Fan coil ‘Analog’

Control Module for Fan Coil Units with Analog Voltage or Relay-Controlled Valves and Fan.

USER MANUAL

User Manual Version: [1.0]_a

www.zennio.com

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DOCUMENT UPDATES

Version	Changes	Page(s)
[1.0]_a	**Changes in the application program:** • Compatibility with binary valves (relays). • Compatibility with binary fans (relays). • Fan-Oriented Control. • Additional objects for manual fan control. • Control signal change limits in analog fan. • Boost mode in analog fan. • Changes in the behaviour of the anti-seize protection. • Scenes.	-

1 INTRODUCTION

A variety of Zennio devices incorporate the **'Analog' Fan Coil control module**, which enables the control of external fan coil units where both the opening of the valves and the fan speed can be controlled through **analog voltage outputs** or **binary outputs** (relays).

The fan coil units to be controlled may be **two-pipe** or **four-pipe**. Each **pair of pipes** constitute a water circuit controlled by a **valve**, whose position is managed by a 0 – 10 VDC analog signal or by a sole binary signal.

Typically, the two water circuits of a four-pipe fan coil unit correspond to the **cooling** and **heating** functions, being therefore both modes available during the device operation. On the other hand, the single water circuit of a two-pipe fan coil unit may be configured for **cooling, heating or both.**

Regarding the fan speed control, a 0 – 10 VDC analog signal or three more binary signals will be available. The latter can be configured as **switching relays** (one specific relay for each fan speed) or as **accumulating relays** (the more relays closed, the higher the fan speed). Additionally, it can be configured whether the speed will be set automatically or manually.

Important: *In order to confirm whether a particular device or application program incorporates the fan coil analog function, please refer to the **device user manual**, as there may be significant differences between the functionality of each Zennio device. Moreover, to access the proper fan coil analog user manual, it is always recommended to make use of the specific download links provided at the Zennio website (www.zennio.com) within the section of the specific device being parameterised.*

2 CONFIGURATION

Please note that the screenshots and object names shown next may be slightly different depending on the device and application program.

2.1 CONFIGURATION

After enabling the module, in the general configuration of the device, the "Fan Coil" tab will be available in the ETS tab tree. In this tab, a box will be provided for each fan coil, in order to configure them independently. Refer to the specific application program manual to identify where these boxes are located.

ETS PARAMETERISATION

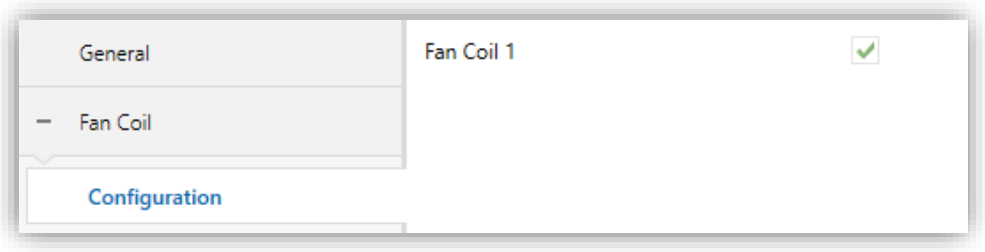


Figure 1. Fan Coil - Configuration

- **Fan Coil X** [*disabled*/*enabled*]: enables the "Fan Coil X" tab in the left menu (see section 0).

2.2 FAN COIL X

In this tab, the generic characteristics of the fan coil unit to be controlled are configured. Among them, the type of fan coil of the installation must be selected:

- A **four-pipe** fan coil unit, which requires the simultaneous management of two independent circuits (one for heating and one for cooling).
- A **two-pipe** fan coil unit, which requires the management of a single circuit (for heating, for cooling or for both).

Depending on the previous settings, the next parameter can be configured:

- **Mode change minimum time:** in cases where the fan coil has both heating and cooling modes, a minimum time can be selected to ensure that the mode change is carried out safely. This time will be applied between the fan deactivation and the valve of the new mode opening.

  Figure 2 shows the above, based on operation in cooling mode operation and after receiving the command to switch to heating mode:

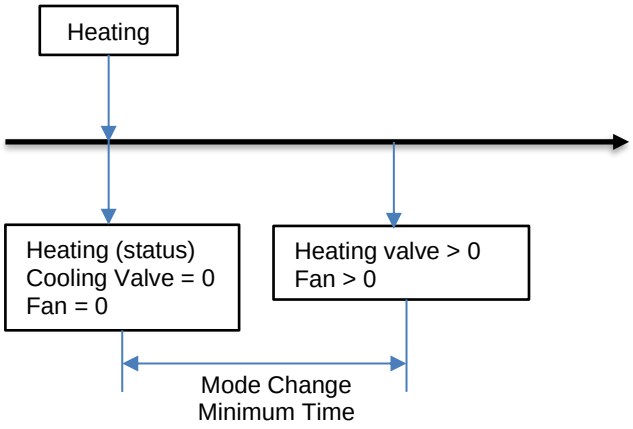


Figure 2. Minimum time for mode change

Next, the **type of valve and fan** need to be determined:

- **Analog**: controlled by a 0 – 10 VDC analog signal.
- **Relays**: controlled by a binary signal, only two possible states, open or closed.

The **control type** can be configured. It determines on which element (valve or fan) the main control is applied. Selecting one option or the other will significantly alter how the device operates:

- **Control applied to the valves**: the fan coil module main control will be exercised over the valve, thus making the fan state remarkably depend on the actions performed by the valve. The configuration of this control type is detailed in section 2.2.1.2, 2.2.2.2, 2.2.3.2 y 2.2.4.2.

- **Control applied to the fan**: the fan coil module main control will be exercised over the fan, thus making the valve state remarkably depend on the actions performed by the fan. The configuration of this control type is detailed in section 2.2.1.1, 2.2.2.1, 2.2.3.1 y 2.2.4.1.

Specific settings are **common to both control types**.

In addition to the type of fan coil and the type of control, the general configuration includes the following options:

- **Scenes**: see section 2.2.5

- **Fan Coil Always On**: a communication object for the switch-on and the switch-off of the fan coil control module is available, as well as its corresponding status object. Alternatively, it is possible to configure the module to maintain the fan coil control permanently switched on and disable the mentioned object.

- **Automatic Air Recirculation in Cooling Mode**: sets whether in the cooling mode the fan should remain on (thus improving the user comfort) even when the valve is closed. See ANNEX I. Automatic Air Recirculation in Cooling Mode.

- **Initialization**: enables to configure the behaviour of the 'Analog' fan coil module after a bus fault or an ETS download. See section 2.2.6.

ETS PARAMETERISATION

After enabling the **Fan Coil X** in the "Configuration" tab (see section 2.1), a new tab with the same name is added to the left tree.

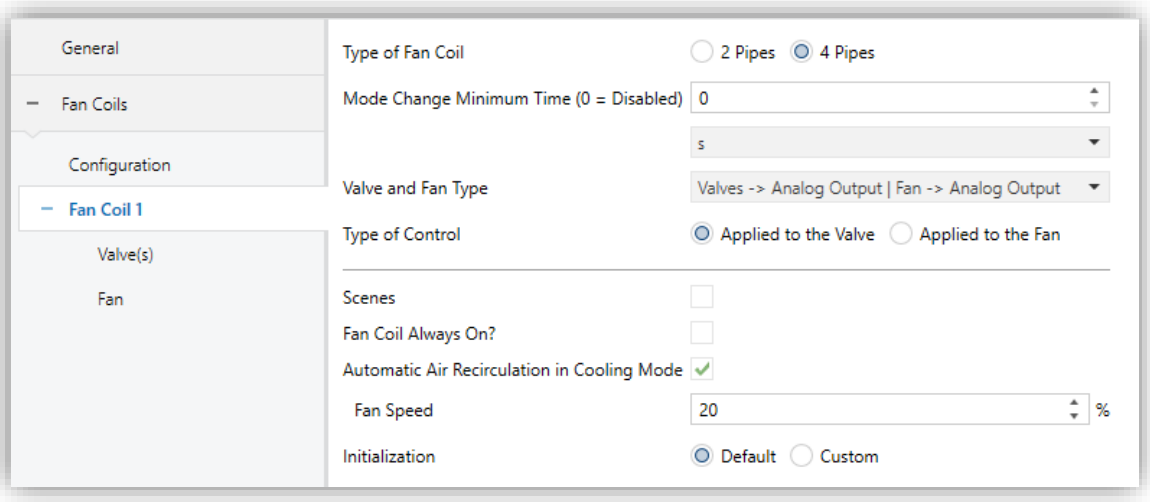


Figure 3. Fan Coil X - General Configuration.

- **Type of Fan Coil** [*2 Pipes / 4 Pipes*].
- **Mode (**only available for "2 Pipes" fan coil unit**)** [*Heating / Cooling / Cooling + Heating*].

  For fan coil of "4 Pipes" or "2 Pipes" with "Cooling + Heating" mode active, there will be the one-bit object **"[FCx] Mode"** for the selection of the desired mode, as well as the corresponding status object **"[FCx] Mode (Status)"**.

- **Mode Change Minimum Time (**only available for fan coil of "4 Pipes" or "2 Pipes" with "Cooling + Heating" mode active**)** [*[0…3600][s] / [0…1440][min] / [0…24][h]*]: time that will elapse from fan deactivation to the opening of the new mode valve.
- **Type of valve** [*Valves -> Analog Output | Fan -> Analog Output* / *Valves -> Analog Output | Fan -> Relays* / *Valves -> Relays | Fan -> Analog Output*].
- **Type of control**: [*Applied to the valve* / *Applied to the fan*].
- **Scenes** [*disabled/enabled*]: enables or disables the "Scenes" tab (see section 2.2.5).
- **Fan Coil Always On** [*disabled/enabled*]: configures the module to maintain the fan coil control permanently switched on. If disabled, the objects "**[FCx] On/Off**"

and **"[FCx] On/Off (Status)"** will allow, respectively, to switch on/off the control and to know its status.

- **Automatic Air Recirculation in Cooling Mode** [*disabled/enabled*]: sets whether in the Cooling mode the fan should remain on, even when the valve is closed. See ANNEX I. Automatic Air Recirculation in Cooling Mode for more information.

  - **Fan Speed** [*0…20…100*][*%*] or [*0, 1, 2, 3*] (depending on the type of control): speed that the fan will reach when the air recirculation is activated. This speed can be modified through the object **"[FCx] Fan: Automatic Air Recirculation Speed"**.

- **Initialization** [*Default / Custom*]: enables configuration of the behaviour of the Fan Coil 'Analog' module after a bus failure or an ETS download. If the "Custom" option is selected, the "Initialization" sub-tab is enabled. See section 2.2.6.

2.2.1 ANALOG VALVE

Two types of control are available for analog valves: applied to the valve or applied to the fan. The following sections detail the operation and parameterisation in each case.

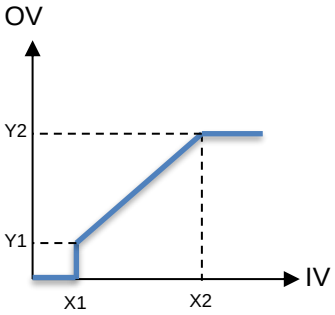
2.2.1.1 FAN-ORIENTED CONTROL

The valve state in this case will be **determined by the state of the fan**, both under an automatic fan control and under a manual fan control (through any of the objects provided for that purpose). See sections 2.2.3.1 y 2.2.4.1. However, this behaviour, will depend on whether **Automatic Air Recirculation in Cooling Mode** has been enabled or not, as further detailed in ANNEX I. Automatic Air Recirculation in Cooling Mode.

The control signal characteristics and limits can be configured, and an anti-seize protection can be enabled for each valve.

- **Control signal scaling:** adjusts the valve control signal (OV) by means of a scaling function of the input control signal (IV) received from the thermostat.

  The **output control value (OV)**, resulting from the scaling function, is defined by the following variables:



$$OV = \begin{cases} Y2, & IV \in (X2,100) \\ \left(\frac{Y2-Y1}{X2-X1}\right)(IV - X1) + Y1, & IV \in [X1,X2] \\ 0, & IV \in (0,X1) \end{cases}$$

- **Input control value (*IV*):** control value received from the thermostat. The objects that will store this value will be **"[FCx] Control Variable (Heating)"** and **"[FCx] Control Variable (Cooling)"**.

- **Minimum/Maximum input value (*X1*/*X2*):** values of the input control signal which determine from which value the valve shall start to open and from which value the valve is considered fully open. For values below the minimum the valve will remain closed and values above the maximum will be ignored, as the valve is considered to be already open.

- **Minimum/Maximum output value (*Y1*/*Y2*):** valve control values determining minimum and maximum opening percentages. These are specific characteristics of each valve.

The objects that will store the output control value, **"[FCx] Valve: Control (1 Byte)"** (for fan coil of two pipes) and **"[FCx] Cooling Valve: Control (1 Byte)"** and **"[FCx] Heating Valve: Control (1 Byte)"** (for fan coil of four pipes), must be linked to the appropriate actuator.

Example**: Valve that, for installation reasons, **is configured:

- ***Y1 = 10%*** → *Minimum valve opening value.*
- ***Y2 = 75%*** → *Maximum valve opening value.*
- ***X1 = 33%*** → *Minimum regulation value for the valve to start opening.*
- ***X2 = 66%*** → *Control value at which the valve is considered fully open (in this case 75%).*

- *With an input value (VE) of 20%, the valve does not open. Minimum input regulation value 33%.*
- *With an input value (VE) of 40%, the valve outlet value (VS) will be 23.8%.*

- *With an input value (VE) of 70%, the valve outlet value (VS) will be 75%.*

- **Control signal change limits:** prevent damage to the valve due to small changes in its position and/or permanent activation of the valve.

- **Anti-seize protection:** automatic and independent functionality for each valve, which prevents the valves from remaining in a fixed position, either open or closed, for longer than the configured time. Every time the anti-seize period expires, the valve will automatically switch to the inverse position, remaining at it until the execution time ends. After that, the valve will recover the previous state or, if a control or mode change command has been received during the run, to the new corresponding position.

  Note: *To minimise the **undesirable effects** that the anti-seize protection may cause (e.g., opening the heating valve in summer, opening the cooling valve in winter, or closing the heating valve in winter), the fan will turn off during the execution of the anti-seize protection, except in the specific case that the action consists in closing the cooling valve and the air recirculation is active; in such case, the desired fan speed will be the air recirculation speed.*

  Note: *For safety reasons, if 4 pipes are configured and the anti-seize protection is initiated on the cooling valve when it is closed and the heating valve is open, then both will change their status avoiding having both valves open at the same time.*

ETS PARAMETERISATION

This section includes all parameters related to the configuration of the cooling and heating valves.

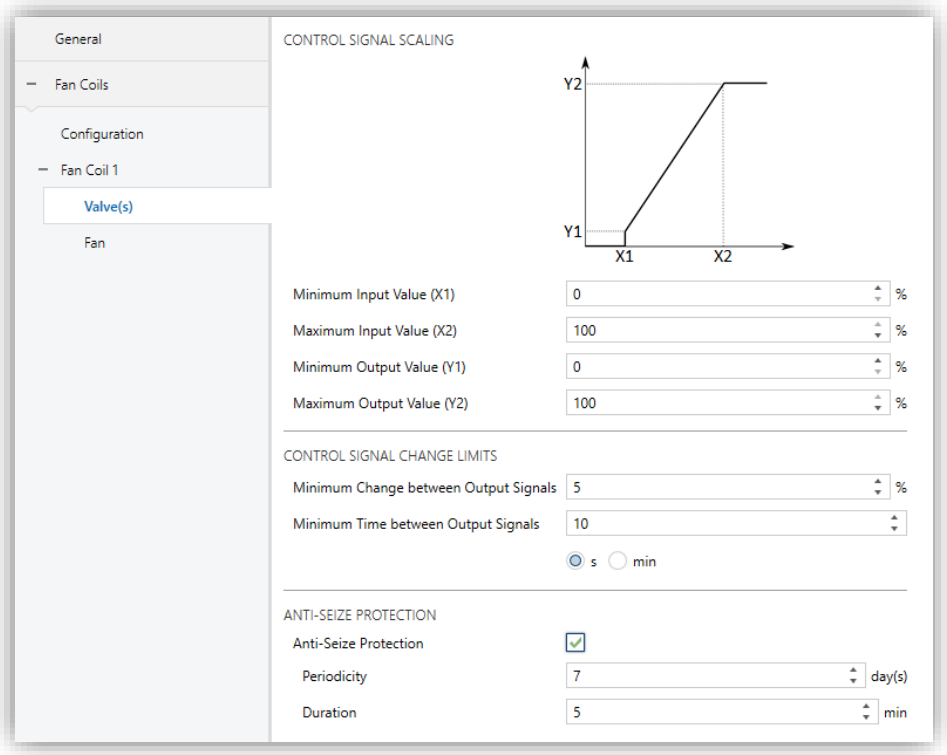


Figure 4. Fan Coil – Analog Valve.

The parameters are the following:

- **Control Signal Scaling**

  - **Minimum Input Value (X1)** [*0…100*][*%*]: defines the minimum regulation value to be received from the thermostat that will cause the valve to start opening.

  - **Maximum Input Value (X2)** [*0…100*][*%*]: defines the maximum regulation value to be received from the thermostat that will cause the maximum opening of the valve.

  - **Minimum Output Value (Y1)** [*0…100*][*%*]: defines the minimum operating value of the valve at which it will start to open.

  - **Maximum Output Value (Y2)** [*0…100*][*%*]: defines the maximum operating value of the valve, maximum opening position.

Note: *If, as a result of a parameterisation error, the minimum value of the control signal (input or output) is greater than a maximum value, 0% (minimum) and 100% (maximum) will be taken as control signal scaling range.*

- **Control Signal Change Limits**

  - **Minimum Change between Output Signals** [*0…5…100*][*%*]: minimum increase or decrease in the output signal value with respect to the last value that caused a change in the valve position.

  - **Minimum Time between Output Signals** [*[0…10…3600][s]* / *[0…1440][min]*]: minimum time that must elapse since the last action that caused a change in valve position.

  Notes:

  - *The parameter minimum change between output signals is not taken into account if the command involves a change to the maximum value, or a closing of the valve.*
  - *Both parameters (minimum change and minimum time between output signals) must be met for the control signal to be sent to the valve. If the output signal exceeds the parameterized minimum change value, but the minimum time between output signals has not been met, the sending will take place once the parameterized time has elapsed.*

- **Anti-Seize Protection**

  - **Anti-Seize Protection** [*disabled/enabled*]: enables or disables the valve anti-seize protection function, and with it the objects **"[FCx] Valve: Anti-Seize Protection (Status)"** (for fan coil of two pipes) and **"[FCx] Cooling Valve: Anti-Seize Protection (Status)"** and **"[FCx] Heating Valve: Anti-Seize Protection (Status)"** (for fan coil of four pipes), which will take the value "1" when the function is running or "0" otherwise.

    - **Periodicity** [*1…7…255*][*day(s)*]: defines the maximum time that the valve can remain in the same position.
    - **Duration** [*1…5…10*][*min*]: defines the run time of the anti-seize protection. During this time the valve will remain in the opposite position.

2.2.1.2 VALVE-ORIENTED CONTROL

In this case, the control will focus on responding the orders over the valves that arrive from the bus, making the fan state depend on these orders.

The control signal characteristics and limits can be configured, and an anti-seize protection can be enabled for each valve. The parameters are analogous to the fan-oriented control. See section 2.2.1.1.

2.2.2 BINARY VALVE (RELAYS)

As with analog valves, two types of control are available for binary valves (relays): applied to the valve or applied to the fan. The following sections detail the operation and parameterisation in each case.

2.2.2.1 FAN-ORIENTED CONTROL

As with the analog valve (see section 1.1.1), the control will focus on responding the orders over the fan that arrive from the bus, making the valve state depend on these orders.

The relay control characteristics and control signal limits can be configured and an anti-seize protection can be enabled for each valve. The latter has the same functionality as the analog valve (see section 2.2.1.1).

- **Relay Control**: set the **value that defines the open state** of the valve, i.e., whether it is the value "0" or the value "1" the one to be interpreted as "open valve" in the object related to the valve.

  - **Input control value (*IV*):** control value received from the thermostat. The objects that will store this value will be **"[FCx] Control Variable (Heating)"** and **"[FCx] Control Variable (Cooling)"**.

  The objects that will store the output control value, **"[FCx] Valve: Control (1 Bit)"** (for fan coil of two pipes) and **"[FCx] Cooling Valve: Control (1 Bit)"** and **"[FCx] Heating Valve: Control (1 Bit)"** (for fan coil of four pipes), must be linked to the appropriate actuator.

- **Control signal change limits:** prevent damage to the valve due to successive commutations of the valve.

ETS PARAMETERISATION

This section includes all parameters related to the configuration of the binary valves.

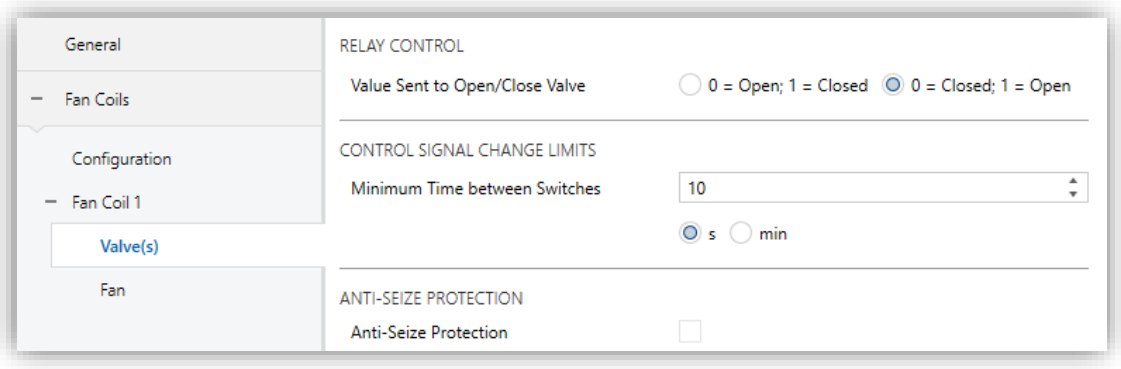


Figure 5. Fan Coil – Binary Valve – Fan-Oriented Control.

The parameters are the following:

- **Value Sent to Open/Closed Valve** [*0 = Open; 1 = Closed / 0 = Closed; 1 = Open*].
- **Minimum Time between Switches** [*[0…10…3600][s] / [0…1440][min]*]: minimum time that must elapse since the last action that caused a change in the valve position.

2.2.2.2 VALVE-ORIENTED CONTROL

In this case, the control will focus on responding to the orders over the valve that may arrive from the bus.

As for fan-oriented control, the relay control characteristics, control signal limits and anti-seize protection can be configured. The parameters are analogous to fan-oriented control (see section 2.2.2.1) except for the method of valve control.

- **Valve control method**: Relay valves may be controlled by two alternative approaches, depending on the type of the communication object (one-byte or binary) used by the external thermostatic controller to send the orders.
  - **Control Variable (1 Bit)**: The input control variable is a **binary value**, and will determine when the valve should open or close.
  - **PI Control (1 Byte)**: The input control variable is a **percentage value**, and will determine the fraction of time the valve should remain open on every

cycle. For instance, a value of 50% means the valve must remain open for half of the cycle time.

Being the valves binary type (relays), the second case implies **controlling them through PWM signals** as well, although calculated according to the percentage value. Therefore, it is necessary to parameterise the specific cycle time desired for that PWM control. In the first case, on the contrary, such cycle time is not necessary.

ETS PARAMETERISATION

When selecting "Applied to the Valve" type of control and the valve is binary type (relays), the "Valve(s)" tab show the next specific options (the rest of the options are analogous to what was explained in section 2.2.2.1)

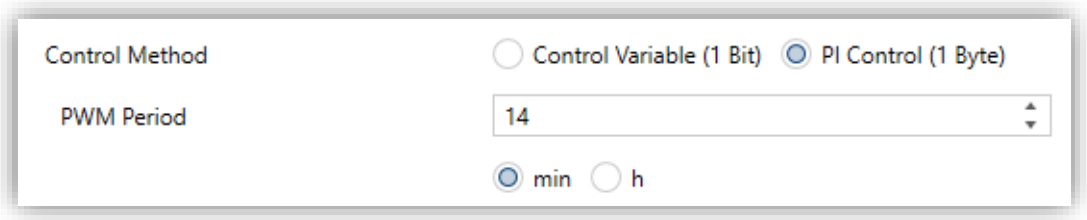


Figure 6. Fan Coil – Binary Valve – Valve-Oriented Control.

The parameters are the following:

- **Control Method** [*Control Variable (1 Bit)* / *PI Control (1 Byte)*].

  - Control Variable (1 Bit): enables the objects "**[FCx] Cooling Valve: Control Variable (1 Bit)**" and / or "**[FCx] Heating Valve: Control Variable (1 Bit)**", provided for the reception of open / close orders for the valve from the KNX bus.

  - PI Control (1 Byte): the objects "**[FCx] Control Variable (Cooling)**" and / or "**[FCx] Control Variable (Heating)**", are provided for the reception of PI control percentage values from the KNX bus. If this option is selected, the following parameter appears:

    - **PWM Period** [*[1…14…1440][min]* / *[1…24][h]*]: sets the cycle time for the PWM control.

  In any of the two cases, the output objects "**[FCx] Cooling Valve: Control (1 Bit)**" and "**[FCx] Heating Valve: Control (1 Bit)**" (for fan coil of four pipes) and "**[FCx] Valve: Control (1 Bit)**" (for fan coil of two pipes) will be available.

2.2.3 ANALOG FAN

The following section detail the operation and parameterisation of an analog fan, for fan-oriented control and valve-oriented control.

2.2.3.1 FAN-ORIENTED CONTROL

The fan features an **automatic** control, in which its speed is calculated by the module itself and an external reference, and a **manual** control, in which the fan speed will be controlled externally; the user can directly take part in the selection of the desired speed through a set communication object of different types, independently of the value received through the objects of the automatic fan control.

The fan speed will always comply a **minimum value to active fan** and a **minimum** and a **maximum allowed speed**. If the latter is less than 100% a **Boost mode** can be additionally configured, in which a fixed value is set, allowing the **maximum value** to be exceeded for a certain period.

When both, the manual and the automatic control modes are allowed, an object is provided to switch from one mode to the other, although **the reception of a manual order** causes itself a switch to the manual control mode. It is possible to parameterise which of the two control modes must be active **after download**, and also a **time-out counter** so the automatic control mode is automatically triggered back after some time with no activity under the manual control mode.

Regarding the **manual control**, the communication objects that permit switching the fan speed are of different types and are in any case conditioned by the number of fan speeds parameterised, according to the next table:

Available speeds	Speed	Percentage
Two speeds	0	0%
	1	50%
	2	100%
Three speeds	0	0%
	1	33%
	2	66%
	3	100%
Four speeds	0	0%
	1	25%
	2	50%
	3	75%
	4	100%
Five speeds	0	0%
	1	20%
	2	40%
	3	60%
	4	80%
	5	100%

Table 1. Equivalence in percentage according to the number or speeds

- **Step-control objects**: one-bit objects for increasing or decreasing the speed level sequentially, either **cyclically** (a further step once reaching the maximum level activates the minimum level again) or not.

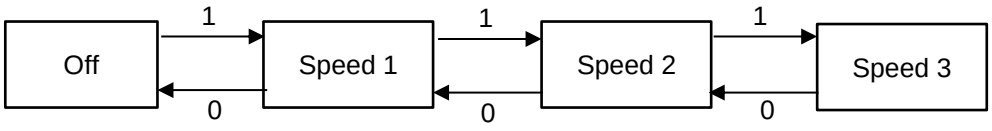


Figure 7. Non-cyclical fan step control

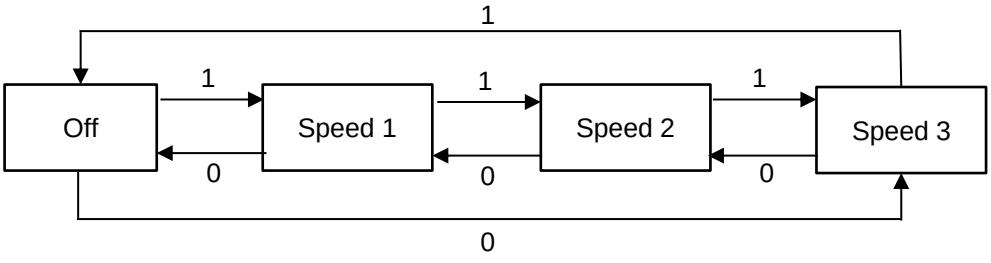


Figure 8. Cyclical fan step control

The above sequence can incorporate an additional state: **the automatic speed mode**, which allows switching to automatic control. The following options are possible:

- Non-cyclical control:
  - Activate automatic speed mode if, being the fan off, a request to decrease the speed is received.
  - Activate automatic speed mode if, being the fan at the maximum speed level, a request to increase the speed level is received.
  - Activate the automatic speed mode in any of the two previous cases.
- Cyclical control: the automatic speed will be an intermediate state between the two ends of the sequence.

- **One-bit objects (one per speed)**, which activate a particular speed level on the reception of the value "1".
- **One-byte enumerated object**: the speed switch will take place upon the arrival of the proper integer value (0, 1, 2, 3, 4, 5).
- **Percentage object**: the speed switch will take place upon the arrival of the proper percentage value.

As with the valve, the **control signal change limits** prevent damages to the fan due to small changes in its speed and/or permanent modifications of the fan speed.

On the other hand, a **delay to activate and deactivate fan** can be defined for each operating mode (cooling/heating). These delays will establish how much time must elapse from the arrival of the control signal that generates the fan on or off, until the output control command is sent to the fan. If there is a parameterised **minimum time for**

mode change (see section 0), this delay will be applied together with the fan activation and deactivation delays as follows:

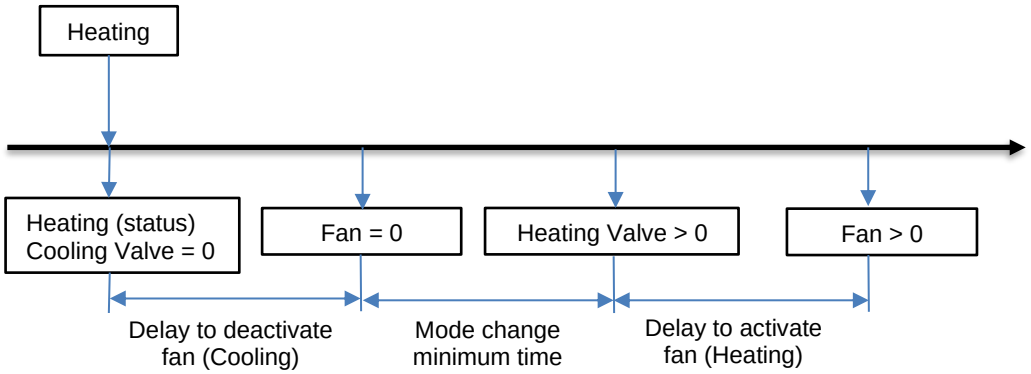


Figure 9. Delay for fan activation/deactivation.

ETS PARAMETERISATION

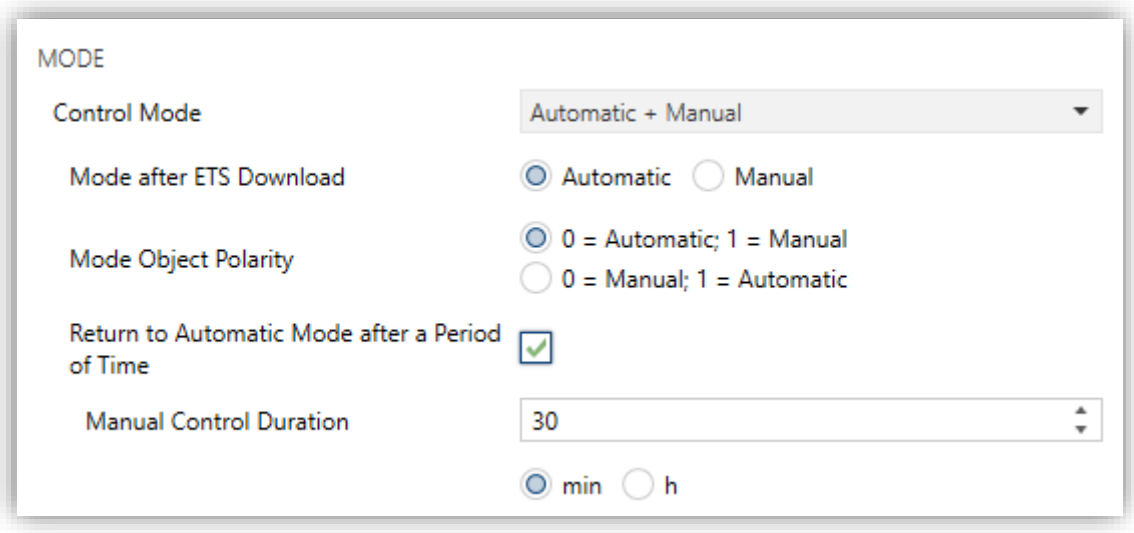


Figure 10. Fan Coil – Fan mode.

- **Control Mode** [*Automatic / Manual / Automatic + Manual*]. If "Automatic + Manual" is selected, the parameters corresponding to the mode change are displayed:
  - **Mode after ETS Download** [*Automatic / Manual*].
  - **Mode Object Polarity** [*0 = Automatic; 1 = Manual / 0 = Manual; 1 = Automatic*]: sets the polarity of the object that enables switching from one control mode to another **("[FCx] Fan: Manual/Automatic"**), as well as its status object (**"[FCx] Fan: Manual/Automatic (Status)"**).

- **Return to Automatic Mode after Period of Time** [*disabled*/*enabled*]. Enabling this functionality displays the parameters for its configuration:

  - **Manual Control Duration** [*0…30…1440*][*min*] / [*0…24*][*h*]. If, after this time, the fan has not received any new manual control command (**"[FCx] Manual Fan: Speed"**), the automatic control mode will be restored. This time can be modified through the object **"[FCx] Manual Fan: Manual Control Duration"**.

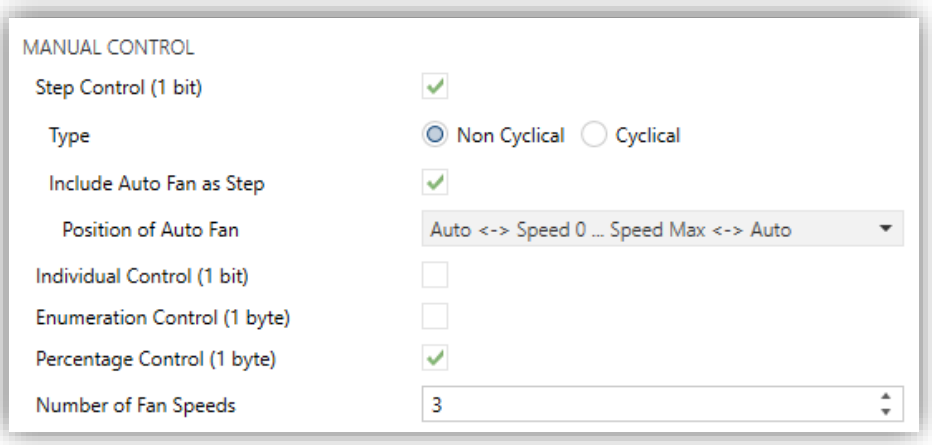


Figure 11. Fan Coil – Manual Fan Control.

If the **Manual** or **Automatic + Manual** option is selected, the parameters for manual control are displayed:

- **Step Control (1 bit)** [*disabled*/*enabled*]: increases or decreases the fan speed on receiving '1' or '0' respectively for the object **"[FCx] Manual Fan: Step Control"**. When this parameter is enabled, it appears:

  - **Type** [*Non Cyclical*/*Cyclical*]: allows activation of the minimum level or auto after the maximum level. If the chosen option is "Non Cyclical" it can be selected:

    - **Position of Auto Fan** [*Auto <-> Speed 0 … Speed Max <-> Auto*/*Auto <-> Speed 0 … Speed Max*/ *Speed 0 … Speed Max <-> Auto*]. Allows to switch to auto when decreasing speed 0, increasing maximum speed or both.

- **Individual Control (1 bit)** [*disabled*/*enabled*]: when a '1' is received through the object **"[FCx] Manual Fan: Speed x"** the corresponding speed of this object is

applied; if a '0' is received and this specific speed was active, the fan is switched off.

- **Enumeration Control (1byte)** [*disabled/enabled*]: receives the fan speed numerically through the object **"[FCx] Manual Fan: Enumeration Control"**.

- **Percentage Control (1 byte)** [*disabled/enabled*]: receives values between 0% and 100% through the object **"[FCx] Manual Fan: Percentage Control"**.

- **Number of Fan Speed** [*2, 3, 4, 5*]: establishes the number of speeds of the fan and assigns a fixed ventilation value depending on the number of configured speeds (see Table 1).

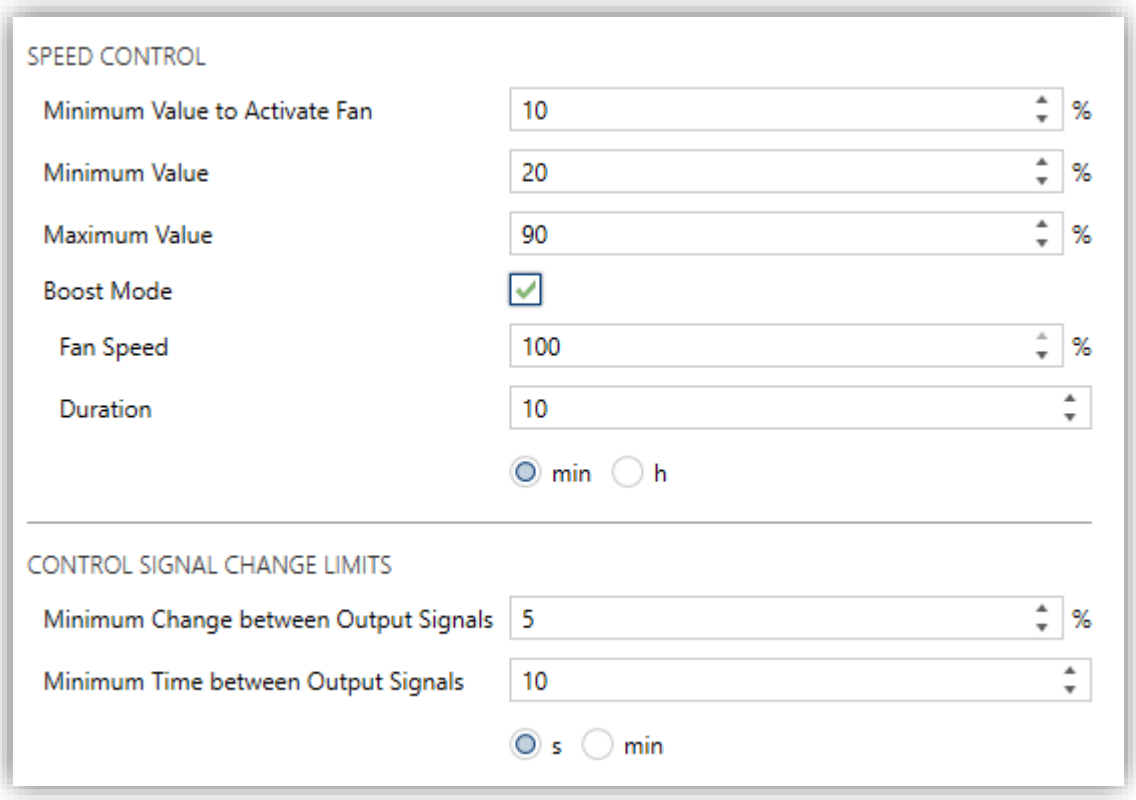


Figure 12. Fan Coil – Analog Fan.

- **Fan Speed Control.**

  An input signal to control the fan coil generates an **output value** according to the following parameterizable limits:

  - **Minimum Value to Activate Fan** [*1...10...100*][*%*]. For any input control value lower than this limit, the output will be equal to **zero**.

Note: *If the fan is on and an input value lower than the minimum value to active is received, the fan will be deactivated, except when automatic air recirculation is applied in cooling mode (see ANNEX I. Automatic Air Recirculation in Cooling Mode).*

- **Minimum Value** [*1...20...100*][*%*]. For any input control value lower than this limit (but above a minimum value to activate), the output will be equal to **minimum value**.

- **Maximum Value** [*1...100*][*%*]: maximum value allowed so that, for any input control value higher than this limit, the generated output will be equal to the **maximum value**.

These parameters also apply to the fan speed manual control through any of the manual control objects.

- **Boost Mode** [*disabled/enabled*]: allows the **maximum value** to be exceeded for a certain period. Only displayed when the maximum value is less than 100%. The following parameters may be configured:

  - **Fan Speed** [*1...100*][*%*]: output speed when the Boost mode command is received by the object **"[FCx] Fan: Boost Mode"**.
  - **Duration** [*1…10…1440*][*min*] / [*1…24*][*h*]: time the output will be in Boost mode.

  Note: *While Boost mode is active, automatic control commands are ignored. However, commands received by any manual control object are applied directly, stopping the Boost mode.*

The generated output value will be sent through the communication object **"[FCx] Fan: Speed Control"**.

- **Control Signal Change Limits**

  - **Minimum Change between Output Signals** [*0…5…100*][*%*]: minimum increase or decrease in the output signal value with respect to the last value that caused a change in the fan speed.

  - **Minimum Time between Output Signals** [*[0…10…3600][s] / [0…1440][min]*]: minimum time that must elapse since the last action that caused a change in the fan speed.

Notes:

- *The parameter minimum change between output signals is not considered if the command involves a change to the maximum value, or a turning off the fan.*
- *Both parameters (minimum change and minimum time between output signals) must be met for the control signal to be sent to the fan. If the output signal exceeds the parameterized minimum change value, but the minimum time between output signals has not been met, the sending will take place once the parameterized time has elapsed.*

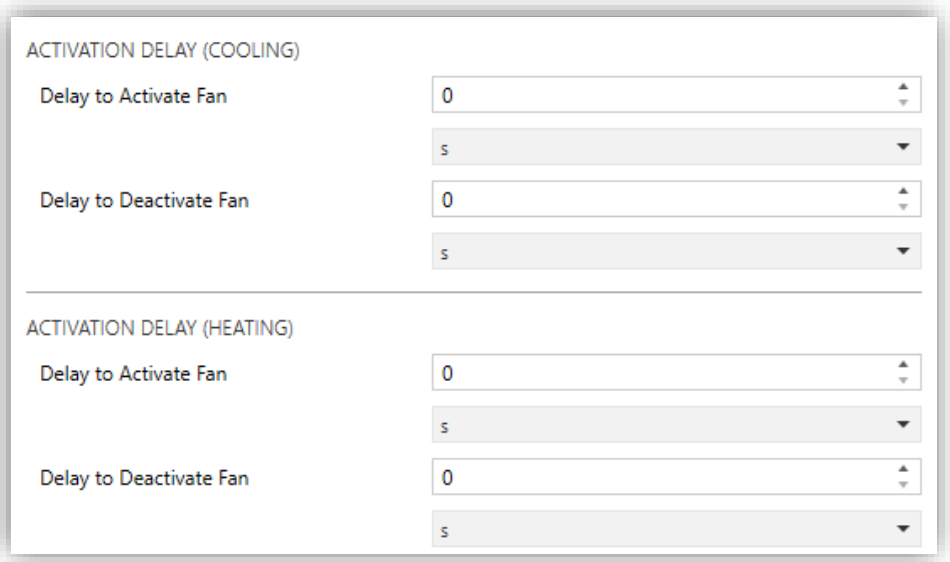


Figure 13. Fan Coil – Activation Delay.

Activation delay

For each operating mode (cooling and heating) there will be the following parameters:

- **Delay to Activate Fan** [*[0…3600][s] / [0…1440][min] / [0…24][h]*]: time that will elapse from the arrival of the control signal that turns on the fan to the sending of the order that will make the activation effective.
- **Delay to Deactivate Fan** [*[0…3600][s] / [0…1440][min] / [0…24][h]*]: time from the arrival of the control signal that will turn off the fan, to the sending of the order that will make the deactivation effective.

2.2.3.2 VALVE-ORIENTED CONTROL

In this case, the control will focus on responding to the orders over the valve that may arrive from the bus, making the fan state depend on these orders.

As for fan-oriented control, **automatic** and **manual** control is available and all parameters are analogous (see section 2.2.3.1) except for the speed control method, which does not have minimum speed to activate, as it is now valve-dependent.

ETS PARAMETERISATION

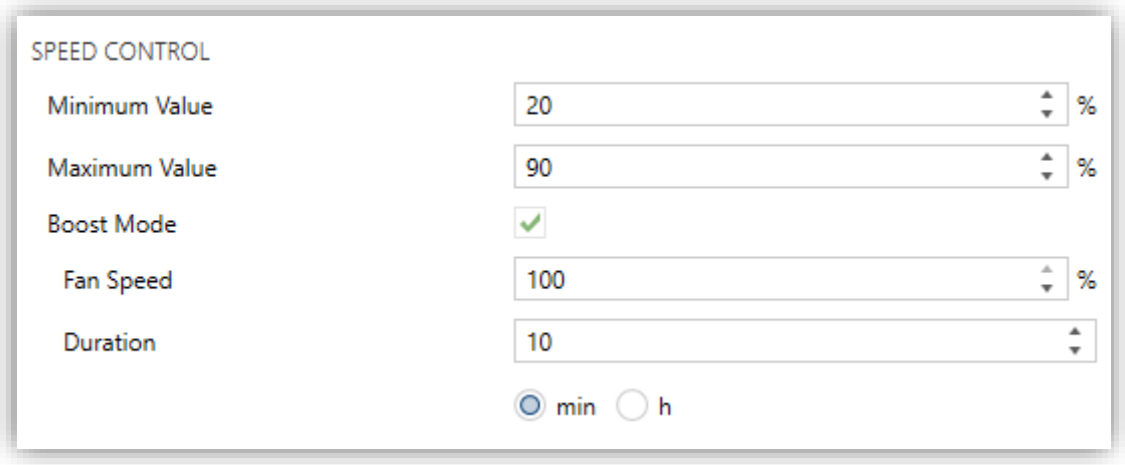


Figure 14. Fan Coil – Analog Fan.

- **Speed Control Mode**

  An input signal to control the fan coil generates an **output value** according to the following parameterizable limits:

  - **Minimum value** [*1...20...100*][*%*]. For any input control value that causes an output lower than this limit, the output will be equal to the **minimum value**.

    Note:

    - *For an input value 0, the output will be equal to 0, so the fan will be deactivated, except when automatic air recirculation is applied in cooling mode (see ANNEX I. Automatic Air Recirculation in Cooling Mode).*
    - *If the control command received involves fan deactivation but opens the valve, the fan will be set to the minimum value.*

- **Maximum Value** [*1...100*] [*%*]: maximum value allowed so that, for any input control value that causes an output higher than this limit, the generated output will be equal to the maximum value.

These parameters also apply to the fan speed manual control through any of the manual control objects.

- **Boost Mode** [*disabled/enabled*]: allows the **maximum value** to be exceeded for a certain period. Only displayed when the maximum value is less than 100%. The following parameters may be configured:

  - **Fan Speed** [*1...100*][*%*]: output speed when the Boost mode command is received by the object **"[FCx] Fan: Boost Mode"**.
  - **Duration** [*1…10…1440*][*min*] / [*1…24*][*h*]: time the output will be in Boost mode.

  Note: *While Boost mode is active, automatic control commands are ignored. However, commands received by any manual control object are applied directly, stopping the Boost mode.*

The generated output value will be sent through the communication object **"[FCx] Fan: Speed Control"**.

2.2.4 BINARY FAN (RELAYS)

The binary fan allows controlling up to **three fan speed levels**. To activate each of them, one binary output becomes active, either through *switching* or through *accumulation*:

- **Switching**: only one of the fan control binary outputs is active each time, (only one relay is closed for the activation of each speed). It is possible to set up a **delay** between the opening of the source speed relay and the closing of the target speed relay (so both stay open for an instant).

- **Accumulation**: the speed will be proportional to the number of active outputs (i.e., closed relays), which therefore get triggered in sequence.

A **fan engine starting characteristic** may be configured, which is useful for some engines that require an extra amount of current in comparison to that required in normal operation. Thus, during the start-up, some engines need to step through a higher speed level (e.g.: 2 or 3) for some time before switching to lower speeds.

It has already been mentioned in previous sections that the fan has a manual an automatic control. Everything concerning the mode, manual control and fan delays is the same as explained in section 2.2.3.1.

The generated binary outputs for each relay will be sent through the communication objects **"[FCx] Fan: Speed X Control"** (one for each configurated speed).

As the status displayed by the outputs simply shows the opening or closing of each relay, the objects **"[FCx] Fan: Speed Enumeration (Status)"** and **"[FCx] Fan: Speed Percentage (Status)"** are included to inform the fan speed, and their equivalence meets the KNX standard as shown in Table 2.

Available speeds	Speed	Percentage
One speed	0	0%
	1	0.4% – 100%
Two speeds	0	0%
	1	0.4% – 50.2%
	2	50.4% – 100%
Three speeds	0	0%
	1	0.4% – 33.3%
	2	33.7% – 66.6%
	3	67% - 100%

Table 2. Equivalence in percentage according to the number or speeds

ETS PARAMETERISATION

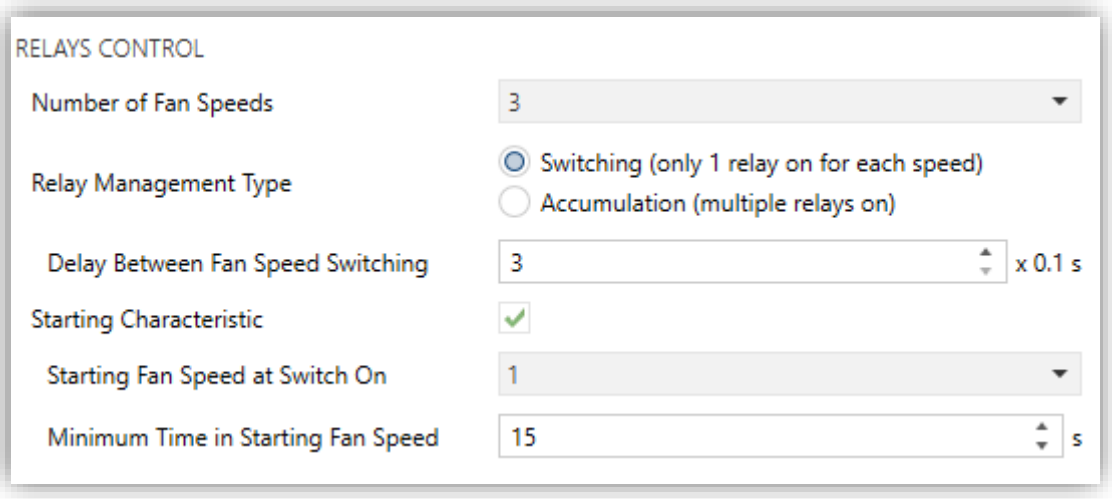


Figure 15. Fan Coil – Relays Control.

- **Number of Fan Speed** [*1/2/3*].

- **Relay Management Type** [*Switching (only 1 relay on for each speed)* / *Accumulation (multiple relays on)*]. If set to "Switching", an additional parameter is shown:
  - **Delay Between Fan Speed Switching** [*3…100*][*x0.1s*]: set a delay since the source relay opens and the target relay closes, thus making both relays remain open during the delay configured.
- **Starting Characteristic** [*disabled*/*enabled*]: enables / disables this functionality.
  - **Starting Fan Speed at Switch On** [*1*/*2*/*3*]: sets the fan speed level the fan engine should adopt when it starts up, before being able to adopt lower speeds. Note that available options depend on the number of fan speed levels.
  - **Minimum Time in Starting Fan Speed** [*1…15…255*][*s*]: sets the time the fan engine should remain at the above speed when it starts up.

2.2.4.1 FAN-ORIENTED CONTROL

The fan control may be **manual** (the fan speed will be controlled externally), **automatic** (the fan speed will be controlled by the module itself), or **both**.

The automatic fan speed control will be subject to the value of one specific **percentage** object per working mode (heating / cooling).

It is therefore required to set the **range of the percentage values** that will determine the fan speeds established when received from the bus (from an external, continuous PI thermostat controller). For this purpose, the value of **Threshold 1**, **Threshold 2** and **Threshold 3** is defined in parameters, so that:

- Value received < Threshold 1 → the fan is turned off.
- Value received ≥ Threshold 1 → speed 1.
- Value received ≥ Threshold 2 → speed 2
- Value received ≥ Threshold 3 → speed 3

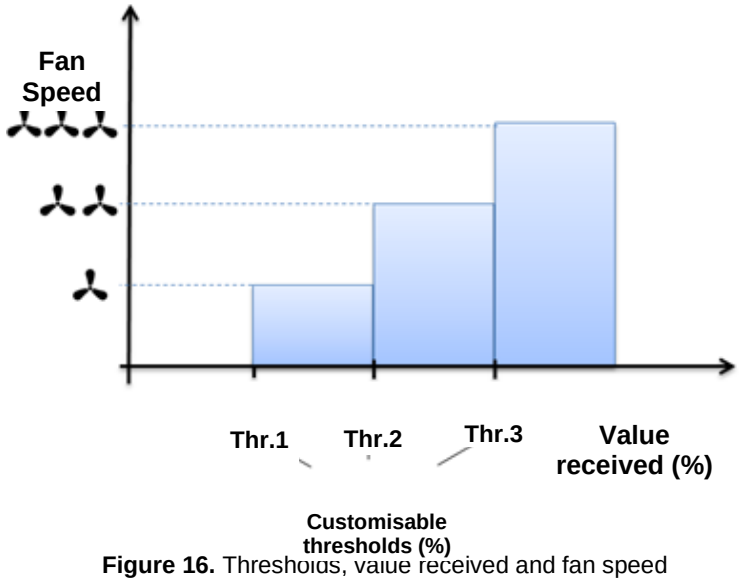


Figure 16. Thresholds, value received and fan speed

Besides, a **hysteresis** can be configured to avoid continuous relays switching when the control signal oscillates around the parameterised thresholds. This way, when the control signal is greater than the configured threshold plus the hysteresis, the system will switch to the immediately upper speed; and to the immediately lower speed when the control signal is lower than the threshold minus the hysteresis.

Having the parameter **Automatic Air Recirculation in Cooling Mode** activated, when a control value in cooling mode lower than Threshold 1 is received, the valve will be closed but the fan will maintain recirculation speed (see ANNEX I. Automatic Air Recirculation in Cooling Mode).

The above criterion, as well as the number of thresholds to be parameterised, may be conditioned by the parameter **Number of fan speeds**.

ETS PARAMETERISATION

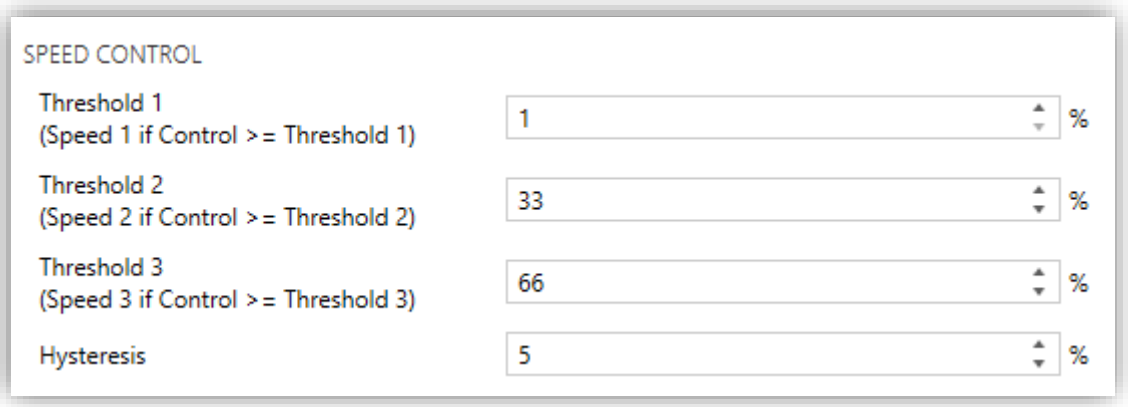


Figure 17. Fan Coil – Fan-Oriented Control – Speed Control.

- **Threshold 1 (Speed 1 if Control ≥ Threshold 1)** [*1…100*][*%*].
- **Threshold 2 (Speed 2 if Control ≥ Threshold 2)** [*1…33…100*][*%*].
- **Threshold 3 (Speed 3 if Control ≥ Threshold 3)** [*1…66…100*][*%*].
- **Hysteresis** [*0…5…10*][*%*]

2.2.4.2 VALVE-ORIENTED CONTROL

In the valve-oriented control, the fan control value is also received through a percentage communication object and may be the same value that controls the valve.

One speed or another will be applied to the fan depending on whether the control value exceeds certain parameterizable thresholds. These thresholds are the same as in fan - oriented control (see section 2.2.4.1), with the exception that it has not threshold 1 since the activation and deactivation of the fan depends on the value of the valve.

2.2.5 SCENES

It is possible to define up to **eight scenes** so that, when the corresponding value is received from the bus, the module adopts a certain state, which must be defined terms of the following:

- On / Off state of the module.
- Fan mode and fan speed .

- If only the **automatic** fan control has been parameterised, it will not be possible to change the fan speed through scenes.
- If only the **manual** fan control has been parameterised, it will be possible to select a specific speed for the fan by parameter or leave it as is.
- If both **automatic** and **manual** fan controls have been parameterised, it will be possible to choose between both of them by parameter (and to select a specific fan speed, in case of switching to manual), or leave the fan as it is.

It is important to bear in mind that executing a scene is equivalent to sending the analogous orders to the corresponding objects. Therefore, the result will depend on the initial state of the fan coil module when the scene is executed.

For example, if a manual speed selection order is received during the anti-seize protection process of the valve, the order will be buffered and executed after the completion of the anti-seize function, as it would happen in case of receiving the request through the analogous communication object.

This module permits the **scene saving**, although it will not be possible to save any states that, for the current configuration and according to the above explanations, may not be available for configuration in ETS during the scene parameterisation (e.g., the fan speed if only the automatic fan control is available). States configured not to change in the original scene parameterisation will not be saved, either.

ETS PARAMETERISATION

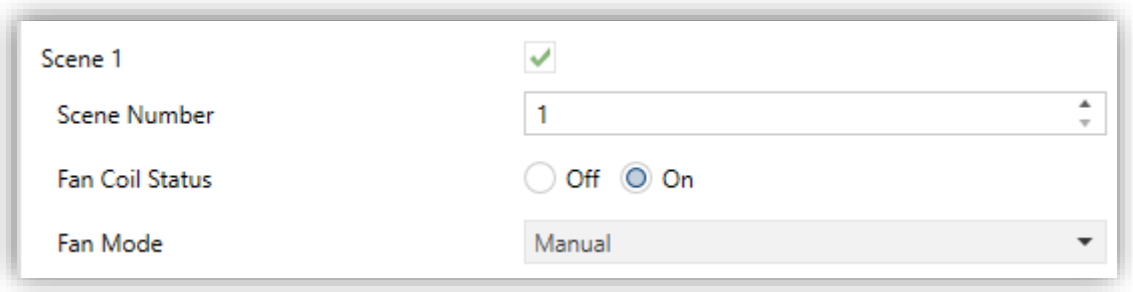


Figure 18. Fan Coil – Scenes.

- **Scene "n"** [*disabled*/*enabled*]: enables or disables scene "n", which should be then configured through the following additional parameters:

- **Scene Number** [*1…64*]: sets the value (1-64) that, when received through the object **"[FCx] Scenes"** will trigger the actions according to the configuration defined next.

- **Fan coil Status** [*Off*/*On*].

The following parameters only apply if *Fan coil* State has been set to "On":

- **Fan Mode** [*Automatic*/*Manual*/*No Change*]. Only available if both, the automatic and the manual fan control have been enabled.

Depending on the type of fan, the way of selecting the speed will change. For analog fan:

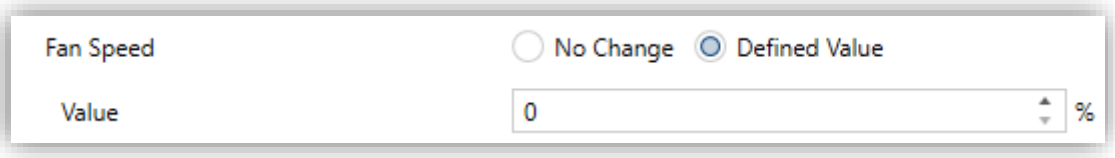


Figure 19. Fan Coil – Scenes – Fan Analog Speed.

- **Fan Speed** [*No Change*/*Defined Value*].

  - **Value** [*0…100*][*%*]: (only available if Fan Model has been set to "Manual", or if only manual fan control is available). Sets the speed to be adopted on the fan.

For binary fan (relays):

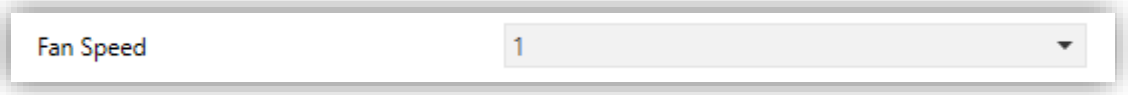


Figure 20. Fan Coil – Scenes – Fan Relays Speed.

  - **Fan Speed** [*0, 1, 2, 3, No Change*]: (only available if Fan Model has been set to "Manual", or if only manual fan control is available). Sets the speed to be adopted on the fan (depending on which are available).

2.2.6 INITIALISATION

For safety reasons, after an ETS download, the fan coil 'Analog' function module, will always initialise off. After a bus failure the module, by default, will keep its previous state.

This tab offers the possibility to configure the initialization of the Fan Coil 'Analog' module by defining aspects such as its initial state or whether an update of the input objects and/or the sending of certain status objects is required after start-up.

If the **input objects update** functionality is enabled, read requests for update will be sent to the following objects:

- **"[FCx] On/Off".**
- **"[FCx] Mode".**
- **"[FCx] Control Variable (Heating/Cooling)".**
- **"[FCx] Fan: Manual/Automatic".**
- **"[FCx] Manual Fan: Percentage Control".**

If, for the purpose of updating other devices in the system the **status sending** start-up is enabled, the available status objects can be additionally selected to be sent:

- **"[FCx] On/Off (status)".**
- **"FCx] Mode (status)".**
- **"FCx] Fan: Speed Enumeration (Status)".** (If it is a relay fan)
- **"FCx] Fan: Speed Percentage (Status)".** (If it is a relay fan)
- **"FCx] Fan: Manual/Automatic (Status)".**

ETS PARAMETERISATION

After selecting the "Custom" option, in the **Initialization** parameter, in the "Fan Coil X" tab (see section 0), a new tab of the same name is added to the left tree.

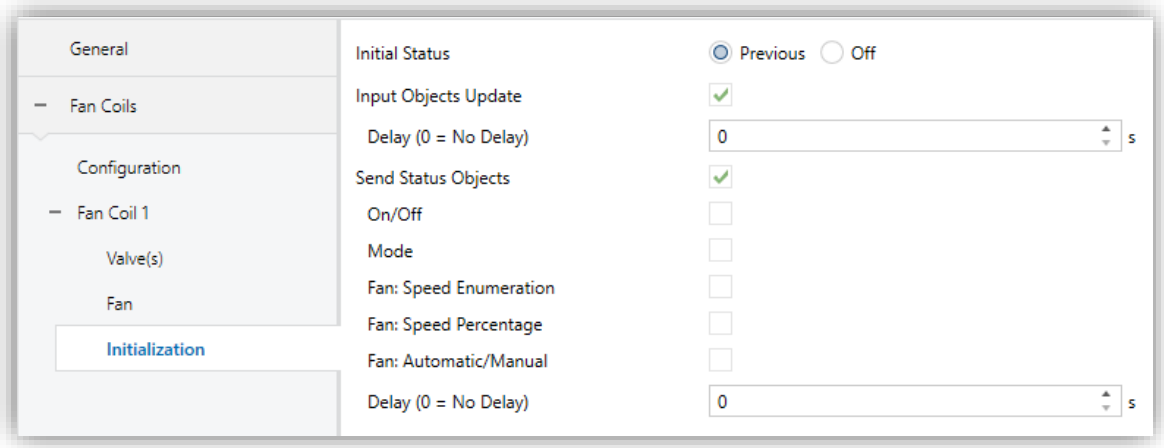


Figure 21. Fan Coil - Initialization.

- **Initial Status** [*Previous / Off*]. If "Previous" is selected, the status before the failure status shall be maintained, except after programming, in which case the output will be off.

- **Input Objects Update** [*disabled/enabled*]: if enabled, a reading of the input objects will be carried out after a bus fault or ETS download. The read requests will start to be sent after the parameterized **delay** ([*0...600*][*s*]).

- **Send Status Object** [*disabled/enabled*]: if enabled, several checkboxes will be displayed to indicate the objects to be sent.

  - **On/Off** [*disabled/enabled*]. Available if the **Fan Coil Always On** parameter (section 0) is disabled.

  - **Mode** [*disabled/enabled*]. Available if the selected **type of fan coil** is "4 Pipes" or "2 Pipes" with the "Cooling + Heating" **mode** active (see section 0).

  - **Fan: Speed Enumeration** [*disabled/enabled*]. Available if the **fan type** selected is "Fan -> Relays" (see section 2.2.4).

  - **Fan: Speed Percentage** [*disabled/enabled*]. Available if the **fan type** selected is "Fan -> Relays" (see section 2.2.4).

- **Fan: Automatic/Manual** [*disabled/enabled*]. Available if the fan **control mode** selected for the fan is "Automatic + Manual" (see section 2.2.3).

The statuses will start to be sent after the parameterized **delay** [*0...600*][s].

ANNEX I. AUTOMATIC AIR RECIRCULATION IN COOLING MODE

If this function **automatic air recirculation in cooling mode** is activated and the system is operating in cooling mode:

- When the Control Variable is 0%, the fan must remain on or switch on.
- In case the input control command is lower than the minimum value to activate (the valve or the fan depending on the type of control), the fan speed will be the value specified by parameter and modifiable by object "**[FCx] Fan: Automatic Air Recirculation Speed**".
- When the manual control is active, the automatic air recirculation speed is not considered; the fan speed will be the speed set by any of the different objects of the manual control (see section 2.2.3.1).

Once recirculation is active, events such as fan coil deactivation, a mode change or a bus failure can force the fan to stop.

Whereas, if **automatic air recirculation in cooling mode** is not enabled or the system is operating in heating mode:

- When receiving a control command lower than the value that activates (the valve or the fan depending on the type of control) both the valve and the fan will take a value of 0%.

The Table 3 below shows the specific effects of having or not having the automatic air recirculation function enabled in different situations. The table is generated starting from a 0% control variable.

Control Type	Speed Control	Automatic Recirculation	Current Mode	Implications		
				Valve		Fan
Fan-Oriented Control	Automatic	Enabled	Heating	Closed	⇦	Switch Off
			Cooling	Closed	⇦	**Recirculation**
		Disabled	Heating	Closed	⇦	Switch Off
			Cooling	Closed	⇦	Switch Off
	Manual	Enabled	Heating	Closed	⇦	Manual = 0
				Open	⇦	Manual ≠ 0
			Cooling	Closed	⇦	Manual = 0
				Open	⇦	Manual ≠ 0
		Disabled	Heating	Closed	⇦	Manual = 0
				Open	⇦	Manual ≠ 0
			Cooling	Closed	⇦	Manual = 0
				Open	⇦	Manual ≠ 0
Valve-Oriented Control	Automatic	Enabled	Heating	Closed	⇨	Switch Off
			Cooling	Closed	⇨	**Recirculation**
		Disabled	Heating	Closed	⇨	Switch Off
			Cooling	Closed	⇨	Switch Off
	Manual	Enabled	Heating	Closed	⇨	Switch Off
			Cooling	Closed	⇨	Manual
		Disabled	Heating	Closed	⇨	Switch Off
			Cooling	Closed	⇨	Switch Off

Table 3. Automatic Air Recirculation.

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