iSMA-B-FCU

User Manual

FCU application

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1 Introduction

This document contains information about iSMA-B-FCU device default application.

1.1 Document change log

This is first version of this document.

1.2 Safety rules

- Note: incorrect wiring of this product can damage it and lead to other hazards. Make sure the product has been correctly wired before turning the power ON.
- Before wiring, or removing/mounting the product, be sure to turn the power OFF. Failure to do so might cause electric shock.
- Do not touch electrically charged parts such as the power terminals. Doing so might cause electric shock.
- Do not disassemble the product. Doing so might cause electric shock or faulty operation.
- Use the product within the operating ranges recommended in the specification (temperature, humidity, voltage, shock, mounting direction, atmosphere etc.). Failure to do so might cause fire or faulty operation
- Firmly tighten the wires to the terminal. Insufficient tightening of the wires to the terminal might cause fire.

2 FCU inputs and outputs

This chapter describes using of all inputs and outputs by default application loaded to iSMA-B-FCU device.

2.1 Special Inputs

iSMA-B-FCU device has four Special Inputs. In default application, to each input has to be connected dedicated temperature sensors and/or potentiometer. The way of connection all Special Inputs is shown in figure below.

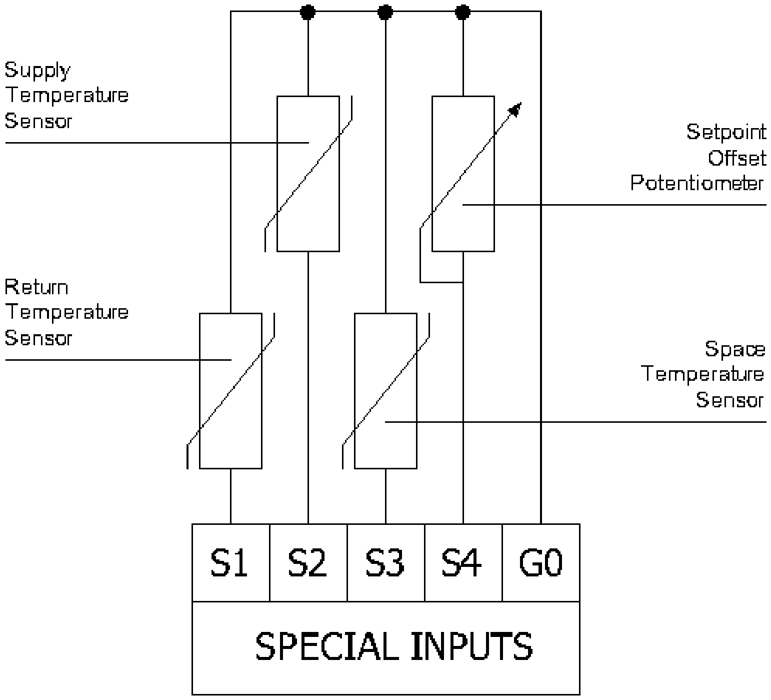


Figure 1 Special Inputs terminal connection

Name	Units	Access	BACnet BV ID	BACnet AV ID	Modbus Coil	Modbus Register	Default Value
S1_Return_Temperature	°C	RO	-	213	-	200	-
S2_Supply_Temperature	°C	RO	-	214	-	201	-
S3_Space_Temperature	°C	RO	-	215	-	202	-
S1_Sensor_Type	N/A	RW	-	43	-	143	1
S2_Sensor_Type	N/A	RW	-	44	-	144	1
S3_Sensor_Type	N/A	RW	-	45	-	145	1

Table 1 Special Inputs network variables

2.2 Digital Inputs

iSMA-B-FCU device has four Digital Inputs. The way of connection all signals to them is shown figure below. Digital Inputs from 1 to 3 can be inverted, based on sensors type which is connected to the device.

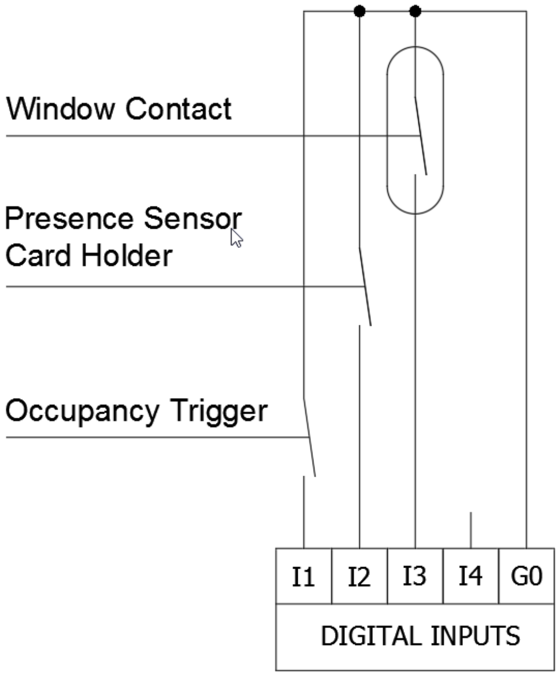


Figure 2 Digital Inputs terminal connection

Name	Units	Access	BACnet BV ID	BACnet AV ID	Modbus Coil	Modbus Register	Default Value
I1_Remote_Occuapancy_Trigger	-	RO	5	-	1205	-	-
I2_Presence_Sensor_Card_Holder	-	RO	6	-	1206	-	-
I3_Window_Conntact	-	RO	7	-	1207	-	-
I1_Remote_Occuapancy_Trigger_Invert	-	RW	67	-	1267	-	Off
I2_Presence_Sensor_Card_Holder_Invert	-	RW	68	-	1268	-	Off
I3_Window_Conntact_Invert	-	RW	69	-	1269	-	Off

Table 2 Digital Inputs network variables

2.3 Triac Outputs

iSMA-B-FCU device has two Triac Outputs to connect heating and cooling valves actuators. Both can work as typical binary outputs (for Binary Temperature Control) or using PWM modulation. In PWM modulation mode output is working in period using two states (low state 0 V and high state 24 V AC or 230 V AC depends on hardware version). The periods time are defined by PWM_Heating_Period network variable for TO1 output and PWM_Cooling_Period network variable for TO2 output. The control signal defines in percentage output high state in working period. Depends on hardware version, the Triac Outputs can work with 230 V AC thermal valve actuators (iSMA-B-FCU-HH) or with 24 V AC thermal valve actuators (iSMA-B-FCU-HL).

The way of connection actuators to the Triac Outputs in 4 pipe application is shown in figure below.

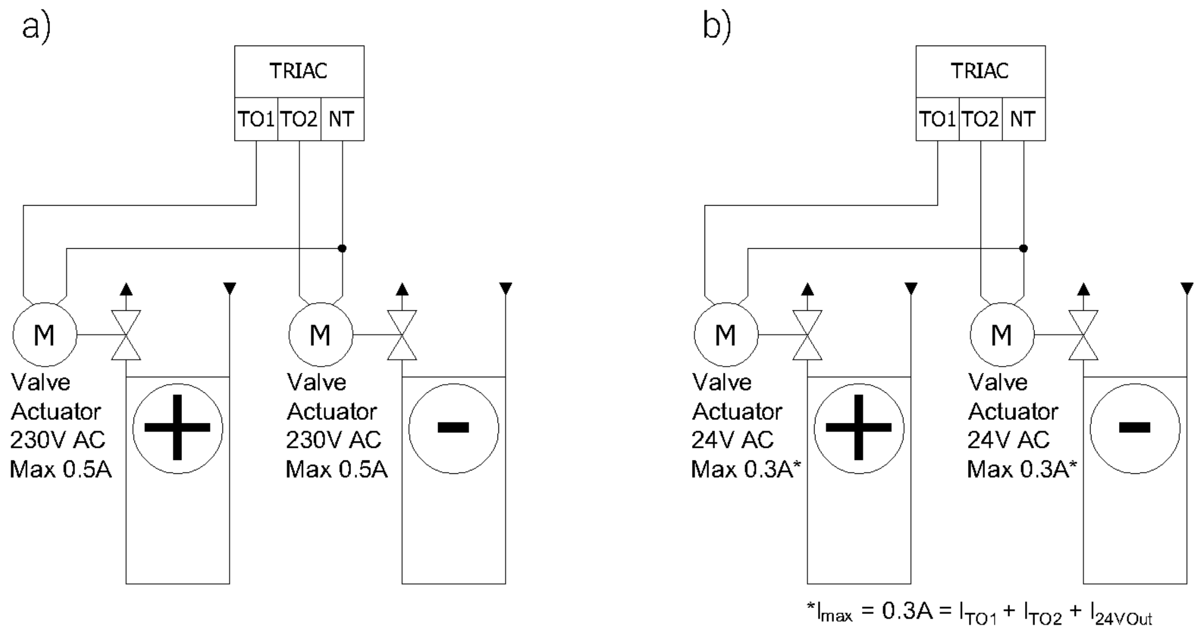


Figure 3 Thermal valves actuators to Triac Outputs connection: a) iSMA-B-FCU-HH; b) iSMA-B-FCU-HL

Note: In case of iSMA-B_FCU-HH device, actuators connected to each Triac Output can consumed up to 0,5 A. In case of iSMA-B-FCU-HL device, sum of power consumption of both Triac Outputs and 24 V AC output cannot exceed 0,3 A (7 VA):

$I_{max} = 0{,}3A = I_{TO1} + I_{TO2} + I_{24VOut}$.

Name	Units	Access	BACnet BV ID	BACnet AV ID	Modbus Coil	Modbus Register	Default Value
Heating_Valve	%	RO	-	110	-	210	N/A
Coolling_Valve	%	RO	-	111	-	211	N/A
PWM_Heating_Period	s	RW	-	15	-	115	300
PWM_Cooling_Period	s	RW	-	16	-	116	300

Table 3 Triac Output network variables

2.4 Digital Outputs

2.4.1 Fan Outputs

iSMA-B-FCU device has three relay outputs, which are dedicated to connect Fan. The way of Fan connection (depends on number of speeds) is shown in figure below. These outputs have internal connection to power supply terminal and are protected by built-in 6 A fuse. Total load for Digital Outputs O1-O3, O5, and Triac (in iSMA-B-FCU-HH) cannot extend 6 A.

WARNING! Please notice that relays have inductive load limitation up to 75 VA.

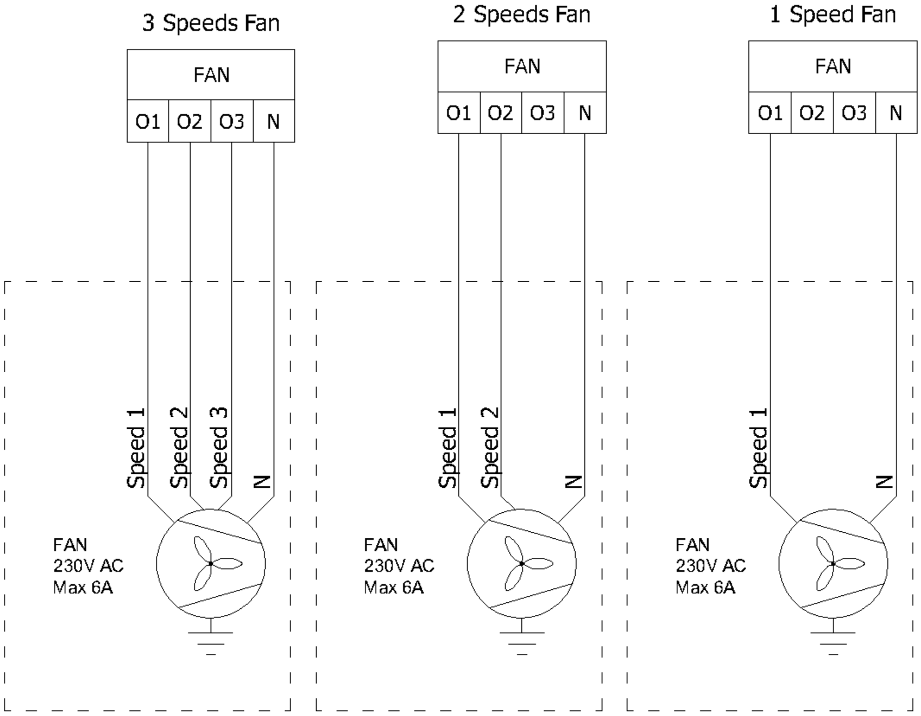


Figure 4 Fan connections

Name	Units	Access	BACnet BV ID	BACnet AV ID	Modbus Coil	Modbus Register	Default Value
Fan Value	%	RO	-	112	-	212	N/A
Fan Type	N/A	RO	-	103	-	203	0

2.4.2 Electrical Heater (HTG)

iSMA-B-FCU device has relay output, which is dedicated to connect Electrical Heater. This output can be used as 1st or 2nd heating stage, depends on CFG DIP switch configuration. This output is not internal connected to the power supply, so it is necessary to use external supply. Relay current cannot exceed 10 A for resistance load at 230 V AC power supply. The way of connection Electric Heater to O4 HTG is shown in figure below.

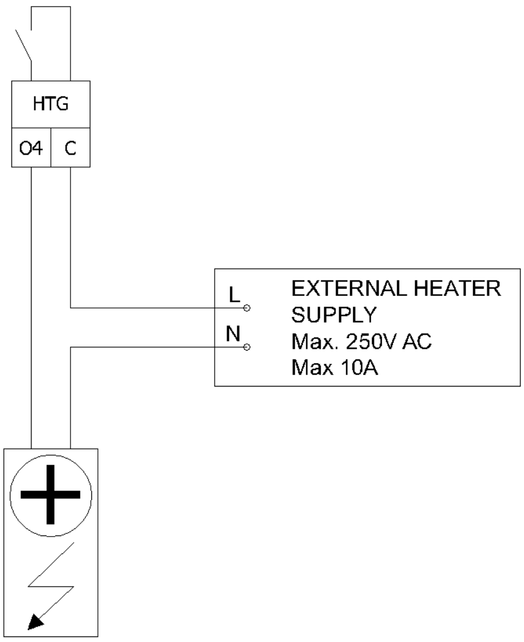


Figure 5 Electrical Heater connection

Name	Units	Access	BACnet BV ID	BACnet AV ID	Modbus Coil	Modbus Register	Default Value
Heating_Second_Stage	-	RO	65	-	1265	-	N/A
HTG Relays Enable	-	RW	3	-	1203	-	Talse

Table 4 Digital Output O4 HTG network variables

2.4.3 Electrical Cooler (CLG)

iSMA-B-FCU device has relay output, which is dedicated to connect Electrical Cooler. This output can be used as 1st or 2nd cooling stage, depends on CFG DIP switch configuration. Relay output is internal connected to power supply, so it is not necessary to connect external supply. Relay current in total with fan and Triac Outputs cannot exceed 6 A. the way of connection Electric Cooler to O4 HTG is shown in figure below.

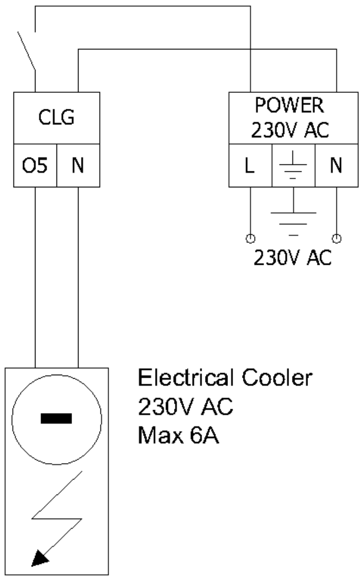


Figure 6 Electrical cooler connection

Name	Units	Access	BACnet BV ID	BACnet AV ID	Modbus Coil	Modbus Register	Default Value
Cooling_Second_Stage	-	-	RO	66	1266	-	N/A
CLG Relays Enable	-	-	RW	4	1204	-	True

Table 5 Digital Output O5 CTG network variables

2.5 Analog Outputs

iSMA-B-FCU device has 3 Analog Outputs 0-10 V DC which can be used to control the following fan coil unit devices:

- A1 (HTG) – Analog heating valve actuator control,
- A2 (CTG) – Analog cooling valve actuator control,
- A3 (FAN) – Analog fan speed control.

The way of connection all Analog Outputs is shown in figures below.

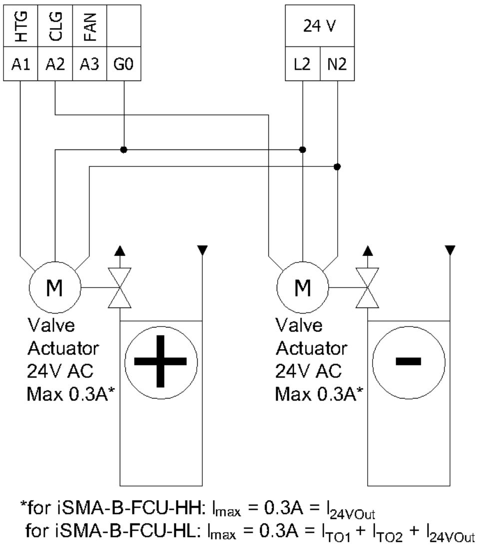


Figure 7 Analog valve actuators connection

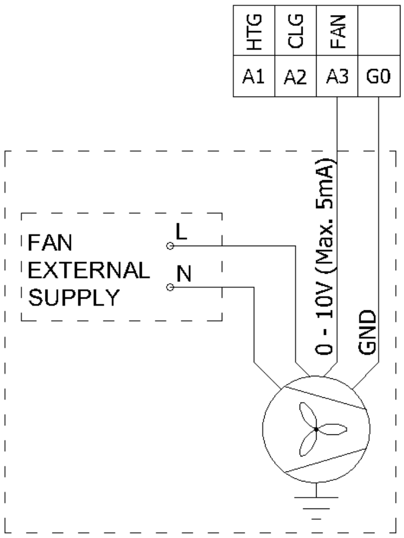


Figure 8 Analog Fan control connection

Analog Outputs status network variables are show in table below.

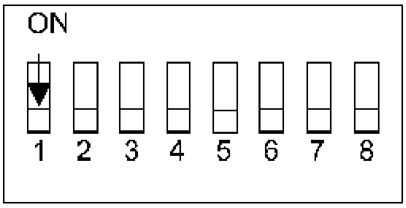
Name	Units	Access	BACnet BV ID	BACnet AV ID	Modbus Coil	Modbus Register	Default Value
Heating_Valve	%	RO	-	110	-	210	-
Cooling_Valve	%	RO	-	111	-	211	-
Fan Value	%	RO	-	112	-	212	-

Table 6 Analog Outputs status network variables

3 FCU DIP switch configuration

The default application has been designed to run with wide range of typical fan coil units. Application adjust is made by CFG DIP switch. The FCU application provides the following list of configurable modes:

- Pipe mode
- Heating 2nd stage
- Cooling 2nd stage
- Heating/cooling control mode
- CV temperature source
- Fan type



CFG

Figure 9 DIP switch CFG

The status of DIP switch configuration is shown in "Dip_Switch_Configuration" network variable.

The DIP switch function is shown in table below:

<table>
<tr><th>Nr</th><th>Name</th><th colspan="2">On</th><th>Off</th><th>Default</th></tr>
<tr><td>1</td><td>Pipe Mode</td><td colspan="2">2 Pipe</td><td>4 Pipe</td><td>4 Pipe</td></tr>
<tr><td>2</td><td>Heating 2nd Stage</td><td colspan="2">Enable</td><td>Disable</td><td>Disable</td></tr>
<tr><td>3</td><td>Cooling 2nd Stage</td><td colspan="2">Enable</td><td>Disable</td><td>Disable</td></tr>
<tr><td>4</td><td>Heating/cooling control mode</td><td colspan="2">Analog</td><td>Digital</td><td>Digital</td></tr>
<tr><td rowspan="2">5</td><td rowspan="4">CV temperature source</td><td>5-Off</td><td>6-Off</td><td>LCD Panel</td><td rowspan="4">LCD Panel</td></tr>
<tr><td>5-Off</td><td>6-On</td><td>Room Sensor SI3</td></tr>
<tr><td rowspan="2">6</td><td>5-On</td><td>6-Off</td><td>Air Return Temp SI1</td></tr>
<tr><td>5-On</td><td>6-On</td><td>Slave</td></tr>
<tr><td rowspan="2">7</td><td rowspan="4">Fan type</td><td>7-Off</td><td>8-Off</td><td>Analog 0-10V</td><td rowspan="4">3 Speed</td></tr>
<tr><td>7-Off</td><td>8-On</td><td>1 Speed</td></tr>
<tr><td rowspan="2">8</td><td>7-On</td><td>8-Off</td><td>2 Speed</td></tr>
<tr><td>7-On</td><td>8-On</td><td>3 Speed</td></tr>
</table>

Table 7 CFG DIP switch particular switch configuration

3.1 Fan coil unit pipe mode system (switch number 1)

3.1.1 4 pipe system

In 4 pipe system mode switch number 1 has to be set in "OFF" position as shown in figure below. In default this mode is ON.

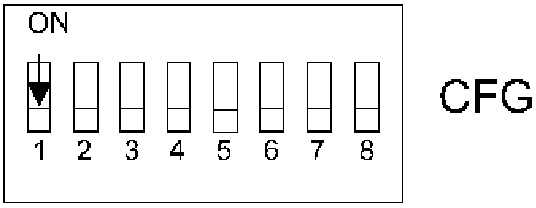


Figure 10 4-pipe system DIP switch configuration

In this configuration fan coil unit is equipped with two separate heating and cooling devices. Electrical connection for 24 V AC Heating and Cooling valves actuators controlled by analog signal (0-10 V DC) is shown in figure below.

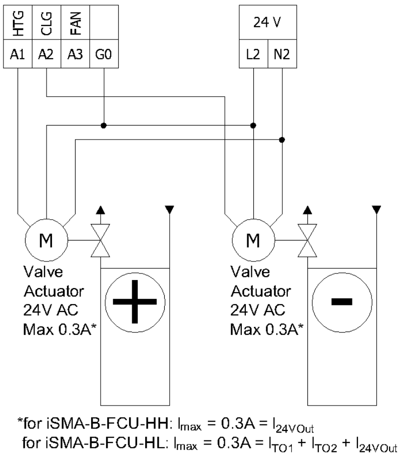


Figure 3 Heater/Cooler valve actuators connection in 4-pipe mode with Analog signals 0-10 VDC

The FCU controller can work with thermal valves actuators. For this option FCU controller has built-in 2 Triac Outputs. The Triac Outputs can work in digital (open/close) or PWM mode chosen by CFG DIP switch number 4. Depending on hardware version FCU controller can work with 230 V AC thermal valve actuators (iSMA-B-FCU-HH) or with 24 V AC thermal valve actuators (iSMA-B-FCU-HL). In both cases thermal valve actuators are supplied from FCU controller.

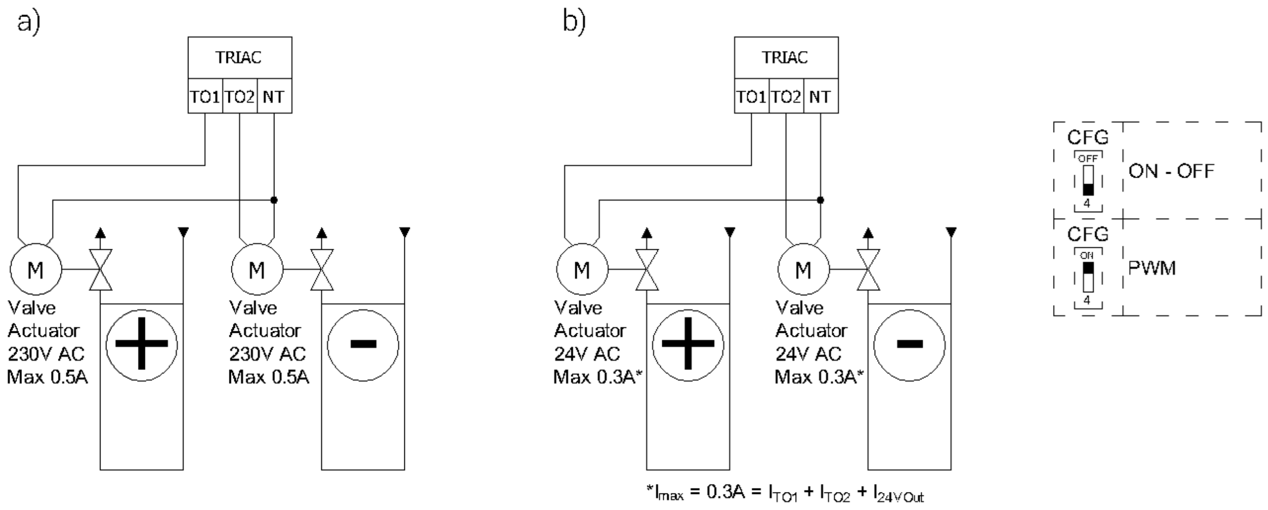


Figure 3 Heating/Cooling valve actuators connecting to Triac Outputs in 4pipe mode

3.1.2 2 pipe system

In 2 pipe system mode switch number 1 has to be set in "ON" position as shown in figure below. In default this mode is OFF.

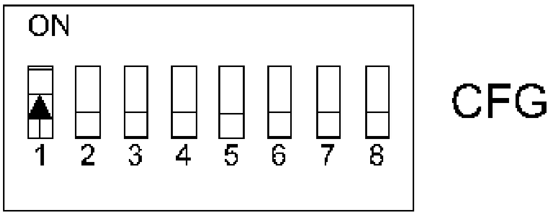


Figure 4 2pipe system DIP switch configuration

In this configuration fan coil unit is equipped with single device for heating or/and cooling. In this case valve actuator has to be connected to Analog Output (A1) or Triac Output (TO1) as shown in figure below.

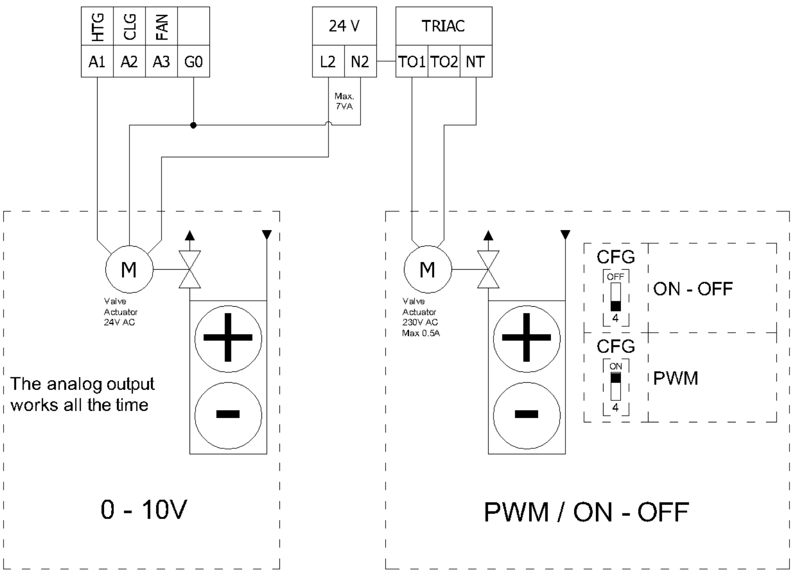


Figure 5 Heating/Cooling valve actuators connection in 2-pipe mode

3.2 Heating 1st and 2nd stage (switch number 2)

iSMA-B-FCU device can work with single heating device (1st stage only) or with two heating devices (basic – 1st stage and additional 2nd stage). The type of operating stages is chosen by CFG DIP switch number 2.

3.2.1 Heating 1st stage

For 1st stage only, depends on control mode, user can choose 1 of 3 outputs:

- A1 Analog Output (only Analog Control Mode),
- TO1 Triac Output (Digital and Analog Control Modes),
- O4 relay output (only Digital Control Mode).

The connections of heating devices is shown in figure below.

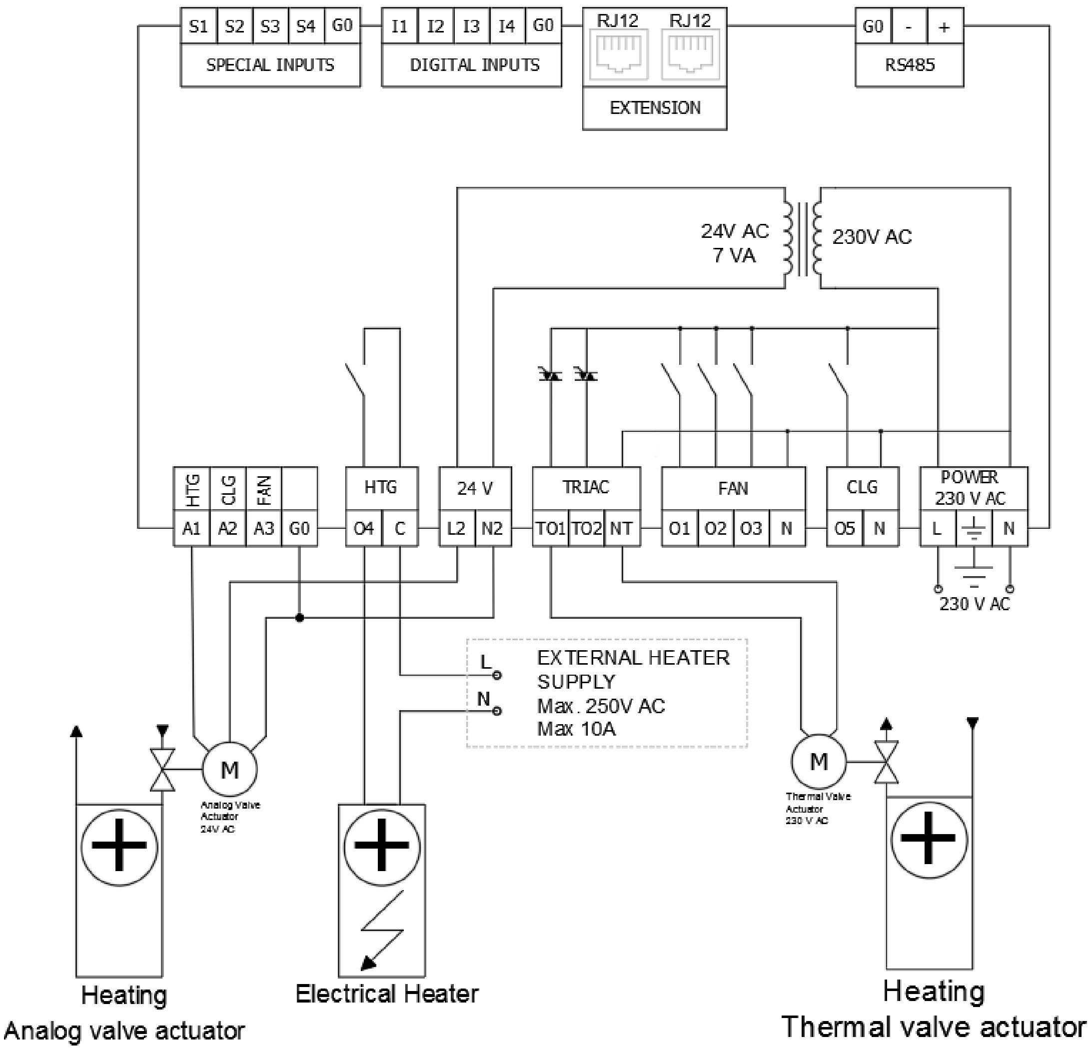


Figure 11 iSMA-B-FCU-HH heating devices connections

3.2.2 Heating 1st stage Digital Control Mode

In this mode control algorithm works as a typical thermostat, based on Effective Setpoint and Control Value with heating Diff parameter defined in “Heating_Binary_Diff” network variable. The output signal is works in 2 states low and high. In heating 1st stage only, user can choose 1 of 2 outputs: TO1 Triac Output or O4 relay output. The A1 output is disable. The thermostat output high value also enables fan working. The heating digital control mode algorithm is shown in chart below.

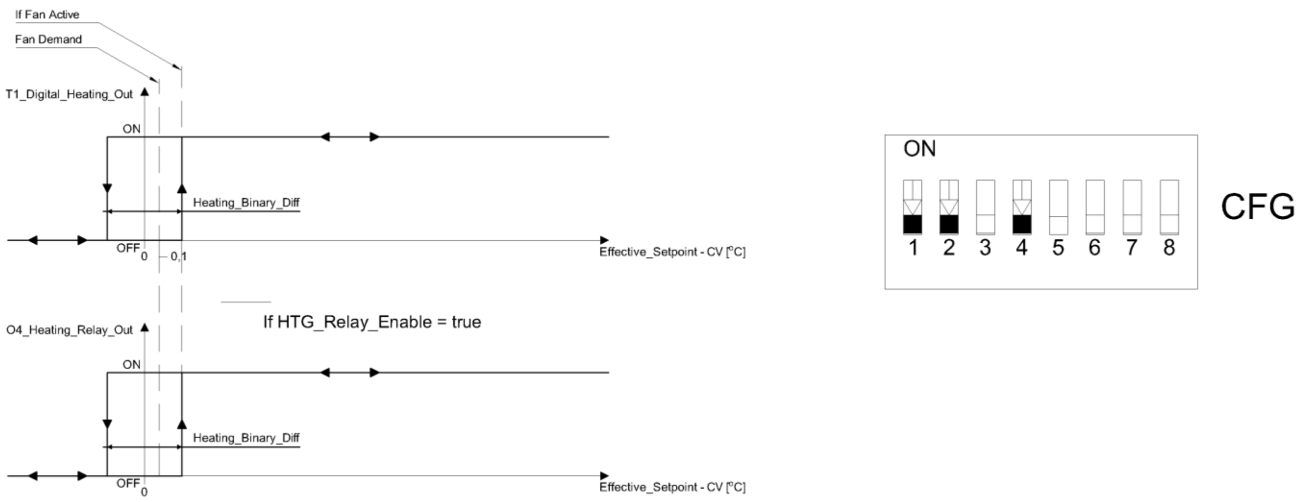


Figure 12 The heating digital control mode and CFG DIP switch configuration

Note: The O4 HTG output relay can be enable/disable by “HTG_Relays_Enable” network variable, in default this relay is enable. When output is not in use it is recommended to disable it.

3.2.3 Heating 1st stage Analog Control Mode

In this mode the algorithm is controlled by PI regulator which calculates the output value in the range from 0 to 100% based on Effective_Setpiont and CV (room temperature) values. The PI regulator can be adjusted by “Kp” and “Ti” network variables. In heating 1st stage user can choose 1 of 2 outputs: A1 Analog Output or TO1 Triac Output PWM. The O4 relay output is disable. The A1 Analog Output value and the TO1 PWM signal is proportional to PI regulator output. When PI regulator output is equal or higher than 5% it enables the fan (Fan Demand). The heating analog control mode algorithm is shown in chart below.

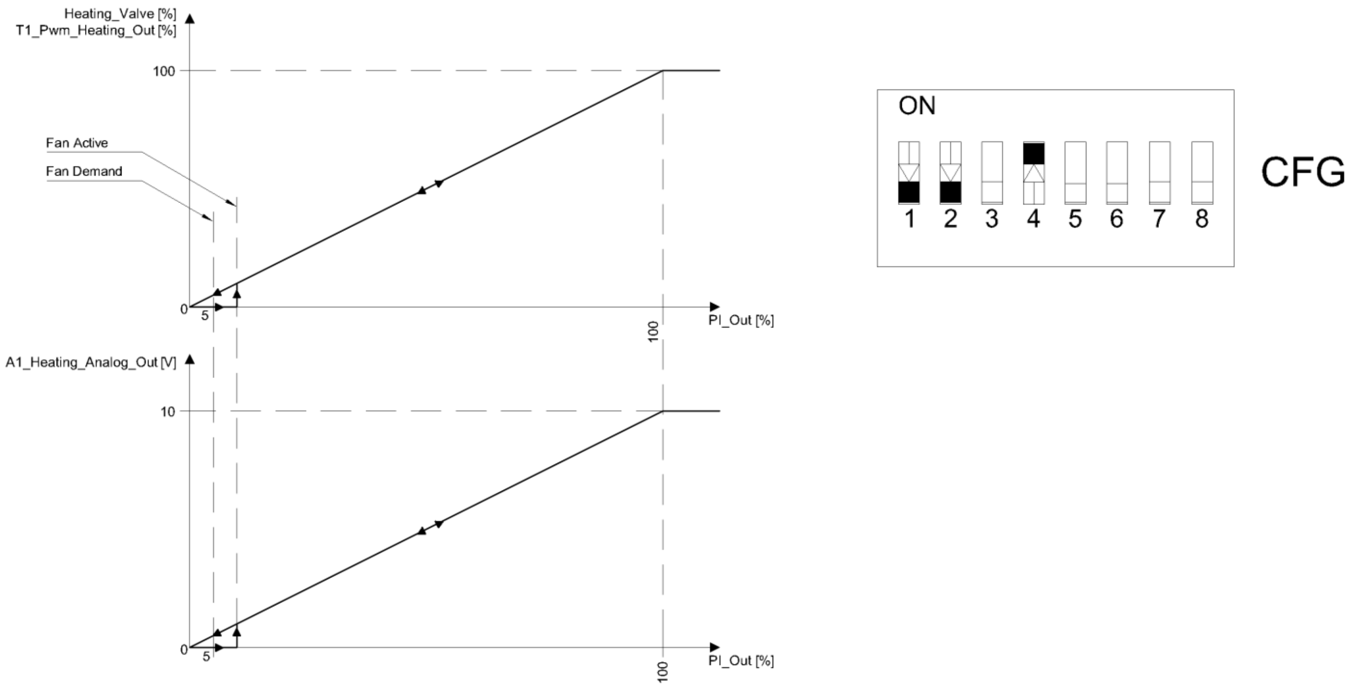


Figure 13 1st stage Analog Control Mode and CFG DIP switch configuration

3.2.4 Heating 2nd stage

As an additional heating 2nd stage the default application can operate only with O4 relay. The 2nd stage heating is enabled by setting CFG DIP (switch number 2 in On position).

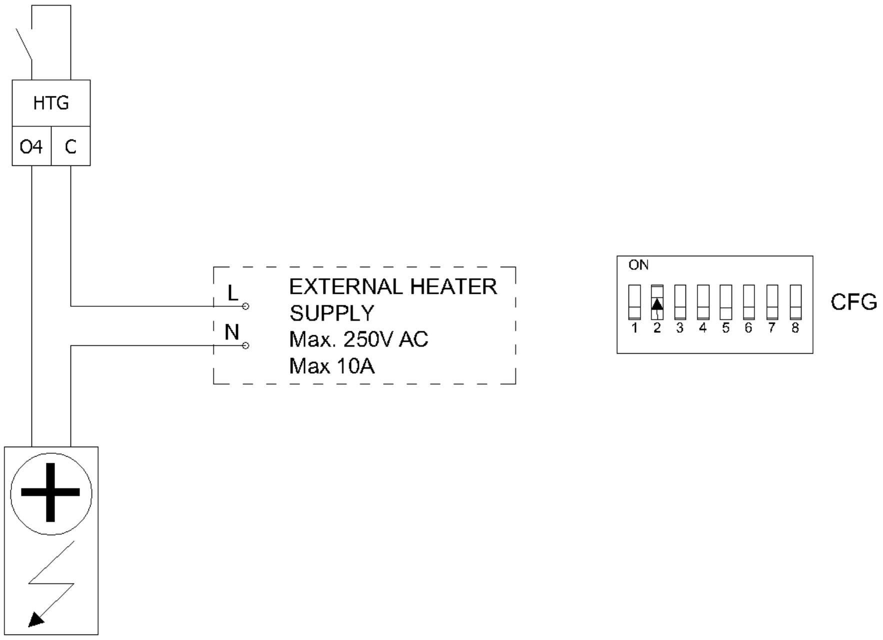


Figure 14 2nd stage Electrical heater connection and Heating 2nd stage enable CFG DIP switch configuration

3.2.5 Heating 2nd stage Digital Control Mode

In this mode control algorithm works using 2 typical thermostats. The 1st stage thermostat is based on Effective Setpoint and Control Value with heating Diff parameters defined in "Heating_Binary_Diff" network variable. The 2nd stage thermostat works with shifted Effective Setpoint and Control Value with heating Diff parameters defined in "Second_Stage_Diff_Binary" network variable. The 2nd stage setpoint shifting value is defined in "Second_Stage_Threshold_Binary" network variable. The 1st stage thermostat output high value also enables fan working. The output signals are working in 2 states low and high. In heating 1st stage, user can use TO1 Triac Output only and in 2nd stage O4 relay output only. The A1 output is disable. The 2nd stage heating Digital Control Mode algorithm is shown in chart below.

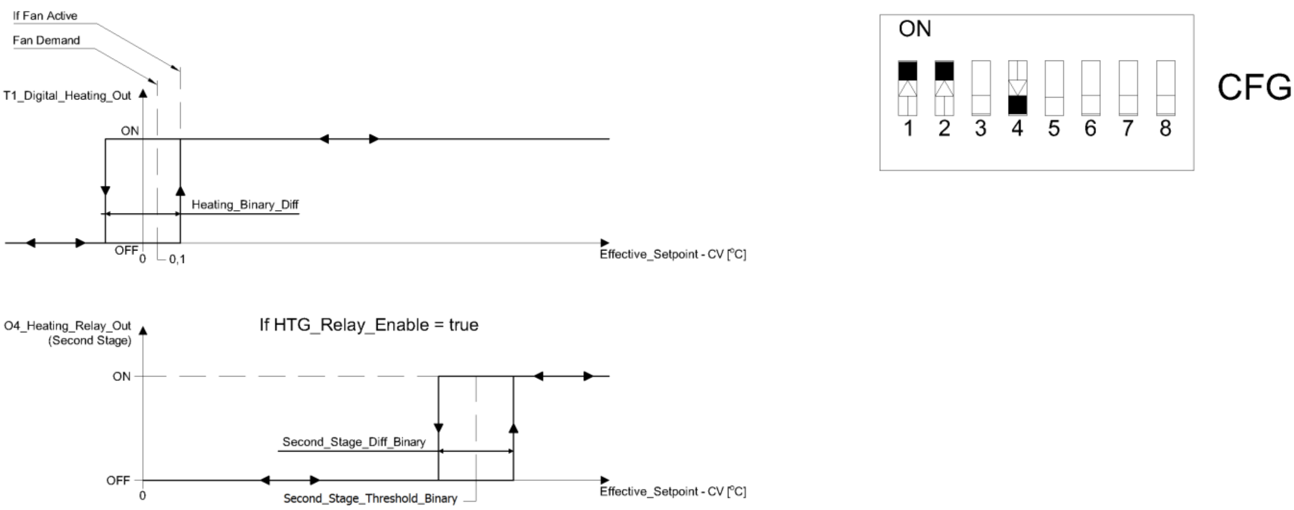


Figure 15 2nd stage heating Digital Control Mode and CFG DIP switch configuration

3.2.6 Heating 2nd stage Analog Control Mode

In this mode the algorithm is controlled by PI regulator which calculates the output value in the range from 0 to 100% based on Effective_Setpiont and CV (room temperature) values. The PI regulator can be adjusted by "Kp" and "Ti" network variables. The 1st stage analog signal is scaled to "Second_Stage_Threshold_Analog" network variable. In range from 0 to "Second_Stage_Threshold_Analog" the analog signal is proportional to PI regulator output in range from 0 to 100%. When PI regulator output is equal or higher than "Second_Stage_Treshold_Analog" the analog signal value is set to 100%. The 2nd stage is works as a thermostat, based on "Second_Stage_Treshold_Analog" as Setpoint, PI regulator output as Control Value and Diff parameters defined in "Second_Stage_Diff_Analog" network variable. In heating 1st stage, user can choose 1 of 2 outputs: A1 Analog Output or TO1 Triac Output PWM. The O4 relay output is dedicated to 2nd stage. The A1 Analog Output value and the TO1 PWM signal is proportional to PI regulator output. When PI regulator output is equal or higher than 5% the fan it enables the fan (Fan Demand). The 2nd stage heating Analog Control Mode is shown in charts bellow.

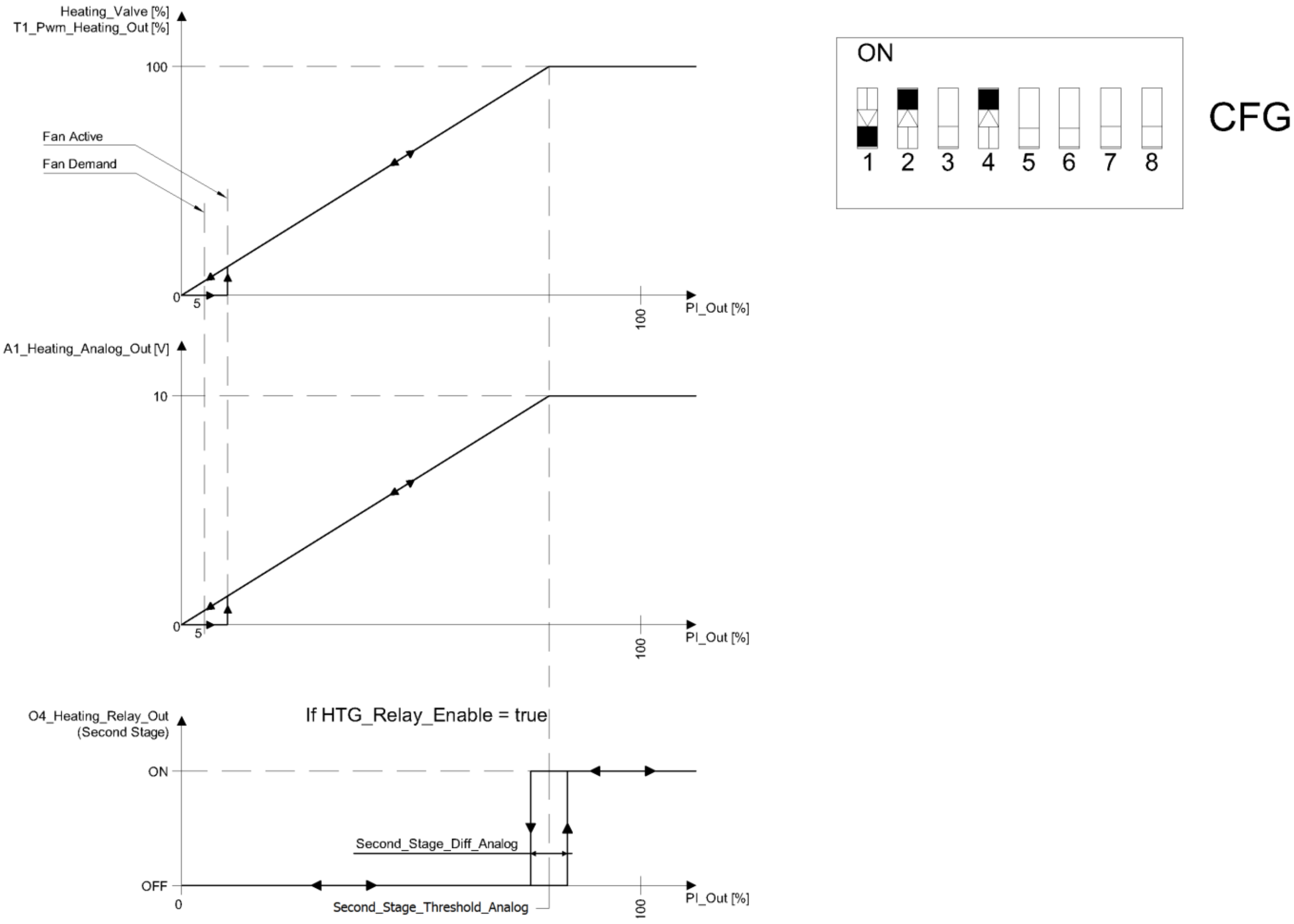


Figure 16 2nd heating stage Analog Control Mode and CFG DIP switch configuration

3.3 Cooling 1st and 2nd stage (switch number 3)

iSMA-B-FCU device can work with single cooling device (1st stage only) or with two cooling devices (basic – 1st stage and additional 2nd stage). The type of operating stages is chosen by CFG DIP switch number 3.

3.3.1 Cooling 1st stage

For 1st stage only, depends on control mode, user can choose 1 of 3 outputs:

- A2 – in 4 pipe mode Analog Output (only Analog Control Mode),
- A1 – in 2 pipe mode Analog Output (only Analog Control Mode),
- TO1 - in 4 pipe mode Triac Output (Digital and Analog Control Modes),
- TO1 - in 2 pipe mode Triac Output (Digital and Analog Control Modes),
- O5 relay output (only Digital Control Mode).

The connections of heating devices is shown in figure below.

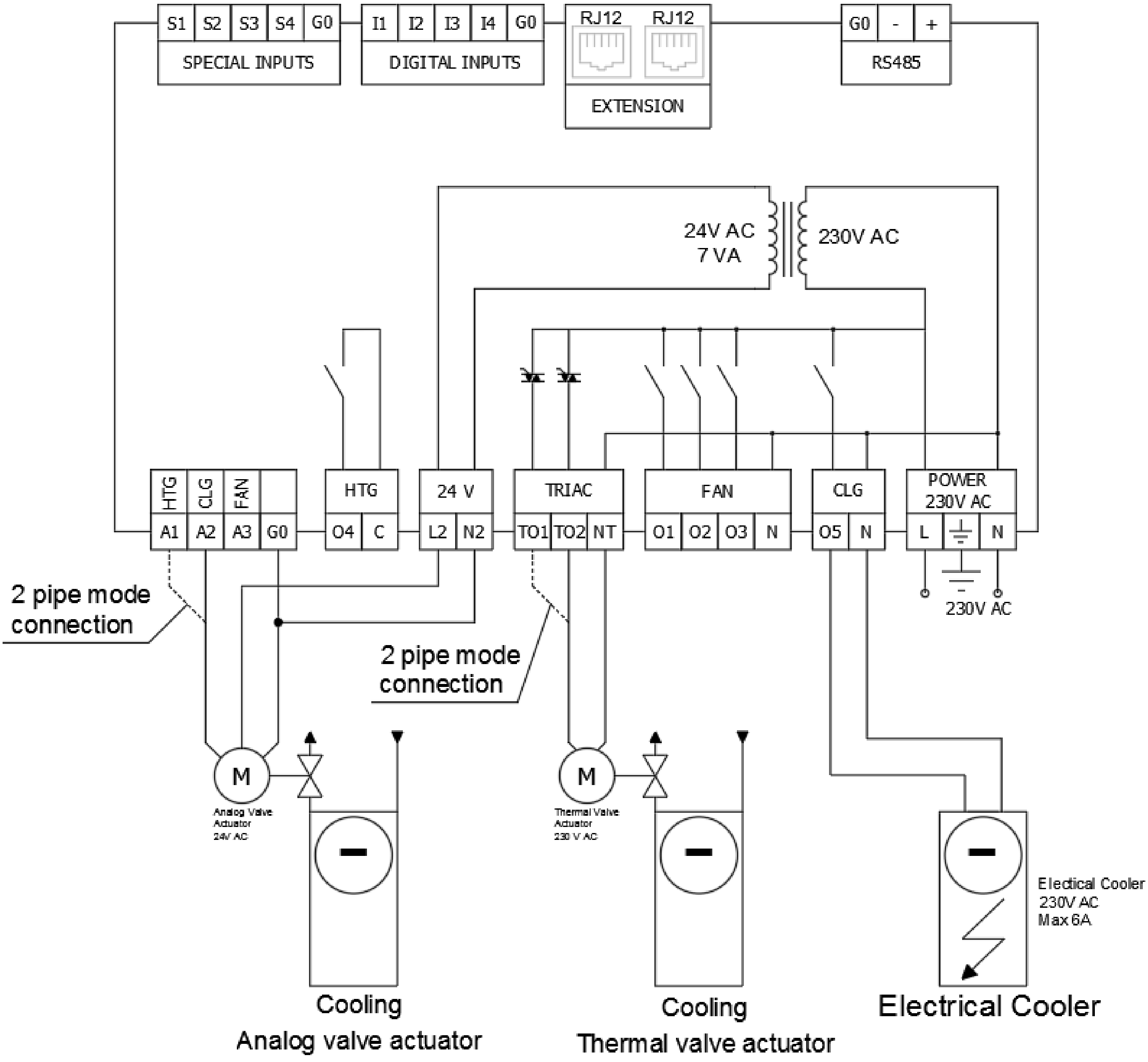


Figure 17 iSMA-B-FCU-HH cooling devices connections

Note: The O5 CLG output relay can be enabled/disabled by "CTG_Relays_Enable" network variable, in default this relay is enabled.

Note: In 2 pipe mode the cooling and heating signals are on the same outputs A1 and TO1.

3.3.2 Cooling 1st stage Digital Control Mode

In this mode control algorithm is works as a typical thermostat, based on Efective Setpoint and Control Value with heating Diff parameters defined in "Cooling_Binary_Diff" network variable. The output signal is works in 2 states low and high. In cooling 1st stage only, user can choose 1 of 2 outputs: TO2 (or TO1 in 2 pipe mode) Triac Output or O4 relay output. The A1 and A2 outputs are disabled. The thermostat output high value also enables fan working. The cooling digital control mode algorithm is shown in chart below.

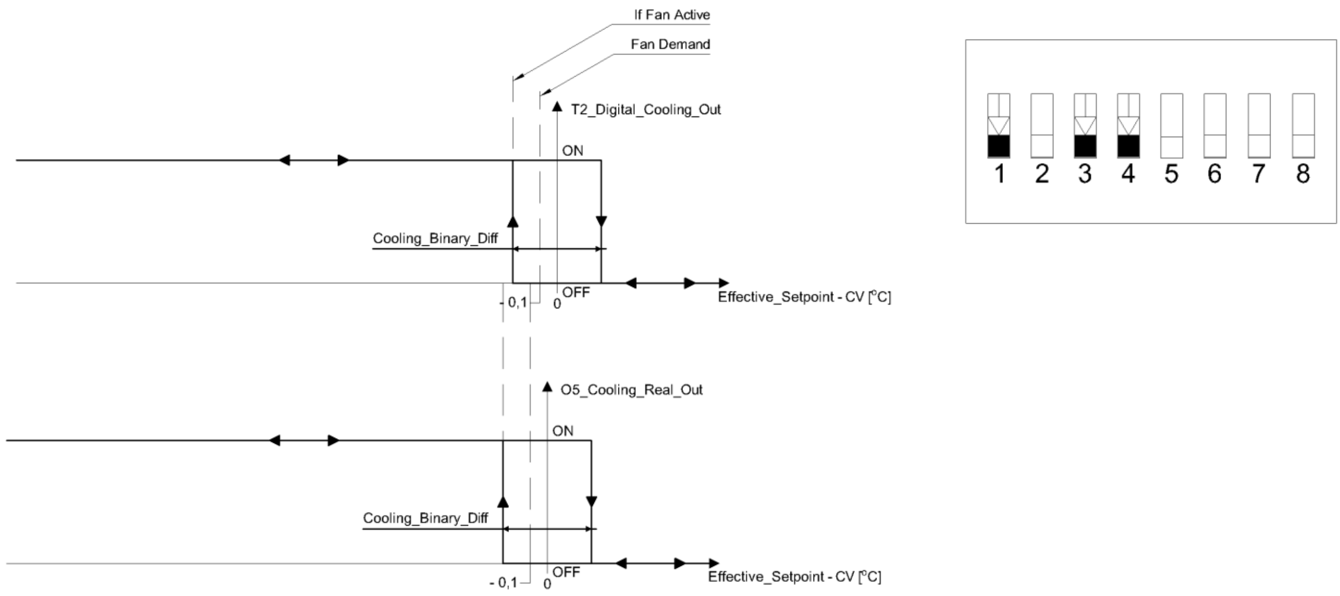


Figure 18 The cooling digital control mode and CFG DIP switch configuration

Note: In 2 pipe mode (CFG DIP switch number 1 in On position) the cooling and heating signals are on the same outputs A1 and TO1.

Note: The O5 CTG output relay can be enabled/disabled by "CTG_Relays_Enable" network variable, in default this relay is enabled. When output is not in use it is recommended to disable it.

3.3.3 Cooling 1st stage Analog Control Mode

In this mode the algorithm is controlled by PI regulator which calculates the output value in the range from -100% to 0 based on Effective_Setpiont and CV (room temperature) values. The PI regulator can be adjusted by "Kp" and "Ti" network variables. In cooling 1st stage user can choose 1 of 2 outputs: A2 (or A1 in 2 pipe mode) Analog output or TO2 (or TO1 in 2 pipe mode) Triac Output PWM. The O5 relay output is disabled. The Analog Output value and the Triac PWM signal is proportional to PI regulator output. When PI regulator output is equal or higher than 5 the fan working is enabled. The cooling Analog Control Mode algorithm is shown in charts below.

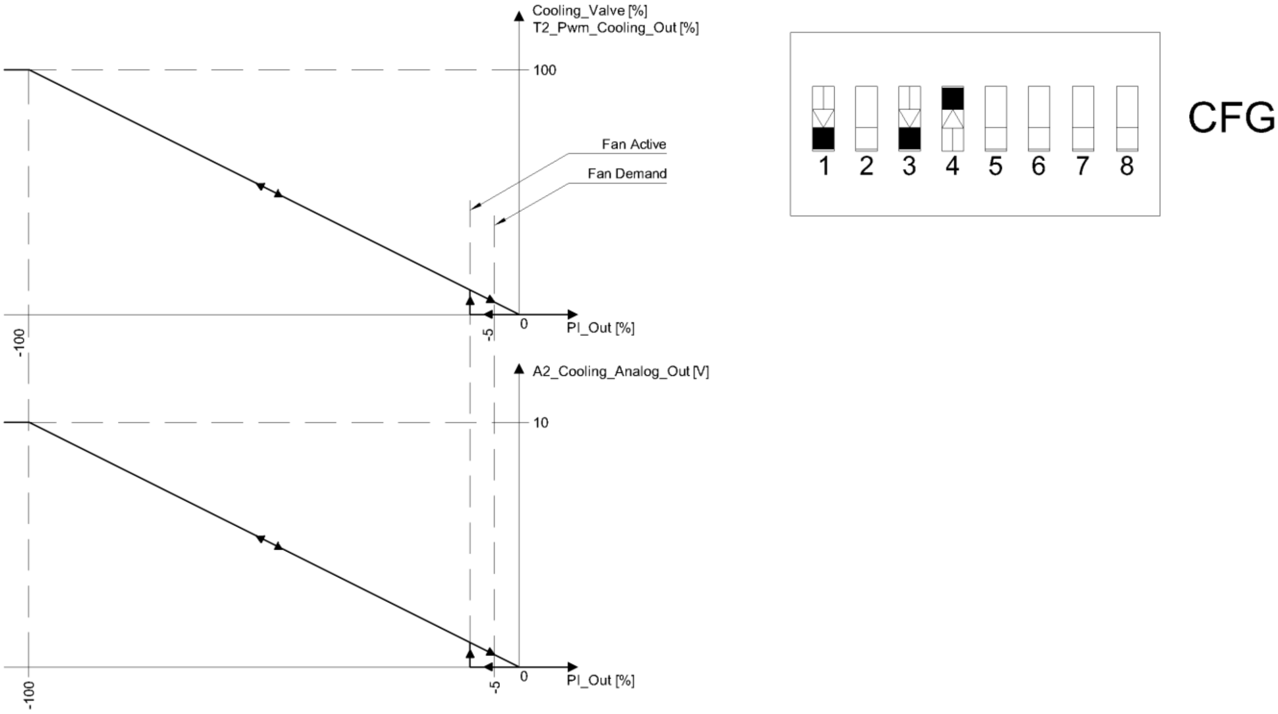


Figure 19 1st stage Analog Control Mode and CFG DIP switch configuration

3.3.4 Cooling 2nd stage

As an additional cooling 2nd stage the default application can operate only with O5 relay. The 2nd stage cooling is enabled by setting CFG DIP (switch number 3 in On position).

The connection and 2nd stage enable CFG DIP switch is shown in figure below.

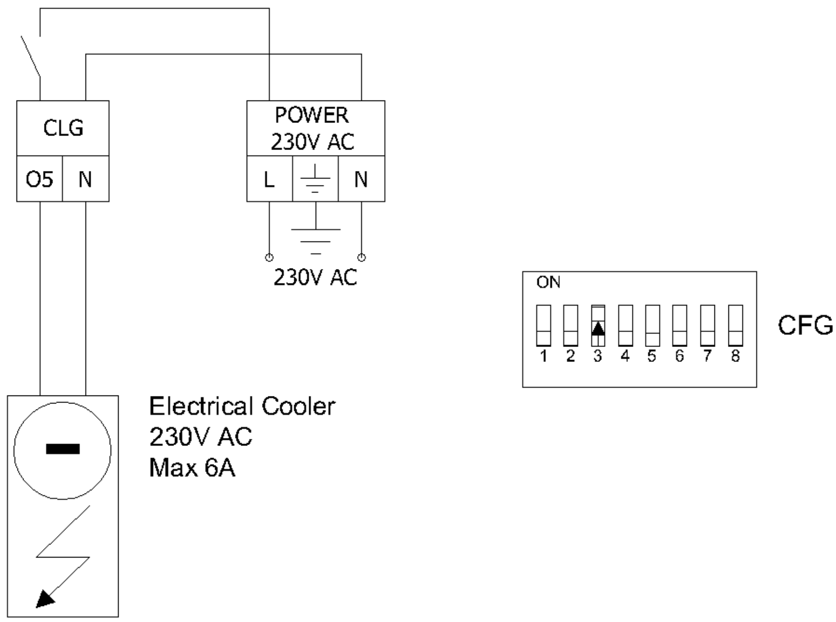


Figure 20 2nd stage Electrical Cooler connection and Cooling 2nd stage enable CFG DIP switch configuration

3.3.5 Cooling 2nd stage Digital Control Mode

In this mode control algorithm works using 2 typical thermostats. The 1st stage thermostat is based on Efective Setpoint and Control Value with cooling Diff parameter defined in "Cooling_Binary_Diff" network variable. The 2nd stage thermostat works with shifted Effective Setpoint and Control Value with cooling Diff parameters defined in "Second_Stage_Diff_Binary" network variable. The 2nd stage setpoint shifting value is defined in "Second_Stage_Threshold_Binary" network variable. The 1st stage thermostat output high value also enables fan working. The output signals work in 2 states low and high. In cooling 1st stage, user can only use TO2 Triac Output and in 2nd stage only O5 relay output. The A1 and A2 outputs are disabled. The 2nd stage cooling Digital Control Mode algorithm is shown in chart below.

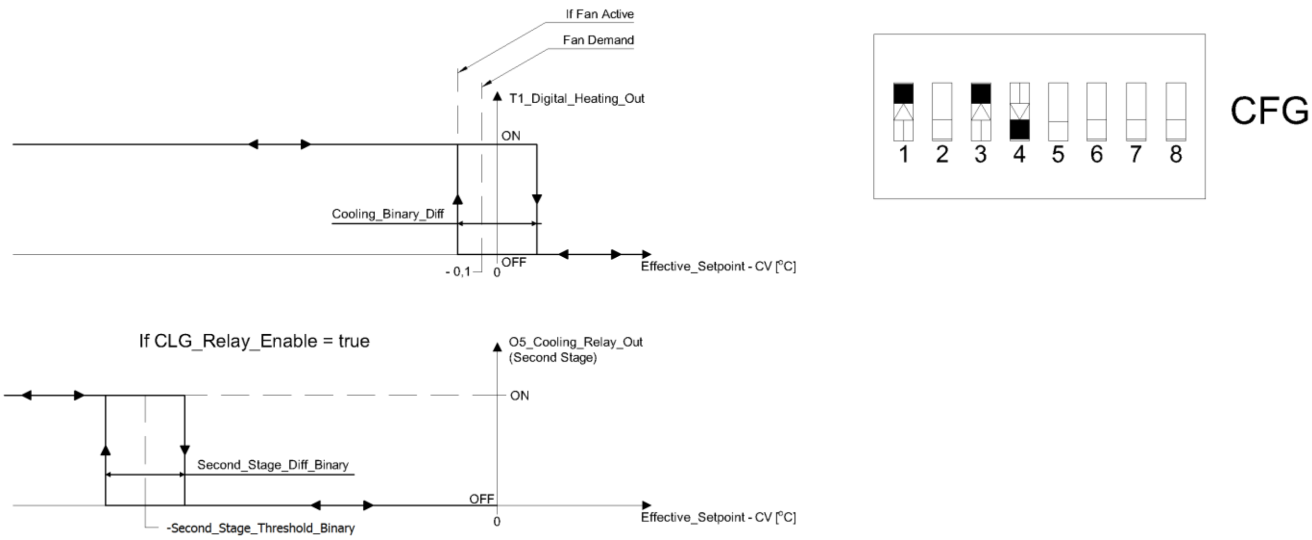


Figure 21 2nd stage cooling Digital Control Mode and CFG DIP switch configuration

3.3.6 Cooling 2nd stage Analog Control Mode

In this mode the algorithm is controlled by PI regulator which calculates the output value in the range from -100% to 0 based on Effective_Setpoint and CV (room temperature) values. The PI regulator can be adjust by "Kp" and "Ti" network variables. The 1st stage analog signal is scaled to "Second_Stage_Threshold_Analog" network variable. In range from 0 to "Second_Stage_Threshold_Analog" the analog signal is proportional to PI regulator output in range from 0 to 100%. When PI regulator output is equal or higher than "Second_Stage_Threshold_Analog", the analog signal value is set to 100%. The 2nd stage works as a thermostat, based on "Second_Stage_Threshold_Analog" as Setpoint, PI regulator output as Control Value and Diff parameters defined in "Second_Stage_Diff_Analog" network variable. In cooling 1st stage user can choose 1 of 2 outputs: A2 Analog Output or TO2 Triac Output PWM. The O5 relay output is dedicated to 2nd stage. The A2 Analog Output value and the TO2 PWM signal is proportional to PI regulator output. When PI regulator output is equal or higher than 5% it enables the fan (Fan Demand). The 2nd stage heating Analog Control

Mode is shown in charts bellow.

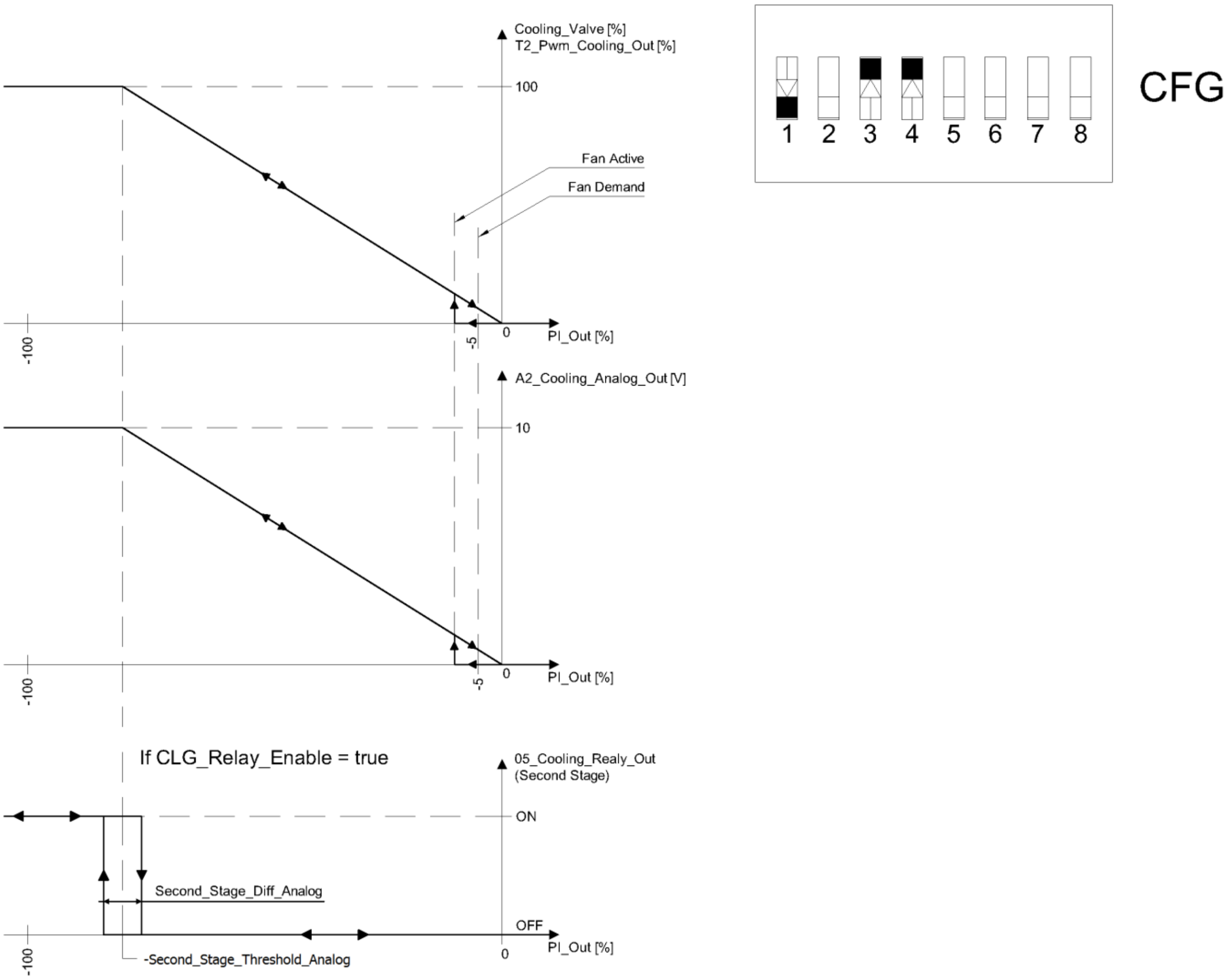


Figure 22 2nd stage cooling Analog Control Mode and CFG DIP switch configuration

3.4 Heating/Cooling control mode (switch number 4)

The FCU application is designed to cooperate with two types of heating/cooling devices (Analog or Digital). The control type is selected by CFG DIP switch number 4 where Off position corresponds to Digital Control and On position corresponds to Analog Control.

Analog control mode

In this mode the algorithm is controlled by PI regulator which calculates the output value in the range from -100% to 100% based on Effective_Setpoint and CV (room temperature) values. Range from -100% to 0 is for cooling control and range from 0 to 100% is for heating control. Based on this output FCU controller control actuators in binary or analog control. The PI regulator can be adjusted by "Kp" and "Ti" network variables.

Digital control mode

In this mode control algorithm is works as a typical thermostat, based on Effective Setpoint and Control Value with heating/cooling Diff parameters.

Note: This mode affects also on outputs enable/disable in the 1st stage. In first stage outputs O4 and O5 can work only in "Binary Control" mode. If user want to run "Binary Control" mode without operating these outputs, they can be disabled by setting corresponding to network variable in false state (O4: "HTG_Relays_Enable" , O5: "CTG_Relays_Enable").

3.5 CV temperature source (switch number 5 and 6)

The default application can work with 4 different CV temperature sources. The CV temperature source is selected by CFG DIP switch number 5 and 6. The configuration table is shown below.

Nr	Name	On		Off	Default
5	Temp. Control Value Source	5-Off	6-Off	Room Panel (iSMA-B-LP)	LCD Panel
		5-Off	6-On	Room Sensor SI3	
6		5-On	6-Off	Air Return Temp SI1	
		5-On	6-On	Network Temp	

Table 8 Control Value CV source select CFG DIP switch configuration

Source description:

- Room Panel – temperature is taken from iSMA-B-LP room panel connected to FCU controller by RJ12 socket,
- Room Sensor - temperature is taken from sensor connected to Special Input S3,
- Air Return Temp - temperature is taken from sensor connected to Special Input S1, for more information about Air Return Temp please see chapter "4.3.4 Return Temperature sensor control"
- Network Temp – temperature is taken from network variable, this source is dedicated for slave device in Master – Slave working mode.

3.6 Fan type (switch number 7 and 8)

The default application is designed to control 1 of 4 different fan types. Fan type is chosen by CFG DIP switch number 7 and 8 which is shown in table below.

Name	Switch position		Fan type	Default
Fan type	7-Off	8-Off	Analog type	3 Speed type
	7-Off	8-On	1 Speed type	
	7-On	8-Off	2 Speed type	
	7-On	8-On	3 Speed type	

Table 9 Fan type CFG DIP switch configuration

Connection of supported fan types is shown in figure below.

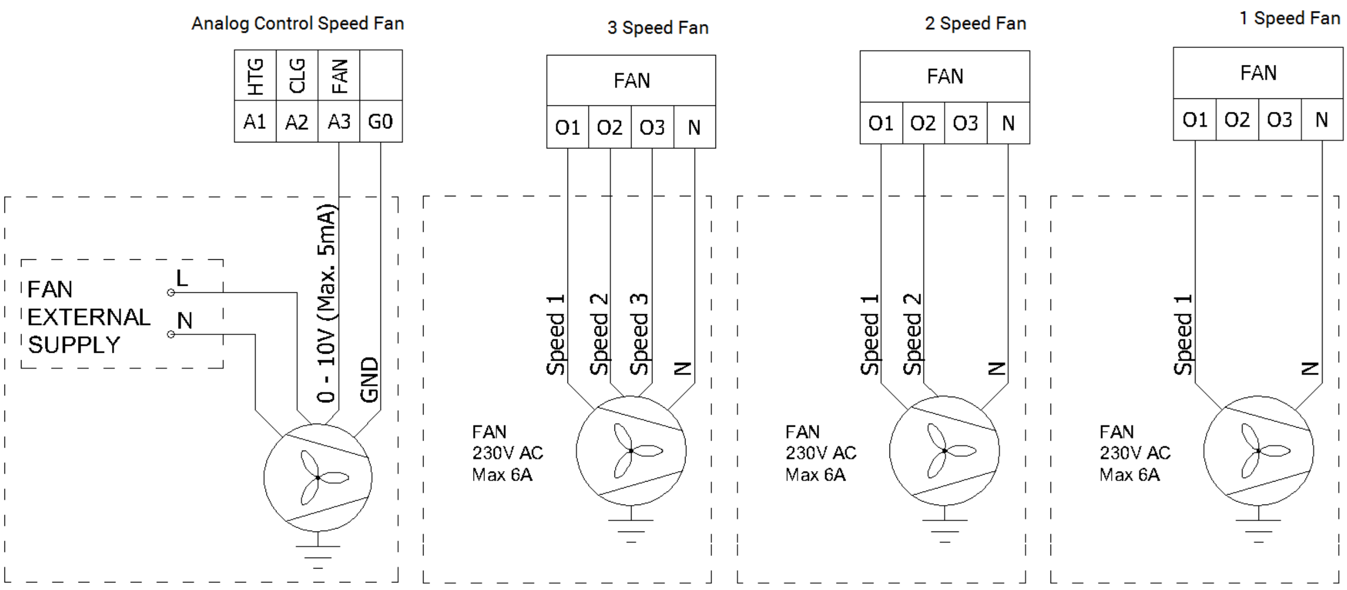


Figure 23 Fan motor connection according to fan control mode

Note: For digital fan speed control the FCU application has built-in protection function to prevent parallel speed switching. There is also 1 second delay between speed changing. During the delay all fan Digital Outputs are switched off.

3.6.1 Fan control algorithm

The FCU application has built-in fan speed control algorithm. The internal variable "Fan Control Value" is scaled by difference between CV and Effective Setpoint. The difference is calculated according to linear conversation where 100% speed is in "Fan_Scale" network variable. For example: in default network variable "Fan_Scale" value is set to 3, so it means when difference between CV and SP is equal or higher than 3°C the internal variable "Fan_Control_Value" is 100%, when the difference is half of "Fan_Scale" (in this case 1,5°C) "Fan_Control_Value" is 50%. The algorithm chart is shown in figure below.

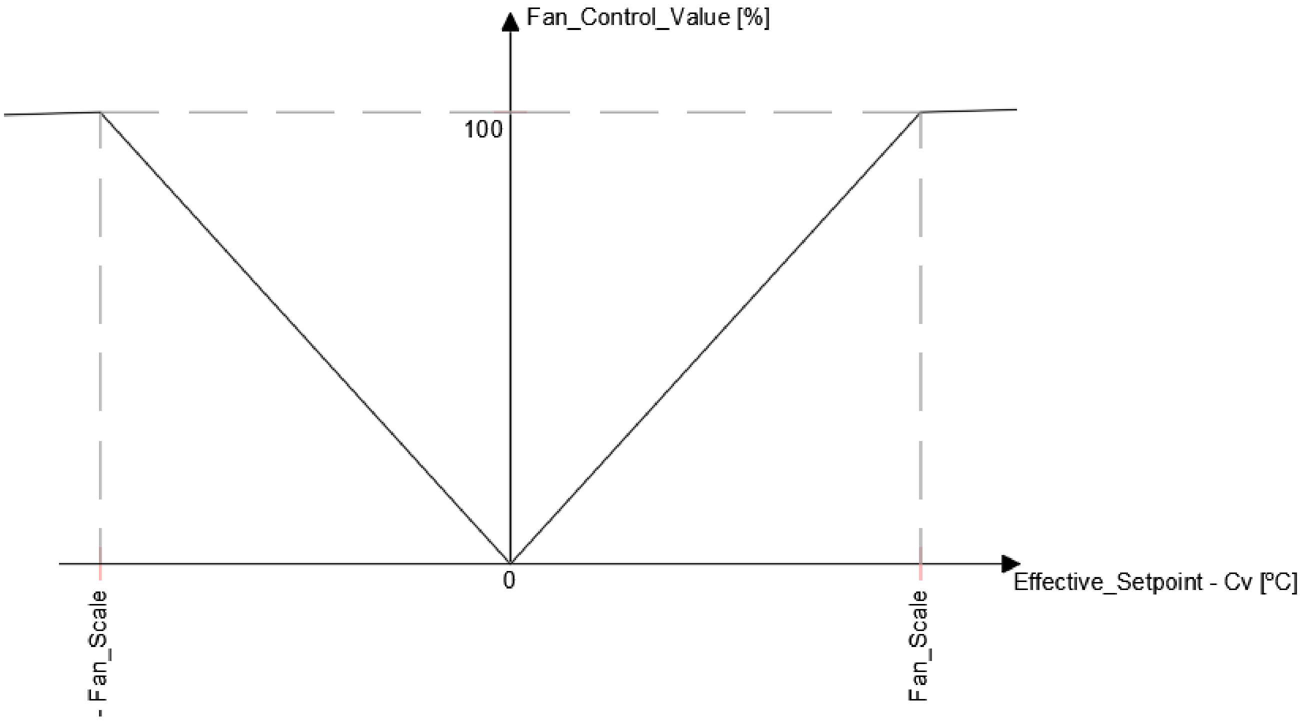


Figure 24 Fan Control Value conversation chart

The fan can run in 3 modes: Off, Manual, Auto. These modes can be changed from room panel or remotely from BMS by "Fan_Mode" network variable. Current Fan status is shown in read only network variable "Fan_Status". "Fan_Mode" and "Fan_Status" functions and corresponding values are shown in table below.

Name	BACnet ID	Modbus Address	Value	Function
Fan Mode	3	103	0	Off
			1	Speed 1 (Manual)
			2	Speed 2 (Manual)
			3	Speed 3 (Manual)
			4	Auto
Fan Status	102	202	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)

Table 10 Fan Mode and Fan Status network variable description

3.6.1.1 Fan Soft Start

This function is dedicated for analog fan type control supply by motor driver to support fan motor start. When fan is starting with small control value the fan motor might not start or starting process will take long time. These two situations could cause driver or fan motor overheat. The Fan Soft Start function overrides fan control signal for time defined in "Fan Soft Star Time" network variable with value defined in "Fan Soft Star Value" network variable. After "Fan Soft Star Time" the control signal switches to application fan control signal.

WARNING! For correct values time and control value, please read motor and driver manufacture instruction. Electrical and thermal parameters cannot exceed values defined by manufacturer.

3.6.1.2 Fan Off Delay

The Fan Off Delay function was designed to keep air flow for defined time after fan switch off signal. The delay time is defined in “Fan Delay Off” network variable. This function is dedicated to protect heating or/and cooling devices after switch off.

3.6.2 Fan Analog type control algorithm

For Fan Analog Control the Fan is controlled by A3 Analog Output signal 0-10 V DC based on “Fan_Value” network variable (0-100%).

In default application, “Fan_Value” network variable is calculated according to internal variable “Fan_Control_Value” and “Fan_Off_Threshold” network variable. When “Fan_Control_Value” is in range from 0 to “Fan_Off_Threshold” the fan will be “switch off”. When “Fan_Control_Value” is equal or higher than “Fan_Off_Threshold”, the fan is “switch on” and start working according to “Fan_Control_Value” or according to Soft Start algorithm.

The fan control algorithm has built-in function which keeps fan running with “Fan_Speed1_Threshold” network variable value when there is no fan demand. This function works only in Occupied mode and has 2 separate network variables for cooling “Fan_Cooling_Occupied_Active” and for heating “Fan_Heating_Occupied_Active”. The fan working algorithm is shown in figure below.

The value of “Fan_Value” network variable depending on “Fan_Control_Value” and “Fan_Off_Threshold” is shown in figure below.

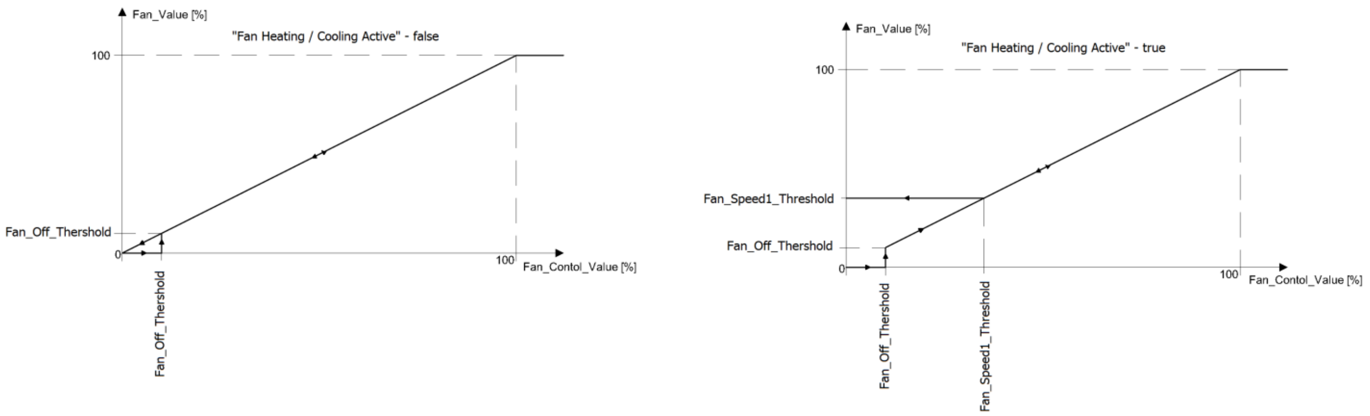


Figure 25 Fan Analog type control algorithm

3.6.3 Fan 1 Speed type control algorithm

For Fan 1 Speeds Control the Fan is controlled by O1 Digital Output only, based on "Fan_Value" network variable (0-Off; 1 – speed 1).

In default application, "Fan_Value" network variable is calculated according to internal variable "Fan_Control_Value" and Threshold function defined by 2 network variables:

- Fan Off Threshold
- Fan Speed 1 Threshold

The fan control algorithm has built-in function which keeps fan running with low value when there is no fan demand. This function works only in Occupied mode and has 2 separate network variables for cooling "Fan_Cooling_Occupied_Active" and for heating "Fan_Heating_Occupied_Active". The fan working algorithm is shown in figure below.

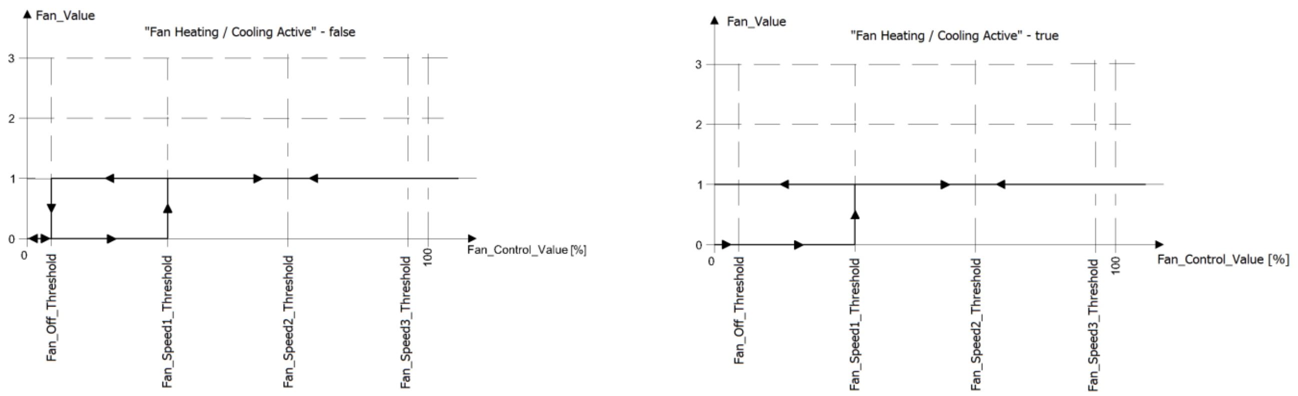


Figure 26 Fan 1 Speed type control algorithm

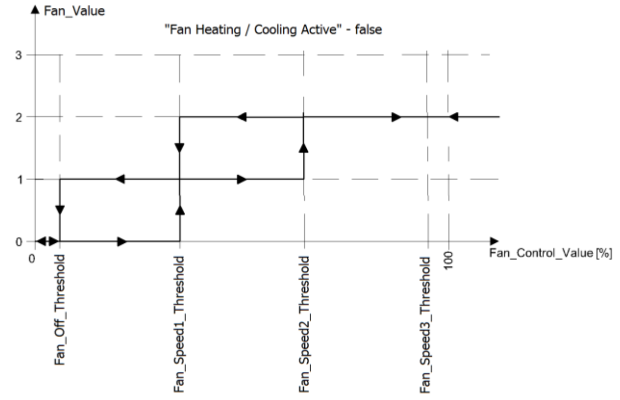
3.6.4 Fan 2 Speeds type control algorithm

For Fan 2 Speeds Control the Fan is controlled by O1 and O2 Digital Outputs based on "Fan_Value" network variable (0-Off; 1 – speed 1; 2 – speed 2).

In default application, "Fan_Value" network variable is calculated according to internal variable "Fan_Control_Value" and Threshold function defined by 3 network variables:

- Fan Off Threshold
- Fan Speed 1 Threshold
- Fan Speed 2 Threshold

The fan control algorithm has built-in function which keeps fan running with low value when there is no fan demand. This function works only in Occupied mode and has 2 separate network variables for cooling "Fan_Cooling_Occupied_Active" and for heating "Fan_Heating_Occupied_Active". The fan working algorithm is shown in figure below.



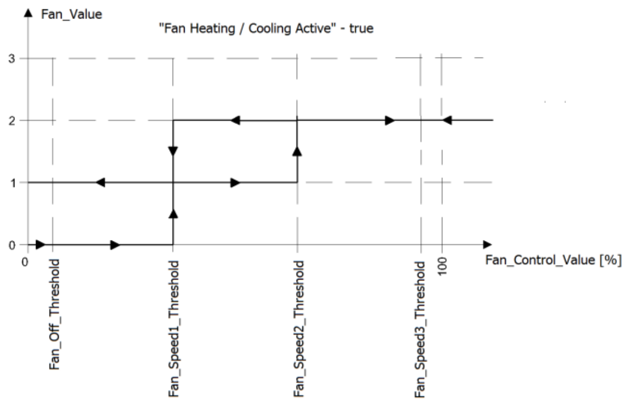


Figure 27 Fan 2 Speed type control algorithm

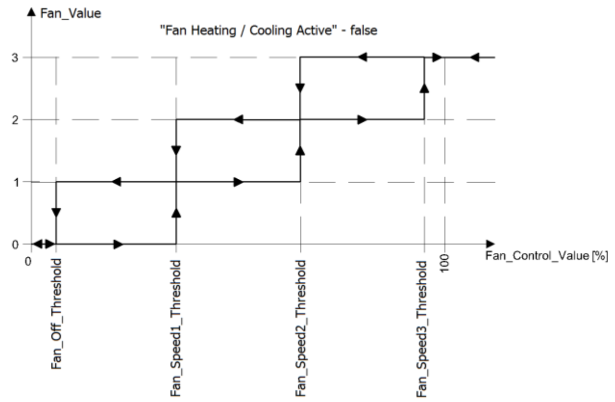
3.6.5 Fan 3 Speeds type control algorithm

For Fan 3 Speeds Control the Fan is controlled by O1, O2 and O3 Digital Outputs based on "Fan_Value" network variable (0-Off; 1 – speed 1; 2 – speed 2; 3 – speed 3).

In default application, "Fan_Value" network variable is calculated according to internal variable "Fan_Control_Value" and Threshold function defined by 4 network variables:

- Fan Off Treshold
- Fan Speed 1 Threshold
- Fan Speed 2 Threshold
- Fan Speed 3 Threshold

The fan control algorithm has built-in function which keeps fan running with low value when there is no fan demand. This function works only in Occupied mode and has 2 separate network variables for cooling "Fan_Cooling_Occupied_Active" and for heating "Fan_Heating_Occupied_Active". The fan working algorithm is shown in figure below.



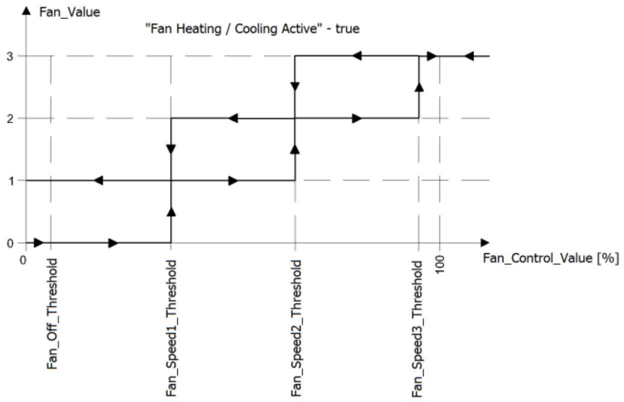


Figure 28 Fan 3 Speed type control algorithm

4 Control algorithm

The default application has been designed to run with 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 default application is designed to control room temperature.

4.1 FCU Occupancy modes

To allows maximum comfort and energy saving the default application has got 4 implemented working modes. These modes are using to switch between user temperature when space is occupied and energy saving when space is unoccupied/standby. Thera are 4 different modes:

- Occupied mode,
- Unoccupied mode,
- Standby mode,
- Forced Occupied.

Each mode can be set by the following sources:

- The Forced Occupied from room panel or Digital Inputs (Occupancy Button, Presence Sensor, Card Holder),
- From BMS by “Occupancy Mode” network variable. “Occupancy Mode” values and corresponding functions are shown in table below.

The FCU Occupancy modes and status with corresponding values are shown in 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 11 Occupancy Mode and Occupancy Status network variables description

4.1.1 Occupancy Mode

In this mode controller is works to keep room temperature set by user.

4.1.1.1 Occupied Effective Setpoint

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

4.1.1.2 Occupied Fan control

In Occupied mode fan can run with auto algorithm (see “3.6.1Fan control algorithm” chapter) or with user manual value. By setting fan in Off mode the user can switch off device.

4.1.1.3 Occupied Heating / Cooling FCU mode switching

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

4.1.2 Unoccupied Mode

This mode is designed to change temperature setpoint level when space is temporary not in use, for example after office working hours. Itallows to reduce energy consumption. Energy saving is done by changing the Effective Setpoint (lower for heating, increase for cooling). From this mode, room temperature can quickly get back to user temperature level.

4.1.2.1 Occupied 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 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 12 Effective Setpoint calculation table in Unoccupied mode

4.1.2.2 Unoccupied Fan control

In Unoccupied mode fan runs in Auto Mode which value is calculated by the application. (See 3.6.1 Fan control algorithm chapter). In this mode Fan Manual Modes are disabled and user cannot switch off or define fan speed. When Unoccupied mode change to Occupied the Fan Mode is switched to previous mode (Auto or user settings).

Note: If user want to switch off the fan, should first switch application to Occupied and then change to Fan Off. In Unoccupied mode there is no option to stop fan running if there is Fan Demand active.

4.1.2.3 Occupied Heating / Cooling FCU mode switching

In this mode (when “FCU_Mode” network variable is set in Auto) the application stay in last running mode (heating or cooling) in Occupied mode. The control algorithm does not change and depends of CFG DIP switch configuration.

4.1.3 Standby Mode

This mode is designed to change temperature setpoint level with bigger value in the Unoccupied mode, when space is not in use for 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.

4.1.3.1 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 variable. The Effective Setpoint calculation according to FCU mode and settings is shown in 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 13 Effective Setpoint calculation table in Stanby mode

4.1.3.2 Unoccupied Fan control

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

Note: If user want to switch off the device, should first switch application to Occupied and then change to Fan Off.

4.1.3.3 Occupied Heating/Cooling FCU mode switching

In this mode (when “FCU_Mode” network variable is set in Auto) the application stays in last running mode (heating or cooling) in Occupied mode. The control algorithm does not change and depends of CFG DIP switch configuration.

4.1.4 Forced Occupied

This mode is called by external devices connected to FCU Digital Inputs or from room panel. This mode is runs by time defined in network variables. The Force Occupied behavior is the same as Occupied mode.

4.1.4.1 Switching to Forced Occupancy Mode by Occupancy Button DI1

Digital Input I1 is dedicated to connect presence button or sensor which will remotely run Forced Occupancy mode. This input is active only in Unoccupied or Standby mode (in Occupied mode this input is inactive). If the application detects rising edge on I1 input it switches to Forced Occupied mode. When the application detects falling edge on I1 input it starts counting time defined in "Occupancy_Time_Remote_Trigger" network variable. During that time, application is in Forced Occupied mode and user cannot switch off before time elapse. After defined time elapsed the application comes back to pervious mode Unoccupied or Standby. By changing "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 shown in figure below.

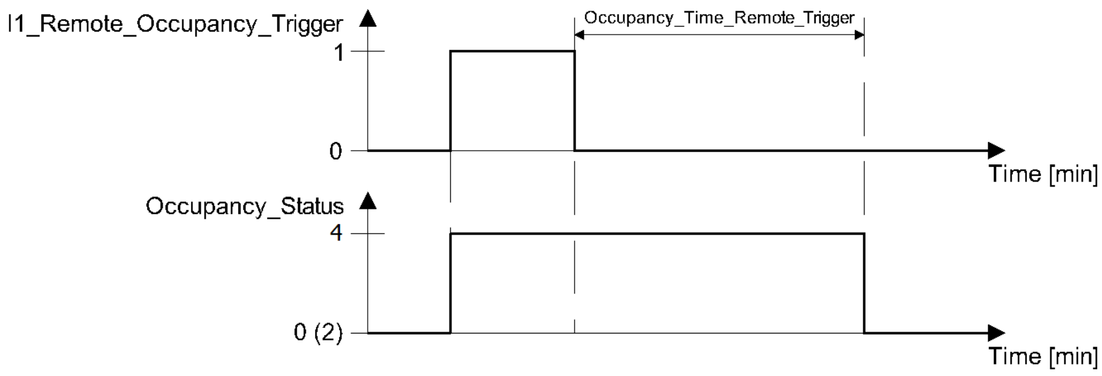


Figure 29 Occupancy Triger time function

4.1.4.2 Switching to Forced Occupancy Mode by Digital Input DI2

Digital Input I2 is dedicated to connect presence button or card holder which will remotely run Forced Occupancy mode. This input is active only in Unoccupied or Standby mode (in Occupied mode this input is inactive). If the application detects rising edge on I2 input it switches to Forced Occupied mode. When the application detects falling edge on I2 input it starts counting time defined in "Occupancy_Time_Presence_Sensor" network variable. During that time application is in Forced Occupied mode and user cannot switch off before time elapse. After defined time elapsed the application is comes back to previous mode Unoccupied or Standby. By changing "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 shown in figure below.

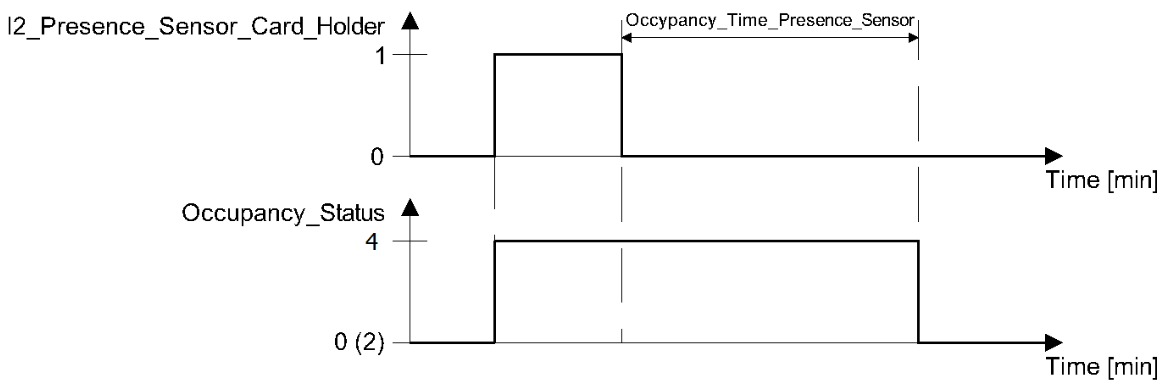


Figure 30 Presence Sensor or Card Holder function time

4.1.4.3 Switching to Forced Occupancy by LCD room panel (iSMA-B-LP)

The FCU default application is designed to work with iSMA-B-LP Room Panel. In this panel menu user can switch from Unoccupied or Standby mode to Forced Occupied for time defined in “Occupancy_Time_Remote_Trigger” network variable. The Forced Occupied mode is shown as a flashing occupied icon. From room panel user can switch off Forced Occupied and come back to previous mode.

4.2 FCU mode

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

- OFF – in this mode FCU controller is software off, only Anti-Frost procreation can start the FCU controller,
- Auto – in this mode FCU controller switches between cooling or heating function based on measurement temperature and effective setpoint temperature,
- Heating Only – in this mode FCU controller can perform only heating function, (dedicated for 2 pipe mode or when cooling medium is not available – winter mode),
- Cooling Only – in this mode FCU controller can perform only cooling function, (dedicated for 2 pipe mode or when heating medium is not available – summer mode),
- Fan Only – in this mode FCU controller can perform only ventilation, heating and cooling functions are disabled.

For remote mode control the default application has “Fcu_Mode” network variable.

<table>
<tr><th>Name</th><th>BACnet ID</th><th>Modbus address</th><th>Value</th><th>Function</th></tr>
<tr><td rowspan="5">FCU Mode</td><td rowspan="5">0</td><td rowspan="5">100</td><td>0</td><td>Off</td></tr>
<tr><td>1</td><td>Auto</td></tr>
<tr><td>2</td><td>Heating Only</td></tr>
<tr><td>3</td><td>Cooling Only</td></tr>
<tr><td>4</td><td>Fan Only</td></tr>
</table>

Table 14 Fcu Mode network variable values description

4.2.1 OFF mode

In this mode Fan is switched off, all heating and cooling devices are disabled. This mode can be set from BMS (by writing 0 value to “FCU_Mode” network variable). This mode is called when “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/CTG 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 deadband defined in “Switchinng_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. When controller comes back to Occupancy mode, algorithm will calculate in which function it should work.

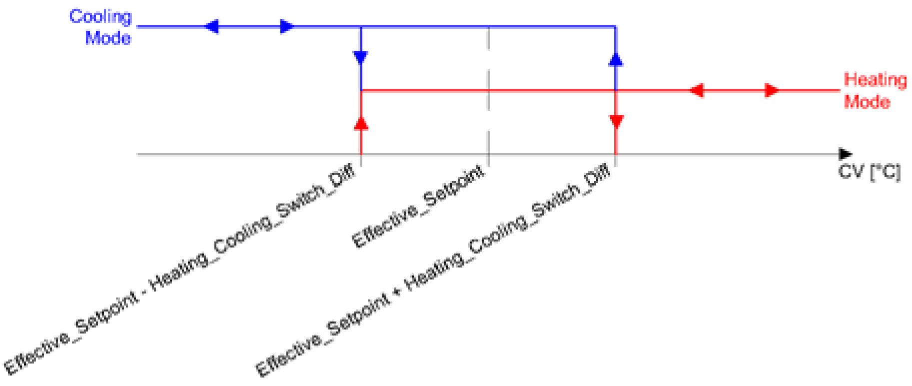


Figure 31 Switching between heating/cooling chart

4.2.3 Heating Only mode

In Heating Only mode the application is running with heating algorithm only. 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 2 pipe system during "Winter Mode" or in 4 pipe where cooling medium is not available.

4.2.4 Cooling Only mode

In Cooling Only mode the application is running with cooling algorithm only. 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 2 pipe system during "Summer Mode" or in 4 pipe where heating medium is not available.

4.2.5 Fan Only mode

In Fan Only mode, only Fan outputs are enabled while heating and cooling valves actuators outputs and HTG/CTG relays are disabled. Fan is working with application algorithm.

4.3 Additional features

4.3.1 Open Window DI3

Digital Input I3 is dedicated to connect window contraction which will check if window is open or close. When input detect “Open Window” status (rising edge on I1 input) it will start counting time defined in “Window_Status_Delay” network variable. After time elapsed, if window is still open the application will call Fcu Off Mode (for more information please see “4.2.1 OFF mode” chapter). When input detects “Close Window” the application will reset counter and continues normal operation working. If input detects “Close Window” before time elapsed, application will also reset counter and continues normal operation working. During “Open Window” only Anti-Frost protection can start. By changing “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 temperature. When application detects temperature drop below 6°C, it will start fan and actives all heating valves actuators (including 2nd stage if it is active) with max. defined value. This action will be kept until room temperature increase above 8°C. The Anti-Frost function is always active even if user switches off device from BMS or local panel. To prevent unnecessary start after sensor fault there is built-in algorithm which detects sensor brake. If temperature value from all available sensors is incorrect (out of range -100°C to 100°C), the Anti-Frost function will be disabled.

4.3.3 Sensors brake down detection

FCU controller has implemented sensor brake down detection. Sensor fault status is when temperature value is below -100°C or above 100°C for more than 5 second. When sensor value returns to correct range status is automatically switched to normal state.

4.3.4 Return Temperature sensor control

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

4.3.5 Supply Air temperature limitation

For room user comfort supply air can have temperature limitation. This function is available only when supply air sensor is connected to SI2 input. Supply air temperature can have upper limitation defined by SupplyTemperatureHighLimit network variable (default value 40°C) and lower limitation defined by SupplyTemperatureLowLimit network variable (default value 10°C). The range between “SupplyTemperatureLowLimit” and “SupplyTemperatureHighLimit” is called “comfort” range.

Supply Air Temperature limitation in 1st stage - binary control

When Supply Air Temperature value is out of “comfort” range the default application will start counting 1min delay time. After 1min if supply air temperature value is still out of “comfort” range the FCU application will disable heating (if temperature value is above “SupplyTemperatureHighLimit”) or cooling (if temperature value is above “SupplyTemperatureLowLimit”). When the supply air temperature value returns to “comfort” range, the FCU application will reset delay counter and returns to normal operation.

Supply Air Temperature limitation in 2nd stage - binary control

When Supply Air Temperature value is out of “comfort” range the default application will disable 2nd stage and starts counting 1min delay time. After 1min if supply air temperature value is still out of “comfort” range the FCU application will disable heating (if temperature value is above “SupplyTemperatureHighLimit”) or cooling (if temperature value is above “SupplyTemperatureLowLimit”). When the supply air temperature value returns to “comfort” range, the FCU application will reset delay counter, enable 2nd stage and returns to normal operation.

Supply Air Temperature limitation in 1st stage analog control

In analog control, when supply air temperature approaches 1°C to the "comfort" range limit, the FCU application will start counting 1min delay time. After 1min if supply air temperature value is still approaches 1°C to the "comfort" range limit, the default application will start built-in algorithm which will reduce air temperature (if temperature value is closed or above “SupplyTemperatureHighLimit”) or increase air temperature (if temperature value is closed or below “SupplyTemperatureLowLimit”). When the supply air temperature value returns to “comfort” range ±1°C, the default application will reset delay counter and returns to normal operation.

Supply Air Temperature limitation in 2nd stage analog control

In analog control, when supply air temperature approaches 1°C to the "comfort" range limit, the FCU application will disable 2nd stage and start counting 1min delay time. After 1min if supply air temperature value is still approaches 1°C to the "comfort" range limit, the default application will start built-in algorithm which will reduce air temperature (if temperature value is closed or above “SupplyTemperatureHighLimit”) or increase air temperature (if temperature value is closed or below “SupplyTemperatureLowLimit”). When the supply air temperature value returns to “comfort” range ±1°C, the default application will reset delay counter, enable 2nd stage and returns to normal operation.

4.3.6 FCU Test Mode

This mode was implemented to do quick heating/cooling test. In this mode the FCU application will start the fan and heating or cooling actuators with 100% value. Depend on "FCU_Test_Mode" network variable value the test mode will active heating or cooling function. Network variable values and corresponding test functions are shown in table below.

Name	BACnet AV ID	Modbus Register	Default Value	FCU_Test_Mode Value	Fan Value	Heating Value	Cooling Value	Description
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 15 FcuTest_Mode network variable values description

5 FCU Master-Slave configuration

FCU controller can work in groups where one device is a master and the rest devices are slaves. This function is useful where there are more than one device working in single room. In this case only Master device can work with room panel and control from BMS. All other devices in the room should follow the master parameters creating the group. In default application the master-slave grouping is active automatically when master and slaves have been set with the right BACnet Device ID. In single group there could be up to 6 devices, 1 Master and up to 5 slaves.

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

5.1 FCU Addressing MAC and ID

The Controller MAC Address is setting using MAC DIP switch. The device BACnet ID is the combination of device manufacture number and MAC address where first 3 digits contain manufacture number and next 3 digits contain MAC address.

Example: Configuration to how to set the FCU controller MAC address 83. Devices manufacture BACnet number is 826.

The MAC address 83 contains the following multiplicity of number 2: 83 = 1 + 2 + 16 + 64. Address DIP switch settings is shown in table below. All addresses of DIP switch configuration is shown in table at the end of this documentation.

Address	S1	S2	S3	S4	S5	S6	S7	S8
83	On	On			On		On	

Table 16 Address 83 DIP switch configuration

In this case BACnet ID will be: 826 083.

5.2 Auto binding addressing

The default application allows to automatically calculate BACnet Device Id of Slave devices in BACnet Master Slave Network, depending on the BACnet Device ID of Master devices. This function is called Auto Binding. The table below shows values of Master BACnet Device Id and corresponding to them 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	8260010
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
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 17 Master Slave Id - Auto Binding

Auto Binding function can be disabled (by setting value true to Local Remote Auto Binding network variable). In this case, Id of Slave devices have to be set by user (in network variables: Remote Slave 1 Device Id – Remote Slave 5 Device Id).

5.3 Master – Slave sharing parameters

When Master device detects that it can communicate with slave device, it sends/receives the following network variables:

Network variable name	Units	Access	BACnet BV Id	BACnet AV Id	Modbus Coil	Modbus Register	Default Value	Driection
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 18 Master-Slave network variables sharing

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

- Net_Temperature - This parameter sends room temperature from master device to slave devices. The slave devices can work without connected temperature sensor (CGF DIP switch number 5 and 6 in On position),
- Setpoint – Devices group Setpoint, based on master device Setpoint and Setpoint_Offset value. This parameter does not include Unoccupied_Offset and Standby_Offset, Effective Setpoint is calculated in slave device according to FCU mode,
- Occupancy_Mode – Devices group occupancy mode based on master device Occupancy_Status value,
- Fcu_Mode - Devices group Fcu_Mode based on master device Fcu_Mode value,
- Fan_Mode - Devices group Fan_Mode based on master device Fan_Mode value,
- Slave_Window_Status – Master device check every 1min slave device "Open Window" status. If master device detects that "Window is open" (their own or one of the devices in group), it will run "Open Window" function (wait time defined in "Window_Status_Delay" network variable and if window is still open, switch off whole group).

Name	Units	Access	BACnet BV ID	BACnet AV ID	Modbus Coil	Modbus Register	Default Value
Local_Remote_Auto_Binding	Bool	RW	8	-	1208		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	71	-	1271	-	N/A
Slave2_Active	Bool	RO	72	-	1272	-	N/A
Slave3_Active	Bool	RO	73	-	1273	-	N/A
Slave4_Active	Bool	RO	74	-	1274	-	N/A
Slave5_Active	Bool	RO	75	-	1275	-	N/A

Table 19 Master device network variables dedicated for Master – Slave function

6 FCU network variable

6.1 FCU BACnet AnalogValues and Modbus Registers

Name	Units	Access	BACnet ID	Modbus Address	Default Value	Description
Occupancy_Mode	N/A	RW	0	100	1	0 – Unoccupied mode, 1 – Occupied mode, 2 – Standby mode
Setpoint	°C	RW	1	101	21	User setpoint temperature value
Setpoint_Offset	°C	RW	2	102	0	User setpoint offset temperature value
Fan_Mode	N/A	RW	3	103	0	0 - Off 1` - Speed 1 (Manual) 2 - Speed 2 (Manual) 3 - Speed 3 (Manual) 4 - Auto
Fcu_Mode	N/A	RW	4	104	1	0 – OFF 1 – Auto 2 – Heating Only 3 – Cooling Only 4 – Fan Only
Setpoint_Offset_Range	°C	RW	5	105	3	Setpoint Offset ± range
Net_Temperature	°C	RW	6	106	21	Temperature network variable, CV source
Heating_Cooling_Switch_Diff	°C	RW	10	110	2	Differential value switching between cooling/heating mode
Unoccupied_Offset	°C	RW	11	111	2	Offset value in for Unoccupied mode
Standby_Offset	°C	RW	12	112	5	Offset value in for Standby mode
Occupancy_Time_Remote_Trigger	min	RW	13	113	60	Forced Occupied mode time value for Occupancy Button I1 and Room Panel
Occupancy_Time_Presence_Sensor	min	RW	14	114	10	Forced Occupied mode time value for Occupancy Presence Sensor I2
PWM_Heating_Period	s	RW	15	115	300	PWM time period for heating valve actuator
PWM_Cooling_Period	s	RW	16	116	300	PWM time period for cooling valve actuator
Fan_Scale	°C	RW	17	117	3	Fan Scale parameter for Fan control algorithm
Fan_Off_Threshold	%	RW	18	118	5	Fan Off Threshold value
Fan_Speed_1_Threshold	%	RW	19	119	30	Fan Speed 1 Threshold value
Fan_Speed_2_Threshold	%	RW	20	120	60	Fan Speed 2 Threshold value
Fan_Speed_3_Threshold	%	RW	21	121	90	Fan Speed 3 Threshold value
Fan_Off_Delay	s	RW	22	122	5	Fan switch off delay time value
Fan_Soft_Start_Time	s	RW	23	123	20	Time value for "Fan Soft Start" function
Kp	N/A	RW	24	124	10	PI regulator parameter Proportional gain
Ti	min	RW	25	125	10	PI regulator parameter Integral time
Heating_Binary _Diff	°C	RW	26	126	0,4	1st stage heating thermostat differential value
Cooling_Binary_Diff	°C	RW	27	127	0,4	1st stage cooling thermostat differential value
Second_Stage_Threshold_Binary	°C	RW	28	128	2	2nd stage shifting parameter in Digital control mode
Second_Stage_Diff Binary	°C	RW	29	129	0,6	2nd stage thermostat differential parameter in Digital control mode

Name	Units	Access	BACnet ID	Modbus Address	Default Value	Description
Second_Stage_Threshold_Analog	%	RW	30	130	80	2nd stage shifting parameter in Analog control mode
Second_Stage_Diff_Analog	%	RW	31	131	10	2nd stage thermostat differential parameter in Analog control mode
Supply_Temperature_Low_Limit	°C	RW	32	132	10	Supply air temperature limit values used in "Supply Air temperature limitation" function
Supply_Temperature_High_Limit	°C	RW	33	133	30	
Supply_Limits_Time	s	RW	34	134	30	Time value used in "Supply Air temperature limitation" function
Window_Status_Delay	s	RW	35	135	60	Time value for "Open Window" function
Return_To_Space_Time	s	RW	36	136	30	Time value for "Return Temperature sensor control" function
FCU_Test_Mode	N/A	RW	37	137	0	0 - Auto operation 1 - Heating test 2 - Cooling test
Return_Temperature_Offset	°C	RW	40	140	0	Return Temperature sensor correction parameter
Supply_Temperature_Offset	°C	RW	41	141	0	Supply Temperature sensor correction parameter
Space_Temperature_Offset	°C	RW	42	142	0	Space Temperature sensor correction parameter
S1_Sensor_Type	N/A	RW	43	143	1	0 – sensor type 10K3A1 NTC 1 - sensor 10K4A1 NTC 2 – sensor type 10K NTC 3 – sensor type 20K6A1 NTC 4 – sensor type 2,2K3A1 NTC 5 – sensor type 3K3A1 NTC 6 – sensor type 30K6A1 NTC 7 – sensor type SIE1 8 – sensor type TAC1 9 – sensor type SAT1
S2_Sensor_Type	N/A	RW	44	144	1	
S3_Sensor_Type	N/A	RW	45	145	1	
LCD_Panel_Temperature_Offset	°C	RW	50	150	0	Room panel temperature sensor correction parameter
LCD_Setpoint_Step	°C	RW	51	151	50	Room panel Setpoint step
LCD_Setpoint_Low_Limit	°C	RW	52	152	180	Room panel Setpoint low limit
LCD Setpoint High Limit	°C	RW	53	153	240	Room panel Setpoint high limit
Remote_Slave1_Device_ID	N/A	RW	54	154	0	BACnet slave device ID number Note: In Modbus protocol this is 32-bits register
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	
Effective Setpoint	°C	RO	100	200	N/A	Effective Setpoint value
Occupancy Status	N/A	RO	101	201	1	0 – Un occupied mode, 1 – Occupied mode, 2 – Standby mode 3 – Forced Occupied mode.
Fan Status	N/A	RO	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	RO	103	203	0	Fan type: 0 - Analog, 1 – Speed 1, 2 – Speed 2, 3 – Speed 3.

Name	Units	Access	BACnet ID	Modbus Address	Default Value	Description
Cv	°C	RO	104	204	N/A	Temperature Control Value
Dip_Switch_Configuration	N/A	RO	105	205	N/A	Current CFG DIP switch bits status
Heating_Valve	%	RO	110	210	N/A	Heaitng Analog Output or Triac PWM value
Coolling_Valve	%	RO	111	211	N/A	Cooling Analog Output or Triac PWM value
Fan Value	%	RO	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	RO	113	213	N/A	Special Input S1 Temperature Value
S2_Supply_Temperature	°C	RO	114	214	N/A	Special Input S2 Temperature Value
S3_Space_Temperature	°C	RO	115	215	N/A	Special Input S3 Temperature Value
LCD Panel Temperature	°C	RO	120	220	N/A	Room Panel iSAM-B-LP Temperature value
LCD Panel Humidity	%	RO	121	221	N/A	Room Panel iSAM-B-LP Humidity value
LCD Panel CO2	ppm	RO	122	222	N/A	Room Panel iSAM-B-LP CO2 value

6.2 FCU BACnet BinaryValues and Modbus Coils

Name	Access	BACnet ID	Modbus Address	Default Value	Description
Offset In Occupied Only	RW	0	1200	False	Enable/Disable Setpoint Offset parameter calculation in Unoccupied and Standby mode
Fan Heating Occupied Active	RW	1	1201	False	Enable/Disable fun running at low speed after no fan demand in heating occupied mode
Fan Cooling Occupied Active	RW	2	1202	True	Enable/Disable fun running at low speed after no fan demand in cooling occupied mode
HTG Relay Enable	RW	3	1203	False	True – Enable, False – Disable O4 relay working
CLG Relay Enable	RW	4	1204	True	True – Enable, False – Disable O5 relay working
I1_Remote_Occ_Trigger_Invert	RW	5	1205	True	False – Normal, True – Invert
I2_Presence_Sensor_Invert	RW	6	1206	False	
I3_Window_Contact_Invert	RW	7	1207	False	
Local_Remote_Auto_Binding	RW	8	1208	False	False – Slave ID from auto binding True - Slave ID from network variable
LCD Temperature Active	RW	16	1216	False	Enable/Disable Room Panel current temperature display
LCD Setpoint Active	RW	17	1217	True	Enable/Disable Room Panel septiont temperature display
LCD Setpoint Editable	RW	18	1218	True	Enable/Disable room panel setpoint edit
LCD Setpoint Fast Edit Mode	RW	19	1219	True	Enable/Disable display fast setpoint edit in room panel display
LCD Fan Visable	RW	20	1220	False	Enable/Disable display fan icon on room panel display

LCD Fan Editable	RW	21	1221	True	Enable/Disable fan parameters edit on room panel display
LCD Fan Fast Edit Mode	RW	22	1222	True	Enable/Disable display fast fan speed edit in room panel display
LCD Occupancy Visable	RW	23	1223	False	Enable/Disable fan parameters edit on room panel display
LCD Occupancy Editable	RW	24	1224	True	Enable/Disable Occupancy mode change on room panel display
LCD Occupancy Fast Edit Mode	RW	25	1225	True	
Occupied Forced	RO	64	1264	N/A	Forced Occupied mode status
Heating_Second_Stage	RO	65	1265	N/A	Heating in second stage current status
Cooling_Second_Stage	RO	66	1266	N/A	Heating in second stage current status
I1_Remote_Occuapancy_Trigger	RO	67	1267	N/A	Digital Input current status
I2_Presence_Sensor_Card_Holder	RO	68	1268	N/A	
I3_Window_Conntact	RO	69	1269	N/A	
I4_Occupancy_LED	RO	70	1270	N/A	
Slave1_Active	RO	71	1271	N/A	Slave device connection status
Slave2_Active	RO	72	1272	N/A	
Slave3_Active	RO	73	1273	N/A	
Slave4_Active	RO	74	1274	N/A	
Slave5_Active	RO	75	1275	N/A	
Slave1_Window_Status	RO	76	1276	N/A	Window status I3 input read from slave device
Slave2_Window_Status	RO	77	1277	N/A	
Slave3_Window_Status	RO	78	1278	N/A	
Slave4_Window_Status	RO	79	1279	N/A	
Slave5_Window_Status	RO	63	1263	N/A	