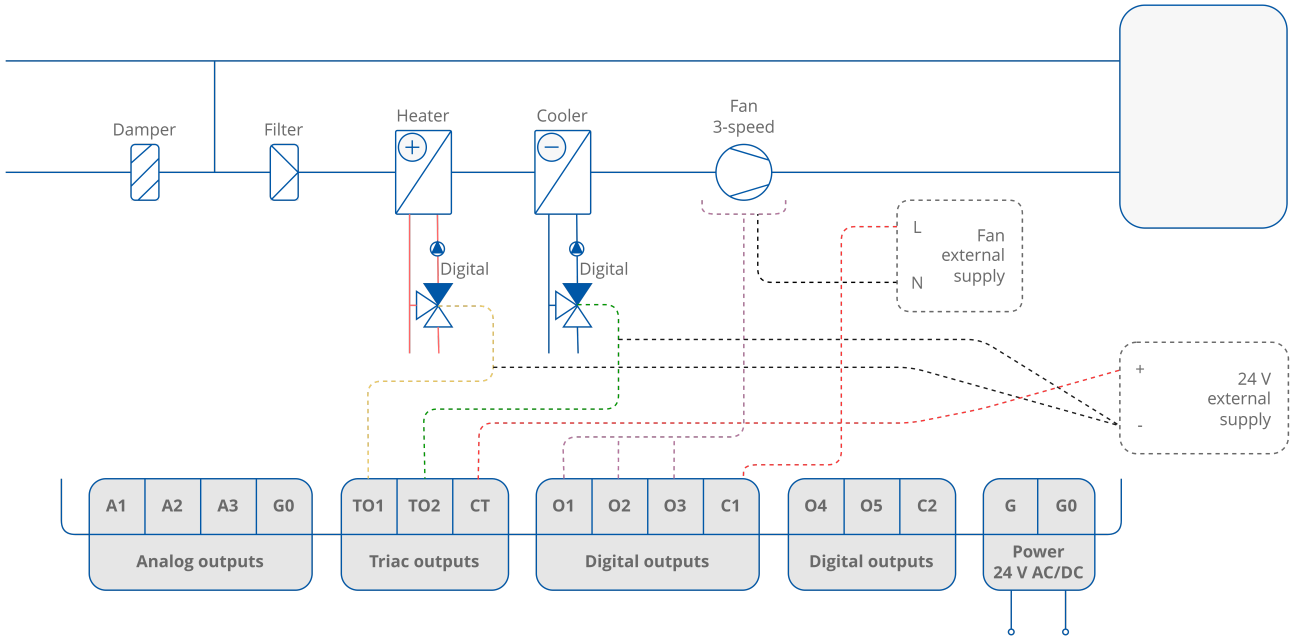
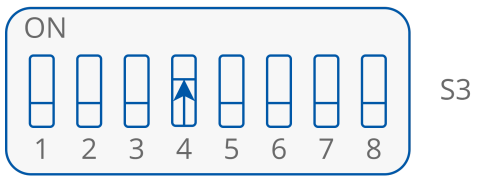


Figure 39. 4-pipe installation with 1-stage digital controlled heating and cooling and 3-speed fan

7.2.5 4-pipe Installation with 1-stage Analog Controlled Heating and Cooling and Analog Controlled Fan



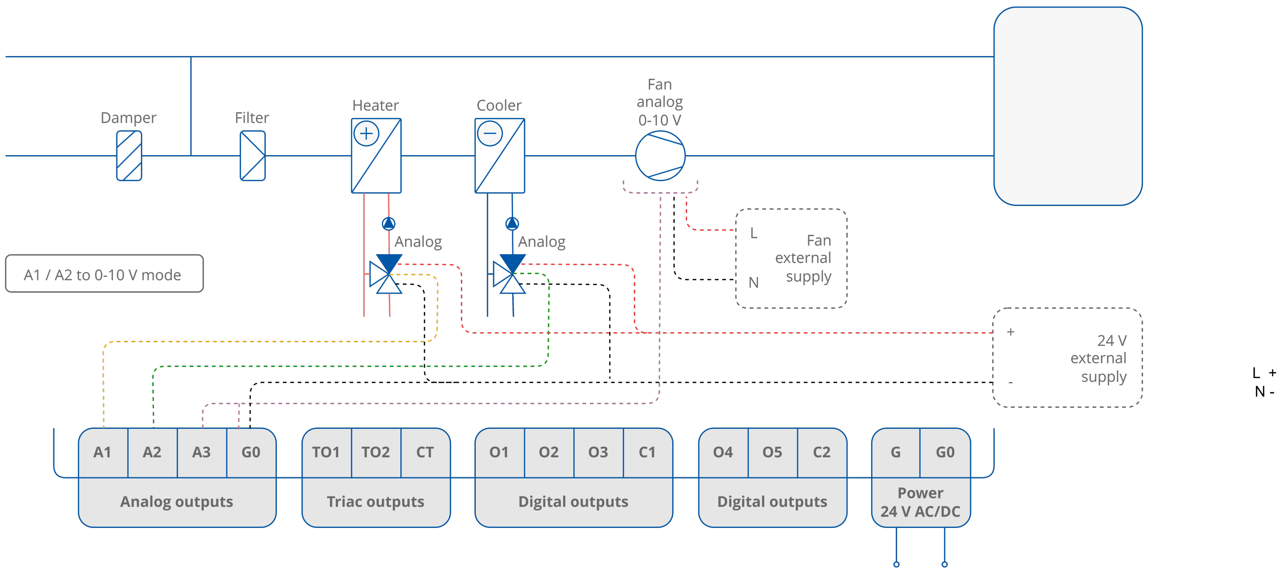


Figure 40. 4-pipe installation with 1-stage analog controlled heating and cooling and analog controlled fan - valve in analog mode

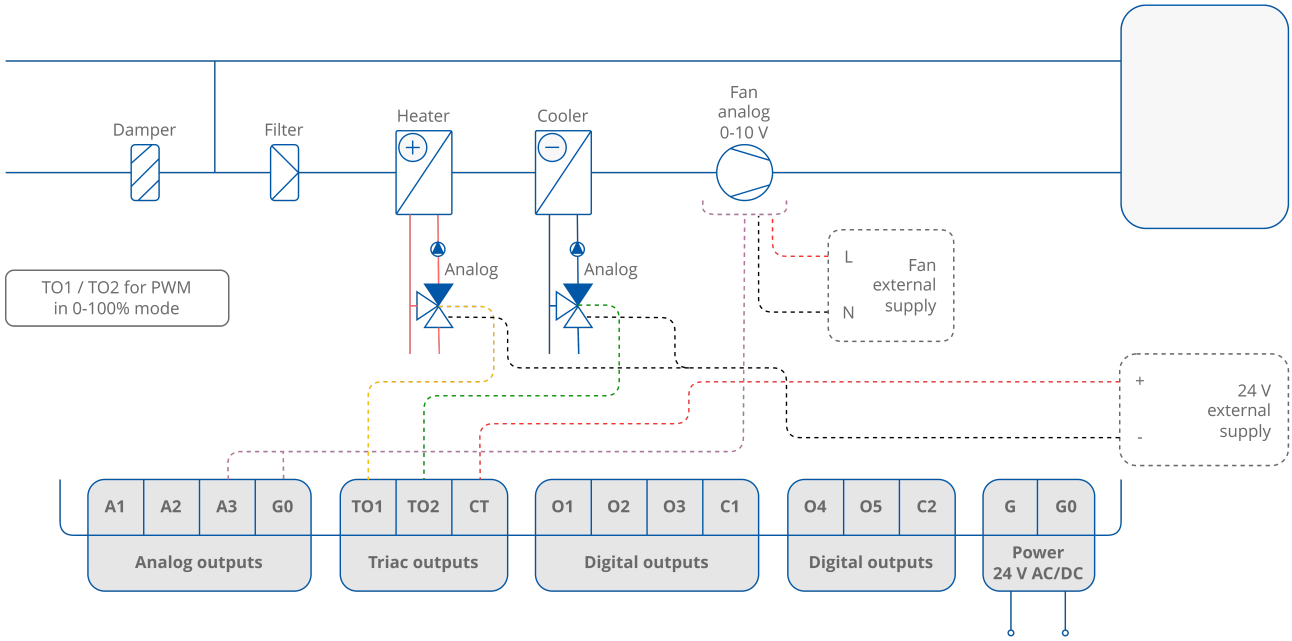
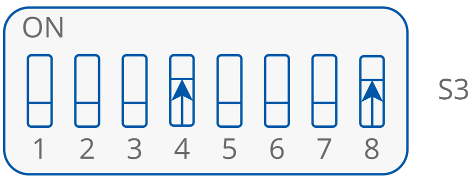


Figure 41. 4-pipe installation with 1-stage analog controlled heating and cooling and analog controlled fan - valve in PWM mode

7.2.6 4-pipe Installation with 1-stage Analog Controlled Heating and Cooling and 1-speed Fan



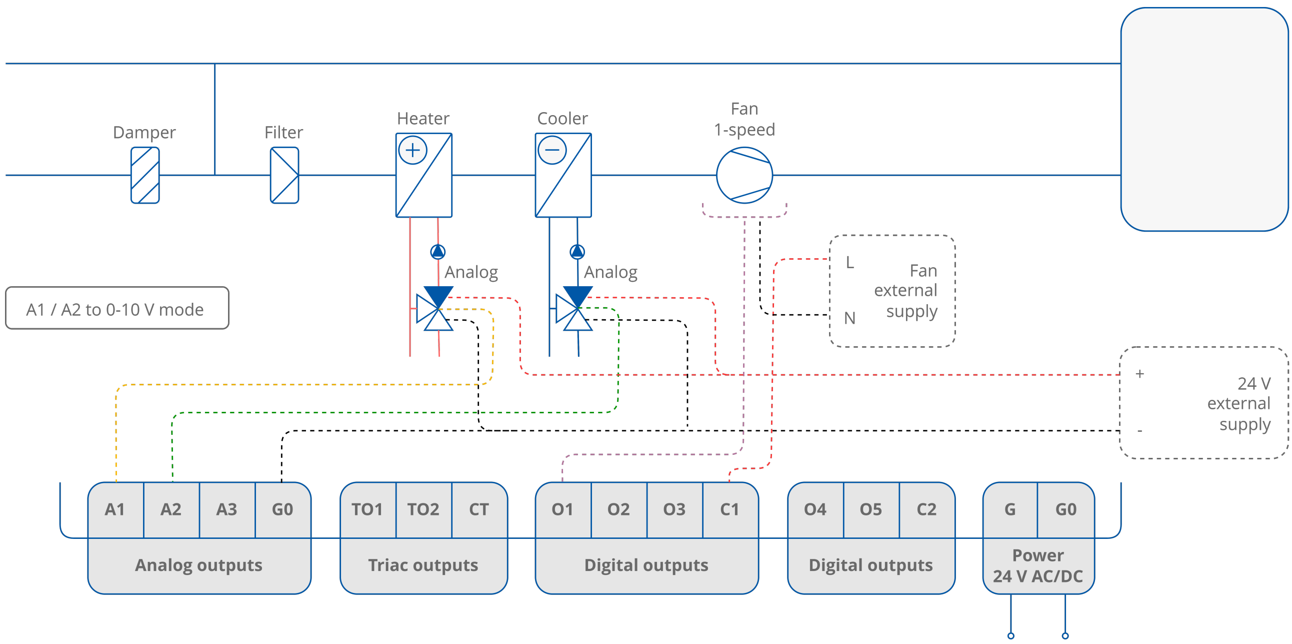


Figure 42. 4-pipe installation with 1-stage analog controlled heating and cooling and 1-speed fan - valve in analog mode

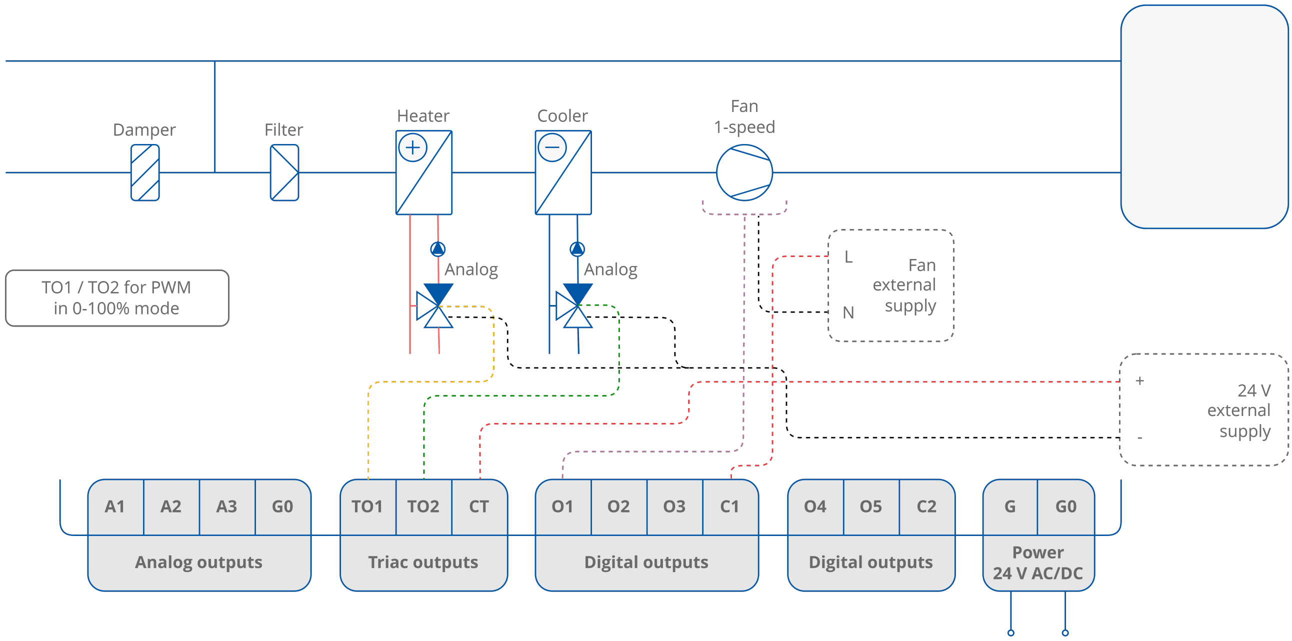
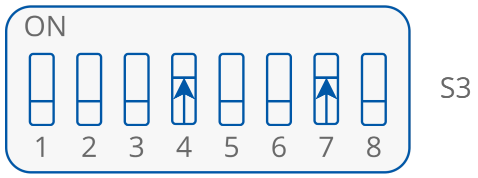


Figure 43. 4-pipe installation with 1-stage analog controlled heating and cooling and 1-speed fan - valve in PWM mode

7.2.7 4-pipe Installation with 1-stage Analog Controlled Heating and Cooling and 2-speed Fan



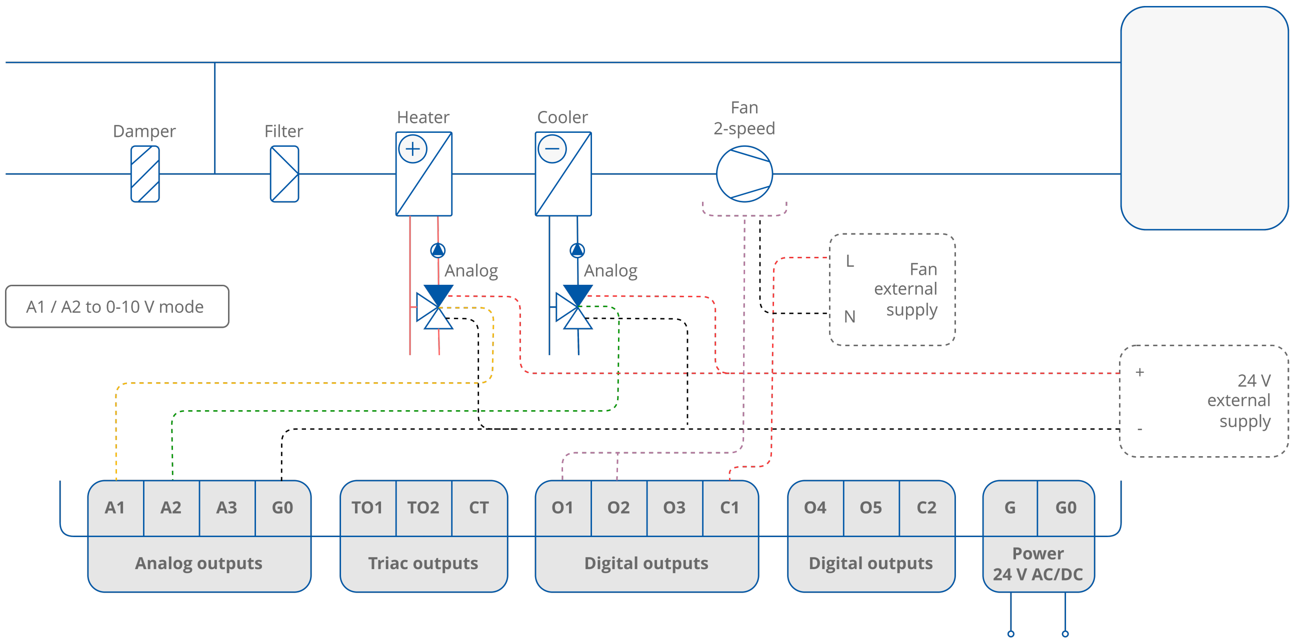


Figure 44. 4-pipe installation with 1-stage analog controlled heating and cooling and 2-speed fan - valve in analog mode

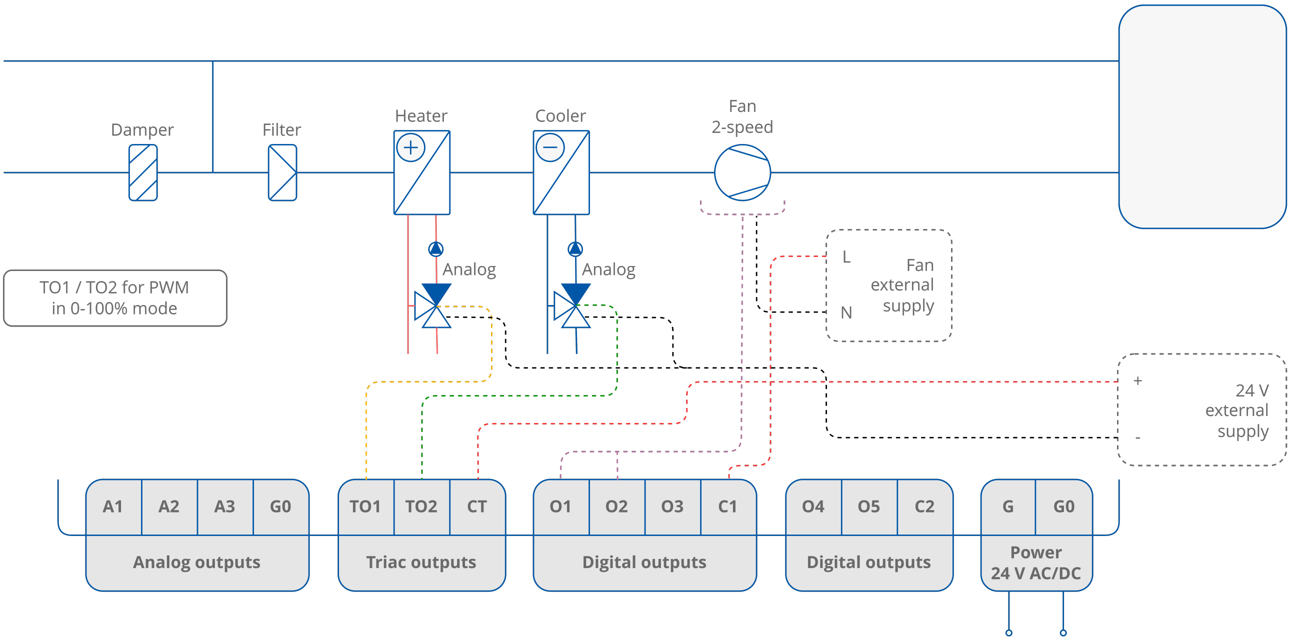
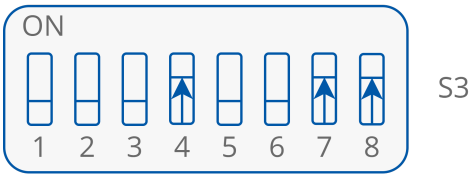


Figure 45. 4-pipe installation with 1-stage analog controlled heating and cooling and 2-speed fan - valve in PWM mode

7.2.8 4-pipe Installation with 1-stage Analog Controlled Heating and Cooling and 3-speed Fan



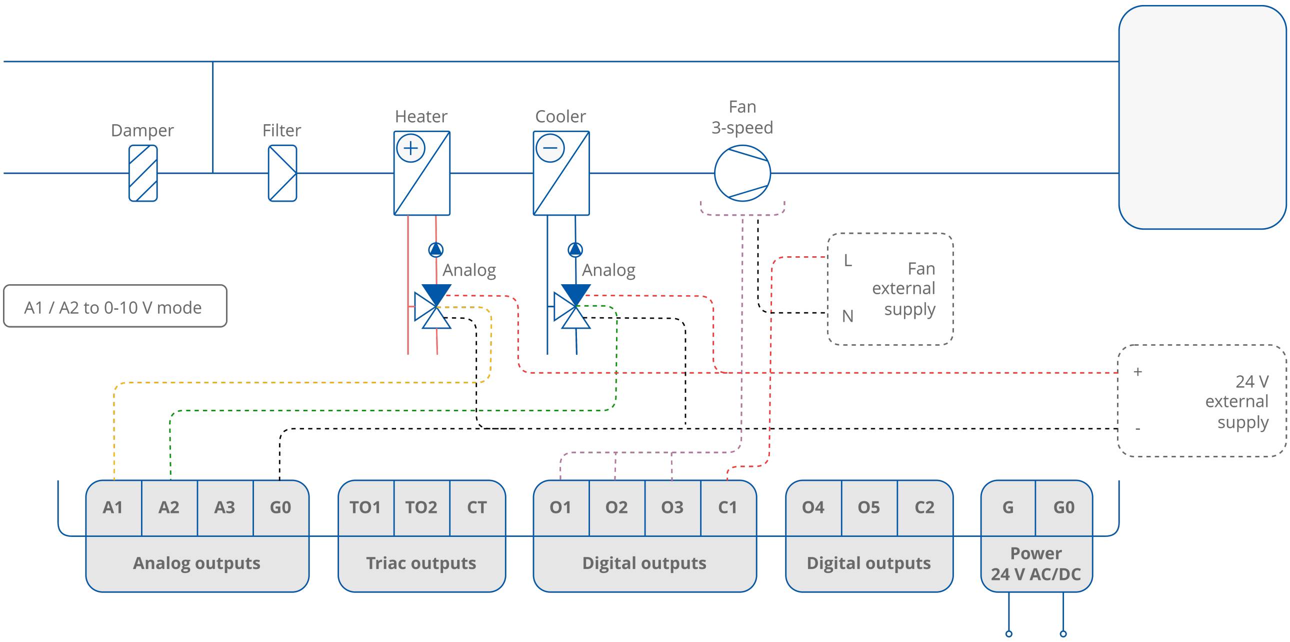


Figure 46. 4-pipe installation with 1-stage analog controlled heating and cooling and 3-speed fan - valve in analog mode

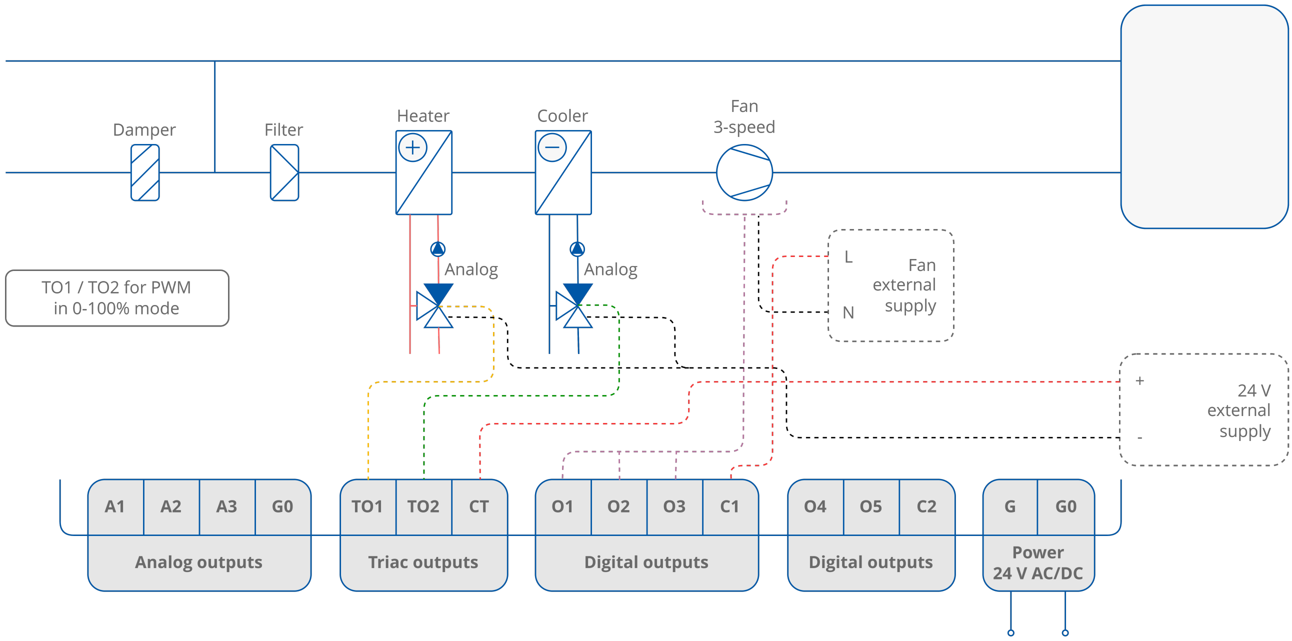


Figure 47. 4-pipe installation with 1-stage analog controlled heating and cooling and 3-speed fan - valve in PWM mode

7.2.9 2-pipe Installation with 1-stage Digital Controlled Cooling and Analog Controlled Fan

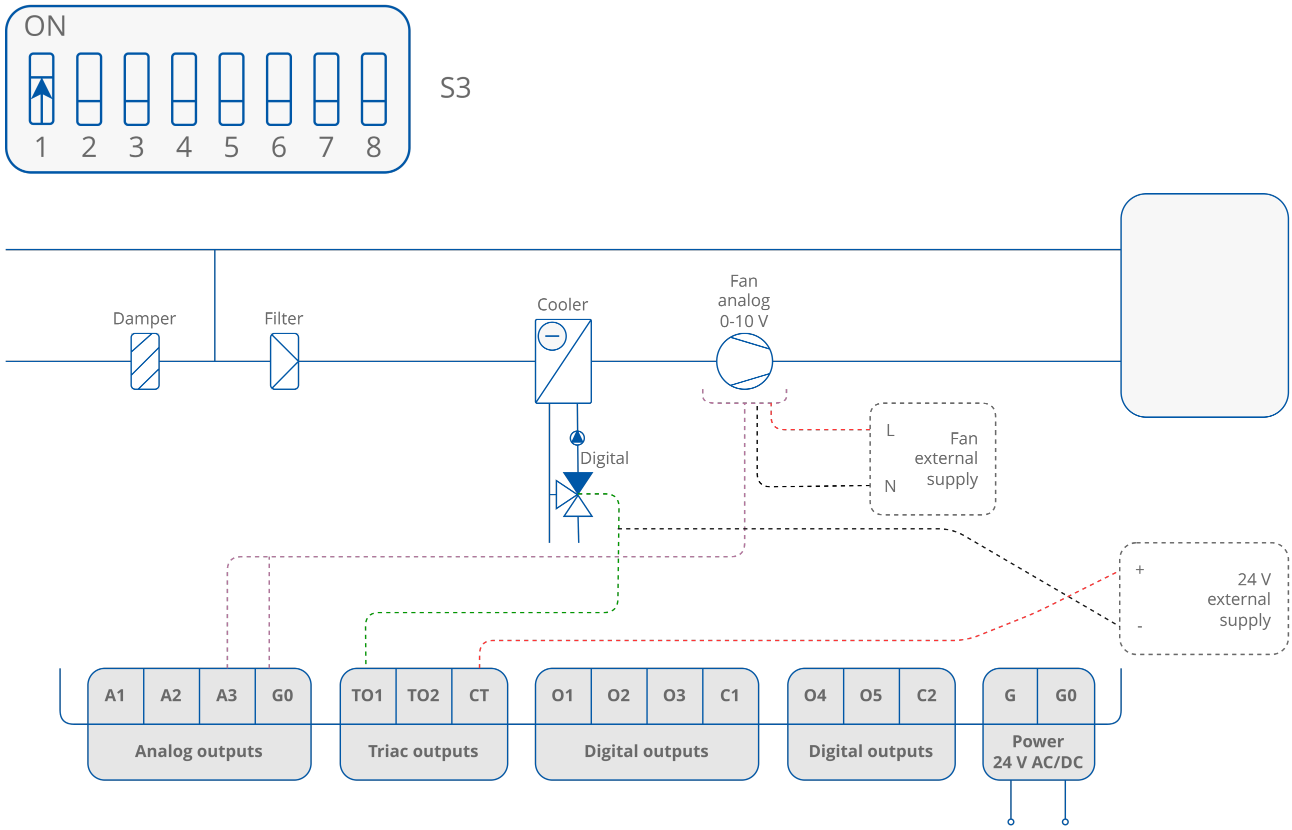
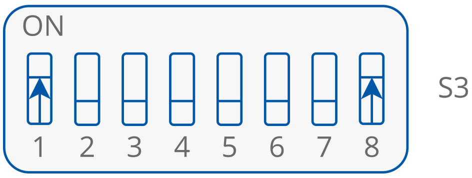


Figure 48. 2-pipe installation with 1-stage digital controlled cooling and analog controlled fan

7.2.10 2-pipe Installation with 1-stage Digital Controlled Heating and 1-speed Fan



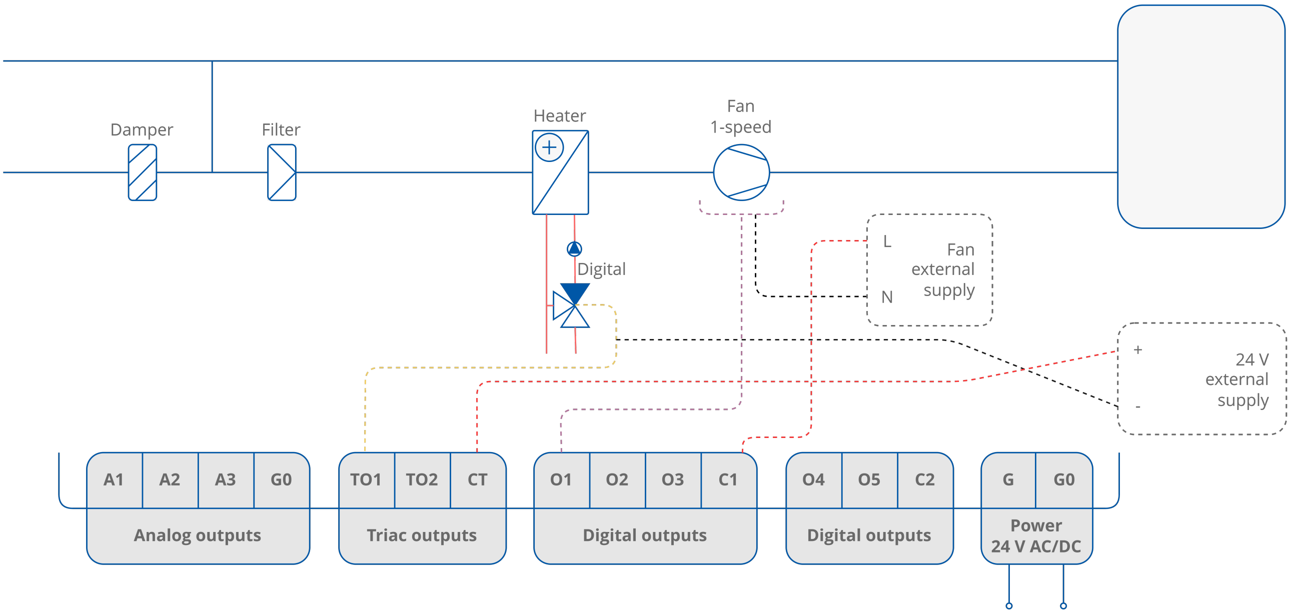
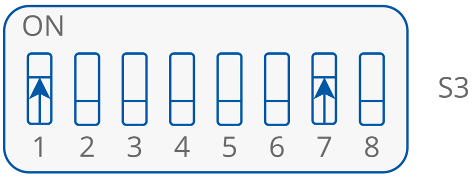


Figure 49. 2-pipe installation with 1-stage digital controlled heating and 1-speed fan

7.2.11 2-pipe Installation with 1-stage Digital Controlled Cooling and 2-speed Fan



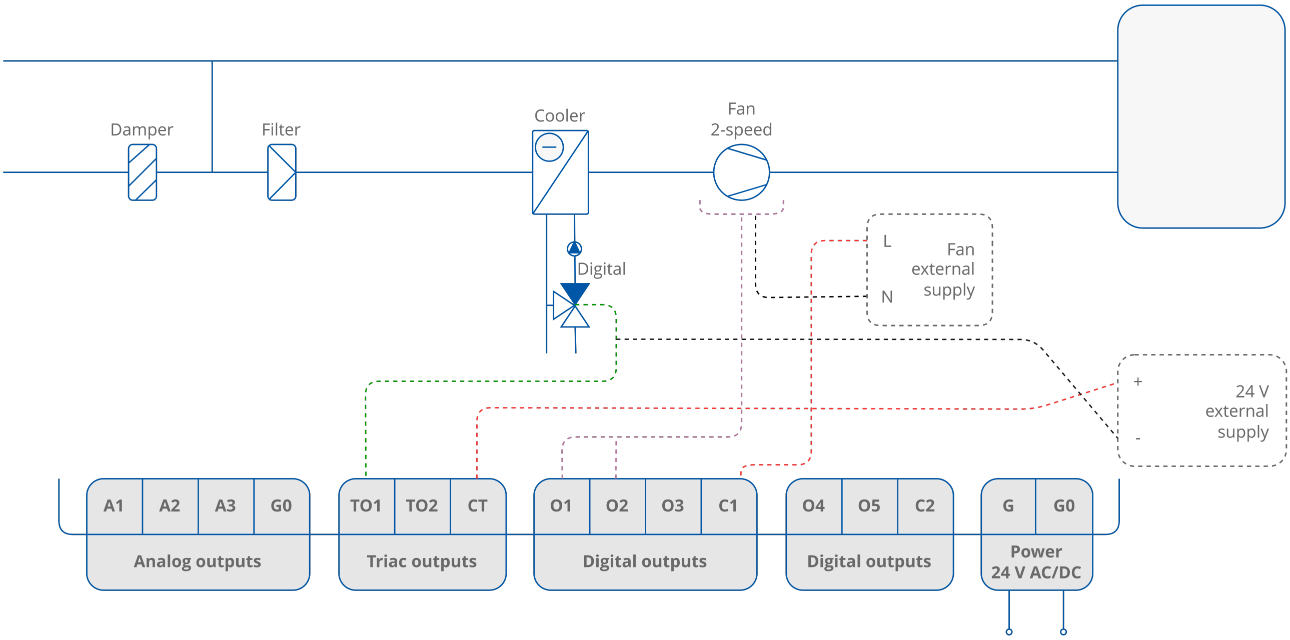
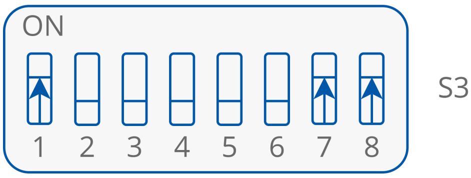


Figure 50. 2-pipe installation with 1-stage digital controlled cooling and 2-speed fan

7.2.12 2-Pipe Installation with 1 Stage Digital Controlled Heating and 3 Speeds Fan



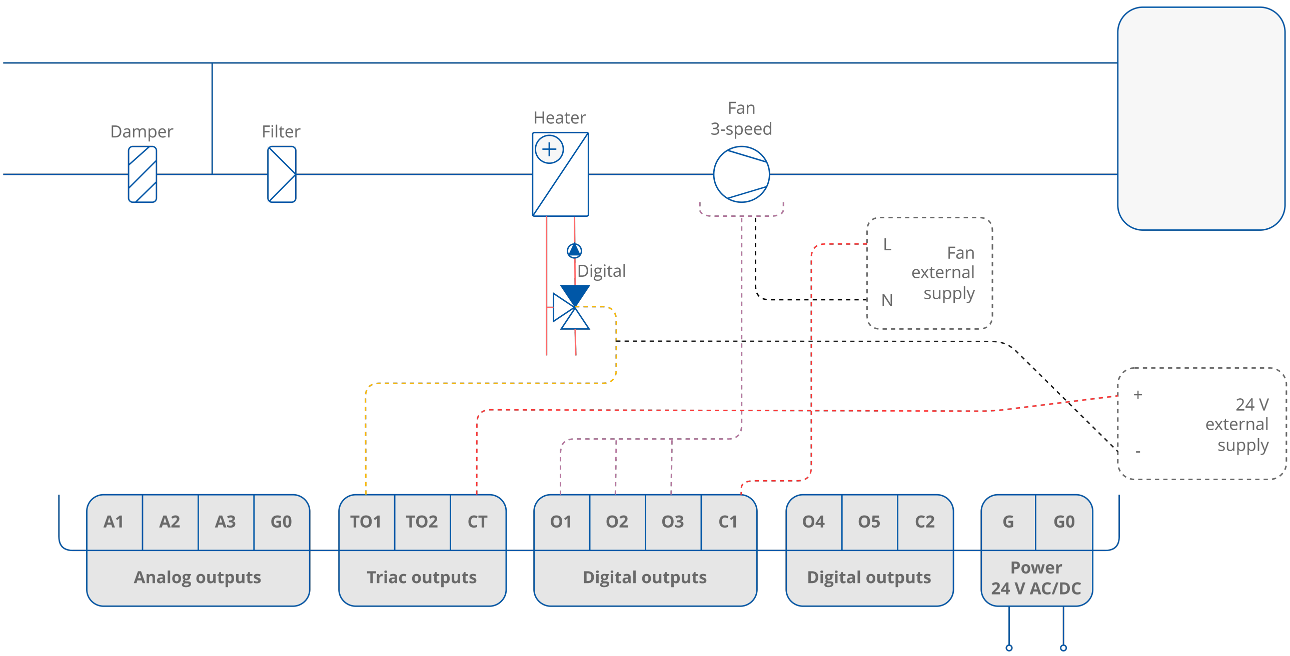
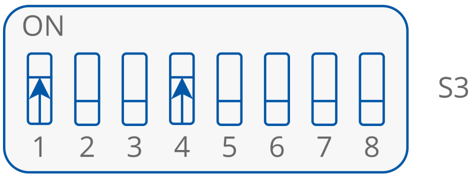


Figure 51. 2-pipe installation with 1-stage digital controlled heating and 3-speed fan

7.2.13 2-pipe Installation with 1-stage Analog Controlled Cooling and Analog Controlled Fan



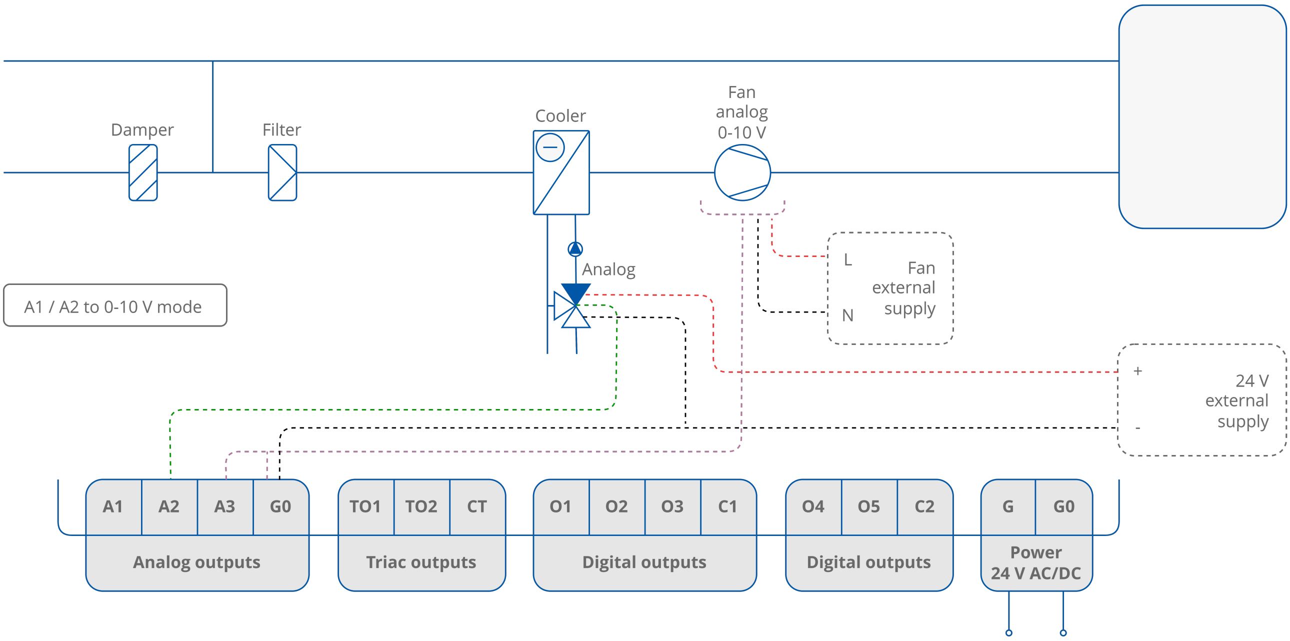


Figure 52. 2-pipe installation with 1-stage analog controlled cooling and analog controlled fan - valve in analog mode

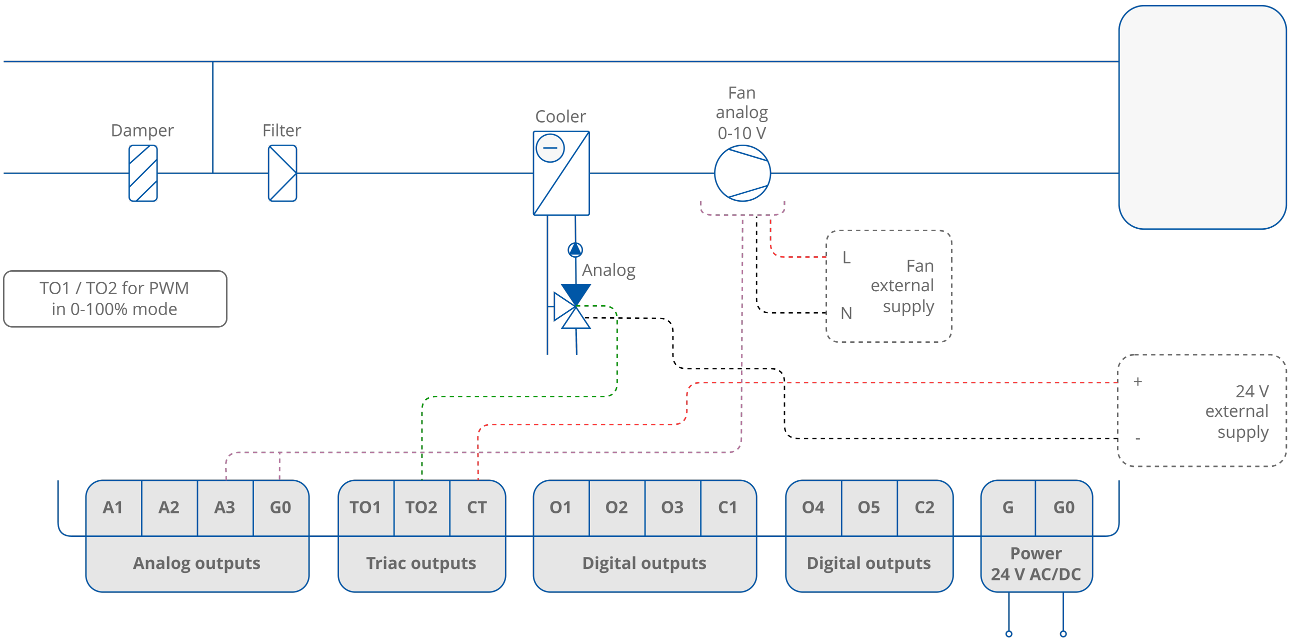
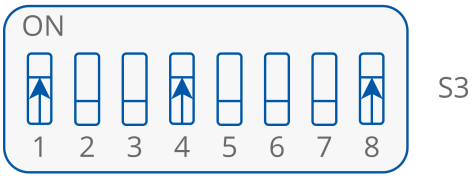


Figure 53. 2-pipe installation with 1-stage analog controlled cooling and analog controlled fan - valve in PWM mode

7.2.14 2-pipe Installation with 1-stage Analog Controlled Heating and 1-speed Fan



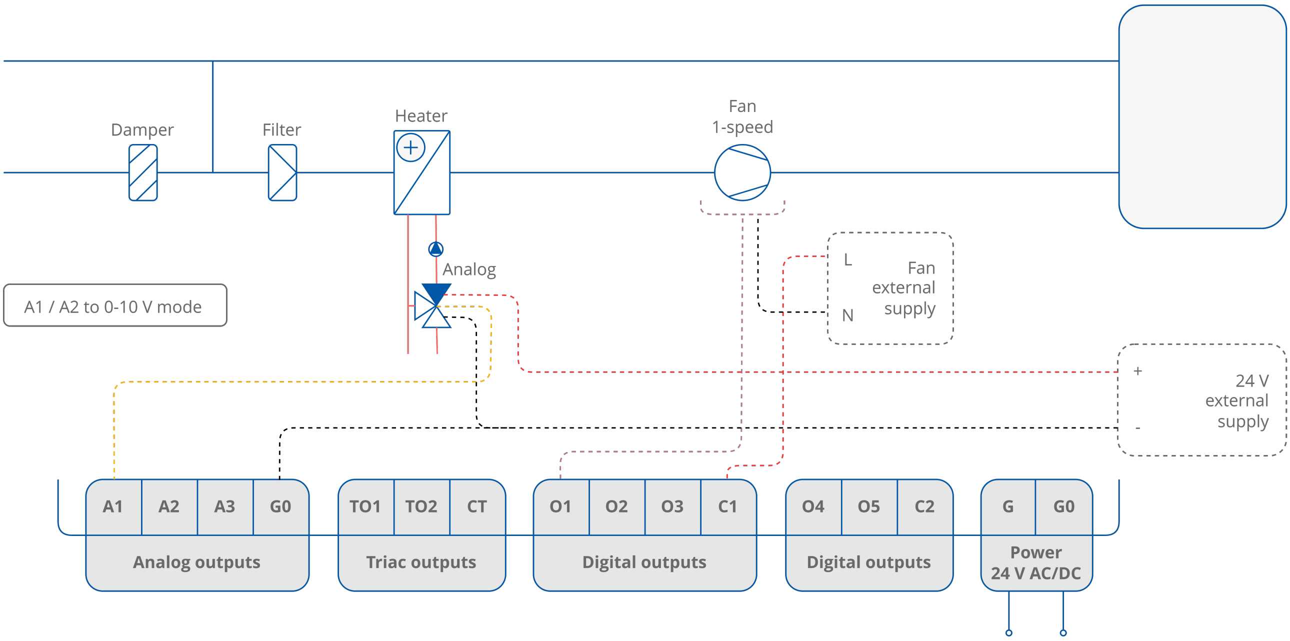


Figure 54. 2-pipe installation with 1-stage analog controlled heating and 1-speed fan - valve in analog mode

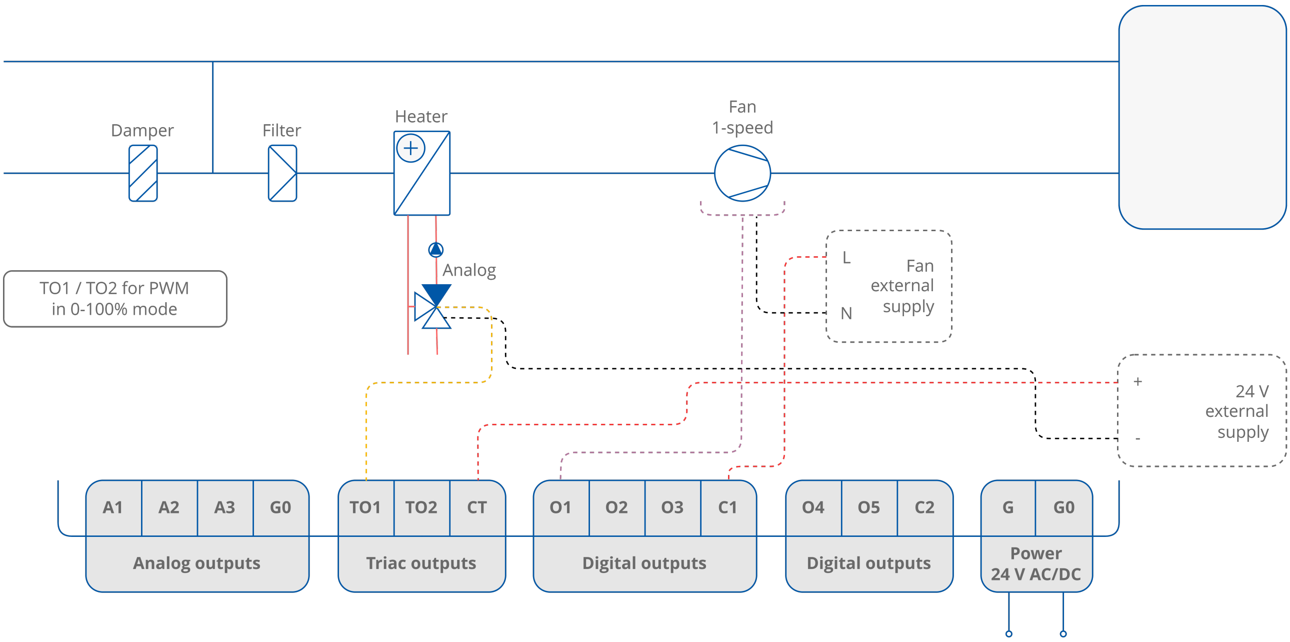
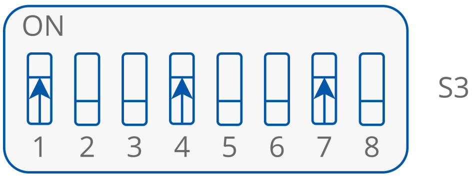


Figure 55. 2-pipe installation with 1-stage analog controlled heating and 1-speed fan - valve in PWM mode

7.2.15 2-pipe Installation with 1-stage Analog Controlled Cooling and 2-speed Fan



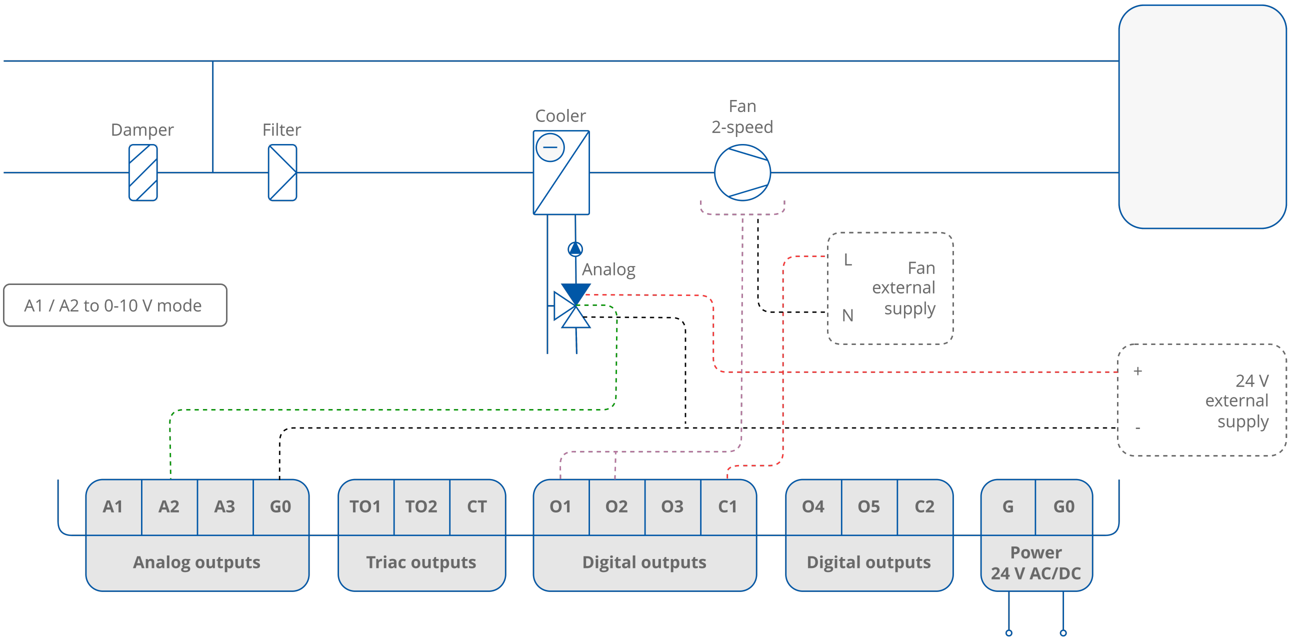


Figure 56. 2-pipe installation with 1-stage analog controlled cooling and 2-speed fan - valve in analog mode

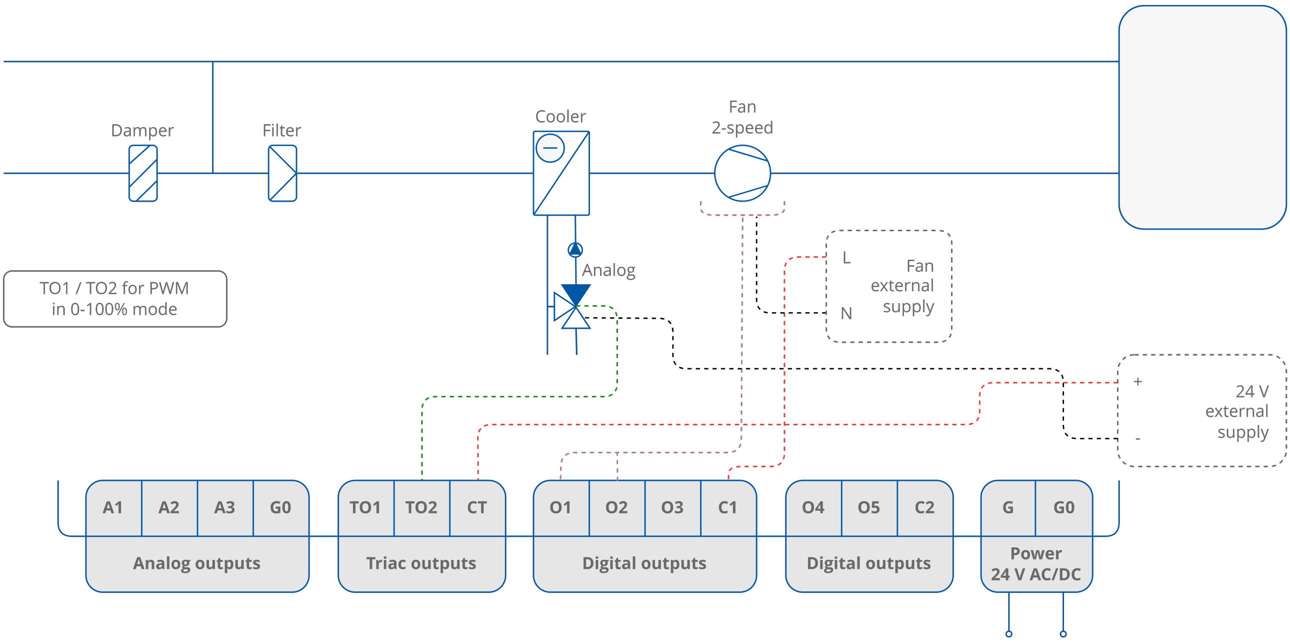
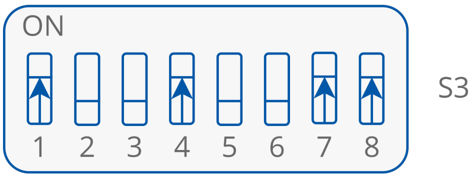


Figure 57. 2-pipe installation with 1-stage analog controlled cooling and 2-speed fan - valve in PWM mode

7.2.16 2-pipe Installation with 1-stage Analog Controlled Heating and 3-speed Fan



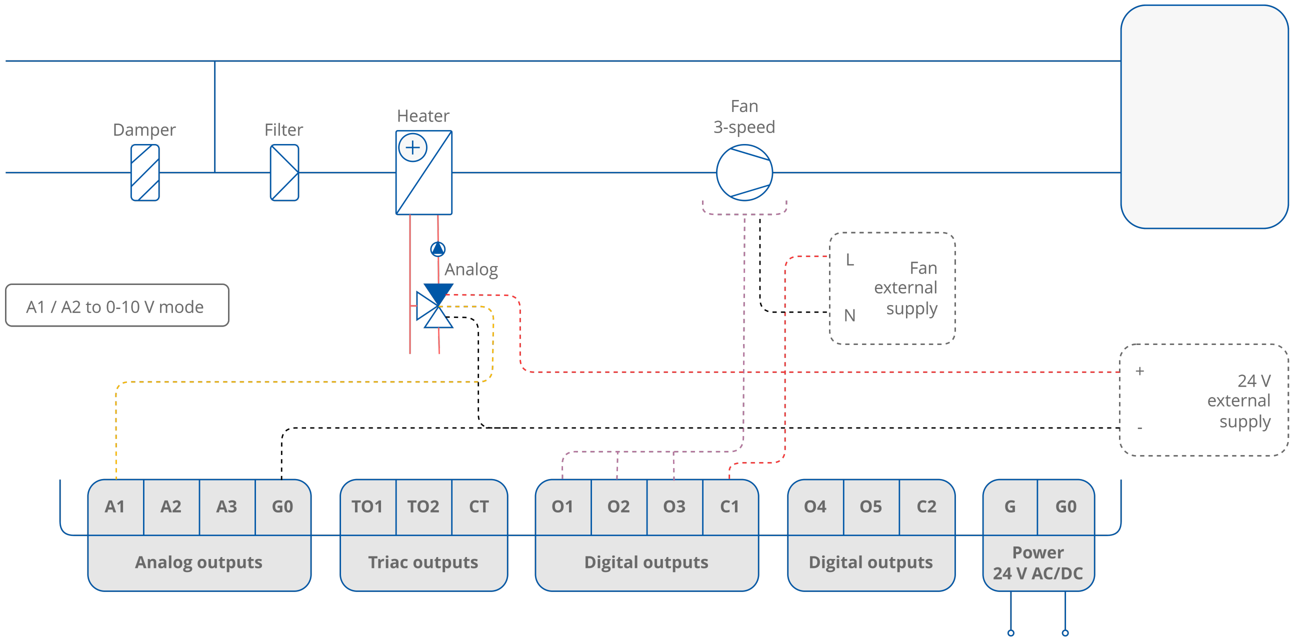


Figure 58. 2-pipe installation with 1-stage analog controlled heating and 3-speed fan - valve in analog mode

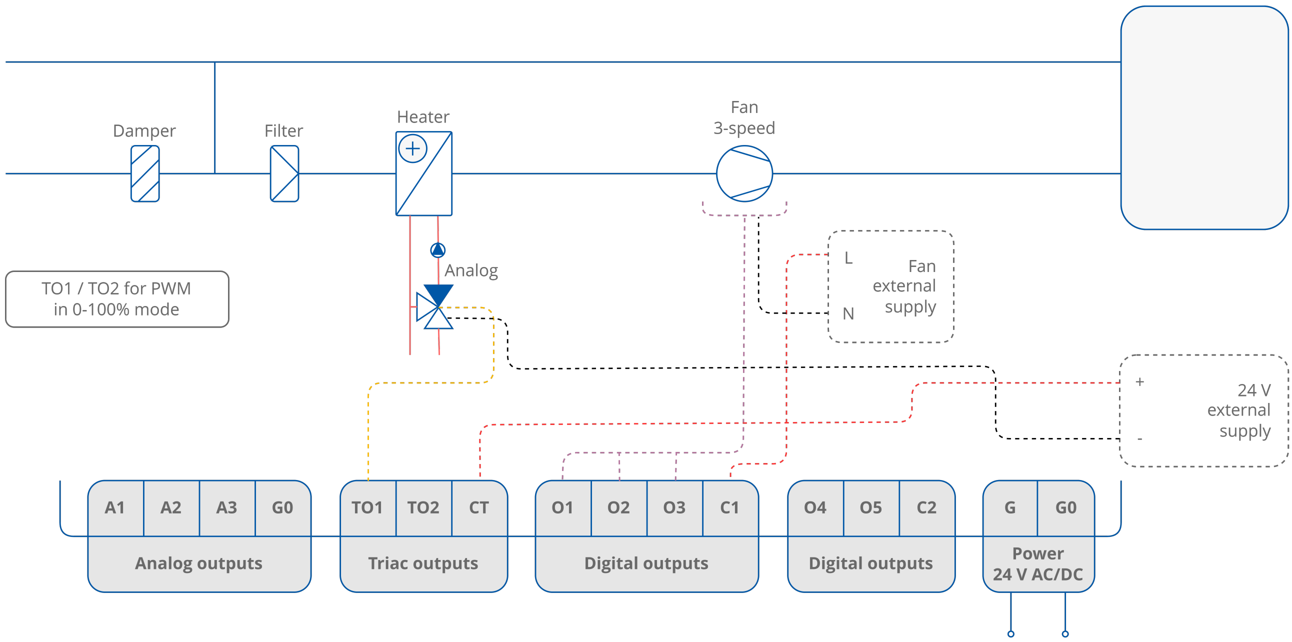


Figure 59. 2-pipe installation with 1-stage analog controlled heating and 3-speed fan - valve in PWM mode

8 Network Variables

8.1 FCU BACnet AnalogValues and Modbus Registers

Name	Units	Access	BACnet ID	Modbus Address	Default Value	Description
App_status	N/A	Read-only	Device Property 5002	99	0	65535 – Initialization, 0 – OK, 1 – Malloc image, 2 – Malloc stack 3 – Malloc static data 4 – Input file not found 5 – Cannot read input file 6 – Bad image magic 7 – Bad image version 8 – Bad image block size 9 – Bad image ref size 10 – Bad image code size 11 – Unknown opcode 12 – Missing native 40 – Invalid args 41 – Cannot initialize application 42 – Cannot open file 43 – Invalid magic 44 – Invalid version 45 – Invalid schema 46 – Unexpected EOF 47 – Invalid kit ID 48 – Invalid type ID 49 – Cannot malloc 50 – Cannot insert 51 – Cannot load link 52 – Invalid application end marker 53 – No platform service 54 – Bad platform service 60 – Invalid comp end marker 61 – Name too long 100 – Null pointer 101 – Stack overflow 102 – Invalid method parameters 253 – Yield 254 – Restart 255 - Hibernate
Occupancy_Mode	N/A	Read/	0	100	0	0 – Unoccupied mode, 1 – Occupied mode,

Name	Units	Access	BACnet ID	Modbus Address	Default Value	Description
		write				2 – Standby mode
Setpoint	°C	Read/write	1	101	210	User setpoint temperature value
Setpoint_Offset	°C	Read/write	2	102	0	User setpoint offset temperature value
Fan_Mode	N/A	Read/write	3	103	0	0 - Off 1 - Speed 1 (Manual) 2 - Speed 2 (Manual) 3 - Speed 3 (Manual) 4 – Auto
FCU_Mode	N/A	Read/write	4	104	1	0 – OFF 1 – Auto 2 – Heating only 3 – Cooling only 4 – Fan only
Setpoint_Offset_Range	°C	Read/write	5	105	30	Setpoint offset ± range
Net_Temperature	°C	Read/write	6	106	210	Temperature network variable, CV source
Heating_Cooling_Switch_Diff	°C	Read/write	10	110	10	Differential value switching between cooling/heating mode
Unoccupied_Offset	°C	Read/write	11	111	50	Offset value in for Unoccupied mode
Standby_Offset	°C	Read/write	12	112	20	Offset value in for Standby mode

Name	Units	Access	BACnet ID	Modbus Address	Default Value	Description
Occupancy_Time_Remote_Trigger	min	Read/write	13	113	60	Forced Occupied mode time value for occupancy button I1 and room panel
Occupancy_Time_Presence_Sensor	min	Read/write	14	114	10	Forced Occupied mode time value for occupancy presence sensor I2
PWM_Heating_Period	s	Read/write	15	115	300	PWM time period for heating valve actuator
PWM_Cooling_Period	s	Read/write	16	116	300	PWM time period for cooling valve actuator
Fan_Scale	°C	Read/write	17	117	30	Fan Scale parameter for fan control algorithm
Fan_Off_Threshold	%	Read/write	18	118	5	Fan Off Threshold value
Fan_Speed_1_Threshold	%	Read/write	19	119	30	Fan Speed 1 Threshold value
Fan_Speed_2_Threshold	%	Read/write	20	120	60	Fan Speed 2 Threshold value
Fan_Speed_3_Threshold	%	Read/write	21	121	90	Fan Speed 3 Threshold value
Fan_Off_Delay	s	Read/write	22	122	5	Fan switch off delay time value
Fan_Soft_Start_Time	s	Read/	23	123	20	Time value for Fan Soft Start function

Name	Units	Access	BACnet ID	Modbus Address	Default Value	Description
		write				
Kp	N/A	Read/write	24	124	100	PI regulator parameter Proportional gain
Ti	min	Read/write	25	125	10	PI regulator parameter Integral time
Heating_Binary_Diff	°C	Read/write	26	126	4	1st stage heating thermostat differential value
Cooling_Binary_Diff	°C	Read/write	27	127	4	1st stage cooling thermostat differential value
Second_Stage_Threshold_Binary	°C	Read/write	28	128	2	2nd stage shifting parameter in digital control mode
Second_Stage_Diff Binary	°C	Read/write	29	129	6	2nd stage thermostat differential parameter in digital control mode
Second_Stage_Threshold_Analog	%	Read/write	30	130	80	2nd stage shifting parameter in analog control mode
Second_Stage_Diff_Analog	%	Read/write	31	131	5	2nd stage thermostat differential parameter in analog control mode
Supply_Temperature_Low_Limit	°C	Read/write	32	132	100	Supply air temperature limit values used in Supply air temperature limitation function
Supply_Temperature_High_Limit	°C	Read/write	33	133	400	

Name	Units	Access	BACnet ID	Modbus Address	Default Value	Description
Supply_Limits_Time	s	Read/write	34	134	30	Time value used in supply air temperature limitation function
Window_Status_Delay	s	Read/write	35	135	60	Time value for open window function
Return_To_Space_Time	s	Read/write	36	136	30	Time value for return temperature sensor control function
FCU_Test_Mode	N/A	Read/write	37	137	0	0 - Auto operation 1 - Heating test 2 - Cooling test
Fan_Soft_Start_Value	%	Read/write	38	138	75	Analog control fan starting value in range from 0% - 100%
Valves_Dead_Band	°C	Read/write	39	139	0	Valves temperature dead band parameter
Return_Temperature_Offset	°C	Read/write	40	140	0	Return temperature sensor correction parameter
Supply_Temperature_Offset	°C	Read/write	41	141	0	Supply temperature sensor correction parameter
Space_Temperature_Offset	°C	Read/write	42	142	0	Space temperature sensor correction parameter
S1_Sensor_Type	N/A	Read/write	43	143	1	0 – Voltage measurement 1 - sensor type 10K3A1 NTC 2 – sensor type 10K4A1 NTC 3 – sensor type 10K NTC 4 – sensor type 20K6A1 NTC 5 – sensor type 2,2K3A1 NTC

Name	Units	Access	BACnet ID	Modbus Address	Default Value	Description
						6 – sensor type 3K3A1 NTC 7 – sensor type 30K6A1 NTC 8 – sensor type SIE1 NTC 9 – sensor type TAC1 NTC 10 – sensor type SAT1 NTC
S2_Sensor_Type	N/A	Read/write	44	144	1	
S3_Sensor_Type	N/A	Read/write	45	145	1	
Heating_Valve_Manual_Value	%	Read/write	46	146	0	Heating valve manual value, to active manual override please active Heating_Valve_Manual_Enable
Cooling_Valve_Manual_Value	%	Read/write	47	147	0	Cooling valve manual value, to active manual override please active Cooling_Valve_Manual_Enable
Fan_Valve_Manual_Value	%	Read/write	48	148	0	Fan valve manual value, to active manual override please active Fan_Valve_Manual_Enable
LCD_Panel_Temperature_Offset	°C	Read/write	50	150	0	Room panel temperature sensor correction parameter
LCD_Setpoint_Step	°C	Read/write	51	151	50	Room panel setpoint step
LCD_Setpoint_Low_Limit	°C	Read/write	52	152	180	Room panel setpoint low limit
LCD Setpoint High Limit	°C	Read/write	53	153	240	Room panel setpoint high limit

Name	Units	Access	BACnet ID	Modbus Address	Default Value	Description
Remote_Slave1_Device_ID	N/A	Read/write	54	154	0	BACnet slave device ID number Note: In Modbus protocol this is 32nd bits register
Remote_Slave2_Device_ID	N/A	Read/write	56	156	0	
Remote_Slave3_Device_ID	N/A	Read/write	58	158	0	
Remote_Slave4_Device_ID	N/A	Read/write	60	160	0	
Remote_Slave5_Device_ID	N/A	Read/write	62	162	0	
Slaves_Ping_Frequency	min	Read/write	64	164	15	Salves ping frequency value
Effective Setpoint	°C	Read-only	100	200	N/A	Effective setpoint Value
Occupancy Status	N/A	Read-only	101	201	0	0 – Unoccupied mode, 1 – Occupied mode, 2 – Standby mode 3 – Forced Occupied mode.
Fan Status	N/A	Read-only	102	202	0	0 - Off 1 - Speed 1 (manual) 2 - Speed 2 (manual) 3 - Speed 3 (manual) 4 - Speed 1 (auto) 5 - Speed 2 (auto) 6 - Speed 3 (auto)
Fan Type	N/A	Read-	103	203	0	Fan type: 0 - Analog, 1 – Speed 1,

Name	Units	Access	BACnet ID	Modbus Address	Default Value	Description
		only				2 – Speed 2, 3 – Speed 3.
Cv	°C	Read-only	104	204	N/A	Temperature control value
Dip_Switch_Configuration	N/A	Read-only	105	205	N/A	Current CFG DIP switch bits status
App_version	N/A	Read-only	106	206	2.0	Application version parameter
Heating_Valve	%	Read-only	110	210	N/A	Heating analog output or triac PWM value
Coolling_Valve	%	Read-only	111	211	N/A	Cooling analog output or triac PWM value
Fan Value	%	Read-only	112	212	N/A	Analog type: range 0-100% Binary type: 0 - stop, 1 – Speed 1, 2 – Speed 2, 3 – Speed 3.
S1_Return_Temperature	°C	Read-only	113	213	N/A	Special input, S1 Temperature Value
S2_Supply_Temperature	°C	Read-only	114	214	N/A	Special input, S2 Temperature Value
S3_Space_Temperature	°C	Read-only	115	215	N/A	Special input, S3 Temperature Value
LCD Panel Temperature	°C	Read-	120	220	N/A	Room panel iSMA-B-LP/Touch Point/FP Temperature value

Name	Units	Access	BACnet ID	Modbus Address	Default Value	Description
		only				
LCD Panel Humidity	%	Read-only	121	221	N/A	Room panel iSMA-B-LP/Touch Point Humidity value
LCD Panel CO2	ppm	Read-only	122	222	N/A	Room panel iSMA-B-LP/Touch Point CO_2 value
VALID_FRAMES_FOR_US_CNT	N/A	Read-only	Property 5101	N/A	N/A	The property contains the number of valid frames on the BACnet MS/TP layer addressed to the controller.
ERROR_FRAMES_CNT	N/A	Read-only	Property 5103	N/A	N/A	The property contains the number of invalid frames on the BACnet MS/TP layer.
TRANSMITTED_FRAMES_CNT	N/A	Read-only	Property 5104	N/A	N/A	The property contains the number of transmitted frames on the BACnet MS/TP layer.

Table 12. FCU BACnet AnalogValues and Modbus registers

8.2 FCU BACnet BinaryValues and Modbus Coils

Name	Access	BACnet ID	Modbus Address	Default Value	Description
Offset In Occupied Only	Read/write	0	200	False	Enable/Disable setpoint offset parameter calculation in unoccupied and standby mode
Fan Heating Occupied Active	Read/write	1	201	True	Enable/Disable fun running at low speed after no fan demand in heating occupied mode
Fan Cooling Occupied Active	Read/write	2	202	False	Enable/Disable fun running at low speed after no fan demand in cooling occupied mode

Name	Access	BACnet ID	Modbus Address	Default Value	Description
Return_To_Space_Enable	Read/write	3	203	False	
HTG Relay Enable	Read/write	4	204	True	True – enable, false – disable O4 relay working
CLG Relay Enable	Read/write	5	205	True	True – enable, false – disable O5 relay working
I1_Remote_Occ_Trigger_Invert	Read/write	6	206	False	False – normal, true – invert
I2_Presence_Sensor_Invert	Read/write	7	207	False	
I3_Window_Contact_Invert	Read/write	8	208	True	
Local_Remote_Auto_Binding	Read/write	9	209	False	False – slave ID from auto binding True – slave ID from network variable
Heating_Valve_Manual_Enable	Read/write	10	210	False	False – auto, true – manual
Cooling_Valve_Manual_Enable	Read/write	11	211	False	
HTG_Relay_Manual_Enable	Read/write	12	212	False	
CLG_Relay_Manual_Enable	Read/write	13	213	False	
Fan_Output_Manual_Enable	Read/write	14	214	False	
LCD Submenu Icons Hidden	Read/write	15	215	True	Show/Hide LCD panel submenu icons

Name	Access	BACnet ID	Modbus Address	Default Value	Description
LCD Temperature Active	Read/ write	16	216	True	Enable/Disable room panel current temperature display
LCD Setpoint Active	Read/ write	17	217	True	Enable/Disable room panel setpoint temperature display
LCD Setpoint Editable	Read/ write	18	218	True	Enable/Disable room panel setpoint edit
LCD Setpoint Fast Edit Mode	Read/ write	19	219	False	Enable/Disable display fast setpoint edit in room panel display
LCD Fan Visable	Read/ write	20	220	True	Enable/Disable display fan icon on room panel display
LCD Fan Editable	Read/ write	21	221	True	Enable/Disable fan parameters edit on room panel display
LCD Fan Fast Edit Mode	Read/ write	22	222	False	Enable/Disable display fast fan speed edit in room panel display
LCD Occupancy Visable	Read/ write	23	223	True	Enable/Disable fan parameters edit on room panel display
LCD Occupancy Editable	Read/ write	24	224	True	Enable/Disable Occupancy mode change on room panel display
LCD Occupancy Fast Edit Mode	Read/ write	25	225	False	Enable/Disable run LCD Occupancy Fast Edit Mode on room panel display
LCD Humidity Active	Read/ write	26	226	True	Enable/Disable room panel humidity value display
LCD CO2 Active	Read/ write	27	227	True	Enable/Disable room panel CO_2 value display
HTG_Relay_Manual_State	Read/ write	28	228	False	HTG Relay state in manual override

Name	Access	BACnet ID	Modbus Address	Default Value	Description
CLG_Relay_Manual_State	Read/write	29	229	False	CLG Relay state in manual override
Occupied Forced	Read-only	64	,264	N/A	Forced Occupied mode status
Heating_Second_Stage	Read-only	80	280	N/A	Heating in second stage current status
Cooling_Second_Stage	Read-only	81	281	N/A	Heating in second stage current status
I1_Remote_Occuapancy_Trigger	Read-only	82	282	N/A	Digital input current status
I2_Presence_Sensor_Card_Holder	Read-only	83	283	N/A	
I3_Window_Conntact	Read-only	84	284	N/A	
I4_Occupancy_LED	Read-only	85	285	N/A	
Slave1_Active	Read-only	96	296	N/A	Slave device connection status
Slave2_Active	Read-only	97	297	N/A	
Slave3_Active	Read-only	98	298	N/A	
Slave4_Active	Read-only	99	299	N/A	
Slave5_Active	Read-only	100	300	N/A	

Name	Access	BACnet ID	Modbus Address	Default Value	Description
Slave1_Window_Status	Read-only	101	301	N/A	Window status I3 input read from slave device
Slave2_Window_Status	Read-only	102	302	N/A	
Slave3_Window_Status	Read-only	103	303	N/A	
Slave4_Window_Status	Read-only	104	304	N/A	
Slave5_Window_Status	Read-only	105	305	N/A	

Table 13. FCU BACnet BinaryValues and Modbus coils

9 Disclaimer

9.1 Applied to: Universal FCU Application

Universal FCU Application is an example application allowing one to familiarize with the capabilities of the controller manufactured by iSMA CONTROLLI S.p.A.:

- RAC18-IP - freely programmable Room Application Controller with a built-in nano EDGE ENGINE, 1x RS485, 2x ETH (fail-safe protected), 1x USB, 4x UI, 4x DI, 5x DO, 3x AO, 2x TO. Power supply 24 V AC/DC.

iSMA CONTROLLI S.p.A. disclaims any responsibility for damages or operational issues arising from the use of the Universal FCU Application with RAC18-IP.

The Universal FCU Application is provided without any guarantees or warranties of any kind. Users are advised to thoroughly test the application in their specific systems and environments before full deployment. iSMA CONTROLLI S.p.A. will not be liable for any direct, indirect, incidental, or consequential damages resulting from the application's use together with the expenses for repairs, replacements, project handover delay penalties, and any other costs that might arise.

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