Zennio
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‘Relays’ Fan Coil

Control Module for Fan Coil Units with On/Off Valves & Relay-Controlled Fan

USER MANUAL

User Manual Version: [0.2]_a

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DOCUMENT UPDATES

Version	Changes	Page(s)
[0.2]_a	**Changes in the application program**: • New anti-seize protection function. • New air recirculation function in Cooling mode. • New hysteresis function in automatic mode. • Under a valve-oriented control, the minimum fan speed when the valve is open is now restricted to speeds 1-3. • Minor changes in the Cyclical Monitoring parameterisation. • Added scene recording function. • Minor improvements and revisions.	-
	New air recirculation function.	8, 14, 20, 21, 38
	Under a valve-oriented control, the minimum fan speed when the valve is open is now restricted to speeds 1-3.	9
	New hysteresis function in automatic mode	11, 18
	New anti-seize protection function.	28 - 30
	Minor changes in the Cyclical Monitoring parameterisation.	31, 32
	Added scene recording function.	34
	Minor text revision.	-

1 INTRODUCTION

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

Every two pipes make up a circuit where the water flow is controlled by means of **an on/off valve**, whose state can be managed through a **binary output**. This module provides up to two binary outputs, thus making it possible to control a two-pipe fan coil (one valve) or a four-pipe fan coil (two valves).

Typically, the two water circuits of a four-pipe fan coil unit correspond to the **cooling** and **heating** functions (and to the cooling and heating valves, respectively), being therefore both modes available during the device operation. The single water circuit of a two-pipe fan coil unit, on the other hand, may be configured:

- Cooling
- Heating
- Cooling and Heating

No. of pipes	Output	Action
4	Valve Output 1	Cooling Valve
	Valve Output 2	Heating Valve
2	Valve Output 1	Heating Valve
		Cooling Valve
		Heating + Cooling Valve

Table 1 Actions performed by the binary outputs associated to the valve control.

Regarding the fan speed control, up to three binary outputs will be available, being possible to configure them as **commuting relays** (one specific relay for each fan speed) or as **accumulating relays** (the more relays closed, the higher the fan speed).

Please refer to the specific user manual and datasheet of each Zennio device in order to confirm whether this feature is available or not, and for instructions on the device connection and installation.

2 CONFIGURATION

2.1 GENERAL

The first thing that needs to be parameterised is the type of the fan coil unit that the 'Relays' Fan Coil module will be controlling:

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

Next, it is necessary to configure the **control type**, depending on the element (valve or fan) the main control is addressed to. 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.
- **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 2.3.

Specific settings are **common to both control types**. These common settings are explained in sections 2.4 and 2.5.

Other than the fan coil type and the control type, the general configuration also involves the following options:

- **Number of Fan Speeds**: up to three fan speeds can be controlled, although it is possible to enable only one or only two, depending on the fan model. This determines the number of relays required for the fan control.
- **Cyclical Monitoring of the Control Values**: see section 2.6.

- **Scenes**: see section 2.7.

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

- **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. This option is enabled by default (see ANNEX I. Automatic Air Recirculation).

- **Initialisation**: sets whether, at the start-up of the device, the 'Relays' Fan Coil module should recover the previous state, or on the contrary perform a custom initialisation (see section 2.8).

- **Action at Bus Voltage Failure**: allows configuring whether the module should remain as is when a KNX bus power failure takes places, or alternatively close the valve and turn off the fan.

ETS PARAMETERISATION

After enabling the fan coil module, the ETS tab tree will contain a category named “Fan coil n”, where “n” will correspond with a certain number. Under this category, a tab named “**Configuration**” will always be available, containing the following general parameters.

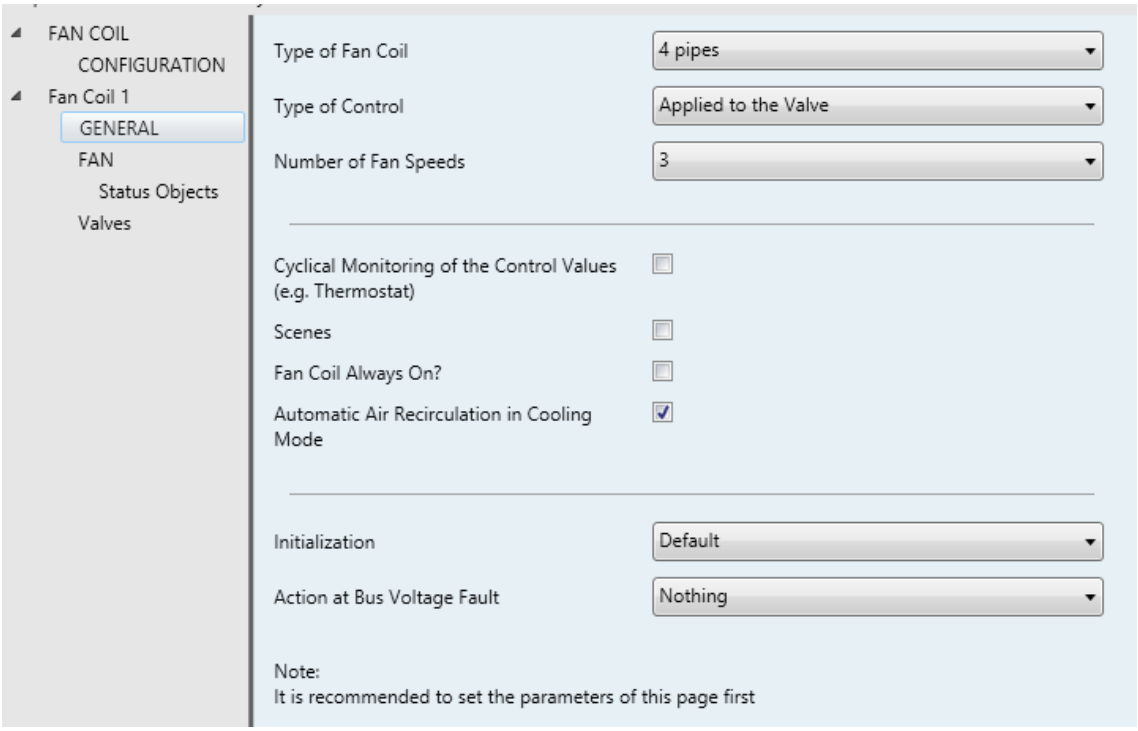

Figure 1. Fan Coil – General Configuration.

- **Fan Coil Type**: “2 pipes” or “4 pipes”.
- **Mode** (only for two pipes): “Heating”, “Cooling” or “Cooling + Heating”.

  In case of selecting “Cooling + Heating” or having configured the fan coil unit as “4 pipes”, a one-byte object (“**[FCn] Mode**”) will be provided to allow the selection of the desired mode (0 = Cooling; 1 = Heating), as well as the corresponding status object.

- **Control Type**: “Applied to the valve” (see section 2.2) or “Applied to the fan” (see section 2.3).
- **Number of Fan Speeds**: “1”, “2” o “3”.
- **Cyclical Monitoring of the Control Values**: enables or disables the “Cyclical Monitoring” tab (see section 2.6).

- **Scenes**: enables or disables the “Scenes” tab (see section 2.7).
- **Fan coil Always On**: enables or disables the continuous operation of the fan coil control module. If disabled, a binary object (“**[FCn] On/Off**”) will be available for switching the control on and off, as well as the corresponding status object.
- **Automatic Air Recirculation in Cooling Mode**: enables or disables the air recirculation in the Cooling mode when the valve is closed. This option is enabled by default (see ANNEX I. Automatic Air Recirculation).
- **Initialisation**: “Default” or “Custom”. The latter adds a new entry to the tab tree (see section 2.8).
- **Action on Bus Voltage Failure**: “Nothing” or “Close Valve and Turn Off Fan”.

Unless the fan coil module has been configured to be always on, an object will be available to turn it on (value “1”) or off (value “0”), “**[FCn] On / Off**”, as well as its corresponding status object.

2.2 VALVE-ORIENTED CONTROL

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

Certain settings must be performed with independence of the control type selected. It is therefore advisable to read sections 2.4 and 2.5 as well.

2.2.1 FAN SETTINGS

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 control mode can be configured to depend on the value of certain objects:

- The value of **PI Control object** (continuous).
- The **difference** between the ambient temperature and the setpoint.

When both, the manual and the automatic control modes are allowed, a communication object will let switching from one control mode to the other, while the corresponding status object will reflect the current mode. It is possible to set in parameters 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. This inactivity is referred to the arrival of manual control orders for the fan.

On the other hand, the integrator may configure the **minimum fan speed that is allowed while the valve remains open**. Note that speed 0 (fan off) is not available, as it would turn to be pointless and since the absence of ventilation with the valve open may entail damage to the installation.

ETS PARAMETERISATION

When the control type has been configured as applied to the valve, the “Fan” tab shows the following specific options (for the remaining parameters, please refer to section 2.4).

- **Fan Control Mode**. “Automatic” (section 2.2.1.1), “Manual” (section 2.2.1.2) or “Automatic + Manual” (section 2.2.1.3)

- **Minimum Fan Speed When the Valve is Open**: the available options may depend on the number of speeds configured under “General” tab (section 2.1).

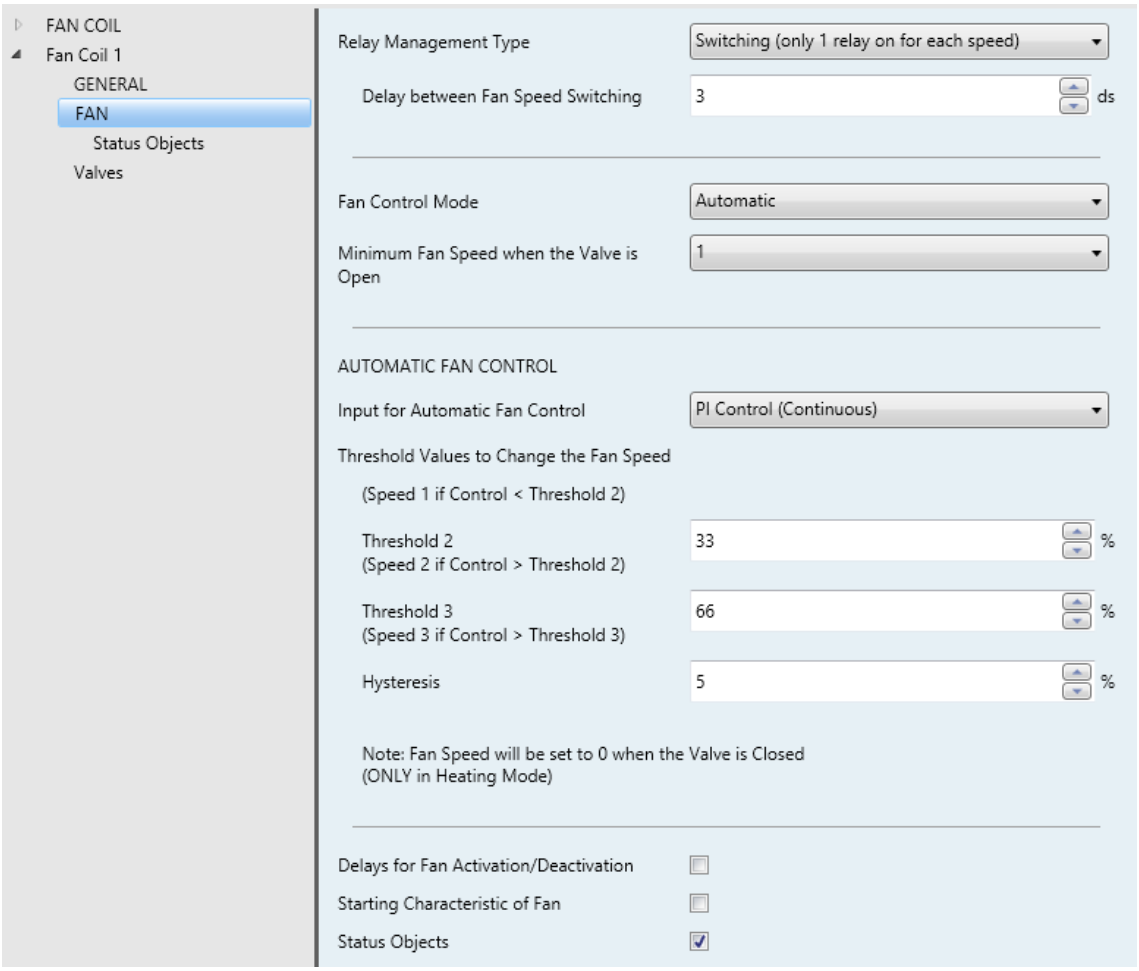

Figure 2. Valve-oriented control: Fan.

2.2.1.1 AUTOMATIC CONTROL

The automatic fan speed control may be subject to an **external PI control** (performed by a thermostat) or to the **difference between a reference temperature and a setpoint**, both received externally as well.

- **PI Control**:

  The PI value is received through a percentage communication object, and may be the same value that controls the valve in case it has been configured to be controlled through a PI control value too.

  The application programme will apply one speed or another to the fan depending on whether such PI value exceeds certain parameterisable thresholds named **Threshold 2** and **Threshold 3**.

- PI Value < Threshold 2 → speed 1.
- PI Value ≥ Threshold 2 → speed 2
- PI Value ≥ Threshold 3 → speed 3

The above criterion, as well as the number of thresholds to be parameterised, may be conditioned to the value assigned to the parameter **Minimum Fan Speed When the Valve is Open** (section 2.2.1).

- **Temperature Difference**:

The fan speed is determined according to the difference between a **temperature setpoint** (or target temperature) and an **ambient temperature** (or reference temperature), both received through their specific objects.

Such difference determines the target speed depending on whether it exceeds or not certain parameterisable thresholds, referred to as **Diff. 2** and **Diff. 3**:

- $|T_{setpoint} - T_{ambient}| <$ Diff. 2 → speed 1.
- $|T_{setpoint} - T_{ambient}| \geq$ Diff. 2 → speed 2.
- $|T_{setpoint} - T_{ambient}| \geq$ Diff. 3 → speed 3.

The above criterion, as well as the number of thresholds to be parameterised, may be conditioned to the value assigned to the parameter **Minimum Fan Speed When the Valve is Open** (section 2.2.1).

An additional parameter to set a **hysteresis** over the above thresholds is also provided. This helps to avoid continuous fan speed switches in case the ambient temperature keeps fluctuating around the limit temperature between contiguous levels.

The following example illustrates this control type.

Example (temperatures difference)

Suppose a hysteresis of 0.5ºC and the following thresholds:

- *Dif 2 = 3ºC.*
- *Dif 3 = 5ºC.*

The current mode is "Cooling" and the temperature setpoint is 25ºC. Given the following ambient temperature values, the fan speed levels will be triggered as indicated:

- **27ºC** ➔ $|T_{setpoint} - T_{ambient}| > (Dif\ 1 + h)$ ➔ Speed 1.
- **30.5ºC** ➔ $|T_{setpoint} - T_{ambient}| \geq (Dif\ 3 + h)$ ➔ Speed 3.
- **28.6ºC** ➔ $|T_{setpoint} - T_{ambient}| > (Dif\ 2 - h)$ ➔ Speed 2.

ETS PARAMETERISATION

On the first hand, it is necessary to configure the following parameter:

- **Input for Automatic Fan Control**: "PI Control (Continuous)" or "Temperature Difference".

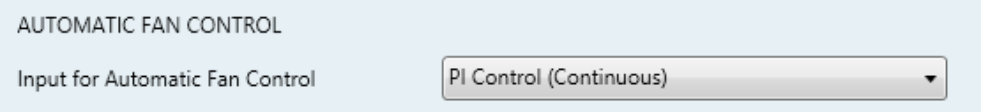

Figure 3. Automatic Fan Control.

In case of selecting "PI Control (continuous)", the integrator should enter the desired values (in terms of percentage) for **Threshold 2** and **Threshold 3**, or those that may be required depending on the minimum fan speed configured.

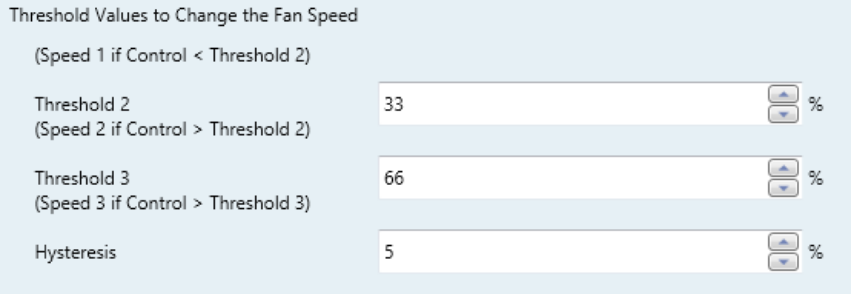

Figure 4. Automatic Fan Control. PI Control (Continuous).

In case of selecting "Temperature Difference", the integrator should enter the desired values (in terms of tenths of a degree) for **Diff 1**, **Diff 2** and **Diff 3**, or those that may be required depending on the minimum fan speed configured. A **hysteresis** (between 0 and 20 tenths of a degree) can also be parameterised, if required.

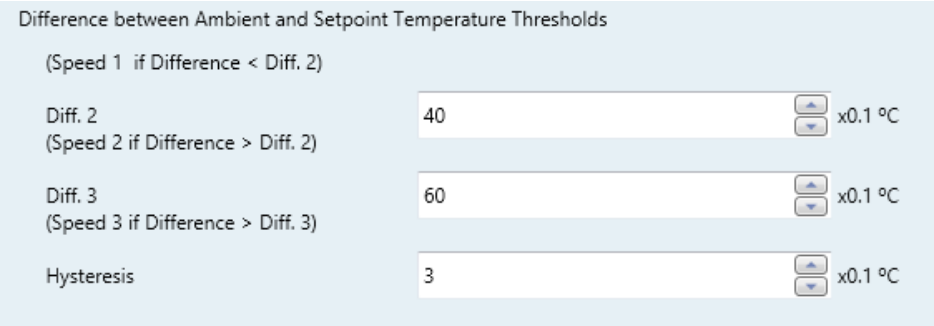

Figure 5. Automatic Fan Control. Temperature Difference.

To perform the temperature difference, two 2-byte objects are provided: "**[FCn] Ambient Temperature**" and "**[FCn] Setpoint Temperature**".

2.2.1.2 MANUAL CONTROL

The manual fan control can be performed **through different kinds of objects** that allow the user select the desired fan speed without taking into account neither the time that the valve remains open nor the temperature differences. However, the following remarks do apply to the manual fan control.

- If the valve is open and **a minimum fan speed** has been configured, the user will not be able to set a speed below it.
- If the fan coil is in Heating mode, the user will not be able to turn on the fan while **the valve remains closed**. On the other hand, if the fan coil is in Cooling mode, the fan state will depend on whether the **Automatic Air Recirculation in Cooling Mode** parameter has been enabled or not (see ANNEX I. Automatic Air Recirculation).

As the manual fan control and the objects provided to perform it are common for both, valve-oriented control and fan-oriented control, the additional details have been included into section 2.4.

2.2.1.3 AUTOMATIC + MANUAL CONTROL

When both the manual fan control and the automatic fan control are permitted, everything explained in sections 2.2.1.1 and 2.2.1.2 will still applicable, however, some additional options will be available, as detailed next.

PARAMETRIZACIÓN ETS

The following specific parameters show up after selecting "Automatic + Manual" for the fan control mode:

- **Fan Control After ETS Download**: "Automatic" or "Manual".
- **Automatic/Manual Switch Object**: sets the particular values that will switch from one control mode to the other, if received through object "**[FCn] Fan: Manual / Automatic**":
  - "0 = Automatic; 1 = Manual"
  - "0 = Manual; 1 = Automatic".
- **Return to Automatic Mode after a Period of Time**: sets if the manual control switches automatically to automatic control after a certain time of inactivity, configured in "**Duration of Manual Control**" (1 to 1440 minutes; 1 to 24 hours). It may be overwritten through the homonymous object.

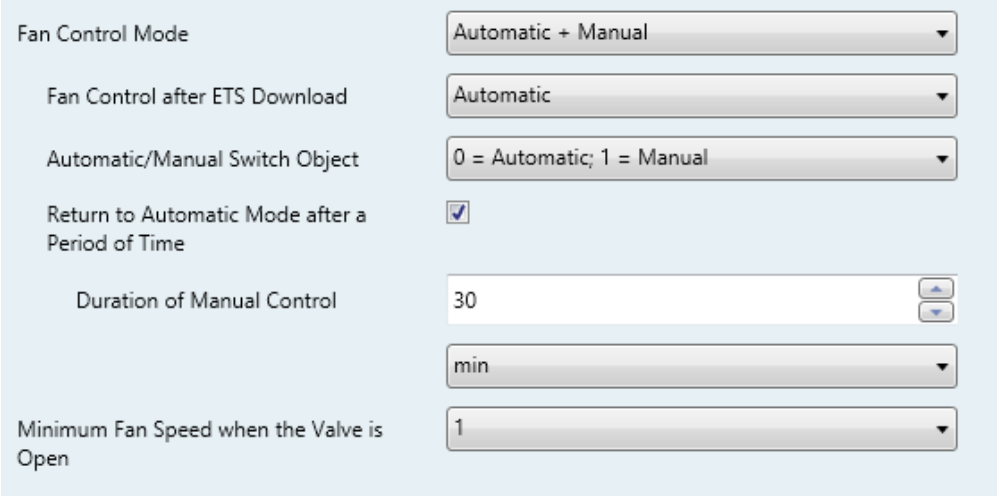

Figure 6. Automatic + Manual Control.

2.2.2 VALVE SETTINGS

The valves (or the valve, if there are only two pipes) 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:

- **PWM Control** (Pulse Width Modulation): 1 bit.
  The control variable sends **binary values**, which determine whether the valve should remain open or closed.

- **PI Control** (Proportional-Integral): 1 byte.
  The control variable sends **percentage values**, which determine the portion of time the valve should remain open every cycle. For instance, a value of 50% means the valve must remain open for half the cycle time.

Being the valves on/off type, the second case implies **controlling them through PWM signals** as well, although calculated according to the percentage value. It is therefore 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 with the exception of the **scene management** (section 2.7).

ETS PARAMETERISATION

When the control type has been configured as applied to the valve, the "Valve" tab (or "Valves", if the fan coil consists of four pipes) shows the following specific options (for any other parameters, please refer to section 2.5):

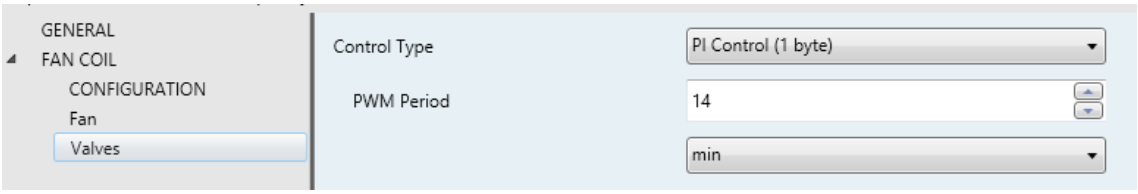

Figura 7. Control type options for the valve.

- **Control Type**: "PI Control (1 byte)" or "Control Variable (1 bit)".

  - PI Control (1 byte): enables the objects "**[FCn] Cooling Valve: PI Control (Continuous)**" and / or "**[FCn] Heating Valve: PI Control (Continuous)**", provided for the reception of PI control percentage values from the KNX bus.

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

  In any of the two cases, the objects "**[FCn] Cooling Valve (Status)**" and "**[FCn] Heating Valve (Status)**" (or, in case of only two pipes, a single object named "**[FCn] Valve (Status)**") will be available. Their value will be "1" while the valve is open, and "0" while it remains closed.

- **PWM Period**: sets the cycle time for the PWM control (3 – 1440 minutes, or 1 – 24 hours). In case of having selected "Control Variable (1 bit)" in the above parameter, the period is inherent to the control signal received, and therefore this parameter is only required for scene management.

2.3 FAN-ORIENTED CONTROL

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

Certain settings must be performed with independence of the control type selected. It is therefore advisable to read sections 2.4 and 2.5 as well.

2.3.1 FAN SETTINGS

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**, although the automatic control mode will be available at any time (the manual control mode needs to be enabled by parameter).

ETS PARAMETERISATION

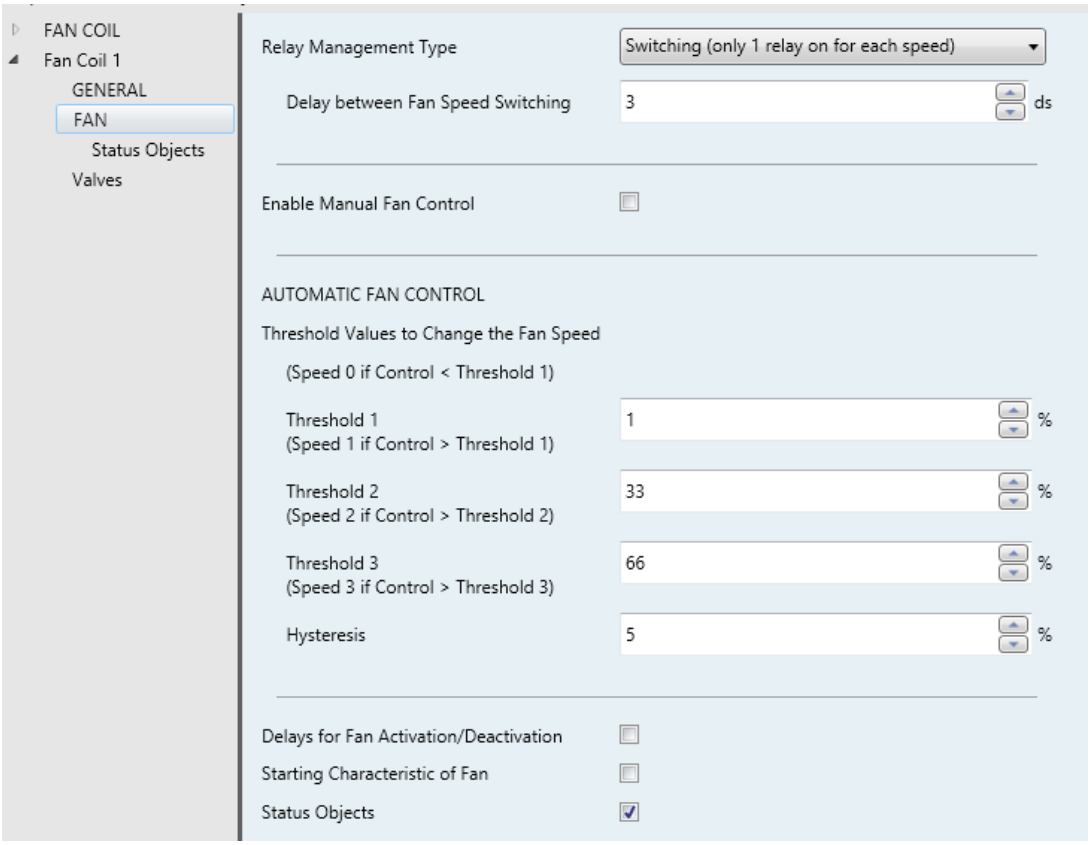

Figure 8. Fan-oriented control: fan.

When the control type has been configured as applied to the fan, the “Fan” tab shows the following specific option (for the remaining parameters, please refer to section 2.4).

- **Enable Manual Fan Control**: sets whether the manual fan control will be required or not (see section 2.3.1.2).

On the other hand, the automatic fan control is available at any time.

2.3.1.1 AUTOMATIC CONTROL

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 stablished 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

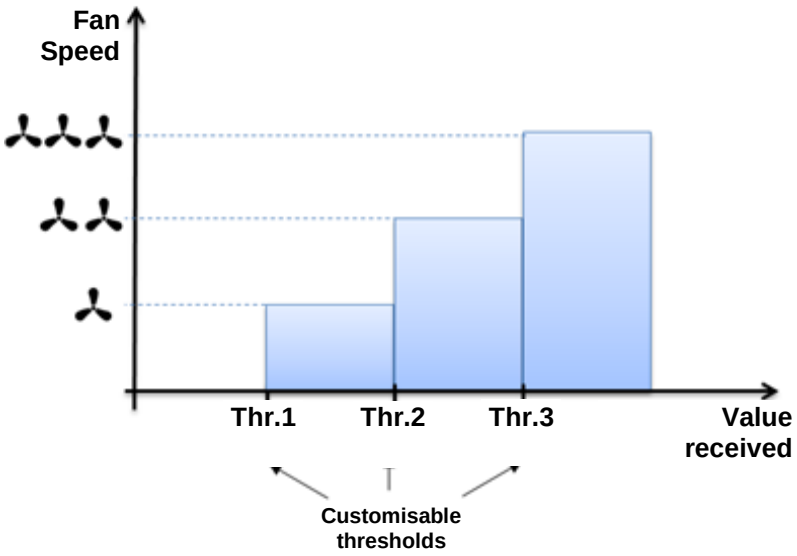

Figure 9. Thresholds, value received and fan speed.

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 speed 1 (see ANNEX I. Automatic Air Recirculation).

The above criterion, as well as the number of thresholds to be parameterised, may be conditioned to the value assigned to **Number of fan speeds** (section 2.1).

ETS PARAMETERISATION

The value of **Threshold 1**, **Threshold 2** and **Threshold 3** are stablished through the following parameters:

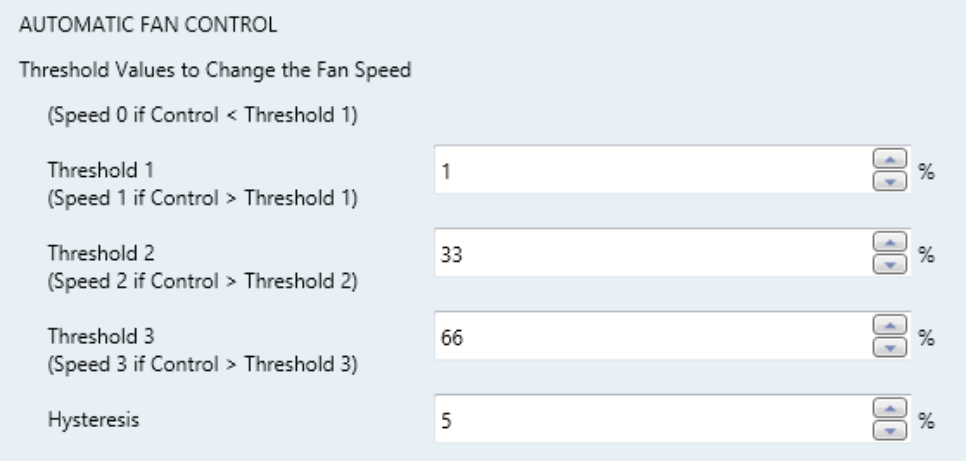

Figure 10. Threshold values to change the fan speed.

The automatic control is performed through the percentage objects "**[FCn] Heating Fan: Continuous Control**" and/or "**[FCn] Cooling Fan: Continuous Control**", which are typically intended to be linked to an external PI thermostatic control.

2.3.1.2 AUTOMATIC + MANUAL CONTROL

The (optional) manual control mode lets the user set a fan speed **from their own user interface** with independence of the value received through the objects of the automatic fan control, which are typically linked to an external thermostat.

An object is provided to **switch from the automatic control mode to the manual one**, as well as an option to switch back to the automatic control when any manual orders have been received after a certain time.

It is also possible to select the desired reaction when, being in the cooling mode and with the manual control mode active, **a percentage value lower than Threshold 1 is received through the automatic control object** (see section 2.3.1.1). Under the automatic control mode this would imply closing the valve and turning the fan off, but under the manual control the options are (see ANNEX I. Automatic Air Recirculation):

- **Close the valve and turn off the fan**, to ensure a minimum thermostat control.
- **Ignore the order**, thus giving always priority to the manual orders even if the temperature setpoint has already been reached. Therefore, the possibility of having the valve closed and the fan off is not avoided.
- **Close the valve and turn off the fan, but only in heating mode**, thus maintaining the user control but preventing that the fan coil unit is left with the heating valve closed and the fan on (which may make the user feel coolness).

The above configuration is only available for the cooling mode, provided that the **Automatic Air Recirculation in Cooling Mode** has not been enabled (if enabled, this configuration will not be available for the cooling mode either).

In the latter two cases, once the fan is turned off and the valve is closed:

- While this turned-off state lasts, any manual orders will be ignored and responded with the current speed (0) and control (automatic) statuses.
- After a percentage value higher than Threshold 1 is received, the corresponding speed will be applied, and the thermostatic control resumed. However, if a new manual order is received afterwards, the manual control will be activated again.

The remaining options are explained in section 2.4 as they are common to both, a valve-oriented control and a fan-oriented control.

ETS PARAMETERISATION

The following specific parameters show up after enabling the manual control mode.

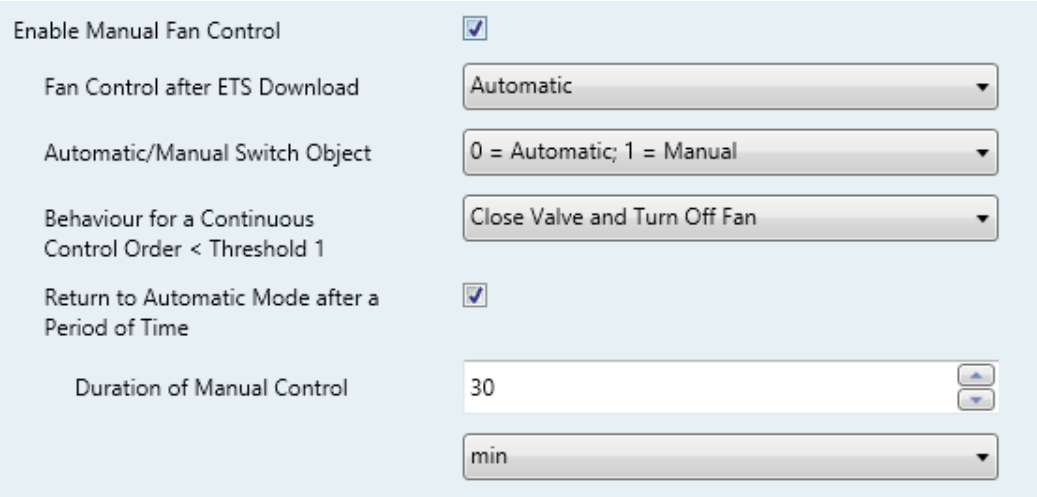

Figura 11. Manual fan control for applied to the fan control configuration.

- **Automatic/Manual Switch Object**: sets the values that should be received through "**[FCn] Fan: Manual/Automatic**" to switch the control mode: "0 = Automatic; 1 = Manual" or "0 = Manual; 1 = Automatic".

- **Behaviour for a Continuous Control Order (PI) < Threshold 1**: sets how to handle automatic switch-off orders that may be received during the manual fan control: "Close Valve and Turn Off Fan", "Nothing (Ignore PI Order in Manual Control" or "Close Valve and Turn Off Fan (Only in Heating)".

- **Return to Automatic Mode after a Period of Time**: sets if the manual control should automatically switch to automatic control after a certain time of inactivity, configured in "**Duration of Manual Control**" (1 to 1440 minutes; 1 to 24 hours). It may be overwritten through the homonymous object.

The remaining parameters in this tab have already been described for the automatic control mode (see section 2.3.1.1) or are common for both, the valve-oriented control and the fan-oriented control and therefore are detailed in section 2.4.

2.3.2 VALVE SETTINGS

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

ETS PARAMETERISATION

When a fan-oriented control has been configured, the “Valve” tab does not show any specific parameters, as all of them are common for a valve-oriented control. See section 2.5.

In addition, any object to directly manipulate the valves is provided in this case, as their state is subject to the state of the fan and to the object that sets the current working mode (heating / cooling).

2.4 COMMON SETTINGS (FAN)

This section details the fan settings that are common for both control types: valve-oriented and fan-oriented.

The ‘Relays’ Fan Coil module 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 some instants).

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

Moreover, the previous sections have already described the possibility of performing an automatic fan control and a manual fan control. Although some differences apply depending on whether the fan coil control is valve-oriented or fan-oriented (see previous sections), the most significant difference is that:

- Under an **automatic control**, the fan speed is calculated automatically according to the parameterisation and to an external reference.

- Under a **manual control**, the user can directly take part in the selection of the desired speed through a set of communication objects of different types.

When both 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. Besides, it is possible to configure a time-out after which, if no additional manual orders have been received, the control will switch back to automatic.

Regarding the **manual control**, the communication objects that permit commuting the fan speed are of the following types, and are in any case conditioned by the number of fan speeds allowed (see section 2.1):

- **One-bit objects (one per speed)**, which activate a particular speed level on the reception of the value "1".
- **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.

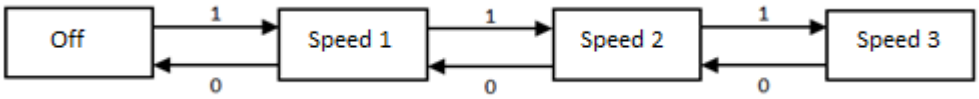

Figure 12. Non-cyclical fan step control.

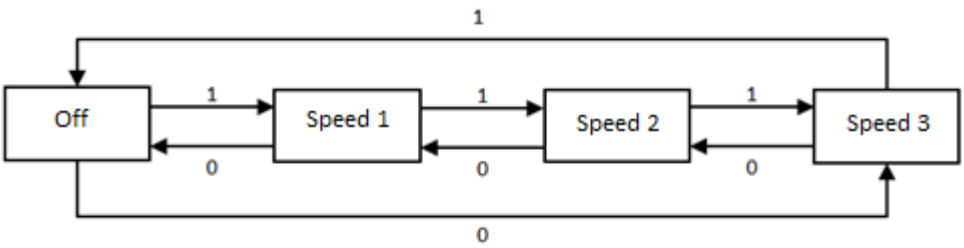

Figure 13. Cyclical fan step control.

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

- Non-cyclical control:
  - Activate automatic speed mode if, being the fan off, a request to increase the speed is received.
  - Activate automatic speed mode if, being the fan at the máximum speed level, a request to increase the speed level is received.

- Activate the automatic speed mode in any of the above two.

➢ Cyclical control: the automatic speed will be an intermediate state between the two ends of the sequence.

- **One-byte enumerated object**: the speed switch will take place upon the arrival of the proper integer value (0, 1, 2, 3).

- **Percentage object**: the speed switch will take place upon the arrival of the proper percentage value; according to the KNX standard (see Table 2).

Available speeds	Speed	Percentage
One speed	0	0%
	1	1% – 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. Manual control through the percentage object

For all the aforementioned objects (with the exception of the step-control object) **an analogous status object** is available, making it possible to request the current fan speed at any time, even during the automatic control.

On the other hand, it is possible to **delay the activation and deactivation of the fan** after an action over the valve (for either the Heating or the Cooling modes):

- Under a **valve-oriented control**, this delay will be applied to the automatic switch-on / switch-off of the fan when the valve is opened or closed.

- Under a **fan-oriented control**, this delay will be applied to the switch-on of the fan when such order is received being the fan off and the valve closed (this will imply that the valve opens), as well as to the switch-off of the fan when such order is received being the fan on and the valve open fan (this will imply that the valve closes).

***Example**: delay in the activation / deactivation.*

Given a valve-oriented control with a delay of two minutes for the activation of the fan and of ten minutes for the deactivation, and assuming an automatic fan control, a PWM value of 50% is received.

- *On the arrival of the order, the valve will open immediately.*
- *Two minutes later, the fan turns on at the speed that may correspond to the parameterisation.*
- *After half of the PWM cycle, the valve closes.*
- *Ten minutes later, the fan turns off.*

Finally, either under a valve-oriented control or a fan-oriented control, 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 they switch to lower speeds

ETS PARAMETERISATION

The following parameters can be found in the "Fan" tab either under a valve-oriented control and under a fan-oriented control (please refer to sections 2.2 and 2.32.3 for the specific parameters of each case).

- **Relay Management Type**: "Switching (only 1 relay on for each speed)" or "Accumulation (multiple relays on)".

  If set to "Switching", an additional parameter ("**Delay between Fan Speed Switching**") is shown to let the integrator configure a delay (3 to 100 tenths of a second) since the source valve opens and the target valve closes, thus making both valves remain open during the delay configured.

- **Delays for Fan Activation / Deactivation**: enables / disables an additional parameter tab named "**Delays**", which contains the following parameters:

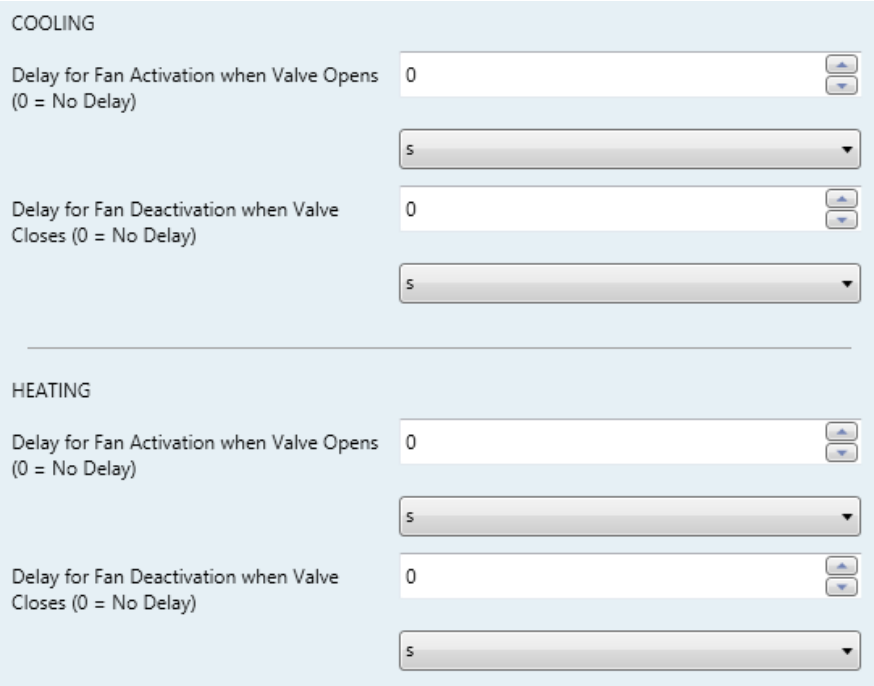

Figure 14. Parameters in "Delays" tab.

- **Delay for Fan Activation when Valve Opens**: sets the amount of time (0 to 3600 seconds, or 0 to 1440 minutes, or 0 to 24 hours) the fan will delay its switch-on after the valve is opened.

- **Delay for Fan Deactivation when Valve Closes**: sets the amount of time (0 to 3600 seconds, or 0 to 1440 minutes, or 0 to 24 hours) the fan will delay its switch-off after the valve is closed.

The above two parameters should be configured for **Heating**, for **Cooling** or for both, depending on the configuration made so far.

- **Starting Characteristic of Fan**: enables / disables an additional parameter tab named "**Starting Characteristic**", which contains the following parameters:

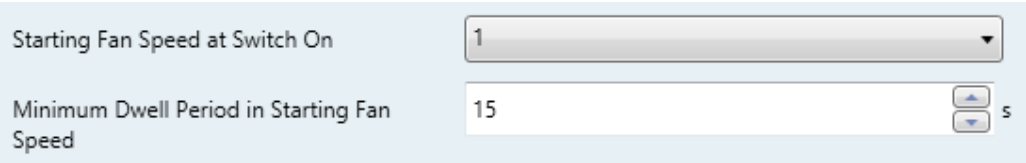

Figure 15. Parameters in "Starting Characteristic" tab.

- **Starting Fan Speed at Switch On**: sets the fan speed level ("1", "2" or "3") the fan engine should adopt when it starts up, before being able to adopt

lower speeds. Note that the available options depend on the number of fan speed levels enabled in the “Configuration” tab (see section 2.1).

- **Minimum Dwell Period in Starting Fan Speed**: sets the time (1 to 250 seconds) the fan engine should remain at the above speed when it starts up.

- **Status Objects**: enables / disables an additional parameter tab named “**Status Objects**”, which permits enabling different fan status objects:

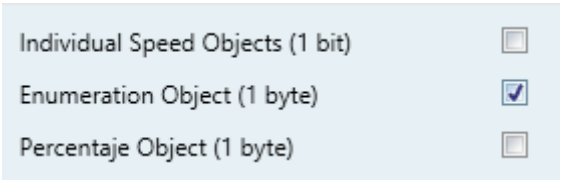

Figure 16. Parameters in the “Status Objects” tab.

- **Individual Speed Objects (1 bit)**: enables/disables the “**[FCn] Fan: Speed x (Status)**” binary objects, where “**x**” runs from 0 to 3. These objects throw the value “1” when the speed level they refer to is active, and “0” when not.

- **Enumeration Object (1 byte)**: enables/disables the “**[FCn] Fan: Enumation Speed (Status)**” one-byte object, which will throw values from 0 to 3 according to the current fan speed.

- **Percentage Object (1 byte)**: enables/disables the “**[FCn] Fan: Percentage Speed (Status)**” one-byte object, which will throw values from 0% to 100% according to the current fan speed and according to the KNX standard (see Table 2).

2.5 COMMON SETTINGS (VALVE)

This section details the valve settings that are common for both control types: valve-oriented and fan-oriented.

On the first hand, it is necessary to 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 objects related to the valve (PWM control, status, etc.).

Equally, it is possible to parameterise a **minimum time lapse between successive valve switches**, which may help to prevent damage due to quick and successive commutations of the valve. It is important to configure this time with caution, as it may improperly delay the operation of the valve, for example if configuring, under a valve-oriented control driven by a continuous PI signal, a cycle time (see section 2.2.2) lower than this minimum time.

It is also possible to set up a **delay over the mode switches** (Cooling / Heating), provided that both modes are available (see section 2.1). This allows delaying (always) the actual opening of the valve of the target mode since the reception of the mode switch order, so that:

- In a **four-pipe** fan coil, it is possible to assure that the two valves do not remain open at the same time when closely-spaced mode switch orders are received.
- In a **two-pipe** fan coil, it is possible to assure that the valve does remain closed before opening again when closely-spaced mode switch orders are received. In this case, the actual delay may be increased if a minimum time lapse between successive valve switches has been configured.

Finally, the configuration of the valve allows **enabling an automatic anti-seize protection function** (independent for each valve), which prevents the valves from remaining at a still position, open or closed, for more time than configured. To that end, it is necessary to configure an **anti-seize period** and an **execution time** (length of the anti-seize function). 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.

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 case it makes the heating valve open - in such case, the desired fan speed will be configurable.

Notes:

- *Both the valve and the fan will **recover their previous states** after the execution time unless control orders or mode change orders are received during the execution – in such case they **will be applied upon completion** of the anti-seize function. Due to this circumstance, as soon as the orders are received the device will respond with the current state, to make it evident that they have not been executed for the moment.*

- *The anti-seize period count is **independent for each valve**, although only one period is configured per fan coil (no matter if it consists of two or four pipes), being therefore possible that more than one valve adopts the anti-seize state in case they have remained still for the same amount of time and have been configured the same periods. Nevertheless, all valves that are not executing the anti-seize function will maintain their states.*

- *The anti-seize period count **is restarted** every time the valve performs an opening or closing action. This count may result delayed in the case of temporary **KNX bus voltage failures**, although it will be independent of the on / off state of the fan coil module.*

ETS PARAMETERISATION

The following parameters can be found in the “Valve” tab (or “Valves”, if the fan coil consists of four pipes) either under a valve-oriented control and under a fan-oriented control (please refer to sections 2.2 and 2.3 for the specific parameters of each case).

- **Value for Open Valve**: “1” or “0”.

- **Minimum Time Between Valve Switches**: either 0 to 3600 seconds, or 0 to 1440 minutes, or 0 a 24 hours.

- **Minimum Delay for Mode Change** (only if Cooling and Heating are available): same range as the above parameter.

- **Anti-Seize Protection:** enables or disables the valve anti-seize protection function, together with the objects "**[FCn] Cooling Valve: Anti-Seize Protection (Status)**" and "**[FCn] Heating Valve: Anti-Seize Protection (Status)**" (which will adopt the value "1" to indicate the function is running and the value "0" to indicate it is not) as well as the following additional parameters:

  - **Periodicity**: sets the maximum time the valve should remain at a still position (1 to 255 days).

  - **Duration**: sets the execution time, i.e., the time (1 to 255 minutes) the valve will remain the opposite position.

  - **Fan Speed when Heating Valve Opens**: sets the speed that will be adopted by the fan (depending on how many speeds have been configured in the General tab; see section 2.1) while the heating valve remains open due to the execution of the anti-seize function.

> **Important**: *speed 0 (fan off) is only recommended in case of evidence that the installation will not result damaged due to heat accumulation in case the heating valve needs to remain open during the anti-seize execution time configured*.

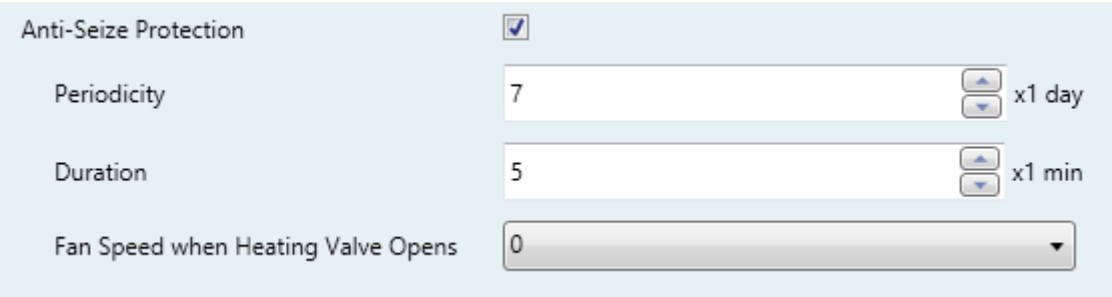

Figure 17. Anti-seize.

2.6 CYCLICAL MONITORING

It is possible to perform a **cyclical monitoring** of the control orders that are received from the external device (e.g.: a thermostat) that controls the fan coil module, with the aim of detecting communication issues.

It is necessary to define a **cyclical monitoring period**, in other words, how frequently these orders are expected to arrive from the bus. If this period is exceeded with no orders received, a certain reaction will be performed and the error will be notified through a specific object.

The **reaction in case of failure** can consist in:

- Closing the valve and turning off the fan.
- Customising the fan state (and that of the valve, when applicable).
- Doing nothing.

The **notification object** will keep sending (every 15 minutes) the value "1" while the error persists, and will send the value "0" (only once) once solved, that is, once the external orders are resumed or when the module enters a state that deactivates the cyclical monitoring:

- The cyclical monitoring only takes place while the module has been turned on and the **anti-seize function** of the valve is not in execution (see section 2.5).
- Under a fan-oriented control, the monitoring will take place unless the **manual control** mode of the fan is active.

Note: *under a valve-oriented control, the monitoring period must be at least equal or greater than the PWM control period*.

ETS PARAMETERISATION

After enabling the cyclical monitoring function from the "Configuration" tab (section 2.1), the "Cyclical Monitoring" tab will be available, containing the following parameters.

- **Monitoring Interval**: either 10 to 3600 seconds, or 1 to 1440 minutes, or 1 a 24 hours.

- **Reaction after a Control Failure**: "Nothing", "Close Valve and Turn Off Fan" or "Custom". If the latter is selected, an additional parameter appears depending on the control type configured:

  - Under a valve-applied control, the parameters available are:

    - **Valve State**: sets the target valve state ("Open", "Closed" or "No change").

      In case the valve state is set to "Open", the following parameter will also show:

    - **Fan Speed**: sets the target fan speed (depending on the fan speeds available).

  - Under a fan-applied control, the only parameter available is **Fan Speed**.

- **Notify with a Communication Object**: enables the "**[FCn] Control Value Error**" binary object, which will send the value "1" every 15 minutes in case of a communication error, and the value "0" (only once) once the error is over.

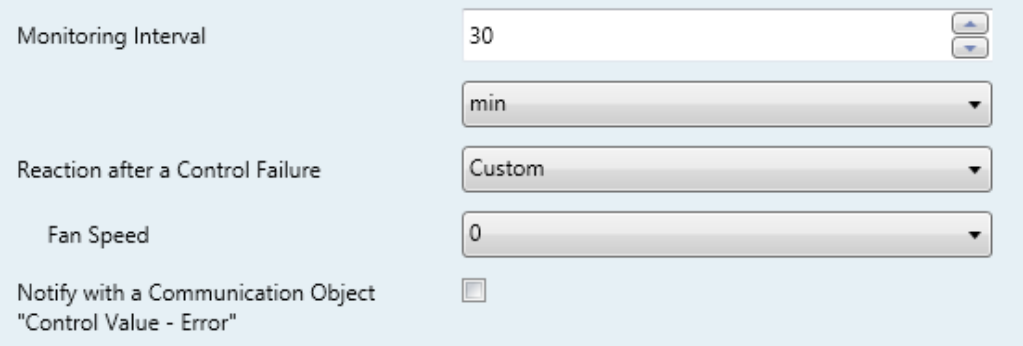

Figura 18. Cyclical Monitoring.

2.7 SCENES

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

- On / Off state of the module.
- Under a **valve-oriented control**:
  - 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 or leave it as is.
  - If both **automatic and manual** fan controls have been parameterised, it will be possible to switch to any of them (and to select a specific fan speed, in case of switching to manual), or leave the fan as is.
- Under a **fan-oriented control**:
  - If the **manual fan control has been disabled** in parameters, it will not be possible to change the fan speed through scenes.
  - If the **manual fan control has been enabled** in parameters, it will be possible to switch to the manual or the automatic modes, and to select a specific fan speed in case of switching to manual.

    Note: *the configuration of parameters* ***Behaviour for a Continuous Control Order PI < Threshold 1*** *(section 2.3.1.2) and* ***Automatic Air Recirculation in Cooling Mode*** *(section 2.1) will be taken into account. See* ANNEX I. Automatic Air Recirculation.

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.

On the other hand, if the scene in execution implies turning the fan coil module off, the response will be immediate, and the anti-seize protection process will be aborted.

This module permits the **scene recording**, although it will not be possible to record 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 manual fan control is available). States configured not to change in the original scene parameterisation will not be recorded, either.

ETS PARAMETERISATION

Once Scenes has been enabled from the "Configuration" tab (see section 2.1), a new tab named "Scenes" is added to the tab tree on the left, containing the following options:

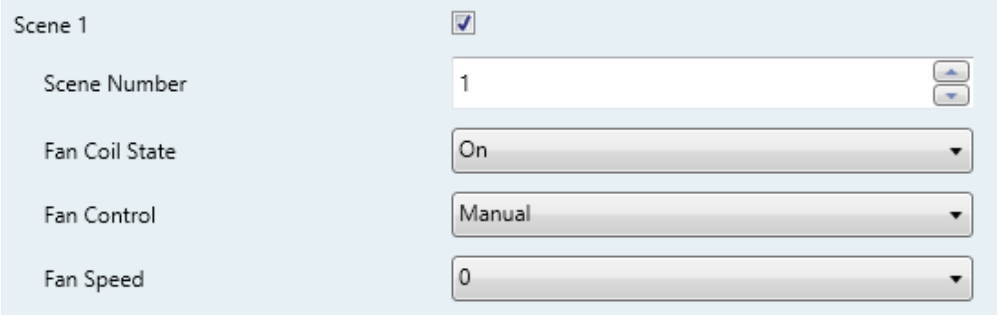

Figure 19. Scenes.

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

  - **Scene number**: sets the value (1-64) that, when received through object "**[Fan coil] Scenes**", will trigger the adoption of the configuration defined next.

  - **Fan Coil State**: may be set to "On" or "Off".

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

  - **Fan Control** (only available if both, the automatic fan control and the manual fan control have been enabled; see section 2.2.1): may be set to

"Automatic" or "Manual".

- **Fan Speed** (only available if the above parameter has been set to "Manual", or if only the manual fan control is available): may be set to "0", "1", "2" o "3", assuming that all of them are available.

2.8 INITIALISATION

Regarding the initialisation of the fan coil module after a download from ETS or a bus failure, it is possible to choose between a custom configuration and the default one.

For a custom initialisation, it is necessary to define the following:

- **The initial state**, which may be off, or the previous one (after a download, it will be always off).
- **Whether to send the status objects to the bus**, so other devices in the installation get updated.

  Any subset of the following objects can be sent (supposing that the functionality they refer to has been enabled in the configuration):

  - On/Off.
  - Mode (Heating / Cooling).
  - Fan Speed (all enabled objects will be sent).
  - Fan Control Mode (Automatic / Manual).
  - State of the Valves (Closed / Open).
  - Anti-Seize Protection State (Active / Not Active).
  - Control Input Failure.

  It is also possible to define a **delay** for this sending.

In the default initialisation no objects are sent, and the module will recover the previous state (off, after a download).

ETS PARAMETERISATION

If the option to customise the initialisation has been selected in the “Configuration” tab (section 2.1), the tab tree will include a new tab named “Initialization”, which will contain the following parameters:

- **Initial State**: “Previous” or “Off”.

- **Send Status Objects**: if activated, several checkboxes will show up to select the specific objects to be sent, as well as the following parameter:
  - **Delay**: sets the delay, since the start-up of the device, after which the objects will be sent (0 to 600 seconds).

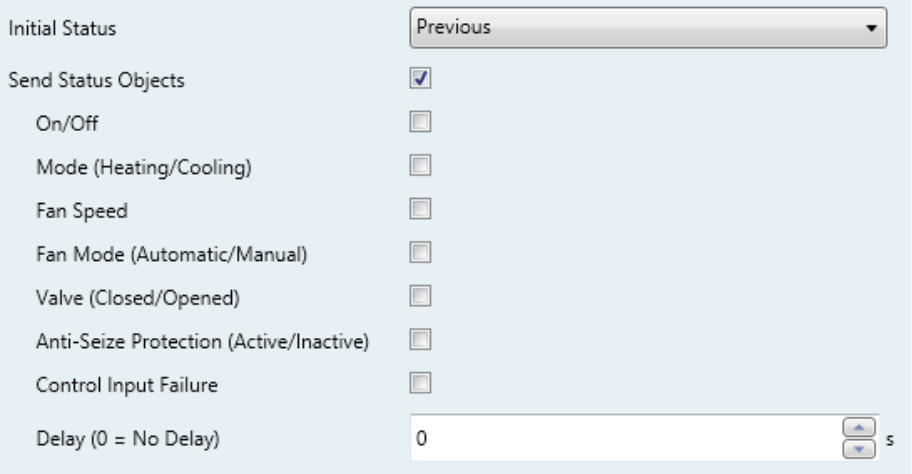

Figura 20. Initialisation.

ANNEX I. AUTOMATIC AIR RECIRCULATION

The table below remarks the specific effects of having the Automatic Air Recirculation function enabled or not in different situations.

Control Type	Speed Control	Automatic Air Recirculation	Current Mode	Consequences
Fan-oriented (The automatic air recirculation affects both the fan and the valve)	**Automatic**	Enabled	Heating	**Fan** = off ↔ **valve** = closed.
			Cooling	**Valve** = closed → **fan** = speed 1.
		Disabled	Heating	**Fan** = off ↔ **valve** = closed.
			Cooling	**Fan** = off ↔ **valve** = closed.
	Manual	Enabled	Heating	Manual control (subject to parameter **Behaviour for a PI < Threshold 1**).
			Cooling	If **valve** = closed, then **fan** = manual.
		Disabled	Heating	Manual control (subject to parameter **Behaviour for a PI < Threshold 1**).
			Cooling	Manual control (subject to parameter **Behaviour for a PI < Threshold 1**).

Valve-oriented (The automatic air recirculation only affects the fan behaviour)	**Automatic**	Enabled	Heating	If **valve** = closed and **Order** < Threshold 1, then **fan** = off.
			Cooling	If **valve** = closed and **Order** < Threshold 1, then **fan** = speed 1.
		Disabled	Heating	If **valve** = closed and **Order** < Threshold 1, then **fan** = off.
			Cooling	If **valve** = closed and **Order** < Threshold 1, then **fan** = off.
	Manual	Enabled	Heating	If valve = **closed**, then **fan** = off.
			Cooling	If valve = **closed**, then **fan** = manual.
		Disabled	Heating	If valve = **closed**, then **fan** = off.
			Cooling	If valve = **closed**, then **fan** = off.

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